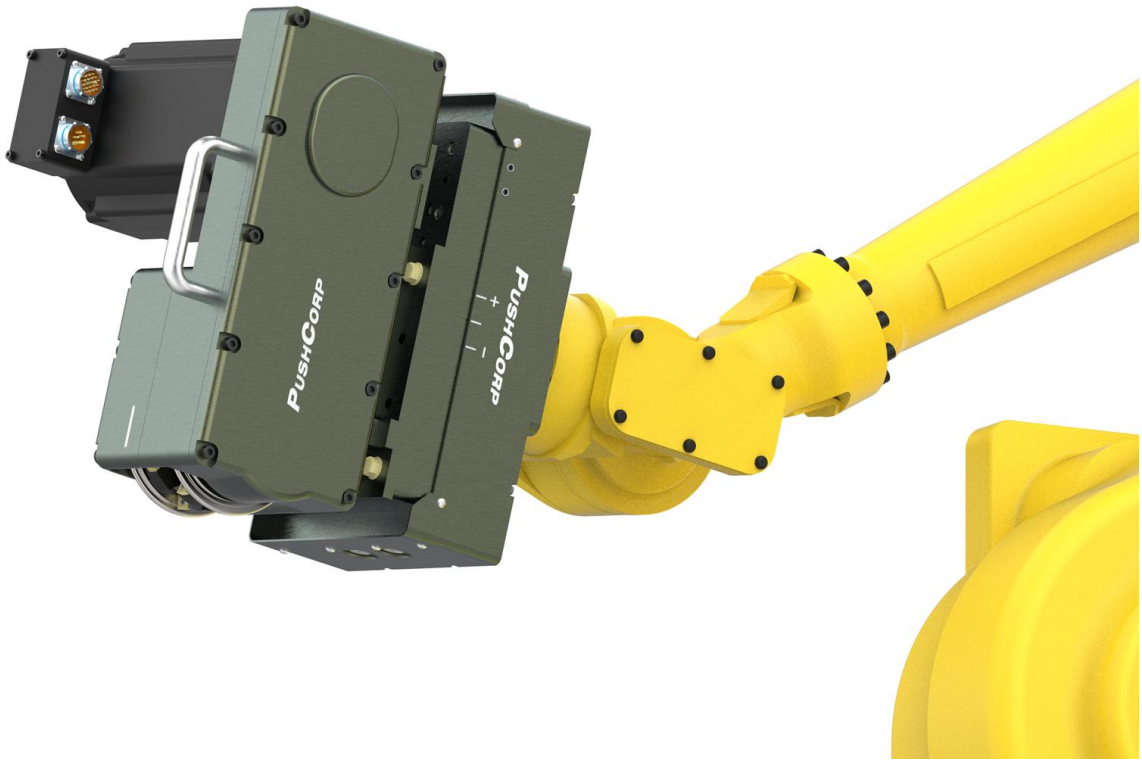
SWS100-3.7/7.2

Series Servo Weld Shavers



Manual

PUSHCORP

! DANGER !

Remove servo motor electrical power before replacing Slot Cutter inserts or servicing weld shaver.

! WARNING !

SAFETY GLASSES ARE ALWAYS REQUIRED

Insert breakage or shatter presents great potential for eye injury.

All *PushCorp,* 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.

Table of Contents

1.0 Limited Warranty

Duration:

One year from date of delivery to the original purchaser.

Who gives this warranty:

PushCorp
Telephone: (972) 840-0208

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

Shipping Address:
3001 W Kingsley Rd
Garland, Texas 75041

Who gives this warranty (purchaser):

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

What products are covered by this warranty:

Any *PushCorp* industrial equipment or accessory supplied of 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 w7arranty:

A. Deliver or ship the *PushCorp, Inc.* product or component to PushCorp, Inc. Service Center, Dallas, TX. 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,* SWS100 Series Servo Weld Shaver provides a fast and effective means to accurately remove excess material from a surface. The Weld Shaver is designed to remove random, inconsistent surface features such as seam welds, parting lines, and flashing, leaving behind a known, consistent, smooth surface. The SWS100 is ideal for use in applications where force-based, abrasive-only operations fail. Using the SWS100 can produce significant cost savings since one set of inserts can often out last hundreds of abrasive disks. A large selection of replaceable Carbide cutting inserts are used to literally peel metal away. The Weld Shaver/AFD combination forms a unique system where force control and positioning are used to perform accurate machining operations with a robot.

