NICHOLSON

A DIVISION OF SPENCE ENGINEERING COMPANY, INC.

- Thermostatic Steam Traps
- Mechanical Steam Traps
- Thermodynamic Steam Traps
- Orifice Steam Traps
- Clean Steam Products
- Condensate Recovery
- Uniflex Steel/Stainless Pipe Couplings
- Air Traps/Liquid Drainers
- Piping Specialties
- Steam Trapping Primer
- Technical Reference
- Application Drawings

ABS Quality Evaluations, Inc. Management System Certification

ISO 9001

Certificate Number: 33694

1.800.398.2493

It is the philosophy of
Nicholson Steam Trap that,
to win and be deserving of the trust of
our customers, we must be ever mindful
of and totally dedicated to quality; in
all that we do; at every level
of our operation.

ISO 9001

Certificate Number: 33694

NICHOLSON STEAM TRAP is a member of the Fluid Controls Institute.

NICHOLSON STEAM TRAP has a policy of continuous product research and improvement and reserves the right to change design and specifications without notice. Responsibility for typographical errors is specifically disclaimed.

Nicholson Steam Trap

Nicholson Steam Trap was founded in 1883 by W. H. Nicholson, Sr. He, along with his sons William, George and Samuel produced a variety of steam specialty products at their facility in Wilkes-Barre, Pennsylvania. Trap manufacturing was begun early in the twentieth century with the precursor to our current weight operated series traps. In the 1930's, a wide range of bellows-activated thermostatic traps were developed, the descendants of which are still built today in a modern facility at Walden, New York which manufactures a wide range of products from safety valves to control valves and, of course, steam traps.

The Nicholson Steam Trap product line is focused on the industrial marketplace and features traps ranging from highly polished stainless steel sanitary traps to innovative free float F&T traps. Nicholson thermostatic traps are known throughout the industry for their value and durability. Equally respected in naval yards are Nicholson orifice traps, offering long life and easy maintenance. A recent product introduction is the Condensate Commander Pump; a steam powered pump available in several sizes including prefabricated skid mounted systems. These continue the Nicholson tradition of providing high performance, value-oriented products to the industrial marketplace.

Nicholson Steam Trap, located in Walden, New York, has been producing a full line of steam specialties including steam traps, condensate pumps, sanitary steam traps, air traps and drain orifice unions since 1883. Nicholson Steam Trap is a Division of Spence Engineering Company, Inc.

For more information on Nicholson Steam Trap, visit our website at www.nicholsonsteamtrap.com or reach us via e-mail at sales@nicholsonsteamtrap.com

NICHOLSON
STEAM TRAP
a Division of Spence Engineering Company, Inc.

How to Use this Handbook

If you already know the product that you want information on, find the product page in the Table of Contents. Detailed product information on materials, ratings, dimensions, weights and applications are found in the Products Sections. General application and design information is in the Primer Section.
If you are not sure of what you need, collect all the following information. You will need it to select the right product for your needs.

Service (i.e.: Steam, Compressed Air, Water, etc.)

Inlet Pressure

Flow Rate (or Capacities)

Outlet or Condensate Return Pressure

Application (i.e.: Condensate Removal, Pump, Pipe Couplings, etc.)

Application data is listed on all Product Pages. If you identify the nature of the installation, it will assist you selecting the proper equipment.

What Kind of Trap is needed?

Bucket? F&T? Disc? Steam Pump? First the objective must be defined - then a trap must be chosen. If pumping is required then a condensate commander must be selected. Once the requirements for condensate removal have been defined, the primer section may be consulted to best match product characteristics to the application at hand. Following the primer section the trap selection guide should help refine the search. For those who possess a basic understanding of traps and the Nicholson product line, starting with the trap selection guide may be appropriate.
Once the application parameters have been defined (e.g. condensate removal from a 70 psi steam system, drip leg application, continuous duty, 180 lb/hr condensate flow) and a design of trap decided upon (e.g. thermostatic, carbon or stainless steel construction, 200 psi minimum operating pressure, integral strainer) the product section should be consulted to determine the range of traps available. Often several traps may meet the need. General preferences such as repairable design versus sealed, maintenance free designs, size and piping configuration, and cost are a few considerations that will help select a specific type trap.

Economical, Long life, or Best suited for the Application

Unfortunately, the best trap for an application may not necessarily be the least expensive or have the longest life span. Typically, other considerations such as ease of maintenance, initial cost, piping considerations, etc may influence trap selection. The product section will outline will list all pertinent specifications including overall length and features that may influence trap selection.

How to Find Nicholson Traps

Nicholson Steam Traps are manufactured and stored in Walden, New York, a village located in the lower Hudson Valley about 60 miles north of New York City. Nicholson goes to market through Manufacturers' Representatives and Stocking distributors across the country. To find the nearest stocking location, contact the Nicholson factory at 914-778-4044 or visit our web site at www.nicholsonsteamtrap.com.

THE NICHOLSON ADVANTAGE IS SERVICE

LOCAL TECHNICAL SUPPORT

Nicholson Steam Trap has a network of technically trained Representatives around the world. These Representatives can direct you to local inventory of our products for fast, fast service. They can also help you in the selection and sizing of Steam Traps, Air Traps, Condensate Pumps and other Steam Specialties.

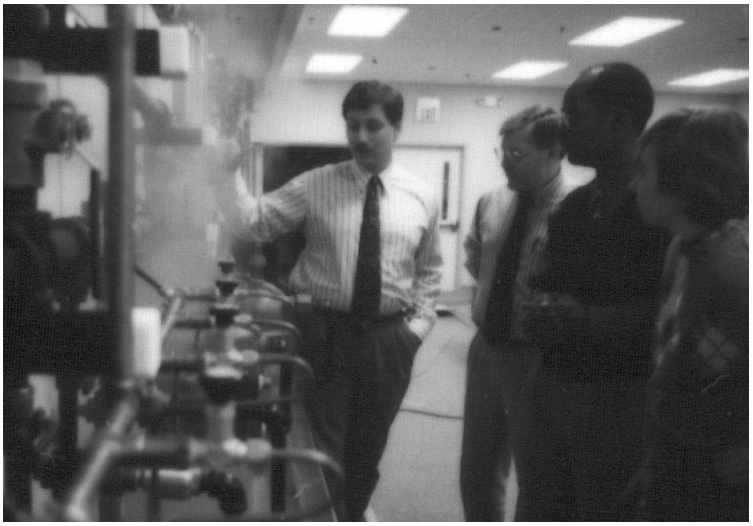
TECHNICAL TRAINING

We offer a regular schedule of workshops covering various technical issues in our state of the art Valve Technology Training Center. We can also schedule customized training sessions to suit your particular needs.

ENGINEERING SEMINARS. These seminars provide the engineer with the skills of steam trap selection and sizing.

DISTRIBUTOR SEMINARS. This seminar will provide you with all the information you need to serve your customers.

MAINTENANCE SEMINARS. Maintenance personnel will receive hands-on training in selection, installation, operation, maintenance and troubleshooting.



NICHOLSON GUARANTEE

Nicholson Steam Trap warrants that the products we manufacture will be free from any defects in material or workmanship for a period of one year (or longer, when specified in product literature) from receipt by purchaser.

INTERNATIONAL SALES

Nicholson is well equipped to provide product to our customers around the world. We regularly ship our products to all parts of the world. Our experienced international sales group can meet the transport and documentation requirements of our international customers with ease. Our network of International Technical Sales Representatives will also be able to provide you with product from local inventory.

CANADIAN SALES

Nicholson maintains a technical sales representative network throughout the Canadian provinces. Nicholson products are registered with Canadian federal and provincial authorities. Canadian Registration Numbers are available. Please consult factory for a particular product CRN.

Steam Trap Selection

Types of Steam Traps

	Thermostatic		Mechanical		Thermodynamic	Orifice
Type	Bellows	Bimetal	F & T	Bucket	Disc	Orifice
Condensate Discharge	Intermittent	Intermittent	Continuous	Intermittent	Intermittent	Continuous

- The optimum application of a trap is dependent upon the characteristics of the process and equipment with which it is used and its pattern of condensate discharge.
- The discharge capacity of a trap is determined by the pressure differential (trap inlet pressure minus outlet pressure) and the size of the orifice. Thermodynamic and Thermostatic traps (radiator and temperature modulating) have a fixed orifice size.
- Mechanical traps differ from the other types in that their orifice (discharge opening) must be selected to accommodate the maximum operating differential pressure.

Caution Failure to select the proper orifice may result in insufficient discharge capacity, waterlogging or locking of the trap.

Selecting a Steam Trap

It is important to select a product with the optimum capacity from the many types which are available. Use the following procedure to make sure the correct product is selected.

1 **Application** — Define the application and the type of service in which it will be used.

The conditions under which a trap must operate will differ according to where it it installed.

2 **Confirmation of Operating Conditions** — Check the maximum operating pressure, temperature, discharge rate and other conditions.

Do not oversize the trap. Select the smallest capacity trap, yet avoid undersizing and ensure safe, accurate operation given the conditions of inlet pressure, temperature and pressure differential under which it will operate.

3 **Maintenance Preference** — Confirm whether inline repair feature or maintenance free technology is desirable.

Steam Trap Application Guide

Check List for Confirming Operating Conditions

Discharge Rate Tables for Each Model

Specification Tables for Each Model

Check List for Confirming Operating Conditions

(A) Confirmation of Conditions

1.	What is the application?	
2.	Which trap is appropriate for the application?*1	
3.	What is the trap inlet pressure?*2	psig
4.	What is the outlet pressure?*2	psig
5.	What is the condensate load?	lb/H

(B) Selection

1. The required discharge capacity of the trap is ___ times*3 the amount of condensate generated.
2. Inlet pressure – Outlet pressure = Pressure differential.
3. Select a trap with a maximum operating pressure equal to or slightly above the inlet pressure to the trap.
4. Select a discharge rate for the pressure differential from the discharge capacity chart.

	Discharge	Product name	Pressure differential	Required discharge capacity
❑			psig	lb/H
❑				
❑				

5. The trap with the smallest discharge capacity greater than that required is the optimum trap.
6. Connection size ____ in
7. Connection Type

❑ Screwed ❑ Flanged (flange standard_____) ❑ Socket weld

*1. See tables for selection of a steam trap by application.

*2. If unknown, is condensate recovered? ..... ❑ Yes ❑ No…(back pressure = 0 psig)

If condensate is recovered

① How many feet does the trap outlet rise?	ft.	x 0.5 =	psig
② What is the total pipe length from the trap to the recovery tank?	ft.	x 0.01 =	psig
③ What is the pressure of the condensate recovery tank?			psig
④ Add ①, ② and ③ .....{This is the outlet pressure (back pressure).} ① + ② + ③ =			psig

*3. Safety Factor

The margin of safety which is determined by the operating characteristics of each piece of equipment is referred to as the "safety factor." The safety factor required will differ according to the type of trap (type of condensate discharge). The discharge rate table for each model shows the values for condensate discharge when the trap is fully open, and the maximum rated condensate load on the equipment should correspond to the value obtained by dividing this discharge rate by the safety factor (see Steam Trap Application Guide on opposite page).

Steam Trap Application Guide

This guide is designed to direct the user to a General Steam Trap Technology section. Once a technology is selected, additional details, regarding specific steam traps, can be found in the catalog under the Technology Selection tab.
These choices, in the Guide, are based on many years of steam trap manufacturing experience. The choices, however are not limited to these alone. Variations in individual systems (superheat, water hammer, insulation, etc.), as well as personal preference, should be taken into consideration.

Application		Thermostatic	Thermo-dynamic	Free Float	Inverted Bucket	Float & Thermostatic	Orifice	Minimum Safety Factor
Drip & Tracing								
Main Drip	to 30 PSIG	1		2	3	2	4	1.5:1
	to 300 PSIG	1	2	3	2	3	3	1.5:1
	to 650 PSIG	1	2			3	2	1.5:1
	to 2500 PSIG						1	1.5:1
Steam Tracing		1	2	2	2	2	3	1.5:1
Process								
Heat Exchanger	to 20 PSIG	2		1	2	1		2:1
	to 150 PSIG	1		1	2	1		2:1
	to 300 PSIG	1		1	2	1		2:1
	to 600 PSIG			1				2:1
Cooker/Reactor	to 15 PSIG	2		1	3	1		3:1
	to 60 PSIG	1		1	3	1		3:1
	to 150 PSIG	1		1	3	1		3:1
	to 600 PSIG	2		1				3:1
Pressing	to 100 PSIG	1		1	2	1		3:1
	to 300 PSIG	1	2	2	2			3:1
Reboiler		2		1	3	1		2:1
Rotating Cylinders		2*		1*	2		3	3:1
Sterilizer		1		2		2		2:1
Tank Heating	Storage	1		2		2		1.5:1
	Line Heater	1		2		2		3:1
Evaporator				1	2	2		2:1
HVAC								
Air Heating Coils	to 15 PSIG	2		1	3	1		2:1
	to 60 PSIG	2		1	2	1		2:1
	to 250 PSIG	2		1				3:1
Radiator		1					4	2:1
Unit Heater		1		1	2	1		2:1
Absorption Chiller		2		1	2	1		2:1

*Requires Steam Lock Release

KEY Blank = not recommended
1 = First Choice 3 = Third Choice
2 = Second Choice 4 = Fourth Choice

Steam Trap Selection Criteria Matrix

FUNCTION	Thermostatic	Thermodynamic	Mechanical		Orifice
			F & T	IB	
Response to Load Changes	Moderate	Slow	Fast		Very Slow
Air Venting	High	Low	Med/High	Low	Low
Thermal Efficiency	High	Medium	Med/High	Medium	High†
Applications	Drip Legs Tracing Process Eqpt.	Drip Legs Tracing	Drip Legs Tracing Process Eqpt.	Drip Legs Tracing Process Eqpt.	Drip Legs
Affected By Ambient Temperatures	No	Yes (unless insulated)	No (susceptible to freezing)		No
Relative Cost	Low	Low	High	Med/Low	Low
Capacity	Medium	Low	High		Low
Pressure Range	to 650 psi	10 to 600 psi	to 650 psi	to 250 psi	to 2500 psi
Size vs. Capacity	Small	Medium	Large		Small
Life Expectancy	Moderate	Moderate	Moderate	Long	Long
Ease of Maintenance	Very Easy	Very Easy	Moderate		Very Easy
Orientation Limits	No	No	Yes		No

† Within narrow load range.

Nicholson Steam Trap Options

SLR Orifice

Specify where immediate elimination of condensate and improved sensitivity is desired. This option may also improve performance in applications where condensate must be lifted upstream from the trap. Allows continuous discharge of condensate. Trap will nominally pass 50 lb/hr of condensate at 50 psi within 2°F of saturated temperature.

Skirted Seat Trim

Recommended for higher pressure service, often over 300 psi. Minimizes erosion by dispersing trap discharge.

Sterilizer Trim

Specify where immediate elimination of condensate and improved sensitivity is desired. Shorter seat opens more quickly in presence of condensate.

Internal Strainer

Recommended where steam may be contaminated with pipe scale or other particulate matter. Screen reduces deposits on valve and seat.

Blowdown Valve

Specify to clean strainer without disassembly.

ISO Filled Actuator

Specify when reduction of return to flash steam, highest thermal efficiency and/or air vent operation is desired. This option will subcool condensate by approximately 40°F.

Convoluted Actuator

Specify where rapid response and/or fail closed operation is desired.

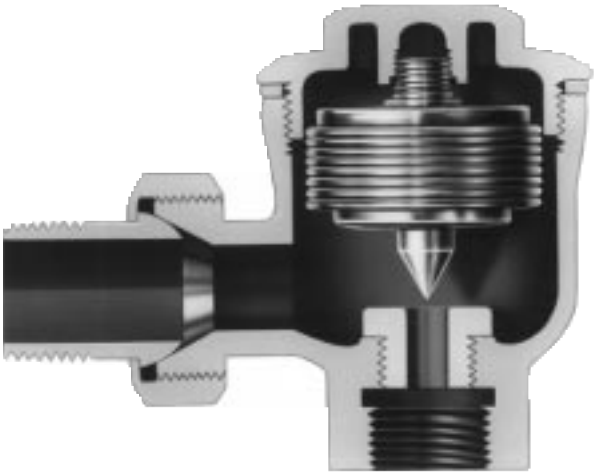
Welded Actuator

Specify where long service life and/or fail open operation is desired.

THERMOSTATIC STEAM TRAPS

NICHOLSON is the originator of the bellows actuated Thermostatic Steam Trap. NICHOLSON's thermostatic product range spans applications from critical tracing to high capacity process. High sensitivity, immediate air venting and exceptional thermal efficiency are the hallmark of NICHOLSON Thermostatic Steam Traps.

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com



N125 Series Thermostatic Steam Traps

Pressures To 125 PSIG (8.75 barg) Temperatures to 400°F (204°C)

Superior Performance —Hardened valve and seats are lapped in matched sets, providing tight shutoff and long service life.

Improved Energy Savings— Maximum elimination of air and non-condensibles–trap closes at saturated steam temperature.

Temperature Sensitive Actuators — One moving part. Monel actuator for caustic corrosion resistance.Choose Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Freeze Proof — Threaded male union horizontal inlet and vertical outlet–self draining.

In-line Maintenance — Threaded cover for one step removal, inspection and service without breaking pipe connections.

Air Vent —Efficient steam service air vent when equipped with ISO Bellows and installed in air vent location.

Guaranteed — Traps with convoluted bellows are guaranteed against defects in materials or workmanship for 1 year and traps with welded actuator for 3 years.

Models

- **N125**–Standard capacity w/monel actuator
- **N125W**–Standard capacity w/welded SS actuator
- **N125L**–Low capacity w/welded SS actuator
- **N125WHC**–High capacity w/welded SS actuator
- **N125HC**–High capacity w/monel actuator
- **N125ST**–Standard capacity w/sterilizer seat & monel actuator

Applications

- Steam Tracing
- Drip Legs
- Automatic Air Vents
- Sterilizers
- Cooking Kettles
- Water Heaters
- Laundry Equipment
- Radiators
- Process Equipment
- Air Handlers

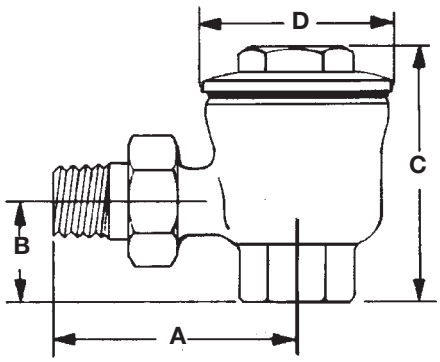
Options *See page 8*

- SS Actuator or Convoluted Monel Bellows
- Sterilizer Trim
- SLR Orifice
- Internal Stainless Strainer
- ISO Filled Actuator

Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load. Restricted orifice in N125L (small opening at bottom of valve seat) prevents trap from discharging continuously on light loads.

N125 Series Thermostatic Steam Traps



Connections: 3/8"–3/4" NPT

Typical Specification

Steam trap shall be of balanced pressure design with monel convoluted actuator or stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required, SLR orifice and Sterilizer trim will be available to allow condensate evacuation at or near saturated temperatures. Where subcooling of condensate is desired alternate thermostatic actuator will be available to allow condensate evacuation at or near 40°F below saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. A minimum of three orifice sizes shall be available allowing for custom capacity sizing. Trap shall be bronze bodied suitable for pressures through 125 psig and available in 3/8" through 3/4" NPT connections.

Maximum Operating Conditions

PMO: Max. Operating Pressure	125 psig	(8.75 barg)
TMO: Max. Operating Temperature	400°F	(204°C)
PMA: Max. Allowable Pressure	125 psig	(8.75 barg)
TMA: Max. Allowable Temperature	400°F	(204°F)

Materials of Construction

Body & Cover: ASTM B283 C37700

Actuator: Convoluted Monel or Welded Stainless Steel

Cover Gasket: Copper Jacketed

Valve & Seat: Hardened 416 Stainless Steel

Dimensions

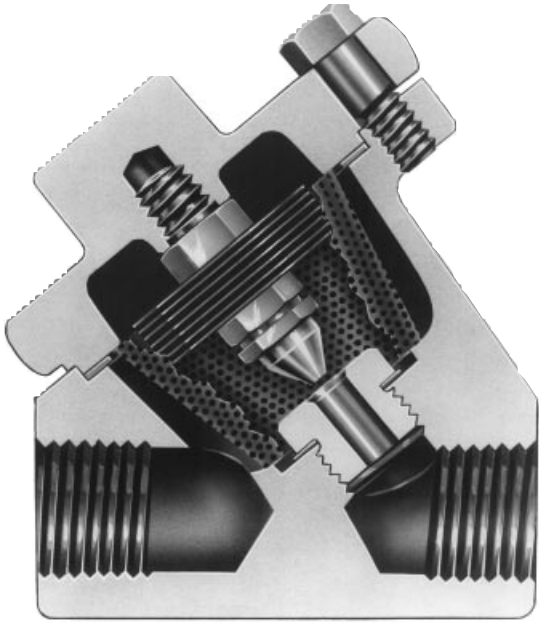
Size	Inch (mm)				Weight lb (kg)
	A	B	C	D	
3/8, 1/2"	2 3/4 (70)	1 1/8 (29)	2 7/8 (73)	2 5/32 (54)	1.5 (.68)
3/4"	3 3/16 (81)	1 9/16 (40)	3 (76)	2 5/32 (54)	1.8 (.82)

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice Inch (mm)	Differential PSIG (barg)					
		5 (0.34)	10 (0.7)	20 (1.4)	50 (3.5)	100 (6.9)	125 (8.6)
N125L[2]	5/64 (2)	84 (38)	119 (54)	168 (76)	265 (120)	348 (158)	375 (170)
N125[1] N125W[2] N125ST[1]	1/4 (6)	550 (249)	825 (374)	1210 (549)	1975 (896)	2825 (1281)	3140 (1424)
N125WHC[2] N125HC[1]	5/16 (8)	860 (390)	1220 (554)	1725 (783)	2725 (1237)	3575 (1623)	3850 (1748)

[1]Convoluted Monel Actuator
[2]Welded Thermal Actuator



N300 Series Thermostatic Steam Traps

Pressures To 450 PSIG (31 barg)
Temperatures to 600°F (316°C)

Compact — Easy to Install.

Inexpensive — Low initial cost.

Improved Energy Savings — High efficiency–maximum elimination of air and non-condensibles.

Temperature Sensitive Actuators — One moving part. Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Hardened Stainless Steel Valve and Seat — Long life. Lapped as a matched set for water tight seal.

Easily Maintained — Can be inspected and serviced without breaking pipe connections.

Freeze Proof — Self draining when installed vertically.

For Superheated Steam Applications — Because the trap closes at saturated steam temperature, superheated steam cannot reach trap.

Air Vent —Efficient steam service air vent when equipped with ISO filled Actuator and installed in air vent location.

Guaranteed — Guaranteed against defects in materials or workmanship. Traps with Welded Actuator–3 Years. Traps with Monel Actuator–1 Year

Positive Shutoff and Long Life — Integral Stainless Steel Strainer helps prevent debris depositing on valve and seat.

Models

- **N302**–Low capacity w/welded SS actuator
- **N302M**–Low capacity w/monel actuator
- **N303**–Standard capacity w/welded SS actuator
- **N303M**–Standard capacity w/monel actuator
- **N304**–High capacity w/welded SS actuator
- **N304M**–High capacity w/monel actuator

Applications

- Unit Heaters
- Air Vents
- Steam Tracing
- Drip Legs
- Platen Presses
- Plating Tanks
- Sterilizers
- Tire Presses
- Cooking Equipment
- Laundry Equipment
- Other Process Equipment

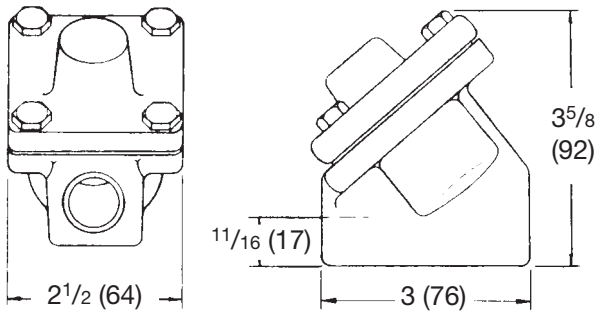
Options *See page 8*

- SS or Convoluted Monel Actuator
- Skirted Seat
- SLR Orifice
- ISO Filled Actuator
- Internal Stainless Strainer (std. on welded actuator)
- Sterilizer Trim
- Socketweld

Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load. Restricted orifice in the #2 seat (small opening at bottom of valve seat) prevents trap from discharging continuously on light loads such as are encountered on tracer lines.

N300 Series Thermostatic Steam Traps



Weight: 3 lbs. (1.4 kg)

Connections:
1/2" or 3/4" NPT or socketweld

Typical Specifications

Steam trap shall be of balanced pressure design with stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required, SLR orifice and Sterilizer trim will be available to allow condensate evacuation at or near saturated temperatures. Where subcooling of condensate is desired alternate thermostatic actuator will be available to allow condensate evacuation at or near 40°F below saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. A minimum of three orifice sizes shall be available allowing for custom capacity sizing. Trap shall be forged carbon steel bodied suitable for pressures through 450 psig and available in ½" and ¾" NPT or socket weld.

Maximum Operating Conditions

Traps with Monel Convoluted Bellows		
PMO: Max. Operating Pressure	300 psig	(20.1 barg)
TMO: Max. Operating Temperature	500°F	(260°C)
Traps with Welded Stainless Actuator		
PMO: Max. Operating Pressure	450 psig	(31 barg)
TMO: Max. Operating Temperature	600°F	(316°C)
Traps with Welded Stainless Actuator, ISO		
PMO: Max. Operating Pressure	450 psig	(31 barg)
TMO: Max. Operating Temperature	600°F	(316°C)
All Traps		
PMA: Max. Allowable Pressure	450 psig	(31 barg)
TMA: Max. Allowable Temperature	750°F	(399°C)

Materials of Construction

Body:	ASTM A105 Forged Steel
Cover:	ASTM A351 Grade CF3M (316L)
Cover Gasket:	347 stainless spiral wound w/graphite fill
Actuator:	Welded SS or Convoluted Monel
Strainer:	.033 perf. 304 Stainless Steel
Valve & Seat:	Hardened 416 Stainless Steel

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice Inch (mm)	Differential PSIG (barg)												
		5 (0.34)	10 (0.7)	20 (1.4)	50 (3.4)	100 (6.7)	125 (8.4)	150 (10.1)	200 (13.4)	250 (16.8)	300† (20.1)	350† (24.1)	400† (27.6)	450† (31.0)
N302 N302M†	1/8 (3)	216 (98)	265 (120)	375 (170)	592 (269)	778 (354)	838 (381)	890 (405)	980 (445)	1055 (480)	1121 (510)	1180 (536)	1235 (561)	1284 (584)
N303 N303M†	1/4 (6)	550 (249)	825 (374)	1210 (549)	1975 (896)	2825 (1281)	3140 (1424)	3425 (1554)	3650 (1656)	3960 (1796)	4100 (1860)	4230 (1919)	4420 (2005)	4600 (2086)
N304 N304M†	5/16 (8)	860 (390)	1220 (554)	1725 (783)	2725 (1237)	3575 (1623)	3850 (1748)	4090 (1857)	4505 (2045)	4850 (2202)	5155 (2340)	5425 (2463)	5675 (2576)	5900 (2679)

†Convoluted Monel Actuators for pressures to 300 PSIG only. Nicholson recommends skirted seat above 300 PSIG.

Liquidator 450 Series Universal Mount Thermostatic Steam Traps

Pressures To 450 PSIG (31 barg) Temperatures to 500°F (260°C)

Easily Maintained — Universal two bolt swivel mounting simplifies removal from system. Kits allow flexibility to replace or rebuild.

Simple Installation — Stainless mounting block mounts permanently into system. Trap installs via two bolt universal connection.

Improved Energy Savings — High efficiency–maximum elimination of air and non-condensibles.

Temperature Sensitive Actuators — One moving part. Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Hardened Stainless Steel Valve and Seat — Long life. Lapped as a matched set for water tight seal.

Easily Maintained — Can be inspected and serviced without breaking pipe connections.

Freeze Proof — Self draining when installed vertically.

For Superheated Steam Applications — Because the trap closes at saturated steam temperature, superheated steam cannot reach trap.

Air Vent —Efficient steam service air vent when equipped with ISO filled Actuator and installed in air vent location.

Guaranteed — Traps are guaranteed against defects in materials or workmanship for three years.

Positive Shutoff and Long Life — Integral Stainless Steel Strainer helps prevent debris depositing on valve and seat.

Models

- **UMT452**–Low capacity w/welded SS actuator
- **UMT453**–Standard capacity w/welded SS actuator

Applications

- Unit Heaters
- Steam Tracing
- Drip Legs
- Tire Presses
- Cooking Equipment
- Laundry Equipment
- Plating Tanks
- Platen Presses
- Air Vents

Options

- SLR Orifice
- ISO Filled Actuator
- Socketweld

Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load. Restricted orifice in N452 (small opening at bottom of valve seat) prevents trap from discharging continuously on light loads such as are encountered on tracer lines.

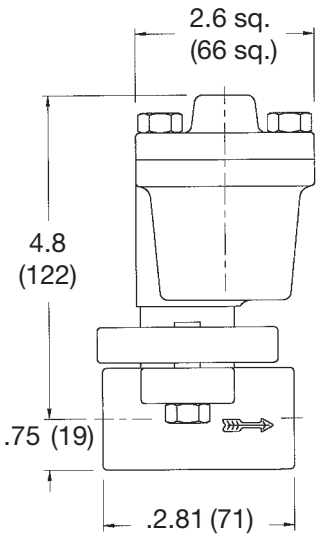
LIQUIDATOR 450 SERIES UNIVERSAL MOUNT THERMOSTATIC STEAM TRAPS

Typical Specifications

Steam trap shall be of balanced pressure design with stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required, SLR orifice and Sterilizer trim will be available to allow condensate evacuation at or near saturated temperatures. Where subcooling of condensate is desired alternate thermostatic actuator will be available to allow condensate evacuation at or near 40°F below saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. A minimum of two orifice sizes shall be available allowing for custom capacity sizing. Trap shall be stainless steel bodied suitable for pressures through 450 psig. Trap connection shall be two bolt universal swivel mount. Mounting block shall be stainless steel and available in ½" through 1" NPT or socket weld.

