

## Introduction

This installation guide provides instructions for installation, startup and adjustment. To receive a copy of the instruction manual, contact your local Sales Office or view a copy at [www.emerson.com](http://www.emerson.com). For further information refer to: CS400 Series instruction manual, D103120X012.

## PED/PE(S)R Categories

This product may be used as a pressure accessory with pressure equipment in the following categories. It may also be used outside of these Directives using Sound Engineering Practice (SEP) per table below. For information on the current PED/PE(S)R revision see Bulletin: D103053X012.

PRODUCT TYPE	CATEGORIES	FLUID GROUP
CS400	I	Groups 1 and 2 according to PED 2014/68/EU, 1st and 2nd family gas according to EN 437 or other gases (compressed air, nitrogen). The gas must be non-corrosive, clean (filtration on inlet side necessary) and dry.
CS404	IV	
European EN Reference Standards	EN 334, EN 14382	

## Specifications

### Available Configurations

See Table 1

### Body Sizes, End Connection Styles and Pressure Rating<sup>(1)</sup>

See Table 2

### Maximum Inlet Pressures<sup>(1)</sup>

**Emergency:** 12.1 bar / 175 psig

**Operating:** See Table 3

### Operating Pressure Ranges<sup>(1)</sup>

**Regulator:** See Table 4

**Integral Monitor Module:** See Table 5

**Slam-shut Module:** See Tables 6 and 7

### Maximum Outlet Pressures<sup>(1)</sup>

**Emergency (Casing):** 1.7 bar / 25 psig

**To Avoid Internal Parts Damage:**

0.34 bar / 5 psig over set pressure

**Operating:** 0.38 bar / 5.5 psig

### Hydrogen

- Up to 25% Hydrogen Blend (By Volume)
- 100% Hydrogen Construction Available (Contact Factory)

### Operating Temperature (TS)<sup>(1)(2)</sup>

#### According to PED Standards:

*All Types:* -20 to 66°C / -4 to 150°F

#### Non-PED:

*All Types:* -29 to 66°C / -20 to 150°F

## Installation and Overpressure Protection

### WARNING

**Personal injury or system damage may result if this regulator is installed, without appropriate overpressure protection, where service conditions could exceed the limits given in the Specifications section and/or regulator nameplate.**

**Regulator installations should be adequately protected from physical damage.**

**All vents should be kept open to permit free flow of gas to the atmosphere. Protect openings against entrance of rain, snow, insects or any other foreign material that may plug the vent or vent line. On outdoor installations, point the spring case vent downward to allow condensate to drain.**

**This minimizes the possibility of freezing and of water or other foreign materials entering the vent and interfering with proper operation.**

**For the Type CS403 with the Integral Monitor or the Type CS404 with slam shut, point the vents of both the Primary Regulator and Integral Monitor or slam shut downward to allow condensate to drain. From the factory, the Integral Monitor or slam shut will always point in the same direction as that of the Primary Regulator.**

**Under enclosed conditions or indoors, escaping gas may accumulate and be an explosion hazard. In these cases, the vent should be piped away from the regulator to the outdoors.**

1. The pressure/temperature limits in this installation guide and any applicable standard or code limitation should not be exceeded.

2. Product has passed Emerson testing for lockup, relief start-to-discharge and reseal down to -40°C / -40°F.

# CS400 Series

**Table 1. Available Configurations**

TYPE NUMBER					OPTIONS	
C	S	4	0			
						<b>OVERPRESSURE PROTECTION MODULE</b>
				0		Without Overpressure Protection Module
				3		With Integral Monitor Module <sup>(1)(3)</sup>
				4		With Slam-shut Module <sup>(2)(3)</sup>
						<b>PRESSURE REGISTRATION</b>
				E		External Registration <sup>(3)</sup>
				I		Internal Registration
						<b>RELIEF</b>
				N		Non-Relief
				T		Token Internal Relief
				R		Internal Relief
Example: Type number CS404IT: CS400 regulator constructed with Type VSX4 slam-shut module, with internal pressure registration and with token relief.						
1. Reference Instruction Manual D103126X012 for information regarding the Integral Monitor module. 2. Reference Instruction Manual D103127X012 for information regarding the Type VSX4 safety shut-off module. 3. Available only with Non-Relieving or Token Relief options, not Internal Relief.						

