

SFS92 Series

Servo Finishing Stand



PUSHCORP. INC.

Dallas, Texas

February, 2022

**NEVER OPERATE THE
SFS92 MANUALLY**

**NEVER OPERATE THE SFS92 WITH
PERSONEL IN THE WORKCELL**

DO NOT USE LUBRICATED AIR.

**This device requires a dry, non-lubricated
100 psi (6.9 bar) maximum air supply
filtered to 5 μ m and a 0.3 micron oil mist
separator.**

**Non-compliance with these requirements
will void the manufacturer's warranty.**

(See Section 3.3)

**All fasteners, mounting holes and pipe
threads on this tool are METRIC.**

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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 181925

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.* Adjustable Force Device or Adjustable Force Device 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 MERCHANTABILITY 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, 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 SFS92 Series Servo Finishing Stand combines passive compliant force control and closed-loop servo motor speed control technology. The SFS92 has been designed from the ground up as a Finishing Stand for robotic applications with many new and unique features.

Accurate force and speed control allows you to achieve unprecedented levels of quality and consistency. The SFS92 enables maximum flexibility for any part-in-hand grinding, sanding, buffing or polishing application. Linear compliance with 1.4 inches (36 mm) of travel and excellent access allow a robot to easily manipulate parts over the Media. An important feature of the SFS92 Finishing Stand is the high torque servo motor and belt drive. The belt drive system provides a 1.5:1 increase in torque at the Media for heavy material removal.

The force control technology in the SFS92 is based on the *PushCorp* Passive AFD90 Series Force Devices. This technology has proven itself in thousands of hours of production systems. An electronic regulator is quoted with the SFS92, which allows the SFS92's pressure to be adjusted from 0 to 5 Bar. This electronic regulator can be adjusted remotely to set the force as needed throughout the robot program. Please note, this regulator has a coarse adjustment since this equipment is geared towards heavy duty applications. For a more accurate force output a precision regulator that operates in a narrow pressure range is required. If a single force is used a manual regulator can be used instead.

In most any finishing process, consistency is of paramount importance. For this reason the SFS92 is powered by a high torque servo motor with adjustable speed control that can be varied at any time during the finishing process. The SFS92 has a 15.5 horsepower (11.5 kW) motor that supplies 38.7 lb·ft (52.4 N·m) of continuous torque and a maximum rotational speed of 1400 RPM at the media mounting shaft. With dual 40mm shafts the user can mix & match their Media allowing multiple finishing operations at the same piece of equipment. This flexibility allows the SFS92 to perform a wide variety of finishing applications.

3.0 Installation

3.1 Mounting the SFS92

The SFS92 Servo Finishing Stand is secured by four (4) fasteners passing through mounting holes located in the Base Plate. The Base Plate mounting hole locations are shown in Figure 1. The SFS92 must be securely mounted to keep the unit from moving during operation, and must be mounted level to achieve the desired force output. A spirit level can be placed on the top of the Finishing Stand and shims can be inserted under the Base Plate as required.

WARNING: Do NOT operate the unit without first mounting it securely.

