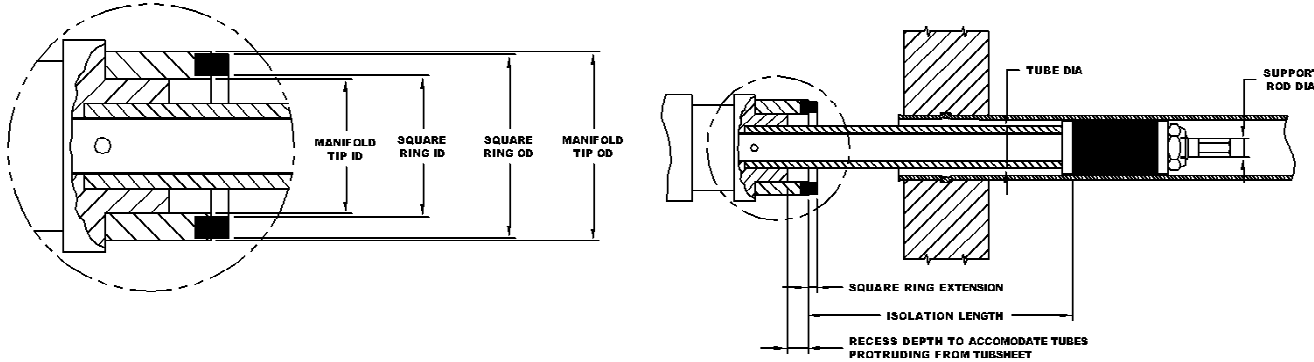


G650 / G650A VACUUM JOINT TESTING GUN SPECIFICATIONS

MANIFOLD SIZE	MANIFOLD PART NUMBER	TUBE ID RANGE				SUPPORT ROD DIA		COMP TUBE DIA		SQUARE RING PART NUMBER	SQUARE RING OD INSTALLED		SQUARE RING ID INSTALLED		MANIFOLD TIP OD		MANIFOLD TIP ID		RECESS DEPTH		SQUARE RING EXTENSION		ISOLATION LENGTH +1/16 (1.6mm)	
		Min (in)	Max (in)	Min (mm)	Max (mm)	(in)	(mm)	(in)	(mm)		(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)
3/8	GSC-6606	0.28	0.34	7.1	8.6	1/8	3.2	0.250	6.35	GSC-6706	0.625	15.88	0.415	10.54	0.664	16.87	0.385	9.78	1/4	6.35	0.11	2.7	3 1/8	79.4
1/2	GSC-6608	0.28	0.46	7.1	11.7	1/8	3.2	0.250	6.35	GSC-6708	0.750	19.05	0.540	13.72	0.790	20.07	0.521	13.23	1/4	6.35	0.11	2.7	3 1/8	79.4
5/8-SP	GSC-6609	0.29	0.49	7.4	12.4	1/8	3.2	0.250	6.35	GSC-6709	0.950	24.13	0.690	17.53	0.985	25.02	0.666	16.92	1/4	6.35	0.11	2.7	3 1/8	79.4
5/8	GSC-6610	0.50	0.59	12.7	15.0	5/16	7.9	0.437	11.10	GSC-6710	0.950	24.13	0.690	17.53	0.985	25.02	0.666	16.92	1/4	6.35	0.11	2.7	3 1/8	79.4
3/4-SP	GSC-6611	0.42	0.47	10.7	11.9	1/8	3.2	0.499	12.67	GSC-6711	1.080	27.43	0.820	20.83	1.115	28.32	0.796	20.22	1/4	6.35	0.11	2.7	3 1/8	79.4
3/4	GSC-6612	0.48	0.71	12.2	18.0	5/16	7.9	0.499	12.67	GSC-6712	1.080	27.43	0.820	20.83	1.115	28.32	0.796	20.22	1/4	6.35	0.11	2.7	3 1/8	79.4