**Table 2. Body Sizes, Material, End Connections and Pressure Ratings**

BODY MATERIAL	INLET SIZE	OUTLET SIZE	END CONNECTION	FACE-TO-FACE DIMENSION		BODY PRESSURE RATING				
				mm	in.	bar	psig			
Gray Cast Iron	1-1/4	1-1/4	NPT	114	4.5	12.1	175			
	1-1/4	1-1/2								
	1-1/2	1-1/2								
	2	2								
	NPS 2 / DN 50	NPS 2 / DN 50	CL125 FF	254	10					
Ductile Iron	1-1/4	1-1/4	NPT	114	4.5	20.0	290			
	1-1/2	1-1/2								
	2	2								
	1-1/4	1-1/4	Rp	114	4.5					
	1-1/2	1-1/2								
	2	2								
		NPS 2 / DN 50	NPS 2 / DN 50	CL125 FF / CL150 FF	254			10		
				PN 10/16	254			10	16.0	232
Steel	1-1/4	1-1/4	NPT	114	4.5	20.0	290			
	1-1/2	1-1/2								
	1-1/4	1-1/4								
	1-1/2	1-1/2	Rp	114	4.5					

## CAUTION

The CS400 Series regulators have an outlet pressure rating lower than their inlet pressure rating. If actual inlet pressure can exceed the outlet pressure rating, outlet overpressure protection is necessary. However, overpressuring any portion of the regulators beyond the limits in Specifications section may cause leakage, damage to regulator parts or personal injury due to bursting of pressure-containing parts.

Some type of external overpressure protection should be provided to the CS400 Series if inlet pressure will be high enough to damage downstream equipment. Common methods of external overpressure protection include

relief valves, monitoring regulators, shut off devices and series regulation.

If the regulator is exposed to an overpressure condition, it should be inspected for any damage that may have occurred. Regulator operation below these limits does not preclude the possibility of damage from external sources or from debris in the pipeline.

### General Installation Instructions

Before installing the regulator,

- Check for damage, which might have occurred during shipment.
- Check for and remove any dirt or foreign material, which may have accumulated in the regulator body.
- Blow out any debris, dirt or copper sulfate in the copper tubing and the pipeline.

**Table 3. Inlet Pressure Ratings and Flow and Sizing Coefficients**

TYPE	ORIFICE SIZE		MAXIMUM OPERATING INLET PRESSURE		FLOW COEFFICIENTS (WIDE OPEN)		C <sub>1</sub>	IEC SIZING COEFFICIENTS		
	mm	In.	bar	psig	C <sub>g</sub>	C <sub>v</sub>		X <sub>T</sub>	F <sub>D</sub>	F <sub>L</sub>
CS400, CS403 and CS404	4.8	3/16	8.6	125	27	0.97	27.7	0.50	0.91	0.89
	6.4	1/4	8.6	125	50	1.77	28.2	0.50	0.92	
	7.9	5/16	6.9	100	82	2.90	28.3	0.50	0.94	
	9.5	3/8	4.1	60	113	3.72	30.4	0.58	0.89	
	12	1/2	2.8	40	182	5.61	32.4	0.66	0.82	
	16	5/8	2.1	30	284	7.26	39.1	0.97	0.74	
	19	3/4	1.4	20	356	9.83	36.2	0.83	0.72	

- Apply pipe compound to the male threads of the pipe before installing the regulator.
- Make sure gas flow through the regulator is in the same direction as the arrow on the body. “Inlet” and “Outlet” connections are clearly marked.
- When designing a pressure reducing station using a CS400 Series regulator, make an analysis if it is necessary to take into account the effects of wind, snow and temperature to avoid unnecessary load and movement to the flanges of the equipment.
- If needed, a support may be used under the piping and regulator/slam-shut body to avoid excessive pressure force on the regulator/slam shut.