The SWS100 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 Weld Shaver to maintain contact with complex surfaces while compensating for any robot/part misalignment.

The SWS100 is comprised of two primary components: a Slot Cutter assembly, and a high torque Servo Motor. PushCorp offers two variations of weld shavers differentiated by their horsepower: 4.8HP and 6.7 HP; the overall structure of the two variations are similar and only differ in height and torque. For each variation of shaver, PushCorp offers a manually and remote method of adjusting the cutter height relative to the parent material.

The machining operation is performed by a 5 inch (125mm) diameter Sandvik Coromill® 331 Slot Cutter with replaceable Cutter Inserts. Each Slot Cutter is capable of machining a 20mm wide path. The SWS100 Series Weld Shavers may be configured with one, two, or three Slot Cutters allowing a width of cut ranging from 20mm to 59mm. The cutting depth of the Slot Cutter can be adjusted to any position from 0.1 inch (2.5mm) above the surrounding part surface to 0.1 inch (2.5mm) below.

A Servo Motor provides the power to turn the Slot Cutter, and allows precision adjustable speed control through a 0-10VDC analog interface. The SWS100-3.7 Series uses a 4.8 Horsepower motor with a speed range of 0 to 4200 RPM; the SWS100-7.2 Series uses a 6.7 Horsepower motor with a speed range of 0 to 2500 RPM. The belt and pulley drive provides a 1.5:1 reduction ratio for the SWS3.7, and a 1.3:1 reduction ratio for the SWS7.2; this reduction reduces the speed and increases the output torque at the Slot Cutter. The Servo Motor allows the Weld Shaver 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* SWS100 Servo Weld Shaver a rugged, state-of-the-art technology capable of providing flexible, cost-effective weld machining operations.

3.0 Installation

3.1 Mounting the SWS100

The SWS100 Series Weld Shavers are designed to attached to the carriage of a *PushCorp* AFD80/90 via a mounting plate. Refer to Figure 1 for proper component stack up.