7/8	GSC-6614	0.55	0.84	14.0	21.3	5/16	7.9	0.499	12.67	GSC-6714	1.203	30.56	0.940	23.88	1.240	31.50	0.916	23.27	1/4	6.35	0.11	2.7	3 1/8	79.4
1	GSC-6616	0.67	0.96	17.0	24.4	5/16	7.9	0.623	15.82	GSC-6716	1.388	35.26	1.127	28.63	1.425	36.20	1.101	27.97	1/4	6.35	0.11	2.7	3 1/8	79.4
1-1/8	GSC-6618	0.80	1.09	20.3	27.7	3/8	9.5	0.748	19.00	GSC-6718	1.513	38.43	1.252	31.80	1.550	39.37	1.226	31.14	1/4	6.35	0.11	2.7	3 1/8	79.4
1-1/4	GSC-6620	0.92	1.21	23.4	30.7	3/8	9.5	0.873	22.17	GSC-6720	1.638	41.61	1.377	34.98	1.675	42.55	1.351	34.32	1/4	6.35	0.11	2.7	3 3/16	81.0
1-1/2	GSC-6624	1.17	1.46	29.7	37.1	3/8	9.5	0.998	25.35	GSC-6724	2.105	53.47	1.715	43.56	2.155	54.74	1.676	42.57	1/4	6.35	0.15	3.7	3 3/16	81.0
1-5/8	GSC-6626	1.30	1.59	33.0	40.4	3/8	9.5	0.998	25.35	GSC-6726	2.230	56.64	1.872	47.55	2.280	57.91	1.801	45.75	1/4	6.35	0.15	3.7	3 3/16	81.0
1-3/4	GSC-6628	1.42	1.71	36.1	43.4	3/8	9.5	0.998	25.35	GSC-6728	2.365	60.07	1.965	49.91	2.415	61.34	1.925	48.90	1/4	6.35	0.15	3.7	3 3/16	81.0
2	GSC-6632	1.64	1.96	41.7	49.8	3/8	9.5	0.998	25.35	GSC-6732	2.615	66.42	2.215	56.26	2.665	67.69	2.176	55.27	1/4	6.35	0.15	3.7	3 1/4	82.6
2-1/4	GSC-6636	1.92	2.21	48.8	56.1	3/8	9.5	0.998	25.35	GSC-6736	2.865	72.77	2.465	62.61	2.915	74.04	2.426	61.62	1/4	6.35	0.15	3.7	3 1/4	82.6
2-1/2	GSC-6640	2.17	2.46	55.1	62.5	3/8	9.5	0.998	25.35	GSC-6740	3.115	79.12	2.715	68.96	3.165	80.39	2.676	67.97	1/4	6.35	0.15	3.7	3 1/4	82.6

