

Honeywell's HercuLine<sup>®</sup> 2000 series actuators are available in four versions: HercuLine<sup>®</sup> 2000, HercuLine<sup>®</sup> 2001, HercuLine<sup>®</sup> 2002, and HercuLine<sup>®</sup> 2003. All are low torque, precision electric rotary actuators. This guide provides you with mechanical and electrical installation information required to mount and connect the HercuLine<sup>®</sup> 2000 Series Actuator to your specific application. Installation considerations, electrical and safety precautions should be observed.

**WARNING**

An external disconnect switch must be installed to break all current carrying conductors connected to the actuator. Turn off power before working on conductors. Failure to observe this precaution may result in serious personal injury.

Refer to the Model Selection Guide on Pages 9 and 10 to determine which features and functions are on your model. For additional information, refer to HercuLine Series 2000 Installation/Operation Manual # 62-86-25-10

## Overview

The procedures to install the HercuLine<sup>®</sup> 2000 Series actuator and place it in service require that you:

1. Select a suitable location for installation.
2. Mount the actuator securely.
3. Install mechanical connections or linkage between control arm and final control element. Use HAL software application to aid in mechanical installation.
4. Make all electrical connections for actuator according to local and national electrical codes.
5. Power up actuator.
6. Enter, verify and adjust set up parameters for proper operation.
7. Check the operation of the Actuator

### 1. Installation Considerations

Mount the actuator in a location where it will be easily accessible for maintenance and for manual operation by means of the hand wheel. The exact location must be determined in accordance with the linkage used.

### 2. Actuator Mounting

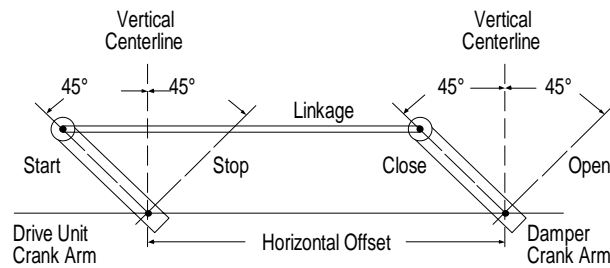
Firmly bolt the actuator to a mounting surface that will not distort when subjected to the torque stresses generated by the actuator. The output shaft of the actuator should be parallel to the output shaft of the driven device. The output shaft crank arm is fully adjustable through 360°.

### 3. Linkage Set-up

Many applications require the use of a linkage assembly and often the final control element does not have a linear torque curve. The actuator linkage can be set up to achieve an optimal delivered torque distribution for specific applications. To assist with linkage design, Honeywell offers a linkage analysis software application (HAL). The software can be ordered as P/N 51197910-001.

#### Constant Torque Linkage (typical)

A constant torque linkage is employed when it is desired to provide a linear torque profile throughout the full range of final control element travel. In this situation, the actuator and driven crank arms will be set-up proportionally with respect to each other.



ah 23199

Figure 1 Constant Torque Linkage

### 3. Linkage Set-up (continued)

#### Variable Torque Linkage

A variable torque linkage is employed when it is desired to provide a non-linear torque profile throughout the full range of final control element travel. In this general situation, the actuator and driven crank arms will be set up to provide a higher torque for seating or unseating the final control element.

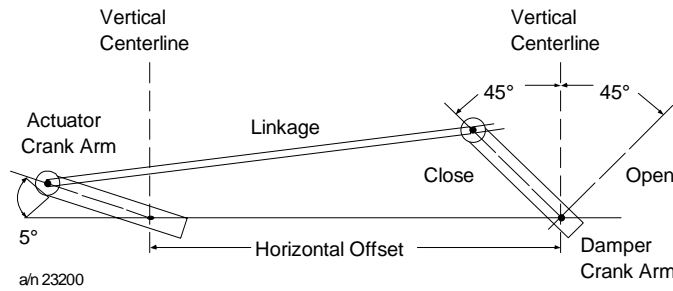


Figure 2 Variable Torque Linkage

### 4. Electrical Connections

The actuator terminal connections for the field wiring are located behind the cover on the actuator case. Power and field wiring is brought into the actuator through two access holes located on the side of the actuator case.