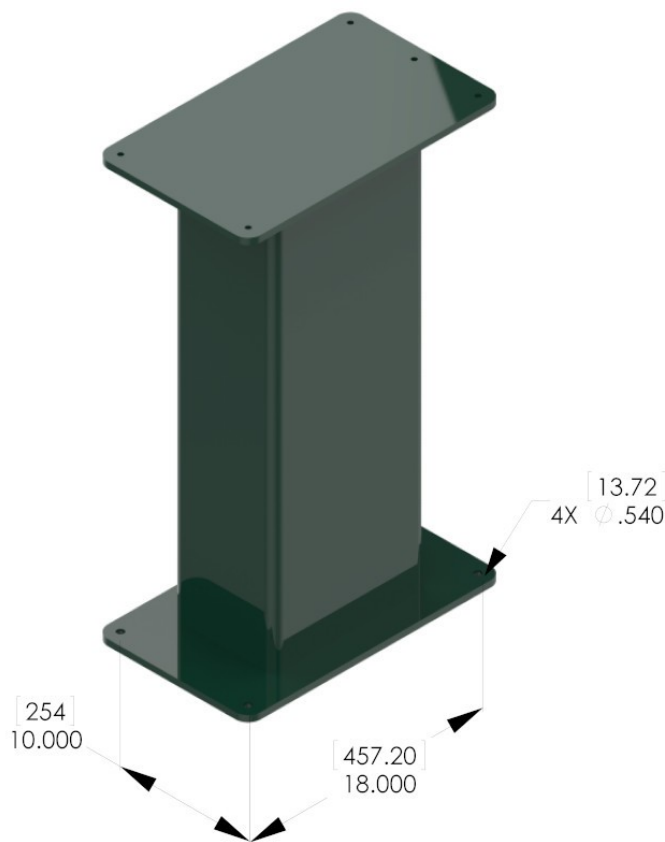


Figure 1: SFS92 Base Plate mounting holes

The SFS92 attaches with four (4) fasteners, 1/2 inch (12 mm) in diameter. These fasteners are to be provided by the installer.

3.2 Communication with the Servo Motor

An electrical control box is included in the standard system. It is meant to be wall mounted outside the robot work area in a relatively clean environment. Otherwise, a raw amplifier can be purchased with the SFS92. This will need to be integrated into a control box with the appropriate fusing and safeties. Both manuals can be found on www.pushcorp.com

If utilizing an Ethernet IP panel, please refer to the manual found in Products → Control Cabinets → SMFBCON-EIP

If utilizing a raw s724 amplifier, please refer to Products → Kollmorgen S724

3.3 Pneumatic Connections

The SFS92 Finishing Stand requires a dry, non-lubricated, 5 micron filtered, 80 to 100 psi (5 to 7 Bar) air supply with a 0.3 micron oil mist separator. Failure to provide supply air to these specifications can degrade performance and will void any warranty repairs concerning pneumatic components.

WARNING: If water condensation is a problem in your air supply system, an air dryer device is highly recommended. Moisture inside the device will cause premature failure that will not be covered under warranty.

The SFS92 Finishing Stand maintains a positive air pressure to impede the infiltration of contaminate materials. It is important to provide a continuous compressed air supply to the device at all times if the work environment contains airborne contaminates. If the environment is clean during non-operational periods, the air supply to the device may be shut off.

The SFS92 has one pneumatic input, an R 1/8 (Metric) port located on the SFS92 regulator. This port supplies all the air needed to operate the Finishing Stand. Before connecting the supply to the air fitting, open the supply valve to blow out any contaminates which may be in the line. Charge the supply line with compressed air and verify that there are no air leaks.

3.3.1 Standard Pneumatic Connections

The standard pneumatic set up for the SFS92 includes a minimum of 80 PSI air supply that leads to a shut off valve, 5µm filter, optional oil/mist separator, and air regulator. Before the air regulator that moderates the air supplied to the Supply +, the airline needs to supply the pressurized air to the force compliance purge. The pneumatic set up for force compliance in one direction can be seen in Figure 2.

