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10Ton Mobile DMS Plant

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10 TON

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10TPH DMS PLANT – Hatch Canada

PARTS & MAINTENANCE MANUAL

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BOND Equipment

10Ton Mobile DMS Plant

10TPH DMS PLANT – Hatch Canada

PARTS & MAINTENANCE MANUAL

Instruction Manual · December 2003

English

Deutsch

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milltronics MCS

SIEMENS

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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Milltronics MCS Belt Scale

English

The Milltronics MCS belt scale is a compact, rugged belt scale with stainless steel load cells for use in mobile crushers and aggregate screening plants.

The MCS belt scale includes:

- a left and a right weigh beam, with one load cell each
- calibration weight arm that mounts to the customer's weighing idler

The addition of an idler (supplied and installed by the customer) completes the weighing assembly. The MCS load cells generate an electrical signal proportional to load, which is fed to the Siemens Milltronics belt scale integrator.

Note: The MCS belt scale is an accurate and repeatable force sensor. Its performance is ultimately dependent on the conveyor system, the quality of the installation, and the accuracy of the alignment.

The Manual

This instruction manual covers the installation, operation and maintenance of the MCS belt scale.

We strongly recommend that you read this manual before installing and starting up any component of the weighing system to which the MCS is being applied. Adhering to the installation and operating procedures ensures a quick, trouble-free installation and allows for the maximum accuracy and reliability of your weighing system.

This manual covers only MCS installation and operating procedures. Integrator and speed sensor instruction manuals are available for download from www.siemens-milltronics.com.

We always welcome suggestions and comments about manual content, design, and accessibility.

Please direct your comments to techpubs@siemens-milltronics.com.

English

Specifications

Accuracy

- ± 0.5 to 1% of totalization over 4 to 1 operating range, application dependent

Load Cell

• construction	stainless steel
• excitation	10 Vdc nominal, 15 Vdc maximum
• output	2 mV/V excitation at rated load cell capacity
• non-linearity	0.02% of rated output
• hysteresis	0.02% of rated output
• non-repeatability	0.01% of rated output
• capacity	50, 100, 250[1] lb stainless steel
• overload	safe 150% of rated capacity, ultimate 300% of rated capacity
• temperature:	-40 to 65 °C (-40 to 150 °F) operating range -10 to 40 °C (15 to 105 °F) compensated

Belt Width

- up to 1200 mm (48" CEMA) width (See *Outline Dimensions* on page 5)

Belt Speed

- up to 3m/s (600 fpm)

Capacity

- up to 1200 t/h (1320 STPH) at maximum belt speed

Conveyor Incline

- ± 20° from horizontal, fixed incline
- up to ± 30° with reduced accuracy

Idler Profile

- flat to 35°
- up to 45° with reduced accuracy

Idler Diameter

- 100 to 150 mm (4 to 6")

Idler Spacing

- 0.6 to 1.2 m (2.0 to 4.0 ft)

1. Size normally used for mobile crusher applications.

English

Hazardous Locations

- with the use of approved intrinsically safe barrier strips

Weight

- up to 20 kg (44 lb), 20 kg (22 lb)/side

Interconnection (to integrator)

- < 150 m (500 ft.) 18 AWG 6 conductor shielded cable
- > 150 m (500 ft.) to 300 m (1000 ft.) 20 AWG 8 conductor shielded cable

Approval

- CE

English

Operation

The MCS belt scale works with an existing troughed conveyor and a Siemens Milltronics integrator. As material moves along the conveyor belt and travels over the belt scale, it exerts a force proportional to the material load through the belt and suspended idler to the load cells.

The MCS reacts only to the vertical component of the applied force. The resulting movement in each load cell is sensed by its strain gauges. When the strain gauges are excited by voltage from the electronic integrator, they produce an electrical signal proportional to weight, which is then returned to the integrator. The vertical movement of the load cells is limited by the positive overload stop incorporated into the MCS design.

Installation

The MCS weighbridge components are shipped from the factory as a single unit in a heavy-duty shipping container. The container is packed to separate each item and to provide protection during shipment. Each item should be inspected as it is removed from the container.

IMPORTANT: Before installation, be sure to determine the ideal position of your MCS belt scale in relation to your conveyor system. See *Installation Location* on page 7 for more information.

Notes:

- Adjust conveyor stringers to be rigid, straight, parallel to, and square with the belt line in the area of the scale installation.
- Adjust pulleys to ensure that the conveyor belt tracks straight and centrally from the head to the tail pulley.

To avoid potential scale installation problems, please compare the site conditions with the MCS installation drawings available on www.siemens-milltronics.com. If you have any questions, please contact your Siemens Milltronics representative.

Follow the installation procedure carefully and read the related materials.

Outline Dimensions

Plan View

Side View

Note: A minimum of 2 approach and 2 retreat idlers should be aligned with the weigh idler to within +1/32" (0.75 mm) to -0" (0 mm).

Front View

English

English

Installation Precautions

Welding

! **CAUTION**: Use extreme caution when arc welding in the area of the belt scale. To avoid damaging the load cells, ensure that no welding currents can flow through the belt scale.

Load Cell Handling

Load cells are sensitive electro-mechanical transducers and must therefore be handled with care. They can tolerate very little mechanical deflection without damage.

Although the load cells are protected by shipping stops that keep the cells from moving, be careful when handling the scale to avoid damaging the cells. The stops are metal strips about 38 mm (1.5") long with holes at each end for screws. One screw holds the stop to the dynamic beam while the other screw holds the stop to the weigh blocks static structure.

When handling the MCS during installation and setup, make sure the stops remain in place.

Reinstall both shipping stops during maintenance or prolonged shutdown.

Scale Handling

Observe the following precautions when handling the scale.

- Do not pry on the idler, its mountings, or the load cells directly.
- Do not stand or lean on the scale.
- Lift the scale by the weigh blocks only. Do not lift the scale by the idler or idler mounting brackets.
- Never subject the scale to sudden impacts or shocks.

Installation Location

The ideal placement of the Siemens Milltronics belt scale depends on the conveyor system. This section provides guidelines to determine MCS placement.

Mobile Crushers

The MCS is installed on mobile crushers because of its durability and low profile. A belt scale can be used effectively in a conveyor of this type, but it requires special consideration.

Recommendation: Consult your Siemens Milltronics representative to discuss using the MCS with mobile crushers.

Control Gates

Note: Ensure steady and uniform material loading to the belt at or near the same speed as the conveyor belt. The installation of a material feed control gate or similar device improves uniform flow of material.

Conveyor Belting

Variations in the number of belt plies, the cover thickness, and the type and number of splices in a given belt can cause considerable change in the weight per unit length of the belt. During the course of zero calibrations, belt scales average the weight of the belt over one complete circuit of the belt. Large deviations from the average adversely affect zero calibrations.

English

English

Head Pulley

Use caution when installing a scale in a short conveyor or when locating the scale near the head pulley. Since head pulleys are flat-faced and carrying idlers are generally troughed, the belt profile must change from troughed to flat in a short distance. To accommodate this, the conveyor manufacturer designs a built-in vertical displacement of the head pulley above the top of the center roll of the adjacent idler. To further ease this transition, idlers of decreasing trough angles are inserted between the head pulley and the normal run of idlers. If these measures are not taken, a considerable amount of stress is exerted on the belt edges and the idlers adjacent to the head pulley. In turn, this stress is transmitted to the scale causing an unreliable measurement.

Recommendation: On conveyors with 20° trough idlers throughout, install the scale idler a minimum of two fixed 20° idlers away from the head pulley

Recommendation: On conveyors with 35° trough idlers throughout, install the scale a minimum of two 35° and one 20° retreat idler away from the head pulley.

Recommendation: On conveyors with 45° trough idlers throughout, install the scale a minimum of two 45°, one 35°, and one 20° retreat idler away from the head pulley.

Recommendation: The vertical displacement of the head pulley relative to the adjacent retreat idler is normally higher than acceptable for belt scale installations. We therefore suggest that when you install the scale close to the head pulley, allow a maximum of 13 mm (½") vertical displacement between the top of the head pulley and the top of the center roll of the adjacent roll.

English

Conveyor Curvature

Vertical curvature, whether concave (internal) or convex (external), disturbs the idler alignment if the scale is installed in the area of curvature. Of the two types of curvature, concave curvature is more difficult to manage because it may lift an empty belt off the idlers around the curve, preventing a good empty belt zero balance for the scale. The diagrams below illustrate the minimum distance the belt scale should be from the curvature to obtain accurate results.

Recommendation: Avoid locating the scale within the tangents of scale curvature.

Concave

Convex

Belt Ploughs

We do not recommend the use of belt ploughs or any conveyor or material control device that changes the profile of the carrying belt in or near the scale area. These devices have a detrimental effect on the belt scale idler alignment and usually create drag on the belt that the scale senses as a material force of load.

Recommendation: Do not install the scale within 9 m (30 ft.) of belt ploughs or similar devices that contact the material or belt.

Stacker Conveyors

Avoid installing the belt scale in any conveyor that is not a permanent structure. Because stacker conveyors usually vary in incline, elevation, or profile, the accuracy of the belt scale can be compromised under these conditions. A belt scale can be used effectively in a conveyor of this type, but it requires special consideration.

Recommendation: Consult your Siemens Milltronics representative to discuss using the MCS with stacker conveyors.

Conveyor Trippers

Not as common as a conveyor with a vertical curvature, trippers can still be troublesome to scales.

Recommendation: On a conveyor with a tripper car, locate the scale using the recommendations for vertical curves, but with the tripper fully retracted.

Skirt Boards and Sealing Strips

In some applications it is necessary to extend the infeed skirt boards and sealing strips the full length of the conveyor. This can create problems in weighing accuracy caused by the effects that the sealing strips exert when contacting the belt and indirectly upon the idlers, especially where pinching occurs. In particular, this situation adversely affects the zero calibrations.

Recommendation: If possible, remove the skirting in the scale area. If this is not possible, adjust the skirting to ensure the sealing strip does not put excess force on the belt or allow pinching of material.

English

Installation Procedure

1. Remove the idler at the chosen location on the conveyor.

2. Remove the idler mounting brackets and cut the spine as shown.

Notes:

- Cut the idler support as shown to allow clearance when the load is applied.
- Maximum allowable idler spine for fitting to an MCS is:

  Angled spine: 75 mm (3")

  Channel spine: 100 mm (4")

3. Position the weigh beams so that the center of the scale idler is centered between the adjacent approach and retreat idlers.
   Ensure that the scale is centered and square to the stringers.

4. Mark the position of the weigh beams and make new mounting holes suited for M12 or ½" bolts. (Refer to *Outline Dimensions* on page 5.)

5. Place the scale on the conveyor stringers with the arrows on the weigh blocks pointing in the direction of belt travel (retreat idlers). Mount the modified idler onto the scale using the clamping brackets.

6. Position the weigh blocks so that they are square to the stringer.
   - Shim as required between the weigh block mounting flange and the conveyor stringer.
   - Level the weigh blocks to one another and tighten the bolts sufficiently to keep the weigh blocks in place until final adjustment.

Note: Off-center or off-square installation can result in poor belt tracking and scale inaccuracy.

Idler Alignment

Precise alignment is very important for maximum accuracy of the weighing system. Improperly aligned idlers could apply undesired forces onto the weighing idler, resulting in measurement errors.

Alignment Procedure

1. Remove the shipping stops to free each weigh block mechanism.

   - Keep the stops and screws stored in a convenient place for use during maintenance or at times when protection of the load cells is necessary.

2. Align and level the idler in the weighing area by raising or lowering the weigh blocks in their mountings.
   - The weighing area includes the scale and at least two idlers on each side of the scale. For conventional flat idler roll conveyors, two additional idler rolls should be included in the alignment procedure.
3. Adjust idlers vertically until they are all within ±0.75 mm (1/32") of each other.

   - Stretch a line across the top surface of each idler roll in the scale area approximately 25 mm (1") from each end of each side idler roll and at the centre roll.
   - Use good quality wire (0.5 mm [0.020"] diameter) or equivalent nylon line to check for alignment. The wire or string aligning lines must be able to withstand sufficient tension to eliminate sag in the line.
4. Check that the idlers are centered and squared to the conveyor as in step 6 of the installation procedure on page 14.

Note: Off-center or off-square installation can result in poor belt tracking and scale inaccuracy.

5. Tighten the weigh blocks' mounting bolts (34 to 40.8 Nm or 25 to 30 ft lbs).
6. Install the speed sensor as described in the speed sensor instruction manual.
7. Connect the speed sensor and the MCS to the belt scale integrator. Refer to the integrator manual and its system interconnection diagram.

Wiring

belt direction
load cell
'A'
load cell
'B'

load cell
'A'
load cell
'B'
red
black
white
green
shield
shield
red
black
white
green
red
black
white
green
white
green
shld
+exc
-exc
-sig A
+sig A
-sig B
+sig B
stringer
mounted
junction box
(by customer)

Calibration

English

After the MCS, the speed sensor, and the integrator have been properly installed and wired, calibrate the weighing system in conjunction with the integrator. Refer to the integrator instruction manual for programming and calibration. All instruction manuals are available for free download at www.siemens-milltronics.com.

Calibrate the scale using the supplied calibration weight. To achieve maximum scale accuracy, perform subsequent material tests. For more information about material tests, refer to the integrator manual.

Balancing

For applications where the conveyor loading does not repeat in locations across the width of the belt, such as side to side loading, we recommend electronically balancing the two load cells. Balancing is completed during the initial start-up, but should be repeated if either load cell is replaced or reinstalled. See the associated integrator manual to complete the balancing procedure.

When balancing load cells, apply a calibration weight to the extreme sides (side A and B) as required. During this procedure, support the calibration weight with the calibration weight arm.

With balancing completed, permanently fix the calibration weight arm toward the center of the idler on the most accessible side of the conveyor.

English

Test Load

The test load value is required for calibration of the integrator. Enter the calculated value into the associated programming parameter of the integrator in kilograms per meter or pounds per foot.

The test load value is calculated as follows:

$$\text{Test load} = \frac{\text{calibration weight}}{\text{idler spacing}} \quad \frac{(\text{kg})}{(\text{m})} \text{ or } \frac{(\text{lb})}{(\text{ft})}$$

Where: idler spacing = L/2 [minimum 0.6 m (2.0 ft)]

Final Calibration

Once installation and load cell balancing are complete, release the belt and allow it to ride normally on the conveyor. Run the conveyor for at least fifteen minutes to limber the belt prior to calibration.

Program the belt scale integrator with parameters suitable for the application. When programming is complete, the system is ready for calibration.

Zero

Perform a zero calibration after the conveyor has been run long enough to allow the belt to limber up and take its natural formation (10 to 20 minutes). Perform the zero calibration as described in the integrator instruction manual while the conveyor is running empty.

Span

After completing zero calibration, perform a span calibration as described in the integrator instruction manual using the supplied calibration weight. Be sure to stop the conveyor when applying and removing the calibration weight.

The span reference (test load) is simulated using the supplied calibration weight.

1. Place the calibration weight onto the calibration weight arm.
2. Perform the span calibration described in the *Calibration* section of the integrator instruction manual.

After completing the span calibration, remove the calibration weight and store it.

With a successful zero and span calibration, and with the calibration weight no longer applied to the belt scale, the MCS system is ready for operation. Ensure that the belt scale integrator is left in the RUN mode.

Material Test

To achieve accuracy with respect to absolute values, perform material tests. Refer to the associated integrator manual for instructions on material testing.

Re-Rating

If the rate, speed, or idler spacing is changed from the original design, you may need to re-program the integrator and re-perform the calibration.

Maintenance

The MCS is virtually a maintenance-free device. In dusty or granular applications, periodically check the load cell stops for material build-up. Remove any build-up in the mechanism to ensure that the load cell maintains free movement.

Note: Re-install the shipping stops during maintenance or any other time when protection of the load cells is required.

Instruction Manual · January 2005

million
in one

milltronics
BW100

SIEMENS

Safety Guidelines: Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel: This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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Milltronics BW100

Note: The Milltronics BW100 is to be used only in the manner outlined in this instruction manual.

The Milltronics BW100 is an economical integrator for use with belt scales. The speed and load signals from the conveyor and scale, are processed to derive rate of material flow and totalization.

The primary values of speed and load, and the derived values of rate and total are available for display on the local LCD, or as output in the form of analog mA, alarm relay and remote totalization. BW100 supports Milltronics proprietary bipolar current loop for long distance communication to PLC or computer. It is also compatible with Milltronics Dolphin interface for remote display, programming and software upgrading.

Milltronics BW100 Features

- multi-field LCD display
- two remote totalizer contacts
- current loop for communications
- Dolphin compatibility
- programmable relay
- isolated mA output
- rate linearization
- local keypad
- Auto Zero

Safety Notes

Special attention must be paid to warnings and notes highlighted from the rest of the text by grey boxes.

⚠ **WARNING means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.**

Note: means important information about the product or that part of the operating manual.

The Manual

It is essential to refer to thismanual for proper installation and operation of your BW100 belt scale integrator. As the BW100 must be connected to a belt scale, and optionally a speed sensor, refer to their manuals as well.

The manual is designed to help you get the most out of your BW100, and it provides information on the following

- How to install the unit
- How to program the unit
- How to operate the keypad and read the display
- How to do an initial Start Up
- How to optimize and maintain accurate operation of the unit
- Outline diagrams
- Wiring diagrams
- Parameter values
- Parameter uses
- Modbus register mapping
- Modem configuration

Note: The Milltronics BW100 is to be used only in the manner outlined in this instruction manual.

If you have any questions, comments, or suggestions about the manual contents, please email us at techpubs@siemens-milltronics.com.

For the complete library of Siemens Milltronics manuals, go to www.siemens-milltronics.com.

Specifications

Power

- standard: 100/115/200/230 VAC ± 15%, 50/60 Hz, 15VA
- optional: 10 to 15 V DC, 15 W
  18 to 30 V DC, 15 W

Application

- compatible with Siemens Milltronics belt scales or equivalent

Accuracy

- 0.1 % of full scale

Note: The accuracy in the presence of RF fields per IEC61000-4-34 Radiated Immunity testing.

Resolution

- 0.02 % of full scale

Environmental

- location: indoor/outdoor
- altitude: 2000 m max
- ambient temperature: -20 to 50 °C (-5 to 122 °F)
- relative humidity: suitable for outdoor
- installation category: II
- pollution degree: 4

Enclosure

- polypropylene alloy
- Type 4X/NEMA 4X/IP 65
- sealed electronics compartment
- integral junction box with termination block for 0.2 to 4 mm solid or 0.2 to 2.5 mm stranded (12 to 24 AWG)

Programming

- via local 4-member keypad with silicone boot and/or Dolphin interface

Display

- 38 x 100 mm (1.5 x 4") multi-field liquid crystal display

Memory

- program stored in non-volatile FLASH memory, upgradable via Dolphin interface
- parameters stored in non-volatile EEPROM

Inputs

• load cell:	0 - 45 mV dc per load cell
• speed sensor:	pulse train: 0-5 V low, 5-15 V high, 1 to 2000 Hz, or open collector switch or relay dry contact
• auto zero:	dry contact from external device

Outputs

• analog:	- optically isolated 0/4 - 20 mA - 750 Ω max loading
• resolution:	- 0.1% of 20 mA
• load cell:	- 10 Vdc compensated for strain gauge type, 2 cells max
• speed sensor:	- 12 Vdc, 50 mA max excitation
• remote totalizer 1:	- contact closure 32 - 288 ms duration - open collector switch rated 30 Vdc, 100 mA max
• remote totalizer 2:	- contact closure 32 - 288 ms duration - open collector switch rated 240 Vac/dc, 100 mA max
• relay output:	programmable function 1 form C SPDT relay contact rated 5 A at 250 Vac, non-inductive

Communications

- Dolphin compatible
- proprietary bipolar current loop

Cable/Separation:

• one load cell/LVDT:	
non-sensing:	Belden 8404, 4 wire shielded, 20 AWG or equivalent, 150 m (500 ft.) max.
sensing:	Belden 9260, 6 wire shielded, 20 AWG or equivalent, 300 m (1000 ft.) max.
• two load cells:	
non-sensing:	Belden 9260, 6 wire shielded, 20 AWG or equivalent, 150 m (500 ft.) max.
sensing:	Belden 8418, 8 wire shielded, 20 AWG or equivalent, 300 m (1000 ft.) max.
• speed sensor	Belden 8770, 3 wire shielded, 18 AWG or equivalent, 300 m (1000 ft.) max.

• auto zero:	Belden 8760, 1 pair, twisted/shielded, 18 AWG, 300 m (1000 ft.) max.
• remote total:	Belden 8760, 1 pair, twisted/shielded, 18 AWG, 300 m (1000 ft.) max.
• analog output:	Belden 8760, 1 pair, twisted/shielded, 18 AWG or equivalent
• bipolar current:	Belden 9552, 2 pair, twisted/shielded, 18
• (comm. port)	AWG, 3000 m (10,000 ft.) max. loop
• remote total	Belden 8760, 1 pair, twisted/shielded, 18AWG,
• t1 (dc)	300 m (1000 ft.) max.

Options:

• Speed Sensor:	- Siemens Milltronics MD-36 series, or equivalent
• Dolphin:	- Milltronics Windows based software interface and infrared ComVerter link

Approvals:

- CE*, CSA $_{NRTL/C}$

*EMC performance available upon request

Installation

Notes:

- Installation shall only be performed by qualified personnel and in accordance with local governing regulations.
- This product is susceptible to electrostatic shock. Follow proper grounding procedures.

Dimensions

Conduit entry area. Recommend drilling the enclosure with a hole saw and the use of suitable cable glands to maintain ingress rating.

Note: Non metallic enclosure does not provide grounding between connections. Use grounding type bushings and jumpers.

Interconnection

Note: Wiring may be run via common conduit. However these may not be run in the same conduit as high voltage contact or power wiring.

System Diagram

Note: Typical system capability. Not all components or their maximum quantity may be required.

Installation

Terminal Block Layout

ac supply

dc supply

All field wiring must have insulation suitable for at least 250 V.

dc terminals shall be supplied from a SELV source in accordance with IEC-1010-1 Annex H.

Load Cell - Single

Note: If load cells are supplied with sense wiring:
terminate brown with black = T17
and blue with red = T20
at junction box

Where separation between the BW100 and belt scale exceeds 150 m (500 ft.):

1. remove the jumpers BW100 TB1 – 17/18 and TB1 19/20
2. run additional conductors from:
   BW100 TB1 – 18 to scale '– EXC'
   BW100 TB1 – 19 to scale '+ EXC'

If the load cell wiring colours vary from those shown, or if extra wires are provided, consult Siemens Milltronics.

Load Cell - Dual

Note: If load cells are supplied with sense wiring:
terminate brown with black = T17
and blue with red = T20
at junction box

Where separation between the BW100 and belt scale exceeds 150 m (500 ft.):

1. remove the jumpers BW100 TB1 – 17/18 and TB1 19/20
2. run additional conductors from:
   BW100 TB1 – 18 to scale '– EXC'
   BW100 TB1 – 19 to scale '+ EXC'

If the load cell wiring colours vary from those shown, or if extra wires are provided, consult Siemens Milltronics.

Speed Sensor

▼ Connect the BW100 TB1 – 7 to the MD - 36 series speed sensor terminal:

- '2' for clockwise speed sensor shaft rotation
- '3' for counter-clockwise speed sensor shaft rotation.

MD shaft rotation is viewed from the front cover side of the MD enclosure.

▲ If a speed sensor is not used, a jumper must be connected across the BW100 TB1 – 5 / 6. If a speed sensor is used, insure that the jumper is removed.

◆ Input device in the form of open collector transistor or dry contact across TB1 – 6 / 7 will also serve as a suitable speed signal.

Installation

Auto Zero

Remote Totalizer 1

Analog Output

Remote Totalizer 2

Relay Output

Installation

Communication

Bipolar Current Loop

Connect shield at one device only, e.g. BW100 TB1 - 21

Maximum loop length 3000 m (10,000 ft.)

Installation

Power Connections

AC Power

Note: The equipment must be protected by a 15 A fuse or a circuit breaker in the building installation.
A circuit breaker or switch in the building installation, marked as the disconnect switch, shall be in close proximity to the equipment and within easy reach of the operator.

DC Power

⇦ dc model indicated on lid nameplate.

dc terminals shall be supplied from an SELV source in accordance with IEC-1010-1 Annex H.

Installation

Comverter

Optional Dolphin Interface

Refer to Dolphin instruction manual for interconnection details.

Units Sticker

Remove the appropriate units sticker from the sheet supplied, and affix to your BW100 as shown.

Start Up

Note: For successful start up, ensure that all related system components such as belt scale and speed sensor are properly installed and connected.

Orientation

Display and Keypad

The BW100 operates under two modes: RUN and PROGRAM. When the unit is initially powered, it starts in the PROGRAM mode.

If the PROGRAM mode is idle, it reverts to the run mode after 10 minutes.

Installation

PROGRAM Mode

LCD

KeyPad

access RUN mode

alternates PROGRAM mode between select parameter and change value

scroll up

scroll down

Maneuvering

To Select a Parameter:

if not in the PROGRAM mode

from the RUN mode

if in the PROGRAM mode

Start Up

Speed Scroll

To speed scroll up or down press the up or down key and hold, then press the ENTER key and hold. Release to stop.

To Change a Parameter Value:

select parameter,
e.g. P005 = 1

initiate change function

security must be disabled

increase or decrease
to the desired value.

if no response,
security not disabled

must be pressed to
save change

save and return to select
parameter function,

e.g. P005 = 3

Start Up

Express:

Parameter
to jump back to P005
or
Value
to jump to the factory setting

e.g. P999

jump back to P005

To Access RUN Mode:

e.g. from the PROGRAM mode, P005

exit and return to **RUN** mode

Start Up

To Access the PROGRAM Mode:

from the run mode

e.g. rate display

last parameter from previous PROGRAM session e.g. P005

Master Reset

Prior to programming, balancing and calibration, a master reset of the BW100 should be done.

Refer to *Parameter P999* on page 64.

Load Cell Balancing

If you are operating a two load cell belt scale, it is recommended that the load cells be balanced electronically prior to initial programming and calibration, or after either or both load cells have been reinstalled or replaced.

Note: Unbalanced load cells adversely affect the performance of your belt conveyor weighing system.

typical dual load cell scale

With the conveyor stopped and locked out, lift the belt off the weighing idlers.

Place the BW100 into the **PROGRAM** mode at P291.

test weight on
load cell B side

P291

select P291 ensure SW2
is closed

SW2
closed

P292

enter and auto advance to P292,
open SW2

SW2
open

P293

enter and auto advance to P293,
leave SW2 open

SW2
open

test weight on
load cell A side

P294

enter and auto advance to P294,
close SW2

SW2
closed

P295

enter and auto advance to P295

P1
adjust until
= 0 +/- 5

Start Up

Remove the test weight, insure that the BW100 SW2 is in 'close' position and that P1 is left as set.

Note: Performing a balance procedure requires a subsequent zero and span recalibration.

Quick Start

Quick Start parameters (P005 to P017) must be programmed for all applications.

Record parameter in Program Record on page 70.

Upon completion of Quick Start programming, a Zero and Span calibration are required for successful entry into the **RUN** mode.

Start Up

Start Up

Program P005 - P017

refer to *Maneuvering* on page 18 for parameter selection and changing values.

program mode P005, units
e.g. 1, t/h

P011, design rate *
e.g. 200 t/h

* from design data sheet, if provided

P014, design speed *
e.g. 0.5 m/s

▲ for constant speed applications, TB1 - 5/6 jumpered, value is locked at 100.

P015, speed constant * ▲
e.g. 100.3 pulse / m

P016, belt length
e.g. 65.72 m

P017, test load *
e.g. 55.56 Kg / m

Examples are typical

Start Up

Test load value should be less than design load (P952). If not, contact Siemens or their agent.

Calibration Note: The duration of Zero and Span Calibration is dependent upon speed (P014), length (P016) and revolutions (P360) of belt.

Note: To cancel a Zero or Span calibration in progress, press

Start Up

Zero Calibration

Note: Run the conveyor for several minutes to warm up the belt and insure that it is empty. Test weights are not used during a zero calibration.

zero calibration required

initial zero count

zero calculation,
frequency count displayed

zero deviation calculated,
initial deviation = 0

zero deviation accepted,
initial zero count = ###
Record this value for future reference

Perform Span Calibration,
see next page

Start Up

Span Calibration

Run the conveyor until the belt is empty and stop it. Suspend the test weight from the scale per its instruction manual. Run the conveyor belt empty.

initial span count

span calculation,
frequency count
displayed

span deviation
calculated
initial deviation = 0

span deviation accepted
initial span count = ####
Record this value for
future reference

Remove the test weight when the Span calibration is complete.

successful entry
into run,
display rate

Start Up

RUN Mode

LCD

Keypad

Start Up

Recalibration

Belt Speed Compensation

In order to achieve optimum accuracy in the rate computation, the belt speed displayed must equal that of the actual belt speed. As the speeds are likely to differ, a belt speed compensation should be performed.

Run the conveyor with the belt empty.

View the belt speed

run mode /speed display, e.g. 0.750 m/s

Stop the conveyor and measure a length of the belt; marking the forward end (start time) and the back end (stop time). Use the belt scale as the stationary reference.

Run the belt and measure the time for the belt length to pass over the scale.

$$\text{speed} = \frac{\text{belt length}}{\text{time}} \qquad \frac{\text{m or ft.}}{\text{s min.}}$$

Refer to *Maneuvering* on page 18 for parameter selection and value change.

with conveyor running empty

PROGRAM mode - assumed speede.g. 0.75 ms

enter calculated speed e.g. 0.8 m/s

jumps to P014 or P015 showing new value

If the BW100 constant speed input (TB1-5/6) is jumpered, the design speed (P014) is automatically adjusted.

If a speed sensor is connected, the speed constant (P015) is automatically adjusted.

The display speed (used in the rate computation) now equals the actual speed.

Record the new value in Appendices/Program Record.

Start Up

Material Tests

Perform material tests to verify the accuracy of the of the span calibration. If the material tests indicate a repeatable deviation exists, a manual span adjust (P019) is then performed. This procedure automatically alters the span calibration and adjusts the test load (P017) value, yielding more accurate span recalibrations.

Note: Test weights are NOT used during material tests.

1. Run the belt empty.
2. Perform a zero calibration.
3. Put the BW100 into **RUN** mode
4. Record the BW100 total as the start value _ _ _ _ _ _
5. Run material at a minimum of 50% of design rate over the belt scale for a minimum of 5 minutes.
6. Stop the material feed and run the conveyor empty.
7. Record the BW100 total as the stop value _ _ _ _ _ _
8. Subtract the start value from the stop value to determine the BW100 total
9. Weigh the material sample if not already known.

BW100 total = _ _ _ _ _ _ material sample weight = _ _ _ _ _ _

- Calculate the span adjust value:

$$\% \text{ span adjust} = \frac{\text{BW100 total - material sample weight}}{\text{material sample weight}} \times 100$$

Recalibration

If the span adjust value is within the accuracy requirements of the weighing system, the material test was successful and normal operation can be resumed.

If the span adjust value is not acceptable, repeat the material test to verify repeatability. If the result of the second material test differs considerably, consult Milltronics or its agent.

If the span adjust values are significant and repeatable, perform a manual span adjust:

refer to *Maneuvering*, page 18 for parameter selection and value change

0.00
P019

PROGRAM mode, P019

if % span adjust is negative, be sure to enter as negative value

0.05
P019

enter % span adjust, e.g. 0.05

99.50
P017

jumps to P017 adjusted test load, e.g. 97.95

Verify the results of the span adjust by material test or return to normal operation

Design Changes

Where parameters have been changed with a resultant impact on the calibration or do not take effect until a recalibration is done, the parameter warning icon is displayed. In order to clear the icon, perform a zero and span recalibration after the reprogramming session is complete.

If significant changes have been made, an initial zero (P377) and/or initial span (P388) may be required.

Recalibration

In order to maintain the accuracy of the weighing system, periodic zero and span recalibrations are required. Recalibration requirements are highly dependent upon the severity of the application. Perform frequent checks initially, then as time and experience dictate, the frequency of these checks may be reduced. Record deviations for reference.

Routine Zero

Run the conveyor empty for several minutes to warm up the belt and insure that it is empty. Test weights are not used during a zero calibration.

From the run mode

initiate zero calibration
current zero count = ####

zero calculation,
load value displayed

zero deviation calculated

accept deviation
new zero count = ####

return to run mode

Note: E3 is an indication that the mechanical system is errant. The use of P377, *initial zero*, should be used judiciously and only after a thorough mechanical investigation has been exercised.

The cause of the increased deviation must be found and rectified. A zero recalibration as previously described can then be retried.

If the operator deems this deviation to be acceptable, set P377 to 1 to invoke an initial zero calibration. Further deviation limits are now based on this new initial zero.

Initial Zero

Perform an initial zero if necessary when a **calibration is out of range** message is shown.

Refer to *Maneuvering* on page 18 for parameter selection and value change.

Perform Initial Span

Direct Zero

Use direct zero entry (P367) when replacing software or hardware, if it is not convenient to perform an initial zero. A record of the last valid zero count is required.

Refer to *Maneuvering* on page 18 for parameter selection and value change.

Routine Span

To perform a routine span recalibration, run the conveyor until the belt is empty and stop it. Suspend the test weights from the belt scale per its instruction manual.

Run the conveyor empty at maximum operating speed.

From the zero calibration

Initiate span calibration current span count = ####

span calculation, load value displayed

span deviation = ##

accept deviation new span count = ####

return to run mode

Notes:

- E6 is a reminder that a zero calibration is strongly suggested before a span calibration is initiated. Press ENTER to bypass this message.
- E4 is an indication that the mechanical system is errant. The use of P388, initial span, should be used judiciously and only after a thorough mechanical investigation has been exercised.

The cause of the increased deviation must be found and rectified. A span recalibration as previously described can then be retried.

If the operator deems this deviation to be acceptable, set P388 to 1 to invoke an initial span calibration. Further deviations are now based on this new initial span.

Note: Remove the test weight when the span calibration is complete.

Initial Span

Note: Perform an initial span when a calibration out of range message appears.

Refer to *Maneuvering* on page 18 for parameter selection and value change.

select P388

invoke initial span

current span count = ####

span calculation,
frequency count displayed

span deviation = ##

span deviation accepted
initial span count = ####

return to run mode

Recalibration

Direct Span

Direct span entry (P368) is intended for use when replacing software or hardware, and when it is not convenient to perform an initial span. A record of the last valid span count is required.

Refer to *Manieuvering* on page 18 for parameter selection and value change.

current span count

enter previously recorded span count

new span count accepted

Factoring

In order to calculate the value of a new or unknown test weight to the current span, the factoring procedure is used.

Note: For optimum accuracy in the factoring results, a routine zero calibration is recommended.

Refer to *Maneuvering* on page 18 for parameter selection and value change.

With the conveyor stopped and the belt empty:

P359 selected

enter

hang new test weight onto belt scale, then run the conveyor empty

initiated Factoring, current test load value e.g. 76.11 kg / m

dynamic test load value e.g. 76.03 kg / m

jumps to P017 dynamic test load value e.g. 76.03 kg / m

return to run mode

Recalibration

Linearization

Conveyor applications where the belt scale is poorly located, or where there is a high degree of variation in belt tension, typically cause the belt scale to report load non-linearly. The BW100 provides a linearizing function (P390 - P396) in order to correct for the deficiency in the weighing system and to provide an accurate report of the actual process.

To verify that the cause of the non-linearity is not mechanical:

1. Run the conveyor belt empty and stop it.
2. Suspend various test weights to the scale to verify mechanical linearity. If the load reported by the BW100 at these tests is non-linear, a mechanical problem is indicated. Refer to the belt scale manual in order to resolve the non-linearity by improved installation or repair.

If it is determined that the non-linearity is due to the weighing application, and not the actual belt scale, apply linearization by performing the following:

- zero calibration
- span calibration at 90 to 100% of design rate
- material tests at 90 to 100% of design rate
- manual span adjust if required
- material tests at 1 to 3 intermediary flow rates where compensation is required.

Notes:

- Compensation points must be at least 10% of the design load apart.
- E8 message occurs if a point is less than 10% of full scale or if points are less than 10% apart.

- calculate the percentage compensation for each flow rate tested.

$$\% \text{ compensation} = \frac{\text{actual weight - totalized weight}}{\text{totalized weight}} \times 100$$

Where: actual weight = material test
totalized weight = BW100 total

Recalibration

Example:

A non-linearity with respect to the ideal response exists in a belt scale application with design rate of 200 t/h. It is decided to do material tests at 25, 50 and 75% of the design rate. After performing a zero and a span calibration at 100% of the design rate, followed by material tests and manual span adjust, three material tests were performed at 50, 100 and 150 t/h, as indicated by the BW100. The following data was tabulated. (This example is exaggerated for emphasis).

The material tests should be run at same belt speed, representative of normal operation; in this case 1.2 m/s. For each rate, record the corresponding load value by scrolling to the BW100 load display during running conditions or by calculation.

$$\text{load} = \frac{\text{rate}}{\text{speed}}$$

BW100 load kg/m	material test tonnes	BW100 total tonnes	compensation* %
11.6	4.2	4.9	-14.3
23.2	8.4	7.6	10.5
34.7	12.6	13.7	-8.0

*calculation example: $\% \text{ compensation} = \frac{4.2 - 4.9}{4.9} \times 100$

$= -14.3$

Recalibration

Program the BW100 as follows:

P390 = 1
P391 = 11.6
P392 = -14.3
P393 = 23.2
P394 = 10.5
P395 = 34.7
P396 = -8

Often only one point of compensation is required, usually at a low load value. In the prior example, if compensation was only required at 11.6 kg/m, the programming could be as follows. Compensation is optimized by establishing the next load value that agrees with the material test, hence where compensation is zero and entering it as the next compensation point.

P390 = 1
P391 = 11.6
P392 = -14.3
P393 = 23.2
P394 = 0
P395 = 34.7
P396 = 0

Recalibration

Operation

Load Sensing

In order for the BW100 to calculate rate and hence totalize material flow along the belt conveyor, a load signal representative of weight of material on the belt is required. The load signal is provided by the belt scale. The BW100 is compatible with belt scales fitted with one or two strain gauge type load cells.

Refer to *Specifications* on page 3 and *Installation/Load Cell* on page 6 for belt scale requirements and connection.

Speed Sensing

In order for the BW100 to calculate rate and hence totalize material flow along the belt conveyor, a speed signal representative of belt speed is required. In constant speed applications (no speed sensor), the BW100 can be programmed to provide an internal speed signal. This is achieved by entering the design speed (P014) and providing a jumper across speed input terminals (TB1-5/6). Speed constant (P015) defaults to 100.

For optimum accuracy of the weighing system, both constant and variable speed applications, a speed sensor is required. Again, the design speed and speed constants need to be programmed, however the jumper across the speed input has to be removed and the speed sensor connected.

Refer to *Specifications* on page 3 and *Installation/Speed Sensor* on page 6 for speed sensor requirements and connection.

Modes of Operation

RUN is the normal or reference mode of operation. It continuously processes the load signal from the belt scale to produce internal load and rate signals, which are in turn used as the basis for totalization, mA output and relay control. The RUN display is programmed (P081) to scroll through rate, totalization, load and speed; either manually by pressing the ENTER key, or automatically. A bar graph is continuously displayed. It is proportional to the analog output as programmed (see *Analog Output* on page 43).

From the RUN mode, access to the PROGRAM mode on and zero and span calibration is made.

The PROGRAM mode allows viewing and, with security permission (P000), changing parameter values. During PROGRAM, RUN mode functions are still active, i.e.: rate, relay, analog output and totalization. Error interrupts are suppressed and the bar graph is disabled.

If the PROGRAM mode is left idle for a period of ten minutes, it automatically reverts to the RUN mode.

Damping

Damping (P080) controls the speed at which the displayed readings and output functions respond to changes in their respective input function; load, speed and the internal rate signals. Changes in the displayed rate of material flow, material loading and belt speed are controlled by the damping. Relay alarm functions based on input functions of flow, load and speed, respond to the damped value.

If the specific mA output damping parameter (P220) is enabled (value other than 0), then the damping (P080) as it pertains to the mA function is overridden, and the output value and bar graph respond independently at the specified mA output damping rate (P220).

Analog Output

The BW100 provides one isolated analog output. The output can be assigned (P201) to represent rate, load or speed. The output range can be set to 0 - 20 mA or 4 - 20 mA (P200). The 0 or 4 mA value corresponds to empty or zero condition, whereas the 20 mA value corresponds to the associated design value: rate (P011), load (P952) or speed (P014). The analog output can be limited for over range levels of 0 mA minimum and 22 mA maximum (P212 and P213 respectively). The output 4 and 20 mA levels can also be trimmed (P214 and P215 respectively) to agree with a millammeter or other external mA input device.

The BW100 LCD provides a bar graph as a function of analog output. It displays the mA value as percentage of the mA range.

The mA output value can be tested using parameter P911. Refer to *Parameter P911* on page 62.

Relay Output

The BW100 offers one single pole double throw (SPDT) relay that can be assigned (P100) to one of the following alarm functions:

- rate: relay alarms on high and/or low material flow rate.
- auto zero: relay alarms when an attempted auto zero calibration reports an out of range condition (E9).
- speed: relay alarms on high and/or low belt speed.
- load: relay alarms on high and or low belt load.
- error: relay alarms on any error condition as it is reported.
- Refer to *Troubleshooting*, page 65.

Except for alarm on 'auto zero' and 'error', the high and low alarm setpoints (P101 and P102 respectively) are required and must be entered in the appropriate units.

The on / off actuation at both setpoints is buffered by the damping (P080) and the programmable dead band (P117), to prevent relay chatter due to fluctuations. The relay is normally energized; i.e. the normally closed (n.c.) contact held open. Upon an alarm condition, the relay is de-energized and the alarm icon on the BW100 display appears. Once in alarm, the relay and icon remain in alarm status until the alarm condition is removed.

Example:

P014 = 2m/s, design speed
P100 = 3, belt speed
P101 = 100% (2m/s)

alarm **ON** is with relay de-energized

Totalization

The totalization function is based on the internal rate (mass per unit time) signal proportional to belt speed and load on the associated belt scale. It is not affected by the damping function (P080). The rate signal is sampled several times a second to accurately count the mass of material conveyed. The count is held in the master totalizer used to increment the internal totalizers and to produce a pulse signal for the remote totalizers.

The BW100 provides four separate totalizer functions:

- internal totalizer 1
- internal totalizer 2
- remote totalizer 1
- remote totalizer 2

To avoid totalizing material at low flow rates, the totalizer drop out limit (P619) is set to a percentage of the design rate. Below this limit, totalization stops. When material flow returns to a rate above the drop out limit, totalization resumes.

Totalizer resolution or count value is set by the respective control parameters, P631 -- P639. If the resolution selected causes the totalizer to lag behind the count rate, an E2 error is displayed after making the parameter entry. The error is rectified by selecting a greater resolution value.

Example: Internal totalizer 1

Given: P005 = 1 (t/h)
P631 = 4

Then: totalizer count increments by 10 for each 10 metric tonnes registered

External totalizer 1

Given: P005 = 1 (t/h)
P638 = 5

Then: contact closure occurs once for every 10 metric tonnes registered

For remote totalization, the contact closure duration is set by the respective control parameters, P643 and P644. The value is automatically calculated upon entry of the design rate (P011) and remote totalizer parameters (P638 and P639), so that the duration of contact closure allows the relay response to track the total up to the design rate. The value can be changed to suit specific contact closure requirements, such as in the case of programmable logic controllers. If an E2 error is displayed, P638 or P639 has to be increased.

The totalizers are reset through the master reset (P999), the totalizer reset (P648) or through the keypad.

- master reset: the reset of all totalizer functions is included in the master reset.
- totalizer reset: totalizer reset can be used to resets internal totalizers 1 and 2, or totalizer 2 independently.
- keypad: pressing simultaneously while in the RUN mode resets internal totalizer 1, as well as the internal counts for both remote totalizers.

Placing the internal totalizers on to the display scroll of the **RUN** mode is controlled by the totalizer display parameter (P647); displaying either one or both totalizers.

Auto Zero

The Auto Zero function allows a zero calibration to be initiated automatically under the following conditions.

- the auto zero input (TB1-9/10) is in a closed state; jumper or remote switch
- the load is less than 2% of the design load

If the resulting zero deviation is less than an accumulated 2% from the last operator initiated zero, the auto zero is accepted.

If the deviation is greater than an accumulated 2%, an E9 error is displayed and the relay, if so programmed, goes into alarm (refer to *Operation/Relay Output*, page 44). The E9 error is cleared after five seconds.

If material feed resumes during an auto zero function, the totalizing function is maintained.

Communications

The BW100 bipolar current loop provides long distance communication to a customer device.

The BW100 communication port (TB1-21 to 25) is software set for baud (P751) and mode enable (P760). Refer to *Installation/Communication* on page 14 for wiring details.

Note: If communicating via Milltronics Dolphin software, the baud rate must be set to 4800.

Protocol

Protocol refers to the format, sequence and value of the data fields used in communication messages. Each data field of a BW100 message contains one or more bytes of ASCII binary code.

Each byte contains:

» 8 data bits
» no parity bit
» 1 stop bit

Data Field Descriptions

The following data fields are used.

som

BW100 start of message, ASCII character = STX (Hex Value = 02).

DEVICE

Identifies the BW100 to which the message applies. The device is a 2 character number that equals the Unit I.D. code, (P761). ASCII characters = 00 to 15.

MT

Identifies the 2 character message type transmitted, ASCII characters:

50 = material flow rate
51 = material load
52 = belt speed
53 = totalizer 1, internal
54 = totalizer 2, internal

READING

Contains the measurement value in the engineering units of measure selected during BW100 programming. The number of bytes in this data field varies dependent upon the reading value. Up to 8 ASCII characters including the decimal point may be transmitted.

UNITS

Three ASCII characters identify the totalizer engineering units (MT=53 and MT=54). The first character is always a space. The remaining characters may be:

t = tonnes
T = tonnes
LT = long tonnes
kg = Kilograms
lb = pounds

eom

BW100 end of message, ASCII character = CR (Hex Value = 0D).

