

# **S70 Electric Actuator Servo *Plus!***

## **Installation & Maintenance Manual**

---

**Version 1.2**

**BRAY CONTROLS  
13333 Westland East Blvd.  
Houston, TX 77041 USA**

**(281) 894-5454  
FAX (281) 890-9499**

- 1. INTRODUCTION..... 2**
- 2. HARDWARE DESCRIPTION..... 3**
  - 2.1 HARDWARE FEATURES..... 3**
  - 2.2 CONNECTOR WIRING ..... 4**
    - 2.2.1 S70 Actuator Motor and Power Connector J1..... 4*
    - 2.2.2 Command Signal Connector ..... 4*
    - 2.2.3 Retransmission Feedback Signal Connector ..... 5*
    - 2.2.4 S70 Interface Connectors..... 5*
    - 2.2.5 Status LED ..... 7*
    - 2.2.6 Serial Communications Port..... 7*
- 3. CALIBRATION..... 8**
- 4. TROUBLESHOOTING ..... 9**
  - 4.1 ACTUATOR DOES NOT RESPOND TO COMMAND SIGNAL..... 9**
  - 4.2 ACTUATOR OPERATION ..... 10**
- 5. FACTORY SETTINGS..... 11**

## 1. Introduction

The Bray S70 Servo Plus! provides complete analog control and monitoring of the Bray S70 Electric Valve Actuator. The basic function of the S70 Servo Plus! is to position the S70 Actuator in response to an analog command signal from the process controller.

The process controller contains a desired process setpoint entered by the user, and continually monitors the process variable (i.e. flow rate, tank level, etc.) through some form of sensor. The process controller calculates and transmits an appropriate analog command signal to the S70 Servo Plus! in order to establish and maintain the desired process setpoint.

Varying the command signal to the S70 Servo Plus! will change the S70 Actuator position, which in turn moves the underlying control valve to create a change in the process variable. The S70 Servo Plus! simultaneously provides a Retransmission Feedback signal representing the actual Actuator position.

The user may select various industry standard analog current or voltage ranges for both the command signal, and the retransmission output. The S70 Servo Plus! also offers additional features and benefits that greatly enhance the operation of the Series 70 Actuator, such as:

- Microprocessor-assisted calibration using two simple pushbuttons instead of several potentiometers
- Optically isolated 2-wire, 0 to 20mA, 0 to 5V, or 0 to 10V command signal input configured by jumpers
- Command signal failure detection, which moves the actuator to a user-defined fail position such as fully open, fully closed, partially open, or fail in last position
- Internal feedback signal failure detection, which keeps the actuator from moving if it does not know its actual position
- An optional Configuration Tool that includes a powerful and intuitive MS Windows Application, and a Cable for configuration and diagnosis of the S70 Servo Plus! using the serial interface
- Speed Control in both the Open and Closed Directions
- Speed Control which can be configured to begin and end at user-defined angles of opening
- Precise Deadband adjustment as a percentage of span
- Instant Reverse Delay to prevent motor run-through on rapid reversal of command signal direction
- Factory setting of all parameters to default values, or user specified values
- User setting of all parameters with the optional Configuration Tool

This document is organized into two main sections:

- S70 Hardware, which includes information on wiring connections, jumper settings, LED functions, installation and operation
- Troubleshooting Guide, which includes information on solving operational difficulties

## 2. Hardware Description

The S70 Servo Plus! consists of a printed circuit board (Figure 1), which includes the Command Signal Input, Retransmission Feedback signal, terminal connections to the S70 Actuator, calibration press buttons and indicators, Status Indicator LEDs, and jumpers to select different operating modes.

