How do Steam Traps Stack Up?

By Evan Gaj and Josh Lannon August 2014

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PURPOSE

The objective of this procedure is to determine the volume of condensate buildup obtained in hygienic steam traps used in the biopharmaceutical industry.

SCOPE

The procedure will be applied to the industry's most common suppliers of Steam Traps including Jordan, Spirax Sarco, and Nicholson. Testing was completed on both ½" and ¾" traps each with unique construction. The test will consist of four trials. Each trial will be of duration of 15 minutes with the coolant flow increasing by 0.4 GPH. The increase supply of coolant flow will result in higher total volume of condensate load. A CS generator will supply the test apparatus with approximately 25 psig with a warmup period of 5 minutes. This will ensure that the results are kept constant. We will observe the height of the condensate through an 18" Polusulfone tube in order to view the condensate height. A pressure gauge is installed on the inlet of the rig and a graduated beaker was used to collect and measure the condensate passed by the trap during each test. Using a previous test performed by Jim McCullough at CBC we were able to model our testing procedure based on the tests and results that he obtained in his experiment.

RESPONSIBILITIES

Two of CBC's interns with the help of a shop specialist were responsible for generating the volume reports and ensure that all the portions of this document are met.

MFG	Model	Size	Ends
Sarco	MST21	3/4"	TC
Sarco	BTM7	1/2"	TC
Sarco	BTD52L	1/2"	TC
Sarco	BT6-BL	1/2"-3/4"	TC
Sarco	BT6-BH	1/2"-3/4"	TC
Sarco	Old BT6	3/4"	TC
Jordan	MK93JR-TC (E2D2)	1/2"-3/4"	TC
Jordan	MK93JR-Weld	1/2"-3/4"	TC
Jordan	MK93	1/2"-3/4"	TC
Nicholson	DS100-DS110	3/4"	TC
Nicholson	CDS204A	3/4"	TC
Nicholson	CDS204B	3/4"	TC

Figure. 1 Steam Traps Used

SAFETY EQUIPMENT
Safety Glasses
Safety Shoes

TECHNIQUE

Test each manufacturer's ½"- ¾" Steam Traps, using the Cotter Brothers Test Apparatus, shown in the test report. All factors will be held constant in each test/trial, and the only factor changed will be the steam trap used. The supplied psig, the warmup period, and the time trials will remain constant. In keeping our trials constant we create reliable and repeatable result.

Figure. 2 Steam Trap Apparatus

EQUIPMENT
Steam Traps
Pressure Gauge (Calibrated)
Steam CS generator
Digital Timer
Sight Tube
5,000mL Flask

PROCEDURE

In order for the Steam Trap Condensate Volume tests to be considered comparable, the following conditions must be adhered to.

1. Set CS generator to approximately 25 psig. Install trap, allow test fixture to heat up to full steam pressure. Set coil coolant flow to achieve desired condensate load.
2. Open CS supply valve, let trap come to temperature, approx. 5 minutes, and then start test with empty container to collect condensate.
3. Observe condensate through sight tube, record all heights of backups that occur.
4. At the end of test, measure and record the amount of condensate passed by the trap.
5. Increase coolant flow to produce next higher condensate load.
6. Repeat test at higher condensate loads.
7. Shut CS valve to test fixture, let cool, install horizontal leg upstream of trap, repeat test.
8. Repeat testing with next model trap.

SUMMARY

This study was conducted to evaluate the level of condensate that builds up above a steam trap during operation. We were able to closely simulate this environment that occurs during this process, by using a steam generator, attached to a "condensate generator." The Condensate generator was a coil with cold water flowing through within the testing fixture that would work to cool down the steam above the steam trap (water at 40/55°F). The condensate generator had a variable flow rate that could be adjusted to change the amount of condensate that was generated.

Steam traps were tested on 15 minute test intervals, with varying flow rates of 0.6, 1.0, 1.4, and 1.8 GPH flowing through the “condensate generator.” After testing each steam trap for a total of 60 minutes (4, 15 minute test intervals), we would turn off the steam generator, and allow the system to cool down.

