

# Quad-Drive Ser.2 & Binary-Drive Ser.2

MANUAL AND PLC CONTROLLED PARAFLOW PHE'S

FORM No.: UM-QBD2 REVISION: 01 12/2012

READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.







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## About this manual

This User Manual covers information specific to the powered (PLC controlled) and manual Quad-Drive Series 2 and Binary-Drive Series 2 Heat Exchangers and should be read in conjunction with the general APV Paraflow Plate Heat Exchanger Instruction Manual, **PHE 1000E-GB**, supplied with this manual.

## Where to begin

- For fully assembled, powered PHE: Connect according to 07 ELECTRICAL SYSTEM and see 09 SCREEN OPERATION for instructions on how to open and close your machine.
- For fully assembled, manual PHE: See subsection 10.1 (QD) or 14.1 (BD) Drive extension in the applicable FRAME ASSEMBLY section.
- For disassembled, powered or manual PHE: Read and follow all applicable sections in the APPLICABLE FRAMES table below, beginning with FRAME CONSTRUCTION.

## Troubleshooting

If you experience any operation difficulty, go to the troubleshooting sections as follows:

| Problem description                     | Manual           | Section | Section Title         |
|-----------------------------------------|------------------|---------|-----------------------|
| General PHE and process issues          | PHE 1000E-GB     | 06      | Startup and operation |
| Screen, electrical and hydraulic issues | This User Manual | 11      | Troubleshooting       |
| Powered frame mechanical issues         | This User Manual | 11      | Troubleshooting       |

### KEY TO APPLICABLE FRAMES

|            |                                             |
|------------|---------------------------------------------|
| <b>QDP</b> | QUAD-DRIVE SER.2 POWERED (PLC CONTROLLED)   |
| <b>QDM</b> | QUAD-DRIVE SER.2 MANUAL                     |
| <b>BDP</b> | BINARY-DRIVE SER.2 POWERED (PLC CONTROLLED) |
| <b>BDM</b> | BINARY-DRIVE SER.2 MANUAL                   |

| No. | SECTION TITLE         | APPLICABLE FRAMES |     |     |     |
|-----|-----------------------|-------------------|-----|-----|-----|
|     |                       | QDP               | QDM | BDP | BDM |
| 00  | INTRODUCTION          | ■                 | ■   | ■   | ■   |
| 01  | QD FRAME CONSTRUCTION | ■                 | ■   |     |     |
| 02  | BD FRAME CONSTRUCTION |                   |     | ■   | ■   |
| 03  | QD FRAME ASSEMBLY     | ■                 | ■   |     |     |
| 04  | BD FRAME ASSEMBLY     |                   |     | ■   | ■   |
| 05  | QD DRIVE ASSEMBLY     | ■                 | ■   |     |     |
| 06  | BD DRIVE ASSEMBLY     |                   |     | ■   | ■   |
| 07  | ELECTRICAL SYSTEM     | ■                 |     | ■   |     |
| 08  | HYDRAULIC SYSTEM      | ■                 |     | ■   |     |
| 09  | SCREEN OPERATION      | ■                 |     | ■   |     |
| 10  | MAINTENANCE           | ■                 | ■   | ■   | ■   |
| 11  | TROUBLESHOOTING       | ■                 |     | ■   |     |

## **Warrantee**

Seller warrants its products to be free from defect in materials and workmanship for a period of one (1) year from the date of shipment. This warranty shall not apply to products which require repair or replacement due to normal wear and tear or to products which are subjected to accident, misuse or improper maintenance. This warranty extends only to the original Buyer. Products manufactured by others but furnished by Seller are exempted from this warranty and are limited to the original manufacturer's warranty.

Seller's sole obligation under this warranty shall be to repair or replace any products that Seller determines, in its discretion, to be defective. Seller reserves the right either to inspect the products in the field or to request their prepaid return to Seller. Seller shall not be responsible for any transportation charges, duty, taxes, freight, labor or other costs. The cost of removing and/or installing products which have been repaired or replaced shall be at Buyer's expense.

Seller expressly disclaims all other warranties, express or implied, including without limitation any warranty of merchantability of fitness for a particular purpose. The foregoing sets forth Seller's entire and exclusive liability, and Buyer's exclusive and sole remedy, for any claim of damages in connection with the sale of products. In no event shall Seller be liable for any special consequential incidental or indirect damages (including without limitation attorney's fees and expenses), nor shall Seller be liable for any loss of profit or material arising out of or relating to the sale or operation of the products based on contract, tort (including negligence), strict liability or otherwise.

## **Shipping Damage or Loss**

If equipment is damaged or lost in transit, file a claim at once with the delivering carrier. The carrier has signed the Bill of Lading acknowledging that the shipment has been received from SPX Flow Technology in good condition. SPX Flow Technology is not responsible for the collection of claims or replacement of materials due to transit shortages or damages.

## **Warranty Claim**

Warranty claims must have a **Returned Goods Authorization (RGA)** from the Seller before returns will be accepted.

Claims for shortages or other errors, exclusive of transit shortages or damages, must be made in writing to Seller within ten (10) days after delivery. Failure to give such notice shall constitute acceptance and waiver of all such claims by Buyer.

## Safety

### **READ AND UNDERSTAND THIS MANUAL PRIOR TO INSTALLING, OPERATING, OR SERVICING THIS EQUIPMENT**

APV recommends users of our equipment and designs follow the latest Industrial Safety Standards. At a minimum, these should include the industrial safety requirements established by:

1. Occupational Safety and Health Administration (OSHA), Title 29 of the CFR  
Section 1910.212- General Requirements for all Machines
2. National Fire Protection Association, ANSI/NFPA 79  
ANSI/NFPA 79- Electrical Standards for Industrial Machinery
3. National Electrical Code, ANSI/NFPA 70  
ANSI/NFPA 70- National Electrical Code  
ANSI/NFPA 70E- Electrical Safety Requirement for Employee Workplaces
4. American National Standards Institute, Section B11

**Attention:** Servicing energized industrial equipment can be hazardous. Severe injury or death can result from electrical shock, burn, or unintended actuation of controlled equipment. Recommended practice is to disconnect and lockout industrial equipment from power sources, and release stored energy, if present. Refer to the National Fire Protection Association Standard No. NFPA70E, Part II and (as applicable) OSHA rules for Control of Hazardous Energy Sources (Lockout-Tagout) and OSHA Electrical Safety Related Work Practices, including procedural requirements for:

- Lockout-tagout
- Personnel qualifications and training requirements
- When it is not feasible to de-energize and lockout-tagout electrical circuits and equipment before working on or near exposed circuit parts

**Locking and Interlocking Devices:** These devices should be checked for proper working condition and capability of performing their intended functions. Make replacements only with the original manufacturer's renewal parts or kits. Adjust or repair in accordance with the manufacturer's instructions.

**Periodic Inspection:** Industrial equipment should be inspected periodically. Inspection intervals should be based on environmental and operating conditions and adjusted as indicated by experience. At a minimum, an initial inspection within 3 to 4 months after installation is recommended. Inspection of the electrical control systems should meet the recommendations as specified in the National Electrical Manufacturers Association (NEMA) Standard No. ICS 1.3, Preventative Maintenance of Industrial Control and Systems Equipment, for the general guidelines for setting-up a periodic maintenance program.

**Replacement Equipment:** Use only replacement parts and devices recommended by the manufacturer to maintain the integrity of the equipment. Make sure the parts are properly matched to the equipment series, model, serial number, and revision level of the equipment.

Warnings and cautions are provided in this manual to help avoid serious injury and/or possible damage to equipment:



**WARNING:** marked with a warning triangle. Hazards or unsafe practices which *COULD* result in severe personal injury or death.



**CAUTION:** marked with a warning triangle. Hazards or unsafe practices which *COULD* result in minor personal injury or product or property damage

#### 1 Frame

A typical, powered Quad-Drive Series 2 Paraflow plate heat exchanger is shown in '5 POWERED QUAD-DRIVE FRAME'. Primary components consist of a stationary head and end support, connected by a top bar and bottom bar. These components are bolted together to form a rigid frame that supports the thin, metal, heat transfer plates, moveable follower and four tie bars.

Each heat transfer plate is separated by a gasket and compressed between the head and follower by rotation of four tie bars located above and below the plate pack. Liquids are introduced to the heat exchanger through connections located in the head, follower and, when supplied, connector grid(s).

For details about plate sequence, number and type of connector grids, Divider Plates (sometimes supplied) and flow arrangement, see the laminated plate arrangement drawing that came with your Paraflow.

When Quad-Drive Paraflows are opened, the follower is drawn back along the top bar by four, simultaneously rotating tie bars to allow full access to each heat transfer plate, Divider Plate and grid.

Quad-Drive frames are designed for sanitary duties and fabricated from stainless steel clad, carbon steel and other sanitary, corrosion resistant alloys. The finish is primarily a #4 polish with certain components receiving a glass bead blast finish. Standard connections are sanitary tube fittings at all locations. Other fittings may have been supplied to special order.

Divider Plates (sometimes supplied) may be used to divide a heat exchanger into separate sections. Divider Plates have no connections but do allow flow from one section to the next.

Connector grids may be used to divide a heat exchanger into separate sections to accommodate multiple duties within a single frame. General details of connector grids will be found in the CONNECTOR GRID section of the General User Manual.

#### 2 Frame types

Quad-Drive frames are available in both manual and powered versions. The frames are also available in a number of different lengths, or frame sizes, to accommodate the required number of plates, grids and Divider Plates.

Except for the largest two sizes (FS6500 & 8000) all frames can accommodate the same minimum number of plates (generally 3) up to the designed maximum.

All but the longest frame is designed to be expandable in length by replacement of the top, bottom and tie bars and sometimes other components.

Manual frames are designed to be easily upgraded to a powered version by adding a power pack, hydraulic motor drive system and modular electrical box. The upgrade can be accomplished within a single day and while the heat exchanger is running its duty.

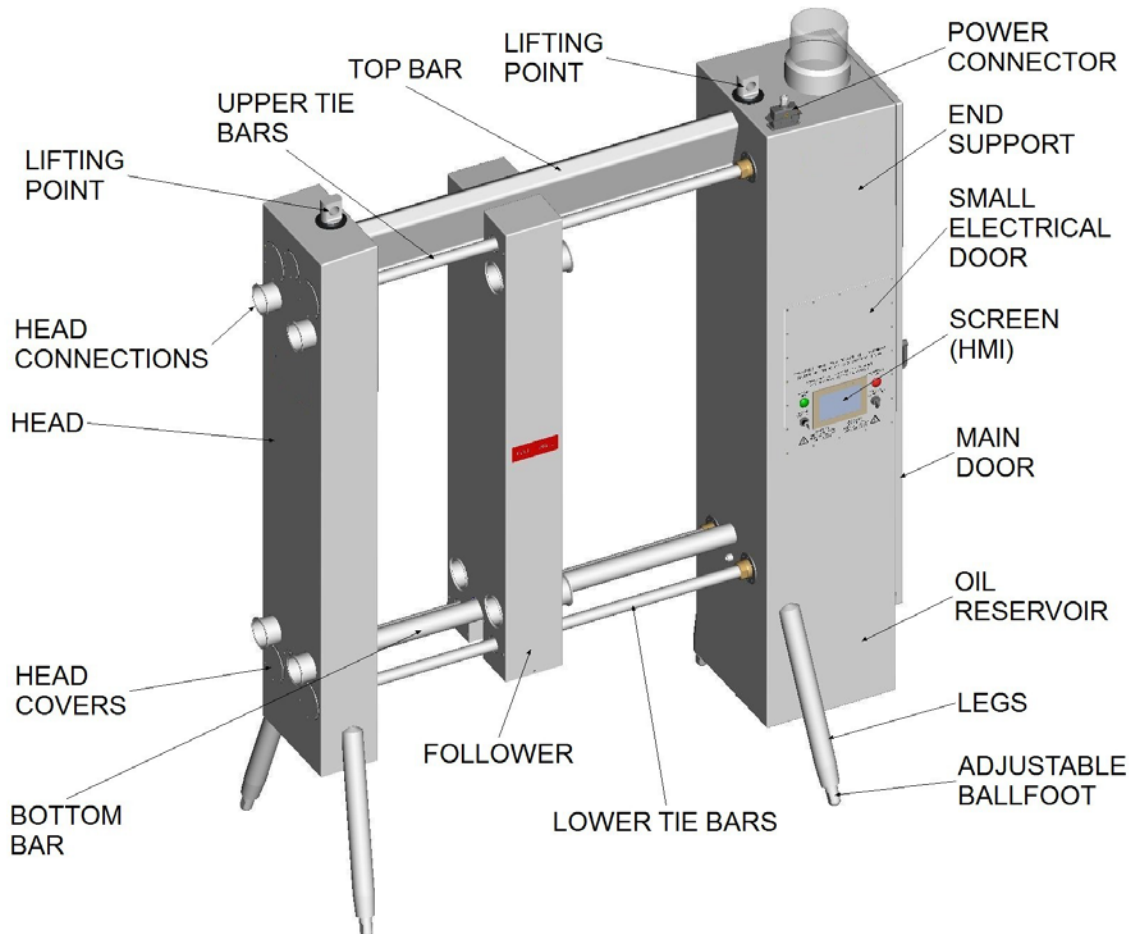
#### 3 Manually closed frame

The manual frame has no hydraulic system but is instead provided with two closing points, each with a different drive ratio. The first, an auxiliary closing extension shaft, is installed on a lower tie bar (usually number 3 on bottom left looking into end support). This is used to rapidly close the machine near to pitch. When tightening becomes difficult, the supplied wrench can be moved to the hexagon on the primary drive to finally bring the Paraflow to pitch. Quad-Drive technology is fully employed on the manual frame ensuring the follower remains parallel to the head at all times.

#### 4 Powered end support

The powered Quad-Drive Paraflow provides completely automated frame opening and closing. An overall view of the powered frame is shown following. See 07 ELECTRICAL SYSTEM section for a description of the electrical system and how to connect the Quad-Drive to the power supply. See also 08 HYDRAULIC SYSTEM section for a description of the hydraulic system.

#### 5 Powered Quad-Drive frame



#### 6 Component items

The following PARTS TABLE lists the major mechanical frame components, including possible replacement items, together with their part numbers. Following the PARTS TABLE is a typical linked tie bar assembly with all associated components.

A more detailed description of the majority of the assembly components is found within 03 QD FRAME ASSEMBLY section. Should the need arise to replace parts for which the part number is not shown, please order by description giving quantity required together with the Paraflow name and serial number engraved on the nameplate (eg: Tie bar sprocket, 4-pieces, R5 Quad-Drive Series 2 Paraflow, serial number 2012-XXXX).

#### 7 Frame extensions and reductions

The following PARTS TABLE may also be used to determine the components needed to increase (or reduce) the frame size should this be necessary. Please note that for powered machines, certain parameters will need to be updated in the PLC by SPX when frame sizes are changed.

Quad-Drive frame extensions and reductions should only be performed by trained personnel to ensure correct disassembly and re-assembly.



#### 8 Parts table

| Description                            | Qty per Frame | Part Number | Remarks                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------|---------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Head assembly Mk2                      | 1             | 3900 3976   | Excludes legs, ballfeet and fasteners                                                                                                                                                                                                                                                                                                |
| Follower assembly                      | 1             | 3900 3127   | Includes slide strips but not rollers                                                                                                                                                                                                                                                                                                |
| End support – Right Hand POWERED Mk2   | 1             | 3900 3979   | Excludes legs, ballfeet and fasteners                                                                                                                                                                                                                                                                                                |
| End support – Left Hand POWERED Mk2    | 1             | 3900 3980   | Excludes legs, ballfeet and fasteners                                                                                                                                                                                                                                                                                                |
| End support – Right Hand MANUAL Mk2    | 1             | 3900 3981   | Excludes legs, ballfeet and fasteners                                                                                                                                                                                                                                                                                                |
| End support – Left Hand MANUAL Mk2     | 1             | 3900 3982   | Excludes legs, ballfeet and fasteners                                                                                                                                                                                                                                                                                                |
| Leg for head and end support           | 4             | 3900 3117   |                                                                                                                                                                                                                                                                                                                                      |
| Ballfoot                               | 4             | 3900 3118   |                                                                                                                                                                                                                                                                                                                                      |
| Leg fastener (M16 x 45lg SHCS)         | 16            | 3900 1541   | (Grade 12.9)                                                                                                                                                                                                                                                                                                                         |
| Modular electrical box (460v Siemens)  | 1             | 3900 3232   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (230v Siemens)  | 1             | 3900 3674   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (460v A/B L31)  | 1             | 3900 3233   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (230v A/B L31)  | 1             | 3900 3675   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (460v A/B L32E) | 1             | 3900 3234   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (230v A/B L32E) | 1             | 3900 3676   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (460v A/B L43)  | 1             | 3900 3235   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Modular electrical box (230v A/B L43)  | 1             | 3900 3677   | Excludes the four aux assy's below                                                                                                                                                                                                                                                                                                   |
| Aux wiring assy - warning light        | 1             | 3900 3172   |                                                                                                                                                                                                                                                                                                                                      |
| Aux wiring assy - internal power cable | 1             | 3900 3173   |                                                                                                                                                                                                                                                                                                                                      |
| Aux wiring assy – door switch          | 1             | 3900 3174   |                                                                                                                                                                                                                                                                                                                                      |
| Aux wiring assy – pulser wire          | 1             | 3900 3175   |                                                                                                                                                                                                                                                                                                                                      |
| Top bar 1500 mm long                   | 1             | 3900 1950   | Also order: Seal rings – 2 x 3900 1585                                                                                                                                                                                                                                                                                               |
| Top bar 2500 mm long                   | 1             | 3900 1951   | Also order: Seal rings – 2 x 3900 1585                                                                                                                                                                                                                                                                                               |
| Top bar 3500 mm long                   | 1             | 3900 1952   | Also order: Seal rings – 2 x 3900 1585                                                                                                                                                                                                                                                                                               |
| Top bar 4500 mm long                   | 1             | 3900 1953   | Also order: Seal rings – 2 x 3900 1585                                                                                                                                                                                                                                                                                               |
| Top bar 5500 mm long                   | 1             | 3900 1954   | Also order: Seal rings – 2 x 3900 1585                                                                                                                                                                                                                                                                                               |
| Top bar 6500 mm long Mk2               | 1             | 3900 3972   | Also order: M36 SHCS – 2 x 3900 1583<br>Lift block - 2 x 3900 3777<br>Spacer at head – 1 x 3900 3778<br>Spacer at E.S. – 1 x 3900 3779<br>Cap for SHCS – 2 x 3900 3967<br>Seal rings – 2 x 3900 1585<br>Seal strip – 2 x 3900 1898<br>Tie bar support assy's – 2 x 3900 3989<br>Guard for tie bar sup – 2 x 3900 2496<br>See note 1. |

|                                              |        |                          |                                                                                                                                         |
|----------------------------------------------|--------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Top bar 8000 mm long Mk2                     | 1      | 3900 3973                | Also order items shown for 6500 top bar. See Note 1.                                                                                    |
| Bottom bar 1500 mm long                      | 1      | 3900 1475 +<br>3900 1269 | Also order: O-rings – 2 x 9041 3411                                                                                                     |
| Bottom bar 2500 mm long                      | 1      | 3900 1335 +<br>3900 1271 | Also order: O-rings – 2 x 9041 3411                                                                                                     |
| Bottom bar 3500 mm long                      | 1      | 3900 1337 +<br>3900 0331 | Also order: O-rings – 2 x 9041 3411                                                                                                     |
| Bottom bar 4500 mm long                      | 1      | 3900 1339 +<br>3900 0333 | Also order: O-rings – 2 x 9041 3411                                                                                                     |
| Bottom bar 5500 mm long                      | 1      | 3900 1476 +<br>3900 1477 | Also order: O-rings – 2 x 9041 3411                                                                                                     |
| Bottom bar 6500 mm long Mk2                  | 1      | 3900 3994                | Also order: Seal rings – 2 x 3900 1478<br>Tie bar support assy's – 2 x 3900 3989<br>Guard for tie bar sup – 2 x 3900 2496<br>See note 1 |
| Bottom bar 8000 mm long Mk2                  | 1      | 3900 3995                | Also order: Seal rings – 2 x 3900 1478<br>Tie bar support assy's – 2 x 3900 3989<br>Guard for tie bar sup – 2 x 3900 2496<br>See note 1 |
| Tie bar detail (FS1500)                      | 4      | 3900 3190                | See Note 2                                                                                                                              |
| Tie bar detail (FS2500)                      | 4      | 3900 3191                | See Note 2                                                                                                                              |
| Tie bar detail (FS3500)                      | 4      | 3900 3192                | See Note 2                                                                                                                              |
| Tie bar detail (FS4500)                      | 4      | 3900 3193                | See Note 2                                                                                                                              |
| Tie bar detail (FS5500)                      | 4      | 3900 3194                | See Note 2                                                                                                                              |
| Tie bar details (FS6500)                     | 4<br>4 | 3900 3192 +<br>3900 1460 | See Note 2. Also order:<br>Link piece – 4 x 3900 1649<br>Link cap – 8 x 3900 1650<br>Link key – 8 x 39001633                            |
| Tie bar details (FS8000)                     | 4<br>4 | 3900 3192 +<br>3900 1461 | See Note 2. Also order:<br>Link piece – 4 x 3900 1649<br>Link cap – 8 x 3900 1650<br>Link key – 8 x 39001633                            |
| Free nut type-1                              | 4      | 3900 3180                | See Note 3                                                                                                                              |
| Free nut type-2                              | 4      | 3900 3222                | See Note 3                                                                                                                              |
| Roller assembly (tire and bearing)           | 2      | 3056 0194                |                                                                                                                                         |
| Roller spindle                               | 2      | 3056 0196                |                                                                                                                                         |
| Roller bolt (M12 x 40 flat head soc. screw)  | 2      | 3900 1542                |                                                                                                                                         |
| Follower slide block type-2                  | 2      | 3900 1654                |                                                                                                                                         |
| Screw for slide block (M8 x 16 button head)  | 4      | 3900 1544                |                                                                                                                                         |
| Roller chain 60RIV – 84.75" inc. master link | 4      | 3900 1595                |                                                                                                                                         |
| Roller chain 80RIV – 50" inc. master link    | 1      | 3900 3140                |                                                                                                                                         |
| M24 ratchet wrench                           | 1      | 500902                   |                                                                                                                                         |
| Ratchet socket wrench for 46 A/F socket      | 1      | 3900 1603                | See Note 4                                                                                                                              |

|                                   |      |           |                                           |
|-----------------------------------|------|-----------|-------------------------------------------|
| Socket 46 mm A/F                  | 1    | 3900 1604 | See Note 4                                |
| Drain screw for oil reservoir     | 1    | 3900 1557 | M16 x 25 hex head S.S. screw              |
| Copper washer for oil drain screw | 1    | 3900 1558 | M16                                       |
| M4 x 12 long button head screw    | each | 3900 3111 | See note 5                                |
| M4 nylon washer                   | each | 3900 3112 | See note 5                                |
| Metal seal assembly Mk3           | 8    | 3900 3750 |                                           |
| Large head cover O-ring           | 4    | 3900 1627 |                                           |
| Small head cover O-ring           | 2    | 3900 1626 |                                           |
| Thrust bearing                    | 4    | 3900 1571 |                                           |
| Ball bearing                      | 10   | 3900 1570 |                                           |
| Split grip ring for head seals    | 4    | 3900 4197 | Previous version, 3900 3749, also useable |
| Flange bearing                    | 2/4  | 3900 1560 | Powered = 2, Manual = 4                   |
| Idler shaft for sprockets         | 5    | 3900 1569 |                                           |
| Idler sprocket – 60B14            | 4    | 3900 1564 | Secondary chains                          |
| Idler sprocket – 80B14            | 1    | 3900 3137 | Primary chain                             |

**Note 1:** the 6500 and 8000 top and bottom bar components identified in remarks (except seals which should always be ordered with 6500 & 8000 bars) are only required when increasing from any frame of 5500 mm long carry bars or below.

**Note 2:** Tie bar detail part numbers are for threaded bars and exclude all other items (nuts, seals, bearings, shims, keys, screws, etc). When changing frame sizes, all existing tie bar assembly parts may be reused except the free nut which, depending on wear, may need to be replaced.

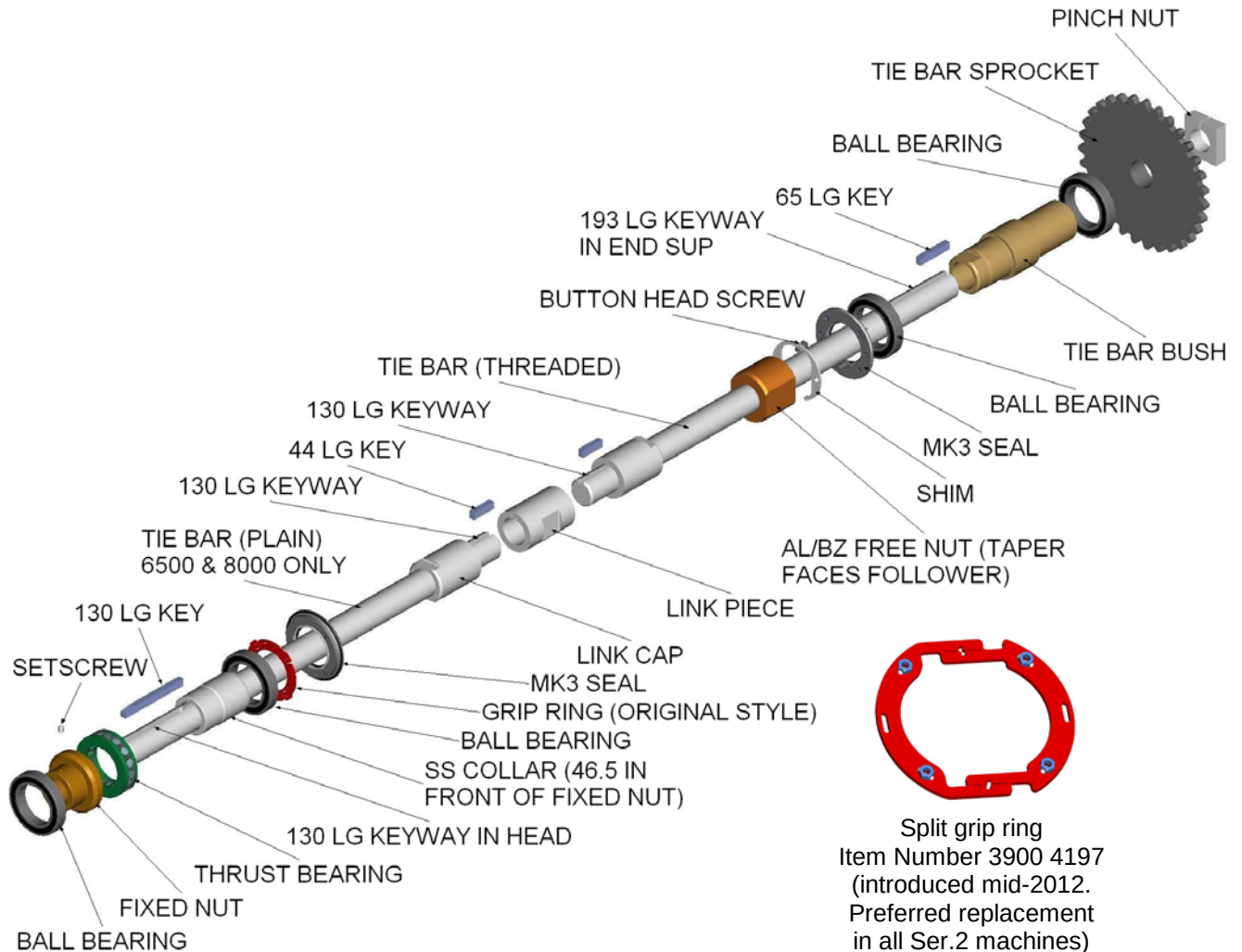
**Note 3:** Type-1 free nuts were supplied on one QDS2 (S/N 2009-0733) only and were 45 mm long. Type-2 free nuts are 67 mm long and supplied on all other Series 2 machines. Type-1 and type-2 free nuts are not interchangeable.

**Note 4:** The ratchet socket wrench and 46 A/F socket will tighten both the powered and manual versions. However, the powered Quad-Drive is not supplied with this tool nor does it normally need it.

**Note 5:** The M4 screw and washer are used for the small electrical door (qty = 20), six head covers (qty = 36) and the manual frames' power-in closing plate (qty = 4).

#### 9 Tie Bar Assembly

The following illustration shows a linked tie bar assembly with all associated components. Many, but not all, are listed in the PARTS TABLE above. The assembly illustrated applies to 6500 mm and 8000 mm long carry bars. For shorter frames, the plain tie bar, link caps and link piece are not used.



#### 10 Powered end support enclosure

For parts breakdown including additional replacement parts for electrical system and all parts for the hydraulic system, see 07 ELECTRICAL SYSTEM and 08 HYDRAULIC SYSTEM' sections.

**1 Frame**

A typical, powered Binary-Drive Series 2 Paraflow plate heat exchanger is shown in '5 POWERED BINARY-DRIVE FRAME'. Primary components consist of a stationary head and an end support, connected by a top bar and bottom bar. These components are bolted together to form a rigid frame that supports the thin, metal, heat transfer plates, moveable follower and two tie bars.

Each plate is separated by a gasket and compressed between the head and follower by rotation of two tie bars located above and below the plate pack. Fluids are introduced to the heat exchanger through connections located in the head, follower and, when supplied, connector grid(s).

For details about plate sequence, number and type of connector grids, Divider Plates (available for some models) and flow arrangement, see the Customer Drawing that came with your Paraflow.

When Binary-Drive Paraflows are opened, the follower is drawn back along the top bar by two, simultaneously rotating tie bars to allow full access to each heat transfer plate, Divider Plate and grid.

Binary-Drive frames are designed for sanitary duties and fabricated from stainless steel clad carbon steel and other sanitary, corrosion resistant alloys. The finish is primarily a #4 polish with certain components receiving a glass bead blast finish. Standard connections are sanitary tube fittings at all locations. Other fittings may have been supplied to special order.

Divider Plates (sometimes supplied) may be used to divide a heat exchanger into separate sections. Divider Plates have no connections but do allow flow from one section to the next.

Connector grids may be used to divide a heat exchanger into separate sections to accommodate multiple duties within a single frame. General details of connector grids will be found in the 'CONNECTOR GRID' section of this User Manual.

**2 Frame types**

Binary-Drive frames are available in both manual and powered versions. The frames are also available in a number of different lengths, called frame sizes, to accommodate the required number of plates, grids and Divider Plates.

Each frame size can accommodate the same minimum number of plates (generally 3) up to the designed maximum.

All but the longest frame is designed to be expandable in length by replacement of the top bar, bottom bar and tie bars.

Manual frames are designed to be easily upgraded to a powered version by adding a power pack, hydraulic motor drive system and modular electrical box. The upgrade can be accomplished within a single day and while the heat exchanger is running its duty.

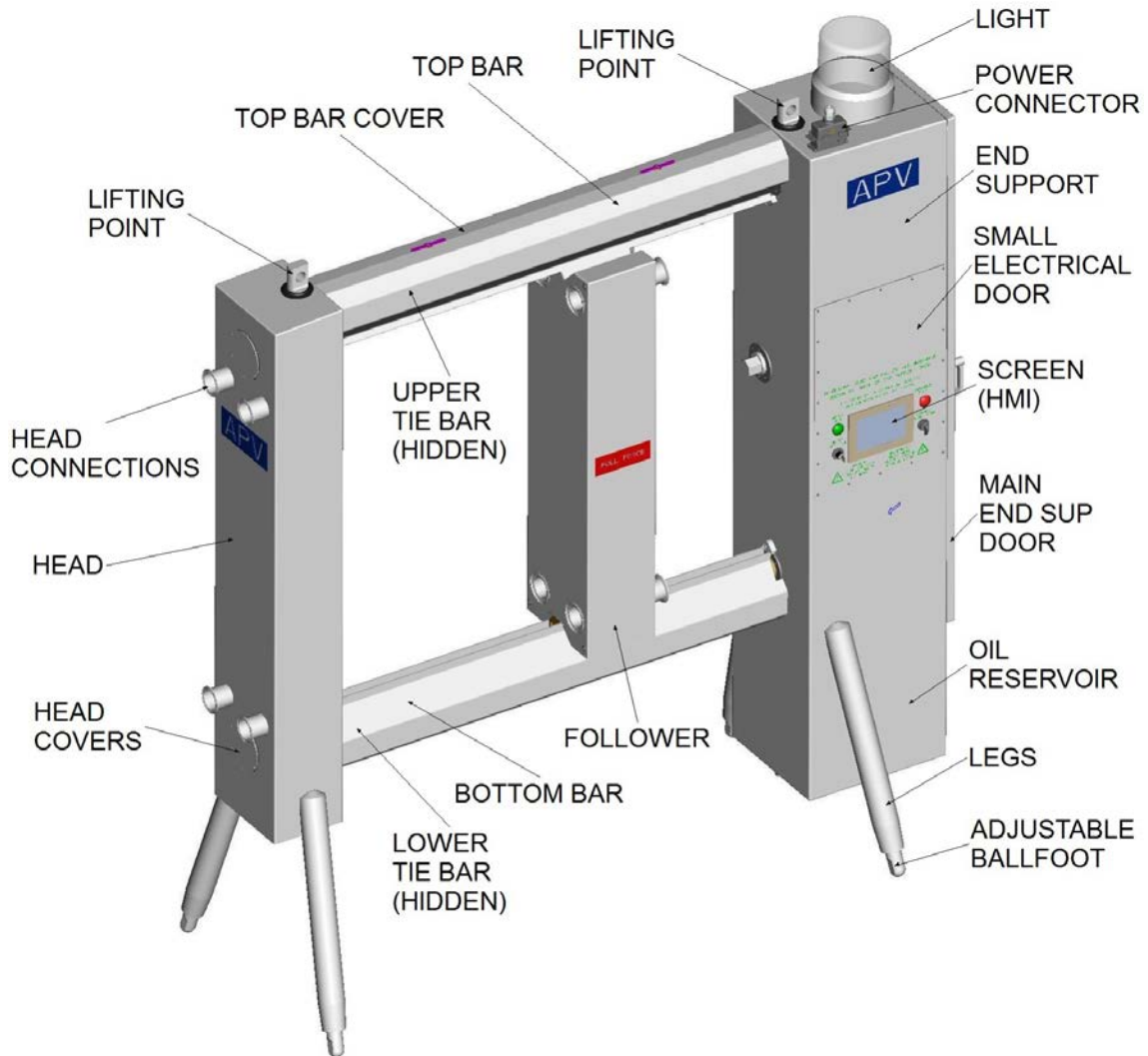
**3 Manual end support**

The manual frame has no hydraulic system but is instead provided with two closing points, each with a different drive ratio. The first, an auxiliary closing extension shaft, is installed on the lower tie bar. This is used to rapidly close the machine near to pitch. When tightening becomes difficult, the supplied wrench should be moved to the primary closing shaft located on the outside of the end support and facing the follower. The Paraflow can then be brought to pitch. Binary-Drive technology is fully employed on the manual frame ensuring the follower remains parallel to the head at all times.

**4 Powered end support**

The powered Binary-Drive Paraflow provides completely automated frame opening and closing. An overall view of the powered frame is shown following. See 07 ELECTRICAL SYSTEM section for a description and breakdown of the electrical system and how to connect the Binary-Drive to the power supply. Also see 08 HYDRAULIC SYSTEM section for a description of the hydraulic system.

#### 5 Powered Binary-Drive frame



#### 6 Component items

The following PARTS TABLE lists the major mechanical frame components, including possible replacement items, together with their part numbers. Following the PARTS TABLE is a typical tie bar assembly with all associated components. A more detailed description of the majority of the assembly components is found within the 04 BD FRAME ASSEMBLY section. Should the need arise to replace parts for which the part number is not shown, please order by description giving quantity required together with the Paraflow name and serial number (eg: Tie bar sprocket, 2-pieces, V028

Binary-Drive Series 2 Paraflow, serial number 2012-XXXX).

#### 7 Frame extensions and reductions

The following PARTS TABLE may also be used to determine the components needed to increase (or reduce) the frame size should this be necessary. Please note that for powered machines, certain machine parameters will need to be updated in the PLC by SPX when frame sizes are changed.

Binary-Drive frame extensions and reductions should only be performed by trained personnel to ensure correct disassembly and re-assembly.