Message Requests

Message requests must be transmitted from the host to the BW100 in the following format.

som DEVICE MT eom

Example:

Data Field	ASCII Character	Example Description
som	STX	start of message
DEVICE	01	for BW100 # 1
MT	50	material flow rate request
eom	CR	end of message

Message Responses

The BW100 response to a flow rate (MT=50) load (MT=51) or speed (MT=52) message request is in the following format.

som DEVICE MT READING eom

Example:

Data Field	ASCII Character	Example Description
som	STX	start of message
DEVICE	00	from BW100 # 0
MT	50	material flow rate response
READING	392.5	is 392.5
eom	CR	end of message

The response to a material total (MT=53) message request is in the following format.

som DEVICE MT READING UNITS eom

Example:

Data Field	ASCII Character	Example Description
som	STX	start of message
DEVICE	01	from BW100 # 1
MT	53	material total response
READING	129.2	is 129.2
UNITS	t	metric tonnes
eom	CR	end of message

Parameters

Note: *f* denotes factory default.

P000 Security lock

Locks out the programming **change value** function such that the values of P001 through P999 cannot be changed. This however does not prevent the **select** function from use; i.e. for viewing values.

Programming is locked out if the value of P000 is other than 1954.

Entry:

1954 = unlocked*f*
~~1954~~ = locked

Communications

Quick Start (P005 to P017)

Note: Quick Start is the minimum parameter programming required before attempting a calibration and successful entry into the RUN mode.

P005 Design Rate Units

Determines the units for programming and measurement.

Entry:

1*f* = t/hr (tonnes per hour)
2 = kg/hr (kilograms per hour)
3 = LT/Hr (long tons per hour)
4 = T/h (short tons per hour)
5 = lb/hr (pounds per hour)

Changing this parameter does not affect the rate (P011), belt speed (P014) or belt length (P016) parameters. These parameters should be re-entered for conformity in units.

t = 1000 kg
LT = 2240 lb.
T = 2000 lb.

P011 Design Rate

Specifies the design rate of material flow for the belt scale.

Enter the design rate from the supplied design data sheet

P014 Design Speed

Specifies the design speed for the conveyor belt.

Speed unit s are:

metre/s if P005 = 1 or 2

feet/min. if P005 = 3, 4 or 5

P015 Speed Constant

This value multiplied with the speed sensor frequency, calculates the actual belt speed.

Entry: If speed input is wired for constant speed (TB1 5/6 jumpered), value defaults to 100.

Enter the speed constant = from the supplied design data sheet

or

$$= \frac{\text{speed sensor pulses per revolution*}}{\text{pulley circumference (m or ft)/ revolution}}$$

* refer to speed sensor nameplate or consult Siemens Milltronics or their agent.

Note: Common speed sensor pulses per revolution:
RBSS - 150.4 pulses/meter (45.8 pulses/ft.)
TASS - 9.947 pulses/meter (3.03 pulses/ft.)

P016 Belt Length

The length of the conveyor belt (one belt revolution).

Length units are:

metre if P005 = 1 or 2

feet if P005 = 3, 4 or 5

Enter the belt length

P017 Test Load

The load to be referenced when performing a span.

Load units are:

kg/m if P005 = 1 or 2

lb./ft. if P005 = 3, 4 or 5

The value for P017 can be calculated as follows:

$$\text{Test Load} = \frac{\text{Total weight of of all test weights}}{\text{idler spacing}} \quad \frac{(\text{kg})}{(\text{m})} \text{ or } \frac{(\text{lb})}{(\text{ft})}$$

End of Quick Start parameters. A calibration can now be performed.

Parameters

P018 Speed Constant Adjust

This parameter allows adjustment to the speed constant (P015).

Initially, this parameter displays the dynamic speed of the belt. If the displayed speed is not equal to the actual speed, enter the actual belt speed.

For speed sensor applications, the value of P015 is automatically adjusted.

For constant speed (TB1 5/6 jumper) the value of P014 is automatically adjusted.

P019 Manual Span Adjust

This parameter allows adjustment to the span calibration.

The adjustment value is generally determined by performing material tests. Refer to *Recalibration/Material Tests*, page 30.

Enter the calculated adjustment.

P022 Minimum Speed Frequency

Sets the minimum frequency that the speed sensor can reliably read. Signals at low frequencies are erratic, adversely affecting the performance of the weighing system.

Entry:

1 = 1 Hz (at 1 Hz, it takes 1 sec before defaulting to 0 speed)
2 = 2 Hz (at 2 Hz, it takes 0.5 sec before defaulting to 0 speed)

P080 Damping

Sets the speed of response to which the displayed readings (rate, load and speed), and outputs (alarm and mA) react to change.

Note: The effect of damping (P080) on mA output can be overridden by mA output damping (P220).

The greater the damping value, the slower the response.

Enter damping value, range 1 - 9999.

P081 Display Mode

Sets the display mode. Normally, the display shows rate, or the last manually selected function. If set to alternating, the display alternates between rate and totalizer (1 and/or 2, as programmed by P647).

Entry:

0 = normal
1 = alternating

Relay/Alarm Function (P100 - P117)

Note: These parameter are specific to the use of the relay/alarm function. Refer to *Operation/Relay Output*, page 13.

P100 Relay Set Up

Sets the alarm mode for the relay.

Entry:

0 = off
1 = rate
2 = auto zero
3 = belt speed
4 = belt load
5 = error

P101 High Alarm

Sets the high alarm setpoint for relay functions P100 = 1, 3 or 4.

Enter the value in % of full scale.

P102 Low Alarm

Sets the low alarm setpoint for relay functions P100 = 1, 3 or 4.

Enter the value in % of full scale.

P117 Alarm Dead Band

Sets the dead band to prevent relay chatter due to fluctuations at the high or low setpoint.

Enter the value in % of full scale

End of relay/alarm parameters.

mA Output Parameters (P200 - P220)

Note: These parameters are specific to the use of the mA output. Refer to *Operation* on page 42 for details.

P200 mA Range

Sets the range for the mA output.

Entry:

1 = 0 - 20 mA
2 = 4 - 20 mA

P201 mA Function

Assigns the mA output to track one of the integrator functions.

Entry:

1 = rate
2 = load
3 = speed

P212 mA Min Limit

Limits the lower mA range (0 or 4 mA) to a minimum output value.

Enter limit value, range 0 - 22.

P213 mA Max Limit

Limits the upper mA range (20 mA) to a maximum output value.

Enter limit value, range 0 - 22.

P214 4 mA Trim

Adjusts the 4 mA output level to agree with a milliammeter or other external mA input device.

Enter trim value, range 0 - 9999.

P215 20 mA Trim

Adjusts the 20 mA output level to agree with a milliammeter or other external mA input device.

Enter trim value, range 0 - 9999

P220 mA Output Damping

Sets the speed at which the mA output reacts to change.

The greater the damping value, the slower the response. If the value is 0, the mA output assumes the damping set in P080.

Enter the damping value, range 0 - 9999

End of mA output parameters.

Load Cell Balancing Parameters (P291 - P295)

Note: These parameters are used for verifying or balancing the load cells (2) on the associated conveyor belt scale. Refer to *Start Up*, page 17, for details and procedure for use of these parameters.

P291 Calculator Input 1

This register displays the count associated with the summation of load cell A and B signals, when balancing the A and B load cells of the associated belt scale.

P292 Calculator Input 2

This register displays the count associated with the load B signal, when balancing the A and B load cells of the associated belt scale.

P293 Calculator Input 3

This register displays the count associated with the load cell B signal, when balancing the A and B load cells of the associated belt scale.

P294 Calculator Input 4

This register displays the count associated with the summation of load cell A and B signals, when balancing the A and B load cells of the associated belt scale.

P295 Load Cell Balance

Used in conjunction with balance calculator parameters (P291 - P 294), this parameter displays the adjustment required to complete the load cell balance procedure.

End of balancing parameters

P341 Run Time

The cumulative days that the application device has been in service. The time is recorded once daily in a non-resetable counter. Periods of less than 24 hr. are not recorded, nor accumulated.

P350 Calibration Security

This parameter provides additional security to the global lock (P000).

Entry:

0 = view parameters, perform zero and span, no reset of totalizer 1
1 = same as level 0, but cannot perform span
2 = same as level 0, but cannot perform zero and span

P359 Factoring

Factoring is used as a method of calculating the value of the test load (P017) to a new physical test weight.

Entry:

0 = idle
1 = factor

Note: Totalization is halted during the factoring procedure, and resumed only upon return to the RUN mode.

P360 Calibration Duration

Sets the number of belt revolutions to use during a zero or span calibration.

Enter number of belt revolutions, range 1 - 99.

P367 Direct Zero

This parameter allows the zero reference count to be viewed or entered directly.

Direct entry is intended for use when replacing software or hardware and it is not convenient to perform an initial zero at that time.

P368 Direct Span

This parameter allows the span reference count to be viewed or entered directly.

Direct entry is intended for use when replacing software or hardware and it is not convenient to perform an initial span at that time.

P370 Zero Limit

Sets the zero calibration deviation limit from the last initial zero. If the accumulated deviation exceeds the limit, the zero calibration is aborted (E3).

Entry:

0 = +/- 12.5% of initial zero
1 = +/- 2% of initial zero

P377 Initial Zero

The initial zero is the reference zero to which all subsequent operator initiated zero calibrations are compared in determining whether they have deviated beyond the zero limit (P370).

Entry:

0 = idle
1 = initial zero

Note: Refer to *Recalibration/Initial Zero* on page 33 for use of this function.

P388 Initial Span

The initial span is the reference to which all subsequent span calibrations are compared in determining whether they have deviated beyond 12.5% of the initial span.

Entry:

0 = idle
1 = initial span

Note: Refer to *Recalibration/Initial Span* on page 36 for use of this function.

Linearization Parameters (P390 - P396)

Note: These parameters are used to compensate for non-linear response of the weighing system to the BW100. Refer to Recalibration/Linearization for details and example on the use of these parameters.

P390 Linearization

Enables or disables the linearization function.

Entry:

0 = OFF
1 = ON

P391 Linearizer, Point 1

Enter the load, in units of P017, for point 1

P392 Compensation, Point 1

Enter the calculated compensation, in percent, for compensation point 1

P393 Linearizer, Point 2

Enter the load, in units of P017, for point 2.

P394 Compensation, Point 2

Enter the calculated compensation, in percent, for compensation point 2.

P395 Linearizer, Point 3

Enter the load, in units of P017, for point 3.

P396 Compensation, Point 3

Enter the calculated compensation, in percent, for compensation point 3.

End of Linearization Parameters.

Totalization (P619 - P648)

The following parameters are specific to the use to the BW100 totalizers. Refer also to *Operation/Totalization*, page 45.

Note: If the resolution (P631 - P639) selected would cause the totalizer to lag behind the count rate, a message E2 is displayed after making the entry.

Select a greater resolution value.

Example

Given:	P005 = 1 (t/h) P631 = 5
Then:	totalizer count increments by 10 for each 10 metric tonne registered

P619 Totalizer Drop Out

This parameter sets the limit, in percent of design rate, below which material rates are not totalized.

The value of 0 is reserved to allow both negative and positive totalization.

Enter drop out value in % of design rate.

P631 Totalizer 1 Resolution, Internal

This parameter sets the resolution of internal totalizer 1.

Entry:

1 = 0.001 (one thousandth)
2 = 0.01 (one hundredth)
3 = 0.1 (one tenth)
4 = 1 (unit)
5 = 10 (x ten)
6 = 100 (x hundred)
7 = 1000 (x thousand)

P632 Totalizer 2 Resolution, Internal

This parameter sets the resolution of internal totalizer 2.

Entry:

1 = 0.001 (one thousandth)
2 = 0.01 (one hundredth)
3 = 0.1 (one tenth)
4 = 1 (unit)
5 = 10 (x ten)
6 = 100 (x hundred)
7 = 1000 (x thousand)

P638 Totalizer 1 Resolution, External

This parameter sets the resolution of external totalizer 1.

Entry:

1 = 0.001 (one thousandth)
2 = 0.01 (one hundredth)
3 = 0.1 (one tenth)
4 = 1 (unit)
5 = 10 (x ten)
6 = 100 (x hundred)
7 = 1000 (x thousand)

P639 Totalizer 2 Resolution, External

This parameter sets the resolution of external totalizer 2.

Entry:

1 = 0.001 (one thousandth)
2 = 0.01 (one hundredth)
3 = 0.1 (one tenth)
4 = 1 (unit)
5 = 10 (x ten)
6 = 100 (x hundred)
7 = 1000 (x thousand)

P643 Totalizer 1 Contact Closure, External

The value of this parameter represents a multiple of 32 ms of contact closure for remote totalizer 1. The value is automatically calculated upon entry of P1 (design rate) and P638 (totalizer 1 resolution, external) so that the duration of contact closure allows the transistor switch response to track the total, up to the design rate.

The value can be changed to suit specific contact closure requirements, such as in the case of programmable logic controllers. If a message E2 is displayed, P638 has to be increased.

Entry:

1 = 32 ms
2 = 64
3 = 96
4 = 128
5 = 160
6 = 192
7 = 224
8 = 256
9 = 288

P644 Totalizer 2 Contact Closure, External

The value of this parameter represents a multiple of 32 ms of contact closure for remote totalizer 2. The value is automatically calculated upon entry of P1 (design rate) and P639 (totalizer 2 resolution, external) so that the duration of contact closure allows the transistor switch response to track the total, up to the design rate.

The value can be changed to suit specific contact closure requirements, such as in the case of programmable logic controllers. If a message E2 is displayed, P639 has to be increased.

Entry:

1 = 32 ms	6 = 192
2 = 64	7 = 224
3 = 96	8 = 256
4 = 128	9 = 288
5 = 160	

P647 Totalizer Display

Selects the totalizer combination to be displayed, either manually through the scroll display key or automatically by control of the display mode (P081).

Entry:

1 = totalizer 1
2 = totalizer 2
3 = totalizers 1 and 2

P648 Totalizer Reset, Internal

Resets the internal totalizers.

Entry:

0 = idle
1 = reset totalizer 2
2 = reset totalizers 1 and 2

End of Totalization parameters.

Communication (P751 - P761)

These parameters are specific to the use of the communication parameters. Refer also to *Communications*, page 47.

P751 Baud Rate

Sets the baud rate for the proprietary bi-polar current loop. This baud rate is not applicable to communication via Milltronics Comverter.

Entry:

300, 1200, 2400, 4800 or 9600 baud

4800 baud is required for Dolphin communications over the bi-polar current loop.

P760 Communication Mode

Selects the communication mode.

- bi-polar current loop: interface with the host device (PLC or computer)
- infrared link: communication is made using the Milltronics ComVerter.
- maintenance: communication is made via the bi-polar current loop for RUN mode operations and infrared link for PROGRAM mode operations

Entry:

1 = bipolar current loop
2 = infrared link
3 = maintenance

P761 Identification Number

Sets the identification number for the unit.

Enter the desired identification number, range 0 - 15.

End of communication parameters.

Test and Diagnostic (P900 - P951)

Note: These parameters are used for test and diagnostic purposes.

P900 Software Revision

Displays the EPROM (Flash ROM) software revision level.

P901 Memory

Tests the memory. Test is initiated by scrolling to the parameter or repeated by pressing ENTER.

Display:

PASS = normal
FAIL = consult Siemens Milltronics.

P907 Programmer Interface

Tests the infrared communications link. Test is initiated by scrolling to the parameter or repeated by pressing ENTER.

Display:

PASS = normal
FAIL = consult Siemens Milltronics.

P911 mA Output Value

Displays the value from the previous measurement. A test value can be entered and the displayed value is transmitted to the output. Upon returning to the RUN mode, the parameter assumes the actual mA output level.

P940 Load Cell A, mV_{in}

Displays the mV signal input from the load cell. Range 0.00 - 60.00 mV.

P941 Load Cell B, mV_{in}

Displays the mV signal input from the load cell. Range 0.00 - 60.00 mV.

P942 V/F converter, V_{in}

Displays the input voltage to the voltage to frequency converter.
Range 0 - 3.98 V

P943 V/F converter, f_{out}

Displays the output frequency of the voltage to frequency converter.
Range 0 - 131,072

P944 Power sensor

Displays a voltage supply reference for diagnostic purposes.

P949 Diagnostic Errors

Enables or disables diagnostic error checking, E101 - E104

Entry:

0 = disable
1 = enable

Refer to *Troubleshooting* on page 65.

P950 Zero register

Registers the number of zero calibrations that have been done since the last master reset.

P951 Span Register

Registers the number of span calibrations that have been done since the last master reset.

P952 Design Load

Displays the value of the design load, which corresponds to the full scale value for alarm and mA output functions. The design load is calculated, based on the design rate and design speed.

End of test and diagnostic parameters.

P999 Master Reset

Resets parameters and totalizers to their factory setting.

Parameters

Troubleshooting

message	diagnosis	action
E1 (program)	security code required	enter access code into P000
E2 (run)	totalizer resolution too low	increase value (P631 - P639)
E3 (run)	zero out of range	consider an initial zero P377, refer to *Recalibration/Initial Zero* on page 33
E4 (run)	span out of range	consider an initial span P388, refer to *Recalibration/Initial Span* on page 36
E5 (run)	parameter not entered	check parameters P005 - P017 for entry
E6 (run)	zero calibration required	do a zero calibration
E7 (run)	span calibration required	do a span calibration
E8 (program)	parameter value error	check that value is valid
E9(run)	auto zero out of range	auto zero has accumulated deviation beyond 2% from last operator initial zero. If error is not caused by material on belt, then do an operator initiated zero.
E10 (run)	rate or span out of range	loading on belt is 300% of rated load or greater. Investigate and if no mechanical cause, check to see if re-rating the design rate is required.
E11 (run)	speed greater than twice the design speed	check design belt speed against actual belt speed, check speed constant, perform speed constant adjust (P018) if necessary
E12 (factoring)	span out of range	test load is either too low or beyond 100% of design load (P952). Replace test weight with a heavier or lighter weight and try factoring again.

message	diagnosis	action
E101 (run)	load cell A mV reading is out of range	error will appear if: • mV signal from load cell A or B is out of the 0-50 mV range • the mV signal from load cell A or B is less than the zero calibration mV level minus one half the span mV level • A or B mV is greater than 4 times the span mV value check load cell mV signal and ensure that it is within range check wiring
E102 (run)	load cell B mV reading is out of range	
E103 (run)	combined mV signal from load cell A and B is out of range	error will appear if the combined mV signal from load cell A and B is too low check both load cell signals and ensure that they are greater than 0 mV check wiring
E104 (run)	faulty memory location found	cycle power and perform memory test (P901) if error reappears, the BW 100 must be repaired or replaced.
OF	no speed signal	check speed circuit or run conveyor

- Error messages are cleared when the condition is remedied.
- RUN mode errors are suppressed during **PROGRAM** mode, zero or span calibration.
- Zero and span errors are cleared when zero or span is initiated. Errors that happen during the calibration require re-starting the procedure.
- Program errors are cleared when any key is pressed.
- The messages E101 through E104 can be turned off (P949).
- The load cell errors are detected by certain conditions where it is apparent that the load cell is not functioning or incorrectly wired. It is not a conclusive test, since even with incorrect wiring, the resulting input from the load cell may be within a valid range.

Maintenance

The BW100 requires no maintenance.

The external surface of the enclosure may be cleaned using a vacuum cleaner and a clean dry paint brush. The display window should be cleaned with a moist non-abrasive cloth.

It is a good idea to check the associated load sensing device, according to its instruction manual.

Software Updates

The software can be updated from a floppy disk by use of a PC (IBM Compatible) with Milltronics Dolphin software. It is recommended that a reset (P999) is done after the software update followed by zero and span calibrations.

Direct zero entry (P367) and direct span entry (P368) will suffice in lieu of dynamic zero and span calibrations. Therefore, zero and span counts should be recorded prior to doing the software update.

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Program Record

Program Record	
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milltronics
BELT SCALES

SIEMENS

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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Preface

Although this instruction manual was originally written to support the MSI belt scale, it can also be used as a reference for models MMI and MUS, or belt scale weighing in general.

Note: All diagrams are specific to the MSI belt scale. When applying this manual to other belt scale models, use diagrams as examples only.

Please refer to the appropriate belt scale instruction manual for full specifications, and installation and calibration procedures. Manuals can be downloaded from the Siemens Milltronics web site at **www.siemens-milltronics.com.**

Belt scale design and manufacture allow for greater accuracy to be achieved when installed and applied according to the guidelines. To help the user maintain the accuracy and performance of the belt scale, this manual provides recommendations for the proper application of belt scales under specific conveyor and environmental conditions.

Belt Conveyor Terminology

Idler Detail

Locating the Scale

Belt Tension

Belt tension varies in relation to material tonnage, belt speed, conveyor length and the height that the material must be raised. The larger these values, the greater the tension and the greater the resulting effect on the scale.

Recommendation

Install the scale close to the tail section where tension and tension variations from no load to full load are minimal.

Material Turbulence

Material leaving the area of the feed point and associated skirtboards will be turbulent and will require a distance of belt to settle. Do not attempt to weigh the material before it settles completely. Locating the scale also depends on the conveyor belt speed and the characteristics of the material.

Recommendation

Locate the scale no less than one idler space beyond the point where turbulence stops. If that cannot be determined, refer to the following chart:

belt speeds	d
up to 1.5 m/sec (300 fpm)	2 m (6 ft)
up to 2.5 m/sec (500 fpm)	3 m (10 ft)
over 2.5 m/sec (500 fpm)	5 m (15 ft)

Curved Conveyors

Vertical curvature in the conveyor design can create difficulties with belt scales. Both concave and convex curvatures will disturb the idler alignment if the belt scale is installed in the area of the curve. The concave curvature is more difficult to manage because it may lift an empty belt off the idlers around the curve, preventing a good empty belt zero balance for the scale. The diagrams below illustrate the minimum distance the belt scale should be from the curvature to obtain accurate results.

Concave

Convex

Belt Ploughs

The use of belt ploughs or any conveyor or material control device that changes the profile of the carrying belt in or near the scale area is not recommended. These devices have a negative effect on the belt scale idler alignment and may create drag on the belt which the scale may sense as a material force or load.

Recommendation

Do not install the belt scale within 9 m (30 ft) of belt ploughs or similar devices that change the profile of the material or belt.

Stacker Conveyors

Any conveyor that is not a permanent structure or that varies in its incline, elevation or profile is not considered a good installation for an accurate belt scale. For applications where a belt scale can be used effectively with a conveyor of this type, please consult your Siemens Milltronics representative.

Conveyor Trippers

A conveyor with a tripper is not as common as a conveyor with fixed curvature, but it can have a similar effect on belt scales. A tripper can cause varying belt tension and can cause lifting of the belt in the scale area if the belt scale is not located in the best position.

Recommendation

On a conveyor with a tripper, locate the scale according to the recommendations for fixed curves, but with the tripper in its fully retracted position.

Conveyor Considerations

Belt Scale Take-up Device

A variety of conveyor belt take-ups can control conveyor belt tension. Of the three basic types, (screw, horizontal gravity and vertical gravity), the vertical gravity take-up is the most reliable because it can react to changes in belt tension and maintain relatively uniform tension. Using a vertical gravity take-up greatly reduces the influence of belt tension on the scale and improves accuracy.

Recommendation

For the best accuracy, use a vertical gravity take-up. If that is not practical or possible, use a horizontal gravity take-up. The use of the screw type take-up should be limited to conveyors with pulley centers of less than 18 m (60 ft).

Material Feed Point

Some conveyor systems require that multiple feed points be in use at the same time. Belt tension can vary considerably depending upon the combination of feeds points in use at any given time.

Recommendation

Whenever possible, install the scale on a conveyor that has only one feed point.

Material Loading

Various methods are used to feed material to the belt. Often, the flow of material from the pre-feeder to the belt is not uniform and at speeds different from the conveyor belt speed. These influences may reduce accuracy.

Without Control Gate

With Control Gate

Recommendation

Ensure steady and uniform material loading to the conveyor belt at or near the same speed as the belt. Install a material feed control gate or similar device to enhance the uniform flow of material.

Material Roll Back

Material roll back (sometimes referred to as material slip) occurs on a conveyor belt when the material, due to its size and shape, rolls back on itself even though the general direction is forward. It may be the result of a conveyor with a steep incline, an inequality between material feed velocity and belt speed, or poorly selected or installed rubber or

chain curtains at the infeed, where the curtain momentarily holds back the material on the top of the pile causing it to slow down in comparison with the rest of the pile.

Recommendation

Make a close inspection of the installation to determine if the proper speed to feed and incline versus material roll back relationships are in use.

Conveyor Belting

The variations in the number of belt plies, the cover thickness and the type and quantity of splices in a given conveyor belt causes considerable variation in the weight per length of that belt. During the course of zero balancing, most belt scales average the weight of the belt over one complete circuit of the belt.

The amount of the deviation (+ or -) from that average, if great enough, can make it difficult to obtain a good zero reference and subsequent scale accuracy.

Belt Stiffness

A belt that is over-rated for its intended use may be so stiff that it cannot flex enough to properly trough in the idlers. When this happens (especially in 35° and 45° idlers), the belt arches across the idler and neither a good zero of the belt nor a good span calibration can be obtained.

Recommendation

When replacing worn sections of belting, ensure that it is the same as the existing belting. When choosing a new belt, select one that suits the application. Avoid selecting an over-rated belt.

Idlers

Of the variety of idlers available, only certain types are permitted for use with a belt scale. Use of the proper idlers is necessary to achieve good idler alignment in and around the scale area.

offset conveyor idler
(acceptable in some applications)

wire rope idler

V-Roll (2 Roll) conveyor idler

catenary idler

Recommendations

a. Do not use wire rope type, 2 roll "V" type, or catenary type idlers on or near scale. Offset type may be acceptable in some installations (consult Siemens Milltronics regarding their use). The only truly acceptable types are the troughed 3 roll in-line type or single roll flat type idlers.

b. The most common troughed idlers are 20° and 35°. 45° troughed idlers may be used but accuracy may suffer. The deeper trough angle tends to magnify the effect that belt tension and belt stiffness have upon the scale, increasing the importance of good idler alignment.

c. Select idlers that have the same dimensions, that have rolls that are concentric within 0.5 mm (.020"), and that have troughs that match within 3 mm (0.12"), when compared to a template. All idlers chosen for scale installation must be of the same manufacture and properly lubricated (in some cases, idlers having "Lube-for-life" bearings are required).

d. Keep all idler rolls clean, free from material build-up, and free spinning without over-greasing. Neglecting this may result in misalignment and poor belt tracking. Replace all idlers that have stiff, stopped or eccentric rolls.

Idler Alignment

The proper and accurate alignment of idlers in the scale area is critical for belt scale function and accuracy. Refer to the installation procedure in the appropriate belt scale manual.

Recommendation

Properly align the scale idlers and at least two (preferably three) idlers on each side of the scale. See diagram on page 2 (Idler Detail) for an example of correct idler alignment.

Head Pulley

Be cautious when installing a scale in a short conveyor or in conditions where the scale must be located in the area near the head pulley. Head pulleys are essentially flat faced with a slight crown. When using troughed idlers, the belt profile must change from the troughed to flat in a short space. To accommodate this, the conveyor manufacturer designs a built-in vertical displacement of the head pulley above the top of the center roll of the adjacent idler. To further aid this transition, idlers of decreasing trough angles are inserted between the head pulley and the normal run of idlers.

If these adjustments are not made, a considerable amount of stress is exerted on the belt edges and the idlers adjacent to the head pulley and, ultimately, these undesired forces are applied to the scale.

Recommendation

a. On conveyors with 20° trough idlers, a minimum of two fixed 20° idlers must be located between the belt scale and the head pulley.

b. On conveyors with 35° trough idlers, a minimum of two 35° and one 20° retreat idlers must be located between the scale and the head pulley.

c. On conveyors with 45° trough idlers, a minimum of two 45°, one 35° and one 20° retreat idlers must be located between the scale and the head pulley.

d. The vertical displacement of the head pulley relative to the adjacent retreat idler is normally in excess of what is acceptable for belt scale installations.

When locating a scale close to the head pulley, maintain a maximum of 13 mm (1/2") vertical displacement between the top of the head pulley and the top of the center roll of the adjacent idler by making the following adjustments:

1. Lower the head pulley on its mounting until the vertical displacement measured from the top of the head pulley does not exceed 13 mm (0.5") above the top of the center roll of the adjacent idler.

   or

2. Shim all the retreat idlers between the head pulley and the scale, the scale idlers and at least two approach idlers to accomplish the same end result mentioned in option 1.

Tail Pulley

Usually, the space reserved for the infeed suppresses any effect the tail pulley might have upon the scale. A problem could occur if the tail pulley is the self-cleaning type with slats or beater paddles, often called a wing pulley. The beating action of this pulley may create oscillations that could be transmitted through the belt to the scale.

Recommendation

If possible, avoid the use of wing type pulleys. Use solid face welded steel pulleys.

Conveyor Rigidity

The conveyor stringers in the scale area should be strong enough to limit relative deflection to 1.6 mm (1/16") or less with supports 2.4 m (8 ft) apart throughout the range of conveyor loading. Stringers should also be straight so that the belt has a better chance of tracking centrally on the conveyor.

Vibration

A belt scale is an inherently sensitive device and should be isolated from equipment that can induce harmful or disturbing vibration. Equipment such as crushers, vibratory feeding equipment, bins subject to hammering, and hammer mills should be avoided.

Conveyor Covers

Covers are required for outdoor installations involving belt scales.

Recommendation

Ensure that the covers do not interfere with the operation of the scale. Install additional shielding to counteract the adverse effects of the elements (wind in particular). The amount of shielding will depend on the geographical area, but typical dimensions are 9 m (30 ft) before and after the center of the scale and 1 to 1.2 m (3 to 4 ft) above and below the carrying belt line.

Belt Tracking and Troughing

A combination of factors determine whether or not the conveyor belt will properly track (i.e. keep its position on the conveyor and idler centerline) and trough (i.e. lay in the idler trough and make good contact with all three idler rolls as intended).

First, consider the belt:

- ensure sufficient ply rating to support the load without being overrated
- ensure that rubber covers are of the proper thickness
- ensure that splices are properly selected and installed

Second, ensure that the conveyor take-up is the right type for the application and that it is properly adjusted and working properly.

Third, consider the idlers:

- ensure the idlers are square to the conveyor and located centrally on the frame
- ensure that all idler rolls turn on their axis
- ensure that training idlers or idlers with guide rollers (if used) are not installed closer than 9 m (30 ft) from a scale idler

Skirtboards and Sealing Strips

In some applications it is necessary to extend the infeed skirtboards and sealing strips the full length of the conveyor. Problems in weighing accuracy can result from the force the sealing strips exert on the belt, and indirectly on the idlers, especially when pinching occurs. Obtaining accurate zero balance and span calibrations under these circumstances is difficult.

Recommendation

Remove the sealing strips or raise them sufficiently to eliminate their effect upon the belt and idlers.

Maintenance and Modifications

Maintenance

Once the conveyor is fitted with a belt scale, it requires more attention as it is now part of the weighing system. To ensure accurate weighing, take good care of the scale and the surrounding area. Perform the following maintenance for proper scale operation:

- lubrication of all pulleys and idlers
- proper belt tracking and training
- proper belt cleaning and scraping
- proper belt take-up operation
- proper material and spillage control

Maintenance Precautions:

- When welding near the scale, do not allow current to pass through the belt scale.
- Reset the shipping stops to reduce physical shock to the load cells during maintenance.

Modifications

Any changes to the conveyor and/or related equipment could have a profound effect upon the operation and resulting accuracy of the belt scale.

Recommendation

Consult your Siemens Milltronics representative for advice regarding belt scale installation in a modified conveyor system.

Material Build-up

Keep the conveyor belt and associated equipment as clean as possible, so that the scale measures only the loads intended and not the added load due to material sticking to the belt. To remove materials that stick to the belt and conveyor equipment, use good quality belt cleaning equipment such as belt scrapers, rotary brushes, vibrating cleaners, shakers, and ploughs. Although scales can be frequently and automatically recalibrated at no load (zero), it is not a good practice to allow material build-up to remain on the belt.

Material Spills

General good housekeeping is always important. Material spillage results in lost production and can also adversely affect scale operation when spilled material wedges between dynamic parts preventing proper scale deflection. In addition, the build-up affects the zero balance of the scale.

Recommendation

Do not overload the conveyor. As a precaution, install deflectors to keep spills from reaching the scale.

Notes

Notes

www.siemens-milltronics.com

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milltronics

MD-36 SPEED SENSOR

SIEMENS

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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Introduction

English

Safety Notes

Special attention must be paid to warnings and notes highlighted from the rest of the text by grey boxes.

! WARNING: means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.

CAUTION: means that failure to observe the necessary precautions can result in considerable material damage.

Note: means important information about the product or that part of the operating manual.

Safety marking symbols

~	Alternating Current
⎓	Direct Current
⏚	Earth (ground) Terminal
⏚	Protective Conductor Terminal

Product Warnings

! WARNINGS:

- **Repair of this equipment shall be carried out by suitably trained personnel in accordance with the applicable Codes of Practice.**
- **If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to use suitable precautions that prevent it from being adversely affected.**
- **The MD–36 Speed Sensors are to be used only in the manner outlined in this manual or protection provided to the equipment may be impaired.**

English

Milltronics MD-36 Speed Sensor

The Milltronics MD-36 is a general purpose and hazardous rated speed sensor. The sensor, coupled to the motor or pulley shaft, converts the rotation of its input shaft into an encoded speed signal. The speed signal is transmitted to the integrating electronics for use in calculating the rate of material flow.

Siemens Milltronics provides a full range of electronic integrators:

- Compuscale III
- Milltronics BW 100
- Milltronics BW 500

The MD-36 sensors can also be used with older model Siemens Milltronics integrators:

- Compuscale
- Compuscale II
- Compuscale IIA
- Compu-M

For further information about Siemens Milltronics products, go to www.siemens-milltronics.com.

The Manual

Notes

- Please follow the installation and operating procedures for a quick, trouble-free installation and to ensure the maximum accuracy and reliability of your Siemens Milltronics weighing system.
- This manual applies to the MD-36 Speed Sensors only. Please consult the separate integrator and belt scale manuals for operating instructions.

This manual will help you set up your MD-36 Speed Sensor for optimum performance. We always welcome suggestions and comments about manual content, design, and accessibility.

Please direct your comments to techpubs@siemens-milltronics.com.

Specifications

English

Power

- MD-36/MD-36A/MD-36SS: +15 V DC, 25 mA from integrator
- MD-36 IS: +5, – 25 V DC from IS Switch Isolator

Temperature

- – 40 to 55 °C (–40 to 130 °F)

Input

- shaft rotation 0 to 2,000 rpm, bi-directional

Output

MD-36/MD-36A/MD-36SS:

- open collector sinking output, max. 25 mA at 15 V DC
- 36 pulses / revolution
- 0 to 2,000 rpm = 0 to 1200 Hz

MD-36 IS:

- load current: 0 – 15mA
- 36 pulses per revolution
- 0 to 2000 rpm = 0 to 1200 Hz

Input: Output

- 1:1 (speed ratio)

Enclosure

- MD-36 and MD-36 IS: aluminum rating – Type 4/NEMA 4/IP 65
- MD-36A: aluminum
- MD-36SS: 304 stainless steel

English

Approvals

- MD-36: CSA, FM – Class II, Gr. E, F&G, Class III, CE
- MD-36 IS:
  - ATEX: II 2 G, EEx ia IIC T6 (with suitable IS Switch Isolator)
  - CSA/FM (with suitable IS Switch Isolator or Switch Amplifier): Class I, Div. 1, Groups A,B,C, and D. Also Class II, Div. 1, Groups E,F, and G system approval
  - CE
- MD-36A, MD-36SS: CE

Switch and Isolator Approvals

Note: The Approval Ratings for the Proximity Switch and the IS Switch Isolator are the property of Pepperl+Fuchs. Copies of these Approval Certificates may be obtained at www.siemens-milltronics.com.

Proximity Switch Approval Ratings (Pepperl+Fuchs #SJ3.5-N)

- ATEX: II 2 G, EEx ia IIC T6 (with suitable IS Switch Isolator)[1]
- CSA/FM (with suitable IS Switch Isolator or Switch Amplifier): Class I, Div. 1, Groups A,B,C, and D. Also Class II, Div. 1, Groups E,F, and G system approval

IS Switch Isolator (Pepperl+Fuchs #KFA5-SOT2-Ex2 and #KFA6-SOT2-Ex2)

- ATEX: II (1) G, [EEx ia] IIC
- CSA/FM: Class I, Div. 1, Groups A,B,C, and D. Also Class II, Div. I, Groups E,F, and G.

Cable (optional)

- Belden 8770, 3 wire shielded, 0.75 mm^2 (18 AWG) or equivalent
- max. run 305 m (1000 ft.)

1. Based on the ATEX rating of the NAMUR slotted sensor and CSA/FM system approvals.

Operation

The speed sensor consists of a main shaft rotating in a bearing assembly fixed to the enclosure. The shaft turns a toothed disk divided into 36 teeth, each separated by a gap equal to the tooth width. In the MD-36/MD-36A/MD-36SS, the encoder card is mounted so that the two optocouplers straddle the disk's teeth.

MD-36/MD-36A/MD-36SS Operation

Power from the integrating device energizes the two optocoupler LEDs and feeds the 5Vdc regulator. The 5Vdc bus powers the logic circuitry and the output driver transistors.

As the shaft rotates, the 36-tooth wheel modulates the light crossing within each optocoupler. The resulting outputs are two 50% duty cycle square waves that are phase shifted by 90 degrees electrical or 1/4 cycle (one cycle of 360 degrees electrical corresponds to the width of one tooth and one gap). This configuration provides directional discrimination.

The optocouplers' square wave outputs are converted into clockwise (CW) and counterclockwise (CCW) square wave output signals by the intermediate logic. When the shaft rotates in a CW direction, the logic produces pulses at the CW output and the CCW output is disabled. When the shaft rotates in a CCW direction, the logic produces pulses at the CCW output and the CW output is disabled.

The speed sensor is immune to any external vibration that would cause the toothed wheel to oscillate 1/4 cycle (1/2 tooth width or 5° of shaft rotation) or less.

MD-36 IS Operation

The MD-36 IS Speed Sensor contains a Pepperl + Fuchs, NAMUR rated, inductive proximity sensor, model # SJ3.5-N, consisting of an oscillator and a coil. The oscillator creates a fequency which is emitted from the coil and out the face of the sensor.

When a metal target enters this radiated field, eddy currents are indicated on this target. As the target moves closer to the sensor, the energy required from the oscillator increases. The IS switch isolator monitors the change in the oscillator load, triggering the output when a predetermined level is reached.

Dimensions

MD-36, MD-36A, MD-36 IS

Front View

Side View

117 mm
(4.6")
61 mm
(2.4")
16 mm (0.63")
ø shaft
84 mm (3.3")
124 mm (4.9")
ref. 61 mm
(2.4")
21mm (0.8")
6 mm (0.25")
ø shaft
(two places)
114 mm
(4.5")
213 mm
(8.4")

English

MD-36SS

Front View

Side View

127 mm
(5.0")
61 mm
(2.4")
16mm (0.63")
ø shaft
86 mm (3.4")
127 mm (5.0")
(ref.) 76 mm
(3.0")
21 mm (0.8")
6 mm (0.25") ø
shaft
(two places)
114 mm
(4.5")
216 mm
(8.5")

Mounting

The MD-36 speed sensor models can be coupled to a tail pulley, bend pulley, or motor shaft.

There are two methods of attaching the sensor: floating and fixed.

Floating Pulley Mount

The input shaft and bearing assembly bear the weight of the speed sensor. The unit's arresting bracket stops the speed sensor from rotating with the shaft.

The arresting bracket straddles a section of angle iron installed by the customer. Make sure to fasten the anti-rotation spring.

Notes:

- When mounting the speed sensor, ensure that the shaft alignment is true to avoid stresses on the shaft bearing.
- For preferred mounting locations, refer to the associated belt scale or weigh feeder application drawings.

Pulley Shaft

Arresting Bracket (B-B Cross Section)

Notes:

- When tail or bend pulley is not supplied by Siemens Milltronics, machining on tail/bend pulley shaft (see *Pulley Shaft* above) to accommodate Milltronics speed sensor is done by customer.
- Arresting bracket is an anti-rotation device only and must not secure or support the speed sensor. Bearing life is greatly reduced if speed sensor is not free to "float." Use anti-rotation spring to prevent mechanical oscillation of speed sensor.
- Grease mating surfaces to prevent seizing.

Fixed Shaft Mount

Side View

Front View

Interconnection

English

CAUTION:

- All wiring must be done in accordance with approved conduit, boxes, and fittings, and to procedures in accordance with all governing regulations.
- Flexible conduit is recommended so excess stress is not applied to the shaft bearings
- Interconnection between the speed sensor and the integrator should be made with 3-wire shielded, 18 AWG cable (Belden 8770 or equivalent).
- Ground the shield at the integrator ONLY!

MD-36 Speed Sensor/Integrator Connection

MD-36		Compu III	BW 100	BW 500
Description	Terminal	TB1	TB1	TB1
+ 15 V DC	1	30	8	19
Speed Out (CW)[1]	2	(31)[2]	(7)	(16)
Speed Out (CCW)	3	(31)	(7)	(16)
Common	4	32	6	17
Ground	G	N/C[3]	N/C	N/C

1. To determine direction of rotation, see *Front View* mounting on page 14.
2. Terminal positions in brackets denote that only one signal may be connected at one time.
3. N/C = No Connection

MD-36 IS Speed Sensor/Isolator/Integrator Connection

MD-36 IS	IS Switch Isolator (P&F #KFA5-S0T2-Ex2)	BW 100	BW 500
Terminal	Terminal	TB1	TB1
3	1		
4	3		
	7	7	16
	8	17	14

Wiring Diagram (MD-36 IS only)

Note: The 115V version is shown. If 230V is required, use isolation barrier Pepperl + Fuchs #KFA6-SOT2-Ex2.

Parts Lists

MD-36/MD-36A/MD-36 IS Parts List

1	Enclosure	1
2	Screw, 6-32 x 5/16	3
3	External Lockwasher #6	5
4	Gasket, Bearing Assembly	1
5	MD-36 Bearing Assembly	1
5a	MD-36A Bearing Assembly	1
6	MD-36 Shroud	1
7	Disc 36 Tooth	1
8	Disc Hub	1
9	Slot Round Head Screw 1/4"	4
10	Lockwasher Split 1/4"	4
11	Enclosure Cover	1
12	Extension Shaft	1
13	Set Screw Socket, 8-32 x 3/16	2
14	External Lockwasher #4	3
15	Bushing	2

16	MD-36/36A: Speed Pickup Card Ver.3	1
	MD-36 IS: Mounting Plate	1
17	Binding Screw, Slot, 6 - 32 x 5/8	4
18	Cap Screw, Socket, 10 - 32	4
19	Lockwasher, Split #10	4
20	Binding Screw, Slot, 4 - 40	3
21	Hex Nut, 6 - 32	2
22	Terminal Block CSA	1
23	Gasket, Cover	1
24	Threaded Plug, 1/2 NPT	2
25	Enclosure Arresting Bracket	1
26	Spring Spnr. B-604	1
27	Bolt, Hex 5/16 - 18 x 1 1/4	2
28	Nut, Hex 5/16 - 18	2
29	Washer, Flat 5/16	2
30	Lockwasher Split 5/16	2

Side View

Front View

Note: Shown with cover removed.

Bearing Assembly Replacement

1. Turn off supply power from integrator and then remove speed sensor from mounting.
2. Remove cover (#11) and the four bearing assembly mounting screws (#18) located externally around shaft.
3. Pull out bearing assembly (#5) c/w card, disc hub, disc, and mounting brackets.
4. Remove screws (#17), bushing (#15), and card (#16).
5. Remove speed sensor shroud screws (#2).
6. Loosen hex screw in shaft and remove extension shaft, disc hub, and disc to free bearing assembly.

MD-36SS Parts List

1	Enclosure	1
2	Screw, 6-32 x 5/16	3
3	External Lockwasher #6	5
4	Gasket, Bearing Assembly	1
5	Bearing Assembly	1
6	MD-36 Shroud	1
7	Disc 36 Tooth	1
8	Disc Hub	1
9	Extension Shaft	1
10	Set Screw Socket, 8-32 x 3/16	2
11	External Lockwasher #4	3
12	Bushing	3
13	Speed Pickup Card Ver.3	1
14	Binding Screw, Slot, 6 - 32 x 5/8	4

15	SS Screw, Socket, 10 - 32	4
16	Lockwasher, Split #10 SS	4
17	Binding Screw, Slot, 4 - 40 x3/8	3
18	Hex Nut, 6 - 32	2
19	Terminal Block	1
20	Cable Connector	1
21	Enclosure Arresting Bracket	1
22	Locknut T&B 1/2 in # 141	1
23	Spring Spnr. B-604	1
24	Bolt, Hex 5/16 - 18 x 1 1/4 SS	2
25	Lockwasher Split 5/16 SS	2
26	Nut, Hex 5/16 - 18 NC SS	2
27	SS Screw, Socket, 10 - 32	2

English

Side View

Front View

Note: Shown with cover removed.

Bearing Assembly Replacement

1. Turn off supply power from integrator and then remove speed sensor from mounting.
2. Open cover and remove the four bearing assembly mounting screws (#15) located externally around shaft.
3. Pull out bearing assembly (#5) c/w card, disc assembly, and MD-36 shroud
4. Remove screws (#14), bushing (#12), and card (#13).
5. Remove MD-36 shroud screws (#2) and MD-36 shroud c/w terminal block (#19) and card (#13).
6. Loosen hex screw in shaft and remove extension shaft, disc hub, and disc to free bearing assembly.

Maintenance

The speed sensor electronics normally requires no maintenance; however, a program of periodic checks would be beneficial. The enclosure and circuit board, or NAMUR sensor should be cleaned if necessary, but only when the power is disconnected using a vacuum cleaner and a clean, dry paint brush. Check all electrical contacts for corrosion and arcing.

The speed sensor bearing should be periodically checked for corrosion, wear and seizing. The bearing's life is dependent upon the mounting, the severity of the application, and surrounding environment.

Notes

Notes

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BOND Equipment

10Ton Mobile DMS Plant

PILOT CRUSHTEC

Parts Manual

ISSUE 01 11 03

PILOT modular mc600

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SECTION 1

SAFETY

1.1 SAFETY INTRODUCTION

1.1.1 GENERAL

Operators should be trained in the correct and safe use of all equipment.