The Jordan MK93 was tested in high condensate conditions, using ice cold 40°F degree water instead of the 55°F degree used in the other tests. We choose to do this in order to test the steam trap under higher intensity conditions.

From these series of tests, we were able to produce a repeatable test that allowed us to determine exactly how much buildup each steam trap held before releasing the load at predetermined settings. Attached is a tabulated summary of the results for all of the tests completed along with detailed graphs showing the comparisons.

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Comparisons/Results

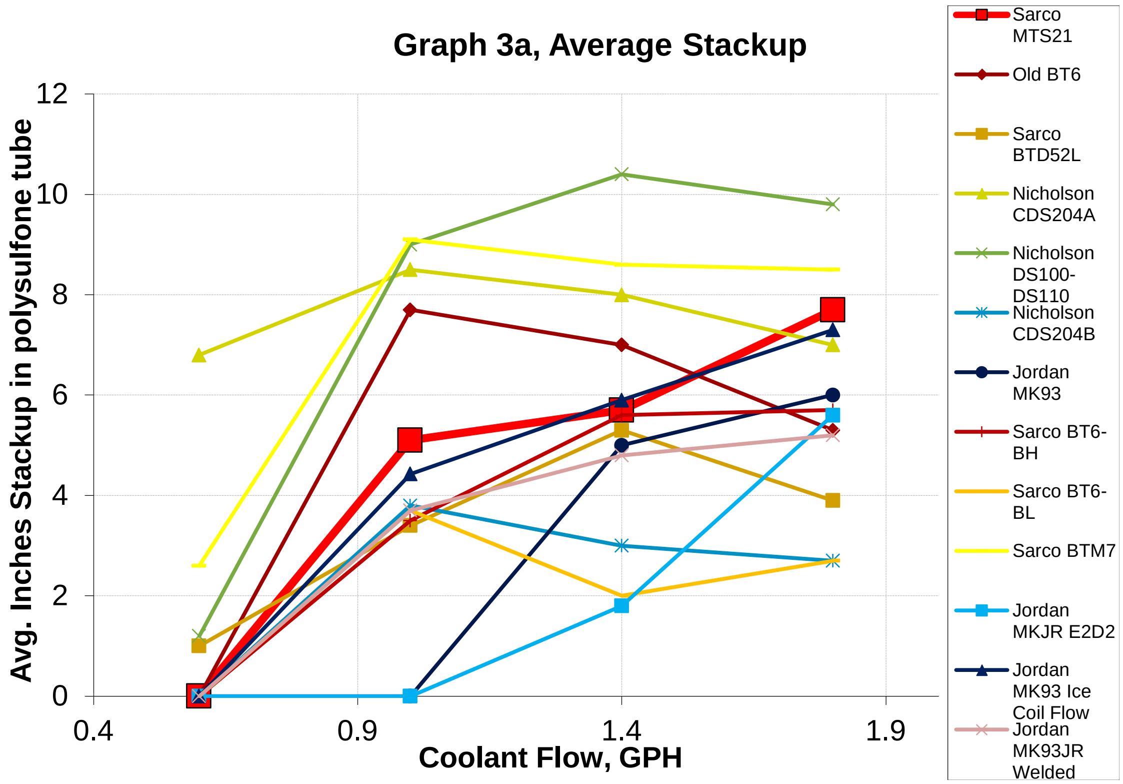


Figure. 3a Average Stack Up Results

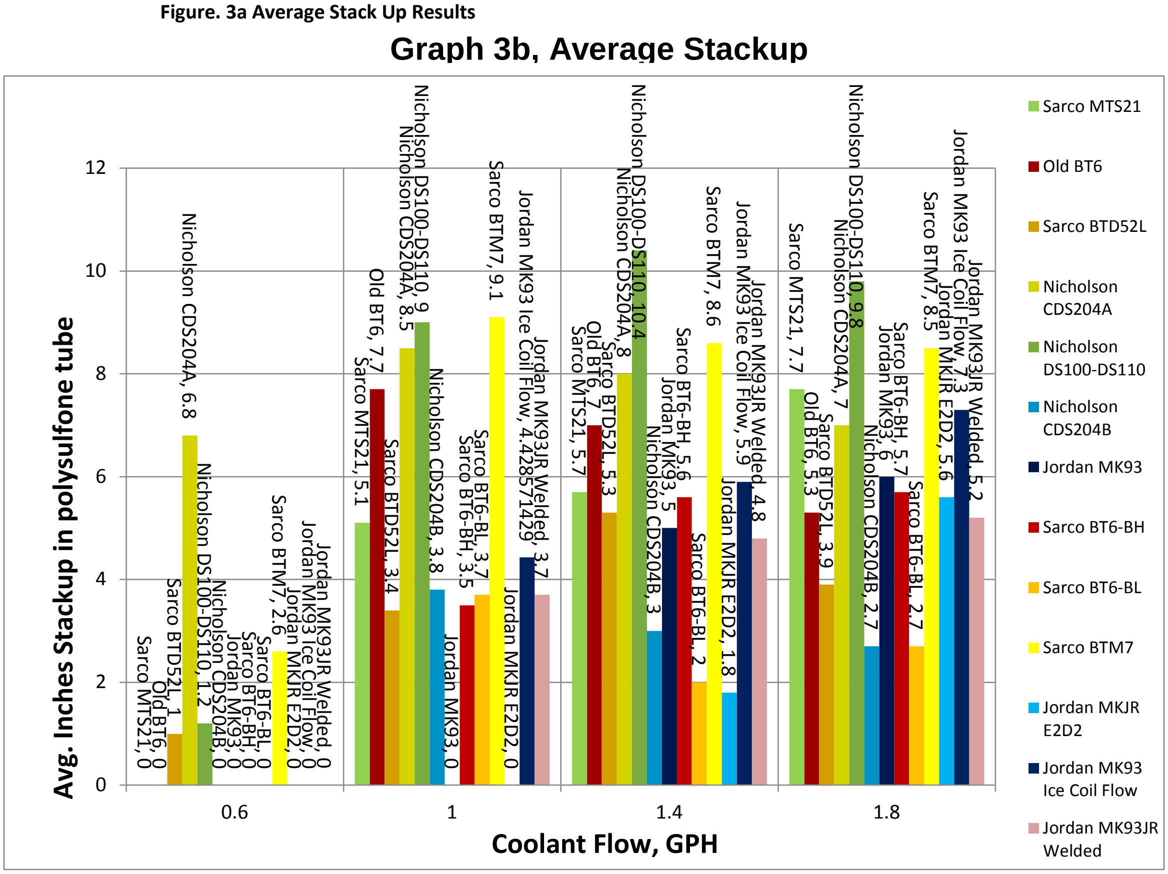


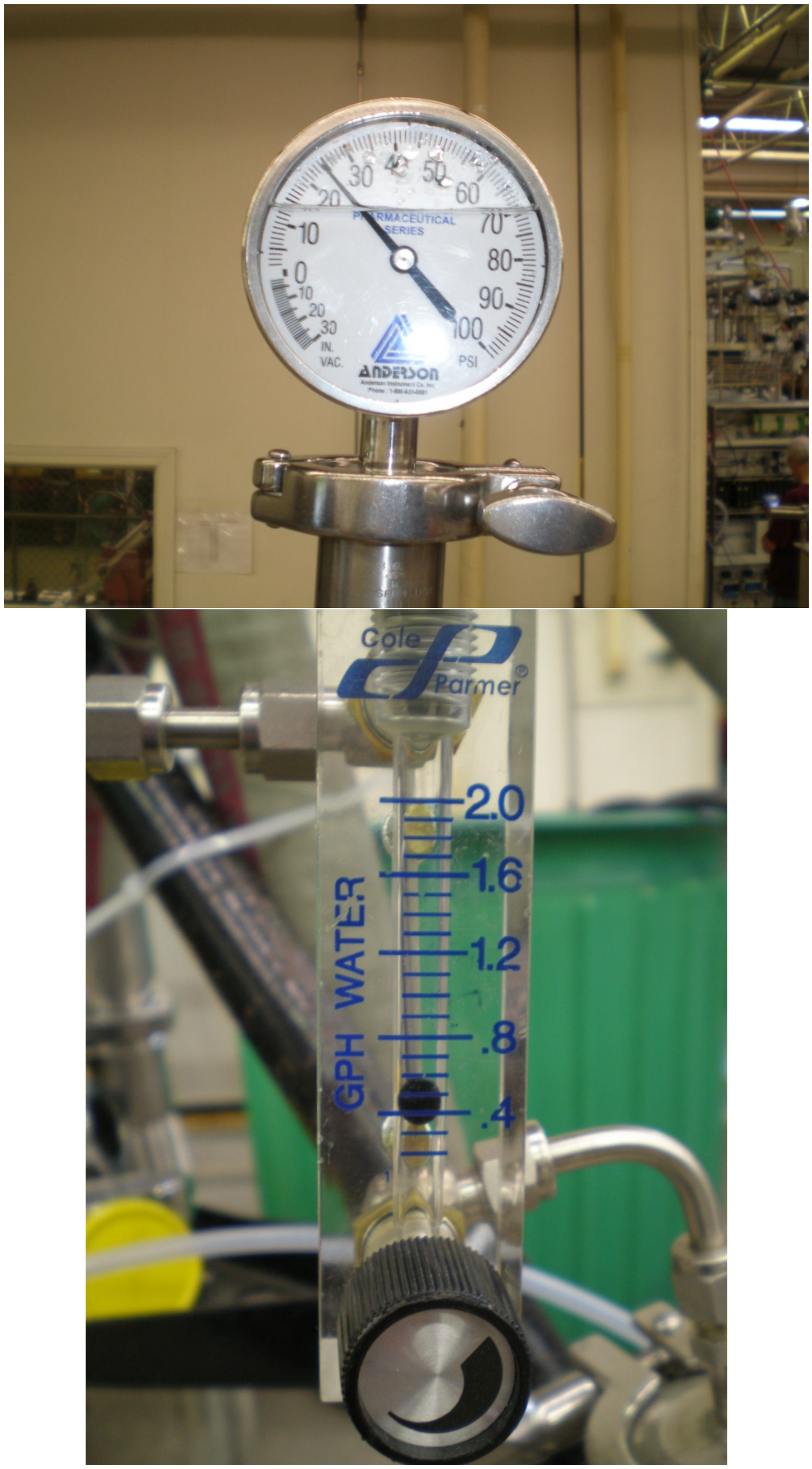
Figure. 3b Average Stack Up Results Bar Graph

