

Choosing a Surge Tank and Determining Pressure Rise

DADCO Surge Tanks are used with open-flow systems to increase the volume in the system thereby reducing the pressure rise when cylinders are stroked. Operating with a lower pressure rise will decrease the wear on the nitrogen gas spring components and reduce the load on the press. To determine the appropriate Surge Tank size for your system please consider the design information provided. *Note: All calculations are based on Isothermal conditions.*

In addition, DADCO offers a Force Calculator at www.dadco.net that calculates pressure rise, initial force and final force during operation for linked systems with or without Surge Tanks.

U / UT / UH / UX Series				90.10 / 90.8 Series			
Model	Internal Volume Adder $V_{internal}$ (L/mm)	Rod Volume Adder V_{rod} (L/mm)	Volume V_0 (L)	Model	Internal Volume Adder $V_{internal}$ (L/mm)	Rod Volume Adder V_{rod} (L/mm)	Volume V_0 (L)
1000	0.0015	0.0006	0.0005	0750	0.0013	0.0005	0.0041
1600	0.0025	0.0010	0.0075	1500	0.0031	0.0010	0.0199
2600	0.0038	0.0016	0.0057	3000	0.0050	0.0020	0.0337
4600	0.0062	0.0028	0.0210	5000	0.0079	0.0033	0.0468
6600	0.0099	0.0044	0.0464	7500	0.0123	0.0050	0.1257
9600	0.0151	0.0064	0.1135	10000	0.0214	0.0071	0.2241
20000	0.0292	0.0133	0.2865				



Surge Tank	ST.30	ST.50	ST.75	ST.100
D	95	120	150	195
X	117	137	152	157
Length: Y	Volume of Tank $V_{S.T.}$			
50	0.59	1.05	1.71	2.92
100	0.85	1.44	2.33	3.99
150	1.10	1.83	2.94	5.06
200	1.35	2.22	3.56	6.13
250	1.60	2.62	4.17	7.20
300	1.85	3.01	4.78	8.27
350	2.10	3.40	5.40	9.34
400	2.35	3.79	6.01	10.41

Solving for Pressure Rise when Nitrogen Gas Springs and Surge Tank is known:

To calculate the pressure rise of a Nitrogen Gas Spring and Surge Tank system, first calculate the internal volume of the gas springs, where $V_{G.S.}$ = Internal Volume of Gas Springs, $V_{internal}$ = Internal Volume Adder, S = Stroke, V_0 = Initial Volume and N = Number of Gas Springs per Surge Tank.

$$V_{G.S.} = (V_{internal} * S + V_0) * N$$

Next, calculate the volume of the system, where V_s = Volume of the System, $V_{G.S.}$ = Volume of the Gas Springs and $V_{S.T.}$ = Volume of the Surge Tank.

$$V_s = V_{G.S.} + V_{S.T.}$$

After the volume of the system is known, calculate the volume that the gas spring rods will displace when retracted, where $V_{Displaced}$ = Displaced Volume, V_{rod} = Rod Volume Adder, T = Travel and N = Number of Gas Springs per Surge Tank.

$$V_{Displaced} = V_{rod} * T * N$$

Calculate the pressure rise where P.R. = Pressure Rise, $V_{Displaced}$ = Displaced Volume and V_s = System Volume.

$$P.R. = \frac{V_s}{(V_s - V_{Displaced})} - 1$$

Application Example

Quantity 4, U.6600.100.TO Nitrogen Gas Springs with a 75 mm travel are linked in a system with a ST.75.250 Surge Tank. What is the Pressure Rise?
Given: S = 100, T = 75; From the Tables: $V_{internal} = .0099$, $V_0 = 0.0464$, $V_{S.T.} = 4.17$, $V_{rod} = 0.0044$

$$V_{G.S.} = (V_{internal} * S + V_0) * N$$

$$V_{G.S.} = (.0099 * 100 + 0.0464) * 4 = 4.146 \text{ L}$$

$$V_s = V_{G.S.} + V_{S.T.}$$

$$V_s = 4.146 + 4.17 = 8.316 \text{ L}$$

$$V_{Displaced} = V_{rod} * T * N$$

$$V_{Displaced} = .0044 * 75 * 4 = 1.32 \text{ L}$$

$$P.R. = \frac{V_s}{(V_s - V_{Displaced})} - 1$$

$$P.R. = (8.316 / (8.316 - 1.32)) - 1 = .19 \text{ or } 19\%$$

Solving for the Surge Tank Size when the Gas Springs and Pressure Rise is known:

To calculate the appropriate surge tank when the gas springs and pressure rise is known, first calculate the volume that the gas spring rods will displace when retracted, where $V_{Displaced}$ = Displaced Volume, V_{rod} = Rod Volume Adder, T = Travel and N = Number of Gas Springs per Surge Tank.

$$V_{Displaced} = V_{rod} * T * N$$

Next, calculate the internal volume of the gas springs, where $V_{G.S.}$ = Internal Volume of Gas Springs, $V_{internal}$ = Internal Volume Adder, S = Stroke (S), V_0 = Initial Volume and N = Number of Gas Springs per Surge Tank.

$$V_{G.S.} = (V_{internal} * S + V_0) * N$$

After the volume of the gas spring is known, calculate the volume of the Surge Tank where $V_{S.T.}$ = Volume of the Surge Tank, $V_{Displaced}$ = Displaced Volume, P.R. = Pressure Rise and $V_{G.S.}$ = Internal Volume of Gas Springs.

$$V_{S.T.} = \frac{V_{Displaced}}{P.R.} + V_{Displaced} - V_{G.S.}$$

Application Example

Quantity 4, U.6600.100.TO Nitrogen Gas Springs are linked in a system with a travel of 75 mm. What Surge Tank should be added to the system to achieve a 20% Pressure Rise?
Given: S = 100, T = 75, P.R. = 20%; From the Tables: $V_{rod} = 0.0044$, $V_{internal} = .0099$, $V_0 = 0.0464$,

$$V_{Displaced} = V_{rod} * T * N$$

$$V_{Displaced} = .0044 * 75 * 4 = 1.32 \text{ L}$$

$$V_{G.S.} = (V_{internal} * S + V_0) * N$$

$$V_{G.S.} = (.0099 * 100 + .0464) * 4 = 4.146 \text{ L}$$

$$V_{S.T.} = \frac{V_{Displaced}}{P.R.} + V_{Displaced} - V_{G.S.}$$

$$V_{S.T.} = (1.32/.2) + 1.32 - 4.146 = 3.77 \text{ L}$$

The closest Surge Tank is ST.75.250.

Miscellaneous Conversions:

$$P \text{ (psi)} = P \text{ (bar)} * 14.50$$

$$\text{Length (inch)} = \frac{\text{Length (mm)}}{25.4}$$

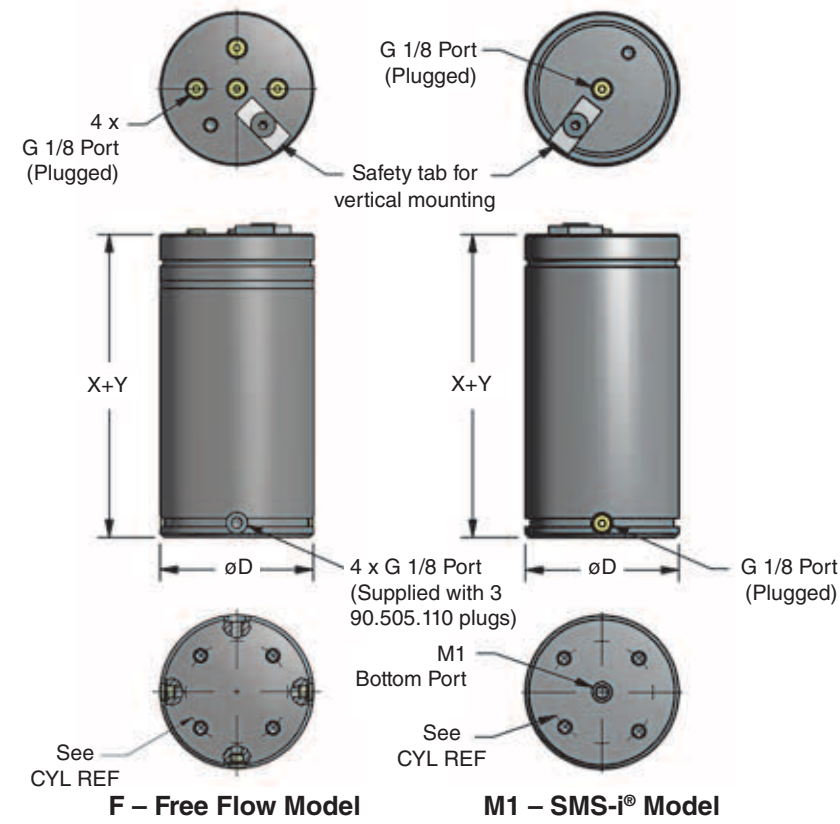
Surge Tank Product Specifications

The Surge Tank is offered in two Models: F – Free Flow Model has multiple open ports supplied as standard for maximum flexibility when piping; M1 – SMS-i® Model has a bottom port for attachment to a base plate. Gauges and shut-off ball valves are available upon request.

For assistance in determining appropriate Surge Tank size for your system, refer to the instructions provided or contact DADCO with the cylinder size, length of stroke being used and amount of pressure rise desired. *DADCO 90.700 (Y-700) / 90.705 (Y-705) hose is generally not recommended for use with Surge Tanks due to restricted flow capability.*



ST.50.150.B29



F – Free Flow Model M1 – SMS-i® Model

ST	30	50	75	100
D	95	120	150	195
X	117	137	152	157
Y	Volume of Tank L (in³)			
50	0.59	1.05	1.71	2.92
100	0.85	1.44	2.33	3.99
150	1.10	1.83	2.94	5.06
200	1.35	2.22	3.56	6.13
250	1.60	2.62	4.17	7.20
300	1.85	3.01	4.78	8.27
350	2.10	3.40	5.40	9.34
400	2.35	3.79	6.01	10.41

Ordering Example:

ST.30. 150. TO. F
 Size: 30, 50, 75, 100
 Length (Y): 50, 100, 150, 200, 250, 300, 400

Operating System:
 F = Free Flow Fitting,
 M1 = SMS-i® (Bottom port + sealing component)
 Mount Option:
 TO = Basic Model. When not specified, default is TO. Mount ordered with cylinder will be attached at factory.

Bulletin No. B14102

Comprehensive Guide

This manual provides product specifications, and a step-by-step maintenance guide for DADCO Surge Tanks.

Note that proper repair requires careful examination of all component parts and replacement of any that are worn or damaged. All DADCO replacement parts are available from factory stock.

Typically, DADCO Surge Tanks can be rebuilt in less than five minutes by replacing only the o-rings.

After reviewing this guide, if you require any additional training or have any questions please contact DADCO for assistance.

Please Note: As you proceed through the basic steps outlined in this bulletin, take care to follow the instructions. All DADCO products are permanently marked with model and serial number. Please refer to these numbers when performing repair work and when ordering replacement parts.

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Surge Tank Design, Installation & Maintenance



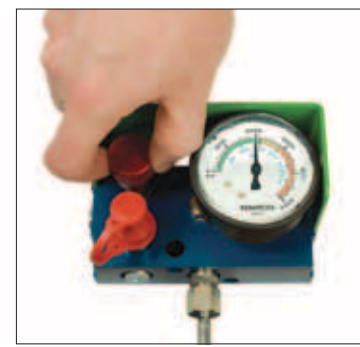
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CAUTION: Always wear safety goggles when performing any maintenance work.

Surge Tank Repair Instructions

I. Exhausting System Pressure and Removing C-Ring



1. Exhaust nitrogen gas by opening the bleed valve on the control panel. Verify all pressure is exhausted by reading the control panel gauge and retracting the gas spring piston rods into the tubes manually. If the rods will not fully retract, **STOP** and contact DADCO.



2A. Remove the Safety Tab from top of the Surge Tank using a hex key. ST.30 uses a 5 mm hex key, ST.50 and ST.75 use a 6 mm hex key and ST.100 uses a 10 mm hex key. Note: It is not necessary to remove a Surge Tank from a SMS or SMS-® plate to perform maintenance if it is mounted using the B11 mount or the bottom tapped holes.

Tank with B29 Mount



2B. Remove the Surge Tank with B29 Mount from the die then remove the mount from the Surge Tank using a hex key. ST.30 uses a 6 mm hex key, ST.50 and ST.75 use a 7 mm hex key and ST.100 uses a 10 mm hex key.



