

# Steam Trap Testing How Do Steam Traps Stack Up?

## PART 2

By

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# How do Steam Traps Stack Up?

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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" Polysulfone 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.

| <u>MFG</u> | <u>Model</u>     | <u>Size</u> | <u>Ends</u> |
|------------|------------------|-------------|-------------|
|            |                  |             |             |
| 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  $\frac{1}{2}$ " -  $\frac{3}{4}$ " 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.

## 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.

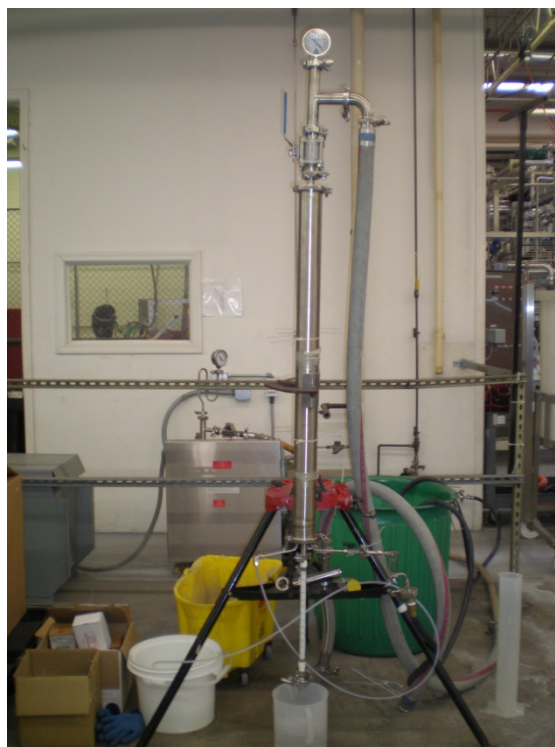


Figure. 2 Steam Trap Apparatus

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.