Before operation the operator(s) must:

i. Have received specific and adequate training in the task to be carried out.
ii. Have read and understood the Operators Manual and the Safety Signs in this manual and around the machine(s).
iii. Know the location and function of controls and safety features such as emergency stop buttons and safety guards.
iv. Be aware of all moving parts of the machine.

1.1.2 SAFETY SIGNS

Overleaf are listed all the safety signs used throughout this manual and on your machine.

Take time to familiarize yourself with the symbols and explanations.

These signs are used frequently throughout this manual to indicate any potential warning or danger when operating this machine.

SAFETY INSTRUCTIONS

1. Read and understand the Operation Manual and all safety labels before operating this machine.
2. Only a trained person is to be permitted to operate this machine. Training should include instruction in operation under normal conditions and emergency situations.
3. This machine is to be serviced only by trained and authorized personnel. Follow lockout procedures before servicing.
4. Never reach into the machine for any reason unless the machine is at a COMPLETE STOP.
5. Never leave the machine stopped in such a manner that another worker can start the machine while you are working on or within the machine.
6. Never change or defeat the function of electrical interlocks or other machine "shutdown" switches.
7. Before starting this machine, check that:
   - All persons are clear of the machine.
   - No maintenance work is being performed on the machine.
   - All guards are in place.
8. Routine inspections and corrective/preventative maintenance measures are to be conducted to ensure that all guards and safety features are retained and function properly.

SAFETY INSTRUCTIONS

SUGGESTED LOCKOUT PROCEDURE

1. Announce lockout to other personnel.
2. Turn power OFF at main panel.
3. Lockout power in OFF position.
4. Put key in pocket.
5. Clear machine of all personnel.
6. Test lockout by hitting RUN button.
7. Block, chain or release stored energy sources.
8. Clear machine of personnel before restarting machine.
9. Take key from pocket.
10. Unlock the lockout device.
11. Turn power on at main panel.
12. Announce machine is ON to other personnel.

WARNING
Nip hazard.
Do not operate without guards or doors in place.
Lockout/tagout before servicing.
©2001 HCS, LLC 800-748-0241
Reorder No. 5087-7XWHPK

DANGER
Nip hazard.
Do not operate without guards or doors in place.
Lockout/tagout before servicing.
©2001 HCS, LLC 800-748-0241
Reorder No. 5087-7XDHPK

WARNING
Crush hazards.
Hand and foot crush points.
Do not use hands or feet to check hole alignment or support machinery.
Always use pins and/or mechanical supports provided.
©2001 HCS, LLC 800-748-0241

WARNING
Crush hazards.
Hard hats must be worn in this area.
©2001 HCS, LLC 800-748-0241
Reorder No. 3005-JSWHPK

DANGER
Fall hazard.
Do not climb on equipment.

WARNING
Hazardous voltage.
This unit is to be serviced by trained personnel only.
©2001 Hazard Communication Systems, LLC 800-746-0241
Reorder No. H6010/6053-Y5W/HPT

WARNING
ALWAYS ENSURE THAT THE CONVEYOR IS ADEQUATELY SUPPORTTED BEFORE LOOSENING ANY FASTENERS ON THE SUPPORT STRUCTURE.
FAILURE TO CORRECTLY SUPPORT THE CONVEYOR COULD RESULT IN DEATH OR SERIOUS INJURY.
Reorder No.: 3755

1.2 ELECTRICAL SAFETY

1. Never work on the electrical system of any equipment unless you are thoroughly familiar with system details.

2. Work on the electrical system must only be carried out by a qualified electrician.

3. If the machine is electric-hydraulic or direct electric drive, the 'mains' electrical supply to the machine should always be isolated by unplugging/uncoupling the 'mains' power socket.

4. The electrical equipment of the machine should be inspected at regular intervals. Damaged cables or loose connections must be corrected immediately. Use only original fuses with the specified current rating.

5. It is recommended that an earth leakage safety switch be fitted in the supply line to the power point on site. Special care should be taken to ensure that earth wires are correctly connected.

6. It is recommended that Pull Switches and/or Emergency Stops be fitted to the conveyor to suit each particular application.

1.3 SAFETY BEFORE AND DURING OPERATION

ONLY QUALIFIED AND TRAINED PERSONNEL SHOULD ATTEMPT TO OPERATE THIS MACHINERY.

1. Read and understand the Operators Manual before you start the machine. Study the DANGER, WARNING, CAUTION and IMPORTANT safety signs on your machine.

2. Check your machine and have all systems in good operational condition.

- Check for broken, missing or damaged parts. Replace and make necessary repairs.
- Ensure all safety guards and emergency stops are fitted and in working order.
- See 'Daily Maintenance' for a more detailed checklist before start-up.

3. Before starting, walk completely around the machine. Make sure no one is under it, on it or close to it. Let other workmen and bystanders know you are starting up and do not start until everyone is clear of the machine.

4. During operation, do not climb onto, over or under moving conveyor belts and rollers. Always use ladders, steps and walkways when mounting and dismounting.

5. Hole alignment on mechanical supports must be checked and secured with pins provided and in accordance with safety signs.

6. Never check the tension of 'V' belts, drive chains and conveyors when the machine is running.

7. Never work or stand beneath machinery or attachments as it is raised or lowered.

8. Never work / stand beneath machinery as they are loaded with discharging material.

9. Follow safe operating practices. Operate the machine controls smoothly. Avoid sudden stops, starts or changes in direction.

10. Only use emergency stop buttons or emergency stop lines (if fitted) in emergency situations or during safety drills.

11. After each day's operation, always run the machine empty, never leave material on the conveyor belt. Starting a machine with a full load will cause strain problems in your machine.

12. Never alter any parts of the conveyor without consulting PILOT CRUSHTEC.

1.4 SAFETY BEFORE AND DURING MAINTENANCE

MAINTENANCE SHOULD ONLY BE CARRIED OUT BY TRAINED AND QUALIFIED PERSONNEL.

1. Whenever maintenance or service is being carried out a minimum of two (2) persons should be present at all times. NEVER WORK ALONE.

2. Prepare yourself. Wear a hard hat, safety goggles, hearing protection and other protective equipment as required by job conditions. Do not wear loose clothing or jewellery that can catch on controls or moving parts. Long hair must be tied back.

3. Prepare the machine. Move the machine onto a level surface and apply chocks. Shut off the motor.

4. Isolate all electrical supplies to the machine to prevent any accidental starting up of the belt feeder, before starting any maintenance work.

5. Never attempt repairs or adjustments to the machine while it is running.

6. Remove only guards or covers that provide access. Wipe away excess grease and oil.

7. Never leave guards off or access doors open when unattended. Keep bystanders away if guards have been removed for maintenance.

8. When working beneath raised equipment, always use blocks, jack-stands or other rigid and stable supports. Never work under unsupported equipment.

9. Performing work above 6ft-6" (2m) always use an approved (EN/ANSI) safety harness. Always use walkways and platforms provided or a safe secure platform approved by the machine operators management. Do not use any unauthorised or unsafe platforms.

10. Wear safety goggles for eye protection.

11. Clean or replace damaged, missing or painted over safety signs that cannot be read.

12. Rotating and moving parts must be inspected during maintenance and replaced if cracked or damaged. Excessively worn or damaged parts can fail and cause injury or death.

13. After maintenance, tighten all bolts, fittings and connections. Install all guards, covers and shields. Replace or repair any damaged ones. Start the motor and check for

vibration. Operate all controls and make sure the machine is functioning properly. After testing, shut down, check the work you performed (any missing cotter pins, washers, locknuts, etc.)? Recheck all bolts before releasing machine for operation.

14. If maintenance has been carried out on the electrical motor or electrical installation, ensure that the BELT DIRECTION has not been altered. Start the motor and check that the belt is running in the correct direction.

15. Always be aware that fully automatic machinery with moving parts may move at any time without warning, never assume a machine to be safe because of lack of movement. Isolate at all times before carrying out any work. Also isolate if the machine is not to be used for an extended period of time.

SAFETY INSTRUCTIONS

1. Read and understand the Operation Manual and all safety labels before operating this machine.
2. Only a trained person is to be permitted to operate this machine. Training should include instruction in operation under normal conditions and emergency situations.
3. This machine is to be serviced only by trained and authorized personnel. Follow lockout procedures before servicing.
4. Never reach into the machine for any reason unless the machine is at a COMPLETE STOP.
5. Never leave the machine stopped in such a manner that another worker can start the machine while you are working on or within the machine.
6. Never change or defeat the function of electrical interlocks or other machine "shutdown" switches.
7. Before starting this machine, check that:
   - All persons are clear of the machine.
   - No maintenance work is being performed on the machine.
   - All guards are in place.
8. Routine inspections and corrective/preventative maintenance measures are to be conducted to ensure that all guards and safety features are retained and function properly.

1.5 SAFETY BEFORE AND DURING TRANSPORT

1. The preparations to move equipment by articulated lorry should be supervised by a minimum of two (2) persons.

2. Ensure persons transporting the machine adhere to all Safety Signs and procedures.

3. Before transportation on public roads, ensure the machine has been properly secured with no loose material left in or on the machine. (See Section 7 – Transport).

4. Extreme caution is required when transporting machinery on site. Soft or uneven ground may cause accidents.

5. When transporting a machine on a truck or trailer, know the overall height to avoid contacting overhead obstructions such as bridges, power lines etc.

1.6 SAFETY SIGNS IN THIS MANUAL

Safety signs throughout this manual are identified by the safety alert symbol. When you see this symbol be alert to the possibility of personal injury or death. Please take time to familiarise yourself with each of these signs and what they mean.

Always follow the instructions in the Safety message.

DANGER

This indicates an imminently hazardous situation which if not avoided, **will** result in death or serious injury.

WARNING

This indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.

⚠ CAUTION

This indicates a potentially hazardous situation which, if not avoided, **may** result in minor or moderate injury.

It may also be used to alert against unsafe practices.

IMPORTANT

This indicates a statement of company policy, which if not adhered to **will** result in damage to your machine and/or other people's property.

1.7 SAFETY SIGNS ON YOUR MACHINE

Safety Signs are important features of your machine. Please take time to familiarise yourself with their meaning and locations on the machine as seen below.

IMPORTANT

ANY DAMAGED, MISSING OR PAINTED OVER SAFETY SIGNS MUST BE REPLACED IMMEDIATELY

1.8 SAFETY GUARDS ON YOUR MACHINE

Safety Guards are important features of the machine. On this machine they take the form of cover plates. Please take time to familiarize yourself with their locations on the machine as seen below.

1. COVER PLATE LEFT
2. COVER PLATE RIGHT
3. SIDE PLATE LEFT
4. SIDE PLATE RIGHT
5. TAIL DRUM GUARD ASSEMBLY
6. SAFETY COVER PLATES
7. GUARD UNDERSIDE TAIL SECTION
8. GUARD UNDERSIDE CENTER SECTION
9. GUARD UNDERSIDE DRIVE SECTION

⚠ WARNING

ALWAYS REPLACE SAFETY GUARDS AFTER MAINTENANCE.
NEVER START THE MACHINE WITH FAULTY OR MISSING GUARDS.

1.9 NOISE LEVELS AROUND YOUR MACHINE

The noise levels of generated by the standard MC600 conveyor working on its own does not exceed 85dB per dose and therefore ear protection would not normally be required. Noise Levels around the MC 600 in its working environment could however exceed 85dB per dose as a result of other machinery working with or near the MC 600 conveyor.

It is recommended that a Risk Assessment program of the conveyor in its particular working environment be conducted and the noise levels of plant be addressed in this Risk Assessment.

Ear Protection must be worn when operating this machine in an environment where the noise levels exceed 85dB per dose.

SECTION 2

TECHNICAL

2.1 FAMILIARISATION

ITEM NO.	DESCRIPTION
1	CENTRE SECTION FRAME
2	FRONT SECTION FRAME
3	TAIL SECTION FRAME
4	CONVEYOR SUPPORT (LEG)
5	AXLE / SLEWING AXLE (OPTIONAL)
6	HANGER / CONVEYOR SUPPORT
7	FEED BOOT
8	PIVOT STAND (OPTIONAL)
9	CONVEYOR BELT

2.2 KEY COMPONENTS

2.2.1 POWER UNIT

The standard conveyor is driven by an electric motor and gearbox assembly mounted on a torque arm arrangement. Different gearbox ratios and electric motor capacities are available to suit all applications. The motor gearbox combination can be removed/exchanged easily. The option of a hydraulic drive is also available.

2.2.2 FEED BOOT

The Feed Boot is designed with a 0.1 cubic metre (3.5 cubic feet) capacity (approximate), and tapered sides for greater efficiency. Rubber skirtings prevent spillage of the loaded material.

2.2.3 FEED BELT/CONVEYOR

The machine uses a 600 mm (23.6") wide conveyor belt. The speed of the conveyor belt is set by the chosen motor/gearbox combination. Belt tracking is done with the adjustable belt tensioners at the back of the assembly as well as on the troughing idlers.

2.2.4 SLEWING AXLE

As an option a slewing axle with pneumatic tyres can be installed for kidney shaped stockpiling.

2.3 TECHNICAL DATA

2.3.1 FEED BOOT CAPACITY:

FEED BOOT STRUCK CAPACITY: Approx. 0.1 m³.

2.3.2 ELECTRIC MOTOR SPEED

	kW	RPM
STANDARD ELECTRIC MOTOR	3	1420
OPTION 1	2.2	1420

2.3.3 MACHINE WEIGHT

CONVEYOR LENGTH (METERS)	4	7	10	13	16
STANDARD CONVEYOR WEIGHT (Kg)	895	950	1055	1105	1155

2.3.4 CONVEYOR SPEEDS

	METERS/S	FEET/S
STANDARD CONVEYOR	0.9	2.9
OPTIONAL VARIABLE SPEED GEARBOX	0.3 TO 0.7	1 TO 2.3
OPTIONAL HYDRAULIC DRIVE	0 TO 0.9	0 TO 2.9

2.3.5 STANDARD EQUIPMENT

1. Modular construction in 4m (13.1 ft) , 7m (23 ft), 10m (32.8 ft), 13m (42.7 ft), or 16 m (52.5 ft) lengths.
2. 600 mm (23.6") wide conveyor.
3. Box type frame.
4. Height adjustable support legs with pneumatic tyres.
5. Tail guard and nip guard.
6. Angle adjustable troughing idlers.
7. Class 200/2ply 3.2 mm top and 1.6 mm bottom cover belting.
8. Rubber lagged drive drum.
9. Easy access maintenance and cover plate guarding.
10. Easy access grease points.
11. Self tensioning belt scraper.

2.3.6 OPTIONAL EXTRAS

1. Direct Hydraulic drive.
2. Slewing axles with pneumatic tyres for kidney shaped stockpiling.
3. Rear pedestals for slewing conveyors.
4. Flat bases for stationary conveyors.
5. Mesh guards for undersides.
6. Heavy duty plough scraper.
7. Side Safety guards for picking applications
8. Trip lines (latching switches).

2.4 WORKING DIMENSIONS

CONVEYOR	A (mm)	B (mm)	C (°)	D (UNIT)	E (UNIT)	F (UNIT)
4m	4000	1810	20	1	1	0
7m	7000	2815	20	1	1	1
10m	10000	3870	20	1	1	2
13m	13000	4895	20	1	1	3
16m	16000	5920	20	1	1	4

2.5 CORRECT USE OF YOUR MACHINE

1. This machine can be used for the feeding of sand, gravel, aggregates, rock, coal and any other hard core material. This does not include hot materials, which may damage the belt of the machine. To avoid long term damage to the machine do not feed rock exceeding 200 mm.

- Should you have any doubt about feeding a type of material not listed, contact Pilot Crushtec or your local dealer for guidance or authorisation.

2. Appropriate space should be allowed for material stockpiles and loading of machine.

3. This machine should only be loaded via its feed boot.

4. Before operating, ensure proper machine installation. (See Section 3 - Installation).

5. Before operating, the machine should be levelled, Ensuring that the weight of the machine is evenly distributed. (See Section 3.2.1 - Before Starting).

6. Before operation the operator(s) must:

- Have received specific and adequate training in the task to be carried out.
- Have read and understood the safety instructions in Section 1.
- Know the location and function of controls and safety features.
- Be aware of all moving parts of the machine.

7. Before operating the operator(s) must ensure that they are properly equipped with a hard hat, ear and eye protectors.

8. Before operation, all safety guards must be in place.

9. Before operation, ensure the machine has been properly lubricated. Always adhere to the lubrication schedule provided (See Section 5.9 - Lubrication Points).

10. Before transportation on public roads, ensure the machine has been properly secured with no loose material left in or on the machine. (See Section 7 - Transport).

11. After each day's operation, always run the machine empty. Starting a machine with a full load will cause strain problems in your machine.

12. Do not climb on the machine while it is running.

SECTION 3

INSTALLATION

3.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

3.2 INSTALLATION

An external electrical power source must be connected to the MC 600 by a qualified electrician to provide power to the modular conveyor. The electric motor must provide smooth power delivery to the machine.

3.2.1 BEFORE STARTING

1. The machine must be on a level, compacted area with firm stable underfoot conditions.
2. Ensure all emergency stop buttons / latching switches are not switched to the STOP position.
3. Check that all bearings have been properly greased.
4. Ensure all electrical controls are in the off position.

3.2.2 STARTING AND CHECKING THE CONVEYOR

1. Announce to all relevant personnel that the conveyor is going to be started.
2. Start up the conveyor via the start button on the external electrical panel. Check if the direction of the conveyor is correct, as can be seen from the sketch below.
3. Check that the tracking of the conveyor belt is correct. The tracking of the belt can only be checked whilst it is in motion. Absolute care must be taken when tracking the belt to avoid injury (See Section 5.4 - Belt Tracking).

3.2.3 SHUTTING DOWN

1. Stop the material feeding into the feed boot.
2. Wait for all the material to pass over the length of the machine, then stop the conveyor by switching the electric motor off.
3. Lock Out the machine in accordance with the relevant procedures when not in use.

It is very important to note that the feed boot of your conveyor should not be left under load for extended periods of time.

3.3 ADJUSTING THE CONVEYOR ANGLE

3.3.1 ADJUSTING CONVEYOR ANGLE ON UNITS FITTED WITH RIGID SUPPORTS

Slight adjustments in the angle of the conveyor can be performed by loosening the retaining bolts on the hangers and sliding them along the length of the centre section. This is potentially a dangerous operation. Make sure that the conveyor is adequately supported and that there is no risk of it falling nor toppling forward. Remember to tighten all the fasteners after any adjustments.

When adjusting the conveyor angle be careful not to tip the conveyor over to the front. Always take care that the centre of gravity of the assembly is between the axle and the tail section to prevent tipping. Tipping over will damage your machine and/or cause injury to personnel.

⚠ WARNING

ALWAYS ENSURE THAT THE CONVEYOR IS ADEQUATELY SUPPORTED BEFORE LOOSENING ANY FASTENERS ON THE SUPPORT STRUCTURE. FAILURE TO DO SO COULD RESULT IN DEATH OF SERIOUS INJURY.

Procedure:

1. Ensure that suitable rigging equipment and qualified personnel are available to support the conveyor. A minimum of two people are required to perform this operation with appropriate scaffolding / platforms.
2. Lock Out the machine in accordance with the relevant procedures.
3. Temporarily support the weight of the conveyor using appropriate rigging equipment.
4. Loosen the retaining bolts on the top hangers.
5. Slowly lift or lower the conveyor to the desired angle. This may require that the hanger brackets be removed if the travel between cross-braces is not enough.
6. Tighten the hanger brackets.
7. Slowly lower the temporary support and check that the conveyor support legs and the hanger brackets can support the weight of the conveyor.
8. Before removing the temporary support completely, check that the centre of gravity is between the axle and the tail pulley. If unsure, repeat the procedure and move the axle further away from the tail pulley.

Remember basic safety rules when working on the conveyor. E.g.

- Never stand under the conveyor.
- Do not climb onto the conveyor.
- Use appropriate safety equipment e.g. safety harness.

3.3.2 ADJUSTING CONVEYOR ANGLE ON UNITS FITTED WITH HYDRAULIC HEIGHT ADJUSTMENT

Adjustments to the angle of the conveyor can easily be performed by making use of hydraulic pump and cylinder provided. This is potentially a dangerous operation. Make sure that the conveyor is on level ground and that there is no risk of it falling nor toppling forward. Remember to replace all the locking pins after any adjustments.

If the conveyor is to be towed, the conveyor angle must be set to it's minimum and all locking pins fitted. The conveyor may only be towed on level and stable ground. Maximum towing speed is 12km/h (7.5 miles/h) (Refer to section 7.6).

⚠ WARNING

ENSURE THAT THERE ARE NO PERSONS OR STRUCTURES IN THE DIRECT VICINITY OF THE CONVEYOR. THIS PROCEDURE IS TO BE CARRIED OUT BY ADEQUATELY TRAINED PERSONNEL ONLY.

Procedure:

1. Ensure that the conveyor is on stable ground and level.
2. Lock Out the machine in accordance with the relevant procedures.
3. Check that the Release Knob on the Hydraulic pump is closed (tighten by turning clockwise).
4. Remove the Handle from its holder and insert into the Hydraulic Pump. Pump the Lever up and down in slow even movements until resistance is felt on the lever.
5. Remove the two locking pins on the extension leg.
6. If the conveyor angle is to be raised, pump the lever until the next locating hole in the extension leg is visible. If the conveyor is to be lowered, slowly unscrew the Release Knob on the Hydraulic Pump and allow the conveyor to drop in a controlled and slow manner until the next locating hole is visible in the extension leg. Close the Release Knob.
7. Replace the Locking Pins.
8. Replace the Lever in it's holder.

NOTE: The hydraulic cylinder is fitted internally with a hose burst protection valve. In the unlightly event of a hose bursting or a fitting being loosened accidently the hose burst protection valve will be triggered by the sudden rush of oil and close. This valve will not open and allow the cylinder to lower unless positive pressure is re-applied on the lower port. The valve may also be triggered if the Release Knob is opened too quickly. **Always lower the conveyor slowly to prevent the valve being triggered.**

Should the Hose burst protection valve be triggered while lowering too fast, close the Release Knob and pump the hand pump to raise the conveyor a few millimeters, then open the Release Knob again and slowly lower the Conveyor.

Remember basic safety rules when working on the conveyor. E.g.

- Never stand under the conveyor.
- Do not climb onto the conveyor.

3.4 CONVERTING TO SLEWING AXLE

The following procedure must be followed to convert the modular conveyor to a slewing axle conveyor. This is applicable only to machines fitted with this option:

Procedure:

1. Ensure that suitable rigging equipment and qualified personnel are available to support the conveyor. A minimum of two people are required to perform this operation.
2. Lock Out the machine in accordance with the relevant procedures.
3. Temporarily support the weight of the conveyor using appropriate rigging equipment.
4. Remove the retaining pin on the inside slewing axle pin (2) and pull the slewing axle pin out.
5. Swing the wheel (3) by hand round on the remaining (outside) slewing axle pin as indicated.
6. Line the hole on the wheel mount up with the back hole on the axle (1) and push the slewing axle pin through.
7. Remember to replace the retaining pins.

SECTION 4

OPERATION

4.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further. The Modular Conveyor is designed to operate under many different conditions and in diverse applications, it is therefore recommended that a customised Hazard Risk Assessment be performed for the specific task / operation where each conveyor is used.

4.2 SAFETY BEFORE AND DURING OPERATION

Only qualified and trained personnel should attempt to operate this machinery.

1. Read and understand the Operators Manual before you start the machine. Study the DANGER, WARNING, CAUTION and IMPORTANT safety signs on your machine.
2. Check your machine and have all systems in good operational condition.

- Check for broken, loose, missing or damaged parts. Replace and make necessary repairs.
- Ensure all safety guards and emergency stops are fitted and in working order.
- See Section 4.3 - 'Checks Before Start Up' for a detailed checklist before start-up.

3. Before starting, walk completely around the machine. Make sure no one is under it, on it or close to it. Let other workmen and bystanders know you are starting up and do not start until everyone is clear of the machine.
4. During operation, do not climb onto, or over the machine. Always use ladders, steps and walkways when mounting and dismounting.

5. Hole alignment on mechanical supports must be checked and secured with pins provided and in accordance with safety signs.
6. Never check the tension of 'V' belts, drive chains and conveyors while the machine is running.
7. Never work or stand beneath machinery or attachments as it is raised or lowered.
8. Never work or stand beneath machinery as they are being loaded with and/or discharging material.
9. Follow safe operating practices. Operate the machine controls smoothly. Avoid sudden stops, starts or changes in direction.

10. Only use emergency stop buttons or emergency stop lines (if fitted) in emergency situations or during safety drills.
11. After each day's operation, always run the machine empty, never leave material in the feed boot. Starting a machine with a full load will cause strain problems in your machine.

4.3 CHECKS BEFORE START-UP

The following inspection routine must be carried out before the first start-up and after lengthy periods of non-operation and after any maintenance has been carried out on the plant.

1. Ensure that the motor is installed correctly, and the direction of rotation is correct.

2. Ensure that nothing is restricting the movement of the electric motor and belt conveyor.
3. Ensure that the bearings have been sufficiently greased.
4. Ensure that all safety guards are in place and properly mounted.
5. Ensure that all the skirting rubbers are in place to prevent unnecessary spillage.
6. Check the belt for any visible damage.

4.4 OPERATING THE MACHINE

After all safety checks have been performed the electric motor can be started. Material can only be fed into the machine by loading it into the feed boot once the conveyor is running at a uniform speed.

4.4.1 INTRODUCING MATERIAL TO THE MACHINE

When starting to feed the machine, the following procedure should be followed to ensure full capacity operation:

1. Ensure that the electric motor is at operating speed, also check that the direction of the belt and the tracking thereof is correct.
2. Begin to feed the conveyor at a low rate, gradually increase the feed until your conveyor, and the system it is operating in, can handle the load.
3. After an initial period stop the machine and check for obstructions.

4.4.2 FEED SIZE SPECIFICATION

This machine can be used for the loading and feeding of sand, gravel, aggregates, rock, coal and any other hard core material to a maximum of 150 mm. This does not include hot materials, which will damage the conveyor belt on your machine

SECTION 5

MAINTENANCE

5.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

5.2 FEED BOOT SKIRTING

Check on the wear of the side and back rubber skirting and replace if necessary.

1. Side rubber skirting
2. Back rubber skirting

5.3 BELT TRACKING

Oblique travel may cause fast deterioration of the belt. In order to assist you we have compiled some of the reasons for oblique travel with appropriate remedies.

Reasons for Oblique Travel	Remedies	Examples of Oblique Travel
1. Insufficient aligning of drums and Idlers.	1. Align all drums, carrying idlers and return idlers at right angles to the travelling direction of the belt. 2. Check that all drums and idlers are level to each other.	 **Fig.1.** Turning carrying idlers.
	If **a&b** are as above then carry out the following: Adjustments are made as indicated on **Figs.1,2&3** by turning drums and carrying idlers in direction of arrow until the belt is running straight and centred on the conveyor. Also return idlers may cause oblique belt travel and therefore they must be aligned at right angles to the travelling direction of the belt and after that adjustment can be made.	 **Fig.2** Turn drums. **Fig.3.** Turning both drum and carrying idlers.
2. Misalignment of frame.	Oblique travel can be reduced by turning forward outer carrying idlers 1-3 degrees in travelling direction of the belt. **See Fig.4:** if this does not correct the oblique travel then align the frame.	 **Fig.4** Turning forward carrying idlers.
3. Material built up on drums and idlers.	Clean idlers and drums. Check belt cleaners and replace if necessary. Possibly change to more efficient type.	

5.4 BELT TRACKING ON YOUR MACHINE

Belt tracking is performed at the tail section of the conveyor. Adjust the belt with the tensioners (1) on the tail section.

A small movement in the adjuster i.e. less than 20mm (0.8") for the 16 m conveyor should be sufficient. The adjustment depends on the length of the conveyor. A greater movement will affect the tension of the belt.

5.5 BELT TENSIONING ON YOUR MACHINE

Belt tensioning is also performed at the tail section of the feed conveyor.

By adjusting the belt tensioners (1) equally on either side of the section, you can either tighten or loosen the belt.
The belt should be sufficiently tight to prevent slippage at the drive drum. If over tight the life of the belt will decrease.

IMPORTANT

BELT TRACKING AND TENSIONING ARE THE ONLY MAINTENANCE TASKS PERMITTED WHEN THE MACHINE IS RUNNING

⚠ DANGER

DO NOT REACH INTO A MOVING MACHINE DANGEROUS NIP POINTS EXIST

5.6 REMOVING THE DRIVE GEARBOX

This section applies only to conveyors fitted with electric motor drives. The electric motor and drive gearbox are directly coupled together and are removed off the machine as a unit.

Procedure:

1. Ensure that suitable rigging equipment and qualified personnel are available to support the weight of the motor and gearbox assembly. A minimum of two people are required to perform this operation with appropriate scaffolding / platforms.
2. Lock Out the machine in accordance with the relevant procedures.
3. The electrical connection to the motor must be removed and isolated by a qualified electrician.
4. Remove the brass nut (1).
5. Hold the lock nut (2) and remove the nut (3).
6. Support the gearbox and motor arrangement with appropriate slings and lifting equipment.
7. Slide the gearbox off the Drive drum shaft. The torque arm bracket comes off with the gearbox.

5.7 TROUGHING IDLER ANGLE ADJUSTMENT

The angle of the troughing idlers can be varied to cater for different materials and conveyor angles. The angle of the 3 idlers closest to the return pulley should never be adjusted, they are factory set at their lowest possible angle so that the skirts on the feed boot seal effectively. Similarly the 3 idlers closest to the drive drum are also set at their minimum angle so that conveyor belt does not slip on the drive drum. A steeper troughing idler angle assists in guiding the conveyed material to the centre of the belt as well as preventing 'roll back'.

Procedure:

1. Ensure that suitable scaffolding / platform is available to perform this operation.
2. Lock Out the machine in accordance with the relevant procedures.
3. Loosen the L-bolt.
4. Loosen the U-bolt.
5. Slide the troughing idler up until the tube clears the L-bolt.
6. Remove the L-bolt and re-insert it in the desired hole further down on the bracket.
7. Slide the troughing idler down so the inside of the tube locates on the L-bolt.
8. Tighten the L-bolt and the U-bolt.
9. Repeat the procedure for the other troughing idler. Note, the angles of left and right troughing idlers must be the same (i.e. the L-bolts must be in the same holes relative to each other).

5.8 TAIL DRUM GUARD

The tail drum guard is fitted with expanded metal so the belt tracking can be checked without removing it. It also has two holes for greasing the tail drum bearings without the need to remove the guard.

5.9 LUBRICATION POINTS

The dots indicate the positions of the lubrication points.

Proper lubrication is necessary to ensure that the bearings operate at maximum efficiency and minimum cost.

Use only a Lithium-based grease with a consistency of 3 (penetration class) and a temperature range between 20 and 130 °C.

The bearings are fully greased when the machine is supplied.

5.10 RECOMMENDED LUBRICANTS

	GENERAL PURPOSE GREASE
B.P.	ENERGREASE LS3
CASTROL	SPHEEROL AP3
SHELL	ALVANIA R3
MOBIL	MOBILUX GREASE No 2

Above are listed the recommended alternatives suitable for use with your machine. The above special greases are lithium base greases of Class 2 with extreme pressure additives.

5.11 RECOMMENDED MAINTENANCE SCHEDULE

No	Description	Daily 8 Hours	Weekly 45 Hours	Reference
	GENERAL MAINTENANCE			
1	Check for material build-up	C		
2	Check all safety Guards are in place	C		
3	Check for loose parts, missing nuts and bolts	C		
4	Check conveyor belts for tears	C		
5	Check belt tension	C		
6	Check belt tracking	C		
7	Check all rollers are free turning	C		
8	Check all rollers are free of obstructions	C		
9	Check for gearbox oil leaks	C		
10	Check for loose / damaged electrical cables	C		
11	Check tension of belt scrapers		C	
12	Check feed boot skirting rubbers		C	
13	Check drive gearbox oil level		C	Shell Tivela S 220 (ISO VG 220)

Key: A - Adjust
C - Check/Top Up
R - Replace

These are the minimum recommended maintenance guidelines. Certain applications and conditions may require more frequent maintenance. Never alter any parts on your machine without consulting **PILOT CRUSHTEC** or your service provider

SECTION 6

SPARE PARTS

6.1 SPARE PARTS ORDERING PROCEDURE

Ordering Procedure: To ensure delivery of your parts, when ordering please quote:

- Machine serial number
- Illustration number
- Item number
- Part number
- Part description
- Quantity required

EXAMPLE:

If you wanted to order SIDE RUBBER SKIRTINGS, place your order in the following fashion:

Machine serial number - MC166 0000 0000

Illustration number - 6.3.6

Item number - 5

Part number - MC6-70-001

Part description - SIDE RUBBER SKIRTING

Quantity required - 2

This information will enable us to supply the correct parts with the minimum of delay.

6.2 SPARE PARTS ORDER FORM

Parts Ordering Form

Date_____

Customer Name

Customer Address

MACHINE DETAILS

Machine Type.	Machine Serial No.

MANUAL DETAILS

Illustration Number	Item No.	Part No.	Part Description	Quantity Required

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6.3.1 MC 600 ASSEMBLY MC6-00-000

ILLUSTRATION 6.3.1 MC 600 ASSEMBLY

Main Assemblies/Components

ITEM	QTY.	DESCRIPTION	PART NO.
1	4*	CENTRE SECTION FRAME ASSEMBLY	REFER TO SECTION 6.3.2
2	1	FRONT SECTION FRAME ASSEMBLY	REFER TO SECTION 6.3.3
3	1	TAIL SECTION FRAME ASSEMBLY	REFER TO SECTION 6.3.4
4	2*	4 m CONVEYOR SUPPORT	MC6-40-150
		2.5 m CONVEYOR SUPPORT	MC6-40-250
		2 m CONVEYOR SUPPORT	MC6-40-350
		0.8 m CONVEYOR SUPPORT	MC6-40-500
5	*	AXLE / BASE PLATE ASSEMBLY	REFER TO SECTION 6.3.5
6	4	HANGER (CONVEYOR SUPPORT)	MC6-60-100
7	1	FEED BOOT	REFER TO SECTION 6.3.6
8	1*	PIVOT STAND	REFER TO SECTION 6.3.7
9	1	COVER PLATE RIGHT	MC6-00-002
10	1	COVER PLATE LEFT	MC6-00-001
11	1	CONVEYOR BELTING	BM1-17-003

* SNR - Serial Number Related (OPTIONAL FEATURE)

Continued - MC 600 ASSEMBLY

ILLUSTRATION 6.3.1 MC 600 ASSEMBLY

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
12	4	M16 x 300 THREADED BAR	00-16-932
13	8	M10 x 40 HEX SCREW	00-10-327
14	8	M12 x 70 HEX SCREW	00-12-321
15	4 (+12)*	M16 x 40 HEX SCREW	00-16-320
16	10	M16 x 70 HEX SCREW	00-16-334
17	2*	M24 x 65 HEX SCREW	00-24-347
18	8	M10 HEX NUT	00-10-102
19	16	M16 HEX NUT	00-16-104
20	8	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
21	8	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
22	4 (+22)*	M16 HEX NYLON INSERTED LOCKNUT	00-16-120
23	2*	M24 HEX NYLON INSERTED LOCKNUT	00-24-123
24	8	M10 FLAT WASHER	00-10-502
25	16	M12 FLAT WASHER	00-12-503
26	36 (+32)*	M16 FLAT WASHER	00-16-504
27	4*	M24 FLAT WASHER	00-24-506
28	8	M10 SPRING WASHER	00-10-510
29	4	M16 SPRING WASHER	00-16-512

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.2 CENTRE SECTION ASSEMBLY MC6-10-000

ILLUSTRATION 6.3.2 CENTRE SECTION

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	CENTRE SECTION FRAME	MC6-10-150
2	1	NIP GUARD	MC6-10-250
3	3	WINGED IDLER SET ASSY REFER TO SECTION 6.3.2.1	MC6-10-300
4	1*	PULL WIRE BRACKET (NOT FOR BELT PICKING APPLICA-TION)	MC6-10-450
5	1*	GUARD UNDERSIDE - OPTIONAL	MC6-10-750
6	1*	GUARD L/H (BELT PICKING APPLICATION ONLY)	MC6-10-850
7	1*	GUARD R/H (BELT PICKING APPLICATION ONLY)	MC6-10-950
8	1	RETURN IDLER	MC6-10-001

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
9	2	M8 U-BOLT	12.08.002
10	6	M12 U-BOLT	12.08.004
11	8*	M10 x 30 HEX SCREW	00-10-336
12	4	M8 HEX NYLON INSERTED LOCKNUT	00-08-117
13	8	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
14	28 (+8)*	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
15	4	M8 FLAT WASHER	00-08-501
16	16*	M10 FLAT WASHER	00-10-502
17	28 (+8)*	M12 FLAT WASHER	00-12-503

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.2.1 WINGED IDLER SET

ILLUSTRATION 6.3.2.1 WINGED IDLER SET

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	WINGED IDLER SUPPORT	19-22-0022
2	1	CENTRE ROLLER	19-22-4018
3	2	WINGED ROLLER	19-22-4020
4	2	IDLER RETAINER CLIP	19-22-000
5	2	M8 U-BOLT	12.08.002
6	2	M8 L-BOLT	12-08-001
7	6	M8 HEX NYLON INSERTED LOCKNUT	00-08-117
8	6	M8 FLAT WASHER	00-08-501

6.3.3 FRONT SECTION MC6-20-000

ILLUSTRATION 6.3.3 FRONT SECTION

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	DRIVE DRUM ASSY	SECTION 6.3.3.2
2	2	BEARING ASSEMBLY	BM1-13-005
3	1	FRONT FRAME ASSEMBLY	MC6-20-150
4	1	BELT SCRAPER ASSY SEE SECTION 6.3.3.1	MC6-20-400
5	1*	BOTTOM COVER	MC6-21-150
6	1	NIP GUARD	MC6-10-250
7	1	WINGED IDLER SET SEE SECTION 6.3.2.1	MC6-10-300
8	1*	SIDE COVER L/H (BELT PICKING APPLICATION ONLY)	MC6-20-001
9	1*	SIDE COVER R/H (BELT PICKING APPLICATION ONLY)	MC6-20-002
10	1*	SIDE COVER R/H (BELT PICKING APPLICATION ONLY)	MC6-20-003
11	1	RETURN IDLER	MC6-10-001

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
12	2	M8 U-BOLT	12.08.002
13	10 (+6)*	M12 U-BOLT	12.08.004
14	7	M10 x 30 HEX SCREW	00-10-336
15	4	M12 x 35 HEX SCREW	00-12-343
16	4	M8 HEX NYLON INSERTED LOCKNUT	00-08-117
17	4	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
18	20 (+12)*	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
19	4	M8 FLAT WASHER	00-08-501
20	11	M10 FLAT WASHER	00-10-502
21	22 (+12)*	M12 FLAT WASHER	00-12-503

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.3.1 BELT SCRAPER MC6-20-400

ILLUSTRATION 6.3.3.1 BELT SCRAPER

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	BELT SCRAPER WELD ASSEMBLY	MC6-20-450
2	2	MOUNTING PLATE	MC6-20-401
3	1	BACKING PLATE	MC6-20-402
4	1	SCRAPER BLADE - RUBBER	MC6-20-403
5	5	M10 x 40 HEX SCREW	00-10-327
6	2	M12 x 40 HEX SCREW	00-12-316
7	5	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
8	10	M10 FLAT WASHER	00-10-502
9	2	M12 FLAT WASHER	00-12-503
10	2	M12 SPRING WASHER	00-12-511

6.3.3.2 DRIVE DRUM ASSEMBLY - OPTIONS

6.3.3.2.1 DRIVE DRUM ASSEMBLY - ELECTRIC

ILLUSTRATION 6.3.3.2 DRIVE DRUM

* SNR - Serial Number Related (OPTIONAL FEATURE)

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	MOTOR MOUNTING BRACKET	MC6-20-350
2	1	DRIVE DRUM	MC01-300-250
3	1*	DRIVE DRUM SHAFT (UPTO AND INCLUDING 3 kW UNIT)	MC6-20-501
	1*	DRIVE DRUM SHAFT (4 kW UNIT)	MC6-20-601
4	1*	BRASS NUT (UPTO AND INCLUDING 3 kW UNIT)	MC6-20-502
	1*	BRASS NUT (4kW UNIT)	MC6-20-602
5	1*	GEARBOX AND MOTOR ASSEMBLY	*
6	2	LOCKING ELEMENT	BM1-18-002
7	1	30 (L) x 10 (B) x 7(H) mm KEY	
8	1	M20 x 155 THREADED BAR	00-20-933
9	4	M10 x 40 HEX SCREW	00-10-327
10	4	M20 HEX NUT	00-20-105
11	4	M10 NYLOC NUT	00-10-118
12	8	M10 FLAT WASHER	00-10-502
13	4	M20 FLAT WASHER	00-20-505

6.3.3.2.2 DRIVE DRUM ASSEMBLY - HYDRAULIC

ILLUSTRATION 6.3.3.2.2 DRIVE DRUM HYDRAULIC

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	TORQUE ARM	MC6-20-850
2	1	GUARD - TORQUE ARM	MC6-20-950
3	1	DRIVE DRUM	MC01-300-250
4	1	SHAFT - DRIVE DRUM	MC6-20-701
5	1	HYDRAULIC MOTOR	BH1-02-001
6	1	LOCKING ELEMENT	BM1-18-001
7	2	LOCKING ELEMENT	BM1-18-002
8	3	M8 x 15 HEX NUT	00-08-356
9	3	M8 FLAT WASHER	00-08-501
10	4	M12 x 50 HEX SCREW	00-12-330
11	4	M12 NYLOC NUT	00-12-119
12	8	M12 FLAT WASHER	00-12-503

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.3.3 SPREADER PLATE ASSEMBLY MC6-41-000

ILLUSTRATION 6.3.3.3 SPREADER PLATE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	PIVOTING SPREADER PLATE	MC6-41-150
2	1	MOUNTING BRACKET	MC6-41-250
3	1	MOUNTING BRACKET	MC6-41-350
4	2	SIDE SKIRT	MC6-41-001
5	2	ADJUSTER BAR	MC6-41-002
6	2	M10 U-BOLT	
7	2	M12 U-BOLT	12.08.004
8	4	M10 NYLOC NUT	00-10-118
9	4	M12 NYLOC NUT	00-12-119
10	4	M10 FLAT WASHER	00-10-502
11	4	M12 FLAT WASHER	00-12-503

6.3.3.4 WINDSOCK CHUTE ASSEMBLY MC6-20-250

ILLUSTRATION 6.3.3.4 WINDSOCK CHUTE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	WINDSOCK CHUTE ASSY - ROUND OUTLET	MC6-20-250
		WINDSOCK CHUTE ASSY - RECTANGULAR OUTLET	MC6-20-800
2	1	MOUNTING BRACKET	MC6-41-250
3	1	MOUNTING BRACKET	MC6-41-350
4	1	WINDSOCK	MC6-20-256

6.3.4 TAIL SECTION ASSEMBLY - OPTIONS

6.3.4.1 TAIL SECTION - STANDARD MC6-30-000

ILLUSTRATION 6.3.4.1 TAIL SECTION ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	TAIL SECTION FRAME	MC6-30-150
2	1	TAIL DRUM ASSEMBLY SEE SECTION 6.3.4.3	MC6-30-200
3	1*	DRAWBAR	MC6-30-350
4	1	TAIL DRUM GUARD ASSEMBLY SEE SECTION 6.3.4.4	MC6-30-400
5	1*	GUARD UNDERSIDE	MC6-31-150
6	1	WINGED IDLER SET SEE SECTION 6.3.2.1	MC6-10-300
7	1	SIDE PLATE LEFT	MC6-30-001
8	1	SIDE PLATE RIGHT	MC6-30-002
9	1	BLADE - SCRAPER	MC6-30-003
10	1	CLAMPING PLATE - SCRAPER	MC6-30-004
11	2	BEARING ASSEMBLY	BM1-13-005

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
12	4 (+2)*	M12 U-BOLT	12.08.004
13	4	M10 x 35 HEX SCREW	00-10-338
14	4	M12 x 35 HEX SCREW	00-12-343
15	4	M12 x 50 COUNTERSUNK SCREW	00-12-437
16	18	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
17	8 (+8)*	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
18	22	M10 FLAT WASHER	00-10-502
19	12 (+8)*	M12 FLAT WASHER	00-12-503

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.4.2 TAIL SECTION - BELT PICKING APPLICATION

ILLUSTRATION 6.3.4.2 TAIL SECTION ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	TAIL SECTION FRAME	MC6-30-150
2	1	TAIL DRUM ASSEMBLY SEE SECTION 6.3.4.3	MC6-30-200
3	1	GUARD REAR	MC6-30-550
4	1	GUARD SIDE L/H	MC6-30-650
5	1	GUARD SIDE R/H	MC6-30-750
6	1*	GUARD UNDERSIDE	MC6-31-150
7	1	WINGED IDLER SET SEE SECTION 6.3.2.1	MC6-10-300
8	1	BLADE - SCRAPER	MC6-30-003
9	1	CLAMPING PLATE - SCRAPER	MC6-30-004
10	2	CLAMPING PLATE	MC6-30-005
11	2	BEARING ASSEMBLY	BM1-13-005

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
12	4 (+2)*	M12 U-BOLT	12.08.004
13	2	M10 x 25 HEX SCREW	00-10-301
14	4	M10 x 20 HEX SCREW	00-10-313
15	4	M12 x 35 HEX SCREW	00-12-343
16	4	M12 x 50 COUNTERSUNK SCREW	00-12-437
17	16	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
18	8 (+8)*	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
19	22	M10 FLAT WASHER	00-10-502
20	12 (+8)*	M12 FLAT WASHER	00-12-503

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.4.3 TAIL DRUM MC6-30-200

ILLUSTRATION 6.3.4.1 TAIL DRUM

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	TAIL DRUM SHAFT	MC6-30-201
2	1	TAIL DRUM	MC6-30-250
3	2	LOCKING ELEMENT	BM1-18-002

6.3.4.4 TAIL DRUM GUARD ASSEMBLY MC6-30-400

ILLUSTRATION 6.3.4.2 TAIL DRUM GUARD

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	TAIL DRUM GUARD	MC6-30-450
2	1	COVER PLATE	MC6-30-401
3	3	M10 x 25 HEX SCREW	00-10-301
4	3	M10 FLAT WASHER	00-10-502
5	3	M10 SPRING WASHER	00-10-510

6.3.4.5 TAIL SECTION - IMPACT IDLER BED

ILLUSTRATION 6.3.4.2 TAIL SECTION ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	6	U-BOLT SQUARE	00-12-942
2	12	FLAT WASHER M12	00-12-503
3	12	NYLOC NUT M12	00-12-119
4	8	IMPACT IDLER	S3R-40-001
5	2	M12 THREADED BAR 250mm long	
6	2	SUPPORT PLATE - REAR	MC6-00-250
7	2	SUPPORT PLATE - FRONT	MC6-00-006

6.3.5 AXLE / BASE PLATE - OPTIONS

6.3.5.1 AXLE ASSEMBLY - SLEWING MC6-50-000

ILLUSTRATION 6.3.5.1 SLEWING AXLE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	SLEWING AXLE	MC6-50-150
2	2	WHEEL MOUNT	MC6-50-250
3	4	SLEWING AXLE PIN	MC6-50-001
4	2	WHEEL	BM1-04-006
5	8	WHEEL NUT	BM1-03-005

6.3.5.2 AXLE ASSEMBLY - FIXED MC6-50-400

ILLUSTRATION 6.3.5.2 FIXED AXLE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	FIXED AXLE WELDED ASSEMBLY	MC6-50-450
2	2	WHEEL	BM1-04-006
3	8	WHEEL NUT	BM1-03-005

6.3.5.3 BASE PLATE ASSEMBLY MC6-90-100

ILLUSTRATION 6.3.5.3 BASE PLATE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	BASE PLATE	MC6-90-150
2	2	PIVOT BRACKET	MC6-90-101
3	2	M16 x 70 HEX SCREW	00-16-334
4	2	M16 NYLOC NUT	00-16-120
5	4	M16 FLAT WASHER	00-16-504

6.3.5.4 BRAKED AXLE ASSEMBLY MC6-50-725

ILLUSTRATION 6.3.5.4 BRAKED AXLE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	2	TYRE AND RIM ASSY	BM1-04-006
2	1	AXLE ASSEMLY - BRAKED	MC6-50-700
3	2	BRAKE CABLE - WHEEL	BM1-05-005
4	8	WHEEL NUT	BM1-03-005
5	*	MAIN BRAKE CABLE - 13m CONVEYOR	BM1-05-004
	*	MAIN BRAKE CABLE - 10m CONVEYOR	BM1-05-006

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.5.4.1 DRAWBAR ASSY - BRAKED AXLE MC6-31-200

ILLUSTRATION 6.3.5.4 BRAKED AXLE ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	14	FLAT WASHER	00-10-502
2	7	NYLOC NUT	00-10-118
3	4	M10 x 95 HEX SCREW	00-10-234
4	1	EYE COUPLER - COMPLETE 2 TON	BM1-03-011
5	1	M10 X 55 HT BOLT	00-10-233
6	1	DRAWBAR BRACKET	MC6-31-250
7	1	M10 X 45 HT BOLT	00-10-232
8	1	BRAKE CABLE 7m	BM1-05-004

6.3.6 FEED BOOT OPTIONS

6.3.6.1 FEED BOOT - STANDARD MC6-70-000

ILLUSTRATION 6.3.6.1 FEED BOOT - STANDARD

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	FEED BOOT	MC6-70-150
2	1	SIDE RUBBER CLAMP (RH)	MC6-70-250
3	1	SIDE RUBBER CLAMP (RH)	MC6-70-350
4	1	BACK RUBBER CLAMP	MC6-70-450
5	2	SIDE RUBBER	MC6-70-001
6	1	BACK RUBBER	MC6-70-002
7	4	M12 x 30 HEX SCREW	00-12-319
8	8	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
9	8	M10 FLAT WASHER	00-10-502

6.3.6.2 FEED BOOT - 2m LONG MC6-71-000

ILLUSTRATION 6.3.6.2 FEED BOOT - 2m LONG

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	FEED BOOT	MC6-72-100
2	1	BACK RUBBER CLAMP	MC6-70-450
3	1	BACK RUBBER	MC6-70-002
4	2	SIDE RUBBER	MC6-72-110
5	2	SIDE RUBBER CLAMP (RH)	MC6-72-150
6	12	M10 FLAT WASHER	00-10-502
7	12	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
8	4	M12 x 30 HEX SCREW	00-12-319

6.3.7 TAIL SECTION STAND OPTIONS

6.3.7.1 PIVOT STAND

ILLUSTRATION 6.3.7.1 PIVOT STAND

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	*1	PIVOT STAND 10"	MC6-80-150
	*	PIVOT STAND 6" (OPTIONAL)	MC6-80-350
2	3	REAR PIVOT	MC6-80-250
3	1	M24 x 80 HEX SCREW	00-24-308
4	1	M24 HEX NYLON INSERTED LOCKNUT	00-24-123
5	2	M24 FLAT WASHER	00-24-506

* SNR - Serial Number Related (OPTIONAL FEATURE)

6.3.7.2 HEIGHT ADJUSTABLE STAND MC6-80-400

ILLUSTRATION 6.3.7.2 HEIGHT ADJUSTABLE STAND

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	STAND BASE - HEIGHT ADJ.	MC6-80-450
2	1	MOUNTING BRACKET - STAND	MC6-80-550
3	1	PIN - HEIGHT ADJUSTABLE STAND	MC6-80-650

6.3.8 SUPPORT LEGS - HYD. ADJUSTABLE MC6-42-000

ILLUSTRATION 6.3.8 SUPPORT LEGS - HYD. ADJUSTABLE

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	10	PIN - MOUNTING BRACET	MC6-50-750
2	4	MOUNTING BRACKET - STAND	MC6-50-550
3	1	SUPPORT BRACE	MC6-42-300
4	1	HYDRAULIC TANK - 10 LT	BH1-25-006
5	1	HAND PUMP	BH1-01-009
6	*1	AXLE ASSEMBLY	REFER TO SECTION 6.3.5
7	2	PIN - CYLINDER MOUNTING	MC6-50-650
8	1	EXTENSION SLIDE - OUTER SECTION	MC6-42-100
9	1	EXTENSION SLIDE - INNER SECTION	MC6-42-200
10	1	HYDRAULIC CYLINDER	BH1-15-003
11	2	LOCKING PIN	MC6-50-850
12	2	R-CLIP	12.01.2014

SECTION 7

TRANSPORT

7.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

7.2 STOPPING THE MACHINE

1. First stop the material feeding into the feed boot of the conveyor and wait for the all the material on the conveyor to be discharged.
2. Stop the conveyor after all the material has been expelled from the machine.
3. Lock Out the machine according to the relevant procedure.

