! DANGER!
REMOVE SERVO MOTOR
ELECTRICAL POWER
before replacing Slot Cutter inserts or servicing Servo Gouger.

! WARNING!
SAFETY GLASSES ARE ALWAYS REQUIRED
Insert breakage or shatter presents great potential for eye injury.

All PushCorp, Inc. electrical cables are rated for high twist and flex robotic applications with a minimum cable bending radius specification of 125mm (5 in). Cable damage resulting from failure to abide by this specification will not be covered under warranty.
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1.0 Limited Warranty

Duration:

One year from date of delivery to the original purchaser.

Who gives this warranty (warrantor):

*PushCorp, Inc.*

Telephone: (972) 840-0208

Corporate Address:
P. O. Box 181915
Dallas, Texas 75218

Shipping Address:
3001 W. Kingsley Rd.
Garland, Texas 75041

Who receives this warranty (purchaser):

The original purchaser (other than for purposes of resale) of the *PushCorp, Inc.* product.

What products are covered by this warranty:

Any *PushCorp, Inc.* industrial equipment or accessory supplied or manufactured by the Warrantor.

What is covered under this warranty:

Defects in material and/or workmanship which occur within the duration of the warranty period.

What is NOT covered in this warranty:

A. IMPLIED WARRANTIES, INCLUDING THOSE OF MERCHANT-ABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE LIMITED TO ONE YEAR FROM THE DATE OF ORIGINAL PURCHASE. Some states do not allow limitations on how long an implied warranty lasts, so the above limitations may not apply to you.

B. ANY INCIDENTAL, INDIRECT, OR CONSEQUENTIAL LOSS, DAMAGE or EXPENSE THAT MAY RESULT FROM ANY DEFECT, FAILURE, MALFUNCTION OF THE *PUSHCORP, INC.* PRODUCT. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you.

C. Any failure that results from an accident, purchaser's abuse, neglect, unauthorized repair or failure to operate the products in accordance with the instructions provided in the owner's manual(s) supplied with the product.

Responsibilities of the Warrantor under this warranty:

Repair or replace, at Warrantor's option, products or components which have failed within the duration of the warranty period.
Responsibilities of the purchaser under this warranty:

A. Deliver or ship the *PushCorp, Inc.* product or component to PushCorp, Inc. Service Center, 3001 Kingsley Rd., Garland, TX 75041. Freight and insurance costs, if any, must be borne by the purchaser.

B. Use reasonable care in the operation and maintenance of the product as described in the owner's manual(s).

When warrantor will perform repair or replacement under this warranty:

Repair or replacement will be scheduled and serviced according to the normal work flow at the service center, and depending on the availability of replacement parts. Purchasers requiring quicker repair may receive such with payment of a *PushCorp, Inc.* predetermined expediting fee.

This Limited Warranty gives you specific legal rights and you may also have other rights which vary from state to state.
2.0 General Overview

The PushCorp, Inc. Servo Gouger provides a fast and effective means to accurately remove excess material from a surface. The Servo Gouger is designed to machine a uniform groove into a steel or aluminum surface for back gouging operations. A large selection of replaceable Carbide cutting inserts are used to literally peel metal away. The Gouger/AFD combination forms a unique system where force control and positioning are used to perform accurate machining operations.

The Servo Gouger enables accurate surface machining by utilizing Tracking Wheels to follow over the part surface profile. An appropriate Adjustable Force Device is used to hold the Tracking Wheels firmly against the part surface. This arrangement allows the Servo Gouger to maintain contact with complex surfaces.

The Servo Gouger is comprised of two primary components: a Slot Cutter assembly, and a high torque Servo Motor.

The back gouging operation is performed by a 8 inch (202mm) diameter Sandvik Coromill® 331 Slot Cutter with replaceable Cutter Inserts. The Slot Cutter is capable of back gouging a 0.5 inch (12mm) wide path. The cutting depth of the Slot Cutter can be adjusted to any position from zero to 1.5 inch (38mm) below the surface.

A Servo Motor provides the power to turn the Slot Cutter, and allows precision adjustable speed control through a 0-10VDC analog interface. The Servo Gouger Series uses a 3.7 Horsepower motor with a speed range of 0 to 4000 RPM. The gear reduction drive provides a 4:1 reduction ratio which reduces the speed and increases the output torque at the Slot Cutter. The Servo Motor allows the Servo Gouger to control Slot Cutter speed within 5%. The projected life of this high quality Servo Motor is over 30,000 hours.

Simple reliable construction combined with high torque, precision speed controlled servo technology make the PushCorp Servo Gouger a rugged, state-of-the-art technology capable of providing flexible, cost-effective weld cutting operations.
3.0 Installation

3.1 Mounting the Servo Gouger

The Servo Gouger is designed to attach to the carriage of a PushCorp Track Carriage. The Weld Shaver Air Knife located on the Track Carriage Arm is used to blow chip cuttings away from the guide wheels. The Air Knife must be removed and the air flow shut off via the Needle Valve before installing the Servo Gouger. See the Tracked Weld Shaver Manual for additional information.