NOTE:

MANIFOLD THREAD O-RING -118; SUPPORT ROD O-RING -114



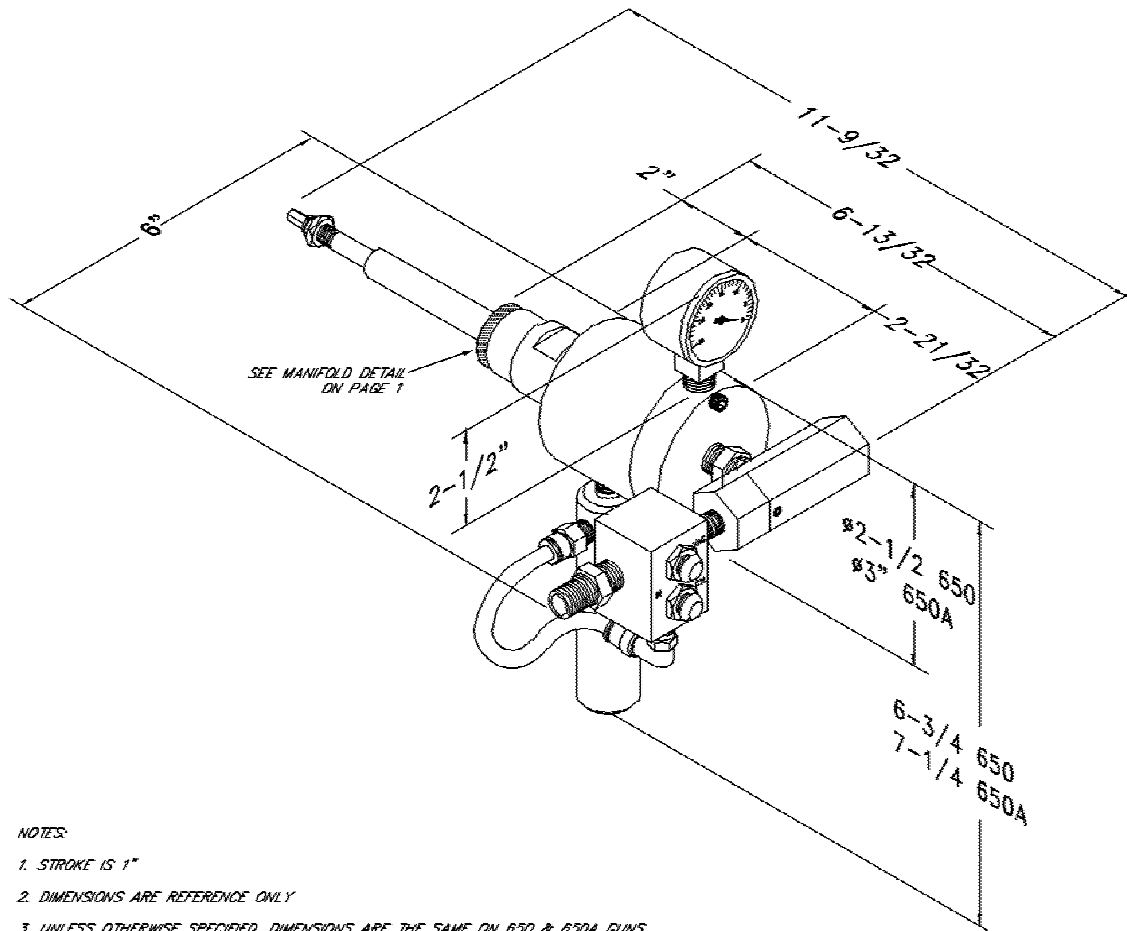
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NOTES:

1. STROKE IS 1"
2. DIMENSIONS ARE REFERENCE ONLY
3. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE THE SAME ON 650 & 650A GUNS

QUESTIONS? Contact EST Customer Service at any of the following locations with questions.

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OPERATING PROCEDURES FOR G650 / G650A VACUUM JOINT TESTING GUN**PRIOR TO TESTING:**

1. The tube ends being tested should be cleaned and any loose deposits or scale should be removed. Any scale present in the tube end may be drawn into the testing gun and clog the internal filter washer, causing the test gun to erroneously indicate a joint leak.
2. Visually inspect the tubesheet. Seriously eroded tubesheets may not be able to be tested using the G-650 since the test gun must seal on the tubesheet face. In some cases use of silicone gasket sealant on the square elastomer ring may aid in making a leak tight seal.
3. Make sure the test gun has the correct size seal and manifold (2 and 6) for the tubes to be tested. G-650 / 650A Seal and Washer Sets should be sized using Table 1. The size of the manifold in inches will be stamped on the body of the manifold and should correspond with the tube OD of the tubes being tested. The correct seal size is considered to be when the seal OD is smaller than the actual tube ID by 0.02 to 0.06" (0.5mm to 1.5mm). If either the Manifold or the Seal and Washer Sets are to be changed please refer to the replacement procedure listed below.

Table 1. G-650 / G-650A Gun Seal and Washer Set Part Numbers.														
G-SERIES REPLACEMENT SEAL DASH NUMBER (XXXX)														
BWG - Birmingham Wire Gauge														
BWG	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	2	2 1/4	2 1/2
8-9		0030	0043	0056	0068	0081	0093	0106	0118	0131	0143	0168	0193	0218
10-11		0037	0047	0062	0072	0087	0097	0112	0122	0137	0147	0173	0198	0223
12-13	0028	0040	0053	0065	0078	0090	0103	0115	0128	0140	0153	0178	0203	0228
14-15	0033	0047	0056	0072	0083	0097	0110	0122	0134	0147	0158	0183	0208	0232
16-17	0037	0050	0062	0075	0087	0100	0112	0126	0137	0150	0162	0187	0212	0237
18-19	0040	0053	0065	0078	0090	0103	0115	0128	0140	0153	0165	0190	0215	0240
20-24	0043	0056	0068	0081	0093	0106	0118	0131	0143	0156	0168	0193	0218	0243

A similar table exists for SWG tubes. Contact EST Customer Service for information.