#### 8 Parts table

| Description                                 | Qty per Frame | Part Number | Remarks                                |
|---------------------------------------------|---------------|-------------|----------------------------------------|
| Head assembly (Ser.2)                       | 1             | 3900 3694   | Includes legs and ballfeet             |
| Follower assembly (Ser.2)                   | 1             | 3900 3697   | Does not include guide block           |
| End support assembly (Ser.2) RH powered     | 1             | 3900 3666   | Includes legs and ballfeet             |
| End support assembly (Ser.2) LH powered     | 1             | 3900 3667   | Includes legs and ballfeet             |
| End support assembly (Ser.2) RH manual      | 1             | 3900 3668   | Includes legs and ballfeet             |
| End support assembly (Ser.2) LH manual      | 1             | 3900 3669   | Includes legs and ballfeet             |
| Top bar assembly 1500 long (FS.1) Ser.2     | 1             | 3900 3685   | Also order: O-rings – 4 x 3900 2100    |
| Top bar assembly 2500 long (FS.2) Ser.2     | 1             | 3900 3686   | Also order: O-rings – 4 x 3900 2100    |
| Top bar assembly 3500 long (FS.3) Ser.2     | 1             | 3900 3687   | Also order: O-rings – 4 x 3900 2100    |
| Bottom bar assy 1500 long (FS.1) Ser.2      | 1             | 3900 3691   | Also order: O-rings – 4 x 3900 2100    |
| Bottom bar assy 2500 long (FS.2) Ser.2      | 1             | 3900 3692   | Also order: O-rings – 4 x 3900 2100    |
| Bottom bar assy 3500 long (FS.3) Ser.2      | 1             | 3900 3693   | Also order: O-rings – 4 x 3900 2100    |
| Tie Bar 1.75" ACME – 1860 LG (FS.1)         | 2             | 3900 3773   | See Note 1                             |
| Tie Bar 1.75" ACME – 2860 LG (FS.2)         | 2             | 3900 3774   | See Note 1                             |
| Tie Bar 1.75" ACME – 3860 LG (FS.3)         | 2             | 3900 3775   | See Note 1                             |
| Free Nut type-4                             | 2             | 3900 2487   | See Note 2                             |
| Retaining screw for free nut                | 6             | 3900 2489   | 1/4"-20 x 1/2" lg SS button head screw |
| Shim typ-2 for free nut                     | 2             | 3900 2486   |                                        |
| Pinch nut assembly                          | 2             | 3900 1948   | See Note 1                             |
| Follower roller with bearing                | 4             | 3056 0194   |                                        |
| Follower roller spindle                     | 4             | 3056 0196   |                                        |
| Follower roller bolt                        | 4             | 3900 2101   | M12 x 35 flat head socket SS screw     |
| Follower Guide Block Ser.2                  | 1             | 3900 3706   |                                        |
| Follower Guide Block Screw                  | 1             | 3900 2066   | M8 x 30 flat head socket SS screw      |
| Ball foot (M42)                             | 4             | 3900 3118   |                                        |
| Roller chain 60RIV – 71.25" inc master link | 2             | 3900 2060   | Used on powered and manual versions    |
| M24 ratchet wrench                          | 1             | 500902      | Chain adjustment only                  |
| M30 ratchet wrench                          | 1             | 500666      | See Note 3                             |
| Drain screw for oil reservoir               | 1             | 3900 1557   | M16 x 25 hex head S.S. screw           |
| Copper washer for oil drain screw           | 1             | 3900 1558   | M16                                    |
| Metal seal assembly Mk.3                    | 5             | 3900 3750   | See Note 1                             |
| Metal seal spacer                           | 2             | 3900 3754   | Head seals only                        |
| Roller bearing (100 x 65 x 18)              | 6             | 3900 1570   |                                        |
| Thrust bearing (100 x 65 x 27)              | 2             | 3900 1571   |                                        |
| Tie bar cover O-Ring (Dash-254)             | 2             | 3900 1627   |                                        |
| Split grip ring for head seals              | 2             | 3900 4197   |                                        |
| Flange bearing                              | 1 or 2        | 3900 1560   | Powered = 1, Manual = 2                |
| Idler shaft for sprockets                   | 2             | 3900 1569   |                                        |
| Idler sprocket – 60B14                      | 2             | 3900 1564   | Secondary chains                       |
| Modular electrical box (460v A/B L43)       | 1             | 3900 3235   | Excludes the four aux assy's below     |
| Modular electrical box (230v A/B L43)       | 1             | 3900 3677   | Excludes the four aux assy's below     |
| Aux wiring assy - warning light             | 1             | 3900 3172   |                                        |
| Aux wiring assy - internal power cable      | 1             | 3900 3173   |                                        |
| Aux wiring assy – door switch               | 1             | 3900 3174   |                                        |
| Aux wiring assy – pulser wire               | 1             | 3900 3175   |                                        |

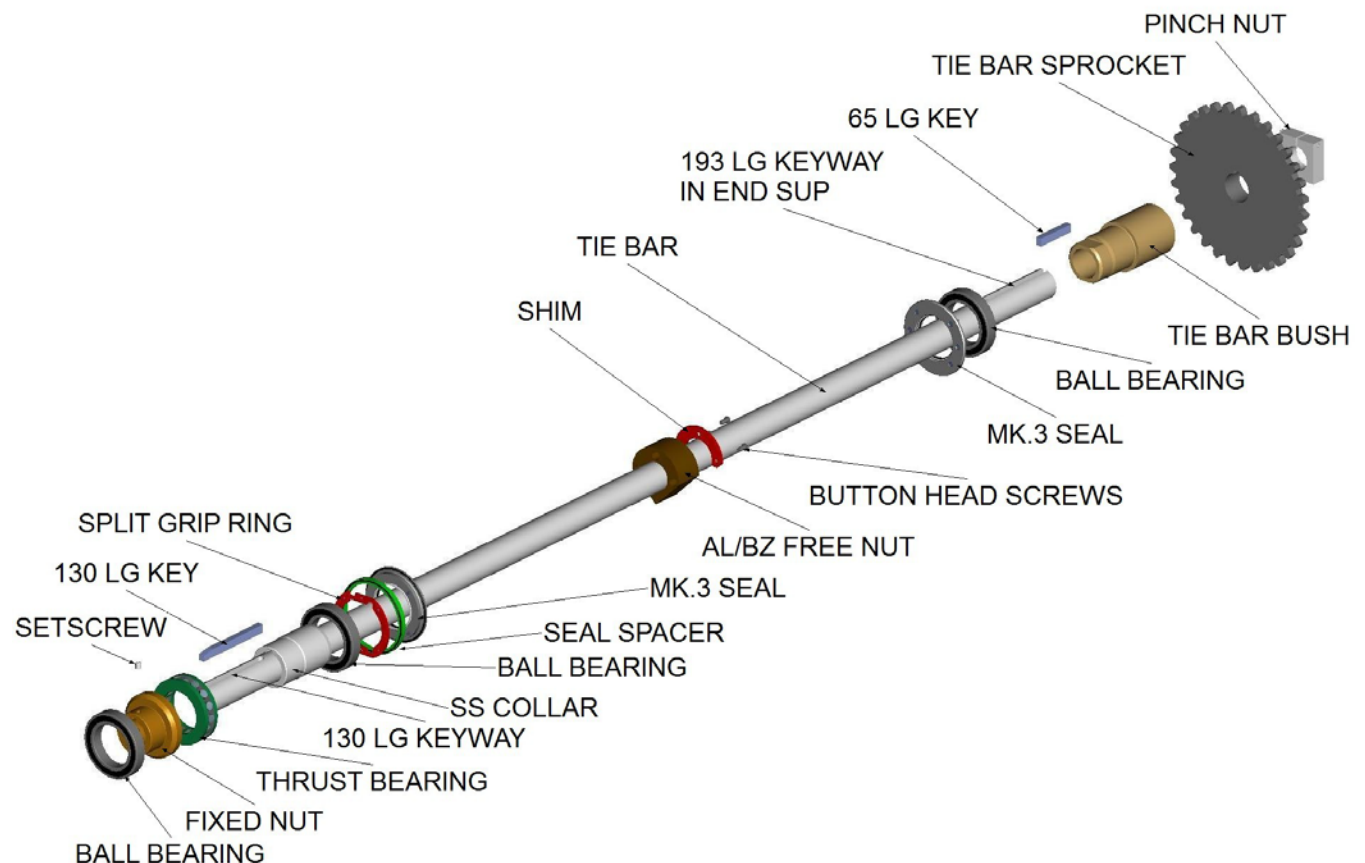
**Note 1:** Tie bar part numbers exclude all other items (nuts, seals, bearings, keys, screws, etc). When changing frame sizes, all existing tie bar assembly parts may be reused except the top and bottom bar O-rings (-213) and metal seal O-rings (-144), which should be replaced, and the free nuts which, depending on usage, may also need to be replaced.

**Note 2:** Free Nuts Type-4 are held by three dowel pins, a shim and three ¼" button head screws each.

**Note 3:** The M30 ratchet wrench will tighten both the powered and manual versions. However, the powered Binary-Drive is not normally supplied with this tool.

## 9 Tie Bar Assembly

The following illustration shows a typical tie bar assembly with all associated components. Many, but not all, are listed in the PARTS TABLE above.



## 10 Powered end support enclosure

For parts breakdown including additional replacement parts for electrical system and all parts for the hydraulic system, see 07 ELECTRICAL SYSTEM and 08 HYDRAULIC SYSTEM' sections.



#### 1 Handling

Quad-Drive Series 2 heat exchangers can be shipped either assembled or unassembled from the factory. When site assembly is required, these instructions must be closely followed to assure safe and correct operation. The personnel undertaking the work should have proper training and experience and must also be equipped with the proper tools and rigging equipment required for the assembly of large, heavy equipment.

#### 2 Lifting

Quad-Drive frames are provided with two points to lift the head and end support or the complete frame. You must use a spreader beam to lift an assembled frame with a 5500mm or longer top bar.



#### Warning:

**The assembled heat exchanger (frame with plates and gaskets) with 6500 and 8000 top bar lengths must not be lifted and moved as a complete unit.**

Weights of primary components:

| Component               | Weight lbs. [kg] |
|-------------------------|------------------|
| Head                    | 1430 [649]       |
| Follower                | 1190 [540]       |
| End support (powered) * | 1230 [558]       |
| End support (manual)    | 580 [1279]       |
| Tie bar for 1500 mm     | 52 [24]          |
| Tie bar for 5500 mm     | 161 [73] †       |
| Top bar 1500 mm         | 92 [42]          |
| Top bar 8000 mm         | 2590 [1175]      |
| Bottom bar 1500 mm      | 111 [50]         |
| Bottom bar 8000 mm      | 562 [255]        |

\* Without power pack.

† Heaviest for all frame sizes. (FS6500 & 8000 use eight shorter tie bars)

#### 3 Consumables

The following consumables are required for assembly (see **11 Appendix** at end of this section for recommended greases):

#### Product

Food grade grease (supplied)  
Black lithium grease  
Clear RTV silicone sealant  
Loctite 246 (blue)

#### Use

seals, ballfeet, tiebars  
Thrust bearings  
Various  
Fasteners

#### 4 Tools

The following tools and equipment are required for assembly (read the numbered tool notes after the illustration). Rigging equipment is not listed and the 'Use' list is not necessarily exhaustive:

#### Tool

2.5 mm A/F Hex key/drive  
4 mm A/F Hex key/drive  
5 mm A/F Hex key/drive  
8 mm A/F Hex key/drive  
14 mm A/F Hex key/drive  
3/16" A/F Hex key/drive  
19 mm A/F Hex drive  
27 mm A/F Hex drive (1)  
8 mm A/F Hex socket  
10 mm A/F Hex socket  
24 mm A/F Hex socket  
36 mm A/F Hex socket  
46 mm A/F Hex socket  
Flat blade screwdriver  
APV tie bar socket – Fig.1  
Ratchet socket wrench  
600lbf.ft + torque wrench  
1ft ratchet extension bar  
36 mm A/F Ratchet wrench  
36 mm A/F open end wrench  
7/16" A/F wrench  
Adjustable wrench 55mm + A/F  
10-lb Sledge hammer  
2" x 4" wood stud  
Spirit level  
25ft Tape measure  
Grease gun and nozzle  
Caulking gun  
6ft ladder (2 required)

#### Use

M4 flat/button hd. (2)  
M6 shoulder screw  
M8 Button head scr.  
M12 flat hd. screw  
M16 SHC screw  
Sprocket setscrews  
M24 SHC screw  
M36 SHC screw (4)  
M5 hex nuts  
M6 hex nuts  
M16 Hex hd. screw  
M24 hex bolts  
Primary drive hex (6)  
Grip rings  
Tie bars (5)  
Various  
Top & bot. bar SHCS  
Various  
Chain adjustment (2)  
Ballfeet  
Warning light  
Various (3)  
Tie bars  
Tie bar drift, E.S. lift  
Frame leveling  
Plate pack sync.  
Seals, tie bars (2)  
RTV sealant  
Various



TIE BAR SOCKET TOOL

Figure 1

**Tool notes:**

- (1) Equivalent to 1-1/16" A/F (or use a 1" A/F hex)
- (2) Supplied with all frames
- (3) Two required for FS6500 & 8000
- (4) Unusual/not readily available tools
- (5) Custom APV assembly tool not supplied w/frame
- (6) Optional (or use 55mm A/F adjustable wrench)

## 5 Assembling the Frame

**Warning:**

**All lifting equipment must have the proper capacity and be in good condition. Personnel must follow safe rigging practices at all times.**

**Caution:**

**All components must be properly supported during all phases of assembly.**

### 5.1 Preparation

a. ASSEMBLY PLANNING: Try to assemble the frame as close as possible to its final destination to reduce frame movement on completion. However, available space will determine how and where the machine can be assembled.

There are two main parts to frame assembly: (a) Standing up the frame and (b) tie bar installation. Standing the frame always requires overhead rigging (using ceiling beams and/or an 'A' frame) and possibly fork lift access.

For tie bar installation, the simplest method (METHOD 1) is to install the tie bars from in front of the head but this requires a full tie bar length of space. The alternative, (METHOD 2), is to install the tie bars from the side of the machine which can be done within the frame's length, but needs ladder space on both sides.

The frame may be moved to its final location before tie bar installation if desired but do plan on how to lift the tie bar assemblies into position (shorter bars can be raised by hand, longer bars will need mechanical assistance).

Determine now if you will assemble the frame remotely or at its final location and which tie bar assembly method you will employ.

b. LOCTITING: It is recommended that the frame be fully standing within 2 hours of the first application of Loctite 246 (ie: before curing) on the carry bar screws since they are torqued after assembly and leveling.

c. UNPACKING: Remove each item from its packing and check that all necessary parts have been supplied and are free of damage prior to assembly. Refer to the Parts Table in 01 QD FRAME CONSTRUCTION section. Components are also identified in this section.

d. EQUIPMENT: Ensure you have a complete set of tools and equipment and the required consumables are available as described above.

e. E.S. DOOR: Two people are required to remove the end support door. With the end support enclosure in the horizontal position, turn the handle ¼ turn counterclockwise, open the door and slide it off its hinges. Place the door in a safe location where it cannot fall or become damaged.

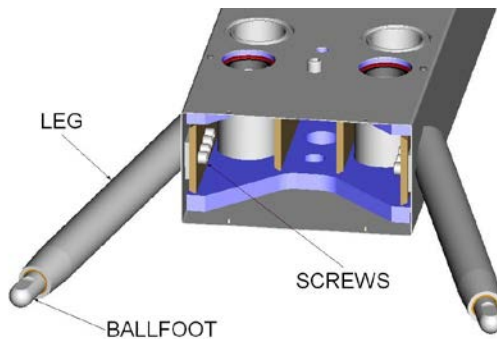
f. HEAD COVERS: If installed, remove the six round covers on the outside of the head. Each cover is retained with six, M4 button head screws (2.5 mm A/F). Store the covers, o-rings, screws and washers in a safe place.

### 5.2 Legs

Prepare the head and end support enclosure by installing the leg assemblies, if necessary, as follows.

Remove the two M4 flat head screws and the bottom cover from the head (store the screws in a safe place). On the outside of both the head and end support enclosure, apply a ring of clear RTV sealant around each set of four, 17mm diameter holes and install all four legs. Use four M16 x 45 long socket head screws with Loctite 246 on each leg. Remove excess RTV sealant.

If ballfoot assembly is necessary, thoroughly grease ballfoot thread (with supplied white grease) and then fully install one into each leg.

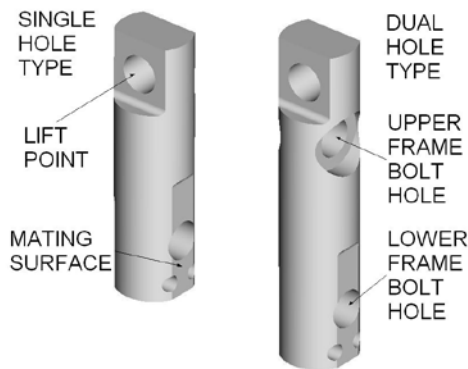


**Figure 2**

#### 5.3 Lift block installation

There are two types of lift block available; single and dual hole. The longer, dual hole lift block is only used on the FS6500 and FS8000 machines.

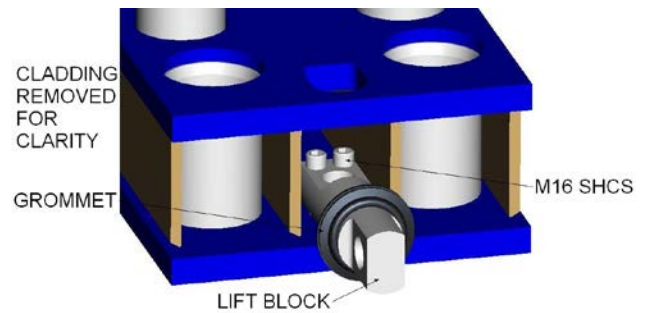
The lift blocks contain one or two horizontal frame bolt holes and incorporate a single hole at the top for lifting the head, end support and the full frame assembly. Both types are installed in the same way. The head and end support lift blocks are identical.



**Figure 3**

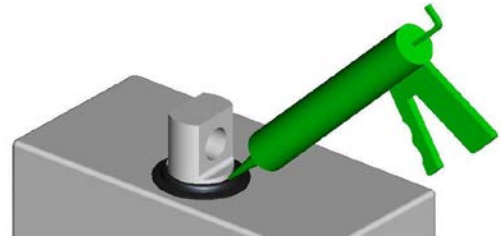
Confirm that the large black grommet is properly installed in the top of the head cladding and, using only water spray as a lubricant (not grease), insert the lift block, small holes first, through the grommet from the outside. The narrow inserted flat is the mating surface.

When the frame bolt hole lines up with the frame bolt hole in the core (visible through the cladding opening) and the lift block is central in the grommet, install the two M16 x 80 long socket head cap screws with Loctite 246 and tighten.



**Figure 4**

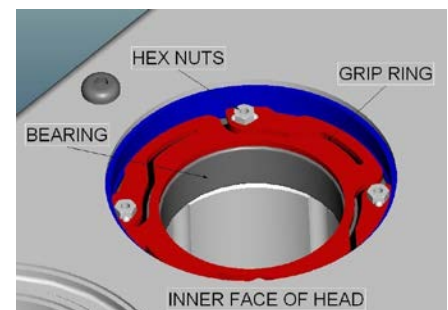
Ensure that the grommet is in its most relaxed position and remove any lubrication water. Apply a small bead of clear RTV sealant around the entire groove formed by the grommet and lift block.



**Figure 5**

#### 5.4 Head Bearing Installation

If not installed, liberally coat with white grease and install one ball bearing (100 x 65 x 18) in the four tie bar openings on the inner face of the head. Ensure each bearing is fully seated below the ring groove. Install one seal grip ring, M4 hex nuts facing outward, in each bore to retain the bearing. Note: older series 2 machines were supplied with a single piece grip ring (Fig. 6a). Newer machines have the split grip ring (Fig. 6b). Ensure grip rings properly expanded into their grooves. Lift the head into an upright position using a strap or chain and hook through the lift block.



**Figure 6a**

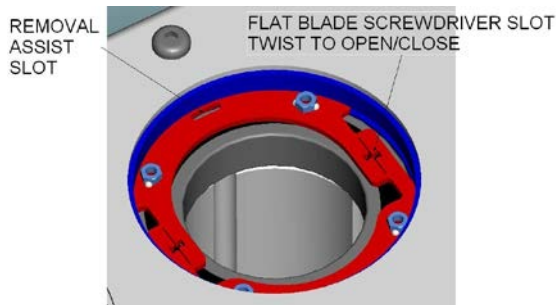


Figure 6b

#### 5.5 Bottom Bar

The method used to assemble the bottom bar depends upon the frame size. For FS6500 & 8000 skip to 5.5.2. All lengths of bottom bar require a seal at both ends (O-ring or rubber washer).

##### 5.5.1 FS1500 - 5500

Install the bottom bar core inside the outer S.S. tube. Apply a light coat of white grease to one sealing o-ring and insert in the end of the bottom bar that is nearest to the head. These bottom bars are not handed. Skip to 5.5.3

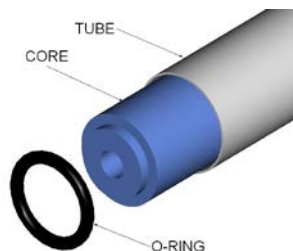


Figure 7

##### 5.5.2 FS6500 & 8000

These bottom bars are single piece and handed. There is a pair of 1" (25mm) diameter holes, one on each side, located 12" (300mm) from the end of the bar, which must be located near the end support. Correctly oriented, there will also be a group of four M8 tappings on each side closer to the head. Insert a lightly greased, 25 mm I/D, rubber washer between the end of the bottom bar and inside of head over the M24 screw.

##### 5.5.3 All FS

Bring the bottom bar into position (correctly oriented if FS6500 or 8000) up to the head and support it with jack stands or blocks. Confirm the O-Ring or seal is in place. Ensure the bottom bar is square to the head and

level and then, using Loctite 246, install an M24 x 70 mm long socket head screw (fully threaded). Do not torque screw until the machine is leveled (described in 5.8.6).

**Ensure that the assembly is stable and cannot fall over when the strap/chain is removed - shorter frame sizes may need additional support at this point.** Remove the strap/chain from the head.

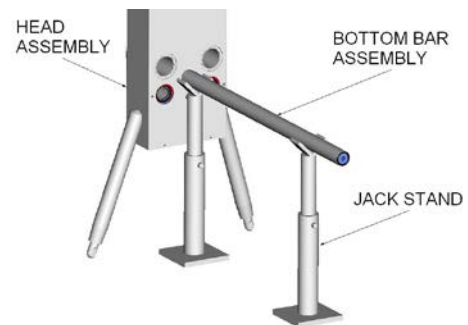


Figure 8

#### 5.6 Top Bar

Insert one M36 x 160 mm long socket head screw through the top bar bolt hole in the head and install one lightly greased, thick rubber washer (38mm I/D) over the protruding end of the bolt. The procedure used to continue top bar assembly depends upon the frame size. For FS1500 – 5500 skip to 5.6.2. For FS6500 & 8000, continue here.

##### 5.6.1 FS6500 & 8000

These large top bars are handed due to location of the M8 tappings for the tie bar hangers. The text "HEAD" will appear on the end that must be assembled to the head. Correctly oriented, the group of four M8 tappings on each side is closer to the head than the end support.

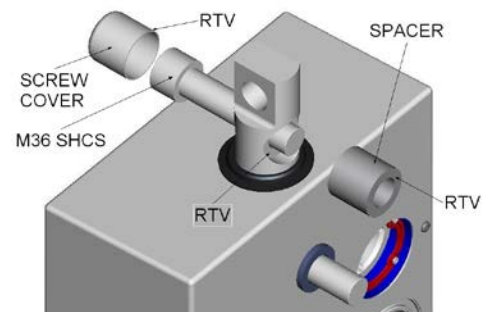


Figure 9

Apply a ring of clear RTV sealant at the bottom of the lift block counterbore of the M36 bolt hole on the side facing the top bar. Insert the longer head spacer (marked HD, 2.3" [58.4 mm] lg) into the counterbore with RTV and press firmly. Wipe off excess RTV.

Immediately prior to top bar assembly, apply a ring of clear RTV sealant around the exposed flat face of the head spacer.

#### 5.6.2 All FS

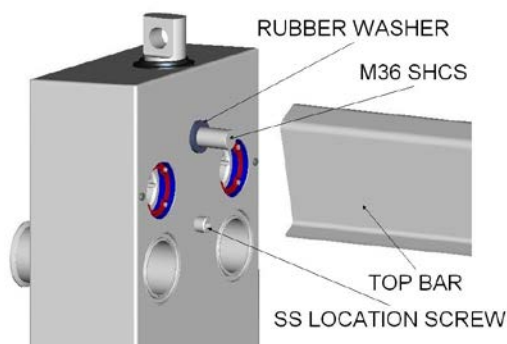


Figure 10

Lift the top bar, avoiding abrasion, into position and confirm that the lightly greased rubber washer is in place. Ensure the top bar is square and level to the head and that the underside of the top bar sits on the head of the pre-installed S.S. location screw.

Using Loctite 246, screw the lower or only M36 x 160 mm long socket head cap screw into the thread in the end of the top bar and tighten. Do not torque screw until the machine is leveled (described in 5.8.6). Ensure that the end face of the top bar fully contacts the inside surface of the head.

For FS1500 – 5500 skip to 5.6.4.

#### 5.6.3 FS6500 & 8000

Using Loctite 246, install the second M36 x 160 SHCS through the upper bolt hole and screw into the top bar. Do not torque screw until the machine is leveled (described in 5.8.6). It may be necessary to slightly loosen the two M16 x 80 setscrews to permit all holes to align. The stainless steel screw cover will be added later after the screws have been correctly torqued.

Push the seal strip into the recess formed by the end of the top bar and inside face of head. Beginning at the center under the spacer and moving outwards either side, apply a line of clear RTV sealant in the groove between the head and seal strip. Level excess RTV with top of head and remove excess.

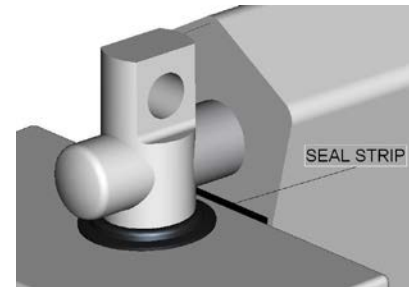


Figure 11

#### 5.6.4 All FS

Install a support of sufficient strength about 1ft [300 mm] from the free end of the top bar. This support must carry ½ the top bar weight plus the follower weight.

#### 5.7 Follower

Confirm that both roller assemblies are correctly installed and their M12 flat head screws are tight. Using straps (not chains) through the two tie bar openings, crane the follower onto the free end of the top bar and over the bottom bar. The connection fittings on the flower face away from the head. Lower the follower so that the rollers sit on the hanging surface of the top bar.

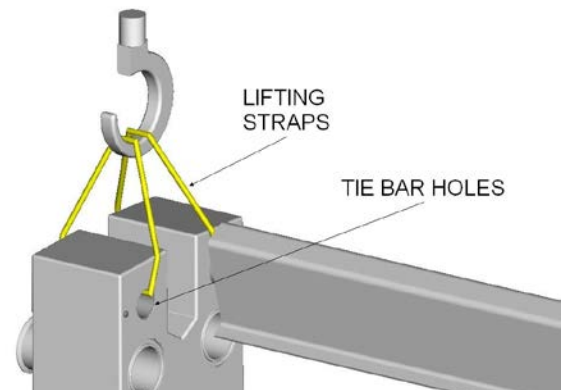


Figure 12



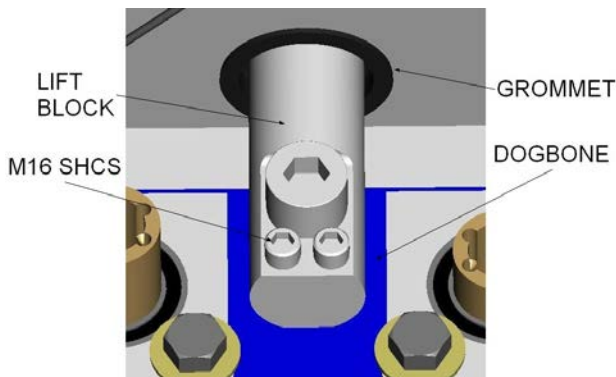
**Prevent the follower from rolling off the free end of the top bar and then remove the straps.**

#### 5.8 End Support

Prepare the end support while in the horizontal position and then assemble to frame as follows.

##### 5.8.1 Lift block installation

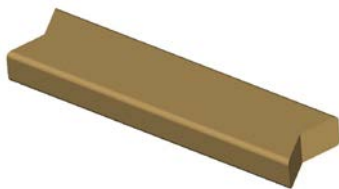
Confirm that the large black grommet is properly installed in the top of the end support cabinet and, using only water spray (not grease) as a lubricant, insert the lift block, small holes first, through the grommet from the outside. The narrow flat towards the end of the lift block is the mating surface. When the frame bolt hole lines up with the frame bolt hole on the dogbone and the lift block is central in the grommet, install the two M16 x 80 long socket head cap screws with Loctite 246 and tighten.



**Figure 13**

##### 5.8.2 End support assembly

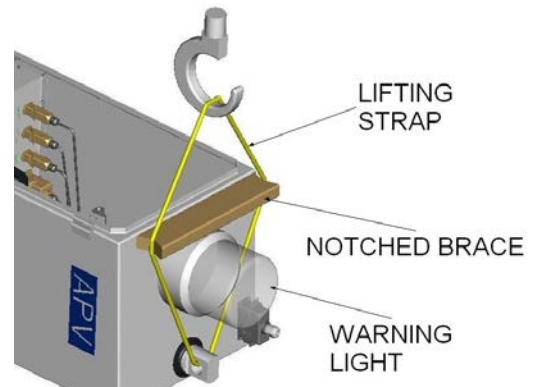
Make a notched brace, approximately 18" (460mm) long from a 2" x 4" stud.



**Figure 14**

The brace is to separate the lifting chain/strap either side of the light – this is to avoid any stress on the light assembly during lifting.

Lift the end support using a strap/chain through the lift block and bring close to end of top bar. Place the upper rubber washer and lower O-ring or rubber washer (both lightly greased) at their respective positions. Skip to 5.8.4 if assembling a FS1500 – 5500.



**Figure 15**

##### 5.8.3 FS6500 & 8000

Install the end support spacer (marked ES, 2.05" [52 mm] lg) with RTV according to the instructions for the head spacer in 5.6.1 and then return here.

##### 5.8.4 Top bar attachment

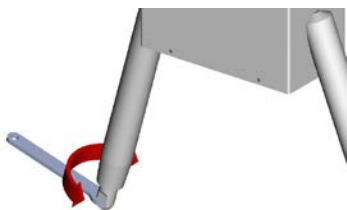
With the top bar slightly raised, bring the end support into position and lower the top bar ensuring it sits on the head of the pre-installed S.S. location screw. Using Loctite 246, bolt the end support to the top bar with one (or two for FS6500 & FS8000) M36 x 160 and bottom bar with M24 x 70 socket head screws. Do not torque screws until the machine is leveled (described in 5.8.6). It may be necessary to slightly loosen the two M16 x 80 set screws and the corresponding screws at the opposite end of the top bar to permit all holes to align but ensure they are retightened.

##### 5.8.5 Rigging Removal

The frame will now be standing without tie bars and with all top and bottom bar screws installed but not tight. Remove all jacks, blocks, support structures and straps/chains.

##### 5.8.6 Frame Leveling

Regardless of current location, it is necessary to level the machine before tie bar installation. Level the machine by turning the four ballfeet with a wrench (1.42" [36 mm] A/F).



**Figure 16**

Each ballfoot is provided with +/- 2" [50 mm] adjustment. Do not extend any ballfoot beyond its red MAX line. Begin with all ballfeet fully inserted. Use a spirit level and check one side and outer face of both the head and end support plus the top surface of the bottom bar near its center. Accurate leveling promotes smooth operation and longest machine life.

Once the machine has been accurately leveled, torque the top and bottom bar screws as follows:

Torque values:

| Size     | lbf.ft (Nm) Min | lbf.ft (Nm) Max |
|----------|-----------------|-----------------|
| M24 SHCS | 600 (813)       | 908 (1231)      |
| M36 SHCS | 600 (813)       | 3154 (4277)     |

#### 5.8.7 Screw Covers for FS6500 & 8000

Apply a ring of clear RTV sealant around the outside diameter of the end of the screw cover and push into the counterbore in the lift block, over the head of the M36 SHCS. Wipe off excess RTV. See Fig. 9.

#### 5.8.8 End Support Seal Strip FS6500 & 8000

Push the seal strip into the recess formed by the end of the top bar and inside face of end support. Beginning at the center under the spacer and moving outwards either side, apply a line of clear RTV sealant in the groove between the end support and seal strip. Level excess RTV with top of end support and remove excess. See Fig. 11.

### 6 Tie bar installation notes

**NOTE 1:** At least four, fully threaded, equal length tie bars are supplied with all machines. These tie bars have a different keyway length at each end. The longer keyway, 7.6" [193 mm], is installed in the end support. In addition, FS6500 & 8000 are supplied with four equal length extension tie bars with end threads and equal length keyways. These tie bars pass into the head and are attached to the fully threaded tie bars with a link system. See tie bar assembly illustration in FRAME CONSTRUCTION section of User Manual.

**NOTE 2:** The head, follower or end support 'inner face' is the exterior surface that faces the plate pack.

**NOTE 3:** From July 2011, the Quad-Drive series 2 was equipped with eight Mk3 metal tie bar seal assemblies, four at the head and four at the end support. The seals are initially placed over the tie bars at the correct point in the assembly sequence. Seal installation and lubrication is performed later. Prior to placing each seal over its tie bar, ensure:

- The seal is preferably (though not absolutely necessary) spirally wrapped to protect the inner O-ring.
- The seal is correctly oriented (heads of screws face away from the seal bore and towards follower).
- The inner and outer O-rings are present.
- You have and follow the Mk3 SEAL INSTALLATION User Manual document.

**NOTE 4:** The tie bar assembly method you follow (METHOD 1 or METHOD 2) is dependant upon the available space around your machine.

**NOTE 5:** IT IS ESSENTIAL THAT EACH OF THE SPECIFIED STEPS BE PERFORMED IN ORDER AND WITHOUT OMISSION. FAILURE TO COMPLETE ANY SPECIFIED STEP IN THE TIE BAR ASSEMBLY SEQUENCE WILL NECESSITATE ENTIRE DISASSEMBLY AND REMOVAL OF THE TIE BAR(S) TO CORRECT THE OMISSION.

#### 6.1 Head bearings

Confirm that the four ball bearings and grip rings have been assembled on the inner face of the head. If not, see part 5.4.

#### 6.2 Installing tie bars

If the four 'housing' washers of the thrust bearings are installed in the bores on the outer face of the head, skip to 6.2.1 (If installed, you should also find the fixed nut and thrust bearing assemblies installed on the end of each tie bar.)

Locate and unpack the four thrust roller bearings (100 x 65 x 27). Install one 'housing' washer (which has the slightly larger inside diameter – part number begins with 'G') into each tie bar opening through the outer face of the head. Ensure that each washer is properly seated at the bottom of the counterbore and that the bearing face (without lettering) is facing outwards (ie: visible). A tie bar bush may help with insertion.

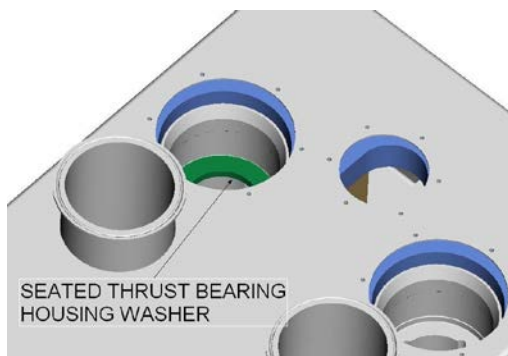


Figure 17

If you have sufficient space in front of the head to install your tie bars, it is recommended that you use METHOD 1 (M1). If you only have space beside the frame, skip to 6.2.5 and follow METHOD 2 (M2). Instructions specific to a method will be labeled M1 or M2. If the fixed nuts and S.S. collars have been pre-assembled onto the tie bars, skip to 6.2.4.

#### 6.2.1 Tie Bar preparation (M1)

For FS1500 – 5500, locate the fully threaded tie bars and place in a location (eg: on a bench or jack stands) that provides at least 1ft (300 mm) of overhang of the end with the shorter (130 mm long) keyway.

For FS6500 & 8000, locate the mainly plain tie bars and place in a location (eg: on a bench or jack stands) that provides at least 1ft (300 mm) of overhang (either end).

The overhanging ends receive the fixed nut assembly.

#### 6.2.2 Tie Bar preparation (M2)

Push the tie bars through the head to reveal about 1ft (300 mm) of tie bar. You will first need to move the follower so that the opposite ends of the tie bars remain supported.

#### 6.2.3 Fixed nut assembly

Install one ball bearing (100 x 65 x 18) onto the long neck of each fixed nut.

Install the 'shaft' washer from each thrust roller bearing onto the short neck of each fixed nut. Ensure that the bearing face (no lettering) is facing outwards (ie: visible).

Thoroughly pack each roller race with black Lithium grease and install one against each 'shaft' washer.

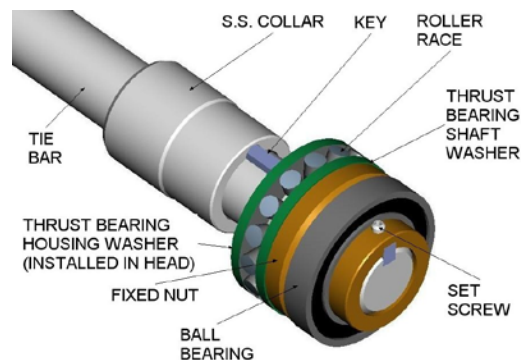


Figure 18

Screw a SS collar, large diameter first, onto each overhanging or protruding tie bar to expose about 3.5" [90 mm] of thread and align the keyways. Do not screw the collar over the thread run-out which can permanently bind the collar to the tie bar.

Screw a fixed nut assembly onto each tie bar, thrust race first, until the fixed nut ends align with the ends of the tie bars. On each bar, observe the relative position of the nut and tie bar keyways and rotate the nut the minimum amount (in either direction) to bring the keyways into alignment. Fully insert a 5.12" [130 mm] long, 3/8" x 1/2" tapered key into each assembly to confirm its correct fit (end of key should be flush with end of tie bar). Remove any burrs if necessary. Remove the key.

Apply a ring of clear RTV sealant to the thread around the full diameter of the tie bar in front of the S.S. collar for a length of about 3/4" [19 mm]. Screw the S.S. collar further onto tie bar, over the RTV, to yield a space of 1.83" [46.5 mm] between the fixed nut and collar. (A wire rod cut to this length may be helpful for measurement).

Screw the collar further onto the tie bar until the keyways align (this could be up to almost one more full revolution).

Insert the key, non-taper end first, until it is flush with the end of the tie bar. Apply Loctite 246 to the M8 x 10 mm setscrew and install into the tapped hole in front of the ball bearing. Tighten setscrew down onto taper. Note that the setscrews on the fixed nuts protrude slightly to retain the ball bearings. Remove any excess RTV on the O/D of the thread in front of the collar.



#### 6.2.4 Inserting tie bars (M1)

For FS1500 – 5500 push the follower almost to the end support.

For FS6500 & 8000 push the follower to the end support side of the group of four M8 tappings on the top and bottom bars.

Insert the tie bar assemblies through the head from outside and, after reading 'Tie bar installation NOTE 3' above, place one metal tie bar seal assembly over the free end of the tie bar on the inside of the head with the heads of the small flat head screws facing the follower.

Push the tie bars through their corresponding openings in the follower. Bring the follower toward the head so that about 4ft (1200mm) of tie bar is protruding towards, but not into, the end support.

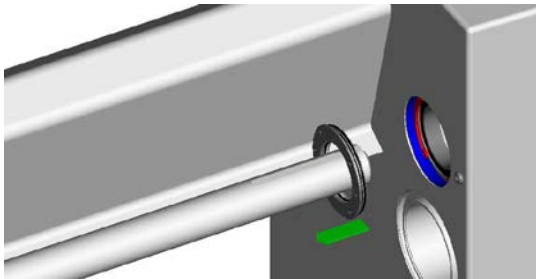


Figure 19

For FS1500 – 5500, skip to 6.4.

For FS6500 & 8000, skip to 6.3.

#### 6.2.5 Fixed Nut Disassembly (M2)

If the fixed nuts and S.S. collars are assembled on the end of the tie bars, they must all be removed before the tie bars can be installed. If the fixed nuts and/or S.S. collars are not assembled on the tie bars, skip to 6.2.6.

If installed on the tie bars, the fixed nut assemblies will have been carefully greased and protected with a bag - keep the assemblies clean and free of contamination during disassembly and re-assembly.

To remove the fixed nuts and collars, first loosen, but do not remove the M8 setscrews and withdraw the keys. Unscrew the fixed nut assemblies off the tie bars. Unscrew the collar off the tie bar. Note that if the collar has been sealed with RTV, a strap wrench (or

similar device applied to the smaller diameter) and special APV tie bar socket tool may be necessary to free it. Remove all old RTV from tie bar and collar.

#### 6.2.6 Inserting tie bars (M2)

For FS1500 – 5500 push the follower up to the head and skip to 6.2.7.

For FS6500 & 8000, push the follower so that its inside face is just under 118" (3000 mm) from the end support and skip to 6.2.8.

#### 6.2.7 FS1500 – 5500 (M2)

Lift or crane one tie bar beside any tie bar location on the frame with the longer keyway oriented toward the end support. Pass the long keyway end of the tie bar through the corresponding tie bar hole in the end support until the opposite end can swing inward to align with the tie bar hole on the outside of the follower. Pass this end through the follower. Repeat for the remaining three tie bars until each is supported between the end support and follower.

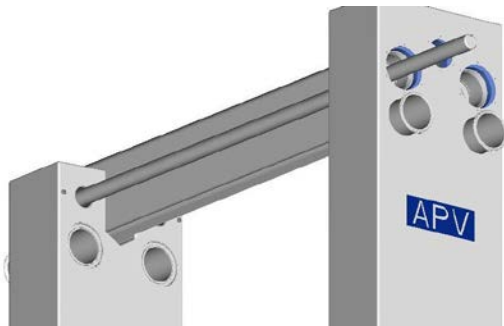
Separate the head and follower by about 1ft (300mm) so that the ends of the tie bars are accessible between the head and follower. Read 'Tie bar installation NOTE 3' above and place one metal tie bar seal assembly over this end of each tie bar with the heads of the small flat head screws facing the follower. Slide the tie bars into the head so that they are now supported by the head and end support. Push the follower to within about 4ft (1200mm) of the end support. Skip to 6.2.9 for fixed nut assembly

#### 6.2.8 FS6500 & 8000 (M2)

Lift or crane one mainly plain extension tie bar beside any tie bar location on the frame, in any orientation (the keyways at each end are 130 mm). Swing the tie bar inward to align its ends with the corresponding holes in the head and follower and push the bar into the head holes about 2" (50mm). Roll the follower up to just support the opposite end of the tie bar. Repeat for the remaining three bars, inserting into the head first until each is supported between the head and follower.

Read '6 Tie bar installation notes, NOTE 3' and then briefly slide each tie bar toward the end support and place one metal tie bar seal assembly over the free end between the head and follower with the heads of the small flat head screws facing the follower. Slide the tie bar back into the head.