Maximum Operating Conditions

Traps with Welded Stainless Actuator		
PMO: Max. Operating Pressure	450 psig	(31 barg)
TMO: Max. Operating Temperature	600°F	(316°C)
Traps with Welded Stainless Actuator, ISO		
PMO: Max. Operating Pressure	450 psig	(31 barg)
TMO: Max. Operating Temperature	600°F	(316°C)
All Traps		
PMA: Max. Allowable Pressure	450 psig	(31 barg)
TMA: Max. Allowable Temperature	750°F	(399°C)



DIMENSIONS - INCHES (MM)
WEIGHT
TRAP - 3.2 LBS. (1.4 KG)
MOUNTING BLOCK - 1.1 LBS. (0.5 KG)

Connections:
1/2", 3/4" or 1" NPT or socketweld

Materials of Construction

Body & Cover:	ASTM A351 Grade CF3M (316L)
Cover Gasket:	347 stainless spiral wound w/graphite fill
Actuator:	Welded SS or Convoluted Monel
Strainer:	.033 perf. 304 Stainless Steel
Valve & Seat:	Hardened 416 Stainless Steel
Mounting Block:	ASTM A351 Grade CF3M (316L)

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice Inch (mm)	Differential PSIG (bar)g												
		5 (0.34)	10 (0.7)	20 (1.4)	50 (3.4)	100 (6.7)	125 (8.4)	150 (10.1)	200 (13.4)	250 (16.8)	300† (20.1)	350† (24.1)	400† (27.6)	450† (31.0)
UMT452	1/8 (3)	216 (98)	265 (120)	375 (170)	592 (269)	778 (354)	838 (381)	890 (405)	980 (445)	1055 (480)	1121 (510)	1180 (536)	1235 (561)	1284 (584)
UMT453	1/4 (6)	550 (249)	825 (374)	1210 (549)	1975 (896)	2825 (1281)	3140 (1424)	3425 (1554)	3650 (1656)	3960 (1796)	4100 (1860)	4230 (1919)	4420 (2005)	4600 (2086)

†Nicholson recommends skirted seat above 300 PSIG.

TA Series Thermostatic Steam Traps

Pressures To 650 PSIG (44.8 barg) Temperatures to 750°F (400°C)

Sealed Stainless Steel Body — Lightweight, compact and corrosion resistant. No bolts or gaskets. Eliminates body leaks.

Self Centering Valve — Leak tight shutoff. Improved energy savings. Assembly of actuator and valve to impingement plate allows valve to self-align with center of valve seat orifice. Provides long lasting valve and seat.

Temperature Sensitive Actuators — One moving part. Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance. Optional fail closed convoluted Monel actuator for caustic corrosion resistance.

For Superheated Steam Applications — Because the trap closes at saturated steam temperature, superheated steam cannot reach trap.

Thermal and Hydraulic Shock Resistant — Impingement plate plus welded construction prevent damage to actuator.

Hardened Stainless Steel Valve and Seat — Long life. Lapped as a matched set for water tight seal.

Inexpensive — Low initial cost.

Maintenance Free — Sealed unit. Replacement traps cost less than repair of more expensive in-line repairable traps.

Freeze Proof — Self draining when installed vertically.

Directional Discharge — Pipe thread erosion prevented by directing discharge to center of pipe.

Air Vent —Efficient steam service air vent when equipped with ISO Bellows and installed in air vent location.

Guaranteed — Guaranteed against defects in materials or workmanship. Traps with Welded Actuator–3 Years. Traps with Monel Actuator–1 Year

Applications

- Unit Heaters
- Air Vents
- Steam Tracing
- Drip Legs
- Platen Presses
- Plating Tanks
- Sterilizers
- Tire Presses
- Cooking Equipment
- Laundry Equipment
- Other Process Equipment

Options *See page 8*

- ISO Filled Actuator
- SLR Orifice
- Socketweld

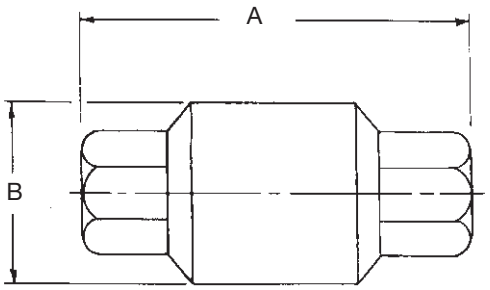
Models

- **TA501**–Extra low capacity w/welded SS actuator
- **TA502**–Low capacity w/welded SS actuator
- **TA503**–Standard capacity w/welded SS actuator
- **TA503M**–Standard capacity w/monel actuator
- **TA504**–High capacity w/welded SS actuator
- **TA504M**– High capacity w/monel actuator

Operation

Thermal actuator is filled at it's free length with a liquid having a lower boiling point than water. As assembled, valve is normally open. When very hot condensate enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from the actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load. Restricted orifice in TA501 (small opening at bottom of valve seat) prevents trap from discharging continuously on light loads such as are encountered on tracer lines.

TA Series Thermostatic Steam Traps



Connections:
3/8" – 1" NPT or socketweld

Typical Specification

Steam trap shall be of balanced pressure design with monel convoluted actuator or stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required or protection from flash steam locking, a SLR orifice will be available to allow condensate and flash steam evacuation at or near saturated temperatures. Where subcooling of condensate is desired alternate thermostatic actuator will be available to allow condensate evacuation at or near 40°F below saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. A minimum of three orifice sizes shall be available allowing for custom capacity sizing. Trap shall be stainless steel bodied suitable for pressures to 650 psig and available in 3/8" through 1" NPT or socketweld.

Maximum Operating Conditions

Traps with Monel Convoluted Actuator

PMO: Max. Operating Pressure	300 psig	(20.7 barg)
TMO: Max. Operating Temperature	500°F	(260°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(427°C)

Traps with Welded Stainless Actuator

PMO: Max. Operating Pressure	500 psig	(34.5 barg)
TMO: Max. Operating Temperature	600°F	(316°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(427°C)

Traps with Welded Stainless Actuator, ISO

PMO: Max. Operating Pressure	650 psig	(44.8 barg)
TMO: Max. Operating Temperature	650°F	(343°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(427°C)

Dimensions

NPT or Socket weld	inches (mm) A	inches (mm) B	Weight Lbs. (kg)
3/8, 1/2"	3 3/4 (95)	1 3/4 (44)	1.1 (0.5)
3/4"	3 15/16 (100)	1 3/4 (44)	1.2 (0.54)
1"	3 3/4 (111)	1 3/4 (44)	1.6 (0.73)

Materials of Construction

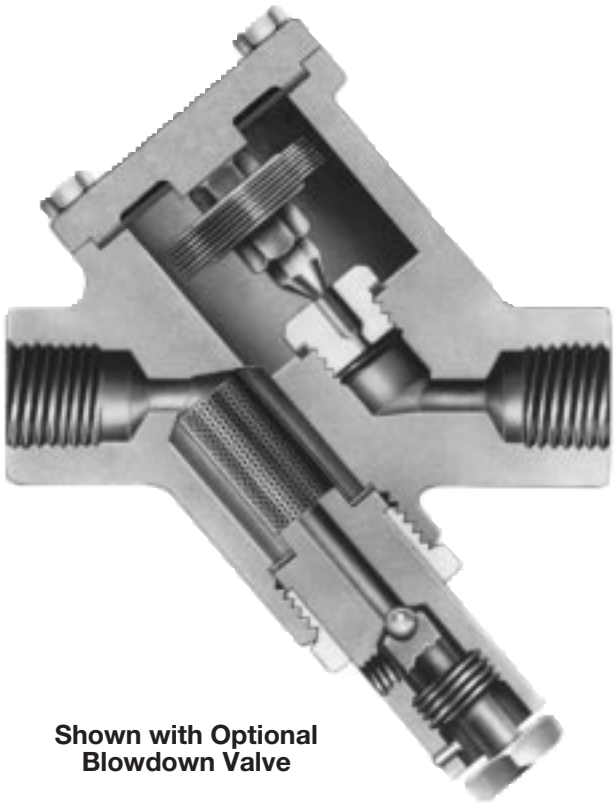
Body & Cover:	ASTM A351 Grade CF3M (316L)
Actuator:	Welded SS or Convoluted Monel
Valve & Seat:	Hardened 416 Stainless Steel

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice Inch (mm)	Differential PSIG (barg) 5 (0.34)	10 (0.7)	20 (1.4)	50 (3.5)	100 (6.9)	125 (8.62)	150 (10.3)	200 (13.8)	250 (17.2)	300 (20.7)	350 (24.1)	400 (27.6)	450 (31.0)	500 (34.5)	550* (37.9)	600* (41.4)	650* (44.8)
TA501	5/64 (2)	84 (38)	119 (54)	168 (76)	265 (120)	348 (158)	375 (170)	398 (181)	439 (199)	472 (214)	502 (228)	529 (240)	553 (251)	575 (261)	595 (270)	615 (280)	635 (289)	650 (295)
TA502	5/32 (4)	291 (132)	411 (186)	581 (264)	919 (417)	1207 (547)	1300 (590)	1381 (626)	1520 (689)	1638 (743)	1741 (790)	1832 (831)	1916 (869)	1992 (904)	2064 (937)	2135 (970)	2210 (1005)	2280 (1036)
TA503 TA503M**	1/4 (6)	550 (249)	825 (374)	1210 (549)	1975 (896)	2825 (1281)	3140 (1424)	3425 (1554)	3650 (1656)	3960 (1796)	4100 (1860)	4230 (1919)	4420 (2005)	4600 (2086)	4760 (2161)	4910 (2232)	5060 (2297)	5190 (2359)
TA504 TA504M**	5/16 (8)	860 (390)	1220 (554)	1725 (783)	2725 (1237)	3575 (1623)	3850 (1748)	4090 (1857)	4505 (2045)	4850 (2202)	5155 (2340)	5425 (2463)	5675 (2576)	5900 (2679)	6110 (2774)	6310 (2868)	6480 (2945)	6625 (3011)

* Nicholson recommends ISO filled Actuator above 500 psi (34.5 bar).
**Maximum pressure for Monel Actuator Traps is 300 PSI.



Shown with Optional Blowdown Valve

N650 Series Thermostatic Steam Traps

Pressures To 650 PSIG (44.8 barg) Temperatures to 750°F (400°C)

Positive Shutoff — Valve and seats are lapped in matched sets, providing tight shutoff for light and no-load conditions which results in improved energy savings.

Freeze Proof — Self draining when installed vertically.

Compact–Easy to Install — Ample extension for pipe wrench provided.

Easily Maintained — Actuator element and valve are attached to cover to facilitate inspection and servicing. Optional stainless blowdown valve permits easy strainer cleaning while in service.

Directional Discharge — Pipe and thread erosion prevented by directing condensate to center of discharge pipe.

Hardened Stainless Steel Valve and Seat — Long life. Lapped as a matched set for water tight seal.

Temperature Sensitive Actuators — One moving part. Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance. Optional fail closed convoluted Monel bellows for caustic corrosion resistance.

Positive Shutoff and Long Life — Integral Stainless Steel Strainer helps prevent debris from depositing onto valve and seat.

Guaranteed — Traps are guaranteed against defects in materials or workmanship. Traps with Welded Thermal Actuator–3 years. Traps with Monel Bellows–1 year

Applications

- Unit Heaters
- Air Vents
- Steam Tracing
- Drip Legs
- Platen Presses
- Plating Tanks
- Sterilizers
- Tire Presses
- Cooking Equipment
- Laundry Equipment
- Other Process Equipment

Options *See page 8*

- Stainless Steel Blowdown Valve
- ISO Filled Actuator
- Skirted Seat
- SLR Orifice
- Socketweld

Models

- **N652**–Y pattern body w/screen and lowdown port tapped & plugged; welded SS actuator& low capacity
- **N653**–Standard capacity on N652
- **N653M**-Convoluted monel actuator on N653
- **N654**–High capacity on N652
- **N654M**–Convoluted monel actuator on N654

Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load. Optional blow-down valve allows fast and easy cleaning of internal strainer without removing trap from operation.

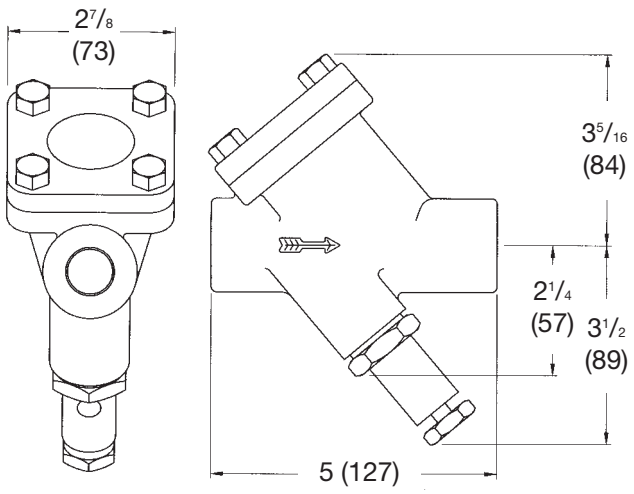
N650 Series Thermostatic Steam Traps

Typical Specification

Steam trap shall be of balanced pressure design with monel convoluted actuator or stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required or protection from flash steam locking, a SLR orifice will be available to allow condensate and flash steam evacuation at or near saturated temperatures. Where subcooling of condensate is desired alternate thermostatic actuator will be available to allow condensate evacuation at or near 40°F below saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. A minimum of three orifice sizes shall be available allowing for custom capacity sizing. Trap shall be forged carbon steel Y pattern body with strainer and available blow down valve suitable for pressures to 650 psig and available in 1/2" and 3/4" NPT or socketweld.

Maximum Operating Conditions

Traps with Monel Convoluted Actuator		
PMO: Max. Operating Pressure	300 psig	(20.7 barg)
TMO: Max. Operating Temperature	500°F	(260°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(427°C)
Traps with Welded Stainless Actuator		
PMO: Max. Operating Pressure	500 psig	(34.5 barg)
TMO: Max. Operating Temperature	600°F	(316°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(427°C)
Traps with Welded Stainless Actuator, ISO		
PMO: Max. Operating Pressure	650 psig	(44.8 barg)
TMO: Max. Operating Temperature	650°F	(343°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(427°C)



Shown with optional blowdown valve
Weight: 5 lbs. (2.3 kg)

Connections:
1/2" or 3/4" NPT or socketweld

Materials of Construction

Body & Cover:	ASTM A105 Forged Steel
Actuator:	Welded SS or Convoluted Monel
Cover Gasket:	347 stainless spiral wound w/graphite fill
Strainer:	.033 perf. 304 Stainless Steel
Blowdown Valve:	416 Stainless Steel
Valve & Seat:	Hardened 416 Stainless Steel

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

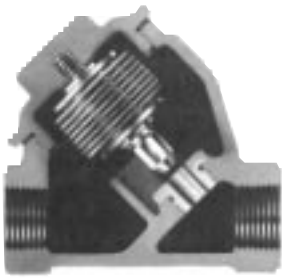
Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice Inch (mm)	Differential PSIG (barg) 5 (0.34)	10 (0.7)	20 (1.4)	50 (3.5)	100 (6.9)	125 (8.62)	150 (10.3)	200 (13.8)	250 (17.2)	300 (20.7)	350 (24.1)	400 (27.6)	450 (31.0)	500 (34.5)	550 (37.9)	600 (41.4)	650 (44.8)
N652	5/32 (4)	291 (132)	411 (186)	581 (264)	919 (417)	1207 (547)	1300 (590)	1381 (626)	1520 (689)	1638 (743)	1741 (790)	1832 (831)	1916 (869)	1992 (904)	2064 (937)	2135 (970)	2210 (1005)	2280 (1036)
N653 N653M†	1/4 (6)	550 (249)	825 (374)	1210 (549)	1975 (896)	2825 (1281)	3140 (1424)	3425 (1554)	3650 (1656)	3960 (1796)	4100 (1860)	4230 (1919)	4420 (2005)	4600 (2086)	4760 (2161)	4910 (2232)	5060 (2297)	5190 (2359)
N654 N654M†	5/16 (8)	860 (390)	1220 (554)	1725 (783)	2725 (1237)	3575 (1623)	3850 (1748)	4090 (1857)	4505 (2045)	4850 (2202)	5155 (2340)	5425 (2463)	5675 (2576)	5900 (2679)	6110 (2774)	6310 (2868)	6480 (2945)	6625 (3011)

†Convoluted Monel Actuator for pressures to 300 psi only
Nicholson recommends ISO filled Actuator above 500 psi (34.5 bar).
Nicholson recommends skirted seat above 400 psi.

ACHIEVER "A" SERIES THERMOSTATIC STEAM TRAPS

Pressures To 200 PSIG (13.8 barg)
Temperatures to 400°F (204°C)



Shown in AHV Configuration

Actuator Construction — Internal guide rod and tube for vibration resistance and positive valve to seat alignment.

Improved Energy Savings— Maximum elimination of air and non-condensibles–trap closes at saturated steam temperature.

Compact — Requires minimum space and provides condensate capacities equal to larger mechanical traps.

Freeze Proof — Type A with horizontal inlet and vertical outlet. Type AHV when installed vertically (outlet down) or horizontally on side (cover perpendicular to ground).

Renewable In-line — With factory packaged, precision matched internal parts kits.

Superior Performance — Fast response to changing pressure and condensate loads. Maximum air handling capability.

Air Vent —Efficient steam service air vent when equipped with ISO filled actuator and installed in air vent location.

Guaranteed — Guaranteed against defects in materials or workmanship. Traps with Welded Actuator–3 Years. Traps with Phosphor Bronze Actuator–1 Year

Applications
- Unit Heaters
- Sterilizers
- Air Vents
- Autoclaves
- Dry Kilns
- Dryers
- Flash Tanks
- Small Heat Exchangers
- Plating Tanks
- Cookers
- Kettles
- Other Process Equipment

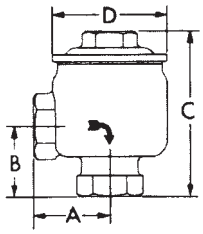
Options *See page 8*
- Sterilizer Trim
- SLR Orifice
- Convoluted Bronze or Welded SS Actuator

Models
- **A31**–1/2" right angle trap w/convoluted bronze actuator
- **A41**–3/4" right angle trap w/convoluted bronze actuator
- **A51**–1" right angle trap w/convoluted bronze actuator
- **A33**–Welded SS actuator on A31
- **A43**–Welded SS actuator on A41
- **A53**–Welded SS actuator on A51
- **AHV31**–1/2" straight thru trap w/convoluted bronze actuator
- **AHV41**–3/4" straight thru trap w/convoluted bronze actuator
- **AHV31**–1" straight thru trap w/convoluted bronze actuator
- **AHV33**–Welded SS actuator on AHV31
- **AHV43**–Welded SS actuator on AHV41
- **AHV53**–Welded SS actuator on AHV51

*Add "HC" to all the above for high capacity.

Operating Principle
Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

ACHIEVER "A" SERIES THERMOSTATIC STEAM TRAPS



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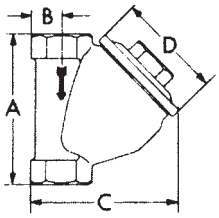


AHV

Typical Specifications

Steam trap shall be of balanced pressure design with bronze convoluted actuator or stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required, SLR orifice and Sterilizer trim will be available to allow condensate evacuation at or near saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. A minimum of two orifice sizes shall be available allowing for custom capacity sizing. Trap shall be bronze bodied suitable for pressures through 200 psig and available in 1/2" through 1" NPT connections.

Maximum Operating Conditions

PMO: Max. Operating Pressure	200 psig	(13.8 barg)
TMO: Max. Operating Temperature	400°F	(204°C)
PMA: Max. Allowable Pressure	200 psig	(13.8 barg)
TMA: Max. Allowable Temperature	400°F	(204°C)

Connections: 1/2" - 1" NPT

Materials of Construction

Body & Cover: ASTM B283 C37700

Actuator: Welded SS or Convoluted Monel

Cover Gasket: Copper Jacketed

Valve & Seat: Hardened 416 Stainless Steel

SIZING INFO

APPLICATION GUIDE

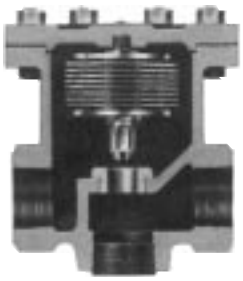
SELECTION CHECKLIST

Dimensions

Bellows		Pipe Size inches	Inch (mm)				Weight lb (kg)
Convoluted Bronze	Welded Stainless		A	B	C	D	
A-31	A-33	1/2	2 (41)	1⅝ (106)	4³⁄₁₆ (76)	3 (1.5)	3.3 (1.5)
A-41	A-43	3/4	2 (47)	1⅞ (113)	4³⁄₁₆ (76)	3 (1.5)	3.3 (1.5)
A-51	A-53	1	2¹³⁄₁₆ (56)	2⁹⁄₁₆ (125)	4¹⁵⁄₁₆ (76)	3 (2.2)	4.8 (2.1)
AHV-31	AHV-33	1/2	4 (19)	¾ (98)	3⅞ (76)	3 (1.4)	3.1 (1.4)
AHV-41	AHV-43	3/4	4¼ (22)	⅞ (108)	4¼ (76)	3 (1.6)	3.6 (1.6)
AHV-51	AHV-53	1	5⅝ (25)	1 (116)	4³⁄₁₆ (76)	3 (2.4)	5.3 (2.4)

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice inch (mm)	Differential PSIG (barg) 1 (0.07)	2 (0.14)	5 (0.34)	10 (0.69)	15 (1.03)	20 (1.4)	40 (2.8)	50 (3.4)	60 (4.1)	80 (5.5)	100 (6.9)	125 (8.6)	150 (10.3)	175 (12.1)	200 (13.8)
1/2" A31,A33,AHV31,AHV33	5/16	785	1050	1650	2325	2575	2825	3295	3815	4200	4675	5035	5535	5720	6085	6210
3/4" A41,A43,AHV41,AHV43	(8)	(357)	(477)	(750)	(1057)	(1170)	(1284)	(1498)	(1734)	(1909)	(2125)	(2289)	(2516)	(2600)	(2766)	(2823)
1" A51,A53,AHV51,AHV53	3/8	985	1390	2180	3070	3255	3735	4225	5040	5480	5990	6645	7315	7560	8045	8200
	(10)	(448)	(632)	(991)	(1395)	(1480)	(1698)	(1920)	(2291)	(2491)	(2723)	(3020)	(3325)	(3436)	(3657)	(3727)
1/2"- 1"	1/2	1140	1610	2545	3600	4405	5090	7195	8045	8810	9800	10560	11375	12090	12725	13305
All High Capacity "HC"	(13)	(518)	(732)	(1157)	(1636)	(2002)	(2314)	(3270)	(3657)	(4005)	(4455)	(4800)	(5170)	(5495)	(5784)	(6048)



Believer "B" Series Thermostatic Steam Traps

Pressures To 250 PSIG (17.2 barg) Temperatures to 450°F (232°C)

Freeze Proof — When installed on side with cover perpendicular to ground.

Renewable In-line — Renew trap in-line with factory packaged precision matched internal parts, replacement kits.

Compact — Requires minimum space while providing condensate capacities equal to larger mechanical traps.

Superior Performance — Maximum air handling capability. Immediate response to changing pressure and condensate loads. No adjustment necessary.

Sensitivity — Increased when installed on side with cover perpendicular to ground.

Actuator Construction — Internal guide rod and tube for vibration resistance and positive valve and seat alignment.

Temperature Sensitive Actuators — One moving part. Bronze Convoluted Actuator provides maximum sensitivity and fail closed operation. Optional Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Guaranteed — Guaranteed against defects in materials or workmanship. Traps with Welded Actuator–3 Years. Traps with Convoluted Bronze Actuator–1 Year

Models

- **B31**–1/2" straight thru trap w/convoluted bronze actuator
- **B41**–3/4" straight thru trap w/convoluted bronze actuator
- **B51**–1" straight thru trap w/convoluted bronze actuator
- **B61**–1-1/4" straight thru trap w/convoluted bronze actuator
- **B71**–1-1/2" straight thru trap w/convoluted bronze actuator
- **B81**–2" straight thru trap w/convoluted bronze actuator
- **B33**–Welded SS actuator on B31
- **B43**–Welded SS actuator on B41
- **B53**–Welded SS actuator on B51
- **B63**–Welded SS actuator on B61
- **B73**–Welded SS actuator on B71
- **B83**–Welded SS actuator on B81

Applications

- Unit Heaters
- Pipe Coils
- Blast Coils
- Steam Mains
- Dry Kilns
- Jacketed Kettles
- Hot Water Heaters
- Dryers (all types)
- Large Heat Exchangers

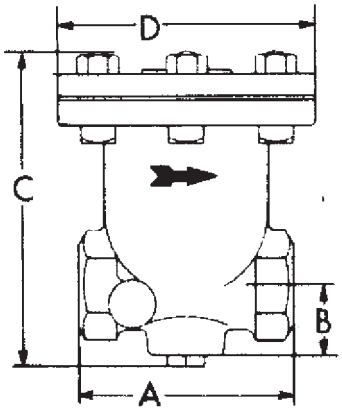
Options *See page 8*

- SLR Orifice
- Convoluted Bronze or Welded SS Actuator

Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

BELIEVER "B" SERIES THERMOSTATIC STEAM TRAPS



Type B

Connections: 1/2"-2" NPT

Typical Specifications

Steam trap shall be of balanced pressure design with bronze convoluted actuator or stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required or protection from flash steam locking, a SLR orifice will be available to allow condensate and flash steam evacuation at or near saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. Trap shall be cast iron or cast steel bodied suitable for pressures to 250 psig and available in 1/2" through 2" NPT.

Maximum Operating Conditions

PMO: Max. Operating Pressure	250 psig	(17.2 barg)
TMO: Max. Operating Temperature	450°F	(232°C)
PMA: Max. Allowable Pressure	250 psig	(17.2 barg)
TMA: Max. Allowable Temperature	450°F	(232°C)

Materials of Construction

Body & Cover:	Cast Iron ASTM A278 Class 30
Actuator:	Convoluted Bronze or Welded SS
Cover Gasket:	Graphite
Valve & Seat:	Hardened 416 Stainless Steel

Dimensions

Actuators		Pipe Size inches	Inches (mm)				Weight lb (kg)
Convoluted Bronze	Welded Stainless		A	B	C	D	
B-31	B-33-W	1/2	3⅞ (98)	1⅛ (29)	5⅞ (149)	4½ (114)	7 (3.2)
B-41	B-43-W	3/4	4¼ (108)	1⅜ (35)	6¾ (171)	5⅛ (129)	10.3 (4.7)
B-51	B-53-W	1	5½ (140)	1⅞ (48)	7 11/16 (195)	5 13/16 (148)	15.6 (7.1)
B-61	B-63-W	1 1/4	5½ (140)	1⅞ (48)	7 11/16 (195)	5 13/16 (148)	15.3 (7.0)
B-71	B-73-W	1 1/2	7¼ (184)	1¾ (44)	9 1/16 (230)	7¾ (197)	33.6 (15.3)
B-81	B-83-W	2	7¼ (184)	1¾ (44)	9 1/16 (230)	7¾ (197)	32.4 (14.7)

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Pipe Size Inch	Differential PSIG (barg)												
		1 (.07)	2 (.14)	5 (0.34)	10 (0.7)	20 (1.4)	50 (3.5)	100 (6.9)	125 (8.6)	150 (10.3)	175 (12.1)	200 (13.8)	225 (15.5)	250 (17.2)
B31,B33	½	985 (448)	1390 (632)	2180 (991)	3070 (1395)	3735 (1698)	5040 (2291)	6645 (3070)	7315 (3325)	7560 (3436)	8045 (3657)	8200 (3727)	8615 (3916)	8915 (4052)
B41,B43	¾	1460 (664)	2055 (934)	3240 (1473)	4560 (2073)	5550 (2523)	7480 (3400)	9865)4484)	10850 (4932)	11225 (5102)	11935 (5425)	12165 (5530)	12770 (5805)	13225 (6011)
B51,B53, B61,B63	1,1¼	1825 (830)	2575 (1170)	4050 (1841)	5700 (2591)	6925 (3148)	9350 (4750)	12340 (5609)	13565 (6166)	14030 (6377)	14920 (6782)	15230 (6923)	15960 (7255)	16540 (7518)
B71,B73, B81,B83	1½,2	2760 (1255)	3890 (1768)	6120 (2782)	8610 (3914)	10470 (4759)	14125 (6420)	18660 (8482)	20520 (9327)	21235 (9652)	22580 (10264)	23015 (10461)	24190 (10995)	25055 (11389)

Conqueror "C" Series Thermostatic Steam Traps

Pressures To 300 PSIG (21 barg)
Temperatures to 500°F (260°C)

Freeze Proof — When installed with horizontal inlet and vertical outlet.

Renewable In-line — Renew trap in-line with factory packaged precision matched internal parts, replacement kits.

Compact — Requires minimum space while providing condensate capacities equal to larger mechanical traps.

Superior Performance — Maximum air handling capability. Immediate response to changing pressure and condensate loads. No adjustment necessary.

Sensitivity — Increased when installed on side with cover perpendicular to ground.

Actuator Construction — Internal guide rod and tube for vibration resistance and positive valve and seat alignment.

Temperature Sensitive Actuators — One moving part. Bronze Convoluted Actuator provides maximum sensitivity and fail closed operation. Optional Stainless Steel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Guaranteed — Guaranteed against defects in materials or workmanship. Traps with Welded Actuator–3 Years. Traps with Convoluted Bronze Actuator–1 Year

Applications

- Unit Heaters
- Pipe Coils
- Blast Coils
- Steam Mains
- Dry Kilns
- Jacketed Kettles
- Hot Water Heaters
- Dryers (all types)
- Large Heat Exchangers

Options *See page 8*

- SLR Orifice
- Convoluted Bronze or Welded SS Actuator
- Scoketweld

Models

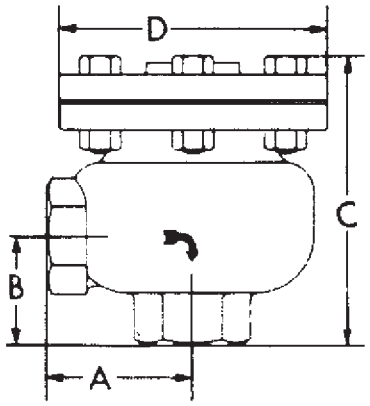
- **C31**–1/2" angle pattern trap w/convoluted bronze actuator
- **C41**–3/4" angle pattern trap w/convoluted bronze actuator
- **C51**–1" angle pattern trap w/convoluted bronze actuator
- **C61**–1-1/4" angle pattern trap w/convoluted bronze actuator
- **C71**–1-1/2" angle pattern trap w/convoluted bronze actuator
- **C81**–2" angle pattern trap w/convoluted bronze actuator
- **C33**–Welded SS actuator on C31
- **C43**–Welded SS actuator on C41
- **C53**–Welded SS actuator on C51
- **C63**–Welded SS actuator on C61
- **C73**–Welded SS actuator on C71
- **C83**–Welded SS actuator on C81

*CS models are the same as above in cast steel.

Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

Conqueror "C" Series Thermostatic Steam Traps



Type C & CS

Connections:
1/2"-2" NPT or Socketweld

Typical Specifications

Steam trap shall be of balanced pressure design with bronze convoluted actuator or stainless steel welded actuator capable of discharging condensate within 10°F of saturated temperature. Where greater sensitivity is required or protection from flash steam locking, a SLR orifice will be available to allow condensate and flash steam evacuation at or near saturated temperatures. Thermostatic actuator shall employ a conical valve lapped in matched sets with the seat ring assuring tight shut off. Trap shall be cast iron or cast steel bodied suitable for pressures to 250 psig and available in 1/2" through 2" NPT.

Maximum Operating Conditions

Type C

PMO: Max. Operating Pressure	250 psig	(17.2 barg)
TMO: Max. Operating Temperature	450°F	(232°C)
PMA: Max. Allowable Pressure	250 psig	(17.2 barg)
TMA: Max. Allowable Temperature	450°F	(232°C)

Type CS

PMO: Max. Operating Pressure	300 psig	(20.7 barg)
TMO: Max. Operating Temperature	500°F	(260°C)
PMA: Max. Allowable Pressure	300 psig	(20.7 barg)
TMA: Max. Allowable Temperature	500°F	(260°C)

Materials of Construction

Body & Cover:	Cast Iron ASTM A216 Grade WCB
Actuator:	Convoluted Bronze or Welded SS
Cover Gasket:	Graphite
Valve & Seat:	Hardened 416 Stainless Steel

Dimensions

Actuators		Pipe Size	Inches (mm)				Weight
Convoluted Bronze	Welded Stainless	inches	A	B	C	D	lb (kg)
C-31	C-33-W	1/2	2⅝ (67)	1 13/16 (46)	4 15/16 (125)	4½ (114)	8.3 (3.8)
C-41	C-43-W	3/4	2 ¾ (70)	2 1/16 (52)	5 7/16 (138)	5 1/16 (129)	11.1 (5.0)
C-51	C-53-W	1	3½ (89)	2 13/16 (71)	6 1/16 (154)	5 13/16 (148)	17.8 (8.1)
C-61	C-63-W	1 1/4	3½ (89)	2 13/16 (71)	6 1/16 (154)	5 13/16 (148)	17.5 (8.0)
C-71	C-73-W	1 1/2	5 (127)	3¾ (95)	8⅜ (213)	7¾ (197)	39.1 (17.8)
C-81	C-83-W	2	5 (127)	3¾ (95)	8⅜ (213)	7¾ (197)	39 (17.7)
CS-31	CS-33-W	1/2	2⅝ (67)	1 13/16 (46)	4 15/16 (125)	4½ (114)	8.6 (3.9)
CS-41	CS-43-W	3/4	2 ¾ (70)	2 1/16 (52)	5 7/16 (138)	5 1/16 (129)	13 (5.9)
CS-51	CS-53-W	1	3½ (89)	2 13/16 (71)	6 1/16 (154)	5 13/16 (148)	19.6 (8.9)
CS-61	CS-63-W	1 1/4	3½ (89)	2 13/16 (71)	6 1/16 (154)	5 13/16 (148)	19.3 (8.8)
CS-71	CS-73-W	1 1/2	5 (127)	3¾ (95)	8⅜ (213)	7¾ (197)	39.2 (17.8)
CS-81	CS-83-W	2	5 (127)	3¾ (95)	8⅜ (213)	7¾ (197)	31.1 (14.1)

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Pipe Size	Differential PSIG (barg)													
	Inch	1 (.07)	2 (.14)	5 (0.34)	10 (0.7)	20 (1.4)	50 (3.5)	100 (6.9)	125 (8.6)	150 (10.3)	175 (12.1)	200 (13.8)	225 (15.5)	250 (17.2)	300 (20.7)
C31,C33,CS31,CS33	½	985 (448)	1390 (632)	2180 (991)	3070 (1395)	3735 (1698)	5040 (2291)	6645 (3070)	7315 (3325)	7560 (3436)	8045 (3657)	8200 (3727)	8615 (3916)	8915 (4052)	9220 (4191)
C41,C43,CS41,CS43	¾	1460 (664)	2055 (934)	3240 (1473)	4560 (2073)	5550 (2523)	7480 (3400)	9865)4484)	10850 (4932)	11225 (5102)	11935 (5425)	12165 (5530)	12770 (5805)	13225 (6011)	13685 (6220)
C51,C53,CS51,CS53 C61,C63,CS61,CS63	1,1¼	1825 (830)	2575 (1170)	4050 (1841)	5700 (2591)	6925 (3148)	9350 (4750)	12340 (5609)	13565 (6166)	14030 (6377)	14920 (6782)	15230 (6923)	15960 (7255)	16540 (7518)	17120 (7782)
C71,C73,CS71,CS73 C81,C83,CS81,CS83	1½,2	2760 (1255)	3890 (1768)	6120 (2782)	8610 (3914)	10470 (4759)	14125 (6420)	18660 (8482)	20520 (9327)	21235 (9652)	22580 (10264)	23015 (10461)	24190 (10995)	25055 (11389)	25915 (11780)

*CS Series Only. C available with screwed connections only. CS available with screwed or socketweld connections.

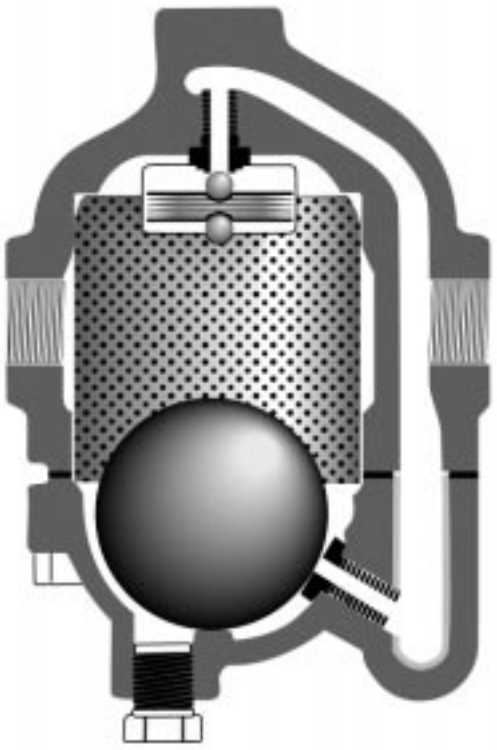
MECHANICAL STEAM TRAPS

NICHOLSON's Mechanical Trap line continues their tradition of offering high value with traditional designs while simultaneously pushing the performance envelope with leading edge technology. As America's only domestic manufacturer of free float technology, NICHOLSON continues to provide performance and value.

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

NOVA NFT250 SERIES VARIABLE ORIFICE STEAM TRAPS

Pressures To 250 PSIG (17.2 barg)
Temperatures to 450°F (232°C)



All Stainless Steel Internal Components — Hardened valves and seats. Extra long life and dependable service.. Resists water hammer.. Protects against erosion and corrosion.

Erosion Proof — Discharge passage is protected with a stainless steel liner.

Integral Strainer — Stainless Steel screen prevents dirt problems. Blow-down connection provided.

Thermostatic Air Vent — Provided with bi-metal or full balanced pressure element for immediate and complete air venting.

Variable Orifice — Condensate is discharged continuously through the seat ring which is modulated by the float. This provides a smooth, even flow without high velocity or steam entrainment.

Guarantee — Traps are guaranteed against defects in materials or workmanship for 3 years.

Applications
- Steam Lines
- Process Equipment
- Steam Cookers
- Steam Heated Vats
- Pressing Machinery
- Unit Heaters
- Oil Preheaters
- Converters
- Coils
- Rotating Drum

Options *See page 8*
- SLR Orifice
- Blowdown Valve
- Orifice Continuous Bleed Air Vent

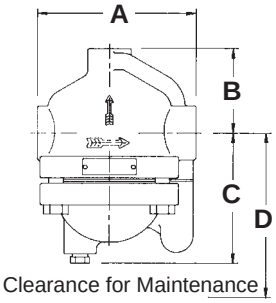
Models
- **NFT250**–Low capacity
- **NFT250SLR**–Low capacity w/steam lock release
- **NFT251**–Medium capacity
- **NFT251SLR**–Medium capacity w/steam lock release
- **NFT252**–High capacity
- **NFT252SLR**–High capacity w/steam lock release
- **NFT253**–Super high capacity
- **NFT253SLR**–Super high capacity w/steam lock release

Operation

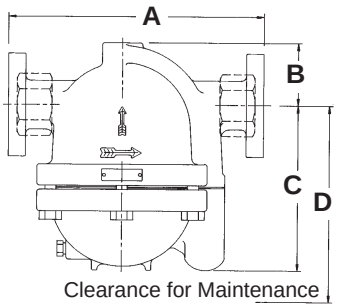
On startup, the thermostatic air vent (caged stainless welded bellows) is open, allowing air to flow freely through the vent valve orifice. When condensate flows into the trap, the float rises, allowing condensate to be discharged. Once air and non-condensibles have been evacuated, hot condensate will cause the thermostatic vent to close. Condensate will continue to be discharged as long as condensation occurs.

During normal operation, an increase in the load causes the liquid level in the trap to rise. The float then rises and rolls off the seat ring, allowing more condensate to flow out. The float sinks as the condensate load decreases, moving nearer to the seat ring, decreasing the effective size of the orifice and allowing less condensate to discharge. This provides smooth, continuous operation that reacts instantly to load variation while maintaining a water seal over the seat ring to prevent live steam loss.

NOVA NFT250 SERIES VARIABLE ORIFICE STEAM TRAPS



Clearance for Maintenance



Clearance for Maintenance

Connections:
½"-2" NPT or 1½"-2" Flanged

Typical Specifications

Steam trap shall be of float and thermostatic design. Float shall be free of levers, linkages, or other mechanical connections. Float shall be weighted to maintain orientation and shall act as the valve being free to modulate condensate through the seat ring. Air vent shall be of balanced pressure design with stainless steel welded encapsulated bellows capable of discharging air and noncondensable gases continuously within 15°F of saturated temperature. Trap shall contain integral strainer and stainless steel exhaust port sleeve. Trap shall be cast iron bodied suitable for pressures to 250 psi and available in 1/2" through 2" NPT or flanged.

Materials of Construction

Body and Cover: Cast Iron ASTM A126B
All Internal Parts: Stainless Steel
Air Vent: Balanced Pressure, Stainless Steel
Cover Gasket: Graphite Fiber

Maximum Operating Conditions

PMO: Max. Operating Pressure

ORIFICE	PMO	
20	20 psig	(1.4 barg)
50	50 psig	(3.5 barg)
100	100 psig	(6.9 barg)
150	150 psig	(10.3 barg)
250	250 psig	(17.2 barg)

PMA: Max. Allowable Pressure: 250 psig (17.2 barg)

TMA: Max. Allowable Temperature: 450°F (232°C)

SIZING INFO

APPLICATION GUIDE

SELECTION CHECKLIST

Dimensions

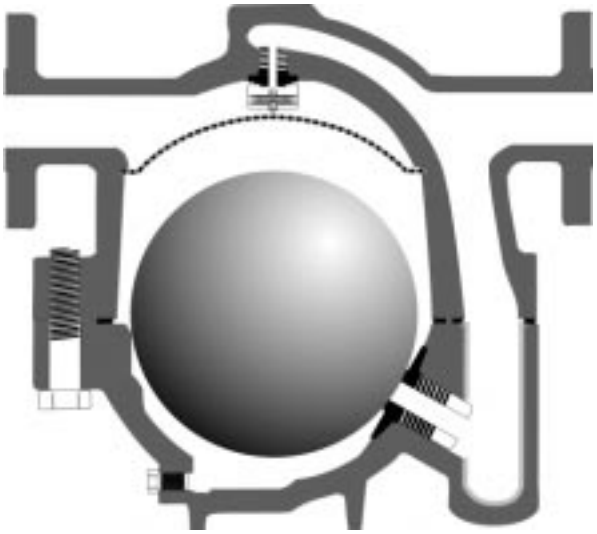
Model	Size	Connection	Inches (mm)				Weight Lbs. (kg)
			A	B	C	D	
NFT250	1/2 & 3/4	NPT	4 1/4 (108)	2 3/4 (69)	3 5/8 (92)	5 1/2 (140)	6 (2.7)
NFT251	3/4 & 1	NPT	5 1/2 (140)	2 15/16 (74)	4 9/16 (116)	6 3/4 (171)	13 (5.9)
NFT252†	1 & 1 1/2	NPT	11 (279)	2 15/16 (74)	7 3/4 (197)	10 (254)	41 (18.6)
NFT253	1 1/2 & 2	NPT	13 3/4 (349)	2 15/16 (74)	11 5/8 (295)	15 3/8 (391)	120 (54.5)
		250# Flg.	15 3/4 (400)	2 15/16 (74)	11 5/8 (295)	15 3/8 (391)	130 (59.1)

Maximum Capacity–lbs/hr (10°F Below Saturation)

Trap	Orifice	Differential – PSIG (barg)														
		1 (.07)	5 (.34)	10 (.69)	15 (1.03)	20 (1.38)	30 (2.07)	50 (3.45)	75 (5.17)	100 (6.90)	125 (8.62)	150 (10.3)	175 (12.1)	200 (13.8)	225 (15.5)	250 (17.2)
NFT250	20	264	810	1050	1100	1200										
	50	190	430	610	750	870	1070	1400								
	100	88	160	250	300	350	425	530	670	710						
	150	70	140	219	260	295	345	410	470	520	555	590				
	250	37	90	140	170	200	240	300	340	390	405	415	440	460	480	500
NFT251	20	590	1600	2100	2400	2450										
	50	340	760	1080	1330	1540	1900	2460								
	100	200	500	650	740	830	950	1100	1300	1400						
	150	170	385	527	627	705	825	990	1130	1240	1330	1415				
	250	110	255	360	425	500	575	700	800	900	940	1000	1050	1100	1150	1200
NFT252	20	2720	6280	8600	10,500	11,700										
	50	1750	3920	5560	6830	7900	9700	12,600								
	100	930	2170	3130	3840	4460	4990	6020	7030	7960						
	150	850	1935	2650	3150	3540	4140	4970	5685	6230	6690	7100				
	250	670	1400	1900	2400	2540	3000	3500	4100	4200	4900	5100	5300	5500	5750	6000
NFT253	20	8000	15,000	18,000	19,900	22,800										
	50	5460	12,600	15,600	16,900	18,400	21,000	25,400								
	100	2800	6350	8700	10,900	12,800	13,700	16,600	18,700	21,000						
	150	2690	6120	8385	9970	11,200	13,100	15,700	17,980	19,700	21,150	22,450				
	250	1600	3770	5300	6470	7560	8610	10,400	12,100	13,600	14,600	15,500	16,300	17,100	17,800	18,400

For Kg/Hr Multiply by .454

Nova NFT650 Series Variable Orifice Steam Traps



Pressures To 650 PSIG (44.8 barg)
Temperatures to 750°F (400°C)

All Stainless Steel Internal Components — Hardened valves and seats. Extra long life and dependable service.. Resists water hammer. Protects against erosion and corrosion.

Erosion Proof — Discharge passage is protected with a stainless steel liner.

Integral Strainer — Stainless Steel screen prevents dirt problems. Blow-down connection provided.

Thermostatic Air Vent —Provided with balanced pressure element for immediate and complete air venting.

Variable Orifice — Condensate is discharged continuously through the seat ring which is modulated by the float. This provides a smooth, even flow without high velocity or steam entrainment.

Guarantee — Traps are guaranteed against defects in materials or workmanship for 3 years.

Models

Models

- **NFT651**–Low capacity
- **NFT651SLR**–Low capacity w/steam lock release
- **NFT652**–Medium capacity
- **NFT652SLR**–Medium capacity w/steam lock release
- **NFT653**–High capacity
- **NFT653SLR**–High capacity w/steam lock release

Applications

- Steam Lines
- Process Equipment
- Steam Cookers
- Steam Heated Vats
- Pressing Machinery
- Unit Heaters
- Oil Preheaters
- Converters
- Coils
- Rotating Drum

Options *See page 8*

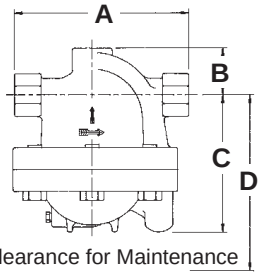
- SLR Orifice
- Blowdown Valve
- Orifice Continuous Bleed Air Vent

Operation

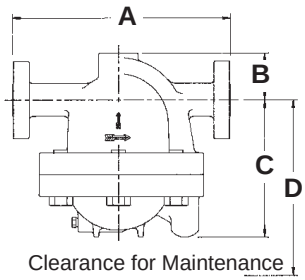
On startup, the thermostatic air vent (caged stainless welded bellows) is open, allowing air to flow freely through the vent valve orifice. When condensate flows into the trap, the float rises, allowing condensate to be discharged. Once air and non-condensibles have been evacuated, hot condensate will cause the thermostatic vent to close. Condensate will continue to be discharged as long as condensation occurs.

During normal operation, an increase in the load causes the liquid level in the trap to rise. The float then rises and rolls off the seat ring, allowing more condensate to flow out. The float sinks as the condensate load decreases, moving nearer to the seat ring, decreasing the effective size of the orifice and allowing less condensate to discharge. This provides smooth, continuous operation that reacts instantly to load variation while maintaining a water seal over the seat ring to prevent live steam loss.

NOVA NFT650 SERIES VARIABLE ORIFICE STEAM TRAPS



Clearance for Maintenance



Clearance for Maintenance

Connections:
½-2" NPT or 1½-2" Flanged

Typical Specification

Steam trap shall be of float and thermostatic design. Float shall be free of levers, linkages, or other mechanical connections. Float shall be weighted to maintain orientation and shall act as the valve being free to modulate condensate through the seat ring. Air vent shall be of balanced pressure design with stainless steel welded encapsulated bellows capable of discharging air and noncondensable gases continuously within 15°F of saturated temperature. Trap shall contain integral strainer and stainless steel exhaust port sleeve. Trap shall be cast steel bodied suitable for pressures to 650 psi and available in 1/2" through 2" NPT, Socket Weld, or flanged.

Materials of Construction

Body & Cover: ASTM A216 Grade WCB

Cover Gasket: Spiral Wound 304 Stainless w/graphite filler

All Internal: Stainless Steel

Air Vent: Balanced Pressure, Welded Stainless Steel

Maximum Operating Conditions

PMO: Max. Operating Pressure

ORIFICE	PMO	
20	20 psig	(1.4 barg)
50	50 psig	(3.5 barg)
100	100 psig	(6.9 barg)
175	175 psig	(12.1 barg)
300	300 psig	(20.7 barg)
400	400 psig	(27.6 barg)
600	600 psig	(41.4 barg)

PMA: Max. Allowable Pressure: 650 psig (44.8 barg)

TMA: Max. Allowable Temperature: 750°F (400°C)

Dimensions

Model	Size	Inches (mm) A NPT	A 300#	A 600#	B	C	D	Weight Lbs. (kg)
NFT651	1/2, 3/4 & 1	5 1/2 (140)	—	—	3 1/16 (78)	5 7/16 (138)	7 1/4 (184)	21 (9.5)
NFT652	1	11 (279)	13 3/4 (349)	13 3/4 (349)	2 15/16 (75)	8 3/4 (222)	11 3/8 (290)	84 (38.2)
	1 1/2 & 2	11 (279)	13 3/4 (349)	14 9/16 (370)	2 15/16 (75)	8 3/4 (222)	11 3/8 (290)	87 (39.5)
NFT653	1 1/2	13 3/4 (349)	16 3/4 (426)	17 3/8 (411)	3 5/16 (84)	11 7/8 (392)	16 (406)	192 (87.3)
	2	13 3/4 (349)	16 11/16 (424)	17 7/16 (443)	3 5/16 (84)	11 7/8 (302)	16 (406)	195 (88.6)

SIZING INFO

APPLICATION GUIDE

SELECTION CHECKLIST

Maximum Capacity–lbs/hr (10°F Below Saturation)

Trap	Orifice	Differential – PSIG (barg) 1 (.07)	5 (.34)	10 (69)	20 (1.38)	50 (3.45)	75 (5.17)	100 (6.90)	150 (10.3)	175 (12.1)	200 (13.8)	250 (17.2)	300 (20.7)	400 (27.6)	500 (34.5)	600 (41.4)
NFT651	20	590	1600	2100	2450											
	50	340	760	1080	1540	2460										
	100	200	500	650	830	1100	1300	1400								
	175	180	350	500	675	900	1000	1100	1300	1400						
	400	100	220	300	390	510	585	640	740	795	835	920	1000	1140		
	600	75	145	180	225	300	340	375	435	465	490	540	585	665	740	800
NFT652	20	2720	6280	8600	11700											
	50	1750	3920	5560	7900	12600										
	100	930	2170	3130	4460	6020	7030	7960								
	175	800	1700	2300	3200	4400	5000	5500	6400	6900						
	300	645	1240	1565	1955	2575	2940	3220	3740	4000	4220	4640	5060			
	400	515	995	1250	1565	2060	2355	2575	2995	3200	3380	3720	4050	4600		
	600	370	710	895	1120	1470	1680	1840	2140	2290	2410	2655	2890	3300	3655	3955
NFT653	20	8000	15000	18000	22800											
	50	5460	12600	15600	18400	25400										
	100	2800	6350	8700	12800	16600	18700	21000								
	175	2400	5500	7600	10300	14400	16500	18200	20750	21900						
	300	1500	3500	5200	7075	9325	10655	11655	13545	14485	15275	16815	18315			
	400	1400	2800	4200	5630	7420	8480	9270	10770	11520	12150	13380	14570	16555		
	600	800	1800	2800	3900	5220	5970	6530	7585	8110	8555	9420	10260	11655	12960	13990

For Kg/Hr Multiply by .454

FTN Series Float & Thermostatic Steam Traps

Pressures To 125 PSIG (8.6 barg)
Temperatures to 450°F (232°C)

Universal Four-port Design — Four possible hookup combinations of the "H" pattern body and piping dimensions similar to other major manufacturers allow maximum installation flexibility for easy replacement of other traps. Inlet and outlet taps on larger sized traps located in the cover to permit larger capacities.

All Stainless Steel Internal Components — Hardened valves and seats. Extra long life and dependable service.. Resists water hammer. Protects against erosion and corrosion.

Balanced Pressure Thermostatic Element — allows venting of non-condensibles while operating at design pressure.

Rugged Welded Stainless Steel Element — Increases service life.

Wide Selection of Differential Pressures — Sizes 3/4" to 2" available with 15, 30, 75 and 125 psig differential pressures.

Repairable In-line — Can be serviced without disturbing system piping.

Models

- **FTN-15**–Pressures to 15 PSIG
- **FTN-30**–Pressures to 30 PSIG
- **FTN-75**–Pressures to 75 PSIG
- **FTN-125**–Pressures to 125 PSIG

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Applications

- Unit Heaters & other Space Heating Equipment
- Heat Exchangers/Reboilers
- Air Heating Coils
- Steam Main Drips
- Process Equipment

Options *See page B11*

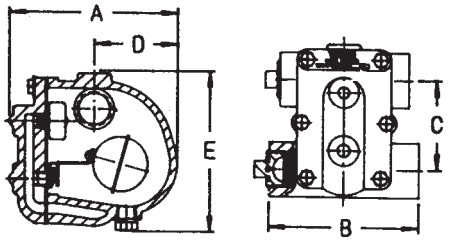
- Repair Kits

Operation

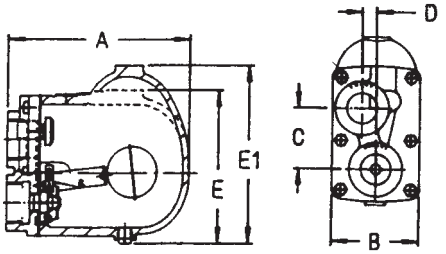
Air entering trap is immediately discharged through the high capacity integral air vent. The thermostatic vent will close just prior to saturation temperature. The balanced design will allow venting of non-condensibles that collect in the float chamber when operating at design pressure. When steam enters the trap, the thermostatic air vent closes to prevent steam loss.

When steam gives up it's latent heat, it becomes condensate. This "condensate" enters the trap and causes the stainless steel ball float to rise. Raising of the float opens the discharge valve, allowing condensate to be continuously discharged as it enters the trap. The condensate level in the trap body is maintained above the discharge seat, providing a positive seal against the loss of steam.

FTN Series Float & Thermostatic Steam Traps



3/4", 1" - All
1 1/4" - FTN-15, FTN-30



1 1/2", 2" - All
1 1/4" - FTN-75, FTN-125

Connections: 3/4"-2" NPT

Typical Specifications

Steam trap shall be of float and thermostatic design. Float shall actuate the valve via a hinged lever and linkage. Air vent shall be of balanced pressure design with stainless steel welded encapsulated bellows capable of discharging air and noncondensable gases continuously within 15°F of saturated temperature. Traps through 1-1/4" shall employ "H" pattern connections to accommodate multiple piping configurations. Trap shall be cast iron bodied suitable for pressures to 125 psi and available in 3/4" through 2" NPT.

Maximum Operating Conditions

PMO: Max. Operating Pressure

ORIFICE	PMO	
15	15 psig	(1.03 barg)
30	30 psig	(2.07 barg)
75	75 psig	(5.17 barg)
125	125 psig	(8.62 barg)

PMA: Max. Allowable Pressure 125 psig (8.62 barg)

TMA: Max. Allowable Temperature 450°F (232°C)

Materials of Construction

Body & Cover: Cast Iron ASTM A126B

All Internal: Stainless Steel

Air Vent: Balanced Pressure, Welded Stainless Steel

SIZING INFO

Dimensions

Model No.	Size	Inches (mm) A	B	C	D	E	E1	Weight lbs (kg)
FTN-15, FTN-30	3/4	6.25 (159)	5.50 (140)	3.31 (84)	3.00 (76)	5.75 (146)	—	9 (4.1)
	1	6.25 (159)	5.50 (140)	3.31 (84)	3.00 (76)	5.75 (146)	—	9 (4.1)
	1 1/4	6.25 (159)	5.75 (146)	3.00 (76)	3.81 (97)	5.75 (146)	—	9 1/2 (4.3)
	1 1/2	8.50 (216)	4.25 (108)	3.00 (76)	0.70 (18)	—	8.40 (213)	18 (8.2)
	2	9.81 (249)	4.94 (123)	4.94 (123)	0.12 (3)	9.12 (232)	—	26 (11.8)
FTN-75, FTN-125	3/4	6.25 (159)	5.50 (140)	3.31 (84)	3.00 (76)	5.75 (146)		9 (4.1)
	1	6.25 (159)	5.50 (140)	3.31 (84)	3.00 (76)	5.75 (146)	—	9 (4.1)
	1 1/4	8.50 (216)	4.25 (108)	3.00 (76)	0.70 (18)	—	8.40 (213)	18 (8.2)
	1 1/2	8.50 (216)	4.25 (108)	3.00 (76)	0.70 (18)	—	8.40 (213)	18 (8.2)
	2	9.81 (249)	4.94 (123)	4.94 (123)	0.12 (3)	9.12 (232)	—	26 (11.8)

Maximum Capacity—lbs/hr (10°F Below Saturation)

Trap	Size NPT	Orifice (in.)	Differential–PSIG (barg) 1/4 (.017)	1/2 (.034)	1 (.069)	2 (.138)	5 (.345)	10 (.690)	15 (1.03)	20 (1.38)	25 (1.72)	30 (2.07)	40 (2.76)	50 (3.45)	75 (5.17)	100 (6.90)	125 (8.62)
FTN-15	3/4"	.218	279	369	489	650	785	1000	1075								
FTN-15	1"	.218	279	369	489	650	785	1000	1075								
FTN-15	1 1/4"	.312	600	770	980	1240	1640	2000	2340								
FTN-15	1 1/2"	.500	1100	1700	2400	3300	5000	6600	7600								
FTN-15	2"	.625	2300	2800	3600	4650	6900	9000	10900								
FTN-30	3/4"	.218	279	369	489	650	785	1000	1075	1210	1300	1370					
FTN-30	1 "	.218	279	369	489	650	785	1000	1075	1210	1300	1370					
FTN-30	1 1/4"	.228	375	500	690	910	1200	1500	1680	1800	1900	2000					
FTN-30	1 1/2"	.390	1000	1300	1700	2300	3400	4600	5500	6000	6600	7000					
FTN-30	2"	.500	1300	1800	2500	3400	5200	6800	7800	8600	9300	10000					
FTN-75	3/4"	.166	160	213	280	365	520	700	795	875	930	970	1120	1230	1450		
FTN-75	1"	.166	160	213	280	365	520	700	795	875	930	970	1120	1230	1450		
FTN-75	1 1/4"	.312	550	725	960	1300	1900	2650	3050	3400	3700	4000	4400	4750	5400		
FTN-75	1 1/2"	.312	550	725	960	1300	1900	2650	3050	3400	3700	4000	4400	4750	5400		
FTN-75	2"	.421	850	1100	1500	2000	3100	4150	4750	5200	5500	5800	6400	6800	7700		
FTN-125	3/4"	.125	100	135	175	230	330	415	500	585	620	685	750	830	970	1110	1190
FTN-125	1"	.125	100	135	175	230	330	415	500	585	620	685	750	830	970	1110	1190
FTN-125	1 1/4"	.246	400	520	680	890	1300	1700	2050	2300	2500	2700	3000	3200	3800	4200	4500
FTN-125	1 1/2"	.246	400	520	680	890	1300	1700	2050	2300	2500	2700	3000	3200	3800	4200	4500
FTN-125	2"	.332	550	675	880	1225	1950	2600	3000	3250	3500	3800	4200	4600	5500	6100	6600

For Kg/Hr Multiply by .454

Dura-Flo Inverted Bucket Steam Traps

Pressures To 250 PSIG (17.2 barg) Temperatures to 450°F (232°C)

Hardened Stainless Steel Valve and Seat — Long life and maximum corrosion resistance.

Stainless Steel Bucket — Long lasting, rugged and naturally resistant to water hammer.

Inexpensive — Low maintenance and initial cost.

Repairable in-line — All working parts lift out of top of trap.

Unique Reusable Gasket — Durable Teflon® cover gasket can be reinstalled numerous times.