The G-650 / G-650A Part Number GSC-XXXX-M is defined as follows:

"GSC" identifies the G-650 and G-650A Gun Set.

"XXXX" is Seal Size form the Table above.

"M" is Seal Material Designation

B - Buna-N

N - Neoprene

S - Silicone

V - Fluoroelastomer (Viton® or Equivalent)

TESTING PROCEDURE:

1. Attach air supply to the test gun. The G-650 will be operational on air supplies from 40 to 125 psi (3 to 8.6 Bars) at a minimum of 5 cfm (2.3 lps).
2. Insert the test gun into the tube to be tested.
3. Apply light pressure to seat the square ring (4) firmly against the tubesheet.
4. Depress the air control button labeled "CYL" on the valve block assembly (15). Air will then fill the cylinder, expand the seal within the tube end and will draw the tubesheet seal firmly against the tubesheet. This operation should be accomplished in 1 to 2 seconds.

Viton is a registered trademark of DuPont Dow Elastomers.



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- Depress the air control button labeled "VAC" on the valve block assembly (15). Hold the air control valve in this position until the maximum vacuum is obtained.

Note: The maximum vacuum obtained will vary in relation to the amount of air being supplied to the test gun.

- At 100 psi (6.9 Bar) and 10 cfm the venturi is capable of producing a vacuum in excess of 16 in-hg vacuum in just a few seconds. Some experimentation should be performed to determine the vacuum that you will be capable of reaching. Steps 4 and 5 should take an experienced operator no more than about 5 seconds.
- The gun operator should observe the vacuum gauge (7). A loss of vacuum will indicate a tube joint leak.

Note: Always check possible leaking tubes more than once. Variations in the tubesheet, the technique of the operator, grit lodged in the check valve or seal wear may cause erroneous joint leak indications. Proceed to step 8.

- To release the air in the cylinder, press the bleed valve (11). Rock the test gun lightly to break the remaining vacuum. Remove the test gun from the tube and rotate the gun approximately 45 degrees. Repeat procedures 2 through 6. If the gun continues to indicate a joint leak mark the tube for repair and continue to the next tube.
- If the test indicates the tube joint to be sound, press the bleed valve (11) to release the air in the cylinder. Rock the test gun lightly to break the remaining vacuum. Remove the test gun from the tube and continue to the next tube.

REPLACING THE SEAL AND WASHER SET:

G-650 Replacement Seal and Washer Sets should be sized using the Table 1. Replacement seals for the G-650 are supplied with corresponding washers. Always replace the seals and washers at the same time.

- Remove the locknut (1) from the end of the support tube (3) and set aside.
- Remove the seal and washers (2). Discard if worn. Under optimum conditions you should be able to test between 100 and 500 tubes per replacement procedure listed below.
- If you are replacing the seal and washer set with the same size set then reverse steps 1 and 2. If you are changing the seal and washer set to test different size tubes please keep in mind that you may also have to change the support tube. To replace the support tube refer to the replacement procedure listed below.
- When replacing the locknut (1) on the support tube (3) do not use a wrench, screw it on finger tight only. A small space between the locknut, seal and washer set, and manifold is normal.

REPLACING THE MANIFOLD:

- Following the procedure outlined above, remove the seal and washer set.
- Using an open end wrench on the flats provided, gently unscrew the manifold assembly (6) from the front of the air cylinder (8).
- Prior to installing the replacement manifold (5), visually inspect the o-ring on the threaded end of the manifold and the o-ring within the manifold to make sure they are in good condition. Lubricate the o-rings, if necessary. Screw the new manifold (5) into the front of the air cylinder (8). The o-ring on the threaded end of the manifold should seat firmly against the face of the air cylinder (8) but should not bulge out. Do not over tighten when threading the manifold (5) and cylinder together (8).