**CAUTION**

Use both openings: one for low level wiring (control signal) and the other for high level wiring (120Vac).  
**Do not run both the High Level and Low Level wiring through the same opening.**

#### Recommended Minimum Wire Size

In general, copper wire used unless locally applicable codes dictate otherwise.

Earth ground wire to common power supply - **14AWG**

Earth ground wire to single actuator. 120/240 Vac line leads. +24 V and common signal leads. Common signal leads, relays, and aux switches - **18AWG**

#### HercuLine® 2000 Wiring Connections

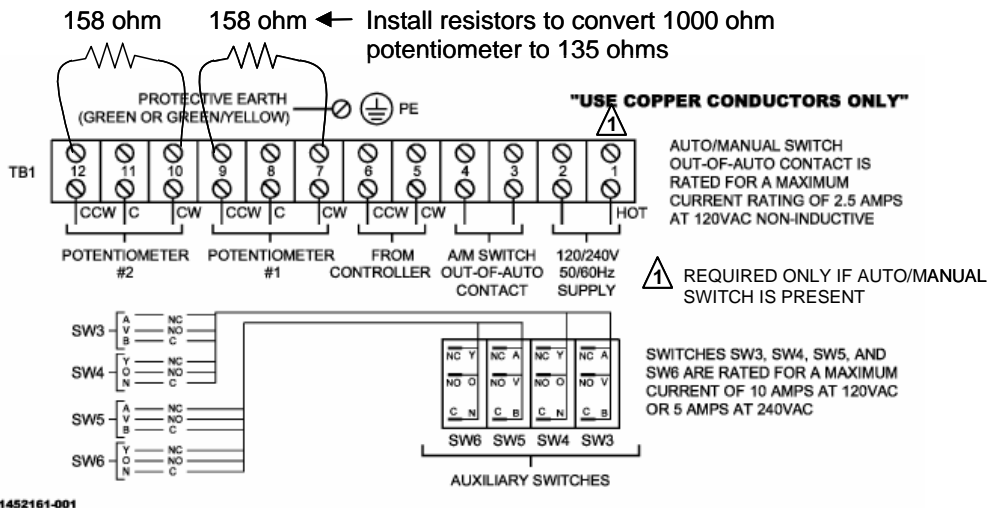
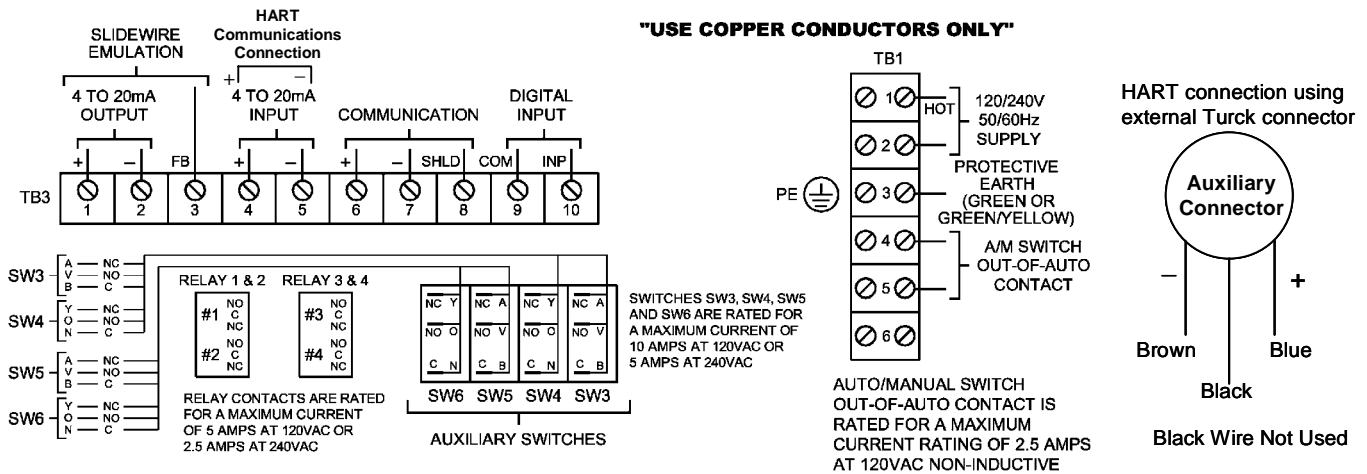