3. Remove the G1/8 Center Port Plug and all additional port plugs using the Port Servicing Tool (90.320.8) or a 5 mm hex key. Remove any fittings located at the top of the Surge Tank.



4. Tap the Surge Tank Head Assembly down into the Tube Assembly. The Head Assembly only needs to be tapped approximately 12 mm below the C-Ring. **DO NOT** force it further into the Tube Assembly.



5. Using the Plastic Assembly Blade (90.357), remove the dust cover from the Surge Tank and discard.



6. Remove the C-Style Retaining Ring using the C-Ring Removal Tool (90.356). Position the correct hooked end of the tool below the C-Ring. For best results locate the tool near either end of the C-Ring. Begin pushing it toward the outside of the gas spring can. The handles will close naturally, and the C-Ring will be extracted as you complete this motion.

II. Replacing the O-rings



1. To remove the Head Assembly, thread the T-Handle (90.320.2) into the center port.



2. Inspect the Tube Assembly for any damage, especially around the mouth of the Tube Assembly. Polish out any scratches at the mouth of the Tube Assembly to avoid damaging seals during the reassembly process. If damage to the Tube Assembly is severe it must be replaced.



3. Choose the appropriate repair kit (90.201ST.x) for the specific model you are repairing. **NOTE: Repair kits are not interchangeable among models.**



4. Using the Plastic Assembly Blade, remove the O-ring Backup Ring from the Surge Tank and discard.



5. Using the Plastic Assembly Blade, remove the O-ring from the Surge Tank and discard.



6. Turn over the Head so the ports are facing bottom. Install the new O-ring Backup Ring using the Plastic Assembly Blade. Verify that the O-ring does not twist when installing.



7. Install the new O-ring using the Plastic Assembly Blade. Verify that the O-ring does not twist when installing. The O-ring will be seated next to the O-ring Backup Ring.

III. Reassembly

CAUTION: Before starting the reassembly process, be sure the repair area is clean. It is imperative that the Surge Tank be free of all contaminants upon reassembly. If this precaution is not taken it may lead to premature failure.



1. Lubricate the inside wall of the tube with entire contents of the bottle of assembly oil then thread the T-Handle into the center port of the Surge Tank Head and install into the Head Assembly. The Head Assembly only needs to be pushed down approximately 12 mm below the C-Ring. **DO NOT** force it further into the Tube Assembly.



2. Insert the C-Style Retaining Ring in the retaining ring groove using a DADCO C-Ring Installation Tool (90.352 or 90.352.10000) or standard bench tools. Tap C-Ring into position. Be sure C-Style Retaining Ring is fully seated in retaining ring groove.



3. Using the T-Handle, pull up on Surge Tank Head Assembly until it is past the C-Ring and the top is flush with the Tube Assembly.



4. Install the new Dust Cover (90.246.x). Tap with a soft mallet until the top of the Dust Cover rests flush with the Tube Assembly.



5A. Install the Safety Tab at the top of the Surge Tank using a key. ST.30 uses a 5 mm hex key, ST.50 and ST.75 use a 6 mm hex key and ST.100 uses a 10 mm hex key.

Tank with B29 Mount



5B. Attach the B29 Mount onto the Surge Tank using a hex key. ST.30 uses a 6 mm hex key, ST.50 and ST.75 use a 7 mm hex key and ST.100 uses a 10 mm hex key.



6. Install all the port plugs at the top of the Surge Tank using the Port Servicing Tool (90.320.8) or a 5 mm hex key. You may install fittings and attach your Surge Tank to your control panel, making sure all connections are tight and that the system nitrogen gas spring rods are extended.

IV. Charging



7. Attach Charging Assembly (90.310.040 or 90.310.045) to the quick disconnect filler valve on the control panel.



8. Open the main valve on the nitrogen tank then set the desired charging pressure on the regulator.

Repair Tools

T-Handle
90.320.2 – M8 thread

To remove the Head Assembly when disassembling and position correctly when reassembling.



C-Ring Removal Tool
90.356

To remove the C-Style Retaining Ring safely in a single controlled motion.



Port Servicing Tool
90.320.8

To remove and install port plugs.



Plastic Assembly Blade
90.357

To remove and install the O-ring and O-ring Backup Ring.



