Model 441-X57 Regulator Brochure

UTILITY SOLUTIONS GROUP

Introduction

Who We Are

Utility Solutions Group is a manufacturer of natural gas regulators and relief valves based in Columbus, OH. All products are made in the USA and compliant with the requirements of the Build America, Buy America Act. Utility Solutions Group's Quality Management System is certified to ISO 9001 by Smithers Quality Assessments.

441-X57 Regulator

The Model 441-X57 is a unique high-pressure, large-capacity, spring-operated regulator. These high-pressure regulators incorporate the same roll-out diaphragm principal that is widely used in the 461-57S and 441-57S models.

Both regulators offer pilot-type performance with spring-operated regulator simplicity. The action of the roll-out diaphragm makes the regulators' exceptional performance possible by reducing droop, the falloff in outlet pressure as a spring regulator opens to increase flow, to a minimum.

This model features a fast response and ease of installation. It is also simple to adjust and service. The 441-X57 is perfect for most high-pressure, large-capacity applications. This includes high-pressure regulator sets, gas distribution systems, town border stations, transmission systems and most industrial applications.

The 441-X57 regulator can also be used to monitor and quickly assume control if a failure in the operating regulator allows the outlet pressure to exceed its set-point. No modifications are required for use as a monitor, even if used as a monitor for other types of regulators.

Maximum Differential and Inlet Pressure for Various Soft-Seated Valve Materials

The differential and inlet pressures given below are only to be used as general guidelines. In all cases, pressures must always remain within the ranges specified in Utility Solutions Group literature. For any given regulator, do not exceed the specified maximum pressures.

Valve Material	Maximum Pressure Differential	Maximum Inlet Pressure
Buna-N (Black, 50 to 55 duro)	250 psi	575 psi
Polyurethane (Red, 65 to 75 duro)	400 psi	720 psi
Polyurethane (Tan, 85 to 95 duro)	600 psi	1,200 psi

NOTE: The maximum temperature for the above materials are 150°F. Viton, if used, has a maximum temperature rating of 300°F and a maximum pressure differential of 250 psi.

Construction Materials

Upper Diaphragm Case	Cast Iron (ASTM A126-71 Class B)
Lower Diaphragm Case: With Ductile Iron Bodies	Cast Iron (ASTM A126-71 Class B)
With Steel Bodies	Steel (ASTM A216-70a gr WCB)
Housing Cover (Upper Case Cover)	Ductile Iron (ASTM A395-71 gr 60-40-18)
Upper Diaphragm Plate and O-ring Piston	Stainless Steel
Diaphragm	Buna-N with Dacron Reinforcement
Diaphragm Connecting Stem and Anti-Friction Bushing	Stainless Steel
Removable Seats (Orifices)	Cast Iron or Stainless Steel
Valve Stems	Brass or Stainless Steel
Soft-Seat Valve Material	Polyurethane Molded Holder
Holder for Valve Material	Steel
Valve Retainer	Cast Iron or Stainless Steel
Bodies	Ductile Iron or Steel

Maximum Inlet Pressure

Body Size	Valve	Maximum Inlet Pressure
3"	2 1/8"	400 psi
3"	1 ¾"	575 psi
2"		
3"	1 ½"	1,000 psi
2"		

Body Pressure Ratings

Regulator Body Type	A	B
Flanged ANSI 250 lb. RF	Cast Iron	575 psi
Flanged ANSI 300 lb. RF	Cast Steel	720 psi
Flanged ANSI 600 lb. RF	Cast Steel	1,200 psi

Spring Ranges

Outlet Pressure Min. to Max.	Spring Color	Nominal Diaphragm Size (I.D.)
75 to 100 psi	Red	2 ½" Diaphragm All Ranges
100 to 175 psi	Brown	
150 to 250 psi	Black	

Roll-Out Diaphragm

The heart of the Model 441-X57 is the "Roll-Out" diaphragm. The 441-X57 is a spring regulator with performance which approximates that of a pilot operated regulator. The "Roll-out" Diaphragm makes this exceptional performance possible because its action reduces "droop" to a minimum, ("droop" being fall off in outlet pressure as a spring regulator opens to increase flow.)

