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Chapter 1

Introduction

The MotoRail 7 is a pre-engineered, modular, overhead linear transporter for standard Motoman robots. MotoRail 7 allows you to service multiple workstations, maximizing productivity and use of capital equipment. The “7” represents 7 axes or degrees of freedom (6 robot axes plus 1 linear axis), providing optimum flexibility for machine tending and welding applications. This flexibility includes maximum reach on both sides of the beam and beyond the beam end. The transporter is designed to carry standard Motoman robots. Custom applications requiring multi-beam sections and carriage assemblies are readily configured utilizing standard, modular components. MotoRail is available in single and multi-robot configurations as required by machine tending or welding applications. Independent or truly coordinated operation is possible. MotoRail can be used for identical or progressive operations at multiple machining cells and is fully supported by Motoman, Inc.

1.1 About This Document

This manual covers both the 7-20 and 7-50 product lines and is intended as an introduction and overview for personnel who have received operator training from Motoman, and who are familiar with the operation of these Motoman robot models. For more detailed information, refer to the manuals listed in Section 1.3. This manual contains the following sections:

SECTION 1 - INTRODUCTION
This section provides general information about the MotoRail 7 system and its components, a list of reference documents, and customer service information.

SECTION 2 - SAFETY
This section provides information regarding the safe use and operation of the MotoRail 7 system.

SECTION 3 - EQUIPMENT DESCRIPTION
This section provides a detailed description of the major components of the MotoRail 7 system. This section also includes a table of component specifications.

SECTION 4 - INSTALLATION
This section provides instructions for set up and installation of the MotoRail 7 system.

SECTION 5 - OPERATION
This section provides instructions for basic operation of the MotoRail 7 system. This section also provides procedures for start-up, normal operation, fault recovery, and shutdown.
SECTION 6 - MAINTENANCE
This section contains a table listing periodic maintenance requirements for the components of the MotoRail 7 system.

1.2 System Overview

Two MotoRail 7 types are available; the 7-20 is designed for the UP20, HP20, and EA1900N type robots, while the 7-50 is designed for the UP50, UP50N, and UP20MN type robots. Left and right hand carriage assemblies are available for maximum flexibility on multi-carriage applications. The legs may be located on either or both sides of a beam system and provide free standing support, which is adequate on most factory floors without any additional foundation work. The standard MotoRail 7 configuration includes a 6 meter beam (7-20) or 8-meter beam (7-50), leg, carriage, and carriage control assemblies. The robot must be ordered separately.

Rail lengths are available in two meter increments (min. 4 meters). The support legs are positioned along the beam with a maximum span of 8 meters and a 1.5 m overhang using mounting holes located at 100 mm increments. Rail lengths greater than 20 meters are possible, depending on controller location, height of rail, and orientation of robot. For non-standard rail designs, contact Motoman Applications Engineering.

![Figure 1 System Layout](image)

Note: This manual is for a standard Motoman system. If yours is a custom or modified system, please use the system drawings and Bill of Material (BOM) provided for troubleshooting and spares provisioning.

DANGER!
Never remove hardstops with robot installed on carriage! Serious injury to personnel and damage to equipment can occur!
1.2.1 Major Components

The MotoRail 7 system includes the following major components:

- Modular beam assembly available in multiple of 2-meter lengths.
- Carriage assembly
- Beam Support Legs
- Carriage control kit including motor, external axis, 1/2 in. air hose plumbed to robot and cable sets available in 20-, 25-, and 30-meter lengths, providing a maximum 31-meter carriage travel with minimal restrictions on controller placement.

Note: Contact Motoman engineering if longer carriage travel is required.

1.2.2 Optional Equipment

The following optional equipment is available for use with the MotoRail 7 system:

- Lateral brace for improved stability. Used to provide additional lateral or transverse robot stability, as the application requires.
- Limit switch kit
- Automatic lubricator kit
- Bulk wire feed conduit (welding)
- Bulk wire assist feeder (welding)

1.3 Reference to Other Documentation

For additional information refer to the following:

- Motoman Manipulator Manual for your robot.
- Güdel MotoRail Manual
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type
- Application Type (material handling, arc welding, etc.)
- System Type (MotoRail 7)
- Software Version (access using TOP MENU > SYSTEM INFO > VERSION > SYSTEM on the programming pendant)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on front door of controller)
NOTES
Chapter 2

Safety

2.1 Introduction

It is the purchaser’s responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-1999). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

RoboticIndustriesAssociation
900VictorsWay
P.O.Box3724
AnnArbor,Michigan48106
TEL:(734)994-6088
FAX:(734)994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the robot system. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the robot cell. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE ROBOT SYSTEM!

We recommend approved Motoman training courses for all personnel involved with the operation, programming, or repair of the robot system. This training is designed to familiarize personnel with the safe and correct operation of the robot system.
This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming, Operation, and Maintenance Safety (Section 2.6)

2.2 Important Advisory Information

Throughout this manual you will find advisory paragraphs (denoted by graphic symbols and bold typeface). All of these (except “NOTE”) direct the reader's attention to information and procedures that are essential to the safety of personnel or protection of equipment.

The type of information contained in the various advisories is described below. These are listed here in decending order of importance to the safety of personnel and protection of equipment.

**DANGER!**
Information appearing under the DANGER caption concerns the protection of personnel from an immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

**WARNING!**
Information appearing under the WARNING caption concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

**CAUTION!**
Information appearing under the CAUTION caption concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

Note: Information appearing in a Note caption provides additional information that can be helpful in understanding the item being explained.

2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
• Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).

• The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.

• In accordance with ANSI/RIA R15.06-1999, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-1999 safety standards, and other local codes that may pertain to the installation and use of industrial equipment. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

• Safety fences and barriers
• Light curtains and/or safety mats
• Door interlocks
• Emergency stop palm buttons located on operator station, robot controller, and programming pendant

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

2.5 Installation Safety

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

• Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06-1999 safety standards are permitted to install the equipment.
• Identify the work envelope of each robot with floor markings, signs, and barriers.
• Position all controllers outside the robot work envelope.
• Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
• Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
• Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming, Operation, and Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this robot should be permitted to program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

• Inspect the robot and work envelope to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
• Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
• Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
• Check the E-Stop button on the programming pendant for proper operation before programming. The robot must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
• Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
• Any modifications to PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!
• Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.
• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.
• Check and test any new or modified program at low speed for at least one full cycle.
• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

• Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.

• Use proper replacement parts.

• Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
NOTES
Chapter 3

Equipment Description

3.1 MotoRail

The MotoRail 7 system is designed to provide linear transport of a ceiling (inverted), or wall mounted Motoman robot. The additional linear axis gives the robot an expanded work envelope with a linear traverse speed of 2.5 meters per second and repeatability of 0.1 mm. Standard rail lengths are available in 2-meter increments with a travel stroke approximately one meter less than the total beam length. See Table 4 for additional specifications.

Table 4 MotoRail 7 Specifications

<table>
<thead>
<tr>
<th></th>
<th>MotoRail 7-20</th>
<th>MotoRail 7-50</th>
</tr>
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<tbody>
<tr>
<td>Max. Carriage Velocity, m/sec</td>
<td>2.5</td>
<td>2.5</td>
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<tr>
<td>Rated Acceleration Time, sec</td>
<td>1.0</td>
<td>0.5</td>
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<tr>
<td>EOA Repeatability, including carriage, mm</td>
<td>+/- 0.10</td>
<td>0.1</td>
</tr>
<tr>
<td>E-Stop Response Time (typical), sec</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>E-Stop Response Distance (typical), sec</td>
<td>550</td>
<td>500</td>
</tr>
<tr>
<td>Duty Cycle, %</td>
<td>60</td>
<td>60</td>
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<tr>
<td>Robot Base Height, mm</td>
<td>2500/2750/3000</td>
<td>2690/3000/3250/3500</td>
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Table 5 MotoRail 7 Configuration

<table>
<thead>
<tr>
<th>System Length (m)</th>
<th>Legs</th>
<th>Cable (m)</th>
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<tr>
<td>Overall</td>
<td>Stroke</td>
<td>1.5 m OH</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
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<td>2</td>
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Table 5 MotoRail 7 Configuration (Continued)

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<th>System Length (m)</th>
<th>Legs</th>
<th>Cable (m)</th>
</tr>
</thead>
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<tr>
<td>Overall Stroke</td>
<td>1.5 m OH</td>
<td>0 m OH</td>
</tr>
<tr>
<td>12 11 3 3 20</td>
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<td></td>
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<td>30 29 5 5 30</td>
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<td></td>
</tr>
<tr>
<td>32 31 5 5 30</td>
<td></td>
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</tr>
</tbody>
</table>

OH = End Over Hang

Figure 2 MotoRail 7-20 System Dimensions
3.1.1 Beam Assembly

The beam assembly weldment is constructed from a structural steel plate with flat bar guideway rails and independent racks or integrated guideway flat bar racks depending on the modules size and/or requirements.

3.1.2 Carriage Assembly

DANGER!

Never remove hardstops with robot installed on carriage! Serious injury to personnel and damage to equipment can occur!

The carriage rides along the beam on the guideway rails via four roller blocks (RB) mounted to the carriage. The carriage is transferred along the beam using a rack and pinion drive system. Güdel manufactures the guideway and drive systems in house. The high precision of the system allows for travels up to 31 meters with velocities up to 2.5 m/sec, accelerations up to 5 m/s². Travel is limited in both directions by standard rubber shock absorbers.
Carriage Control Kit
The carriage control kit includes the external axis motor, cables and air hose.

Energy Chain
The energy chain provides a consistent means to manage the cables as the robot travels along the beam. The energy chain can be mounted on either side of the beam assembly, providing further design flexibility.

Carriage Homing
Depending on the specific configuration, carriage homing is achieved by either aligning a plastic pin with the carriage, or a fixed block with one of the RB housings.

3.1.3 Support Legs
The MotoRail beam assemblies are supported by a system of free standing columns or support legs. The legs can be mounted on either side of the beam assembly at 100 mm increments, with an 8 m maximum leg span (center to center) and 1.5 m maximum end overhang. This provides optimum flexibility as required by the machine tending or welding application. Refer to your specific system prints for support leg locations.

3.2 Optional Equipment

3.2.1 Lateral Brace
An optional leg brace is available for improved stability. It has a “weld in place” adapter plate and can be used to provide additional lateral or transverse robot stability as the application requires. The lateral brace can be positioned against any column of the rail system to accommodate the application layout. Refer to your specific system prints for lateral brace locations.

Note: Mounting pads for lateral brace must be welded at installation.

3.2.2 Limit Switch Kit
An optional 3-position limit switch kit is available (P/N 147583-3). Refer to your Güdel manual for more information.

3.2.3 Auto Lube Kit
An optional auto lube kit is available for the robot carriage (P/N 147584-1). Refer to your Güdel manual for more information.
3.2.4 Remote Wire Feeder

An optional remote wire feeder is available that includes a remote assist feed motor designed to be located at the bulk wire container and push the wire through a lengthy conduit to the welding wire feeder. Conduit kits are also available. The conduit kits start at the assist feeder and terminate at the robot carriage. Refer to Appendix A for installation information.

Wire Feeder Kit (149858-1): This kit includes a constant torque, air-driven assist wire feeder, filter, lubricator, regulator (FRL), ON-OFF valve, support stand, and drum hood for a 20.4-in. diameter bulk wire drum. Standard drive rollers handle 0.045-in. wire. Wire feed “push” is controlled by regulating the air pressure. Wire feed speed is controlled by demand of the welding wire feeder. Maximum speed is 1200 IPM.

Conduit Kit (149862-1): This kit includes blue poly conduit, a male QD connector to the assist feeder, securing brackets for the MotoRail 7 carriage, and a female QD connector at the carriage. The conduit length provides a minimum 5 meters set back from the end of the cable tray for any MotoRail 7 using 20-meter manipulator cables. The (-2) conduit kit includes conduit lengths suitable for systems using 25-meter cables. The (-3) conduit kit includes conduit lengths suitable for systems using 30-meter cables.

Figure 4 Remote Wirefeeder
3.3 Robot

The Motoman manipulator represents the state-of-the-art in robotics technology today. These Motoman robots provide high speed, accurate path control, large work envelope, and reliability for your automation needs.

For additional information, please refer to the manipulator manual for your robot model (see Section 1.3).

3.4 Controller

The robotic controller coordinates the operation of the MotoRail 7 system. It controls manipulator and track movement and processes input and output signals. It maintains variable data and performs numeric processing to convert to and from different coordinate systems. In addition, the controller provides the following: main logic functions, servo control, program and constant data memory, and power distribution. For more information, refer to the controller or manipulator manual that came with your system.

![Figure 5 XRC 2001 Controller]
Figure 6 NX100 Controller
Chapter 4

Installation

Because MotoRail 7 is a modular system, it is not possible for us to give you specific installation instructions for your system. Use the following instructions as guidelines along with your specific system prints. For additional information, refer to the Güdel and other vendor manuals supplied with your system.

Note: It is recommended that you thoroughly read both the Güdel and Motoman manuals before proceeding with the installation.

Follow established safety procedures at all times throughout the installation process. Failure to use safe work practices can result in damage to the equipment and injury to the workers.

CAUTION!
Installation of the MotoRail 7 system is not a task for the novice. The MotoRail 7 system is not fragile, but it is a highly sophisticated robotic system. Handle components with care. Rough handling can damage system electronic components.

WARNING!
It is possible that the fasteners may loosen during shipment; therefore, verify that all fasteners are tightened to the proper torque specification as required after transportation.

DANGER!
At no time during installation or operation of the module, should any person or persons be in position underneath the suspended load.

WARNING!
Improper setup can cause mechanical components to be overloaded and/or wear at an accelerated rate.

DANGER!
Never remove hardstops with robot installed on carriage! Serious injury to personnel and damage to equipment can occur!
4.1 **Materials Required**

All system hardware necessary for installing the MotoRail 7 system is included with the system. This section identifies customer-supplied items and tools required to complete installation.

4.1.1 **Customer-Supplied Items**

- Suitable floor anchors rated at 4000-kgf working load
- Forklift and/or overhead crane

4.1.2 **List of Tools**

- Safety glasses
- Face shields
- Gloves
- Level
- Hammer drill with appropriate concrete bits
- Phillips and flat screwdrivers
- 0.025 mm (0.001 inch) feeler gauge
- Socket set
- Forklift and/or overhead crane
- Large torque wrench
- Welder
- Large hex sockets-M14, M17, M19, M24
- Wrench sets (standard and metric)
- Taps for 7-20: M20-2.5 & M16-2.0
- Taps for 7-50: M24-3 & M20-2.5

4.2 **Site Preparation**

The MotoRail system components must be firmly mounted on a foundation rigid enough to support the static and dynamic forces. Review drawing package for specifications. To prepare your site, proceed as follows:

1. Clear the floor space needed for your MotoRail system. Refer to your system layout drawings for needed dimensions.
2. Gather all customer-supplied items and required tools listed in Section 4.1.
4.3 Unpacking MotoRail

MotoRail system components are shipped individually on a flat-bed trailer. Depending on the total length of your system, MotoRail may ship with beam assembly fully assembled or the beam assembly may be shipped in separate sections. To unpack MotoRail, proceed as follows:

**WARNING!**
Be sure that the lifting device used to lift components is capable of handling these weights or damage to the equipment or injury to personnel can result.

<table>
<thead>
<tr>
<th>Approximate Component Masses, Kg</th>
<th>7-20</th>
<th>7-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam Assy, 2m section</td>
<td>310</td>
<td>450</td>
</tr>
<tr>
<td>Carriage Assy</td>
<td>175</td>
<td>320</td>
</tr>
<tr>
<td>Leg Assy</td>
<td>500</td>
<td>750</td>
</tr>
</tbody>
</table>

1. Lift each component from the trailer and place on floor.
2. Carefully remove protective plastic wrapping from system components.
3. Inspect system for shipping damage.

*Note: If damage is found, notify shipper immediately.*

4.4 Installation

Do not tighten (final torque) bolts when assembling MotoRail 7. All bolts will be torqued after the system is properly aligned and levelled. Pay careful attention to your system layout drawings for proper support leg and beam position and orientation.

4.4.1 Shorter Single Beam Systems

Shorter, single beam systems are typically set up and tested prior to shipment. If this is the case, the cables are already installed in the e-chain and secured to the beam assembly with the appropriate carriage.

**WARNING!**
Be sure that the lifting device used is capable of handling MotoRail weight or damage to the equipment or injury to personnel can result.

1. Locate the first support leg and loosely lag it to the floor. Do not torque lag bolts at this time.
2. Refer to your layout drawings to locate support leg mounting holes on top of beam. Using appropriate tap, remove any paint or other debris from mounting hole threads.
3. Lift the beam assembly into position and attach to first support leg using 8 mounting bolts. Do not torque bolts at this time.
4. Move second leg into position and attach to beam using 8 mounting bolts. Again, do not torque bolts.
**Figure 7** Beam Assembly (MotoRail 7-20 shown)

**Table 6** Fastener Torques (size/torque (N·m))

<table>
<thead>
<tr>
<th>Type</th>
<th>Beam-Leg</th>
<th>Butt Joint</th>
<th>Rack</th>
<th>Guide</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-20</td>
<td>M20/420</td>
<td>M24/1020</td>
<td>M8/26</td>
<td>M10/51</td>
<td>M12/76</td>
</tr>
<tr>
<td>7-50</td>
<td>M24/725</td>
<td>M24/1020</td>
<td>N/A</td>
<td>M10/51</td>
<td>M12/76</td>
</tr>
</tbody>
</table>
4.4.2 Multiple Beam Systems

1. Working from your system layout drawings, mark each beam with the beam number, carriage side, and support leg locations to provide a quick reference when assembling. When practical, we recommended installing the cables, energy chain, and cable tray while the beam is on the ground.

Figure 8 Beam Assembly

WARNING!
Be sure that the lifting device used is capable of handling the weight or damage to the equipment or injury to personnel can result.

2. Working from your system prints, assemble beams for each carriage assembly. Refer to Section 4.4.3, "Cables (Initial)", and Section 4.4.5, "Butt Joint Assembly".

3. Locate the first support leg and loosely lag it to the floor. Do not torque lag bolts at this time.

4. Refer to your layout drawings to locate support leg mounting holes on top of beam. Using appropriate tap, remove any paint or other debris from mounting hole threads.

5. Lift the first beam assembly into position and attach to first support leg using 8 mounting bolts. Do not torque bolts at this time.

6. Move the next leg into position and attach to beam using 8 mounting bolts. Again, do not torque bolts.

7. Paying careful attention to your system layout drawings for proper position and orientation, move next support leg into position and attach to beam using 8 mounting bolts. Do not torque bolts at this time.
8. Paying careful attention to your system layout drawings, continue assembly until entire track has been assembled.

### 4.4.3 Cables (Initial)

The MotoRail system may have been set up and tested prior to shipment to your site. If this is the case, the cables are already installed in the e-chain and secured to the beam assembly with the appropriate carriage.

If MotoRail has not been set up and tested prior to the shipment to your site, the system cables arrive packed in a box. System cables must be installed in the e-chain and secured to the beam assembly as follows:

1. Unpack cables and hose. Uncoil and lay out on the floor for 24 hours (to eliminate cast).
2. Match each cable set with the appropriate carriage assembly.
3. Disconnect the e-chain from the carriage brace and lay out in cable tray.
4. Disconnect all upper e-chain cross links.

5. Lay cables and air hose (swivel end to robot) in the e-chain leaving approximately 3 meters of cable beyond the robot end of the e-chain.

*Note: XRC cable sets - place connectors at robot end. NX100 cable sets - place female connectors at robot end.*

6. Using separators as appropriate, space cables and hoses evenly across the width of the e-chain. For additional information on motorail cable installation see Section 4.4.4.

7. Replace the upper e-chain cross links.

8. Reconnect the e-chain to the carriage bracket and temporarily secure the loose cables and hose to the carriage.

9. If the system layout calls for the cables to drop down the end leg opposite the e-chain, lay the remainder of the cables and hose in the cable tray.

**OR**

10. Feed the controller ends of the cables out the bottom of the cable tray near where the cables exit the e-chain (if required, remove the bottom panel of the tray).

11. Feed the cables up between the tray and the beam structure and remove all slack.

12. Temporarily secure the remainder of the cables to the top of the beam.
### 4.4.4 Motorail Cable Installation Guide Lines

1. Cable must be laid out straight, without twisting. Cables must not be uncoiled from top of spool. Cables must be laid out for 24 hours before installation.

   ![Correct!](image1) ![Wrong!](image2)

   **Figure 11** Cable Uncoiling

2. The cables must be laid so that each individual cable can move freely from side to side.

3. The cables must be able to move freely along the radius. This must be double checked if the upper run operates at the cable’s maximum bending radius.

   ![Correct!](image3) ![Wrong!](image4)

   **Figure 12** Cable Placement at Radius

   **Note:** It is important to prevent cables and hoses from tangling.

4. The division of the carrier’s interior using interior separators is necessary if several cables and/or hoses with varying diameters are laid out.

5. Cables and hoses with very different diameters should be laid separately. The separation is achieved by the use of modular separators.

6. Cables and hoses **must not** tangle. The clearance height of a compartment with the same size or similar size cables or hoses next to one another must not amount to more than one and a half times the cable/hose diameter.

7. For cables and hoses with different jacket materials, it is important to prevent them from “sticking” to one another. If necessary they should be separated.
8. Round electrical cables must be secured with strain relief at both ends.

![Detachable tie-wrap plate for the profile rail](image)

![Simple strain relief with cable tie-wrap attached to turner tie-wrap plate and integrated into the mounting bracket](image)

Ideal installation of cables in Energy Chains®. Chanflex® cables can be directly strain-relieved in the mounting bracket (minimum gap to the last curved chain link is not necessary).

**Figure 13 Strain Reliefs for Cable Entry and Exit**

9. The cable or hose weight should be symmetrically distributed along the width of the cable track.

**Correctly** Laid Cables with interior separation

![Correctly Laid Cables](image)

**Improperly** Laid Cables and Hose placement in Cable Track called **Corkscrewing**.

![Improperly Laid Cables](image)
### 4.4.5 Butt Joint Assembly

When design dictates joining two beams together a butt-joint type end connection is used. This design includes plates welded onto the end of each of the beams to be joined. Assembly of these pieces requires a key, bolts and careful positioning.

**Note:** Refer to the Güdel manual for additional information.

**Note:** Ideally, the butt joint is assembled on the ground with the beam upside down. However, the following steps are valid regardless of beam orientation or location (suspended).

1. Each butt joint has been mated, matched and pre-assembled at the factory. Verify butt joint is properly matched.
2. Clean all mating surfaces with an oilstone, wiping dry with a clean cloth. Also clean surfaces that mate with the butt joint key and the exposed mounting surface of the removed guideway.
3. Verify butt joint key is installed in one of the beam keyways.

**Note:** Shim packs are matched and supplied for each joint. Be sure to use the appropriate shim pack for each butt joint.

4. Loosely assemble the butt joint with the shims in place using the M24 bolts provided.

**Note:** Lock washers should be on the nut side.

![Figure 14 Butt Joint Assembly](image)

5. Adjust the beams so that the shoulders for mounting the guideways on the two rails are co-planar within 0.02 mm.
6. Using a torque wrench, tighten the M24 bolts to 83 Nm. There should be no gap between the two beams or the two guideways. Verify this with a 0.02 mm or smaller feeler gauge.

![Figure 15 Rack and Guideway Rail](image)

7. Clean any foreign debris from the shoulder milled into beam

8. Loosely install guideway rails onto beam using hardware provided.

![Figure 16 Guideway Installation](image)

Perform the following step on one beam section first, starting at the guideway rail end.

9. Starting at one end of the guideway, use two large C-clamps positioned approximately six inches apart to pull the guideway rails tight against shoulder.