Single Direction Force Compliance

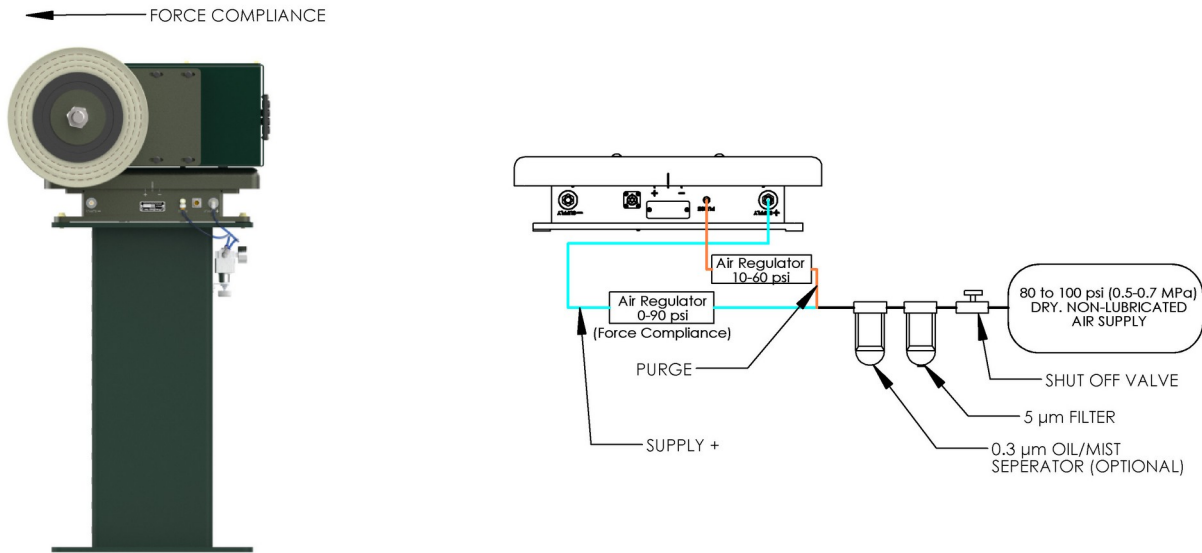


Figure 2: Standard Pneumatic Connections

3.3.2 Standard Pneumatic Connections with Retraction

The SFS92 features two air cylinders, which enables the operator to retract the unit to the negative side. This can be used during e-stop situations to position the sliding carriage toward the negative side and eliminate contact with the finishing abrasive to the part. The pneumatic connections are the exact same with the addition of a solenoid valve and airline that is connected to the positive supply. This can be seen in the figure below in Figure 3. In order to perform the retract function air 0 PSI is supplied to the Supply (+) port and the solenoid is actuated to send the fully supply pressure to Supply (-). This should not be used in daily operation as it will prematurely wear the neoprene bumper.

Single Direction Force Compliance with Retraction

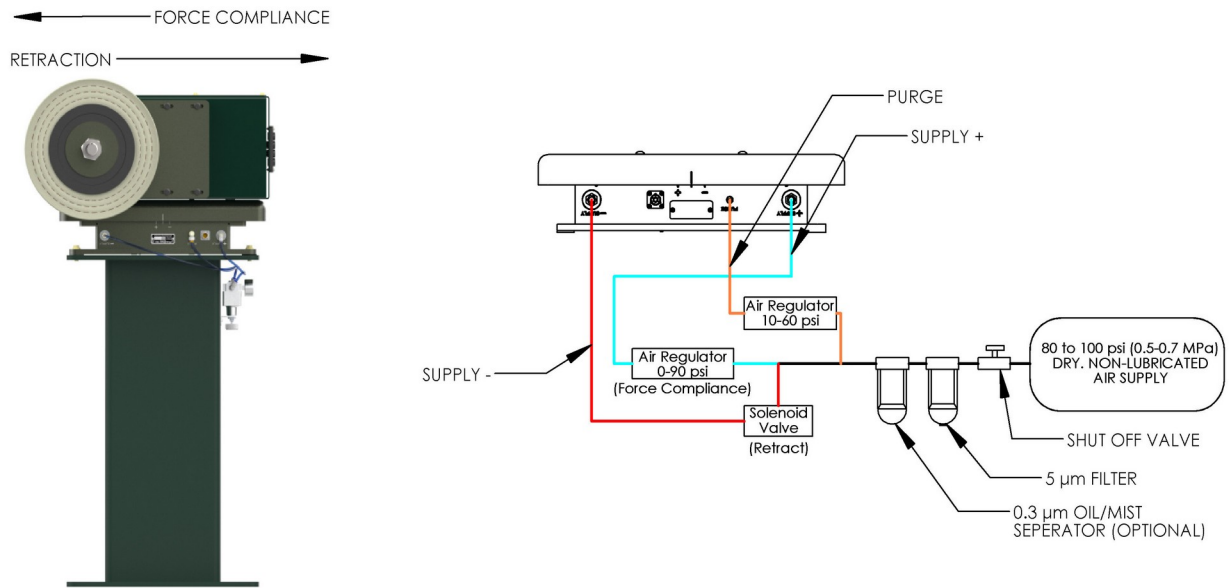


Figure 3: Standard Pneumatic Connections with Retraction

4.0 Operation

4.1 Media Mounting

The SFS92 has dual 40mm diameter Mounting Shafts that protrude 16.3 in. (414.3 mm). The main shaft is machined with a 1.25-5 ACME thread and flats to transmit the required torque through the 140MM drive flange. It is important to note that the shaft is machined with right handed threads on one end and left handed threads on its opposite end. Once all of the components are stacked up as shown in Figure 4, the locknut should then be torqued down.