### Installation Location

- The installed regulator should be adequately protected from vehicular traffic and damage from other external sources.
- Install the regulator with the vent pointed vertically down. If the vent cannot be installed in a vertically down position, the regulator must be installed under a separate protective cover. Installing the regulator with the vent down allows condensation to drain, minimizes the entry of water or other debris from entering the vent and minimizes vent blockage from freezing precipitation.
- Do not install the Types CS400, CS403 or CS404 in a location where there can be excessive water accumulation or ice formation, such as directly beneath a downspout, gutter or roof line of building. Even a protective hood may not provide adequate protection in these instances.
- Install the Regulator so that any gas discharge through the vent or vent assembly is over 0.91 meters / 3 ft away from any building opening.

### Regulators Subjected to Heavy Snow Conditions

Some installations, such as in areas with heavy snowfall, may require a hood or enclosure to protect the regulator from snow load and vent freeze over.

### Downstream Control Line Installation

A CS400 Series regulator with an EN or ET in the type number has a blocked throat, an O-ring stem seal and a 3/4 NPT control line tapping in the lower diaphragm casing. A regulator with a downstream control line is used for monitoring installations or other applications where there is other equipment installed between the regulator and the pressure control point.

For Types CS400ET and CS400EN regulators, connect downstream control line tubing to the lower casing and run the tubing approximately 508 mm / 20 in. downstream. For best results, the outer diameter of the control line tubing should be 9.5 mm / 3/8 in. or larger.

### Startup



**Pressure gauges should always be used to monitor downstream pressure during Startup.**

With the downstream system depressurized, use the following procedure to startup the regulator:

1. Check to see that all appliances are turned off.
2. Slowly open the upstream shut-off valve.
3. Check inlet and outlet pressure for correct values.
4. Check all connections for leaks.
5. Turn on utilization equipment and recheck the pressures.

# CS400 Series

**Table 4. Outlet Pressure Ranges**

TYPE	OUTLET PRESSURE RANGE		SPRING COLOR	SPRING WIRE DIAMETER		SPRING FREE LENGTH	
	mbar	In. w.c.		mm	In.	mm	In.
CS400, CS403 and CS404	9 to 12	3.5 to 5	Red	2.49	0.098	106	4.18
	11 to 16	4.5 to 6.5	Purple	2.03	0.080	110	4.32
	15 to 20	6 to 8	Gold	2.74	0.108	106	4.18
	19 to 27	7.5 to 11	Blue	2.79	0.110	112	4.40
	25 to 35	10 to 14	Unpainted	2.79	0.110	112	4.40
	30 to 47	12 to 19	Green	2.85	0.112	119	4.70
	45 to 69	18 in. w.c. to 1 psig	Orange	3.05	0.120	125	4.94
	69 to 138	1 to 2 psig	Black	3.56	0.140	118	4.66
	138 to 380	2 to 5.5 psig	Yellow	4.37	0.172	112	4.42

**Table 5. Type CS403 Regulator and Integral Monitor Outlet Pressure Ranges**

TYPE	PRIMARY REGULATOR			INTEGRAL MONITOR				
	Setpoint		Spring Color	Setpoint <sup>(1)</sup>		Spring Range		Spring Color
	mbar	In. w.c.		mbar	In. w.c.	mbar	In. w.c.	
CS403	10	4	Red	35	14	30 to 52	12 to 21	Blue
	12	5	Purple					
	17	7	Gold					
	27	11	Blue	52	21	45 to 75	18 to 30	Green
	35	14	Unpainted					
	45	18	Green	69	1 psig	65 to 99	26 to 40	Orange
	69	1 psig	Orange	103	1.5 psig	97 to 200	1.4 to 2.9 psig	Black
	138	2 psig	Black	172	2.5 psig	97 to 200	1.4 to 2.9 psig	Black
	207	3 psig	Yellow	241	3.5 psig	179 to 255	2.6 to 3.7 psig	Purple
	276	4 psig		345	5 psig	248 to 414	3.6 to 6 psig	Dark Blue
345	5 psig	414		6 psig	352 to 517	5.1 to 7.5 psig	Red	

1. Integral Monitor setpoints shown represent the minimum setpoint difference between the Integral Monitor and the Primary regulator. Higher monitor setpoints can be chosen, e.g., for Primary regulator setpoint of 17 mbar / 7 in. w.c., the Integral Monitor can also be set at 35, 52, 69 mbar / 14, 21 in. w.c., 1 psig or higher.