**Note:** For 7-50 guideways with integrated racks or external racks, clamp the companion part over the joint between each segment to ensure proper rack tooth pitch is maintained.
10. Use a 0.025 mm feeler gauge to verify that there is no gap between the guideways and the mounting shoulders on the beam.

11. Using a torque wrench, tighten the guideway screws between the clamps to 51 Nm.

12. Re-positioning one C-clamp at a time, work your way towards the other guideway end torquing each guideway screw to 51 Nm. Remove clamps and assembly pieces only after all fasteners are securely fastened.

Figure 17  Rack Installation

The following steps refer to the 7-20 system with separate rack:

13. Using companion part to verify correct pitch and distance between teeth, loosely install guideway rack using hardware provided.

Note: Refer to the Güdel manual shipped with your system, for additional information.

14. Using two large C-clamps, one on either side of the companion part, pull the guideway rack tight against the rail.

15. Verify parallelism and pitch tolerance using a feeler gauge (0.001 thousands of an inch).

16. Re-positioning one C-clamp at a time, work your way towards the other end of the rack, torquing each rack bolt to 26 Nm. Remove clamps and assembly pieces only after all fasteners are securely fastened.

17. Install any necessary cable trays and brackets over butt joint. Refer to system drawings.

18. Final tighten the M24 bolts to 1020 Nm.
4.5 Leveling and Securing MotoRail

After everything is in position, level the equipment using a laser or transit level. Tighten all fasteners to the proper torque. The customer must provide suitable anchoring hardware. Each leg column requires four to 6 anchors rated at 4000-kgf working load. A 22-mm hole is provided through the leveling bolt for anchoring purposes. Install anchors per manufactures’ recommendations. Torque all lag bolts to the manufacturers rated torque.

4.6 Installing Optional Lateral Brace

Position the lateral brace in the desired location.

1. Refer to the system prints to determine location of lateral braces.
2. Bolt the mounting pad to the lateral brace.
3. Place the brace in the desired position, including the leveling bolts/pads, and clamp the mounting pad to the column.
4. Weld the mounting pad to the leg column. Use certified welder.
5. When the weld has cooled, clean and paint welded area as required.
6. Final torque leg bolts to 255 N•m (188 ft-lb).
7. Adjust all leveling bolts hand tighten against the leveling pad.
8. Tighten all leveling bolts an additional 1/4 to 1/2 turn, ensuring all share the load.
9. Install four anchors per manufacturers’ recommendations.
### 4.7 Installing the Robot

**WARNING!**

The 7-20 robots weigh approximately 280 kg. The 7-50 robots weigh approximately 550 kg. Be sure the lifting device used to lift the robot is capable of handling this much weight or damage to equipment, or injury to personnel can result.

1. Using the appropriate tap, clean any paint or debris from mounting holes.
2. Lift the robot and invert it. Orient the robot on the track mounting plate per the system drawings. Contact Motoman if assistance is required to invert the robot.
3. Refer to your robot manual for torque values and instructions for inverting the robot.

**DANGER!**

Never remove hardstops with robot installed on carriage! Serious injury to personnel and damage to equipment can occur!
4.8 Installing the Carriage Servo Motor

The carriage servo motor is typically installed at the factory. However, if installation is required due to maintenance or other cause, refer to the Gudel-Motoman vendor manual in Appendix A.

4.9 Cables (Final Installation)

The following describes the typical 7-20 standard system. Due to leg design variations, some details may be different. Refer to your application layout drawings for additional information.

*Note:* Verify the fixed end of the cable e-chain is terminated in the correct position.

1. Carefully engaging connectors, connect the robot cables on back of robot.
2. Pull any cable slack back thru the e-chain and secure to carriage as required.
3. Secure the cables and hose to the cable brace using wire ties and ensure the cables do not drag on the cable tray.

*Note:* Do not secure the cables and hoses at the cable tray (stationary) end of the e-chain. Securing the cables and hoses at both ends of the e-chain will cause pre-mature cable failure.

![Figure 20 Connecting Robot to Controller](FROM_CONTROLLER.png)

4. Neatly route cables along the beam top to support leg nearest controller.
5. Install felt pad inside support leg opening to protect cables.
6. Route cables and air hose down through the support leg and to the controller.

![Figure 21 Cable Layout](image)

7. Route cables into side of controller. Refer to manipulator manual for controller connections.

4.10 Connecting the Power

After all of the system components have been properly installed, connect the power to MotoRail. To connect incoming power to MotoRail, proceed as follows:

**DANGER!**

*Power should be connected only by a qualified electrician. Electrical and grounding connections must comply with applicable portions of the national electrical code and/or local electrical codes.*

1. Install 3-phase power wiring to the circuit breaker located inside the left wall of the controller cabinet (see Figure 22). Table 7 shows the size and type of wire needed.

2. Tighten screws to the torque indicated in Table 7.
3. Install an M5 lug on the incoming ground wire.

4. Terminate the ground wire to the frame ground stud with hardware provided.

Note: The MotoRail is configured for 3-phase 460/480V AC, unless other voltage was requested. If other voltage is required for your plant, you must make the necessary modifications to the transformer. For more information, refer to the manipulator manual that came with your system.
4.11 Robot Setup

The MotoRail 7 system is delivered with the basic robot and controller parameters pre-installed. Verify/Set the carriage home (see Section 6.3) and softlimits (refer to the Operator’s manual for your application). If you have any need for assistance, please contact the Motoman service staff at (937) 847-3200.

4.12 Conducting a Safety/Operation Check

Before operating the MotoRail system, take a few minutes to perform a safety/operation check. To perform a safety/operation check, proceed as follows:

1. Check that all cable connections are tight.
2. Check that all component hardware is tight.
3. Check cable tray. Verify there is no interference between cables and support legs.
4. Verify that at the farthest travel extent, there are 21 links in the e-chain service loop. A link is the bar that goes across the energy chain.

<table>
<thead>
<tr>
<th>Table 7</th>
<th>Incoming Power Specifications (Decal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lug Data</td>
<td>60/75° C wire</td>
</tr>
<tr>
<td>Catalog No.</td>
<td>TCAL14</td>
</tr>
<tr>
<td>Wire Size</td>
<td>Refer to system drawings</td>
</tr>
<tr>
<td>Torque</td>
<td>#14-7, 4.0 N•m (35 in.-lb)</td>
</tr>
</tbody>
</table>
Chapter 5
Operation

5.1 Programming

The operation of this system is programming dependent. The following operating instructions are based on one possible configuration of this system. Your system configuration and job structure may differ slightly from that presented here; however, basic operation will be the same. For additional programming instructions, refer to the controller and operator manuals that came with your system.

Any changes made to your system configuration and/or job structure will alter the operation of this cell. Motoman recommends you do not modify the original jobs and system configuration that came with your system. If modifications need to be made, they should be made to copies of these jobs and not to the originals. Modifications should only be performed by personnel who have received operator training from Motoman, and who are familiar with the operation of this Motoman system. If you have questions concerning the configuration of your system please contact the 24 hour Service Hotline, at (937) 847-3200 (see Section 1.4).

5.2 Daily Operation

The procedures below represent the typical operating sequence from power up to shutdown. Yours basic operating procedures will vary.

5.2.1 Start-Up

To start up the MotoRail 7 system from a Power-Off condition, proceed as follows:

1. Set MAIN POWER switch on controller to ON.
2. Make sure robot is in Home position or other dedicated starting position.
3. Select Master job.
4. Put controller in PLAY mode.
5. Select AUTO/CYCLE mode of operation
6. Turn ON servo power.
7. Press the start button to start playback of job.
5.2.2 Shutdown

Use the following procedure to shut down the cell after operation is complete:

1. Make sure the robot is in the Home position or other dedicated starting position.
2. Turn OFF system servo power.
3. Press TEACH mode button on playback panel.
4. Set Main Power switch on auxiliary equipment to OFF position.
5. Set controller Main Power switch to OFF position.

The MotoRail 7 system is now shut down.

5.3 System Recovery

Under certain conditions you will be required to clear an alarm or error. Clearing an alarm or error requires different operator actions depending on the type. The paragraphs below describe the different types of alarms and errors you may encounter and how to remedy them when you do.

5.3.1 Alarms and Errors

Alarms and errors will cause the program to stop. There are three levels of alarms and errors: Error Messages, Minor Alarms, and Major Alarms. For more detailed information about alarm recovery, refer to manipulator manual that came with your system.

Error Messages
These are simple errors such as pressing the START button when the robot is not in PLAY mode, or enabling the programming pendant without the servo power being live. Errors like these are cleared by pressing the CANCEL button on the programming pendant.

Minor Alarms
Minor alarms are usually programming errors. Minor alarms might occur if a circle has been programmed with fewer than three circular points, etc. These alarms are cleared by pressing the RESET (F5) soft key on the programming pendant.

Major Alarms
Major alarms are hardware failures. Major alarms might occur because of a servo tracking error or an abnormal speed and are usually associated with crashes. To clear these alarms, you must turn off the controller and then turn it on again.
5.3.2 E-Stop Recovery

An E-Stop can occur under any of the following conditions:

- Pressing the E-Stop button on the operator station, programming pendant, or playback panel.
- Entering the cell area when the robot is not in Teach mode.

**Restart**

To restart the MotoRail 7 system after an E-Stop condition occurs, follow the procedure below.

1. Release the E-Stop button on the programming pendant, or controller.
2. Clear personnel from cell area.
3. Make sure controller is in PLAY mode.
4. Press SERVO ON button.
5. Press START.

The MotoRail 7 system is now ready to continue operation.

5.3.3 Using the Brake Release

The brake release control panel is located on front of the controller. Each axis brake is controlled by an individual axis buttons. Simultaneously pressing the ENABLE button and one of these axis buttons releases the indicated axis. To release the brakes, proceed as follows:

1. Press E-Stop button on programming pendant, playback panel, or operator station, to be sure servo power is OFF.
2. Provide adequate support for axis to be released. Support should withstand payload of robot and approximate weight of robot.

**WARNING!**

Releasing brakes could cause personal injury or machine damage. Always support the axis to be released BEFORE you release it.

3. Release specific axis brake by pressing and holding corresponding axis button and ENABLE button at same time.

*Note: You must hold both the axis and ENABLE buttons down for the axis to remain released. Releasing either button will automatically lock the brakes again.*
NOTES
Chapter 6

Maintenance

Maintenance of MotoRail components should be performed only by authorized personnel who are familiar with the design and construction of this product. The following procedures should be performed only as needed. Read through the instructions completely before performing any maintenance procedure. Be sure that you understand the procedure, have the proper tools, and observe all applicable safety precautions.

6.1 Parts Ordering

To order replacement parts, contact the Motoman service staff at:

Motoman Customer Service
805 Liberty Lane
West Carrollton, Ohio 45449
Telephone: 937.847.3200
Fax: 937.847.3211

Please provide the following information:

- System Type (MotoRail)
- Application Type (material handling, arc welding, etc.)
- Part Name
- Motoman Part Number
- Quantity of Parts

6.2 Maintenance/Troubleshooting

For maintenance and troubleshooting procedures, please refer to the manipulator manual for your robot model and the Güdel vendor manual provided with this system.
6.3 Resetting the Robot Carrier to Home Position

Resetting of the Home position is typically done before a gripper is installed, or after the motor has been serviced. Depending on the specific configuration of your system, Homing the robot carrier can be performed in one of three ways. Your system layout should identify the homing locations for your system.

6.3.1 Method 1 (Hard Stop)

This method uses a plastic pin inserted into the hard stop to determine the Home location. To reset home position, proceed as follows:

1. Locate the homing hole in the hard stop.
2. Install the homing pin into the homing pin hole (see Figure 6-1) located in the hard stop. The pin may need to be gently tapped in with a hammer.

3. Place the robot in TEACH MODE and jog the robot carrier slowly until it is just touching the homing pin. If you go too far, the pin will bend, causing an inaccuracy. Slowly jog the carrier in reverse until the pin is straight but is still touching the carrier.
4. Place the programming pendant in MAINTENANCE MODE.
5. Press TOP MENU key on programming pendant.
6. Cursor to ROBOT and press SELECT.
7. Cursor to HOME POSITION and press SELECT.
8. Press the PAGE OVER key to the desired station (indicated in the top right corner).
9. Make sure the robot carrier is in the position that you want to teach as home and press SELECT.
10. Cursor to YES and press SELECT. The carrier is now reset to zero.
11. Remove the alignment pin from the hard stop.

6.3.2 Method 2 (Beam)

This method uses a plastic pin inserted into the beam structure to determine the Home location. To reset home position, proceed as follows:

1. Locate the homing hole in the beam structure.
2. Install the homing pin into the homing pin hole located in the beam structure. The pin may need to be gently tapped in with a hammer.
3. Place the robot in TEACH MODE and jog the robot carrier slowly until it is just touching the homing pin. If you go too far, the pin will bend, causing an inaccuracy. Slowly jog the carrier in reverse until the pin is straight but is still touching the carrier.
4. Place the programming pendant in MAINTENANCE MODE.
5. Press TOP MENU key on programming pendant.
6. Cursor to ROBOT and press SELECT.
7. Cursor to HOME POSITION and press SELECT.
8. Press the PAGE OVER key to the desired station (indicated in the top right corner).
9. Make sure the robot carrier is in the position that you want to teach as home and press SELECT.
10. Cursor to YES and press SELECT. The carrier is now reset to zero.
11. Remove the alignment pin from beam structure.

6.3.3 Method 3 (Guide Block)

This method uses a homing block mounted directly to one of the guideway rails. The homing block is generally mounted at the factory and uses the same hole pattern as the guideway rails. Should the homing block need to be moved, simply unbolt it and move to the desired location. Insure the guideway rail bolts are properly tightened to the specified torque.

Home position is defined when the leading surface of the bearing block opposite the motor/gear assembly is aligned with the leading surface of the homing block. This can be verified using a straight edge or steel rule across both surfaces. To reset home position, proceed as follows:
1. Locate the homing block on the guideway rail.
2. Place the robot in TEACH MODE and jog the carrier slowly until the leading edge of the bearing block opposite the motor is aligned with the homing block. If you go too far, simply jog the carrier in reverse until the bearing block and homing block are aligned.

![Figure 24 Home Position](image)

3. Place a straight edge or steel rule across both surfaces to verify alignment.
4. Place the programming pendant in MAINTENANCE MODE.
5. Press TOP MENU key on programming pendant.
6. Cursor to ROBOT and press SELECT.
7. Cursor to HOME POSITION and press SELECT.
8. Press the PAGE OVER key to the desired station (indicated in the top right corner).
9. Make sure the carrier is in the position that you want to teach as home and press SELECT.
10. Cursor to YES and press SELECT. The carrier is now reset to zero.
11. Remove the alignment pin from beam structure.

### 6.4 Maintenance of Carriage Bearing System, Rack, and Gear Box

Refer to the Gudel/Motoman documentation included in Appendix B for all maintenance schedules and adjustment procedures.
6.5 Carriage Removal

**WARNING!**
The 7-20 robots weigh approximately 280 kg. The 7-50 robots weigh approximately 550 kg. Be sure the lifting device used to lift the robot is capable of handling this much weight or damage to equipment, or injury to personnel can result.

1. Using a fork truck or crane to secure the robot, carefully remove the robot from the carriage. Contact Motoman if assistance is required to remove the robot.

2. Carefully invert the robot and place in a safe location for storage. Refer to your robot manual for instructions for inverting the robot.

3. Disconnect cables from carriage servo motor.

**WARNING!**
The carriage servo motor weighs approximately 30 kg. Be sure to secure the motor before unbolting to avoid dropping. Damage to equipment, or injury to personnel can result.

4. With the motor securely supported, remove the 4 M12 bolts securing the motor to the carriage, and carefully remove.

**DANGER!**
Never remove hardstops with robot installed on carriage! Serious injury to personnel and damage to equipment can occur!

5. With the robot and carriage motor removed, it is safe to remove the hardstops. Refer to Gudel/Motoman instructions found in Appendix B for detailed instructions.

6. Refer to Gudel/Motoman instructions in Appendix B to remove the carriage. Be sure to relieve the roller preload before removing the carriage.
Notes
Appendix A

Options Installation

A.1 Remote Assist Wire Feeder Kit

The optional remote Wire Feeder Kit (149858-1) includes a remote assist feed motor designed to be located at the bulk wire container and push the wire through a lengthy conduit to the welding wire feeder. A Conduit Kit (149862-1) is also available. The conduit kit start at the assist feeder and terminate at the robot carriage. Refer to your system drawings for additional information. To install the remote wirefeeder kit, proceed as follows:

1. Lag stand in desired location.
2. Position bulk wire drum and install hood.
3. Mount Assist Feeder and adjust stand so inlet of feeder sets on hood.
4. Connect air and adjust per Assist Feeder instructions.
5. Place a 180° tight bend in the wire end before feeding into the conduit. The smooth, rounded end will feed better than the sharp cut end.
A.2 Conduit Kit

1. Feed blue poly conduit into cable tray and insert into the e-chain at the fixed anchor point.
2. Continue to feed conduit through e-chain as required to secure conduit clamp.
3. Install female QD fitting as follows:
4. Remove spring nut and slide onto conduit.
5. Install split ferrule.
6. Push female QD fitting onto conduit until it bottoms out.
7. Tighten spring nut on female QD fitting.
8. Clamp conduit just above spring and position as required on support bracket.
9. Use wire ties to secure conduit at e-chain moving anchor.
10. Use wire ties to secure conduit in cable tray as required. Do not secure within 3 ft of e-chain fixed anchor.
11. Trim length as required by bulk wire placement.
12. Install male QD fitting same as female QD fitting.
Installation and Maintenance Manual

Güdel Module Type: MotoRail 7-20 & 7-50
Güdel Project: 04-1305 & 04-2177

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2/14/2008 Rev2
Güdel, Inc.

Güdel was established in Switzerland, in 1954. With several decades of experience and offices worldwide Güdel has built an outstanding reputation as a reliable supplier of linear guideway systems for applications requiring high precision and/or handling extremely high payloads.

Güdel’s worldwide business operations include the development, manufacture, and marketing of high quality linear guideway, power transmission, and automation products. Güdel is dedicated to providing quality products and utmost customer satisfaction. We make every effort to exceed customer expectations with Güdel quality and professionalism.

General Description

MotoRail 7-20 & 7-50 Robot Transporters

General descriptions of the sub-assemblies that make up this module are given below. The respective subassembly drawings can be found in the back of this manual.

Beam Assembly:
The beam assembly is constructed from a steel plate weldment which is precision machined for the mounting of flat bar guideway rails and integrated flat bar guideway racks. This beam also includes a standard mounting pattern opposite the guideway surface for attaching cable tray brackets and a support structure.

Carriage:
The carriage assembly rides along the beam assembly on the guideway rails via four roller blocks (RB) mounted to the carriage. It is available in left and right hand configurations with different gear ratios as required for the application. The load is transferred along the beam assembly using a rack and pinion drive system. Güdel manufactures the guideway and drive systems in house. The high precision of the system provides velocities up to 2.5 m/s, accelerations up to 5 m/s² and repeatability of ±0.15 mm. The carriage plate is machined for the mounting of the appropriate Motoman robot. The travel is limited in both directions by standard rubber shock absorbers.

Legs:
The legs are constructed of a weldment of steel tubing and steel plates. All feet are furnished with leveling screws for vertical leveling capability.

Gusset:
The gussets are constructed of a weldment of steel tubing and steel plates. The gussets mount to the side of the leg via a mounting pad which is to be welded at assembly in the necessary location. All feet are furnished with leveling screws for vertical leveling capability.
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### Sub Assembly Drawing Numbers:

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</table>

### Supplier Documentation:

- Memolub® Lubrication System
- Vogel Progressive Feeders
I Service & Support

Güdel, Inc. recommends that all equipment supplied by Güdel be carefully and regularly inspected and maintained according to all Güdel and/or customer specifications. (See maintenance section near the end of this manual.)

Güdel is dedicated to superior performance and customer satisfaction in all of our products. To ensure this we offer comprehensive service and support including maintenance arrangements (contact Güdel for details).

In the case of any equipment failure, certified personnel must perform all necessary repairs, immediately after detection of the damages. Any service by unqualified personnel during the warranty period is a violation of the warranty and will void any benefits.

To ensure expedient and correct repair, Güdel maintains a staff of trained technicians certified to perform any repairs to the module. Güdel also maintains a staff of qualified service engineers that can provide technical support at any time.

Please contact our service and support department for technical assistance or to schedule any maintenance or repairs necessary at:

Güdel, Inc.
4881 Runway Blvd.
Ann Arbor, MI 48108
Telephone No.: (734) 214-0000
Facsimile No.: (734) 214-9000
E-Mail Address: service@gudel.com
2 Safety Regulations

All person(s) who perform maintenance or work with the module must be certified and must observe all applicable accident prevention regulations. If modifications of any kind are made to the module or any person(s) who are not certified operate or perform maintenance on the module, Güdel, Inc. refuses to accept any liability for damages to the module and/or consequential damages to any person or equipment.

The following is a list of recommended minimum safety procedures to be addressed and is not intended to be a complete list of safety procedures. All person(s) who operate or maintain the equipment must abide by the Health and Safety regulations applicable to any federal, state or local, regulations where the equipment is installed.

2.1 Cautions & Warnings

- **Access to all emergency switches and escape routes must be clear of obstructions at all times.**
- **Signs must be clearly posted that mark all potential safety hazards.**
- **Only trained and certified technical personnel should work on or with any electrical or welding equipment.**
- **Instructions for the behavior of the operating and servicing personnel on the occurrence of extraordinary events, as well as supplemental safety regulations, must be worked out by the caretaker of the machine and must also be accessible and known to all personnel responsible for operating or performing maintenance on the machine.**
3 Warranty Conditions, Liability For Deficiencies

The warranty conditions of Güdel, Inc. are defined precisely in our “Standard Terms of Sale”, or can be ordered from Güdel directly, free of charge.

The warranty shall apply only if deficiencies in or damages to the supplied module occur due to improper installation and/or manufacture on behalf of Güdel, Inc., despite customer’s observation of all points covered in the technical documentation and any other instructions provided by Güdel, Inc.

In the event of deficiencies covered by warranty, a claim must be filed with Güdel, Inc. immediately upon discovery of deficiency. This claim must include Güdel project number, as well as the exact description and part number of the assembly or part in question. In the event of deficiencies or damages being rectified by the customer or by third parties without prior consent of Güdel, Inc., Güdel, Inc. denies responsibility and will not honor such claims. Warranty is limited to replacement parts only and does not include labor or expenses.

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4 Installation & Leveling

The installation of the MotoRail must be completed by certified technicians (trained mechanical, assemblers) and carried out following the guidelines below.

4.1 Cautions & Warnings

△ Do NOT leave the module unattended at any point during this installation procedure.
△ Do not remove shims and joint bolts until instructed.
△ It is possible that the fasteners may loosen during shipment; therefore, verify that all fasteners are tightened to the proper torque specification as required after transportation.
△ At no time during installation or operation, should any person or persons be in position underneath the suspended load.
△ To move the carriage if the gearbox ratio is larger than 10:1, it is necessary to manually turn the gearbox input.
△ Improper setup can cause the mechanical components used in the module to be overloaded and/or wear at an accelerated rate.
△ Do not remove carriages from beams.
△ If the carriage binds or moves erratically at any step, verify that all previous steps were completed properly. If the carriage still has problems, it may be necessary to adjust the guideway rollers according to Section 7 “Adjustment of the Guideway Rollers”. Do NOT force the carriage through any binding condition.
△ Verify that all components (including motor, robot, wiring and any other equipment that are to be mounted on the carriage) do not exceed the maximum payload according to Sect. 10 “Standard Configurations”.
△ Do not remove shipping hardware used to secure carriage(s) until directed. All previous installation steps must be complete and verified first for safety reasons.
△ If this machine will be disassembled and shipped to a different location for final installation, all carriages must be secured from unintentional motion along the beam prior to shipment.