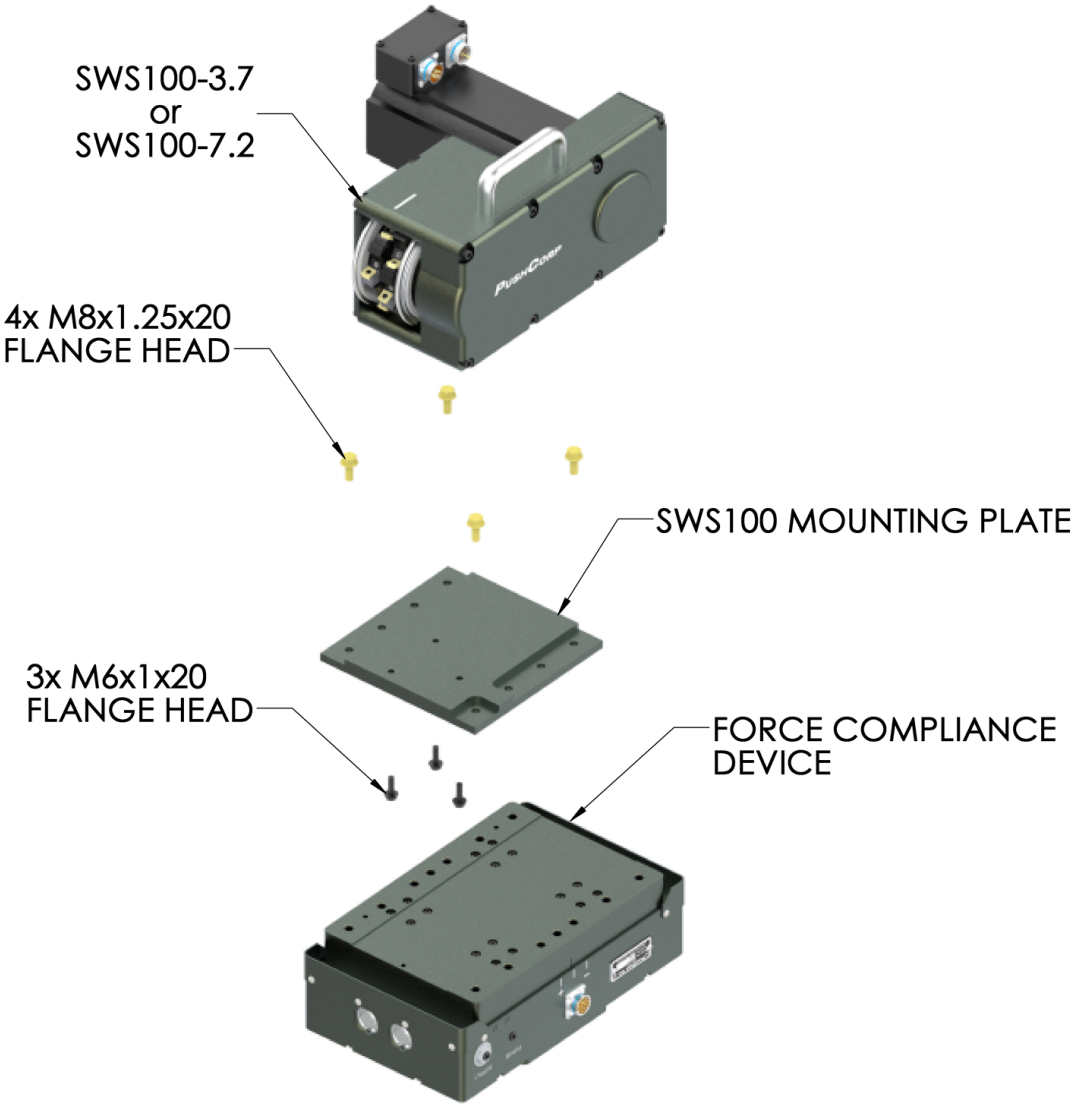


FIGURE 1: MOUNTING THE SWS100-20, SWS100-39, AND SWS100-59

The SWS100 attaches to the mounting plate with 3x M6x1x20 flange-head fasteners provided by PushCorp. The mounting plate can then be mounted to the AFD carriage via 4x M8x1.25x20 flange-head fasteners. If necessary, the Adapter Plate can be extended beyond the end of the carriage to allow for more clearance.

CAUTION: If alternate fasteners are used make sure they do not exceed a depth of 0.525 inch (13.3 mm) into the AFD Carriage or damage can occur.

3.2 Electrical Connections

To use the SWS100 Series Weld Shavers it is necessary to connect the Servo Power, and Servo Feedback cables correctly. The servo amplifier is pre-configured to accept a 0 – 10VDC analog command velocity signal and a 24VDC digital signal to enable the motor. These are the only two signals that are required for operation and no other configuration is required to operate the motor. Other more advanced features are available and may be configured by referring to the supplied servo amplifier documentation on the PushCorp website.

3.2.1 S724 Servo Amplifier – Default Electrical Connections

This amplifier is already properly configured for a PushCorp shaver. No further configuration is required if the below settings will work for your application.

Analog Velocity Mode

+/-10VDC Analog Input for command velocity

Analog Interface

Connector	Pin	Function
X3B	9	-Analog-In 1 – Command Velocity
X3B	10	+Analog-In 1 – Command Velocity
X3B	13	AGND - Shield

Digital Interface

Connector	Pin	Function
X3A	1	Enable – Enable Drive Output
X3A	2	Digital-In 1 – Fault Reset
X3A	6	Digital-Out 1 – Fault Present
X3A	7	Digital-Out 2 – At Zero Speed
X3B	14	BTB/RTO – Ready To Operation (Dry Contact)
X3B	15	BTB/RTO – Ready To Operation (Dry Contact)
X3B	16	DGND – Digital 0VDC Common

Optional Analog Output (MUST HAVE ANALOG CARD INSTALLED IN SLOT 3)

Connector	Pin	Function
X3C	17	Analog Out 1 - Velocity Feedback
X3C	18	AGND
X3X	19	Analog Out 2 - Motor Load Feedback
X3C	20	AGND

For more information an instruction manual is available at:

S724-instruction-manual.pdf

For all other questions please contact:

PushCorp Tech Support: 1.972.840.0208, 8am – 5pm Central Time

Kollmorgen Tech Support: 1.540.633.3545, 8am – 5pm Eastern Time

4.0 Operation

4.1 Kollmorgen Motor

PushCorp provides both a 4.8HP and a 6.7 HP version of weld shaver. The SWS100-3.7 has a speed range of 0-3640 RPM, and the SWS100-7.2 has a speed range of 0-2427 RPM There are 200 steps per full revolution both the 4.8HP and 6.7HP motors. The belt pulley drive provides a 1.5:1 reduction ratio for the SWS100-3.7 and a 1.3:1 reduction ratio for the SWS100-7.2.