REPLACING THE SUPPORT TUBE:

- Remove the seal set and manifold as outlined above.
- Using an open end wrench on the wrench flats provided on the piston and a pipe wrench on the support tube (3) gently unscrew the support tube (3) from the piston.
- Reverse steps 1 and 2 above. Do not use excessive force in tightening the support tube.



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4. Prior to replacing the seal and washer set (2) inspect the support tube for scars left from the replacement procedure. File smooth if present.

OTHER REPLACEMENTS AND REPAIRS:

Under no condition should you attempt to service the air cylinder, venturi or valve block assemblies. Please contact EST Customer Service Department at any of the following locations to arrange for return and repair.

QUESTIONS? Contact EST Customer Service at any of the following locations with questions.

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Table 2. G-650 / G-650A Tube Testing Gun Set Parts List

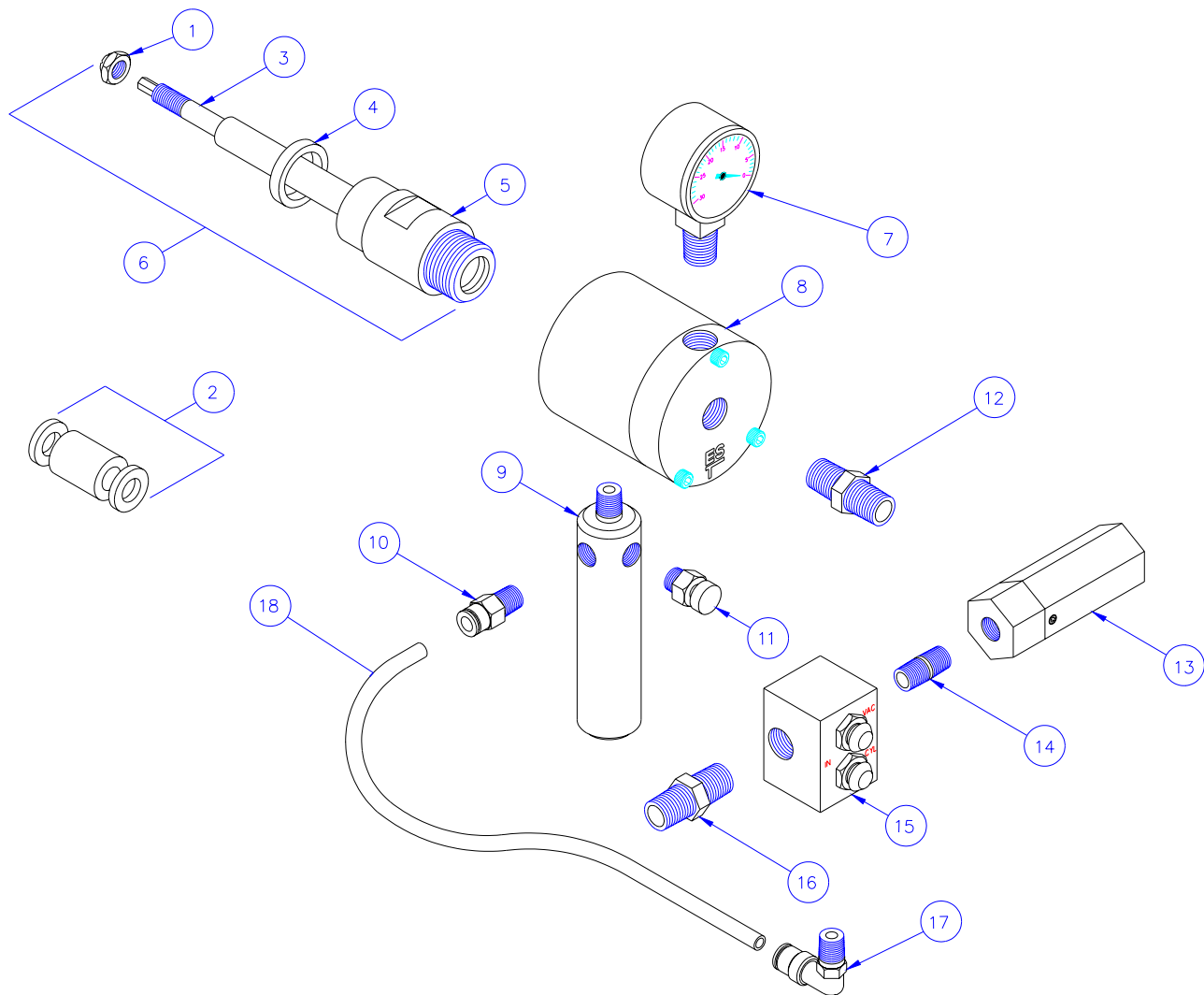
ITEM	QUANTITY	DESCRIPTION	PART NUMBER
1	1	LOCK NUT .28 - .48	GSA-1530
		.49 - .83	GSA-1531
		.84 - 2.53	GSA-1532
2	2	REPLACEMENT SEAL & WASHER SET	*GSC-XXXX-M
3	1	SUPPORT ROD .28 - .48	SEE ITEM 6
		.49 - .83	SEE ITEM 6
		.84 - 2.53	SEE ITEM 6
4	1	SQUARE ELASTOMER RING	
		5/16 MANIFOLD	GSC-6705
		3/8 MANIFOLD	GSC-6706