Cast Iron Body — Durable heavy wall construction provides years of reliable service.

Suitable for Wide Variety of Loads/Applications — Horizontal and vertical models in ten body sizes.

Resists Dirt and Scale — Valve and seats positioned at top of traps and internal stainless strainer available on most horizontal models ensure long service.

Applications

- Steam Lines
- Process Equipment
- Steam Cookers
- Steam Heated Vats
- Pressing Machinery
- Unit Heaters
- Oil Preheaters
- Converters
- Coils
- Rotating Drum

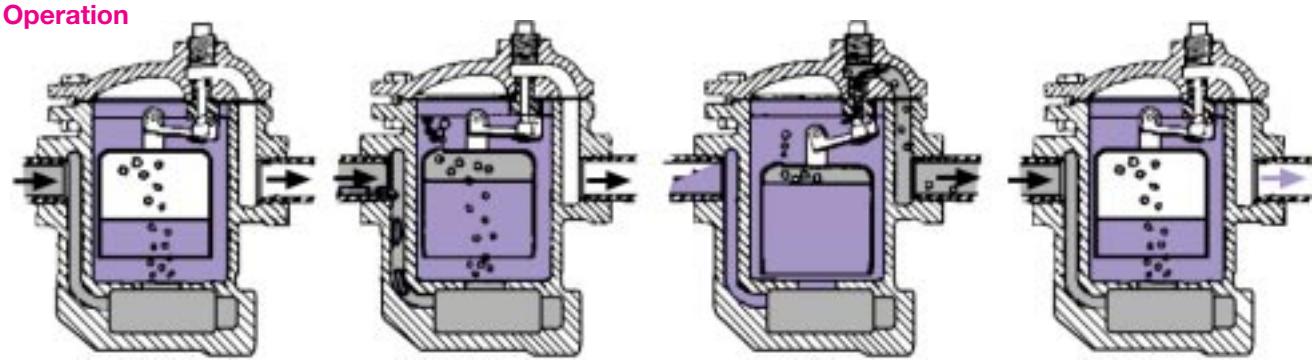
Options *See page B11*

- Repair Kits

Models

- **80S**–Low capacity horizontal w/integral strainer
- **81S**–Medium low capacity horizontal w/integral strainer
- **82S**–Medium capacity horizontal w/integral strainer
- **83S**–Medium high capacity horizontal w/integral strainer
- **85**–High capacity horizontal w/integral strainer
- **21**–Low capacity vertical
- **22**–Medium low capacity vertical
- **23**–Medium capacity vertical
- **25**–Medium high capacity vertical
- **26**–High capacity vertical

Operation



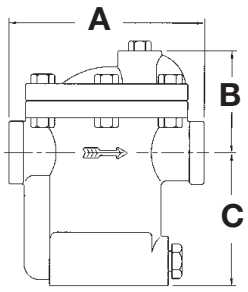
Trap Closed – After trap is installed and primed, steam entering the trap collects in the top of the bucket, floating the bucket and forcing the valve into its seat.

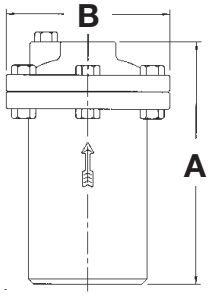
Trap Begins to Open – As condensate begins to flow into the trap, steam and air are forced from the bucket. This causes the bucket to begin losing buoyancy, tending to pull the valve from its seat.

Trap Discharges – When enough condensate has entered the trap, displacing the steam and air, the bucket drops, pulling the valve from the seat and allowing condensate and air to discharge.

Trap Closes – As the flow of condensate stops, steam enters the trap and refloats the bucket, forcing the valve into its seat. The cycle then repeats as more condensate reaches the trap.

DURA-FLO INVERTED BUCKET STEAM TRAPS





Connections: ½" – 2" NPT

Typical Specification

Furnish and install as shown on the plans, inverted bucket traps capable of discharging condensate, air and other non-condensible gases without loss of steam. These traps shall have a heavy cast iron body, hardened stainless steel valve and seat, all stainless steel linkage and bucket, and reusable Teflon® body gasket.

Maximum Operating Conditions

PMO: Max. Operating Pressure	see orifice selection	
TMO: Max. Operating Temperature	saturated at pressure	
PMA: Max. Allowable Pressure	250 psig	(114 barg)
TMA: Max. Allowable Temperature	450°F	(232°C)

Construction

Body & Cover:	Cast Iron ASTM-A-126/A48
Bucket & Linkage:	Stainless Steel
Valve & Seat:	Hardened Stainless Steel
Standpipe:	Steel Pipe
Cover Gasket:	Teflon®

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Dimensions

Model	NPT Size	Inches (mm)			Weight Lbs. (kg)
		A	B	C	
80S	1/2, 3/4	5 1/16 (129)	2 5/8 (67)	3 7/16 (87)	7 (3.2)
81S	1/2, 3/4	5 (127)	2 5/8 (67)	4 7/16 (113)	8 (3.6)
82S	1/2, 3/4	7 (178)	3 5/8 (92)	5 3/4 (146)	22 (10)
83S	3/4,1	8 1/8 (206)	5 (127)	7 3/8 (187)	32 (14.5)
85	1 1/2 ,2	10 1/4 (260)	8 3/16 (208)	8 1/16 (206)	74 (33.6)
21	1/2	6 3/8 (162)	4 1/4 (108)	—	6.5 (3)
22	1/2, 3/4	8 (203)	5 5/8 (143)	—	16 (7.3)
23	3/4,1	10 1/2 (267)	6 7/8 (175)	—	28 (12.7)
25	1, 1 1/2	14 3/8 (365)	9 1/16 (230)	—	60 (27.3)
26	1 1/2, 2	16 11/16 (424)	10 1/4 (260)	—	90 (40.9)

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

DURA-FLO CAPACITY TABLES

Trap	Orifice		0.50	1	5	10	15	20	25	30	40	60	70	80	100	125	130	150	180		200	225
250	Size	Differential	0.034	0.069	0.345	0.690	1.03	1.38	1.72	2.07	2.76	4.14	4.83	5.52	6.90	8.62	8.97	10.3	12.4		13.8	15.5
17.2																						
80S	3/16	20	200	270	450	560	640	690														
80S	1/8	80	80	110	200	300	360	420	460	500	540	620	660	690								
80S	7/64	125	-	55	90	145	195	260	305	345	400	485	525	565	640	680						
80S	7/69	150	-	-	70	110	150	200	240	270	310	380	410	440	480	540	545	570				
81S & 21	1/4	15	300	450	830	950	1060															
81S & 21	3/16	30	190	300	540	670	770	880	950	1000												
81S & 21	5/32	70	100	165	180	430	495	585	655	710	770	900	950									
81S & 21	1/8	125	70	130	220	340	390	460	515	560	610	710	760	800	860	950						
81S & 21	7/64	200	-	65	150	230	275	335	375	405	455	545	580	610	665	735	780	810	850		860	
81S & 21	7/69	250	-	-	100	150	190	240	270	290	340	420	450	470	520	575	585	620	670		700	730
760																						
82S & 22	5/16	15	570	850	1600	1900	2100															
82S & 22	1/4	30	350	500	950	1380	1630	1800	1900	2050												
82S & 22	3/16	70	250	420	785	950	1120	1260	1395	1500	1700	2000	2200									
82S & 22	5/32	125	180	300	560	680	800	900	995	1070	1220	1440	1550	1650	1800	2000						
82S & 22	1/8	200	100	180	325	465	505	575	650	710	805	980	1050	1105	1225	1375	1410	1500	1560		1600	
82S & 22	7/64	250	75	130	240	340	370	420	480	520	590	720	770	810	900	1010	1020	1100	1170		1230	1280
1300																						
83S & 23	1/2	15	1410	1880	2900	3500	3900															
83S & 23	3/8	30	990	1400	2300	2700	3300	3500	3800	4000												
83S & 23	5/16	60	600	940	1730	2045	2510	2825	2995	3135	3800	4400										
83S & 23	9/32	80	510	735	1350	1595	1960	2205	2340	2450	2880	3490	3800	4000								
83S & 23	1/4	125	385	600	1100	1300	1600	1800	1910	2000	2350	2850	3100	3300	3600	3900						
83S & 23	7/32	180	300	490	860	1165	1350	1595	1865	2085	2205	2510	2695	2820	3065	3185	3300	3500	3700			
83S & 23	3/16	250	255	400	700	950	1100	1300	1520	1700	1800	2050	2200	2300	2500	2600	2700	2800	3020		3200	3400
3500																						
85 & 25	3/4	15	3100	4160	7600	9000	10000															
85 & 25	9/16	30	1800	2900	5200	6400	7700	8500	9200	9800												
85 & 25	7/16	60	1400	2200	3800	5000	6000	6600	7100	7600	8300	9500										
85 & 25	3/8	100	1100	1700	3000	3600	4500	5200	5800	6100	7000	8500	9200	9700	10400							
85 & 25	11/32	130	900	1500	2600	3200	3900	4500	5000	5400	6200	7500	8050	8500	9600	10900	11000					
85 & 25	5/16	180	750	1200	2100	2600	3200	3700	4100	4500	5400	6600	7000	7257	8118	8979	9040.5	9500	10000			
85 & 25	9/32	225	600	970	1700	2100	2600	2950	3300	3600	4500	5400	5700	5900	6600	7300	7350	7850	8400		9200	9800
85 & 25	1/4	250	400	700	1200	1500	1900	2100	2400	2600	3200	3800	4000	4150	4600	5100	5150	5500	5950		6350	6650
7000																						
26	1-1/16	15	6240	8400	14500	17300	19200															
26	7/8	25	4100	5490	10000	12930	15620	18500	20000													

For Kg/Hr Multiply by .454

DURA-FLO INVERTED BUCKET STEAM TRAPS PCA REPAIR KITS

Quick, easy and economical

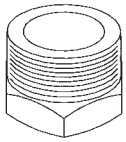
Simplifies and standardizes inventory

All stainless steel corrosion resistant internal parts

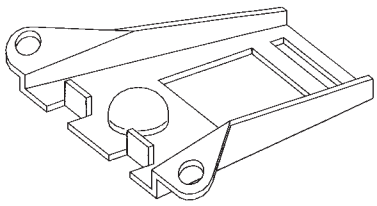
Hardened stainless steel condensate valves and seats for extra long life

Models

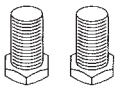
- **80S**–Orifice ratings 20, 80, 125, 150
- **81S & 21**–Orifice ratings 15, 30, 70, 125, 200, 250
- **82S & 22**–Orifice ratings 15, 30, 70, 125, 200, 250
- **83S & 23**–Orifice ratings 15, 30, 60, 80, 125, 180, 250
- **85 & 25**–Orifice ratings 15, 30, 60, 100, 130, 180, 225, 250
- **26**–Orifice ratings 15, 25, 40, 60, 80, 125, 180, 250



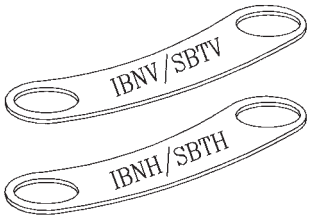
SEAT RING



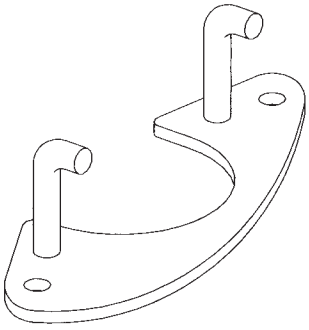
VALVE LINKAGE ASS'Y



CAP SCREWS (2 req'd)



NAMEPLATES (2 req'd)



PIVOT BRACKET

Supplied in a labeled, clear plastic bag.

FTN SERIES FLOAT & THERMOSTATIC STEAM TRAPS REPAIR KITS

High quality replacement kits

Rebuild existing F & T Traps far more economically than replacement

Quick, easy and economical

Simplifies and standardizes inventory

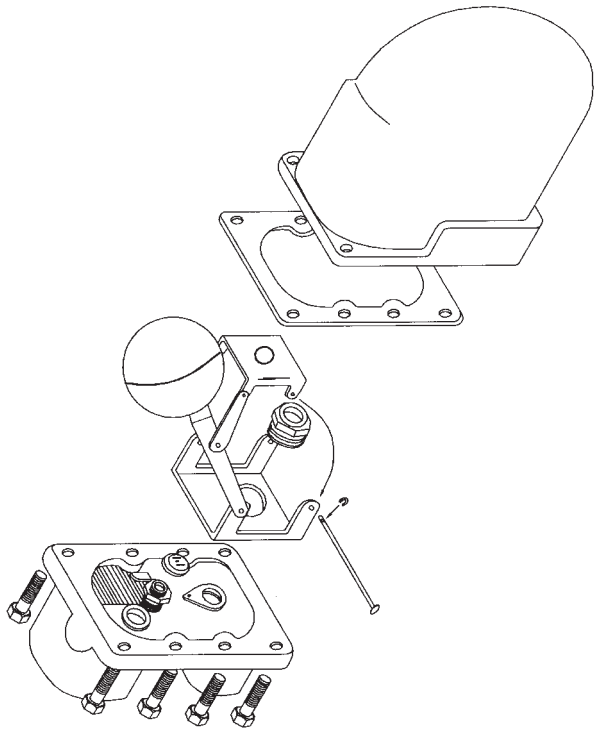
All stainless steel corrosion resistant internal parts

Hardened stainless steel condensate valves and seats for extra long life

Repairs other leading manufacturers' F & T Traps

Models

- **FTN-15** available in ¾", 1", 1¼", 1½" and 2"
- **FTN-30** available in ¾", 1", 1¼", 1½" and 2"
- **FTN-75** available in ¾", 1", 1¼", 1½" and 2"
- **FTN-125** available in ¾", 1", 1¼", 1½" and 2"



All ¾", 1" and 1¼" FTN-15 and FTN-30 supplied with cover assembly.

All 1¼", 1½" and 2" FTN-75 and FTN-125 supplied as mechanism complete.

Consult factory for latest crossover fitments.

See page B7 for Capacity Charts

Series H Super Capacity Float & Thermostatic Steam Traps

Pressures To 450 PSIG (31 barg) Temperatures to 500°F (260°C)

Features

- "H" series offer rugged cast iron body and cover
- "HS" series offer cast steel body and cover
- Stainless steel float and lever mechanism
- Heat treated chrome steel valve and seat
- "12" & "13" series–single seat condensate orifice
- "14" & "23" series–double seat condensate orifice
- Integral thermostatic air vent encased by stainless steel cage for pressures up to 250 psig (114 barg)
- When pressures exceed 250 all "13HS" and "14HS" models are not furnished with air vents. Venting can be accomplished by addition of thermostatic bellows trap to external piping.

Models

- **12H**–Cast iron, standard super capacity, single seat
- **13H**–Cast iron, high super capacity, single seat
- **23H**–Cast iron, standard super capacity, double seat
- **14H**–Cast iron, high super capacity, double seat

* Add "S" for steel construction on 13H through 23H

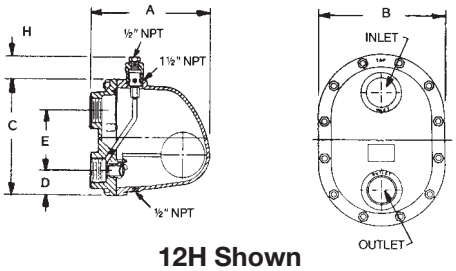
Options

- Floor mounting brackets for "13" and "14" series traps (recommended for pressures above 30 psig)
- Integral vacuum breaker for pressures to 150 psig
- Armored gage glass for 13H, 13HS, 14H and 14HS series for pressures to 250 psig (114 barg) @ 425°F (218°C).

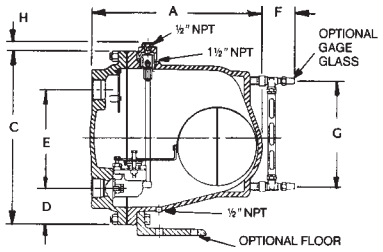
Operation

During startup, air and non-condensible gases enter the trap and are automatically vented through an accurate balanced pressure internal thermostatic air vent. As condensate enters the trap, the float and lever mechanism is raised, lifting the valve off the seat, discharging the condensate. Condensate will continue to be discharged at the same rate at which it is entering. Any air or non-condensible gas that may accumulate will be continually and efficiently passed by the thermostatic air vent.

SERIES H SUPER CAPACITY FLOAT & THERMOSTATIC STEAM TRAPS



12H Shown
23H Similar



13H/HS Shown
14H/HS Similar

Connections: 2" or 2½" NPT

Typical Specification

Steam trap shall be of float and thermostatic design. Float shall actuate the valve via a hinged lever and linkage. Air vent shall be of balanced pressure design with stainless steel welded encapsulated bellows capable of discharging air and noncondensable gases continuously within 15°F of saturated temperature. Trap shall be cast iron or cast steel bodied suitable for pressures to 450 psi and available in 2" and 2-1/2" NPT.

Maximum Operating Conditions

PMO: Max. Operating Pressure		see orifice selection	
TMO: Max. Operating Temperature		saturated at pressure	
PMA: Max. Allowable Pressure	CI	250 psig	(17.2 barg)
	CS	450 psig	(31.0 barg)
TMA: Max. Allowable Temperature	CI	450°F	(232°C)
	CS	500°F	(260°C)

Materials of Construction

Body & Cover:	"H" Series Cast Iron "HS" Series Cast Steel
Body & Cover Gasket:	Non-asbestos
Valve & Seat:	Heat Treated Chrome Steel
Thermostatic Air Vent:	Phosphor-bronze Bellows, Encased w/SS Cage

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Dimensions

Model	Inches (mm) A	B	C	D	E	F	G	H	Weight lbs (kg)
12H	13 1/16 (348)	9 1/16 (264)	13 1/16 (332)	2 15/16 (75)	6 5/8 (168)	—	—	1 13/16 (460)	80 (36.4)
13 & 14H	19 3/4 (502)	14 3/4 (375)	20 1/4 (514)	4 3/16 (106)	11 5/16 (287)	3 3/4 (95)	12 (305)	5/8 (16)	196 (89)
13 & 14HS	20 (508)	15 1/4 (387)	20 (508)	4 3/16 (106)	11 5/16 (287)	3 3/4 (95)	12 (305)	5/8 (16)	290 (132)
23H	14 1/16 (373)	9 1/16 (246)	13 1/16 (332)	2 15/16 (75)	6 5/8 (168)	—	—	1 13/16 (460)	87 (39.5)

Maximum Capacity–lbs/hr (10°F Below Saturation)

Trap	Pipe Size	Orifice	Differential – PSIG (barg) ¼ (.017)	½ (.034)	1 (.069)	2 (.138)	5 (.345)	10 (.690)	15 (1.03)	20 (1.38)	30 (2.07)	50 (3.45)	75 (5.17)	100 (6.90)	125 (8.62)	150 (10.3)	175 (12.1)	200 (13.8)	250 (17.2)	300	400 (20.7)	450 (27.6)	(31.0)
12H-15	2	1 1/16	5585	7900	10100	12500	17000	21600	25000														
12H-30	2	¾	2335	3900	5500	7000	10900	14100	16000	18400	20000												
13HS-30 13H-30	2 or 2 ½	1 5/8	11670	16500	21000	26000	34000	40500	43200	46500	48000												
12H-75	2	9/16	2190	3100	3960	4900	5900	10000	11400	12000	13700	16500	19700										
13HS-100 13H-100	2 or 2 ½	1 1/8	5975	8450	11400	14500	20500	25000	28300	31500	35000	40600	45100	50000									
12H-125	2	½	2120	3000	3420	4100	4600	7100	9200	10500	11600	13100	15900	18300	19500								
13HS-150 13H-150	2 or 2 ½	7/8	5160	7300	9800	12500	17000	20000	22800	24000	27500	33500	37700	44000	49000	52000							
12H-175	2	7/16	1980	2800	330	3600	4200	6000	7100	7800	9500	10800	12000	14000	15500	17000	18000						
13HS-250 13H-250	2 or 2 ½	1 1/16	4275	6050	8100	10500	14000	17500	18500	20000	21500	24000	27000	31500	34000	37000	40000	43500	50000				
13HS-450 40000	2 or 2 ½	½	2760	3900	4500	5400	7200	9000	10200	12500	14000	16500	20000	23000	25500	27000	28500	30000	33000	35000	38500		
23H-50	2 ½	1 7/8	21200	30000	35000	42000	55000	67000	75000	79000	89000	10500											

For Kg/Hr Multiply by .454

THERMODYNAMIC STEAM TRAPS

NICHOLSON has a wide variety of Thermodynamic Steam Traps to accommodate applications through 600 psi. Most models utilize NICHOLSON 's exclusive Celtron® Cartridge. The Celtron® facilitates inline maintenance while simultaneously providing superior performance. The all-stainless NTD 600 is the value leader of the line, providing the performance NICHOLSON users have come to expect in a conventional, recognizable design.

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

NTD 600 Series Thermo-active Steam Traps

Pressures To 600 PSIG (41.3 barg)
Temperatures to 800°F (426°C)

Compact Design — Hardened stainless steel disc is the only moving part.

Inexpensive — Low initial cost is less expensive than repairable technologies.

Simplifies Installation — Works in any position.

Rugged — Handles water hammer and superheat.

Reliable, Efficient Operation — Blast discharge helps to eliminate dirt buildup and provides tight shutoff

Freeze resistant — Self draining design prevents freezing.

All Stainless Steel Construction — Resists both internal and external corrosion.

Easy to Monitor — Audible discharge cycle makes checking operation simple.

Models

- **NTD 600**–Thermodynamic Disc Trap

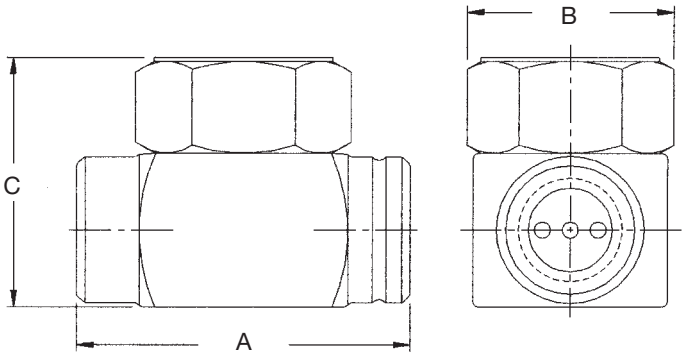
Applications

- Steam Tracing
- Drips
- Heating

Operation

Incoming air and condensate flow through the trap body and into the control chamber. Line pressure raises the disc off the seat allowing complete discharge. When flashing condensate enters the cartridge, flow velocity increases, creating low pressure underneath the disc. Flashing condensate at high velocity strikes the inside wall of the disc chamber and is deflected to the top of the disc causing a pressure buildup. The disc is forced down onto the seat by this pressure imbalance. The trap remains closed as flashed vapor in the control chamber keeps the disc seated. Pressure inside the cap is not lowered until the trapped flash vapor condenses due to body radiation. Condensing steam lowers the pressure above the disc. Disc is then lifted and the cycle repeated.

NTD 600 Series Thermo-active Steam Traps



Connections: ⅜" – 1" NPT

Typical Specification

Steam trap shall be of thermodynamic design. Body shall be of all stainless construction and hardened throughout. Seat shall be integral to body. Cover shall seal to body without gaskets or seals. Trap shall be suitable for pressures through 600 psi and available in 3/8" through 1".

Maximum Operating Conditions

PMO: Max. Operating Pressure	600 psig	(41.3 barg)
TMO: Max. Operating Temperature	800°F	(426°C)
PMA: Max. Allowable Pressure	600 psig	(41.3 barg)
TMA: Max. Allowable Temperature	800°F	(426°F)

Materials of Construction

Body:	420F SS ASTM A743 CA40F
Cap & Disc:	416 SS ASTM A582

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Dimensions in inches (mm)				Weight in Lbs. (kg)
Size	A	B	C	
3/8"	2 (51)	1 3/4 (44)	1 3/4 (44)	.8 (.36)
1/2"	2 11/16 (68)	1 3/4 (44)	2 (51)	1.2 (.55)
3/4"	2 13/16 (71)	2 5/16 (59)	2 7/16 (62)	1.85 (.86)
1"	3 5/16 (84)	2 1/2 (64)	2 7/8 (73)	3.1 (1.8)

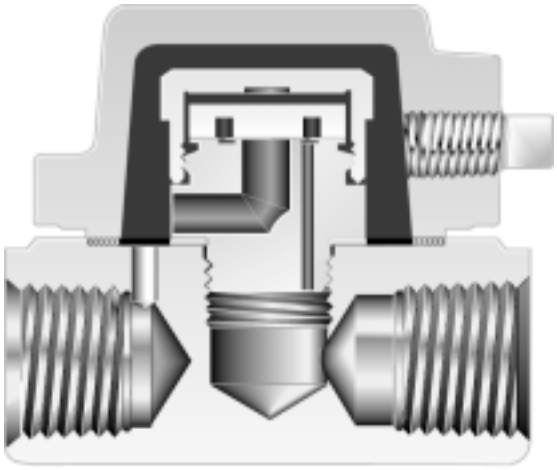
Maximum Capacity—lbs/hr 10°F Below Saturation

NPT Connection	Differential PSIG (barg)													
	3.5 (0.24)	5 (0.34)	10 (0.7)	20 (1.4)	30 (2.1)	50 (3.4)	75 (5.2)	100 (6.9)	150 (10.3)	200 (13.8)	300 (20.7)	400 (27.6)	500 (34.5)	600 (41.3)
3/8"	180	185	190	200	215	245	305	370	500	610	790	960	1100	1250
1/2"	300	310	345	410	465	575	700	810	1000	1140	1410	1630	1830	2000
3/4"	405	420	470	560	640	810	1000	1160	1450	1670	2100	2430	2750	3050
1"	640	670	725	865	980	1200	1470	1750	2200	2600	3250	3780	4250	4700

For Kg/Hr Multiply by .454

S610 Series Thermodynamic Steam Trap

Pressures To 600 PSIG (41.3 barg) Temperatures to 800°F (426°C)



Shown with optional tapped blowdown connection.

Applications
- Steam Tracing
- Drips
- Heating

Options
- Socketweld Connections
- Tapped Blowdown Connection
- Stainless Steel Blowdown Valve

Celtron®
plastic-packed replaceable cartridge for fast and simple replacement

Improved Energy Savings — Lowers steam waste due to steam jacketing. Trap cycle is unaffected by ambient temperatures or precipitation.

Extended Trap Life — Integral strainer keeps disc and seat clean. Non-violent discharge reduces wear. Heavy disc prevents warpage and improves performance.

Easily Maintained — Completely renewable without disturbing piping connections by removing cover, unscrewing and replacing Celtron® cartridge. Celtron® replacement cartridges are packaged individually with cover and gaskets in a protective bag.

Freeze Proof — When mounted vertically or on its side horizontally.

Multi-functional — Integral check valve eliminates need for additional fittings.

Economical — First cost and maintenance cost are low.

Spiral-wound Cover Gasket — assures positive closure.

Models
- **S610**–3/8" & 1/2" standard capacity
- **S610L**–Low capacity on S610
- **S610S**–Tapped blowdown connection on S610
- **S610LS**–Tapped blowdown connection on S610L
- **S610V**–Blowdown valve on S610
- **S610LV**–Blowdown valve on S610L
- **S611**–3/4" standard capacity
- **S611L**–Low capacity on S611
- **S611S**–Tapped blowdown connection on S611
- **S611LS**–Tapped blowdown connection on S611L
- **S611V**–Blowdown valve on S611
- **S611LV**–Blowdown valve on S611L
- **S612**–1" standard capacity
- **S612S**–Tapped blowdown connection on S612
- **S612V**–Blowdown valve on S612

Operation

Incoming air and condensate flow through the trap body and into the Celtron® cartridge. Line pressure raises the disc off the seat allowing complete discharge. When flashing condensate enters the cartridge, flow velocity increases, creating low pressure underneath the disc. Flashing condensate at high velocity strikes the inside wall of the disc chamber and is deflected to the top of the disc causing a pressure buildup. The disc is forced down onto the seat by this pressure imbalance. The trap remains closed as steam in the jacket prevents exposure of the Celtron® cartridge to ambient temperatures. Pressure inside the cap is not lowered until the trapped flash vapor condenses. Condensing steam lowers the pressure above the disc. Disc is then lifted and the cycle repeated.

S610 Series Thermodynamic Steam Trap

Typical Specification

Steam trap shall be of thermodynamic capsule design. Body shall be of forged carbon steel construction housing stainless steel Celtron capsule. Celtron capsule shall contain all working components. Capsule shall be hardened throughout. Seat shall be stress relieved to eliminate warpage. Trap shall contain integral strainer with available blowdown port and valve. Cover shall seal to body utilizing spiral wound graphite gasket. Trap shall be suitable for pressures through 600 psi and available in 3/8" through 1".