4.2 Installation & Levelling Procedure

1. Assemble the leveling screws on the base plates of legs. Set the legs in the desired location on the leveling plates.
2. Align the vertical legs in all directions by adjusting the leveling screws.
3. Confirm that the positions of the beam-mounting surface or surfaces on the legs are within tolerances (± 2mm / 0.08”).
4. Loosely anchor the legs to the floor. If anchors have already been installed and tightened, loosen the anchor screws, and ensure that the connection is “hand” tightened (excessive torque on the anchors will make some of the following adjustments more difficult).
5. Assemble the beam assembly(s) to the mounting surface of the legs using the beam with the carriage first (for modules with multiple beam segments refer to Section 5 “Beam Butt-Joint Assembly.”)
6. Verify that the guideways on all beam assemblies are level and/or parallel to the application as appropriate. Adjust leveling screws as necessary.

7. Adjust the guideways on both sides of the beam to be co-planer and parallel (within ±0.5mm or better depending on application requirements) by using the leveling and anchor screws.

8. Tighten the leveling screw nuts and anchor screws to the proper torque specification according to Table 1 (Appendix 1.0) while maintaining the desired alignment.

9. Attach the gusset supports to the legs. (If applicable)

10. Adjust the cable loop location for each carriage as necessary.

11. Verify that the carriage is not under load of any kind (including gravity) that would cause the carriage to move unexpectedly, or the carriage is securely supported by external equipment against such motion. If for any reason there are any influencing forces or factors that make this unsafe or make it impossible to secure the carriage, then proceed directly to step 15.

12. Temporarily remove the shipping hardware that is securing the carriage (steps 12-14 should be performed one carriage at a time in multiple carriage installations). Do NOT leave the module unattended during this procedure.

13. Verify that the carriage is free to travel the entire length of the beam assembly (it may be necessary to manually turn the gearbox input to facilitate motion). If the carriage is not able to travel the entire length of the beam assembly, verify that steps 1 through 10 were properly completed.

14. Re-secure the carriage to the beam with the previously removed shipping hardware, or equivalent equipment. Do NOT proceed passed this step without securing the carriage position.

15. Verify that all leveling screw nuts and anchor screw are tightened to the proper torque specification.

16. Install the motor (supplied by customer) according to Section 6 “Motor Installation”.

17. Install the robot and/or any other equipment (supplied by customer) that is to be mounted on the carriage and/or robot and securely fasten with the proper fasteners for the application. Contact Motoman directly for assistance.

18. Install all necessary wiring (supplied by customer) to any devices that are required for the application.

19. When the installation is complete (see note below) and the module is ready to be put into service remove all external hardware used to secure the carriage(s).

20. Begin controls programming being certain to slowly and carefully move (jog) the carriage to verify that it is free to travel the entire length of the beam assembly.

21. Continue with controls programming, setup and verify that the controls do not cause any of the following conditions:
   a. Interference that cause a shock or induce additional forces to the module.
   b. Accelerations in excess of those specified in Section 10.1 “Overall Specifications.”
   c. Motor velocities limited to 3000RPM, unless specified by Güdel Inc.

---

1 Please refer to the local regional safety organization standards (OSHA) for requirements of a complete installation.
22. Final verification:

a. Inspect the guideway rails on the beam assembly to verify that they are level. If necessary repeat this procedure starting at step 4.

b. Verify that the carriage is secure perpendicular to the axis of motion. If necessary inspect and/or adjust rollers according to Section 7 “Adjustment of the Guideway Rollers”.

c. Verify that the carriage is free to travel the entire length of the beam assembly.

d. Verify that all fasteners are properly tightened to the recommended torque specification according to Table 1 (Appendix 1.0) of this manual.
5 Beam Butt-Joint Assembly

When design dictates joining two or more beams together it is typical that we use a butt-joint type end connection. This design includes plates welded onto the end of each of the beams to be joined. Assembly of these pieces requires a key, bolts, shims and careful positioning. The following steps are required for proper assembly.

5.1 Cautions & Warnings

Note: butt joint assembly requires the mounting surfaces to be coplanar within 0.02mm / 100mm (0.0008” / 4”) or the support structure must include a leveling device capable of achieving this tolerance.

5.2 Beam Butt-Joint Assembly Procedure

1. ID match all of the beam joints and layout the beam sections in order.
2. Remove factory installed joint bolts and shims. Take care to keep these components with the joint from which they were removed. Do NOT remove the key from the beam.
3. Set the first beam in place on the legs. This should be a beam with a robot carriage. See Section 4.2 “Installation & Leveling Procedure” steps 4 thru 8.
4. Rough position the next beam on the legs. If there are no keys or keys in both beams, repeat step 1. Align guideway surfaces within ±2mm in all directions. If there is still a problem with alignment, contact Güdel; do NOT remove any of the preassembled keys.
5. Align the keyway of the one beam with the preassembled key on the other beam.
6. Assemble joint bolts and shims, previously removed in step 2, loosely so there is a gap showing.
7. Loosely assemble the guideways to both beams. Do not install independent rack (7-20) yet.
8. Adjust the guideway bolts to full engagement (no torque). The guideway surface and/or the rack teeth (7-50) should be coplanar within 0.02mm (0.0008”). Use the guideway as a reference for all measurements. Make adjustments to leveling hardware as necessary.
9. Clamp the two guideways together at each end of the guideway and at the beam joint.
10. Using the joint bolts, pull the two beams together until the gaps at each end of both guideways are less than 0.02mm (0.0008”). Verify this with a feeler gage.
11. Tighten guideway bolts to the proper torque according to Table 1 (Appendix 1.0).
12. Tighten joint bolts to the proper torque according to Table 1 (Appendix 1.0).
13. Verify that the guideways are still coplanar within 0.02mm (0.0008”).
14. Install the independent rack section, if necessary (7-20), otherwise (7-50) proceed to step 15.
   a. Loosely assemble rack section to beam with all fasteners.
   b. Clamp the rack to the adjacent guideway at each end of the guideway and at the beam joint.
      Use a mating rack piece at one end to ensure tooth pitch alignment.
   c. Tighten guideway bolts to the proper torque according to Table 1 (Appendix 1.0).
15. Repeat at next joint location, or return to Section 4.2 “Installation & Leveling Procedure”
6 Motor Installation

All Güdel modules include custom-machined motor flanges and motor couplings to support customer specified motors. The dimensions required for proper fit are determined as part of the approval process at the time of design. This allows for simple installation of the motors to the gantry.

6.1 Cautions & Warnings

⚠️ The pilot of the motor should be a very close fit with the gearbox. Do not force the motor into the gearbox. Note: Excessive force may damage the teeth of the spline on the gearbox and the motor coupling as well as the motor mounting flange.

⚠️ Improper installation of the motor coupling on the motor shaft can cause premature wear or severe damage to several components of the gearbox and motor.

⚠️ Make sure that the input cables face the correct direction before installing the motor.

⚠️ Secure the motor to the flange with the proper size metric fasteners. See Section 6.2 Motor & Coupling Mounting Procedures

6.2 Motor & Coupling Mounting Procedures

This procedure must be followed for the initial installation of a motor to the module. This procedure may be necessary if a motor, gearbox, or motor coupling is replaced for any reason.

1. Verify that the depth of the input shaft (L) is adequate to accept coupling.
2. Make sure coupling and shaft of motor are clean and free of grease. Slide coupling onto shaft. Verify that the coupling offset distance is the same distance measured in step 1 (L) within a tolerance of -0.2/-0.5mm (-0.008/-0.020").
3. Tighten screws to the proper torque according to Table 1 (Appendix 1.0). Apply grease, according to Table 2 (Appendix 1.0) to the spline of the Motor Coupling.
4. Slide motor with coupling onto the gearbox flange. Slowly rotate the motor while inserting to ensure smooth engagement of the spline.
5. Bolt the motor to the gearbox.
7 Adjustment of the Guideway Rollers

Adjusting the guideway rollers require a fine adjustment and is normally carried out in our factory. In some situations certified technicians may need to perform this adjustment. The following are examples of typical adjustments:

a. During the assembly stage.
b. To adjust backlash between the rack and the pinion.
c. To add preload to the bearings in order to increase rigidity.
d. Check and Adjust Rollers if necessary after 1000 hrs of operation per instructions below.

7.1 Cautions & Warnings

- Excessive tensioning will reduce the service life of the system.
- Insufficient tensioning of the rollers will cause improper performance of the module, a significant loss of rigidity and/or premature wear.
- A correct preload means that the non-load-carrying rollers can still be rotated manually.
- Improper adjustment of the rollers can cause problems with accuracy, decrease stability, and be a source of premature wear to most of the modules components.
- Improper setup can cause the mechanical components used in the module to be overloaded and/or wear at an accelerated rate.
- If this procedure is not completely understood by the certified technician performing these adjustments, please contact the service department at Güdel, Inc. for clarification.

7.2 Heavy Duty Roller Configuration

On a standard MotoRail unit the backlash setting and the pre-tensioning of the rollers take place by adjusting the eccentric hub of rollers 1 & 3 (ER). Roller 2 (BR) is concentric and cannot be adjusted. (See Figure 4 above)
To adjust the rollers, first loosen the nuts, and then use a hex key to turn and preload the eccentric rollers. (See Figure 5)

Be certain to tighten the nuts to the proper torque specification according to Table 1 (Appendix 1.0) after adjustments are completed.

### 7.2.1 Backlash & Preload Adjustment Of Rollers

The rollers are adjusted as follows:

1. Tighten the nuts of the concentric rollers 2 and 5. Loosen the nuts of the eccentric rollers 1, 3, 4 and 6. Turn the eccentric hubs to the minimal position.
2. Turn the eccentrics of the rollers 1 and 4 to adjust the pre-tensioning of the rollers. Rollers must be able to turn using moderate force. Then tighten the nuts gently.
3. Position a dial gauge against the edge of the carriage plate inline with the drive pinion. (See Figure 6)

4. Adjust rollers 3 & 6 until the measurement X of the roller supports A and B are identical. At the same time, the tooth backlash must be zero. Rollers must be able to turn using moderate force. (See Figure 6)

5. Reset the dial gauge.

6. Adjust the backlash clearance: Re-adjust rollers 3 and 6 and subsequently turn the eccentric hubs so that the dial gauge displays $\Delta Z=0.07\text{mm}$ when the carriage plate is pushed back and forth in the direction of the travel while being certain that the output shaft of the gearbox does not rotate. The measurement $X$ must be equal again on both roller supports and should have changed by approximately 0.10mm from the 'zero backlash' position.

7. Tighten the eccentric rollers while the value $\Delta Z=0.07\text{mm}$ is maintained. (See Figure 6)

8. Check the pre-tensioning: Rollers that are not under load must be able to turn using moderate force. If they are not free, loosen rollers 1, 4 and 6 and adjust them again.

9. Verify that the backlash and preload adjustments are acceptable over the entire length of the track to assure that the carriage is free to travel its entire length.
8 Maintenance & Adjustment Instructions

All components of the module should be inspected periodically. If during the inspection signs of dirt build-up or rough operations are observed, the offending components should be cleaned and/or lubricated as necessary according to sections 8.2 and 8.4. A comparison table of lubricants acceptable for use with the module is also given in Table 2 (Appendix 1.0). Other lubricants may be acceptable. Güdel reserves the right to approve any substitute lubricants proposed by the customer. A detailed outline of the maintenance of the Gearboxes follows in section 8.3.

8.1 Cautions & Warnings

⚠️ No grease of any kind should be used inside the gearboxes under any circumstances. This will cause the gearbox to overheat and rapidly destroy itself.

⚠️ Güdel gearboxes are not prepared to be serviced by an automatic lubrication system.

⚠️ Be certain that there are no external forces acting on the module that may cause the module to move when the motor and gearbox are removed from the module.

⚠️ To aid the flow of oil from the gearbox, remove the plug on the opposite side of the gearbox.

⚠️ Güdel reserves the right to approve any substitute lubricants proposed by the customer.

⚠️ Output shaft “Tension Sets” are designed to be used once. Once a tension set is properly tightened and removed, physical changes in the part may cause the clamping force to be inadequate. This may lead to pinion slipping and potential damage to the gearbox, the machine and/or other equipment. It is strongly recommended that this part is not reused.

⚠️ Output shaft “Tension Sets” must be secured by tightening the fasteners in numerical order according to Figure 8 in a clockwise direction. Do NOT tighten the bolts in a diagonal or alternating pattern. This may cause the internal pieces of the tension set to become misaligned, therefore, compromising the torque capacity of the “Tension Set” and rendering the assembly ineffective.

⚠️ The motor must be removed from gearbox and the gearbox removed from the module before any maintenance can be performed on the gearboxes.

⚠️ If the motor is removed, it must be reinstalled properly according to Section 6 and a homing routine must be performed before resuming any other type of controlled operation.

⚠️ If there is a loss of lubrication (oil) from a Güdel gearbox during any adjustment procedure, the oil should be completely drained and replaced according to the instructions in Section 8.3.1.

8.2 Lubrication Instructions

All modules supplied without automatic lubrication systems should follow the maintenance schedules in Sect. 8.4. For modules with automatic lubrication systems, There are two types of central lubrication systems used for the MotoRail unit. These systems are either Battery powered or 24V DC controller powered. Refer to Appendix 2.0 for Module Lubrication Recommendations.

All modules are supplied with initial lubrication of the gearboxes, racks, pinions (felt pinion option only), motor couplings and roller covers. For the initial lubrication Güdel, Inc. uses Mobil products according to Table 2 (Appendix 1.0). If lubricants other than the Mobil products are used, please check with manufacturer for compatibility and/or lubrication instructions.
8.3 Special Maintenance of Güdel Gearboxes

The efficiency of the Gearboxes, operating for long periods or over extended cycles, depends greatly on the type and grade of oil used.

Güdel Gearboxes are virtually maintenance free under normal operating conditions. However, they should be inspected for leaks at least once a year. To ensure maximum performance the motor coupling should also be greased every time the gearboxes are removed from the gantry.

Gearboxes should be refilled according to maintenance schedules in section 8.4. Refilling instructions are in section 8.3.1. If seals are damaged or leaks are detected during scheduled maintenance inspection periods the gearboxes should be returned to Güdel for repair. A spare gearbox should then be installed.

8.3.1 Refilling Procedure for Güdel Gearboxes

1. Remove the motor from the gearbox and remove the gearbox from the module.
2. Remove plug on gearbox, located 90° from input shaft.
3. Completely drain oil from gearbox.
4. It is recommended that the gearbox be flushed thoroughly with a solvent recommended by the lubricant supplier before refilling. If using oil different from previously installed oil (or previous oil is unknown), this step is absolutely necessary.
5. Fill the gearbox with the proper quantity of oil according to the table below, with one of the lubricants according to Table 2 (Appendix 1.0).
6. Grease the spline of the motor coupling using grease from Table 2 (Appendix 1.0).
7. Install the gearbox onto the module, and then install the motor according to Section 5.
8. Verify that the backlash of the rack and pinion is still correct according to Section 6.

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<th>Lube Fill</th>
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<tr>
<td>MotoRail 7-50</td>
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8.3.2 Adjustment Procedures for Gearboxes Tension Sets

The following instructions are for the proper installation of the compression couplings (referred to here and in our catalogues as “Tension Sets”) that are supplied with our servo series AE type worm gearboxes. Illustrations and dimensions of each size as it corresponds to our gearboxes are provided in section 7 of our “Components” catalogue.

Each of the gearboxes supplied with Güdel modules include one of these couplings inside of the output housing.
8.3.2.1 Installing a Tension Set

1. Loosen, but do not remove all bolts (S1, See Figure 8) on the tension set and insure that the pieces on the tension set can be freely moved by hand. If the pieces of the tension set cannot be moved by hand refer to the section below for “Removing Tension Set from Gearbox.”

2. Place the tension set on the hollow output shaft of the gearbox.

3. Clean the internal bore of the hollow output shaft on the gearbox and the shaft of the pinion. These surfaces must be dry and free of all dirt, grease, oil, or any other contaminant before the pinion is assembled to the gearbox.

4. Insert the pinion assembly into the gearbox.

5. Secure all bolts (S1) on the tension set in numerical order according to Figure 8 in a clockwise direction.
   a. Tighten by hand.
   b. Mark the bolt in position 1 with a permanent marker or paint pen.
   c. Tighten all bolts (S1) to ½ the torque value according to Table 1 (Appendix 1.0). Start with the marked bolt. Repeat this step for three complete revolutions in the numerical direction indicated in Figure 8.
   d. Tighten all bolts (S1) to the full torque value according to Table 1 (Appendix 1.0). Repeat this step for at least six (6) complete revolutions in the numerical direction indicated in Figure 8, or as many times as it takes until further attempts to tighten all bolts do not noticeably move the bolts, whichever is greater.

8.3.2.2 Removing a Tension Set from Gearbox

The “Tension Sets” that are used by Güdel consist of three pieces. While these units are more reliable and stronger than the two piece versions, repeated removal and installation of these couplings will cause the internal ring (see Figure 9) to wear down beyond the point where the use of these couplings is effective. Güdel therefore recommends that the “Tension Sets” are not reused once they are removed for any reason.

1. Loosen all bolts on the “Tension Set”. The clamping force of the coupling should immediately release.
2. If the “Tension Set” is still engaged, gently tap the edges with a blunt tool.
3. Slide the pinion, bearing, and spacer ring out of the gearbox.
4. Remove the “Tension Set” and discard it.

8.3.3 Gearbox Backlash Adjustment Procedures

When first installed, the gearboxes are set to at minimum backlash (less than 6 arc min.). However, this setting may change over time. If the backlash increases to more than 8 arc min, the backlash can be adjusted by turning the eccentric output shaft covers.
1. Remove the cover fastening screws on both sides of the casing. Do not remove the covers (this will result in loss of oil).

2. Turn the covers in the direction of the next higher number indicated on the casing one increment. This may be an intermediate position on some of the gearboxes. Both covers must be set in the same position. Both covers should be rotated simultaneously. It is possible to damage the support bearings and shafts if one cover is rotated sufficiently farther than the other.

3. The gearbox must be stationary and the input worm must be in a locked position in order to check the backlash. If backlash is unacceptable (greater than 6 arc min) go back to step 2.

4. Replace and tighten the screws from step 1 using the appropriate torque according to Table 1 (Appendix 1.0)

5. Rotate the input shaft until the output shaft rotates a complete 360°. If the gearbox is difficult to manipulate or binds, repeat procedure. In this case, however, turn the covers in the direction of the next lowest number on the gearbox casing.

6. Grease the spline of the motor coupling (do not grease the motor shaft) with the proper grease according to Table 2 (Appendix 1.0) before reinstalling gearbox.
8.4 Regular Maintenance & Adjustment Schedule

This section includes schedules of regular maintenance and adjustments that should be carried out on a regular basis. These are sub-divided into three different types of inspections: complete, basic, and visual. The recommended tasks and period of each type of inspection is detailed in sections 8.4.1, 8.4.2, and 8.4.3. All maintenance periods specified in this manual are a guideline only. It is very possible that this equipment may require much greater care in a severe environment or under aggressive operating conditions. These tasks and schedules should be reevaluated periodically.

8.4.1 Complete Maintenance Inspection

The following tasks should be completed at any time the unit is out of service for an extended period of time that will allow access to the equipment. This should be performed on a minimum once per calendar year basis, but Güdel recommends that these tasks be performed once every six months or sooner as is possible based on the application. If the operation of the module is frequently impaired due to problems addressed in this inspection, the period of this inspection should be increased accordingly to compensate.

<table>
<thead>
<tr>
<th>Complete Maintenance Inspection Tasks</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Element</strong></td>
<td><strong>Operation</strong></td>
</tr>
<tr>
<td>Gearbox</td>
<td>Remove the gearbox from the module and the motor from the gearbox.</td>
</tr>
<tr>
<td></td>
<td>Check the backlash in each of the gearboxes and adjust if necessary according to Section 8.3.3</td>
</tr>
<tr>
<td></td>
<td>Visually inspect the input and output seals for leaks. If leaks are present, contact Güdel to discuss repair or replacement of the gearbox.</td>
</tr>
<tr>
<td></td>
<td>If the module has been in operation for more than 15,000 hours, or will exceed 15,000 hours of operation before the next Complete Maintenance Inspection will be performed, change oil in gearbox according to the instructions in Section 8.3.1. (15,000 hours of operation, ~3½ years in a 2-shift operation)</td>
</tr>
<tr>
<td></td>
<td>Before reinstalling the motor and gearbox back onto the module, perform maintenance on the Motor Coupling and Pinion as described below.</td>
</tr>
<tr>
<td>Motor Coupling</td>
<td>While the motor is still detached from the gearbox, grease the spline (not the motor shaft) on the motor coupling.</td>
</tr>
<tr>
<td>Pinions</td>
<td>Inspect pinions for wear when the gearboxes are removed for oil change. Replace pinions if:</td>
</tr>
<tr>
<td></td>
<td>Any of the teeth on the pinion are flaking, chipped, broken, and/or pitted</td>
</tr>
<tr>
<td></td>
<td>The pinion shaft shows signs of slipping in the coupling</td>
</tr>
<tr>
<td>Lubrication</td>
<td>Remove and inspect the felt pinion insert installed on the rack side of the carriage plate. If the surface of the felt pinion is frayed, hardened, or otherwise damaged or the felt pinion is unable to absorb and hold oil, or replace the felt insert.</td>
</tr>
<tr>
<td></td>
<td>Remove and inspect all felt roller inserts attached to the roller blocks (2 pieces / MotoRail 7-50 carriage and 4 pieces / MotoRail 7-50 carriage). If the surface of the felt insert is frayed, hardened, or otherwise damaged or the felt insert is unable to absorb and hold oil, or replace the felt insert.</td>
</tr>
<tr>
<td></td>
<td>Inspect all lubrication lines. Verify that all lines are present and clear of obstruction. If any lines are missing, damaged, or obstructed (do NOT attempt to clear clogged lube lines), replace the offending lines.</td>
</tr>
<tr>
<td>General</td>
<td>Complete all tasks detailed for the Basic Maintenance Inspection and Visual Maintenance Inspection in sections 8.3.2 and 8.3.1</td>
</tr>
</tbody>
</table>
## 8.4.2 Basic Maintenance Inspection

The following tasks should be completed on a frequent basis to ensure that the module is in peak operating condition at all times. This should be performed on a minimum once per month basis, but Güdel recommends that these tasks be performed as often as possible based on the operational duty requirements, the availability of the module, and the application environment. If the operation of the module is frequently impaired due to problems addressed in this inspection, the period of this inspection should be increased accordingly to compensate.