Figure 3 HercuLine® 2000 connections

Connection	Terminal	Description
Hot	1	Hot wire for 120/240VAC main supply. <b>NOTE:Use only if Auto/Manual switch is present.</b>
Neutral	2	Neutral wire for 120/240VAC main supply
Auto/Manual Switch Contact	3	Switch contact to indicate setting of actuator AUTO/MANUAL switch.
	4	Switch is closed when actuator is "NOT-IN-AUTO"

CW from Controller	5	CW Motor Drive
CCW from Controller	6	CCW Motor Drive
Potentiometer #1	7 8 9	Clockwise-End Slidewire feedback Counterclockwise-End
Potentiometer #2	10 11 12	Clockwise-End Slidewire feedback Counterclockwise-End
Protective Ground		Ground wire connection for main supply

**HercuLine® 2001/2002 Wiring Connections**



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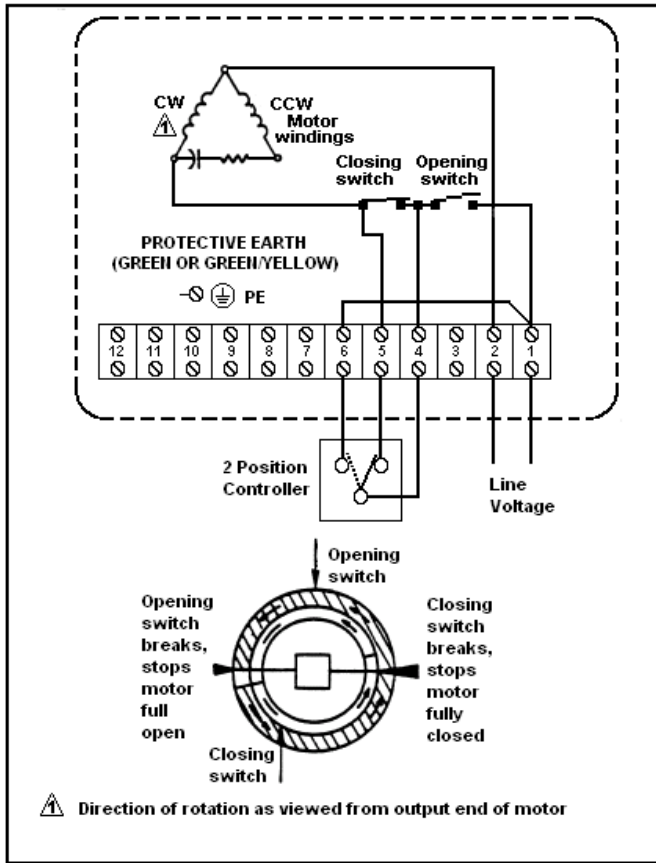
**Figure 3 HercuLine® 2001/2002 Connections**

Connection	Terminal	Description
<b>TB1</b>		
Hot	1	Hot wire for 120/240VAC main supply
Neutral	2	Neutral wire for 120/240VAC main supply
Protective Ground	3	Ground wire connection for main supply
Auto/Manual Switch Contact	4 5	Switch contact to indicate setting of actuator AUTO/MANUAL switch. Switch is closed when actuator is "NOT-IN-AUTO"
	6	
<b>TB3</b>		
4 to 20mA Output*	1 (+) 2 (-)	Analog signal output
Feedback	3	Feedback signal used in conjunction with 4 to 20mA OUTPUT voltage when using Slidewire Emulation
4 to 20mA Input	4 (+) 5 (-)	Analog signal input
Modbus Communication	6 (+) 7 (-) 8 Shield	Connection for RS485 Modbus loop wires
HART Communications	4 (+) 5 (-)	HART Communication is 4-20 mA only.
Digital Input	9 Com 10 Input	Customer's contact closure

\* Optional

**4. Electrical Connections (continued)**

**HercuLine® 2003 Wiring Connections**



**Figure 5 HercuLine® 2003 Wiring Connections**

**HercuLine® 2003 Operation**

The 2003 actuator is uni-directional (it does not reverse rotation with a reversal in control action). Figure 5 illustrates the internal wiring and the external connections.