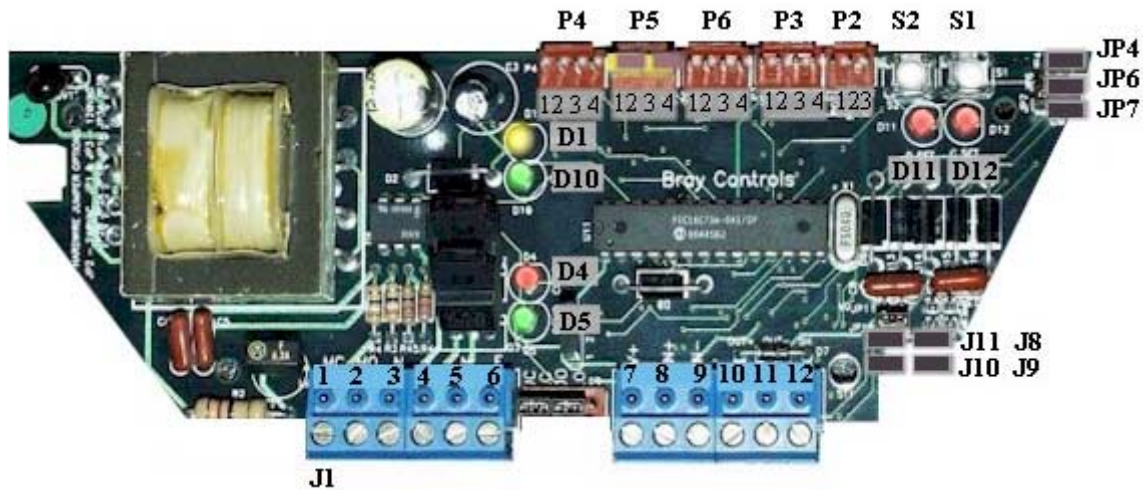


Figure 1: S70 Servo Plus!

### 2.1 Hardware Features

The microprocessor controlled S70 Servo Plus! enhances the operation of the Series 70 actuator by providing full positioning control and signal Retransmission Feedback while sensing operating conditions such as travel limit switches, torque limit switches, handwheel switch, and the potentiometer feedback signal.

The S70 Servo Plus! microprocessor eliminates the need to adjust potentiometers during calibration. The calibration is simply performed by providing an appropriate Command Signal, moving the actuator to the closed position, and then pressing a button to store closed calibration point. The process is repeated for the open position. The calibration is stored in a non-volatile memory.

The Command signal and Retransmission Feedback signal are jumper selectable, as either a current range (20 mADC max) or a voltage range (5 VDC or 10 VDC max). The Command Signal and Retransmission Feedback signal may be set to different ranges.

The S70 Servo Plus! includes a Serial Interface which may be connected to a Personal Computer with the optional Configuration Tool software to provide complete monitoring and configuration of the S70 Servo Plus! in real time. Refer to the S70 Servo Plus! Configuration Tool Installation and Maintenance Manual for more information.

## 2.2 Connector Wiring

The S70 Servo *Plus!* must be wired correctly to the Series 70 Actuator for proper operation. The following sections describe various features of the S70, and the associated wiring details.

### 2.2.1 S70 Actuator Motor and Power Connector J1

Connector J1 has pins to connect main line power the S70 Actuator and to terminate the leads from the Actuator motor. Refer to Table 1 below:

PIN	Description	Electrical Notes	Feature Notes
1	Motor Closed	Usually a Blue Wire	Factory Wired
2	Motor Open	Usually a Red Wire	Factory Wired
3	Motor Common (Neutral)	Usually a Black Wire	Factory Wired
4	AC Line Power Hot	120 or 220 VAC	Must match motor voltage
5	AC Line Power Neutral	120 or 220 VAC	Must match motor voltage
6	Earth (Ground)		

**Table 1: Connector J1 – Motor and Power Pins**

The S70 Actuator also has a safety grounding lug on the switchplate for connection to earth ground.

### 2.2.2 Command Signal Input Connector

The Command Signal input is jumper selectable as either a current or voltage range as described in Table 3. The Command Signal input can be configured as a current with a maximum range from 0 to 20 mADC, or as a voltage with a maximum range from 0 to 5 VDC, or 0 to 10 VDC.

Beyond the jumper settings, which define the type of signal and maximum range, the Servo *Plus!* can be calibrated to operate within a range that is less than the full input span. As an example, to operate the Command Signal input from 4 to 20 mADC rather than 0 to 20 mADC, the lower Command Signal current would be set to 4 mA, rather than 0 mA during calibration. This same technique applies to the voltage input, where the upper and lower Command Signal calibration references can be any value inside of the selected minimum and maximum ranges. Refer to Section 3 for further calibration information.

The Servo *Plus!* may also be operated from a potentiometer command signal.