#### 6.2.9 Fixed nut assembly (M2)



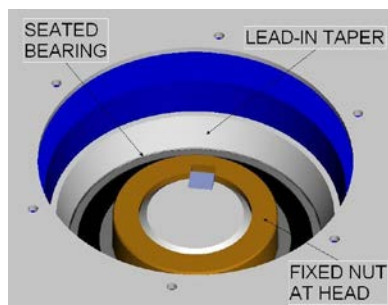
**Figure 20**

To conclude METHOD 2, it is now necessary to install the S.S. collars and fixed nut assemblies. Go back to 6.2.2 and follow the fixed nut assembly instructions. If necessary, first remove any old RTV sealant from the threads of the tie bar and S.S. collar. At the conclusion of 6.2.3, (when fixed nut assembly is complete), return to this point.

For FS1500 – 5500, skip to 6.4 Free nut assembly.  
For FS6500 & 8000, continue with 6.2.10 Thrust bearing seating.

#### 6.2.10 Thrust bearing seating

Push each tie bar with fixed nut and S.S. collar back through the head until their thrust bearings are seated (a short, 2" x 4" wooden stud may be used as a drift). Care must be taken to ease the S.S. collar through the ball bearing (retained with grip ring) in the head as clearance is minimal.



**Figure 21**

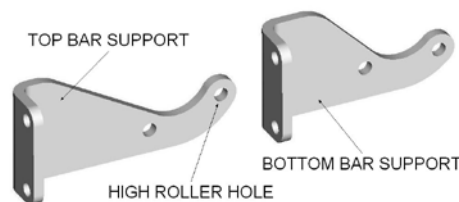
The assembly is seated when the visible face of the ball bearing is flush (+/- 0.5 mm) with the bottom of the lead-in taper (also confirmed by a change in tone as the drift is struck).

#### 6.3 Linked tie bars

FS6500 & 8000 frames use eight tie bars, linked in pairs and supported by special roller assemblies. The roller assemblies are attached to the top and bottom bars on the head side of the tie bar link pieces.

##### 6.3.1 Tie bar roller support assembly

Confirm that the follower sits on the end support side of the group of four, M8 tappings on the top and bottom bars. There are two types of roller support arm, one type for the top bar and one type for bottom bar. Observe the differing ramp angles and relative roller hole positions to differentiate.



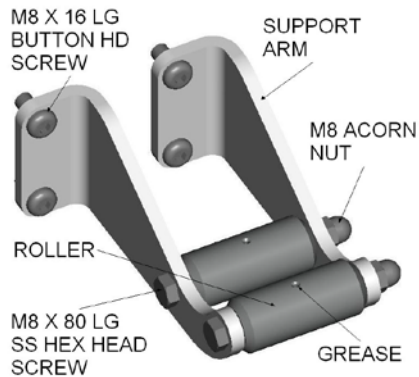
**Figure 22**

Before attaching the roller assemblies to the top and bottom bars, lift the tie bars slightly at the link pieces to relieve the strain while tightening the roller assembly screws. This can be achieved by the use of jack stands on the lower tie bars and straps over the top bar on the upper tie bars.

Apply a light ring of clear RTV sealant around the perimeter of the two mating faces of the roller assembly support arms. Also, apply a light ring of RTV around each screw hole.

Loosely attach the support arms to the top and bottom bars as shown in the following illustration using the four M8 button head screws and Loctite 246. Take care to pair the legs correctly.

Place the back roller in position and insert an M8 x 80 hex screw through both legs as shown. Repeat for front roller. Tighten the four M8 button head screws. Using Loctite 246, install the M8 acorn nuts and tighten to the arm while permitting the rollers to still spin freely. Apply white grease through the grease holes until it appears at the ends of the rollers.



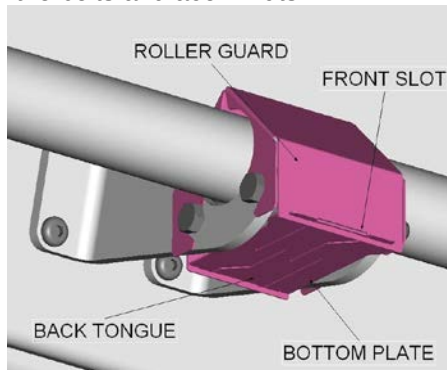
**Figure 23**

Fill the two crevices formed by the radius of the arms and the top/bottom bar with clear RTV sealant forming a clean radius. Wipe off excess RTV.

Note that the assemblies will be offset from each other on opposite sides of the machine but will support the plain portion of the tie bars just behind the link pieces.

Remove the tie bar lifts to allow the tie bars to sit on the rollers. Roll the follower toward the end support such that the end of the tie bars sit about midway inside the follower.

Install the roller guard as follows. Open the guard by hand and snap into position over the tie bar and the heads of the bolts and acorn nuts.



**Figure 24**

Push the two tabs at the narrow end of bottom plate through back slot of the guard while pressing the back tongue upward. The tongue will snap into place. Push the two tabs at the wide end of the bottom plate through the front slot while pressing the front tongue

upward (the guard may need to be squeezed closed to engage the front tongue).

#### 6.3.2 Free nut assembly

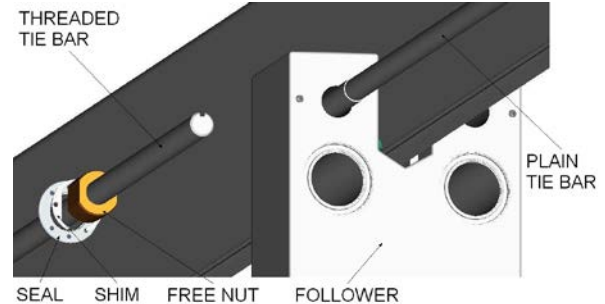
The free nuts, shims and seals must now be installed on the four, fully threaded tie bars before these tie bars are assembled into the frame.

Lift or crane one fully threaded tie bar beside any tie bar location on the frame with the longer keyway (193 mm [7.6"]) towards the end support. Place one metal tie bar seal assembly over the short keyway end of this fully threaded tie bar with the heads of the small flat head screws facing the follower.

After the seal, place one free nut shim over the same end of the tie bar and slide it up to the seal.

After the shim, screw one free nut, with the taper facing the follower, onto the same end of the tie bar, about 2ft [600 mm].

Follow the above procedure for the three remaining tie bars.



**Figure 25**

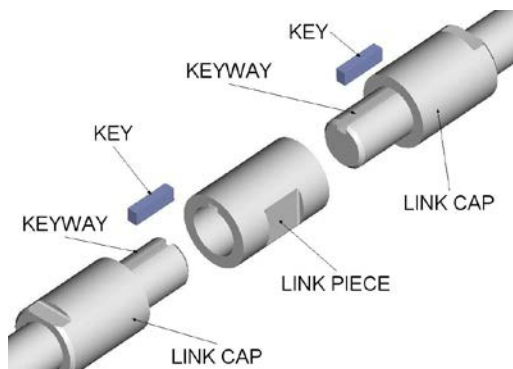
#### 6.3.3 Link assembly

The fully threaded tie bar assemblies must now be installed in the frame and linked to the 'plain' tie bars.

Pass the long keyway end of the tie bar through the corresponding tie bar hole in the end support until the opposite end can swing inward to align with the tie bar hole on the outside of the follower. Pass this end into the follower until it touches the other tie bar. Repeat for the remaining three tie bars until each is supported between the end support and follower.

Roll the follower toward the end support such that the adjacent ends of the tie bars become visible on the

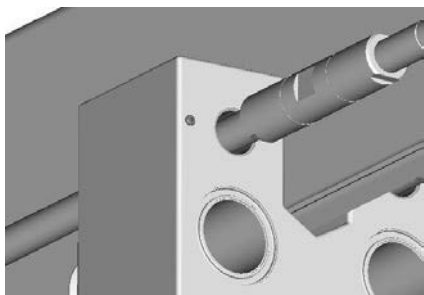
head side and create a gap of about 6" (150mm) between them. Screw one link cap, flats first, onto the free end of each tie bar, just past the keyway.



**Figure 26**

Screw a link piece onto each 'plain' extension tie bar until exactly 2" [51 mm] of thread is covered. Further rotate each link piece the minimum amount in either direction to align the keyways. Load a 44mm long key into each keyway and slide it into the link piece.

Turning only the fully threaded tie bar, screw each end into its corresponding link piece until the tie bar ends touch. Unscrew each fully threaded tie bar just enough to align the keyways and install the remaining four 44mm long keys. Apply Loctite 648 to the full diameter of the thread for the length of the exposed keyways and tighten each pair of link caps hard against the link pieces. Use a pair of 2.165" (55mm) A/F wrenches to ensure the link caps are tight. Skip to 6.5.



**Figure 27**

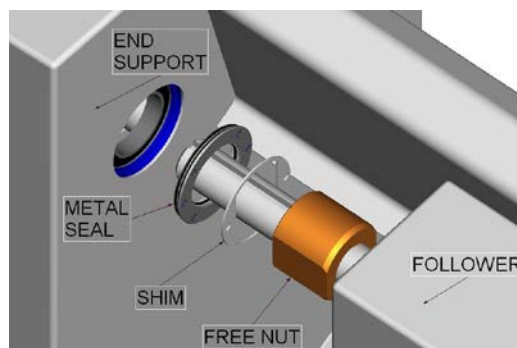
#### 6.4 FS1500 – 5500. Free nut assembly

Screw one free nut (bronze in color), with the large taper first (ie: taper facing the follower), over the free end of the tie bar (the long keyway end) about 3ft [900 mm].

After the nut, determine the type of free nut shims supplied with the frame. If the full ring types are supplied (shown below), place one shim over the tie bar and slide it up to the nut. If the horseshoe, open style shims are supplied, set them aside for later assembly.

Next, place one metal tie bar seal assembly with the heads of the small flat head screws facing the follower.

Confirm that the larger taper on each free nut is facing the follower.



**Figure 28**

It is now necessary to seat the thrust bearings. Go back to 6.2.10 and follow the thrust bearing seating instructions. At the conclusion of 6.2.10 (when the thrust bearings are seated), return to this point.

#### 6.5 Assembly at End Support

At this point, all tie bars should be passing through their respective tie bar holes in the end support.

Note that tie bars and their S.S. bushes are numbered according to their corresponding port. ie: while *looking into the end support*, the top right (TR) bar/bush is No. 1. The remaining tie bars/bushes are numbered in a counter-clockwise direction, 2 (TL), 3 (BL) and 4 (BR).

Four S.S. tie bar bushes are provided, two with an additional neck and each a different length. The bushes should be numbered on one end as follows:

|                                 |           |
|---------------------------------|-----------|
| Length 1 (shortest)...          | Bush No.3 |
| Length 2...                     | Bush No.4 |
| Length 3 (w/additional neck)... | Bush No.1 |
| Length 4 (w/additional neck)... | Bush No.2 |
| See Figure 29.                  |           |



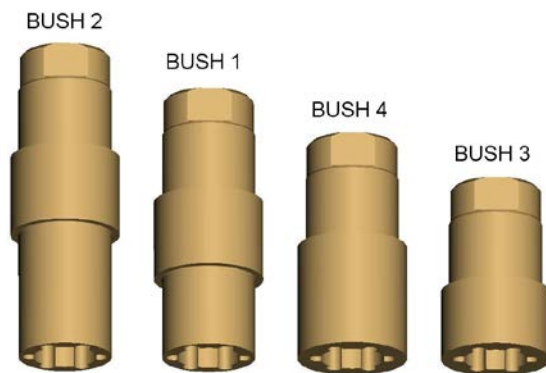


Figure 29

#### 6.5.1 Tie Bar bush Installation

Screw one tie bar bush, flats first, onto the end of each tie bar from inside the end support. Hand-tighten each bush until its mating face is in full contact with the ball bearing.

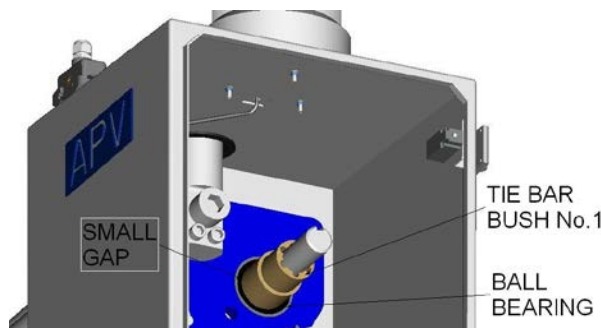


Figure 30

While preventing tie bar rotation with the special socket, tighten each bush a little more with a wrench until mild resistance is felt, using the flats (2.165" [55mm] A/F) that protrude through the end support. Tighten in order No.1, No.3, No.2 and No.4. A rapid increase in resistance will be experienced once all play in the tie bar assembly is removed. Stop tightening when this force is felt.

Each bush will protrude from the face of the end support cabinet by about 1.75" [44.5 mm]. Check this dimension and correct any problem before proceeding to the next step.

#### 6.5.2 Loading tie bars

With all four tie bars installed, the tie bar loading sequence can begin. **Do not attempt to load any tie**

bar unless all four tie bars are installed and their bushes are seated in the bearings as previously described.

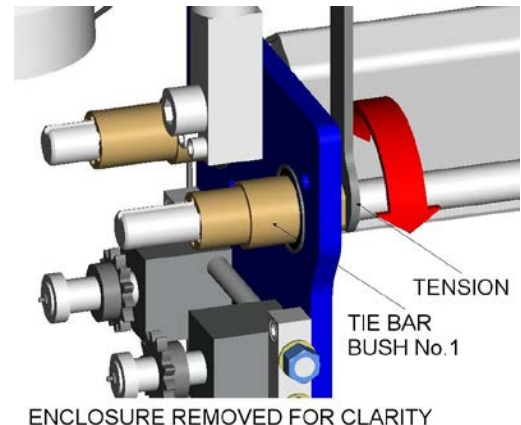


Figure 31

At tie bar No. 1, (top right) inside the end support, position a ratchet wrench with the special socket tool over the tie bar such that it is prevented from rotating clockwise (react arm against inside of end support cabinet).

You will notice that each bush has six 'tunnels', any of which can receive the key – refer to Figure 32. Obtain help to tighten the bush using the flats protruding through the inner face of the end support.

Rotate the bush, clockwise viewed from the end support end, so that the next available 'tunnel' aligns with the keyway on the tie bar. Push the key (65mm long) into the 'tunnel' to lock the bush to the tie bar. Note that there will be about 1.25" [32mm] of key that will not enter the bush.

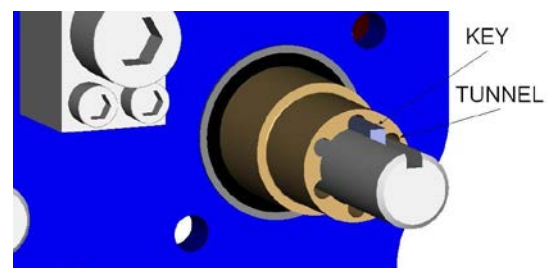


Figure 32

Repeat this step for the remaining three tie bars in the following order, No. 3 – No. 2 – No. 4.

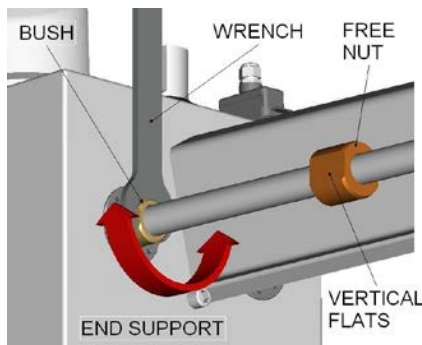
#### 7 Tie bar synchronization

Synchronization is a critical process that places the follower parallel to the head (within manufacturing tolerances) while permitting the follower and free nuts to be in their most relaxed condition thus ensuring each nut sees equal force during follower movement.

Smooth machine running and maximum component, plate and gasket life are dependent upon careful synchronization. Keep the tape measure horizontal and untwisted when measuring. Synchronization requires two people but may be performed with or without the plate pack in the frame.

##### 7.1 Free Nut Placement

Spin the free nuts on the tie bars so that the gap between all four and the end support is equal to within 0.040" (1 mm). Next, rotate each tie bar with a wrench on the bush to orient the nut flats vertically.



**Figure 33**

Now, on tie bars one (1) and three (3), turn the free nuts one full rotation closer to the end support (1/4" [6.35 mm]).

Apply a coat of white grease to the exterior of all four free nuts and push the follower over them; only two will fully engage.

##### 7.2 Synchronize tie bars 2 and 4

Attach the shims (open side down if applicable) on bars 2 and 4 with the two M8 x 16 long S.S. button head screws and Loctite 246 (Fig 34).

Measure and record the head to follower distances at the centerline of both ports two (2) and four (4). Reduce the larger dimension to equal the smaller dimension (+/- 0.020" [0.5 mm]) by turning its tie bar

the appropriate amount. Since 1 revolution translates to approximately 6 mm of movement, every 1 mm of movement requires 1/6 turn (60 deg).

##### Example (tie bars 2 & 4):

Head to follower dim at port 2 = 2897 mm

Head to follower dim at port 4 = 2901 mm

Difference (2901 – 2897) = 4 mm

Amount of rotation = 4 x 60 deg = 240 deg

Turn tie bar 4, 240 deg (2/3 turn) CCW facing follower.

##### 7.3 Synchronize tie bars 1 and 3

Measure and record the head to follower distance at the centerline of both ports one (1) and three (3) and calculate the difference. Determine the amount of rotation necessary to move half this figure. Initially turn the tie bar at the largest dimension to seat the free nut in its socket, flush to 0.020" (0.5 mm) under-flush (do not move the follower). Further adjust this bar by the calculated rotation amount which will bring corners 1 and 3 to equal dimensions.

##### Example (tie bars 1 & 3):

Head to follower dim at port 1 = 2895 mm

Head to follower dim at port 3 = 3000 mm

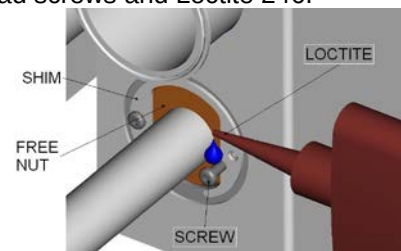
Difference (3000 – 2895) = 5 mm

Amount of rotation = 2.5 x 60 deg = 150 deg

Turn tie bar 3 to seat free nut, CCW facing follower

Turn tie bar 3 a further 150 deg CCW facing follower

Turn the diametrically opposite tie bar (1 or 3) until the free nut seats in its socket, flush to 0.020" (0.5 mm) under-flush (do not move the follower). Re-measure the head to follower distance at tie bars 1 and 3 and confirm that the difference between 1 and 3 is less than 0.040" [1 mm]. If further adjustment is necessary to balance the distances, tighten the largest figure by half the difference and loosen the smallest figure by half the difference. Attach the shims (open side down if applicable) on bars 1 and 3 with the M8 x 16 long S.S. button head screws and Loctite 246.



**Figure 34**

## 8 Drive assembly

The chain drive system must now be installed.

### 8.1 Yoke plate assembly

Lightly grease and install a ball bearing (100 x 65 x 18) into each of the two yoke plates.

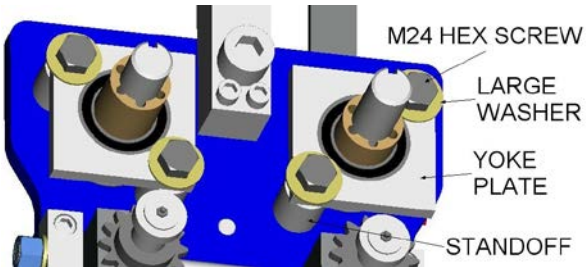


Figure 35

Place one yoke plate over tie bar bush No.1 so that the bearing passes over the corresponding diameter of the bush. While holding a standoff behind the yoke plate and aligning it with one of the two M24 tapings, loosely install one M24 x 100 mm long hex head screw (36 mm A/F) and M24 large (60mm) diameter washer using Loctite 246.

Install the other standoff, bolt and washer also using Loctite 246. Fully tighten both M24 screws. Install the other yoke plate in the same way.

### 8.2 Sprocket assembly

On each tie bar sprocket, screw in (clockwise) the pair of setscrews about  $\frac{1}{4}$ " (6 mm) and apply a drop of Loctite 246 on the female threads visible in the bores. Screw the setscrews back into their threads.

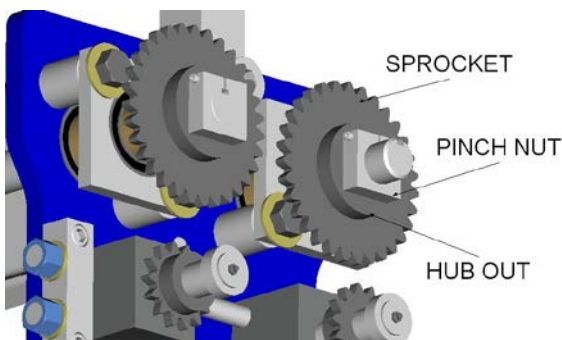


Figure 36

Install one sprocket, hub outward, on each tie bar, over the pre-installed key, ensuring the back face of each sprocket mates with its tie bar bush.

Install one pinch nut (2.5" [63.5 mm] sq) on each tie bar, ensuring the sprocket is hard against the tie bar bush and tighten the M6 socket head screw (5 mm A/F). Tighten the two setscrews (3/16" A/F) on the hub of each sprocket.

If the primary drive components and/or hydraulic motor have not been assembled, (powered units only), refer to 05 QD POWERED DRIVE ASSEMBLY section before proceeding.

### 8.3 Chain assembly

Chain tensioner assemblies are provided with a lock system to prevent unwanted de-adjustment and chain slippage. The two lock assemblies are installed on the right side pair of the upper and lower hex nut chain tensioners and are each retained with a single M6 (8) shoulder screw. Retrofit locks are also available for machines without the M6 tapping in the tensioner end blocks, which are retained with a pair of square section O-rings over the hex nuts.

A positive detent will be felt during screw rotation which assists with chain adjustment. The supplied ratchet wrench may be used on the same side as the lock or the opposite side as desired.

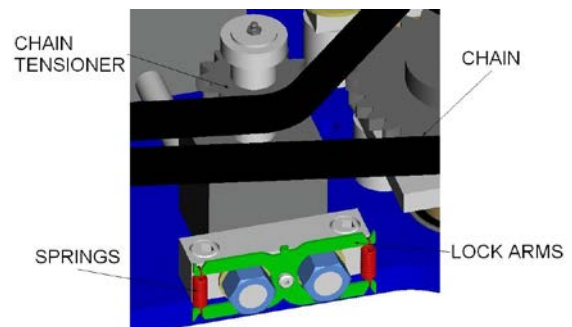
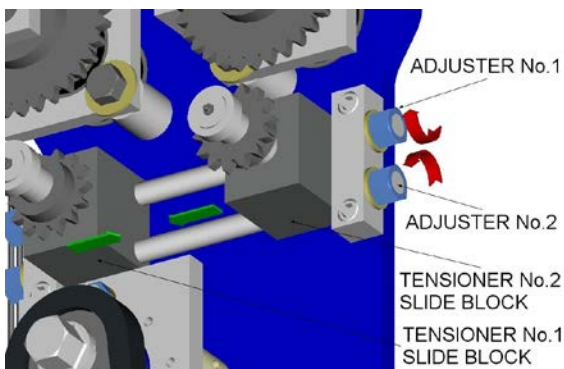


Figure 37

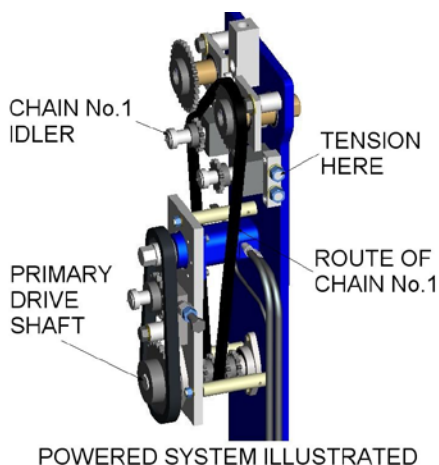
To prepare for chain installation, de-adjust all four idler sprockets toward the vertical centerline of the machine (if not already in this position) using the M24 ratchet wrench. To move the idler for tie bar No. 1, turn the hex nut at either end of the correspondingly numbered threaded rod. The adjusters are numbered from top to bottom, 1, 2, 3 & 4.





**Figure 38**

Locate and unpack the four, pre-cut, secondary drive chains and their master connecting links. Install each chain in the sequence: 3, 4, 1, 2 (ie: farthest to nearest). Each chain goes around a small central sprocket on the primary driven shaft, a tie bar sprocket and a small idler sprocket on the adjustment mechanism. Sprockets may rotate  $\frac{1}{2}$  a tooth width to permit chain engagement but **do not** allow them to move more. Install the master connecting link from the back of the chain to ease spring clip assembly.



**Figure 39**

Adjust each idler sprocket with the M24 ratchet wrench until just before each chain has become taught on all three straights. The chains should have approximately 2 x chain width of slack. Too much slack is **not desirable** as this is a bi-directional drive system. Too much tension will tend to bind the system, increase the running noise and wear.

**Important:** Once the plate pack has been closed to pitch (with power or manually), all chain tensions will require one more adjustment before placing the unit into service. Readjust chain tension as above paragraph after the machine has been closed to pitch.

#### 8.4 Tie bar lubrication

Lightly lubricate the tie bars with the recommended white food grade grease (supplied). Begin to open the plate pack manually by turning the central drive shaft clockwise (looking into end support) and confirm smooth operation of the follower and drive system. Do not continue to the next step unless everything is working correctly at this stage.

### 9 Final frame assembly

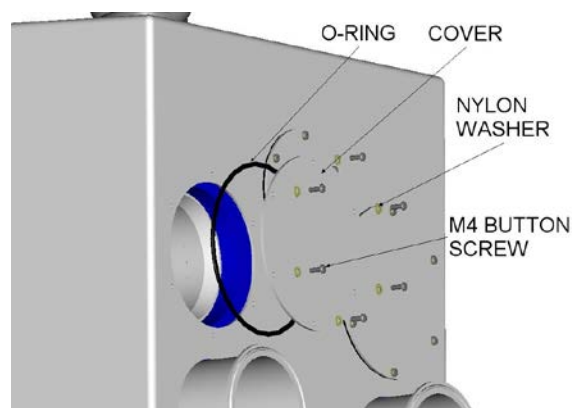
To complete the frame assembly it is necessary to install the metal tie bar seals and various covers. For powered frames, the power pack and certain electrical components must also be installed.

#### 9.1 Metal seal installation

This procedure is described in the separate document: **UM-QBD2 MK3 SEAL INSTALLATION**. Once installed, the eight seals must be lubricated. This procedure is described in the separate document: **UM-QBD2 SEAL LUBRICATION**.

#### 9.2 Round head covers

The head is provided with four large round covers for tie bar access and two small round covers for top and bottom bar bolt access. All six are installed in a similar fashion.



**Figure 40**

Without the sealing O-ring, loosely attach each cover with six, M4 button head screws and nylon washers. Lightly grease an o-ring with food grade grease and stretch it over the correspondingly sized cover until it drops into the recess between the cover and cladding.

Tighten the six screws avoiding over compression which may cause the o-ring to extrude out of the groove. The o-ring will remain visible. Repeat this step for the remaining five covers.

#### 9.3 End support door

Replace the large end support door onto the hinges and close it. Two people are recommended for this operation, simultaneously aligning the door with the upper and lower hinge pins on the cabinet.

#### 9.4 Rectangular head cover

Replace the cover on the underside of the head. Locate the two holes in the cover over the two pegs on the inside of the cladding and then push the front lip up into the space. Secure with the two M4 stainless steel flat head screws removed and stored earlier.

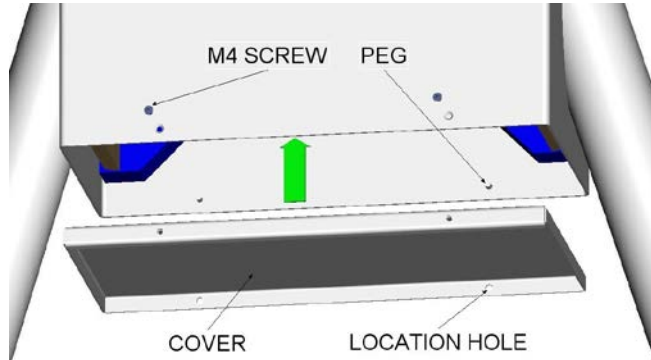


Figure 41

#### 9.5 Frame location

If necessary, move the assembled frame to its final location. Spreader discs under the ballfeet may be used if desired (not supplied).

If moved, the frame will require re-leveling. Go back to 5.8.6 and perform this operation again. When leveling is complete, return to this point.

### 10 Completing frame assembly

If you purchased the powered version of the Quad-Drive frame, please continue with 05 QD POWERED DRIVE ASSEMBLY section.

If you purchased the manual version of the Quad-Drive frame please continue in this section.

#### 10.1 Drive extension

Locate and unpack the manual drive extension piece.

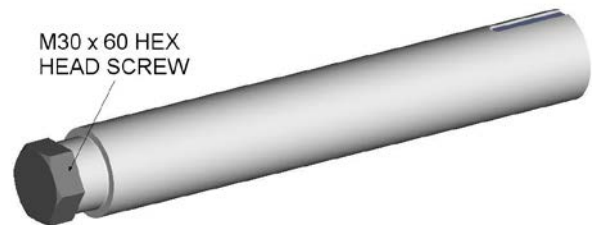


Figure 42

If the M30 x 60 mm long hexagon head screw has not been pre assembled into the extension piece, locate and unpack the screw also. Insert the M30 x 60 mm long hexagon head screw into the tapped spigot using Loctite 277 (red) and tighten fully. Allow to cure before use.

Slide the extension assembly over tie bar number 3 (lower left corner while looking into the end support cabinet) aligning the key on the extension with the keyway on the tie bar. Ensure that the end of the extension butts up to the face of the pinch nut.

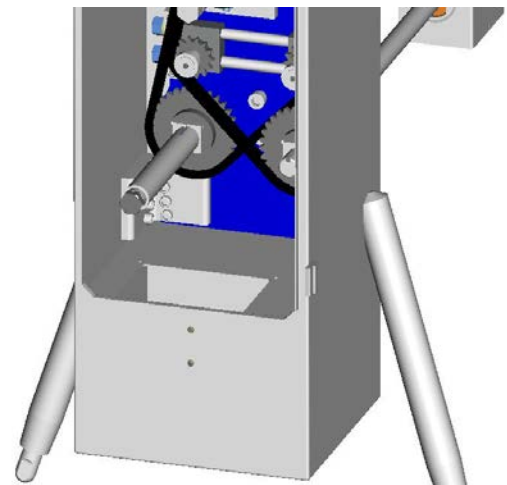


Figure 43

Note that the extension piece may be assembled and used on either lower tie bar but that tightening access is improved when installed on the side that is furthest from the main door hinges. If access requires

tightening on the same side as the hinges, the main door can be removed for improved access.

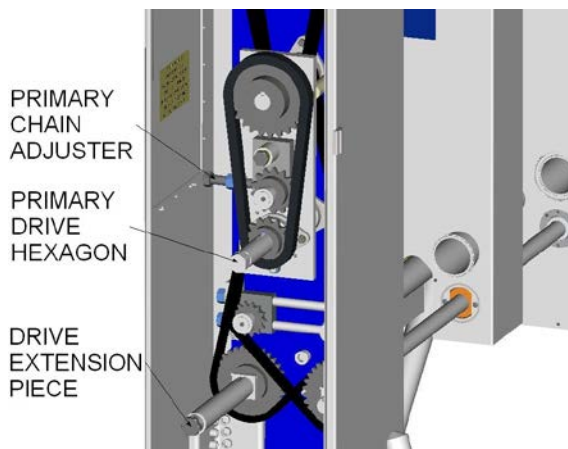
To remove the main door, lift with two people vertically upwards off the three hinges and place it in a location where it cannot be damaged or fall causing injury. Replace and close the main door once opening/closing has been completed.

#### 10.2 Manual tightening

The installed drive extension may now be used for rapid opening and closing of the frame.

During machine closing, once sufficient resistance is felt to make movement difficult, transfer the wrench to the primary drive hexagon and continue to close the machine to the designated pitch.

Note that for manual machines, the primary drive assembly is oriented towards the bottom of the machine, placing the hexagon at a comfortable height for tightening.



**Figure 44**

To open the machine, use the primary drive hexagon first until movement becomes relatively easy and then transfer the wrench to the drive extension on the tie bar and continue to open the machine.

The extension piece may be left in position on the tie bar when not in use.

Close (and replace if necessary) the main door once opening/closing has been completed.

#### 10.3 Powered upgrade

The Manual Quad-Drive Series 2 has been designed to be easily upgraded to powered operation. The upgrade may be performed within one day while the machine is running its duty. Please contact your regular sales representative for details.

#### 11 Appendix

During frame assembly and for continued trouble free operation, the following greases are recommended. It is also recommended that you continue to use the same greases for maintenance as used in initial assembly.

##### 11.1 Recommended food grade greases

###### a. Rocol Foodlube ® Multi Paste

|       |               |
|-------|---------------|
| 15750 | 85g Tube      |
| 15751 | 400ml aerosol |
| 15753 | 500g can      |
| 15756 | 5kg can       |

Ref: [www.rocolnorthamerica.com](http://www.rocolnorthamerica.com)

###### b. Loctite ® Food Grade Anti-Seize

|       |                       |
|-------|-----------------------|
| 51168 | 8-Ounce brush top can |
|-------|-----------------------|

Ref: [www.loctite.us](http://www.loctite.us)

###### c. Saf-T-Eze ® Food/Drug Anti-Seize

McMaster Carr part numbers

|         |                               |
|---------|-------------------------------|
| 1404K11 | 8-Ounce brush top can         |
| 1404K12 | 14-Ounce Grease Gun Cartridge |
| 1404K14 | 14-Ounce Container            |
| 1404K15 | 2 lb container                |
| 1404K16 | 1-gallon container            |

Ref: [www.mcmaster.com](http://www.mcmaster.com)

##### 11.2 Recommended thrust bearing greases

###### a. Exxon Mobil Corporation Mobilith ® AW-2

Ref: [www.mobil.com/USA-English/Lubes](http://www.mobil.com/USA-English/Lubes)

###### b. Exxon Mobil Corporation Mobilgrease ® XHP 222

Ref: [www.mobil.com/USA-English/Lubes](http://www.mobil.com/USA-English/Lubes)

###### c. Bostik Never Seez ® Black Moly

|         |                      |
|---------|----------------------|
| NSB150  | 1 lb can             |
| NSBC-1  | 14.1-Ounce cartridge |
| NSB-35B | 35 lb pail           |

Ref: [www.rocolnorthamerica.com](http://www.rocolnorthamerica.com)

### 1 Handling

Binary-Drive Series 2 heat exchangers can be shipped either assembled or unassembled from the factory. When site assembly is required, these instructions must be closely followed to assure safe and correct operation. The personnel undertaking the work should have proper training and experience and must also be equipped with the proper tools and rigging equipment required for the assembly of large, heavy equipment.

### 2 Lifting

Binary-Drive frames are provided with two points to lift the head and end support or the complete frame.

Maximum weights of primary components:

| Component               | Weight lbs. [kg] |
|-------------------------|------------------|
| Head                    | 767 [348]        |
| Follower                | 500 [227]        |
| End Support (powered) * | 666 [302]        |
| End support (Manual)    | 573 [260]        |
| Tie Bar for 1500 mm     | 52 [24]          |
| Tie bar for 3500 mm     | 105 [48]         |
| Top Bar 1500 mm         | 67 [31] †        |
| Top Bar 3500 mm         | 152 [69] †       |
| Bottom Bar 1500 mm      | 60 [27] †        |
| Bottom Bar 3500 mm      | 136 [62] †       |

\* Without power pack.

† Complete top or bottom bar assembly.

### 3 Consumables

The following consumables are required for assembly (see **17 Appendix** at end of this section for recommended greases):

| Product                      | Use                       |
|------------------------------|---------------------------|
| Food grade grease (supplied) | seals, ballfeet, tie bars |
| Black lithium grease         | Thrust bearings           |
| Clear RTV silicone sealant   | Various                   |
| Loctite 246 (blue)           | Fasteners                 |

### 4 Tools

The following tools and equipment are required for assembly (read the numbered tool notes after the

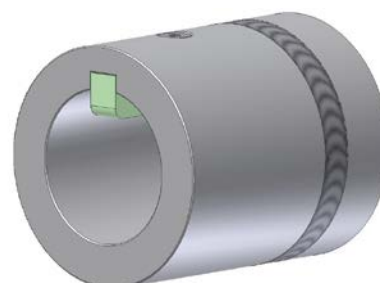
illustration). Rigging equipment is not listed and the 'Use' list is not necessarily exhaustive:

#### Tool

2.5 mm A/F Hex key/drive  
 4 mm A/F Hex key/drive  
 5 mm A/F Hex key/drive  
 8 mm A/F Hex key/drive  
 10 mm A/F Hex key  
 14 mm A/F Hex key/drive  
 3/16" A/F Hex key/drive  
 8 mm A/F Hex socket  
 10 mm A/F Hex socket  
 24 mm A/F Hex socket  
 46 mm A/F Hex socket  
 Flat blade screwdriver  
 APV tie bar socket – Fig.1  
 Ratchet socket wrench  
 600lbf.ft + torque wrench  
 1ft ratchet extension bar  
 36 mm A/F Ratchet wrench  
 36 mm A/F open end wrench  
 7/16" A/F wrench  
 Adjustable wrench 55mm+ A/F  
 10-lb Sledge hammer  
 2" x 4" wood stud  
 Spirit level  
 25ft Tape measure  
 Grease gun and nozzle  
 Caulking gun  
 6ft ladder (2 required)

#### Use

M4 But & flat hd. (2)  
 M6 shoulder scr (1)  
 M8 But & flat hd. scr.  
 M12 flat hd. screw  
 M16 flat hd. screw  
 M16 SHCS/M24 FHS  
 Sprocket setscrews  
 M5 hex nuts  
 M6 hex nuts  
 M16 Hex hd. screw  
 Primary drive hex (4)  
 Grip rings  
 Tie bars (5)  
 Various  
 Top & bot. bar SHCS  
 Various  
 Chain adjustment (2)  
 Ballfeet  
 Warning light  
 Various (3)  
 Tie bars  
 Tie bar drift  
 Frame leveling  
 Plate pack sync.  
 Seals, tie bars (2)  
 RTV sealant  
 Various



TIE BAR SOCKET TOOL

**Figure 1**

Tool notes:

- (1) Suits chain adjuster locks and follower nut shims
- (2) Supplied with all frames
- (3) For tie bar synchronization
- (4) Optional (or use 55mm A/F adjustable wrench)
- (5) Custom APV assembly tool not supplied w/frame



## 5 Standing the Frame



**Warning:**  
All lifting equipment must have the proper capacity and be in good condition. Personnel must follow safe rigging practices at all times.



**Caution:**  
All components must be properly supported during all phases of assembly.

### 5.1 Preparation

a. ASSEMBLY PLANNING: Try to assemble the frame as close as possible to its final destination to reduce frame movement on completion. However, available space will often determine how and where the machine can be assembled.

Standing the frame always requires overhead rigging (using ceiling beams and/or an 'A' frame) and possibly fork lift access.

For tie bar installation, the simplest and preferred method is to install the tie bars through the head when the machine is partially assembled but this requires a full tie bar length of space in front of the machine. Consider tie bar weight and if mechanical assistance will be needed to lift.

The alternative is to install the top and bottom bars onto the machine with the tie bars already placed inside them but this more complex.

Determine now if you will assemble the frame remotely or at its final location and which tie bar assembly method you need to employ.

b. LOCTITING: It is recommended that the frame be fully standing within 2 hours of the first application of Loctite 246 (ie: before curing) to permit any necessary bolt torquing after assembly and leveling.

c. UNPACKING: Remove each item from its packing and check that all necessary parts have been supplied and are free of damage prior to assembly. Refer to the Parts Table in 02 BD FRAME CONSTRUCTION section. Components are also identified in this section.

d. EQUIPMENT: Ensure you have a complete set of tools and equipment and the required consumables are available as described above.

e. E.S. DOOR: Remove the door as follows; two people may be required. With the end support enclosure in the horizontal position, turn the handle  $\frac{1}{4}$  turn counterclockwise, open the door and slide it off its hinges. Place the door in a safe location where it cannot fall or become damaged.