The smaller insert of the figure describes the limit switch action for one complete cycle. When the two-position controller detects a sufficient fall in temperature in a heating application, the switch portion between the “4” and “5” terminals will close.

The motor then rotates for 180° or until the opening switch breaks (stops are adjustable, factory set at 180°), and stops in full open position.

A subsequent rise in temperature causes the controller to close the switch between the “4” and “6” terminals when the motor will start to rotate (in the same direction) for 180° or until the closing switch breaks.

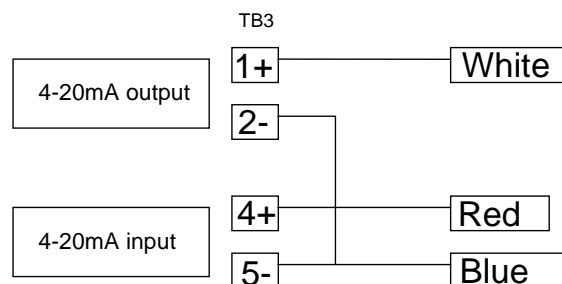
The motor stops in the closed position and completes one cycle.

**Series 90 Control – HercuLine® 2001 model only**

Series 90 Controls are commonly used in building environmental systems and flame safeguard systems to provide modulating control. The control is affected by balancing a 135 ohm potentiometer. The HercuLine 2001 provides an emulation of this system as follows. The current output is used to excite the potentiometer in the controller. To do this it is set permanently at 11 mA. This produces a 1.5 volt span. The wiper is then connected to the HercuLine 2001 input, which is operating in voltage mode. The returns from both the input and the output are tied together.

Series 90 terminals are typically color coded white, red and blue. Conventionally, red is the wiper and white and blue are the two ends of the potentiometer. On a drop in temperature, the wiper moves toward the blue terminal.

**Connections**



**Figure 6 Series 90 connections**

### Considerations

1. This connection performs an emulation of a series 90 motor. If the controller being used is also an emulation of a Series 90, the connections required may be different. Shown in Figure 7 are the connections found necessary to connect a T775 controller through an S443A S90 Auto/Manual Control. If the controller has the capability to provide a 4/20 or voltage output, it is easier to use that mode. It will require only two wires and it will allow the independent use of the 4/20 output. If help is required, contact Honeywell.
2. Due to variations in the definition of rotation directions, it may be necessary to reverse the action of the actuator from CCW to CW or vice versa.

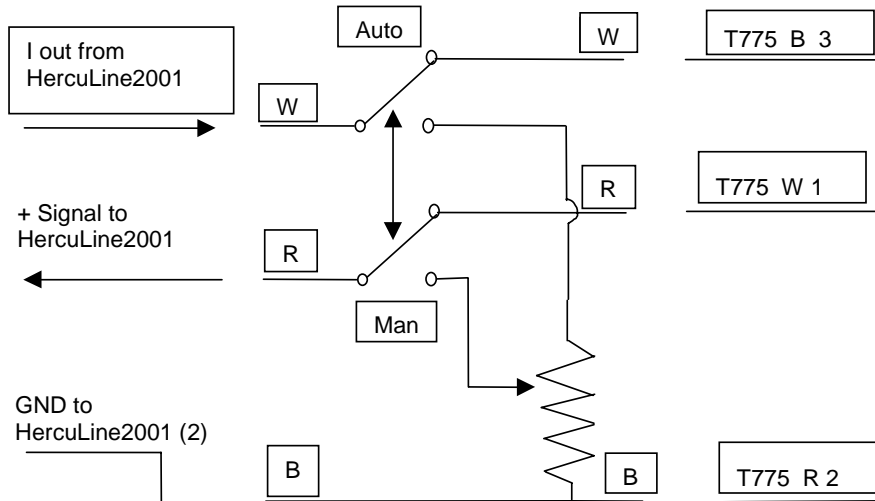


Figure 7 T775 Controller connections

3. In the T775 controller manual there are several examples of using resistances or potentiometers as high and low limit controls. Because of the mode of emulation of Series 90, it is likely that these connections will not work as intended. Instead, use the output or input limits which are programmable in the HercuLine<sup>®</sup> 2001.