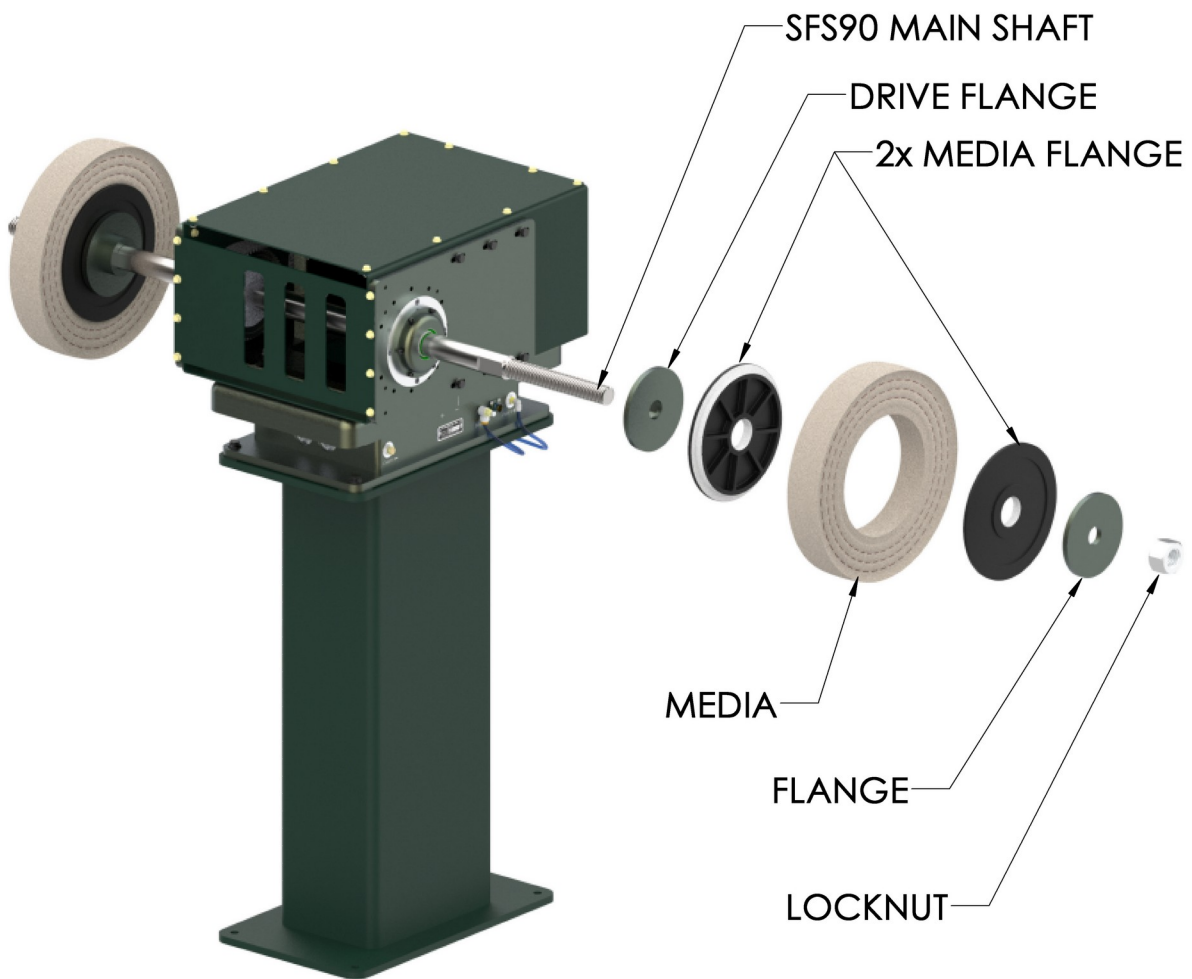


Figure 4: Example of Media mounting

4.2 Achieving Desired Force

The SFS92 uses a passive 90 Series AFD to supply a compliant force from 2 to 215 lbs. (8 to 956 N). To achieve max force a regulator with a higher max pressure must be used. The passive force device requires the user to provide regulated air pressure to achieve a desired force output at the Contact Wheels. Use the following equations to determine the pressure required to achieve the desired output force:

$$F_a = 2.6 X P_s \quad \text{English Units}$$

$$F_{am} = 166 X P_s \quad \text{Metric Units}$$

Where:

$$F_a = \text{Net applied force (lb}_s\text{) at Contact Wheels}$$

$$F_{am} = \text{Net applied force (N) at Contact Wheels}$$

$$P = \text{Supply pressure (psi)}$$

PushCorp includes an electronic regulator standard in their quote. This will allow customers to adjust the force electronically during the operation. If the force is not changed throughout the process a manually adjustable pressure regulator may be sufficient. The accuracy of the force output is directly related to the precision and quality of the pressure regulator. For the most precise force output a regulator that operates in a limited range (i.e., 0-15 psi) is required.