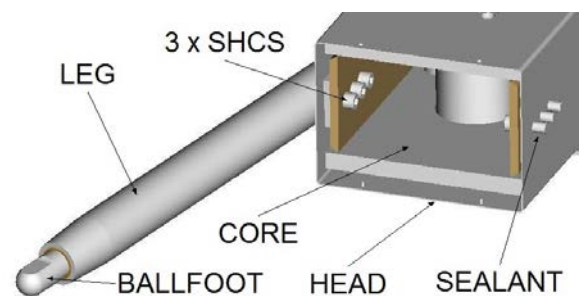
f. HEAD COVERS: If installed, remove the two round covers on the outside of the head. Each cover is retained with six, M4 button head screws (2.5 mm A/F). Store the covers, O-rings, screws and washers in a safe place.

### 5.2 Legs

Prepare the head and end support enclosure by installing the leg assemblies, if necessary, as follows.

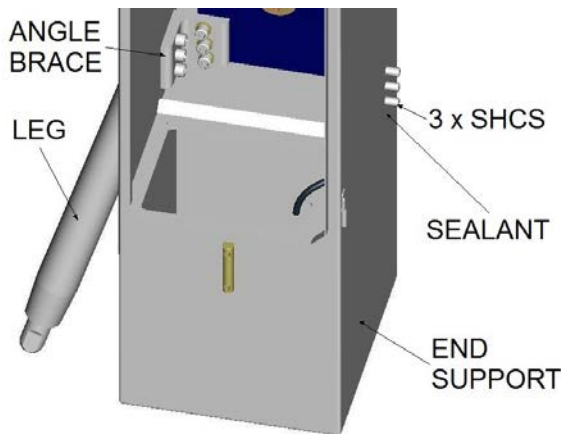
Remove the two M4 flat head screws and the bottom cover from the head (store the screws in a safe place).

On the outside of both the head and end support enclosure, apply a ring of clear RTV sealant around each set of four, 17mm diameter holes and install all four legs. Use three M16 x 45 long socket head screws with Loctite 246 on each leg. Remove excess RTV sealant.



**Figure 2**

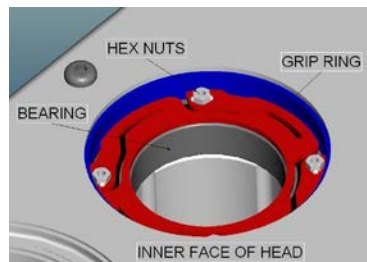
If ballfoot assembly is necessary, thoroughly grease ballfoot thread (with supplied white grease) and then fully install one into each leg.



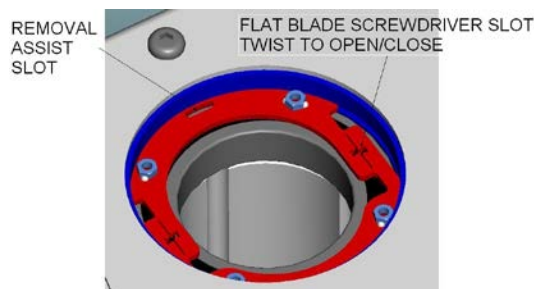
**Figure 3**

#### 5.3 Head bearing installation

If not installed, liberally coat with white grease and install one ball bearing (100 x 65 x 18) in the two tie bar openings on the inner face of the head. Ensure each bearing is fully seated below the ring groove. Install one seal grip ring, M4 hex nuts facing outward, in each bore to retain the bearing.



**Figure 4a**



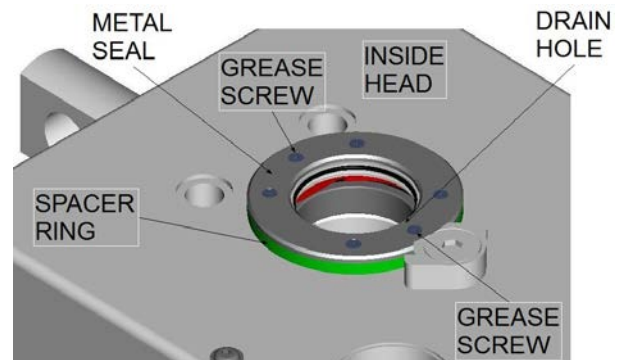
**Figure 4b**

Note: older series 2 machines were supplied with a single piece grip ring (Fig. 4a). Newer machines have

the split grip ring (Fig. 4b). Ensure grip rings properly expanded into their grooves.

Lift the head into an upright position using a strap or chain and hook through the lift block.

#### 5.4 Top bar assembly preparation



**Figure 5**

Unpack and install two metal seal assemblies and spacer ring assemblies into the top and bottom tie bar openings on the inside face of the head as follows.

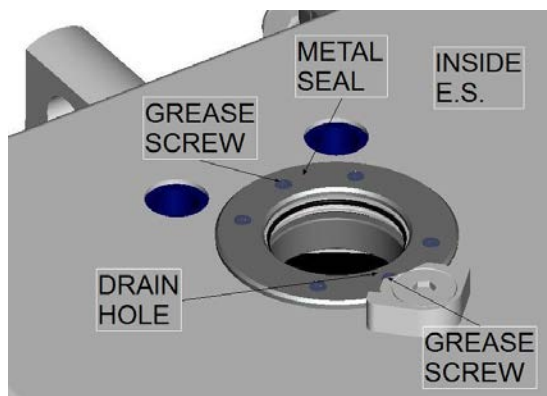
The large O-ring in the back of the seal and the back of the spacer ring should be lightly coated with white, food grade grease before assembly. Do not loosen the grease screws. Rotate the seal so that the small drain hole is at the bottom and screw the four, equi-spaced M4 (2.5 mm A/F) x 16 mm long flat head screws evenly into the nuts on the grip ring to fully compress the two O-rings (Fig.5).

If the screws fail to pick up the grip ring threads, assistance can be provided by some even pre-compression on the face of the seal assembly, sufficient to compress both large O-rings.

Pre-compression can be achieved by clamping through the tie bar hole (protect cladding and seal faces from clamp damage) or, alternatively, using two M4 x 18 mm long (no longer) flat head screws, inserted and tightened into any two opposing seal screw openings.

Replace the 18 mm screws with the supplied 16 mm screws once the remaining two supplied screws are installed. The two M4 screws on the vertical centerline will be used later to grease the seal.





**Figure 6**

Unpack and install the remaining three metal seal assemblies into the top and bottom tie bar openings and the central drive nut on the inside face of the end support as follows.

The large O-ring in the back of the seal should be lightly coated with white, food grade grease before assembly. Do not loosen the grease screws. Rotate the seal so that the small drain hole is at the bottom and screw the four, equi-spaced M4 (2.5 mm A/F) flat head screws evenly into the tappings in the end support to fully compress the O-ring (Fig.6).



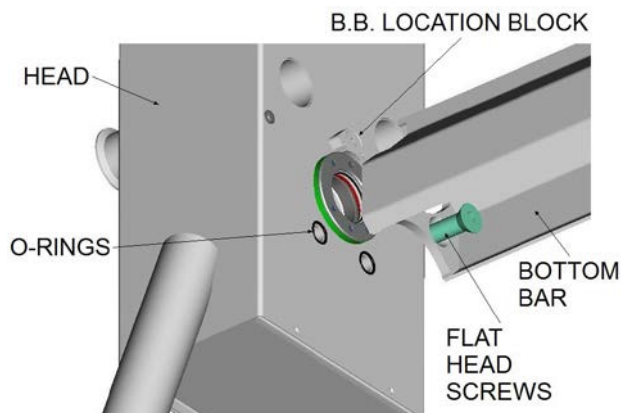
**Figure 7**

Locate and unpack the two thrust roller bearings (100 x 65 x 27). Apply a liberal coat of black lithium grease to the bottom of both counterbores where the thrust bearings sit. Install one 'housing' washer (which has the slightly larger inside diameter – part number begins with 'G') into each tie bar opening through the outer face of the head. Ensure that each washer is properly

seated inside the smaller diameter at the bottom of the counterbore and that the bearing face (without lettering) is facing outwards (ie: visible). A tie bar bush may help with insertion.

#### 5.5 Top and bottom bar assembly

Apply a coating of white, food grade grease to two carry bar O—Rings (0.921" I/D x 0.139" sect) and insert them into the cladding recesses of the two bottom bar bolt holes.



**Figure 8**

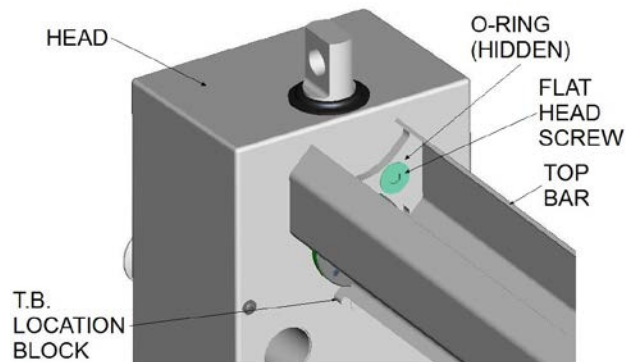
**IMPORTANT ASSEMBLY NOTE:** Insertion of the tie bars into the top and bottom bars is described in the following paragraph in case there is insufficient room beyond the head to insert both of the tie bars later. However, if a complete tie bar length is available beyond the head, it is recommended that the tie bars be inserted later.

If you need to insert the tie bars now, lightly grease (white, food grade) one tie bar while leaving 250 mm (10") grease-free at each end and carefully place it, correctly oriented, inside the bottom bar assembly (avoiding damage) with the overhang all at the end support end. NOTE: the keyways at the ends of the tie bars are different lengths. The longer (193mm) keyway sits in the end support, the shorter (130mm) keyway sits in the head.

Crane or fork-lift the bottom bar assembly (with tie bar overhang away from head if inserted) into position over the O-Ring sealed holes on the head. Engage the two upward facing plate guide rails into the downward facing slots of the bottom bar location block. Line up the two bolt holes with the tapings in the head. Ensure

the bottom bar is square to the head and level and then fasten using two M24 x 70 mm long S.S. flat head socket head screws. Use Loctite 246 and tighten fully.

Support the bottom bar at least 500 mm (20") from its free end using a jack stand or similar and, after confirming that the head and bottom bar assembly are stable, remove the crane holding the head.

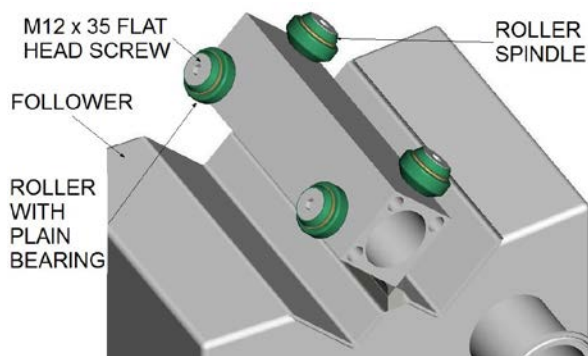


**Figure 9**

Assemble the top bar (and if necessary a lightly greased and correctly oriented tie bar) in a similar way to the bottom bar except that the underside of the hanging surfaces on the top bar rest on the top bar location block. Apply non damaging support to the top bar at least 500 mm (20") from the free end. The support must also be able to accept the full follower weight.

#### 5.6 Follower installation

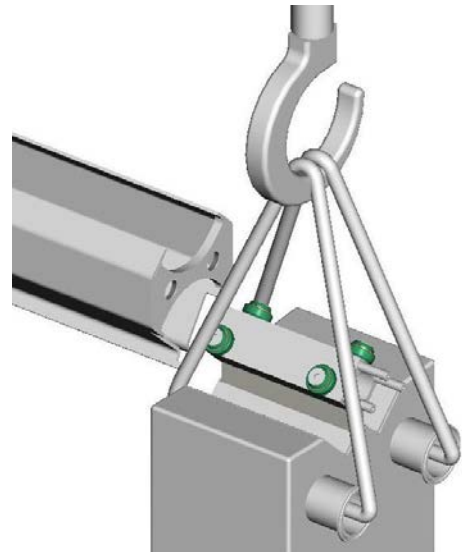
Ensure the two covers on the bottom of the follower are in place. Install the four roller assemblies onto the top 'diamond' of the follower using Loctite 246.



**Figure 10**

If tie bars were placed in the carry bars, carefully push them through the head, lifting them over or protecting the O-Ring in the metal seals, until they are at least 500 mm (20") in from the free ends of the top and bottom bars.

With two straps, one passing through each upper port, crane the follower into position at the free end of the top and bottom bars and with connections facing away from head. Move the crane so that the top and bottom 'diamond' of the follower enters the inside of the top bar and bottom bar respectively. Stop when the ports are past the free end of the top/bottom bars.



**Figure 11**

Lower the follower so that the rollers rest on the inside of the top bar. The crane and straps may now be removed.

#### 6 Tie bar assembly

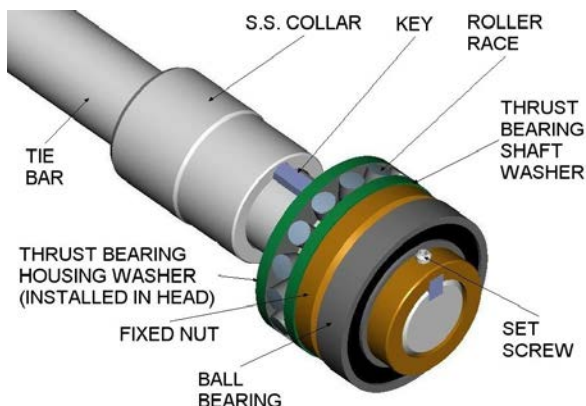
If the tie bars have not yet been inserted in the machine, the following procedure can be performed on a bench or saw horses. However, if the tie bars now reside inside the carry bars, fixed nut assembly must be performed at the machine.

##### 6.1 Fixed nut assembly

Install one ball bearing (100 x 65 x 18) onto the long neck of each fixed nut.

Install the 'shaft' washer from each thrust roller bearing onto the short neck of each fixed nut. Ensure that the bearing face (no lettering) is facing outwards (ie: visible).

Thoroughly pack each roller race with black Lithium grease and install one against each 'shaft' washer.



**Figure 12**

At the head end (130mm keyway), screw a SS collar, large diameter first, onto each tie bar to expose about 3.5" [90 mm] of thread and align the keyways.

Screw a fixed nut assembly onto each tie bar, thrust race first, until the fixed nut ends align with the ends of the tie bars. On each bar, observe the relative position of the nut and tie bar keyways and rotate the nut the minimum amount (in either direction) to bring the keyways into alignment.

Fully insert a 5.12" [130 mm] long, 3/8" x 1/2" tapered key into each assembly to confirm its correct fit (end of key should be flush with end of tie bar). Remove any burrs if necessary. Remove the key.

Apply a ring of clear RTV sealant to the thread around the full diameter of the tie bar in front of the S.S. collar for a length of about 3/4" [19 mm]. Screw the S.S. collar further onto tie bar, over the RTV, to yield a space of 1.83" [46.5 mm] between the fixed nut and collar. (A wire rod cut to this length may be helpful for measurement).

Screw the collar further onto the tie bar until the keyways align (this could be up to almost one more full revolution).

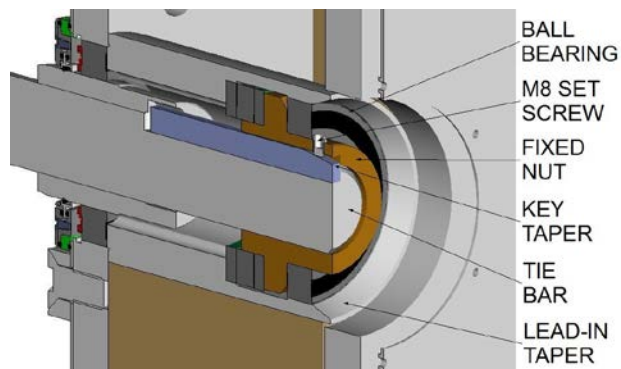
Insert the key, non-taper end first, until it is flush with the end of the tie bar. Apply Loctite 246 to the M8 x 10 mm setscrew and install into the tapped hole in front of the ball bearing. Tighten setscrew down onto taper. Note that the setscrews on the fixed nuts protrude slightly to retain the ball bearings. Remove any excess RTV on the O/D of the thread in front of the collar.

If the tie bars are not yet installed, lightly grease them (white, food grade) while leaving 250 mm (10") grease-free at the end support end and carefully push the tie bars through the head, lifting the thread over or protecting the O-Ring in the metal seals until the ends are near the follower.

Apply a full coat of white grease to the large diameter of each S.S. collar to assist with passage through the metal seal O-rings. Confirm that the metal seal inner O-rings are in place.

Align the ends of the tie bars with the holes in the 'diamonds' of the follower and continue to push or drift the tie bars until the S.S. collars pass through the previously installed ball bearings and partly emerge from the metal seals.

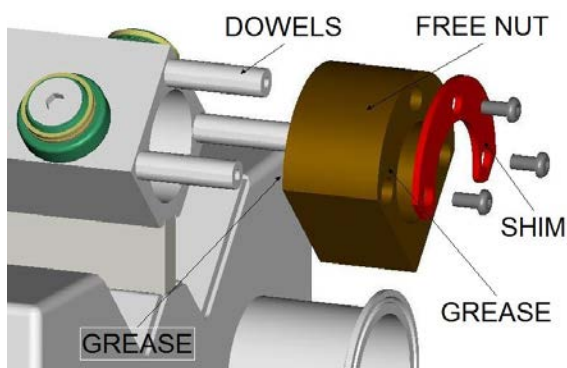
Ensure that the O-ring has not been pushed out (check entire collar perimeter) and that the thrust bearings are fully seated (the ball bearing will be flush with the bottom of the lead-in taper when fully seated).



**Figure 13**

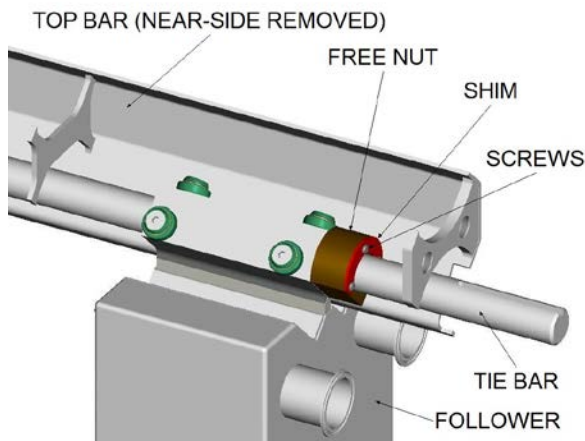
#### 6.2 Free nut installation

Lubricate with white, food grade grease the leading and trailing faces of the two Al/Bronze free nuts and wind them onto the top and bottom tie bars until they almost touch the end of the top and bottom bars.



**Figure 14**

Align the 'V' points of the two free nuts to face each other and using the special tie bar socket tool (or a sprocket and key rotated with gloved hands), rotate the tie bars counter-clockwise while assisting the free nuts past the end of the top/bottom bars and towards the follower. Continue rotating until the three holes in each nut engage over the three dowel pins protruding from the follower 'diamonds' and the greased nut face touches the follower.



**Figure 15**

Install a 'horseshoe' shim on each free nut over the ends of the dowels using  $\frac{1}{4}$ "-20 S.S. x  $\frac{1}{2}$ " long socket head button screws (use  $\frac{5}{32}$ " A/F hex key). Three screws are used per shim and installed with Loctite 246. Note that a 0.5mm gap will result so the free nuts will not be clamped by the shims.

### 6.3 Initial synchronization

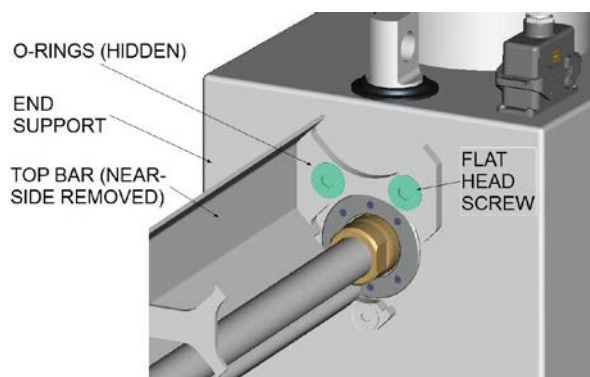
**Ensure that the leading edge of the top and bottom free nut measure the same distance from the head**

**before continuing. Rotate the one tie bar to bring the free nuts to the same dimension if necessary.**

### 7 End support assembly

Confirm that the tie bar roller bearings have been installed on the inside of the end support in the 'dogbone'. This helps protect the lip seals during end support assembly. If bearing installation is necessary, lightly grease (white, food grade) two bearings (100 x 65 x 18) and place one in each counterbore. (No Loctite is required). The bearing sits 2mm (0.080") proud of the dogbone face. Confirm that the two metal seals are installed and that their inner O-rings are present.

Apply a coating of white, food grade grease to the remaining four carry bar O-rings (0.921" I/D x 0.139" sect) and insert them into the four cladding recess of the top and bottom bar bolt holes in the end support.



**Figure 16**

Crane the end support close to but not touching the free ends of the top and bottom bars (eg: 20 mm [ $\frac{3}{4}$ " away) using a strap/chain through the lifting eye provided. Line up the top bar bolt holes and loosely engage two M24 x 70 mm long flat head socket screws applying Loctite 246. Line up the bottom bar bolt holes and loosely engage the last two M24 x 70 mm long flat head socket screws applying Loctite 246.

With both the top bar and bottom bar screws engaged, evenly and fully tighten all four, ensuring that the top and bottom bars engage with their respective location blocks.

The straps/chains may now be removed from the end support. The top bar and bottom bar supports may also be removed.

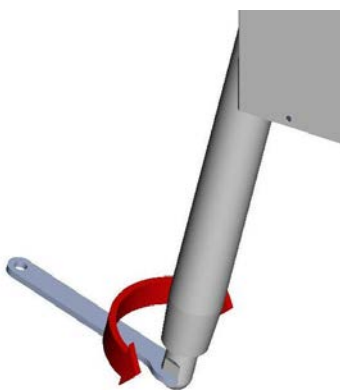


#### 8 Machine leveling

It is now important to level the machine before continuing. You must also follow this procedure if the machine is relocated after assembly.

Starting with all ballfeet fully inserted, level the machine in all three planes by turning the flats with a wrench (1.42" [36 mm] A/F).

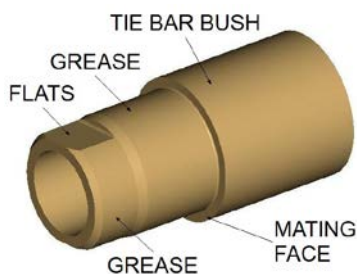
Use a bubble (spirit) level on the side and inside (face with drive nut) of the end support. Also check that the bottom bar is horizontal. Each ballfoot is provided with +/- 2" [50 mm] adjustment. Do not extend past the max mark on the ballfoot.



**Figure 17**

#### 9 Tie bar bush assembly

Locate the two S.S. tie bar bushes and apply a coat of white grease fully around the smallest (with flats) and middle outer diameters of both.

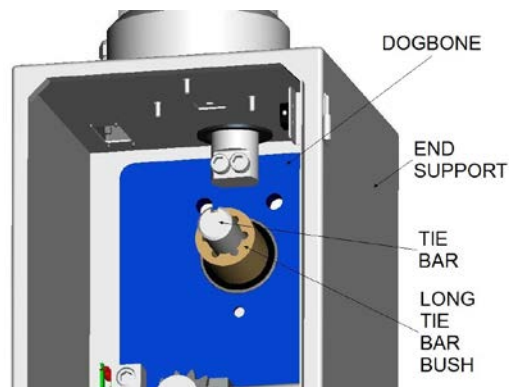


**Figure 18**

While preventing the tie bar from turning, screw the longer tie bar bush, flats first, onto the end of the top tie bar from inside the end support until it mates with the ball bearing and is hand tight.

While preventing the tie bar from turning, screw the shorter tie bar bush, flats first, onto the end of the bottom tie bar from inside the end support until it mates with the ball bearing and is hand tight.

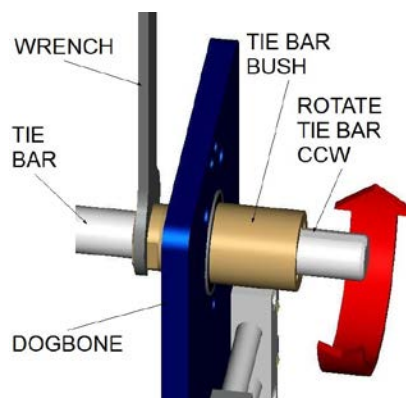
The tie bar bushes will both emerge from the face of the metal seals by about 1.75" (45mm).



**Figure 19**

#### 9.1 Loading the tie bars

Using the special tie bar socket tool and ratchet wrench (14" extension bar recommended) on the exposed end of the tie bar, rotate the tie bar and bush together the minimum amount to orient the flats on the bush vertically (observed through the wider opening of the top and bottom bar respectively). Help will be needed for this step.

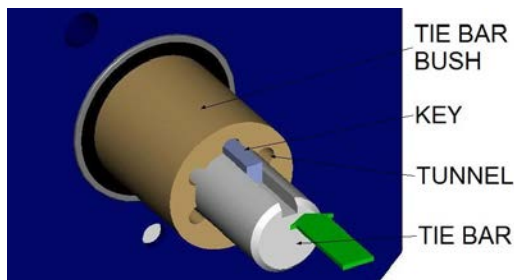


**Figure 20**

Engage an open ended wrench on the flats of each tie bar bush in turn (2.165" [55mm] A/F) and prevent the bush from turning. Help will also be needed for this step. See fig. 20 with cabinet removed for clarity.

Turn the tie bar counter-clockwise with just enough force to ensure all slack has been removed. Further rotate in the same direction but with more force to line up the keyway on the tie bar with the next nearest tunnel in the bush. The maximum tie bar rotation will be 1/6 turn for this final step. If, using only hand tightening force, the keyway cannot be aligned with the next tunnel, back off to the previous one.

Push the key (3/8" x 1/2" x 65 mm long) into the 'tunnel' to lock the bush to the tie bar.



**Figure 21**

Note that there will be about 1.25" (32mm) of key that will not enter the bush. Repeat this step for the lower tie bar.

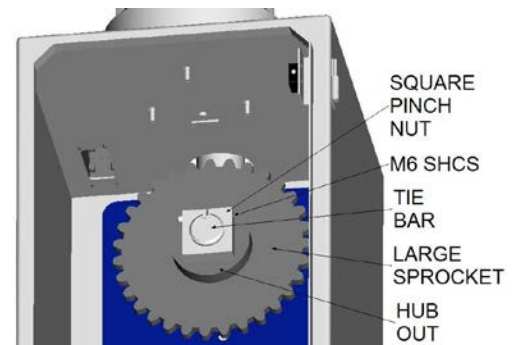
## 10 Drive assembly

Install one large sprocket on each tie bar ensuring engagement with the drive key. The hubs of the sprockets face outward.

Locate the two square pinch nuts and ensure that the M6 socket head screws are loose. Install a pinch nut (2.5" A/F [63.5mm]) on each tie bar and tighten each nut to ensure the sprocket is hard against its tie bar bush.

Tighten the M6 socket head cap screw (5mm A/F), applying Loctite 246, on each pinch nut to prevent nut rotation on the tie bar.

Tighten the two setscrews (3/16" A/F) on each sprocket applying Loctite 246.

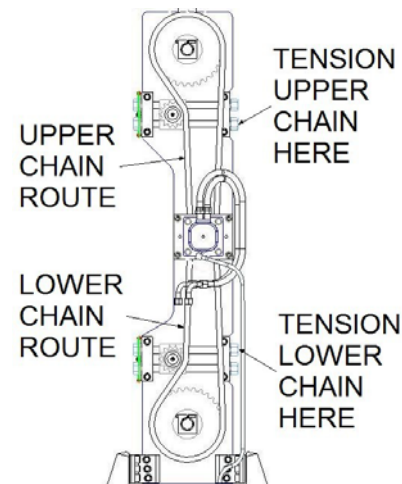


**Figure 22**

### 10.1 Chain assembly

De-adjust both idler sprockets toward the left side of the machine (if not already in this position) using the M24 ratchet wrench supplied.

To de-adjust the upper idler, turn the lower hex nut on the right, anticlockwise (off). To move the lower idler, turn the upper hex nut on the right, anticlockwise (off). See Fig.23 for locations. Note that an adjuster lock is provided on the left side of each pair providing a positive lock as the bars are rotated.



**Figure 23**

Before installing the two chains, confirm that the follower has not moved out of parallel to the head by measuring the distance between the leading edges of top and bottom free nuts and the head. Correct if there is more than 1mm (0.040") difference between top and bottom nut.



Locate and unpack the two drive chains and their master links. Install the lower chain and then the upper chain as illustrated above. Each chain goes around a small central sprocket, a larger tie bar sprocket and a small idler sprocket on the adjustment mechanism. Prevent tie bar rotation while installing the chains.

Install the master link from the back of the chain to ease spring clip assembly.

Adjust each idler sprocket with the M24 ratchet wrench until each chain has become nearly taught on all three straights. The chains should have approximately 2 x chain width of slack in their longest straight. Too much slack is **not desirable** since this is a bi-directional drive system. Too much tension will tend to bind the system, increase the running noise and wear.

Any further head to follower synchronization can only be achieved with the follower compressing plates and will be checked and adjusted if necessary after the plate pack has been installed.

#### 11 Tie bar bush sealing

It is now necessary to seal the tie bar bushes. Obtain assistance to rotate the central drive shaft protruding through the inside face of the end support. Turn by hand wrench (1.81" [46mm] A/F).

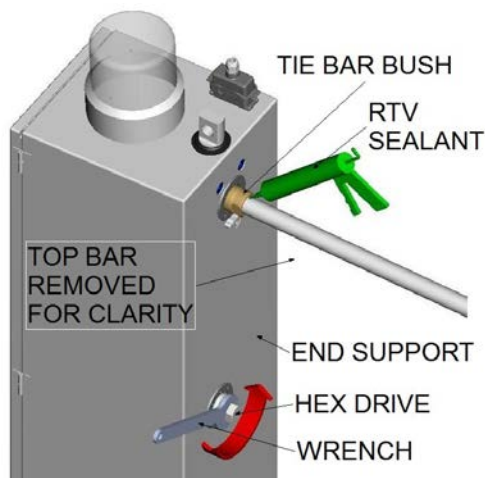


Figure 24

Apply a full ring of clear RTV sealant at the junction of the top tie bar and tie bar bush as the tie bar is rotated. Form a smooth radius and wipe off excess. Repeat this step for the lower tie bar.

#### 12 Follower guide block

Apply a spot of white food grade grease to the two side faces of the guide block that will be in contact with the inside of the bottom bar.

Install the correctly oriented follower guide block on the inside face of the follower using the M8 x 30 mm long flat head socket screw (5mm A/F). Use Loctite 246 and tighten fully. If insertion between the bars is difficult, gently pry the bottom bar halves apart.

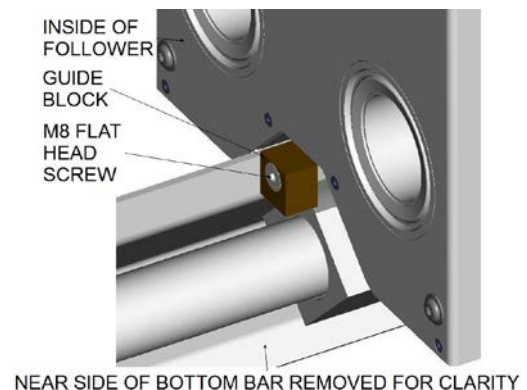


Figure 25

#### 13 Greasing

Lubricate the following surfaces with the recommended white, food grade grease where indicated. (See appendix at end of this document for grease recommendations).

| Component                       | Grease location        |
|---------------------------------|------------------------|
| Top and bottom tie bars *       | Where follower travels |
| Top bar plate hanging surfaces  | Full T.B. length       |
| Bottom bar plate guide surfaces | Full B.B. length       |
| Bottom bar foll. guide surfaces | Where follower travels |

\* grease only if necessary

#### 14 Drive system

Before continuing with this procedure, install the appropriate drive system as follows:

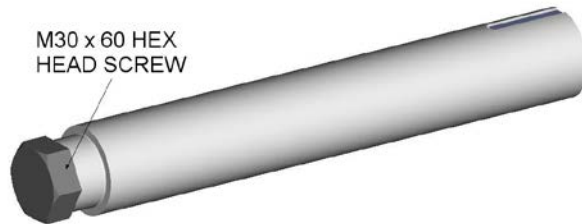
If you purchased the powered version of the Binary-Drive frame, please proceed with the power pack installation. See 06 BD POWERED DRIVE ASSEMBLY section for details. Once the drive system is in place, return to this procedure and continue at **15**

**Final synchronization**, to complete the frame assembly.

If you purchased the manual version of the Binary-Drive frame, please continue in this section.

#### 14.1 Drive extension

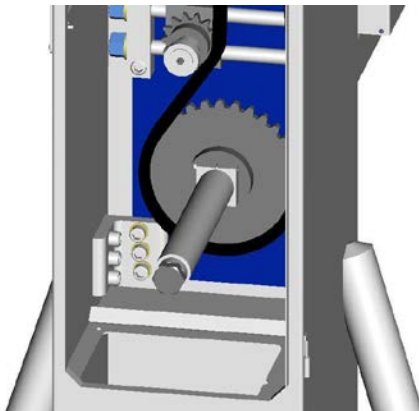
Locate and unpack the manual drive extension piece.



**Figure 26**

If the M30 x 60 mm long hexagon head screw has not been pre-assembled into the extension piece, locate and unpack the screw also. Insert the M30 x 60 mm long hexagon head screw into the tapped spigot using Loctite 277 (red) and tighten fully. Allow to cure before use.

Slide the extension assembly over the lower tie bar aligning the key on the extension with the keyway on the tie bar. Ensure that the end of the extension butts up to the face of the pinch nut.

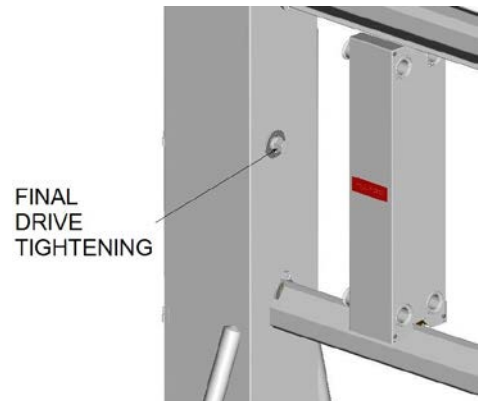


**Figure 27**

#### 14.2 Manual tightening

The installed drive extension may now be used for rapid opening and closing of the frame, counterclockwise to close and clockwise to open.

During machine closing, once sufficient resistance is felt to make movement difficult, transfer the wrench to the final drive tightening hexagon on the outside of the end support facing the follower. Continue to close the machine, now turning clockwise, to the designated pitch.



**Figure 28**

To open the machine, turn the final drive tightening hexagon counterclockwise first until movement becomes relatively easy and then transfer the wrench to the drive extension on the tie bar and continue to open the machine turning clockwise.

The extension piece must be removed to close the end support door.

Close (replacing if necessary) the end support door once opening/closing has been completed.

#### 14.3 Powered upgrade

The Manual Binary-Drive Series 2 has been designed to be easily upgraded to powered operation. The upgrade may be performed within one day while the machine is running its duty. Please contact your regular sales representative for details.

#### 15 Final synchronization

Install the plate pack including any grids and other items.

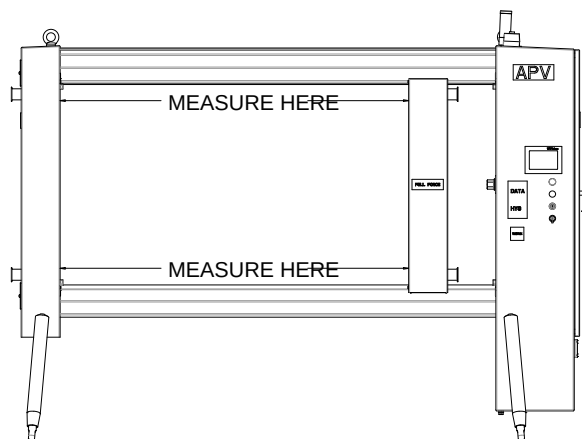
**Warning: Machine damage can occur while closing or opening if the follower and head are out of parallel by more than about 1/8" [3 mm]. For this reason, check that the follower remains parallel to the head within this band during the initial tightening process. If head and follower are out of**

**parallel by more than the above figure prior to or during closing, stop tightening and make the following adjustment IMMEDIATELY.**

Out of parallelism can occur if a thrust bearing was not fully sealed and from other manufacturing variations.

In service mode (if powered) or with the supplied ratchet wrench (if manual), close the machine to a point where the plate pack is clearly bound. This will place tension on the tie bars and remove any slack in the system (fully closing to the compressed pitch is not necessary).

Determine if the head and follower are parallel by measuring just below the top ports and just above the lower ports using a tape measure.



**Figure 29**

Measure on both sides of the machine and average the top two and the bottom two dimensions. The machine is considered synchronized if the average top and bottom dimensions are no more than about 0.040" (1 mm) apart. Ensure you measure inside the vertical corner radius of the head and follower cladding.

If the head and follower are parallel within the prescribed amount, you do not need to make further adjustment – go on to 16 Final frame assembly. If the difference between the top and bottom average measurements is over 1 mm (0.040"), an adjustment is necessary.

Calculate the difference between the bottom and top average dimensions. If the top dimension is larger than

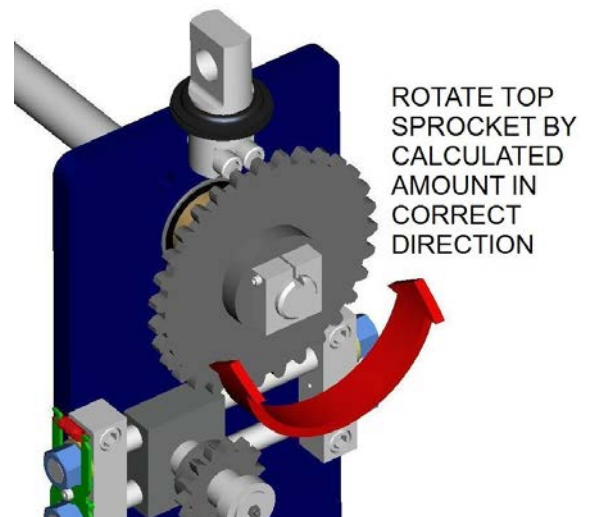
the bottom, it is considered too loose and vice-versa. We will leave the bottom of the follower as the reference point.

One revolution of tie bar = 6.35 mm (1/4") of follower movement. Examples:

(a) If the top of the follower is 2 mm too tight, you will need to rotate the sprocket about 1/3 revolution in a clockwise direction.

(b) If the top of the follower is 3 mm too lose, you will need to rotate the sprocket about 1/2 turn in a counterclockwise direction.

Before attempting to rotate the sprocket, open the follower to fully relieve plate pack compression and then remove the top tie bar chain.



**Figure 30**

Rotate the top sprocket with gloved hands in the correct direction by the calculated amount and replace the chain and master link, re-adjusting its tension as necessary.

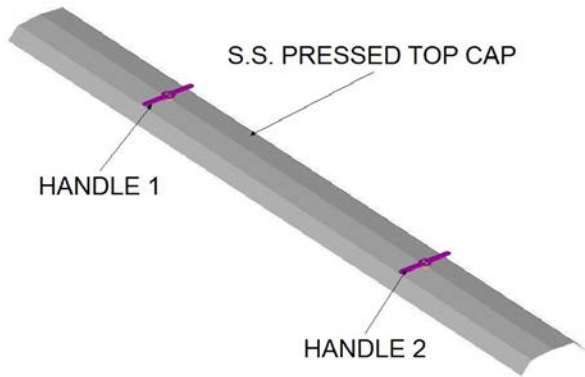
Now close the machine to the NOMINAL plate pack pitch and recheck the dimensions. Repeat the above procedure if necessary (extremely unlikely).