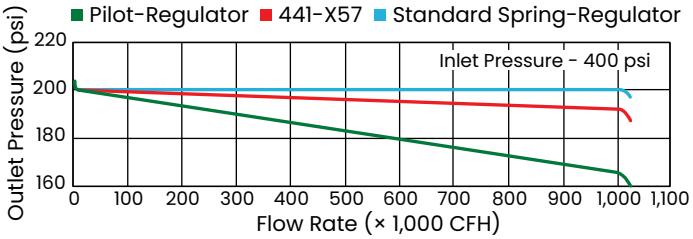
The action of the "Roll-Out" diaphragm differs from that of the conventional diaphragm in the manner which the change in effective area occurs. Where the effective area of a conventional diaphragm would increase as the regulator opens, the "Roll-Out" area decreases. Conversely, where the area of the conventional diaphragm decreases during closing, the "Roll-Out" area increases. The following explanation and the graph below show how this affects performance.

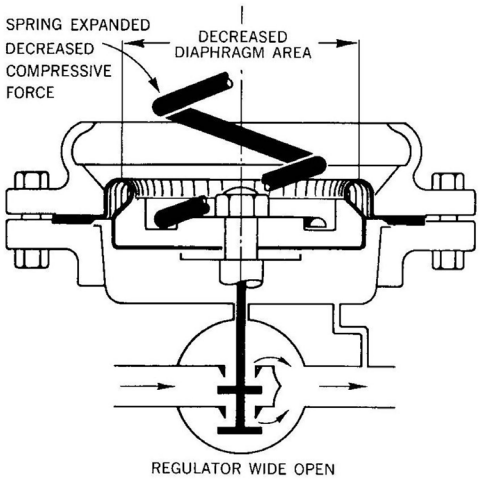
Spring-type regulators are operated by the inter-action between spring and diaphragm. The compressive force of the spring works to open the regulator and is balanced by the opposing force of outlet pressure on the diaphragm which provides the closing force.

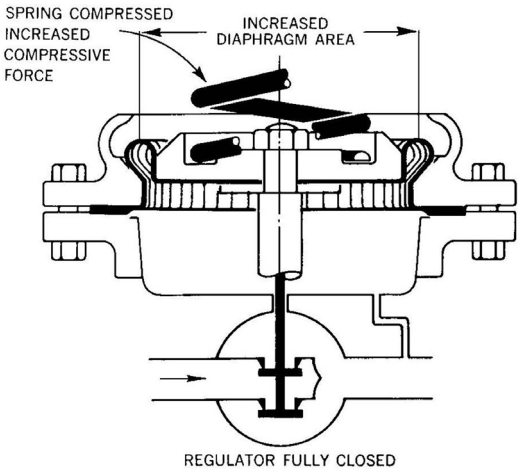
As the regulator opens, the compressive force of the spring decreases. However, as this spring force decreases, there must be a corresponding decrease in the opposing force from the diaphragm. For this opposing diaphragm force to decrease, either the effective area or the outlet pressure must decrease. Herein is the essential difference; with a conventional diaphragm the outlet pressure must decrease, where as with the "Roll-Out" diaphragm it is the effective area that decreases, permitting the outlet pressure to remain constant.

The operation actually is quite simple, yet the action of the "Roll-Out" diaphragm is so effective that "droop" is practically eliminated.

The Model 441-X57 provides constant pressure regulation. It approaches pilot performance, and additionally offers further advantages of simplicity, dependability, freedom from freeze-up, and exceptionally fast response.



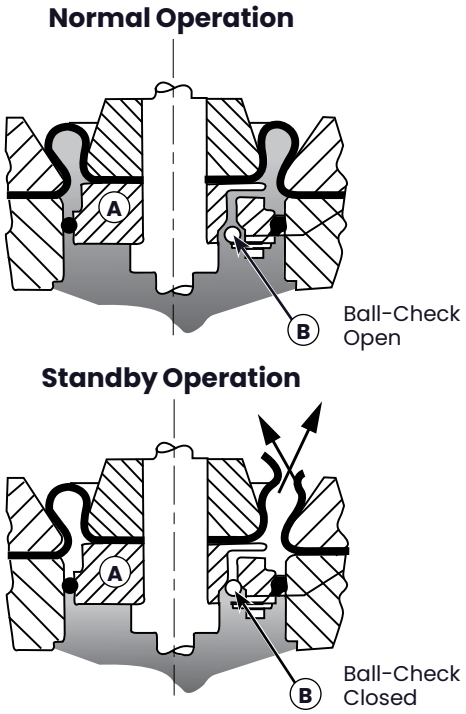




Ball-Check Safety Sentry

The ball-check diaphragm sentry is a safety device for keeping the regulator in operation in case of diaphragm failure. Refer to illustrations, to the right, this is how it works:

1. O-ring piston A holds the Roll-Out diaphragm in correct alignment during normal operation.
2. Ball-check B is normally open to put outlet pressure against the Roll-Out diaphragm.
3. If a break should occur in the diaphragm, outlet pressure gas instantly begins to escape through the break and out the vent to atmosphere. This escaping gas flow immediately closes B. With B closed, outlet pressure is trapped beneath O-ring piston A, which then becomes a substitute for the diaphragm. With A as a substitute for the diaphragm, the regulator continues to operate.
4. The closing of B also prevents the diaphragm break from allowing gas to escape through the vent. Ball-Check Diaphragm Sentry
5. Regulation with the O-ring piston will show increased deviation from set point. This deviation is the warning that a failure has occurred.



Monitoring

The Model 441-X57 is also excellent for use as a monitor: a stand-by regulator mounted in series which assumes control if a failure in the operating regulator permits the outlet pressure to rise above its set point.

The 441-X57 has a fast rate of response and, therefore, will take control quickly in case of emergency. It requires no changes or modifications when used for monitoring. Its simple design and rugged construction make it an exceptionally dependable regulator, and its control accuracy and freedom from "droop" mean that it will provide excellent regulation if an emergency calls it into operation.

Two monitor set arrangements are shown in the illustrations below. The first shows a set in which the operating regulator and the monitor are both Model 441-X57. This makes an unusually neat and compact installation.

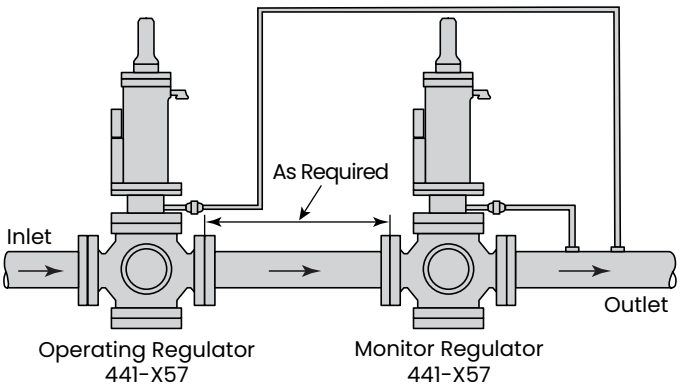
The 441-X57 is also used for monitoring other types of regulators. This is shown in the second Illustration. It is excellent for monitoring pilot operated regulators.

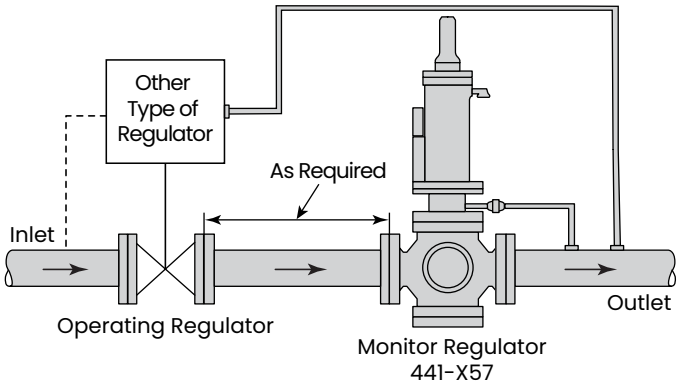
Both illustrations show the monitor in the downstream position. When installed this way, the 441-X57 is usually set for an outlet pressure 4 to 6 psi higher than the operating regulator and thus is wide open during normal operation.

The monitor can also be located upstream, and with this arrangement the 441-X57 is usually set for an outlet somewhat higher than the above.