		1/2 MANIFOLD	GSC-6708
		5/8 MANIFOLD	GSC-6710
		3/4 MANIFOLD	GSC-6712
		7/8 MANIFOLD	GSC-6714
		1" MANIFOLD	SC-6716
		1-1/8 MANIFOLD	GSC-6718
		1-1/4 MANIFOLD	GSC-6720
		1-1/2 MANIFOLD	GSC-6724
		1-5/8 MANIFOLD	GSC-6726
		1-3/4 MANIFOLD	GSC-6728
		1-7/8 MANIFOLD	GSC-6730
		2" MANIFOLD	GSC-6732
		2-1/4 MANIFOLD	GSC-6736
		2-3/8 MANIFOLD	GSC-6738
		2-1/2 MANIFOLD	GSC-6740
		2-7/8 MANIFOLD	GSC-6746
		3" MANIFOLD	GSC-6748
5	1	MANIFOLD	SEE ITEM 6
6	1	MANIFOLD ASSEMBLY (INCLUDES ITEMS 1,3,4&5)	
		5/16 MANIFOLD	GSC-6605
		3/8 MANIFOLD	GSC-6606
		1/2 MANIFOLD	GSC-6608
		5/8 MANIFOLD	GSC-6610
		3/4 MANIFOLD	GSC-6612
		7/8 MANIFOLD	GSC-6614
		1" MANIFOLD	GSC-6616
		1-1/8 MANIFOLD	GSC-6618
		1-1/4 MANIFOLD	GSC-6620
		1-1/2 MANIFOLD	GSC-6624
		1-5/8 MANIFOLD	GSC-6626
		1-3/4 MANIFOLD	GSC-6628
		1-7/8 MANIFOLD	GSC-6630
		2" MANIFOLD	GSC-6632
		2-1/4 MANIFOLD	GSC-6636
		2-3/8 MANIFOLD	GSC-6638
		2-1/2 MANIFOLD	GSC-6640
		2-7/8 MANIFOLD	GSC-6646
		3" MANIFOLD	GSC-6648
8	1	CYLINDER BODY COMPLETE .28 - 1.23	GSC-6680
		1.24 - 2.53	GSC-6681
9	1	HANDLE, PORTED W/O BLEED VALVE	GSC-6671
10	1	STRAIGHT TUBE FITTING	GSC-6561
11	1	BLEED VALVE	GSA-1560
12	1	CHECK VALVE	GSC-6693
13	1	VENTURI ASSEMBLY	GSC-6692
14	1	SHORT NIPPLE, 1/8 NPT	GSA-1551
15	1	VALVE BLOCK	GSC-6691
16	1	HEX NIPPLE, 1/4 NPT	GSA-1553
17	1	ELBOW TUBE FITTING	GSC-6560
18	1	TUBING, POLYETHYLENE	GSA-6662