#### **16 Final frame assembly**

A few external items now need to be installed to complete assembly.

#### 16.1 Top cap

Locate the top cap assembly and ensure all handles are at 90 deg. to the long axis.

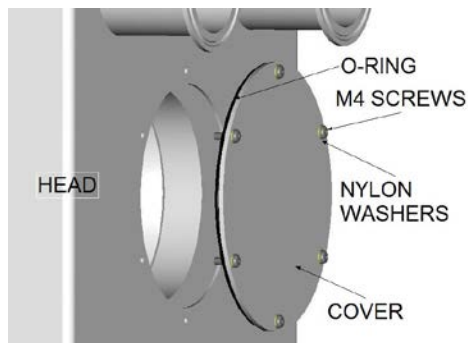


**Figure 31**

Place the cap onto the top bar and, while applying downward pressure, rotate one handle approximately 90 deg. Apply sufficient pressure to ensure the sides of the cap conform to the top bar shape. The rotating cam will grip the inside of the top bar. Repeat this process for each handle on the top cap.

#### 16.2 Round head covers

The head includes two large openings for tie bar access. A round cover assembly is provided to seal each of these openings.

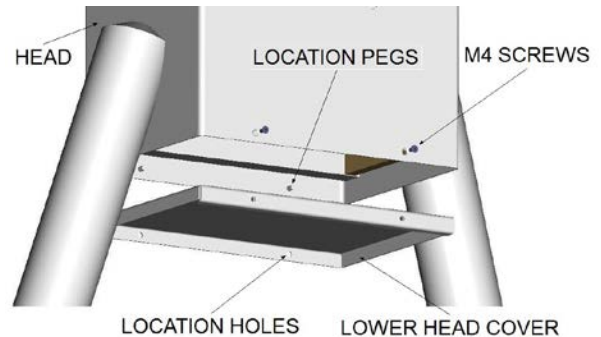


**Figure 32**

Without the sealing O-ring, loosely attach each cover with six, M4 button head screws (2.5 mm A/F) and nylon washers. Lightly grease an O-ring with food grade grease and stretch it over the cover until it drops into the recess between the cover and cladding. Tighten the six screws avoiding over compression which may cause the O-ring to extrude out of the groove. The O-ring will remain visible.

#### 16.3 Head cover

Install the lower head cover (correctly oriented – see Figure 34) on the underside of the head. Slide the cover over the location pegs and raise the cover into place. Secure the cover in place by using the two M4 stainless steel flat head screws removed and stored earlier.



**Figure 33**

#### 16.4 Relocation

If the machine needs to be moved to another, final destination, level again according to the instructions in **8 Machine leveling**. The installed plate pack need not be removed to move the frame.

### 17 APPENDIX

During frame assembly and for continued trouble free operation, the following greases are recommended. It is also recommended that you continue to use the same greases for maintenance as used in initial assembly.

#### 17.1 Recommended food grade greases

##### a. Rocol Foodlube ® Multi Paste

|       |               |
|-------|---------------|
| 15750 | 85g Tube      |
| 15751 | 400ml aerosol |
| 15753 | 500g can      |
| 15756 | 5kg can       |

Ref: [www.rocolnorthamerica.com](http://www.rocolnorthamerica.com)

##### b. Loctite ® Food Grade Anti-Seize

|       |                       |
|-------|-----------------------|
| 51168 | 8-Ounce brush top can |
|-------|-----------------------|

Ref: [www.loctite.us](http://www.loctite.us)

##### c. Saf-T-Eze ® Food/Drug Anti-Seize

|                            |                       |
|----------------------------|-----------------------|
| McMaster Carr part numbers |                       |
| 1404K11                    | 8-Ounce brush top can |

1404K12      14-Ounce Grease Gun Cartridge  
1404K14      14-Ounce Container  
1404K15      2 lb container  
1404K16      1-gallon container  
Ref: [www.mcmaster.com](http://www.mcmaster.com)

#### **17.2    Recommended thrust bearing greases**

a. Exxon Mobil Corporation Mobilith ® AW-2

Ref: [www.mobil.com/USA-English/Lubes](http://www.mobil.com/USA-English/Lubes)

b. Exxon Mobil Corporation Mobilgrease ® XHP 222

Ref: [www.mobil.com/USA-English/Lubes](http://www.mobil.com/USA-English/Lubes)

c. Bostik Never-Seez ® Black Moly

NSB150      1 lb can

NSBC-1      14.1-Ounce cartridge

NSB-35B      35 lb pail

Ref: [www.rocolnorthamerica.com](http://www.rocolnorthamerica.com)

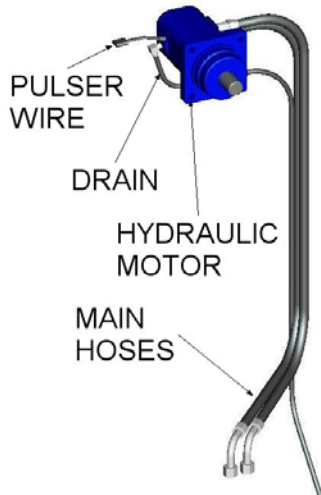


#### 1 Installing the hydraulic motor

The hydraulic motor and primary drive system are normally supplied pre-installed in the end support for both assembled and unassembled powered series 2 Quad-Drives. However, follow this procedure, should some assembly be necessary. If the hydraulic motor and primary drive system are fully installed, skip to 2 Hydraulic oil.

##### 1.1 Hydraulic motor hoses

Locate and attach the two identical (larger diameter) flexible main hydraulic hoses to the hydraulic motor using the straight union ends. PTFE tape may be used.



**Figure 1**

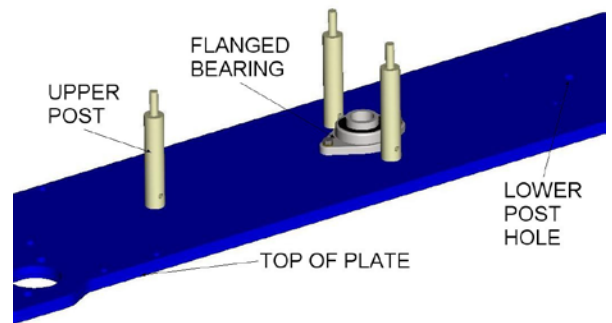
Locate and attach the (smaller diameter) longer flexible hydraulic drain hose to the hydraulic motor with the elbow end (orient as Fig.1 above). PTFE tape may be used.

If the motor plate is assembled inside the end support, it must be removed before the hydraulic motor can be attached. The motor plate is assembled on the three support posts and supports the primary drive shaft and associated sprockets and flanged bearing. The following procedure assumes a full assembly is required. Use whichever portions apply.

##### 1.2 Motor plate assembly

Attach a two-bolt flange bearing to the back plate ('dogbone') using two M12 x 40 long hex head screws (18 mm A/F) and lock washers. Orient the grease fitting to the right side.

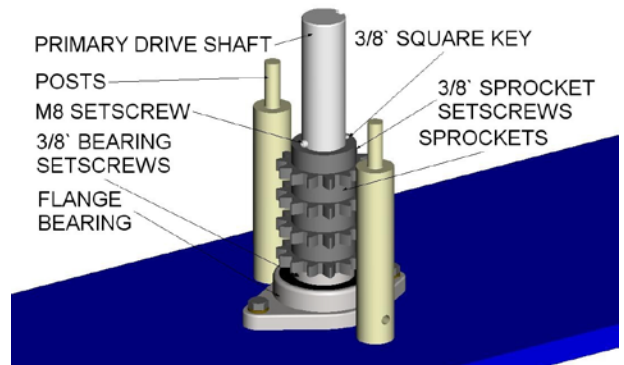
Install the three posts into the dogbone using Loctite 246. A through hole is provided for tightening the posts. Note that the post on the vertical centerline installs above the flanged bearing for powered frames and the lower post hole (for manual frames) is unused.



**Figure 2**

Using Loctite 246, install the M8 x 10 mm long setscrew (4 mm A/F) into the primary drive shaft. The setscrew protrudes slightly and acts as a stop. On the opposite side, load the 3/8" square x 130 mm long key into the keyway.

Place a drop of Loctite 246 on the female thread where it enters the bore of both setscrew holes on each of the four 60BS14 - 1.75" bore sprockets. Partially back out setscrews first with 3/16" A/F hex key. Load the four sprockets, hub first, onto the longer end of the shaft, up to the M8 setscrew and over the key.

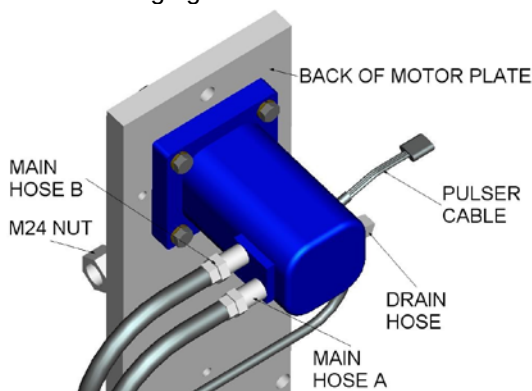


**Figure 3**

Ensure the sprockets touch each other and the first one is hard against the M8 setscrew. Align the end of the key flush with the last sprocket and securely tighten both 3/8" setscrews (3/16" A/F) on each sprocket.

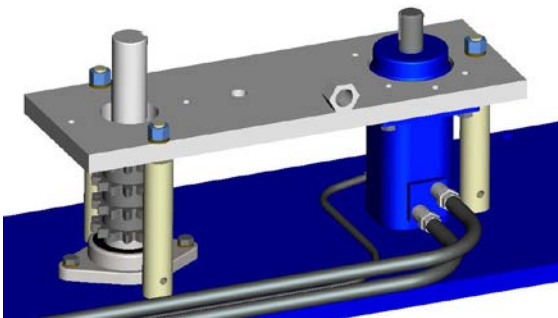
Insert the short, protruding section of shaft into the assembled flange bearing allowing the key and last sprocket to rest on the bearing. Using Loctite 246, tighten the two 3/8" setscrews (3/16" A/F) on the flange bearing to secure the primary drive shaft. Ensure these setscrews engage into the waist at the end of the shaft

Attach the hydraulic motor to the back of the motor plate (the side without the M24 hex nut) using four M12 x 40 mm long hex bolts (18 A/F) and 4 spring-lock washers. Note correct orientation of hoses and pulser cable in following figure.



**Figure 4**

Place the motor plate, with the motor away from you, onto the three posts and over the primary drive shaft. Secure with three M16 lock washers and hex nuts (24 mm A/F). Lifting gear may be necessary for this operation.



**Figure 5**

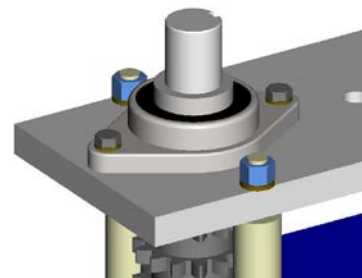
Route the three hoses down the right side of the cabinet ready for connection to the power pack when installed.

Join the three-conductor electrical connector on the end of the cable that exits from the hydraulic motor to

its mating socket which is on the end of the cable that plugs into the white electrical box labeled PULSER. Route loose cable close to the left side of the end support cabinet and install sufficient adhesive cable ties to ensure the cable can not fall into the path of a chain.

#### 1.3 Primary drive assembly

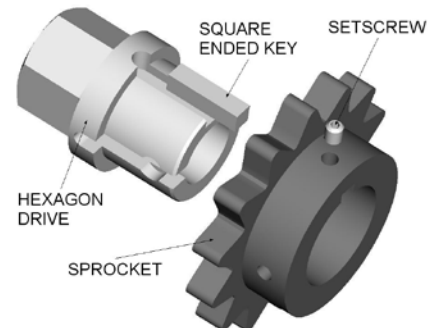
Install the second flange bearing over the primary drive shaft and onto the motor plate using the same procedure as the first flange bearing. Orient the grease fitting to the right side. Using Loctite 246, tighten the two 3/8" setscrews (3/16" A/F) on the flange bearing to further secure the primary drive shaft.



**Figure 6**

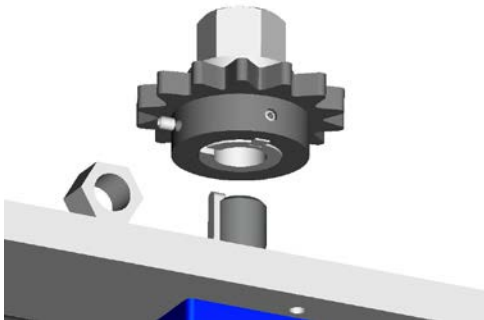
Locate and unpack the short hexagon drive (see following figure) and install the 3/8" square section, square ended x 38 mm long key in the blind keyway.

Locate and unpack the 80BS14 - 2" bore sprocket and place a drop of Loctite 246 on the female thread where it enters the bore of both setscrew holes. Place this sprocket, hub out, over the hexagon drive shaft. With the sprocket tight against the flange of the hexagon drive shaft, tighten the 3/8" setscrew (3/16" A/F) over the key to secure the sprocket in place.



**Figure 7**

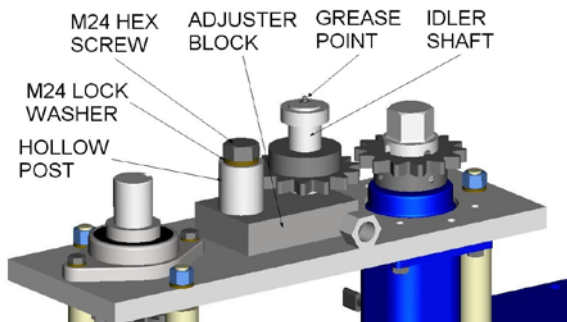
Install the 5/16" square section, 41 mm long, round ended key in the keyway on the motor shaft and mount the hexagon drive shaft/sprocket assembly until it is fully home on the motor shaft and engaged over the round ended key. Tighten the remaining 3/8" setscrew (3/16" A/F) in the sprocket.



**Figure 8**

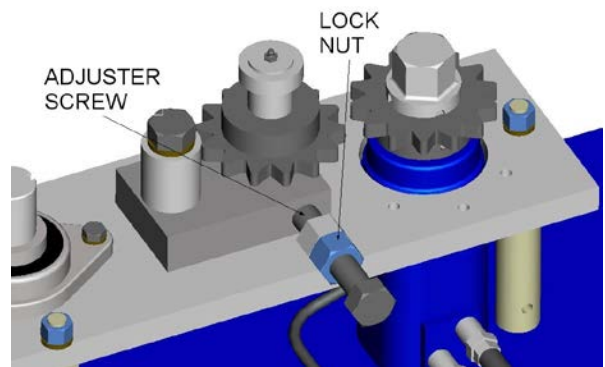
Locate one M24 x 120 mm long hex head screw (36 A/F) and load it with one M24 lock washer and hollow post. Place the primary chain adjuster assembly over the M24 tapped hole and orient the long side of the adjuster block parallel with the side of the motor plate. Fix in position with the above M24 screw assembly but don't tighten.

Ensure the idler sprocket can rotate freely and slide along the idler shaft. If necessary, fill the idler shaft with grease using the grease fitting.



**Figure 9**

Locate the other M24 x 120 long hex head screw and load it with one M24 hex nut (for locking purposes). Screw this through the M24 nut affixed to the motor plate until the screw end touches the adjuster block. Install a 3/8" square x 65 mm long key into the keyway on the primary drive shaft.

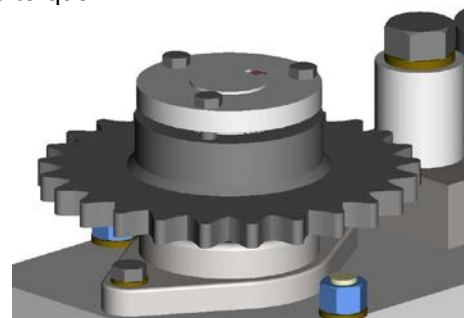


**Figure 10**

Locate and unpack the MST (Martin Split Taper) hub (which includes three, 3/8" screws – 9/16" A/F) and the 80Q25H sprocket. Ensure the outer cone surface of the hub and inner cone surface of the sprocket are clean and free of anti-seize lubricants and assemble the hub into the sprocket. Loosely install the three hex head screws into the hub and place assembly over end of shaft, and 65 mm long key.

Using a 600+ mm (2+ ft) straight edge, align this larger sprocket with the one mounted on the motor. Confirm that the idler sprocket can slide into alignment also.

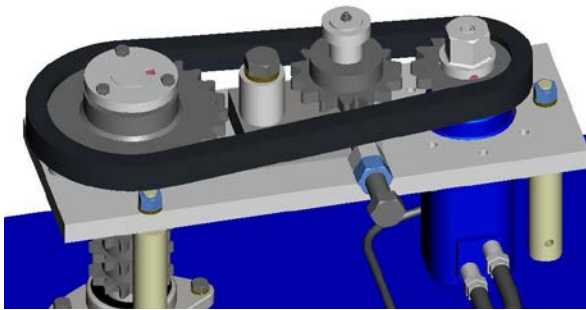
Begin tightening the three, 3/8" hex head screws with a torque wrench working from screw to screw. Note that during tightening, the sprocket draws toward the hub, necessitating slight sprocket realignment during this process. Continue tightening until a torque of 50 ft.lbs (67.8 Nm) has been reached on each screw (ignore torque value on included Martin instruction sheet). Do not over or under tighten. There must be a gap between the flange of the hub and face of the sprocket when tight. Confirm sprocket alignment after arriving at the final torque.



**Figure 11**

If sprocket removal is necessary, remove all three screws and insert two into the removal holes. Tighten the two screws until the sprocket is loose on shaft.

Install the precut '80' roller chain around the two outer sprockets and join with the master link. Screw in the adjuster screw to properly tension the chain. Tighten the M24 locking nut up to the fixed nut to lock the adjuster screw in place. Secure the adjuster block by tightening the M24 hex screw.



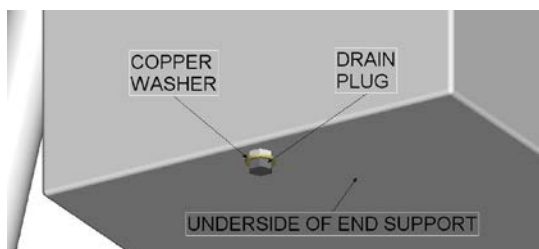
**Figure 12**

## 2 Hydraulic oil

Although oil may need to be added through the filler after the power pack has been installed, it is easier to add the majority of the oil first. Ensure that the power pack can be installed immediately following the filling process to avoid contamination of the oil.

If necessary, remove and discard the cardboard, oil tank cover in the end support by removing the four M8 x 16 mm long button socket head screws (5 A/F) and washers. Inspect and clean the inside of the tank to ensure that it is free of debris.

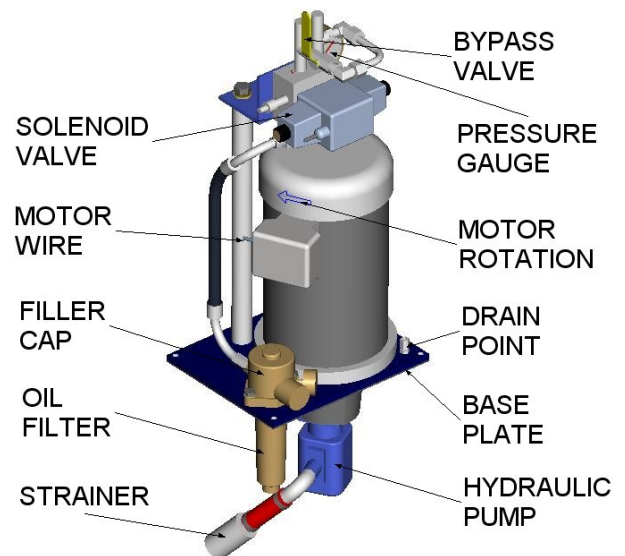
Confirm the presence of the oil level gauge on the outside of the tank (below the main door) and tightness of drain plug and presence of the copper washer (on underside of end support).



**Figure 13**

Fill the tank with approximately 20 US gallons (75.7 liters) of the specified hydraulic oil (refer to the 08 HYDRAULIC SYSTEM section in this User Manual). The oil level should reach about half way up the level gauge at this point due to the later displacement of the components below the power pack base plate. Clean any oil spills inside the enclosure.

## 3 Installing the power pack



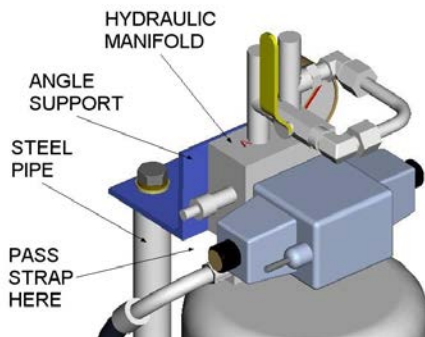
**Figure 14**

Inspect the power pack to ensure that all packing and protection materials have been removed. Also confirm that the strainer has been installed on the hydraulic pump and that the perimeter seal strip is in place on the underside of the base plate and in good condition.

A mechanical lift is recommended for the next step. Weight of power pack is 140 lbs [63.5 kg].

Pass a long lift strap between the back of the hydraulic manifold and vertical, steel pipe so that the strap can lift on the underside of the manifold angle support. Avoid stressing any hydraulic lines.





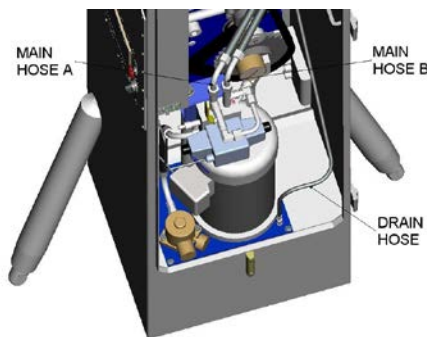
**Figure 15**

Using the strap, lift the power pack onto the oil tank opening – the steel pipe is oriented toward the back of the end support cabinet. Align the base plate bolt holes and install the four M8 x 16 mm long button socket head screws (5 A/F) and plain steel M8 fender washers. Remove the lift strap.

#### 4 Hose connections

Connect the three hydraulic hoses as follows. Orientations are described as you look into the end support cabinet (see following Figure and also Figure 4):

- **Main hose A**, connected to the rear most port (farthest from drive shaft) on the hydraulic motor connects to the A port on the manifold on top of the power pack (left side).
- **Main hose B**, connected to the front most port (closest to drive shaft) on the hydraulic motor connects to the B port on the manifold on top of the power pack (right side).
- **Drain hose**, connected to the hydraulic motor connects to the drain point at the near right of the power pack base plate.

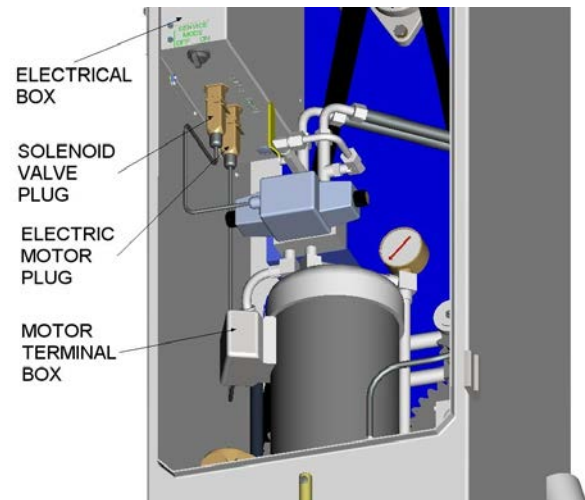


**Figure 16**

#### 5 Electrical connections

Connect the plug on the electrical cord that exits from the left side of the solenoid valve to the receptacle on the underside of the white electrical box labeled VALVE.

Connect the plug on the electrical cord that exits from the motor terminal box to the receptacle on the underside of the white electrical box labeled MOTOR.



**Figure 17**

Install sufficient adhesive cable ties to ensure that all cables and hoses can not fall into the path of a chain.

#### 6 Final checks

Inspect the oil level gauge and, if necessary, top up the oil to the full line (upper black mark).

To fill, remove the black filler cover (turn counterclockwise) and remove the installed filter. If a large quantity of oil is required, also remove the black plastic filter bowl by wiping the inside top dry with a clean rag and pulling up with friction force on the inside surface.

Once filled, replace the filter bowl, filter and filler cap securely. Note that the cap must be carefully started on the thread by keeping it horizontal while applying pressure as it is turned. If the cap will not close fully, check that the filter element is properly seated (about 1/8" [3mm] above filler body). Never start the pump with the cap missing or incompletely closed.



Clean any spills after filling the reservoir with oil.

If any electrical connections are still required, see 07 ELECTRICAL SYSTEM section.

At this point all frame and power pack assembly work should be complete. Make one final check that everything is in order, that no tools or other loose items are inside the end support enclosure and replace the M24 ratchet wrench in the provided holder.

Finally, close the main end support door.

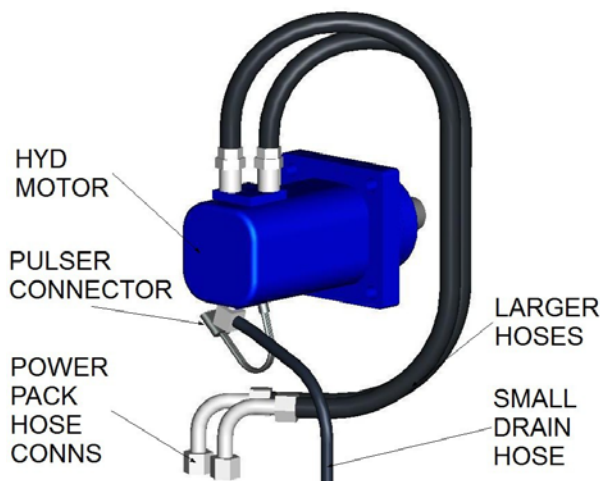
**STOP:** Although the frame assembly is now complete, it is essential that **correct motor rotation** is established BEFORE running the machine. See the procedure described in 3.2 Motor rotation in the 07 ELECTRICAL SYSTEM section. Also complete the electrical connections described in this section.

### 1 Installing the hydraulic motor

The hydraulic motor and drive system are normally supplied pre-installed in the end support for both assembled and unassembled powered Series 2 Binary-Drive frames. However, follow this procedure should some assembly be necessary. Note that removal of the white electrical box on the side of the end support will greatly assist with this assembly process. See 9 Electrical Box Removal in the 07 ELECTRICAL SYSTEM section for instructions. If the hydraulic motor and drive system are fully installed, skip to 2 Hydraulic oil.

#### 1.1 Hydraulic motor hoses

Locate and attach the two identical (larger diameter) flexible hydraulic hoses to the hydraulic motor using straight union ends. PTFE tape may be used.



**Figure 1**

Locate and attach the (smaller diameter) longer flexible hydraulic drain hose to the hydraulic motor with the elbow end (orient as Fig.1 above). PTFE tape may be used.

#### 1.2 Motor Plate Assembly

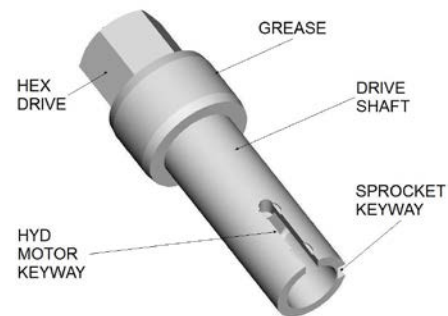
Attach a two-bolt flanged bearing to the back plate ('dogbone') using two M12 x 40 long hex head screws (18 mm A/F) and lock washers. Orient the grease fitting to the right side.

Attach the four posts to the dogbone using Loctite 246 and then attach the motor plate to the posts with four M12 x 40 long hex head screws, four lock washers, four plain washers and Loctite 246.



**Figure 2**

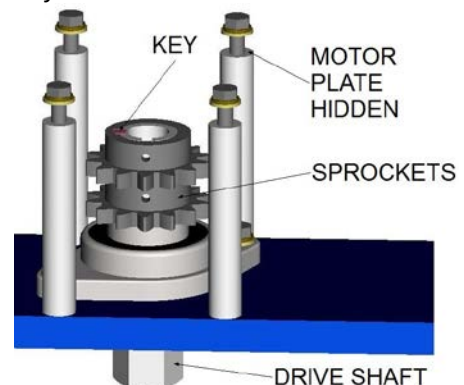
Apply a thin coat of white, food grade grease to the large diameter and tapers of the drive shaft. Insert the drive shaft, keyways first through the metal seal from the outside of the end support into the flanged bearing until the two touch.



**Figure 3**

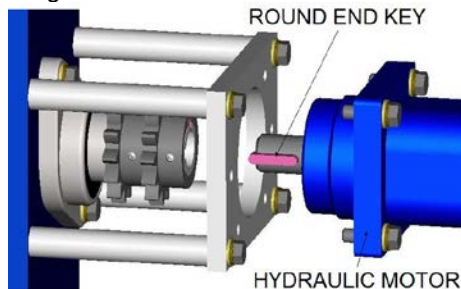
Partially back out the 3/8" setscrews with 3/16" A/F hex key on each of the two 60BS14 - 1.75" bore sprockets. Place a drop of Loctite 246 on the female thread where it enters the bore of both setscrew holes.

Install the 3/8" square, 63 mm long drive key into the sprocket keyway of the drive shaft and load the two drive sprockets, teeth first, onto the drive shaft and over the key.



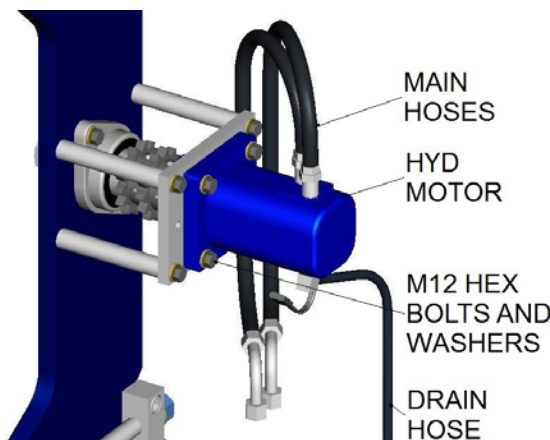
**Figure 4**

Install the special round ended key into the hydraulic motor shaft keyway and carefully insert the motor shaft into the inner diameter of the drive shaft ensuring the keyways align.



**Figure 5**

Correctly orient the hydraulic motor (main hoses exit at the top) and attach the motor plate using four M12 x 40 long hex head screws, four lock washers, four plain washers and Loctite 246. Note that the drive shaft will push out slightly as the motor approaches the drive plate.



**Figure 6**

Ensuring that the drive shaft is pushed fully home towards the hydraulic motor, apply Loctite 246 to the two 3/8" setscrews on the flanged bearing collar and tighten fully. Confirm that the drive shaft cannot be pulled out by the hexagon.

Fully tighten the four 3/8" setscrews on the sprockets (2 per sprocket), sliding both sprockets towards the collar of the flanged bearing first if necessary. All the clearance will now be between the last sprocket hub and hydraulic motor.

It will now be necessary to install the two drive chains. Follow instructions in 10.1 Chain assembly in the 02 BD FRAME ASSEMBLY section.

Install the electrical box if necessary. See 10 Electrical Box Installation in the 07 ELECTRICAL SYSTEM section for instructions.

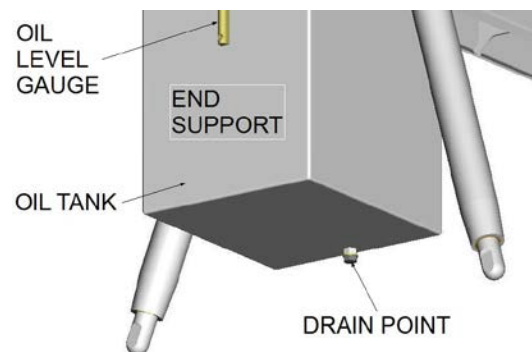
Join the three-conductor electrical connector (on the short cable that exits from the hydraulic motor) to its mating socket (on the long trailing cable that exits from the electrical box). Route the cable well away from the chains and sprockets. Install sufficient cable ties to ensure the cable can never fall into the path of a chain.

## 2 Hydraulic oil

Although oil may need to be added through the filler after the power pack has been installed, it is easier to add the majority of the oil first. Ensure that the power pack can be installed immediately following the filling process to avoid contamination of the oil.

If necessary, remove and discard the cardboard, oil tank cover in the end support by removing the four M8 x 16 mm long button socket head screws (5 A/F) and washers. Inspect and clean the inside of the tank to ensure that it is free of debris.

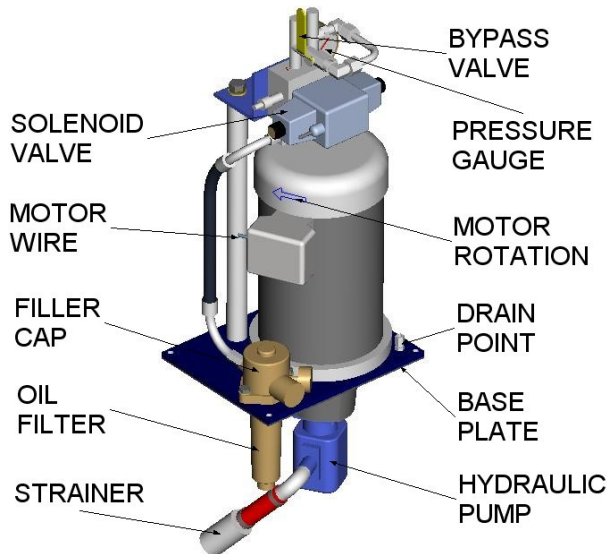
Confirm the presence of the oil level gauge on the outside of the tank (below the main door) and tightness of drain plug and presence of the copper washer (on underside of end support).



**Figure 7**

Fill the tank with approximately 20 US gallons (75.7 liters) of the specified hydraulic oil (refer to the 08 HYDRAULIC SYSTEM section in this User Manual). The oil level should reach about half way up the level gauge at this point due to the later displacement of the components below the power pack base plate. Clean any oil spills inside the enclosure.

### 3 Installing the power pack

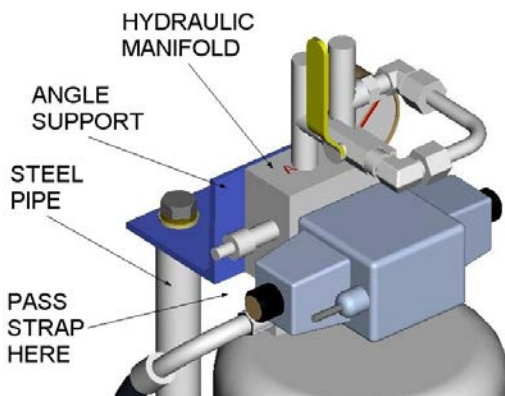


**Figure 8**

Inspect the power pack to ensure that all packing and protection materials have been removed. Also confirm that the strainer has been installed on the hydraulic pump and that the perimeter seal strip is in place on the underside of the base plate and in good condition.

A mechanical lift is recommended for the next step. Weight of power pack is 140 lbs [63.5 kg].

Pass a long lift strap between the back of the hydraulic manifold and vertical, steel pipe so that the strap can lift on the underside of the manifold angle support. Avoid stressing any hydraulic lines.



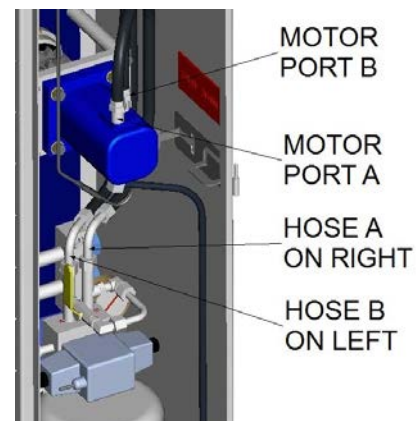
**Figure 9**

Using the strap, lift the power pack onto the oil tank opening – the steel pipe is oriented toward the back of the end support cabinet. Align the base plate bolt holes and install the four M8 x 16 mm long button socket head screws (5 A/F) and plain steel M8 fender washers. Remove the lift strap.

### 4 Hose connections

Connect the three hydraulic hoses as follows. Orientations are described as you look into the end support cabinet (see following Figure and also Figure 6):

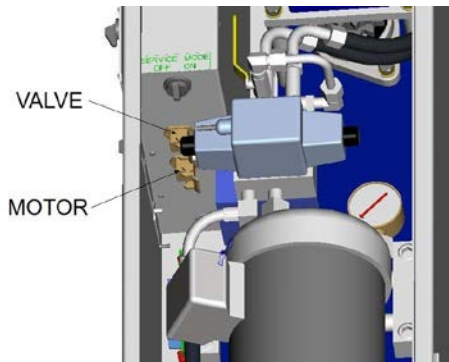
- **Main hose A**, connected to the rear most port (nearest to back, farthest from drive shaft) on the hydraulic motor connects to the B port on the manifold on top of the power pack (right side).
- **Main hose B**, connected to the front most port (closer to drive shaft) on the hydraulic motor connects to the A port on the manifold on top of the power pack (left side).
- **Drain hose**, connected to the hydraulic motor connects to the drain point at the rear right of the power pack base plate.



**Figure 10**

Connect the plug on the electrical cord that exits from the left side of the solenoid valve to the receptacle on the underside of the white electrical box labeled VALVE.

Connect the plug on the electrical cord that exits from the motor terminal box to the receptacle on the underside of the white electrical box labeled MOTOR.

**Figure 11**

ELECTRICAL SYSTEM section. Also complete the electrical connections described in this section.

Install sufficient cable ties to ensure that all cables and hoses can never fall into the path of a chain.

## **6 Final checks**

Inspect the oil level gauge and, if necessary, top up the oil to the full line (upper black mark).

To fill, remove the black filler cover (turn counterclockwise) and remove the installed filter. If a large quantity of oil is required, also remove the black plastic filter bowl by wiping the inside top dry with a clean rag and pulling up with friction force on the inside surface.

Once filled, replace the filter bowl, filter and filler cap securely. Note that the cap must be carefully started on the thread by keeping it horizontal while applying pressure as it is turned. If the cap will not close fully, check that the filter element is properly seated (about 1/8" [3mm] above filler body). Never start the pump with the cap missing or incompletely closed.

Clean any spills after filling the reservoir with oil.

If any electrical connections are still required, see 07 ELECTRICAL SYSTEM section.

At this point all frame and power pack assembly work should be complete. Make one final check that everything is in order, that no tools or other loose items are inside the end support enclosure and replace the M24 ratchet wrench in the provided holder.

Finally, close the main end support door.

**STOP:** Although the frame assembly is now complete, it is essential that **correct motor rotation** is established BEFORE running the machine. See the procedure described in 3.2 Motor rotation in the 07



#### 1 Description

The Quad/Binary-Drive Series 2 electrical control system is housed inside a modular electrical box which is attached with fasteners to the inside of the end support enclosure. The system is UL508/CUL compliant. See the end of this section for removal and installation instructions.

The end support cabinet is designed to meet NEMA 4X and when fully assembled with doors closed, all electrical components may be subjected to typical wash down regimes without harm.

Power is supplied to the Quad/Binary-Drive Paraflow via a hermetically sealed connector situated on the top of the end support enclosure. A mating connector is supplied with each machine. See '2 VOLTAGE' for standard voltage and current ratings available. See '3 WIRING DETAILS' for Quad/Binary-Drive electrical connection.

The backlit, touch screen LCD display on the small electrical door offers a user interface to control the system and provides feedback to the user. See 09 SCREEN OPERATION section for instructions on how to operate the Quad/Binary-Drive Paraflow.

The PLC (Programmable Logic Control) and other electrical components are housed inside the modular electrical box which is covered by the small electrical door, secured by twenty, M4 button head screws (2.5mm A/F key) and nylon sealing washers.

Series 2 machines supplied before late 2012 were provided with a loose white rubber seal between the small electrical door and end support to permit machine wash-down without ingress of liquids.