Tabulated Summary

Trap	Test#	Measured Cond Load, milliliters/15 Mins	Measured Cond Load, Oz/15 min	Frequency of stackup	Max cond height	Average cond height	Coolant Flow, GPH	Cond Load, lbs/hr
Sarco MTS21	1	1380	46.66	0	0	0.0	0.6	12.25
Sarco MTS21	2	1340	45.31	16	13	5.1	1	11.90
Sarco MTS21	3	1540	52.07	17	13	5.7	1.4	13.67
Sarco MTS21	4	1660	56.13	19	13	7.7	1.8	14.74
Old BT6	1	925	31.28	0	0	0.0	0.6	8.21
Old BT6	2	1200	40.58	15	10	7.7	1	10.66
Old BT6	3	1270	42.94	25	13	7.0	1.4	11.28
Old BT6	4	1440	48.69	32	13	5.3	1.8	12.79
Sarco BTD52L	1	720	24.35	2	1	1.0	0.6	6.39
Sarco BTD52L	2	1300	43.96	37	7	3.4	1	11.54
Sarco BTD52L	3	1400	47.34	34	13	5.3	1.4	12.43
Sarco BTD52L	4	1600	54.10	55	13	3.9	1.8	14.21
Nicholson CDS204A	1	1100	37.20	6	13	6.8	0.6	9.77
Nicholson CDS204A	2	1750	59.17	17	13	8.5	1	15.54
Nicholson CDS204A	3	1900	64.25	13	13	8.0	1.4	16.87
Nicholson CDS204A	4	1700	57.48	13	13	7.0	1.8	15.10
Nicholson DS100-DS110	1	700	23.67	4	3	1.2	0.6	6.22
Nicholson DS100-DS110	2	1700	57.48	8	13	9.0	1	15.10
Nicholson DS100-DS110	3	1500	50.72	6	13	10.4	1.4	13.32
Nicholson DS100-DS110	4	1650	55.79	9	13	9.8	1.8	14.65
Nicholson CDS204B	1	1250	42.27	0	0	0.0	0.6	11.10
Nicholson CDS204B	2	1750	59.17	6	5	3.8	1	15.54
Nicholson CDS204B	3	1700	57.48	4	4	3.0	1.4	15.10
Nicholson CDS204B	4	1750	59.17	5	5.5	2.7	1.8	15.54
Sarco BT6-BH	1	880	29.76	0	0	0.0	0.6	7.81
Sarco BT6-BH	2	1780	60.19	29	13	3.5	1	15.81
Sarco BT6-BH	3	2200	74.39	24	13	5.6	1.4	19.54
Sarco BT6-BH	4	1825	61.71	14	13	5.7	1.8	16.21
Sarco BT6-BL	1	800	27.05	0	0	0.0	0.6	7.10
Sarco BT6-BL	2	2000	67.63	4	5	3.7	1	17.76
Sarco BT6-BL	3	1900	64.25	6	5	2.0	1.4	16.87
Sarco BT6-BL	4	1800	60.87	12	5	2.7	1.8	15.98
Sarco BTM7	1	950	32.12	7	5.5	2.6	0.6	8.44
Sarco BTM7	2	1250	42.27	9	13	9.1	1	11.10
Sarco BTM7	3	1600	54.10	10	13	8.6	1.4	14.21
Sarco BTM7	4	1500	50.72	12	13	8.5	1.8	13.32
Jordan MKJR Tri-Clamp	1	900	30.43	0	0	0.0	0.6	7.99
Jordan MKJR Tri-Clamp	2	1300	43.96	0	0	0.0	1	11.54
Jordan MKJR Tri-Clamp	3	1560	52.75	19	4	1.8	1.4	13.85
Jordan MKJR Tri-Clamp	4	1460	49.37	14	12	5.6	1.8	12.96
Jordan MK93 Ice Coil Flow	1	640	21.64	0	0	0.0	0.6	5.68
Jordan MK93 Ice Coil Flow	2	1380	46.66	7	13	4.4	1	12.25
Jordan MK93 Ice Coil Flow	3	1420	48.02	8	13	5.9	1.4	12.61
Jordan MK93 Ice Coil Flow	4	1680	56.81	7	13	7.3	1.8	14.92
Jordan MK93	1	1200	40.58	0	0	0.0	0.6	10.66
Jordan MK93	2	1700	57.48	0	0	0.0	1	15.10
Jordan MK93	3	2000	67.63	8	13	5.0	1.4	17.76
Jordan MK93	4	1300	43.96	19	13	6.0	1.8	11.54
Jordan MK93JR Welded	1	680	22.99	0	0	0.0	0.6	6.04
Jordan MK93JR Welded	2	1180	39.90	18	8	3.7	1	10.48
Jordan MK93JR Welded	3	1720	58.16	14	13	4.8	1.4	15.27
Jordan MK93JR Welded	4	1600	54.10	19	13	5.2	1.8	14.21