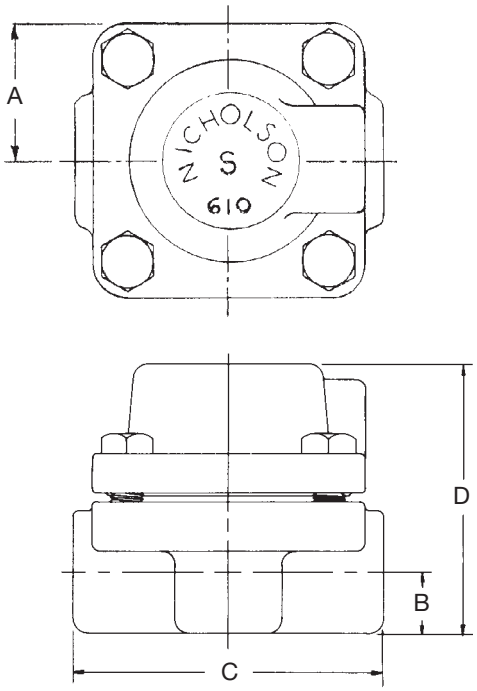
Maximum Operating Conditions

PMO: Max. Operating Pressure	600 psig	(41.3barg)
TMO: Max. Operating Temperature	800°F	(426°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(426°C)

Materials of Construction

Body & Cover:	ASTM A105 Forged Steel
Celtron® Cartridge:	416 Stainless Steel w/hardened disc & seat
Bolts:	High temperature alloy
Cover Gasket:	347 Stainless Spiral-wound w/graphite filler
Integral Strainer:	304 Stainless Steel

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST



Connections:
3/8"–1" NPT or Scoketweld

Dimensions in inches (mm)					Weight in Lbs. (kg).
Size	A	B	C	D	
3/8"– 1/2"	1 17/64 (32)	21/32 (17)	3 1/4 (83)	2 15/32 (63)	2.3 lbs (1.05)
3/4"	1 1/2 (38)	3/4 (19)	3 3/4 (95)	2 25/32 (71)	3.4 lbs (1.5)
1"	1 19/32 (40)	7/8 (22)	4 3/16 (106)	3 15/16 (100)	5 lbs (2.3)

DISCHARGE CAPACITIES IN LBS. PER HOUR OF CONDENSATE

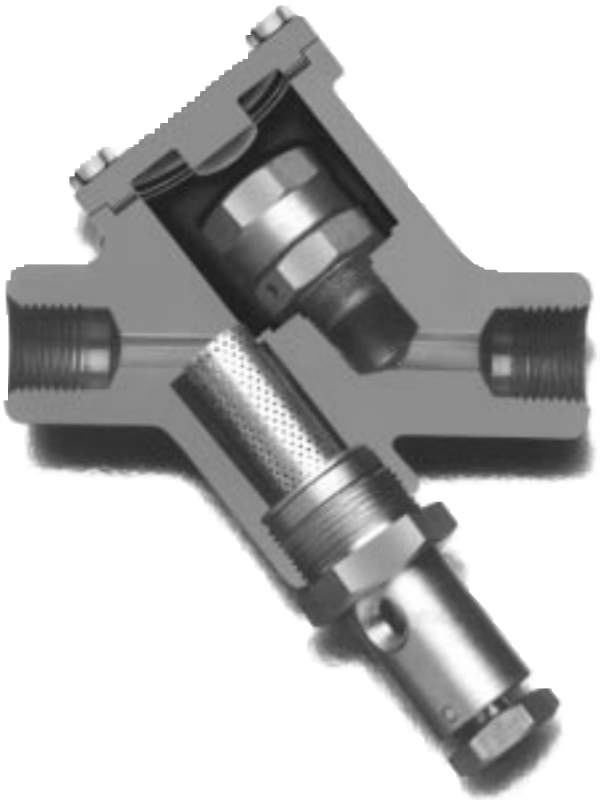
NPT Threaded or Socketweld Connections	Trap	Differential – PSIG (barg)									
		5 (0.34)	10 (0.7)	25 (1.7)	50 (3.4)	75 (5.2)	100 (6.9)	200 (13.8)	300 (20.7)	400 (27.6)	600 (41.3)
3/8" – 1/2"	S610L	105	150	235	330	395	435	550	630	690	790
3/8" – 1/2"	S610	240	265	420	590	700	770	980	1120	1240	1400
3/4"	S611	450	500	790	1130	1340	1460	1850	2100	2300	2630
3/4"	S611L	105	150	235	330	395	435	550	630	690	790
1"	S612	1090	1200	1900	2700	3200	3550	4450	5100	5650	6400

For Kg/Hr Multiply by .454

The S610 Series trap works efficiently at all line pressures between 2 and 600 psi and back pressures to 80% of line pressure.

S650 Series Thermo-active Steam Trap

Pressures To 600 PSIG (41.3 barg)
Temperatures to 800°F (427°C)



SHOWN WITH OPTIONAL BLOWDOWN VALVE

Space Saving — Design incorporates a built-in strainer and optional blowdown valve. Eliminates four connections and four fittings.

Improved Energy Savings — Lowers steam waste due to steam jacketing. Trap cycling is unaffected by ambient temperatures.

Non-violent Discharge — Soft discharge which is unique in a steam trap of this type.

Easily Maintained — Completely renewable without disturbing piping connections by removing cover, unscrewing and replacing Celtron® cartridge. Celtron® replacement cartridges are packaged individually with cover and gaskets in a protective bag. Optional blowdown valve permits easy strainer cleaning while in service.

Freeze Proof — When mounted vertically or on its side horizontally.

Low in Cost — Purchase and maintenance costs are low.

Applications
- Steam Tracing
- Drips
- Heating

Options
- Stainless Steel Blowdown Valve
- Socketweld Connections

Models
- **S650**–Y pattern body with screen and blowdown port tapped and plugged
- **S650L**–Low capacity on S650
- **S650B**–Y pattern body with screen and blowdown port tapped and plugged
- **S650BL**–Low capacity on S650B

Celtron®
plastic-packed replaceable cartridge for fast and simple replacement

Operation

Incoming air and condensate flow through the trap body and into the Celtron® cartridge. Line pressure raises the disc off the seat allowing complete discharge. When flashing condensate enters the cartridge, flow velocity increases, creating low pressure underneath the disc. Flashing condensate at high velocity strikes the inside wall of the disc chamber and is deflected to the top of the disc causing a pressure buildup. The disc is forced down onto the seat by this pressure imbalance. The trap remains closed as steam in the jacket prevents exposure of the Celtron® cartridge to ambient temperatures. Pressure inside the cap is not lowered until the trapped flash vapor condenses. Condensing steam lowers the pressure above the disc. Disc is then lifted and the cycle repeated.

S650 Series Thermo-active Steam Trap

Typical Specification

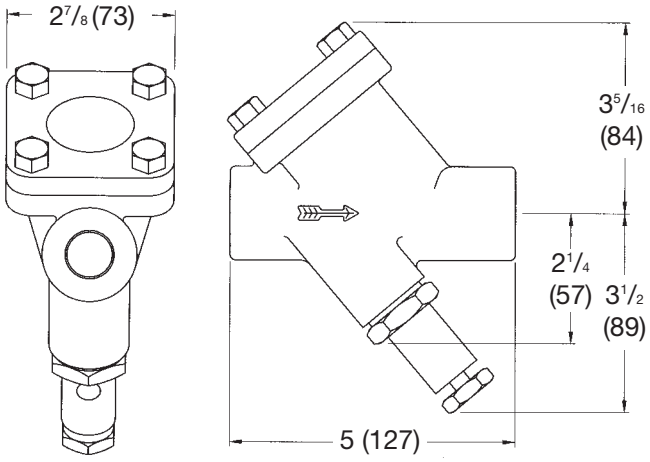
Steam trap shall be of thermodynamic capsule design. Body shall be of forged carbon steel construction housing stainless steel Celtron capsule. Celtron capsule shall contain all working components. Capsule shall be hardened throughout. Seat shall be stress relieved to eliminate warpage. Trap shall contain integral Y pattern strainer with available blowdown valve. Cover shall seal to body utilizing spiral wound graphite gasket. Trap shall be suitable for pressures through 600 psi and available in 1/2"-3/4" NPT.

Maximum Operating Conditions

PMO: Max. Operating Pressure	600 psig	(41.3 barg)
TMO: Max. Operating Temperature	800°F	(426°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	800°F	(426°C)

Materials of Construction

Body & Cover:	ASTM A105 Forged Steel
Celtron Cartridge:	416 Stainless Steel w/hardened disc & seat.
Cover Gasket:	347 stainless spiral wound w/graphite fill
Strainer:	.033 perf. 304 Stainless Steel
Blowdown Valve:	416 Stainless Steel



Dimensions in inches (mm)
Shown with optional blowdown valve
Weight: 5 lbs. (2.3 kg)

Connections:
1/2" or 3/4" NPT or socketweld

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Differential PSIG (barg)									
	5 (0.34)	10 (0.7)	25 (1.7)	50 (3.5)	75 (5.2)	100 (6.9)	200 (13.8)	300 (20.7)	400 (27.6)	600 (41.3)
S650L, S650BL	105	150	235	330	395	435	550	630	690	790
S650, S650B	240	265	420	590	700	770	980	1120	1240	1400

For Kg/Hr Multiply by .454

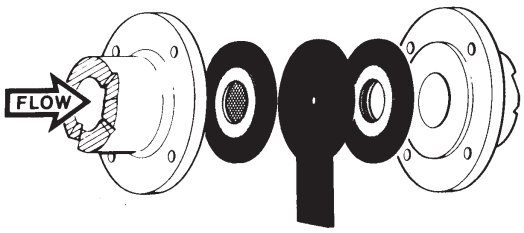
ORIFICE STEAM TRAPS

NICHOLSON is an industry leader in orifice technology for condensate removal. The NICHOLSON technology (developed in conjunction with the US Navy in the 1970's) has provided nuclear and conventional vessels with safe, efficient condensate removal for more than a quarter century. This technology, adapted to commercial and industrial applications, provides consistent condensate removal via virtually maintenance free devices. These products, with life spans exceeding 10 years, further the NICHOLSON reputation for providing high performance products at competitive prices.

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

TYPE DFA DRAIN ORIFICE STEAM TRAP

Pressures To 2500 PSIG (172 barg)
Temperatures to 750°F (400°C)



Applications

- Pressure Reduction
- Ratio of Flow-mixing two or more fluids at fixed ratio
- Fixed Flow-i.e. gland seal recirculation of cooling water on pumps, compressors, process analyzers, etc.
- Intermittent Drainage-i.e. air tools, air storage tanks, cleaning fixtures, air vents, etc.
- Cryogenic Storage Venting
- Low Pressure Blanking
- Sampling of process fluids at a fixed flow rate for use with Instrument Analyzers

Maintenance Benefits

- Typical service life exceeds 10 years.
- Zero maintenance costs over the service life of the Orifice.
- No moving parts offers maintenance free operation when properly installed.
- Low spare parts inventory.
- Easy to install.

Energy Saving Benefits

- Design factor results in reduced initial steam loss.
- Fuel savings to 50% achieved in applications during past 10 years.
- Maintains low rate of steam loss over entire service life.
- Cannot fail open, eliminating large steam losses.

Operating Benefits

- Accommodates varying condensate loads created by modulating pressures.
- Freeze proof.
- Resists thermal and hydraulic shock.
- Reduces make-up water to boiler and water chemical treatment costs.
- Maintains constant pressure to condensate return systems.
- Meets MS 18301 Specifications.

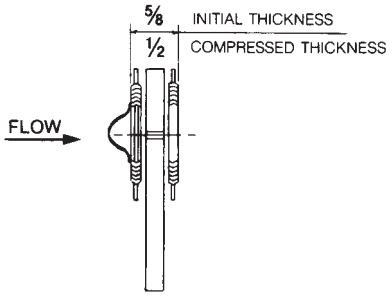
Models

- **DFA**–Drain Orifice Trap with gaskets and inlet screen.
- **DFR**–Replacement gasket kit including inlet screen.

Operation

The Nicholson Drain Orifice Trap is an engineered, continuous flow device. The controlling element in the Drain Orifice Assembly is a flat S.S. plate, 1/4" thick. Drain Orifices discharge air, condensate and all other non-condensible gases with minimal live steam loss. The fixed orifice size is calculated, for a given application, to discharge the condensate load at a maximum thermal efficiency. Approximately 10-25% of discharging hot condensate flashes to steam at the downstream side of the orifice, at a constant pressure drop. This flashing effect further restricts the flow of saturated steam, In actual conditions, a minimum percentage of steam, by weight, is discharged with condensate, since the specific volume of steam is large compared to that of the condensate. The velocity through the orifice is highly turbulent. The initial calculated steam loss can be expected to remain relatively constant over the expected 10+ years trap life. The major factor for energy efficient performance is based on initial orifice sizing for the application. Properly sized, thermal efficiencies of 98%+ can be attained. The Drain Orifice Trap is ideally suited for use on high pressure steam (saturated or super-heated) from 600 PSIG to 2500 PSIG with minimum steam loss, zero maintenance and long service life.

TYPE DFA DRAIN ORIFICE STEAM TRAP



Connections: 1/2" – 1" NPT

Typical Specification

Orifice Drain shall comply with MILSPEC MS 18301 consisting of 1/4" 304 stainless orifice plate fixed between user supplied flanges. It shall be sealed by spiral wound gaskets. Inlet gasket shall be modified with a stainless steel dome mesh strainer affixed across the inside diameter. Orifice shall be sized for the application to a minimum of 0.020".

Maximum Operating Conditions

PMO: Max. Operating Pressure	2500 psig	(172 barg)
TMO: Max. Operating Temperature	750°F	(400°C)
PMA: Max. Allowable Pressure	2500 psig	(172 barg)
TMA: Max. Allowable Temperature	750°F	(400°C)

Materials of Construction

Inlet Gasket: Spiral-wound 347 S.S./Graphite w/S.S. 60 mesh dome strainer insert

Orifice Plate: 304 S.S., 1/4" thick

Outlet Gasket: Spiral-wound 347 S.S./Graphite

Customer to supply ANSI B16.5 flanges.

Sizing

Consult Factory–required information:

Condensate Load _____
Inlet Pressure _____
Outlet Pressure _____
Elevation of return line over trap (if any) _____

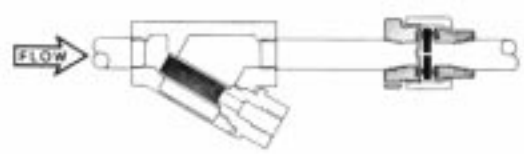
APPLICATION GUIDE

SELECTION CHECKLIST

Dimensions

Pipe Size NPT	Min. Pipe Bore (in.)	Min. Orifice
1/2"	9/16	.020
3/4"	3/4	.020
1"	7/8	.020

TYPE DUA ORIFICE UNION & DUM-T DRAIN UNION ASSEMBLY



Pressures To 3000 PSIG (207 barg) Temperatures to 850°F (454°C)

Reliable Operation — High reliability labyrinth-type seal: leak tight seal is maintained when subjected to expansion or contraction due to temperature or pressure changes in the line. Positive, leak-tight seal eliminates loss of product.

Ease of Installation — No danger of damaging seats or losing seal by overtorquing during installation. Requires normal torque to obtain a leak-tight seal. Welding repairs reduced; no need to replace union components welded to pipe.

Low Cost Maintenance — Downtime, labor and material costs drastically reduced. Service is required only when the union is disassembled, then only a change of gaskets is required to put it back in service. Eliminates the need to replace the union housing.

Flexibility — Orifice easily replaced where a different orifice size is required for a specific application. Orifice can be re-drilled to a larger size, if necessary, eliminating need to replace the entire assembly. Infinite range of orifice sizes available from a minimum 0.020" diameter.

Applications

- Condensate Removal
- Pressure Reduction
- Ratio of Flow-mixing two or more fluids at fixed ratio
- Fixed Flow-i.e. gland seal recirculation of cooling water on pumps, compressors, process analyzers, etc.
- Intermittent Drainage-i.e. air tools, air storage tanks, cleaning fixtures, air vents, etc.
- Cryogenic Storage Venting
- Low Pressure Blanking
- Sampling of process fluids at a fixed flow rate for use with Instrument Analyzers

Options

- Blowdown Valve (on DUM-T)

Models

- **DUA**–Orifice Union
- **DUM-T**–Orifice Union Module consisting of Y strainer and connecting nipple.
- **RUA**–Orifice Kit includes gasket, orifice plate and inlet screen.
- **DUR**–Orifice Kit includes gasket set with inlet screen.

Operation

The Nicholson Drain Orifice Trap is an engineered, continuous flow device. The controlling element in the Drain Orifice Assembly is a flat S.S. plate, 1/4" thick. Drain Orifices discharge air, condensate and all other non-condensible gases with minimal live steam loss. The fixed orifice size is calculated, for a given application, to discharge the condensate load at a maximum thermal efficiency. Approximately 10-25% of discharging hot condensate flashes to steam at the downstream side of the orifice, at a constant pressure drop. This flashing effect further restricts the flow of saturated steam, In actual conditions, a minimum percentage of steam, by weight, is discharged with condensate, since the specific volume of steam is large compared to that of the condensate. The velocity through the orifice is highly turbulent. The initial calculated steam loss can be expected to remain relatively constant over the expected 10+ years trap life. The major factor for energy efficient performance is based on initial orifice sizing for the application. Properly sized, thermal efficiencies of 98%+ can be attained. The Drain Orifice Trap is ideally suited for use on high pressure steam (saturated or super-heated) from 300 PSIG to 3000 PSIG with minimum steam loss, zero maintenance and long service life.

TYPE DUA ORIFICE UNION & DUM-T DRAIN UNION ASSEMBLY

Typical Specification

Orifice Union shall consist of 1/4" 304 stainless steel plate fixed inside a gasketed union housing. Seal shall be provided by spiral wound gaskets whose inlet shall be modified with a stainless steel dome mesh strainer fixed across the inside diameter. Orifice shall be sized for the application to a minimum of 0.020 inches.

Maximum Operating Conditions

DUA

PMO: Max. Operating Pressure — see Chart
TMO: Max. Operating Temperature — see Chart

DUM-T

PMO: Max. Operating Pressure

Cast Steel Strainer	600 psig	(41 barg)
Cast Iron Strainer	250 psig	(17.2 barg)

TMO: Max. Operating Temperature

Cast Steel Strainer	700°F	(371°C)
Cast Iron Strainer	425°F	(218°C)

Materials of Construction

Body:	Forged Carbon Steel
Inlet Gasket:	Spiral-wound S.S./Graphite w/S.S. 60 mesh dome strainer insert
Orifice Plate:	304 S.S., 1/4" thick
Outlet Gasket:	Spiral-wound S.S./Graphite

DUM-T only

Strainer Body:	Cast Iron or Cast Steel
Nipple:	Steel SCH 80

Sizing

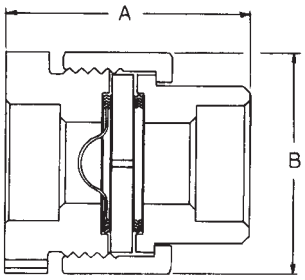
Consult Factory–required information:

- Condensate Load _____
- Inlet Pressure _____
- Outlet Pressure _____
- Elevation of return line over trap (if any) _____

Temperature/Pressure Ratings

Temperature* °F	Pressure (PSIG) Carbon Steel
100	3000
200	2735
300	2655
400	2565
500	2425
600	2220
700	2155

*Minimum recommended temperature is -20°F.



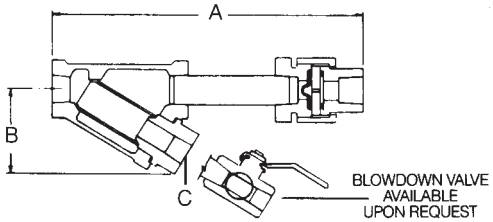
DUA

Connections: 1/2" – 1" NPT

Dimensions

Pipe Size NPT	Inches A	Inches B	Weight Lbs.*
1/2	2.42	1.8	1.2
3/4	2.73	2.20	1.8
1	2.94	2.57	2.6

*Average weight-actual weights may vary slightly.



DUM-T

Connections: 1/2" – 1" NPT

Dimensions

Class	Pipe Size NPT	Inches A	Inches B	Inches C	Weight Lbs.*
250 PSIG	1/2	9.00	2.19	3/8	3.2
	3/4	10.25	2.75	1/2	5.0
	1	11.12	3.25	3/4	7.8
600 PSIG	1/2	9.00	3.12	1/4	3.6
	3/4	9.88	3.63	3/8	5.8
	1	10.88	4.25	1/2	9.6

*Average weight-actual weights may vary slightly.

APPLICATION GUIDE

SELECTION CHECKLIST

CLEAN STEAM PRODUCTS

Clean Steam is high purity steam that is sterile and pyrogen free. It is used by hospitals and research institutions as well as in the Pharmaceutical, Biotechnical, Electronics, Food and Cosmetics Industries.
NICHOLSON has become an innovator in Clean Steam applications through extensive research and development, working closely with major engineering firms in the pharmaceutical and biotechnical industries throughout the United States. From revolutionary new designs such as the CDH Series to the value oriented DS100 Series, **NICHOLSON** innovations set the standard for Clean Steam management.

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

CDS Sanitary Thermostatic Steam Traps

Pressures To 100 PSIG (6.7 barg)
Temperatures to 338°F (170°C)

Steepest Interior Surfaces—Designed to completely drain without puddling, even in screwed lines.

Stainless Steel Body—Body Material is 316L Stainless Steel with 20 µ in. Ra internal finish and 32 µ in. Ra external finish. Available with mechanical polishing to 10 µ in. Ra and/or electropolish.

Self centering Valve—Leak tight shut off. Assembly of actuator and valve to impingement plate allows the valve to self align with center of the orifice.

Temperature Sensitive Actuator—One moving part. Inconel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Directional Discharge—Erosion prevented by directing discharge to center of piping.

Maintenance—Can be easily removed and disassembled for sterilization and/or repair.

Three Year Guarantee—Guaranteed for three years against defects in material or workmanship.

Food Grade Gasket—White EPDM food grade gasket offers superior performance for higher pressure steam applications.

Large Orifice Selection—Broad selection of orifice sizes provide greatest sizing and selection flexibility.

Superior Air Handling—Best air handling capability provides for fast startup.

Unique SLR Orifice Option—Provides drainage at saturated temperatures, instant reaction to load changes and guaranteed fail-open operation for extra critical operations.

Applications
- CIP/SIP System Condensate Drainage
- Sterilization of Process Vessels
- Culinary Steam
- Humidifiers
- WFI System Sterilization
- Fermenter Sterilization

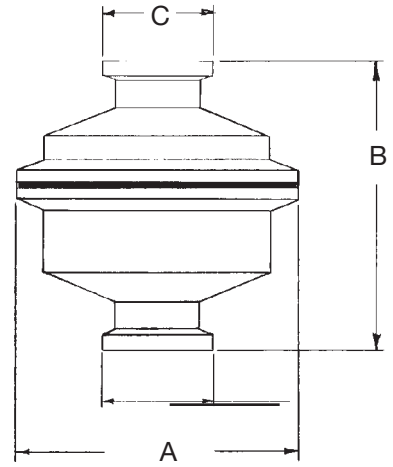
Options
- Mechanical Polish to 10 Ra
- Electropolish
- SLR Orifice

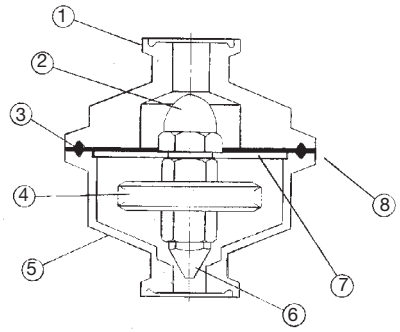
Models
- **CDS202**–Low capacity
- **CDS203**–Medium capacity
- **CDS204**–High capacity

Operation

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open to discharge air, non-condensibles and condensate. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from the actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

CDS Sanitary Thermostatic Steam Traps





Connections: 1/2" – 1½" Ferrule

Typical Specification

Steam trap shall be of balanced pressure design with inconel welded bellows capable of releasing condensate within 10°F of saturated pressure. All other interior wetted components shall be of 316 or 316L stainless. It shall have interior body finish of at least 20 µ in. Ra and exterior body finish of at least 32 µ in. Ra. Trap shall utilize sanitary body clamp allowing disassembly for inspection or cleaning and be entirely self draining when installed in vertical configuration. Thermostatic actuator shall employ a conical valve lapped to the seat. A minimum of three orifices shall be available.Traps shall have SLR orifice where drainage at saturated temperatures is required. Traps shall be guaranteed against defects for 3 years.

Maximum Operating Conditions

PMO: Max. Operating Pressure	100 psig	(6.9 barg)
TMO: Max. Operating Temperature	338°F	(170°C)
PMA: Max. Allowable Pressure	150 psig	(10.3 barg)
TMA: Max. Allowable Temperature	366°F	(186°C)

Body Surface Finish

<20 µ in. Ra internal

<32 µ in. Ra external

optional mechanical polishing to 10 µ in. Ra and/or electropolish

Gasket Approvals

FDA, USDA, USPH,
3A Sanitary Standard, NSF

Service Notes

Trap is designed to be self draining for vertical installation (discharge down).

½" - ¾" service trap should be installed with ¾" gasket on inlet.

1" - 1½" service trap should be installed with 1½" gasket on inlet.

SLR Orifice Option

Specify when immediate elimination of condensate and improved sensitivity is desired. A 1/32" orifice at the apex of the valve allows for continuous discharge of condensate. Trap will nominally pass 50 lb/hr of condensate at 50 psi within 2°F of saturated temperature.

Dimensions

Service	inches (mm)			Weight Lbs. (kg)
	A	B	C	
½", ¾"	2 1/2	2 5/8	63/64	1.8
1", 1 1/2"	2 1/2	2 5/8	1 63/64	2.3

Materials of Construction

Item	Part Name	Material
1	Body – Inlet	316L
2	Actuator Nut	316
3	Gasket	Viton
4	Actuator	Inconel
5	Body – Outlet	316L
6	Valve	316
7	Clamp (not shown)	304
8	Centering Plate	316

SIZING INFO

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Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation

Trap	Orifice Inches	Differential PSIG (bar)										
		5 (0.34)	10 (0.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.4)	60 (4.2)	70 (4.9)	80 (5.6)	90 (6.2)	100 (6.9)
CDS 202	5/32	291 (132)	411 (186)	581 (264)	719 (326)	831 (377)	919 (417)	1000 (454)	1075 (488)	1130 (513)	1174 (533)	1207 (547)
CDS 203	1/4	550 (249)	825 (374)	1210 (549)	1495 (678)	1750 (794)	1975 (896)	2175 (987)	2350 (1066)	2525 (1145)	2650 (1202)	2825 (1281)
CDS 204	5/16	861 (391)	1217 (552)	1722 (781)	2150 (975)	2475 (1123)	2722 (1235)	2940 (1334)	3125 (1417)	3290 (1492)	3450 (1565)	3575 (1622)

For Kg/Hr Multiply by .454

CDH Sanitary Thermostatic Steam Traps

Pressures To 100 PSIG (6.7 barg)
Temperatures to 338°F (170°C)

Universally Configurable—Horizontal connections from any direction on standard model; AI and AO models feature one multi-directional horizontal and one vertical connection.

Steepest Interior Surfaces—Designed to completely drain without puddling, even in significantly sloped lines.

Stainless Steel Body—Body Material is 316L Stainless Steel with 20 µ in. Ra internal finish and 32 µ in. Ra external finish. Available with mechanical polishing to 10 µ in. Ra and/or electropolish.

Self centering Valve—Leak tight shut off. Assembly of actuator and valve to impingement plate allows the valve to self align with center of the orifice.

Temperature Sensitive Actuator—One moving part. Inconel, fail open, welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

One Size Suits Most Services—Universal ferruled end connection fits both 1/2" and 3/4" piping.

Maintenance—Can be easily removed and disassembled for sterilization and/or repair.

Four Year Guarantee—Guaranteed for four years against defects in material or workmanship.

Food Grade Gasket—White Viton food grade gasket offers superior performance for higher pressure steam applications.

Superior Air Handling—Best air handling capability provides for fast startup.

Unique SLR Orifice Option—Provides drainage at saturated temperatures, instant reaction to load changes and guaranteed fail-open operation for extra critical operations.

Models

- **CDH**–Horizontal inlet and outlet
- **CDH-AI**–Horizontal inlet, vertical outlet
- **CDH-AO**–Vertical inlet, horizontal outlet

Applications

- CIP/SIP System Condensate Drainage
- Sterilization of Process Vessels
- Culinary Steam
- Humidifiers
- WFI System Sterilization
- Fermenter Sterilization

Options

- Mechanical Polish to 10 Ra
- Electropolish
- SLR Orifice

Operation

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open to discharge air, non-condensibles and condensate. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from the actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

CDH Sanitary Thermostatic Steam Traps

Typical Specification

Steam trap shall be of balanced pressure design with inconel welded bellows capable of releasing condensate within 10°F of saturated pressure. All other interior wetted components shall be of 316 or 316L stainless. It shall have interior body finish of at least 20 µ in. Ra and exterior body finish of at least 32 µ in. Ra. Trap shall utilize sanitary body clamp allowing disassembly for inspection or cleaning and be entirely self draining in horizontal or angle piping configuration. Thermostatic actuator shall employ a conical valve lapped to the seat. Traps shall have SLR orifice where drainage at saturated temperatures is required. Traps shall be guaranteed against defects for four years.

Maximum Operating Conditions

PMO: Max. Operating Pressure	100 psig	(6.9 barg)
TMO: Max. Operating Temperature	338°F	(170°C)
PMA: Max. Allowable Pressure	150 psig	(10.3 barg)
TMA: Max. Allowable Temperature	366°F	(186°C)

Connection

Sanitary Ferrule accommodates ½" and ¾" service

Body Surface Finish:

<20 µ in. Ra internal

<32 µ in. Ra external

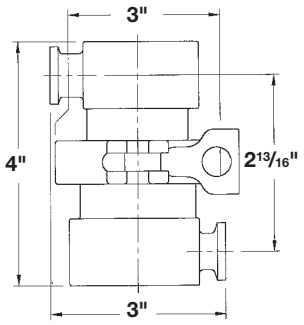
optional mechanical polishing to 10 µ in. Ra and/or electropolish

Gasket Approvals:

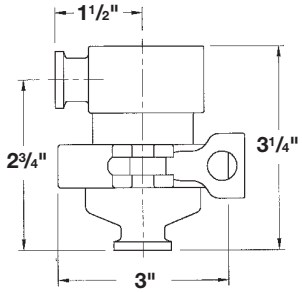
FDA, USDA, USPH,
3A Sanitary Standard, NSF

SLR Orifice Option

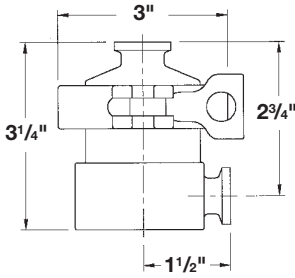
Specify when immediate elimination of condensate and improved sensitivity is desired. A 1/32" orifice at the apex of the valve allows for continuous discharge of condensate. Trap will nominally pass 50 lb/hr of condensate at 50 psi within 2°F of saturated temperature.



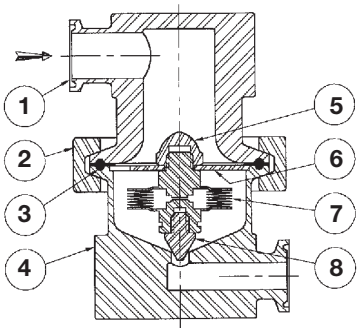
CDH – 3.9 lb.



CDH-AI – 2.6 lb.



CDH-AO – 3.1 lb.



Connections: 1/2/3/4" Ferrule

Materials of Construction

Item	Part Name	Material
1	Body – Inlet	316L
2	Clamp	304
3	Gasket	Viton
4	Body – Outlet	316L
5	Actuator Nut	316
6	Centering Plate	316
7	Actuator	Inconel
8	Valve	316

SIZING INFO

APPLICATION GUIDE

SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation

Trap	Orifice Inches	Differential PSIG (bar)										
		5 (0.34)	10 (0.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.4)	60 (4.2)	70 (4.9)	80 (5.6)	90 (6.2)	100 (6.9)
CDH	1/4	550 (249)	825 (374)	1210 (549)	1495 (678)	1750 (794)	1975 (896)	2175 (987)	2350 (1066)	2525 (1145)	2650 (1202)	2825 (1281)

For Kg/Hr Multiply by .454

DS100 Series Thermostatic Steam Traps

Pressures To 150 PSIG (10.3 barg)
Temperatures to 366°F (186°C)

Stainless Steel Body—Body materials of all models are Type 316L Stainless Steel.