### Basic Maintenance Inspection Tasks

<table>
<thead>
<tr>
<th>Element</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rollers</strong></td>
<td>Saturate the felt insert inside each wiper and lubrication unit (roller cover) with oil according to Table 2 (Appendix 1.0). If an automatic lubrication system is used, this step is not necessary. Do NOT use grease in the fittings on the roller covers unless the felt inserts have modified accordingly for a specific application. If the rollers are not tracking properly, or there is looseness in the carriage, adjust the rollers according to section 7. Visually inspect rollers for proper operation and wear. Replace the rollers if any of the following conditions are true: The seals between inner and outer rings of the bearings are visibly loose or damaged The inner and outer race of the bearing are visibly loose and/or out of alignment The outer surface of a roller appears to be flaking, distorted, and/or pitted (a slight discoloration along the line of contact with the guide is normal, and does not require replacement of the roller) Attempts to adjust the rollers cannot be completed properly and/or adjustment does not improve the operation of the module.</td>
</tr>
<tr>
<td><strong>Racks / Pinions</strong></td>
<td>Saturate the felt insert inside the pinion lubrication unit with oil according to Table 2 (Appendix 1.0). If an automatic lubrication system is used, this step is not necessary. Do NOT use grease in the fittings on the felt pinion lubrication unit.</td>
</tr>
<tr>
<td><strong>Rail Surfaces</strong></td>
<td>Apply a layer of oil to each of the rail surfaces. If an automatic lubrication system is used with the wiper and lubrication unit, this step is not necessary.</td>
</tr>
<tr>
<td><strong>Automatic Lubrication (if applicable)</strong></td>
<td>Check oil levels at all reservoir locations (typically one reservoir per robot carriage). If the oil levels are low, add lubricant or replace cartridges as is appropriate for the type of automatic lubrication system installed. Verify that all lubrication pumps are operating properly. See manufacturer’s documentation for specific instructions. Repair or replace any pumps not operating (for battery operated units, check batteries before contacting Güdel or manufacturer for assistance). Verify that sufficient lubrication is getting to all lubrication points. If the pump is functioning properly, there is sufficient lubricant in the reservoir, check the components listed under Lubrication in the Complete Maintenance Instruction Tasks in section 8.4.1. If there is still a problem with the lubrication system after all of the areas are addressed, contact Güdel for assistance.</td>
</tr>
</tbody>
</table>

## 8.4.3 Visual Maintenance Inspection

The following tasks are items that should be observed on a continual basis during the operation of the module to ensure that the process is not affected by improper operation of the module. For unattended operations these items should be observed on a minimum once per four (4) hours of operation, but Güdel recommends that the module be within direct line of sight of a qualified operator as often as possible. If frequent interruptions occur in an attended or unattended operation...
operation mode, it is recommended that a Complete Maintenance Inspection be performed on the module and all recurring issues be addressed immediately.

<table>
<thead>
<tr>
<th>Continuous Element</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Surfaces</td>
<td>Look for tribocorrosion (reddish discoloration). This is an indication that the rollers and/or module are overloaded, and/or the rails are under lubricated.</td>
</tr>
<tr>
<td>Rack Teeth</td>
<td>Look for excessive wear near the start and stop points of each axis. This is an indication of improper backlash adjustment, overloading of the module and/or acceleration higher than rating (see Section 10.).</td>
</tr>
<tr>
<td>Assembly</td>
<td>Look for jerky motion, excessive lateral movement, noise, and/or vibrations. This is an indication that the rollers are not properly adjusted, one or more components are damaged, and/or the rack and pinion backlash is incorrect.</td>
</tr>
<tr>
<td>Positioning</td>
<td>Look for inconsistent positioning and/or a loss of repeatability. This is an indication that the gearbox needs adjustment and/or the pinion backlash is incorrect.</td>
</tr>
</tbody>
</table>

8.4.4 Preventative Maintenance Contracts

Güdel will provide on-site service technician support for any or all maintenance tasks. This can be supplied upon an annual service contract basis or single visit basis. For further information please contact Güdel at:

Güdel, Inc.
4881 Runway Blvd.
Ann Arbor, MI 48108
Telephone No.: (734) 214-0000
Facsimile No.: (734) 214-9000
E-Mail Address: service@gudel.com
9 Instructions for Ordering Replacement Parts

9.1 Spare Parts

Part description and part numbers are detailed per sub-assembly on attached drawings. Call for a Recommended Quantity for each wearable part. A complete bill of materials is available on request.

9.2 Delivery

To ensure efficient delivery of the correct replacement parts verify that any order for parts includes the following information:

a. Original Order Number (Güdel Order Number)

b. Customer Order Number

c. Assembly Drawing Number

d. Part Number and Description

10 Standard Configurations

10.1 Overall Specifications

<table>
<thead>
<tr>
<th></th>
<th>7-20</th>
<th>7-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Per Application</td>
<td>Per Application</td>
</tr>
<tr>
<td>Width</td>
<td>Per Application</td>
<td>Per Application</td>
</tr>
<tr>
<td>Height</td>
<td>Per Application</td>
<td>Per Application</td>
</tr>
<tr>
<td>Minimum Travel</td>
<td>1.11m</td>
<td>1.02m</td>
</tr>
<tr>
<td>Maximum Travel</td>
<td>Min. + x • 2m</td>
<td>Min. + x • 2m</td>
</tr>
<tr>
<td>Servo Series Gearbox Size</td>
<td>AE060</td>
<td>AE090</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±0.1 mm</td>
<td>±0.1 mm</td>
</tr>
<tr>
<td>AC Servomotor</td>
<td>Standard</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td>SGMDH-32A2A-YR11</td>
<td>SGMDH-45A2B-YR13</td>
</tr>
<tr>
<td></td>
<td>Optional</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>SGMR-30A2A-YR11</td>
<td></td>
</tr>
<tr>
<td>Gearbox Reduction Ratio</td>
<td>Standard</td>
<td>4:1</td>
</tr>
<tr>
<td></td>
<td>Optional</td>
<td>6:1</td>
</tr>
<tr>
<td>Maximum Rated Speed (m/s)</td>
<td>2.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Maximum Rated Acceleration (m/s²)</td>
<td>2.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Linear Travel Per Motor Revolution (mm.)</td>
<td>37.5</td>
<td>25</td>
</tr>
</tbody>
</table>
## Table 1: Tightening Torque For Fasteners

<table>
<thead>
<tr>
<th>Size</th>
<th>Grade</th>
<th>Nm</th>
<th>ft-lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>M4</td>
<td>8.8</td>
<td>3.1</td>
<td>2.3</td>
</tr>
<tr>
<td>M5</td>
<td>10.9</td>
<td>8.65</td>
<td>6.4</td>
</tr>
<tr>
<td>M6</td>
<td>8.8</td>
<td>10.5</td>
<td>7.7</td>
</tr>
<tr>
<td>M8</td>
<td>8.8</td>
<td>26</td>
<td>19.2</td>
</tr>
<tr>
<td>M10</td>
<td>8.8</td>
<td>51</td>
<td>37.6</td>
</tr>
<tr>
<td>M12</td>
<td>8.8</td>
<td>89</td>
<td>65.6</td>
</tr>
<tr>
<td>M20</td>
<td>8.8</td>
<td>420</td>
<td>309.8</td>
</tr>
<tr>
<td>M24</td>
<td>8.8</td>
<td>725</td>
<td>534.7</td>
</tr>
<tr>
<td></td>
<td>10.9</td>
<td>1020</td>
<td>752.3</td>
</tr>
</tbody>
</table>

### Table 2: Lubricant Selection

<table>
<thead>
<tr>
<th>Type</th>
<th>Mobil</th>
<th>Texaco</th>
<th>AMSOIL</th>
<th>Shell</th>
<th>CITGO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>Glygoyle HE 460</td>
<td>Pinnacle 460</td>
<td>RCO ISO 460</td>
<td>Tivela SD</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2.0
Güdel Module Lubrication Recommendation for Central Systems

The purpose of this recommendation is to establish a starting point for setup of centralized lubrication systems used on Güdel Modules. Sufficient Lubrication is as important as the correct selection/sizing of the mechanical components and/or modules.

Lubrication correctly setup at initial operation of the module reduces friction and prevents premature wear caused by tribocorrosion. Tribocorrosion is usually an indication of insufficient lubrication. Tribocorrosion can be easily identified by a reddish discoloration of the rail surfaces.

The actual requirements for each application will require modifications depending upon several factors. Harsh environments may require more lubrication while cleaner environments may require less.

The module should be inspected at regular intervals during startup, initial installation and operation to verify adequate lubrication is being supplied to all applicable areas. The cycle of the lubrication system should be adjusted accordingly to assure proper long-term performance.

There are two types of central lubrication systems used for the MotoRail unit. These systems are either Battery powered or 24V DC controller powered. Refer to the Memolube attachments for the system that applies.

Guideway Rollers:

All heavy-duty Flat Rollers are initially greased with high complex lithium soap grease KP2K-30 DIN 51 825. The lubrication is designed to last for the full displacement path of 10,000 km. For most applications this is sufficient for the life of the rollers. However, harsh environments may require re-lubrication, typically at the same interval as the Worm Gear Unit (See page 26).

Guideway Rails:

Lubrication of the guideway surfaces should be accomplished using the Wiper and Lubrication Unit supplied on the standard Güdel Modules. These units include an oiled felt insert, which lubricates the running surface of the roller. The Roller in turn supplies the lubrication to the guideway surface.

The Wiper and Lubrication Units are supplied initially with a metric “Zerk” type fitting and can easily be modified to accept common NPT fittings used in central lubrication systems.

It is not necessary that all Wiper and Lubrication Units on the module be piped for lubrication. It is only necessary to lubricate one roller per guideway. For example, on a Standard MotoRail Module, the two roller blocks at the gearbox end of the carriage should be lubricated. This is acceptable where the strokes are long enough so that the roller being lubricated travels beyond the
position of the other roller on the particular guideway, thus lubricating both rollers in contact with
the guideway.

Due to the design of the rollers and guideways, the amount of lubrication supplied to the rollers is
not affected by the various sizes of rollers. As mentioned above the environment that the module
is subjected to has a much greater affect to the amount of lubrication required.

<table>
<thead>
<tr>
<th>Lubricant</th>
<th>Volume / Lubrication Point</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Axis Travel &lt; 9m</td>
<td>Axis Travel &gt; 9m</td>
</tr>
<tr>
<td>Oil</td>
<td>0.005in³ (0.08cm³)</td>
<td>0.010in³ (0.16cm³)</td>
</tr>
</tbody>
</table>

Güdel, Inc. recommends that each roller to be oil lubricated as outlined in the table above with a
starting volume of 0.005in³ (0.08cm³) every 8 hours of operation of the module. This volume is
valid for strokes up to 9 meters; for strokes over 9 meters, this amount should be doubled. This
amount should also be supplied at the startup of the module if it has not been in operation for over
8 hours. As mentioned above the amount of lubrication will require adjustment, according to the
environment.

Rack Teeth:

It is recommended that the Pinion and Rack be maintained regularly, and re-lubricated with oil iii
(see table below). A unit with oil soaked felt pinion is supplied on all standard Güdel Modules³. This can be oil
lubricated (see table below) from the central oil lubrication system much like the rails. However,
this unit has a G 1/8" port, which will require an adaptor fitting in order to be used with the
common NPT fittings used in centralized lubrication systems.

<table>
<thead>
<tr>
<th>Lubricant</th>
<th>Volume / Lubrication Point</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Axis Travel &lt; 9m</td>
<td>Axis Travel &gt; 9m</td>
</tr>
<tr>
<td>Oil</td>
<td>0.005in³ (0.08cm³)</td>
<td>0.010in³ (0.16cm³)</td>
</tr>
</tbody>
</table>

On request, a grease lubrication block can be supplied for this. Approximately 0.005in³ (0.08cm³)
of grease should be used every 8 hours of operation. This volume is valid for strokes up to 9
meters; for strokes over 9 meters, this amount should be doubled. Again, this amount should also
be supplied at the startup of the module if it has not been in operation for over 8 hours.

If using the oil soaked felt pinion, the amount of oil supplied to the felt should be the same as that
which is supplied to the rollers, 0.005in³ (0.08cm³) every 8 hours of operation and again at the
startup of the module if it has not been in operation for over 8 hours. This amount is valid for
strokes up to 9 meters; for strokes over 9 meters, this amount should be doubled. As mentioned
above the amount of lubrication will require adjustment, according to the environment.
Worm Gear Unit:

The worm gear unit is supplied with oil and is designed to last for 15,000 hours of operation. See the Section 8.3 for the recommended oil change procedure as part of the required maintenance schedule. Refer to Section 8.3.1 for all fill volumes and Table 2 (Appendix 1.0) for lubricant selection.

- The gearboxes are not prepared to be serviced by an automatic lubrication system.
- No grease of any kind should be used inside the gearboxes under any circumstances. This will cause the gearbox to overhead and rapidly destroy itself.

Motor Coupling:

The Motor Coupling is initially greased with Mobilux EP-2. See the Section 8.3 for the recommended maintenance procedure as part of the required maintenance schedule. Refer to Table 2 (Appendix 1.0) for lubricant selection.

- The motor couplings are not prepared to be serviced by an automatic lubrication system.

<table>
<thead>
<tr>
<th>Lubricant</th>
<th>Volume / Lubrication Point</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grease</td>
<td>Lightly Coated</td>
<td>15,000 Hours</td>
</tr>
</tbody>
</table>

i These are not intended for use with grease.
ii For multiple carriage configurations or for very short strokes, additional lubrication points may be required. Please contact Güdel for clarification in these situations.
iii All standard modules designed after 4/1/2000 are supplied with felt pinion/oil lubrication as a standard. Grease lubrication is available as an option upon request. If the module has been equipped with a felt pinion, do NOT use grease to lubricate the racks or pinions.
The
MEMOLUB® HPS

User’s Guide
4.7

PLI, LLC

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P.O. Box 044051
Racine, WI 53404

Phone: (800) 635-8170
Fax: (262) 637-4090
www.memolub.com

Represented By:

Revised: July 2007
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MEMOLUB® HPS has a 2-year limited warranty for replacement due to defects in material and labor. Not responsible for consequential damages beyond replacement or refund of amount paid. MEMOLUB is a registered trademark of MEMOLUB International, s.a. © 2003 PLI, LLC.
1 The MEMOLUB® HPS

1.1 Overview

The MEMOLUB® HPS is an automatic, self-contained, electro-mechanical lubricator. The "HPS" in its name stands for High Pressure System. It ejects grease or oil under programmable control at an output pressure of 350psi. There are three available models:

<table>
<thead>
<tr>
<th>Model</th>
<th>Cartridge Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>120cc (Standard)</td>
<td>120cc  ¼ pound</td>
</tr>
<tr>
<td>240cc (Mega)</td>
<td>240cc ½ pound</td>
</tr>
<tr>
<td>480cc (Giga)</td>
<td>480cc 1 pound</td>
</tr>
</tbody>
</table>

The MEMOLUB® HPS is a highly versatile device of robust design that can be used to satisfy a variety of application requirements. Its value and reliability have been proven through years of use by hundreds of companies in thousands of applications.

- The MEMOLUB® is a single point lubricator that can be mounted directly on the bearing point, slide, gear, or other object requiring lubrication.
- The MEMOLUB® can be mounted remotely for safety, ease of service, or avoidance of hostile environments.
- A single MEMOLUB® HPS becomes a 2-point lubricator when used with the Splitter-MEMO.
- The MEMOLUB® can be used as a miniature, low-cost, central lubrication system to lubricate from 2 to 12 bearings, using a distribution block.

The MEMOLUB® is easily and quickly programmed to eject lubricant at the desired rate of output and operates as a self-contained lubricator using a battery pack for its source of power. The EPC (External Power Control) and EPS (External Power Source) versions expand the application potential of the MEMOLUB®. These versions can be turned on and off by the machine on which they are being used. This is a valuable feature when lubrication is required on intermittently or infrequently used equipment. The EPC version of the MEMOLUB® is battery-powered. The EPS version is powered by an external source.

Under control of a PLC (Programmable Logic Controller) the MEMOLUB® EPC or MEMOLUB® EPS can be used to lubricate equipment based upon runtime hours, machine cycles, time of day, or other criteria. The basic MEMOLUB® HPS is composed of three parts.

- The MEMO, which is used to program the rate of lubricant output.
- The MEMOLUB®, consisting of a red motor housing and a transparent dome with spring and locking ring.
- The replaceable lubricant cartridge and battery pack.
1.2 The MEMO

1.2.1 Description

The MEMO regulates the rate of grease output of the MEMOLUB® HPS. It consists of a brass adapter, a black plastic timing-ring holder, and three plastic timing rings (one white, one red, and one black). The MEMO is permanently fitted onto the bearing or other component, and all MEMOLUB® HPS lubricators of any size will recognize its program setting.

1.2.2 Volumetric Setting of the MEMO

The brass adapter is an extension of the MEMOLUB's pump cylinder. One end has a short \( \frac{3}{4} \)” NPT thread used to mount the MEMO on the bearing. The other end is an M12x1.50 thread that screws into the MEMOLUB® lubricator. A set of special stroke-limiting washers is supplied with each MEMOLUB® for use in programming the volume of lubricant ejected on each output cycle.

When the MEMO is used without washers (yielding full piston stroke), the output volume at each stroke is 0.635cc. For each washer inserted into the brass adapter of the MEMO, the output volume will decrease by 0.04cc per stroke. A maximum of 8 washers (including a lock washer) can be inserted into the brass adapter. If the stroke-limiting washers are used, the lock washer should be inserted last to hold the others in place. If only one washer is used, use the locking washer. Important Note: When using the 2-Point Splitter (see Section 3: The 2-Point Splitter), volumetric setting is not possible.

1.2.3 Frequency Setting of the MEMO

The white, red, and black plastic timing rings are used to set the frequency of ejection cycles of the MEMOLUB® HPS. They are inserted into the black plastic ring-holder either individually or in combination to obtain the desired frequency of output cycles.

The seven output frequency settings of the MEMOLUB® HPS are as follows:

<table>
<thead>
<tr>
<th>Rings Used</th>
<th>Code</th>
<th>Ejection Cycles Per Day</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red, White, &amp; Black</td>
<td>RWB</td>
<td>24</td>
<td>1 Hour</td>
</tr>
<tr>
<td>Red &amp; White</td>
<td>RW</td>
<td>12</td>
<td>2 Hours</td>
</tr>
</tbody>
</table>
Using the volumetric program settings described in Section 1.2.2 above, and the frequency settings shown here, it is possible to achieve 52 different rates of lubricant output. The output settings are shown on two pages in the Appendix titled “Basic Program Settings” and “Fine Tuning Your Lubrication Program”.

When the MEMOLUB® HPS lubricator is shipped, all three timing rings are seated in the plastic holder. To remove them, just use a small screwdriver.

1.3 The Lubricator Body

1.3.1 Description

The lubricator body consists of a red motor housing, a transparent dome, a spring, a compression plate, a black rubber seal, and a black locking ring. The red motor housing contains all of the electro-mechanical parts of the MEMOLUB® HPS. The black rubber seal covers the battery compartment. Because of the configuration of its grease cartridge, the Model 480 lubricator does not require this black seal.

The transparent polycarbonate dome protects the lubricant cartridge and allows for the easy viewing of lubricant remaining. The spring and the compression plate maintain the position of the lubricant cartridge on the inlet valve of the pump in the red housing.

1.3.2 Function

An electric motor drives a gearbox. A cam fitted on the outlet gear drives a lever which lifts the hollow piston and simultaneously compresses a spring. When the piston reaches the top of its stroke, the lever is freed from the cam and the piston begins its downward (working) stroke, driven by the spring. Lubricant is sucked into the chamber formed above the piston during its downward ejection stroke, thus preparing the piston for the next cycle.

1.4 Lubricant Cartridges and Battery Packs

1.4.1 Lubricant Cartridges

Each size lubricator has its own corresponding lubricant cartridge. Every grease cartridge is filled with care and precision, and is centrifuged during the filling operation to avoid air pockets in the cartridge that might create an air lock in the pump. Cartridges are not
reusable. The volume of grease in each cartridge is carefully calculated and the weight of each cartridge depends on the specific weight of the lubricant inside.

PLI, LLC stocks over 250 different greases and oils for filling lubricant cartridges, but almost any lubricant with a rating of NLGI-2 or less is suitable for use in the MEMOLUB® HPS.

PLI does not recommend lubricants for a particular application. If a MEMOLUB® user is uncertain of the type of lubricant to be used PLI can often assist by providing general information. We can also assist by referral to the Technical Services Department of the desired lubricant manufacturer. These Technical Services Departments offer expert advice on the lubricant requirements for specific applications and the product in their line best suited to the need.

### 1.4.2 Battery Packs
A MEMOLUB® Battery Pack is delivered with each MEMOLUB® HPS replacement cartridge. Each battery pack can empty a lubricant cartridge while operating at continuous temperatures as low as the following:

- **STANDARD Model 120 (120cc) cartridge:** +21°F (-5°C)
- **MEGA Model 240 (240cc) cartridge:** +32°F (0°C)
- **GIGA Model 480 (480cc) cartridge:** +41°F (+5°C)

For continuous operating temperatures lower than those shown, available cold-weather lithium battery packs should be used.

Battery packs should be changed every time the lubricant cartridge is replaced to assure proper voltage to the system; and each battery pack should only be used once. A new battery pack is supplied with each replacement cartridge purchased.

### 1.4.3 Stocking
Cartridges and battery packs must be stored in a cool, dark location (ideally in their original packaging). The shelf-life of stored batteries is 2 years.

### 1.5 MEMOLUB® EX
The MEMOLUB® EX is the same self-contained, battery powered lubricator as the MEMOLUB® model with a modified enclosure rated for limited hazardous locations. This version is identified by the black motor base housing.
(See Appendix for EX Ratings)
2 The Multi-Point Lubrication System

2.1 Function

Using a MEMOLUB® distribution block, the MEMOLUB® HPS Multi-Point System can service from 2 to 12 lubrication points. The distribution block is completely sealed to keep out airborne contaminants, dust, and dirt, and works on the principal of piston valves. During operation, a series of pistons inside the block is actuated by the flow of lubricant from the MEMOLUB® lubricator. Lubricant flows through a series of internal channels in the distribution block, when one piston valve is filled the other is emptied through its output port. The pistons move in a prearranged sequence to allow for the progressive distribution of lubricant to all lubrication points.

A built-in check function can be used to confirm that the system is operating properly. An indicator pin is located on the last piston of the distribution block. The pin moves back and forth at the completion of a lubrication cycle. If there is a blockage anywhere in the system, the system stops lubricating and the indicator pin ceases to move. Visual inspection of the indicator pin can be used to verify proper operation of the system.

To remotely and continuously monitor operation of the system a distribution block with an optional limit switch is available. An electric circuit is attached to the limit switch. The limit switch is activated by the indicator pin, which makes or breaks contact in the electrical circuit. This signal may be tied into a monitoring device to display visual or audible indication of the system's operation.

2.2 Distribution Blocks

On each output cycle of the distribution block each outlet port ejects .3cc’s of lubricant. Multi-point systems are available using distribution blocks with an even number of outlet ports (i.e. 4, 6, 8, 10 and 12). Multi-point lubrication systems are designed using these basic distribution blocks and the coupler bridging elements described in Section 2.3 below. The coupler bridging elements permit the design of systems with a number of outlet ports other than those of the basic distribution block.

MEMOLUB® multi-point lubrication systems are generally delivered to the user pre-assembled with the specified number (2 through 12) of lubricant outlet ports, charged with the appropriate lubricant and ready to install. Tubing pre-filled with the desired lubricant is available in various lengths to facilitate installation. These ready-to-use systems are termed MEMOLUB® Plug 'n Lube™ Systems. Empty tubing is also available which the user may charge with lubricant upon installation.

On occasion it may be desired to retrofit a previously-purchased MEMOLUB® lubricator into a multi-point system, or change the number of outlet ports in a multi-point system.
that was previously installed. When this occurs, individual distribution blocks and coupler bridging elements are available from PLI.

PLI and its distributors are always available to assist in the design, layout, and ordering of a multi-point system appropriate for your needs.

2.3 Coupler Bridging Elements

For those applications requiring an odd number of lube points, coupler bridging elements may be required for linking two outlet ports together. In this case, the lubricant volume at the outlet of the coupler will be doubled. For instance, an eight-port distribution block with two outlet ports linked together by a coupler becomes a seven-port distribution block with one port receiving twice as much lubricant as the other six ports. Cross-porting using coupler bridging elements can be advantageous when designing systems in which some bearings on the system require greater amounts of lubricant than others. The use of couplers for cross-porting outlet ports on distribution blocks is illustrated and further explained in the Appendix (see “Distribution Block Set-Up Guide”).

3 The 2-Point Splitter (Also known as "Splitter-MEMO")

3.1 Description

The Splitter-MEMO divides the volume of lubricant at each ejection cycle of the MEMOLUB® HPS. It is specially designed for the economical lubrication of two-bearing shaft systems such as electric motors, pumps, and fans. It transforms the MEMOLUB® HPS into a two-outlet system.