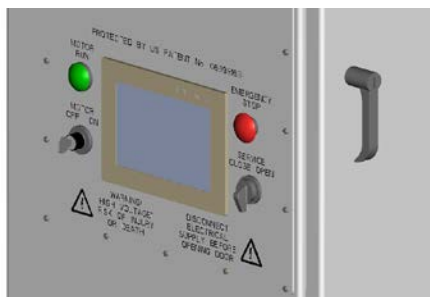


Figure 1

On the left side of the screen are situated a key switch (2 keys supplied) for switching on the electric motor (which energizes the hydraulic system) and a green light (which confirms that the electric motor circuit is energized).

On the right side of the screen are situated a red emergency stop button which cuts power to the electric motor (effectively halting all mechanical movement) and a 'Service Mode' close/open switch.

A safety cutoff switch is situated behind the large end support enclosure door to disable powered movement when the door is open. The door must therefore be closed for the electrical and hydraulic system to function.

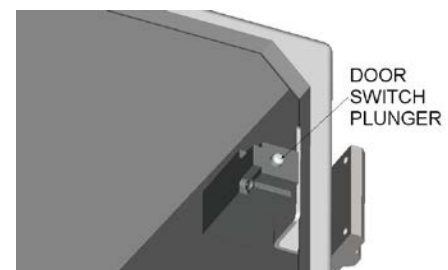


Figure 2

The PLC sends and receives information to provide accurate follower positioning. Should it be necessary to open the small electrical door, ensure that the nylon sealing washers are replaced with the screws.

The small electrical door has two internal, double articulated hinges to permit the door to open, swing out and be rotated for access.

As a safety feature, a warning light is provided on the top of the end support cabinet which flashes five seconds before powered opening or closing and throughout follower movement.

A service mode is provided to facilitate machine setup and offer continued operation should there be a failure of the PLC, screen or associated components. See **4 Service Mode** for details.

It is quite acceptable to power down the machine after operation for an indefinite period of time. The PLC is designed to permanently store all critical machine data.

## 2 Voltage

Standard powered Quad/Binary-Drive machines are supplied to suit one of the following voltage options.

460 VAC 3-phase 60Hz 15 amp  
230 VAC 3-Phase 60Hz 30 amp

Other voltages are sometimes provided at customer request. Please refer to your laminated customer drawing to confirm the actual voltage of your machine.

## 3 Wiring details



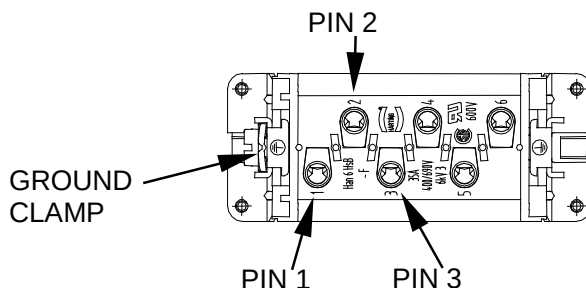
**WARNING! RISK OF ELECTRIC SHOCK**

The following operations must be performed by a qualified electrician.

The customer is required to provide a suitably sized drop lead, conforming to all local and national electrical codes, and a breaker box situated within sight of the Paraflow and easily accessible in case of emergency. This step is necessary since the machine does not include a breaker that provides total electrical isolation. Do not lay electrical cable on the floor.

### 3.1 Power in connector

Remove the mating connector from the top of the end support enclosure by pressing down firmly on the clips at each end of the connector. Remove the connector block insert from the hood. The following illustration shows the back of the insert.



**Figure 3**

Connect the cables as follows:

Line 1 to Pin 1  
Line 2 to Pin 2  
Line 3 to Pin 3  
Ground to Ground clamp

Ensure that all wires are properly fastened in their correct positions and no loose or bare wires are present. Insufficiently clamped wires can trip the motor starter protector (MSP). Replace hood and secure cable gland to prevent ingress of liquid. Connect the assembled plug to its mating receptacle on the top of the enclosure.

### 3.2 Motor rotation

**Before any powered operation, it is essential that correct motor rotation be established.**

Unlock and open the large door by turning the handle 90 deg. Briefly operate the service mode switch located on the underside of the white modular electrical box and observe the fan rotation direction (seen through the motor cowling).



**Figure 4**

If the rotation does not match the rotation indicator arrow (clockwise looking down on the motor cowling), the motor polarity must be reversed.

If you need to reverse motor direction, disconnect power from the machine first! Polarity can be reversed in a number of ways (choose the most appropriate):

- Remove the cover plate on the terminal box of the motor. Swap any two of the white motor wires and replace the cover plate securely.
- Remove the hood from the main power in connector and swap any two wires connected to pin 1, 2 or 3. Replace the hood and reconnect.

c. Unplug and remove the hood from the largest connector on the top of the modular electrical box. Swap any two wires connected to pin 1, 2 or 3. Replace the hood and reconnect.

d. Swap any two of the three power wires at the source (inside breaker box).

Restore the power to the machine and perform the motor rotation check once again to confirm a correct wire swap. Close and lock the enclosure door. Once filled with oil, the Quad/Binary-Drive Paraflow is ready for normal operation.

#### **4 Service mode**

The service mode switches are provided for factory setup and customer emergency situations. This mode should only be used if the PLC or screen has failed and the machine must be opened or closed.

**WARNING! When the Paraflow is placed in service mode, the PLC is totally uncoupled from the system and no longer updates the position of the follower when moving. In addition, most safeguards programmed into the PLC, which prevent machine or component damage, will not function.**

**NOTE: If the follower is moved, even briefly, in the service mode, returning to normal PLC/screen operation will require the FOLLOWER POSITION to be reset. See 09 SCREEN OPERATION section for details.**

##### *Service Mode operation:*

Before running in 'Service Mode' it is helpful to note the CLOSED DIMENSION on the OPERATION screen (also found on your laminated customer drawing).

Open the end support door and locate the 'Service Mode' switch. Turn the switch to the ON position. The hydraulic system will start running. Close the door.

On the small electrical door, below the E-stop, locate the 'Service Mode' CLOSE and OPEN switch.

Before operating the machine ensure that all personnel are clear of the follower and plate pack. Operate this switch as required, noting that a tape measure will be necessary while closing the machine to arrive at the correct pitch as noted in the CLOSED DIMENSION box.

When operation is complete, return the 'Service Mode' switch inside the end support to the OFF position (overheating and machine damage can occur if left running for long periods). Ensure that the end support door is closed.

#### **5 PLC software upgrade**

From time to time, APV may upgrade the PLC and HMI (screen) software to add functionality or address user issues.

PLC updates are usually provided to the customer in the form of a memory cartridge/CF card from which the new software is transferred. Updates may also be installed by APV personnel from a laptop running the source software.

Upgrading a Siemens system requires briefly installing the supplied memory cartridge onto the PLC. Once installed, the new software will be transferred to the PLC on power up. Clear, step-by-step instructions are provided with the memory cartridge (document UM-QBD2 MEMORY CARTRIDGE). After upgrade, the cartridge MUST be removed from the PLC and should be returned to APV.

#### **6 Fuses**

If a fuse blows, it must be replaced with one of the same type and rating. If a new fuse blows immediately after replacement, refer to 11 TROUBLESHOOTING section within this User Manual first. If this is unsuccessful, contact APV for assistance.

All fuses are located in the modular electrical box. Open the small electrical door for access.

##### **Fuse FU107 & FU108**

Rating: 1 AMP 460 V

Location: Back panel

Notes: If either one of these fuses fails, no power will be supplied to the transformer and therefore the PLC, screen, solenoid valve or motor starter.

These fuses provide protection to the transformer and are typically the last fuses to fail.

#### Fuse FU110

Rating: 2 AMP 120 V

Location: Back panel

Notes: If this fuse fails, no power will be supplied from the transformer and therefore the PLC, screen, solenoid valve or motor starter.

This fuse provides protection to the PLC / Solenoid Valve / motor starter.

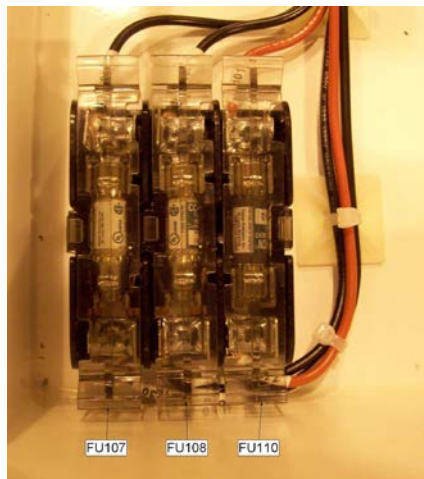


Figure 5

#### Fuse FU308 & FU309

Rating: 2 AMP 120 V

Location: Left and centre fuse holder

Notes: If these fuses fail, no power is supplied to the solenoid valve. Although the electric motor will run, the hydraulic system will not work.

These fuses provide protection to the solenoid valve.

#### Fuse FU310

Rating: 1 AMP 120 V

Location: Right fuse holder

Notes: If this fuse fails, no power is supplied to the motor starter. The electric motor cannot be started.

This fuse provides protection to the motor starter.



Figure 6

## 7 Spares

In addition to common electrical spares, additional spares items for your specific machine depend upon the manufacturer of the control system (Siemens or Allen-Bradley). See the following lists as applicable. Where no APV part number is shown, please order by description.

### 7.1 Common spares

| Part              | Description                                                         | APV Part No. |
|-------------------|---------------------------------------------------------------------|--------------|
| Door seal         | White rubber seal (see door seal kit for recommended replacement)   | 3900 3161    |
| Door seal kit     | Seal tape, screen guard and installation instruction kit            | 3900 5259    |
| Door screw        | M4 x 12 mm long button socket head screw                            | 3900 3111    |
| Door screw washer | M4 plain nylon washer                                               | 3900 3112    |
| Warning light     | Complete top warning light assembly with cable and plug             | 3900 3172    |
| Power cable       | Main power plug, receptacle and secondary power plug cable assembly | 3900 3173    |

|                   |                                           |           |
|-------------------|-------------------------------------------|-----------|
| Door switch cable | Door micro switch and plug cable assembly | 3900 3174 |
| Pulser cable      | Hydraulic motor pulser cable with plugs   | 3900 3175 |

## 7.2 Siemens Spares

| Part                 | Description                                             | APV Part No. |
|----------------------|---------------------------------------------------------|--------------|
| Screen               | SIEMENS TP177micro HMI For S7-200 PLC With Project      | 3900 2169    |
| PLC                  | SIEMENS PLC - S7-200 CPU-222 (AC/DC Relay) With Project | 3900 2168    |
| Transformer          | ACME Transformer CE99-0100-F3                           |              |
| 460VAC MSP           | SIEMENS Motor Starter/Protector 3RV1011-1HA10 5.5-8amp  | 3900 2166    |
| 230VAC MSP           | SIEMENS Motor Starter/Protector 3RV1021-4AA10 11-16amp  |              |
| 460VAC Motor starter | SIEMENS Motor Starter 3RT1016-1AK61                     | 3900 2165    |
| 230VAC Motor starter | SIEMENS Motor Starter 3RT1026-1A                        |              |
| 120VAC Relay         | SIEMENS Relay 3TX7123-5DF13                             | 3900 2164    |

## 7.3 Allen-Bradley Spares

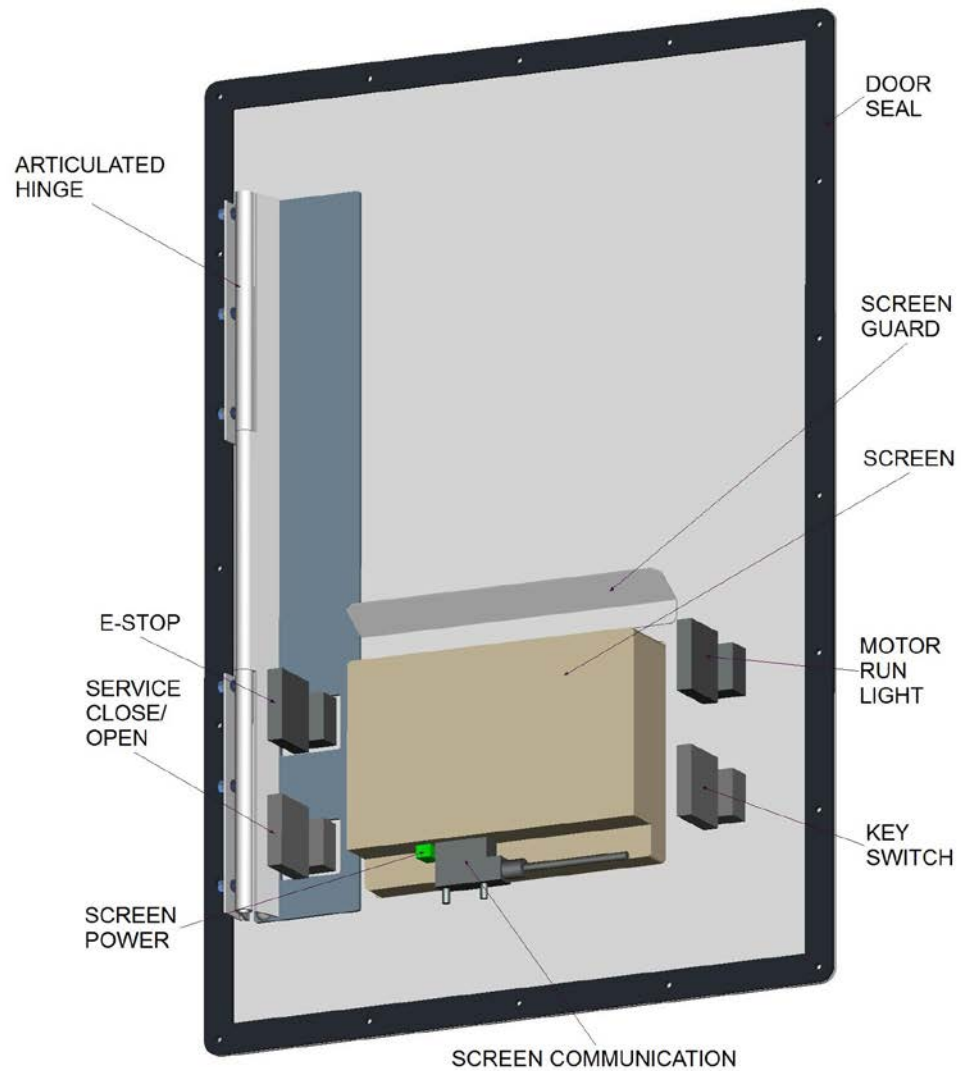
A/B controlled machines can be supplied with a variety of PLC's. Please confirm the specific PLC model number before requesting spares by Part Number. Alternatives to components shown below may have been supplied. APV records the PLC type with your machine data and can furnish this information if the heat exchanger serial number is known. The PLC type is also identified on your laminated customer drawing

| Part         | Description                                      | APV Part No. |
|--------------|--------------------------------------------------|--------------|
| Screen       | A/B Panelview Plus 600 2711P-T6M2OA              |              |
| PLC L31      | A/B PLC - Compactlogix Processor – 1769 L31      | 3900 2190    |
| PLC L32E     | A/B PLC - Compactlogix Processor – 1769 L32E     | 3900 2191    |
| PLC L43      | A/B PLC - Compactlogix Processor – 1769 L43      |              |
| Power supply | A/B Power Supply - 1768-PA3                      |              |
| I/O Module   | A/B 6 In 4 Out Combination Module - 1769-IQ6X0W4 |              |
| 460VAC MSP   | A/B 140M-C2E-C10 6.3-10 amp                      |              |
| 230VAC MSP   | A/B 140M-C2E-C16 10-16 amp                       |              |
| Contactors   | A/B 9A 120V Contactor - 100-C09D10               |              |
| 120VAC Relay | A/B DPDT Relay - 700-HF32A1                      |              |
| Power supply | Rhino 24V DC power supply - PSP24-024S           |              |

## 8 Electrical arrangement

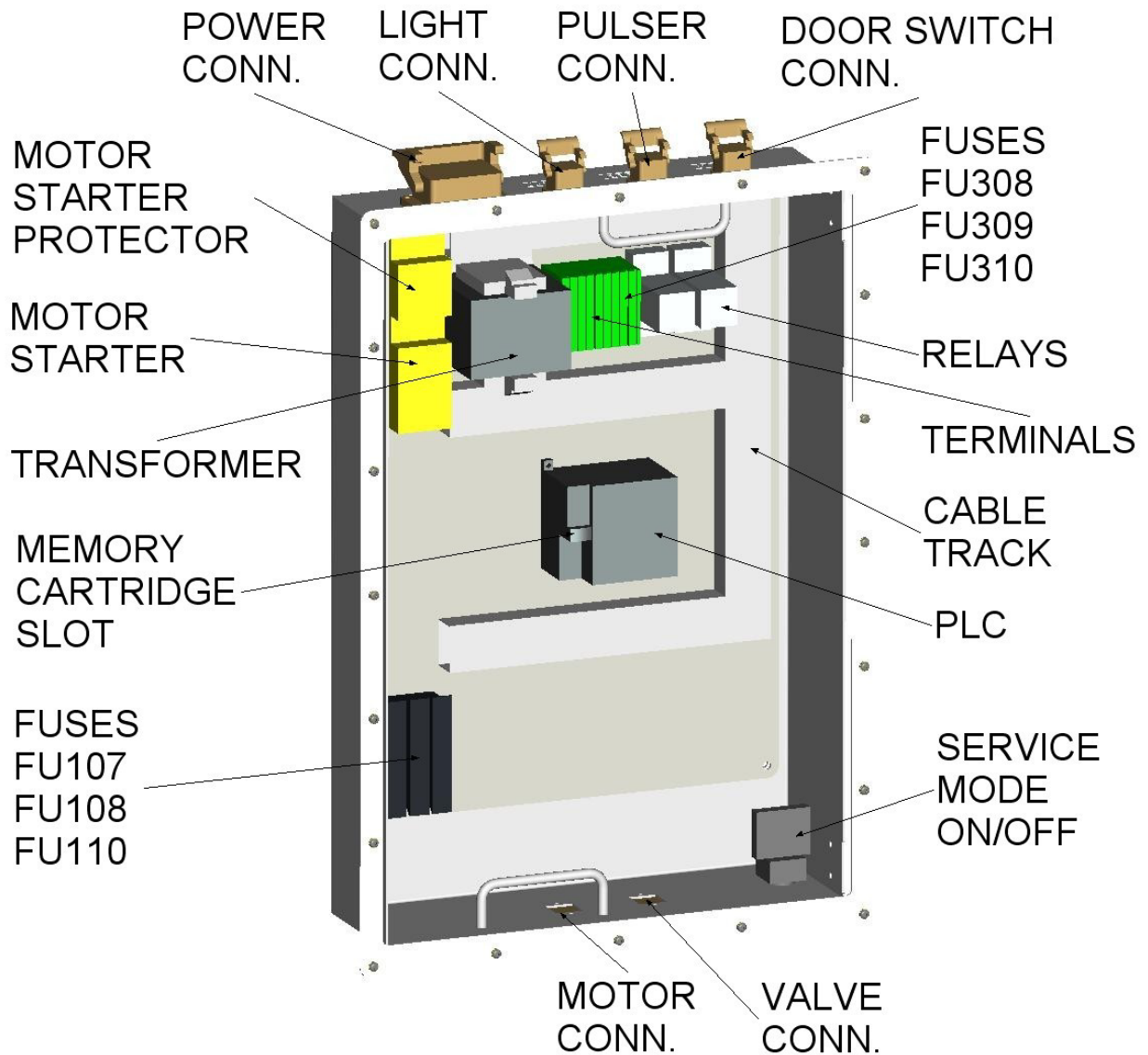
The locations of electrical components vary only slightly according to the specification of the primary components (Siemens or Allen-Bradley). The following illustrations identify the major electrical components within the modular electrical box for a Siemens unit.





BACK OF DOOR

Figure 7

**MODULAR ELECTRICAL BOX****Figure 8**

## **9 Electrical Box Removal**

Should it be necessary to remove the modular electrical box, employ the following procedure. Electrical box assembly is covered in 10 BOX INSTALLATION.

### **9.1 Disconnection**

**Disconnect power.** Open the end support main door and unclip all six Harting connectors (four on top of box and two on bottom) and unplug the connectors. Remove the keyswitch key if inserted.

### **9.2 Electrical Door Removal**

Remove the four corner M4 x 20 mm long button head screws from the electrical door (2.5mm A/F hex key – one is supplied with frame for tie bar seal lubrication) and screw them back into their holes from inside the end support cabinet by hand. Permit the threads to protrude by 1/8" (3mm) past the face of the door. Leave the nylon washers on the screws.

Remove the remaining 16 M4 x 12 mm long button head screws which will allow the door to rest on the four inverted screws. Store the removed screws and washers in a safe place.

Holding the door by the lower sides and bottom edge, support its weight and pull it toward you off the four screws. Swing the door open (hinge is on the right).

Separate the inline multi-pin connector (for earlier electrical boxes without this connector, remove all contact blocks from the back of the four switch/light units). Unscrew the data cable entering the bottom of the screen (use flat blade electrical screwdriver). Disconnect the two wire power connector entering the bottom of the screen. Do not unscrew any terminals or attempt to remove any wires. Some cable ties may need to be cut.

Lift the door off its hinges and lay it down in a safe place, protecting the screen. No tools are required for this operation.

If necessary, partially withdraw the four M4 x 20 mm long door corner screws enough to prevent their

damage when removing the electrical box. Only remove them completely if necessary since they will be used during reassembly.

### **9.3 Box removal**

Remove the lower two and least accessible upper M6 Nyloc hex nuts (10 mm A/F) and S.S. washers from the back of the electrical box (accessible from inside main cabinet).

Support the electrical box using the upper handle and remove the remaining M6 Nyloc hex nut. Store the nuts and washers in a safe place.

Stand facing the electrical box on the side of the end support and grasp both handles (grasp upper handle with palm upward). Tip the top of the box away from you enough to clear the upper M6 studs and lift the box off the lower M6 studs.

Gently guide the box through the opening pulling the lower edge out first. If necessary, obtain assistance to support the weight of the electrical box during removal.

## **10 Electrical Box Installation**

Grasp both handles inside the electrical box (grasp upper handle with palm upward) and stand facing the electrical box opening on the side of the end support cabinet. Tip the top of the box away from you and gently guide the box through the opening leading with the upper edge. If necessary, obtain assistance to support the weight.

Once fully through the opening, pull the bottom of the box toward you and drop down onto the two lower M6 studs. Pull the top of the box toward you and over the two upper M6 studs. While still holding the upper box handle, install one M6 S.S. washer and Nyloc hex nut over the most accessible upper M6 stud.

Releasing the handle, install the remaining three M6 Nyloc nuts and S.S. washers. Ensure sufficient tightness but do not over tighten.

### 10.1 Door Installation

If not already present, screw the four corner M4 x 20 mm long button head screws (2.5mm A/F hex key – one is supplied with frame for tie bar seal lubrication) into the corner holes from inside the end support cabinet by hand. Permit the threads to protrude from the face of the end support cabinet by 1/4" (6mm). The nylon washers are not needed at this stage.

Offer the door up to the two hinge pins and drop into place. Ensure the door will engage over the four protruding corner screws.

### 10.2 Connections

Insert the data cable into the bottom of the screen and tighten the two screws (flat blade electrical screwdriver). Insert the twin-wire power connector into the bottom of the screen (observe correct orientation).

Reconnect the inline multi-pin connector (or switch/light contact blacks). Some cable ties may need to be replaced.

On the inside of the end support cabinet, connect the six Harting connectors to their respective sockets (four at top and two at bottom). The connectors are pin-coded and labeled to ensure correct assembly.

### 10.3 Testing

At this point, before the electrical door is screwed closed, the main end support enclosure door should be closed and power restored to perform various tests and, if necessary, complete any setup, diagnostic or software installation.

If software needs to be installed or updated, do this now according to the separate document provided with the memory cartridge or Compact Flash card.

**WARNING:** New software will require some data entry before normal screen operation (and before certain tests) can commence. In this case, read 09 SCREEN OPERATION section before continuing.

With power restored, check the following:

- a. Screen boots correctly
- b. Pump can be switched on (using keyswitch)

- c. Green 'pump on' light operates.
- d. E-Stop initiates screen message
- e. Opening main door initiates screen message
- f. Follower moves in correct direction with OPEN and CLOSE screen buttons and automatically stops at the designated positions.
- g. With keyswitch off, the Service Mode switch on the bottom of the electrical box, when switched on, will start the pump.

**IMPORTANT:** In the following step (h), you are instructed to move the follower in Service Mode which normally requires the follower position to be reset. However, if desired, you can invoke exactly equal tie bar revolutions in each direction to check Service Mode and avoid the reset operation. If a reset becomes necessary, close the machine (in Service Mode) to the CLOSED DIMENSION shown on the screen (check with a tape measure). Go to the SETTINGS screen, enter this figure in the FOLLOWER POSITION box and press accept.

- h. In Service Mode, confirm that the CLOSE – OPEN switch on the electrical door correctly moves the follower.

### 10.4 Door Closing

Ensure the back perimeter of the electrical door and the gasket sealing area on the end support cabinet is clean.

Close the electrical door, aligning it with the four protruding screws. It may be necessary to lift the door slightly to do this. Push the door 'home' to the gasket ensuring that no wires have been trapped across the gasket sealing face.

Install the sixteen M4 x 12 mm long S.S. button head screws (2.5 mm A/F hex key) and Nylon washers. Remove the four corner screws and install them, with Nylon washers, in their correct orientation through the face of the door. Ensure all twenty door screws are properly tightened.





## 1 Description

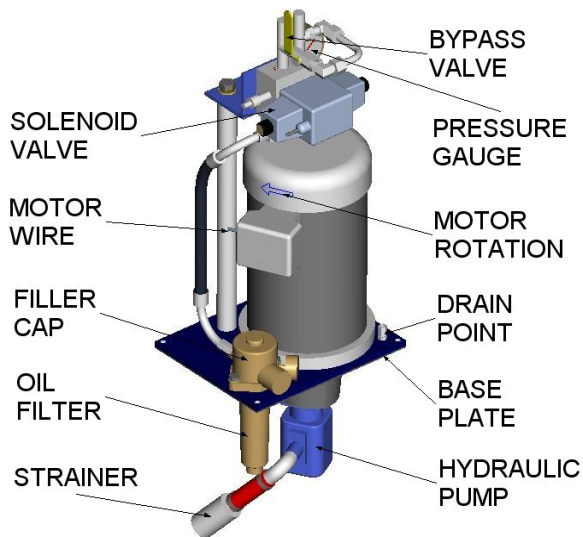
The Quad/Binary-Drive Series 2 hydraulic system comprises two main components: a self-contained, power pack and an hydraulic motor. Three hydraulic hoses connect the hydraulic motor to the power pack. The lower portion of the end support cabinet acts as the hydraulic oil reservoir whose large surface area assists in cooling the oil.

An externally mounted oil level gauge with integral thermometer allows easy viewing of oil level, quality and temperature.

Oil is returned to the reservoir via a surface mounted cartridge type filter. A pressure gauge is mounted on the oil feed (high pressure) side of the hydraulic system.

An electronic pulser is incorporated into the hydraulic motor and is used by the PLC to ensure correct follower position.

## 2 Power Pack components

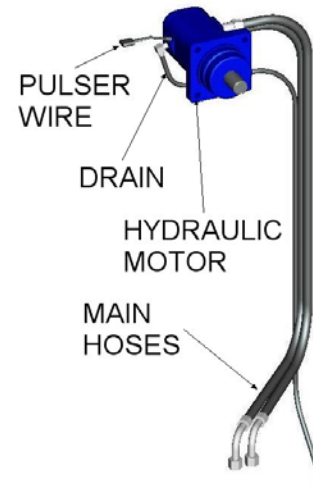


**Figure 1**

## 3 Hydraulic motor

The following illustration shows the hydraulic motor and the three attached hoses as they would be routed inside the Quad-Drive Series 2 end support cabinet.

For Binary-Drive Ser 2 configuration, refer to 06 BD POWERED DRIVE ASSEMBLY section.



**Figure 2**

## 4 Principle of operation

**Warning:** Before operating the machine, check motor rotation. See 07 ELECTRICAL SYSTEM section, 3.2 Motor Rotation.

The hydraulic system is energized by turning the key-switch to the ON position (situated to the left of the screen). The green light, above the key-switch, will confirm that the system is running. When energized, the electric motor drives the hydraulic pump. In this condition, oil is circulated but not passed to the hydraulic motor. When the 'CLOSE' button is pressed on the screen, a five second countdown is initiated where the warning light on the top of the end support cabinet will flash and a warning message 'PREPARE FOR FOLLOWER MOVEMENT' appears on the screen.

After the countdown, the solenoid valve is energized which directs oil through the manifold via one of the two primary hydraulic hoses to the hydraulic motor. The screen will display 'CLOSING TO PITCH'. The solenoid valve is bi-directional enabling forward and reverse oil flow.

The power pack is a two-speed system that provides rapid Paraflow closing until about one inch (25mm) before the final compressed dimension. At this point, oil pressure is increased and the follower gradually

slows until the PLC determines that the machine is at the correct pitch. At pitch, the PLC de-energizes the solenoid and the hydraulic motor stops.

The hydraulic system continues to run while bypassing oil, until it is operated again ('OPEN' or 'CLOSE' is pressed) or switched off with the key. The system will also shut itself off 5 minutes after the last operation or screen use. Turn the key-switch off and then on to restart the pump.

A third, smaller, hydraulic hose provides a return for bypassed oil from the hydraulic motor to the oil reservoir.

## 5 Manual Closing/Opening

If there is a failure in either the electrical supply/system or hydraulic system and it is necessary to open or close the heat exchanger, a manual procedure can be followed to achieve this.

An M30 (46mm A/F) socket and 1" sq. drive ratchet wrench is recommended for manual opening/closing of the Quad-Drive.

An M30 (46mm A/F) flat ratchet wrench is recommended for the Binary-Drive.

These wrenches are not supplied as standard on powered machines but may be purchased from APV as follows:

### Description

Ratchet wrench 1" sq drive, 30" long  
46mm A/F socket, 1" sq drive  
46mm A/F flat ratchet wrench

### APV P/N

3900 1603  
3900 1604  
500666

## 5.1 Procedure

**a. Disconnect power** (in case it should be restored during manual opening/closing)

**b.** Open end support door.

Note: For Quad-Drives, removal of the door (by lifting it vertically off its hinges) may assist with wrench access.

**c.** Turn the hydraulic oil bypass valve ¼ turn (in line with the pipe) to permit oil to circulate when the hydraulic motor is rotated.

**d.** Using an M30 wrench (46 mm A/F) on the hexagon drive, open and/or close the machine as required.

Hexagon drive location:

*Quad-Drive:* Inside cabinet, on primary drive

*Binary-Drive:* Outside cabinet, facing follower

**e.** Before running in normal powered operation, return the bypass valve to its original position (90 deg to pipe) and re-hang (if removed) and close the door. See also

**5.2 Follower position reset** below.

## 5.2 Follower position reset

It will be necessary to perform a FOLLOWER POSITION reset operation after manual movement of the follower. See 09 SCREEN OPERATION section, 5.7 Follower position for details.

## 6 Hose and fitting details

| DESCRIPTION             | NOMINAL HOSE SIZE                         | HYDRAULIC MOTOR FITTING TYPE                          | ATTACHMENT TO HYDRAULIC MOTOR                   | POWER PACK FITTING TYPE             | ATTACHMENT TO POWER PACK @                                  |
|-------------------------|-------------------------------------------|-------------------------------------------------------|-------------------------------------------------|-------------------------------------|-------------------------------------------------------------|
| Primary hose for port A | ½" #<br>QD=46",BD=37.5"<br>3000 psi rated | 'O' Ring boss, straight male adaptor.<br>6400-08-10-0 | Port 'A'. (towards back of hydraulic motor)     | Straight male adaptor<br>2404-08-08 | QD: Port 'A' (on left side)<br>BD: Port 'B' (on right side) |
| Primary hose for port B | ½" #<br>QD=46",BD=37.5"<br>3000 psi rated | 'O' Ring boss, straight male adaptor.<br>6400-08-10-0 | Port 'B'. (towards front of hydraulic motor)    | Straight male adaptor<br>2404-08-08 | QD: Port 'B' (on right side)<br>BD: Port 'A' (on left side) |
| Drain hose              | ¼" *<br>QD=74",BD=39"<br>Low pressure.    | 'O' Ring boss 90° male adaptor.<br>6801-04-04 90°     | Case drain point (Adjacent to sensor wire exit) | Straight male adaptor<br>2404-04-08 | Front right of base plate                                   |

# Both primary hoses are identical with a straight 3/4-16 JIC female at one end and a 90° swivel (PL A3000-08 0A) 3/4-16 JIC female elbow at the other.

\* The drain hose has a straight 7/16-20 JIC female thread at each end.

@ IMPORTANT: Note that the Binary-Drive hydraulic connections are reversed at the manifold on the

Power Pack (A to B and B to A) due to the inverted orientation of the hydraulic motor.

Replacement hoses and fittings can usually be obtained locally (refer to above table). However, hydraulic system component can also be supplied by calling APV service.

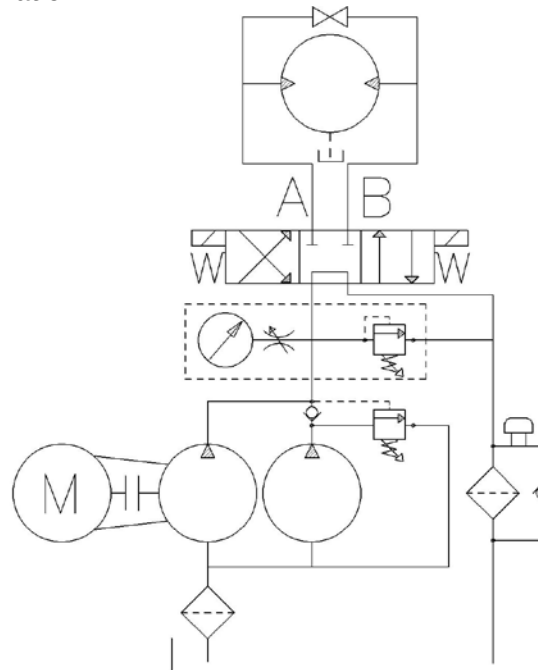
## 7 Spares

| Part                                                                    | Description                                                           | APV Part Number                        |
|-------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------|
| Hydraulic oil (QD & BD) # @                                             | 20 US Gallons (75.7 liters). Chevron FM ISO 32                        | 3900 4271 (5 gal container) 4 required |
| Replacement filter cartridge (7.9" tall - return line main filter) #    | ERB11NCC by UFI (Universal Filter International)                      | 3900 1914                              |
| Replacement filter cartridge (1" tall – return line small top filter) # | 004.0388.6 by UFI (Universal Filter International)                    | 3900 1963                              |
| Complete hose and fitting kit                                           | Three pieces as described in 6 above.                                 | 3900 3145 (QD S2)<br>3900 3237 (BD S2) |
| Power pack (Ser 2) 460V<br>Power pack (Ser 2) 230V                      | Complete, self contained, drop in unit.                               | 3900 3144<br>3900 3236                 |
| Hydraulic motor                                                         | Char-Lynn 2000 series with pulser                                     | 3900 2020                              |
| Hydraulic manifold & relief valve (set to 2400 psi)                     | Manifold (BT00525 - SPA05P8-1/BC)<br>Valve (CB03152 - CP210-B0EC-XXX) | 3900 3406                              |
| Solenoid valve assembly                                                 | Hystar #DSG-3C6-03-R110-3090-S with strain relief & cord              | 3900 2194                              |
| Coil (replacement) service kit for solenoid valve                       | Hystar #4-DSG-03-R1 (for Hystar solenoid valve 3900 2194)             | 3900 2195                              |

# See 10 MAINTENANCE section for frequency of replacement and/or inspection

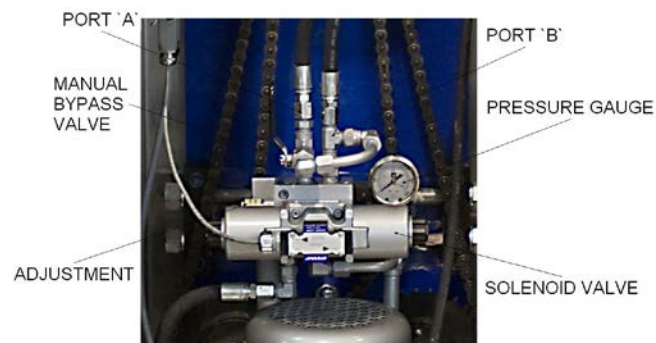
@ It is permitted to mix this oil with the previously supplied A/W 32 non-food grade oil, TA70445. However, unless all previous, non-food grade oil is flushed and the hydraulic system cleaned, the use of food grade oil may not provide the expected compliance.

## 8 Hydraulic system schematic



**Figure 3**

## 9 Hydraulic Pressure Adjustment



**Figure 4**

At closing pitch, the hydraulic pressure should briefly touch a maximum of 2400 psi, which can be observed on the pressure gauge seen in the above photo.

If adjustment is necessary, apply the following procedure:

1. Ensure power is OFF

2. Mark hose positions and disconnect 'A' & 'B' hoses from top of the manifold and cap both ends.

- a. Manifold - 1/2" JIC Caps
- b. Hoses - 1/2" JIC Plugs

**NOTE:** If caps are not available, don't disconnect hoses. Instead, bring machine to within 1/2" of closed pitch.

3. Loosen the relief valve lock nut on left side of manifold with a 3/4" wrench and back out valve (counter-clockwise) one turn with 1/4" A/F Allen wrench. Retighten lock nut.
4. Turn power back on and start motor - Check Rotation is clockwise.
5. Ensure manual bypass valve is closed between port A and B.
6. Press CLOSE on the HMI and turn relief valve clockwise with Allen wrench until correct pressure is reached. 2200 to max of 2400 psi.

NOTE 1: If caps are not used, wait for the machine to reach pitch and max pressure. This may require a couple of open/close operations. Only open to about ½" greater than closed dimension.

NOTE 2: If it's not possible to energize the valve electronically, either end of the valve may be depressed with a suitably sized Allen key to actuate the hydraulic system (the electric motor must be running). Hand actuating the **right** end of the solenoid will **CLOSE** the machine, Hand actuating the **left** end of the solenoid will **OPEN** the machine

7. De-energize solenoid valve and energize again to check pressure.
8. If further adjustment is necessary, repeat step 3 above with smaller or larger valve rotations as judged necessary.
9. Once pressure is correct, turn motor OFF and turn power OFF.
10. If disconnected, re-connect 'A' & 'B' hoses back to manifold. Ensure hoses go back on the correct ports depending upon machine type as follows:

**Quad-Drive:**

The hose from hydraulic motor port 'A' attaches to port 'A' on the manifold (ie: the hose closest to the back [farthest from drive shaft] of the motor attaches to the left side of the manifold).

The hose from hydraulic motor port 'B' attaches to port 'B' on the manifold (ie: the hose closest to the front [near drive shaft] of the motor attaches to the right side of the manifold).

**Binary-Drive:**

The hose from hydraulic motor port 'A' attaches to port 'B' on the manifold (ie: the hose closest to the back [farthest from drive shaft] of the motor attaches to the right side of the manifold).

The hose from hydraulic motor port 'B' attaches to port 'A' on the manifold (ie: the hose closest to the front [near drive shaft] of the motor attaches to the left side of the manifold).





## 1 Introduction

**Please read this entire introduction before inserting the key and starting the machine.**

The powered Quad/Binary-Drive Series 2 Paraflow is equipped with a Programmable Logic Control (PLC) device and a backlit, LCD touch-screen display. When navigating the touch-screen, press the 'buttons' firmly.

See **5.0 Settings** to adjust screen contrast or change the units (inches or mm).

There are three user accessible screens for machine operation plus an opening screen. To change screens touch the appropriate tab at the top.

There are also SERVICE screens, which are only accessible via a password and used by APV to assist with setup and on-site service.

The screen shots in this section often include 'boxes' containing '0000', indicating user information.