**Table 6. Type CS404 Regulator and Slam-shut OPSO Pressure Ranges**

TYPE	REGULATOR				SLAM-SHUT DEVICE			
	Setpoint		Spring Range		Overpressure Shutoff (OPSO)			
	mbar	In. w.c.	mbar	In. w.c.	Factory Setpoint <sup>(1)</sup>		Spring Range	
CS404	10	4	9 to 12	3.5 to 5	45	18	30 to 60	12 to 25
	12	5	11 to 16	4.5 to 6.5	47	19		
	17	7	15 to 20	6 to 8	52	21		
	27	11	19 to 27	7.5 to 11	62	0.9	40 to 110	0.58 to 1.6 psig
	35	14	25 to 35	10 to 14	75	1.1		
	45	0.65 psig	30 to 47	0.45 to 0.7 psig	96	1.4 psig	75 to 110	30 to 44
	50	0.72 psig	45 to 69	0.65 to 1 psig	112	1.6 psig		
	69	1 psig			172	2.5 psig		
	103	1.5 psig	69 to 138	1 to 2 psig	207	3.0 psig	95 to 280	1.4 to 4.1 psig
	138	2 psig			241	3.5 psig		
	207	3 psig			138 to 380	2 to 5.5 psig	434	6.3 psig
	276	4 psig	503	7.3 psig				
	345	5 psig	572	8.3 psig				
380	5.5 psig	606	8.8 psig					

1. For Types CS404IT and CS404ET equipped with Token Relief, if Non-Factory slam-shut OPSO setpoints are specified, they must not encroach on the Token Relief Start-to-Discharge values provided in Table 4 of the CS400 Bulletin.

**Table 7. Type CS404 Regulator and Slam-shut OPSO and UPSO Pressure Ranges**

TYPE	REGULATOR				SLAM-SHUT DEVICE							
	Setpoint		Spring Range		Overpressure Shutoff (OPSO)				Underpressure Shutoff (UPSO)			
					Factory Setpoint <sup>(1)</sup>		Range		Factory Setpoint		Range	
	mbar	psig	mbar	psig	mbar	psig	mbar	psig	mbar	psig	mbar	psig
CS404	35	0.51	25 to 35	0.36 to 0.51	75	1.1	50 to 130	0.73 to 1.9	22	0.32	10 to 75	0.14 to 1.1
	45	0.65	30 to 48	0.45 to 0.70	96	1.4			30	0.4		
	50	0.72	45 to 69	0.65 to 1	112	1.6			97 to 270	1.4 to 3.9		
	69	1			172	2.5	150 to 380	2.2 to 5.5	40	0.58		
	103	1.5	69 to 138	1 to 2	207	3.0			50	0.73	25 to 159	0.36 to 2.3
	138	2			241	3.5	69	1				
	207	3	138 to 380	2 to 5.5	434	6.3	262 to 600	3.8 to 8.7	121	1.75	100 to 500	1.5 to 7.3
	276	4			503	7.3			140	2		
	345	5			572	8.3	400 to 1100	5.8 to 16	200	2.9		
	380	5.5			606	8.8			250	3.6		

1. For Types CS404IT and CS404ET equipped with Token Relief, if Non-Factory slam-shut OPSO setpoints are specified, they must not encroach on the Token Relief Start-to-Discharge values provided in Table 4 of the CS400 Bulletin.

## Adjustment

### Note

For Types that include the Integral Monitor module, refer to the instruction manual for Type TM600 Integral Monitor for Adjustment and Maintenance of the Integral Monitor. For Types that include the slam-shut module, refer to the instruction manual for Type VSX4 slam shut for Adjustment and Maintenance of the slam shut.

The range of allowable pressure settings is stamped on the nameplate. If the required setting is not within this range, substitute the correct spring (as shown in Table 4). If the spring is changed, change the nameplate to indicate the new pressure range.