4.3 Achieving Desired Media Speed

If your unit was purchased with the S724 without a control panel (SMFBCON), the rpm is controlled via a +/- 10 VDC analog signal. This is applied to pins X3B9 (-) and X3B10 (+). The user must scale the command voltage to the servo motor amplifier from 0 to 10 Volts, which equates to rotational speed from 0 to 1400 RPM. The user is responsible for determining the maximum speed for their media. The SFS92 is factory limited to operate at a maximum Mounting Shaft rotational speed of 1400 rpm.

4.4 Drive Belt Replacement

The SFS92 uses a 1.5:1 reduction timing belt drive to transfer power from the Servo Motor to the Mounting Shaft. This drive incorporates a high-strength Gates Poly Chain GT2 belt, PushCorp Part No. PAR04695-1. Should this Drive Belt ever require replacement, contact PushCorp for the proper procedure.

4.5 Media Position Feedback

The SFS92 comes equipped with an internal potentiometer that provides a 0-10 volt signal based on the linear position of the Media. The voltage signal is at a minimum value when the Media is pushed back against the rubber stops, and a maximum value when the Media is forward against the rubber stops. The total linear compliant stroke is 1.4 in. (36 mm).

Depending on the cable supplied, reading this value will be slightly different. This is based on whether you ordered your system with the SMFBCON control panel or not. The linear position signal must be calibrated for each installation. Based on the cable provided, the calibration is easily accomplished using one of the following two procedures.

4.5.1 Without SMFBCON - 575AG-811M14-897G

1. Attach the High-Flex Cable to the Carriage Position Feedback Connector on the SFS92.
2. Turn off the supply air to the SFS92
3. Move the Contact Wheels to the full rearward (negative) position.
4. Read the voltage signal on the POSN Position Signal output. Record this voltage for future reference. This will be referred to as V_{neg} .
5. Move the Contact Wheels to the full forward (positive) position.
6. Read the voltage signal on the POSN Position Signal output. Record this voltage for future reference. This will be referred to as V_{pos} .
7. The position of the Contact Wheels can now be determined by measuring the current voltage on the POSN Position Signal output (V_m) and inserting the value into the following equation:

$$p = 1.4 \text{ inch} \times \left(\frac{V_m - V_{negative}}{V_{pos} - V_{negative}} \right) \text{ English Units}$$

$$p = 36 \text{ mm} \times \left(\frac{V_m - V_{negative}}{V_{pos} - V_{negative}} \right) \text{ Metric Units}$$

Where,

p = Contact Wheel Position (inch, mm)

V_m = Voltage measured on POSN signal wire (V)

$V_{negative}$ = Calibrated voltage at fully negative Carriage position (V), (0 inch, 0 mm)

V_{pos} = Calibrated voltage at fully positive Carriage position (V), (1.4 inch, 36 mm)

- +V

Supply Voltage - The supply voltage input for the SFS92. The supply should be well regulated to +/- 10%. The load resistance is $3000\ \Omega \pm 30\%$. The supply voltage should not exceed 24VDC. A 12VDC supply will yield a POSN signal output voltage between 0 and 10VDC.
- COM

Supply Common - The supply common input for the SFS92. It should be connected to the common terminal for the supply as well as the analog common for the position signal.
- POSN

Position Signal - The linear potentiometer signal output. This voltage signal represents the Carriage position. The device connected to this output should have an input impedance of equal to or greater than $100k\Omega$. The linear potentiometer signal is not calibrated from the factory but is linear to $\pm 1.0\%$.
- SHLD

Cable Shield - The drain wire for the overall cable shield. Connect this wire to the central grounding point of the panel.