### 5. Power up actuator.

Depending on which power supply selection is ordered for your actuator, wire the power input (MAIN POWER) as described in the previous tables and figures. Wiring must conform to national and local electrical codes.

**6. Enter, verify and adjust set up parameters for proper operation. (2001/2002 with optional display)**

Pressing the SET UP key on the keypad provides access to the various set up groups and allows you to set up operating parameters, (such as input types and alarms), set communications, and check actuator status. The Table below lists the set up groups that are available by using the SET UP and FUNCTION keys on the keypad.

Setup Groups	Function Prompts
<b>INPUT</b>	IN TYP   INP HI   INP LO   FILTYP   Direct   Dband   FSTYPH   FsVALH FSTYPL   FsVALL   CHAR   CUSTOM   X0 VAL   ...   X20 VAL Y0 VAL   ...   Y20 VAL
<b>RELAY<sub>n</sub></b>	RTYP <sub>ny</sub> Rny VAL   Rny E*   Rny HL   RTYP <sub>ny</sub> Rny VAL   Rny E* Rny HL   RLY <sub>n</sub> HY   n = 1,2,3 or 4   y = 1 or 2
<b>CURROUT</b>	CURROUT
<b>COMM</b>	COMM   ADDRES   BAUD   XmtDLY   DBLBYT
<b>DIGINP</b>	DIGINP   EndPos
<b>DISPLA</b>	DECMAL   EUNITS   UNITS
<b>LOCK</b>	LOCKID   LOCK   MAENAB
<b>STATUS</b>	FAILSF   RAMTST   SEETST   CFGTST   CALTST
<b>DRVINF</b>	VERNON   SPEED   POWER   ROTATE   TAG   MFGDAT LREP   LCAL   REPTYP
<b>MAINT</b>	TEMP   TEMPHI   TEMPLO   ACSTAL   STARTS   RLICNT RL2CNT   RL3CNT   RL4CNT   REGN0   ...   REGN9   TOTDEG DATSAV   PASSWD   MANRST   LD CAL   LD CFG   RESTRT

**You can use this procedure to access the set up groups and select all parameters.**

*Set Up Procedure Using Display and Keypad*

Step	Operation	Press	Result
1	Enter Set Up Mode	SET UP	Upper Display = <b>SET UP</b> -Lets you know you are in the set up mode and a set up group title is being displayed in the lower display. Lower Display = <b>INPUT</b> -This is the first set up group you see when you press SET UP.
2	Select any Set Up Group	SET UP	Successive presses of the SET UP key will display the other set up group titles. You can also use the ▲ or ▼ keys to scroll through the set up groups in both directions. Stop at the set up group title that describes the group of parameters you want to configure. Then proceed to the next step.
3	Select a Function Parameter	FUNCTION	Upper Display - Shows the current value or selection for the function prompt in the selected set up group. Lower Display - Shows the first function prompt within the selected set up group.

Step	Operation	Press	Result
4	Select other function parameters	FUNCTION	Successive presses of the FUNCTION key will sequentially display the other function prompts of the selected set up group. Stop at the function prompt that you want to change, and then proceed to the next step.
5	Change the Value or Selection	▲ or ▼	These keys increase or decrease the value, or display the next available selection for the selected function prompt. Change the value or selection to meet your needs. NOTE: If the display flashes, you are trying to make an unacceptable entry, or the value on the display is at its range limit. The display may also show "KEYERR" (Key error).
6	Enter Value or Selection	FUNCTION or SET UP	This key selects another function prompt. This key selects another set up group. NOTE: Pressing either key will cause the previously selected value or selection to be entered into memory.
7	Exit Set Up mode	DISPLAY	Exits set up mode and returns actuator to the same state it was in immediately preceding entry into the set up mode. Any changes you have made are stored in memory. If you do not press any keys for 30 seconds, the display times out and reverts to the mode and display shown prior to entering the set up mode.