4.2 Setting the Depth of Cut

PushCorp provides two methods for adjusting the cutting depth of the weld shaver. Based on the unit you have this operation can be done remotely via a stepper motor or manually with a cam knob. Adjusting the weld shaver's depth of cut is accomplished by raising or lowering the adjustment depth wheels. Raising the depth wheels to the maximum position will result in a cut approximately 0.1 inch (2.5mm) below the parent material. Lowering the depth wheels to their lowest position will set the cutting inserts approximately 0.1 inch (2.5mm) above the parent material. Both of these examples assume the surface is flat and these depths would be different if the surface is curved.

CAUTION: Remove all power from the Servmo Motor before performing <u>any</u> adjustments to the SWS100 Series Weld Shaver

FIGURE 2: DEPTH WHEEL EXTENDED & RETRACTED

4.2.1 Manually Setting the Depth of Cut

To manually adjust the depth of cut, first loosen the four (4) Depth Adjustment Locking Screws approximately 1/4 turn shown in Figure 3.

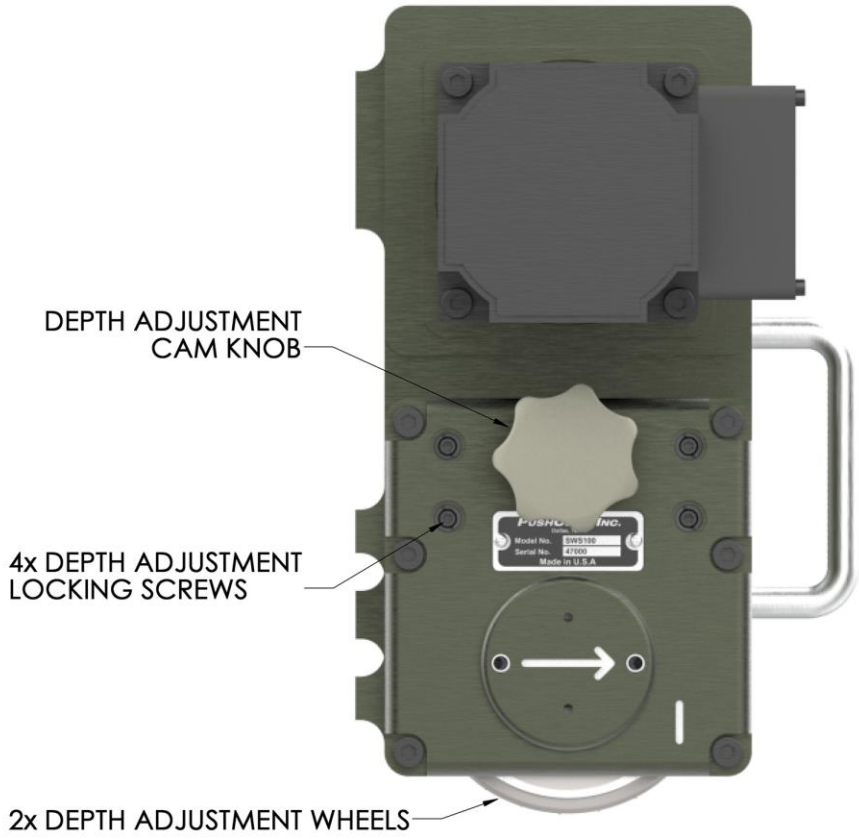


FIGURE 3: DEPTH OF CUT ADJUSTMENT

CAUTION: It is required that the Depth Adjustment Locking Screws are released before the Depth Adjustment Knob is rotated. Failure to release the Depth Adjustment Locking Screws can damage the mechanism and require the unit to be returned to the factory service center for a *non-warranty* repair.

Rotate the depth adjustment cam knob to move the depth adjustment wheels relative to the slot cutter. Rotating the depth adjustment knob one complete revolution will result in the Tracking Wheels moving 0.2 inches (5mm). A straight edge can be placed on the depth adjustment wheels to position the cutter inserts to cut flush with the surface. In other cases it is most expeditious to approximate the initial setting and fine tune the Tracking Wheel position with sample passes. Once a depth-of-cut has been selected, the four (4) M8 Depth Adjustment Locking Screws should be re-tightened to the torque specified in Section 7.0 before beginning machining operations.