Shutoff and bypass valving varies with individual practices and requirements. The "Typical Installation" illustration, (see Page 7), can be used as a guide for the arrangement of these valves.

When identical 441-X57 Regulators are used for both the operating regulator and the monitor, the total maximum capacity through both may be figured as 70 percent of the capacity of one of them alone. This applies with the monitor located either downstream or upstream.





Construction Features

Simple Design- Dependable regulation, trouble free operation, and fast response.

Standard Face to Face Dimensions

Standardized 441 Bodies and Inner Valve Assemblies- Easy maintenance, parts are interchangeable with other 441 models.

Simplified Valve Adjustment- Accurate, easy to adjust for tight lock-up.

Molded Soft Seats- Positive tight shut-off, high erosion resistance, and will not blow out.

Sensitive Diaphragms- Large areas give accurate regulation.

O-Ring Stem Seal- With removable anti-friction bushing.

Bushing Guided Inner Valve- Accurate stem alignment and valve seating.

Side Inspection Plates- Both sides of body-quickly removable.

O-Ring Body Seals- Eliminates gaskets on upper and lower body openings, and side inspection plates.

Self-Aligning Spring Adjustment- Color-coded springs.

Flanged Removable Seats (Orifices)- Easily changed without special tools.

V-Port Orifice Restrictors- Allows regulator to maintain outlet pressure performance at lower flow rates.

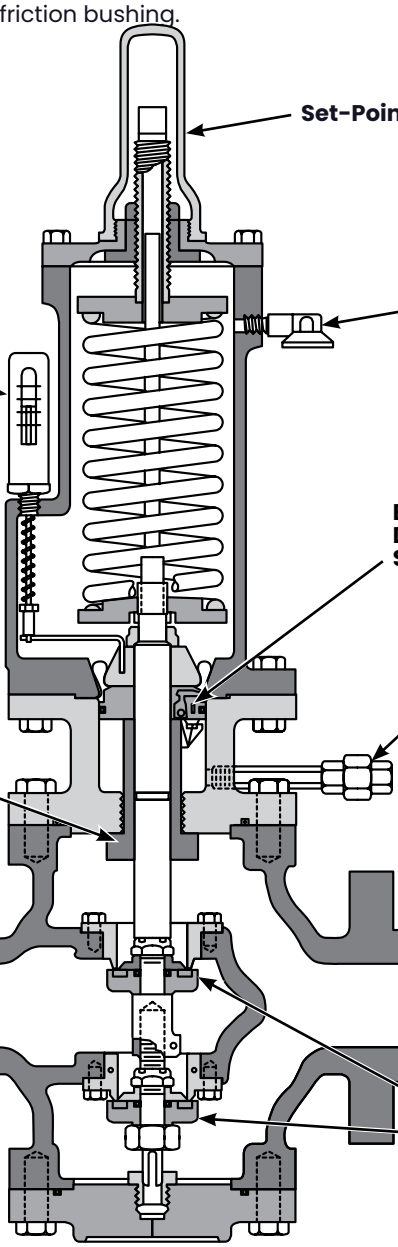
NOTE: V-Port valve increases the turndown to 40:1.

Large Capacity

- High-Pressure Regulator sets
- Gas Distribution Systems
- Town Border Stations
- Transmission Systems
- Monitoring
- High-Pressure Industrial Applications

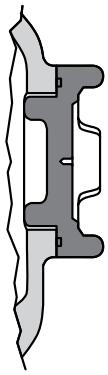
Heavy Duty Construction

- Weather-proof
- Watertight
- For Indoor or Outdoor Installations



Side Inspection Plates

- Located on both sides of the body
- Quickly removable
- Provide easy inspection and servicing of th inner valve



Inlet Pressures and Capacities
(See Page 4)

Outlet Pressure Range
75 to 250 psi

NOTE: For outlets of 3 to 100 psi, refer to Model 441-57S.