Self Centering Valve—Leak tight shut off. Assembly of actuator and valve to impingement plate allows valve to self-align with center of valve seat orifice. Provides long lasting valve and seat.

Temperature Sensitive Actuator—316L Stainless welded actuator for maximum corrosion, thermal and hydraulic shock resistance. One moving part.

Thermal and Hydraulic Shock Resistant—Impingement plate plus welded construction prevents damage to actuator.

Long Life Valve and Seat—Stainless steel valve and seat matched together for water tight seal.

Maintenance—All models are sealed and maintenance free.

Directional Discharge—Erosion prevented by directing discharge into the center of pipe or tubing.

Best Air Handling Capacity—Fast start up and operation.

Fast Response—Quickly adjusts to condensate load or temperature changes.

One Size Suits Most Services—Universal ferruled end connection fits both 1/2" and 3/4" piping.

Two Year Guarantee—Trap guaranteed for two years against defects in material or workmanship.

Models

- **DS100**–Ferrule clamp end 1⅞" OAL
- **DS100TE**–Tube end
- **DS110**–Ferrule clamp end 2⅝" OAL

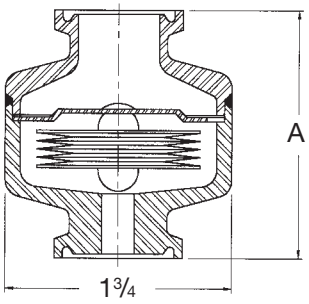
Applications

- CIP/SIP System Condensate Drainage
- Sterilization of Process Vessels
- Culinary Steam
- Humidifiers
- WFI System Sterilization
- Main Drips

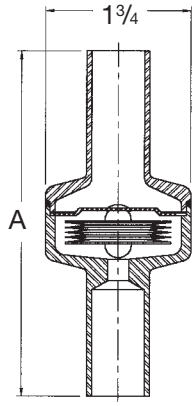
Operating Principle

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open to discharge air, non-condensibles and condensate. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

DS100 Series Thermostatic Steam Traps



Ferrule Connection



Tube Connection

Connections: 1/2" – 1" Tube
1/2/3/4" Ferrule

Specification

Steam trap shall be thermostatically actuated and maintenance free. Actuator shall be of single piece, fail open design consisting of 1.2" diameter, welded 316L stainless plates. Trap shall be constructed entirely of 316L stainless steel components with wetted body surfaces finished to 20 µ inch Ra or better. Trap shall be self draining when installed vertically in piping systems. Trap shall have tube or universal ferruled connections. Ferruled connections shall be Tri-clamp® compatible and designed to fit both ½" and ¾" service. Trap shall be guaranteed against defects for 2 years.

Maximum Operating Conditions

PMO: Max. Operating Pressure	150 psig	(10.3 barg)
TMO: Max. Operating Temperature	366°F	(170°C)
PMA: Max. Allowable Pressure	300 psig*	(20.7 barg)
TMA: Max. Allowable Temperature	500°F*	(260°C)

*May be limited by rating of utilized end connection.

Body Surface Finish:

<20 µ in. Ra internal

Machine Polished external

Service Notes

Trap is designed to be self draining for vertical installation (discharge down).

½" - ¾" ferrule service trap should be installed with ¾" gasket on inlet.

Dimensions

Trap	End Connections	Size	inches (mm) A
DS100	Tube	½",¾", & 1"	4⅛ (??)
DS100	Ferrule	½"& ¾"	1⅞ (??)
DS110	Ferrule	½"& ¾"	2⅝ (??)

Materials of Construction

Part Name	Material
Body – Inlet	316L
Actuator	316L
Body – Outlet	316L
Valve	316L

SIZING INFO

APPLICATION GUIDE

SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation

Trap	Orifice Inches	Differential PSIG (bar)												
		5 (0.34)	10 (0.7)	20 (1.4)	30 (2.1)	40 (2.8)	50 (3.4)	60 (4.2)	70 (4.9)	80 (5.6)	90 (6.2)	100 (6.9)	125 (8.62)	150 (10.3)
DS 100	1/4	550 (249)	825 (374)	1210 (549)	1495 (678)	1750 (794)	1975 (896)	2175 (987)	2350 (1066)	2525 (1145)	2650 (1202)	2825 (1281)	3140 (1424)	3425 (1554)

DS200 Series Thermostatic Steam Traps

Pressures To 500 PSIG (34.5 barg)
Temperatures to 500°F (260°C)

Stainless Steel Body—Body materials are Type 316L Stainless Steel.

Self Centering Valve—Leak tight shut off. Assembly of actuator and valve to impingement plate allows valve to self-align with center of valve seat orifice. Provides long lasting valve and seat.

Temperature Sensitive Actuator—One moving part. Inconel welded actuator for maximum corrosion, thermal and hydraulic shock resistance.

Thermal and Hydraulic Shock Resistant—Impingement plate plus welded construction prevents damage to actuator.

Valve and Seat—Long life, stainless steel valve and seat lapped and matched together for water tight seal.

Maintenance—All models are sealed and maintenance free.

Three Year Guarantee—Trap guaranteed for three years against defects in material or workmanship.

Additional Features—Best air handling capability for fast start up and operation. Fastest response to condensate load or temperature changes. Broad application range. Selection of orifice and pipe sizes meet majority of condensate removal demands in deionized steam systems.

Unique SLR Orifice Option—Provides drainage at saturated temperatures, instant reaction to load changes and guaranteed fail-open operation for extra critical operations.

Applications
- Culinary Steam
- WFI System Sterilization
- Main Drips
- Drainage of Steam Filters and Separators
- Sterilizer Drainage and Air Venting

Options
- SLR Orifice

Models
- **DS202**–Low capacity
- **DS203**–Medium capacity
- **DS204**–High capacity

Operation

Thermal actuator is filled at its free length with a liquid having a lower boiling point than water. On start-up, valve is normally open to discharge air, non-condensibles and condensate. When steam enters trap, thermal actuator fill vaporizes to a pressure higher than line pressure. This forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermal actuator, lowering internal pressure. Line pressure will then compress thermal actuator to open valve and discharge condensate. Valve opening automatically adjusts to load conditions from minimum on very light loads to full lift at maximum load.

DS200 Series Thermostatic Steam Traps

Typical Specification

Steam trap shall be of balanced pressure design with inconel welded bellows capable of releasing condensate within 10°F of saturated pressure. Where drainage at saturated temperatures is required, trap shall have SLR orifice. All other components shall be of 316 or 316L stainless steel. Trap shall be self draining and normally open.

Materials of Construction

Body: ASTM 743 CF-8M Stainless Steel

Welded Actuator: Inconel Plates, 316L Fittings

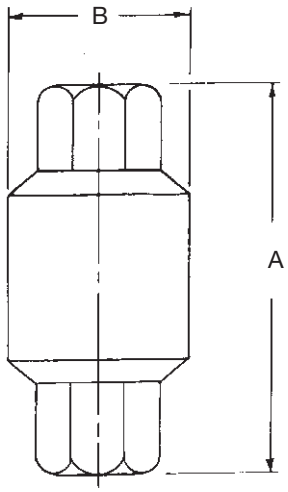
Valve & Seat: 316L Stainless Steel

Maximum Operating Conditions

PMO: Max. Operating Pressure	500 psig	(34.5 barg)
TMO: Max. Operating Temperature	500°F	(260°C)
PMA: Max. Allowable Pressure	650 psig	(44.8 barg)
TMA: Max. Allowable Temperature	750°F	(399°C)

SLR Orifice Option

Specify when immediate elimination of condensate and improved sensitivity is desired. A 1/32" orifice at the apex of the valve allows for continuous discharge of condensate. Trap will nominally pass 50 lbs/hr of condensate at 50 psi within 2°F of saturated temperature.



Connections:
3/8" – 1" NPT or Socketweld

Dimensions

NPT or Socket weld	inches (mm)		Weight Lbs. (kg)
	A	B	
3/8", 1/2"	3 3/4 (95)	1 3/4 (44)	1.1 (0.5)
3/4"	3 15/16 (100)	1 3/4 (44)	1.2 (0.54)
1"	3 3/4 (111)	1 3/4 (44)	1.6 (0.73)

SIZING INFO | APPLICATION GUIDE | SELECTION CHECKLIST

Maximum Capacity—lbs/hr 10°F Below Saturation (Kg/hr 5°C Below Saturation)

Trap	Orifice Inch (mm)	Differential PSIG (bar)													
		5 (0,34)	10 (0,7)	20 (1,4)	50 (3,5)	100 (6,9)	125 (8,6)	150 (10,3)	200 (13,8)	250 (17,2)	300 (20,7)	350 (24,1)	400 (27,6)	450 (31,0)	500 34,5
DS202	1/8 (3)	216 (98)	265 (120)	375 (170)	592 (269)	778 (354)	838 (381)	890 (405)	980 (445)	1055 (480)	1121 (510)	1180 (536)	1235 (561)	1284 (584)	1323 (601)
DS203	1/4 (6)	550 (249)	825 (374)	1210 (549)	1975 (896)	2825 (1281)	3140 (1424)	3425 (1554)	3650 (1656)	3960 (1796)	4100 (1860)	4230 (1919)	4420 (2005)	4600 (2086)	4760 (2161)
DS204	5/16 (8)	860 (390)	1220 (554)	1725 (783)	2725 (1237)	3575 (1623)	3850 (1748)	4090 (1857)	4505 (2045)	4850 (2202)	5155 (2340)	5425 (2463)	5675 (2576)	5900 (2679)	6110 (2774)

Steam Scrubber Stainless Steel Filter

Pressures To 145 PSIG (10 barg)
Temperatures to 353°F (178°C)

Etched and Passivated 304 Stainless Steel Housing, Externally Polished—Free of inaccessible crevices. Optional 316L housing available.

Double O-ring EPDM Housing Gasket—Designed to reduce potential downstream leakage of unfiltered medium. Other gasket materials available.

Inline NPT Connections—Simple to install. Optional flange or welded ends.

Single Clamp Closure—Allows rapid removal of filter element for cleaning or replacement.

Sintered 316 Stainless Steel Filter Media—Porosity level greater than 50% assures good flow rate at low differential pressure.

Filter Media in 1, 5 or 25 Micron Absolute Ratings—1 and 5 micron ratings suitable for culinary steam.

Filter Element Endcaps of 304 Stainless Steel—Plug connection assures element remains fixed.

Renewable Filter Media—Element may be regenerated in ultrasonic bath.

Single Open End Filter Element—Provides consistent, reliable filtering.

Audible Pressure Warning—Sounds loud warning whistle if disassembly is attempted when pressurized.

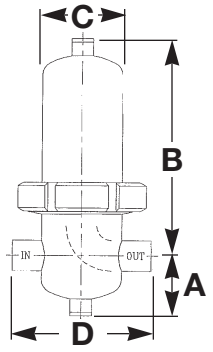
Applications
- Culinary Grade Steam
- Sterilizers
- Autoclaves
- Pharmaceutical & Biotechnology Process Equipment
- Clean Room Humidification
- Chemical Industry
- Electronic Industry
- Plastic Industry

Models
- **SS12**–1/2" standard capacity
- **SS34**–3/4" standard capacity
- **SS1**–1" standard capacity
- **SS114**–11/4" standard capacity
- **SS112**–11/2" standard capacity
- **SS2L**–2" low capacity
- **SS2**–2" standard capacity
- **SS212**–21/2" standard capacity
- **SS3L**–3" low capacity
- **SS3**–3" standard capacity

Operation

Steam enters the filter body and is directed through the sintered stainless steel element. Particulate matter is retained on the element while filtered steam passes through and exits the filter body. Element may be removed and renewed when pressure differential peaks.

STEAM SCRUBBER STAINLESS STEEL FILTER



Specification

Furnish and install as shown on the plans, high efficiency inline horizontal filter for air, steam or gas constructed with housing of 304 or 316L stainless steel and single, open ended element. Filter shall have an absolute rating of 1, 5 or 25 microns and utilize double o-ring gaskets to reduce potential downstream leakage of unfiltered medium. External surface finish of filter housing shall be no less than 180 grit (25-35 Ra microinch) and joined utilizing a single clamp. Filter media shall be of sintered 316L stainless steel and be regenerable. 1 and 5 micron media shall conform to 3A sanitary standards for production of culinary steam and be USDA accepted. Connections shall be NPT, flanged ANSI 150 or welded.

Construction

Housing	304 Stainless Steel Std. 316L Stainless Steel Opt.
Clamp	304 Stainless Steel
Plug	304 Stainless Steel
Gaskets	EPDM Std. Silicone Opt. Viton Opt. Buna N Opt.
Filter Media	Sintered 316L Stainless Steel
Filter End Caps	304 Stainless Steel

Maximum Operating Conditions

PMO: Max. Operating Pressure Limit for Saturated Steam	145 psig (10 barg) 125 psig (8.6 barg)
TMO: Max. Operating Temperature	353°F (178°C)
PMA: Max. Allowable Pressure	232 psi/g0-400°F (16 barg/0-204°C)
TMA: Max. Allowable Temperature	400°F/0-232 psig (204°C/0-16 barg)

Connections:
1/2" – 3" NPT, Flanged or Welded

Selection Example

For optimum service life, the filter should have a 1 psi maximum pressure drop. Select a 5 micron filter for a flow rate of 110 lbs/hr (w) of saturated steam at 45 psi.

Where: $Cs = \frac{w}{CmCp}$

Designing for .75 PSI differential pressure, Cm is 225 from the capacity chart and Cp is 2.0.

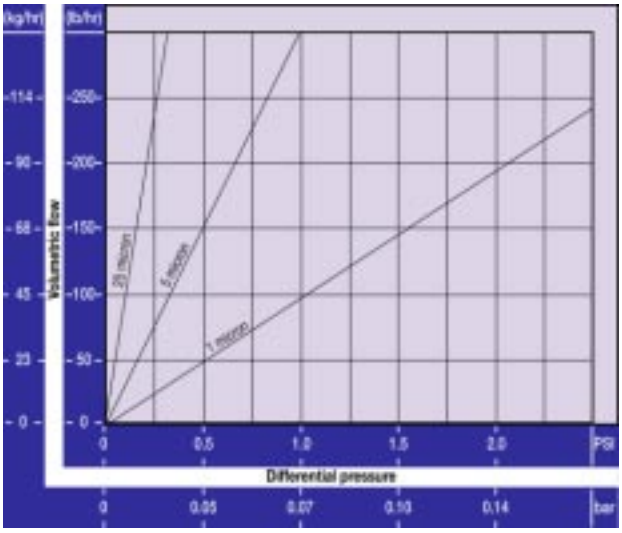
Therefore: $Cs = \frac{110}{(225)(2.0)} = .24$ so 3/4" should be used.

DIMENSIONS

Size in.(mm)	Dimensions, Inches (mm) A	B	C	D	Weight lbs (kg)	Conversion Factors (Cs)
½ (13)	2⅛ (55)	7⅜ (188)	2¾ (70)	4⅛ (108)	4.2 (1.9)	0.17
¾ (19)	2⅛ (55)	8⅜ (211)	2¾ (70)	4⅞ (125)	4.4 (2.0)	0.25
1 (25)	2⅞ (74)	8⅝ (219)	3⅜ (85)	4⅞ (125)	5.7 (2.6)	0.39
1¼ (32)	2⅞ (74)	10⅝ (270)	3⅜ (85)	5½ (140)	6.6 (3)	0.50
1½ (38)	3¾ (94)	11½ (292)	4⅛ (104)	6⅝ (170)	10.1 (4.6)	0.67
2L (51)	3¾ (94)	14⅜ (366)	4⅛ (104)	6⅝ (170)	10.6 (4.8)	1.00
2 (51)	3¾ (94)	19⅜ (493)	4⅛ (104)	6⅝ (170)	11.7 (5.3)	1.50
2½ (64)	4¼ (106)	24⅝ (626)	5⅛ (129)	8½ (216)	19.8 (9)	2.00
3L (76)	4¼ (106)	34⅝ (881)	5⅛ (129)	8½ (216)	23.8 (10.8)	2.70
3 (76)	4⅝ (119)	35¾ (907)	6 (154)	9⅜ (240)	35.6 (16.2)	4.00

L denotes low capacity

Saturated Steam Capacity — 2"L, 250°F, 15 PSI (Cm)*



*For other pressures and sizes, see conversion factors.

Steam Pressure Conversion Factors (Cp)											
Steam Pressure	PSI	0	15	30	45	60	75	90	105	120	135
	bar	0	1	2	3	4	5	6	7	8	9
Conversion factor		0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Type D50 Stainless Steel Steam Pressure Reducing Valve

Pressures To 300 PSIG (21 barg) Temperatures to 420°F (216°C)

Tight Shutoff—Spherical seating surface on floating stainless steel disc ensures ANSI/FCI 70-2 Class IV Shutoff.

Unique Adjustable Aspirator—Allows valve to be adjusted to suit service requirements.

Three Spring Ranges—Provide for wide range of controlled pressures.

External Adjusting Screw—Allows for quick, accurate change of reduced pressure set point.

High Grade Stainless Steel Spring—Accommodates wide range of adjustment without dangerous spring overload.

Large Area Diaphragm—Assures high sensitivity and accurate control.

External Body Cap—Provides easy access to internal screen for cleaning.

Models

- **D50SS**–Stainless Steel D50

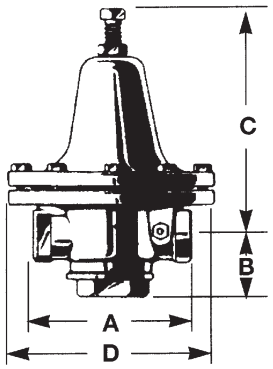
Applications

- Clean steam systems utilizing deionized steam
- In-line sterilization of liquid storage tanks and distribution equipment
- Cleaning and sterilizing process piping systems
- Powering sterilizers and autoclaves

Operation

Regulator is actuated by changes in the downstream pressure. Any increase in the downstream pressure above the set point (due to decreased fluid demand) will force the diaphragm up and overcome the resistance of the spring, allowing the valve to close. Any decrease in the downstream pressure (due to an increased fluid demand) will decrease the pressure on the diaphragm and permit the spring to open the valve.

TYPE D50 STAINLESS STEEL STEAM PRESSURE REDUCING VALVE



Connections: 1/2" – 1" Screwed

Specification

Valve shall be self operated, requiring no external energy source. Valve shall operate quickly and provide dead end shutoff. Valve shall have a stainless steel body and be rated 300 psi at 420°F. Valve trim material shall be stainless steel. Valve shall have a standard aspirator to allow for adjustment of operation.

Maximum Operating Conditions

PMO: Max. Operating Pressure	300 psig	(20.7 barg)
TMO: Max. Operating Temperature	420°F	(116°C)
PMA: Max. Allowable Pressure	300 psig	(20.7 barg)
TMA: Max. Allowable Temperature	420°F	(116°C)

Materials of Construction

Body	ASTM 743 CF-8M
Stem	304 St. Stl ASTM 276 Cond. A
Disc	316 St. Stl. ASTM 276 Cond. A
Seat	304 St. Stl ASTM 276 Cond. A
Gasket	Teflon
Diaphragm	304 St. Stl ASTM 276 Cond. A
Spring	302 St. Stl.

Spring Ranges

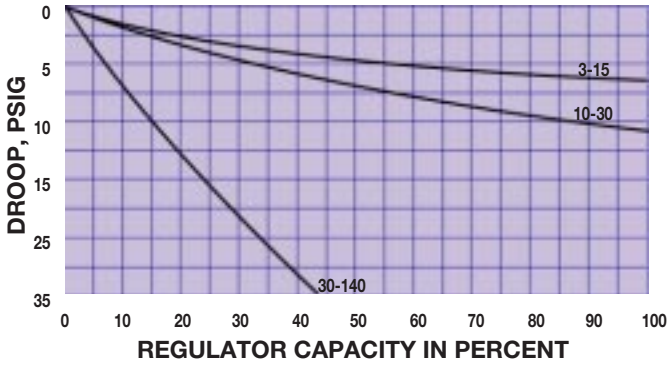
3 - 15 psig
10 - 30 psig
30 -140 psig

Dimensions

Size	Dimensions, Inches (mm)				Weight
	A	B	C	D	lbs (kg)
1/2" (13)	5 (127)	1 5/8 (41)	5 1/2 (140)	4 7/8 (124)	8 (3.6)
3/4", 1" (19, 25)	5 5/8 (143)	2 1/4 (57)	6 1/2 (165)	7 7/16 (191)	22 (10)

Rated Flow Coefficients (Cv)	VALVE SIZE		
	1/2"	3/4"	1"
	2.2	3.3	4.9

3/4" VALVE DROOP CHART*



*Droop for other sizes similar

Rated Steam Capacity Tables (lbs./hr)

PSI IN	10	20	30	40	50	75	100	125	150	175	200	250	60	75	85	100	125	150	175	200	250
PSI OUT	5	10	10	30	30	30	30	30	30	30	30	30	50	50	50	50	50	50	50	50	50
1/2"	41	68	100	87	130	200	255	315	370	425	480	595	115	190	230	280	340	405	465	525	650
3/4"	59	97	145	125	185	290	370	450	530	615	695	855	165	275	335	410	500	590	675	765	945
1"	80	130	195	170	250	390	495	605	715	825	930	1150	250	420	510	625	760	895	1030	1170	1440

PSI IN	85	100	125	150	175	200	225	250	110	125	150	200	225	250	135	150	175	200	225	250	160	175	200	225	250
PSI OUT	75	75	75	75	75	75	75	75	100	100	100	100	100	100	125	125	125	125	125	125	140	140	140	140	140
1/2"	130	215	325	405	465	525	585	650	190	310	460	675	755	830	210	340	500	635	755	830	315	425	580	710	835
3/4"	190	315	470	590	675	765	855	945	310	500	745	1095	1220	1350	340	550	810	1030	1230	1350	510	690	940	1150	1350
1"	290	480	720	895	1030	1170	1300	1440	380	620	920	1350	1510	1670	420	680	995	1270	1510	1670	630	855	1160	1420	1670

CONDENSATE RECOVERY

NICHOLSON's broad range of Commander Series Pressure Actuated Pumps are recognized for their quality, durability and versatility. Skid systems, fabricated to meet customer requirements, are a value added specialty that differentiate NICHOLSON's products from the competitors.

Condensate Commander Pump

Pressures To 250 PSIG (17.2 barg)
Temperatures to 400°F (198°C)

No Electricity Needed
–Uses pressurized gas or steam as the pumping force.
–Preferable for remote or hazardous locations.

Lifetime Warranty on Spring
–Single spring mechanism operates in compression only to assure long service life
–Stainless steel snap acting mechanism in continuous compression offers superior performance.

Rugged Mechanism
–Unaffected by turbulence.
–No adjustments or maintenance necessary.

Superior Valve Technology
–Supply and exhaust valves are lapped for tight shutoff.
–Self centering design assures reliable performance.
–Unique floating ball design and hardened sealing surface of the supply valve provide long service life.

Suitable for a Wide Variety of Liquids
–Condensate from steam systems.
–High back pressure, low pressure and vacuum systems.
–Ideal in a sump or other submersible applications.
–Suitable for acids and other process fluids that may be incompatible with conventional pumps.

ASME Code Stamped Tank
–Fabricated steel tank is standard.

3 Year Warranty
– Longest warranty in the industry.

Retrofit Mechanism Available
–Head assembly can fit other manufacturer's tanks.

Required suction head is minimal
–Optimal performance achieved at only 12 inches.

Models
- **Classic**–Standard capacity, vertical tank
- **Big Boy**–Super capacity, horizontal tank
- **Horizontal**–Standard capacity, high pressure, horizontal tank
- **Little Boy**–Reduced capacity, vertical tank
- **Skid**–Standard or custom multiplex configurations

Applications

Collection of Condensate
- Remote Locations such as tank farms
- Low pressure and vacuum systems
- Condensate systems with high back pressure
- High capacity process applications such as heat exchangers

Electrical Service is Unavailable or Prohibited
- Remote locations
- Hazardous locations

Submerged Areas
- Sumps or low lying areas
- Manholes

Hazardous Fluids
- Process fluids that may be difficult for conventional electric pump technology to handle

Options
- Glass Water Gage
- Cycle Counter
- Check Valves
- Insulating Jacket
- Skid Mount
- Supply Pressure Regulator
- Drain Line Freeze Protection

Operation

The vent valve is open, the pressure supply valve is closed and the float is positioned in the lower part of the tank as the condensate or other liquid enters the tank through the inlet check valve. As the tank fills with liquid, the float rises to the point where the spring mechanism snaps past the center position. The compressed spring instantly closes the vent valve and opens the pressure supply. This allows pressure into the tank which forces the liquid through the outlet check valve.

As the liquid level falls, the float lowers to the point where the spring mechanism snaps past the center position which immediately closes the pressure supply valve and opens the vent valve. The pressure in the tank decreases, allowing liquid to flow through the inlet check valve, repeating the cycle.

CONDENSATE COMMANDER CLASSIC PUMP

Typical Specification

Pump shall be a pressure vessel drainer operated by steam, compressed air or other pressurized gas to 200 psig. Body shall be fabricated steel ASME code to 200 psi. Pump mechanism shall be all stainless steel without external packing or seals. Mechanism shall employ one spring operating from free length to compression. Spring shall be warrantied for the life of the unit. When required, unit shall be equipped with an external cycle counter, sight glass and insulating jacket.

Maximum Operating Conditions

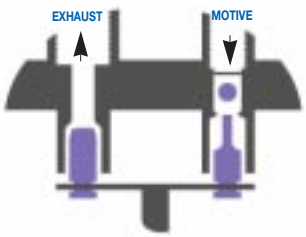
PMO: Max. Operating Pressure	200 psig	(13.8 barg)
TMO: Max. Operating Temperature	400°F	(198°C)
PMA: Max. Allowable Pressure	200 psig	(13.8 barg)
TMA: Max. Allowable Temperature	650°F	(343°C)

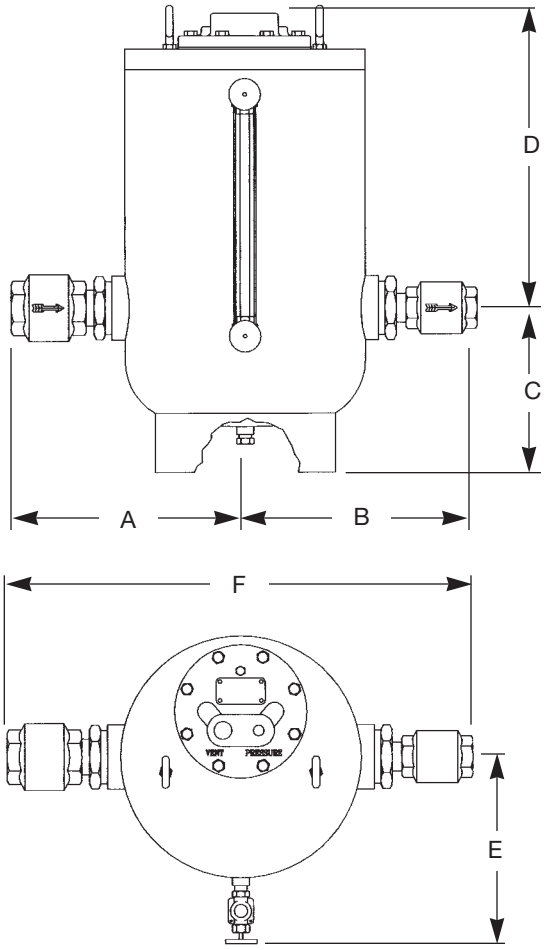
Materials of Construction

Tank Weldment	Steel
Trip Mechanism w/Flange	DI/Stl/SS
Gasket	Graphite
Bolt, Hex Head	Steel
Eye Bolt	Steel
Nut	Steel
Nameplate	Aluminum
Drive Screw	Steel
Pipe Plug, 1/2" NPT	Steel
Water Level Gage	Bronze
Inlet Reducer	M. Iron
Inlet Nipple	Steel
Inlet Check Valve	Stainless Steel
Outlet Reducer	M. Iron
Outlet Nipple	Steel
Outlet Check Valve	Stainless Steel

Operating Characteristics

Pump Discharge per Cycle:	7.8 - 8.6 Gal
Max. Instantaneous Discharge Rate:	90 GPM (w/2" outlet check)
Steam Consumption:	~3 lbs per 1000 lbs. of liquid pumped
Air Consumption:	~100 SCF per 1000 lbs. of liquid pumped
Recommended Filling Head:	12"





Exhaust outlet: 1" NPT
Motive inlet: ½" NPT

See capacities on page F7

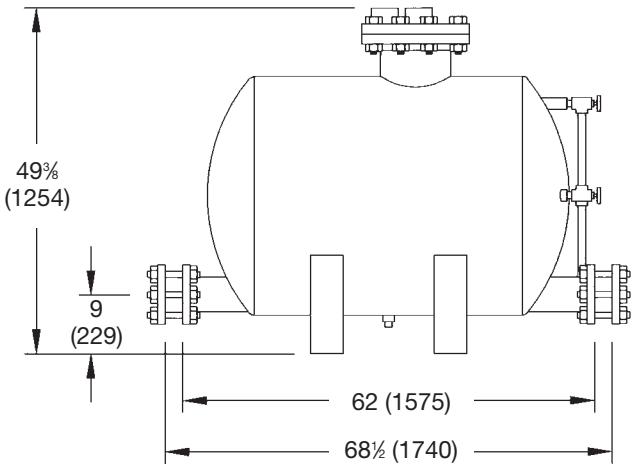
Connections:
1" x 1" – 3" x 2" Screwed

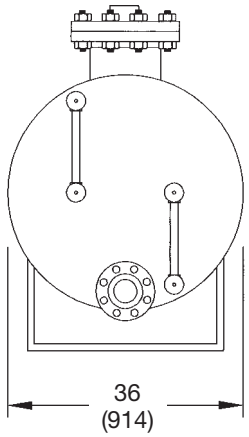
Dimensions

Size	Inches (mm) A	B	C	D†	E*	F	Weight lbs(kg)
1"x 1"	13 3/8 (340)	13 3/8 (340)	11 (279)	21 3/4 (552)	9 (278)	17 3/4 (451)	168 (76)
1 1/2"x 1 1/2"	14 3/4 (375)	14 3/4 (375)	11 (279)	21 3/4 (552)	9 (278)	17 3/4 (451)	170 (77)
2"x 2"	15 (381)	15 (381)	11 (279)	21 3/4 (552)	9 (278)	17 3/4 (451)	173 (79)
3"x 2"	16 1/2 (419)	15 (381)	11 (279)	21 3/4 (552)	9 (278)	17 3/4 (451)	185 (84)

*Add 5" for Water Gage.
†Allow additional 21" clearance for maintenance.