The Splitter-MEMO can be used with any of the three sizes of MEMOLUB® HPS lubricators (namely the Model 120, Model 240, or Model 480). Refer to the Appendix for Splitter-MEMO Output Programming.

The Splitter-MEMO replaces the brass fitting of the normal MEMO. The black plastic timing ring holder and three colored timing rings are used with the Splitter-MEMO to program the frequency of lubricant ejection cycles. The black plastic timing-ring holder is fit onto the Splitter-MEMO in the same manner as on the brass fitting of the standard MEMO. The Splitter-MEMO comes equipped with 5/16” (8mm) push-in tube fittings on the outlet ports. **Important:** The Splitter-Memo can only operate under full-piston stroke. **Do not attempt to insert stroke-limiting washers into the Splitter-MEMO.**

It is recommended that the Splitter-MEMO be used with greases having a base-oil viscosity of no more than 10,000cSt, at working temperature. Check with your MEMOLUB® distributor, lubricant supplier, or with PLI for base-oil viscosity information.

The lengths of tubing that can be used with the Splitter-MEMO applications are determined by the base-oil viscosity at the working temperature of the grease used. The
table in Section 5.2 provides information on recommended maximum tube lengths to be used with the Splitter-MEMO. Contact your MEMOLUB® distributor, PLI, or your lubricant supplier for information on the temperature at which the base-oil of the grease being used reaches this viscosity.

3.2 How It Works

An explanation of the operation of the Splitter-MEMO, with diagrams, is provided in the Appendix. Also provided in the Appendix are dimensional drawings of the system when used with each of the three sizes of MEMOLUB® Lubricators.

Caution: Splitter-MEMO’s are carefully pre-filled to 100% capacity at the factory with the same grease ordered in the MEMOLUB® cartridge. Do not open the Splitter-MEMO or manually activate the Stem Valve. In both cases air will be introduced into the system.

3.3 Retrofitting a MEMOLUB®

A MEMOLUB® HPS can be retrofit in the field to a 2-point Splitter-MEMO. Retrofitting is accomplished by removing the black timing ring holder from the brass fitting of the MEMO and placing it on the Splitter-MEMO.

Retrofitting a MEMOLUB® HPS in the field may require recharging the Splitter-MEMO with the grease being used. SPLITTER MEMO’s purchased without a MEMOLUB® Lubricator have been pre-charged with lithium-based grease at the factory. If incompatible grease or a special grease (e.g. food-grade) is to be used, it will be necessary to recharge the Splitter-MEMO. To do this, use the Zerk grease nipple that is supplied with the Splitter-MEMO to pump the correct grease through the outlet port labeled #1 (see illustration above). This is the outlet port closest to the base of the Splitter-MEMO. The Splitter-MEMO must be recharged without the MEMOLUB® Lubricator mounted on it. Pump grease into outlet port #1 until it seeps through the piston at the top of the Splitter.

4 The MEMOLUB® HPS with External Power Control or Supply

4.1 The MEMOLUB® EPC Version

The EPC (External Power Control) version of the MEMOLUB® HPS is ideal for avoiding over-lubrication in applications where machinery is used infrequently or intermittently. The MEMOLUB® EPC operates under its own battery power but the lubricator is turned on and off externally. A 12” lead-wire extending from the base of the lubricator is connected to a relay. This relay is opened and closed in concert with the on-off switch of the machine on which it is being used. Extension cables and connectors (as shown in picture on previous page) are supplied as a part of this system, and relays are available.

When the relay is closed (machine is operating) the MEMOLUB® operates under its own
battery power and under control of the MEMO program. Upon initial closure of the relay, the MEMOLUB® goes through an immediate output cycle and then reverts control to the preset MEMO program.

The relay may also be controlled by a PLC, permitting ejection cycles to occur based upon cumulative hours of machine runtime, clock hours, or some other event determined by the PLC. For an output cycle to occur, the PLC must close the relay for at least 15 seconds, and there must be a 60-second interval between output cycles. The MEMO program is not used when operating under PLC control; however a white timing ring should be in place.

When operating under External Power Control (EPC) the life of the lubricant cartridge cannot be determined by the setting of the MEMO program. It will therefore be necessary to estimate cartridge change-out based on the MEMO setting and normal machine runtime hours or, if used with a PLC, other criteria being used to control ejection cycles. When the MEMOLUB® EPC is operating under PLC control, the PLC can calculate the cartridge change-out by counting the number of output cycles ordered, and considering the programmed output volume and lubricant cartridge size.

Relay contacts must be gold-plated, and the type of relay used will be dictated by the application. Furthermore, the distance between the MEMOLUB® EPC and the relay will determine the extension-wire gage and the connector sizes. Refer to the price sheets or contact PLI, LLC for pricing and availability of relays, cables, and connectors.

4.2 The MEMOLUB® 4.5VDC, 12VDC & 24VDC EPS Version

The EPS (External Power Supply) version of the MEMOLUB® HPS operates from an external power source, either 4.5VDC, 12VDC or 24VDC, bypassing the unit’s battery chamber. A lead-wire extends from the bottom of the lubricator, and must be connected to an external power source in order to operate. Extension cables and connectors are provided by PLI, LLC to facilitate this connection.

External Power may be supplied continuously from a transformer, in which case the MEMOLUB® EPS will operate under program control of the MEMO. Functioning will be identical to that of the standard MEMOLUB® HPS.

Regulated power may also be supplied by a PLC. In this case the program of the PLC may be used to control the ejection cycles by periodically providing power to the MEMOLUB® EPS. The frequency of lubricant ejection cycles can thus be controlled by cumulative hours of machine runtime or clock hours, or some other event determined by the PLC. The duration of the power pulse supplied by the PLC should be approximately 6 seconds. While the MEMO does not control the operation of the unit in this mode of operation, it must still be in place with the white timing ring installed.

When operating under External Power Supply (EPS) the life of the lubricant cartridge cannot be determined by the setting of the MEMO program. The frequency of cartridge change-out is dictated by the PLC criteria (which controls the ejection cycles) and the volume setting of the MEMO. The PLC calculates the cartridge change-out by counting
the number of output cycles ordered and considering the programmed output volume and lubricant cartridge size.

PLI, LLC offers several types of power transformers that are compatible with the MEMOLUB® EPS. If a transformer is purchased elsewhere, it should have the following characteristics:

- High efficiency
- Overload/Over-Voltage protection
- Short-Circuit Protection
- Output Voltage: 4.5- 6VDC, 12VDC or 24VDC
- Output Current: 2Amps peak demand, 1Amp working demand

**Electrical Wiring**

- At the outlet of the MEMOLUB® EPS:
  - + Brown
  - - White
- Length and type of wire to use between MEMOLUB® EPS and transformer:
  - AWG 20 (Cross section 2 x 0.5mm²) – 16 feet (5 meters) or less
  - AWG 18 (Cross section 2 x 1.0mm²) – 33 feet (10 meters)

In the case of pole inversion, the MEMOLUB® EPS will not work. The transformer can only supply power to one lubricator at a time. For multiple lubricators, multiple transformers must be used.

### 4.3 The MEMOLUB® PLCd 24VDC Controlled Version

The MEMOLUB® PLCd 24VDC Controlled model lubricator is especially designed for PLC-controlled machinery (or mobile equipment) where a 24VDC power supply is available. The PLC supplies the power and controls the frequency of output cycles. It is ideal for lubricating a wide variety of robots, conveyors, and OEM applications. This model can be used for single-point applications or lubricating from 2 to 12 lube points with a MEMOLUB® Multi-Point Lubrication System.

The MEMOLUB® PLCd 24VDC Controlled lubricator has a unique design utilizing a Power-Through Memo which contains the electrical connections needed to power the unit. This gives the user the ability to quickly remove the lubricator for fast lubricant cartridge change-out while avoiding disconnecting the electrical connections. A 5-foot extension cable on the Power-Through Memo is connected to a PLC-controlled power supply. Because the PLC program controls the frequency of lubrication output cycles, they may be based upon elapsed clock hours, machine cycles, a count of parts produced, or other desired criteria. Further control is provided by adjusting the volume of lubricant ejected on each cycle. A set of 8 special stroke-limiting washers are supplied with each lubricator. When the Power-Through Memo is used without washers (yielding full piston stroke), the output volume at each stroke is 0.635cc. For each washer (including the "C"-
shaped lock washer) inserted into the brass adapter of the Power-Through Memo, the output volume is decreased by 0.04cc per stroke.

(Note: The lock washer should always be inserted last to hold the others in place.)

**Output per spacer washers:**

<table>
<thead>
<tr>
<th>Washer</th>
<th>Volume (cc/stroke)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.63</td>
</tr>
<tr>
<td>1</td>
<td>0.59</td>
</tr>
<tr>
<td>2</td>
<td>0.55</td>
</tr>
<tr>
<td>3</td>
<td>0.51</td>
</tr>
<tr>
<td>4</td>
<td>0.47</td>
</tr>
<tr>
<td>5</td>
<td>0.43</td>
</tr>
<tr>
<td>6</td>
<td>0.39</td>
</tr>
<tr>
<td>7</td>
<td>0.35</td>
</tr>
<tr>
<td>8</td>
<td>0.31</td>
</tr>
</tbody>
</table>

*Please see Appendix for Installation Instructions*

**Specifications:**

- PLC-controlled lubrication cycles
- 2-wire, 5ft extension cable, Brown(+), Blue(-)
- Input voltage: 24VDC
- Max Amps: .5A
- Single cycle duration: 7.5 seconds
- Minimum time between output cycles: 10 Minutes
- Maximum continuous running time: 30 Seconds
- Polarity Protection

## 5 Accessories

### 5.1 Tubing

Only tubes rated at a minimum working pressure of 580psi should be used. Polyamide tubes (air) are not suitable for use with the MEMOLUB® HPS. Keep in mind that a tube’s pressure resistance diminishes with increased temperature. The following table lists the appropriate tubing for a particular ambient temperature range:

<table>
<thead>
<tr>
<th>Tube Material</th>
<th>Working Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nylon (Rilsan)</td>
<td>Less than 158°F (70°C)</td>
</tr>
<tr>
<td>Copper</td>
<td>Less than 320°F (160°C)</td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>Less than 482°F (250°C)</td>
</tr>
</tbody>
</table>

Nylon tubes (Rilsan) can be used in most cases. Transparent tubes are not resistant to UV exposure and should therefore not be used for outdoor applications. Black or colored nylon tubing should be used when exposure to sunlight is a factor. For moving components, use tubing that is adequate and appropriate for that application. When in doubt, consult your tube supplier, your MEMOLUB® distributor, or PLI.

PLI offers tubing of various materials and diameters. This tubing is sold empty (up to 100 feet) or pre-filled with the lubricant of your choice (up to 30 feet). Please note that tubing with an inside diameter of less than ¼” (6mm) is not recommended for grease applications.
5.2 **Table of Recommended Pipe and Tubing Lengths**

The table is based on the following:

- Tube internal diameter of 1/4 inch (6mm)
- Threads on lube point of no less than 1/8" NPT
- No inner pressure present in the component

<table>
<thead>
<tr>
<th>Base-Oil Viscosity (@ Working Temp.)</th>
<th>Directly Mounted</th>
<th>Remote (Single Point)</th>
<th>w/Splitter MEMO</th>
<th>w/Distribution Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 cSt</td>
<td>ok</td>
<td>40ft (12m)</td>
<td>16ft (5m)</td>
<td>33ft (10m)</td>
</tr>
<tr>
<td>700 cSt</td>
<td>ok</td>
<td>30ft (9m)</td>
<td>14ft (4m)</td>
<td>24ft (7m)</td>
</tr>
<tr>
<td>1000 cSt</td>
<td>ok</td>
<td>26ft (8m)</td>
<td>13ft (4m)</td>
<td>20ft (6m)</td>
</tr>
<tr>
<td>1500 cSt</td>
<td>ok</td>
<td>23ft (7m)</td>
<td>12ft (4m)</td>
<td>18ft (5m)</td>
</tr>
<tr>
<td>3000 cSt</td>
<td>ok</td>
<td>18ft (5m)</td>
<td>9ft (3m)</td>
<td>15ft (5m)</td>
</tr>
<tr>
<td>5000 cSt</td>
<td>ok</td>
<td>13ft (4m)</td>
<td>7ft (2m)</td>
<td>11ft (4m)</td>
</tr>
<tr>
<td>9000 cSt</td>
<td>ok</td>
<td>7ft (2m)</td>
<td>3ft (1m)</td>
<td>7ft (2m)</td>
</tr>
<tr>
<td>15000 cSt</td>
<td>ok</td>
<td>3ft (1m)</td>
<td>N/A</td>
<td>3ft (1m)</td>
</tr>
</tbody>
</table>

5.3 **Fittings**

A variety of adapters, tube fittings, and check valves are available from PLI, LLC or through your MEMOLUB® Distributor. Push-in tube fittings allow “instant” connection of nylon tubing to the lubricator (in single-point applications), distribution block (for multi-point applications), or 2-point splitter. To attach tubing, simply push the tube into fitting until it can go no further. (Be certain that plastic tubing has a square cut.) Holding and sealing is accomplished instantaneously. To detach tubing, simply depress the manual release ring, then pull the tube out of the fitting. Plastic and brass fittings are good for most applications. For high temperatures, steel and stainless steel compression fittings are also available. Refer to the *Installation Parts* section of the Appendix or call for a listing of available fittings.

6 **Installation**

6.1 **Installing the MEMO**

Before installing the MEMO on the bearing, the user should manually lubricate the component with the same grease as the one contained in the MEMOLUB®. *Caution: Not all lubricants are compatible. When in doubt, contact PLI, your MEMOLUB® distributor, or your lubricant supplier.*

The MEMOLUB® HPS must be installed in a location where ambient temperature does not exceed 140°F (60°C) and is not exposed to aggressive or corrosive environment or to vibrations. In those cases, refer to *Section 7.2.2: Remote Installation.*

Screw the brass adapter of the MEMO firmly into the bearing or other component. The black plastic timing-ring holder should be installed with the flat surface on the shoulder of the brass adapter. The MEMO should be installed with an end wrench of 21mm or 7/8".
6.2 Opening and Closing the MEMOLUB® HPS

6.2.1 Opening the MEMOLUB® HPS

To open, place the lubricator upright on a flat surface. With one hand on top of the transparent housing, press firmly. With the other hand, hold the ribbed surface of the locking ring and turn it counter-clockwise. Remove the locking ring and the transparent housing.

6.2.2 Closing the MEMOLUB® HPS

To close, use the same technique. Pressing down on the housing, hold the locking ring by its ribbed surface and turn it clockwise until it clicks into the locked position. Ensure that the locking ring locks by holding the ring on its smooth surfaces and turning clockwise. If the housing is correctly locked into place, it will not be possible to open it while holding the locking ring on its smooth surfaces.

6.3 Installing a Grease Cartridge

Replace the grease cartridge using the following procedure:

- Open the MEMOLUB® HPS as described above (Section 6.2.1).
- Prime the MEMOLUB® HPS (if necessary) with a hand grease gun. This step is required only if the MEMOLUB® was permitted to operate without a cartridge in place or operate with an empty cartridge. Do this by placing the outlet of the hand grease gun on the inlet of the MEMOLUB® HPS and pumping until grease appears at the outlet end of the MEMOLUB® HPS. Two pumps of grease are generally sufficient.
- Lift the black rubber seal back to reveal the battery chamber, and insert the battery pack into the red housing by holding it by its strip. The battery pack has to be inserted according to the instructions on the red housing. When the battery pack is inserted, the motor will be activated for a second. Put the rubber seal back in place. {Note: The black rubber seal is not used on the Model 480, Giga lubricator.}
• Remove the paper, disk-shaped label from the replacement cartridge and fill in the following sections: “Start Date” and “Change Date”. The change date is determined by the programming, which can be looked up on your programming chart. Place the label on the inside top surface of the transparent housing, so that the information can be viewed from the top of the lubricator.

• Carefully squeeze air out of the cartridge until grease begins to emerge from the outlet. This step avoids pump airlock and ensures an uninterrupted flow of grease to the piston pump.

• Place the cartridge on the pump inlet of the red housing. Make certain that the cartridge neck is well seated on the pump inlet.

• Place spring and compression plate into the transparent housing, with the compression plate facing the housing opening. Then place the housing assembly (transparent housing, spring and compression plate) over the lubricant cartridge which is seated on the red base. The compression plate should be seated evenly on the lubricant cartridge.

• Lock the transparent housing in place with the black locking ring according to Section 6.2.2.
6.4 Installing an Oil Cartridge

Installing an oil cartridge is similar to that for grease, as described in Section 6.3, but the oil cartridge cannot be placed upside down on the red housing without spilling. First, lift the black rubber seal back and place the battery pack into the red housing (note: the Giga model, shown at left, does not use rubber seal). Insert the identification label, spring, and compression plate into the transparent housing. Next, hold the oil cartridge delicately in one hand and place the red housing on the neck of the cartridge. While holding the oil cartridge firmly on the red housing, reverse their position. Place the red housing and cartridge on a hard surface and place transparent housing on top. Lock as instructed in Section 6.2.2.

6.5 Testing the MEMOLUB® HPS (Check Function)

To ensure that the MEMOLUB® HPS is working, gently push on one of the three switches at the bottom of the red housing for a few seconds. The MEMOLUB® HPS will then go through an ejection cycle. This will confirm that electronics, mechanics and batteries are okay. It is important that this be done only with a lubricant cartridge installed. Operating the MEMOLUB® HPS without a cartridge or with an empty cartridge will “un-prime” the pump (refer to Section 6.3: Installing a Grease Cartridge).

6.6 Mounting the MEMOLUB® HPS onto the MEMO

Screw the MEMOLUB® HPS lubricator onto the MEMO (which should already be screwed into the bearing housing) using care not to damage the threads. Once the MEMOLUB® HPS is mounted onto the MEMO, it will immediately start one or two ejection cycles. This is the test function.

6.7 Testing the MEMOLUB® HPS (While Mounted)

The MEMOLUB® HPS can be checked at any time while in operation. To do so, unscrew the MEMOLUB® HPS from the MEMO approximately one turn and then screw it back down (hand-tight). If the unit is working properly, it will immediately complete one ejection cycle. If, due to a noisy environment, it is not possible to hear the MEMOLUB® HPS functioning during this test, unscrew the MEMOLUB® HPS completely from the MEMO, go to a quieter location, and follow the instructions in Section 6.5.

6.8 Maintenance

The MEMOLUB® HPS does not require any specific maintenance. When used in humid
or dusty atmospheres the MEMOLUB® HPS can be cleaned with compressed air or a slightly damp rag. **Important:** To clean the MEMOLUB® HPS do not use solvents or submerse the unit in any liquid. A Dust/Rain cover is available that can also be used to keep the MEMOLUB® HPS clean.

7  Mounting Do’s and Don’ts

7.1 General

In general, the MEMOLUB® HPS should be installed where it can be easily serviced and where the operating conditions (temperature, vibrations, etc.) is not too harsh. When remote installation is necessary, use only fittings and tubing that are appropriate for your application. The fitting threads should be sealed to assure optimal performance of your system. To obtain a good seal on all screwed fittings, it is preferable to use Teflon® tape or a paste.

7.2 Single-Point Installation

7.2.1 Direct Installation

Avoid installing the MEMOLUB® HPS directly onto vibrating components or components exposed to a harsh chemical environment or temperatures above 120°F. For those situations, install the MEMOLUB® HPS remotely (see Section 7.2.2). If it is not possible to install the MEMOLUB® HPS remotely, use appropriate equipment (such as vibration mounts, special protection baffles, etc…) to protect the lubricator. Ask your MEMOLUB® distributor or call PLI for more details.

The brass fitting on the MEMO has ¼” NPT thread. If the female thread on your bearing housing is not ¼” NPT, use available reduction fittings. Avoid using a reduction fitting that is smaller than ¼”-28 straight (if installed vertically) or smaller than 1/8” NPT (if installed horizontally). Do not install MEMOLUB® HPS horizontally on even slightly vibrating components. The MEMOLUB® HPS fitted directly on the lube point can be used with greases having a base-oil viscosity of up to 15,000cSt at working temperature. For assistance in determining the base-oil viscosity of a lubricant at working temperature, contact your lubricant supplier or PLI.

7.2.2 Remote Installation

When remotely mounting the MEMOLUB® HPS, tubing should have an inside diameter of no less than 1/4” (6mm) and should not exceed 40 feet in length when the ambient temperature is 68°F or higher and when using a lubricant with a base-oil viscosity of 100cSt (refer to table in Section 5.2). When in doubt, consult PLI or your MEMOLUB® distributor.

7.3 Mounting with the 2-Point Splitter (Splitter- MEMO)

The Splitter-MEMO must be mounted with tubing of 1/4” (6mm) minimum internal diameter and with lubricant having a maximum base-oil viscosity of 9,000cSt at working temperature (refer to the table in Section 5.2). Best results will be achieved when both tubes are the same length.
7.4 Mounting with the Progressive Distribution Block

Use only progressive distribution blocks supplied or recommended by PLI. Using other distribution blocks could lead to malfunctions and overall mechanical failures.

When mounting, do not obstruct the inlet valve of the distribution block with sealing paste or any other sealing material. Never plug an outlet on the distribution block with anything other than a coupler element provided by PLI (see Section 2.3). Doing so would completely stop lubricant flow in the system. The MEMOLUB® distribution blocks have 1/8” BSPT inlet and outlet threads.

If the need arises, it is possible to install the MEMOLUB® HPS remotely up to 6 feet from the distribution block. When this is done, however, the distance between distribution block and lube points will have to be reduced by the same length. Some grease may not be suitable for use with the distribution block.

8 Troubleshooting

8.1 The MEMOLUB® HPS does not work

Perform a manual test of the MEMOLUB® HPS by using a MEMO with all three timing rings in the ring-holder. If the MEMOLUB® HPS does not work, check the following:

• Is there a battery pack in the MEMOLUB® HPS and is it correctly inserted?
• Are the batteries okay? Use another battery pack to check.
• Is there a plastic ring inside the ring-holder? If not, no switch will be activated and the MEMOLUB® HPS will not work.

8.2 No lubricant is coming out of the MEMOLUB® HPS

If the MEMOLUB® HPS does function, and no grease comes out of the unit when doing a manual test, consider the following:

• Is there a lubricant cartridge installed? If not, recharge the unit with a cartridge as described in Section 6.3.

• Were the spring and compression plate inserted correctly inside the transparent housing dome? (See Section 6.3)

• Is the pump of the MEMOLUB® HPS primed? If the MEMOLUB® HPS cartridge was completely emptied before replacement, some air could have been sucked into the system and the pump would be pumping air for a certain number of cycles. Place a hand grease gun on the inlet of the red housing and pump grease through the unit (See Section 6.3). If a grease gun is not available, prime the pump by manually cycling the MEMOLUB® approximately 10 times while the new cartridge is in place (see Section 6.5).

8.3 The lubricant cartridge does not empty correctly

If the MEMOLUB® HPS functions and lubricant is ejected, however, the lubricant
cartridge does not empty or not in the predicted timing, check the following:

- Is the tubing clogged? Use a hand grease gun to clear tubing.
- Is one of the outlets of the distributor block obstructed? Use a hand grease gun and maintenance adapter (available through PLI) to flush the distribution block until grease runs freely from all ports in equal amounts.
- Is tubing damaged? Replace tubing.
- Is counter-pressure higher than 290psi? Only use tubing with ¼” (6mm) inner diameter or more, fittings with 1/8” NPT threads or higher, and a maximum 12-point distribution block. When counter-pressure is between 290psi and 350psi, the MEMOLUB® HPS will empty at a slower pace.
- At working temperature, the base-oil viscosity of the grease is higher than what’s described in 5.2 Table of pipe and tubing lengths. Use a grease appropriate for your application.
- The constant temperature where the MEMOLUB® HPS is used is too cold for the standard alkaline battery pack. Use cold weather (Lithium) battery packs in extreme cold situations (refer to section 1.4.2: Battery Packs).