Record your selections on the Configuration Record Sheet

**Configuration Record Sheet**

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT	IN TYP		From MSG
	INP HI		100
	INP LO		0.0
	FILTYP		LPAS
	LPFILT		0.5
	DIRECT		CCW
	DBAND		0.5
	FSTYPH		UP
	FSVALH		100
	FSTYPL		DOWN
	FSFVALL		0
	CHAR		LINR
	CUSTOM		EQU
	X1 VAL		5
	X2 VAL		10
	X3 VAL		15
	X4 VAL		20
	X5 VAL		25
	X6 VAL		30
	X7 VAL		35
X8 VAL		40	
X9 VAL		45	
X10 VAL		50	
X11 VAL		55	
X12 VAL		60	
X12 VAL		65	

Group Prompt	Function Prompt	Value or Selection	Factory Setting
INPUT (CONT)	X14 VAL		70
	X15 VAL		75
	X16 VAL		80
	X17 VAL		85
	X18 VAL		90
	X19 VAL		95
	X20 VAL		100
	Y1 VAL		5
	Y2 VAL		10
	Y3 VAL		15
	Y4 VAL		20
	Y5 VAL		25
	Y6 VAL		30
	Y7 VAL		35
	Y8 VAL		40
	Y9 VAL		45
	Y10 VAL		50
	Y11 VAL		55
	Y12 VAL		60
	Y13 VAL		65
Y14 VAL		70	
Y15 VAL		75	
Y16 VAL		80	
Y17 VAL		85	
Y18 VAL		90	
Y19 VAL		95	
Y20 VAL		100	

Group Prompt	Function Prompt	Value or Selection	Factory Setting
<b>RELAYn</b>	RTYP		NONE
	RnyE		X1
	RnyVAL		0.0
	RnyHL		LO
	RLYnHY		0.0
<b>CU OUT</b>	CUROUT		NONE Depends on MSG
<b>COMM</b>	COMM		DIS
	ADDRES		1
	BAUD		19.2
	XmtDLY		20ms
	DBLBYT		FP B
<b>DIGINP</b>	DIGINP		NONE
	EndPos		0
<b>DISPLA</b>	DECMAL		8888
	EUNITS		PCNT
	UNITS		ENGL
<b>LOCK</b>	LOCKID		0
	LOCK		NONE
	MAENAB		ENAB
<b>STATUS</b>	FAILSF	Read Only	Read Only
	RAMTST	Read Only	Read Only
	SEETST	Read Only	Read Only
	CFGTST	Read Only	Read Only
	CALTST	Read Only	Read Only
<b>DRVINF</b>	VERSON	Read Only	Read Only
	SPEED	Read Only	Read Only
	POWER	Read Only	Read Only
	ROTATE	Read Only	Read Only
	TAG		6 alpha characters
	MFGDAT	Read Only	Read Only
	LREP	Factory Set	Factory Set
	LCAL	Factory Set	Factory Set
REPTYP	Factory Set	Factory Set	

Group Prompt	Function Prompt	Value or Selection	Factory Setting
<b>MAINT</b>	TEMP		NONE
	TEMPHI		X1
	TEMPLO		0.0
	hh:mm:ss	ACST	Read Only
	STARTS	Read Only	Accumulated Motor Starts
	RnCNT n=1,2,3,or4	Read Only	Relay Cycle Counts
	REGNn n= 0 to 9	Read Only	Accumulated Motor Starts
	TOTDEG	Read Only	Total Degrees of Motor Travel
	DATSAV		DIS
	PASSWRD		Nnnn
	MANRST		NONE
	LD CAL		NONE
	LD CFG		DIS
	RESTRT		DIS

## 7. Start up/Operation

After the actuator is completely installed, wired, and the preliminary adjustments made, check the operation of the actuator and controlled device before placing it in service. Operate the controlled device and check its direction of travel in response to an increase of the input signal and make sure it is correct for the process. Actuators having the optional auto-manual switch must have the knob set in the AUTO position.