PIN	Description	Current Input	Voltage Input	Potentiometer Input
7	+5 Volts	N/C	N/C	Full Clockwise End
8	Command Signal Source	(+)	(+)	Wiper
9	Command Signal Common	(-)	(-)	Full Counterclockwise End

**Table 2: Connector J1 - Command Signal Input Pins**

JP4	JP6	JP7	Description
Installed	Removed	Removed	4 – 20mA Input Command Signal
Installed	Removed	Installed	0 – 5 Volt Input Command Signal
Removed	Installed	Installed	0 – 10 Volt Input Command Signal
Installed	Removed	Installed	5 K Ohm Potentiometer Input Command Signal

**Table 3: Jumper Settings for Command Signal Input**

### 2.2.3 Retransmission Feedback Signal Connector

The Retransmission Feedback signal is calibrated at the factory to match the Command Signal input range described in Table 3. A description of the jumper settings for the Retransmission Feedback is shown in Table 5. The Retransmission Feedback can be configured as a current with a maximum range from 0 to 20 mADC, or as a voltage with a maximum range from 0 to 5 VDC, or 0 to 10 VDC. (The Retransmission Feedback will require calibration if output signal type is changed. Contact your Bray representative for further information.)

PIN	Description	Current Output	Voltage Output
10	Output Source	(+)	(+)
11	Output Return	(-)	(-)
12	Shield / Earth	Ground	Ground

**Table 4: Connector J1 - Retransmission Feedback Signal Pins**

JP8	JP9	JP10	JP11	Description
Removed	Removed	Installed	Removed	Current Output Retransmission Signal (20mA Max)
Installed	Removed	Removed	Installed	Voltage Output Retransmission Signal (5 V Max)
Removed	Installed	Removed	Installed	Voltage Output Retransmission Signal (10 V Max)

**Table 5: Jumper Settings for Retransmission Feedback**

### 2.2.4 S70 Interface Connectors

The S70 Servo Plus! monitors several operational parameters of the Series 70 Actuator. The Open and Close travel limit switches are sensed during calibration, as well as normal operation. These switches must be wired correctly (as shown in Table 6) for proper actuator operation. *Commands must not be given to simultaneously activate these connector pins.*

All limit switch interface pins are pairs. The first pin in each pair is an input. The second pin in each pair is connected to ground. The limit switch normally closed contact connects the pair together and grounds the input. A low input is considered to be “normal operation” by the Servo Plus! If the limit switch contact opens, the pins are no longer connected and the ground is removed. The input pin goes high, which the Servo Plus! considers to be “limit reached.”

If the wiring to the limit switch is open, or if the interface connectors are not in place, the input pin will go high, which will appear to be “limit reached.”

Any limit reached will prevent the S70 Actuator motor from traveling any further in that particular direction. For instance, if the Closed Limit Switch is reached, the S70 Actuator will not travel any further in the Closed direction. It would still be possible for the S70 Actuator to travel in the Open Direction.

PIN	Description	Electrical Notes	Feature Availability
1	CL1 – Closed Limit Input	Low = Normal; High = Limit Reached	Standard
2	CL2 - Closed Limit Common	Ground	Standard
3	OL1 - Open Limit Input	Low = Normal; High = Limit Reached	Standard
4	OL2 - Open Limit Common	Ground	Standard

**Table 6: Interface Connector P4 – Travel Limit Switches**

The optional Open Torque and Close Torque limit switches are monitored during normal operation. These switches must be wired correctly (as shown in Table 7) for proper actuator operation. *If Torque limit switches are not installed in the Series 70 Actuator, then Pin 1 must be jumpered to Pin 2, and Pin 3 must be jumpered to Pin 4 for the actuator motor to operate.*

PIN	Description	Electrical Notes	Feature Availability
1	CT1 - Closed Torque Input	Low = Normal; High = Limit Reached	Optional
2	CT2 - Closed Torque Common	Ground	Optional
3	OT1- Open Torque Input	Low = Normal; High = Limit Reached	Optional
4	OT2- Open Torque Common	Ground	Optional

**Table 7: Interface Connector P5 – Torque Limit Switches**

The Handwheel Switch on the Series S70 Actuator is used to detect if the Handwheel is engaged (pulled outward allowing manual actuator operation), or disengaged (pushed inward allowing remote actuator operation). This switch must be wired correctly (as shown in Table 8) for proper actuator operation.