SIZING INFO | CAPACITY CHART





Exhaust outlet: 2" NPT
Motive inlet: 2" NPT

Dimensions–Inches (mm)

See capacities on page F7

Connections:
4" x4" NPT

SIZING INFO

CAPACITY CHART

Condensate Commander Big Boy Pump

Typical Specification

Pump shall be a pressure vessel drainer operated by steam, compressed air or other pressurized gas to 125 psig. Body shall be fabricated steel ASME code to 125 psi. Mechanism shall employ springs operating from free length to compression. Springs shall be warrantied for the life of the unit. When required, unit shall be equipped with an external cycle counter and sight glass.

Maximum Operating Conditions

PMO: Max. Operating Pressure	125 psig	(8.6 barg)
TMO: Max. Operating Temperature	400°F	(198°C)
PMA: Max. Allowable Pressure	125 psig	(8.6 barg)
TMA: Max. Allowable Temperature	650°F	(343°C)

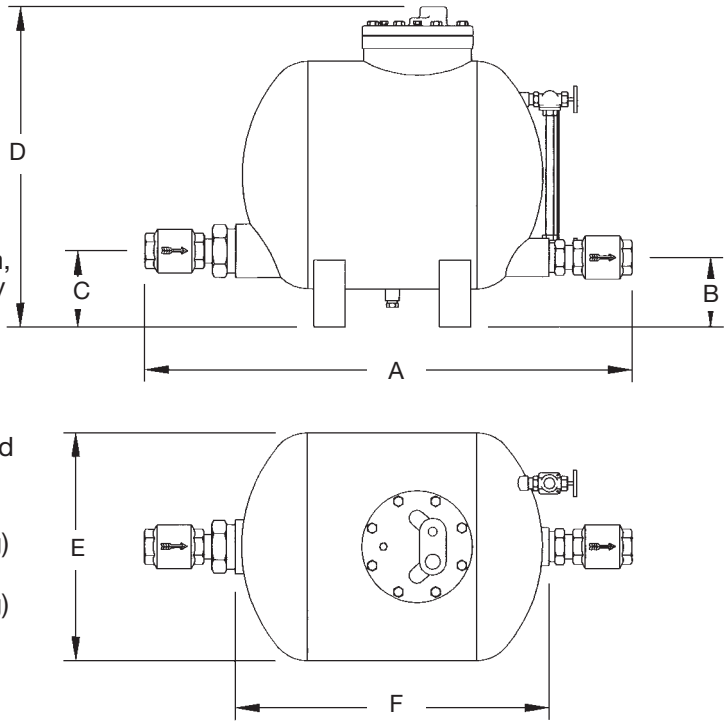
Materials of Construction

Tank Weldment	Steel
Trip Mechanism w/Flange	Stl/SS
Gasket	Non-asbestos
Stud, Flange	Steel
Nut, Hex	Steel
Nameplate	Aluminum
Drive Screw	Steel
Pipe Plug, 3/4" NPT	Steel
Water Level Gage	Bronze
Inlet Check Valve	Stainless Steel
Inlet Flange	Steel
Outlet Check Valve	Stainless Steel
Outlet Flange	Steel

Operating Characteristics

Pump Discharge per Cycle:	32 - 40 Gal
Max. Instantaneous Discharge Rate:	195 GPM
Steam Consumption:	~3 lbs per 1000 lbs. of liquid pumped
Air Consumption:	~100 SCF per 1000 lbs. of liquid pumped
Recommended Filling Head:	12"

CONDENSATE COMMANDER HORIZONTAL PUMP



Exhaust outlet: 1" NPT
Motive inlet: 1/2" NPT

See capacities on page F7

Connections:
1" x 1" – 3" x 2" Screwed

Typical Specification

Pump shall be a pressure vessel drainer operated by steam, compressed air or other pressurized gas to 250 psig. Body shall be fabricated steel ASME code to 250 psi. Pump mechanism shall be all stainless steel without external packing or seals. Mechanism shall employ one spring operating from free length to compression. Spring shall be warrantied for the life of the unit. When required, unit shall be equipped with an external cycle counter, sight glass and insulating jacket.

Maximum Operating Conditions

PMO: Max. Operating Pressure	250 psig	(17.2 barg)
TMO: Max. Operating Temperature	400°F	(198°C)
PMA: Max. Allowable Pressure	250 psig	(17.2 barg)
TMA: Max. Allowable Temperature	650°F	(343°C)

Materials of Construction

Tank Weldment	Steel
Trip Mechanism w/Flange	DI/Stl/SS
Gasket	Non-asbestos
Bolt, Hex Head	Steel
Nameplate	Aluminum
Drive Screw	Steel
Pipe Plug, 1/2" NPT	Steel
Water Level Gage	Bronze
Inlet Reducer	M. Iron
Inlet Nipple	Steel
Inlet Check Valve	Stainless Steel
Outlet Reducer	M. Iron
Outlet Nipple	Steel
Outlet Check Valve	Stainless Steel

Operating Characteristics

Pump Discharge per Cycle:	7.8 - 8.6 Gal
Max. Instantaneous Discharge Rate:	90 GPM (w/2" outlet check)
Steam Consumption:	~3 lbs per 1000 lbs. of liquid pumped
Air Consumption:	~100 SCF per 1000 lbs. of liquid pumped
Recommended Filling Head:	12"

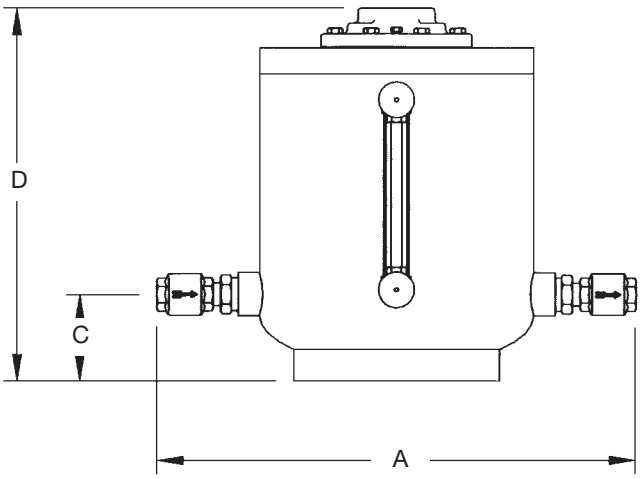
SIZING INFO

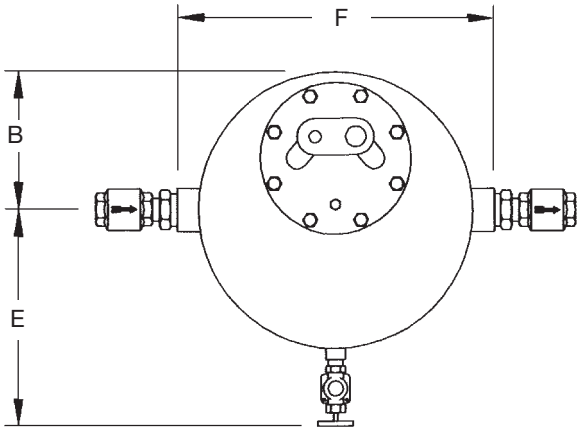
CAPACITY CHART

Dimensions

Size	Inches (mm)						Weight lbs(kg)
	A	B	C	D†	E*	F	
1"x 1"	34¼ (879)	5½ (140)	6 (152)	25¼ (641)	18 (457)	25 (635)	174 (79)
1 1/2"x 1 1/2"	36¾ (933)	5½ (140)	6 (152)	25¼ (641)	18 (457)	25 (639)	178 (81)
2"x 2"	37⅛ (943)	5½ (140)	6 (152)	25¼ (641)	18 (457)	25 (639)	183 (83)
3"x 2"	38¼ (971)	5½ (140)	6 (152)	25¼ (641)	18 (457)	25 (639)	190 (86)

CONDENSATE COMMANDER LITTLE BOY PUMP





See capacities on page F7

Connections:
1" x 1" – 1½" x 1½" NPT

Dimensions

Size	Inches (mm) A	B	C	D†	E*	F	Weight lbs(kg)
1"x 1"	26¾	8	5	21¼	9	17¾	145
	(679)	(203)	(127)	(540)	(229)	(451)	(66)
1½"x 1½"	29½	8	5	21¼	9	17¾	155
	(749)	(203)	(127)	(540)	(229)	(451)	(71)

*Add 5" for Water Gage.
†Allow additional 18" clearance for maintenance.

Typical Specification

Pump shall be a pressure vessel drainer operated by steam, compressed air or other pressurized gas to 125 psig. Body shall be fabricated steel. Mechanism shall employ one spring operating from free length to compression. Spring shall be warrantied for the life of the unit. When required, unit shall be equipped with an external cycle counter and sight glass.

Maximum Operating Conditions

PMO: Max. Operating Pressure	150 psig	(10.3 barg)
TMO: Max. Operating Temperature	400°F	(198°C)
PMA: Max. Allowable Pressure	150 psig	(10.3 barg)
TMA: Max. Allowable Temperature	650°F	(343°C)

Materials of Construction

Tank Weldment	Steel
Trip Mechanism w/Flange	DI/Stl/SS
Gasket	Non-asbestos
Bolt, Hex Head	Steel
Nameplate	Aluminum
Drive Screw	Steel
Water Level Gage	Bronze
Inlet Reducer	M. Iron
Inlet Nipple	Steel
Inlet Check Valve	Stainless Steel
Outlet Reducer	M. Iron
Outlet Nipple	Steel
Outlet Check Valve	Stainless Steel

Operating Characteristics

Pump Discharge per Cycle:	4.2 - 5.1 Gal
Max. Instantaneous Discharge Rate:	60 GPM (w/1½" outlet check)
Steam Consumption:	~3 lbs per 1000 lbs. of liquid pumped
Air Consumption:	~100 SCF per 1000 lbs. of liquid pumped
Recommended Filling Head:	6"

SIZING INFO | CAPACITY CHART

CONDENSATE COMMANDER PUMP CAPACITY TABLE*

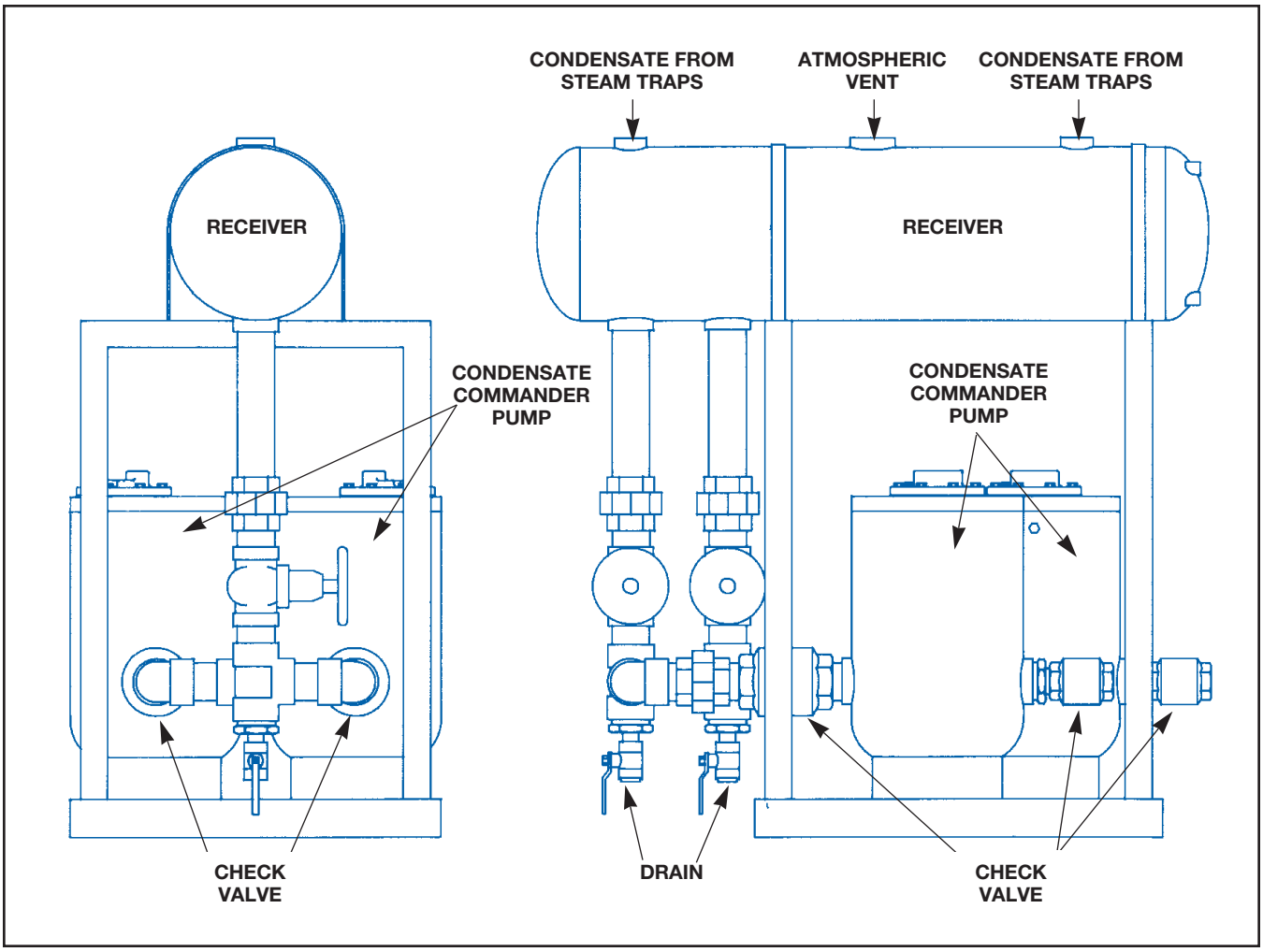
Motive Pressure		Back Pressure		Fill Head 6" Little Boy		Fill Head 12" Commander Classic				Fill Head 12" Big Boy	Fill Head 12" Classic Duplex
psig	barg	psig	barg	1 X 1	1.5 X 1.5	1 X 1	1.5 X 1.5	2 X 2	3 X 2	4 X 4	3 X 2
250	17.24	40	2.76	–	–	2703	6392	10196	11537	–	23073
		60	4.14	–	–	3670	7203	7787	8551	–	17101
		80	5.52	–	–	3457	6071	6531	7105	–	14209
		100	6.90	–	–	3891	5278	5753	6202	–	12404
		120	8.28	–	–	3700	4730	5213	5587	–	11173
		150	10.34	–	–	3196	4074	4552	4842	–	9683
		175	12.07	–	–	2845	3624	4092	4331	–	8663
		200	13.79	–	–	2456	3152	3650	3847	–	7694
		225	15.52	–	–	1963	2732	3221	3380	–	6761
200	13.79	40	2.76	–	–	2503	5919	9441	10682	–	21364
		60	4.14	–	–	3398	6669	7210	7918	–	15835
		80	5.52	–	–	4021	5579	6110	6619	–	13238
		100	6.90	–	–	3741	4855	5403	5804	–	11607
		120	8.28	–	–	3286	4242	4768	5088	–	10177
		150	10.34	–	–	2741	3533	4058	4297	–	8593
		175	12.07	–	–	2151	2926	3476	3661	–	7321
150	10.34	25	1.72	1814	5739	2314	5722	10376	12105	–	24210
		40	2.76	3058	4860	3386	7077	8465	9450	–	18899
		60	4.14	3127	4234	4464	6338	6995	7630	–	15260
		80	5.52	2620	3472	3763	4974	5607	6040	–	12080
		100	6.90	2261	2957	3168	4150	4743	5064	–	10128
		120	8.28	1935	2530	2669	3522	4156	4408	–	8815
125	8.62	25	1.72	2470	5645	2942	6740	10712	12337	48101	24674
		40	2.76	3215	4619	3983	7197	7965	8836	44256	17672
		60	4.14	2788	3768	4066	5513	6220	6758	38625	13516
		80	5.52	2358	3117	3326	4416	5064	5432	33012	10863
		100	6.90	1920	2535	2656	3544	4216	4482	25862	8964
		115	7.93	1491	2151	1952	2976	3589	3788	17512	7575
100	6.90	15	1.03	2036	6211	2762	6393	11889	14241	47156	28482
		25	1.72	3132	5336	3763	7658	9818	11170	45212	22340
		40	2.76	3082	4323	4569	6603	7403	8164	42041	16327
		60	4.14	2534	3406	3612	4893	5641	6092	35589	12184
		80	5.52	1959	2620	2716	3681	4428	4721	27783	9442
75	5.17	15	1.03	2975	6022	3867	7978	11977	14038	46485	28075
		25	1.72	3340	4940	4649	7823	8914	10026	43084	20052
		40	2.76	2817	3891	4078	5723	6654	7273	40027	14546
		60	4.14	2003	2732	2786	3863	4721	5057	20002	10114
50	3.45	10	0.69	3701	6273	4692	9227	12492	14737	46092	29474
		25	1.72	2976	4250	4343	6387	7603	8421	39727	16843
		40	2.76	2053	2891	2863	4120	5172	5578	19899	11156
25	1.72	5	0.34	3872	6625	5825	10486	13760	16560	45329	33120
		10	0.69	3315	5063	4845	7774	9812	11193	39945	22385
		15	1.03	2751	4016	3950	6043	7657	8513	18694	17026
10	0.69	2	0.14	3894	6646	5610	10348	14520	17621	–	35242
		5	0.34	2945	4600	4150	6954	9708	11085	–	22170
5	0.34	2	0.14	2981	5115	4130	7602	11747	13781	–	27562

*Capacities shown are obtained with factory supplied check valves
For Kg/Hr multiply by .454
For other multiplex capacities, consult factory.

SIZING INFO

CONDENSATE COMMANDER PUMP SKID MOUNTED SYSTEM

Where the condensate load exceeds the capacity of one Condensate Commander Pump, multiple pumps may be used in tandem. Skid mounted units may be simplex (one pump), duplex (two pumps), triplex (three pumps) or quadruplex (four pumps). The units are equipped with a receiver, Condensate Commander Pump(s) and all necessary piping fully connected and ready for use.



Typical Duplex Condensate Commander Pump Skid Mount System

The skid mount systems are designed to provide a complete condensate collection and condensate pump unit ready to pipe. All necessary connections are in place. The filling head dimension has already been determined.

CONDENSATE COMMANDER PUMP PRIMER

The NICHOLSON Condensate Commander belongs to a class of pressure operated pumps primarily intended to move condensate or other fluids without the use of electricity. When compared to conventional electrical pumps, the Condensate Commander is particularly suited to pumping "difficult" media such as high temperature condensate and corrosive fluids. Pressure operated pumps and the Condensate Commander in particular enjoy a reputation of long life with very little required maintenance. Generally these types of pumps, by eliminating rotating seals, electrical motors, and impellers, last five to ten times as long as conventional electrical pumps while eliminating most of the standard maintenance.

- Returns hot condensate conserving boiler feed water chemicals and reducing fuel cost associated with reheating boiler feed water.
- Pumps without requiring electrical service.
- Pump design provides safe operation for hazardous or explosive environments.
- Operates on steam, compressed air or gas from 5 psig to 250 psig depending on model.
- Capacities to 48,000 lbs./hr.

OPERATION

The Condensate Commander pumps by displacing fluid with steam or compressed gas. The float is connected to a linkage and spring that simultaneously actuates a motive valve and an exhaust valve. During the fill cycle the motive valve closes while the exhaust valve opens, allowing condensate to fill the pump housing. When the float, rising with the entering fluid level, reaches the top of its stroke, the mechanism releases the spring, opening the motive and closing the exhaust valves. Steam or compressed gas then flows into the pump displacing the fluid. Check valves positioned at the inlet and outlet of the pump direct the fluid in the direction of the flow.

CHARACTERISTICS

Flow capacity is dependent on several parameters. Bearing in mind that that the Condensate Commander pumps in discreet, relatively consistent slugs of fluid, the total capacity will depend on how quickly the Commander cycles. Motive pressure available and resistance in the flow line are the obvious causative and limiting factors of capacity. Less obvious is the Cv of the check valves, pressure or head of the incoming fluid, resistance in the vent line, and characteristics of the motive gas used.

There is no "vacuum" side of a Commander pump. While there certainly is an inlet side, it is important to understand that the class of pumps the Condensate Commander belongs to does not draw or suck fluid into it. The media must flow by gravity into the pump. The greater the pressure and/or head, the greater the Cv of the inlet check, and to a lesser extent the greater the Cv of the exhaust vent, the faster the fill portion of the cycle will complete. With the fill portion completed the Commander mechanism will shut off the exhaust vent and open the motive valve. Steam or compressed gas will now displace the fluid contained in the pump housing. Factors controlling the speed of the discharge portion of the cycle include pressure of motive steam or gas, outlet check Cv, downstream backpressure, and potentially temperature of flow media and/or ambient conditions if steam is utilized as the motive gas. This last component is often overlooked, but the fact that steam will condense and reduce actual motive pressure could become significant in some applications.

RECEIVER

Conventional electric condensate pumps typically require a receiver sized to allow condensate to cool and vent flash steam. This is necessary, as the suction side of the pump will lower pressure potentially allowing the hot condensate to boil as it is drawn past the impeller. This action, known as cavitation, will quickly erode the impeller. While the temperature of the flow media is generally not a concern it must be remembered that the Condensate Commander pumps in discrete cycles. While the Commander is expelling fluid the body is pressurized and cannot receive fluid. If fluid is draining to the Commander in a continuous fashion, a receiver sized to accommodate the maximum volume expected during the time require to discharge the commander must be utilized. Failure to do so will back condensate up and possibly increase pressure, potentially causing problems.

CONDENSATE COMMANDER PUMP SELECTION GUIDELINES

FULL CHART

To correctly select a Condensate Commander Pump that meets the requirements of the application, some specific data is needed.

1. Condensate load in lbs/hr. *
2. Motive pressure available (air or steam).
3. Total lift in feet (hydraulic head).
4. Pressure in return piping.
5. Filling head available in inches (recommended minimum of 12 inches).

EXAMPLE 1, Steam motive:

1. Condensate Load: 4,000 lb/hr.
2. Steam pressure available: 50 psig
3. Total vertical lift: 20 ft.
4. Pressure in return piping: 10 psig
5. Filling head available: 12 inches
   For filling head other than 12 inches, multiply capacity by correction factor found in Table 3.

SOLUTION:

1. Calculate total back pressure. Back pressure is the total head in feet multiplied by 0.433 plus the pressure in the return piping.

   (20 ft. x .433) + 10 psig = 19

2. Select from the Pump Capacity Table a pump with 50 psig motive pressure and greater than 19 (25) psig total back pressure: a 1" x 1" Condensate Pump.

EXAMPLE 2, Air motive:
(conditions same as Example 1)

1. To determine correction factor for air, divide total back pressure from Example 1 by motive pressure available (BP÷MP).

   19 ÷ 50 = 38%

   Correction factor from Table 2 is 1.10

2. Divide required condensate load by correction factor.

   4000 ÷ 1.10 = 3636

   Select from the Pump Capacity Table (Table 1) a 1" x 1" Condensate Pump.

*CONVERSIONS:

GPM to lbs/hr:: GPM x 500
Lbs/hr to GPM: Lbs/hr. x .002
Lbs/hr to KG/hr: Lbs/hr. x .454

Pump Capacity Table–(lbs/hr)

Operating Pressure Inlet (psig)	Total Backpressure (psig)	Stainless Steel Check Valves				
		1"x1"	1½"x1½"	2"x2"	3"x2"	3"x2" Duplex
5	2	4130	7602	11747	13781	27562
10	5	4150	6954	9708	11085	22170
	2	5610	10348	14520	17621	35242
25	15	3950	6043	7657	8513	17026
	10	4845	7774	9812	11193	22386
	5	5825	10486	13760	16560	33120
50	40	2863	4120	5172	5578	11156
	25	**4343**	6387	7603	8421	16842
	10	4692	9227	12492	14737	29474
75	60	2786	3863	4721	5057	10114
	40	4078	5723	6654	7273	14546
	15	3867	7978	11997	14038	28076
100	80	2716	3681	4428	4721	9442
	60	3612	4893	5641	6092	12184
	40	4569	6603	7403	8164	16328
	15	2762	6393	11889	14241	28482
125	115	1952	2976	3589	3788	7576
	100	2656	3544	4216	4482	8964
	80	3326	4416	5064	5432	10864
	60	4066	5513	6220	6758	13516
	40	3983	7197	7965	8836	17672
	25	2942	6740	10712	12337	24674
150	120	2669	3522	4156	4408	8816
	100	3168	4150	4743	5064	10128
	80	3763	4974	5607	6040	12080
	60	4464	6338	6995	7630	15260
	40	3386	7077	8465	9450	18900
	25	2314	5722	10376	12105	24210

TABLE 1

Capacity Correction Factors for Motive Gas Supply other than Steam

% Back Pressure vs. Motive Pressure (BP ÷ MP)								
10%	20%	30%	40%	50%	60%	70%	80%	90%
1.04	1.06	1.08	1.10	1.12	1.15	1.18	1.23	1.28

TABLE 2

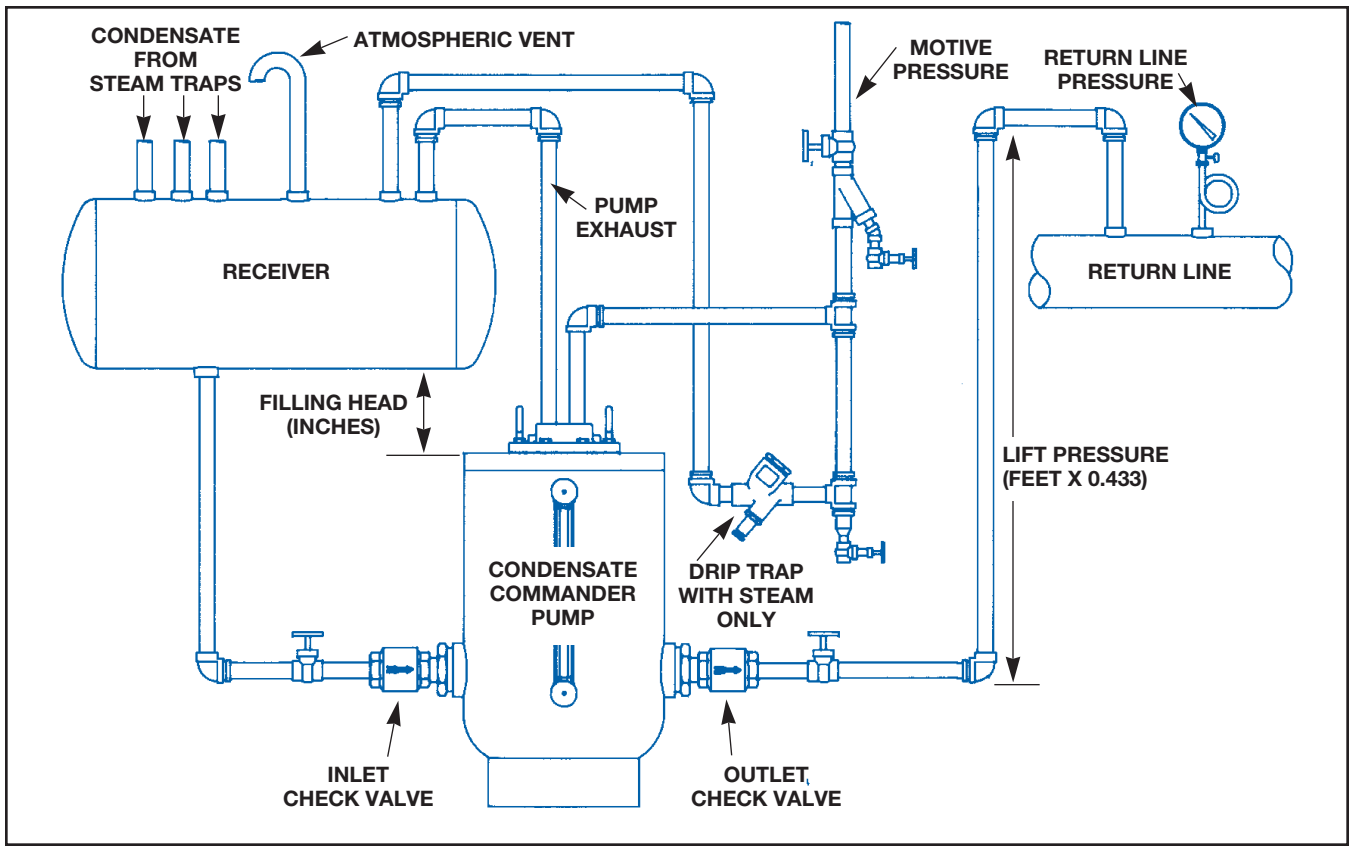
Capacity Correction Factor for Filling Head Variation

Filling Head (inches)	Check Valve and Piping Size Inches			
	1"	1½"	2"	3" x 2"
6	0.70	0.70	0.70	0.84
12	1.00	1.00	1.00	1.0
24	1.20	1.20	1.20	1.08
36	1.35	1.35	1.35	1.20

TABLE 3

Typical Installation of a Condensate Commander Pump with a Vented Receiver

Condensate is being pumped from a vented receiver to an overhead elevated condensate return line that may contain pressure. For safety, the pump exhaust and receiver should be vented to atmosphere if steam is used for the motive pressure.



To efficiently drain condensate from an open system, the vented receiver should be horizontally located a minimum of twelve inches above the pump. To allow for sufficient volume of condensate and flash vapor, the receiver must be sized adequately to permit the complete separation of flash vapor from condensate. The receiver may be either an ASME coded tank or a length of large diameter pipe.