When power is applied to the actuator, the actuator electronics performs a diagnostic routine on various device components. These tests include a:

- RAM diagnostic (RAMTST),
- Check of the electrically erasable PROM (SEETST),
- Verification that valid parameter values are in the actuator configuration (CFGTST),
- Verification of valid calibration values (CALTST)
- Test of the local display and LED indicators (all display segments and LED indicators light simultaneously).

The optional local display shows the status of the diagnostics as they are completed during power up. TEST DONE is shown on the display when diagnostics are complete and actuator should be in AUTO mode.

If the Actuator Motor is "Hunting" (Motor does not drive to a position and stop) the process control loop is not tuned correctly. Refer to the Instruction Manual for your controller on how to tune a loop.



## Model Selection Guide

### Instructions

- Select the desired key number. The arrow to the right marks the selection available.
- Make the desired selections from Tables I thru VIII using the column below the arrow.  
A dot (•) denotes unrestricted availability.

Key Number	I	II	III	IV	V	VI	VII	VIII	IX
_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

### KEY NUMBER - Motor Selection

	Selection	Availability			
Basic Motor Unit (no electronics)	2000	↓			
Basic Motor Unit plus Digital Electronics	2001		↓		
Enhanced Performance Motor Unit with Non-contact Position Sensing	2002			↓	
Unidirectional Motor (M640D Replacement)	2003				↓

**TABLE I - TORQUE & SPEED SELECTION (speed per 150 degree rotation)**

Torque, lb-in/(N-M)	50Hz (90°/150°)	60Hz (90°/150°)				
50 / (6.0)	4.5 / 7.5 sec	4 / 6 sec	050	•	•	•
100 / (11.5)	9 / 15 sec	7 / 12 sec	100	•	•	•
200 / 22.5)	18 / 30 sec	15 / 25 sec	200	•	•	•
400 / (45.0)	36 / 60 sec	30 / 50 sec	400	•	•	•
400 / (45.0)	54 / 90 sec	45 / 75 sec	600	•	•	•

**TABLE II - ROTATION**

Travel	90 degrees	090	•	•	•	
	150 degrees	150	•	•	•	
	360 degrees	360				•

**TABLE III - POWER SUPPLY**

Single Phase	100 - 130 Vac, 60 Hz	126	•	•	•	•
	100 - 130 Vac, 50 Hz	125	•	•	•	•
	200 - 240 Vac, 60 Hz	246	•	•	•	•
	200 - 240 Vac, 50 Hz	245	•	•	•	•

**TABLE IV - ANALOG INPUT/OUTPUT SIGNALS**

Input	3 Wire Drive up/down	0 __	•			
	0/4-20 mA, 0/1-5 Vdc, 0-10 Vdc	2 __		•		
	0/4-20 mA, 0/1-5 Vdc, 0-10 Vdc	3 __			•	
	0 to 135 ohm input (Series 90 control)	4 __				a
	Contact Input for 2003	6 __				
Output	None	_ 00	•	•	•	•
	(Note 1) Dual 1000 Ohm (1000 ohms over 150 degrees)	_ 15	b			
	(Note 1) Dual 1000 Ohm (1000 ohms over 90 degrees)	_ 19	c			
	Slidewire Emulation	_ 60		•		
	Slidewire Emulation	_ 65			•	
	0/4-20mAdc (0/1-5 Vdc, 0-16 Vdc)	_ 80		•		
0/4-20mAdc (0/1-5 Vdc, 0-16 Vdc)	_ 85				•	

**TABLE V - SWITCH AND RELAY OUTPUTS** (2 end-of-travel limit switches are standard)

Auxiliary Outputs	No Auxiliary Switches	0 _	•	•	•	•
	2 Auxilliary Switches	2 _	•	•	•	•
	4 Auxilliary Switches	4 _	•	•	•	•
Relay Outputs	No Relays	_ 0	•	•		•
	2 Programmable Relay Outputs	_ 2		•		
	2 Programmable Relay Outputs	_ 3			•	
	4 Programmable Relay Outputs	_ 4		•	•	