8.4 Lubricant does not get to the application
If the MEMOLUB® HPS does function and empty correctly, however no lubricant is getting into the component:

a) Tubing is damaged and should be replaced.

b) A fitting is not correctly screwed in or the seal may be missing.

9 Warranty
PLI, LLC warrants the MEMOLUB® Lubricator against defects in material and workmanship under normal use for two years from the date of original purchase. This warranty extends to the original purchaser only and can not be transferred. During the warranty period PLI, LLC will, at its option, repair the lubricator with new or reconditioned parts, replace the unit with a new or reconditioned lubricator or refund the purchase price. Repaired or replaced lubricators are warranted for 90 days or for the remainder of the original warranty period, whichever is longer. All lubricators or parts returned under this warranty become the property of PLI, LLC. The warranty does not apply to defects or damage resulting from abnormal use, misuse, mishandling, accident or tampering. PLI, LLC is not responsible for consequential damages beyond replacement or refund of amount paid. It is the user’s responsibility to regularly check the correct functioning of the product. This warranty is valid only in the USA, Canada and Mexico.
MEMOLUB® HPS Specifications

Applications................................Up to 12 Lube Points (with distribution block)
Operating Pressure.............................350psi (25 bar)
Pressure Build-up...............................Immediate
Check Function................................Yes
Stop/Start......................................Immediate
Temperature Range.........................5°F to 120°F (-15°C to 50°C)
Electronic Controls..........................Quartz Timer, Microprocessor
Lubricants.....................................Oils and Greases (to NLGI #2)
Battery Pack..................................4.5v Alkaline (optional Lithium)
Housing........................................Translucent Polycarbonate
Installation Thread..........................¼” NPT (adaptors optional)
Remote Installation.........................Up to 40 feet (12 meters)
Reusable......................................Yes
Dimensions:
  Standard (Model 120)..............4 ½” x 4” (115mm x 101mm)
  Mega (Model 240)...............5 ¾” x 4” (147mm x 101mm)
  Giga (Model 480)...............10 3/8” x 4” (264mm x 101mm)
Cartridge Capacity:
  Standard (Model 120)........120cc (approx. ¼ pound)
  Mega (Model 240).............240cc (approx. ½ pound)
  Giga (Model 480).............480cc (approx. 1 pound)
Output Adjustment......................52 Settings

Typical Applications:

- Conveyors
- Pumps
- Electric Motors
- Bridge, Stacker, and Jib Cranes
- Air Makeup Units
- Roof Fans
- Air Conditioners
- Industrial Robots
- Waste-Water Equipment
- Heat-Treat Furnaces
- Coal-Handling Equipment
- Paper Mill Equipment
- Mining Equipment
- Production Equipment of All Kinds
MEMOLUB® HPS STANDARD - MEGA - GIGA

**Metric**

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<td>Giga Model 480</td>
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**English**

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MEMOS - Setting The Output Rate

MEMOs are the method used to set the output rate of the MEMOLUB® Lubricator. Once programmed, the MEMO is screwed into the bearing and remains there unless it is decided to change the output rate. The MEMOLUB® Lubricator is then screwed onto the MEMO. This turns the lubricator on to eject lubricant at the rate of output programmed.

MEMOs are supplied with 3 colored plastic rings (black, white and red) and a black plastic ring holder. The timing of lubricant ejection cycles is determined by which ring or combination of rings are placed in the ring holder. The number of ejection cycles per day, determines the volume of lubricant entering the bearing. With each output cycle, 0.63 cc’s of lubricant is injected into the bearing. The rates of daily lubricant output using different ring combinations are shown in the following chart.

To inject daily quantities of lubricant into your bearing other than those shown in the Basic Settings chart, refer to Fine Tuning Your Lubrication Program. Using the “Stroke Limiting Washers” it is possible to select from 52 different rates of injection.

MEMOLUB® HPS Lubricator Basic Settings (The Simple Approach)

Note:  B = Black Ring / W = White Ring / R = Red Ring

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<tr>
<th>Memo Program</th>
<th>Rings (color)</th>
<th>Strokes Per Day</th>
<th>CC’s per Cycle</th>
<th>Daily Output in CC’s</th>
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<th>Model 240 HPS</th>
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* Ejection cycle every other day (48 hours)
### LUBRICANT OUTPUT PROGRAMMING

#### Timing Ring Color
- **R** = Red Ring
- **W** = White Ring
- **B** = Black Ring

#### Model 120 HPS 120 cc Capacity

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<th># Of Washers</th>
<th>CC's Per Stroke</th>
<th>Daily Output in CC's</th>
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<th>Weeks To Empty</th>
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#### Model 480 HPS 480 cc Capacity

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#### BW 1.5 Strokes Per Day

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#### W 1 Strokes Per Day

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<th>Daily Output in CC's</th>
<th>Days To Empty</th>
<th>Weeks To Empty</th>
<th>Months To Empty</th>
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<tbody>
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<td>0.16</td>
<td>744.2</td>
<td>110</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

* We recommend that Battery Packs and Lubricant Cartridges be changed at no more than 12 month intervals
** Ejection cycle every 16 hours
*** Ejection cycle every other day
How to order your complete Multi-Point Lubrication System

A complete MEMOLUB® MPS (Multi-Point System) can be ordered by using the quick coding below. Simply replace the “X’s” with the code corresponding to your selection in the sub-menus. Additional installation parts and nylon tubing (empty or pre-filled with lubricant) are also available.

**MPS - XXX - XXX - XX - X - XXX**

**Lubricator size**
- 120 = Standard HPS Model 120 (120cc of lubricant)
- 240 = Mega HPS Model 240 (240cc of lubricant)
- 480 = Giga HPS Model 480 (480cc of lubricant)

**Power Options**
- R = HPS - Regular Configuration, Alkaline Battery Pack
- L = HPS - with Cold Temperature Lithium Battery Pack
- C = EPC - External On/Off Control, Battery Powered and MEMO Controlled
- S0 = EPS - 4.5VDC Externally Powered - MEMO Controlled
- S11 = EPS - 12VDC Externally Powered - MEMO Controlled
- S21 = EPS - 24VDC Externally Powered - MEMO Controlled
- P0 = PLCd - 24VDC Externally Powered and Controlled

Power Transformers and wire extension kits are available for all EPC, EPS and PLCd MEMOLUB® Power Options. Please call for availability.

**Number of outlet ports**
Refer to Set-up Guide for details
- 02 = 2 outlet ports (2 outlets @ .6 cc’s)
- 03 = 3 outlet ports (3 outlets @ .6 cc’s)
- 04 = 4 outlet ports (4 outlets @ .3 cc’s)
- 05 = 5 outlet ports (4 outlets @ .3 cc’s, 1 outlet @ .6 cc’s)
- 06 = 6 outlet ports (6 outlets @ .3 cc’s)
- 07 = 7 outlet ports (6 outlets @ .3 cc’s, 1 outlet @ .6 cc’s)
- 08 = 8 outlet ports (8 outlets @ .3 cc’s)
- 09 = 9 outlet ports (6 outlets @ .3 cc’s, 3 outlets @ .6 cc’s)
- 10 = 10 outlet ports (8 outlets @ .3 cc’s, 2 outlets @ .6 cc’s)
- 11 = 11 outlet ports (10 outlets @ .3 cc’s, 1 outlet @ .6 cc’s)
- 12 = 12 outlet ports (12 outlets @ .3 cc’s)

**Type of Distribution Block**
- O = Oil
- G = Grease

**Example:**
The part # MPS - 240 - R - 04 - G - 02 will be a Grease system with a 4 point distribution block, a Mega MEMOLUB® HPS Lubricator (Model 240 HPS) with straight bearing fittings having a 1/4” NPT Male thread.

**Bearing Fittings**
- **5/16” (8mm) OD Nylon Tubing Fittings**
  (These systems use IF3109-08-10 Block Fittings)
  - Plastic Push-In Fittings
    - 01 = Straight 1/8” NPTM - (IF3175-08-11)
    - 02 = Straight 1/4” NPTM - (IF3175-08-14)
    - 03 = 90° - 1/8” NPTM - (IF3109-08-11)
    - 04 = 90° - 1/4” NPTM - (IF3109-08-14)
  - Stainless Steel Push-In Fittings
    - SS1 = Straight 1/8” NPTM - (IF3805-08-11)
    - SS2 = Straight 1/4” NPTM - (IF3805-08-14)
    - SS3 = 90° - 1/8” NPTM - (IF3889-08-11)
    - SS4 = 90° - 1/4” NPTM - (IF3889-08-14)
- **1/4” OD Nylon Tubing Fittings**
  (These systems use IF3109-56-10 Block Fittings)
  - 51 = Straight 1/8” NPTM - (IF3175-56-11)
  - 52 = Straight 1/4” NPTM - (IF3175-56-14)
  - 53 = 90° - 1/8” NPTM - (IF3109-56-11)
  - 54 = 90° - 1/4” NPTM - (IF3109-56-14)
- **5/16” (8mm) OD Copper Tubing**
  Compression Fittings
  (These systems use IF3175-08-10CCP Block Fittings)
  - CC1 = Straight 1/8” NPTM - (IF3175-08-11CCP)
  - CC2 = Straight 1/4” NPTM - (IF3175-08-14CCP)
  - CC3 = 90° - 1/8” NPTM - (IF3109-08-11CCP)
  - CC4 = 90° - 1/4” NPTM - (IF3109-08-14CCP)
- **1/4” OD Copper Tubing**
  Compression Fittings
  (These systems use IF3175-56-10CCP Block Fittings)
  - CC6 = Straight 1/8” NPTM - (IF3175-56-11CCP)
  - CC7 = Straight 1/4” NPTM - (IF3175-56-14CCP)
  - CC8 = 90° - 1/8” NPTM - (IF3109-56-11CCP)
  - CC9 = 90° - 1/4” NPTM - (IF3109-56-14CCP)
- **5/16” (8mm) OD Steel Tubing**
  Compression Fittings
  (These systems use IF3175-08-10SCP Block Fittings)
  - SC1 = Straight 1/8” NPTM - (IF3175-08-11SCP)
  - SC2 = Straight 1/4” NPTM - (IF3175-08-14SCP)
  - SC3 = 90° - 1/8” NPTM - (IF3109-08-11SCP)
  - SC4 = 90° - 1/4” NPTM - (IF3109-08-14SCP)

**Additional Ordering Information Required:**
1. **MEMO Setting**
   - Lubricant output is determined by preprogramming the “MEMO” fitting. Please refer to the MEMOLUB® HPS Lubricator Installation Instructions for proper output settings.
2. **Lubricant required.**
MEMOLUB® Multi-Point System Configurations

- Standard HPS Model 120
- Mega HPS Model 240
- Giga HPS Model 480

- MPS-02
- MPS-03

- MPS-04
- MPS-05
- MPS-06

- MPS-07
- MPS-08
- MPS-09

- MPS-10
- MPS-11
- MPS-12
### Multi-Point Lubrication Distribution Block Set-Up

<table>
<thead>
<tr>
<th>Size Distribution Block To Use</th>
<th>Size Distribution Block To Use</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2 Point Distribution</strong></td>
<td><strong>7 Point Distribution</strong></td>
</tr>
<tr>
<td>4 Point</td>
<td>8 Point</td>
</tr>
<tr>
<td>Use 4 Point Block</td>
<td>Use 8 Point Block</td>
</tr>
<tr>
<td>2 Horizontal Couplers</td>
<td>1 Vertical Coupler</td>
</tr>
<tr>
<td>2 Outlet Ports @ .6cc each</td>
<td>6 Outlet Ports @ .3cc each</td>
</tr>
<tr>
<td><strong>3 Point Distribution</strong></td>
<td><strong>8 Point Distribution</strong></td>
</tr>
<tr>
<td>6 Point</td>
<td>8 Point</td>
</tr>
<tr>
<td>Use 6 Point Block</td>
<td>Use 8 Point Block</td>
</tr>
<tr>
<td>1 Horizontal Coupler</td>
<td>8 Outlet Ports @ .3cc each</td>
</tr>
<tr>
<td>2 Vertical Couplers</td>
<td></td>
</tr>
<tr>
<td>3 Outlet Ports @ .6cc each</td>
<td></td>
</tr>
<tr>
<td><strong>4 Point Distribution</strong></td>
<td><strong>9 Point Distribution</strong></td>
</tr>
<tr>
<td>4 Point</td>
<td>10 Point</td>
</tr>
<tr>
<td>Use 4 Point Block</td>
<td>Use 10 Point Block</td>
</tr>
<tr>
<td>4 Outlet Ports @ .3cc each</td>
<td>10 Oulet Ports @ .3cc each</td>
</tr>
<tr>
<td><strong>5 Point Distribution</strong></td>
<td><strong>10 Point Distribution</strong></td>
</tr>
<tr>
<td>10 Point</td>
<td>10 Point</td>
</tr>
<tr>
<td>Use 10 Point Block</td>
<td>Use 10 Point Block</td>
</tr>
<tr>
<td>4 Vertical Coupler</td>
<td>10 Oulet Ports @ .3cc each</td>
</tr>
<tr>
<td>1 Horizontal Couplers</td>
<td>1 Oulet Port @ .6cc</td>
</tr>
<tr>
<td>5 Outlet Ports @ .6cc each</td>
<td></td>
</tr>
<tr>
<td><strong>6 Point Distribution</strong></td>
<td><strong>11 Point Distribution</strong></td>
</tr>
<tr>
<td>6 Point</td>
<td>12 Point</td>
</tr>
<tr>
<td>Use 6 Point Block</td>
<td>Use 12 Point Block</td>
</tr>
<tr>
<td>6 Outlet Ports @ .3cc each</td>
<td>12 Oulet Ports @ .3cc each</td>
</tr>
<tr>
<td><strong>7 Point Distribution</strong></td>
<td><strong>12 Point Distribution</strong></td>
</tr>
<tr>
<td>8 Point</td>
<td>12 Point</td>
</tr>
<tr>
<td>Use 8 Point Block</td>
<td>Use 12 Point Block</td>
</tr>
<tr>
<td>1 Vertical Coupler</td>
<td>12 Oulet Ports @ .3cc each</td>
</tr>
</tbody>
</table>

On each complete cycle of the Distribution Block, each output port ejects .3 cc's of lubricant. When 2 output ports are coupled using either the horizontal or vertical coupler, one of the output ports is blocked and its output diverted to the second port. The bearing that is connected to a coupled output port receives the lubricant from both ports or .6 cc's per cycle of the Distribution Block.

The actual volume of lubricant flowing from each output port during the period of one day is controlled by the amount of lubricant that has been programmed to be ejected by the MEMOLUB Lubricator. To program the MEMOLUB to eject the required volume of lubricant for a multi-point application, it is necessary to determine the daily volume of grease required by all of the bearings attached to the system. To do this, multiply the requirement for one bearing times the number of output ports on the system. This is the daily output that the MEMOLUB must be programmed to deliver. Bearing lubricant requirements are generally stated in cubic centimeters over some fixed interval of time.

It is important to remember that each bearing on the system will receive an equal amount of grease unless that bearing is receiving lubricant from an output port that has been coupled, in which case it will receive twice as much grease as a bearing that has not been coupled.

For additional assistance in planning your multi-point application or for information on programming the MEMOLUB Lubricator, please contact PLI, LLC.

MEMOLUB "Plug and Lube" Multi-point Lubrication Systems may be ordered completely set up, preprogrammed and ready to install with pre-filled lube lines. Call for more information.
Lubricant Output Programming

Timing Rings are placed in the Black Ring Holder individually or in combination. This programs the number of ejected cycles that occur each day and thus the daily lubricant output.

Each output stroke ejects .635 cc's of lubricant. This lubricant is divided between the two output ports.

The Stroke Limiting Washers used with the Single Point MEMOLUB® to adjust the volume of output per stroke are NOT used with the MEMOLUB® HPS 2-Point Splitter System.

The frequency of cartridge change-out is shown under each HPS model.

<table>
<thead>
<tr>
<th>Program</th>
<th>Ejection Cycles Per Day</th>
<th>Daily Output in CC's</th>
<th>HPS Standard, Model 120</th>
<th>HPS Mega, Model 240</th>
<th>HPS Giga, Model 480</th>
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<tr>
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<td>31 4 1</td>
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<td>7.62</td>
<td>16 2 -</td>
<td>31 4 1</td>
<td>63 9 2</td>
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<tr>
<td>RB</td>
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<td>2.54</td>
<td>47 7 1</td>
<td>94 13 3</td>
<td>189 27 6</td>
</tr>
<tr>
<td>R</td>
<td>2</td>
<td>1.27</td>
<td>94 13 3</td>
<td>189 27 6</td>
<td>381 54 12</td>
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<tr>
<td>BW</td>
<td>1.5*</td>
<td>0.95</td>
<td>126 18 4</td>
<td>253 36 8</td>
<td>505 72 12</td>
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<tr>
<td>W</td>
<td>1</td>
<td>0.64</td>
<td>189 27 6</td>
<td>381 54 12</td>
<td>750 107 25</td>
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<tr>
<td>B</td>
<td>.5**</td>
<td>0.32</td>
<td>381 54 12</td>
<td>750 107 25</td>
<td>- - -</td>
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</table>

If, at the ejection rate selected, the “Months to Empty” exceed 12 months, it is recommended that the Lubricant Cartridge and Battery Pack be replaced at least every 12 months.

To extend Battery Pack and Lubricant Cartridge change-out to 24 months, we suggest the use of “Cold Weather” Lithium Battery Packs.

* Ejection cycle occurs every 16 hours. Daily Output shown is average lubricant output per day.
** Ejection cycle occurs every other day. Daily Output shown is average lubricant output per day.
How the Splitter MEMO Works

The Valve Stem is maintained in the upper position by the spring. When the MEMOLUB® HPS ejects lubricant, the MEMOLUB® HPS pump piston simultaneously pushes the Valve Stem downwards. Lubricant flows through the hollow Valve Stem and, as shown in stage 1, out through Outlet 1. As the Valve Stem moves downwards, Outlet 1 is closed and Outlet 2 opens allowing lubricant to flow through it, as shown in stage 2. Upon completion of the output cycle the Return Spring pushes the Valve Stem into the upper position to complete the cycle.

Mounting Dimensions

<table>
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<tr>
<th>Model</th>
<th>Height (mm)</th>
<th>Height (cm)</th>
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<td>Giga</td>
<td>40</td>
<td>1.57</td>
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<tr>
<td>Mega</td>
<td>43</td>
<td>1.69</td>
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<tr>
<td>Standard</td>
<td>48</td>
<td>1.91</td>
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</table>
Pre-charging and Annual Maintenance of Lubrication Systems

The Maintenance Adapter can be used to “pre-charge” a remote line or a distribution block and its associated lines. This pre-charge procedure may become necessary during initial equipment installation or when changing the type of grease being used. It can also be used to conveniently add grease to a bearing on which the MEMO has already been installed. The Maintenance Adapter has a M12 x 1.50 female thread, which matches the male thread of the brass MEMO fitting.

The Maintenance Adapter is also useful in flushing old grease from remote lines and distribution systems. It is recommended that this procedure be performed on an annual basis to eliminate the potential problems associated with grease/oil separation that can occur with some greases.

MEMOLUB® Multi-Point Systems ordered as a Plug’n Lube™ system, with tubing that has been pre-filled at the factory, already contains the correct lubricant and does not require filling in the field during installation.

Note: The Maintenance Adapter is not to be used with the 2-Point Splitter System. Please refer to Section 3.3 for information on the proper procedure to be used in priming the Splitter-MEMO.

If additional Maintenance Adapters are needed they can be ordered as part number: OPMaintADPT
Mounting Brackets and Dust Covers

Mounting Bracket with Dust Cover
- LDCS-2 Standard Model 120
- LDCM-2 Mega Model 240
- LDCG-2 Giga Model 480

Dust Cover Only
- DCS-1 Standard Model 120
- DCM-1 Mega Model 240
- DCG-1 Giga Model 480
- DCSPLIT-120 Splitter Model 120
- DCSPLIT-240 Splitter Model 240
- DCSPLIT-480 Splitter Model 480

Mounting Bracket Only
- MLLB-1 Bracket for 1 lubricator
- MLLBK-1 Bracket for 2 or 3 lubricators

Power Supply Options (used with the MEMOLUB® EPS lubricators)

#OPEPS110AC5V2A
EPS Plug in Power
Run the MEMOLUB® EPS lubricator off any 110VAC outlet with the plug in power transformer.

#OPEPS110AC5V2A
EPS Rack Mount Power
Connect a 110VAC power supply from your machine or PLC to the rack mount power transformer to run the MEMOLUB® EPS lubricator.

Adapters

- A-1 1/4" NPT(F) x 1/4-28 Straight (M), Brass
- A-2 1/4" NPT(F) x 1/8" NPT (M), Brass
- A-3 1/4" NPT(F) x 1/4" NPT(M) x 90°, Brass
- A-4 1/4" NPT(F) x 1/4" NPT(M) x 45°, Brass
- A-5 1/8" NPT(F) x 1/8" NPT(M) x 45°, Brass
- A-6 1/8" NPT(F) x 1/4-28 Straight (M), Steel
- A-7 1/2" NPT(F) x 1/4" NPT(M), Steel
- A-8 1/4" NPT(F) x 1/4" NPT(M), Brass
- A-9 1/8" NPT(F) x 1/8 BSPT(M), Brass
- A-10 1/8" NPT(F) x 1/4-28 Straight (M) x 90°, Steel
- A-11 1/8" BSPT(F) x (8M x 1.0)(M), Brass
- A-12 1/8" BSPT(F) x (8M x 1.25)(M), Brass
- A-13 1/8" BSPT(F) x 1/8 NPT(M), Brass
- A-14 1/8" BSPT(F) x 1/8 BSPT(M), Steel
- A-15 1/8" NPT(F) x 1/8 BSPT(M), Steel
- A-16 1/8" NPT(F) x (6M x 1.0)(M), Steel
- A-17 1/8" NPT(F) x (6M x .75)(M), Steel

Other Parts

- B4N-1.375H 1/4" NPT(M) x 1/4" NPT(M) x 1.375", Brass Hex Nipple
- B4BN-1H 1/4 BSPT(M) x 1/4" NPT(M) x 1", Brass Hex Nipple Adapter
- B4BN-2 1/4 BSPT(M) x 1/4" NPT(M) x 2", Brass Hex Nipple Adapter
- B4BN-2.5 1/4 BSPT(M) x 1/4" NPT(M) x 2.5", Brass Hex Nipple Adapter
- B4BN-3 1/4 BSPT(M) x 1/4" NPT(M) x 3", Brass Hex Nipple Adapter
- B4BN-3.5 1/4 BSPT(M) x 1/4" NPT(M) x 3.5", Brass Hex Nipple Adapter
- B4BN-4.13 1/4 BSPT(M) x 1/4" NPT(M) x 4.13", Brass Hex Nipple Adapter
- BUSHB4NM8NF 1/8" NPT(F) x 1/4" NPT(M), Brass Bushing
- CKV-1 1/4"NPT(F) -- 1/4"NPT(M), 3 psi cracking pressure, Check Valve
- CKV-2 1/8"NPT(M) -- 1/8"NPT(F), 3 psi cracking pressure, Check Valve
- CKV-3HP 1/4"NPT(F) -- 1/4"NPT(M), 5 psi cracking pressure, HP Check Valve
- CKV-4 1/4"NPT(F) -- 1/4"NPT(M), 15 psi cracking pressure, Check Valve
- COUPLB4C 1/4" NPT(F) x 1/4" NPT(F), Brass Coupler
- OPMaintAdpt Maintenance Adapter
- RV-1 1/8" NPT(M) x 1 PSI Cracking Pressure, Relief vent
Push-in Tube Fittings

6mm OD Tube Fittings:
- 3101-06-19 M5(M), Straight
- 3106-06-00 6mmOD x 6mmOD Tube to Tube Straight
- 3109-06-10 1/8BSPT(M) x 90°
- 3109-06-11 1/8"NPT(M) x 90°
- 3109-06-14 1/4"NPT(M) x 90°
- 3109-06-6MPC M6(M) x 90°
- 3114-06-10 1/8BSPT(F), Straight
- 3114-06-13 1/4BSPT(M), Straight
- 3169-06-13 G1/4BSPP(M) x 90°
- 3175-06-10 1/8BSPT(M), Straight
- 3175-06-11 1/8"NPT(M), Straight
- 3175-06-6M MPC M6(M), Straight
- 3199-06-19 M5(M) x 90°

1/4" OD Tube Fittings:
- 3009-56-11 1/8"NPT(F) x 90°
- 3014-56-11 1/8"NPT(F), Straight
- 3014-56-14 1/4"NPT(F), Straight
- 3109-56-10 1/8BSPT(M) x 90°
- 3109-56-11 1/8"NPT(M) x 90°
- 3109-56-14 1/4"NPT(M) x 90°
- 3109-06-6MPC M6(M) x 90°
- 3114-06-10 1/8BSPT(F), Straight
- 3114-06-13 1/4BSPT(M), Straight
- 3169-06-13 G1/4BSPP(M) x 90°
- 3175-06-10 1/8BSPT(M), Straight
- 3175-06-11 1/8"NPT(M), Straight
- 3175-06-6MPC M6(M), Straight
- 3199-06-19 M5(M) x 90°

5/16" (8mm) OD Tube Fittings:
- 3009-08-11 1/8"NPT(F) x 90°
- 3009-08-14 1/4"NPT(F), Straight
- 3014-08-11 1/8"NPT(F), Straight
- 3014-08-14 1/4"NPT(F), Straight
- 3109-08-00 8mmOD x 8mmOD Tube to Tube, Straight
- 3109-08-10 1/8BSPT(M) x 90°
- 3109-08-11 1/8"NPT(M) x 90°
- 3109-08-13 1/4BSPT(M) x 90°
- 3109-08-14 1/4"NPT(M) x 90°
- 3168-08-06 8mmOD(F) x 6mmOD(M) Expander
- 3169-08-13 G1/4BSPP(M) x 90°
- 3169-08-17 G3/8BSPP(M) x 90°
- 3175-08-10 1/8BSPT(M), Straight
- 3175-08-11 1/8"NPT(M), Straight
- 3175-08-13 1/4BSPT(M), Straight
- 3175-08-14 1/4"NPT(M), Straight
- 3805-08-10 1/8BSPT(M), Straight Stainless Steel
- 3805-08-11 1/8"NPT(M), Straight Stainless Steel
- 3805-08-13 1/4BSPT(M), Straight Stainless Steel
- 3805-08-14 1/4"NPT(M), Straight Stainless Steel
- 3889-08-10 1/8BSPT(M) x 90° Stainless Steel
- 3889-08-11 1/8"NPT(M) x 90° Stainless Steel
- 3889-08-14 1/4"NPT(M) x 90° Stainless Steel

Tubing and Accessories

Nylon tubing is sold two ways; pre-filled in 5 foot increments from 5 to 30 feet, or empty in any length from 1 to 100 feet.