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Figure 1. G-650 Gun Drawing

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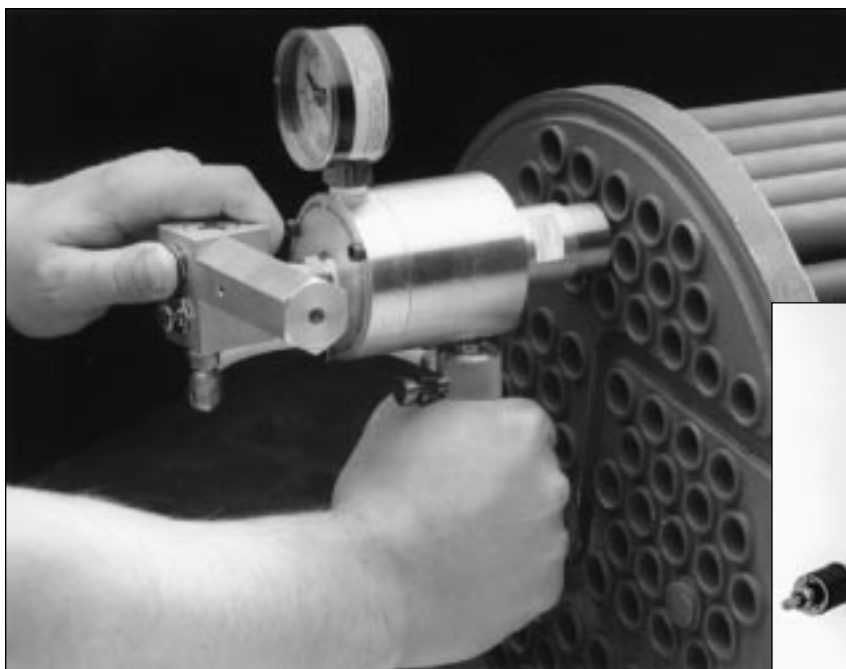
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G-650 Vacuum Joint Testing Gun



G-650 Testing Guns

G-150 Testing Guns

G-450 Testing Guns



Find Tube Joint Leaks Fast With Unique Vacuum Tester.

EST's G-650 Vacuum Joint Testing Gun uses air pressure to generate a vacuum around the tube to tubesheet joint to pinpoint leaking connections. Just insert the Test Gun into the tube end and press the air control valve to fill the cylinder with air. This expands a seal inside the tube, pulling a second seal firmly against the tubesheet surrounding the tube end. Next press the vacuum control valve to divert air through a venturi, creating a vacuum around the tube joint area. Any reduction in vacuum shown on the integral gauge indicates a faulty tube joint.

Here's what the G-650 Vacuum Joint Testing Gun has to offer:

- **Interchangeable Manifolds:** Allows the G-650 to test tube OD's from 3/8" to 1-1/4" (9.52 to 31.75 mm). The G-650A is used for tube OD's from 1-1/2" to 2-1/2" (38.1 to 63.5 mm).
- **Light Weight:** Weighs less than 2.7 lbs (1.2 kg), when equipped with a 3/4" manifold.
- **Uses standard plant air supplies from 40 to 125 psi.**
- **Standard seal material:** Neoprene, Viton® optional.
- **Quality Assurance System:** Meets requirements of ANSI N45.2, 10CFR50 Appendix B, 10CFR21, and is certified to ISO-9001.



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G-650/G-650A Vacuum Joint Testing Gun And Replacement Parts

G-650

Nominal Tube Size	Tube ID Size Range	Testing Gun Part Number	Manifold Part Number	Square Ring Part Number
3/8" (9.5 mm)	.28" to .33" (7.1 to 8.4 mm)	GSC-6506	GSC-6606	GSC-6706
1/2" (12.7 mm)	.28" to .45" (7.1 to 11.4 mm)	GSC-6508	GSC-6608	GSC-6708
5/8" (15.9 mm)	.49" to .58" (12.4 to 14.7 mm)	GSC-6510	GSC-6610	GSC-6710
3/4" (19.1 mm)	.50" to .70" (12.7 to 17.8 mm)	GSC-6512	GSC-6612	GSC-6712
7/8" (22.2 mm)	.57" to .83" (14.5 to 21.1 mm)	GSC-6514	GSC-6614	GSC-6714
1" (25.4 mm)	.70" to .95" (17.8 to 24.1 mm)	GSC-6516	GSC-6616	GSC-6716
1-1/8" (28.6 mm)	.83" to 1.08" (21.1 to 27.4 mm)	GSC-6518	GSC-6618	GSC-6718
1-1/4" (31.8 mm)	.95" to 1.20" (24.1 to 30.5 mm)	GSC-6520	GSC-6620	GSC-6720