7.3 PREPARING FOR TRANSPORT

1. A qualified electrician must disconnect the electrical power source from the machine.The power cable to the machine must also be disconnected from the stand alone electrical panel to ensure that no shock hazards exist from the machine's disconnected power supply.
2. Inspect the Feed Boot to ensure that the machine is clear of all material.
3. Ensure that the electric cable running to the motor is disconnected and the entry into the motor is adequately sealed.
4. Wash the conveyor to remove all debris and material.
5. Remove the slewing axle and supports by unbolting the hangers at the top of the legs. This is a potentially dangerous operation, it requires appropriate rigging equipment to support the conveyor and competent personnel.
6. Should the conveyor be too long for transport, it will need to be stripped into 2 or more sections. Firstly slacken the conveyor belt by screwing the tensioning bolts on the tail section all the way in.
7. Remove the tail drum.
8. Remove the bolts holding the two centre sections together. Slide the two sections apart.
9. Fold the one section over the other section. Note, packing blocks need to be placed between the two sections to prevent damaging the troughing idlers.

10.Secure the two sections together using appropriate straps.

7.4 READY FOR TRANSPORT

The machine should now be ready for transport. The machine can be lifted with a crane. Once loaded on the transport vehicle, secure the machine with the vehicles' locking devices as well as with chain shackles to the loadbed.

7.5 PRIOR TO HAULAGE

1. Recheck for loose parts or debris on the machine.
2. Ensure all pins are secured with 'R' and Split pins.
3. Ensure persons transporting the machine adhere to all safety signs and procedures.

7.6 ON SITE TRANSPORT

This section is only applicable to the conveyors fitted with the optional drawbar and pneumatic tyres on an axle.

The conveyor can be provided with the option of a drawbar attached to the tail section. This provides an easy and convenient way of moving the machine around your site. ALWAYS remember that this drawbar is only intended for on site use and NOT for long distance towing. Do not under any circumstances exceed 12 km/h (7.5 miles/h) while towing the conveyor since it is top-heavy and could topple over when cornering. Always be aware of the machine height when towing to prevent it striking over-head equipment / spans / cabling.
The option of a braked axle connected to the tow coupler is available where conditions require it (Refer to Section 6.3.5).

SECTION 8

FAULT FINDING

The following guide is intended to describe basic procedures to remedy some problems that may arise.

8.1 CONVEYOR NOT WORKING WHEN MOTOR IS RUNNING

POSSIBLE FAULT	REMEDY
LOCKING ELEMENT NOT TIGHT OR BROKEN	REPAIR OR REPLACE LOCKING ELEMENT
DRIVE DRUM SHAFT KEY MISSING	REPLACE KEY

8.2 SCREECHING NOISE WHEN CONVEYOR IS RUNNING

POSSIBLE FAULT	REMEDY
LACK OF BEARING LUBRICATION	GREASE ALL BEARINGS
CONVEYOR BELT WEDGED OR RUBBING AGAINST FIXED PARTS	CLEAR OBSTRUCTION, ADJUST AND TRACK CONVEYOR BELT
BELT SCRAPER TOO TIGHT	EASE PRESSURE AT SCRAPER
ROLLER SEIZED	REPLACE RELEVANT ROLLER
SKIRTS OVER TIGHT	RE-ADJUST SKIRTS

8.3 CONVEYOR BELT NOT RUNNING

POSSIBLE FAULT	REMEDY
LOCKING ELEMENT BROKEN OR LOOSE	REPLACE OR TIGHTEN LOCKING ELEMENT
BEARING COLLAPSED OR SIEZED	REPLACE BEARING
DEBRIS OBSTRUCTING DRIVE DRUM	REMOVE OBSTRUCTION

NOTE: Repair and maintenance work.

It is recommended that repair and maintenance work of an intricate nature, such as the electrical / hydraulic systems which contain safety components, is referred to qualified personnel in the field.

Never alter any equipment or parts of equipment without consulting with Pilot Crushtec (SA) (Pty) Ltd.

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All conditions and warranties expressed or implied by any statute common law, trade usage or otherwise are hereby excluded. No liability is accepted by **Pilot Crushtec (SA) (Pty) Ltd** for any loss, damage or injury to property or persons arising directly or indirectly from any failure or defect in the machinery supplied. The materials employed by **Pilot Crushtec (SA) (Pty) Ltd** in the manufacture of their machinery, to the best of their knowledge, are the highest available quality of their respective kinds. **Pilot Crushtec (SA) (Pty) Ltd** undertake to replace or repair free of cost any part supplied to them direct to the customer of which they shall receive notice and which shall be proved to the satisfaction of **Pilot Crushtec (SA) (Pty) Ltd** within a period of six months of delivery to be defective in workmanship or materials provided:

A. The written note of complaint is given within seven days of the discovery of the defect

B. That the part is returned carriage paid to **Pilot Crushtec (SA) (Pty) Ltd** and shall, in the event of replacement become their property.

C. That **Pilot Crushtec (SA) (Pty) Ltd** shall not be liable for the cost of removal of the defective part or the cost of fitting a new part.

D. That the defect has not been caused by carelessness or improper or inadequate lubrication.

E. That the guarantee period shall be proportionally reduced if the machinery is run for more than one eight hour shift per day.

No unauthorized alternation or modification has been made to the plant or machine or component the subject of the claim.

The new part will be delivered by **Pilot Crushtec (SA) (Pty) Ltd**, carriage paid to the customers nearest station in the RSA or F.A.S. port of exportation.

In case of parts or components not manufactured by **Pilot Crushtec (SA) (Pty) Ltd** the customer will be entitled to the benefits in so far as it may be transmitted to the customer, of any guarantees given by the manufacturer in respect thereof and **Pilot Crushtec (SA) (Pty) Ltd** liability in respect of such goods is limited to making the benefits of the manufacturers guarantees available to the customer to the extent aforesaid.

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The guarantee contained aforesaid hereof is personal to **Pilot Crushtec (SA) (Pty) Ltd** customer and may not be assigned.

MILLTRONICS

INCLINE COMPENSATOR

Instruction Manual PL-294 September 2001

Operation Manual

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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SPECIFICATIONS

Power		» 115 V ± 15%, » 230 V ± 15%, » 50/60 Hz, 12 VA » voltage selection hardwired
Fuse	- 115 V - 230 V	» 1/8 amp MDL SLO-BLO » 1/16 amp MDL SLO-BLO
Input		» 10.0 ± 0.1 V DC (static load cell excitation from electronic integrator)
Output		» 10.0 ± 0.1 V DC at 0° incline » 11.5 ± 0.1 V DC at ± 30° incline
Range		» 0 to ± 30° off horizontal
Accuracy		» will maintain integrator specification
Resolution		» will maintain integrator specification
Temperature	- operating - exposure	» -40 to 60°C (-40 to 140°F) » -55 to 65°C (-67 to 149°F)
Enclosure		» NEMA 4 style » 292 mm H x 203 mm W x 102 mm D (11.5" H x 8" W x 4" H)
Weight	- open style - NEMA 4	» 735 g (1.6 lb) » 4.5 Kg (10 lb)

GENERAL

The Milltronics Incline Compensator provides dynamic load cell excitation to compensate for the varying vertical force component applied to the belt scale, due to varying inclination of a belt conveyor.

The Incline Compensator receives the static load cell excitation voltage from the electronic integrator and transmits a dynamic load cell excitation voltage, proportional to the secant of the angle of incline.
$V_{out} = V_{in} \times \text{secant } ø$

where: V_{in} = static load cell excitation voltage
V_{out} = dynamic load cell excitation voltage
ø = angle of incline from horizontal

Although the Incline Compensator was designed to work in conjunction with Milltronics integrators and scales, it can be used with equipment not of our manufacture, providing that the required excitation voltage meets our specification. For excitation voltages other than that specified, please consult Milltronics.

INSTALLATION

The Incline Compensator is mounted in a painted steel NEMA 4 enclosure, suitable for the rugged outdoor environment in which variable incline conveyors are found. The unit must be mounted to the conveyor such that the card will be standing vertically and right side up when the conveyor is level. It should be rigidly mounted on the conveyor stringer and in line with the center of the belt scale. Furthermore the unit should be mounted such that it is not subjected to excessive vibration or shock from falling material.

WIRING

All wiring must be done in conjunction with approved conduit, boxes and fittings and to procedures in accordance with all governing regulations.

The power supply cable to the Incline Compensator must be run in a conduit separate from the load cell excitation and signal cable. Refer to figure 3 for interconnection wiring of compensator between integrator and belt scale.

CALIBRATION

The Incline Compensator is factory calibrated to yield the specified dynamic load cell excitation through the range of 0 to ± 30°.
The dynamic load cell excitation ensures that the load cell signal output will remain constant for given load on the belt scale through the specified range of inclination. As such, Zero and Span calibrations of the integrator are not affected by the presence of an Incline Compensator in the load cell circuit. Refer to the associated integrator instruction manual and follow the calibration procedures as outlined.

MAINTENANCE

The Incline Compensator requires no maintenance, however the associated integrator and belt scale should be well maintained in accordance with their respective manuals.
A periodic inspection of the Incline Compensator should be initiated. The enclosure and circuit board should be cleaned only when the power is disconnected at the main breaker and by using a vacuum cleaner and a clean, dry paint brush. Check all electrical contacts for corrosion and arcing.
Check enclosure for evidence of shock from falling material. Provide suffient protection if unit is being subjected to direct shock.

SPARE PARTS

ITEM	
circuit board	- 115 V supply
	- 230 V supply
fuse	- 115 V supply
	- 230 V supply

INCLINE COMPENSATOR
OUTLINE AND MOUNTING

FIG. 1

CIRCUIT BOARD LAYOUT

FIG. 2

93/06/07

INCLINE COMPENSATOR CONNECTION DIAGRAM

Single load cell

NOTE

1. use sense connections for runs over 150 m (500 ft)
2. for 230 V AC operation jumpers J1 & J2 on incline compensator card must be removed and jumper J3 installed
3. signal B not applicable for single load cell scales
4. all wiring by customer

FIG. 3A

INCLINE COMPENSATOR CONNECTION DIAGRAM

NOTE

1. use sense connections for runs over 150 m (500 ft)
2. for 230 V AC operation jumpers J1 & J2 on incline compensator card must be removed and jumper J3 installed
3. all wiring by customer

FIG. 3B

93/06/07

Notes

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BOND Equipment

10Ton Mobile DMS Plant

PILOT CRUSHTEC

Parts Manual

ISSUE 01 11 03

PILOT modular mc600

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1.1 SAFETY INTRODUCTION

1.1.1

Operators should be trained in the correct and safe use of all equipment.

Before operation the operator(s) must:

i. Have received specific and adequate training in the task to be carried out.
ii. Have read and understood the Operators Manual and the Safety Signs in this manual and around the machine(s).
iii. Know the location and function of controls and safety features such as emergency stop buttons and safety guards.
iv. Be aware of all moving parts of the machine.

1.1.2

Overleaf are listed all the safety signs used throughout this manual and on your machine.

Take time to familiarize yourself with the symbols and explanations.

These signs are used frequently throughout this manual to indicate any potential warning or danger when operating this machine.

WARNING
Nip hazard.
Do not operate without guards or doors in place.
Lockout/tagout before servicing.
©2001 HCS, LLC 800-748-0241
Reorder No. 5087-7XW15PK

WARNING
Hazardous voltage.
This unit is to be serviced by trained personnel only.
©2001 Hazard Communication Systems, LLC 800-748-0241
Reorder No. HE010/5052-YSWHPT

DANGER
Nip hazard.
Do not operate without guards or doors in place.
Lockout/tagout before servicing.
©2001 HCS, LLC 800-748-0241
Reorder No. 4502-7XD61PK

DANGER
Read and understand operator's manual before using this machine.
Failure to follow operating instructions could result in death or serious injury.

WARNING
Entanglement hazard.
Always wear correctly fitting EN/ANSI approved protective clothing.
©2001 HCS, LLC 800-748-0241
Recorder No. 6169-8CWHPK

WARNING
Crush hazards.
Hard hats must be worn in this area.
©2001 HCS, LLC 800-748-0241
Recorder No. 3005-JSWHPK

SAFETY INSTRUCTIONS

1. Read and understand the Operation Manual and all safety labels before operating this machine.
2. Only a trained person is to be permitted to operate this machine. Training should include instruction in operation under normal conditions and emergency situations.
3. This machine is to be serviced only by trained and authorized personnel. Follow lockout procedures before servicing.
4. Never reach into the machine for any reason unless the machine is at a COMPLETE STOP.
5. Never leave the machine stopped in such a manner that another worker can start the machine while you are working on or within the machine.
6. Never change or defeat the function of electrical interlocks or other machine "shutdown" switches.
7. Before starting this machine, check that:
   - All persons are clear of the machine.
   - No maintenance work is being performed on the machine.
   - All guards are in place.
8. Routine inspections and corrective/preventative maintenance measures are to be conducted to ensure that all guards and safety features are retained and function properly.

SAFETY INSTRUCTIONS

SUGGESTED LOCKOUT PROCEDURE

1. Announce lockout to other personnel.
2. Turn power OFF at main panel.
3. Lockout power in OFF position.
4. Put key in pocket.
5. Clear machine of all personnel.
6. Test lockout by hitting RUN button.
7. Block, chain or release stored energy sources.
8. Clear machine of personnel before restarting machine.
9. Take key from pocket.
10. Unlock the lockout device.
11. Turn power on

DANGER
Fall hazard.
Do not climb
on equipment.

WARNING
Hot surface.
Contact may
cause burn.
Do not touch.

1.2 ELECTRICAL SAFETY

1. Never work on the electrical system of any equipment unless you are thoroughly familiar with system details.

2. Work on the electrical system must only be carried out by a qualified electrician.

3. If the machine is electric-hydraulic or direct electric drive, the 'mains' electrical supply to the machine should always be isolated by unplugging/uncoupling the 'mains' power socket.

4. The electrical equipment of the machine should be inspected at regular intervals. Damaged cables or loose connections must be corrected immediately. Use only original fuses with the specified current rating.

5. It is recommended that an earth leakage safety switch be fitted in the supply line to the power point on site. Special care should be taken to ensure that earth wires are correctly connected.

1.3 SAFETY BEFORE AND DURING OPERATION

ONLY QUALIFIED AND TRAINED PERSONNEL SHOULD ATTEMPT TO OPERATE THIS MACHINERY.

1. Read and understand the Operators Manual before you start the machine. Study the DANGER, WARNING, CAUTION and IMPORTANT safety signs on your machine.

2. Check your machine and have all systems in good operational condition.

- Check for broken, missing or damaged parts. Replace and make necessary repairs.
- Ensure all safety guards and emergency stops are fitted and in working order.
- See 'Daily Maintenance' for a more detailed checklist before start-up.

3. Before starting, walk completely around the machine. Make sure no one is under it, on it or close to it. Let other workmen and bystanders know you are starting up and do not start until everyone is clear of the machine.

4. During operation, do not climb onto, over or under moving conveyor belts and rollers. Always use ladders, steps and walkways when mounting and dismounting.

5. Hole alignment on mechanical supports must be checked and secured with pins provided and in accordance with safety signs.

6. Never check the tension of 'V' belts, drive chains and conveyors when the machine is running.

7. Never work or stand beneath machinery or attachments as it is raised or lowered.

8. Never work / stand beneath machinery as they are loaded with discharging material.

9. Follow safe operating practices. Operate the machine controls smoothly. Avoid sudden stops, starts or changes in direction.

10. Only use emergency stop buttons or emergency stop lines (if fitted) in emergency situations or during safety drills.

11. After each day's operation, always run the machine empty, never leave material on the conveyor belt. Starting a machine with a full load will cause strain problems in your machine.

12. Never alter any parts of the hopper without consulting PILOT CRUSHTEC.

1.4 SAFETY BEFORE AND DURING MAINTENANCE

MAINTENANCE SHOULD ONLY BE CARRIED OUT BY TRAINED AND QUALIFIED PERSONNEL.

1. Whenever maintenance or service is being carried out a minimum of two (2) persons should be present at all times. NEVER WORK ALONE.

2. Prepare yourself. Wear a hard hat, safety goggles, hearing protection and other protective equipment as required by job conditions. Do not wear loose clothing or jewellery that can catch on controls or moving parts. Long hair must be tied back.

3. Prepare the machine. Move the machine onto a level surface and apply chocks. Shut off the motor.

4. Isolate all electrical supplies to the machine to prevent any accidental starting up of the belt feeder, before starting any maintenance work.

5. Never attempt repairs or adjustments to the machine while it is running.

6. Remove only guards or covers that provide access. Wipe away excess grease and oil.

7. Never leave guards off or access doors open when unattended. Keep bystanders away if access doors are open.

8. When working beneath raised equipment, always use blocks, jack-stands or other rigid and stable supports. Never work under unsupported equipment.

9. Performing work above 6ft-6" (2m) always use an approved (EN/ANSI) safety harness. Always use walkways and platforms provided or a safe secure platform approved by the machine operators management. Do not use any unauthorised or unsafe platforms.

10. Wear safety goggles for eye protection.

11. Clean or replace damaged, missing or painted over safety signs that cannot be read.

12. Rotating and moving parts must be inspected during maintenance and replaced if cracked or damaged. Excessively worn or damaged parts can fail and cause injury or death.

13. After maintenance, tighten all bolts, fittings and connections. Install all guards, covers and shields. Replace or repair any damaged ones. Start the motor and check for

vibration. Operate all controls and make sure the machine is functioning properly. After testing, shut down, check the work you performed (any missing cotter pins, washers, locknuts, etc.)? Recheck all bolts before releasing machine for operation.

14. If maintenance has been carried out on the electrical motor or electrical installation, ensure that the BELT FEEDER DIRECTION has not been altered. Start the hopper and check that the belt is turning in the correct direction.

15. Always be aware that fully automatic machinery with moving parts may move at any time without warning; never assume a machine to be safe because of lack of movement. Isolate at all times before carrying out any work. Also isolate if the machine is not to be used for an extended period of time.

SAFETY INSTRUCTIONS

1. Read and understand the Operation Manual and all safety labels before operating this machine.
2. Only a trained person is to be permitted to operate this machine. Training should include instruction in operation under normal conditions and emergency situations.
3. This machine is to be serviced only by trained and authorized personnel. Follow lockout procedures before servicing.
4. Never reach into the machine for any reason unless the machine is at a COMPLETE STOP.
5. Never leave the machine stopped in such a manner that another worker can start the machine while you are working on or within the machine.
6. Never change or defeat the function of electrical interlocks or other machine "shutdown" switches.
7. Before starting this machine, check that:
   - All persons are clear of the machine.
   - No maintenance work is being performed on the machine.
   - All guards are in place.
8. Routine inspections and corrective/preventative maintenance measures are to be conducted to ensure that all guards and safety features are retained and function properly.

1.5 SAFETY BEFORE AND DURING TRANSPORT

1. The preparations to move equipment by articulated lorry should be supervised by a minimum of two (2) persons.

2. Ensure persons transporting the machine adhere to all Safety Signs and procedures.

3. Before transportation on public roads, ensure the machine has been properly secured with no loose material left in or on the machine. (See Section 7 – Transport).

4. Extreme caution is required when transporting machinery on site. Soft or uneven ground may cause accidents.

5. When transporting a machine on a truck or trailer, know the overall height to avoid contacting overhead obstructions such as bridges, power lines etc.

1.6 SAFETY SIGNS IN THIS MANUAL

Safety signs throughout this manual are identified by the safety alert symbol. When you see this symbol be alert to the possibility of personal injury or death.

Please take time to familiarise yourself with each of these signs and what they mean.

Always follow the instructions in the Safety message.

This indicates an imminently hazardous situation which if not avoided, **will** result in death or serious injury.

This indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.

This indicates a potentially hazardous situation which, if not avoided, **may** result in minor or moderate injury.
It may also be used to alert against unsafe practices.

This indicates a statement of company policy, which if not adhered to **will** result in damage to your machine and/or other peoples property.

1.7 SAFETY SIGNS ON YOUR MACHINE

Safety Signs are important features of your machine. Please take time to familiarise yourself with their meaning and locations on the machine as seen below.

IMPORTANT

ANY DAMAGED, MISSING OR PAINTED OVER SAFETY SIGNS MUST BE REPLACED IMMEDIATELY

1.8 SAFETY GUARDS ON YOUR MACHINE

Safety Guards are important features of the machine. On this machine they take the form of doors. Please take time to familiarize yourself with their locations on the machine as seen below.

1. DRIVE DOOR
2. NON DRIVE SIDE DOOR
3. SIDE MIDDLE DOOR
4. SIDE REAR DOOR
5. BOTTOM COVER

⚠ WARNING

ALWAYS REPLACE SAFETY GUARDS AFTER MAINTENANCE.
NEVER START THE MACHINE WITH FAULTY OR MISSING GUARDS.

1.9 NOISE LEVELS AROUND YOUR MACHINE

Noise Levels for the GFH 560 could exceed 85dB per dose.

Ear Protection must be worn at all times when operating this machine.

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2.1 FAMILIARISATION

ITEM NO.	DESCRIPTION
1	SKID FRAME
2	BELT FEEDER FRAME
3	LOWER HOPPER ASSY
4	UPPER HOPPER
5	GRIZZLY BAR PIVOT ASSY
6	GRIZZLY ASSY

2.2 KEY COMPONENTS

2.2.1 POWER UNIT

The machine is driven by a 3 kW 380 V three phase, 50 Hz, cast iron, squirrel cage electric motor. The drive unit incorporates a variable speed selection and a seperate gearbox. Speed selection is set manually while the motor is running. Fitted on a base plate the chain tension is set through a belt tensioner. The motor can be removed/exchanged easily.

2.2.2 HOPPER

The Hopper fitted is designed with a 5.6 cubic metre (198 cubic feet) capacity (approximate), and tapered sides for greater efficiency. Grizzly bars of 50 mm (2") diameter are spaced at 100 mm (3.9") , giving a feed size of up to 250 mm (9.8"). The grizzly assembly can easily be swung open or removed depending on the application.

2.2.3 FEED BELT/CONVEYOR

The machine uses a 650 mm (25.6") wide conveyor belt. The speed range of the conveyor belt is set by the chain/sprocket assembly used. The speed can however be adjusted within this range through the use of the variable speed gearbox. Belt tracking is done with the adjustable belt tensioners at the back of the assembly.

2.2.4 DRIVE SET

The drive set consists of a 12B 3/4" (simplex) sprocket on the electric motor, a 12B 3/4" sprocket on the drive drum, and 3/4" simplex chain to suit. Taperlocks are used where aplicable. A 12B 3/4" 13 Teeth idler sprocket is used for chain tensioning.

The size of the drive set may vary according to application and customers' needs.

2.2.5 WEIGHTED DOORS

The machine also features weighted, feed restricting doors, which can be adjusted to help control the rate of feed.

2.2.6 HOPPER EXTENSION

The size of the hopper can be increased at the expense of the grizzly bar screenby adding a bigger hopper in the place of the grizzly.

2.3 TECHNICAL DATA

2.3.1 GRIZZLY FEED SIZE: Rock up to 150 mm (5.9 inches)

2.3.2 HOPPER CAPACITY: Approx. 5.6 m³ (1.5 * 3.2 m hopper load area)

2.3.3 ELECTRIC MOTOR SPEED

	RPM
MAX SPEED	1410

2.3.4 VARIABLE SPEED CONTROL

	RPM
DRIVE DRUM SPEED ADJUSTMENT RANGE	1.4 TO 7

2.3.5 GEARBOX

	RATIO
GEARING RATIO	30.7 : 1

2.3.6 MACHINE WEIGHT

	TONS
TOTAL MACHINE WEIGHT	3.9

2.3.7 CONVEYOR SPEEDS

	METERS/MIN	FEET/MIN
FEED CONVEYOR (VARIABLE SPEED)	1.2 - 6.6	3.9 - 21.6

2.3.8 STANDARD EQUIPMENT

1. Approximately 5.6 m³ (198ft³) Hopper capacity.
2. 650 mm (25.6") wide variable speed belt feeder.
3. Class 500/4ply 5mm top and 1.6 mm bottom cover belting.
4. Rubber lagged drive drum.
5. Heavy duty skid frame and support structure.
6. 3kW electric drive with variable speed reduction gearbox.
7. Continuous self-tensioning chain and sprocket drive.
8. Feed resricting adjustable weighted doors.
9. Easy acces maintenace and inspection door guarding.
10. Easy access grease points.
11. Heavy duty reject grid set at between 100 and 125 mm grid rod spacing.

2.3.9 OPTIONAL EXTRAS

1. No scalping grizzly but extensions added.
2. Rubber impact idlers.
3. Low friction poly hi-solidur liners.
4. Hardox 400 abrasion resistant liners.
5. Skidframe extensions to increase hopper height.
6. Extensions to increase hopper capacity when scalping grizzly is removed.
7. Electric hydraulic/diesel hydraulic drive.
8. Hydraulic tipping of the grizzly with or without remote control (requires hydraulic drive).

2.4 WORKING DIMENSIONS

2.5 CORRECT USE OF YOUR MACHINE

1. This machine can be used for the loading & feeding of sand, gravel, aggregates, rock, coal and any other hard core material. This does not include hot materials, which may damage the belt of the machine. The variable speed allows the rate of feed to be adjusted to suit almost any requirement. The grizzly has been designed to remove large rock that may be present in the feed material. To avoid long term damage to the machine do not feed rock exceeding 250 mm. The grizzly should not be used as a screen (seperator), it merely provides protection for the belt feeder.

- Should you have any doubt about feeding a type of material not listed, contact Pilot Crushtec or your local dealer for guidance or authorisation.

2. Appropriate space should be allowed for material stockpiles and loading of machine.

3. This machine should only be loaded via its feed hopper.

4. Before operating, ensure proper machine installation. (See Section 3 - Installation).

5. Before operating, the machine should be levelled across the skidframe. Ensuring that the weight of the machine is evenly distributed. (See Section 3.2.1 - Before Starting).

6. Before operation the operator(s) must:

- Have received specific and adequate training in the task to be carried out.
- Have read and understood the safety instructions in Section 1.
- Know the location and function of controls and safety features.
- Be aware of all moving parts of the machine.

7. Before operating the operator(s) must ensure that they are properly equipped with a hard hat, ear and eye protectors.

8. Before operation, all safety guards (doors) must be in place.

9. Before operation, ensure the machine has been properly lubricated. Always adhere to the lubrication schedule provided (See Section 5.7 - Lubrication Points).

10. Before transportation on public roads, ensure the machine has been properly secured with no loose material left in or on the machine. (See Section 7 - Transport).

11. After each day's operation, always run the machine empty. Starting a machine with a full load will cause strain problems in your machine.

12. Do not climb on the machine while it is running.

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3.2 INSTALLATION ***28***

3.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

3.2 INSTALLATION

An external electrical power source must be connected to the GFH 560 by a qualified electrician to provide power to the grizzly feed hopper The electric motor must be started to check smooth power delivery to the machine.

3.2.1 BEFORE STARTING

1. The machine must be on a level, compacted area with firm stable underfoot conditions.
2. Ensure all emergency stop buttons are not depressed.
3. Check that all bearings have been properly greased.
4. Check the chain tension and chain tensioning device.
5. Ensure all eletrical controls are in the off position.

3.2.2 STARTING AND CHECKING THE CONVEYOR

1. Start up the screenbox via the start button on the external electrical panel. Check if the direction of the conveyor is correct. This can be seen facing the motor on the short front side. The top of the belt drive should be turning towards you.

2. Allow the belt to reach full speed. Adjust the variable speed control on the drive by turning the knob in both directions and checking the effect on the belt speed. Always remember that the motor should be running when any adjustments are made.

3. Check that the tracking of the conveyor belt is correct. The tracking of the belt can only be checked whilst it is in motion. Absolute care must be taken when tracking the belt to avoid injury (See Section 5.4 - Belt Tracking).

3.2.3 SHUTTING DOWN

1. Stop the feed to the hopper.

2. Wait for all the material to pass through the machine then stop the conveyor by shutting the electric motor off.

It is very important to note that the hopper should not be left under load for extended periods of time.

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4.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

4.2 SAFETY BEFORE AND DURING OPERATION

Only qualified and trained personnel should attempt to operate this machinery.

1. Read and understand the Operators Manual before you start the machine. Study the DANGER, WARNING, CAUTION and IMPORTANT safety signs on your machine.

2. Check your machine and have all systems in good operational condition.
   - Check for broken, loose, missing or damaged parts. Replace and make necessary repairs.
   - Ensure all safety guards and emergency stops are fitted and in working order.
   - See Section 4.3 - 'Checks Before Start Up' for a detailed checklist before start-up.

3. Before starting, walk completely around the machine. Make sure no one is under it, on it or close to it. Let other workmen and bystanders know you are starting up and do not start until everyone is clear of the machine.

4. During operation, do not climb onto, or over the machine. Always use ladders, steps and walkways when mounting and dismounting.

5. Hole alignment on mechanical supports must be checked and secured with pins provided and in accordance with safety signs.

6. Never check the tension of 'V' belts, drive chains and conveyors while the machine is running.

7. Never work or stand beneath machinery or attachments as it is raised or lowered.

8. Never work or stand beneath machinery as they are being loaded with and/or discharging material.

9. Follow safe operating practices. Operate the machine controls smoothly. Avoid sudden stops, starts or changes in direction.

10. Only use emergency stop buttons or emergency stop lines (if fitted) in emergency situations or during safety drills.

11. After each day's operation, always run the machine empty, never leave material in the hopper. Starting a machine with a full load will cause strain problems in your machine.

4.3 CHECKS BEFORE START-UP

The following inspection routine must be carried out before the first start-up and after lengthy periods of non-operation and after any maintenance has been carried out on the plant.

4.3.1.Ensure that the motor is installed correctly, and the direction of rotation is correct.
4.3.2.Ensure that nothing is restricting the movement of the electric motor, chain drive, belt conveyor as well as the weighted doors.
4.3.3.Ensure that the bearings have been sufficiently greased.
4.3.4.Ensure that the chain is in place and that the tension is correct (idler sprocket).
4.3.5.Ensure that all safety guards are in place and properly mounted.
4.3.6.Ensure that all the skirting rubbers are in place to prevent unnecessary spillage.
4.3.7.On machines using liners ensure that the liners have enough life left to complete at least one shift. This goes for grizzly bars as well.

4.4 OPERATING THE MACHINE

After all safety checks have been performed the electric motor can be started. Only after this has been perfomed, can material be fed into the machine. Feeding the machine is done by use of either a shovel loader or an excavator. Some operators build a ramp at the side of the machine to give their shovel loader a better reach into the Hopper. If you do build a ramp avoid contact with the side of the machine.

4.4.1 INTRODUCING MATERIAL TO THE MACHINE

When starting to feed the machine, the following procedure should be followed to ensure full capacity operation:

1. Ensure that the electric motor is at operating speed, also check that the direction of the belt and the tracking thereof is correct.
2. Turn the feed rate of the belt feeder down and begin to load the hopper at a low rate. Gradually increase the feed until your conveyor, and the system it is operating in, can handle the load.
3. After an initial period stop the machine and check for obstructions in the weighted doors.

Note: As product stockpiles are usually very varied, their composition is not uniform. A beltfeeder speed setting that provides a constant feed out of the machine may have to be adjusted when changes in feed material occur.

4. The feed from the machine can be adjusted by loosening the retaining bolt on the weighted doors and sliding the weight in or out. Sliding it away from the machine will increase the pressure that the door exerts and restrict the feed.

4.4.2 FEED SIZE SPESIFICATION

This machine can be used for the loading & feeding of sand, gravel, aggregates, rock, coal and any other hard core material. This does not include hot materials, which will damage the conveyor belt on your machine.

The ø 50 mm (2") grizzly bars are spaced at 100 mm (3.9"), giving a maximum feed size of approximately 250 mm (9.8").

4.4.3 CONVEYOR SPEED CONTROL

Speed control on this machine is done by turning the knob on the speed control gearbox of the drive assembly.

To **INCREASE** the Beltfeeder speed, rotate the knob **ANTI-CLOCKWISE.**

To **DECREASE** the beltfeeder speed, rotate the knob **CLOCKWISE.**

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5.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

5.2 FEED CONVEYOR DRIVE DRUM SKIRT

Check on the wear of the skirts and replace if necessary.

5.3 HOPPER SKIRTING

Check on the wear of the side and back rubber skirting and replace if necessary.

5.4 BELT TRACKING

Oblique travel may cause fast deterioration of the belt. In order to assist you we have compiled some of the reasons for oblique travel with appropriate remedies.

Reasons for Oblique Travel	Remedies	Examples of Oblique Travel
1. Insufficient aligning of drums and Idlers.	a. Align all drums, carrying idlers and return idlers at right angles to the travelling direction of the belt. b. Check that all drums and idlers are level to each other. If **a&b** are as above then carry out the following: Adjustments are made as indicated on **Figs.1,2&3** by turning drums and carrying idlers in direction of arrow until the belt is running straight and centred on the conveyor. Also return idlers may cause oblique belt travel and therefore they must be aligned at right angles to the travelling direction of the belt and after that adjustment can be made.	 **Fig.1.** Turning carrying idlers. **Fig.2** Turn drums. **Fig.3.** Turning both drum and carrying idlers.
2. Misalignment of frame.	Oblique travel can be reduced by turning forward outer carrying idlers 1-3 degrees in travelling direction of the belt. **See Fig.4:** if this does not correct the oblique travel then align the frame.	 **Fig.4** Turning forward carrying idlers.
3. Material built up on drums and idlers.	Clean idlers and drums. Check belt cleaners and replace if necessary. Possibly change to more efficient type.	

5.5 BELT TRACKING ON YOUR MACHINE

Belt tracking is performed at the tail drum of the feed conveyor. Adjust the belt with the tensioners (1) on the tail drum.

A small movement in the adjuster i.e. less than 10mm (0.4") should be sufficient. A greater movement will affect the tension of the belt.

5.6 BELT TENSIONING ON YOUR MACHINE

Belt tensioning is performed at the tail drum of the feed conveyor.

By adjusting the belt tensioners (1) equally on either side of the drum, you can either tighten or loosen the belt.

IMPORTANT

BELT TRACKING AND TENSIONING ARE THE ONLY MAINTENANCE TASKS PERMITTED WHEN THE MACHINE IS RUNNING

The belt should be sufficiently tight to prevent slippage at the drive drum. If over tight the life of the belt will decrease.

DANGER

DO NOT REACH INTO A MOVING MACHINE DANGEROUS NIP POINTS EXIST

5.7 LUBRICATION POINTS

The red dots indicate the positions of the lubrication points.

Proper lubrication is necessary to ensure that the bearings operate at maximum efficiency and minimum cost. Apply 4 grams/2 pumps per bearing every 45 hours.

Use only a Lithium-based grease with a consistency of 3 (penetration class) and a temperature range between 20 and 130 °C.

The bearings are fully greased when the machine is supplied.

5.8 RECOMMENDED LUBRICANTS

	GENERAL PURPOSE GREASE	GEARBOX OIL	VARIATOR OIL
SHELL	ALVANIA R3	OMALA 150 ISO VG 150	ATF Dexron II

Above are listed the recommended alternatives suitable for use with your machine. The above special greases are lithium base greases of Class 2 with extreme pressure additives.

At no time should the chain & sprockets be greased.

5.9 CHAIN / SPROCKET REPLACEMENT ON YOUR MACHINE

To ensure optimum operational efficiency and availability on your machine the drive assembly should be checked regularly. The chain tensioner should normally provide sufficient tension and take up slack caused by chain stretch. Inspect the drive pulleys and should it become necessary to replace it, (i.e. to prevent chain slippage) follow the steps as described below.

1. Open the drive side door of the machine.
2. The chain and sprockets on your machine can be easily replaced. Simply loosen the bolt securing the chain tensioner and swing the device out of the way. The chain slack should be enough so the chain can be easily removed.
3. The sprocket on the motor-gearbox assembly is removed by loosening the grub-screws on the sprocket with the correct size Allen key and sliding it of the shaft.
4. The taper-lock bush on the conveyor drive pulley needs to be loosened in order to remove the sprocket. Follow the instructions laid out in Annexure A to remove/install the taper lock bush.
5. Reversing the sequence described above will see the sprockets and chain reinstalled. Make sure the keys are inserted in the keyway and didn't fall out in the removal process.
6. Put the chain over the sprockets and line the sprockets up before tightening them. Also line up the chain tensioner sprocket with the other sprockets
7. Swing the chain tensioner over and make sure the teeth of the tensioner mesh correctly into the chain before tightening the fixing bolt.
8. Feel that the chain tension is correct by pushing the chain inwards on the long straight side. The chain should not deviate more than 40-50 mm.
9. Always replace sprockets and chain at the same time.

5.10 RECOMMENDED MAINTENANCE SCHEDULE

No	Description	Daily 8 Hours	Weekly 45 Hours	Reference
	GENERAL MAINTENANCE			
1	Check for material build-up	C		
2	Check all safety Guards are in place	C		
3	Check for loose parts, missing nuts and bolts	C		
4	Check conveyor belts for tears	C		
5	Check belt tension	C		
6	Check belt tracking	C		
7	Check all rollers are free turning	C		
8	Check all rollers are free of obstructions	C		
9	Check for gearbox oil leaks	C		
10	Check for loose / damaged electrical cables	C		
11	Check tension of belt scrapers		C	
12	Check feed boot skirting rubbers		C	
13	Check drive gearbox oil level		C	Shell Omala 150 (ISO VG 150)
14	Check variator oil level		C	Shell ATF Dexron II
15	Grease drive and tail drum bearing		A	4 grams / 2 pumps per bearing.
16	Check chains and sprockets for wear / tension		C	
Key:	A - Adjust C - Check/Top Up R - Replace			

These are the minimum recommended maintenance guidelines. Certain applications and conditions may require more frequent maintenance. Never alter any parts on your machine without consulting **PILOT CRUSHTEC** or your service provider

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6.1 SPARE PARTS ORDERING PROCEDURE

Ordering Procedure: To ensure delivery of your parts, when ordering please quote:

- Machine serial number
- Illustration number
- Item number
- Part number
- Part description
- Quantity required

EXAMPLE:

If you wanted to order DEFLECTOR BARS, place your order in the following fashion:

Machine serial number - GFH 560 0207 039

Illustration number - 6.3.7

Item number - 2

Part number - G56-60-102

Part description - DEFLECTOR BAR

Quantity required - 21

This information will enable us to supply the correct parts with the minimum of delay.