July 21<sup>st</sup>, 2014

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# Comparisons/Results

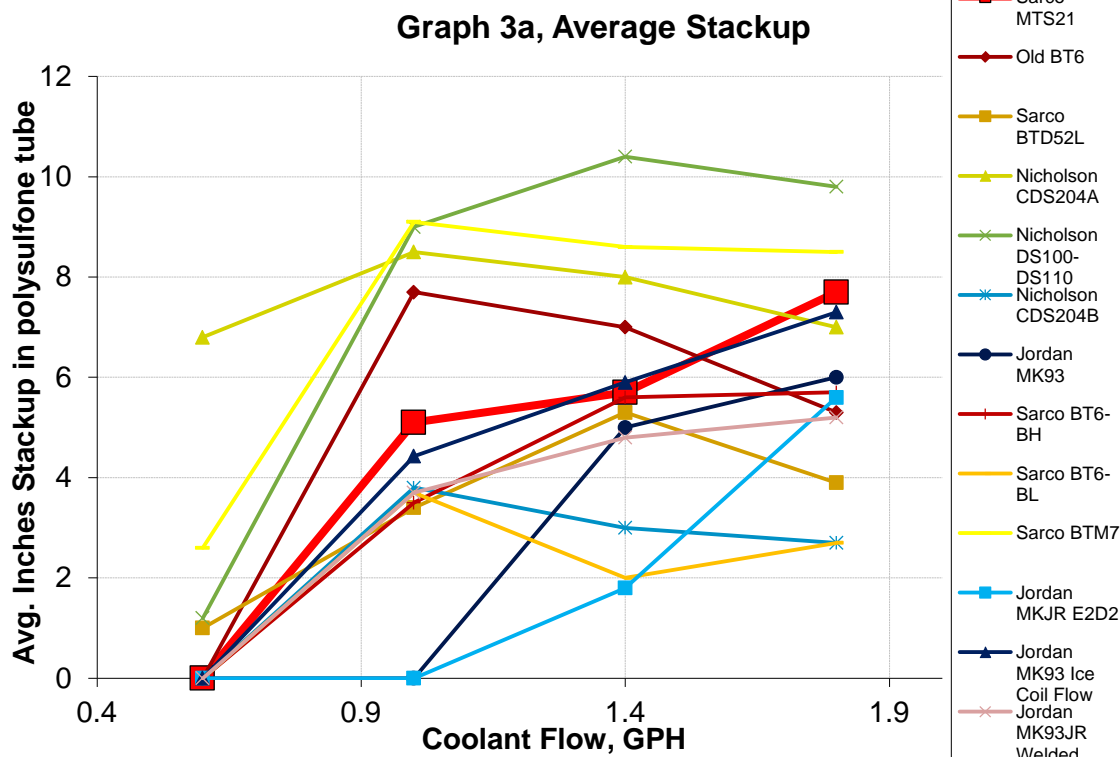


Figure. 3a Average Stack Up Results

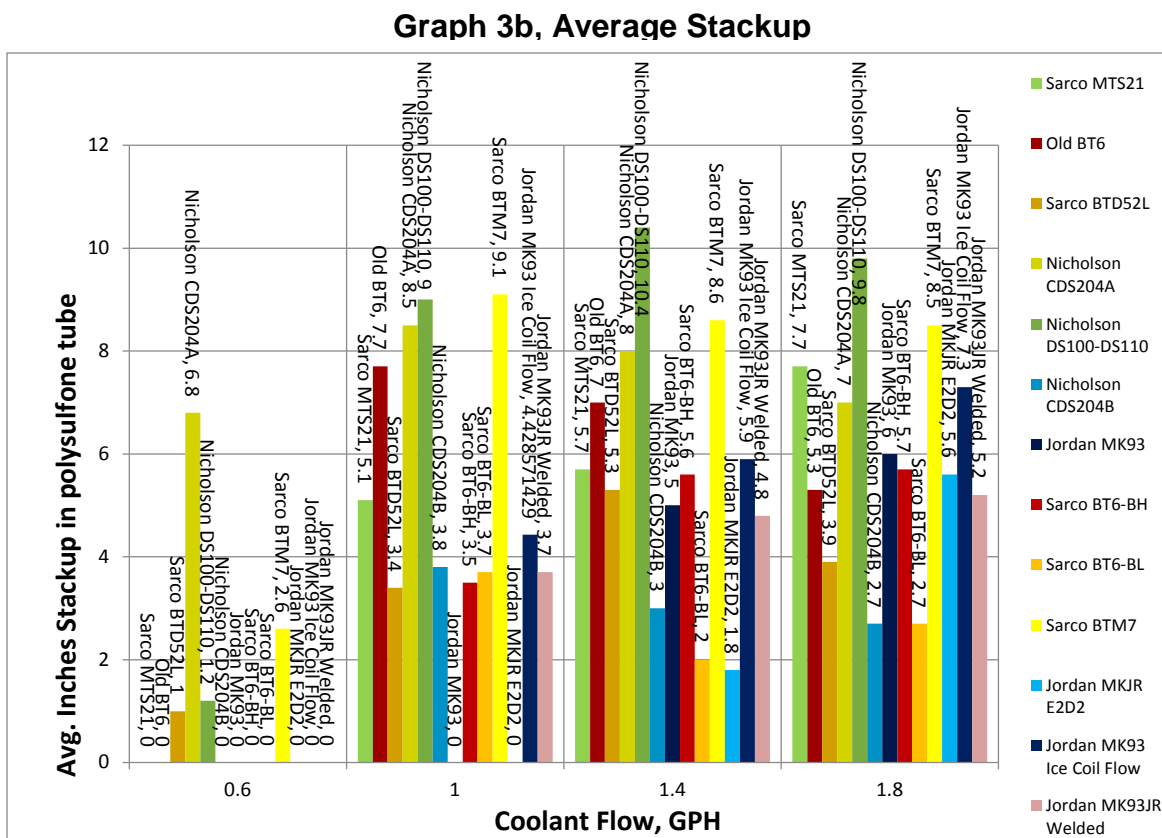


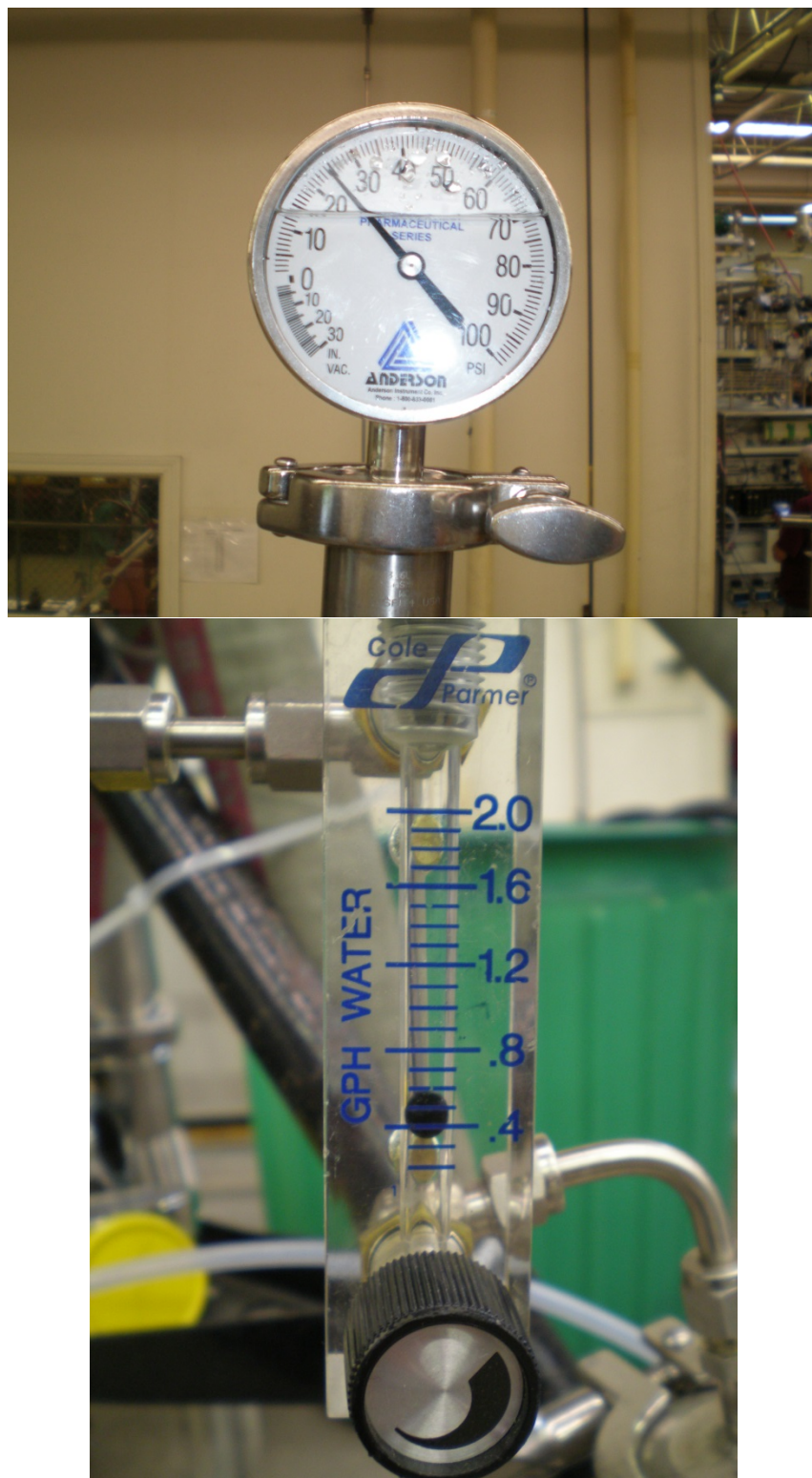
Figure. 3b Average Stack Up Results Bar Graph

# Tabulated Summary

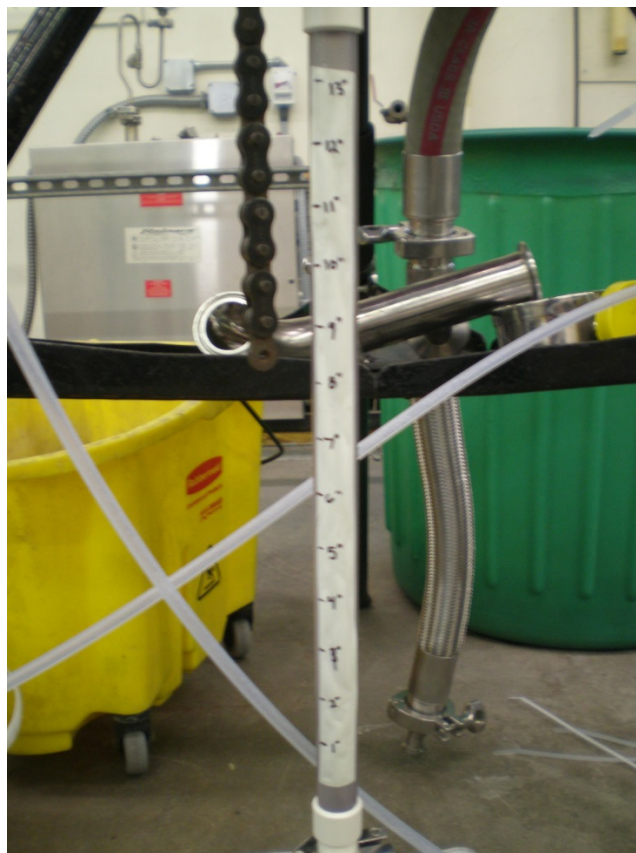
| Trap                      | Test# | Measured<br>Cond Load.<br>milliliters/15<br>Mins | Measured<br>Cond Load.<br>Oz/15 min | Frequency<br>of stackup | Max cond<br>height | Average<br>cond height | Coolant<br>Flow, GPH | Cond Load.<br>lbs/hr |
|---------------------------|-------|--|-------------------------------------|-------------------------|--------------------|------------------------|----------------------|----------------------|
| 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 BT52L               | 1     | 720  | 24.35                               | 2                       | 1                  | 1.0                    | 0.6                  | 6.39                 |
| Sarco BT52L               | 2     | 1300   | 43.96                               | 37                      | 7                  | 3.4                    | 1                    | 11.54                |
| Sarco BT52L               | 3     | 1400   | 47.34                               | 34                      | 13                 | 5.3                    | 1.4                  | 12.43                |
| Sarco BT52L               | 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