- TB6MM 6mm OD Nylon Tubing
- TBP5600 1/4" OD Nylon Tubing
- TBP5800A 5/16" (8mm) OD Nylon Tubing
- TBP6000 3/8" OD Nylon Tubing
- TB3000-71-00 Nylon Tubing Cutter
- TBCLIP-08 5/16" (8mm) OD Installation Clip
- TB5800CP 5/16" OD Copper Tubing

Plug 'n Lube™ pre-filled tubing

Just specify tubing O.D., length and lubricant desired.

<table>
<thead>
<tr>
<th>Tubing O.D.</th>
<th>Tubing Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>6MM</td>
<td>6mm OD</td>
</tr>
<tr>
<td>056</td>
<td>1/4&quot; OD</td>
</tr>
<tr>
<td>58A</td>
<td>5/16&quot; OD</td>
</tr>
<tr>
<td>060</td>
<td>3/8&quot; OD</td>
</tr>
</tbody>
</table>


Chain Oil Brush Assemblies

Chain Oil Brush Assembly includes a brush, 18" length of 5/16" OD nylon tubing and 2 push-in tube fittings. We recommend using a check valve (part # CKV-2) with all Chain Oil Brush Assemblies. Mounting brackets are also available for easy installation.

- CA-1 Chain Oil Assembly with 2" Flat Nylon Brush
- CA-1S Chain Oil Assembly with 2" Flat Stainless Brush
- CA-2 Chain Oil Assembly with 5/8" Round Nylon Brush
- CA-2S Chain Oil Assembly with 5/8" Round Stainless Brush
- CA-3 Chain Oil Assembly with 1" Round Nylon Brush
- CA-3S Chain Oil Assembly with 1" Round Stainless Brush
- OPLBKT-2 Oil brush mounting bracket

Brushes

- OPBRUSH5/8RD 5/8" Round Nylon Brush
- OPBRUSH1RD 1" Round Nylon Brush
- OPBRUSH2FLAT 2" Flat Nylon Brush
- OPBRUSH5/8RDSS 5/8" Round Stainless Steel Brush
- OPBRUSH1RDSS 1" Round Stainless Steel Brush
- OPBRUSH2FLATSS 2" Flat Stainless Steel Brush
MEMOLUB® HPS

Manual Lubrication vs MEMOLUB® HPS Automatic Lubrication

Relubrication

Typical Manual Lubrication Pattern

1) Infrequent
2) Irregular
3) Over Lubricated
4) Under Lubricated

Missing more than one re-lubrication cycle and a bearing is likely to sustain damage.

Typical MEMOLUB® HPS Lubrication Pattern

- Frequent
- Regular
- Reliable

Programmable:
- 7 Time Choices
- Up to 8 Stroke Volume Selections
- 52 Daily Output Ejection Settings

System Switched off During Shutdown

Time
The MEMOLUB® EX is the same self-contained, battery powered lubricator as the MEMOLUB® HPS model with a modified enclosure rated for limited hazardous locations. *(See rating listed below)*

The MEMOLUB® EX is available in three sizes, the Standard (Model 120), the Mega (Model 240) and the Giga (Model 480). The lubricant cartridges are pre-filled with the customers choice of over 200 stock lubricants, thus eliminating the costly process of manually refilling reservoirs. Lubricant cartridge replacement normally takes less than 1 minute.

The MEMOLUB® EX may be used as a single point lubricator, either mounted directly on the bearing or remotely using pipe or flexible tubing. The MEMOLUB® EX can also be used with our progressive distribution block as a multi-point system, lubricating 2 to 12 bearing points, or with the MEMOLUB® 2 Point Splitter.

### Rating:

**EEX nC II T6 - T85°C - IP66**

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II</td>
<td>Equipment destined to be used in places where an atmosphere which could explode due to gases and/or dusts can occur.</td>
</tr>
<tr>
<td>Category 3</td>
<td>Equipment made to assure a normal level of protection. Those equipments are destined to be placed in an environment where an explosive atmosphere (due to gases, vapors and dusts) has a little probability to occur.</td>
</tr>
<tr>
<td>Applications to Zones 2 and 22</td>
<td>Places where an explosive atmosphere due to mist, gases or vapors (zone 2) or due to dusts (zone 22) is not likely to occur under normal working conditions.</td>
</tr>
<tr>
<td>T6-85°C</td>
<td>Maximum temperature.</td>
</tr>
<tr>
<td>IP-66</td>
<td>Resist to dust and powerful jets of water.</td>
</tr>
<tr>
<td>ISSePO4 ATEX077</td>
<td>Certificate number and laboratory identification.</td>
</tr>
</tbody>
</table>

### MEMOLUB® HPS Specifications:

<table>
<thead>
<tr>
<th>Dimensions:</th>
<th>Temperature Range: 5°F to 120°F (-15°C to 50°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 4-1/2&quot; x 4&quot; (115mm x 101mm)</td>
<td>Operating Pressure: 350psi (25 bar)</td>
</tr>
<tr>
<td>Mega 5-3/4&quot; x 4&quot; (147mm x 101mm)</td>
<td>Battery Pack: 4.5V Alkaline (optional Lithium)</td>
</tr>
<tr>
<td>Giga 10-3/8&quot; x 4&quot; (264mm x 101mm)</td>
<td>Installation Thread: 1/4&quot; NPT (adapters optional)</td>
</tr>
<tr>
<td>Cartridge Capacity:</td>
<td>Remote Installation: Up to 40 feet (12 meters)</td>
</tr>
<tr>
<td>Standard 120cc (approx. 4 ounces)</td>
<td>Applications: 1 to 12 Lube Points (with distribution block)</td>
</tr>
<tr>
<td>Mega 240cc (approx. 1/2 pound)</td>
<td>Compatible Lubricants: Oils and Greases (to NLGI #2)</td>
</tr>
</tbody>
</table>
Battery Operated Lubrication with External Control

The MEMOLUB® EPC offers the advantage of providing automatic lubrication to machines that are infrequently or intermittently used, avoiding the problems of over lubrication.

The lubrication process can be turned on and off in concert with the machine being lubricated or manually using a simple switch.

The MEMOLUB® EPC is battery powered and requires no external power source. It operates under its own MEMO program that you preset. This controls the frequency of lubrication cycles and volume of lubricant injected.

The MEMOLUB® EPC can be mounted directly on the bearing or remote from the bearing using pipe or flexible tubing. It may be used as a Multi-Point System lubricating from 2 to 12 lube points and is available in any of the three MEMOLUB® sizes.

The 12 inch cable that extends from the bottom of the lubricator serves to interrupt the electric circuit to the drive motor. When the circuit is closed the MEMOLUB® first goes through an output cycle and then proceeds to operate under its own preset program control. When the circuit is opened the lubrication process stops.

Extension wire kits are also available in 15 and 30 foot lengths. Each kit comes with quick connectors to easily remove the MEMOLUB® lubricator during cartridge change-out.

Control over the lubrication process can be achieved in several ways.

* A simple switch can be used to manually turn the lubricator on during machine operation and off when use is complete.

* A relay, that is associated with the main power switch of the machine being lubricated, can be used. Relay contact must be gold plated. The type of relay is determined by the application. The distances between the MEMOLUB® EPC and the relay determines the gauge of the wire and the associated connectors to be used.

* PLC control is also an option in closing and opening the circuit. For an output cycle to occur the PLC must close the circuit for a minimum of 15 seconds and there must be a minimum 60-second interval between output cycles. The timing of ejection cycles is controlled by the PLC. The white timing ring must be in place. The volume of lubricant ejected per cycle continues to be controlled by the MEMO.

For additional information please contact PLI, LLC.
Controlled lubrication with a 4.5VDC, 12VDC or 24VDC External Power Supply

The MEMOLUB® EPS is ideally suited to applications in which machinery is intermittently or infrequently used. It provides the control needed to insure proper lubrication during periods of operation while avoiding the problem of over lubrication.

An external 4.5VDC, 12VDC or 24VDC power source is connected to the 12 inch cable extending from the bottom of the MEMOLUB®. A battery pack is not required. Extension lead wires and connectors are available.

The MEMOLUB® EPS can be mounted directly on the bearing point or remote from the bearing using pipe or flexible tubing. It may also be used as a Multi-Point System lubricating from 2 to 12 lube points. The EPS is available in any of the three MEMOLUB® sizes.

Control of the lubrication injection cycles occurs in one of two ways.

The MEMOLUB® EPS is periodically supplied with DC power by a PLC under program control. Lubrication output cycles of the MEMOLUB® can be based upon hours of machine operation, a count of machine cycles or any other desired criteria.

The MEMOLUB® EPS operates under its own program control. A constant 4.5VDC, 12VDC or 24VDC power is supplied during periods of machine operation. The MEMOLUB® program controls the frequency of lubricant output cycles.

Suggested activation configurations:

- A PLC or relay associated with the main power switch of the machine can be used to turn the MEMOLUB® lubricator on and off during machine operation.
  
  OR

- A manual switch can also be used to turn the MEMOLUB® lubricator on and off during machine operation.

Specifications & Operating Characteristics:

Transformers: (see parts list)
- High efficiency
- Overload/Over-Voltage protection
- Short-Circuit Protection

Output Voltage: 4.5 VDC, 12VDC or 24VDC
Output Current: 2 Amps peak / 1 Amp working
Connectors & Extension Cables are available.

PLC Program Control:
- White Timing Ring is used.
- Duration of PLC power pulse is 15 seconds
- Delay interval between pulses is 60 seconds
- Empty Cartridge - PLC program counter

Electrical Wiring:
- Brown (+) / White (-)
- Wiring length between MEMOLUB® EPS and transformer:
  - AWG 20 (Cross section 2 x 0.5mm²) - 16 feet (5 meters) or less
  - AWG 18 (Cross section 2 x 1.0mm²) - 33 feet (10 meters)

MEMOLUB® Output Program:
- The MEMOLUB® lubricator volumetric output will be determined by the standard settings in our Installation Instruction sheets. However due to intermittent cycle times, the frequency of output cycles is determined by the customer and therefore the cartridge change-out time will need to be calculated or determined by visual inspection.
PLC Powered and Controlled Lubrication

The MEMOLUB® 24V-PLCd model lubricator is especially designed for PLC-controlled machinery (or mobile equipment) where a 24VDC power supply is available. It is ideal for lubricating a wide variety of robots, conveyors, and OEM applications. The MEMOLUB® 24V-PLCd can be direct-mounted for single-point applications, or remote-mounted using pipe or flexible tubing. In addition, lubrication from 2 to 12 lube points is possible with a MEMOLUB® Multi-Point Lubrication System.

The MEMOLUB® 24V-PLCd lubricator has a unique design utilizing a Power-Through Memo which contains the electrical connections needed to power the unit. This gives the user the ability to quickly remove the lubricator for fast lubricant cartridge change-out while avoiding contact with the electrical connections. A 5-foot extension cable on the Power-Through Memo is connected to a PLC-controlled power supply. The PLC program controls the frequency of lubrication output cycles, which may be based upon elapsed clock hours, machine cycles, a count of parts produced, or other desired criteria. Further control is provided by adjusting the volume of lubricant ejected on each cycle. A set of 8 special stroke-limiting washers are supplied with each lubricator. When the Power-Through Memo is used without washers (yielding full piston stroke), the output volume at each stroke is 0.635cc. For each washer (including the "C"-shaped lock washer) inserted into the brass adapter of the Power-Through Memo, the output volume is decreased by 0.04cc per stroke.

(Note: The lock washer should always be inserted last to hold the others in place.)

<table>
<thead>
<tr>
<th>Output per spacer washers:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = 0.63cc/stroke</td>
</tr>
<tr>
<td>1 = 0.59cc/stroke</td>
</tr>
<tr>
<td>2 = 0.55cc/stroke</td>
</tr>
<tr>
<td>3 = 0.51cc/stroke</td>
</tr>
<tr>
<td>4 = 0.47cc/stroke</td>
</tr>
<tr>
<td>5 = 0.43cc/stroke</td>
</tr>
<tr>
<td>6 = 0.39cc/stroke</td>
</tr>
<tr>
<td>7 = 0.35cc/stroke</td>
</tr>
<tr>
<td>8 = 0.31cc/stroke</td>
</tr>
</tbody>
</table>

The MEMOLUB® 24VDC-PLC is available in three sizes: the Standard (Model 120), the Mega (Model 240), and the Giga (Model 480). Like the HPS model, it is reusable with available replacement lube cartridges. These cartridges are carefully filled at the factory using a precise centrifuging process that eliminates air pockets and contamination. Cartridge change-out normally takes less than 60 seconds! MEMOLUB® is a valuable alternative to time-consuming and costly manual lubrication.

Specifications:
* PLC-controlled lubrication cycles
* 2-wire, 5ft extension cable, Brown(+), Blue(-)
* Input voltage: 24VDC
* Max Amps: .5A
* Single cycle duration: 7.5 seconds
* Minimum time between output cycles: 10 Minutes
* Maximum continuous running time: 30 Seconds
* Polarity Protection
Lubricator Installation Instructions

1. Program the volume of lubricant output by inserting the stroke-limiting washers.
2. Install the Power-Through Memo fitting, either direct or remote mounted.
3. Screw the MEMOLUB® 24VDC-PLC on the Power-Through Memo fitting.
4. The MEMOLUB® 24VDC-PLC must be connected to a PLC for its power supply. The PLC determines the frequency of output cycles. *(PLC Not Included)*

Lubricant Cartridge Change Out Instructions

1. To open, place the lubricator upright on flat surface. Press firmly and turn locking ring counter-clockwise while holding the ribbed surface.
2. Remove the paper, disk-shaped label from the replacement cartridge and fill in the "Start Date" and "Change Date".
3. Carefully squeeze air out of the cartridge until grease begins to emerge from the outlet.
4. Place the cartridge on the inlet of the red housing.
5. Place the clear housing assembly over the lubricant cartridge and red housing.
6. Holding the locking ring by its ribbed surface, turn it clockwise until it clicks into the locked position.

SAFETY PRECAUTIONS

*Warning: Lower red housing contains a loaded spring. Do not open.*
*Use only factory pre-filled cartridges with MEMOLUB® lubricator.*
Which MEMOLUB® Lubrication System to order.

<table>
<thead>
<tr>
<th>Input Power Source</th>
<th>Battery Pack / 4.5VDC</th>
<th>Battery Pack / 4.5VDC</th>
<th>External 4.5VDC or 110VAC (with transformer)</th>
<th>External / 12VDC</th>
<th>External / 24VDC</th>
<th>External / 24VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Programming Control</td>
<td>MEMO</td>
<td>MEMO</td>
<td>MEMO or PLC</td>
<td>MEMO or PLC</td>
<td>MEMO or PLC</td>
<td>PLC</td>
</tr>
<tr>
<td>Lubricator On/Off Control</td>
<td>Manual</td>
<td>External</td>
<td>External</td>
<td>External</td>
<td>External</td>
<td>External</td>
</tr>
<tr>
<td>Lubricator Output Settings</td>
<td>52</td>
<td>52</td>
<td>52+</td>
<td>52+</td>
<td>52+</td>
<td>52+</td>
</tr>
<tr>
<td>Multi-Point Compatible</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Splitter Block Compatible*</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Motor Housing Color</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Blue</td>
<td>Blue</td>
<td>Yellow</td>
</tr>
<tr>
<td>Use with Grease (to NLGI #2)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use with Oil</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Available in all 3 sizes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Output Pressure</td>
<td>350 PSI (25 bar)</td>
<td>350 PSI (25 bar)</td>
<td>350 PSI (25 bar)</td>
<td>350 PSI (25 bar)</td>
<td>350 PSI (25 bar)</td>
<td>350 PSI (25 bar)</td>
</tr>
<tr>
<td>Temperature Range **</td>
<td>+5°F to +120°F (-15°C to +50°C)</td>
<td>+5°F to +120°F (-15°C to +50°C)</td>
<td>+5°F to +120°F (-15°C to +50°C)</td>
<td>+5°F to +120°F (-15°C to +50°C)</td>
<td>+5°F to +120°F (-15°C to +50°C)</td>
<td>+5°F to +120°F (-15°C to +50°C)</td>
</tr>
<tr>
<td>Remote Installation (single-point)</td>
<td>Up to 40 feet (12 meters)</td>
<td>Up to 40 feet (12 meters)</td>
<td>Up to 40 feet (12 meters)</td>
<td>Up to 40 feet (12 meters)</td>
<td>Up to 40 feet (12 meters)</td>
<td>Up to 40 feet (12 meters)</td>
</tr>
</tbody>
</table>

* Splitter Blocks cannot be used with oil, and are limited to 7 lubricant output settings.
* ** Lower temperatures can be achieved by using a lowtemp grease and cold-weather battery packs.
### Attachments:

#### Sub Assembly Drawing Numbers:

<table>
<thead>
<tr>
<th>MotoRail 7-20</th>
<th>MotoRail 7-50</th>
<th>Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>413055C4L-5</td>
<td>42177SC5-0</td>
<td>41305SSG-0</td>
</tr>
<tr>
<td>41305SC4R-5</td>
<td>42177SC6-0</td>
<td>41305SSG2-0</td>
</tr>
<tr>
<td>41305SY6-4</td>
<td>42177SC8-0</td>
<td>TMLUB-HPS-0</td>
</tr>
<tr>
<td>41305SS2-4</td>
<td>42177SY8-4</td>
<td>TMLUB-EPS-0</td>
</tr>
<tr>
<td>41305SYBA-0</td>
<td>42177SS2-1</td>
<td></td>
</tr>
<tr>
<td>41305SYHA-0</td>
<td>42728SYBA-0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>42728SYHA-0</td>
<td></td>
</tr>
</tbody>
</table>

#### Supplier Documentation:

Memolub® Lubrication System  
Vogel Progressive Feeders
NOTES:
1) THIS CARRIAGE ASSEMBLY CAN BE REASSEMBLED AS RIGHT HAND UNIT 413055C4R.
(GEARGEAR 413055G4R CAN BE REASSEMBLED TO MAKE GEARGEAR 413055G4R.)

2) CARRIAGE TO BE PAINTED MITULMAN RED, SHERWIN WILLIAMS #63R12.

3) TORQUE M10-15 SHCS CLASS 8.8 USED FOR ROLLER BLOCK AND GEARGEAR MOUNTING TO 51nm.

4) TORQUE M12-175 SHCS CLASS 8.8 USED FOR MOTOR MOUNTING TO 89nm.
NOTES:
1) TORQUE MB-125 SHCS CLASS 8.8 USED FOR MOUNTING RACKS TO BEAM.
2) TORQUE MB-15 SHCS CLASS 8.8 USED FOR MOUNTING RAILS TO BEAM.
3) TORQUE M4-7 SHCS CLASS 10.9 USED FOR BUTT JOINTS TO BEAM.
4) BEAM TO BE PAINTED MIDTAN HEB, SHELLBAY WILLIAMS II SIG.
NOTE:
1) TORQUE M20-2.5 HCS CLASS 8.8 USED FOR LEG MOUNTING TO 420N-m.
2) LEG TO BE PAINTED DARK GRAY,
SHERWIN WILLIAMS #637X/95ABB89-619-4389.
NOTES:
1) CARRIAGE TO BE PAINTED METAL MAN. RED, SHERWIN WILLIAMS HW5930.
2) TORSION M2-1/16 SAE CH1 BRadding FOR ROLLER BLOCK AND GEARBOX MOUNTING TO 90MM.
3) TORSION M2-1/16 SAE CH1 BRadding FOR METER FLANGE TO 90MM. DO NOT INCREASE TORQUE REGARDLESS OF FASTENER (GRAB).
NOTES

1) CARRIAGE TO BE PAINTED METALLIC RED, SHERWIN WILLIAMS METAL.

2) TORQUE M6x1.05 SAE CLASS 8.8 LS USE 3 FOR ROLLER BLOCK AND GEARBOX MOUNTING TO 89NM.

3) TORQUE M8x1.75 SAE CLASS 8.8 LS USE 3 FOR MOTOR FLANGE TO 89NM. DO NOT INCREASE TORQUE REGARDLESS OF FASTENER GRADE.
NOTES:

1) TORQUE M8-1.25 SLOE CLASS 8.8 USED FOR MOUNTING RACKS TO 25A-240.

2) TORQUE M8-1.0 SLOE CLASS 8.8 USED FOR MOUNTING RAILS TO 25A-240.

3) TORQUE M6-1.0 SLOE CLASS 8.8 USED FOR BUSH JOINTS TO 25A-240.

4) BEAM TO BE PAINTED MOTTMAN RED, SHERWIN WILLIAMS #62912.
NOTE:
1) TORQUE M24-3 HICHES CLASS 8.8 USED FOR LEG MOUNTING TO 725kN.  
2) LEG TO BE PAINTED DARK GRAY, SHERWIN WILLIAMS #637X295A389-619-4389.
NOTES:

1) TORQUE M20-2.5 HHC5 CLASS 8.8 USED FOR GUSSET TO LEG MOUNTING TO 42CH

2) GUSSET TO BE PAINTED DARK GRAY, SHERWIN WILLIAMS #F637XZ99AB0-619-4389.