Balanced Valve

- Soft Seats
- Double-Seat
- Available reduced size valves and V-Port Valves

Capacities Table

Measurements in SCFH of Natural Gas (0.6 Specific Gravity - 14.65 psi - 60°F)

Inlet Pressure (psi)	Outlet Pressure (psi)	2" Model		3" Model		
		1 ¾" Valve	1 ½" Valve	2 ⅛" Valve	1 ¾" Valve	1 ½" Valve
80	75	115	90.3	187	140	90.3
85	75	163	127	265	198	127
	80	118	92.8	193	144	92.8
90	75	200	156	325	243	156
	80	167	131	273	203	131
	85	121	95.3	198	147	95.3
100	75	258	202	420	313	202
	80	237	185	386	288	185
	85	210	165	343	256	165
	90	176	138	287	214	138
110	75	305	239	497	371	239
	80	290	227	473	353	227
	90	249	195	406	303	195
	100	184	144	300	224	144
120	75	346	271	563	421	271
	80	335	262	546	407	262
	90	305	239	497	371	239
	100	260	204	425	317	204
	110	192	150	313	234	150
140	75	415	325	677	506	325
	80	410	321	669	500	321
	90	394	308	642	480	308
	100	369	289	601	448	289
	120	282	221	460	344	221
160	80 or less	474	371	772	576	371
	90	466	365	760	567	365
	100	451	354	736	549	354
	120	400	313	651	486	313
	140	303	237	493	368	237
180	90 or less	528	414	862	643	414
	100	521	408	850	634	408
	120	489	383	798	595	383
	140	428	335	698	521	335
	160	322	252	524	391	252
200	100 or less	583	457	950	710	457
	120	565	443	921	688	443
	140	524	411	855	638	411
	160	455	356	742	554	356
	180	340	266	554	413	266
225	110 or less	653	511	1,064	794	511
	120	648	507	1,055	788	507
	140	624	489	1,018	760	489
	160	580	454	946	706	454
	180	510	400	831	620	400
	200	399	312	650	485	312
250	125 or less	721	565	1,175	877	565
	140	710	556	1,158	864	556
	160	683	535	1,113	831	535
	180	636	498	1,036	773	498
	200	564	442	920	686	442
	225	421	330	687	513	330

Inlet Pressure (psi)	Outlet Pressure (psi)	2" Model		3" Model		
		1 ¾" Valve	1 ½" Valve	2 ⅛" Valve	1 ¾" Valve	1 ½" Valve
275	140 or less	787	616	1,283	957	616
	160	772	605	1,258	940	605
	180	741	580	1,207	901	580
	200	691	541	1,126	841	541
	225	596	467	972	725	467
	250	443	347	722	539	347
300	150 or less	857	671	1,397	1,043	671
	175	839	657	1,367	1,020	657
	200	798	625	1,300	971	625
	225	730	572	1,190	888	572
	250	626	491	1,021	762	491
325	165 or less	923	723	1,505	1,124	723
	180	915	717	1,491	1,113	717
	200	892	699	1,454	1,085	699
	225	843	660	1,374	1,026	660
	250	767	601	1,251	934	601
350	180 or less	991	776	1,615	1,205	776
	200	977	766	1,593	1,189	766
	225	943	739	1,536	1,147	739
	250	886	694	1,444	1,078	694
375	190 or less	1,061	831	1,730	1,291	831
	225	1,033	809	1,683	1,256	809
	250	991	776	1,615	1,205	776
400	200 or less	1,130	885	1,841	1,374	885
	225	1,116	874	1,818	1,357	874
	250	1,085	850	1,769	1,320	850
425	215 or less	1,198	938	-	1,457	938
	250	1,172	918	-	1,426	918
450	230 or less	1,266	992	-	1,540	992
	250	1,253	982	-	1,525	982
475	250 or less	1,330	1,041	-	1,617	1,041
500		1,402	1,098	-	1,706	1,098
575		1,606	1,258	-	1,954	1,258
800		-	1,738	-	-	1,738
1,000		-	2,165	-	-	2,165
"K" Factors Standard Valves		5,450	4,270	8,880	6,630	4,270
"K" Factors V-Port Valves		5,260	4,160	8,440	6,390	4,160
For V-Port Valves, multiply table values by the following:		0.965	0.974	0.950	0.964	0.974

Size each regulator on the basis of the minimum expected inlet pressure and the maximum outlet pressure.