6.2 SPARE PARTS ORDER FORM

Parts Ordering Form

Date_____

Customer Name

Customer Address

MACHINE DETAILS

MANUAL DETAILS

Machine Type.	Machine Serial No.	Illustration Number	Item No.	Part No.	Part Description	Quantity Required

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6.3.1 GFH 560 MAIN ASSEMBLY

ILLUSTRATION 6.3.1 GFH 560 ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	SKID FRAME	SECTION 6.3.2
2	1	BELT FEEDER	SECTION 6.3.3
3	1	LOWER HOPPER ASSEMBLY	SECTION 6.3.4
4	1	UPPER HOPPER ASSEMBLY	SECTION 6.3.5
5	1	GRIZZLY BAR PIVOT ASSEMBLY	SECTION 6.3.6
6	1	GRIZZLY RETAINER ASSEMBLY	SECTION 6.3.7
7	2	WELDED PIN	G56-70-150

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
8	1	ELEC. MOTOR (VARIABLE SPEED GEARBOX)	BE1-07-002*
		VARIABLE SPEED GEARBOX	BM1-07-002
9	1	IDLER SPROCKET	11.06.0309
10	1	DRIVE SPROCKET	13.03.7519
11	1	DRIVEN SPROCKET	13.03.7576
12	1	TAPERLOCK BUSH (DRIVEN)	13.04.9014
13	1	TAPERLOCK BUSH (DRIVE)	13.04.8652
14	1	DUPLEX CHAIN	13.05.0066
15	2	5 mm SPLIT PIN	00-19-914
16	2	8 mm CHAIN (24 LINKS)	G56-70-108
17	-	-	-
18	4	M10 U-BOLT	12.08.0003
19	3 (+4)**	M12 x 30 HEX SCREW	00-12-319
20	12	M16 x 40 HEX SCREW	00-16-320
21	24	M16 x 45 HEX SCREW	00-16-305
22	4	M16 x 50 HEX SCREW	00-16-306
23	1	M16 x 60 HEX SCREW	00-16-311
24	4	M20 x 70 HEX SCREW	00-20-338
25	8	M10 HEX NYLON INSERTED LOCKNUT	00-10-118
26	29	M16 HEX NYLON INSERTED LOCKNUT	00-16-120
27	4	M20 HEX NYLON INSERTED LOCKNUT	00-20-121
28	8	M10 FLAT WASHER	00-10-502
29	3 (+4)**	M12 FLAT WASHER	00-12-503

ITEM NO.	QTY.	DESCRIPTION	PART NO.
30	3 (+4)**	M12 SPRING WASHER	00-12-511
31	70	M16 FLAT WASHER	00-16-504
32	12	M16 SPRING WASHER	00-16-512
33	8	M20 FLAT WASHER	00-20-505
34	2	M24 FLAT WASHER	00-24-506
35	1	12.7 x 9 x 60 KEY	G56-70-109
36	1	14 x 9 x 70 KEY	G56-70-110
37	1	ENDLESS BELT 650mm WIDE	G56-20-003

* SNR - Serial Number Related

6.3.2 SKID FRAME ASSEMBLY

ILLUSTRATION 6.3.2 SKID FRAME ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	2	BASE CHANNEL ASSEMBLY	G56-10-101
2	2	SKID FRAME PILLAR ASSEMBLY	G56-10-102
3	1	UPPER SUPPORT FRAME	G56-10-103
4	3	CROSS BEAM	G56-10-104

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
5	-	-	-
6	72	M 16 x 40 HEX SCREW	00-16-305
7	48	M16 HEX NYLON INSERTED LOCKNUT	00-16-120
8	120	M16 FLAT WASHER	00-16-504
9	24	M16 SPRING WASHER	00-16-512

6.3.3 BELT FEEDER FRAME

ILLUSTRATION 6.3.3 BELT FEEDER FRAME ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	BELT FEEDER FRAME	G56-20-101
2	1	TAIL DRUM AJUSTMENT BRACKET (LH)	G56-20-102
3	1	TAIL DRUM AJUSTMENT BRACKET (RH)	G56-20-103
4	1	DRIVE DRUM ASSY	SECTION 6.3.3.1
5	1	TAIL DRUM ASSY	SECTION 6.3.3.2
6	1	TAIL DRUM SCRAPER	G56-20-106
7	1	BOTTOM COVER	G56-20-107
8	6	IDLER SUPPORT PLATE	G56-20-108
9	2	IDLER SUPPORT PLATE	G56-20-109

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
10	12	IMPACT IDLER	19.25.4028
11	4	2" PLUMMER BLOCK	11.05.0230
12	24	IDLER RETAINER CLIP	19.22.0000
13	-	-	-
14	4	M12 x 40 HEX SCREW	00-12-316
15	22	M16 x 40 HEX SCREW	00-16-320
16	4	M16 x 65 HEX SCREW	00-16-351
17	4	M16 x 75 HEX SCREW	00-16-333
18	4	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
19	30	M16 HEX NYLON INSERTED LOCKNUT	00-16-120
20	8	M20 HEX NUT	00-20-105
21	8	M12 FLAT WASHER	00-12-503
22	60	M16 FLAT WASHER	00-16-504
23	8	M12 FLAT WASHER	00-20-505
24	2	CLAMP PLATE - TAIL DRUM BEARINS	G56-20-110

6.3.3.1 DRIVE DRUM

ILLUSTRATION 6.3.3.1 DRIVE DRUM

ITEM NO.	QTY.	DESCRIPTION	PART NO.
		DRIVE DRUM ASSEMBLY	G56-20-104
1	1	DRIVE DRUM	G56-20-111
2	1	DRIVE DRUM SHAFT	G56-20-112
3	2	LOCKING ELEMENT	BM1-18-006

6.3.3.2 TAIL DRUM

ILLUSTRATION 6.3.3.2 TAIL DRUM

ITEM NO.	QTY.	DESCRIPTION	PART NO.
		TAIL DRUM ASSEMBLY	G56-20-105
1	1	TAIL DRUM	G56-30-113
2	1	TAIL DRUM SHAFT	G56-20-114
3	2	LOCKING ELEMENT	BM1-18-006

6.3.4 LOWER HOPPER ASSEMBLY

ILLUSTRATION 6.3.4 LOWER HOPPER ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	LOWER HOPPER WELD ASSEMBLY	G56-30-101
2	1	DRIVE DRUM GUARD	SECTION 6.3.4.1
3	1	SIDE RUBBER CLAMP (RH)	G56-30-103
4	1	SIDE RUBBER CLAMP (LH)	G56-30-104
5	1	BACK RUBBER CLAMP	G56-30-105
6	2	DEFLECTOR DOOR 1	SECTION 6.3.4.2
7	1	DEFLECTOR DOOR 2	SECTION 6.3.4.3
8	2	CLAMPING PLATE	G56-30-108
9	1	SWIVEL BAR	G56-30-109
10	1	BACK RUBBER	G56-30-110
11	2	SIDE RUBBER	G56-30-111

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
12	1	ROSTA TE 38 CHAIN TENSIONER	BM1-08-003
13	2	6 mm SPLIT PIN	00-19-929
14	-	-	-
15	12	M12 x 35 HEX SCREW	00-12-343
16	12	M12 x 30 CSK SCREW	00-12-403
17	1	M16 x 150 HEX SCREW	00-16-219
18	27	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
19	39	M12 FLAT WASHER	00-12-503
20	12	M12 SPRING WASHER	00-12-511
21	1	M16 FLAT WASHER	00-16-504
22	1	M16 SPRING WASHER	00-16-512
23	2	M24 FLAT WASHER	00-24-506

6.3.4.1 DRIVE DRUM GUARD

ILLUSTRATION 6.3.4.1 DRIVE DRUM GUARD ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	DRIVE DRUM GUARD WELD ASSEMBLY	G56-30-115
2	1	BELT SCRAPER PLATE	G56-30-116
3	2	DRIVE DRUM RUBBER CLAMP	G56-30-117
4	2	DRIVE RUBBER MAT	G56-30-118
5	1	RUBBER MAT	G56-30-119
6	-	-	-
7	3	M12 x 45 HEX SCREW	00-12-326
8	14	M12 x 35 CSK SCREW	00-12-404
9	14	M12 HEX NYLON INSERTED LOCKNUT	00-12-119
10	17	M12 FLAT WASHER	00-12-503
11	3	M12 SPRING WASHER	00-12-511

6.3.4.2 DEFLECTOR DOOR 1

ILLUSTRATION 6.3.4.2
DEFLECTOR DOOR 1

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	DEFLECTOR DOOR 1 WELD ASSEMBLY	G56-30-125
2	1	COUNTERWEIGHT	G56-30-126
3	1	M12 x 45 HEX SCREW	00-12-326
4	1	M12 HEX NUT	00-12-103

6.3.4.3 DEFLECTOR DOOR 2

ILLUSTRATION 6.3.4.3
DEFLECTOR DOOR 2

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	DEFLECTOR DOOR 2 WELD ASSEMBLY	G56-30-124
2	1	COUNTERWEIGHT	G56-30-126
3	1	M12 x 45 HEX SCREW	00-12-326
4	1	M12 HEX NUT	00-12-103

6.3.5 UPPER HOPPER ASSEMBLY

ILLUSTRATION 6.3.5 UPPER HOPPER ASSEMBLY

Main Assemblies/Components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	UPPER HOPPER WELD ASSEMBLY	G56-40-101
2	1	CROSS MEMBER	G56-40-102
3	1	BACKING PLATE	G56-40-103
4	1	GRIZZLY SIDE PLATE (LH)	G56-40-104
5	1	GRIZZLY SIDE PLATE (RH)	G56-40-105
6	1	SUPPORT CHANNEL ASSEMBLY	G56-40-106
7	1	UPPER CHANNEL ASSEMBLY	G56-40-107
8	1	FRONT BEAM ASSEMBLY	G56-40-108
9	3	GRIZZLY BAR GUIDE	G56-40-109

Loose components

ITEM NO.	QTY.	DESCRIPTION	PART NO.
10	-	-	-
11	9	M16 x 35 HEX SCREW	00-16-315
12	13	M16 x 40 HEX SCREW	00-16-320
13	25	M16 x 45 HEX SCREW	00-16-305
14	4	M16 x 50 HEX SCREW	00-16-306
15	4	M12 x 40 CSK SCREW	00-12-437
16	51	M16 HEX NYLON INSERTED LOCKNUT	00-16-120
17	82	M16 FLAT WASHER	00-16-504
18	20	M16 TAPER WASHER	00-16-522

6.3.6 GRIZZLY BAR PIVOT ASSEMBLY

ILLUSTRATION 6.3.6 GRIZZLY BAR PIVOT ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	GRIZZLY BAR PIVOT FRAME	G56-50-101
2	2	DEFLECTOR PLATE ASSEMBLY	G56-50-102
3	2	6 mm SPLIT PIN	00-19-929
4	-	-	-
5	8	M16 x 40 HEX SCREW	00-16-320
6	8	M16 HEX NYLON INSERTED LOCKNUT	00-16-120
7	8	M16 FLAT WASHER	00-16-504
8	8	M16 TAPER WASHER	00-16-522
9	1	PIVOT EXTENSION	G56-50-103
10	1	PIVOT MOUNT PIN	G56-50-104

6.3.7 GRIZZLY ASSEMBLY

ILLUSTRATION 6.3.7 GRIZZLY ASSEMBLY

ITEM NO.	QTY.	DESCRIPTION	PART NO.
1	1	GRIZZLY BAR HOLDER	G56-60-101
2	21	DEFLECTOR BAR	G56-60-102

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7.1 SAFETY INTRODUCTION

Read and fully understand SECTION 1: SAFETY before continuing any further.

7.2 STOPPING THE MACHINE

1. First stop the feed to the hopper of the machine and wait for the audible load on the machine to decrease.
2. Stop the conveyor after all the material has been expelled from the machine.

7.3 DISCONNECTING THE POWER SOURCE

A qualified electrician must disconnect the electrical power source from the machine. The power cable to the machine must also be disconnected from the stand alone electrical panel to ensure that no shock hazards exist from the machine's disconnected power supply.

7.4 PREPARING FOR TRANSPORT

Inspect the Hopper to ensure that the machine is clear of all material. The machine should be washed to remove all debris. Ensure that the electric cable running to the motor is unplugged/disconnected when washed.

7.5 REMOVING ATTACHMENTS FROM THE MACHINE

When using the increased hopper size or increased skidframe height, it may be necessary to split the machine between the upper and lower hopper in order to decrease the transport height.

7.6 READY FOR TRANSPORT

The machine should now be ready for transport. The machine can be lifted with a crane. Attach the chain to the lifting lugs on the upper hopper. Once lifted on the transport vehicle, secure the machine with the vehicles' locking devices as well as chain shackles to the loadbed.

7.7 PRIOR TO HAULAGE

1. Recheck for loose parts or debris on the machine.
2. Ensure all pins are secured with 'R' and Split pins.
3. Ensure persons transporting the machine adhere to all safety signs and procedures.

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The following guide is intended to describe basic procedures to remedy some problems that may arise.

8.1 CONVEYOR NOT WORKING WHEN MOTOR IS RUNNING

POSSIBLE FAULT	REMEDY
TAPER LOCK BUSHES NOT TIGHT OR BROKEN	REPAIR OR REPLACE TAPERLOCK BUSHES
KEY MISSING	REPLACE KEY

8.2 SCREECHING NOISE WHEN CONVEYOR IS RUNNING

POSSIBLE FAULT	REMEDY
LACK OF BEARING LUBRICATION	GREASE ALL BEARINGS
CONVEYOR BELT WEDGED OR RUB-BING AGAINST FIXED PARTS	CLEAR OBSTRUCTION, ADJUST AND TRACK CONVEYOR BELT
TOP END DRUM BELT SCRAPER TOO TIGHT	EASE PRESSURE AT SCRAPER
ROLLER SEIZED	REPLACE RELEVANT ROLLER
SKIRTS OVER TIGHT	RE-ADJUST SKIRTS

8.3 CONVEYOR BELT NOT RUNNING

POSSIBLE FAULT	REMEDY
BELT DRIVE COUPLING BROKEN OR LOOSE	REPLACE OR TIGHTEN COUPLING
BEARING COLLAPSED OR SIEZED	REPLACE BEARING
DEBRIS OBSTRUCTING DRIVE DRUM	REMOVE OBSTRUCTION

8.4 CONVEYOR BELT RUNNING IRREGULARLY

POSSIBLE FAULT	REMEDY
CHAIN AND/OR SPROCKETS EXCESSIVELY WORN CAUSING SLIPPAGE	REPLACE CHAIN AND SPROCKETS
CHAIN NOT SUFFICIENTLY TENSIONED	CHECK CHAIN TENSIONING DEVICE

NOTE: Repair and maintenance work.

It is recommended that repair and maintenance work of an intricate nature, such as the electrical and hydraulic systems which contain safety components, is referred to qualified personnel in the field.

Never alter any equipment or parts of equipment without consulting with Pilot Crushtec (SA) (Pty) Ltd.

WARRANTY

All conditions and warranties expressed or implied by any statute common law, trade usage or otherwise are hereby excluded. No liability is accepted by **Pilot Crushtec (SA) (Pty) Ltd** for any loss, damage or injury to property or persons arising directly or indirectly from any failure or defect in the machinery supplied. The materials employed by **Pilot Crushtec (SA) (Pty) Ltd** in the manufacture of their machinery, to the best of their knowledge, are the highest available quality of their respective kinds. **Pilot Crushtec (SA) (Pty) Ltd** undertake to replace or repair free of cost any part supplied to them direct to the customer of which they shall receive notice and which shall be proved to the satisfaction of **Pilot Crushtec (SA) (Pty) Ltd** within a period of six months of delivery to be defective in workmanship or materials provided:

A. The written note of complaint is given within seven days of the discovery of the defect

B. That the part is returned carriage paid to **Pilot Crushtec (SA) (Pty) Ltd** and shall, in the event of replacement become their property.

C. That **Pilot Crushtec (SA) (Pty) Ltd** shall not be liable for the cost of removal of the defective part or the cost of fitting a new part.

D. That the defect has not been caused by carelessness or improper or inadequate lubrication.

E. That the guarantee period shall be proportionally reduced if the machinery is run for more than one eight hour shift per day.

No unauthorized alternation or modification has been made to the plant or machine or component the subject of the claim.

The new part will be delivered by **Pilot Crushtec (SA) (Pty) Ltd**, carriage paid to the customers nearest station in the RSA or F.A.S. port of exportation.

In case of parts or components not manufactured by **Pilot Crushtec (SA) (Pty) Ltd** the customer will be entitled to the benefits in so far as it may be transmitted to the customer, of any guarantees given by the manufacturer in respect thereof and **Pilot Crushtec (SA) (Pty) Ltd** liability in respect of such goods is limited to making the benefits of the manufacturers guarantees available to the customer to the extent aforesaid.

This understanding is in lieu of and excludes any other conditions guarantees, or warranties expressed or implied, statuary or otherwise. In no event shall **Pilot Crushtec (SA) (Pty) Ltd** be liable (except to the extent if any of its undertaking as aforesaid) for any loss injury or damage howsoever caused or arising.

The guarantee contained aforesaid hereof is personal to **Pilot Crushtec (SA) (Pty) Ltd** customer and may not be assigned.

ANNEXURE A

FITTING TAPER-LOCK BUSHES

1. Firstly ensure that the mating taper surfaces are completely clean and free from oil and dirt. Insert the bush in the hub and line the holes up. Oil the thread and the front end of the grub screws sparingly. Place screws in holes threaded in hub shown thus in illustration.

2. Clean shaft and fit hub and bush to shaft as a unit. Locate it in the desired position remembering that the bush will nip the shaft first and only then will the hub be drawn slightly onto the bush

3. Using an Allen (hex) key tighten the screws gradually and alternately until all are pulled very tight.

4. Using a block or sleeve to prevent damage, hammer against the large end of the bush to ensure that the bush is seated squarely in the bore. The screws should now turn a little more. Repeat this operation once or twice to ensure maximum grip on the shaft.

5. Use a parallel key which is side fitting with top clearance if a key is used.

6. Stop the drive after a while running under load and check the screws for tightness.

7. Fill empty holes with grease to prevent dirt build-up.

Insert bush into flange

Insert screws and locate on shaft

Tighten screws finger tight

Tighten screws alternately

REMOVING TAPER-LOCK BUSHES

1. Slacken all screws by several turns. Removing holes are shown as follows.

Insert the required amount of grub screws (one or two depending on the type of bush) in the removing holes. Remember to oil the thread and the point thereof first.

2. Tighten screw(s) alternately until the bush is loosened in the hub and free from the shaft.

3. Remove the assembly from the shaft.

To remove

BOND Equipment

10Ton Mobile DMS Plant

Centrifugal Pump

ETA

FLANGE DETAIL	ITEM	DESCRIPTION	WEIGHT	DATE:	17/06/2004	SCALE: N.T.S.
Suction Flange 125mm DIN 2533/16	PUMP	ETA 100-400	159	KSB PUMPS (SA)(PTY)LTD TEL: +2711-876-5600 FAX +2711-822-2013		GENERAL ARRANGEMENT
	MOTOR	30kW 4 Pole - 200L	240			
Discharge Flange 100 mm DIN 2533/16	BASEPLATE	1550 X 620 X 152	69.5			
	COUPLING	F80 FF 42x55	9.8		DRAWING NO: E 10318	REV NO: 1
	GUARD	254dia X 244Lg	0.5			

MAR.29.2006 15:15 01182220113 KSB PUMPS

Operating Instructions

Low Pressure Centrifugal Pumps ETA

with hydraulics and main dimensions according to DIN 24 255

Low Pressure Centrifugal Pumps ETA

with hydraulics and main dimensions according to DIN 24 255

Works Serial No.

KSB PUMPS (SA) (PTY) LTD. (Reg. No. 1959/0004476/07)
Cor. North Reef and Activia Roads, Activia Park, Germiston
P.O. Box 2938, Primrose 1416
Telephone: (011) 876-5600
Telefax: (011) 822-2013
e-mail: pumpsales@ksbpumps.co.za

J/1162,8 E

Introduction

Meticulous care and continuous manufacturing inspection controls go into the manufacture of KSB products; therefore, they will always give you reliable and satisfactory service, provided that they are erected, maintained and operated carefully and correctly.

In order to ensure trouble-free operation, the instructions and recommendations contained in this booklet should be carefully followed. It is therefore essential that every person concerned with the erection and operation of the pump should be thoroughly familiar with the contents of this booklet in good time, i.e. prior to erection and commissioning. It should therefore be readily available to all personnel concerned with the erection, maintenance and operation of the pump.

Please make sure to check every item of the consignment immediately after receipt, to ascertain that no damage has occurred during transit, and that every item has been received. Any damage should be reported immediately in writing to the consignor (Works, Forwarding Agent etc.), giving the necessary details and documentation. Please handle all pump components most carefully, and avoid any damage to threads and machined surfaces.

Remember that every part has been manufactured with the greatest care and precision, and will only give reliable service if it is in perfect condition. If the instructions contained in this operating manual are duly observed, you will be covered by the guarantee contained in our Conditions of Supply and in our Confirmation of Order. Our guarantee will however become void if:

the machine is used to pump different fluids, fluid concentrations, or fluids at different temperatures and performance ranges that those specified in our Confirmation of Order;

any damage results from improper manipulation or operation,

the use of unsuitable operating materials, faulty erection, unskilled or faulty laying of the piping etc.

During the period of validity of our guarantee, any dismantling of the pump or of its individual components should only be carried out after having obtained our previous consent in writing. We cannot accept responsibility for any damage resulting from the failure to observe the instructions contained in this manual.

The rating plate features the principal operating data of the pump, and its Works **serial number; this number should be quoted in all correspondence concerning the pump, particularly when ordering spare parts or replacements.**

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1. Description of Pump

The construction of the pump is illustrated in the sectional drawings on pages 27 to 30. The ETA pump is a single-stage, single-entry, volute casing pump with an end suction nozzle and a radial discharge nozzle.

The one piece volute casing is flanged onto a sturdy bearing bracket. The pump rotor can be withdrawn through to the back so that the casing need not to be disconnected from the piping in case of repair work. If a spacer coupling is fitted, the driving motor can also remain in position on the baseplate during repairs. The shaft is sealed by a soft-packed stuffing box or alternatively, by a mechanical seal. The shaft is supported by two grease lubricated deep groove ball bearings. The inner faces of the bearings are sealed by a sealing ring known as a Nilos Ring. Oil lubrication is available if required. In that case the bearings are not sealed and the bearing pedestal is equipped with an oil dipstick.

If the operating temperature of the fluid pumped exceeds 105°C (220°F), up to 160°C (320°F) max., the stuffing box is cooled, and a cooling compartment cover is provided for this purpose.

2. Erection

2.1 Installation and Alignment of Pumping Set

If we supply the motor and baseplate together with the pump, the pump and motor are aligned at our Works on the baseplate before despatch. This allignment is to be rechecked after installation.

The baseplates of ETA pumps are made of structural steel section.

If a concrete foundation is used, make sure that it has firmly set and is completely dry before placing the pump on it. The baseplate should be levelled up with the aid of a spirit level. If necessary, use shims or wedges to level it up true.

With a welded steel plate, this should, after aligning, be grouted with a quick-setting cement mixture. Great care must be taken that all sections are completely filled with the cement mixture, leaving absolutely no cavities. The foundation bolts should be tightened firmly and evenly after the concrete has set firmly. When the piping is connected to the pump, make sure that it does not transmit any stresses or strains onto the pump nozzle. After completion of this work, the coupling alignment should be carefully checked, and if necessary the set should be re-aligned (on the motor) (See 2.2.).

This is necessary even in those cases where a complete set consisting of pump, motor and combined baseplate was supplied by us, already aligned at our Works, because a combined baseplate cannot for economic reasons be designed heavy and rigid enough to prevent possible warping or distortion during transport, or if it is placed on an uneven foundation. When erection is completed, it must be possible to rotate the rotating assembly easily by hand at the coupling. Faulty erection soon reveals itself in the shape of operating troubles and premature wear of the pump internals.

In cases where the driver is not supplied by us, the same sequence of erection work as described above should be followed when installing the driver.

In order to achieve practically silent running and to avoid the transmission of vibration and noise to the entire piping system, it may be necessary to mount the baseplate on metal vibration dampers (resilient mounting) and to fit compensators between the pump and the suction or discharge lines.

2.2. Fitting the flexible Coupling

Direct-driven pumps are connected to their driver by a flexible coupling (Figures 1 and 2).

The pump and driver shafts must be carefully aligned, because any shaft misalignment will rapidly lead to disintegration of the flexible transmission members of the coupling, and will also damage the pump. The set can be considered correctly aligned if a straight edge placed over the two coupling halves, parallel to the shaft, maintains the same distance from the shaft at all points around the periphery. Furthermore, the gap between the two coupling halves must remain the same at all points around the periphery.

This should be checked by means of a feeler gauge or a gauge block (Figure 3). On request, we can lend or supply a special alignment jig, which enables the alignment to be effected quickly and very acurately (Figure 4). When signs of wear become apparent on the flexible membrane packs, after prolonged operation, these components should be replaced by new ones in good time.

Fig. 1
Typical Flexible Coupling

Fig. 2
Typical Flexible Coupling
(with spacer sleeve)

Fig. 3 Aligning the coupling with the aid of a gauge block and a straight edge

Fig. 4
Coupling alignment jig

Fig. 5
Dismantling the coupling

To pull off the coupling, the driver must first be removed from the pumping set. If the set is provided with a spacer-type coupling (Figure 2), there is no need to remove the driver from the baseplate for repairs to the pump. This also avoids the time-wasting necessity of re-aligning the motor after repairs. The coupling can be pulled off by means of a conventional wheel puller or extractor (Figure 5). It should not be driven off the shaft by hammer blows, as this might damage the pump bearings.

Check direction or rotation. For this purpose, switch on the set for a short instant only, against a closed discharge valve, then switch it off again immediately. Observe the behaviour of the shaft while it is running down to a standstill.

2.3 Shaft Seal

2.3.1. Soft packed stuffing box

The pumps are usually despatched from our Works with the stuffing box already packed. On request, they can be despatched with an unpacked stuffing box; in this case, one set of stuffing box packing is supplied loose with the pump.

The stuffing box execution will depend in each case on the special operating conditions which prevail.

2.3.2 Stuffing box construction

2.3.2.1. Uncooled stuffing box (N)

Construction N/a

Application: For clean fluids and suction lift operation, or for positive suction head operation at suction pressures not exceeding 0,5kp/cm^2 at pump suction nozzle.

Temperature range: Up to 105°C (220°F)
Sealing: Sealing by product pumped

Construction N/b

For positive suction head operation at suction pressures exceeding 0,5 kp/cm^2; also for fluids with an unpleasant odour (e.g. ammonia water; for petrol, benzol and lubricating oils, if the pump is installed in the open).

Up to 105°C (220°F)
No sealing fluid

Construction N/c

For fluids pumped out of vacuum vessels.

Up to 105°C (220°F)
Always use a sealing fluid from an outside source

2.3.2.2. Cooled stuffing box (HW)

Construction HW

7A	Cooling fluid outlet	Construction HW
7E	Cooling fluid inlet	Construction HW
8A	Leakage fluid drain	Construction VSM/b
10E	Sealing fluid inlet	Construction VSM/a, N/c
11E	Flushing fluid inlet	Construction VSH

Sealing or flushing fluid can be fed to the stuffing box.
The relevant connections are shown in the table of dimensions and on the sectional drawings.

Temperature range: 105 to 160°C (220 to 320°F)
Sealing: No sealing fluid
Cooling: Cooling fluid is fed to the stuffing box

2.3.2.3. Extra-deep stuffing box VSM and VSH

Construction VSM/a

Application: For clean fluids and operation under vacuum, in cases where contamination of the product pumped by the sealing fluid must be kept down to a minimum. This construction is also the standard construction for pure sugar juices.

Temperature range: Up to 105°C (220°F)
Sealing: Sealing fluid fed to stuffing box

Construction VSM/b

For products with a positive suction pressure of at least 1 kp/cm^2 abs., in cases where the stuffing box leakage must be trapped upstream of the exit (solvents of all kinds, ammonia, petrol, kerosene). The leakage fluid is led through the lantern ring to the exterior and is collected in closed vessels.

Up to 105°C (220°F)
Leakage fluid led away

Construction VSH

For fluids containing abrasive particles, where the shaft and stuffing box packing must be protected against the abrasive action of the fluid pumped (e.g. untreated river water).

Up to 105°C (220°F)
Sealing fluid fed to stuffing box

2.3.3. Mechanical Seal

The mechanical seal consists essentially of two rings in close rubbing contact, which are pressed against one another by a spring. These rings are sealed respectively from the shaft or shaft protecting sleeve and from the stuffing box housing by O-rings.

As mechanical seal variations are extensive, details can only be supplied once the mechanical seal has been finalized and detailed in our order confirmation.

2.4. Connecting Piping

Fig. 6 Correct laying of suction lift line

1. A concentric reducer promotes the formation of air pockets, therefore use an eccentric reducer; fitted belly down.

2. An isolating valve with its stem pointing vertically upwards also promotes the formation of air pockets, therefore fit the valve with its stem horizontal (the valve in the suction lift line must always be kept in fully open position when the pump is running).

3. The suction lift line should rise towards the pump at a steady incline.

4. Only use standard pipe bends, avoid all sharp bends.

5. Make sure that the suction strainer basket is installed as low as possible, to prevent any air being entrained at low water levels.

2.4.1 Suction lift line and positive suction head line

Trouble-free operation of the pump depends on the correct laying of the suction lift line. It must be absolutely leaktight, and should not present any features tending to promote the formation of air pockets. It should be laid with a steadily rising incline towards the pump.

If the suction lift line has a larger diameter than the nominal size of the pump suction nozzle, an eccentric reducer, fitted belly down, should be used to connect the horizontal portion of the line to the pump nozzle (Fig. 6, Item 1).

The suction mouth (foot valve) should be installed at a sufficient depth beneath the lowest water level to avoid the possibility of any air being entrained into the pump. On the other hand, the suction mouth should not be situated too close to the floor of the pit, otherwise sand or mud will be stirred up and entrained into the pump. resulting in premature wear and clogging of the pump. The nominal size of the pump suction flange is no guide to the correct size of the suction lift line. The flow velocity in the suction lift line should preferably not exceed 2 metres per second (6.5 feet/second). It is generally preferable to provide an individual suction lift line for each pump. If this is not possible for practical reasons, the common suction line should be sized for as low a velocity as practicable, and its nominal size should preferably remain constant right up to the last pump on the line (Figures 7a and 7b).

Fig. 7a

Fig. 7b
Connection of several pumps to a com-con suction lift line
a) Correct b) wrong

All sharp bends, sudden and abrupt changes of cross-section and direction must be avoided at all costs. Make sure that the flange gaskets do not protrude inside the pipe.

If no vent pump is provided for the suction lift line, the latter should be sealed at it extremity by a foot valve. The foot valve is ussualy with a suction strainer basket, which prevents foreign matter from penetrating inside the pump.

If the suction line is laid in an underground trench, it should be hydrostatically tested at 3 to 4 kp/cm^2 (40 to 60 PSIG) before being buried. If an isulating valve is incorporated in the suction lift line, its stem should be horizontal or point vertically downwords, to prevent the formation of air pockets. It is advisable to install an isolating valve with a sealing water connection or a water seal.

If the pump operates on a positive suction head, the positive suction head line should be laid with a slight and steady downward incline towards the pump, to avoid the formation of air pockets.

As regards the other aspects of the laying and features of positive suction head lines, the same considerations apply as for suction lift lines.

Positive suction head lines should preferably incorporate an isolating valve, so that the pump can be isolated from its source of supply in the event of checks or repairs.

Isolating valves in suction lift lines and positive suction head lines are solely intended to isolate the line. They must always be kept fully open when the pump is running.

2.4.2. Discharge line

The nominal size of the pump discharge nozzle is no guide to the correct size of the discharge line. The flow velocity in the discharge line should not exceed 3 metres/second (10 feet/second). Sharp bends and branches in the discharge line should preferably be avoided. If the discharge head exceeds 15 metres (50 feet) or if the discharge line is of appreciable length, a non-return valve should be incorporated in the line. This valve will absorb any water hammer created when the pump is suddenly switched off, and thus protect the pump and the foot valve. It is also advisable to fit a valve in the line, in order to adjust the desired operating point capacity and if necessary to prevent overloading the driver.

2.4.3. Vacuum balance line

If the product is led to the pump from a vessel under vacuum – as in the case of condensate pumps, for example – it is advisable to install a vacuum balance line, as illustrated in Figure 8, especially if the positive suction head is low. The air and gas bubbles entrained with the product can then be evacuated through this vacuum balance line. It should be connected as close as possible to the entry of the pump impeller, and lead back to the apex of the vacuum vessel. Its internal diameter will depend on the capacity of the pump, and is usually between 25 and 50mm diameter.

Figure 8
Vacuum balance line

The apex of the pump casing (vent boss 6D) should be connected by a short line to the vacuum balance line, in order to vent the pump before start-up. After venting, the vacuum-tight isolating valve E in this connecting line must be closed before start-up. The main isolating valve A in the vacuum balance line must always be kept fully open while the pump is running, and only be closed when the pump is shut down.

2.5. Commissioning and Start-up

Check that the stuffing box is tightened lightly and evenly. Excessive tightening, tightening askew, will cause the shaft to run hot, and may damage the shaft or the shaft protecting sleeve. On small pumps with a low absorbed horse power, excessive tightening of the gland may result in overloading the driver. Rotate the shaft by hand, to check that it runs without excessive resistance.

Close the isolating valve in the discharge line of the pump completely, and open the isolating valve in the suction lift line or positive suction head line fully.

In the case of positive suction head lines, check the pressure in the line. Prime the pump and the suction lift line (if applicable) with the fluid pumped. During priming, rotate the pump shaft repeatedly by hand. Priming is effected either through the priming funnel (with valve), through the priming opening, or with the aid of a special vent pump. In certain cases, priming can be accomplished with water from the discharge line, after opening the by-pass line on the non-return valve. In this event, make sure that the suction strainer basket and the suction lift line are not subjected to an excessive pressure. The pump must also be vented in this case. Pumps fitted with a mechanical seal must under no circumstances be started up without being fully primed beforehand with liquid, not even for checking purposes, as this would damage the mechanical seal.

If the pump is fitted with a cooled stuffing box, turn on the cooling water and check that it runs away freely. If the stuffing box has a sealing fluid or flushing fluid supply from an outside source, open the relevant sealing fluid line and check the flow.

Check direction of rotation. To do this, switch on driver for a short instant only, with the discharge valve closed, then switch it off again immediately. Observe the shaft rotating to a standstill. Make sure that the direction of rotation is correct (in accordance with the arrow). In automatic pumping installations, it is only necessary to start the set against a closed discharge valve on the first start-up (i.e. on commissioning). After the pump has attained full rotational speed, open the discharge valve slowly until the specified discharge pressure is attained on the pressure gauge. Opening the discharge valve beyond this point may result in overloading the driver. When adjusting the operating duty point, it is advisable to watch the ammeter, to ensure that the permissible current consumption is not exceeded.

With the stuffing box gland tightened lightly, there will be appreciable leakage at first, after commissioning. If this leakage does not cease of its own accord after a certain time, the nuts of the stuffing box gland studs should be tightened slowly and evenly on both sides while the pump is running, until the stuffing box only drips slightly.

If the stuffing box does not drip at all, or starts to smoke, the nuts should be slackened slightly. Every newly-packed stuffing box needs a certain running-in period before it beds down, and it should be kept under observation during this period.

2.6. Shutdown

Close isolating valve in the discharge line.
If applicable, close vacuum gauge cock on suction side of pump.
Switch off driver, and observe pump shaft running evenly to a standstill.
If applicable, turn off cooling water.
If applicable, turn off sealing or flushing fluid supply.

Note: The stuffing box of condensate pumps which receive their operating fluid under vacuum must be supplied with sealing water even when the pump is shut down.

3. Supervision during Operation and Maintenance

3.1. General Supervision

Every pump and driver should be carefully supervised during operation. The following points should be kept under observation, as far as the pump is concerned:

The pump should run quietly, smoothly and without vibration at all times. The water level in the suction pit or suction vessel, and the pressure at the pump suction nozzle should be checked at intervals.

The load on the pumping set should be checked by comparing the actual pump discharge pressure or the current absorbed by the motor with the operating data stamped on the rating plate at regular intervals.

The stuffing boxes should be observed, particularly during the running-in period (see 3.3.1.).

If the pump has a cooled stuffing box, check that the cooling water runs away freely. A 10°C (18°F) temperature differential between outlet and inlet of the cooling water is normal.

If standby pumping sets are installed, it is advisable to operate them on a rota system, or at intervals, thus ensuring that they will always be in good condition for instant start-up if required. The shafts of standby pumps should also be rotated by hand at regular intervals.

3.2. Maintenance of Bearings

If the deep groove ball bearings are oil lubricated, the pump is despatched from our Works without oil. The oil is to be of good quality and manufactured by a recognised oil company. This oil should conform to SAE30 or recognised equivalent, for operating temperatures which fall below freezing, refer back to our Works for recommended lubricant.

If the operating conditions are arduous, the bearings should be checked once a year. For this purpose, the bearings are dismantled together with the shaft, and cleaned. After cleaning and assembly new oil must be used.

The deep groove ball bearings are packed with grease at our Works before despatch, and this initial grease fill should be adequate for 15 000 hours of operation, ie. 2 years. Grease nipples are provided on gearing covers for purpose of lubrication during operation.

A good quality lithium soap ball bearing grease should be used for this purpose. It should be free of resin and acid, should not solidify or crumble, and should act as a rust preventive. It should have a penetration number between 2 and 3, corresponding to a worked penetration of 220 to 295mm/10. Its drop point should exceed 175 °C (350 °F). During operation, the bearing temperature and quietness of running should be kept under observation.

The bearing temperature may be allowed to rise up to 50 °C (90 °F) above the surrounding room temperature, but should not exceed a maximum of 80 °C (175 °F).

3.3. Maintenance of Shaft Seal

3.3.1. Soft-packed stuffing box

The stuffing box should drip slightly during operation. If it starts to smoke, or does not drip at all, the nuts on the gland studs should be slightly slackened.

After the packing has been compressed by the width of one packing ring approximately (by repeated tightening of the gland nuts) it is time to renew the packing. On this occasion, the condition of the shaft or of the shaft protecting sleeve should be checked; if the surface shows signs of pronounced grooving or surface roughness, a new shaft or shaft protecting sleeve should be fitted. It is particularly important to fit packing material of the correct dimensions (see Fig. 11, page 15). An adequate stock of spare packing should preferably be kept in store.

3.3.1.1. Packing the stuffing box

The stuffing box can only give satisfactory and trouble-free service if it is carefully packed and correctly maintained. Before packing or re-packing, the packing compartment and the shaft or the shaft protecting sleeve should be thoroughly cleaned. The packing rings must be cut cleanly at either end with a scarf joint (Fig. 9a) after picking off their correct length from the pump shaft; alternatively, a piece of pipe or round wood having the same diameter as the pump shaft can be used, and the rings cut as shown in Figure 9b. The ring butts of each packing ring should press lightly against each other when the ring is wrapped around the shaft.

Figure 9 a

Figure 9 b

Before insertion in the packing compartment, the packing rings should be thoroughly soaked in oil.

Each individual ring is pushed in place with the aid of the stuffing box ring. The ring butts of adjoining packing rings should be offset 90° to one another (see Fig. 10). The location of the lantern ring in relation to the packing rings is indicated on an indicator plate (see also "stuffing box constructions" page 7). The packing rings and lantern ring must always be inserted in the sequence shown on this plate. No indicator plate is affixed to pumps which do not have a lantern ring. In order to prevent the possibility of the stuffing box gland being tightened askew, a gap of at least 4 mm (5/32") should be left at the end of the compartment after insertion of the last packing ring, to positively guide the stuffing box ring. The nuts on the stuffing box gland studs should be tightened lightly and evenly.

Fig. 10
Off-setting and packing rings

3.3.1.2. Packing compartment of stuffing box

Dimensions in mm

Pump size	Shaft-unit	Packing compartment of stuffing box a Ø	b Ø	c	Packing-ring
40-200	25	30	46	51	8 x 126
40-250	25	30	46	51	8 x 126
40-315	35	40	60	64	10 x 165
50-200	25	30	46	51	8 x 126
50-250	25	30	46	51	8 x 126
50-315	35	40	60	64	10 x 165
65-200	25	30	46	51	8 x 126
65-250	35	40	60	64	10 x 165
65-315	35	40	60	64	10 x 165
80-200	35	40	60	64	10 x 165
80-250	35	40	60	64	10 x 165
80-315	35	40	60	64	10 x 165
80-400	45	50	70	64	10 x 196
100-200	35	40	60	64	10 x 165
100-250	35	40	60	64	10 x 165
100-315	35	40	60	64	10 x 165
100-400	45	50	70	64	10 x 196
125-200	35	40	60	64	10 x 165
125-250	35	40	60	64	10 x 165
125-315	45	50	70	64	10 x 196
125-400	45	50	70	64	10 x 196
150-200	35	40	60	64	10 x 165
150-250	35	40	60	64	10 x 165
150-315	45	50	70	64	10 x 196
150-400	45	50	70	64	10 x 196

(see also section 6)

Fig. 11 Dimensions of packing compartment of stuffing box

3.3.2. Mechanical seal

A mechanical seal should be absolutely leaktight during operation of the pump. It may happen on occasion that a mechanical seal will drip in the initial phase after commissioning, but it will soon bed itself in.

Mechanical seals require no maintenance.

4. Operating Troubles: Causes and Remedies

4.1. Pump does not deliver rated Capacity

Possible Causes:	Remedy:
Excessive discharge pressure	Increase rotational speed. If this is not possible on an electrically driven pump, it may be necessary to fit an oversize impeller or to provide a larger pump. Please consult us first.
Pump incompletely primed	Prime the pump and piping again, and carefully vent them.
Suction line or impeller clogged	Clean out the suction line, and dismantle the impeller if necessary.
Formation of air pockets in the piping	Change piping layout, if necessary fit vent valves.
Available NPSH is too low (on positive suction head pumps)	Check liquid level in suction vessel; investigate piping to see if friction losses are excessive. Check that isolating valves in suction line are fully open, and lock them open if necessary.
Excessive suction lift on pumps operating with suction lift	Clean out suction strainer basket and suction pipe, and if necessary fit larger bore suction piping. Make sure that the foot valve opens to its full extent. Check liquid level in the pit.
Entrainement of air through the stuffing box	Increase sealing fluid pressure, check sealing fluid line for clogging if necessary arrange for sealing fluid supply from an outside source.
Reverse rotation	Cross over pole connections on the motor. If the pump has run in reverse rotation for some time, check that the impeller nut seats properly, and tighten it if necessary.

Possible Causes:	Remedy:
Rotational speed is too low	If the pump fails to deliver the required capacity at its full load rotational speed, it may be possible to correct this by fitting an oversize impeller. Failing this, a larger pump may have to be installed. If the pump is driven by an internal combustion engine, it speed can be adjusted within certain limits by adjusting the fuel supply on the governor.
Excessive wear of the pump internals	Open up the pump and check the clearances between components subjected to wear (casings and impeller); if necessary fit new components. The standard clearance between casings and impeller neck is 0.3 mm on the diameter.
4.2. Driver is overloaded	
Pump discharge pressure is lower than the figure specified at the time of the order	Gradually close the discharge valve until the pump discharge pressure corresponds with the figure specified in the purchase order. If the overloading persists, trim the impeller after having previously consulted us.
4.3. Excessive Pump Discharge Pressure	
Excessive rotational speed	Check speed accurately. If it is not possible to reduce the speed, the impeller should be trimmed after previously consulting us.
4.4. Leakage at Cooling Water Compartment	Shut down the pump, release the internal pressure and renew the O-rings after the pump has cooled down; to do this, dismantle the bearing bracket, impeller, stuffing box housing and cooling compartment cover.
4.5. Leakage at Stuffing Box	
Worn, unsuitable or badly fitted packing	Repack the stuffing box with fresh packing and use a suitable grade of packing.
Scoring or grooving of the shaft or shaft protecting sleeve, due to excessive tightening, or tightening askew of the stuffing box gland	The shaft or shaft protecting sleeve should be reground or replaced by a new one.
The pump runs rough, i.e. the shaft chatters	No stuffing box will remain leaktight for long if the shaft chatters. Check the shaft for true running.

Possible Causes:	Remedy:
4.6. Excessive Bearing Temperature	Check alignment at the coupling.
The pumping set is misaligned	Ensure that the piping transmits no stresses or strains onto the pump by altering the piping layout if necessary.
The piping causes the pump to warp	Realign the pumping set.
Excessive axial thrust caused by clogging of the balance holes or excessive wear of the casing/impeller wearing faces.	Clean out balance holes. Check clearances between casing impeller. (4.1.)
The prescribed coupling gap has not been observed (the motor exerts thrust on the coupling)	Restore correct coupling gap (For measurement see foundation drawing)
Too litle or unsuitable lubricant	Renew lubricant (see 3.2. Maintenance of bearings).
4.7. Freezing up of Pump Pump is not protected against frost	Precautions: Protect pump against frost. Failing this, drain pump completely after shutdown in cold weather. To do this, unscrew drain plug at bottom of volute casing.

5. Dismantling and Reassembly

Dismantling and reassembly should always be undertaken with the aid of the relevant sectional drawing. The sealing fluid or cooling water line connections should be disconnected.

The pump design enables the volute casing to remain in situ on the baseplate and connected to the piping during dismantling. If the set is provided with a spacer type coupling, the driving motor can also remain in situ on the baseplate.

The procedure described in the following paragraphs refers to complete dismantling and reassembly of the pump. Should a partical dismantling only be necessary for inspection purposes, or to replace certain components, then the relevant operations described below should be carried out as required.

5.1. Dismantling

1. If applicable, dismantle coupling spacer sleeve, otherwise (standard coupling) disconnect driving motor and remove it from the baseplate.

2. Unscrew casing stud nuts (see Fig. 12).

3. Pull off bearing pedestal together with stuffing box housing and complete rotating assembly (see Fig. 13).

4. Unscrew hexagonal nut (920.3). Remove spring washer (930) and washer (550 only on shaft units 20 and 25) and pull off impeller (240). Remove key (figs. 13 and 15).

5. Loosen stuffing box gland (452).

6. Push off stuffing box housing (451). On cooled stuffing boxes, remove the cooling compartment cover (165); do not damage the O-ring (Fig. 17).

7. Remove packing (461) and stuffing box gland (452).

8. Pull off shaft protecting sleeve (524) and thrower (507).

Fig. 12
Unscrewing the casing stud nuts

Fig. 13
Pulling off the pump casing from the bearing bracket

Fig. 14
Unscrewing the hexagonal nut

Fig. 15
Pushing off the impeller with the aid of two screwdrivers or similar tools

Fig. 16
Dismantling the stuffing box housing

Fig. 17
Loosening the bearing cover

9. Loosen both bearing covers (360) (Fig. 17).

10. Drive shaft (210) carefully out of the bearing pedestal (332) by gentle taps on the end of the stub shaft (Fig. 18). Pull off deep groove ball bearings (321) from the shaft. For this purpose, the bearings should first be heated up, taking care not to heat up the shaft as well.
Then the shaft is driven out of the bearing by gentle taps (see Fig. 19). On shaft unit 45 (see sectional drawing, page 29) the bearings are sealed by Nilos rings (500.1) only on grease lubricated units at their inner faces. These rings should also be removed.

After completion of dismantling, all dismantled components should be carefully cleaned and examined for signs of wear. Damaged or worn components should be touched up or replaced by new parts. Deposits on the impeller and the volute casing should be cleaned off.