4.2.2 Remotely Setting the Depth of Cut

To remotely set the depth of cut, connect the SWS100 Remote Adjust to the stepper motor amp via the appropriate control cable. Refer to 4 for proper cable pin out.

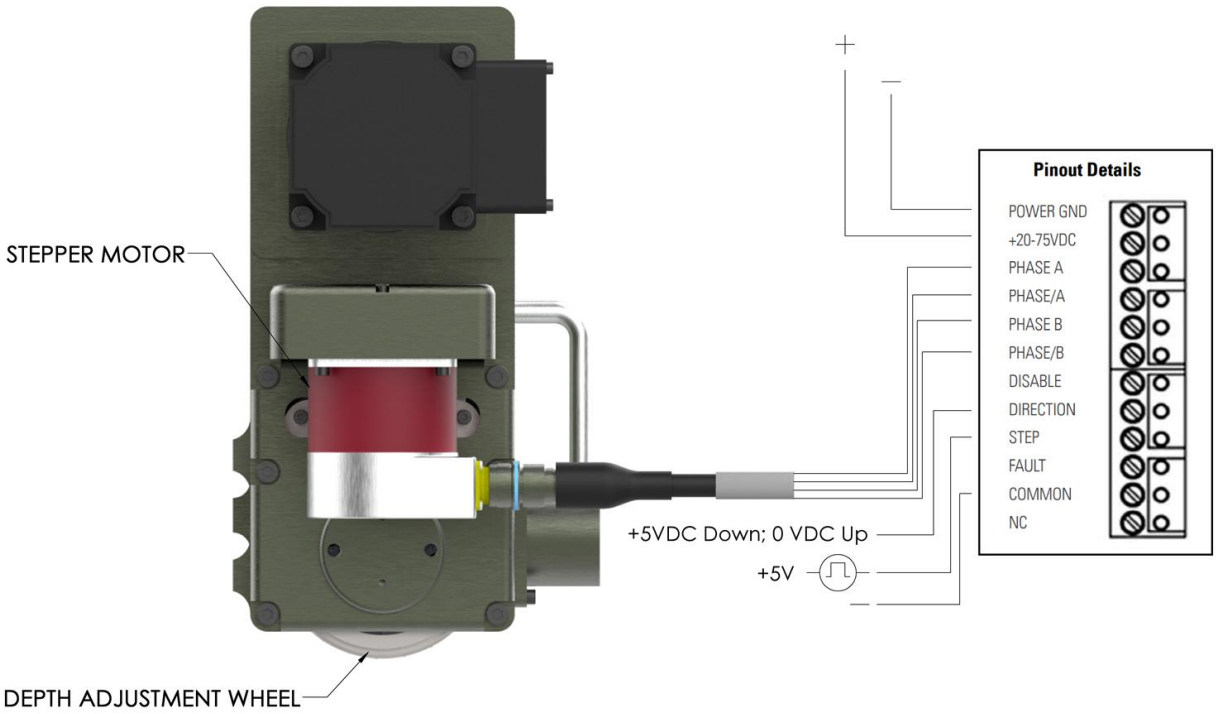


FIGURE 4: REMOTE DEPTH OF CUT ADJUSTMENT

This will allow you to adjust the wheels up and down using a robot controller or PLC. The stepper motor for both the SWS100-3.7 and SWS100-7.2 has a single step of 1.8 degrees and a total of 200 steps for a full revolution. This translates to a 0.0625" (1.59mm) height change for a full rotation and .0003"/step (0.008mm/step). The remote adjust weld shaver amp does not utilize a built-in position feedback. As a result, the following steps can be used to zero the position.

1. Position the weld shaver above the parent material.
2. Apply 5V to the DIRECTION pin.
3. Send 625 pulses on the STEP pin to fully extend the depth adjustment wheels.
4. Once in position, reset the step counter (on your PLC or robot controller) to zero.
5. Keep track of the number and direction of steps required to maintain the depth adjustment wheel location.

If more accurate positional data is required, an alternative method is to utilize an optical sensor in the workcell and step the motor to make/break the beam to know its location.

4.3 Setting Speeds and Feeds

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). Every application and material will have different cutter speeds and feedrates. It will be up to the end user to dial in both parameters based on their application. Section 4.3 outlines some of the corrective actions that can be taken to help determine these values more quickly.

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 (Robot Feed Rate).