The General Purpose input listed in Table 8 is an optional feature reserved for future use.

PIN	Description	Electrical Notes	Feature Availability
1	HW1 - Handwheel Switch Input	Low = Disengaged; High = Engaged	Standard
2	HW2 - Handwheel Switch Common	Ground	Standard
3	GP1 - General Purpose Input	Low = Normal; High = Limit Reached	Reserved
4	GP2 - General Purpose Common	Ground	Reserved

**Table 8: Interface Connector P6 – Handwheel Switch**

The Internal Feedback Potentiometer is used to translate the physical position of the actuator to an analog voltage that is processed by the S70 Servo Plus!. Refer to Table 9 for proper wiring. The Internal Feedback Potentiometer is not available for connection to external instruments. The Retransmission Feedback signal is used to provide external indication of valve position.

PIN	Description	Electrical Notes
1	Reference voltage	Potentiometer fully open end point
2	Voltage relative to valve position	Potentiometer wiper
3	Ground	Potentiometer fully closed end point

**Table 9: Interface Connector P2 – Internal Feedback Potentiometer**

### 2.2.5 Status LED

The S70 Status LED D10 (Figure 1) indicates the current status of the S70 Servo Plus!. Table 10 describes the different states of the status LED.

LED State	Description
Off	The S70 is not powered or has failed to start.
Flashing Green (1S on, 1S off)	The S70 is running normally.
Solid Green	The Internal Feedback position signal has failed. (The Servo Plus! does not know the actual actuator position, so the motor is electrically disabled and the actuator motor will not move)
Flashing Green (0.25S on, 0.5S off)	The input command signal has failed. (The Servo Plus! does not know the desired valve position, so the motor is commanded to the preset <i>fail position</i> )
Flashing Green (0.5S on, 0.5S off)	The handwheel is engaged (When the handwheel is pulled outward and engaged, the actuator motor is electrically disabled)

**Table 10: S70 Status LED D10**

### 2.2.6 Serial Communications Port

The Servo Plus! serial port connection provides the capability to monitor and configure the S70 from a Personal Computer using the optional Configuration Tool. The Configuration Tool is Bray P/N 70-0012-22934-536 and consists of a software application, a communications cable and an instruction manual.

The Configuration Tool and serial communications port are not required to calibrate the Servo Plus!, since that is done by pressing the pushbuttons. The Calibration Tool is not required to change the Command Signal input range, or Retransmission Feedback output range, since those are done by jumper settings.

The Configuration Tool graphically displays all the operational parameters of the Servo Plus! and provides some diagnostic information. This makes commissioning and troubleshooting even easier and faster. The Configuration Tool also allows the user to change the factory default settings, and even reset the factory defaults if the unwanted changes have been made.

Some parameters, such as Deadband, Fail Position, Speed Control and Instant Reverse Delay may only be viewed or changed by use of the Configuration Tool. These parameters are usually set by the factory and are not modified by the user. However, the user may have the parameters modified at any Bray factory or distributor, or modify the parameters themselves with a Configuration Tool.

A single Configuration Tool can communicate with only one Servo Plus! at a time.

### 3. Calibration

The calibration procedure defines the limits of operation of the Series 70 Actuator between the fully open valve position and the fully closed valve position. The cams on the Series 70 Actuator define the fully open and closed positions of the valve and may be set at any degree of opening. The only requirement is that the open cam limit setting must set at a higher degree of opening than the closed cam limit setting. In other words, the "Open" position must be more open than the "Closed" position.

Calibration is performed as follows:

1. Adjust the Open and Closed limit switch cams on the Series 70 Actuator to the desired position.
2. Engage the handwheel and move the Series 70 Actuator to until the Closed limit switch cam is engaged.
3. Apply a "fully closed" Command Signal input (usually 4 mA DC) to the proper pins of Connector J1. See Table 2 for proper wiring and polarity.
4. Press and hold the C Set pushbutton S1 (Figure 1) for a minimum of 2 seconds. LED D12 will light to signify the pushbutton is pressed. After 2 seconds, release pushbutton S1. This will cause the closed calibration data to be stored in the Servo Plus! non-volatile memory. If pushbutton S1 is held for less than two seconds, such as an accidental touch, the calibration data will not be stored in the memory.
5. Rotate the handwheel counter-clockwise until the fully Open cam is engaged.