Fig. 18
Driving the shaft out of the bearing pedestal

Fig. 19
Removing the ball bearing from the shaft.

5.2. Reassembly

Reassembly proceeds in reverse sequence to dismantling. The following points should be borne in mind:

All sealing elements (flat gaskets, O-rings, Nilos rings, if applicable) should be replaced by new ones, if damaged. If new deep groove ball bearings are fitted, they should first be heated in an oil bath to 80°C (175°F) approx., slipped onto the shaft, and if necessary driven against the shaft shoulder with the aid of a length of piping applied onto the inner race of the bearing (Fig. 20). The greatest cleanliness should be observed. The bearings should be packed with grease (see section 3.2.).

If the sealing gap between impeller neck and casing is worn, and the sealing gap clearance is consequently excessive, wear rings must be fitted in the volute casing and in the stuffing box housing.

Fig. 21 illustrated the fitting of a new casing wear ring. If necessary, the impeller should be touched up, and casing wear rings with an undersize bore should be fitted. The clearance in new condition between the casing wear ring and the impeller is 0.3 mm on the diameter. This operation is carried out on repair pumps only.

See relevant sections of this instruction book with regard to renewing the grease fill and the stuffing box packing and reassembly of the pumping set.

Fig. 20
Fitting a ball bearing

Fig. 21
Fitting a casing wear ring in repair pumps only

6. Bearing Sizes and Stub Shaft Dimensions

Stub shaft according to DIN 748
Key according to DIN 6885

Pump size	Deep groove ball bearing DIN 625, item No. 321	Stub shaft			
		Ø d k6	l	u	t
40-200	6305 C3	24	50	8	26,9
40-250	6305 C3	24	50	8	26,9
40-315	6307 C3	32	80	10	35,3
50-200	6305 C3	24	50	8	26,9
50-250	6305 C3	24	50	8	26,9
50-315	6307 C3	32	80	10	35,3
65-200	6305 C3	24	50	8	26,9
65-250	6307 C3	32	80	10	35,3
65-315	6307 C3	32	80	10	35,3
80-200	6307 C3	32	80	10	35,3
80-250	6307 C3	32	80	10	35,3
80-315	6307 C3	32	80	10	35,3
80-400	6409 C3	42	110	12	45,1
100-200	6307 C3	32	80	10	35,3
100-250	6307 C3	32	80	10	35,3
100-315	6307 C3	32	80	10	35,3
100-400	6409 C3	42	110	12	45,1
125-200	6307 C3	32	80	10	35,3
125-250	6307 C3	32	80	10	35,3
125-315	6409 C3	42	110	12	45,1
125-400	6409 C3	42	110	12	45,1
150-200	6307 C3	32	80	10	35,3
150-250	6307 C3	32	80	10	35,3
150-315	6409 C3	42	110	12	45,1
150-400	6409 C3	42	110	12	45,1

Dimensions in mm

These bearing references are for oil only, for grease the suffix RS is to follow C3 with the exception of 80-400, 100-400, 125-315, 125-400, 150-135, 150-400 where a nylos ring 6409 AV is required.

7. Protection of Pump during prolonged Shutdowns and Transport

If a pump is shut down for a prolonged period, it must be carefully protected. It should be completely dismantled and all components thoroughly cleaned and dried. Then it is reassembled (see page 21), and the suction and discharge nozzles should be blanked off by wooden covers, to prevent foreign bodies entering the pump. All open connections for cooling water should likewise be plugged. Any machined parts on the assembled pump which are exposed to atmosphere should be coated with a rust preventive varnish, or thoroughly oiled or greased.

If the pump is sent back to our Works for repairs, it should be completely drained first, and all the pipe connections and flanges carefully plugged or blanked off, as mentioned above. The pump should always be despatched in the fully assembled state, as the sealing faces of the individual components might otherwise be damaged in transit.

8. Spare Parts

It is advisable to keep the following components in stock, as they are needed as replacements when the pump is dismantled, or are required for maintenance purposes:

1	set of deep groove ball bearings (see page 24 for bearing sizes)	Item 321
1	set of Nilos rings (only on shaft unit 45) (only on grease lubricated units)	Item 500.1
1	set of flat gaskets	Items 400.1 and 400.2
1	complete set of stuffing box packing	Item 461
1	set of O-rings (only on HW (cooled) construction)	Items 412.1 and 412.2

It is also advisable to keep the following components, which are subject to wear, in stock:

1	complete rotating assembly, consisting of: Shaft, washer (only on shaft units 20 and 25), hexagonal nut, disc and keys	Items 210, 554, 922 and 930
1	impeller	Item 230
1	shaft protecting sleeve (only on shaft units 35 and 45)	Item 524

9. Sectional Drawings and Lists of Components

ETA pump with uncooled (N) and cooled (HW) stuffing box
(shaft units 20 and 25)

Pump size	Shaft unit
40-250	25
50-200	25
50-250	25
65-200	25

Impeller with balance holes for hydraulic balancing

Pump size	Shaft unit
40-200	25

Impeller with back vanes for hydraulic balancing

Part No.	Designation
102	Volute casing
165	Cooling cover
210	Shaft
230	Impeller
321	Deep groove ball bearing
332	Bearing pedestal
360	Bearing cover
400.1/.2	Flat gasket
412.1/.2	O-ring
451	Stuffing box housing
452.1	Stuffing box gland
457	Throat ring
458	Split lantern ring
461	Stuffing box packing
507	Thrower
524	Shaft protecting sleeve
550	Washer
920.3	Hexagonal nut
930	Spring washer
1 M	Pressure gauge
6 B	Draining
7 A	Cooling liquid outlet
7 E	Cooling liquid inlet
8 B	Leakage drain
10 E/	Sealing liquid inlet
11 E	Flushing liquid inlet

ETA pump with uncooled (N) and cooled (HW) stuffing box (shaft units 35 and 45)[1]

Pump size	Shaft unit
65-250	35
80-200	35
80-250	35
100-200	35
100-250	35
100-315	35
125-200	35
125-250	35
125-400	45
150-200	35
150-250	35
150-400	45

Impeller with balance holes for hydraulic balancing

ETA pump with uncooled (N) ano cooled (HW) stuffing box (shaft unit 35 and 45)[1] [2]

Pump size	Shaft unit
40-315	35
50-315	35
65-315	35

Impeller unbalanced

1) Only on sizes 80-400, 100-400, 125-315, 125-400, 150-200, 150-250, 150-315, 150-400 are pump feet integrally cast onto the volute casing.
2) Shaft protecting sleeves are also fitted to pump sizes 40-315, 50-315, 65-250 and 65-315.

ETA pump with uncooled (N) and cooled (HW) stuffing box
(shaft units 35 and 45)

Pump size	Shaft unit
80-315	35
80-400	45
100-400	45
125-315	45
150-315	45

Impeller with back vanes for hydraulic balancing

Part No.	Designation
102	Volute casing 1)
165	Cooling cover
210	Shaft
230	Impeller
321	Deep groove ball bearing
332	Bearing pedestal
360	Bearing cover
400.1/.2	Flat gasket
412.1/.2	O-ring
451	Stuffing box housing
452	Stuffing box gland
458	Split lantern ring
461	Stuffing box packing
507	Thrower
524	Shaft protecting sleeve
920.3	Hexagonal nut
930	Spring washer
1 M	Pressure gauge
6 B	Draining
7 A	Cooling liquid outlet
7 E	Cooling liquid inlet
8 B	Leakage drain
10 E/	Sealing liquid inlet/
11 E	Flushing liquid inlet

1) Feet are integrally cast to the volute casing of sizes 80-400, 100-400, 125-315, 125-400, 150-200, 150-250, 150-315 and 150-400.

2) Only for sizes with shaft unit 45.

CH Warman PUMP GROUP

WARMAN PUMPS

ASSEMBLY, OPERATING AND MAINTENANCE INSTRUCTIONS

PART 2A

SERIES 'A' SLURRY PUMPS
TYPE 'AH' AND 'M'

PC2A

WARMAN PUMPS

ASSEMBLY, OPERATING AND MAINTENANCE INSTRUCTIONS

PART 2A

SERIES 'A' SLURRY PUMPS TYPE 'AH' AND 'M'

Issue Date: 1 November 2000

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SAFETY INFORMATION

The following safety information relating to pump operation and maintenance should be carefully observed, and correct procedures followed, to avoid injuries to personnel, and damage to equipment. All statutory requirements relating to this equipment must be complied with at all times.

DO NOT APPLY HEAT TO THE IMPELLER HUB OR INLET EYE TO ASSIST IMPELLER REMOVAL. APPLICATION OF HEAT MAY RESULT IN SHATTERING OF THE IMPELLER , RESULTING IN INJURY OR EQUIPMENT DAMAGE.

DO NOT OPERATE THE PUMP FOR AN EXTENDED TIME WITH ZERO OR VERY LOW FLOWRATE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OVERHEATING OF THE PUMP, AND VAPORISATION OF THE PUMPED FLUID, WITH GENERATION OF VERY HIGH PRESSURES. SERIOUS INJURY TO PERSONNEL, OR DAMAGE TO EQUIPMENT MAY RESULT FROM SUCH ACTION.

CHECK DRIVE MOTOR ROTATION PRIOR TO FITTING OF DRIVE BELTS OR COUPLINGS. INCORRECT MOTOR ROTATION MAY CAUSE PERSONNEL INJURY OR EQUIPMENT DAMAGE.

DO NOT FEED VERY HOT OR VERY COLD FLUID INTO A PUMP AT AMBIENT TEMPERATURE. THERMAL SHOCK MAY RESULT IN FRACTURE OF PUMP WET-END PARTS.

A WARMAN PUMP MUST BE REGARDED AS BOTH AN ITEM OF ROTATING MACHINERY, AND A PRESSURE VESSEL. ALL RELEVANT SAFETY PRECAUTIONS AND PROCEDURES FOR SUCH EQUIPMENT SHOULD BE OBSERVED DURING PUMP INSTALLATION, OPERATION AND MAINTENANCE.

WHERE AUXILIARY EQUIPMENT IS ASSOCIATED WITH A PUMP (eg MOTORS, DRIVE BELTS, DRIVE COUPLINGS, SPEED REDUCERS, VARIABLE SPEED DRIVES, ETC), ALL RELEVANT INSTRUCTION MANUALS SHOULD BE CONSULTED, AND RECOMMENDED PROCEDURES IMPLEMENTED, DURING INSTALLATION, OPERATION AND MAINTENANCE OF THE PUMP SYSTEM.

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1. INTRODUCTION

This publication, **Part 2A**, forms part of a set which together comprise the Assembly, Operating, and Maintenance Instruction Manual for Warman Pumps, Type AH and M. Other publications in the set comprise the following:

Part 1: Assembly, Operating and Maintenance Instructions - General Instructions for all Types of Warman Pumps.

Part 3A, 3B or 3C - One of these publications, depending on the type of Bearing Assembly fitted, viz. Basic, Modified Basic, or Oil Filled.

Part 4A: Impeller Release Collar (if applicable)

2. APPLICATION AND FEATURES OF SERIES 'A' TYPE 'AH' AND 'M' SLURRY PUMPS

These pumps are of heavy-duty construction, designed for continuous pumping of highly abrasive and corrosive slurries. They feature a wide choice of replaceable abrasion resistant metal or moulded elastomer casing liners and Impellers, which are all interchangeable within a common casing assembly.

The pumps may be fitted with a range of seal types depending on the particular requirements, comprising the Warman centrifugal seal, a water flushed packed gland seal, and the Warman Dyna Seal. Third party mechanical seals may also be fitted where special sealing requirements favour this type of seal.

If problems are experienced during pump operation, reference should be made to the Fault Detection Chart in the Appendix. If operating problems are not rectified by following instructions in the Chart, assistance should be sought from the nearest C.H. Warman Group office, or its local representative.

Important design features of this range of Warman Slurry Pumps include:

- Cartridge type Bearing Assembly
- Split-tapered Impeller Release Collar on large pumps
- Heavy duty screw thread Impeller attachment
- Through-bolt design throughout
- Easily replaceable Shaft Sleeve
- Replaceable casing liners
- Minimum number of casing bolts

3. IDENTIFICATION OF PARTS

Each Warman pump part has a unique name and a three-digit Basic Part Number. Parts with the same name have the same Basic Part Number, regardless of pump size. For example, the Expeller of every Warman pump has the Basic Part Number 028.

Additional letters and numbers are added before and after the Basic Part Number to further define a component part of a particular pump, as described in Part 1 of the Assembly, Operating, and Maintenance Instruction Manual. This expanded marking is identified as the Part Number, and represents a unique identification for each component part. The Part Number is normally cast or otherwise prominently marked on each part.

For example, Part Number D3017M identifies the Cover Plate Liner to fit the casing of the 4/3D-AH Warman Pump.

Refer to the Component Diagram of the appropriate size of Warman Pump for complete identification and description of component parts. Part names and Basic Part Numbers are used in assembly instructions throughout this instruction manual. Warman Basic Part Numbers are listed in the Appendix of this publication.

In all communications with the C.H. Warman Group, or its representatives, and particularly when ordering spare parts, it is recommended that the correct component names and Part Numbers be used at all times to avoid supply of incorrect parts. The pump serial number should also be quoted if any doubt exists as to part identification.

4. BEARING ASSEMBLY - ASSEMBLY AND MAINTENANCE

The Bearing Assembly is assembled and maintained as described in the separate publication, Part 3A, 3B or 3C of the Instruction Manual, depending on the type fitted, as indicated in Section 1.

5. LUBRICATION - BEARING ASSEMBLY AND CENTRIFUGAL SEAL

It is recommended that grease used for lubricating both the rolling bearings, and the packed gland of the centrifugal seal, should have the following characteristics:

Lithium soap base grease with EP additives and oxidation inhibitors.

N.L.G.I. Consistency No:	2
Drop Point	> 170° C
Work penetration 25°C A.S.T.M.	265 - 295
RECOMMENDED GREASE:	**SHELL ALVANIA EP GREASE 2, CASTROL EPL2,** or equivalent

For detailed description of lubrication requirements for the rolling bearings, refer to the separate publication, Part 3 of the Instruction Manual as listed in Section 1, for the particular Bearing Assembly to be fitted to the pump.

The static seal chamber of centrifugally sealed pumps should be lubricated sparingly but regularly by means of the grease nipple fitted to the Expeller Ring. Several shots from a grease gun per 12 hours running time, based on mid range pump size, are recommended to form an adequate seal at the packing rings.

6. PUMP ASSEMBLY INSTRUCTIONS

Reference to a Component Diagram for the particular pump being assembled will be of assistance in following the instructions outlined in the following sections.

It should be noted that intake and discharge flanges on 10/8F-M, 10/8F-R, 12/10F-M, and 12/10F-R pumps are provided with 12 bolt holes in each flange. This is to provide for both 4 and 8 bolt flanges that are specified in different pump sizes, for which the Cover and Frame Plates are common to both sizes. The Type 'M' pumps, ie 10/8F-M and 12/10F-M, provide

for 8 bolts in the intake and discharge flanges, whereas the Type 'R' pumps, ie 10/8F-R, and 12/10F-R, provide for 4 bolts in both flanges, located in the "off-centreline" positions. Type 'M' and 'R' pumps of the same size use common parts for the Cover and Frame Plates.

All parts dismantled during pump overhaul should be inspected to assess suitability for re-use, and identification of new parts should be checked.

Parts suitable for re-use should be cleaned and painted. Matching faces should be free of rust, dirt, and burrs, and have a coating of anti-seize compound applied prior to assembly.

Small fasteners should preferably be replaced, and all threads coated with graphite grease before assembly.

Replacement of all elastomer seals is recommended at major overhauls, as these materials tend to deteriorate with use. Exposure to direct and continuous sunlight will accelerate material degradation.

6.1 FRAME ASSEMBLY

6.1.1 Fitting Bearing Assembly to Base - Refer Figs 1 and 13

Fig. 1 Frame Assembly

(i) Insert ADJUSTING SCREW (001) in BASE (003) from end face. Fix to Base by fitting one nut and fully tighten. Fit two additional nuts separated by two flat washers. These nuts should be loose on Adjusting Screw and spaced well apart.

(ii) Apply anti-seize compound to semi-circular machined surfaces (Bearing Housing support cradle) in Base.

(iii) Lower BEARING ASSEMBLY (005) into Base. Approximately match machined surfaces of the Bearing Housing with those in Base.
Ensure that the Bearing Housing lug has fitted over the Adjusting Screw mounted in the Base, and that it fits between the nuts and washers.

(iv) Fit CLAMP BOLTS (012) through Base from below. Mount CLAMP WASHER (011) on each bolt (domed side up) and screw on nuts.
Fully tighten Clamp Bolts on side 'A', i.e. on left hand side of Base as viewed from the Impeller end (refer Figs 1 and 13). Clamp Bolts on the other side (i.e. Side 'B') should not be tightened at this stage. Leave finger tight only, to maintain alignment but allow axial movement of the Bearing Assembly.

(v) Apply anti-seize compound to SHAFT (073) protruding from LABYRINTH (062) at Impeller end. This will assist fitting and removal of shaft components, and prevent damage to Shaft surfaces by moisture.

(vi) Fit two pieces of timber, or an appropriate assembly cradle, to underside of Base to prevent the pump from tipping forward during assembly of casing, as shown in Fig 2. Ensure that the Base is at a sufficient height above the floor to enable casing components to be assembled.

6.1.2 Fitting Frame Plate and Cover Plate Bolts - Refer Fig 2

(i) Fit FRAME PLATE (032) to Base, ensuring that the Frame Plate locating spigot engages with the corresponding Base recess. Before fitting Frame Plate, apply anti-seize compound to the recess to assist future dismantling.
On large pumps, Frame Plates are provided with radially tapped holes for eyebolts to assist lifting.

(ii) Insert FRAME PLATE STUDS (039) or FRAME PLATE BOLTS (034), depending on pump size. Fit nuts and fully tighten.
In some pumps the Frame Plate is bolted externally using studs. Some other pumps use bolts which are inserted from within the Frame Plate.
The Frame Plate can be rotated to provide eight alternative angular discharge positions, except for B Frame pumps, and the 3/2C-AH pump, where only 4 positions are provided.

(iii) **(a)** **Rubber Lined Pumps** - Fit COVER PLATE BOLTS (015) through Frame Plate lugs, screw on nuts, and torque all bolts evenly to value shown in Table 1. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure described in Appendix B.

Fig. 2 Fitting Frame Plate

(b) Metal Lined Pumps - Fit through Frame Plate lugs, only those COVER PLATE BOLTS (015) that will **NOT** engage lugs on outside of metal VOLUTE LINER (110) (check Volute Liner for positions of lugs), attach nuts, and torque all bolts evenly to values shown in Table 1, or as described in Appendix B, if a torque wrench is not available.

NOTE: *On some pumps, Cover Plate Bolts are fitted with KEEPER PLATES (081) that engage lugs on the outside of the Volute Liners. This applies to the 6/4 AH, 8/6 AH, 10/8 M, and 12/10 M pumps. These Cover Plate Bolts will be fitted later in the assembly.*

TABLE 1

TIGHTENING TORQUE FOR COVER PLATE BOLTS

PUMP SIZE	MINIMUM TORQUE (N m)
1.5/1 AH	50
2/1.5 AH	50
3/2 AH	50
4/3 AH	110
6/4 AH	220
8/6 AH	220
10/8 AH	570
12/10 AH	570
14/12 AH	950
16/14 AH	1500
20/18 AH	1500
10/8 M	220
10/8 F-R	220
12/10 M	220
12/10 F-R	220

6.2 SEAL ASSEMBLY

6.2.1 GLAND SEAL ASSEMBLY

- **Fitting Stuffing Box, Lantern Restrictor, (or Neck and Lantern Rings), Packing, Gland, Shaft Sleeve, Shaft Spacer, and Shaft Sleeve O-Rings**
- **Refer Figs 3 and 8.**

Alternative Stuffing Box assemblies, which may be used depending on the particular pump application, are shown in Fig 4. Gland Sealing Water flowrate may be minimized by using a non-metallic LANTERN RESTRICTOR (118-1), as shown in Fig 4b.

Alternative procedures are described below for assembling the seal components, which differ according to pump Frame size. Either method may be used according to individual preference.

Figure 3 shows the relative position of Impeller Release Collar, Shaft Spacer, Shaft Sleeve, O-Rings, etc, on the Shaft. The specific arrangement of these components on the Shaft may vary according to pump size. Table 2 lists the components assembled onto the Shaft, in the order in which they are fitted, commencing at the LABYRINTH (062) at the Impeller-end of the Bearing Assembly. Pumps having similar arrangements of parts are grouped together in the Table. Generally, pumps having Modified Basic Frames (CC, DD, etc) will have the same shaft components as those having Basic Frames (C, D, E, etc).

Fig. 3 Gland Seal assembly

Fig. 4 Alternative Gland arrangements for Stuffing Boxes

TABLE 2
GLAND SEAL - ORDER OF ASSEMBLY OF COMPONENTS ON SHAFT

FRAME	PUMP	SHAFT COMPONENTS (in order from Labyrinth to Impeller)	
B	1.5/1B-AH	109	Shaft O-Ring
C	2/1.5B-AH	075	Shaft Sleeve
	3/2C-AH	109	Shaft O-Ring
		117	Shaft Spacer
		217	Impeller O-Ring
C	4/3C-AH	109	Shaft O-Ring
D	4/3D-AH	075	Shaft Sleeve
E	10/8E-M & 12/10E-M	109	Shaft O-Ring
	6/4E-AH	117	Shaft Spacer
	8/6E-AH	064	Impeller O-Ring
D	6/4D-AH	109	Shaft O-Ring
F	8/6F-AH	075	Shaft Sleeve
G	10/8F-M & 12/10F-M	109	Shaft O-Ring
	10/8F-R & 12/10F-R		
	10/8G-AH & 12/10G-AH	117	Shaft Spacer
	14/12G-AH	109	Shaft O-Ring
F	10/8F-AH	109	Shaft O-Ring
	12/10F-AH	239	Impeller Release Collar
	14/12F-AH	109	Shaft O-Ring
		075	Shaft Sleeve
		FAM117	Shaft Spacer
		G109	Shaft O-Ring
		G117	Shaft Spacer
		G109	Shaft O-Ring
G	16/14G-AH	109	Shaft O-Ring
		076	Shaft Sleeve (long)
		109	Shaft O-Ring
G	20/18G-AH	109	Shaft O-Ring
		239	Impeller Release Collar
		109	Shaft O-Ring
		076	Shaft Sleeve (long)
		109	Shaft O-Ring
H	16/14H-AH	109	Shaft O-Ring
		239	Impeller Release Collar
		109	Shaft O-Ring
		075	Shaft Sleeve
		109	Shaft O-Ring
		117	Shaft Spacer
		064	Impeller O-Ring

6.2.1.1 Frames: B, C, D, E, F, CC, DD, EE, FF

Assemble components for Gland Seal Assembly as described below.

(i) Place STUFFING BOX (078) flat on bench, gland side up.

(ii) Place LANTERN RESTRICTOR (118) (large diameter up) in gland recess, to rest on retaining lip.
A NECK RING (067) is fitted in place of the Lantern Restrictor in some applications, as shown in Fig 4c.

(iii) Stand SHAFT SLEEVE (075, or 076) on end, and slide through Lantern Restrictor.

(iv) Fit the following items in turn:

(a) Fit first PACKING RING (111) of required length to fill the Stuffing Box annulus.

(b) Fit remaining Packing Rings (stagger joints) to almost completely fill the Stuffing Box chamber. Flatten each one separately.
NOTE - *When a NECK RING (067) is used, fit LANTERN RING (063) after first Packing Ring, and press down to compress packing. Fit remaining Packing Rings, taking care to stagger joints.*

(v) Assemble GLAND (044) halves, fit GLAND CLAMP BOLTS (126), and fully tighten. Place Gland in Stuffing Box, around Shaft Sleeve, and press down to compress Packing Rings. Fit GLAND BOLTS (045) and tighten just sufficiently to hold Shaft Sleeve (final adjustment will be made when test running pump). A cable tie may be used to secure bolts in position.

(vi) Determine which components fit between the LABYRINTH (062) and the SHAFT SLEEVE (075 or 076), from the pump Components Diagram, or from Table 2, for the particular pump being assembled. Fit these components to the Shaft. Refer to Part 4A of the Instruction Manual for details of fitting the IMPELLER RELEASE COLLAR (239), if required.

(vii) Fit the assembled Stuffing Box to the Frame Plate, tapping into position with a mallet. Locate Stuffing Box with Gland Seal Water connection at the top. LIFTING PLATE (310) should be used in fitting the assembled Stuffing Box to the Frame Plate on pump frames G, and larger, as shown in Fig 8.
If the Shaft Sleeve remains forward of its correct position, it should be pushed back until it is firmly in contact with other items assembled on the Shaft. Ensure that any Shaft O-Rings are correctly positioned in grooves.

(viii) Fit remaining O-Rings and Shaft Spacers as indicated in Table 2.

NOTE:

(a) Apply heavy grease to the O-Ring groove to assist in holding the O-Ring which seals against the back face of the Impeller.

(b) All O-Rings will be compressed and fully contained within their respective grooves when the Impeller is screwed on to the Shaft.

(ix) Apply anti-seize compound liberally to Shaft thread.

6.2.1.2 Frames: G, GG, H

Assemble components for Gland Seal Assembly as described below.

(i) Determine which components fit between the LABYRINTH (062) and IMPELLER, from the pump Components Diagram, or from Table 2, for the particular pump being assembled, and fit these components to the Shaft. Refer to Part 4A of the Instruction Manual for details of fitting the IMPELLER RELEASE COLLAR (239), if required.

NOTE:

(a) Apply heavy grease to the O-Ring groove to assist in holding the O-Ring which seals against the back face of the Impeller.

(b) All O-Rings will be compressed and fully contained within their respective grooves when the Impeller is screwed on to the Shaft.

(ii) Place LANTERN RESTRICTOR (118) (small diameter towards Impeller end) over Shaft Sleeve, and push against Bearing Housing.
In some applications, a NECK RING (067), and LANTERN RING (063) are fitted in place of the Lantern Restrictor, as shown in Fig 4c.

(iii) Attach LIFTING PLATE (310) to STUFFING BOX (078), using the 3 jacking screws provided, and ensure that the Gland Seal Water connection in Stuffing Box is in line with the Lifting Beam (see Fig 8).

(iv) Lift Stuffing Box with Lifting Plate, using a hoist, and insert Stuffing Box in Frame Plate, tapping into position with a mallet.

(v) Assemble all Gland parts in Stuffing Box in the following manner, after all other parts of pump have been assembled.

(a) Slide LANTERN RESTRICTOR (118) or NECK RING (067) inside Stuffing Box against retaining lip.

(b) Fit first PACKING RING (111) of required length to fill the Stuffing Box annulus, and push against the Neck Ring or Lantern Restrictor.

(c) Slide LANTERN RING (063) and press to flatten first Packing Ring. When a Lantern Restrictor is used, the Lantern Ring is omitted.

(d) Fit remaining Packing Rings (stagger joints) to almost completely fill the Stuffing Box chamber. Flatten each one separately.

(e) Assemble GLAND (044) halves over Shaft Sleeve with Gland spigot towards Stuffing Box, fit GLAND CLAMP BOLTS (126), and fully tighten. Fit Gland into Stuffing Box, and push down to compress Packing Rings. Fit Gland Bolts (045) and tighten sufficiently to remove slack (final adjustment will be made when test running pump).

(vi) Apply anti-seize compound liberally to Shaft thread.

TABLE 3

CENTRIFUGAL SEAL - ORDER OF ASSEMBLY OF COMPONENTS ON SHAFT (Special cases only - for other pumps refer to Table 2, and replace 117 Shaft Spacer with 028 Expeller)

FRAME	PUMP	SHAFT COMPONENTS (in order from Labyrinth to Impeller)	
D F	6/4D-AH 8/6F-AH	109	Shaft O-Ring
		075	Shaft Sleeve
		109	Shaft O-Ring
		028	Expeller
		064	Impeller O-Ring or 109 Shaft O Ring
C	4/3C-AH	109	Shaft O-Ring
		075	Shaft Sleeve
		109	Shaft O-Ring
		CAM117E	Shaft Spacer
		109	Shaft Spacer O-Ring
		D028	Expeller
		064	Impeller O Ring
E	8/6E-AH 10/8E-M 12/10E-M	109	Shaft O-Ring
		075	Shaft Sleeve
		109	Shaft O-Ring
		EAM117E	Shaft Spacer
		F109	Shaft Spacer O-Ring
		F028	Expeller
		109	Shaft O Ring
G	16/14G-AH 20/18G-AH	109	Shaft O-Ring
		239	Impeller Release Collar
		109	Shaft O-Ring
		075	Shaft Sleeve
		109	Shaft O-Ring
		028	Expeller
		109	Shaft O-Ring

6.2.2 CENTRIFUGAL SEAL ASSEMBLY

- **Fitting Expeller Ring, Neck Ring, Lantern Ring, Packing, Shaft Sleeve, Shaft Sleeve O-Rings, and Expeller**
- **Refer Figs 5, 6, and 8**

Either metal (029) or elastomer (029R) EXPELLER RINGS may be fitted to the pump. The gland of metal Expeller Rings is normally fitted with packing, whereas elastomer Expeller Rings should be fitted with lip seals only. Elastomer Expeller Rings are not suitable for use with packing, as lubrication is not provided, and the elastomer inhibits dissipation of heat generated by the packing.

Alternative assembly methods are described below for the centrifugal seal depending upon pump and frame size. The method used in a particular case may be varied according to individual requirements.

Figs 5 and 6 show typical assemblies of shaft components, indicating the relative position of parts on the pump Shaft, which varies according to pump size. Table 2 lists shaft components for a **gland sealed pump** in the order in which are fitted to the Shaft, commencing at the end face of the LABYRINTH (062) on the pump end of the Bearing Assembly. Pumps with similar sets of Shaft components are grouped together in the Table. Generally, in **centrifugally sealed pumps**, the same sets of component parts apply as for **gland sealed pumps**, except for substituting the EXPELLER (028) for the SHAFT SPACER (117). Exceptions to the general case are listed in Table 3.

Modified Basic Frames (CC, DD, etc) generally have the same sets of shaft components as the Basic Frames (C, D, etc)

6.2.2.1 Metal/Polyurethane Lined Expeller Ring (029) - refer Fig 5

The following instructions describe the procedure to pack the gland of the metal Expeller Ring, which differs according to the pump frame size.

(a) Frames: B, C, D, E, F, CC, DD, EE, and FF

(i) Place EXPELLER RING (029) flat on bench, gland side up.

(ii) Place NECK RING (067) in gland recess, to rest on retaining lip.

(iii) Stand SHAFT SLEEVE (075) on end, and slide through Neck Ring.

(iv) Assemble the following items in turn:

(1) Fit first PACKING RING (111) of required length to fill the packing annulus.

(2) Fit LANTERN RING (063), and press down to flatten first packing ring.

(3) Fit remaining Packing Rings, staggering joints, to almost completely fill the packing chamber. Flatten each ring separately.

(v) Assemble GLAND (044) halves, fit GLAND CLAMP BOLTS (126), and fully tighten. Place Gland in Expeller Ring, around Shaft Sleeve, and push down to compress Packing Rings. Fit GLAND BOLTS (045) and tighten just sufficiently to hold Shaft Sleeve (final adjustment will be made when test running pump).

(vi) Determine which components fit between the LABYRINTH (062) and the SHAFT SLEEVE (075), from the pump Components Diagram, or from Tables 2 and 3 for the particular pump being assembled. Fit these components to the Shaft. Refer to Part 4A of the Instruction Manual for details of fitting the IMPELLER RELEASE COLLAR (239), if required.

Fig.5 Centrifugal Seal assembly - Metal/Polyurethane Lined Expeller Ring

(vii) Apply anti-seize compound to Expeller Ring location recess in Frame Plate to assist future removal of Expeller Ring. Fit the assembled Expeller Ring to the Frame Plate, and tap into position with a mallet. Locate Expeller Ring with the grease inlet connection at the top. LIFTING PLATE (310) may be used in fitting the assembled Expeller Ring to the Frame Plate on the larger pump sizes, as shown in Fig 8.
If the Shaft Sleeve remains forward of its correct position, it should be pushed back until it is firmly in contact with other items assembled on the Shaft. Ensure that any Shaft O-Rings are correctly positioned in grooves.

(viii) Assemble remaining O-Rings and Shaft Spacers, which fit between SHAFT SLEEVE (075) and EXPELLER (028), as indicated in Tables 2 and 3.

(ix) Fit EXPELLER (028) to Shaft, and compress assembled parts.

(x) Fit O-Ring (109 or 064) to groove in Expeller.

NOTE:

(1) Apply heavy grease to the O-Ring groove to hold the O-Ring which seals against the back face of the Impeller.

(2) All O-Rings will be compressed and fully contained within their grooves when the Impeller is screwed to the Shaft.

(xi) Apply anti-seize compound liberally to Shaft thread.

(xii) Assemble gland lubricating parts, as follows, only when the pump assembly is otherwise complete.
Fit GREASE NIPPLE to Expeller Ring. Apply grease to Nipple with grease gun, to charge Lantern Ring cavity.
If requested, an optional GREASE CUP may be fitted in lieu of the Grease Nipple.
Fit GREASE CUP ADAPTOR (138) and GREASE CUP to Expeller Ring. Fill Grease Cup with recommended grease, and screw down to charge Lantern Ring cavity. Re-fill Grease Cup with grease.

(b) Frames G, GG, and H

(i) Determine which components fit between the LABYRINTH (062) and EXPELLER (028), from the pump Components Diagram, or from Tables 2 and 3, for the particular pump being assembled. Fit these components to the Shaft. Refer to Part 4A of the Instruction Manual for details of fitting the IMPELLER RELEASE COLLAR (239), if required.

(ii) Assemble LANTERN RING (063) followed by NECK RING (067) on Shaft Sleeve, and push against Bearing Assembly.

(iii) Fit EXPELLER RING (029) to EXPELLER RING LIFTING BEAM (310), using the three jacking screws, as shown in Fig 8. Ensure that grease inlet on Expeller Ring is in line with the Lifting Beam.

(iv) Apply anti-seize compound to Expeller Ring location recess in Frame Plate to assist future removal of Expeller Ring. Lift Expeller Ring, assembled to Lifting Beam, using a hoist, and fit to Frame Plate, tapping into position with a mallet.

(v) Assemble gland parts in Expeller Ring as described below, when all other pump assembly is complete.

(1) Slide NECK RING (067) along Shaft Sleeve into Expeller Ring gland recess, to rest on retaining lip.

(2) Fit first PACKING RING (111) of required length to fill the packing annulus, and push against Neck Ring.

(3) Slide LANTERN RING (063) on Shaft Sleeve, and press down to flatten first packing ring.

(4) Fit remaining Packing Rings (stagger joints) to almost completely fill the packing chamber, flattening each ring separately.

(5) Assemble GLAND (044) halves over Shaft Sleeve, with gland spigot towards Expeller Ring, fit GLAND CLAMP BOLTS (126), and fully tighten. Engage Gland in Expeller Ring seal annulus, and push down to compress Packing Rings. Fit GLAND BOLTS (045) and tighten just sufficiently to hold Shaft Sleeve (final adjustment will be made when test running pump).

(6) Assemble gland lubricating parts, as follows, only when the pump assembly is otherwise complete.
Fit GREASE NIPPLE to Expeller Ring. Apply grease to Nipple with grease gun, to charge Lantern Ring cavity.
If requested, an optional GREASE CUP may be fitted in lieu of the Grease Nipple.
Fit GREASE CUP ADAPTOR (138) and GREASE CUP to Expeller Ring. Fill Grease Cup with recommended grease, and screw down to charge Lantern Ring cavity. Re-fill Grease Cup with grease.

(vi) Assemble SHAFT O-RING (109) between SHAFT SLEEVE (075) and EXPELLER (028), as indicated in Tables 2 and 3.

(vii) Fit EXPELLER (028) to Shaft, and compress assembled parts.

(viii) Fit O-Ring (109 or 064) to groove in Expeller.

NOTE:

(1) Apply heavy grease to the Expeller O-Ring groove to hold the O-Ring which seals against the back face of the Impeller.

(2) All O-Rings will be compressed and fully contained within their grooves when the Impeller is screwed to the Shaft.

(ix) Apply anti-seize compound liberally to Shaft thread.

6.2.2.2 Elastomer Expeller Ring (029R) - refer Fig 6

The following instructions describe the procedure to assemble the Centrifugal Seal, incorporating an elastomer Expeller Ring. The procedure varies according to pump size.

(a) Pump Sizes 1.5/1 AH, 2/1.5 AH, 3/2 AH, and 4/3 AH

Expeller Ring Studs or Lipseal Glands are not required with these pump sizes.

Only two seals are required, and these are retained by recessed grooves moulded into the Expeller Ring.

(i) Place EXPELLER RING (029R) flat on bench, 'wet' side up, and fit two LIPSEALS (090) into the bore of the Expeller Ring. Use liquid soap or rubber lubricant to assist fitting if required.

Continue assembly from item (c) on following page

Fig. 6 Centrifugal Seal assembly - Elastomer Expeller Ring

(b) Other Pump Sizes

(i) Place EXPELLER RING (029R) flat on bench, 'wet' side down.

(ii) Fit two EXPELLER RING STUDS (079) in tapped holes in Expeller Ring, and fully tighten.

(iii) Fit two LIPSEALS (090) against retaining lip in gland recess, with Seal lips pointing towards Impeller, so that fluid pressure activates the Seals. Apply liquid soap or rubber lubricant to the periphery of the Seals to assist fitting if required. Note that LANTERN RING (063R) is only required in pump sizes 10/8, 12/10, and 14/12 AH.

(iv) Engage LIP SEAL GLAND (241) in Expeller Ring gland recess, fit nuts to studs, and fully tighten. Gland adjustment is not required.

(c) All Pump Sizes

(i) Determine which components fit between the LABYRINTH (062) and the SHAFT SLEEVE (075), from the pump Components Diagram, or from Tables 2 and 3 for the particular pump being assembled. Fit these components to the Shaft. Refer to Part 4A of the Instruction Manual for details of fitting the IMPELLER RELEASE COLLAR (239), if required.

(ii) Fit the assembled Expeller Ring over the Shaft Sleeve, into the Frame Plate, and tap into position with a mallet. Locate the Expeller Ring with Studs on horizontal plane. If the Shaft Sleeve remains forward of its correct position, it should be pushed back until it is firmly in contact with other items assembled on the Shaft. Ensure that any Shaft O-Rings are correctly positioned in grooves.

(iii) **For 10/8, 12/10, and 14/12 AH Pumps only** - Assemble gland lubricating parts, as follows, only when the pump assembly is otherwise complete.
Fit GREASE NIPPLE to Expeller Ring. Apply grease to Nipple with grease gun, to charge Lantern Ring cavity.
If requested, an optional GREASE CUP may be fitted in lieu of Grease Nipple. Fit GREASE CUP ADAPTOR (138) and GREASE CUP to Expeller Ring. Fill Grease Cup with recommended grease, and screw down to charge Lantern Ring cavity. Re-fill Grease Cup with grease.

(iv) Assemble SHAFT O-RING (109) between SHAFT SLEEVE (075) and EXPELLER (028), as indicated in Tables 2 and 3.

(v) Fit EXPELLER (028) to Shaft, and compress assembled parts.

(vi) Fit O-Ring (109 or 064) to groove in Expeller.

NOTE:

(1) Apply heavy grease to the Expeller O-Ring groove to hold the O-Ring, which seals against the back face of the Impeller.

(2) All O-Rings will be compressed and fully contained within their grooves when the Impeller is screwed to the Shaft.

(vii) Apply anti-seize compound liberally to Shaft thread.

6.2.3 DYNA SEAL ASSEMBLY

- **Fitting Expeller Ring, Shaft Sleeve, Shaft Sleeve O-Rings, Dyna Seal and Expeller**
- **Refer Figs 7 and 8**

Fig 7 shows a typical assembly of shaft components, indicating the relative position of parts on the pump Shaft, which varies according to pump size. Table 2 lists shaft components for a **gland sealed pump** which are fitted to the Shaft in order of assembly, commencing at the end face of the LABYRINTH (062) on the pump end of

the Bearing Assembly. Pumps with similar sets of Shaft components are grouped together in the Table. Generally, in **Dyna Sealed pumps**, the same sets of component parts apply as for **gland sealed pumps**, except for substituting the EXPELLER (028-20) for the SHAFT SPACER (117). Exceptions to the general case are listed in Table 3.
Modified Basic Frames (CC, DD, etc) generally have the same sets of shaft components as the Basic Frames (C, D, etc).

The following instructions describe the procedure to assemble the Dyna Seal to all applicable pump frame sizes, viz. B, C, D, E, F, G, CC, DD, EE, and FF, GG.

(i) Determine which components fit between the LABYRINTH (062) and the EXPELLER (028-20), from the pump Components Diagram, or from Tables 2 and 3 for the particular pump being assembled. Fit these components to the Shaft. Refer to Part 4A of the Instruction Manual for details of fitting the IMPELLER RELEASE COLLAR (239), if required.

Fig. 7 Dyna Seal assembly

(ii) Apply anti-seize compound to Expeller Ring location recess in Frame Plate to assist future removal of Expeller Ring. Fit EXPELLER RING (029-20) to the Frame Plate, and tap into position with a mallet. LIFTING PLATE (310) may be used in fitting the assembled Expeller Ring to the Frame Plate on the larger pump sizes, as shown in Fig 8. If the Shaft Sleeve remains forward of its correct position, it should be pushed back until it is firmly in contact with other items assembled on the Shaft. Ensure that all Shaft O-Rings are correctly positioned in grooves.

(iii) Place EXPELLER (028-20) flat on bench, with vanes up. Place DYNA SEAL (425) loosely in centre of Expeller, with part number markings up. Apply liquid soap or rubber lubricant to lower sealing land surface of Dyna Seal. Adjust angular position of Dyna Seal so that drive lugs projecting from periphery of Seal fit between Expeller vanes. Apply downward pressure on Dyna Seal to expand lower sealing land over matching conical surface of Expeller, and engage sealing land in locating recess in Expeller. If necessary apply load unevenly, at one point on Seal periphery, to locally engage sealing land in recess, and progress around seal to complete engagement.

(iv) Ensure that the Shaft Sleeve O-Ring at the end of the Shaft Sleeve is positioned in its locating groove.

(v) Apply liquid soap or rubber lubricant to inner conical sleeve surface of Expeller Ring. Place EXPELLER (028-20) on Shaft, and carefully apply axial force to back face of Expeller to expand Dyna Seal lip over Expeller Ring sleeve as the Expeller moves along the Shaft into contact with the end of the Shaft Sleeve.

Fig. 8 Pump assembly tools

(vi) Fit O-Ring (109 or 064) to groove in exposed face of Expeller.

NOTE:

(1) Apply heavy anti-seize compound to the O-Ring groove to hold the O-Ring which seals against the back face of the Impeller.

(2) All O-Rings will be compressed and fully contained within their grooves when the Impeller is screwed to the Shaft.

(vii) Apply anti-sieze compound liberally to Shaft thread.

6.2.4 MECHANICAL SEAL ASSEMBLY

Adaptor kits are available for fitting a number of third party mechanical seals to Warman Pumps. When fitting these seals, reference should be made to supplementary instructions for the particular seal being installed. Further details of third party Mechanical Seals, for which adaptor kits are available, may be obtained from the C.H, Warman Group.

6.3 PUMP CASING ASSEMBLY

Table 4 lists the type of pump casing liner configurations for the full range of pump sizes, for both Metal and Elastomer liners, and indicates the relevant section reference for assembly instructions. Liner fit-up is independent of FRAME size. Metal and Elastomer liners may be fitted interchangeably, and a mix of Metal and Elastomer liners is also possible. In these cases reference should be made to the relevant sections indicated in Table 4 for the particular liner combinations used.

TABLE 4
PUMP CASING ASSEMBLY

	ELASTOMER LINERS			METAL LINERS	
PUMP	**TWO PIECE Sect 6.3.1**	**THREE PIECE Sect 6.3.2**	**FOUR PIECE Sect 6.3.3**	**TWO PIECE Sect 6.3.4**	**THREE PIECE Sect 6.3.5**
1.5/1 AH	●			●	
2/1.5 AH	●			●	
3/2 AH	●			●	
4/3 AH	●			●	
6/4 AH		●			●
8/6 AH		●			●
10/8 AH		●			●
12/10 AH		●			●
14/12 AH			●		●
16/14 AH			●		●
20/18 AH			●		●
10/8 M		●			●
10/8 F-R			●		
12/10 M			●		●
12/10 F-R			●		

NOTE: ● indicates Standard Liner fit-up, and is independent of Frame size.

6.3.1 ELASTOMER LINERS - TWO PIECE

- **Fitting Frame Plate Liner, Impeller, Cover Plate Liner, and Cover Plate.**
- **Refer Fig 9.**

Fig. 9 Casing assembly with two-piece elastomer Liners

Pumps at the small end of the range have only two elastomer casing liners, comprising the Cover Plate Liner and Frame Plate Liner. In larger pumps, one or both of these liners are divided into two separate liners. Pumps having Two-Piece elastomer liners comprise **sizes 1.5/1 AH, 2/1.5 AH, 3/2 AH, and 4/3 AH.** The pump casing assembly, with Two-Piece elastomer liners, is described below.

(i) Fit FRAME PLATE LINER (036) as described below:

(a) Fit and tighten STUDS (026) to tapped bosses in Frame Plate Liner. If Studs are not square to the face of the Liner, screw a nut on the thread, and adjust by tapping lightly with a hammer.

(b) Lift Liner in position, lining up Studs with corresponding holes, and push into Frame Plate. Fit Nuts to Studs, and tighten finger tight plus a half turn (max).

(ii) Select the appropriate IMPELLER required for the pump assembly, and fit as follows:

(a) Place Impeller (thread up) on a flat surface, apply anti-seize compound to thread, and screw Impeller to Shaft.

(b) Fit SHAFT KEY (070) in Shaft keyway, and bolt SHAFT WRENCH (306) to Shaft, over key. While restraining Shaft with Wrench, and turning Impeller with a bar between vanes, firmly screw Impeller to Shaft, but do not overtighten. Ensure that the various O-Rings on the Shaft are not damaged, and are covered by adjacent parts

(iii) Fit COVER PLATE LINER (017), and COVER PLATE (013), as described below.