3.2 Electrical Connections

To use the Servo Gouger it is necessary to connect the Servo Power, and Servo Feedback cables correctly (See Figure 1). The Track Shaver Control Console will provide all the control signals necessary to control the Gouger motor.
4.0 Operation

4.1 Setting the Depth of Cut

Adjusting the Servo Gouger’s depth of cut is accomplished by changing the Tracking Wheel assembly (Figure 2). Different Tracking Wheel assemblies can be supplied to provide a depth of cut from zero to 1.5 inches (38mm). The maximum depth of cut per pass is 0.25 inch (6mm). The two Tracking Wheel assemblies are attached with four (4) M6x20 caphead fasteners.

CAUTION: Remove all power from the Servo Motor before performing any adjustments to the Servo Gouger.

Once a depth-of-cut has been selected, the four (4) M6 Depth Adjustment Locking Screws should be re-tightened to the torque specified in Section 7.0 before beginning machining operations.

4.2 Setting Feeds and Speeds

Speed and Feed are important factors to consider for best results in milling. Improper Feed and Speed often cause low production, poor work quality and unnecessary wear to the inserts. In milling, Cutter Speed is measured in peripheral feet per minute, (revolutions per minute times the Slot Cutter circumference in feet). This will be referred
to as the Cutter Speed here. In general use lower Cutter Speeds for hard materials, tough materials, abrasive materials, heavy cuts and maximum insert life. Use higher Cutter Speeds for: softer materials, light cuts, better finishes, maximum production rates. Table 1 gives approximate starting Cutter Speed values for some common materials. Additional information can be found in Machinery’s Handbook or from the Insert manufacturer (http://www.sandvik.com).

<table>
<thead>
<tr>
<th>Work Material</th>
<th>Cutter Speed (ft./min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminum</td>
<td>1000</td>
</tr>
<tr>
<td>Silicon Bronze</td>
<td>1500</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>300</td>
</tr>
<tr>
<td>Steel</td>
<td>450</td>
</tr>
</tbody>
</table>

Table 1. Cutter Speed for various materials.

Feed is usually measured in inches per minute. It is the product of Feed per Cutter Insert times revolutions per minute times the number of Inserts in the Slot Cutter. Feed per Cutter Insert affects chip thickness which is a very important factor in Insert life. Very thin, or feather-edge chips dull cutting edges more rapidly than thick chips. In general, the highest possible Feed per Cutter Insert will usually produce longer Insert life. However, excessive Feeds may also overload the Cutter Inserts and cause breakage or chipping of the cutting edge. Excessive feed can also cause the Gouger motor to stall or the servo amplifier to fault.

As a guideline, use higher Feeds for: heavy, roughing cuts, easily machined materials, high tensile strength materials, abrasive materials. Use lower Feeds for: light and finishing cuts, difficult to machine materials, low tensile strength materials. A typical Feed per Cutter Insert for the Servo Gouger is 0.005 inches (0.12 mm). The Carriage Feed Rate is the speed that the carriage moves the Servo Gouger across the part in inches per minute.

\[
\text{Servo Motor RPM} = \text{Cutter Speed (ft/min)} \times 1.9 = (\text{Rev./min.}) \quad (\text{Eq. 1})
\]

\[
\text{Feed/Cutter Insert} = \frac{\text{Carriage Feed Rate (in/min)}}{4.0 \times \text{Servo Motor RPM}} = (\text{in./Cutter Insert}) \quad (\text{Eq. 2})
\]

\[
\text{Carriage Feed Rate} = 4.0 \times \text{Feed/Cutter Insert} \times \text{Servo Motor RPM} = (\text{in./min.})(\text{Eq. 3})
\]

The above equations are provided to help determine initial settings for the Servo Gouger. Note that the Servo Motor rotates at four times the speed of the Slot Cutter. Each Slot Cutter has sixteen (16) identical inserts. This has been included in the equations above. These equations apply only to the Servo Gouger and should not be used for any other machines.

To help illustrate the use of the equations, the following Example Problems are provided:

Example Problem (1)

Determine the Servo Motor RPM for a Steel gouge.

Material: Steel → Cutting Speed = 450 (ft./min.) (See Table 1)

\[
\text{Servo Motor RPM} = 450 \times 1.9 = 855 \, (\text{Rev./min.}) \quad (\text{Eq. 1})
\]

Example Problem (2)

Determine the Feed/Cutter Insert for a Carriage Feed Rate of 20 (in./min.) and a Servo Motor RPM of 855 (Rev./min.).
Example Problem (3)
Determine the Carriage Feed Rate based on a 0.006 (in./Cutter Insert) and a Servo Motor RPM of 855 (Rev./min.).