G-650A

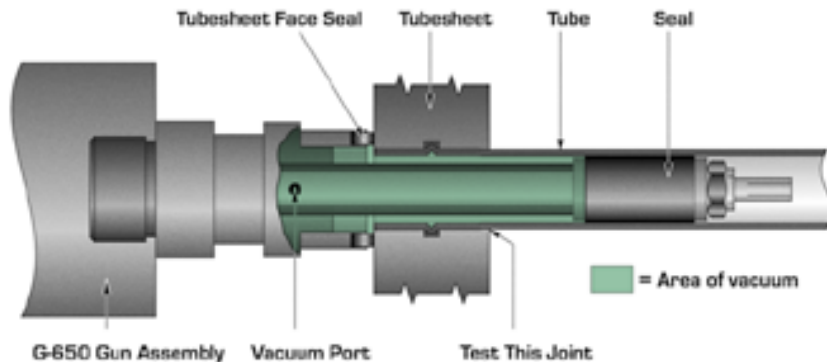
Nominal Tube Size	Tube ID Size Range	Testing Gun Part Number	Manifold Part Number	Square Ring Part Number
1-1/2" (38.1 mm)	1.20" to 1.45" (30.5 to 36.8 mm)	GSC-6524	GSC-6624	GSC-6724
1-3/4" (44.5 mm)	1.45" to 1.70" (36.8 to 43.2 mm)	GSC-6528	GSC-6628	GSC-6728
2" (50.8 mm)	1.70" to 1.95" (43.2 to 49.5 mm)	GSC-6532	GSC-6632	GSC-6732
2-1/4" (57.2 mm)	1.95" to 2.15" (49.5 to 54.6 mm)	GSC-6536	GSC-6636	GSC-6736
2-1/2" (63.5 mm)	2.20" to 2.40" (55.9 to 61.0 mm)	GSC-6540	GSC-6640	GSC-6740

G-650 Manifold Extensions

For easier testing when a channel head or water box is present

Length (Ft)	Part Number
1 ft. (304.8 mm)	GSC-6700-01
2 ft. (609.6 mm)	GSC-6700-02
3 ft. (914.4 mm)	GSC-6700-03
4 ft. (1,219.2 mm)	GSC-6700-04

Ordering Information: When ordering, please provide tube OD and wall thickness.



G-650/G-650A Neoprene Seal And Washer Sets

Part number, GSC-XXXX-N, where XXXX is the number listed in the chart for the appropriate tube OD and BWG

Tube OD BWG	1/2"	5/8"	3/4"	7/8"	1"	1-1/8"	1-1/4"	1-3/8"	1-1/2"	1-5/8"	1-3/4"	2"	2-1/4"	2-1/2"
8-9	—	0030	0043	0056	0068	0081	0093	0106	0118	0131	0143	0168	0193	0218
10-11	—	0037	0047	0062	0072	0087	0097	0112	0122	0137	0147	0173	0198	0223
12-13	0028	0040	0053	0065	0078	0090	0103	0115	0128	0140	0153	0178	0203	0228
14-15	0033	0047	0056	0072	0083	0097	0110	0122	0134	0147	0158	0183	0208	0232
16-17	0037	0050	0062	0075	0087	0100	0112	0126	0137	0150	0162	0187	0212	0237
18-19	0040	0053	0065	0078	0090	0103	0115	0128	0140	0153	0165	0190	0215	0240
20-24	0043	0056	0068	0081	0093	0106	0118	0131	0143	0156	0168	0193	0218	0243

Notes

- G-650 seal and washer sets contain two seals and four washers.
- For seal sizing and part numbers in SWG, metric or other tube sizes, contact EST.
- Optional seal material: Viton®
- Caution: G-650 guns cannot be used where the tubesheet is extremely corroded/eroded; where tube ends are flared and flares overlap; or where tube-to-tubesheet joints are welded.