(a) Fit and tighten STUDS (023) to tapped bosses in Cover Plate Liners (3/2 AH and 4/3 AH pumps only). If Studs are not square to the face of the Liner, screw a nut on the thread, and adjust by tapping lightly with a hammer.

(b) Place Cover Plate Liner on a flat surface, intake flange up. Liberally apply liquid soap or rubber lubricant to the intake flange and intake surface of the Cover Plate.

(c) Place Cover Plate over Cover Plate Liner, lining up Studs with corresponding holes (3/2 AH, 4/3 AH pumps only), and push Cover Plate down until it engages firmly with the Liner. Place a small tyre lever, or similar, between intake surface and Liner, and lever flange out of Cover Plate intake. Fit Nuts to Studs, and tighten finger tight plus half a turn (max).

(d) Lift Cover Plate, with Liner fitted, and align holes with COVER PLATE BOLTS (015) assembled in the Frame Plate. Fit Nuts to Cover Plate Bolts, and tighten evenly, and in accordance with the tightening sequence indicated in Fig B of Appendix B, ensuring that Cover Plate lugs engage firmly with shoulders on Cover Plate Bolts.

(iv) Complete the assembly of gland parts in the Stuffing Box or Expeller Ring, as described in Section 6.2 (Seal Assembly).

(v) The pump is now ready for fitting of Joint Rings (refer 6.3.6) and Impeller adjustment (refer 6.4).

6.3.2 ELASTOMER LINERS - THREE PIECE

- **Fitting Frame Plate Liner, Impeller, Throatbush, Cover Plate Liner, and Cover Plate.**
- **Refer Figs 8, 10 and 13.**

Fig. 10 Casing assembly with three-piece elastomer Liners

Intermediate size pumps are fitted with three elastomer casing liners, comprising Frame Plate Liner, Cover Plate Liner, and Throatbush. Pumps having Three-Piece elastomer liners comprise **sizes 6/4 AH, 8/6 AH, 10/8 AH, 12/10 AH, and 10/8 M.** The pump casing assembly, with Three-Piece elastomer liners, is described below.

(i) For 10/8F-M pump only, fit SEAL HOLDER (143) as follows:
Fit and tighten SEAL HOLDER STUDS (144) to tapped bosses on Seal Holder. Lift Seal Holder, and position about Shaft axis with Seal Holder Studs adjacent FRAME PLATE (032), and aligned with holes in annular recess.
Push Seal Holder to engage outer diameter with corresponding diameter of annular recess in Frame Plate, with Studs engaging holes in recess.Fit STEPPED WASHERS (080) to Studs, screw on nuts, and tighten uniformly.

(ii) Fit FRAME PLATE LINER (036) as follows:

(a) Fit and tighten STUDS (026) to tapped bosses in Frame Plate Liners. If Studs are not square to the face of the Liner, screw a nut on the thread, and adjust by tapping lightly with a hammer.

(b) Lift Liner in position, lining up Studs with corresponding holes, and push into Frame Plate. Fit Nuts to Studs, and hand tighten sufficiently to hold Liner in its fitted position in the Frame Plate.

(c) Restrain Shaft with wrench, and fit LOCATING NUT (303) on Shaft thread, as shown in Fig 8. Manually adjust the radial position of the Frame Plate Liner so that its inner diameter is approximately concentric with the conical surface of the Locating Nut. Tighten all Studs or Bolts on Insert finger tight plus half a turn (max), and remove Locating Nut.

(iii) Fit IMPELLER as described below.

(a) Fit SHAFT KEY (070) in Shaft keyway, and bolt SHAFT WRENCH (306) to Shaft, over key. Ensure that CLAMP BOLTS (012) on Side 'B' of Base (refer Fig 13) are sufficiently tight to hold Bearing Assembly horizontal, but not lock it.

(b) Select IMPELLER, and apply anti-seize compound to thread. Lift Impeller, supported on a rope, with hoist, and screw to Shaft.

(c) While restraining Shaft with Wrench, turn Impeller with a bar between vanes, and firmly screw Impeller to Shaft. Ensure that the various O-Rings on the Shaft are not damaged, and are covered by adjacent parts

(iv) Fit COVER PLATE LINER (018), and THROATBUSH (083), as described below.

(a) 6/4 AH, 8/6 AH, 10/8 AH, and 10/8 M Pumps only.

In these pumps the LINER SEAL (124) is an integral part of the COVER PLATE LINER (018). Proceed with assembly as described below.

(1) Place COVER PLATE LINER (018) on a flat surface, peripheral sealing flange down, and position a timber spacer, of sufficient height to finish flush or slightly above the Liner, in the centre of the Liner. Place the THROATBUSH (083), intake end upward, on the timber spacer.

(2) Liberally apply liquid soap or rubber lubricant to the tapered periphery of the Throatbush, and the inner sealing lip of the Liner.

(3) Lift Liner and tilt to engage lip seal over one third of the Throatbush periphery. Insert a small tyre lever, or similar, with rounded edges, between Throatbush and Liner, and lift seal lip to engage upper surface of Throatbush. Ensure that the seal lip is uniformly engaged.
This operation should be carried out carefully to avoid damaging seal lip.
Continue assembly instructions at Section (iv) (a) (5), below.

(4) **For 10/8 AH pump only**, fit STUDS (026) to tapped bosses in Throatbush.

(5) **For all pumps, comprising 6/4 AH, 8/6 AH, 10/8 AH, 12/10 AH, and 10/8 M pumps,** lift COVER PLATE (013), intake flange upwards, and place over Throatbush and Liner, taking care to engage Studs in corresponding holes in Cover Plate, where applicable.

(6) **For 6/4 AH, 8/6 AH, and 10/8 M pumps only**, insert COTTERS (085) through slots in neck of Cover Plate, and tap carefully and evenly until the Throatbush is held firmly in the Cover Plate.

(7) **For 10/8 AH pump only**, screw Nuts to Studs in Throatbush, and tighten finger tight plus a half turn (max).

(b) 12/10 AH Pump only.

(1) Place COVER PLATE (013) on suitable supports on a flat surface, intake flange down, to keep flange about 25mm above surface.

(2) Fit VOLUTE LINER SEAL (124) to groove in Cover Plate, mounted flat face in, using contact cement adhesive if required.

(3) Fit THROATBUSH STUDS (026) to tapped holes in THROATBUSH (083), align Studs with holes in Cover Plate, and lower Throatbush into place in Cover Plate. Fit Nuts to Studs, and hand tighten.

(4) Fit and tighten COVER PLATE LINER STUDS (023) to tapped bosses in Cover Plate Liner. Fit Liner in Cover Plate, ensuring that Studs are engaged with corresponding holes in Cover Plate. Fit Nuts to Studs and tighten finger tight plus a half turn (max).

(5) Tighten Throatbush Studs (026) finger tight plus a half turn (max).

(v) Fit COVER PLATE (013).
Lift Cover Plate, with Throatbush and Cover Plate Liner fitted, and align holes with COVER PLATE BOLTS (015) assembled in the Frame Plate. Note that large Cover Plates are provided with radially tapped holes for eyebolts, to assist lifting. Fit Nuts to Cover Plate Bolts, and tighten evenly, and in accordance with the tightening sequence indicated in Fig B of Appendix B, ensuring that Cover Plate lugs engage firmly with shoulders on Cover Plate Bolts.

(vi) Complete the assembly of gland parts in the Stuffing Box or Expeller Ring, as described in Section 6.2 (Seal Assembly).

(vii) The pump is now ready for fitting of Joint Rings (refer 6.3.6) and Impeller adjustment (refer 6.4).

6.3.3 ELASTOMER LINERS - FOUR PIECE

- **Fitting Liner Seals, Frame Plate Liner Insert, Frame Plate Liner, Impeller, Throatbush, Cover Plate Liner, and Cover Plate.**
- **Refer Figs 8, 11 and 13.**

Fig. 11 Casing assembly with four-piece elastomer Liners

The larger size pumps are fitted with four elastomer casing liners, comprising Frame Plate Liner Insert, Frame Plate Liner, Cover Plate Liner, and Throatbush. Pumps having Four-Piece elastomer liners comprise **sizes 14/12 AH, 16/14 AH, 20/18 AH, 10/8 F-R, 12/10 F-R, and 12/10 M.** The pump casing assembly, with Four-Piece elastomer liners, is described below.

(i) **For 10/8F-R pump only,** fit SEAL HOLDER (143) as follows:
Fit and tighten SEAL HOLDER STUDS (144) to tapped bosses on Seal Holder.
Lift Seal Holder, and position about Shaft axis with Seal Holder Studs adjacent FRAME PLATE (032), and aligned with holes in annular recess.
Push Seal Holder to engage outer diameter with corresponding diameter of annular recess in Frame Plate, with Studs engaging holes in recess.
Fit STEPPED WASHERS (080) to Studs, screw on nuts, and tighten uniformly.

(ii) Fit VOLUTE LINER SEAL (124), FRAME PLATE LINER INSERT (041), and FRAME PLATE LINER (043) as follows:

(a) 14/12 AH, 16/14 AH, and 20/18 AH pumps only.

(1) Fit VOLUTE LINER SEAL (124) to groove in Frame Plate, mounted flat face in, using contact cement adhesive if required.

(2) Fit and tighten STUDS (026) to tapped bosses in FRAME PLATE LINER INSERT (041). If Studs are not square to the face of the Insert, screw a nut on the thread, and adjust by tapping lightly with a hammer.

(3) Suspend LIFTING TUBE (302) from a hoist (refer Fig 8). Stand Frame Plate Liner Insert on edge, and engage Lifting Tube in bore of Insert. Lift Tube with Insert attached, and slide tube over Shaft thread. Align Studs with holes, and push Insert against Frame Plate. Loosely fit nuts to Studs, and remove Lifting Tube.

(4) Fit and tighten FRAME PLATE LINER STUDS (023) to tapped bosses in FRAME PLATE LINER (043).

(5) Lift Frame Plate Liner with hoist, and place in position with Studs aligned with holes in Frame Plate. Push Liner onto Frame Plate to engage Studs with holes, and fit nuts.

(b) 10/8 F-R, 12/10 F-R, and 12/10 M pump only.

(1) Lift FRAME PLATE LINER (043) with hoist, and fit to Frame Plate. Apply liquid soap or rubber lubricant to inner surface Liner which engages with Frame Plate Liner Insert.

(2) Fit and tighten STUDS (026) to tapped bosses in FRAME PLATE LINER INSERT (041). If Studs are not square to the face of the Insert, screw a nut on the thread, and adjust by tapping lightly with a hammer.

(3) Lift FRAME PLATE LINER INSERT (041) with hoist, and place in position with Studs aligned with holes in Frame Plate. Push Insert onto Frame Plate Liner to engage Studs with holes, and fit nuts finger tight only.

(iii) Fit IMPELLER as follows:

(a) Fit SHAFT KEY (070) to Shaft keyway, and bolt SHAFT WRENCH (306) to Shaft, over key. Ensure that CLAMP BOLTS (012) on Side 'B' of Base (refer Fig 13) are sufficiently tight to hold Bearing Assembly horizontal, but not clamp it.

(b) Restrain Shaft with Wrench, and fit LOCATING NUT (303) on Shaft thread, as shown in Fig 8. The conical face will locate the Frame Plate Liner Insert in its correct radial position. Tighten all Studs (Frame Plate Liner Insert Studs, and/or Frame Plate Liner Studs), finger tight plus half a turn (max), and remove Locating Nut.

(c) Select IMPELLER, and apply anti-seize compound to thread. Lift Impeller, supported on a rope, with hoist, and screw to Shaft.
While restraining Impeller, turn Shaft with Wrench to engage Impeller and Shaft threads. Tighten Impeller on Shaft by placing bar between Impeller vanes, and flogging Shaft Wrench.

Ensure that the various O-Rings on the Shaft are not damaged, and are covered by adjacent parts

(iv) Fit COVER PLATE LINER (018) and THROATBUSH (083) to COVER PLATE (013) as described below.

(a) 14/12 AH, 16/14 AH, and 20/18 AH pumps only.

(1) Place COVER PLATE (013) on suitable supports on a flat surface, intake flange down, to keep flange about 25mm above surface.

(2) Fit LINER SEAL (124) to groove in Cover Plate, mounted flat face in, using contact cement adhesive if required.

(3) Fit THROATBUSH STUDS (026) to tapped holes in THROATBUSH (083), align Studs with holes in Cover Plate, and lower Throatbush into place in Cover Plate. Fit Nuts to Studs, and hand tighten.

(4) Fit and tighten COVER PLATE LINER STUDS (023) to tapped bosses in Cover Plate Liner. Fit Liner in Cover Plate, ensuring that Studs are aligned with corresponding holes in Cover Plate. Fit Nuts to Studs and tighten finger tight plus half a turn (max).

(5) Tighten THROATBUSH STUDS (026) finger tight plus half a turn (max).

(b) 10/8 F-R, 12/10 F-R, and 12/10 M pump only.

(1) Place COVER PLATE (013) on suitable supports on a flat surface, intake flange down, to keep flange about 25mm above surface.

(2) Fit COVER PLATE LINER (018) to COVER PLATE (013), and apply liquid soap or rubber lubricant to recess in Liner which engages with Throatbush.

(3) Lower THROATBUSH (083) into Cover Plate, and push down firmly to engage with Cover Plate Liner.

(4) Insert COTTERS (085) through slots in neck of Cover Plate, and tap carefully and evenly until the Throatbush is held firmly in the Cover Plate.

(v) Fit COVER PLATE (013).
Lift Cover Plate, with Throatbush and Cover Plate Liner fitted, and align holes with Cover Plate Bolts (015) assembled in the Frame Plate.
Note that large Cover Plates are provided with radially tapped holes for eye bolts, to assist lifting.
Fit Nuts to Cover Plate Bolts, and tighten evenly, and in accordance with the tightening sequence indicated in Fig B of Appendix B, ensuring that Cover Plate lugs engage firmly with shoulders on Cover Plate Bolts.

(vi) Complete the assembly of gland parts in the Stuffing Box or Expeller Ring, as described in Section 6.2 (Seal Assembly).

(vii) The pump is now ready for fitting of Joint Rings (refer 6.3.6) and Impeller adjustment (refer 6.4).

6.3.4 METAL LINERS - TWO PIECE

- **Fitting Seal Rings, Frame Plate Liner Insert, Volute Liner Seals, Volute Liner, Impeller and Cover Plate**
- **Refer Figs 8, 12, and 13**

Fig. 12 Casing assembly with two-piece metal Liners

In Two Piece metal lined pumps, a separate Throatbush is not provided, this part being combined with the Volute Liner as a single composite liner. This applies to **pump sizes 1.5/1 AH, 2/1.5 AH, 3/2 AH, and 4/3 AH.** The pump casing assembly, with Two-Piece metal liners, is described below.

(i) Fit 'C'-section SEAL RING (122) to periphery of Stuffing Box or Expeller Ring, preferably using contact cement adhesive. Apply adhesive to compression face of Seal Ring in about 4 to 6 points only to avoid undue restraint of Seal during compression.

(ii) Fit VOLUTE LINER SEAL (124 or 125), which is one of two types:

(a) O-Ring Type: VOLUTE FRAME SEAL (125).
- Pump sizes 1.5/1 AH, 2/1.5 AH, and 3/2 AH. This Seal is fitted at a later stage (refer to (iii)(a)(5) below)

(b) 'C'-Section Type: VOLUTE LINER SEAL (124) - **4/3 AH Pump.**
Fit to groove in the Frame Plate, mounted flat face in, using contact cement adhesive if required.

(iii) Fit FRAME PLATE LINER INSERT (041) and IMPELLER.
The Frame Plate Liner Insert is clamped in position by engagement of its conical periphery with a corresponding conical surface on the VOLUTE LINER (110). Radial alignment of the Insert is provided by engagement of a spigot on the Insert with a recess in the Frame Plate (**1.5/1 AH, 2/1.5 AH, and 3/2 AH pumps**). In the 4/3 AH pump, radial alignment of the Insert is provided only by engagement with the Volute Liner.

(a) 1/5/1 AH, 2/1.5 AH, and 3/2 AH Pumps only.

(1) Place IMPELLER (thread up) on a flat surface, and apply anti-seize compound to thread.

Fig. 13 Fitting metal casing Liners

(2) Place FRAME PLATE LINER INSERT (041) over Impeller boss, with Insert vanes away from Impeller, and screw Impeller to Shaft. Ensure that the various Seals are not displaced, and that the spigot on the back face of the Frame Plate Liner Insert engages with the Frame Plate bore.

(3) Fit SHAFT KEY (070) in Shaft keyway, and bolt SHAFT WRENCH (306) to Shaft, over key. While restraining Shaft with Wrench and turning Impeller with a bar between vanes, firmly screw Impeller to Shaft, but do not overtighten.

(4) Ensure that CLAMP BOLTS (012) on Side 'B' of Base (refer Fig 13) are sufficiently tight to hold Bearing Assembly horizontal, but not lock it. Move Bearing Assembly back by adjusting nut on Adjusting Screw (001) to temporarily clamp Frame Plate Liner Insert in its correct position.

(5) Fit O-Ring type VOLUTE FRAME SEAL (125) over periphery of Frame Plate Liner Insert, and adjacent Frame Plate.

(b) 4/3 AH Pump only.

(1) Place IMPELLER (thread up) on a flat surface, and apply anti-seize compound to thread.

(2) Place FRAME PLATE LINER INSERT (041) over Impeller boss, with Insert vanes away from Impeller, and screw Impeller to Shaft. Ensure that the various Seals are not displaced.

(3) Fit SHAFT KEY (070) in Shaft keyway, and bolt SHAFT WRENCH (306) to Shaft, over key.

(c) 1/5/1 AH, 2/1.5 AH, 3/2 AH, and 4/3 AH Pumps.

(iv) Fit VOLUTE LINER (110) - Place Volute Liner around Impeller, and move back towards Frame Plate until the tapered surface of the Frame Plate Liner Insert engages with the matching taper of the Volute Liner. Ensure that the Volute Liner Seal (O-Ring) has not been displaced. Fit a G clamp to temporarily clamp the Volute Liner discharge nozzle to the flange of the Frame Plate, as shown in Fig 13.

ENSURE THAT THE VOLUTE LINER IS FIRMLY CLAMPED DURING ASSEMBLY TO PREVENT INJURY TO PERSONNEL.

(v) Lift COVER PLATE (013) over Volute Liner and align bolt holes with Cover Plate Bolts fitted to Frame Plate. Fit nuts to Cover Plate Bolts, and leave loose. Remove G clamp supporting Volute Liner, and tighten Cover Plate bolts evenly to torque values not less than indicated in Table 1, and in accordance with the tightening sequence indicated in Fig B of Appendix B, ensuring that Cover Plate lugs engage firmly with shoulders on Cover Plate Bolts. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure and sequence as described and indicated in Appendix B.

(vi) Complete the assembly of gland parts in the Stuffing Box or Expeller Ring, as described in Section 6.2 (Seal Assembly).

(vii) The pump is now ready for fitting of Joint Rings (refer 6.3.6) and Impeller adjustment (refer 6.4).

6.3.5 METAL LINERS - THREE PIECE

- **Fitting Seal Ring, Frame Plate Liner Insert, Volute Liner Seals, Volute Liner, Impeller, Throatbush, and Cover Plate**
- **Refer Figs 8, 13, and 14**

Fig. 14 Casing assembly with three-piece metal Liners

In Three Piece metal lined pumps, a separate Throatbush is provided, independent of the Volute Liner. This applies to pump sizes **6/4 AH and larger.**

(i) Fit SEAL RING (122) to Stuffing Box or Expeller Ring. The Seal Ring may be one of two types:

(a) 'C' Section Seal Ring: **Pump sizes 6/4 AH and 8/6 AH.**

Fit 'C'-section SEAL RING (122) to periphery of Stuffing Box or Expeller Ring, preferably using contact cement adhesive. Apply adhesive to compression face of Seal Ring in about 4 to 6 points only to avoid undue restraint of Seal during compression.

(b) O-Ring Type Seal Ring: **Pump sizes above 8/6 AH.**

Fit Seal to groove on the compression face on the periphery of the Stuffing Box or Expeller Ring.

(ii) **For 10/8F-M, 12/10E-M, and 12/10F-M pumps only,** fit SEAL HOLDER (143) as follows:
Fit and tighten SEAL HOLDER STUDS (144) to tapped bosses on Seal Holder.

Lift Seal Holder, and position about Shaft axis with Seal Holder Studs adjacent FRAME PLATE (032), and aligned with holes in annular recess.
Push Seal Holder to engage outer diameter with corresponding diameter of annular recess in Frame Plate, with Studs engaging holes in recess.
Fit STEPPED WASHERS (080) to Studs, screw on nuts, and tighten uniformly.

(iii) Fit VOLUTE LINER SEAL (124). This is a 'C'-Section pressure activated Seal. Fit to groove in the Frame Plate, or Seal Holder if applicable, mounted flat face in, using contact cement adhesive if required.

(iv) Fit FRAME PLATE LINER INSERT (041) and IMPELLER.
The Frame Plate Liner Insert is fixed to the Frame Plate by means of Studs or Bolts.

(a) Firmly fasten STUDS (026) in tapped holes on Frame Plate Liner Insert. If Insert equipped with 'T'-Slots, fit BOLTS (040). Fit Locknuts to Bolts, and tighten to firmly hold Bolts. This will assist in fitting Bolts to holes in Frame Plate, and in preventing dislodging of 'C' Section Seals.

(b) Suspend LIFTING TUBE (302) from a hoist (refer Fig 8). Stand Frame Plate Liner Insert on edge, and engage Lifting Tube in bore of Insert. Lift Tube with Insert attached, and slide tube over Shaft thread. Align Studs (or Bolts) with holes, and push Insert against Frame Plate. Ensure that the various Seals have not been displaced. Fit nuts to Studs or Bolts, and leave loose. Remove Lifting Tube.

(c) Fit SHAFT KEY (070) in Shaft keyway, and bolt SHAFT WRENCH (306) to Shaft, over key. Ensure that CLAMP BOLTS (012) on Side 'B' of Base (refer Fig 13) are sufficiently tight to hold Bearing Assembly horizontal, but not lock it.
Restrain Shaft with Wrench, and fit LOCATING NUT (303) on Shaft thread, as shown in Fig 8. The conical face will locate the Frame Plate Liner Insert in its correct radial position. Fully tighten all Studs, or Bolts, on Insert, and remove Locating Nut.

(d) Ensure that the O-Ring (109 or 064) at the end of the Expeller or Shaft Spacer is positioned in its locating groove.

(e) Select IMPELLER, and apply anti-seize compound to thread. Lift Impeller, supported on a rope, with hoist, and screw to Shaft.
While restraining Impeller, turn Shaft with Wrench to engage Impeller and Shaft threads. Tighten Impeller on Shaft with bar between Impeller vanes, and flogging Shaft Wrench.
Ensure that the various O-Rings on the Shaft are not damaged, and are covered by adjacent parts.

(v) Fit VOLUTE LINER (110) to Frame Plate as described below.

(a) Lift VOLUTE LINER (110) using VOLUTE LIFTING BEAM (304) and hoist, as shown in Fig 8. Place Volute Liner around Impeller, and move back towards Frame Plate until the tapered surface of the Frame Plate Liner Insert engages with the matching taper of the Volute Liner. Check that the Volute Frame Seal has not displaced.

(b) Fit a G clamp to temporarily clamp the Volute Liner discharge nozzle to the flange of the Frame Plate, as shown in Fig 13.

ENSURE THAT THE VOLUTE LINER IS FIRMLY CLAMPED DURING ASSEMBLY TO PREVENT INJURY TO PERSONNEL.

(c) Lugs are provided around the Volute Liner periphery in large pumps. These lugs are positioned to engage some Cover Plate Bolts provided with special slots or KEEPER PLATES (081). These Cover Plate Bolts were described in Section 6.1.2.

Fit these COVER PLATE BOLTS (015) to the Frame Plate to support the Volute Liner during subsequent pump assembly stages.

Ensure that for each Bolt with a slot, the slot engages the Volute lug before tightening. For Bolts with Keeper Plates, slide the Keeper Plate over the Cover Plate Bolt on to the spigot diameter on the bolt centre section, and push Bolts through Frame Plate such that the Keeper Plate is closest to the Frame Plate, bends away from it, and engages the lug on the Volute Liner.

(vi) **For 12/10F-M pump only,** fit SEAL HOLDER (143) as follows:
Lift Seal Holder, and position about Shaft axis with flat face adjacent COVER PLATE (013).
Push Seal Holder to engage inner spigot diameter with corresponding recess in Cover Plate.

(vii) Fit THROATBUSH (083) to COVER PLATE (013).

(a) Place COVER PLATE (013) on suitable supports on a flat surface, intake flange down, to keep flange about 25mm above surface.

(b) Fit VOLUTE LINER SEAL (124) to groove in Cover Plate, or Seal Holder if applicable, mounted flat face in, using contact cement adhesive if required.

(c) If applicable, fit THROATBUSH STUDS (026) to tapped holes in THROATBUSH (083) and leave finger tight at this stage **(for 12/10 AH pumps and larger).**

(d) Lower THROATBUSH (083) into Cover Plate.

(e) If applicable, insert COTTERS (085) through slots in neck of Cover Plate, and tap carefully and evenly until the Throatbush is held firmly in the Cover Plate **(for 6/4 AH to 10/8 AH, 10/8 M, and 12/10F-M pump sizes only).** Do not fix Cotters firmly at this stage.

(viii) Lift COVER PLATE (013) with hoist, place over Volute Liner, and align bolt holes with Cover Plate Bolts fitted to Frame Plate. Fit nuts to Cover Plate Bolts, and leave loose. Remove G clamp supporting Volute Liner, and tighten Cover Plate bolts evenly to torque values not less than indicated in Table 1, and in accordance with the tightening sequence indicated in Fig B of Appendix B, ensuring that Cover Plate lugs engage firmly with shoulders on Cover Plate Bolts. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure and sequence as described and indicated in Appendix B.

(ix) Fully tighten all Throatbush Cotters and Studs.

(x) Complete the assembly of gland parts in the Stuffing Box or Expeller Ring, as described in Section 6.2 (Seal Assembly).

(xi) The pump is now ready for fitting of Joint Rings (refer 6.3.6) and Impeller adjustment (refer 6.4).

6.3.6 MISCELLANEOUS FITTINGS
- Refer Fig 15

Fig. 15 Assembled pump

The pump assembly is now substantially complete, and requires only fitting of miscellaneous external components.

(i) The INTAKE JOINT RING (060) and DISCHARGE JOINT RING (132) are supplied loose with pumps requiring these items.
Fit Intake Joint Ring and Discharge Joint Ring as shown in Fig 15, using contact cement adhesive to provide support during fitting of intake and discharge pipework.

(ii) Fit piping from Drip Tray in BASE (003), if fitted, to convey leakage from gland seal.

(iii) Fit elastomer NUT COVERS (430) to all external nuts to prevent fouling of threads with slurry.

6.4 IMPELLER ADJUSTMENT
- **Refer Figs 13 and 16.**

Fig. 16 Impeller adjustment

(a) Initial Adjustment

With a Gland Seal fitted, both Rubber and Metal Lined Pumps should be adjusted to operate with the Impeller having minimum axial clearance with the front casing liner (Throatbush or Cover Plate Liner). This is most important with High Efficiency Impellers.
Adjustment of Impeller front-end clearance is carried out as follows:

(i) Rotate the Shaft clockwise (as viewed from the drive end) by hand, and move the Bearing Assembly forward (towards the pump intake) by adjusting the rear nut on the ADJUSTING SCREW (001) until the Impeller rubs on the front Liner.

(ii) Unscrew the rear nut by one sixth of a turn, and move the Bearing Assembly back by adjustment of the front nut on the Adjusting Screw until the lug on the Bearing Assembly contacts the rear nut. Fully tighten the front nut to secure the Bearing Assembly in position.

(iii) Ensure that the Shaft can now rotate freely without contact of the Impeller with the front Liner. If contact occurs, repeat step (ii).

NOTE: After each Impeller adjustment is completed, the BEARING HOUSING CLAMP BOLTS (012) must be tightened to torque values indicated in Table 5, below. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure as described in Appendix B.

With a Centrifugal Seal assembly fitted, the pump should be adjusted to operate with the Impeller having approximately equal axial clearance with the front and rear casing liners.

With a Dyna Seal assembly fittted, the pump should be adjusted to operate with the Impeller having minimum axial clearance with the rear casing liner.

If leakage occurs from the Centrifugal or Dyna Seals during pump operation, the Impeller should be adjusted rearwards to minimise axial clearance between the Impeller and rear casing liner. If seal leakage persists after Impeller adjustment, this indicates that the intake pressure is excessive for the Impeller fitted. Leakage may be prevented by fitting of an alternative Impeller having improved intake pressure sealing characteristics. This may require fitting of a differential Impeller.

(b) Periodic Adjustment

Periodic adjustment of Impeller clearance over its operating life is an important factor in maximising wear life of both Impeller and front Liner. Extensive field experience has shown that an increase in wear life of up to 50 percent can be achieved by regular Impeller adjustment, compared with pumps not subject to initial or ongoing adjustment. Regular Impeller adjustment has shown an increase in wear life of typically 20 percent compared with pumps subjected only to initial adjustment.

The recommended procedure for periodic Impeller adjustment is as follows:

(i) At initial pump assembly, adjust Impeller to "just clear" the Throatbush or front Liner, as described in (a).

(ii) After 50 to 100 hours of pump operation, re-adjust Impeller front-end clearance.

(iii) Re-adjust Impeller front-end clearance a further two or three times at regular intervals over its wear life. This may coincide with regular pump maintenance intervals, typically 500 hours.

(iv) After each Impeller adjustment is completed, the Bearing Housing Clamp Bolts must be tightened to torque values indicated in Table 5, below.

NOTE: After each Impeller adjustment is completed, the BEARING HOUSING CLAMP BOLTS (012) must be tightened to torque values indicated in Table 5, below. If a torque wrench, or equivalent device is not available, bolts should be tightened in accordance with the procedure as described in Appendix B.

TABLE 5
TIGHTENING TORQUE
FOR BEARING HOUSING CLAMP BOLTS

Frame Size	Minimum Torque (N m)
A & B	10
C & D	45
E & F	185
G	325
H	1500

7. DISMANTLING PUMP AND REMOVAL OF IMPELLER

The procedure for dismantling the pump is generally the reverse of that described for pump assembly, with the exception of Impeller removal on large pumps.

Access to the IMPELLER requires removal of the COVER PLATE (013), THROATBUSH (083), COVER PLATE LINER (017, 018) (elastomer lined casing), and VOLUTE LINER (110) (metal lined casing). These parts may be withdrawn after removal of nuts on the COVER PLATE BOLTS (015).
Impellers are fitted to Shafts with a right hand screw thread attachment on all Warman pumps. Impeller removal generally involves applying an impulsive torque loading to the Impeller, while separately restraining the Shaft from rotation. IMPELLER RELEASE COLLARS (239) are fitted to Shafts of large pumps to assist Impeller removal. The Impeller Release Collar is first removed, to relieve compressive loading on the Impeller hub, allowing the Impeller to be readily unscrewed from the Shaft.

Instructions for using IMPELLER RELEASE COLLARS (239) are presented in Warman Manual Part 4A, Impeller Release Collar.

APPENDIX A

WARMAN BASIC PART NUMBERS

WARMAN BASIC PART No.	STANDARD WARMAN MATERIAL CODE	PART NAME
001	E62	Adjusting Screw
003	G01	Base
005	-	Bearing Assembly
011	E62, E63	Clamp Washer
012	E62	Clamp Bolt
013	D20	Cover Plate
015	E62, E63	Cover Plate Bolt
017	R26A	Cover Plate Liner
018	R26A	Cover Plate Liner (Half)
023	E62	Cover Plate Liner Stud
024	D20	End Cover
026	E62	Frame Plate Liner /Insert Stud
028	A05A	Expeller
028-20	A05A	Expeller (Dyna Seal)
029	A05A	Expeller Ring
029-20	A05A	Expeller Ring (Dyna Seal)
029R	R08A	Expeller Ring (Rubber)
032	D20	Frame Plate
034	E62	Frame Plate Bolt
036	R26A	Frame Plate Liner
039	E63	Frame Plate Stud
040	E62	Frame Plate Liner Insert Bolt
041	A05A, R26A	Frame Plate Liner Insert
043	R26A	Frame Plate Liner (Half)
044	K24, C02	Gland
045	E62	Gland Bolt
060	R08A	Intake Joint
062	D20	Labyrinth
063	K31, C02	Lantern Ring
064	S18	Impeller O-Ring
067	P50A, C23	Neck Ring
070	E05	Shaft Key
073	E05	Shaft
075	D20	Shaft Sleeve
076	D20	Shaft Sleeve (Long)
078	G01	Stuffing Box
079	C23	Expeller Ring Stud
081	E02	Keeper Plate
083	A05A, R26A	Throatbush
085	E02	Cotter

APPENDIX A

WARMAN BASIC PART NUMBERS (Cont.)

WARMAN BASIC PART No.	STANDARD WARMAN MATERIAL CODE	PART NAME
090	S10	Lip Seal
109	S18	Shaft O-Ring
110	A05A	Volute Liner
111	Q05A	Packing
117	E62, C23	Shaft Spacer
118	K31, C02	Lantern Restrictor
118-1	P50A	Lantern Restrictor (Non-metal)
122	R11A	Expeller Ring/Stuffing Box Seal
122-20	R11A	Expeller Ring Seal (Dyna Seal)
124	R08A	Volute Liner Seal
125	R08A	Volute Frame Seal
126	E62, C23	Gland Clamp Bolt
132	R08A	Discharge Joint Ring
138	E62	Grease Cup Adaptor
179	C23	Shaft Sleeve Spacer
210	S46	Shaft O-Ring
217	S18	Impeller O-Ring
239	C23	Impeller Release Collar
241	K24, C02	Lip Seal Gland
302	E02	Lifting Tube
303	E02	Locating Nut
304	E02	Volute Lifting Beam
306	E02	Shaft Wrench
310	E02	Stuffing Box/Expeller Ring
		Lifting Beam
425	R08A	Dyna Seal
430	U04A	Nut Covers
-	-	Grease Cup
-	-	Grease Nipple

NOTE: For details of specific Warman Material Codes, refer to Assembly, Operating and Maintenance Instructions, Part 1 – General Instructions for all Types of Warman Pumps, Appendix B.

APPENDIX B

ALTERNATIVE BOLT TIGHTENING PROCEDURE

In situations where a torque wrench or equivalent device is not available, bolts should be tightened in accordance with the following procedure, described as the "Turn-of-the-nut method", which is consistent with SABS Standard SABS 094 -1982.

Bring the parts of the joint into full contact by tightening sufficient bolts to achieve a "snug-tight" condition. The "snug-tight" condition is described to be 10% of the bolt's full tension or yield tension. This is achieved to reasonable accuracy and repeatability by the full effort of an average man (approximately 70kg) using a standard podger spanner, or by a few impacts from an impact wrench, after initial slackness in the nut has been taken up.
Make corresponding permanent marks on the nut and the protruding thread of the bolt, from which subsequent rotation of the nut or bolt can be measured.
Then using the appropriate turns in Table B, turn the bolts/nuts, according to the tightening sequence shown in Figure B, if appropriate, to achieve 70% of yield tension in the bolts.

TABLE B

Bolt Size (mm)	Shank Length Between Load Faces Of Bolt and Nut (mm)	Final Torsional Displacement Between Bolt and Nut (turns)
M16 – M22	<120	0.5
	>120	0.75
M24 – M36	<160	0.5
	>160	0.75
M38 – M64	<200	0.5
	>200	0.75

APPENDIX B

Fig B. Bolt Tightening Sequence

APPENDIX C — FAULT DETECTION CHART

PERFORMANCE SYMPTOMS												POSSIBLE FAULTS	
No Discharge	Reduced Discharge	Low Discharge Pressure	Excessive Power Consumption	Loss of Prime	Excessive Noise or Vibration	Overheating or Pump Seizure	Bearing Life too Low	Feed Hopper Overflows	Stuffing Box Leaks	Life of Gland Packing too Low	Expeller Ring Leaks		
			●		●	●	●		●	●	●	Mis-alignment of pump and/or drive	MECHANICAL FAULTS
			●		●		●		●	●	●	Bent shaft	
			●		●	●	●					Contact between rotating and stationary parts	
					●	●	●			●		Worn bearings	
●	●	●			●							Worn or faulty impeller	
●	●	●						●				Defective casing seal, permitting internal leakage	
●	●	●		●	●			●				Partial blockage of impeller	
			●						●		●	Incorrect packing for operating duty	
									●	●	●	Excessive wear of shaft sleeve	
			●						●	●	●	Incorrect fitting of packing	
					●	●	●		●	●	●	Impeller out of balance	
					●	●	●		●	●	●	Shaft running off-centre due to worn bearings or misalignment	
									●	●	●	Excessive clearance in stuffing box causing extrusion of packing	
									●	●	●	Excessive wear or blockage of expeller	
									●	●	●	Solid material in gland seal water causing shaft sleeve wear	
			●							●		Gland too tight - inadequate seal water leakage	
					●	●	●					Inadequate bearing lubrication	
					●	●	●					Incorrect bearing installation	
					●	●	●					Excessive lubricant in bearing housing, causing bearing overheating	
					●	●	●					Excessive axial thrust caused by mechanical failure in casing	
					●		●					Water contamination of bearings, causing corrosion	
					●		●					Solid matter contamination of bearings	
					●							Pump support too flexible	
											●	Excessive impeller back clearance - adjust impeller rearwards	
●	●			●								Air pockets in suction line	INTAKE FAULTS
●	●			●				●				Suction line - blocked, too long, or diameter too small	
●	●			●	●							Pump or suction pipe incompletely filled with liquid	
●	●			●	●							Excessive suction lift	
●	●				●	●						Inadequate margin between intake pressure and vapor pressure	
	●	●		●				●				Excessive air or gas in liquid	
	●			●								Air leaks into pump via suction pipe or stuffing box	
●	●			●	●			●				Inadequate submergence of inlet pipe entrance	
●						●		●				Pump not primed	
	●				●							Foot valve - too small or partially blocked	
●	●	●	●					●				Total head of pipe system greater than pump head	SYSTEM FAULTS
●	●	●	●					●				Incorrect direction of pump rotation	
●	●	●						●				Low pump speed	
●	●	●		●				●				Air entrainment in slurry - pump hopper requires baffles	
●	●	●		●	●			●				Poor piping design, or partial blockage in piping	
	●	●	●									Slurry viscosity differs from design value	
	●		●									High pump speed	
			●					●				Slurry specific gravity higher than design value	
			●									Total head of pipe system less than pump head	
					●	●						Very low slurry feed flowrate	

CH Warman PUMP GROUP

WARMAN PUMPS

ASSEMBLY, OPERATING AND MAINTENANCE INSTRUCTIONS

PART 3A

BASIC BEARING ASSEMBLIES
(WARMAN BASIC PART NUMBER 005)
PUMP FRAME SIZES A,B,C,D,E,F,G & H

PC3A

WARMAN PUMPS

ASSEMBLY, OPERATING AND MAINTENANCE INSTRUCTIONS

PART 3A

BASIC BEARING ASSEMBLIES (WARMAN BASIC PART NUMBER 005) PUMP FRAME SIZES A, B, C, D, E, F, G & H

Issue Date: 1 November 2000

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SAFETY INFORMATION

The following safety information relating to pump operation and maintenance should be carefully observed, and correct procedures followed, to avoid injuries to personnel, and damage to equipment. All statutory requirements relating to this equipment must be complied with at all times.

DO NOT APPLY HEAT TO THE IMPELLER HUB OR INLET EYE TO ASSIST IMPELLER REMOVAL. APPLICATION OF HEAT MAY RESULT IN SHATTERING OF THE IMPELLER , RESULTING IN INJURY OR EQUIPMENT DAMAGE.

DO NOT OPERATE THE PUMP FOR AN EXTENDED TIME WITH ZERO OR VERY LOW FLOWRATE. FAILURE TO OBSERVE THIS WARNING COULD RESULT IN OVERHEATING OF THE PUMP, AND VAPORISATION OF THE PUMPED FLUID, WITH GENERATION OF VERY HIGH PRESSURES. SERIOUS INJURY TO PERSONNEL, OR DAMAGE TO EQUIPMENT MAY RESULT FROM SUCH ACTION.

CHECK DRIVE MOTOR ROTATION PRIOR TO FITTING OF DRIVE BELTS OR COUPLINGS. INCORRECT MOTOR ROTATION MAY CAUSE PERSONNEL INJURY OR EQUIPMENT DAMAGE.

DO NOT FEED VERY HOT OR VERY COLD FLUID INTO A PUMP AT AMBIENT TEMPERATURE. THERMAL SHOCK MAY RESULT IN FRACTURE OF PUMP WET-END PARTS.

A WARMAN PUMP MUST BE REGARDED AS BOTH AN ITEM OF ROTATING MACHINERY, AND A PRESSURE VESSEL. ALL RELEVANT SAFETY PRECAUTIONS AND PROCEDURES FOR SUCH EQUIPMENT SHOULD BE OBSERVED DURING PUMP INSTALLATION, OPERATION AND MAINTENANCE.

WHERE AUXILIARY EQUIPMENT IS ASSOCIATED WITH A PUMP (eg MOTORS, DRIVE BELTS, DRIVE COUPLINGS, SPEED REDUCERS, VARIABLE SPEED DRIVES, ETC), ALL RELEVANT INSTRUCTION MANUALS SHOULD BE CONSULTED, AND RECOMMENDED PROCEDURES IMPLEMENTED, DURING INSTALLATION, OPERATION AND MAINTENANCE OF THE PUMP SYSTEM.

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1. INTRODUCTION

This publication, **Part 3A**, forms part of a set which together comprise the Assembly, Operating, and Maintenance Instruction Manual for Warman Pumps. Other publications in the set comprise the following:

Part 1: Assembly, Operating and Maintenance Instructions - General Instructions for all Types of Warman Pumps.

Part 2: Instructions for each specific Type of Warman Pump.

Part 4A: Impeller Release Collar (if applicable)

This publication, **Part 3A**, is applicable for Warman Pumps fitted with Basic Bearing Assemblies, which are defined by a single letter representing the **FRAME SIZE**, immediately following the **PUMP SIZE**, eg 4/3D-AH, 200F-M.

2. IDENTIFICATION OF PARTS

Each Warman pump part has a unique name and a three-digit Basic Part Number. Parts with the same name, have the same Basic Part Number, regardless of pump size. For example, the Expeller of every Warman pump has the Basic Part Number 028.

Additional letters and numbers are added before and after the Basic Part Number to further define a component part of a particular pump, as described in Part 1 of the Assembly, Operating, and Maintenance Instruction Manual. This expanded marking is identified as the Part Number, and represents a unique identification for each component part. The Part Number is normally cast or otherwise prominently marked on each part.

For example, Part Number D3017M identifies the Cover Plate Liner to fit the casing of the 4/3D-AH Warman Pump.

Bearing Assembly part numbers containing the letters 'AM' immediately following the initial Frame Size identifying letter/s indicate intermediate Bearing Assemblies, having larger Impeller-end thread, which enable Pump Frames to fit wet-ends having the next higher Frame Size. For example, a DAM005M Bearing Assembly, which fits to a range of pumps including the 6/4D-AH pump, enables a size D Pump Frame to be fitted to a 6/4 AH wet-end, for which an E or EE Pump Frame is the standard Frame Size. Intermediate 'AM' Bearing Assemblies extend the range of Pump Frame power ratings that are available for matching to a particular pump wet-end. 'AM' type Bearing Assemblies are available in both Basic and Modified form.

Refer to the Component Diagram for the appropriate size of Warman Pump for complete identification and description of component parts. Part names and Basic Part Numbers are used in assembly instructions throughout this instruction manual. Warman Basic Part Numbers for all component parts in Basic Bearing Assemblies are listed in the Appendix of this publication.

In all communication with the C.H. Warman Group, or its representatives, and particularly when ordering spare parts, it is recommended that the correct component names and Part Numbers be used at all times to avoid supply of incorrect parts. The pump serial number should also be quoted if any doubt exists as to part identification.

3. BEARING LUBRICATION

It is recommended that grease used for lubricating both the rolling bearings, and the Labyrinth seals, should have the following characteristics:

Lithium soap base grease with EP additives and oxidation inhibitors.

N.L.G.I. Consistency No:	2
Drop Point	> 170° C
Work penetration 25°C A.S.T.M.	265 - 295
RECOMMENDED GREASE:	SHELL ALVANIA EP GREASE 2, CASTROL EPL2, or equivalent.

Use only clean, recommended grease at all times.

Warman bearing assemblies that are correctly assembled and greased will have a long and trouble-free life, provided that they are adequately maintained, and protected against contamination by water and other foreign matter. Careful attention should be paid to labyrinth purging on a regular basis to maximise bearing life. Reduction of contaminant entry to bearing assemblies, by regular labyrinth grease application, will result in increased bearing life and reduced maintenance costs.

Maintenance personnel should determine the appropriate intervals (not to exceed 12 months) to dismantle bearing assemblies for inspection of bearings, re-greasing, and determining the time for the next scheduled inspection.

The frequency and amount of grease to be applied to bearings depends on a number of factors, including bearing size, pump speed, duration and extent of pump operation, ambient and operating bearing temperatures, and extent and nature of splash affecting the labyrinth seal region of the bearing assembly.

If regular grease application is considered appropriate by maintenance personnel, the plugs on the bearing assembly should be replaced with grease nipples. It is important that grease nipples are regularly cleaned prior to use to prevent entry of contaminants to the bearing cavity with periodic grease application. Grease should be applied often and sparingly, rather than in large quantities at long intervals. **DO NOT OVER-GREASE BEARINGS.**

Excess Grease Application - Over-lubrication of bearings will result in overheating due to churning of the grease. If bearings overheat after grease addition, or change, this is likely to be caused by excess grease. Under no circumstances should additional grease be applied to rectify the condition.

Most pumps operate well below maximum recommended bearing speeds, however over-lubrication is a common cause of bearing overheating, particularly with smaller bearing sizes. Experience and judgement should be applied in determining the most appropriate lubrication procedures for a particular pump. New pump installations should be monitored closely in the initial stages of operation, with particluar attention being paid to bearing temperature and cleanliness.