**IMPORTANT: Certain safeguards are built in to the PLC that prevent machine damage; however, before you operate this Paraflow, you must familiarize yourself with the location of the EMERGENCY-STOP (red button to right of screen) and the safety warnings throughout this manual.**

### 1.1 Before you begin

- a) If necessary, fill machine with approximately 20 US gallons of hydraulic oil (supplied). See POWERED DRIVE ASSEMBLY for details.
- b) Check motor rotation on newly installed machines. See 07 ELECTRICAL SYSTEM section, 3.2 Motor Rotation.
- c) If the machine/screen does not respond as expected, see 11 TROUBLESHOOTING section in this manual.
- d) Ensure that the stored number of plates, grids and Divider Plates are correct. See **4 Enquiry** for details.
- e) Ensure that the stored length of any pipe-work to be left on the follower connections when the machine is opened is correct. This includes the case where blanks (port supports) will be left on the machine when opened (most

Quad/Binary-Drive heat exchangers fall in this category). See **5.6 Fitting Length** for details.

- f) **Warning : Ensure all personnel are clear of tie bars, follower and plate pack before operation.**
- g) Ensure that the end support door is properly closed as it incorporates a safety cutoff switch.

### 1.2 Hydraulic system

Once filled with oil, the hydraulic system must be energized with the key switch, located to the left of the screen, prior to powered opening or closing. A green RUN light to the left of the screen and audible motor noise will indicate that the hydraulic system is running.

If the hydraulic system is left idle for five minutes, it will automatically stop. To restart, switch the key 'OFF' and then 'ON' again.

**It is recommended that the key be removed from the Paraflow after powered operation to prevent unauthorized/accidental machine operation or key breakage.**

### 1.3 Screen Saver

The screensaver is usually set at the factory to 30 minutes but should this need to be changed or disabled follow these steps:

Whenever the machine is powered up, three buttons briefly appear during the boot sequence; Transfer, Start and Control Panel.

- a. Select the Control Panel button and double-tap the screensaver icon.
- b. Enter the required number of minutes and press enter. (The 30 minute setting ensures the screensaver will not activate during a normal open or close cycle). A zero will switch off the screensaver.
- c. Touch **ok** in the top right corner of the screen saver.
- d. Touch **X** in the top right corner of the Control Panel.
- e. Touch **Start** button to continue to initial screen.

When the screensaver activates, simply touch the screen anywhere to clear it and return to the previously displayed screen. Note that the password function only provides the means to restrict access to Control Panel options.

#### 1.4 Memory backup

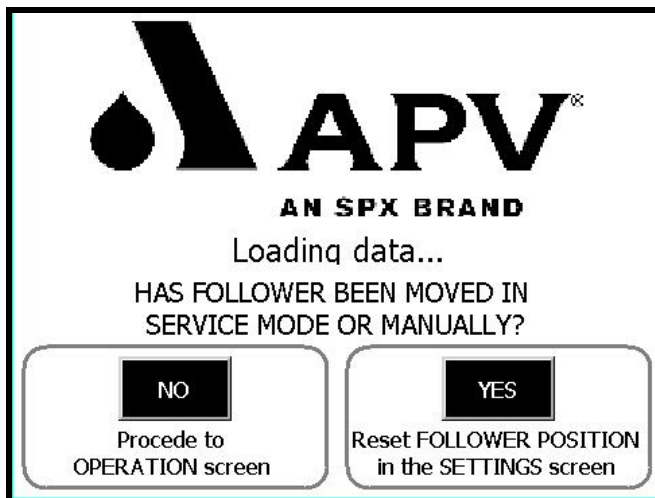
It is quite acceptable to power down the machine after operation for an indefinite period of time as all volatile machine data are stored in permanent memory.

Should the machine be switched off for extended periods of time (months), any data lost will be restored from permanent memory at the next power up.

#### 2 Initial screen

After the boot sequence, the initial screen displays a Loading data... message followed by the machine type. Below this, a question is asked:

“HAS THE FOLLOWER BEEN MOVED IN SERVICE MODE OR MANUALLY?”



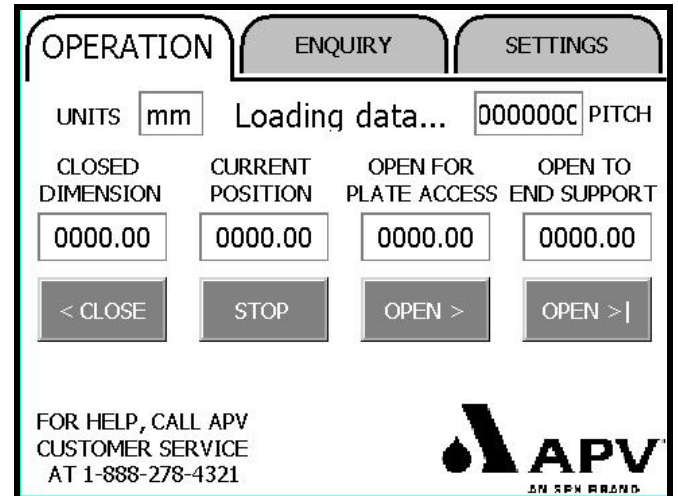
Press the **NO** button if the follower has not been moved since last normal operation. You will be taken to the OPERATION screen.

Press the **YES** button if the follower has been moved either in Service Mode (with power) or manually (using a wrench). You will be taken to the SETTINGS screen (via a warning message) where you will need to enter the new follower position.

If you move to the OPERATION screen while data is still loading, the Loading data... message will continue to show until data loading is complete.

#### 3 Operation

This screen will be displayed most of the time. Here you perform the basic tasks of opening the Paraflow to access the plates and closing the machine to pitch.



##### 3.1 Warning Strobe Light

Your machine is fitted with a movement warning system. A five second countdown appears on the screen prior to follower movement and the strobe light is activated during countdown and follower movement.

##### 3.2 Open And Close

To **open** the machine:

- Turn the key to the 'ON' position (pump will start)
- Press **OPEN >** for plate access - OR Press **OPEN >|** to move follower to end support
- Turn key to 'OFF' when follower stops (pump will stop).

To **close** the machine:

- Turn the key to the 'ON' position (pump will start)
- Press **< CLOSE**
- Turn key to 'OFF' when follower stops (pump will stop).

To **prematurely stop** the machine:

- Press **STOP**
- Turn key to 'OFF' (pump will stop)

The machine may be stopped or reversed at any time during movement without harm.

### 3.3 Information Shown

ENQUIRY and SETTINGS tabs at the top of the screen take you to the other screens (discussed later).

**UNITS:** Displays either inches or mm. All figures shown on the OPERATION screen are in the selected units. (TIP – touch the units to go to the SETTINGS screen if you wish to make a change).

**Loading Data...:** The frame type is displayed after the data has been loaded.

**PITCH:** The currently selected compressed plate pitch. See **5.4 PLATE PITCH** for details. (TIP – touch the pitch to go to the SETTINGS screen if you wish to make a change).

**CLOSED DIMENSION:** The distance between the inside of the head and follower when the machine is closed.

**CURRENT POSITION:** The current distance between the inside of the head and follower. This is continuously updated as the follower moves.

**OPEN FOR PLATE ACCESS:** The distance between the inside of the head and follower when the machine is open sufficiently for access to any plate.

**OPEN TO END SUPPORT:** The distance between the inside of the head and follower when the machine is open fully. The follower (or attached pipework) will automatically stop 5mm before the End Support.

The box below these buttons is used to inform you which operation is being performed or provide warning messages.

## 4 Enquiry

Touch the ENQUIRY tab to access the enquiry screen. This screen allows you to view (but not change) most parameters or settings within the machine.

The ENQUIRY screen displays the following information:

- OPERATION** (selected tab)
- ENQUIRY** (active tab)
- SETTINGS** (available tab)
- DISPLAY PREV. PLATE** and **DISPLAY NEXT PLATE** buttons.
- 0000000000 NONE
- PLATE QUANTITY 0000
- UNCOMP PITCH mm 00.000
- NOMINAL PITCH mm 00.000
- MINIMUM PITCH mm 00.000
- GRID QUANTITY 00
- DIVIDER PLATE QTY 00
- OTHER ITEMS mm 0000.00
- PLATE REMOVAL mm 0000.00
- MACHINE NUMBER 0000 0000
- MAXIMUM OPEN DIM 0000.00
- ACTUAL FITTING LEN 0000.00
- MAX FITTING LEN 0000.00
- CURRENT UNITS mm
- BUILD MONTH DAY YEAR
- DATE 00 00 0000
- OPEN+CLOSE HOURS 00000
- MACHINE LOCKUPS 000
- PLC S/W VERSION 00000
- HMI S/W VERSION V4.4
- APV AN SPH BRAND logo

### 4.1 Display Prev./Next Plate Buttons

Up to three different types of plate can be installed in your machine but usually you will have just one type.

The data displayed below these buttons shows the plate number (1/3, 2/3 or 3/3) the plate type (name, thickness and material) and the associated quantity and pitch data (in mm regardless of UNITS setting).

Press the **DISPLAY NEXT PLATE** button to see data for the next plate if you have more than one type installed. Press the **DISPLAY PREV. PLATE** button to show the previous plates' data.

### 4.2 Other Installed Components

**GRID QUANTITY:** Total number of grids installed in the frame. Grids consume 149 mm (5.866")

**DIVIDER PLATE QTY:** Total quantity of solid Divider Plates installed in the frame. (DP's consume 15.88 mm (0.625"))

**OTHER ITEMS:** The total dimension of any other installed component(s) apart from plates, grids or Divider Plates (always in mm) or used for non-standard thickness grids or Divider Plates.

**PLATE REMOVAL:** The space reserved to remove a plate from the Paraflow when it's in the OPEN FOR PLATE ACCESS position (always in mm).

## 4.3 Machine Number

The four digit year of order and the up to four digit machine serial number (without leading zeros). This will agree with the corresponding serial number shown on the Data Plate.

## 4.4 Parameters

**MAXIMUM OPEN DIM:** The maximum distance available between the head and follower when fully opened. This figure takes into account any pipework (FITTING) attached and a safety space of 5mm.

**ACTUAL FITTING LEN:** The actual fitting length stored by the user (if entered).

**MAX FITTING LEN:** The maximum length of pipe-work that may be left on a follower connection when **OPEN >|** is pressed. This figure varies depending upon the frame size and plate pack dimension.

**CURRENT UNITS:** Currently selected units in inches or millimeters. The above three figures are displayed in the currently selected units.

## 4.5 Build Date

APV Manufacture (or ship) date of the Paraflow.

## 4.6 Usage Information

**CLOSE + OPEN HOURS:** The total number of hours that the follower has been moving (opening or closing in normal mode) since manufacture, refurbishment or PLC software update. This is useful for determining periodic maintenance.

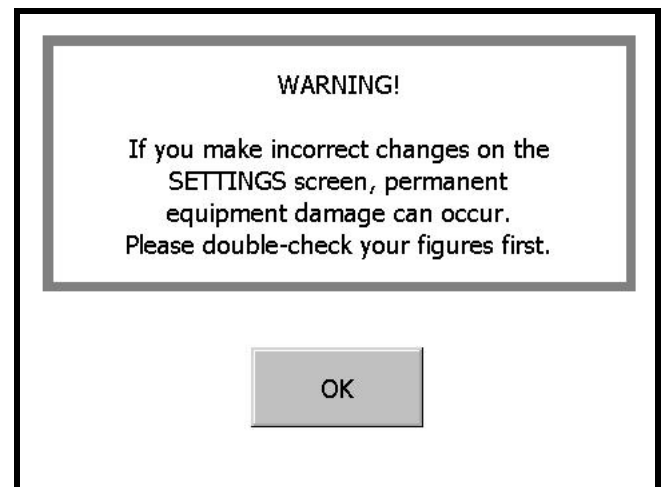
**MACHINE LOCKUPS:** The number of times that the PLC has detected a fault condition where the follower has been instructed to move but the PLC is not receiving pulses. See 11 TROUBLESHOOTING section for more details.

**PLC S/W VERSION:** Revision of the Quad/Binary-Drive series 2 project loaded in the PLC.

**HMI S/W VERSION:** Revision of the Quad/Binary-Drive series 2 project loaded in the screen (Human Machine Interface).

## 5 Settings

Touch the **SETTINGS** tab to access the settings screen. Prior to opening the **SETTINGS** screen, a warning is displayed as follows.



Entering fewer plates than actually loaded, not identifying a fitting left on the follower when opened or entering a larger follower position dimension than actual can lead to the indicated damage.

Once you have read and understood the warning, press **OK** to enter the **SETTINGS** screen.

This screen allows you to **change** certain data. Ensure that correct figures are entered.

| OPERATION                     |                                               | ENQUIRY            |              | SETTINGS   |            |
|-------------------------------|-----------------------------------------------|--------------------|--------------|------------|------------|
| UNITS = mm<br>touch to change |                                               | SCREEN CALIBRATION |              | CONTRAST - | CONTRAST + |
| PLATE PITCH                   | ORDER = INITIAL <> 2nd <> 3rd <> 4th <> FINAL |                    |              |            |            |
|                               | RELAX                                         | 0000000            | TIGHTEN      |            |            |
| PLATE QUANTITY                | NONE<br>0000                                  | NONE<br>0000       | NONE<br>0000 |            |            |
| FITTING LENGTH                | MAXIMUM LENGTH AVAILABLE = 0000.00            |                    |              |            |            |
|                               | 0000.00                                       | mm                 | ACCEPT       |            |            |
| FOLLOWER POSITION             | CURRENT FOLLOWER POSITION = 0000.00           |                    |              |            |            |
|                               | 0000.00                                       | mm                 | ACCEPT       |            |            |

**5.1 Units**

Touch this button to swap between inches or millimeters.

**5.2 Screen Calibration**

Touch this button to recalibrate the screen. Follow the on-screen instructions.

**5.3 Contrast - / Contrast +**

Touch either of these buttons to reduce or increase the contrast of the screen.

**5.4 Plate Pitch**

When gaskets are subjected to compression and elevated temperatures, over time they tend to suffer 'compression set' which reduces their sealing ability. The 'Plate Pitch' setting allows you to compensate for this effect by incrementally reducing the pitch from nominal (INITIAL) to its minimum (FINAL) value in five even steps. In this way, gasket life can be extended to the maximum possible.

Before making this adjustment, eliminate other possible causes of leaks such as debris on the sealing faces or a misaligned gasket. Adjustment should generally be used at the onset of a small plate pack leak caused by compression set but note that there are some other circumstances that necessitate a smaller plate pitch setting. See 5.4.1 Special need for plate pitch reduction.

When adjustment becomes necessary, press the **TIGHTEN** button once. A new closing dimension is calculated by the PLC and stored. Only when the **CLOSE** button is next pressed, will the follower move to the slightly reduced pitch.

Once the new pitch is stored, ensure that inlet and outlet valves are open all sections and press **CLOSE**. The follower will move to its new position. After movement, confirm that the leak has been eliminated. If the machine still leaks after one more reduction, call APV for assistance.

Step reductions can be repeated over the life of the gasket until FINAL is shown in the display. From this point, the Paraflow may continue to be used until a leak develops again. At this point no further reduction is possible and gaskets must be replaced.

**DO NOT ATTEMPT TO DEFEAT THIS FEATURE SINCE IRREPAIRABLE PLATE DAMAGE CAN OCCUR.**

To minimize machine downtime, it is recommended that gasket replacement is considered once the 4<sup>th</sup> or FINAL pitch has been reached. Once new gaskets have been installed, reset the pitch by repeatedly pressing **RELAX** until INITIAL is displayed.

**5.4.1 Special need for plate pitch reduction**

Some arrangements of new plates can require the use of a smaller pitch than INITIAL. One example is in certain multi-section units. In these cases it is acceptable to compress to lower than INITIAL or even minimum pitch to obtain an adequate seal. Refer to the accompanying General User manual for a more detailed discussion on this subject.

**5.5 Plate Quantity**

From time to time it is necessary to change the number of plates in a Paraflow. It is essential that the new installed quantity is correctly stored in the machine.

To change the quantity, touch the current figure below the appropriate plate type. A 'keypad' will be displayed. Enter the new figure and press the enter button. The new plate quantity will be stored. Confirm that the correct figure is displayed.

The machine will allow you to increase this quantity before physically adding the plates, even if the follower is below the new closed dimension. However, if you press the **CLOSE** button in this condition, the follower will actually *open* to the new, larger closed dimension (no message is displayed during this movement).

**5.6 Fitting Length**

Sometimes it is desirable to leave one or more fittings in place on the follower connections when the machine is opened (eg: to avoid repeated removal of sensitive equipment such as a thermometer or pressure gauge).

By entering a figure here, you tell the PLC to take such 'permanently' attached pipe-work into account when opening to the machine, thus avoiding damage.

The length of pipe-work left on a machine when opened can be no greater than the space available.

This is automatically calculated and displayed for you above the **ACCEPT** button.

Determine the length of the longest piece of pipe-work (blank, tee, elbow, bush etc.) you wish to permanently leave on the follower. The figure is the distance between the face of the follower connection and the end of your pipework (or the point which will touch the End Support enclosure first).

Touch the current figure and enter the new number in the current units on the 'keypad'. Press enter and then **ACCEPT** if correct.

**IMPORTANT:** In most cases, a blank (port support) will be the only fitting left on the follower when the machine is opened. A figure of 1" (25 mm) must be entered in this case.

If your figure is greater than the space available, no change is accepted and a warning message is displayed at the bottom of the screen.

If there is insufficient space available, the pipework must be removed from the follower before opening the machine.

### 5.7 Follower Position

If the follower has been moved by any method other than the **OPEN** and **CLOSE** buttons on the OPERATION screen or if an 'ABNORMAL FOLLOWER STOP...' message is issued, then the new current follower position *must* be measured and entered. Unregistered follower movement can happen (a) manually (with a wrench) (b) in Service Mode (with power) (c) under a fault condition (where pulses are not detected). The cause of the fault must be determined and corrected before proceeding with a follower position reset.

Measurement **MUST** be performed with plates installed and the follower at the closed position. To do this, note the closed dimension figure on the OPERATION screen and then place the machine in Service Mode (see **4 Service Mode** in 07 ELECTRICAL SYSTEM section).

In Service Mode, close machine to the closed dimension figure while measuring the distance between the inside of the head and follower (measure

just above the lower ports). Ensure the tape measure does not sag and is parallel with the machine.

A good method is to tape a thin (0.5mm/0.020" or less) steel rule or similar to the inside of the head and follower, extending at least 25 mm (1") past the side of the machine, just above the lower ports. Measure across the two rules, close to the side of the machine. Measure to one decimal place in mm or two places in inches.

Note that if the measured figure is even slightly below the current closed dimension the figure will be rejected by the PLC. In this case, open the machine a little (2 to 3 mm over the closed dimension) and re-measure.

Switch back from Service Mode to normal operation and wait for the OPENING screen to appear. Select **YES** to go to the SETTINGS screen (via the warning message).

Touch the current follower position figure and a 'keypad' will appear. Enter the actual measured figure, and press enter. Confirm that the figure is correct and press **ACCEPT**. The current follower position figure will be updated if a legal distance is entered.

**It is essential that a correct figure be entered. Double-check your measurement and any unit conversion calculation.**

If you enter an out-of-range figure, a warning will appear at the bottom of the screen and the figure will not be changed.

### 6 APV Service

Password protected SERVICE screens are available to allow APV personnel to change some settings and adjust data. Note that, for safety and security reasons, it is not APV's policy to allow end-user access to these screens.

### 7 Troubleshooting

If the machine cannot or does not respond as you expect while attempting to use the screen, perform a power cycle one time. If screen buttons are visible, ensure you have pressed the button firmly and given a second or two for a response. If this does not resolve the issue, please refer to 11 TROUBLESHOOTING section in this manual before contacting APV.



## 1 Introduction

The Quad/Binary-Drive Paraflow frames are designed to give many years of trouble free service and require minimal maintenance. This document describes the recommended inspection and maintenance procedures to care for the unit and ensure the best performance. Details that apply only to the powered Quad/Binary-Drive are noted.

If not included here, refer to FRAME CONSTRUCTION (QUAD-DRIVE or BINARY-DRIVE) sections for part numbers of replaceable items.

SPX is also equipped to maintain your Quad/Binary-Drive in top condition. Please call SPX Service at 1-888-APV-4321 (1-888-278-4321)

## 2 Maintenance schedule

### 2.1 Tie Bars

The section of tie bars where the follower travels must hold a light coat of food grade grease whenever the machine is opened or closed. Always check **before powered operation**. If external machine cleaning has removed such grease, a fresh application must be made. Frequency of lubrication will be dependant upon the type and frequency of external machine cleaning and the frequency of opening/closing. An elevated free nut temperature and/or a high-pitched whine will be audible when closing the machine if there is insufficient lubrication on any tie bar. Aggressive and/or frequent machine cleaning will increase the need for lubrication.

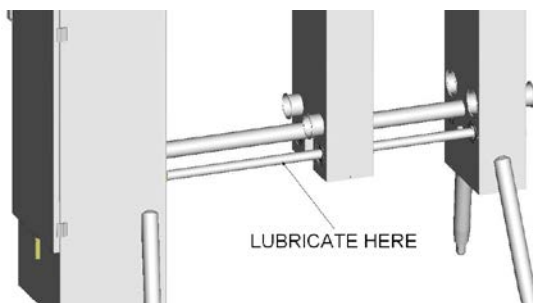


Figure 1

### 2.2 Carry Bars

A light coat of food grade grease should be present on the carry bars, where the plates touch the hanging strip on the top bar and on the sides of the bottom bar whenever the machine is opened or closed. Additionally, the Binary-Drive requires the inside, upper

vertical faces of the bottom bar halves to be greased. Always check **before powered operation**. Frequency of lubrication will be dependant upon the type and frequency of external machine cleaning and the frequency of opening/closing. A loud clicking noise will be audible when closing the machine if there is insufficient lubrication. However, a properly lubricated top bar hanging surface will not completely eliminate plate clicking. Aggressive and/or frequent machine cleaning will increase the need for lubrication.

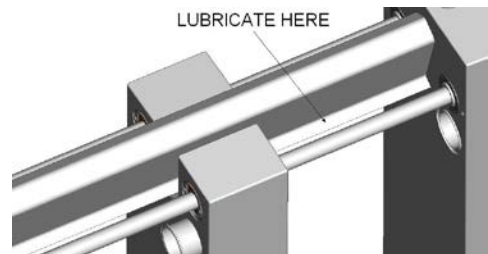


Figure 2

### 2.3 System inspection (Powered QD & BD)

Inspect all the hydraulic hoses and their fittings and all electrical cables every **6 months** or 60 runtime hours whichever comes first. Check hoses for leaks and hoses and cables for signs of chaffing or broken/detached ties. Do not power the Paraflow open or closed if any hydraulic hose or electrical cable shows signs of chaffing deeper than purely surface marks – replace the hose or cable first. Replace any broken or detached ties. Tighten (and reseal if necessary) any hydraulic fittings that are leaking.

### 2.4 Idler sprockets and shafts

Inspect the idler shafts (5 on QD, 2 on BD) every **6 months** or 60 runtime hours whichever comes first. If any shaft appears dry, add black lithium grease to each shaft through the grease point provided. Add grease **annually** to all shafts regardless of condition.



Figure 3

#### 2.5 Drive chains

Inspect the drive chains in the End Support cabinet (5 on QD, 2 on BD) every **6 months** or after **60 hours** of runtime, whichever comes first.

##### Chain lubrication:

If the chains appear dry, apply a light coat of chain oil to each one.

##### Chain adjustment:

*Tie Bar chains (4 on QD, 2 on BD)* – check play in middle of longest length. Adjust if necessary to keep play within 3/4" (19mm). For Quad-Drives, make the adjustment with the hex nut labeled with the corresponding tie bar number. For Binary-Drives, adjust the hex nut on the rod closest to the central sprockets. The hex nut at either end of the rod may be turned, whichever is most accessible. Use the supplied M24 ratchet wrench.

*Primary chain (1) - (Powered QD only)* Adjust if necessary to keep play within 1" (25mm). Make the adjustment by slightly loosening the M24 hex screw (36 mm A/F) that holds the adjuster block and backing off the M24 hex nut that locks the M24 adjuster hex screw. Turn adjuster screw clockwise to push the adjuster block until the chain has 1" (25 mm) of play. When tension is correct, retighten the lock nut and retighten the adjuster block screw. Recheck tension. Use the supplied M24 ratchet wrench.

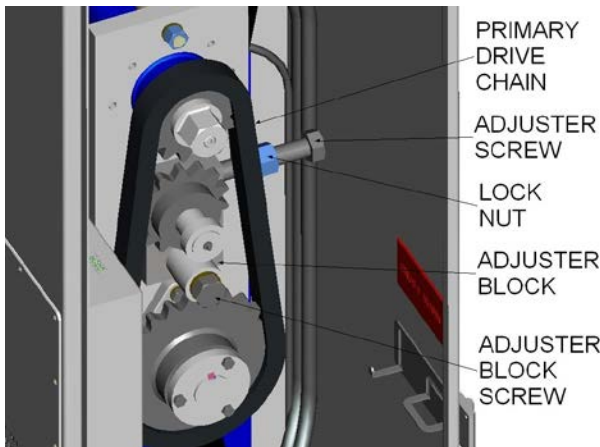


Figure 4

#### 2.6 Hydraulic oil and filters (Powered QD & BD only)

Check oil level **before powered operation**. Oil level must be between the bold, upper and lower marks on the gauge located on the outside of the End Support Cabinet just below the main door. Add a sufficient quantity of new, hydraulic oil if necessary. To top up,

open the end support door (the door key may be required), unscrew the oil filler cap, remove the main filter cartridge and add oil. Replace filter and cap when filled. Do not overfill. Clean any oil spills inside and outside of the end support enclosure.

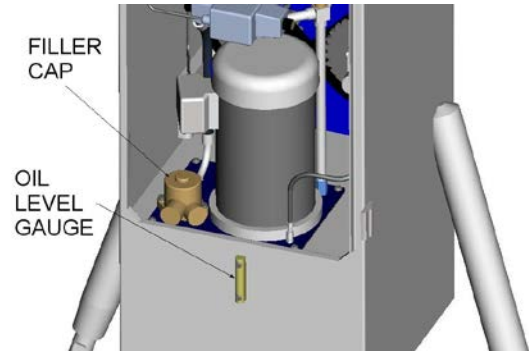


Figure 5

If oil becomes dirty (dark), milky (opaque) or otherwise contaminated, replace oil. Open end support door, remove filler cap, main filter and black plastic filter bowl (wipe the inside top dry with a clean rag and pull up with friction force on the inside surface) and drain tank thoroughly from the drain point at the bottom of the enclosure (M16 hex head screw).

If oil has become seriously contaminated, it is recommended that the power pack be removed and the tank manually cleaned. See DRIVE ASSEMBLY section for details.

Re-install M16 hex head screw and copper washer and refill with 20 US Gallons (75.7 liters) of new, recommended hydraulic oil. Re-install the filter bowl, install a new main filter cartridge and replace the cap. Remove the small filter cap beside the small pressure gauge and replace the small filter. See 08 HYDRAULIC SYSTEM section for Item Numbers and oil specification.

Clean any oil spills inside or outside the end support enclosure. Change oil and filters every **3 years** regardless of condition.

#### 2.7 Follower slide strips (Quad-Drive) OR Follower guide block (Binary-Drive)

*Quad-Drive:* Inspect the two follower slide strips, located in the cutout at the bottom of the follower, every **6 months**. Correction will be necessary when excessive side-to-side movement is seen at the lower

end of the follower when opening or closing. Restore proper guiding by rotating both pads through 90 degrees. The strips may be rotated three (3) times before needing replacement. Always replace in pairs. Each strip is retained by two M8 button head socket screws (6mm A/F). The screw heads sit in a recess in the slide strips.

For long frame sizes (FS6500 & 8000), the follower must be moved towards the end support to allow the 1" dia (25.4 mm) access holes in the side of the bottom bar to align with the M8 button head screws. Align the first pair of screws and remove them. Then move the follower another 2" (50 mm) and remove the remaining two screws.

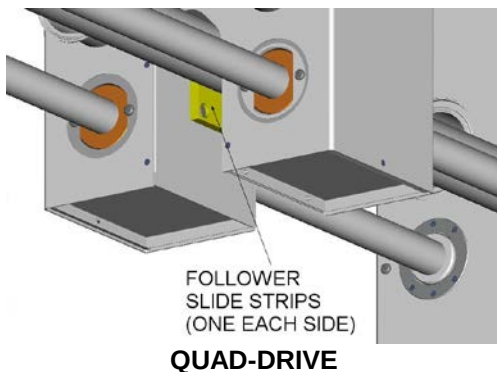


Figure 6

*Binary-Drive:* Inspect the follower guide block, located on the inside of the follower between the bottom bar halves, every **6 months**. Guide block replacement will be necessary when excessive side-to-side movement is seen at the lower end of the follower when opening or closing. The block is retained by an M8 x 30 mm long countersunk socket head SS screw (5mm A/F)

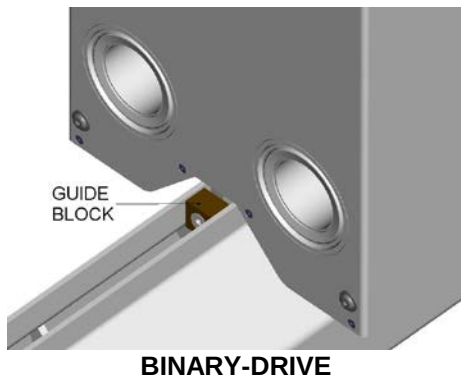


Figure 7

#### 2.8 Fasteners

It is prudent to check the tightness of fasteners from time-to-time on any powered equipment. Inspect **annually** and, if necessary, retighten.

#### 2.9 Flange bearings

Inspect and, if necessary, grease the flange bearings every **12 months** (there are one or more bearings depending upon model). Flange bearings are located inside the end support and support the drive shaft(s). An inspection mirror may be helpful.

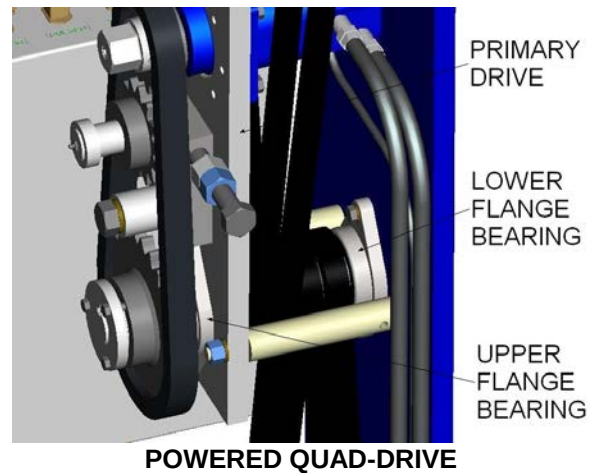


Figure 8

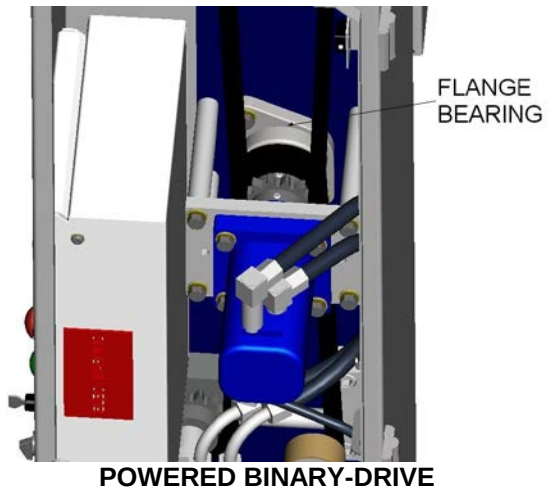


Figure 9

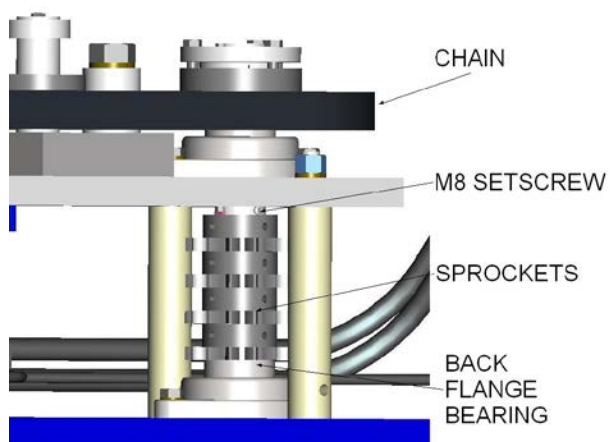
#### 2.10 Driven sprocket (Quad-Drive only)

Inspect the primary drive driven sprocket after the **first few openings** (up to 5) to ensure that alignment has not been disturbed between assembly and use.

Thereafter, check every **6 months** or after **60 hours** of runtime, whichever comes first.

Check for driven sprocket or shaft migration by use of a straight edge between the driven sprocket face and driving sprocket face on the hydraulic motor.

If sprocket misalignment is due to shaft migration, there will be a gap between the back flange bearing, the four sprockets and/or the M8 setscrew protruding from the shaft. If the driven sprocket has migrated, the shaft will be recessed in the sprocket hub. Any misalignment must be corrected. See 03 QD FRAME ASSEMBLY section in this User Manual for adjustment procedure.

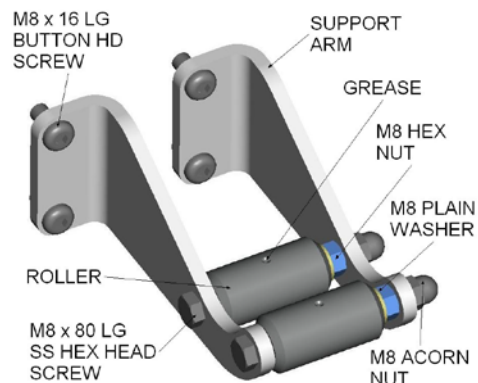


**DRIVEN DRIVE SHAFT ASSEMBLY  
(SECONDARY CHAINS REMOVED)**

**Figure 10**

#### 2.11 Tie bar rollers (Quad-Drive 6500 & 8000 top bars only)

Remove the four roller guards and inspect the two rollers at each location every **6 months** or after **60 hours** of runtime, whichever comes first.



**Figure 11**

Inspect for lack of grease and excessive surface wear. If necessary, re-grease with white grease (supplied with the frame and located in end support). Replace rollers if wear is within 0.020" (0.5mm) of the stainless steel arms (Item Numbers below).

Note that some rollers may not touch the tie bars and therefore will not rotate. This is acceptable. Some rollers may not rotate even when touching rotating tie bars. This is also acceptable.

Request UM-QBD2 TIEBAR ROLLER RETROFIT document for guard and roller disassembly and reassembly procedures if necessary.

Tie bar roller spares Items:

| Description        | Item Number |
|--------------------|-------------|
| Roller             | 3900 3984   |
| M8 x 80 SS bolt    | 3900 4258   |
| M8 SS acorn nut    | 3900 3999   |
| M8 SS hex nut      | GB506276    |
| M8 SS plain washer | 3900 1639   |

Item Numbers are for one piece of each. Total on machine is 8 of each.



### 1 Introduction

This troubleshooting section is divided into five parts (2.1, 2.2, 2.3, 2.4 & 2.5), each covering different categories of problem. To use this section:

- a. **Before you begin, refer to the following important Notes and Warnings**
- b. Select the most appropriate category
- c. Find the three criteria that match your situation (light and motor condition and problem description)
- d. Try any SOLUTIONS with a matching WARNING message and viable CHECK question

Most problems encountered are described in this section but if a solution is not found after using this guide, please contact SPX.

#### 1.1 Notes and Warnings

a. **WARNING! A qualified electrician must perform work that requires the small electrical door to be opened.** 

b. If the machine cannot or does not respond as you expect while attempting to use the screen, perform a power cycle one time.

c. If screen buttons are visible, ensure you have pressed the button firmly.

d. In certain cases you are directed to access electrical components. Before doing so and whenever directed to disconnect power in this troubleshooting guide, you must **DISCONNECT POWER BY APPLYING APPROVED LOCKOUT/TAGOUT PROCEDURES AND FOLLOWING ALL LOCAL, STATE AND NATIONAL (NEC) CODES**. Electrical work should also be carried out by a qualified electrician.

e. Allen Bradley version wiring logic is similar, but not identical to the Siemens version. However, component locations and PLC connections can differ. Contact SPX if such differences are not described and prevent diagnosis.

f. To access components behind the small electrical door, remove the twenty, M4 button head screws (use 2.5 mm A/F key). The door will hinge away from the end support. To reattach the door, ensure correct seating of the seal (if loose type supplied) and reinstall at least two screws with their nylon washers before restoring power unless instructed otherwise.

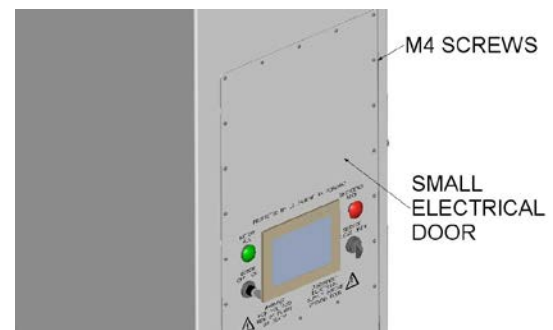


Figure 1

g. A multi-meter capable of reading 460 VAC, 120 VAC, 24 VDC and resistance will be necessary to check voltages and continuity.

h. To perform certain checks, the large door safety switch plunger must be temporarily depressed. In these cases, complete the necessary check with extreme caution and release the door safety switch as soon as the test is complete. **Warning: Keep hands and clothing away from chains and other moving parts.**

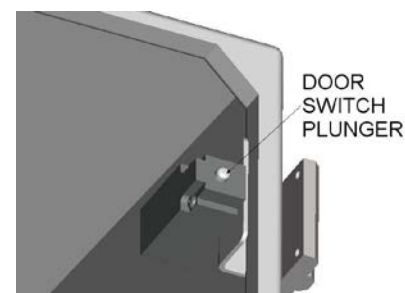


Figure 2

i. In certain cases you are directed to check a fuse. These are all located behind the small electrical door. After replacing a blown fuse, restore power and try operation again. If a fuse blows repeatedly, call SPX.

## 2 PROBLEM CATEGORIES

Select the appropriate category from the five shown below (a – e) and go to the indicated paragraph number [2.X]. Next, match the three criteria - green 'RUN' light status, electric motor activity and problem description [2.X.X]. Finally, try any SOLUTIONS with a matching WARNING message and viable CHECK question [2.X.X.X].

| Category description                                                                      | Para. | Page |
|-------------------------------------------------------------------------------------------|-------|------|
| a. Follower stationary or didn't move to the correct position when pressing OPEN or CLOSE | [2.1] | 2    |
| b. Screen will not accept numeric data (OPEN and CLOSE work)                              | [2.2] | 15   |
| c. Screen is not responding                                                               | [2.3] | 15   |
| d. Mechanical problem (OPEN and CLOSE buttons respond)                                    | [2.4] | 17   |
| e. A light is not working                                                                 | [2.5] | 18   |

### 2.1 INCORRECT FOLLOWER MOVEMENT

#### 2.1.1

GREEN LIGHT: ON or OFF  
 ELECTRIC MOTOR: NOT RUNNING  
 PROBLEM: TIE BARS DIDN'T TRY TO ROTATE - No movement when OPEN or CLOSE was pressed (chains were not tensioned)

##### 2.1.1.1

WARNING: MOTOR OFF – OPERATE KEYSWITCH  
 CHECK: Is keyswitch off or did the machine auto-stop?  
 SOLUTION: Switch keyswitch ON or OFF and then ON.

#### 2.1.2

GREEN LIGHT: ON  
 ELECTRIC MOTOR: RUNNING  
 PROBLEM: TIE BARS DIDN'T TRY TO ROTATE - No movement when OPEN or CLOSE was pressed (chains were not tensioned)

##### 2.1.2.1

WARNING: E-STOP ENGAGED  
 CHECK: Is E-Stop depressed?  
 SOLUTION: Pull out the red Emergency Stop button. Confirm that the screen no longer displays the warning message.

##### 2.1.2.2

WARNING: MAIN DOOR OPEN  
 CHECK: Is the main door open?  
 SOLUTION: Close the main door. Confirm that the screen no longer displays the warning message. If the message persists, open main door and manually operate switch plunger near the top hinge. If the message disappears, the switch may need to be moved forward slightly to activate when the door closes. If the message does not disappear with manual actuation, contact SPX.