For best performance of the Model 441-X57, use full table capacity values. For smaller capacities, refer to a Model 461-X57.

NOTE: V-Port valve increases the turndown to 40:1.

NOTE: The above performance data is based on normal testing at 70° F flowing temperature. Changes in performance can occur at extreme low-flowing temperatures.

Overpressurization Protection

Methods of overpressuirzation protection include relief valves, monitor regulators, shutoff devices, or similar mechanisms. These protect the downstream piping system and the regulator's low-pressure chambers against overpressurization due to possible regulator malfunction or failure to achieve complete lockup. The allowable outlet pressure is the lowest of the maximum pressures permitted by federal codes, state codes, and other applicable standards.

CAUTION

Turn gas on slowly. If an outlet stop valve is used, it should be opened first. Do not overload the diaphragm with a sudden surge of inlet pressure. Monitor the outlet pressure during start-up to prevent an outlet pressure overload.

Maximum Emergency Pressures

Before using any of the below data, ensure this entire section is clearly understood.

The following are the maximum inlet pressures which the regulator body may be subjected to under abnormal conditions without causing internal damage are:

Ductile Iron Body ..... Maximum Inlet Pressure + 60 psi
Cast Steel Body ..... Maximum Inlet Pressure + 100 psi

The maximum outlet pressure which the diaphragm may be subjected to under abnormal conditions without causing internal damage is:

Maximum Outlet Pressure ..... set-point + 50 psi.

NOTE: The "set-point" is the outlet pressure the regulator is adjusted to deliver.

The maximum pressure that can be safely contained by the diaphragm case is:

Maximum Pressure ..... 350 psi

NOTE: Safely contained means no leakage and no bursting.

CAUTION

If any pressure exceeds the above values the regulator must be removed from service and inspected. Damaged or otherwise unsatisfactory parts must be repaired or replaced before returning the regulator to service.

Other Gases

The Model 441-X57 regulator is mainly used with natural gas. However, they perform equally as well with liquid propane gas (LPG), nitrogen, dry carbon dioxide (CO_2), air and others. When using with other gases, the regulator capacities must be adjusted using the following correction factors:

Type of Gas	Correction Factor
Air (Specific Gravity 1.0)	0.77
Propane (Specific Gravity 1.53)	0.63
1350 BTU Propane-Air Mix (Specific Gravity 1.20)	0.71
Nitrogen (Specific Gravity 0.97)	0.79
Dry Carbon Dioxide (Specific Gravity 1.52)	0.63

For other non-corrosive gases, use the following formula:

$$\text{Correction factor} = \sqrt{\frac{0.60}{\text{Specific gravity of the gas}}}$$

For use with gases not listed above, please contact your Utility Solutions Group representative or Authorized Distributor.

Capacities at Other Pressures

Capacity for pressure reductions not listed on Page 4 can be calculated with the following formula:

$Q = K\sqrt{P_o(P_i - P_o)}$ ..... (for P_i/P_o less than 1.894)

$Q = \frac{K P_i}{2}$ ..... (for P_i/P_o less than 1.894)

Q = Maximum capacity of regulator, in SCFH of 0.6 specific gravity natural gas

K = the "K" factor, the regulator constant (see table below)

P_i = absolute inlet pressure (psi)

P_o = absolute outlet pressure (psi)