Initial Grease Application - Recommended quantities of grease to be applied to each bearing for the range of pump frame sizes are shown in the Basic Bearing Assemblies Lubrication Data Sheet, located in the Appendix. New or re-conditioned pumps or Bearing Assemblies, which are supplied by the C.H. Warman Group, are normally supplied with grease applied in accordance with these specifications. Additional grease should only be applied according to recommendations for ongoing lubrication.

Periodic Grease Application - The following tabulation of lubrication intervals, as a function of pump speed, may be used as a guide for average pump conditions.

TABLE 1
TYPICAL LUBRICATION INTERVALS FOR PUMP BEARINGS

Pump Frame	Bearing Part No	Grease Addition per Brg -gms	LUBRICATION INTERVAL - HOURS										
			200 rpm	300 rpm	400 rpm	500 rpm	750 rpm	1000 rpm	1250 rpm	1500 rpm	2000 rpm	2500 rpm	3000 rpm
A	A009	5							2700	2400	1800	1400	1000
B	B009	10						2500	2400	2100	1500	1100	800
C	C009	15						2000	2400	1500	1000	700	600
D	D009	25				3500	2600	1800	1300	1100	750		
E	E009	40			4000	3000	2300	1600	1200	1000			
F	F009	65		4000	3500	2500	2100	1200	900				
G	G009	120	5000	3500	2500	2000	1400	900					
H	H009	325	4000	2500	2100								
	H009D	155	18000	12000	8000								

The above lubrication intervals are based on average pump operating conditions as listed below.

- Ambient temperature in range 10 - 35° C
- Clean environment
- Pumps enclosed for protection from extreme weather conditions
- Operating conditions below maximum rating for the pump
- Absence of splash from excessive gland leakage or hose cleaning application
- Lubrication intervals assume bearing temperatures measured at the outer bearing ring do not exceed 70° C. Where this temperature is exceeded, intervals should be halved for each 15° C increment above 70°C. Maximum recommended grease operating temperature should not be exceeded under any circumstances

If any of these conditions are exceeded, in particular, if pumps operate in an excessively damp or dirty environment, lubrication intervals should be reduced accordingly.

4. LABYRINTH SEAL LUBRICATION

A grease purged Labyrinth seal is provided at each end of the Bearing Assembly to ensure effective protection against water and grit entry to the bearing cavities. This results in longer life of bearings, and contributes to reduced pump operating cost, hence careful attention to Labyrinth grease purging is an important maintenance requirement. The grease purged Labyrinth seal, termed the '-10' ('dash 10') Bearing Seal, is shown in Fig 1. Grease is injected from a grease nipple or automatic grease feeder point, in the End Cover of each seal, to a point between two Piston Rings on the rotating Labyrinth, to form a pressurised grease barrier between the Piston Rings. Grease passing the inner Piston Rings enters the bearing cavities, and contributes to Bearing lubrication. Grease passing the outer Piston Rings purges water and grit from the seal entry regions, and provides continuous protection of the Bearings from entry of contaminants. V-Ring seals, and large diameter Labyrinth-flingers are also essential components of the seal assembly to provide additional protection against entry of contaminants. The effectiveness of Bearing sealing is maximised by fitting automatic grease feeders, in lieu of grease nipples, for supply of regular shots of grease to the Labyrinth seals, in particular to the casing-side End Cover. Grease capacities of automatic grease feeders of typically three months for pump frame sizes A to E, and one month for larger sizes are recommended.

Fig. 1 '-10' Bearing Seal

As noted in section 3, the same grease should be used for Bearing lubrication and Labyrinth seal purging.

Where automatic grease feeders are used, reservoir levels should be checked on a regular basis, and re-filled when required. Where End Covers are fitted with grease nipples, for manual grease application, the above recommendations for maintenance frequency are provided to ensure effective seal operation.

The '-10' Bearing seal is a design improvement which is now standard equipment on Basic Bearing Assemblies, supplied as Bearing Assembly units, or fitted to new pumps. Existing Bearing Assemblies of the previous design may be converted to the '-10' design by fitting of revised and additional new component parts available as Retro-fit kits.

TABLE 2
SUGGESTED FREQUENCY FOR LABYRINTH SEAL GREASE APPLICATION

Labyrinth Seal	24hr Operation per day	16hr Operation per day	8hr Operation per day
Impeller-end	4 shots* each 12 hours	4 shots per day	2 shots per day
Drive-end	4 shots each 120 hours	4 shots per week	2 shots per week

* Shots from a standard manual grease gun.

5. BEARING ASSEMBLY PROCEDURE

All parts dismantled during Bearing Assembly overhaul should be closely inspected to assess suitability for re-use, and identification of new parts checked. Parts suitable for re-use should be cleaned and painted. Matching faces should be free of rust, dirt, and burrs, and have a coating of grease applied prior to assembly.

Small fasteners should preferably be replaced, and all threads coated with graphite grease before assembly.

Replacement of all elastomer seals is recommended at major overhauls, as these materials tend to deteriorate with use.

5.1 Frames A, B, C, D, E, F, and G

5.1.1 Fitting Bearing Cones to Shaft
- Refer Fig 2

Fig. 2

(i) Apply oil or anti-sieze compound to bearing lands on SHAFT (073).

(ii) Fit one GREASE RETAINER (046) with flange against Shaft shoulder.

(iii) Fit cone of BEARING (009) to Shaft with large diameter against Retainer, preferably preheating the Bearing cone before fitting. It is recommended that a proprietary bearing induction heater be used for this purpose. An alternative method is to immerse parts in a heated bath of a suitable heating oil. With Shaft in a vertical position, the heated Bearing cone should be slipped on, and pressed or tapped up to the Grease Retainer.

(iv) Fit the other Grease Retainer and Bearing cone as described above. It is important that both Grease Retainers are located hard against the Shaft shoulders, and Bearings are hard against the Grease Retainers. Check that these conditions are satisfied when the bearings have cooled to room temperature.

5.1.2 Fitting Bearing Cup (Impeller-end) to Bearing Housing
- Refer Fig 3

Fig. 3

(i) Apply oil or anti-sieze compound to bore at each end of BEARING HOUSING (004).

(ii) Press (or tap carefully with mallet) cup of BEARING (009) into Impeller end of Bearing Housing until cup is slightly below end face of Housing, with small diameter of cup facing out. The current design of Bearing Housing has the Impeller-end clearly marked. If no markings are present, the cup may be fitted to either end, as the Bearing Housing is symmetrical in the absence of markings. The assembly operation is best carried out with the Housing supported in a vertical orientation.

(iii) Fit END COVER (024-10) with one SHIM (025) to Housing, and insert END COVER SET SCREWS (027). Use one thick Shim only (typically 0.5 mm) to provide effective sealing.

(iv) Tighten Set Screws uniformly. This will adjust the Bearing cup to its correct position.

5.1.3 Fitting Shaft to Bearing Housing - Refer Fig 4

Fig. 4

The following procedure should be carried out with the Bearing Housing supported in a horizontal orientation for frame sizes A, B and C. With larger frame sizes, it is recommended that the Housing be supported vertically, so that Bearings will fit up concentrically.

(i) Dispense quantities of grease for both Bearings corresponding with the type as specified in section 3, and amounts as indicated in the Basic Bearing Assemblies Lubrication Data Sheet, located in the Appendix.

(ii) Distribute grease from a grease gun into Bearing mounted on Shaft, to fill spaces between cone, rollers, and cage. Discharge remainder of grease to space between Bearing and Grease Retainer.

(iii) Repeat item (ii) for other Bearing.

(iv) Fit Shaft through Bearing Housing with threaded end emerging through End Cover.

(v) Press remaining Bearing cup into Housing (small diameter outwards) until it is slightly below the Housing end face.

The remaining steps in this procedure depend on the method used to measure and set the Shim gap, and will be described in Section 5.1.4.

5.1.4 Determination of Shim Gap at Drive End - Refer Figs 5 and 6.

Any one of several available methods may be used to determine the required thickness of Shims between the Bearing Housing, and End Cover faces, provided that the correct value of end-play between the Bearings is obtained, as indicated in Table 3. Two alternative methods will be described here in detail.

Procedures for adjusting Bearing end-play should be carried out with the Bearing Housing supported in a horizontal orientation for frame sizes A, B and C. With larger frame sizes, it is recommended that the Housing be supported vertically, so that Bearings will fit up concentrically.

TABLE 3
RECOMMENDED BEARING END-PLAY
(Grease Lubricated Assembly)

Frame Size	End Play - Cold (mm)
A	0.03 - 0.05
B	0.05 - 0.10
C	0.10 - 0.15
D	0.13 - 0.18
E	0.18 - 0.23
F	0.25 - 0.30
G	0.36 - 0.41

(a) Setting Bearing End-Play - Method 1

Proceed from Section 5.1.3 (v), as described below.

(i) Distribute grease in recessed area of END COVER (024-10).

(ii) Fit End Cover, with remaining SHIMS (025), and insert END COVER SET SCREWS (027).

(iii) Tighten End Cover Set Screws uniformly.

(iv) Press Shaft from both ends of Bearing Assembly, preferably using hydraulic loading equipment, to ensure Bearing cups are firmly against End Covers, taking care to avoid damage to Shaft. Refer Fig 6.

(v) Proceed to Section 5.1.5 "Measurement and Adjustment of Bearing End-Play", and determine the measured end-play. This should be in excess of the value indicated in Table 3.

(vi) Calculate the amount of Shims to be removed to give the recommended end-play, from Table 3.

Fig. 5

(vii) Remove End Cover and excess Shims from the drive-end of the Housing.

(viii) Replace End Cover with required Shim thickness, and fit End Cover Set Screws.

(ix) Tighten End Cover Set Screws uniformly.

(x) Press Shaft from both ends of Bearing Assembly to ensure Bearing cups are firmly against End Covers, taking care to avoid damage to Shaft.

(xi) Proceed to Section 5.1.5 to re-check Bearing end-play. If this value is outside the range indicated in Table 3, continue from item (vii) above.

(b) **Setting Bearing End-Play - Method 2**

Proceed from Section 5.1.3 (v), as described below.

(i) Fit END COVER (024-10) into Housing, insert END COVER SET SCREWS (027), and screw in by hand. Do not fit SHIMS (025) at this stage. Refer to Fig 5.

(ii) While rotating shaft slowly by hand, gradually tighten Set Screws until the Bearing cup has been pushed right up to the Bearing cone, whereby the Shaft barely rotates, and the Bearings have almost no end play.

Fig. 6

(iii) Measure gap between faces of End Cover and Bearing Housing, using feeler gauges, as shown in Fig 5. Providing Set Screws have been tightened uniformly, this method usually yields reliable values. Alternatively, the End Cover should be removed, and the following measurements taken with a depth micrometer:

(1) Depth of Bearing cup below end face of Bearing Housing.

(2) Length of End Cover spigot.

The "gap" thickness is then determined by subtracting (1) from (2).

(iv) Select Shim set having a thickness equal to the "gap" (refer item (iii) above) PLUS recommended end-play as indicated in Table 3.

(v) Fit Shims, replace End Cover, and insert End Cover Set Screws. Adjust Set Screws to within about 3 mms of fully tightened position.
Note - With Shims inserted (refer Fig 5), the drive-end Bearing cup must now be displaced slightly to contact the End Cover spigot face, and provide increased Bearing end-play, as shown in Fig 6.

(vi) Apply force at Impeller-end of Shaft, or gently tap, to ensure that Bearing cup at drive-end is in contact with the loosely fitted End Covers. Care should be taken to avoid damage to Shaft thread.

(vii) Tighten End Cover Set Screws uniformly at drive-end to ensure even contact between End Cover and Bearing cup. Both Bearing cups should now be firmly in contact with the adjacent End Covers, and Bearing end-play set to the required value.

(viii) Follow procedure in Section 5.1.5 to measure the current value for Bearing end-play. If this value is outside the range indicated in Table 3, remove drive-end End Cover, adjust Shim thickness by the required amount, and proceed from item (v) above.

5.1.5 Measurement and Adjustment of Bearing End-Play - Refer Fig 7

The Bearing cups are now firmly in contact with the adjacent End Covers, and Set Screws fully tightened. The following procedure should be followed to accurately measure the actual end-play in the Bearing Assembly.

(a) **Frames A, B, and C**

(i) Set up Bearing Assembly with Shaft horizontal, and Housing firmly supported. Hold in bench vice if possible.

(ii) Attach mounting bracket with dial indicator micrometer securely fixed to Housing by means of one SET SCREW (027), and position dial actuating pin against end of Shaft.

(iii) Oscillate Shaft, and push it firmly backwards and forwards by hand several times to establish a consistent dial reading, and note end-play value as indicated by the total movement.

(b) Frames D, E, F, and G

(i) Set up Bearing Assembly with Shaft vertical, Impeller-end down. Support Assembly at lower End Cover with Shaft free. The whole Assembly must be located in a position where it is accessible by a hoist.

(ii) Attach mounting bracket, with dial indicator, as described in (a) (ii) above.

(iii) Fit BEARING ASSEMBLY LIFTING PLATE (307), with eyebolts up, to upper end of Shaft, and attach LABYRINTH LOCKNUT (061) temporarily to Shaft. Fit rope, suspended from a hoist, to eyebolts on Lifting Plate, as shown in Fig 7.

(iv) Move Shaft up and down by lifting the whole Assembly off the support by means of the hoist, and then returning it to the support. Observe maximum and minimum readings on the dial indicator. Repeat several times until consistent values are obtained for measured total Shaft movement. Note end-play value as indicated by the total Shaft movement.

Fig. 7

(c) **Frames A, B, C, D, E, F, and G**

If measured Bearing end-play is outside the ranges indicated in Table 3, Shims must be added of removed, at the drive-end, as required.

(i) To reduce Shim thickness, remove drive-end End Cover, remove appropriate number of Shims, replace End Cover, and tighten End Cover Set Screws.

(ii) To increase Shim thickness, follow procedure for fitting Shims, and moving Bearing cup back to End Cover as described in Sections 5.1.4 (a) and (b), indicated in Fig 6.

After re-adjustment of Bearing end-play by addition or removal of Shims, the actual end-play must again be measured with the dial indicator to confirm the correct value.

5.1.6 Fitting Labyrinths, Piston Rings, Bearing Seal and Locknut. - Refer Fig 1

(i) Smear PISTON RINGS (108) with bearing grease (refer section 3), and fit two Rings to the grooves of each LABYRINTH (062-10). Position Ring gaps diametrally opposite.

NOTE: *Some F and G frame pumps have a different type of Labyrinth at the ends of the Bearing Assembly. Refer to the appropriate Component Diagram.*

(ii) For Frames A and B, fit BEARING SEAL (089-10) to groove in **Labyrinth**, with Seal lip exposed. For Frames C to G, fit Bearing Seal to groove in **End Cover**, with Seal lip exposed. Refer Table 4, and Fig 1.

(iii) Slide Labyrinth over Shaft, and push into End Cover until Piston Ring prevents further entry.

(iv) Rotate Piston Rings to position gaps diametrally opposite grease purge feed points in End Covers. Compress Piston Rings with RING COMPRESSOR (301), then push Labyrinth right into and against Bearing cone.

(v) Fit LABYRINTH LOCKNUT (061), and tighten with C-SPANNER (305).

(vi) Fit HEX PLUGS to Bearing Housing, and GREASE NIPPLES to End Covers.

(vii) Pump grease into each End Cover Grease Nipple to flush Labyrinths.

The completed BEARING ASSEMBLY takes the Warman Basic Part Number (005), and is ready for installation in the pump.

TABLE 4
FITTING OF BEARING SEAL (089-10)

Frame Size	Fit to Labyrinth	Fit to End Cover
A	●	
B	●	
C		●
D		●
E		●
F		●
G		●

5.2 Frame H

5.2.1 Fitting Drive-End Bearing Inner Ring, and Impeller-End Bearing Cone to Shaft

- Refer Fig 8

(i) Apply light oil or anti-sieze compound to bearing journals of SHAFT (073).

(ii) Fit inner ring of BEARING (009D) to drive-end of Shaft, against shoulder, preferably preheating the Bearing inner rings and cones before fitting. It is recommended that a proprietary bearing induction heater be used for this purpose. An alternative method is to immerse parts in a heated bath of a suitable heating oil. With Shaft in a vertical position, the heated Bearing inner ring should be slipped on, and pressed or tapped up to Shaft shoulder.

Fig. 8

(iii) Turn Shaft end-to-end (Impeller-end up), fit one cone of BEARING (009) with large diameter against Shaft shoulder.

(iv) Fit cone spacer of BEARING (009) on Shaft against smaller end of cone, and move cup into position against cone.

(v) Fit second cone of BEARING (009) on Shaft with smaller end against cone spacer. The Bearing cones and cone spacers must be firmly in contact against one another, and against the Shaft shoulder. Check this again after the Bearing cools to ambient temperature.

NOTE: *BEARING (009) is an assembly of separate parts comprising two cones, a cup, and a spacer. Spacers are sized to suit individual bearing sets, and are not interchangeable. In some bearings, the components are marked with an identifying serial number or other marking to assist in preventing mis-matching of component parts between different bearing sets. Where markings are present, bearings must be assembled with parts having common markings. Some small bearing units are not provided with markings on component parts, and are also not interchangeable. These bearing units must be assembled as received.*

(vi) Distribute grease from a grease gun into Bearing from both sides, until grease appears from holes in cup periphery. Discharge remainder of grease uniformly in Housing and End Cover. Refer to the Basic Bearing Assemblies Lubrication Data Sheet, located in the Appendix, for recommended grease specification and quantity.

5.2.2 Fitting Drive-End Bearing Outer Ring to Bearing Housing - Refer Fig 9

(i) Apply light oil or anti-sieze compound to drive-end bore (marked DRIVE END) of BEARING HOUSING (004).

(ii) Support Bearing Housing with drive-end up, and fit GREASE RETAINER (046) (flat side down).

Fig. 9

(iii) Fit outer BEARING (009D), and tap evenly with a soft hammer until it rests against Grease Retainer.

(iv) Distribute grease into Bearing mounted in Housing, and apply liberal quantity inside Housing. Half fill space between Grease Retainer and Bearing, and distribute remainder of grease in End Cover. Refer to Basic Bearing Assemblies Lubrication Data Sheet, located in the Appendix, for recommended grease specification and quantity.

(v) Place END COVER (024) on bench, flat side up, and lightly grease inside recess.

(vi) Fit BEARING SEAL (089) into End Cover recess, lip down, and tap into place against recess shoulder.

(vii) Fit End Cover, with END COVER GASKET (025), to Bearing Housing. Insert END COVER SET SCREWS (027), and tighten evenly.

5.2.3 Fitting Shaft to Bearing Housing
- **Refer Fig 10**

(i) Place Bearing Housing on two timber blocks with fitted End Cover down. Clean and lightly grease bearing bore.

(ii) Fit GREASE RETAINER (046), flat side down.

Fig. 10

(iii) Screw standard EYE BOLT (311) into Impeller end of Shaft, and lift carefully into Housing, using a hoist. Fit Bearing, and tap evenly with a soft hammer until it rests against Grease Retainer.

(iv) Place second END COVER (024) on bench, recess up, and lightly grease recess.

(v) Fit BEARING SEAL (089) into End Cover recess, lip down, and tap into place against recess shoulder.

(vi) Fit End Cover, with END COVER GASKET (025), to Bearing Housing. Insert END COVER SET SCREWS (027), and tighten evenly.

5.2.4 Fitting Labyrinths, Piston Rings, and Locknut - Refer Fig 11

(i) Smear PISTON RINGS (108) with grease, and fit two Rings to the grooves of each LABYRINTH (062). Position Ring gaps diametrally opposite.

(ii) Slide BEARING SLEEVE (008) over drive-end of Shaft, and push it against Bearing.

Fig. 11

(iii) Slide both Labyrinths over Shaft, and push into End Covers until Piston Rings prevents further entry.

(iv) Rotate Piston Rings to position gaps diametrally opposite grease purge feed points in End Covers. Compress Piston Rings with RING COMPRESSOR (301), then push each Labyrinth, in turn, right into End Cover.

(v) Fit LABYRINTH LOCKNUT (061), and tighten with C-SPANNER (305).

(vi) Fit HEX PLUGS to Bearing Housing, and GREASE NIPPLES to End Covers.

(vii) Pump grease into each End Cover Grease Nipple to flush Labyrinths.

The completed BEARING ASSEMBLY takes the Warman Basic Part Number (005), and is ready for installation in the pump.

5.2.5 Checking Bearing End-Play

Although the H Frame Bearing Assembly is wholly supported for axial location from the Impeller-end Bearing, and not subject to adjustment of end-play, it is suggested that end-play be checked, as an indication of correct assembly. End-play should be in the range 0.18 to 0.31 for this Bearing Assembly.

The Bearing cones (Impeller-end) must remain firmly in contact with the Shaft shoulder during measurement of Bearing end-play to ensure reliable measurements. Proceed as follows to satisfy this requirement:

(i) Fit Impeller Release Collar over Impeller-end of Shaft, to bear against Labyrinth. This is required to prevent damage to angled bearing surface of Labyrinth. Refer to section 6 regarding fitting of Impeller Release Collar.

(ii) Fit a length of tube over Shaft to bear against Impeller Release Collar, and hold firmly using a suitable clamping plate bolted to the tapped hole in the end of the Shaft.

Proceed as follows to measure the Bearing end-play of the completed Bearing Assembly:

(a) Set up Bearing Assembly with Shaft vertical, Impeller-end up, mounted on two timber blocks. The Assembly must be located in a position where it is accessible by a hoist.

(b) Attach a dial indicator (preferably with a magnetic base) to the Assembly to measure the relative axial movement between the Shaft and Housing. Clamp dial indicator base to the End Cover, with the stem positioned on top of the SHAFT LIFTING NUT/EYE BOLT (311) (refer Fig 10).

(c) Move Shaft up and down by lifting the whole Assembly off the support by means of the hoist, and then returning it to the support. Observe maximum and minimum readings on the dial indicator. Repeat several times until consistent values are obtained for measured total Shaft movement. Note end-play value as

indicated by the total Shaft movement. If end-play is outside the range of 0.18 - 0.31 mms, the assembly procedure should be reviewed, and repeated if necessary, particularly with regard to fitting of the Impeller-end Bearing and End Cover.

6. IMPELLER RELEASE COLLAR

Impellers are fitted to Shafts with a screw thread (generally right hand) attachment on all Warman pumps. Impeller removal generally involves applying an impulsive torque loading to the Impeller, while separately restraining the Shaft from rotation. IMPELLER RELEASE COLLARS (239) are fitted to Shafts of large pumps (FAM, G, and H frames) to assist Impeller removal. The Impeller Release Collar, which fits against the Impeller-end Labyrinth, is first removed, to relieve compressive loading on the Impeller hub, allowing the Impeller to be readily unscrewed from the Shaft.

Instructions for using IMPELLER RELEASE COLLARS (239) are presented in Warman Manual Part 4A, Impeller Release Collar.

NOTE: *Before fitting the Impeller Release Collar, fit SHAFT SLEEVE O-RING (109) to groove in Impeller-end LABYRINTH (062), refer Fig 11. This step may be omitted if the Impeller Release Collar is subsequently removed following measurement of end-play, or completion of test running.*

7. TESTING OF BEARING ASSEMBLY

In some cases it may be standard practice to test run each Bearing Assembly before placing the unit in service or store.

This operation may be carried out by mounting the Assembly on a test rig, or on a pump BASE (003). The test speed may be obtained by connecting the Shaft to a small electric motor via a coupling or Vee-belt drive.

It is necessary to provide for axial loading of the Impeller-end Labyrinth, on all frame sizes, to prevent the adjacent Bearing moving on the Shaft during testing. The Impeller Release Collar should be fitted before proceeding further, if required for the particular Bearing Assembly (refer Section 6). This is required to prevent damage to angled bearing surface of Labyrinth. Fit a length of tube over Shaft to bear against Impeller Release Collar, and hold firmly using a suitable clamping plate bolted to the tapped hole in the end of the Shaft. For smaller Bearing Assemblies not requiring an Impeller Release Collar, the Labyrinth may be loaded by fitting all Impeller-end Shaft components. The Impeller may be replaced by a suitable threaded sleeve to engage the Shaft thread.

Testing for one hour should be adequate. One of two outcomes will occur:

(i) If Bearing end-play and amount of grease are correct, and all components are in good order, little or no heating of the Bearing Housing in the region of the Bearings should be apparent.

(ii) If one or both Bearings heat quickly and excessively, the test should be stopped, and the Assembly allowed to cool. Heating is excessive if the Bearing Housing is too hot to touch for more than a few seconds.

Rapid heating may be caused by excessive grease in the Bearings. Allow to cool, and then re-start the test. If over-heating is repeated, stop the test.
If excessive heating persists, dismantle the Bearing Assembly, and closely inspect all components. In particular, examine for foreign material in grease and on component parts.

It is normal practice for the C.H. Warman Group to seal the End Cover Set Screws at both ends of the Bearing Assembly, following satisfactory completion of test running, to protect the product Warranty on the Assembly. Holes should be drilled through the heads of two Set Screws, normal to the Set Screw axes. Plaited wire should be threaded through the drilled hole in each Set Screw, and the wire ends encapsulated in a Quality Assurance lead seal to detect prior dismantling. Damage to the lead seal may result in voiding of the product Warranty.

8. STAND-BY PUMPS

Where stand-by pumps remain idle for long periods of time, it is recommended that Shafts be rotated by a quarter turn on a weekly basis. This ensures that static loads and vibrations are shared equally over all rolling elements of Bearings, thus avoiding localised deterioration.

APPENDIX 1

WARMAN BASIC PART NUMBERS

WARMAN BASIC PART No.	STANDARD WARMAN MATERIAL CODE	PART NAME
003	G01	Base
004	G01	Bearing Housing
005	-	Bearing Assembly
008	E02	Bearing Sleeve
009	-	Bearing
009D	-	Bearing - Drive End
024	D20	End Cover
025	P30	Shim/End Cover Gasket
027	-	End Cover Set Screw
046	G01	Grease Retainer
061	E62	Labyrinth Locknut
062	D20	Labyrinth
073	E05	Shaft
089	S10	Bearing Seal
108	G02	Piston Ring
239	E62	Impeller Release Collar
301	E02	Piston Ring Compressor
305	E02	'C' Spanner
307	E02	Lifting Plate
311	-	Shaft Lifting Nut/Eye Bolt
-	-	End Cover Grease Nipple
-	-	Hex Plug

APPENDIX 2

BASIC BEARING ASSEMBLIES - LUBRICATION DATA SHEET

GREASE SPECIFICATION

Lithium soap base grease with EP additives and oxidation inhibitors.

N.L.G.I. Consistency No:	2
Drop Point	> 170° C
Work penetration 25°C A.S.T.M.	265 - 295

RECOMMENDED GREASE: **SHELL ALVANIA EP GREASE 2, CASTROL EPL2,** or equivalent.

GREASE QUANTITY

The recommended initial quantity of grease to be applied to each bearing is as follows:

Bearing Assembly Frame Size	Grease Quantity - gms per Bearing
A	20
B	30
C, CAM	50
D, DAM	100
E, EAM	200
F, FAM	500
G, GAM	1150

Work initial quantity of grease by hand into Bearing on Shaft to fill space between cone, rollers, and roller cage. Spread remainder of grease between Bearing and Grease Retainer.

8HP Molded-Plastic Distribution System

General data

Overview

The SENTRIC HP molded-plastic distribution system is a modular system for low-voltage small distribution boards, control panels and power distribution boards.

SENTRIC HP distribution board with support rack and cable space cover

Benefits

High-quality materials of the enclosures fulfill all the common demands made of such systems in an ideal way. These include:

- Protective insulation
- Corrosion resistance
- Mechanical strength
- Easy to work with
- Temperature resistance
- Free of maintenance
- Flame retardant, self-extinguishing
- Halogen-free (thus preventing consequential damages resulting from fire).
- Low weight of components.

Protective insulation

All enclosure parts and operating mechanisms are constructed so that they fulfill the conditions of the protective measure "total insulation" according to DIN VDE 0100, Part 410, when they are closed during operation. Enclosure fixings are situated outside the device installation space.

Area of application

It can be installed in all industrial plants, power stations, in large public or private buildings and in public utilities as well as in office buildings and residential buildings.

The components of the SENTRIC HP distribution system fulfill the requirements specified for type-tested low-voltage switchgear assemblies (TTA) according to EN 60439-1 (VDE 0660 Part 500). The enclosure corresponds to the protective measure "total insulation" according to DIN VDE 0100.

Specifications

DIN EN 60439-1

Specifications for type-tested low-voltage switchgear assemblies (TTA).

DIN EN 60664-1

Specifications for the rating of creepage distances and clearances of electrical equipment

DIN EN 60947-3

Specifications for low-voltage switchgear and controlgear switches, disconnectors, switch-disconnectors and fuse-combination units.

DIN VDE 0100 (similar IEC 60364)

Specifications for the erection of power installations with rated voltages up to 1000 V.

Statement of conformity

Herewith is stated that the components and distribution boards conform to the safety requirements for low-voltage equipment as laid down in the EEC Directive of February 19, 1973.

Special tests

Fire tests for equipment used in mining are performed by the "Versuchsgrube Tremonia", Dortmund, Germany.

Shock tests for equipment used in protective rooms are performed by the "Bundesamt für Zivilschutz", Bonn, Germany, regulation category RK 1.0/10 to safety level "A", Certificate of use 036 /95.

Earthquake tests are performed by the "IAB", Ottobrunn, Germany. Test for the use in EX-Zone 2 (special versions).

The enclosure is **UL-certified.**

Installation conditions

Installation	Climatic conditions according to DIN 50010	Special operating and ambient conditions
Indoor installation No additional measures required.	An indoor environment is an environment in rooms that are designed such that objects are largely separated from the direct influence of an open-air climate.	If the operating and ambient conditions differ from the standard conditions to DIN VDE 0660 Part 500, Item 6.1, appropriate measures must be taken to protect and maintain the operating capability of the switchgear and controlgear assembly for "Special operating and ambient conditions" according to Item 6.2 (mechanical protection, ventilation, indoor heating, breathers etc.)
External installation Measures: e.g. protected installation or protective roof, if appropriate with additional walls and door (protective cabinet).	An external environment is an environment in rooms that are designed such that objects are protected against direct sunlight and precipitation and possibly against wind, but otherwise are exposed to an open-air climate.	
Outdoor installation Only permissible with measures as for external installation.	An open-air climate is an environment that affects objects in the open air.	

Conversion from Pg to metric screwed glands

A new possibility of using metric screwed glands was tested for the SENTRIC HP molded-plastic distribution system. The result of this test showed that the Pg openings listed in the following table are also suitable for the use of metric screwed glands. Metric screwed glands with lock nut are used. Corresponding sealing washers are used in order to ensure degree of protection IP65.

The values for the tested conversions from Pg to metric screwed glands are shown in the following table.

Pg	Drilling diameter mm	Metric thread
13.5	20.4	M20
16	22.5	M22
21	28.3	M28
29	37	M36
36	47	M46
42	54	M52
49	59.3	M58

Design

The distribution system consists of 5 enclosure sizes with a basic dimension of 307 mm.

The enclosures have removable knockouts for flange openings and cable entries. They can be used for distributed as well as for single installation.

Non-transparent or transparent covers are available (size 2.5 only transparent).

The covers are fitted with quick-release locks which require a tool for opening. They also can be equipped with locks for manual operation as well as with screwed locks.

The internal mounting depth of the enclosures is 147 mm. For enclosure size 2 additional covers are available for mounting depth 212 mm; for enclosure size 2.5 a transparent cover is available for mounting depth 185 mm.

The mounting depth of enclosure sizes 3 and 4 can be extended by means of an intermediate frame. Several frames can be used. Each frame increases the mounting depth by 92.5 mm.

Installation conditions under various climatic conditions, "Application – Installation conditions". Appropriate measures are to be taken (e.g. ventilation, indoor heating) for installation in rooms with high air humidity and heavily varying temperatures in order to exclude generation of harmful condensation water. Breathers must be installed when temperatures vary to a great extent.

Technical specifications

Rated current		A	250	400	630	1000
Rated operating voltage U_e		V	AC 690, DC 600			
Rated insulation voltage U_i		V	AC 1000, DC 1200			
Molded plastic group I	acc. to DIN VDE 0110 Parts 1 and 2/01.89		600 ≤ CTI For the installed devices, the specifications listed in the following catalogs are applicable:			
Rated withstand voltage/pollution degree			8 kV/3			
Minimum air clearances		mm	8			
Minimum creepage distances		mm	12.5			
Rated current	Busbars	V	250	400	630	1000
	Integrated devices	A	800			
	Infeed	A	1800			
Degree of protection	acc. to EN 60529, DIN VDE 0470		IP65 (8HP1 520 cable entry plate and incoming feeder panel with additional measures)			
Color	Enclosure parts		RAL 7035, light gray			
	Transparent cover		Colorless			
	Cable space cover		RAL 7035, light gray			
Ambient temperature		°C	-40... +55			
Busbars						
Rated current		A	250	400	630	1000

8HP Molded-Plastic Distribution System

General data

Rated current		**A**	**250**	**400**	**630**	**1000**
Bar dimensions	Main conductor L1, L2, L3	mm	12 × 5	20 × 8	2 × 20 × 8	2 × 30 × 10
	N- and PE bar	mm	12 × 5	20 × 8	20 × 8	30 × 10
Infeed	Single-sided	A	250	400	630	1000
	Centered	A	400	800	1000	1800
Short-circuit strength of the busbar						
Rated current		A	250	400	630	1000
Max. spacing of busbar holders	307 mm I_{th} (1 s)	kA	10	40	10	40
	307 mm I_s	kA	40	70	20	70
	614 mm I_{th} (1 s)	kA	10	70	30	70
	614 mm I_s	kA	40	80	30	60

Characteristics

	Test acc. to	Unit	Enclosure bottom parts, opaque cover, cover plates	Transparent cover	Cable entry plate, cover lock
Material			Glass-fiber reinforced polyester	Polycarbonate/Makrolon	PBTP-GV
Electrical characteristics					
Surface resistance	DIN 53482	Ω	$>10^{12}$	$>10^{15}$	$>10^{13}$
Tracking resistance	DIN 53480	Level	KA 3c	KA 1	KB 225
Specific insulation resistance	DIN 53482	Ω/cm	$>10^{14}$	$>10^{15}$	$>10^{15}$
Physical characteristics					
Density	DIN 53479/B	g/cm³	1.7	1.2	1.37
Water absorption	DIN 53495/C	%	0.20	0.15	0.45
Temperature resistance					
Flammability	DIN VDE 0304/3		BH2<10 mm	BH2<30 mm	BH2<30 mm
Continuous operating temperature		°C	120	115	120
Mechanical characteristics					
Bending strength	DIN 53452	N/mm²	120	90	140
Notched bar impact strength	DIN 53453	kJ/m²	40	>25	–
Impact strength	DIN 53453	kJ/m²	50	not broken	45
Chemical resistance					
Acid (weak)			resistant	resistant	resistant
Alkali (weak)			resistant	conditionally resistant	conditionally resistant
Alcohol			resistant	resistant	resistant
Gasoline			resistant	resistant	resistant
Benzene			resistant	use polyester cover	resistant
Grease and oil			resistant	conditionally resistant	resistant
Chlorinated hydrocarbons			resistant	use polyester cover	resistant

Impact strength according to Belgian standard NBN C20-001 and French standard NF C20-010

Code	Test values M kg	h m	Enclosure bottom part	Cover
IP65 7	1.5	0.4	8HP1 101 8HP1 102	8HP1 201 8HP1 202/8HP1 212
IP65 8	5	0.2	8HP1 103 8HP1 104	8HP1 203 8HP1 204
IP65 10	15	0.235	8HP1 101 8HP1 102 8HP1 103 8HP1 104	8HP1 221 8HP1 222 8HP1 223 8HP1 224
IP65 11	15	0.4	8HP1 102 8HP1 107	8HP1 232 8HP1 247

REV		DESCRIPTION	PACKAGE NO.	EQPT. NO.	QTY.	UNIT	CAPACITY	SIZE	WEIGHT
		CRUSHING PLANT							
	1	Bin - crushing plant feed	PM-002	10-BN-001	one	each			
	2	Conveyor - crushing plant feed	PM-002	10-CV-001	one	each			
	3	Screen - sizing	PM-002	10-SN-001	one	each			
	4	Conveyor - sizing screen undersize	PM-002	10-CV-002	one	each			
	5	Crusher - primary jaw	PM-002	10-CR-001	one	each		4m long x 0.6m	
	6	Conveyor - jaw crusher product	PM-002	10-CV-003	one	each		9m long x 0.6m	
	7	Stacking conveyor, screen u/size	PM-002	10-CV-004	one	each		12m long x 0.6m	
	8	Stacking conveyor, screen o/size/cone crusher feed	PM-002	10-CV-005	one	each		12m long x 0.6m	
	9	Stacking conveyor, jaw crusher product	PM-002	10-CV-006	one	each		12m long x 0.6m	
	10	Stacking conveyor, cone crusher product	PM-002	10-CV-007	one	each		24S	4400
	11	Secondary cone crusher	PM-005	10-CR-002	one	each			1500
	12	Cone crusher stand and drive	PM-007	n/a	one	each			200
	13	Cone crusher oil tank heater	PM-005	n/a	one	each			50
	14	Cone crusher oil tank heater	PM-005	10-HX-002	one	each			50
	15	Jaw crusher oil tank heater	PM-002	10-HX-001	one	each			
		BULK SAMPLING PLANT - FRONT END EQUIPMENT							
	1	Bin - sample plant feed	PM-001	30-BN-001	one	each		4m x 2m	
	2	Belt feeder	PM-001	30-BF-001				13m long x 0.6m	
	3	Conveyor - sample plant feed	PM-001	30-CV-001	one	each		1.5m diam x 2.4m long	
	4	Scrubber	PM-001	30-SC-001	one	each		1.2m x 3.65m single deck	
	5	Screen - scrubber sizing	PM-001	30-SN-001	one	each			
	6	Pumpbox - effluent	PM-001	30-PB-001	one	each			
	7	Pumpbox - DMS bin feed	PM-001	30-PB-002	one	each		KSB	
	8	Pump - process water	PM-001	20-PU-003	one	each		???	
	9	Pump - effluent (slimes pump)	PM-001	30-PP-001	one	each		4/3WI	
	10	Pump - DMS bin dewatering screen feed (product pump)	PM-001	30-PP-002	one	each		4/3WI	
	11	Pump - secondary cone crusher	PM-001	30-PP-003	one	each		10m long x 0.6m	
	12	Conveyor - secondary crusher feed	PM-001	30-CV-002	one	each		24S	4400
	13	Secondary cone crusher	PM-005	30-CR-001	one	each			200
	14	Cone crusher oil tank heater	PM-005	30-HX-001	one	each			
	15	Pumpbox - secondary cone product	PM-001	30-PB-003	one	each		0.6m x 1.8m	
	16	Screen - DMS feed dewatering	PM-001	30-SN-002	one	each			
	17	Underpan - dewatering screen	PM-001	30-UP-001	one	each			
		DMS MODULE							

1	DMS bin	PM-001	30-BI-001	one	each			
2								
3	Conveyor - DMS feed	PM-001	30-CV-003	one	each			
4	Screen - feed preparation	PM-001	30-SN-003	one	each		0.9m x 2.4m single deck	
5	Underpan - feed prep screen	PM-001	30-UP-002	one	each			
6	Pump - Correct medium	PM-001	30-PP-004	one	each		3/2WI	
7	Agitator - FeSi tank	PM-001	30-AG-001	one	each			
8	Pump - cyclone feed	PM-001	30-PP-005	one	each		4/3WI	
9	Pump - densifier	PM-001	30-PP-006	one	each		1.5/1WI	
10	Cyclone - DMS	PM-001	30-CY-001	one	each		250mm diam	
11	Screen - floats/sinks	PM-001	30-SN-004	one	each		1.2m x 2.4m double deck	
12	Underpan - float/sink screen	PM-001	30-UP-003	one	each			
13	Conveyor - DMS minus 6mm rejects (DMS tailings)	PM-001	30-CV-004	one	each		10m x 0.6m	
14	Conveyor - minus 20mm, plus 6mm recrush feed	PM-001	30-CV-005	one	each		7m long x 0.6m	
15	Magnetic separator	PM-001	30-MS-001	one	each		0.6m diam x 1m	
16	Demag coil	PM-001	30-MC-001	one	each			
17	Pump - magnetic separator effluent	PM-001	30-PP-008	one	each		Jamas spindle	
18	Pump - DMS effluent (slimes)	PM-001	30-PP-009	one	each		3/2WI	
19	Cone crusher - recrush	PM-005	30-CR-002	one	each		24FC	4400
20	Pumpbox - recrush product	PM-001	30-PB-004	one	each			
21	Pump - recrush cone crusher	PM-001	30-PP-007	one	each		3/2WI	
22	Cone crusher oil tank heater	PM-005	n/a	one	each			
23	Cone crusher oil tank	PM-005	30-HX-002	one	each			200
24	Chute - swing conveyor discharge	PM-001	30-CH-001	one	each			
	OTHER EQUIPMENT							
1	Polymer injection system, Clearwater model 50	PP-002	20-PD-001	one	each	HOLD	690X1140X1400 mm	90
2	Raw water pump	PP-001	20-PU-001	one	each	38 usgpm@170 ft TDH	1052 mm X 864 diam	237
3	Reclaim water pump	PP-001	20-PU-002	one	each	380 usgpm@42 ft TDH	1068 mm X 834 diam	245
4	Heat tracing - raw water line		n/a	one	each			
5	Heat tracing - effluent line		n/a	one	each			
6	Heat tracing - reclaim water line		n/a	one	each			
7	Outdoor lighting		n/a	one	each			
8	Indoor ligting		n/a	one	each			
9	Welding machine		n/a	one	each			
10								
11	Diesel powered electrical generator - Main	PE-001	20-DG-001	one	each		160"L x 62"W x 98" H generator; day tank 64" x 10" x 17"	3700
12	Diesel powered electrical generator - Crushing plant	PE-001	20-DG-002	one	each		102"L x 36"W x 86"H generator; 132"L x 36"W x 24"H fuel tank	1850
13								

14	Fan number 1 - Conveyor 30-CV-001		20-FN-001	one	each			
15	Fan number 2 - Conveyor 30-CV-004		20-FN-002	one	each			
16								
17								

SUPPLIER	ELECTRIC	MOTOR	REMARKS
	HP	KW	
	na	n/a	
J.W.Jones Equipment	2 x 10 HP		Two motors one for conveyor and one for feed plate
J.W.Jones Equipment	30 HP		
J.W.Jones Equipment	10 HP		
J.W.Jones Equipment	30 HP		
J.W.Jones Equipment	10 HP		
J.W.Jones Equipment	10 HP		
J.W.Jones Equipment	10 HP		
J.W.Jones Equipment	10 HP		
J.W.Jones Equipment	10 HP		
Klinger Machinery	30 HP		After site preparation will be installed in DMS module
Klinger Machinery	n/a	n/a	Includes belt transmission and guard. Made in three bolted sections, approximately 500 kg each
Klinger Machinery	n/a	n/a	
Klinger Machinery		1.5 KW	1.5 KW for integrated oil heater. After site preparation will be installed in DMS module
J.W.Jones Equipment		1.5 KW	1.5 KW for integrated oil heater.
Bond Industries	n/a		C/W grizzly 100mm aperture
Bond Industries	4HP	3	
Bond Industries	2HP	1.5	VSM Mechanical
Bond Industries	2 x 10HP	2 x 7.5	300mm pneumatic tyre driven
Bond Industries	2 x 3HP	2 x 2	2.4m @ 1mm & 1.6m @ 20mm apertures
Bond Industries	n/a	n/a	
Bond Industries	n/a	n/a	
Bond Industries	50HP	37	
Bond Industries	40HP	30	Warman International
Bond Industries	20HP	15	Warman International
Bond Industries	20HP	15	Warman International
Bond Industries	4 HP	3	
Klinger Machinery	30HP	22	Moved from crushing plant, after site preparation
Klinger Machinery		1.5 KW	1.5 KW for integrated oil heater. Moved from crushing plant after site preparation. Was identified 10-HX-001 in crushing plant
Bond Industries	n/a	n/a	
Bond Industries	2 x 0.5HP	2 x 0.37	
Bond Industries	n/a	n/a	

Bond Industries	n/a	n/a	
Bond Industries	2HP	1.5	VSM Mechanical
Bond Industries	2 x 3HP	1 x 2.2	
Bond Industries	n/a	n/a	
Bond Industries	20HP	15	Warman International
Bond Industries	7.5HP	5.5	
Bond Industries	30HP	22	Warman International
Bond Industries	7.5HP	5.5	Warman International
Bond Industries	n/a	n/a	Multotec
Bond Industries	2 x 3HP	2 x 2.2	
Bond Industries	n/a	n/a	
Bond Industries	4HP	3	
Bond Industries	2HP	1.5	
Bond Industries	1HP	0.75	Eriez
Bond Industries	n/a	n/a	
Bond Industries	7.5 HP	5.5	Jamas
Bond Industries	10HP	7.5	Warman International
Klinger Machinery	30HP	22	
Bond Industries	n/a	n/a	
Bond Industries	15HP	11	Warman International
Klinger Machinery	1.5 KW		1.5kW for integrated oil heater
Klinger Machinery	n/a	n/a	
Bond Industries	n/a	n/a	
Clearwater Industries	7 KW		Power consumption 30A, 115/1/60
ITT Flygt	25 HP		Flygt NS3153 SH
ITT Flygt	20 HP		Flygt NS3153 MT
	11 KW		Also on emergency stand by
	5.5 KW		Also on emergency stand by
	3KW		Also on emergency stand by
	7 KW		Also on emergency stand by
	5 KW		Also on emergency stand by
	27 KW		
Diesel Service and Supply	410KW		Prime power
Diesel Service and Supply	160KW		Prime power

LAJOIE SOMEC	1HP		
LAJOIE SOMEC	1HP		

			Warman International
			Warman International
			Warman International
			Multotec
			Eriez
			Jamas
			Warman International
			Warman International
			1.5kW for integrated oil heater
			Power consumption 30A, 115/1/60
			Flygt NS3153 SH
			Flygt NS3153 MT
			Also on emergency stand by
			Also on emergency stand by
			Also on emergency stand by
			Also on emergency stand by
			Also on emergency stand by
			Prime power
			Prime power