**2.1.2.3**

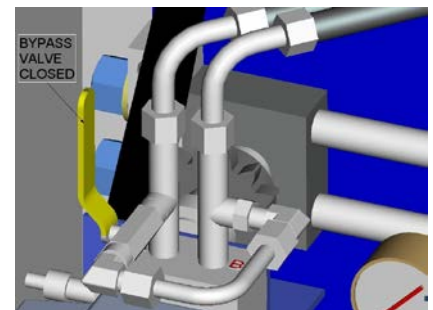
**WARNING:** PREPARE FOR FOLLOWER MOVEMENT...  
**CHECK:** Has countdown elapsed?  
**SOLUTION:** Wait for a full five seconds before expecting movement.

**2.1.2.4**

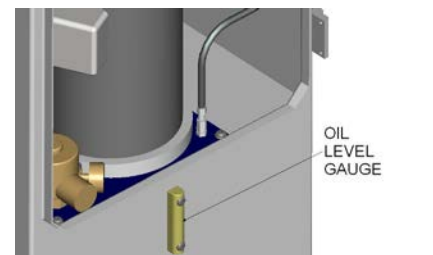
**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE  
**CHECK:** Does motor rotation agree with arrow sticker on motor cowling?  
**SOLUTION:** If incorrect, reverse the phase. Swap any two of the three power wires (at source, in top plug or in motor terminal box)

**2.1.2.5**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE  
**CHECK:** Is bypass valve handle on top of the power pack 90 deg to the valve body (ie: closed)?  
**SOLUTION:** If open (in-line with valve body), turn handle 90 deg to close valve

**2.1.2.6**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE  
**CHECK:** Is oil level between the upper and lower lines on the gauge?  
**SOLUTION:** Investigate any cause of oil loss (Check drain plug and oil level gauge for leaks). Refill with new hydraulic oil to upper fill line. Note that oil can remain at the bottom of the level gauge even if the tank is empty, giving the appearance that oil is present. Also note that machines arrive without oil in end support.

**2.1.2.7**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE  
**CHECK:** Is the pressure gauge on the filler/filter unit in or near the red zone?  
**SOLUTION:** If this gauge is in or near the red zone, an oil filter might be clogged. To check, with the door switch depressed and the motor running, observe the pressure gauge on the filter/filler assembly. Remove and inspect the main (large) filter. Replace if any signs of clogging. You may briefly (for seconds) run the unit without filter (but with the cap) to determine if this is the problem. Also check the small filter on the top of the filler/filter and replace if suspect.

**2.1.2.8**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE  
**CHECK:** Is the machine in SERVICE MODE?

**SOLUTION:** If so, open the end support door and move the SERVICE MODE switch, located on the bottom of the white electrical box, to the OFF position.

**2.1.2.9**

**WARNING:** ALREADY ARRIVED AT THIS POSITION

**CHECK:** Did you press OPEN or CLOSE and screen displayed the above warning?

**SOLUTION:** The follower will not move if already arrived at defined dimension. Only alternative buttons will move follower.

**2.1.2.10**

**WARNING:** FOLLOWER MOVED MANUALLY – RESET POSITION

**CHECK:** Did you press OPEN or CLOSE and screen displayed the above warning?

**SOLUTION:** The follower will not move if it has detected prior manual movement. Measure the inside head to follower dimension and check against the figure shown below the CURRENT POSITION on the OPERATION screen. If the numbers do not agree, see 5.7 FOLLOWER POSITION in 09 SCREEN OPERATION section. Only a valid CURRENT FOLLOWER POSITION figure will clear the warning message. (A valid position will be equal to or between the CLOSED DIMENSION and OPEN TO END SUPPORT).

**2.1.2.11**

**WARNING:** ALREADY PASSED THIS POSITION

**CHECK:** Did you press OPEN FOR PLATE ACCESS and screen displayed the above warning?

**SOLUTION:** The follower will not move if already arrived at defined dimension. If you need more space, press OPEN TO END SUPPORT.

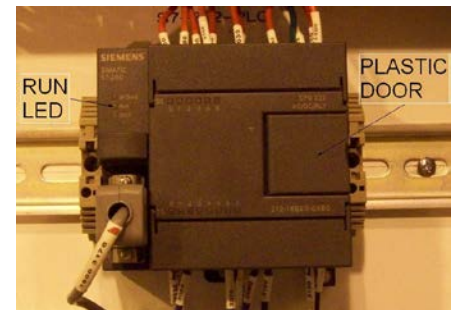
**2.1.2.12**

**WARNING:** None

**CHECK:** Do OPEN and CLOSE fail to work *and* numeric data cannot be entered?

**SOLUTION:** Check if the PLC has been left in 'STOP' mode.

- Siemens: Open the small plastic door on the right side of the face of the PLC. Move the small switch fully to the up (RUN) position and close the PLC door.
- A/B: Switch the small key counterclockwise to the RUN position. Siemens and A/B: Restore power and confirm that the green 'RUN' LED is lit.

**2.1.2.13**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Are any of the Bronze follower nuts binding on the tie bars?

**SOLUTION:** Inspect tie bars and free nuts for excessive wear, galling or seizure. Ensure tie bars are greased. Measure the distance between the inside of the head and inside of the follower at all four tie bars – if the greatest difference is more than about 5/16" (4mm), a follower synchronization is required. See FRAME ASSEMBLY section in User Manual for details.

**2.1.2.14**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is there an oil leak?

**SOLUTION:** Check and tighten or reseal any leaking fittings and replace ruptured hoses. Pump/oil related problems can often be confirmed by incorrect oil pressures. Depress the door switch and check

the large pressure gauge inside the cabinet while running. The normal readings are as follows: Idle pressure (not closing or opening) is 50 ~ 250 psi. Maximum pressure when closing is 2,400 psi.

**2.1.2.15**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Are follower fittings striking the end support?

**SOLUTION:** Close machine sufficiently to separate fitting(s) from end support. Remove fittings or enter the dimension of the longest removable fitting into fitting length in SETTINGS

**2.1.2.16**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Are there too many plates, grids or dividers?

**SOLUTION:** If in doubt, go to the ENQUIRY screen and check that all quantities agree with the actual installed components. Only plate *quantities* can be adjusted in settings. Other quantity changes require SPX to provide an updated memory cartridge/card.

**2.1.2.17**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Has the electric motor become decoupled from the hydraulic pump?

**SOLUTION:** If suspected, briefly 'bump' the service mode switch and observe the time it takes the electric motor to come to rest. If coupled correctly, approx. 2 sec., if decoupled, 10 ~ 15 sec. Contact SPX if decoupling suspected.

**2.1.2.18**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the voltage too low?

**SOLUTION:** Note that all three phases must be of correct voltage. If any phase shows no voltage, check fuses FU107, FU108 and FU110. If ok, check the link module between the Motor Starter Protector and Contactor to confirm all three legs are intact. If ok, continue tracing the three wires up through the connector on the white electrical box, main power in connector and, if necessary, to the source supply.

**2.1.2.19**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is power getting to the solenoid valve?

**SOLUTION:** To confirm, one white triangular LED on the face of the Hystar solenoid valve should light 5 seconds after OPEN or CLOSED is pressed.

- If LED's light but tie bars don't move, go on to 2.1.2.20 "Has the solenoid valve seized?"
- If LED's don't light, place in SERVICE MODE and while depressing door switch, try the CLOSE OPEN rotary switch. If LED's light but tie bars don't move go on to 2.1.2.21 "Has the solenoid valve connector failed?"
- If LED's light and tie bars move, go on to 2.1.2.32 "Are the PLC outputs energizing?"
- If LED's do not light and tie bars do not move go on to 2.1.2.24 "Is solenoid valve ground wire disconnected?"

**2.1.2.20**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Has the solenoid valve seized?

**SOLUTION:** Locate 'button' at each end of solenoid valve. In SERVICE MODE and with the electric motor running, briefly actuate the button on the left end (depress sufficiently to overcome spring force) with an Allen key for example. If forced actuation moves tie bars, or the 'button' is stuck resulting in no tie bar movement, the solenoid valve must be serviced or replaced.

#### **2.1.2.21**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Has the solenoid valve connector failed?

**SOLUTION:** If suspect, check connector is inserted and locked. If ok, remove and check wiring as follows: PIN 1: Open (Red), PIN 2: Coding pin, PIN 3: Ground (white), PIN 4: Close (Black), PIN 5: Coding pin. 120 VAC will be present on red and black when Open and Close are pressed respectively.

#### **2.1.2.22**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the solenoid valve input wiring ok?

**SOLUTION:** If suspect, remove the cover from the Hystar solenoid valve (Four Phillips screws). Confirm that the wires are securely connected and in correct locations. Top row of screws: White to middle, link from middle to right. Bottom row: Red to left, black to middle. Make any adjustments necessary and replace cover (cover printing must be upside down).

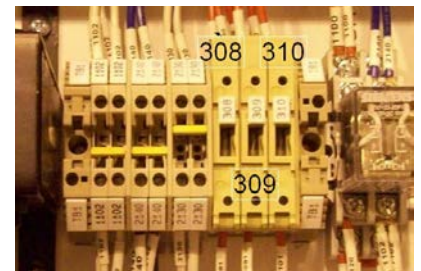


#### **2.1.2.23**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Has a fuse blown (FU308 for open or FU309 for close)?

**SOLUTION:** Replace if blown. Fuses are near relay. Contact SPX if they blow repeatedly.



#### **2.1.2.24**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is solenoid valve ground wire disconnected?

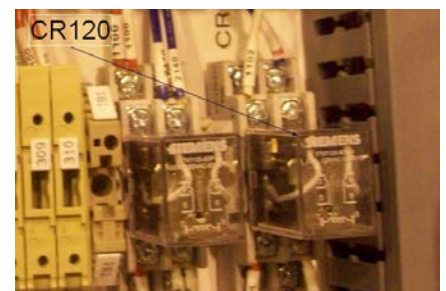
**SOLUTION:** Close the large door and check continuity from pin 3 in the VALVE's Harting socket to ground. If open circuit, check continuity in the wire from the safety switch relay (CR120) to pin 3 of the solenoid valve socket.

#### **2.1.2.25**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is relay CR120 properly inserted and its wiring sound?

**SOLUTION:** If suspect, check that relay is fully inserted. Check continuity from relay CR120 output wire 1102 to ground. If no continuity on output side, apply power and check that the coil side wires 3081 and 3091 are energized with 120 VAC when open or close is pressed. If the solenoid valve is receiving power when open or close is pressed check continuity from white wire to ground.





**2.1.2.26**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Are solenoid valve fuses receiving power?

**SOLUTION:** Fuse FU308 must receive 120VAC when OPEN is pressed and FU309 when CLOSED. If suspect, in SERVICE MODE, apply power and check that 120 VAC is present at the inputs to the solenoid valve fuses.

- Switching to OPEN supplies power to fuse FU308
- Switching to CLOSE supplies power to fuse FU309

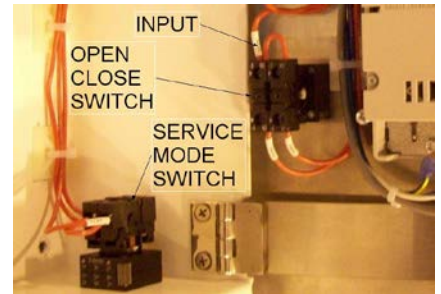
If no reading in either case, disconnect power and check continuity of the two wires running from the output of the CLOSE OPEN switch to the fuse block.

**2.1.2.27**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the OPEN/CLOSE switch receiving power in SERVICE MODE?

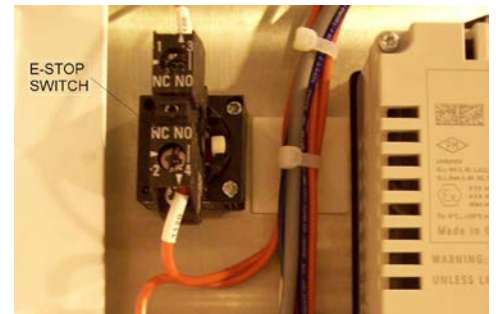
**SOLUTION:** Note that 120 VAC must be present at both contacts of the 3-position CLOSE OPEN switch when in SERVICE MODE. In SERVICE MODE, apply power and check that 120 VAC is present at both input contacts of the 3-position CLOSE OPEN switch. In SERVICE MODE, power to the inputs should be present regardless of switch position. If no reading, disconnect power and check continuity of the wire running from the SERVICE MODE ON/OFF switch to the input of the CLOSE OPEN switch. Also check presence and continuity of the short link wire between the input terminals of the switch.

**2.1.2.28**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the SERVICE MODE ON/OFF switch receiving power?

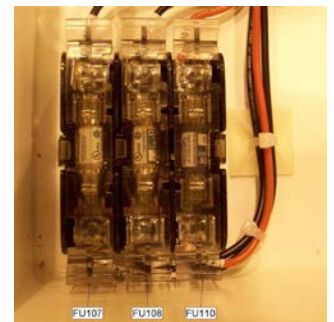
**SOLUTION:** Note that 120 VAC must be present on both sides of both contacts of the SERVICE MODE ON/OFF switch when ON. In SERVICE MODE, apply power and check that 120 VAC is present on both sides of both contacts of the SERVICE MODE ON/OFF switch. If no reading, disconnect power and check the continuity of the wire running from the E-Stop to the input of the SERVICE MODE ON/OFF switch.

**2.1.2.29**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the E-Stop switch receiving power?

**SOLUTION:** Note that 120 VAC must be present on both sides of the E-Stop when pulled out. In SERVICE MODE, apply power and check that 120 VAC is present on both sides of the E-Stop switch (ensure E-stop is out). If no reading, disconnect power and check continuity of the wire running from fuse FU110 to the input of the E-Stop. Also check fuse FU110. Check continuity of the wire from fuse FU110 to the transformer.

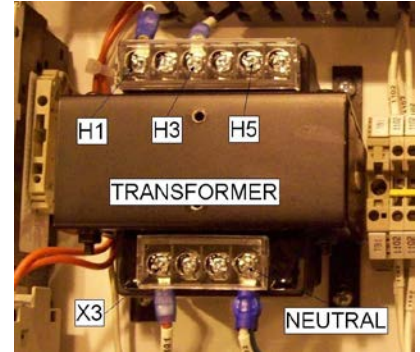


**2.1.2.30**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the transformer outputting power?

**SOLUTION:** Note that 120 VAC should be present across transformer terminals X3 (hot) and X1 (neutral). In SERVICE MODE, apply power and check for 120VAC across transformer terminals X3 (1101) and X1 (neutral). If no reading, check the supply to transformer. 460VAC - check across H1 and H5, 230VAC - check across H1 and H3. If no power, after disconnecting power, since fuses FU107 and FU108 were checked earlier and the motor is operational, the only remaining problem in SERVICE MODE is with the wires running from the Harting power connector (labeled POWER) to these fuses.

**2.1.2.31**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Are the PLC LED's indicating correctly?

**SOLUTION:** Refer to the table of LED status' below. If any LED's fail to light as listed, contact SPX.

There are two rows of green LED's, UPPER and LOWER. Rows are numbered from the left starting at 0.

| <i>Operation</i>                                                    | <i>Activity</i>           | <i>Status LED's lit</i>            |
|---------------------------------------------------------------------|---------------------------|------------------------------------|
| Keyswitch OFF                                                       | None                      | Upper row: none<br>Lower row: none |
| Keyswitch ON, fault condition<br>(screen will indicate which fault) | None                      | Upper row: none<br>Lower row: 3    |
| Keyswitch ON, no fault                                              | None                      | Upper row: 2<br>Lower row: 3       |
| Keyswitch ON, OPEN                                                  | During 5 second countdown | Upper row: 2, 5<br>Lower row: 3    |
| Keyswitch ON, OPEN                                                  | During follower movement  | Upper row: 0, 2, 5<br>Lower row: 3 |
| Keyswitch ON, CLOSE                                                 | During 5 second countdown | Upper row: 2, 5<br>Lower row: 3    |
| Keyswitch ON, CLOSE                                                 | During follower movement  | Upper row: 1, 2, 5<br>Lower row: 3 |

**2.1.2.32**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Are the PLC outputs energizing?

**SOLUTION:** Are the PLC outputs energizing? 120 VAC will be seen at output 0 when OPEN is pressed, and at output 1 when CLOSE is pressed. If no voltage on outputs, check as follows.

- Siemens: Input 1L (top left terminal on PLC)



- A/B: Input VAC/VDC 1

This input is powered from one side of the SERVICE MODE switch when the switch is OFF. Check voltage and integrity of this wire.

**2.1.3**

GREEN LIGHT: ON

ELECTRIC MOTOR: RUNNING

PROBLEM: FOLLOWER MOVED FOR 5 SECONDS AND STOPPED - OPEN or CLOSE buttons on screen move follower in correct direction for 5 seconds and then it stops

**2.1.3.1**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the 'pull down resistor' in circuit?

SOLUTION: Confirm presence and integrity of 'pull down resistor' (1k ohm, ¼ watt, carbon film type, sheathed in black shrink wrap).

- Siemens units: one end of resistor (labeled 2040) enters terminal '0.0' on the lower edge of the PLC. The other end (labeled 2140) enters terminal 'L+', also on the lower edge of the PLC.
- Allen Bradley units: one end terminates at input terminal '0' of the PLC. The other end enters the terminal block (TB2) at terminal 8.

**2.1.3.2**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the pulser wire intact?

SOLUTION: Check that the 3-pin Weatherpack connector that sits between the hydraulic motor and white electrical box is connected. Check that the wire is not broken or chafed. Check the Harting connector is secure and locked.

**2.1.3.3**

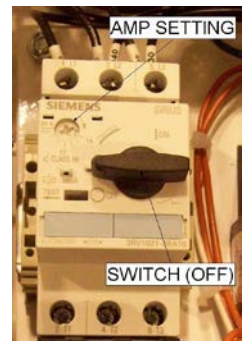
WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Has motor starter protector (MSP) tripped?

SOLUTION: Switch the MSP switch off and on to reset. Note that the switch may be a rocker or rotary switch depending upon voltage. If tripped, ensure current (Amp) setting is correct.

- Siemens: 460VAC - 7.5 amps, 230VAC – 15 amps.
- Allen Bradley: 460VAC - 10 amps, 230VAC – 20 amps.

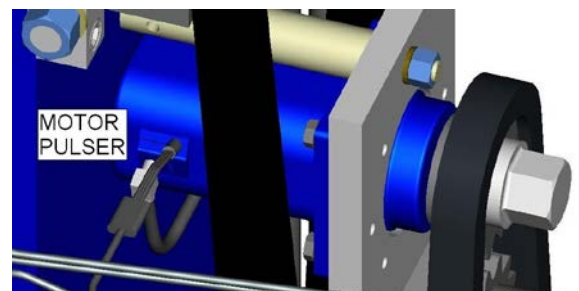
If MSP continues to trip, check integrity of each terminal of power source (plugs, sockets, screw terminals). A poorly connected power wire can cause MSP tripping even if amperage is correctly set.

**2.1.3.4**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Has the hydraulic motor pulser failed?

SOLUTION: Check the sensor (motor pulser). The sensor is installed from the outside of the hydraulic motor and is user replaceable. To remove sensor, slacken larger hexagon nut (0.69" A/F) and unscrew sensor with smaller hexagon (0.57" A/F). Look for signs or wear on the end face of sensor and the toothed wheel at bottom of sensor hole. Any sensor damage



will require a replacement sensor. Any damage to the toothed wheel will require a replacement hydraulic motor (or shaft). Do not open or close the machine hydraulically with the sensor removed. Sensor replacement must follow the published EATON installation instructions.

**2.1.3.5**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Has the follower become unsynchronized?

**SOLUTION:** Measure the distance between the inside of the head and inside of the follower at all four tie bars – if the greatest difference is more than about 5/16" (4mm), a follower synchronization is required. See FRAME ASSEMBLY section for details. Investigate cause before continuing.

**2.1.3.6**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the drive train slipping or broken?

**SOLUTION:** All chains and sprockets must be serviceable and properly adjusted for correct operation. Inspect chains and sprockets for excessive wear, correct adjustment and sufficient lubrication.

**2.1.4**

**GREEN LIGHT:** ON

**ELECTRIC MOTOR:** RUNNING

**PROBLEM:** FOLLOWER CLOSED BUT NOT COMPRESSED ENOUGH - Follower closes but the measured plate pack distance is more than the screen CLOSED DIMENSION.

**2.1.4.1**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the oil contaminated?

**SOLUTION:** System pressure should reach 2400 psi at closed pitch. Measurement should agree with CLOSED DIMENSION on screen. Measure the head to follower dimension when machine stops to confirm that pitch is too large. If pressure is too low, check oil quality - replace if contaminated (milky, dirty, old).

**2.1.4.2**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the oil level too low?

**SOLUTION:** System pressure should reach 2400 psi at closed pitch. Measurement should agree with CLOSED DIMENSION on screen. Measure the head to follower dimension when machine stops to confirm that pitch is too large. If pressure is too low, check oil quantity - refill with recommended oil. Note that oil can remain at the bottom of the level gauge even if the tank is empty, giving the appearance that oil is present.

**2.1.4.3**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is there an oil leak?

**SOLUTION:** System pressure should reach 2400 psi at closed pitch. Measurement should agree with CLOSED DIMENSION on screen. Measure the head to follower dimension when machine stops to confirm that pitch is too large. If pressure is too low, investigate cause of oil loss (Check drain plug and oil level gauge for leaks). Refill with new hydraulic oil to upper fill line. Note that oil can remain at the bottom of the level gauge even if the tank is empty, giving the appearance that oil is present.

**2.1.4.4**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the oil filter clogged?

SOLUTION: The pressure gauge on the filler/filter unit must not be in or near the red zone. Firstly, with the door switch depressed, observe the pressure gauge on the filter/filler assembly with the motor running. The gauge may be near or in the red if there is clogging. Secondly, remove and inspect the long filter. Replace if any signs of clogging. You may briefly (for seconds) run the unit without filter (filler cap must be replaced) to determine if this is the problem.

**2.1.4.5**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the plate pack brand new?

SOLUTION: In rare cases, a new plate pack with new gaskets can require a period of settling after the first closure, before initial pitch can be reached. In these cases, either leave the machine overnight in the compressed condition or bring the plate pack up to normal working pressure for 15 min.

**2.1.4.6**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the pressure setting too low?

SOLUTION: System pressure should reach 2400 psi at closed pitch. Measurement should agree with CLOSED DIMENSION on screen. If pressure is too low (after previous checks), adjust the screw on the left side, under the solenoid valve in increments of about ¼ turn clockwise. Do not exceed 2,400psi. If pressure cannot be reached the pump, motor or another hydraulic component may need replacement.

**2.1.4.7**

WARNING: None

CHECK: Is the follower position correctly stored in the PLC?

SOLUTION: The follower must be at the actual location shown on the screen when closed to pitch. Measure the head to follower dimension when machine stops to confirm that pitch is too large. Reset follower position at compressed dimension according to 09 SCREEN OPERATION in this manual.

**2.1.4.7**

WARNING: None

CHECK: Is the declared frame type correct?

SOLUTION: Since the Quad-Drive and Binary-Drive employ different gearing, an incorrect frame type will position the follower incorrectly. A new memory cartridge or CF card is required from SPX.

**2.1.5**

GREEN LIGHT: ON

ELECTRIC MOTOR: RUNNING

PROBLEM: FOLLOWER CLOSED BUT COMPRESSED TOO MUCH - Follower closes but the measured plate pack distance is less than expected.

**2.1.5.1**

WARNING: None

CHECK: Is the machine in SERVICE MODE?

SOLUTION: Open the large end support door and move the SERVICE MODE switch to OFF. Use the screen to OPEN and CLOSE. A follower position reset will be required if the follower was moved in SERVICE MODE. See section 09 SCREEN OPERATION in this manual.

**2.1.5.2**

WARNING: None

CHECK: Is the CURRENT POSITION on the screen larger than the measured follower position?

SOLUTION: The CURRENT POSITION must agree with the actual follower position when machine is closed. Move follower to correct closed dimension (in SERVICE MODE if necessary) and enter this figure into FOLLOWER POSITION in the SETTINGS screen. See section 09 SCREEN OPERATION in this manual.

**2.1.5.3**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Are there more plates (or grids or Divider Plates) than shown on the ENQUIRY screen?

SOLUTION: Adjust plate quantity in the SETTINGS screen to agree with actual installed quantity. Incorrect grid and Divider Plate quantities or installed plate type(s) require an updated memory cartridge (Siemens) or CF card (A/B)

**2.1.5.4**

WARNING: None

CHECK: Is the PITCH step tighter than expected?

SOLUTION: A reduced PITCH will yield a dimension below the *nominal* compressed pitch. Ensure that the PITCH setting is at an appropriate step. Some machine configurations, even when new, require a lower than INITIAL setting to operate.

**2.1.5.5**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the declared frame type correct?

SOLUTION: Since the Quad-Drive and Binary-Drive employ different gearing, an incorrect frame type will position the follower incorrectly. A new memory cartridge or CF card is required from SPX.

**2.1.6**

GREEN LIGHT: ON

ELECTRIC MOTOR: RUNNING

PROBLEM: TIE BARS TRIED TO TURN BUT CAN'T - Tie bars tried to turn but follower would not open (chains clearly put in tension)

**2.1.6.1**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the machine pressurized?

SOLUTION: The follower will not open if the plate pack is subjected to about 50 psi or more. Depressurize all plate sections

**2.1.6.2**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

CHECK: Is the oil too low or empty?

SOLUTION: Investigate cause of oil loss (Check drain plug and oil level gauge for leaks). Refill with new hydraulic oil to upper fill line. Note that oil can remain at the bottom of the level gauge even if the tank is empty, giving the appearance that oil is present. Also note that machine is shipped without oil in end support.

**2.1.6.3**

WARNING: ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Is the oil filter clogged?

**SOLUTION:** The pressure gauge on the filler/filter unit must not be in or near the red zone. Firstly, with the door switch depressed, observe the pressure gauge on the filter/filler assembly with the motor running. The gauge may be near or in the red if there is clogging. Secondly, remove and inspect the long filter. Replace if any signs of clogging. You may briefly (for seconds) run the unit without filter (but with the cap) to determine if this is the problem.

#### **2.1.6.4**

**WARNING:** ALREADY ARRIVED AT THIS POSITION

**CHECK:** Are you trying to close when machine is already closed?

**SOLUTION:** Machine can only be opened once compressed to pitch (CLOSED DIMENSION).

#### **2.1.6.5**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Have the Bronze follower free nuts seized?

**SOLUTION:** If one or more nuts have seized, they will need to be replaced. If the tie bars have suffered damage they may also need to be replaced. Do not attempt to run the machine in this state.

#### **2.1.6.6**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Has the follower become unsynchronized?

**SOLUTION:** The follower must be parallel to the head to ensure unimpeded operation. Measure the distance between the inside of the head and inside of the follower at all four tie bars – if the greatest difference is more than about 5/16" (4mm), a follower synchronization is required. See FRAME ASSEMBLY section in this manual for details. Investigate cause before continuing.

#### **2.1.6.7**

**WARNING:** ABNORMAL FOLLOWER STOP – CHECK CAUSE

**CHECK:** Have tie bar bearings seized in the head?

**SOLUTION:** Remove large round head covers (6 x M4 button head screws [2.5 mm A/F]) and inspect bearings for corrosion. Open hydraulic bypass valve on top of power pack in end support and attempt to move any tie bar about 1/4 turn with wrench using tie bar bush flats (at end support, facing follower [55mm A/F]).

### **2.1.7**

**GREEN LIGHT:** ON

**ELECTRIC MOTOR:** RUNNING

**PROBLEM:** FOLLOWER OPENED, BUT TOO MUCH OR TOO LITTLE - Follower opened beyond either OPEN dimension on the screen (possibly resulting in a clash) OR not as far as the OPEN dimension selected.

#### **2.1.7.1**

**WARNING:** None

**CHECK:** Is the machine in SERVICE MODE?

**SOLUTION:** Open the large end support door and move the SERVICE MODE switch to OFF. Use the screen to OPEN and CLOSE. A follower position reset will be required if the follower was moved in SERVICE MODE. See section 09 SCREEN OPERATION in this manual.

#### **2.1.7.2**

**WARNING:** None

**CHECK:** Are all pulses being counted?

**SOLUTION:** If some pulses are being 'dropped' the follower will open further than it should. Such behavior can be an indication of a damaged serrated shaft inside the hydraulic motor (perhaps caused by a recent pulser replacement), a damaged pulser tip (striking the shaft) or from a poorly connected pull down resistor. Seek APV help to resolve this issue.

#### **2.1.7.3**

**WARNING:** None

**CHECK:** Has the follower been moved manually?

**SOLUTION:** Close machine to pitch (using SERVICE MODE if necessary) and re-entre FOLLOWER POSITION in SETTINGS screen. See 09 SCREEN OPERATION for details.

#### **2.1.7.4**

**WARNING:** None

**CHECK:** Is the declared frame type correct?

**SOLUTION:** Since the Quad-Drive and Binary-Drive employ different gearing, an incorrect frame type will position the follower incorrectly. A new memory cartridge or CF card is required from SPX.

### **2.1.8**

**GREEN LIGHT:** ON

**ELECTRIC MOTOR:** RUNNING

**PROBLEM:** FOLLOWER MOVED IN WRONG DIRECTION - Follower moved in opposite direction to command chosen

#### **2.1.8.1**

**WARNING:** None

**CHECK:** Is the wiring correct?

**SOLUTION:** Check direction in SERVICE MODE. If correct, check wiring from PLC to Hystar solenoid valve. Siemens: OPEN energizes PLC output 0.0, through wire 3080 to fuse FU308, wire 3081 and pin 1 on solenoid valve plug; red wire from plug to lower left terminal in solenoid valve. CLOSE energizes output 0.1, wire 3100 to fuse FU309, wire 3091 and pin 4 on solenoid valve plug; black wire from plug to lower middle terminal on solenoid valve. If SERVICE MODE is incorrect check next question on hydraulics. Then check wires from OPEN CLOSE rotary switch. OPEN energizes wire 3080, CLOSE energizes wire 3090.

#### **2.1.8.2**

**WARNING:** None

**CHECK:** Are the hydraulic hoses connected correctly?

**SOLUTION:** Ensure hoses exit the hydraulic motor and enter the solenoid manifold in the correct location.

- Quad-Drive 'A' to 'A' and 'B' to 'B'
- Binary-Drive 'A' to 'B' and 'B' to 'A'

If a swap is necessary, make the change at the solenoid manifold on the top of the power pack. See section 08 HYDRAULIC SYSTEM in this manual.

#### **2.1.8.3**

**WARNING:** None

**CHECK:** Have you just made a pitch step or other data adjustment?

**SOLUTION:** Follower can move in 'opposite' direction if the target position is on opposite side of actual position. No correction necessary.



**2.2 NUMERIC DATA REJECTED****2.2.1**

GREEN LIGHT: ON or OFF  
ELECTRIC MOTOR: RUNNING (if keyswitch on) or NOT RUNNING (if keyswitch off)  
PROBLEM: WARNING ON SCREEN

**2.2.1.1**

WARNING: FIGURE ABOVE MAX OPEN DIM - NO CHANGE MADE  
CHECK: Does the SETTINGS screen refuse your open follower position?  
SOLUTION: The follower dimension cannot be above (by even the slightest amount) the valid range calculated by the PLC. You must enter a figure equal to or below the MAX OPEN DIMENSION. Ensure the follower is at this location. IMPORTANT: For follower to close to the correct CLOSED DIMENSION, you must enter the follower position when the machine is closed to pitch.

**2.2.1.2**

WARNING: FIGURE BELOW CURRENT CLOSED DIM - NO CHANGE MADE  
CHECK: Does the SETTINGS screen refuse your closed follower position?  
SOLUTION: The follower dimension cannot be below (by even the slightest amount) the valid range calculated by the PLC. You must enter a figure equal to or above the CLOSED DIMENSION. Ensure the follower is at this location.

**2.2.1.3**

WARNING: OPEN PAST CLOSED DIMENSION FIRST  
CHECK: Does the SETTINGS screen refuse to relax the pitch?  
SOLUTION: The CLOSED DIMENSION cannot be greater than the current follower position. Open the follower above the new relaxed CLOSED DIMENSION first.

**2.2.1.4**

WARNING: FITTING LENGTH TOO LONG - NO CHANGE MADE  
CHECK: Does the SETTINGS screen refuse your fitting length?  
SOLUTION: There must be sufficient space available for the extra fitting when the machine is open. If the fitting is actually the length you are trying to enter, you will have to remove this fitting from the follower before opening the machine because there is insufficient space available to leave it on the frame when opened. See MAX FITTING LENGTH on the ENQUIRY screen to find the longest fitting length that can be left on the follower when opening for plate access.

**2.3 SCREEN NOT RESPONDING****2.3.1**

GREEN LIGHT: ON or OFF  
ELECTRIC MOTOR: RUNNING (if keyswitch on) or NOT RUNNING (if keyswitch off)  
PROBLEM: UNABLE TO OPERATE SCREEN - Screen buttons are visible but not responding to presses OR buttons are partially or completely obscured (white, black or unpowered screen)

**2.3.1.1**

WARNING: None  
CHECK: Are you pressing the buttons correctly?

**SOLUTION:** Most selections give a visual response when correctly selected (reverse video or button outline). Ensure that you are pressing firmly enough, in the correct position and have given sufficient time for a response.

#### **2.3.1.2**

**WARNING:** None

**CHECK:** Does the contrast need adjusting?

**SOLUTION:** View screen from different angle and with a shade. If possible, select SETTINGS, and then CONTRAST - or + as appropriate. If screen appears powered but still too dark or light to read, go to 09 SCREEN OPERATION in this manual, find the SETTINGS screen to judge button positions and attempt to select SETTINGS and then CONTRAST - or + as necessary.

#### **2.3.1.3**

**WARNING:** None

**CHECK:** Is the screen fully or partially dark?

**SOLUTION:** With power applied, check that at least one LED is lit on the PLC. If no LED is lit, check fuse FU110 and that 120 VAC is present. Check that the 2 Siemens or 3 A/B conductor power plug is fully inserted into bottom of screen and that the copper wires are securely clamped (not the insulation).

- Siemens: Check that 24 VDC is present across the power plug
- A/B: Check that 120VAC is present across the black and white wires in the power plug

If power is present and the screen is still dark, the screen will need to be replaced.

#### **2.3.1.4**

**WARNING:** None

**CHECK:** Do dimensional information boxes show #####?

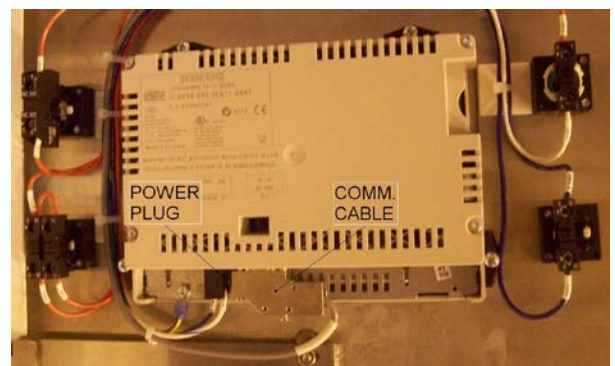
**SOLUTION:** Siemens: Check the PLC. If the SF (system fault) LED (top left) is red the PLC is in a fault condition. In some cases this can be cleared with Siemens PLC software but generally it is due to an internal component failure. In this case, replace the PLC with a new unit from SPX with your machine data pre-installed.

#### **2.3.1.5**

**WARNING:** None

**CHECK:** Do dimensional information boxes show ##### but there is no system fault?

**SOLUTION:** Siemens: Secure each end of the communication cable that enters the face of the PLC and underside of the screen. Use a small, flat bladed screwdriver to tighten the two screws on each plug. If the ##### display persists after tightening the screws, if available, temporarily substitute the communication cable with a straight through DB9 male/male cable of 'any' length. If the substitute works a replacement data cable is required. Contact SPX for a replacement.



**2.3.1.6**

WARNING: None

CHECK: Do boxes show ##### but there is no system fault and communication cable plugs are tight?

SOLUTION: Siemens: If the ##### display persists after tightening the screws, if available, temporarily substitute the communication cable with a straight through DB9 male/male cable of 'any' length. If the substitute works a replacement data cable is required. Contact SPX for a replacement.

**2.3.1.7**

WARNING: None

CHECK: Do buttons activate when pressing outside their boundaries?

SOLUTION: Select the SETTINGS screen and touch the SCREEN CALIBRATION button. Follow on screen instructions to re-calibrate.

**2.4 MECHANICAL PROBLEM****2.4.1**

GREEN LIGHT: ON

ELECTRIC MOTOR: RUNNING

PROBLEM: EXCESSIVE NOISE OR WEAR – unusually loud noise or visible component wear

**2.4.1.1**

WARNING: None

CHECK: Are there Bronze filings on the floor below the tie bars?

SOLUTION: Bronze follower free nuts should give 10+ years of daily service and never visibly shed material. Check that the tie bars are lubricated before operation. Check if the follower is parallel to the head. Refer to the synchronization procedure in the FRAME ASSEMBLY section of this manual. If unsynchronized, check cause (free nut wear, chain slippage, stretch, break, sprocket wear, drive key breakage).

**2.4.1.2**

WARNING: None

CHECK: Is there an excessive whining noise from the tie bars?

SOLUTION: The Bronze follower free nuts should not be audible over the running motor when moving. Check that the tie bars are lubricated before operation. Check if the follower is parallel to the head. Refer to the synchronization procedure in the FRAME ASSEMBLY section of this manual. If unsynchronized, check cause (free nut wear, chain slippage, stretch, break, sprocket wear, drive key breakage).

**2.4.1.3**

WARNING: None

CHECK: Is there a clicking noise when closing or opening?

SOLUTION: Some clicking is normal with certain plates. To minimize noise, ensure that the plate hanging surfaces are properly (but not excessively) lubricated with a food grade grease.

**2.4.1.4**

WARNING: None

CHECK: Is there excessive noise from the end support?

SOLUTION: The drive train should be considerably quieter than the electric motor/pump system when opening or closing. Check if the chains need adjusting (slack = 2 x chain width on longest length). Check

if chains need lubrication. Check if idler sprockets need grease or their bores are worn (slightly slacken chain and check for idler sprocket wobble - replace if necessary). Check that chains are not touching each other or other items.

## **2.5 LIGHT PROBLEM**

Note: Screen backlight problems are covered under 2.3

### **2.5.1**

GREEN LIGHT: ON  
ELECTRIC MOTOR: RUNNING  
PROBLEM: A LIGHT IS NOT WORKING – The strobe warning light is not working but the electric motor is running.

#### **2.5.1.1**

WARNING: None  
CHECK: Has the strobe light on the top of the cabinet failed?  
SOLUTION: Check if power (120 VAC) is present at the light socket on the electrical box when the machine is being opened or closed. Presence of power indicates that the light has failed and a replacement will be necessary.

#### **2.5.1.2**

WARNING: None  
CHECK: Is the strobe light wiring loose or disconnected?  
SOLUTION: Check integrity of wires 3150 and 1102 that enter and exit strobe light. Check Harting plug is connected and locked. If connected remove and inspect wires. Pin 2 is power in, pin 3 goes to ground. Pin 1, 4 & 5 are for coding (unused).

### **2.5.2**

GREEN LIGHT: OFF  
ELECTRIC MOTOR: RUNNING  
PROBLEM: A LIGHT IS NOT WORKING – The green 'RUN' light is not working but the electric motor is running.

#### **2.5.2.1**

WARNING: None  
CHECK: Has the bulb blown in the green indicator panel light?  
SOLUTION: Replace bulb with new equivalent.

#### **2.5.2.2**

WARNING: None  
CHECK: Is the green indicator wiring loose or disconnected?  
SOLUTION: Check integrity of wires 1181 and 1102 that enter and exit back of indicator light.



# Quad-Drive Ser.2 & Binary-Drive Ser.2

MANUAL AND PLC CONTROLLED  
PARAFLOW PHE'S

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