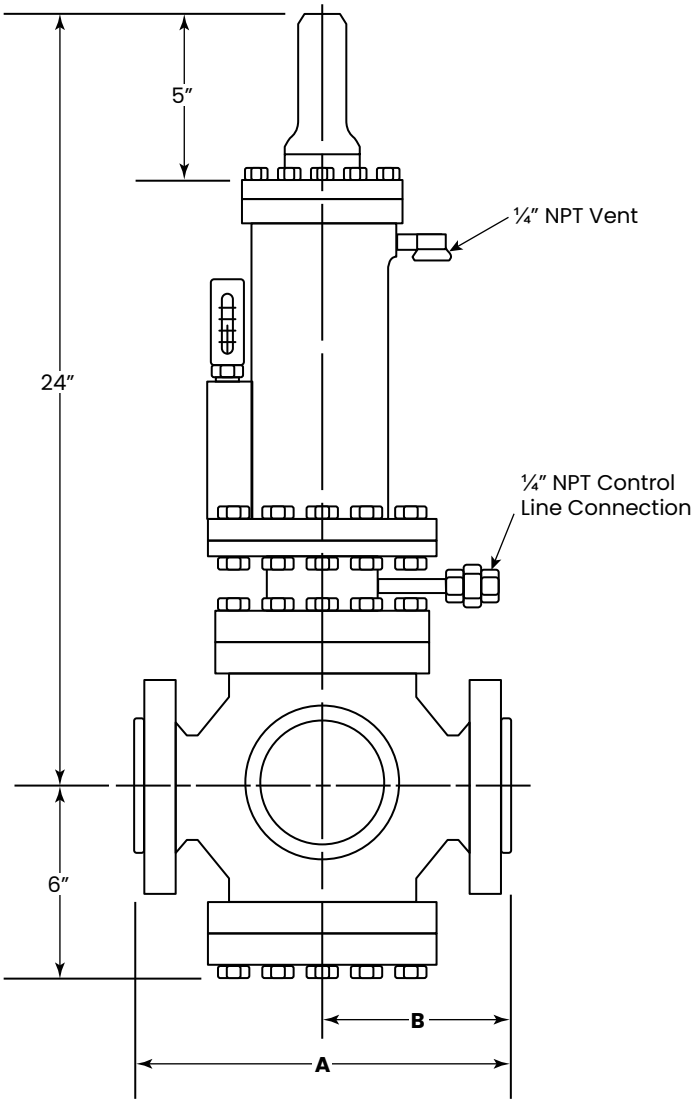
Temperature Limits

The Model 441-X57 Regulator can be used for flowing temperatures from -20°F to 150°F.

Buried Service

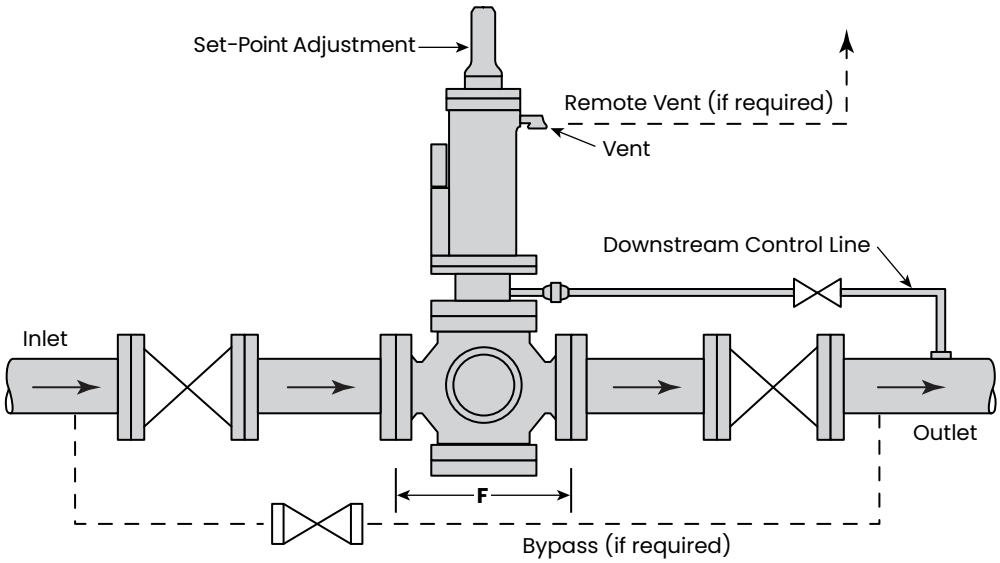
The Model 441-X57 Regulator is not recommended for buried service.

Dimensions



Regular Body Type		Pipe Size	
		2″	3″
Flanged ANSI 250 lb. Ductile Iron or 300 lb. Steel	A	10″	12 ½″
	B	5 $^{9}/_{19}$″	6 ½″
Flanged ANSI 600 lb. Steel	A	11 ¼″	13 ¼″
	B	5 $^{15}/_{16}$″	6 ⅞″
Shipping Weight (lbs.)		140	180

Typical Installation



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