Figure. 4 Experiment Data

Figure. 5 Experimental Photos




13"
12"
11"
10"
9"
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3"
2"
1"

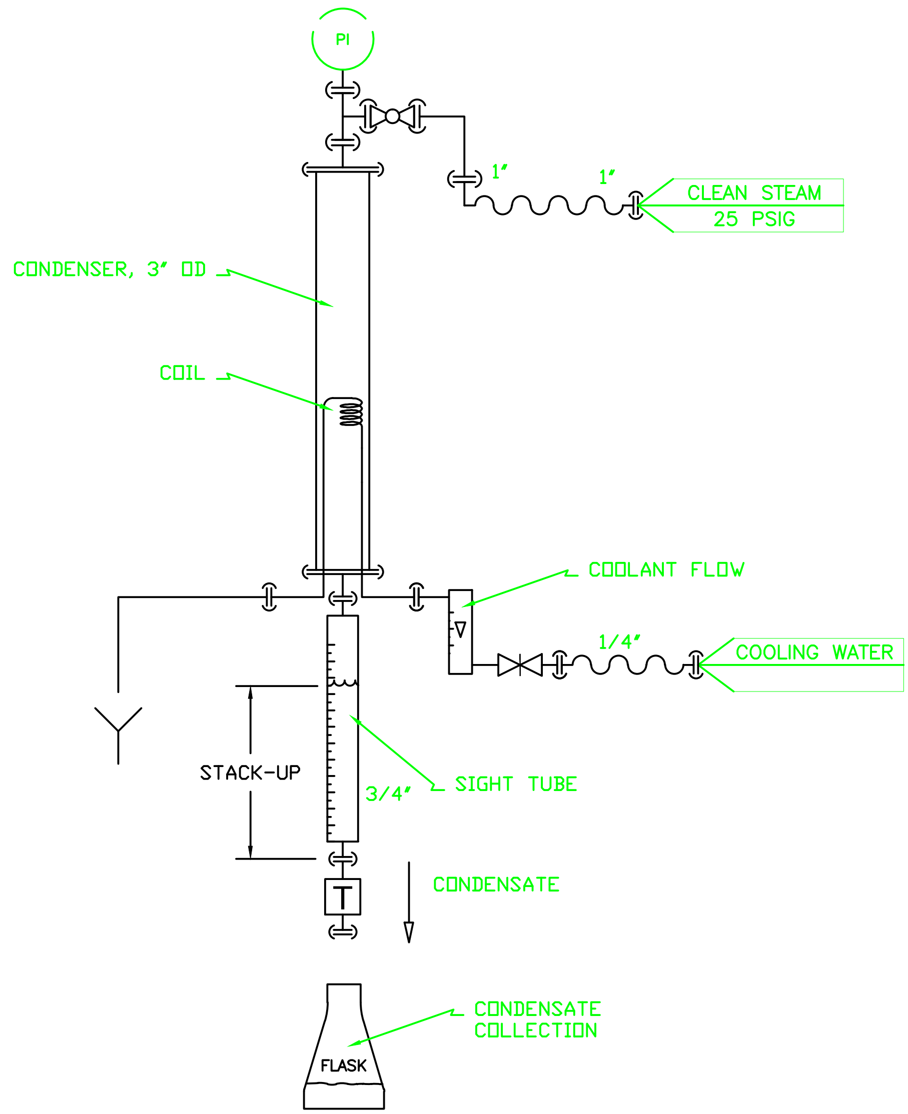

Fig. 1A: TEST RIG

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Title
STEAM TRAP STACK UP TEST RIG DIAGRAM

Drawn by	Evan Gaj	Date	08/07/14
Checked by	Randy Cotter	Date	08/07/14
Dwg. Type	DETAIL	Scale	NONE

Drawing No.	Sheet No.	Revision
CBC-0911-F01	1 OF 1	0

Rev. No.	Rev. Date	Revision	Drn by	App'd
0	09/11/06	ISSUED FOR TEST	JEM	
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