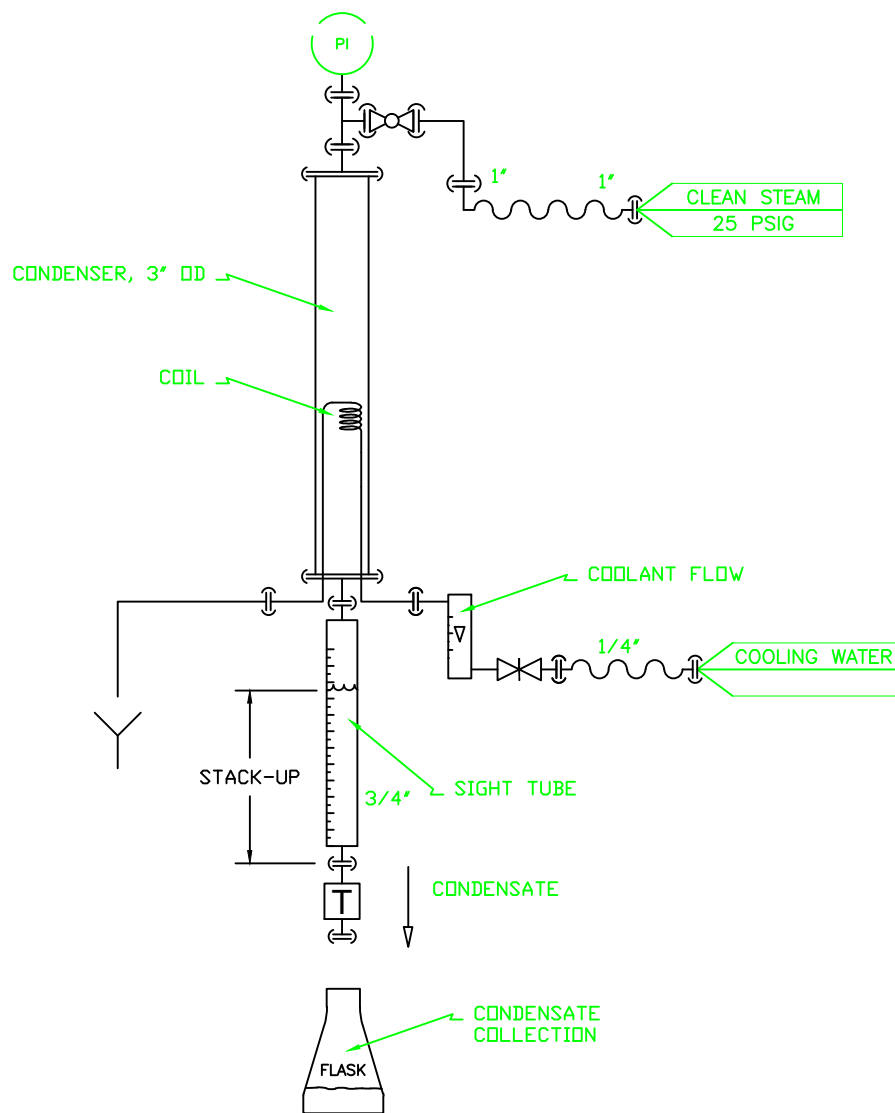


Fig. 1A: TEST RIG

## COTTER BROTHERS CORPORATION

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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

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|          |           |                 |              |
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| Rev. No. | Rev. Date | Revision        | Drn by App'd |