6. Apply a “fully open” Command Signal input (usually 20 mA DC) to the proper pins of Connector J1. This “fully open” Command Signal must be greater in magnitude than the “fully closed” command signal.
7. Press and hold the O Set calibration pushbutton S2 (Figure 1) for a minimum of 2 seconds. LED D11 will light. After 2 seconds, release pushbutton S2. This will cause the calibration data to be stored in the Servo *Plus!* non-volatile memory. If pushbutton S2 is held for less than two seconds, such as an accidental touch, the calibration data will not be stored in the memory.

After completing the calibration procedure, it is good practice to apply the fully closed and fully open Command Signals, and verify that the S70 Actuator moves to the proper positions.

## **4. Trouble Shooting**

### **4.1 Actuator does not respond to Command Signal**

If the Actuator does not respond to a Command signal and it has been confirmed that the signal is within the correct range (either current or voltage), use the flow chart shown in Figure 1:

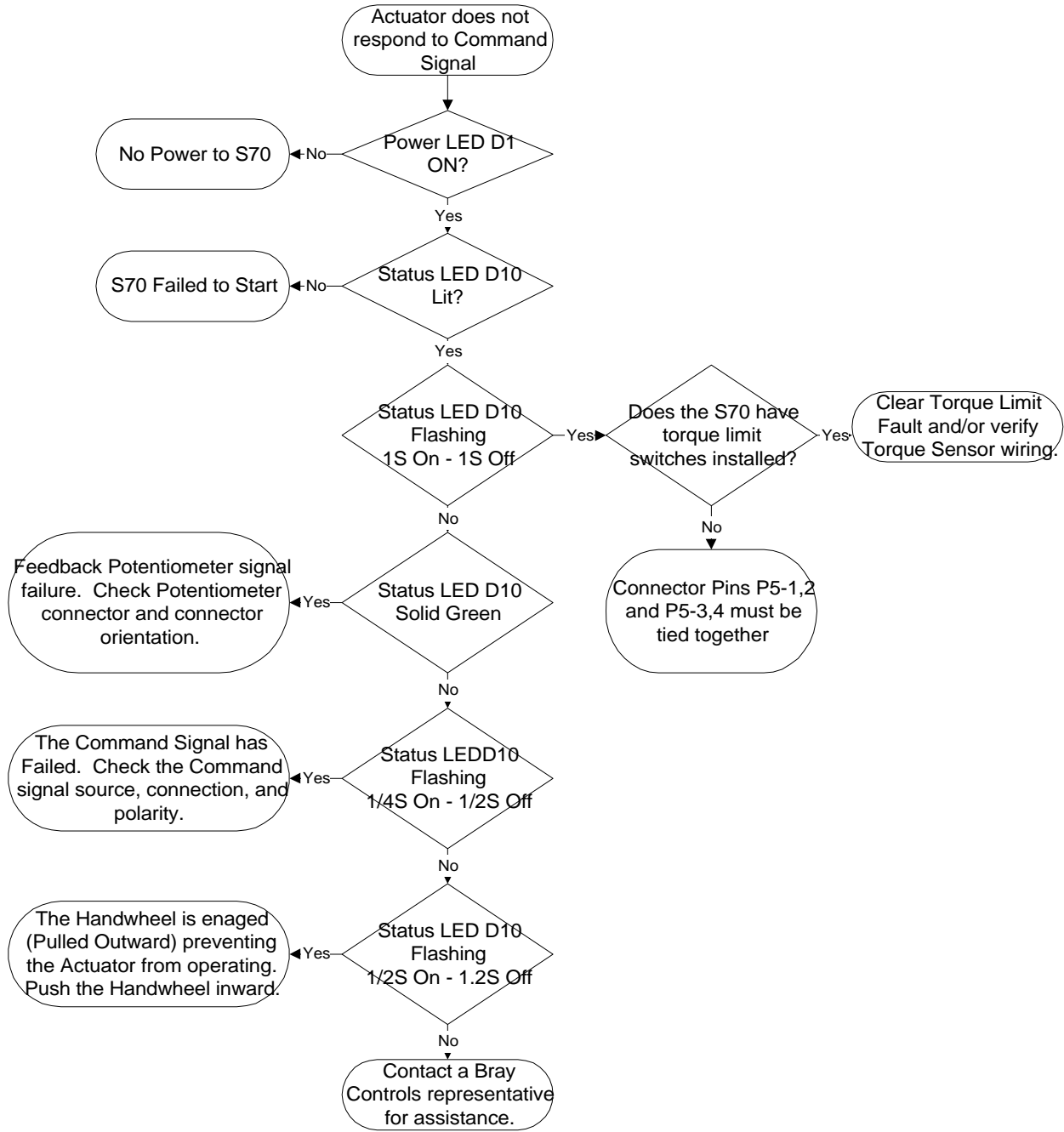


Figure 2: Actuator Trouble-Shooting Flow Chart

### 4.2 Actuator Operation Modes

The Series 70 Actuator can be operated in a Remote mode (Command Signal Control) or a Local mode (manual control) if the Series 70 has the Control Station option installed.

If the Series 70 Actuator is not operating while in the Remote mode, or if the optional Control Station is not installed (Remote mode is default), verify the following:

1. The Status LED D10 (Figure 1) should be flashing (1 second on, 1 second off) indicating that the S70 is online and operating normally. Refer to Table 10 for other diagnostic status indications of this LED.
2. Torque Limit Switch - If the Torque Limit Switch is engaged, take the appropriate steps to clear the fault including clearing any obstructions that could cause the fault. Verify proper operation and adjustment of the Torque Limit Switches, and check the Torque Limit Switch connections and wiring.
3. Handwheel - The Handwheel must be completely pushed in for Remote operation. If the Handwheel does not turn freely with little effort, it is not completely disengaged. If the Handwheel is completely disengaged but is still reported as "Engaged", the S70 is not wired correctly or the Handwheel switch is malfunctioning. Review to Section 2.2 to correct the wiring fault.