TABLE 1: TROUBLES AND CORRECTIVE MEASURES

Problem	*Corrective Action*
Lack of rigidity (Robot Flexing)	Increase Cutting Speed, reduce Feed
Excessive abrasion on the insert	Reduce Cutting Speed, increase Feed
Chipping of the cutting edge	Reduce Feed/Cutter Insert
Burning of the cutting edge	Reduce Cutting Speed
Cratering of cemented carbide	Reduce Feed and Cutting Speed
Chatter	Try other combinations of Feed and Cutting Speed

4.5 Teaching the Weld Shaver Path

Teaching the path over the part surface is greatly simplified because of the force device's compliance. The force control carriage stroke of the AFD allows the Weld Shaver Guide Wheels to easily maintain consistent contact with the part surface. **Both Guide Wheels must maintain continuous contact with the part surface during the machining operation.**

The required AFD force is dependent on the application, however a 20 lbs. (89 N) applied force is usually a good starting point. 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 Weld Shaver only follows the part surface. Therefore any dirt, contamination, or weld spatter will affect the final quality of the cut.

5.0 Slot Cutter and Inserts

The Slot Cutter provides for Cutter Insert location plus adjustable width 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 & Michigan Drill.

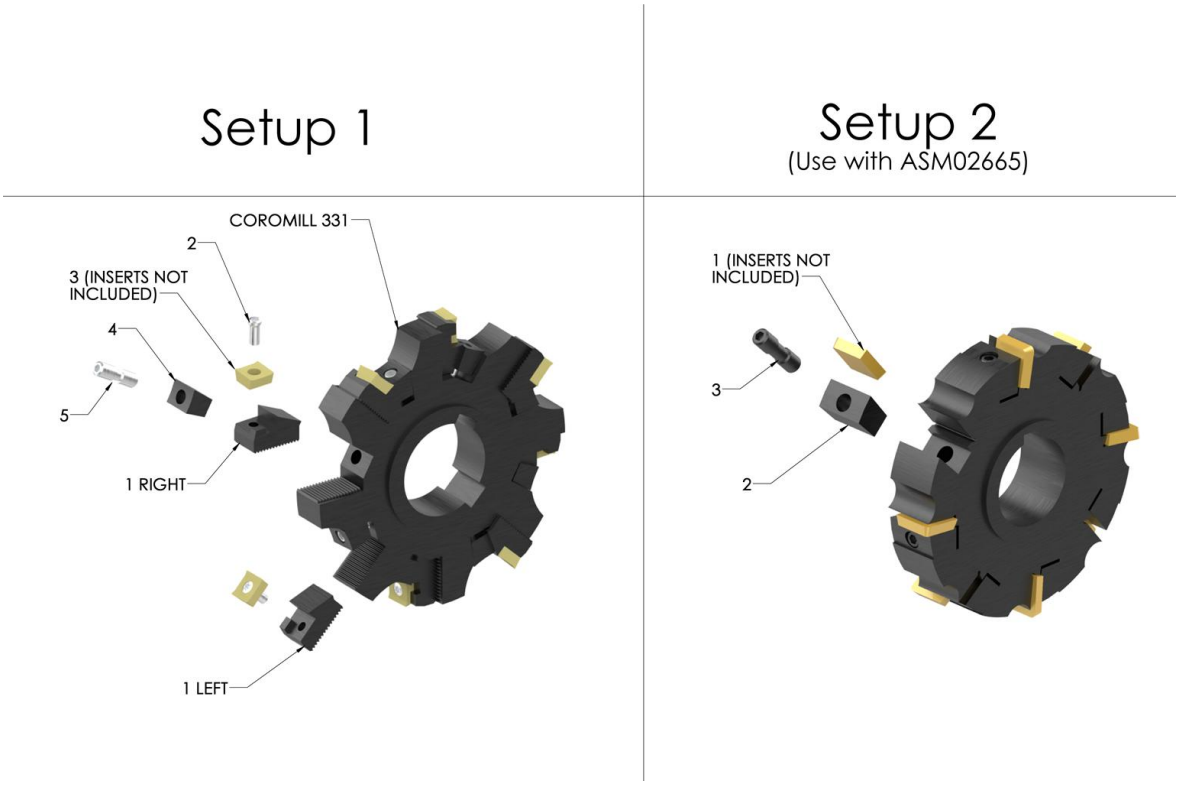


FIGURE 5: SLOT CUTTER ASSEMBLY

SETUP 1				SETUP 2			
Item	*Manufacturer*	*Part Number*	*Description*	*Item*	*Manufacturer*	*Part Number*	*Description*
1 RIGHT	Sandvik	5321 240-07	RIGHT CASSETTE	1	Michigan Drill	CTA-8 3/32 TC	CUTTER INSERT
1 LEFT		5321 240-08	LEFT CASSETTE				
2		5513 020-29	INSERT SCREW	2		Part W8	WEDGE
3		USER SELECTED	CUTTER INSERT				
4		5431 105-04	WEDGE	3		Part SMC2	WEDGE SCREW
5		339-831	WEDGE SCREW				

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 1 Procedure

1.	Determine the correct insert for the material to be milled.
2.	Remove the Insert Screw (2) shown in Figure 5 and install or index the dull Cutter Insert.
3.	Insure that the Slot Cutter is Cassette Pocket (1) is clean.
4.	Hand position the Cutter Insert (3) between 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 (8) eight 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: N331.1A-11 50

Set up 2 Procedure

1.	Determine the correct insert for the material to be milled.