3) TOUCH-UP PAINT PROVIDED.
NOTES:
1) TORQUE M80-2.5 HCS CLASS 8.8 USED FOR GUSSET TO LEG MOUNTING TO 420N.m.
2) GUSSET TO BE PAINTED DARK GRAY,
SHERWIN WILLIAMS #637XZ99A89-619-4389.
3) TOUCH-UP PAINT PROVIDED.
CARRIAGE

1. Cycle Switch
2. Screw Plug
3. 1/8 NPT Male Elbow
4. 1/8 NPT to 1/4 NPT Fitting Adapter
5. 1/8 NPT Male Connector
6. 1/8 x 1/4 Tube Adapter
7. 30 Degree Street Elbow, 1/8 NPT Male to 1/4 NPT Female
8. Progressive feeder with 3 pairs of parts (G, I, H)

1. GUS P/N
2. MFG P/N
3. MFG
MEMOLUB® HPS Lubricator - Installation Instructions

General

The MEMOLUB HPS (High Pressure System) is both an advanced design, highly accurate, single point automatic lubricator and a low cost miniature central lubricating system, all in one. It is self-contained and operates without an outside supply of energy or controls. Using the MEMOLUB progressive distribution block, it can be used to lubricate between 2 and 8 lubrication points. Using pipe or tubing, the MEMOLUB HPS can be mounted great distances from the bearing being lubricated (see page 4 for details). This feature is valuable when it is necessary to lubricate out of reach bearings, to avoid extremely high temperatures, harsh or hazardous environments or mount the MEMOLUB HPS away from vibration.

The MEMO programming system controls the rate of lubricant ejection. The MEMO is programmed only once before being permanently installed on a bearing, bulkhead fitting or inlet of a progressive distributor. It is removed only if it is desired to change the programmed rate of lubricant ejection.

Installation

On first installation, use a hand grease gun and the same type of lubricant to pre-charge the MEMO, all fittings, lines, the bearings, and, if one is used, the progressive distributor. This step does not need to be repeated when changing the MEMOLUB HPS lubricant cartridge. The MEMOLUB HPS positive displacement pump has been primed before shipment and is ready for use. If, however, the pump becomes unprimed due to running the lubricator with an empty lubricant cartridge, or operating the lubricator without a cartridge in place, it should be primed before installing the new lubricant cartridge. To prime the pump, using a hand grease gun (without the nipple adapter), pump grease through the upper valve of the MEMOLUB HPS until grease comes out of the bottom outlet. Two pumps of grease is generally sufficient. The "Check Function" (page 2) can be used to insure that the pump is primed.

The MEMO has a ¼" NPT thread. It can be adapted to other thread sizes using standard adapters. Commonly used adapters are listed on the TechLube™ Installation Parts and Accessories sheet.

Batteries

MEMOLUB HPS will operate successfully at temperatures up to 140°F. Higher temperatures will cause battery leakage and therefore corrosion, also softening and leakage of grease cartridges and softening and deformation of plastic parts. Areas of high temperatures can often be serviced by remote mounting the MEMOLUB HPS using pipe or tubing. If constant low temperatures (i.e. -4°F or lower) are encountered, low temperature approved greases and MEMOLUB Cold Weather Battery Packs should be used. The Cold Weather Battery Pack should always be used when using the MEMOLUB HPS Giga (Model 480) at temperatures lower than 32°F. The test function should be used on a regular basis when working under extreme temperature conditions. The shelf life of a battery pack stored at 68°F is 2 years. Only MEMOLUB battery packs should be used in the MEMOLUB HPS. Use of batteries other than the MEMOLUB battery pack voids warranty and could permanently damage the MEMOLUB.

How MEMOLUB HPS Works

MEMOLUB® HPS is a fully self-contained electro-mechanical lubricator which utilizes a patented positive displacement pump.

The main components are a motor, gearbox, piston pump, microprocessor and a 4.5v Battery Pack. A cam fitted to the outlet gear drives a lever which lifts the hollow piston and simultaneously compresses a spring. When the piston reaches the top of its stroke, the lever is freed from the cam and the piston begins its downward (working) stroke, driven by the spring. Lubricant is sucked into the chamber formed above the piston during its downward ejection stroke preparing it for the next cycle.

MEMOLUB® HPS Standard Dimensions: Height 4 1/2" Width 4"  
MEMOLUB® HPS Mega Dimensions: Height 5 3/4" Width 4"  
MEMOLUB® HPS Giga Dimensions: Height 10 3/8" Width 4"
Opening & Closing the MEMOLUB, Mounting

To open the MEMOLUB HPS, place the pump body on a flat surface, press the transparent housing downward with one hand while the other hand squeezes the “rippled” part of the locking ring, turning it counterclockwise. The ring is now unlocked and the transparent housing will easily lift off. When closing the MEMOLUB HPS, grasp the rippled part of the locking ring and turn the locking ring clockwise until it clicks into the locked position. **Important:** Always test that the housing is in the locked position by turning the housing counter-clockwise. When installing the MEMOLUB HPS Lubricator, screw the MEMOLUB body onto the memo by gripping only on the smooth part of the locking ring.

Lubricant Cartridges

When installing replacement lubricant cartridges always install a new battery pack. Lube cartridges and battery packs are always sold together as a Replacement Kit. Lubricants available for use in the MEMOLUB HPS have a weight of NLGI 2 or lighter. Best results are achieved with oil filled cartridges when the oil viscosity is ISO 280 or heavier. It is recommended that in cold applications lubricant with an NLGI 1 or lighter be used. MEMOLUB HPS with oil filled cartridges should be installed with a TechLube™ Check Valve (Part Number CV-2). When placing cartridge outlet onto the pump inlet, remove the plug and compress the cartridge slightly until grease just appears at the outlet.

Turn on/turn off

The MEMOLUB HPS is an electromechanical device. Operation begins instantly when it has been turned on. The MEMOLUB HPS may be turned off and back on later if a machine is taken out of production and put back into use at a later date. To turn off the MEMOLUB HPS, simply unscrew it 1 turn. To turn it on, screw it back down onto the MEMO (hand tight).

MEMOS - Setting The Output Rate

Memos are the method used to set the output rate of the MEMOLUB Lubricator. Once programmed, the Memo is screwed into the bearing and remains there until it is decided to change the output rate. The MEMOLUB Lubricator is screwed onto the Memo. This turns on the lubricator to eject lubricant at the desired rate.

Memos are supplied with 3 colored plastic rings (black, white and red) and a black plastic ring holder. The timing of lubricant ejection cycles is determined by which ring or combination of rings are placed in the ring holder. The number of ejection cycles per day determines the volume of lubricant entering the bearing. With each cycle, 0.63 cc's of lubricant are injected into the bearing. The rates of daily lubricant output using different ring combinations are shown in the following chart.

**MEMOLUB HPS Lubricator Basic Settings (The Simple Approach)**

<table>
<thead>
<tr>
<th>Memo Program</th>
<th>Model 120HPS</th>
<th>Model 240HPS</th>
<th>Model 480HPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rings (color)</td>
<td>Strokes Per Day</td>
<td>CC's Per Cycle</td>
<td>Daily Output in CC's</td>
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<tr>
<td>B</td>
<td>0.5*</td>
<td>0.63</td>
<td>0.3</td>
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</table>

* Ejection cycle every other day (48 hours)

"Check Function"

The operation of the MEMOLUB HPS can be tested using the "Check Function". Simply back off the MEMOLUB HPS ¼ turn from the MEMO and then turn it back down, hand tight. The MEMOLUB HPS will immediately go through an output cycle.

Corrosive Environment

The MEMOLUB HPS is a complete miniature machine with electronics, electrical motor, gear box and piston pump. Corrosive, wet environments will damage the MEMOLUB HPS even though it is sealed. Hostile environments can be easily identified as machines are corroded and rusty and electrical or electronic equipment will generally not be found installed in the area. The MEMOLUB HPS must be protected from corrosive, wet or aggressive environments. It should be placed in a protected environment (use piping) or enclosed in a protective cover.

Vibrations

The MEMOLUB HPS gearbox is a relatively heavy unit and is fitted to the plastic housing. Vibrations will cause it to oscillate in the housing (similar to fretting) and this, with time, will generate play and failure. In cases of vibrations, especially high frequency, remote mount the MEMOLUB HPS with flexible tubing or install on the application using the TechLube™ Vibration Mount.
MEMO Programming

The MEMO fitting is permanently screwed into the grease nipple socket, mounting bracket or progressive distributor. Its upper bore is an extension of the MEMOLUB HPS piston cylinder. Adding special MEMOLUB HPS washers into this bore shortens the working stroke of the piston and thus reduces lubricant output.

One, two or all of the colored timer rings are selected and placed in the black MEMO Ring Support. This controls the micro switches on the base of the unit, thus selecting the frequency of the lubrication cycle.

The MEMOLUB HPS Output Chart shows the timer ring and number of washers required to program any of the 50 available output rates. The output rates that are outlined in boxes are those most frequently used.

The locking washer counts as one washer. Always install the locking washer in the MEMO last where multiple washers are required. If only one washer is called for, use the locking washer. The programmed output rate may be changed at any time by pushing the washers back out of the MEMO and changing the number of washers used.

The MEMO normally remains on the lube point when the MEMOLUB HPS is removed for replacement of the lubricant cartridge and battery pack.

In relating the output of the MEMOLUB HPS to manual lubrication practice, generally one stroke from a hand grease gun is equal to 1 cc of grease.

Fine Tuning the Output Program

In many lubrication situations, the lubricant output rates available using the timing rings alone will meet the application requirement. In applications where you want to “fine tune” lubricant output, it is possible to adjust the volume of lubricant ejected on each cycle.

This adjustment is made by placing from 1 to 8 specially designed steel "stop washers" in the bore of the MEMO. These serve to restrict the distance of travel of the pump piston, thus adjusting the output. Over 50 output rates are available for selection.

MEMOLUB HPS

Fine Tuning Your Lubrication Program

<table>
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<tr>
<th>Timing Rings</th>
<th># of Washers</th>
<th>CC's Per Stroke</th>
<th>Daily Output in CC's</th>
<th>Weeks To Empty</th>
<th>Months To Empty</th>
<th>Days To Empty</th>
<th>Weeks To Empty</th>
<th>Months To Empty</th>
<th>Days To Empty</th>
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<td>10</td>
<td>32.3</td>
</tr>
</tbody>
</table>

Preprogrammed Memos

Preprogrammed MEMOS may be specified at time of order. When ordering preprogrammed MEMOS, please indicate the part number (i.e. RWB3 would indicate the Red, White and Black rings with 3 washers) and output rate desired.
Remote Installation - Pipe & Tubing

Pipe or tubing may be used with the MEMOLUB HPS to reach remotely located lubrication points or those in high temperature, dangerous or hazardous areas. The maximum length of piping that should be used is shown in the chart. When using greases with heavy base oils, the piping length should be reduced. If there is a question about the base oil viscosity (ISO) of a particular lubricant, PLI will provide this information upon request.

This chart assumes that an NLGI #2 grease is being used and that the application is operating in an ambient temperature of 68°F or warmer. At colder temperatures, pipe length should be reduced.

In all cases, pipe, tube, fittings and distribution blocks (if used) should be filled with the correct lubricant before installing the MEMOLUB HPS. The best rule for remote installation is not to over do it, but to mount the MEMOLUB HPS using the shortest route possible.

### SPECIFICATIONS

**MEMOLUB® HPS**

- **Applications**: 1 to 8 Lube Points (with distribution block)
- **Operating Pressure**: 350 psi
- **Pressure Build-up**: Immediate
- **Check Function**: Yes
- **Stop/Start**: Immediate
- **Temperature Range**: -5°F and +141°F
- **Electronic Controls**: Quartz Timer, Microprocessor
- **Lubricants**: Oils & Greases to NLGI 2
- **Battery Pack**: 4.5v Alkaline
- **Housing**: Translucent Polycarbonate
- **Installation Thread**: 1/4" npt
- **Remote Installation**: Up to 40 feet
- **Reusable**: Yes

**Dimensions:**
- Standard Model 120 HPS: 4 1/2" x 4"
- Mega Model 240 HPS: 5 3/4" x 4"
- Giga Model 480 HPS: 10 3/8" x 4"

**Cartridge Capacity:**
- Standard Model 120: 120cc (approx 4 oz)
- Mega Model 240: 240cc (approx 1/2 lb)
- Giga Model 480: 480cc (approx 1 lb)

**MEMO:**
- Output Adjustment: 52 Settings
- Frequencies/Ejection Cycles per 24 hour period: 24, 12, 4, 2, 1.5*, 1 and 5**
  * One Cycle every 16 hours
  **Ejection cycle every other day

MEMOLUB HPS carries a 2 year limited warranty from date of purchase for defects in parts and labor. Disassembly of drive unit or use of batteries other than MEMOLUB battery packs voids warranty. Not responsible for consequential damages beyond replacement of product or refund of amount paid. MEMOLUB® HPS is a registered Trademark of Memolub International.
Features of progressive systems

- Universally applicable in respect to mode of operation (continuous/intermittent) and lubricants.
- Central monitoring of functioning of all feeder points possible with little effort or expense.
- Max. number of cycles: 200/min (this is used to calculate the maximum possible amount of oil per outlet port in the case of circulating systems).
- Exact apportionment of the lubricant, even when back pressure is encountered at the lube points, thanks to fitted pistons.
- Max. number of lube points roughly 100; several hundred in the case of ring-line systems with in-line metering pumps.
- Possible pressures: 30 - 200 bars in circulating-oil systems 300 bars in grease systems.
**The principle**
A progressive system essentially consists of a pump, feeders and a control system.

The amount of lubricant delivered by the pump is fed to the lube points by the individual progressive feeders in keeping with their number of pistons and metering rates.

**Function**
The task of the progressive feeder is to feed pressurized lubricant (grease or oil) to the connected lube points one after another in specified fractional amounts.

The lubricant is dispensed as long as it is fed to the progressive feeder under pressure. The fractional amounts are produced by the motion of the pistons. Two lubricant outlet ports are assigned to each piston at both end positions of the piston’s path.

The number of pistons inside a feeder can vary. When lubricant is delivered under pressure, the pistons in a feeder move to their end position one after another. As a result of the piston’s motion, the lubricant stored in front of the piston is displaced and fed to the downstream outlet port in a fractional amount.

A piston can begin traveling only after the upstream piston has returned to its end position. If all the pistons are in the left or right end position, defined further travel of the pistons is assured by interconnecting bores inside the feeder. Once all the pistons have moved to the left or right end position, all the connected lube points have been supplied with the specified amount of lubricant.

The partial amounts of two outlet ports are determined by the diameter and travel of the piston. The required fractional amount is chosen when the feeder is configured. Later changes in the fractional amounts can only be made by converting the feeder.

---

Piston side 4 is pressurized by the pump, piston side 1 has delivered to outlet port 1a. Due to the motion of the piston 1/4 the connection between the main line and piston side 5 has been opened.

Piston side 5 is pressurized and piston side 2 discharges via outlet port 2a. Piston side 6 is the next to be pressurized – etc.
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<th>VPK</th>
<th>VP</th>
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</tr>
<tr>
<td>External link (crossporting) possible</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>–</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Cycle indicator</td>
<td>VPB.-ZY</td>
<td>VPK.-ZY</td>
<td>VP.-ZY</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Cycle switch</td>
<td>2-wire version</td>
<td>177-300-096</td>
<td>177-300-092</td>
<td>177-300-091</td>
<td>●</td>
<td>177-300-091</td>
</tr>
<tr>
<td>3-wire version</td>
<td>177-300-097</td>
<td>177-300-095</td>
<td>177-300-094</td>
<td>–</td>
<td>177-300-094</td>
<td>●</td>
</tr>
<tr>
<td>Actuating pressure [bars]</td>
<td>min.</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>max.</td>
<td>400</td>
<td>250</td>
<td>250</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Number of cycles</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Volume per cycle and outlet [ccm]</td>
<td>0.2</td>
<td>0.05 - 0.6</td>
<td>0.1 - 1.2</td>
<td>0.16 - 0.32</td>
<td>0.06 - 0.84</td>
<td>0.8 - 3.2</td>
</tr>
</tbody>
</table>

**Please note**
The delivery rate depends on the system and application. In certain circumstances it can drop to roughly 2/3 of the indicated value. This has to be taken into account when planning a system.
**Apportioning of quantities**

Progressive feeders divide up a quantity of lubricant delivered by a pump and feed it to a number of outlet ports in ratios determined by the feeder.

The different amounts discharged in a feeder are achieved by using different piston diameters (but not with VPB feeders) or by combining two or more outlet ports.

The indicated quantities of lubricant result from the piston diameter and the maximum travel of the piston. Depending on the system’s configuration, these delivery rates can differ by as much as minus 40%.

In the case of master-feeder/secondary-feeder systems check valves have to be installed in the outlets on the master feeder if they are not already a constituent part of the feeder.

**Group VPK**

Internal link (crossporting) of outlet ports on each side.

Three piston displacements of one side combined with two displacements of the other side to form one respective outlet port.

**Group VP and VPB**

Example: (VP feeders)
- \(2T = 0.2 \text{ ccm per outlet} \)
- \(3T = 0.3 \text{ ccm per outlet} \)
- \(6T = 0.6 \text{ ccm per outlet} \)

**Group PSG**

Three piston displacements of one side combined with two displacements of the other side to form one respective outlet port.

**Group VPK, VP and PSG** come with sections for two ports \((T = \text{Twin})\) or for one port \((S = \text{Single})\). In the case of S-sections the two outlet ports opposite each other are connected internally.

When block feeders comprising Group VPB are involved, it is possible to arrive at a single version later on by removing a dummy screw.

Moreover, adjacent outlet ports can also be combined by cross-porting bars.

In the case of VPK feeders, on the other hand, two adjacent outlet ports can still be combined internally after the feeder has been installed.
Example of possible variations for 1 to 6 lube points on one 3-section feeder

**Group VPK**
- 1 outlet port
- 2 outlet ports
- 3 outlet ports
- 4 outlet ports
- 5 outlet ports
- 6 outlet ports

**Groups VP, VPB, PSG**
- 1 outlet port
- 2 outlet ports
- 3 outlet ports
- 4 outlet ports
- 5 outlet ports
- 6 outlet ports

*Wrong! 2 feeder sections won’t work!*

- Second outlet port must not be closed on T-sections.
- S-section can supply only one outlet port exactly!

*Right! At least 3 feeder sections!*

- Plug and outlet side can be interchanged with each other.
- When two T-sections are connected by crossporting, one outlet must be open on the crossporting side!

Two external crossporting bars (1 T-, 1 S-section)

One external crossporting bar (2 S-sections)

If you want to combine 2 sections (4 outlets) to form one outlet port, you can do it this way but it’s better this way!
Two adjacent outlet ports are combined in the direction leading from the end section to the inlet section, and, namely, by first screwing the respective 917-006-101 plug out of the outlet port closest to the end section and closing the outlet bore with a screw plug 1). The quantity of both outlet ports then emerges from the adjacent outlet port in the direction of the inlet section. Please note: the feeder section downstream of the inlet section must not be closed!

NB!

Always make absolutely sure that the 917-006-101 plug has been removed before the screw plug 1) is screwed in, as otherwise the feeder would be blocked.

In this way it is possible to combine the outlet ports of a whole feeder side, provided there is no S-section between them. The S-section completes the formation of a group; a new group can only be formed again behind the S-section.

If it later turns out that the quantities of two adjacent outlet ports have to be separated again because, for instance, a lube point has been added, that can be done without further ado. It is only necessary to screw plug 917-006-101 back in again and connect the hitherto closed outlet port to the new lube point.

1) Screw plug 466-431-001 with VPKM feeders, 466-419-001 with VPKG feeders.

Examples of how several adjacent outlet ports can be combined

<table>
<thead>
<tr>
<th>Quantity 5 and 6 combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity 2 and 4 combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity 9 and 10 combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity 3, 7, 8 combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity 2 and 6 combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
</tr>
</tbody>
</table>
Group VPB

- Modular system, smallest feeder group, primarily for grease-lubricated machines and installations.
- Uniform metering rate: 0.2 ccm
- Possible to connect two opposite outlet ports at a later date by screwing the stopper out of the right-hand outlet bore (outlet bores on top as viewed from lubricant inlet) and closing one of the two outlet ports.
- Combination of two or more adjacent outlet ports by external crossporting bars.
- Without built-in check valves.
- Without alternative outlet ports.
- Actuating pressure: min. 5 bars; max. 400 bars

<table>
<thead>
<tr>
<th>Order No.</th>
<th>Number of feeder sections</th>
<th>Number of poss. outlets</th>
<th>l [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPBM-3</td>
<td>3</td>
<td>6</td>
<td>60</td>
</tr>
<tr>
<td>VPBM-4</td>
<td>4</td>
<td>8</td>
<td>75</td>
</tr>
<tr>
<td>VPBM-5</td>
<td>5</td>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>VPBM-6</td>
<td>6</td>
<td>12</td>
<td>105</td>
</tr>
<tr>
<td>VPBM-7</td>
<td>7</td>
<td>14</td>
<td>120</td>
</tr>
<tr>
<td>VPBM-8</td>
<td>8</td>
<td>16</td>
<td>135</td>
</tr>
<tr>
<td>VPBM-9</td>
<td>9</td>
<td>18</td>
<td>150</td>
</tr>
<tr>
<td>VPBM-10</td>
<td>10</td>
<td>20</td>
<td>165</td>
</tr>
</tbody>
</table>

With metric threads

<table>
<thead>
<tr>
<th>Order No.</th>
<th>A</th>
<th>With metric threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPBM-3</td>
<td>M10x1</td>
<td>VPBM-3</td>
</tr>
<tr>
<td>VPBM-4</td>
<td></td>
<td>VPBM-4</td>
</tr>
<tr>
<td>VPBM-5</td>
<td></td>
<td>VPBM-5</td>
</tr>
<tr>
<td>VPBM-6</td>
<td></td>
<td>VPBM-6</td>
</tr>
<tr>
<td>VPBM-7</td>
<td></td>
<td>VPBM-7</td>
</tr>
<tr>
<td>VPBM-8</td>
<td></td>
<td>VPBM-8</td>
</tr>
<tr>
<td>VPBM-9</td>
<td></td>
<td>VPBM-9</td>
</tr>
<tr>
<td>VPBM-10</td>
<td></td>
<td>VPBM-10</td>
</tr>
</tbody>
</table>

With Whitworth pipe threads

<table>
<thead>
<tr>
<th>Order No.</th>
<th>A</th>
<th>With Whitworth pipe threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPBM-3</td>
<td>G 1/8</td>
<td>VPBM-3</td>
</tr>
<tr>
<td>VPBM-4</td>
<td></td>
<td>VPBM-4</td>
</tr>
<tr>
<td>VPBM-5</td>
<td></td>
<td>VPBM-5</td>
</tr>
<tr>
<td>VPBM-6</td>
<td></td>
<td>VPBM-6</td>
</tr>
<tr>
<td>VPBM-7</td>
<td></td>
<td>VPBM-7</td>
</tr>
<tr>
<td>VPBM-8</td>
<td></td>
<td>VPBM-8</td>
</tr>
<tr>
<td>VPBM-9</td>
<td></td>
<td>VPBM-9</td>
</tr>
<tr>
<td>VPBM-10</td>
<td></td>
<td>VPBM-10</td>
</tr>
</tbody>
</table>

Functional diagram

Plug 917-006-101 (hexagon socket head WAF3)

Screw plug 466-431-001 with VPBM 466-419-001 with VPBG
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