When the Control Station option is installed, jumpers are fitted onto the interface connectors for the travel limit switches (P4), the torque limit switches (P5), and the handwheel (P6). Therefore, all interrupt switches must be wired in series with the actuator motor.

## 5. Factory Settings

The Bray Controls S70 Servo Plus! is a highly sophisticated electronic device with many programmable features. The S70 Servo Plus! is shipped from the factory in a configuration that will suit most customer requirements. The following table lists the programmable features of the S70 Servo Plus! with the factory default settings.

If the user wishes to change these settings, the optional S70 Servo Plus! Configuration Tool is an extremely simple to use Personal computer application program which displays all of the S70 Servo Plus! operating parameters, and provides access to key features of the S70 Servo Plus! such as Speed Control, Fail Position, Instant Reverse Delay, and Deadband. Once these settings are changed, they are permanently stored in the S70 Servo Plus! non-volatile memory.

Bray distributors are equipped with the Configuration Tool, and can provide assistance configuring your S70 Servo Plus!. Customers may order the S70 Servo Plus! with desired optional settings, or have the factory settings modified by a Bray distributor. Customers may also purchase a Configuration Tool and modify their own settings.

Feature	Description	Factory Default	Optional Range
Speed Control	Opening and Closing Actuator Speed control with independent Opening and Closing Speeds. Opening and Closing Speed Rates are fully adjustable. Opening speed and Closing Speed rates may be programmed to occur at	Disabled – the actuator will run full speed in both Opening and Closing directions.	Enabled with programmable speeds and ranges.

	specific travel positions.		
Fail Position	The Fail position is active when the Command Position signal is outside of its operating range.	Fail to the fully closed position.	Fail to any programmed position, or fail in last position.
Instant Reverse Delay	To prevent Motor “Run Through”, a programmable delay is inserted between actuator motor reversals.	½ Second	0 to 12.5 Seconds
Deadband	The percentage of Command Signal around the setpoint that is ignored before the Command Signal is considered to have changed. A low Deadband percentage makes the actuator more sensitive to small Command Signal changes. If the Deadband is too low, however, the actuator may oscillate.	2%	0.5% to 100%

**Table 11: S70 Servo Plus! Factory Settings**