2.	Remove the Wedge Screw (3) shown in Figure 5 and install or index the dull Cutter Insert.
3.	Hand position the Cutter Insert (3) with the wedge
4.	Securely tighten the Wedge Screw (3). The Wedge Screw is a standard hex. The recommended *Michigan Drill* torque wrench is listed below.
5.	Continue this process until all (8) eight Cutter Inserts are replaced or correctly indexed.

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

Cutter Insert Screw torque wrench:

Standard Hex

Wedge Screw Key:

Michigan Drill P/N: CTA-8 3/32 TC

Cutter Inserts:

Michigan Drill ordering code: SM612158 W-8

6.0 Technical Specifications

6.1 SWS100-3.7 Specifications

TOOL WEIGHT:

SWS100-3.7-20: 45 lbs. (20.5 kg)
SWS100-3.7-39: 52 lbs. (23.6 kg)
SWS100-3.7-59: 60 lbs. (27.3 kg)

MOTOR SPECIFICATIONS:

Power: 4.8 Hp (3.6 kW)
Continuous Cutter Torque: 11 lb-ft (14.7 N·m)
Maximum Motor SFM: 3640 SFM
Supply Voltage: 240-480 VAC, 3Φ, 50 / 60 Hz

Please contact techsupport@pushcorp.com for supply voltages less than 480V

Drive Belt Specification: Gates P/N 8MGT-640-21

Requires separate power supply, amplifier and cables.

CUTTER SPECIFICATIONS:

Manufacturer: Sandvik 331 Coromill
Insert Size: 11
Insert Style: N331.1A-11 50
Diameter: 4.9 inch (125mm)
No. Inserts: 8
Cutting Width: 20mm, 39mm, 59mm

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

Specifications subject to change without notice.

6.2 SWS100-7.2 Specifications

Category	Specification
Power	6.7 Hp (5 kW)
Continuous Cutter Torque	18.5 lb-ft (25 N·m)
Maximum Motor SFM	2427 SFM
Supply Voltage:	480 VAC, 3Φ, 50 / 60 Hz
Drive Belt Specification	Gates P/N 8MGT-720-21
Tool Weight	SWS100-7.2-20: 61 lbs. (27.7 kg) SWS100-7.2-39: 68 lbs. (30.9 kg) SWS100-7.2-59: 76 lbs. (34.5 kg)

Requires separate power supply, amplifier and cables.

CUTTER SPECIFICATIONS

Parameter	Value
Manufacturer	Sandvik 331 Coromill
Insert Size	11
Insert Style	N331.1A-11 50
Diameter	4.9 inch (125mm)
No. Inserts	8
Cutting Width	20mm, 39mm, 59mm

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

Specifications subject to change without notice.

TORQUE SPECIFICATIONS:

Fastener Tightening Torque Specs					
	Torque			Minimum Depth	
Fastener Size	in.-lbs.	ft.-lbs.	N·m	in.	mm
M4 x .7	50	4.2	5.6	0.17	4.3
M5 x .8	85	7.1	9.6	0.21	5.3
M6 x 1	140	11.7	15.8	0.25	6.3
M8 x 1.25	348	29.0	39.3	0.33	8.4
M10 x 1.5	600	50.0	67.8	0.41	10.5