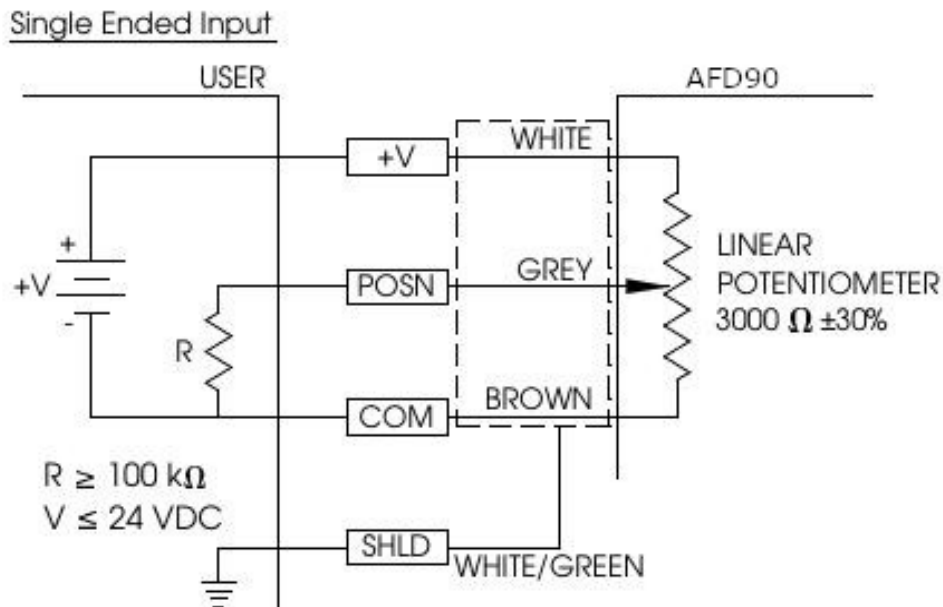


Figure 5: Position Feedback Wire Diagram - 575AG-811M14-897G

NOTE: Care should be taken to ensure that all signal and voltage source commons are connected together on the user end to avoid D.C. offset errors.

4.5.2 With SMFBCON - 983G-4684M14-982G

For more detailed information refer to the SMFBCON manual found in Products → Control Cabinets → SMFBCON-EIP

1. Attach the High-Flex Cable to the Carriage Position Feedback Connector on the SFS92 and the PL4 connector on the bottom of the SMFBCON panel.
2. Turn off the supply air to the SFS92
3. Move the Contact Wheels to the full rearward (negative) position.
4. Read the signal on Analog In – 3. Record this voltage for future reference. This will be referred to as Vneg.
5. Move the Contact Wheels to the full forward (positive) position.
6. Read the voltage signal on Analog In – 3. Record this voltage for future reference. This will be referred to as Vpos.
7. The position of the Contact Wheels can now be determined by measuring the current signal on Analog In - 3 (Vm) and inserting the value into the following equation:

$$p = 1.4 \text{ inch} \times \left(\frac{V_m - V_{negative}}{V_{pos} - V_{negative}} \right) \text{ English Units}$$

$$p = 36 \text{ mm} \times \left(\frac{V_m - V_{negative}}{V_{pos} - V_{negative}} \right) \text{ Metric Units}$$

Where,

$p = \text{Contact Wheel Position (inch, mm)}$

$V_m = \text{BITS measured on Analog Input 3}$

$V_{negative} = \text{Calibrated voltage at fully negative Carriage position (BITS), (0 inch, 0 mm)}$

$V_{pos} = \text{Calibrated voltage at fully positive Carriage position (BITS), (1.4 inch, 36 mm)}$

5.0 Technical Specifications

Maximum Applied Force:	215 lbs. (956 N)
Torque:	38.7 lb-ft [52.4 N·m]
Shaft Speed:	0-1400 RPM
Weight:	415 lbs. (188.2 kg)
Force Scale Factor:	1.4 lbs/psi (890 N/MPa)
Compliant Stroke:	1.4 in. (36 mm)
Supply air:	Non-lubricated, Dry, 5µm Filtered, 100 psi (0.7 MPa) Max.
Supply Voltage:	480 VAC, 3-Phase +/-10%
Max. Cont. Current:	30 Amps
Max. Peak Current:	60 Amps (2 Seconds)

Specifications subject to change without notice.

Fastener Tightening Torque Specs					
Fastener Size	Torque			Minimum Depth	
	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