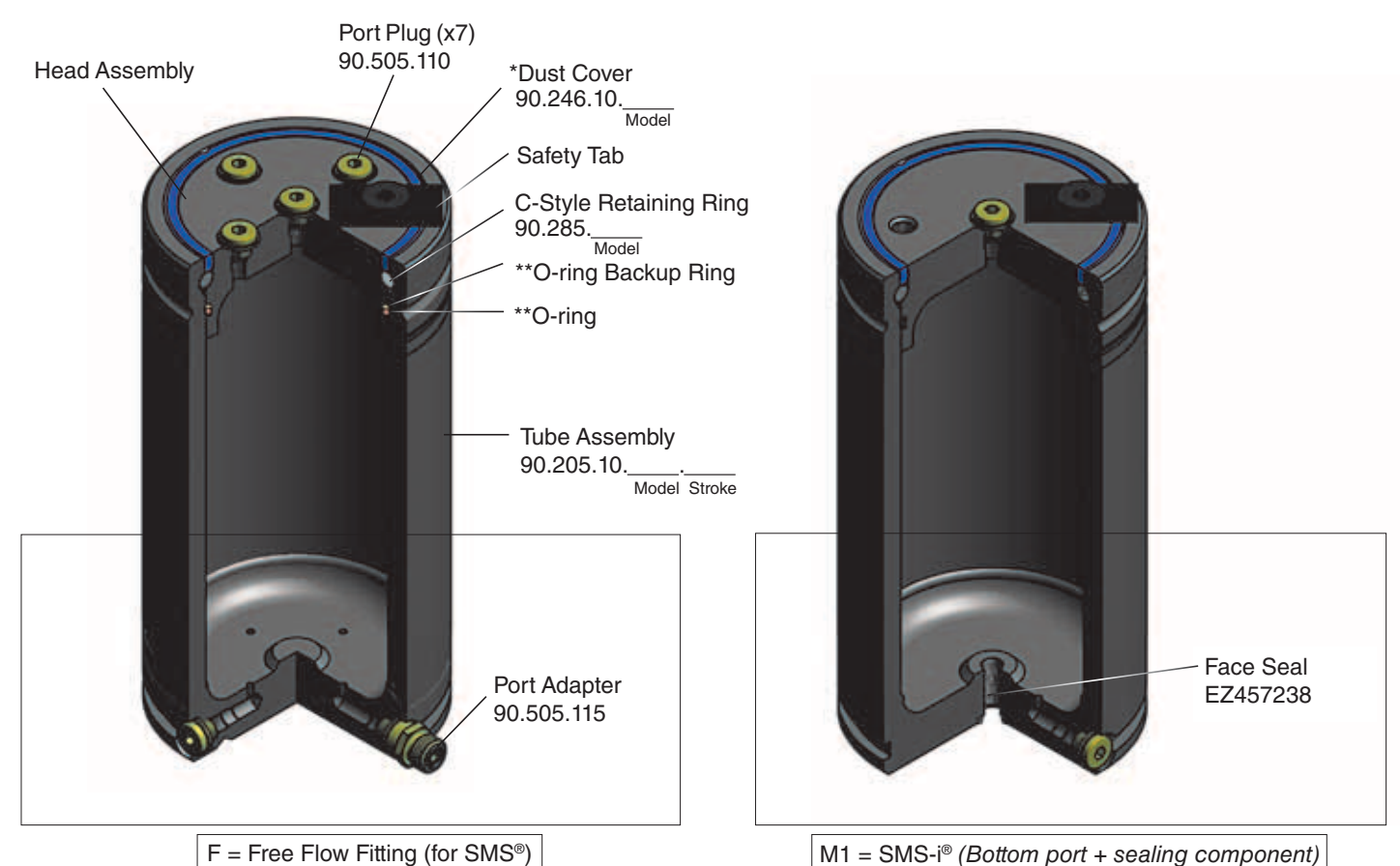
C-Ring Installation Tool
90.352 (01500 – 07500 Models)
90.352.10000 (10000 Model)

To insert the C-Style Retaining Ring into the retaining ring groove.



Parts List

* Included in the Repair Kit



Repair Kits

Include an O-ring, O-ring Backup Ring, Dust Cover, assembly oil and repair instructions.

Model	Repair Kit	Model	Repair Kit
ST.30	90.201ST.03000	ST.75	90.201ST.07500
ST.50	90.201ST.05000	ST.100	90.201ST.10000