Carriage Feed Rate = 4.0 x 0.006 x 855 = 20 (in./min.)  \(\text{(Eq. 3)}\)

4.3 Setting the Applied Contact Wheel Force

Teaching the path over the part surface is greatly simplified because of the force device’s compliance. The force of the compliant slide allows the Servo Gouger Guide Wheels to easily maintain consistent contact with the part surface. Three Guide Wheels must maintain continuous contact with the part surface during the machining operation.

The required AFD force is dependent on the mounting orientation of the system. Choose “Down Hand”, “Horizontal”, “Vertical”, or “Overhead” on the Track Shaver Control Console based on the job’s installation configuration. If the force is too low, the Guide Wheels can rise from the surface and cause damage to the cutter inserts. Conversely, applying too much force can cause the part surface to deflect or deform and places unnecessary loads on the Guide Wheels.

The Guide Wheels should straddle the weld seam to produce the best results. Remember, the Servo Gouger only follows the part surface. Therefore any dirt, contamination, shavings, or weld spatter will affect the final quality of the cut.

4.4 Problems and Corrective Measures

Table 2 shows some of the more common troubles encountered and the recommended corrective measures involving variations in Cutter Speeds (Servo Motor RPM) and Feeds (Carriage Feed Rate).

<table>
<thead>
<tr>
<th>Problem</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of rigidity (Carriage Flexing)</td>
<td>Increase Cutting Speed, reduce Feed</td>
</tr>
<tr>
<td>Excessive abrasion on the insert</td>
<td>Reduce Cutting Speed, increase Feed</td>
</tr>
<tr>
<td>Chipping of the cutting edge</td>
<td>Reduce Feed/Cutter Insert</td>
</tr>
<tr>
<td>Burning of the cutting edge</td>
<td>Reduce Cutting Speed</td>
</tr>
<tr>
<td>Cratering of cemented carbide</td>
<td>Reduce Feed and Cutting Speed</td>
</tr>
<tr>
<td>Chatter</td>
<td>Try other combinations of Feed and Cutting Speed</td>
</tr>
<tr>
<td>Lack of rigidity (Track Lifting)</td>
<td>Remove shavings under magnets and firmly seat magnets</td>
</tr>
</tbody>
</table>

Table 2. Troubles and Corrective Measures

5.0 Slot Cutter and Inserts

The Slot Cutter provides for Cutter Insert location and indexing capabilities. The Cutter Inserts are retained securely in position by Insert Screws which permit the Cutter Inserts to be “indexed”. A large selection of Cutter Inserts are available from Sandvik.
<table>
<thead>
<tr>
<th>Item</th>
<th>Sandvik Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5321 250-03</td>
<td>CASSETTE</td>
</tr>
<tr>
<td>2</td>
<td>5513 020-09</td>
<td>INSERT SCREW</td>
</tr>
<tr>
<td>3</td>
<td>USER SELECTED</td>
<td>CUTTER INSERT</td>
</tr>
<tr>
<td>4</td>
<td>5431 105-02</td>
<td>WEDGE</td>
</tr>
<tr>
<td>5</td>
<td>339-831</td>
<td>WEDGE SCREW</td>
</tr>
</tbody>
</table>

Figure 3. Slot Cutter Assembly
DANGER: Remove all power from the Servo Motor before changing or indexing Cutter Inserts.

WARNING: Insure Wedge Screws are securely tightened into the Slot Cutter, before rotating with the Servo Motor.

Set up Procedure

1. Determine the correct insert for the material to be milled.
2. Remove the Insert Screw (2) shown in Figure 3 and remove or index the dull Cutter Insert.
3. Insure that the Slot Cutter Cassette Pocket (1) is clean.
4. Hand position the Cutter Insert (3) in the Cassette.
5. Securely tighten the Insert Screw (2) with a torque of 26 lb.-in. (3 N·m). The Insert Screw is a type Torx Plus 15IP. The recommended Sandvik torque wrench is listed below.
6. Continue this process until all sixteen (16) Cutter Inserts are replaced or correctly indexed.

NOTE: Cutter Inserts can be indexed (i.e., rotated) 180°.

Cutter Insert Screw torque wrench:
Sandvik P/N: 5680 100-06 (Torx Plus)

Wedge Screw Key:
Sandvik P/N: 265.2-817 (3.0mm)

Cutter Inserts:
Sandvik ordering code: RCKT 1204MO-PM 4240
6.0 Maintenance

6.1 Replacing the Drive Belt

The Drive Belt used in the Servo Gouger transfers power from the Servo Motor to the Slot Cutter. The Drive Belt has been sized to handle the largest possible peak Servo Motor torque, so that fatigue will most likely be the cause of any belt failure. It is not unusual for a belt of this type to perform for thousands of hours, however actual performance is highly dependent on the application.