A pressure gauge should always be used to monitor downstream pressure while adjustments are being made.

1. Remove the closing cap (key 60).
2. To increase the outlet setting, turn the adjusting screw (key 65) clockwise. To decrease the outlet setting, turn the adjusting screw counterclockwise.
3. Replace the closing cap.

### CS400 Series with Integral Monitor Module

When adjusting the Primary Regulator and Integral Monitor for operation, ensure that the pressure differences between the Primary Regulator and the integral monitor shown in Table 6 are observed. For example, if the Primary Regulator setpoint is set at 17 mbar / 7 in. w.c., then the Integral Monitor should be set at a minimum of 35 mbar / 14 in. w.c. or higher.

To test the Integral Monitor operation, the Primary regulator setpoint must be adjusted above the Integral Monitor's setpoint to simulate a failure of the primary regulator. If the spring range of the Primary Regulator is sufficiently high, it can simply be adjusted above the Integral Monitor's setpoint by following step 2 above. Otherwise, a different spring with a setpoint higher than the Integral Monitor's setpoint must be installed to check the operation of the Integral Monitor.

### CS400 Series with Slam-shut Module

When adjusting the primary regulator and slam shut for operation, reference Tables 6 and 7 for the OPSO and UPSO setpoints of the slam shut for the given regulator spring ranges.

### WARNING

In the case of a downstream line break, numerous factors affect the capability to evacuate gas from the pipeline. These factors include the distance of pipe to the break, the diameter of the pipe, size of the break and the number of restrictions, such as valves, elbows and bends, downstream of the regulator and/or slam-shut device. Due to these factors additional protections should be installed to stop flow in the event of a line break.

# CS400 Series

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## Shutdown

Installation arrangements may vary, but in any installation it is important that the valves be opened or closed slowly and that the outlet pressure be vented before venting inlet pressure to prevent damage caused by reverse pressurization of the regulator. The steps in the following page apply to the typical installation as indicated.

1. Open valves downstream of the regulator.
2. Slowly close the upstream shut-off valve.
3. Inlet pressure will automatically be released downstream as the regulator opens in response to the lowered pressure on the diaphragm.