TABLE VI - OPTIONS		Selection	Availability			
			2000	2001	2002	2003
Local keypad/ display	No local display interface supplied (Note 2)	0_____	•	•	•	•
	Integrally mounted local display/keypad interface	1_____				
Local Auto/ manual switch	No auto/manual switch	_0_____	•	•		•
	Auto/manual switch with "Out of Auto Contact"	_1_____	•	•		
	Auto/manual switch with "Out of Auto Contact"	_2_____			•	
Handwheel	No Handwheel	__0___	•	•	•	•
	Handwheel	__1___	•	•	•	•
Certificates	None	___0__	•	•	•	•
	Certificate of Conformance	___1__	•	•	•	•
Approvals	UL Type 4/IP66, CSA (Note 4)	___0_	•	•	•	•
	CE	___1_	•	•	•	•
Shipped Rotation	Counter clockwise shaft rotation on increasing signal	___0	•	•	•	•
	Clockwise shaft rotation on increasing signal	___1				

**TABLE VII - COMMUNICATIONS/PROTOCOL**

None	No communications option board or protocol	0	•			•
Modbus RTU RS485	RS-485 Modbus compliant - standard with EEU	1		•	•	
HART 5	HART Communications Protocol	2		•	•	

**TABLE VIII - MANUALS**

Standard	English	0	•	•	•	•
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**TABLE IX - FACTORY OPTIONS**

Factory Options	None	00	•	•	•	•
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**Restrictions**

Restriction Letter	Available Only With		Not Available With	
	Table	Selection	Table	Selection
a	IV	_ 00	IV	_ 60, _ 80
b	II	150	II	090
c	II	090	II	150

**ACCESSORIES**

Mounting Hardware  Linkage Assembly	Mounting plate adapter for Barber Colman Series MP495	51452354-501
	Mounting plate adapter for Landis & Staefa SQM53/56	51452354-502
	Direct Couple Valve Hardware	51452354-503
	North American Valve Retrofit Kit	51452354-511
	Ball joint for 5/16" dia. Pushrod	51452354-504
	Pushrod 12 in. (304,5 mm) long, 5/16 " dia.	51452354-505
	Pushrod 18 in. (457,2 mm) long, 5/16 " dia.	51452354-506
	Pushrod 24 in. 609,6 mm) long, 5/16 " dia.	51452354-507
HART	Pushrod 48 in. (1219,2 mm) long, 5/16 " dia.	51452354-508
	Turk Cable for Handheld Connection	51452352-501
Handheld Config. (Note 3)	HercuLink™ PC and Palm PDA Software	51452354-509
	Battery powered 232/485 converter with cable	51452354-510
Remote Mount Control	Remote 4-20 mA requires 135 ohm fdbk, 120V 50/60Hz	R7195A1031
	Remote 4-20 mA requires 1000 ohm fdbk, 120V 50/60Hz	R7195A1056
	Remote 4-20 mA requires 135 ohm fdbk, 220V 50/60Hz	R7195A1064
	Remote 135 ohm input requires 135 ohm fdbk, 120V 50/60Hz	R7195B1021
V51 Valve Kits	HercuLine 2000 V51 2.5" - 3" Valve Mounting Kit	51452354-513
	HercuLine 2000 V51 4" Valve Mounting Kit	51452354-514

- Notes:**
- 135 ohm available by parallelling 1K potentiometer with 158 Ohm resistor (supplied).
  - HercuLink™ software (pn 51452354-509), RS232/485 converter (pn 51452354-510), customer supplied Palm™ PDA running OS3.5 or higher and Palm serial cable are required for the 2001 and 2002 actuators if no display is selected.
  - Requires PDA manufacturer's serial interface cable.
  - CSA approval is good for 75°C and a maximum relay load of 3.5 amps or 70°C with a relay load of 5 amps.