One of the benefits of synchronous belt drives is lower belt pretensioning in comparison to other belt drives. However, proper installation tension is still important in achieving the best possible performance. In general terms, belt tensioning is needed for proper belt/pulley meshing to prevent belt ratcheting under peak loading.

DANGER: Remove all power from the Servo Motor before servicing the Servo Gouger.

Drive Belt Replacement Procedure

1. Remove the twelve (12) M6x1 Socket Head Cap Screws securing the Belt Cover to provide access to the Drive Belt.

2. Loosen the four (4) M10x1.5 Flange Bolts, shown in Figure 4, approximately ¼ turn. This will allow the Servo Motor to move, but constrain the Drive Pulley to remain essentially parallel to the Driven Pulley during tensioning.

3. Move the Servo Motor in the slots toward the Driven Pulley. This is the shortest distance between the two pulleys.
4. Slide the Drive Belt off the Drive Pulley (no flanges) until it is clear, and slip the Drive Belt off of the Driven Pulley.

5. To install the new Drive Belt, first place it over the Driven Pulley and then slide it over the Drive Pulley. It is absolutely critical that the belt teeth are correctly meshed with the teeth on both of the pulleys. This is accomplished by moving the Servo Motor away from the Driven Pulley while rotating the pulleys in opposite directions by hand.

6. Proceed to Section 6.2 to set the proper Drive Belt tension.

6.2 Setting the Proper Drive Belt Tension

Applying the proper Drive Belt tension is a very important factor in the life of the Drive Belt and the Servo Motor. Too little tension will allow the Drive Belt to jump teeth on the pulleys. Too much tension will cause premature failure of the Servo Motor bearings. The Servo Gouger requires tension in each belt segment of 118 lbs. (525 N) for a new belt, and 101 lbs. (450 N) for a used belt, which results in a separation force of 235 lbs. (1045 N) and 200 lbs. (892 N), respectively, between the Drive and Driven Pulleys.

The main problem with tensioning the Drive Belt is accurately applying the required separation force with tools readily available on the factory floor. Set tension by placing a Pry Tool on top of the Cutter Housing and underneath the mid-point of the Servo Motor flange. The pry bar location is shown in Figure 4 as the Pry Point. This allows the Drive Belt to be easily tensioned. The lever/fulcrum creates a force multiplier.

With the Servo Gouger in the vertical position, as shown in Figure 4, the proper Tension Force at 15 inches (381 mm) will be 20 lbs. (87 N) for a new belt, and 17 lbs. (74 N) for a used belt. Once the proper Tension Force has been applied, tighten the (4) four M10 Flange Head Bolts to the torque specified in Section 7.0. Replace the Belt Cover and reinstall the twelve (12) M6 Socket Head Cap Screws. Tighten the M6 Socket Head Cap Screws to the torque specified in Section 7.0.

CAUTION: Never operate the Servo Gouger without the Belt Cover properly installed.
7.0 Specifications

TOOL WEIGHT:
85 lbs. (39 kg)

MOTOR SPECIFICATIONS:
- Power: 3.7 hp (2.8 kW)
- Continuous Torque: 8.9 lb-ft (12.1 N·m)
- Maximum RPM: 4000 RPM
- Motor to Cutter Ratio: 4:1
- Supply Voltage: 480 VAC, 3Φ, 50 / 60 Hz
- Drive Belt Specification: Gates P/N 8MGT-720-21

CUTTER SPECIFICATIONS:
- Manufacturer: Sandvik 311 Coromill
- Maximum Speed: 1000 RPM
- Insert Size: 11
- Insert Style: RCKT 1204MO-PM
- Diameter: 7.9 inch (202mm)
- No. Inserts: 16
- Cutting Width: 12mm

For specific dimensions see http://www.pushcorp.com for detail drawings.

Specifications subject to change without notice.

<table>
<thead>
<tr>
<th>Fastener Size</th>
<th>Torque</th>
<th>Minimum Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in.-lbs.</td>
<td>ft.-lbs.</td>
</tr>
<tr>
<td>M4 x .7</td>
<td>50</td>
<td>4.2</td>
</tr>
<tr>
<td>M5 x .8</td>
<td>85</td>
<td>7.1</td>
</tr>
<tr>
<td>M6 x 1</td>
<td>140</td>
<td>11.7</td>
</tr>
<tr>
<td>M8 x 1.25</td>
<td>348</td>
<td>29.0</td>
</tr>
<tr>
<td>M10 x 1.5</td>
<td>600</td>
<td>50.0</td>
</tr>
</tbody>
</table>