## Parts List

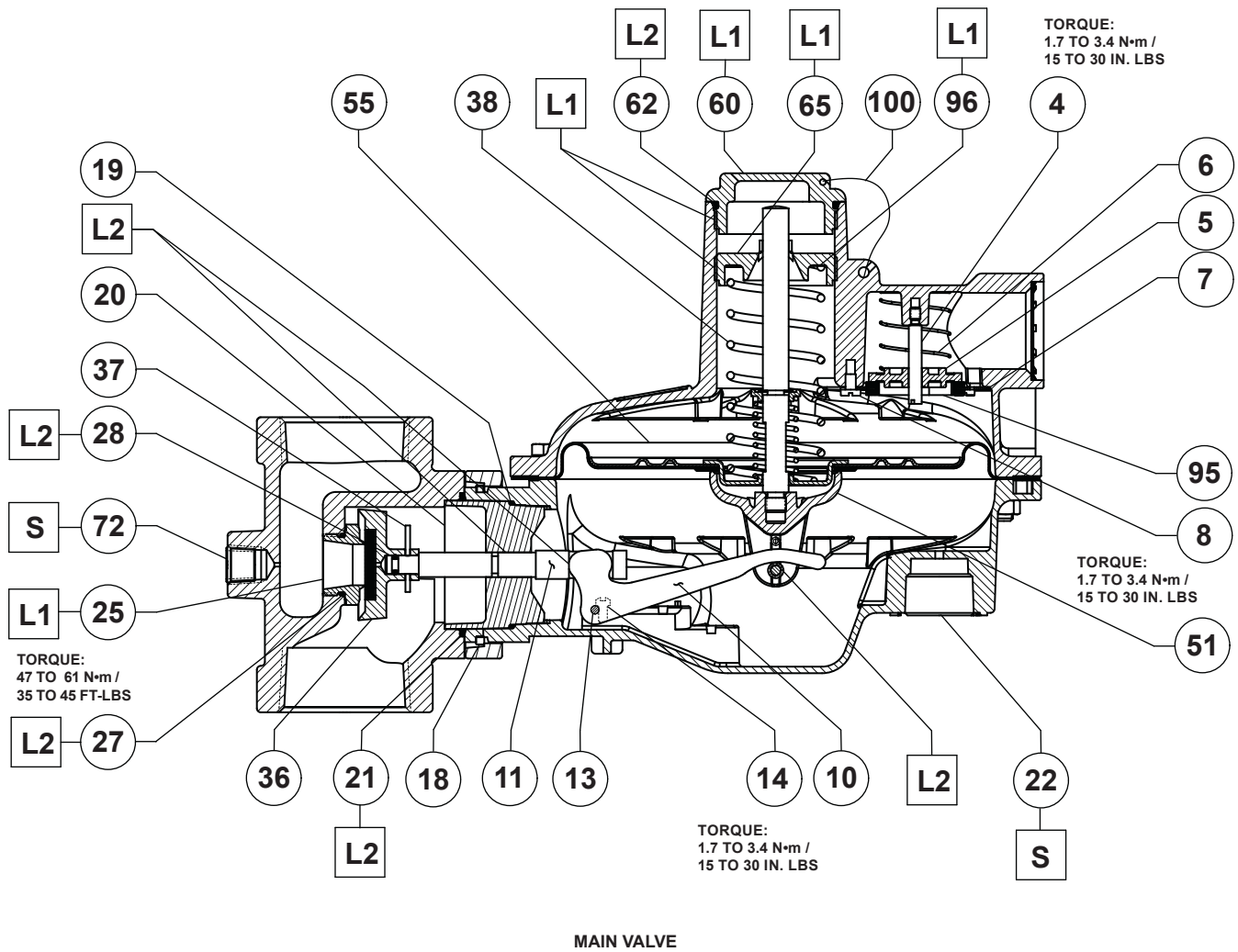
### Key Description

1	Spring Case
2	Vent Screen
3	Retaining Ring
4	Stabilizer Guide
5	Stabilizer
6	Stabilizer Spring
7	Stabilizer Retaining Ring
8	Stabilizer Screw
9	Lower Casing
10	Lever
11	Stem
12*	O-ring, External Registration
13	Lever Pin
14	Lever Screw
15	Cap Screw
16	Nut
17	Union Ring
18	Snap Ring
19*	O-ring
20	Stem Guide
21*	O-ring
22	Pipe Plug
23	Screw
24*	O-ring
25*	Orifice
26*	OPP Orifice
27*	O-ring
28*	O-ring
36*	Valve Disk
37	Disk Clip
38	Control Spring
41	R.V. Spring

42	Spring Retainer
43	Spring Seat
44	Valve Stem
45	Diaphragm Screw Retainer for Non-Relief
47*	Adjustable Upper Seat Token Relief
48	Token Restrictor Plate
51	Pusher Post
53	Pusher Post Pin
54	Roller Pin
55*	Diaphragm Head Assembly
55a	Diaphragm
55b	Diaphragm Head
56	Retaining Ring, Pusher Post Pin
57	Slotted Spring Pin
58	E-Ring (Standard Relief)
60	Closing Cap
62*	O-ring
65	Adjusting Screw
70	Globe Valve Body
71	Cap Screw
72	Pipe Plug
74	Blanking Plug
75*	Metric O-ring
76	Half Flange
77*	Metric O-ring
80	Cap Screw
90	Nameplate
91	Warning Label
93	Information Label
94	Overlay Label
95	Grommet
96	Slip Disk
100	Lockwire
101	Slotted Spring Pin

\*Recommended spare part





ERAA03738

- APPLY LUBRICANT (L) / SEALANT (S)<sup>(1)</sup>:
  - L1 = ANTI-SEIZE LUBRICANT
  - L2 = SILICONE GREASE
  - S = THREAD SEALANT

1. Lubricants and sealant must be selected such that they meet the temperature requirements.

**Figure 1. CS400 Series Regulator Assemblies**

# CS400 Series

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