Vented Receiver Sizing Table

Receiver size based on 36" OAL

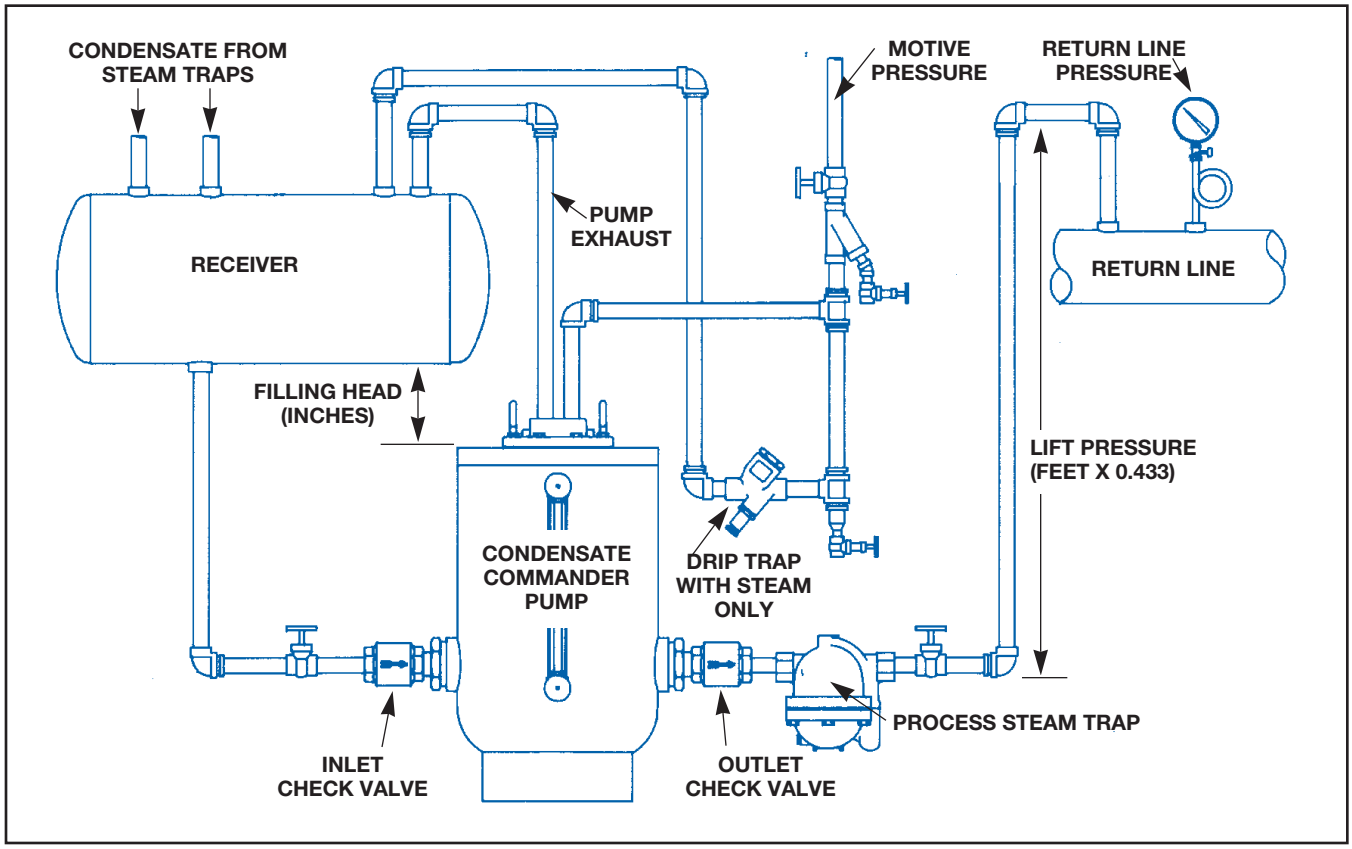
Flash Vapor (lbs/hr)	Pipe Diameter (inches)	Vent Line Size (inches)
75	4	1 1/2
150	6	2
300	8	3
600	10	4
900	12	6
1200	16	6
2000	20	8

Percent of Flash Steam Formed

Initial Steam Pressure psig	Sat. Temp. °F	Receiver Tank Pressure, psig							
		0	5	10	20	30	40	50	75
10	239	3.0	2.0	0	0	0	0	0	0
25	267	5.7	4.1	3.0	1.0	0	0	0	0
50	298	9.0	7.4	6.2	4.3	2.6	1.0	0	0
75	320	11.3	10.8	8.6	6.7	5.0	3.7	2.5	0
100	338	13.3	11.7	10.6	8.7	7.0	5.7	4.6	2.2
125	353	14.8	13.4	12.2	10.3	8.7	7.4	6.3	3.8

Typical Installation of a Condensate Commander Pump in a Closed System

Condensate is flowing from a pressurized system to another pressurized system with greater pressure. Both the inlet and return line may be elevated. This installation will also service a high capacity process installation using a pressurized receiver.



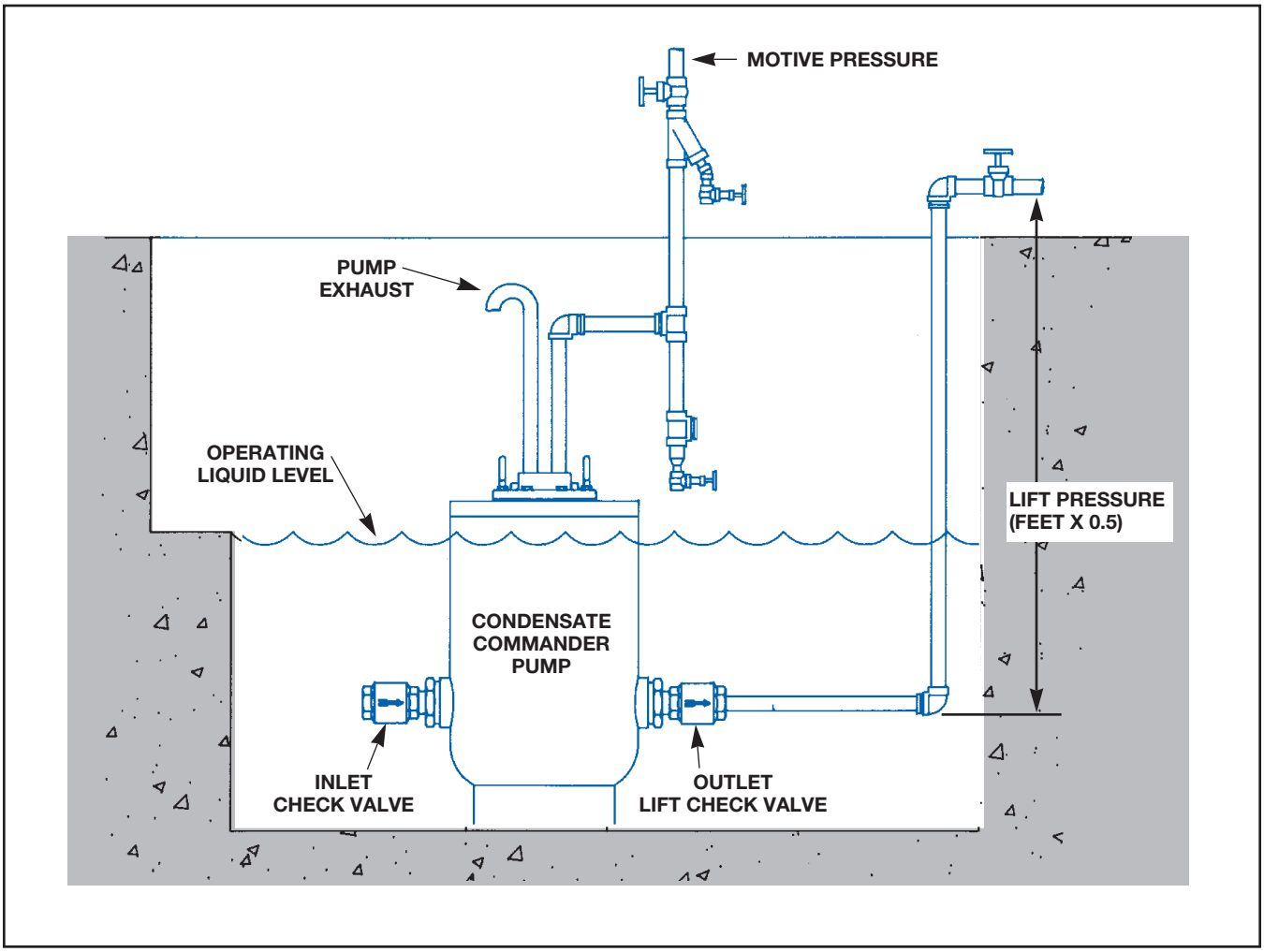
To efficiently drain condensate in a closed system, the receiver should be horizontally located a minimum of twelve inches above the pump to allow for sufficient condensate collection. The receiver must be sized to provide the minimum condensate capacity required to prevent equipment flooding. The receiver may be either an ASME coded tank or a length of large diameter pipe. A safety relief valve may be required.

Inlet Receiver Sizing Table

Liquid	Receiver Pipe Size (feet)				
(lb/hr)	3"	4"	6"	8"	10"
>500	2	—	—	—	—
1000	2	—	—	—	—
1500	3	2	—	—	—
2000	3.5	2	1	—	—
3000	—	3	2	—	—
4000	—	4	2	1	—
5000	—	6	3	2	—
6000	—	—	3	2	—
7000	—	—	3	2	—
8000	—	—	4	2	—
9000	—	—	4.5	3	2
10,000	—	—	5	3	2
11,000	—	—	5	3	2

Typical Installation of a Condensate Commander Pump in a Submerged Application

Liquid is pumped from a sump, manhole or other low-lying area where it may accumulate. For back pressure applications, multiply the total vertical lift by .5 plus any back pressure in the return line.



Condensate Commander Pumps can pump liquids from low lying areas such as manholes, steam pits or any area that may collect liquid or flood. The non-electric feature makes it a good choice if compressed air or any other gas is readily available for use as the driving force. Steam is not recommended as a motive vapor because a submerged pump may quickly condense the motive steam, potentially reducing performance.

UNIFLEX STEEL/STAINLESS PIPE COUPLINGS

Reduce your maintenance and stocking costs with NICHOLSON's Uniflex Pipe Coupling. Uniflex has a spiral wound gasket that has successfully solved frequent leakage, intensive maintenance and stocking difficulties associated with ground joint pipe unions. A spreadsheet program is available upon request which calculates guaranteed savings when using Uniflex. NICHOLSON innovations set the standard.

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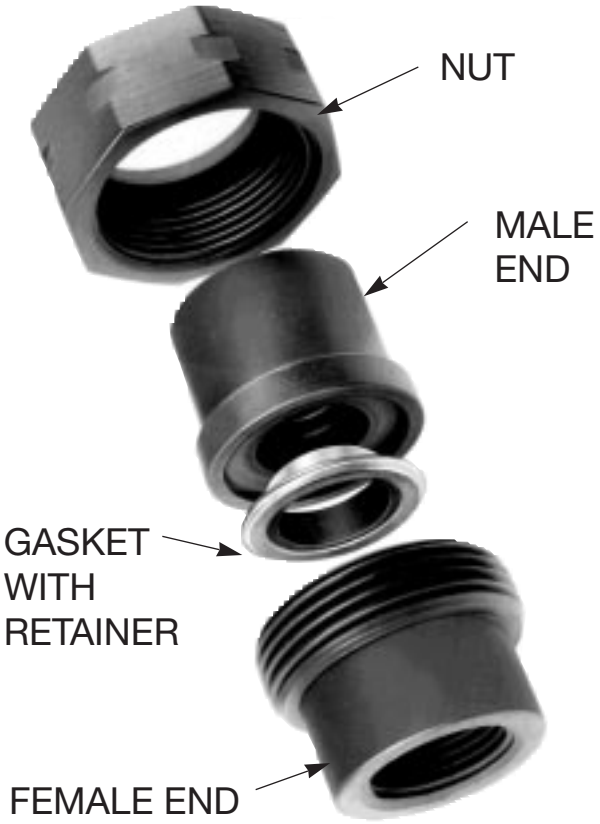


UNIFLEX STEEL/STAINLESS PIPE COUPLINGS

Pressures To 3000 PSIG (207 barg)
Temperatures to 850°F (454°C)

No Energy Losses — from expensive steam and process fluid leaks. A spiral-wound gasket ensures a leak-tight seal.

Lower Maintenance/Labor Costs — Replacement of the union housing is eliminated. Only a change of gasket is required when the Uniflex Coupling is disassembled. No need to spring the pipe during make-up or disassembly. It is less costly to make and break than flanges.

Lower Inventory Costs — Only a few Uniflex Pipe Couplings and gasket kits in each size are required to back up installations. One Uniflex satisfies all pressure series of flanges in pipe sizes 1/2" to 2".

Ease of Installation — The gasket is held firmly in place with a patented retainer. There is no danger of damaging the seal during installation as it is fully protected from overtorquing.

Welded Piping Systems — With the gasket removed while welding coupling into the piping, the danger of damaging the seal is eliminated. Costly removal of sections of pipe to replace leaky unions is eliminated.

Component Interchangeability — All components of the Uniflex Couplings, in each size class, are fully interchangeable. End connections can be socket weld, threaded, or a combination of both.

Applications

- Steam Systems–up to 1500 PSIG Superheat
- Dowtherm
- Variety of process fluids and gases to 3000 PSIG CWP, i.e.: Acids, Caustics, Nitrogen, etc.
- Steam Trap, Valve, Pump & Compressor Manifolds
- Nuclear Power Plants
- Hydraulic Fluids/Hot Oils

Options

- Teflon Gasket Filler
- Type 347 SS, Type 316 SS, Monel, Inconel 600, Hastalloy, Nickel Gasket Windings (other materials available on request)
- NPT or Socketweld

Models

- **SUA**–Uniflex Pipe Coupling
- **SUG**–Uniflex Replacement Gasket Kit
- **SUGR**–Uniflex Replacement Gasket Kit w/retaining ring

Call Nicholson or visit our website for *FREE* cost savings spreadsheet.

Operation

The Uniflex Pipe Coupling (SUA) has successfully solved frequent leakage, intensive maintenance and stocking difficulties associated with ground joint-pipe unions.

The SUA is a modified forged steel or stainless steel pipe union utilizing a Spiral-Wound Gasket to provide a leak-tight joint. This design, similar in principle to flange joints, has been proven in the field for many years. Because the joint seal is formed by the replaceable gasket (not a ground joint finish), failures caused by poor mating surfaces are eliminated. Components may be stocked and replaced individually because mated parts are not required for sealing.

UNIFLEX STEEL/STAINLESS PIPE COUPLINGS

Typical Specification

Union shall be of the straight-through design with connections oppositely aligned, suitable for either horizontal or vertical piping installations. Union shall meet standards of MSS SP-83 for 3000 lb. unions. Connections shall be either screwed or socketweld and union shall have threaded nut. Gasket shall be of the spiral wound design and a retainer shall be utilized to locate and hold gasket during installation.

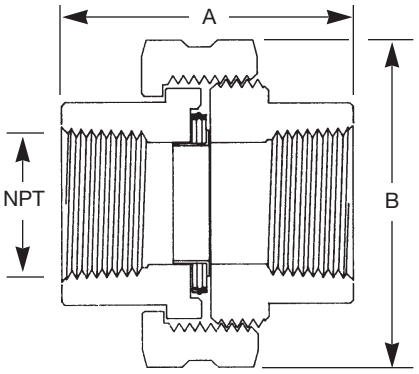
Union housing shall be forged steel ASTM A105 and have a pressure rating of 3000 PSIG at 100°F or type 316L stainless steel and have a pressure rating of 2430 PSIG at 100°F. Gasket winding shall be type 304 stainless steel with filler material of graphite. Gasket retainer shall be of type 316 stainless steel.

Maximum Operating Conditions

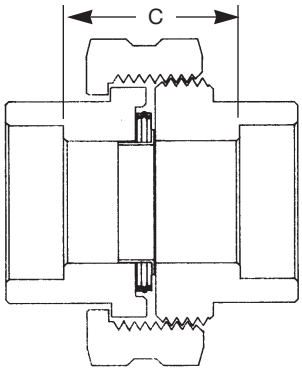
PMO: Max. Operating Pressure see Chart
TMO: Max. Operating Temperature see Chart

Materials of Construction

Housing:	Forged Carbon Steel, ASTM-A-105 or Type 316L SS
Gasket:	Spiral wound 304 Stainless w/graphite filler
Gasket Retainer:	Type 316 Stainless Steel



Uniflex Model SUA-T



Uniflex Model SUA-W

Connections:
1/2"-2" NPT or socketweld

Dimensions

Pipe Size	Inches A	Inches B	Inches C	Weight lbs.
1/2"	2.0 (51)	1.8 (46)	.9 (24)	0.8 (.36)
3/4"	2.2 (56)	2.2 (56)	1.1 (29)	1.2 (.55)
1"	2.4 (62)	2.6 (65)	1.1 (29)	1.6 (.73)
1 1/4"	2.8 (71)	3.0 (77)	1.4 (35)	2.5 (1.2)
1 1/2"	3.0 (76)	3.4 (86)	1.5 (38)	3.3 (1.5)
2"	3.4 (86)	4.1 (103)	1.6 (41)	4.7 (2.2)

1-1/4" not available in 316L SS
Average weights listed–actual weights may vary slightly

Temperature/Pressure Ratings†

Temperature	Pressure (PSIG) Carbon Steel	Pressure (PSIG) 316L SS
100°F	3000 (-20°F*)	2430 (-325°F*)
200°F	2735	2050
300°F	2655	1835
400°F	2565	1670
500°F	2425	1545
600°F	2220	1460
700°F	2155	1390
800°F	—	1330
850°F	—	1300

*Minimum recommended temperature
†For 3000 lb. unions from MSS SP-83.

Replacement Gaskets
Spare part kits include a package or 10 gaskets without retainer (SUG) of 10 gaskets with retainer (SUGR)

Air Traps/ Liquid Drainers

NICHOLSON's Air Traps and Liquid Drainer Line continues our tradition of offering high value with traditional traps while simultaneously pushing the performance envelope with leading edge technology. NICHOLSON innovations set the standard.

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Drain-Air & Mini-Drains

Condensate Removal from Air Systems
Pressures To 600 PSIG (41.4 barg)
Temperatures to 220°F (104°C)

Automatic and Positive Drain — Effectively removes condensate from compressed air systems with minimum air loss and rapid shutoff on no load conditions.

Reliable — Only one moving part.

Low Maintenance Cost — No adjustments necessary. Replaceable cartridge for in line repair and/or cleaning.

Long Service Life — Stainless Steel internals.

Freezeproof — Will not freeze when installed in vertical position with muffler removed.

Quiet Operation — Meets OSHA noise standards.

Simplifies Startup — No need to drain air lines through manual valves or petcocks. Top performance is reached without waiting for system to purge.

Sized for Most Applications — Drain-Air available in 3/8" and 1/2"; Mini-Drain available in 1/8" and 3/8".

Models

- **Drain Air**–Forged body w/SS internal mechanism & nylon muffler
- **Mini Drain**–All SS integral body w/nylon muffler

Applications

Drain-Air

- Air Header Drainage (pocket risers, end of line)
- Air Station or Location where petcock is used for blowdown, collecting wells, separators.

Mini-Drain

- Pneumatic Tools
- Air Filters
- Pneumatic Valves

Operation

A simple disc is used with no linkage or close fitting parts to eliminate problems found in ordinary small float or piston-operated devices used in drip legs on air lines. Disc will lift off seat on a periodic time cycle, allowing moisture to be discharged and atomized through the muffler. Positive action of the disc assures reliable condensate removal with minimum loss of air and rapid shutoff on no load condition. Intermittent discharges atomize condensate to avoid messy accumulations produced by other devices. Highly effective, specially designed muffler eliminates noise and diffuses moisture so that discharge drain piping is usually unnecessary. Freeze proof when mounted in vertical position with outlet facing down and muffler removed.

DRAIN-AIR & MINI-DRAINS

Typical Specification

The liquid drain trap shall be of thermodynamic design with screwed NPT connections. Internal mechanism shall be stainless steel with hardened working surfaces. A pneumatic muffler shall be employed to reduce exhaust sound pressure level.

Maximum Operating Conditions

PMO: Max. Operating Pressure	600 psig	(41.4 barg)
TMO: Max. Operating Temperature	220°F	(104°C)
PMA: Max. Allowable Pressure	600 psig	(41.4 barg)
TMA: Max. Allowable Temperature	800°F	(426°C)

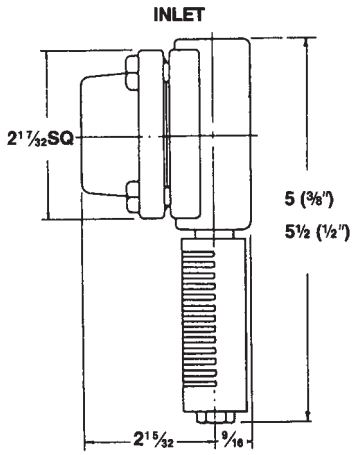
Materials of Construction

DRAIN-AIR

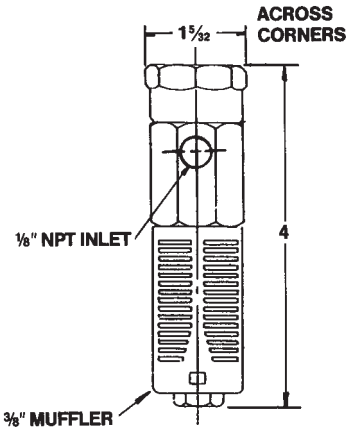
Body & Cover:	ASTM A105 Forged Steel
Celtron® Cartridge:	416 Stainless Steel w/hardened disc & seat
Bolts:	High temperature alloy
Cover Gasket:	347 Stainless Spiral-wound w/graphite filler
Integral Strainer:	304 Stainless Steel
Muffler:	Nylon Housing, Aluminum Screen
Connections:	3/8"-1/2" NPT

MINI-DRAIN

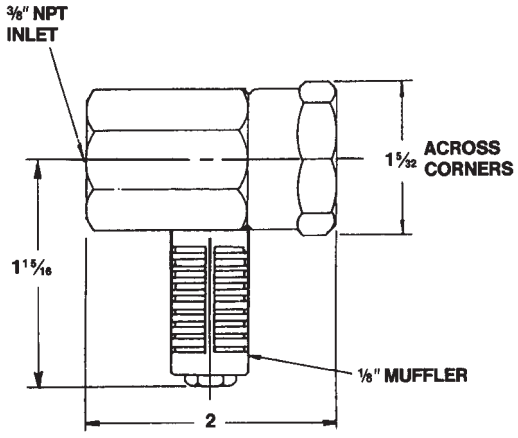
Cap, Seat & Disc:	416 Stainless, Hardened
Muffler:	Nylon Housing, Aluminum Screen



3/8" & 1/2" DRAIN-AIR



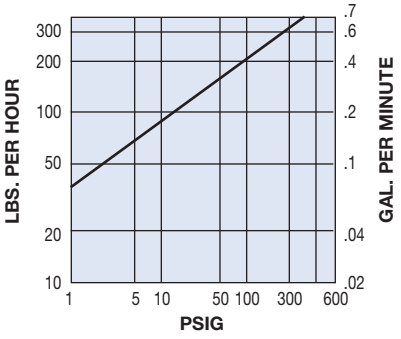
1/8" MINI-DRAIN



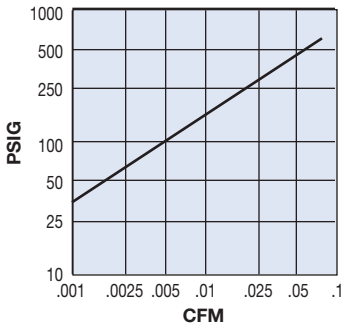
3/8" MINI-DRAIN

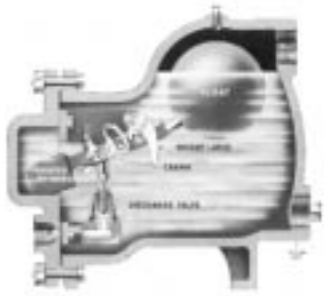
Connections: 1/8"-3/8" NPT

DISCHARGE CAPACITY



AIR LOSS–NO LOAD CONDITION





JR Weight Operated Traps

Pressures To 300 PSIG (20.7 barg)
Temperatures to 750°F (400°C)

Applications

Saturated & Superheated Steam
- Condensate Removal for most Steam Equipment
- Superheated Steam Service

Compressed Air
- Receivers
- Intercoolers
- Separators
- Reservoirs
- Drip Legs

Gas
- Separators
- Scrubbers
- Accumulators
- After-absorbers
- Compressor Station Suction Lines

Model JRS Chemical Service
- Corrosive Chemical Applications

Model JR & JRT Steam Service
- Paper Machine Dryer Cylinders
- Plastic & Rubber Moulding Machine Platens
- Large Blast Heaters & Feed Water Heaters
- Contaminated Steam Systems, i.e. Geothermal

Options

- Chemical Service Model JRS, with all stainless steel internals
- Air Vent Model JRT, with external thermostatic air vent for steam service only
- Oil Eliminating Screen for compressed air service
- Gage Glass Complete
- Gage Glass Tapping - 3/8" NPT, plugged
- Cartridge Heating Unit - prevents freezing or congealing of oil.
- Stellite Facing on Valves & Seats

Resists Wiredrawing — Rapid opening and closing prevents wiredrawing of valve and seat.

No Blow-through — A permanent liquid seal is maintained over the discharge valve, preventing the loss of steam, air or gas.

No Dribbling — Rapid wide opening means quick flushing of liquids and debris and tight closing prevents leakage.

Protected from Line Debris — Internal Strainer prevents most debris from reaching valve and seat (except compressed air applications).

No Sludge Build-up — Oil eliminating screen over discharge valve prevents build-up of sludge in compressed air service.

Low Maintenance — Clean-out and maintenance are reduced because dirt and oil are flushed out during each discharge.

Models

- **JR**–Air & gas service, steam service*
- **JRT**–Steam service w/thermostatic vent
- **JRS**–All SS internals
- **JRC**–Cast steel body

*Specify steam or air & gas service when ordering.

Operation

The Model JR Trap operates on an entirely different principle than ordinary “float” traps. In operation, the condensate raises the float to its highest point of travel, releases the weight latch, allowing the counterweight to fall. This opens the discharge valve fully and instantaneously through a crank mechanism. A link latch holds the valve wide open until the float descends to its low point, where the weight latch engages the counterweight. The link latch then disengages, closing the discharge valve instantaneously.

JR Weight Operated Traps

Maximum Operating Conditions

Cast Iron

PMO: Max. Operating Pressure	250 psig	(17.2 barg)
TMO: Max. Operating Temperature	450°F	(232°C)
PMA: Max. Allowable Pressure	250 psig	(17.2 barg)
TMA: Max. Allowable Temperature	450°F	(232°C)

Cast Steel

PMO: Max. Operating Pressure	300 psig	(20.7 barg)
TMO: Max. Operating Temperature	750°F	(400°C)
PMA: Max. Allowable Pressure	300 psig	(20.7 barg)
TMA: Max. Allowable Temperature	750°F	(400°C)

Materials of Construction

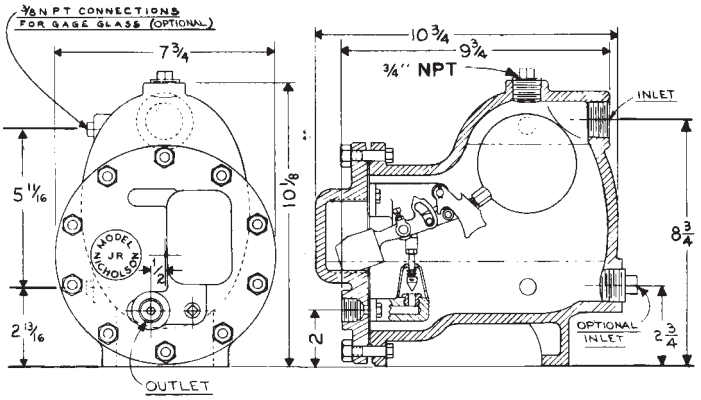
Body: Cast Iron ASTM A278 Class 30 or Cast Steel ASTM A216 WCB

Float: Stainless Steel

Valves & Seats: Hardened Stainless Steel

Internal Linkage JR: Bronze & Stainless Steel

JRS: All Stainless Steel



WEIGHT:
Cast Iron 36 Lbs. (16.4 kg)
Cast Steel 37 Lbs. (16.8 kg)

Connections: 1/2"-1" NPT

Orifice Diameters & Maximum Capacity[3]—lbs/hr

Differential Pressure[1] PSIG (barg)	Compressed Air/Gas SG = 1.00 to 0.85 Orifice inches (mm)	Compressed Air/Gas SG = 1.00 to 0.85 Capacity[2] GPM (L) @ 60°F	Compressed Air/Gas SG = 0.84 to 0.50 Orifice inches (mm)	Compressed Air/Gas SG = 0.84 to 0.50 Capacity[2] GPM (L) @ 60°F	Steam Pressure PSIG (barg)	Steam Orifice inches (mm)	Steam Capacity lbs/hr. (mm)
2 (.14)	3/8 (9.5)	2.3 (8.7)	3/8 (9.5)	2.3 (8.7)	2 (.14)	3/8 (9.5)	775 (352)
5 (.35)	3/8 (9.5)	3.5 (13.2)	3/8 (9.5)	3/5 (13.2)	5 (.35)	3/8 (9.5)	1000 (455)
10 (.69)	3/8 (9.5)	5.0 (18.9)	3/8 (9.5)	5.0 (18.9)	10 (.69)	3/8 (9.5)	1400 (636)
25 (1.7)	5/16 (8)	6.4 (24.2)	9/32 (7)	5.5 (20.8)	25 (1.7)	5/16 (8)	1750 (795)
50 (3.4)	7/32 (5.5)	5.6 (21.2)	3/16 (5)	4.6 (17.4)	50 (3.4)	7/32 (5.5)	1700 (733)
75 (5.2)	3/16 (5)	5.3 (20.0)	5/32 (4)	4.0 (15.1)	75 (5.2)	3/16 (5)	1900 (864)
100 (6.9)	5/32 (4)	4.8 (18.2)	1/8 (3)	3.0 (11.4)	100 (6.9)	5/32 (4)	1600 (727)
125 (8.6)	1/8 (3)	3.4 (12.9)	1/8 (3)	3.4 (12.9)	125 (8.6)	1/8 (3)	1180 (536)
150 (10.3)	1/8 (3)	3.7 (14.0)	3/32 (2.4)	2.1 (8)	150 (10.3)	1/8 (3)	1275 (580)
200 (13.8)	3/32 (2.4)	2.4 (9.1)	3/32 (2.4)	2.4 (9.1)	200 (13.8)	3/32 (2.4)	1075 (489)
250 (17.2)	3/32 (2.4)	2.7 (10.2)	3/32 (2.4)	2.7 (10.2)	250 (17.2)	3/32 (2.4)	1175 (534)
300 (20.7)	3/32 (2.4)	3.0 (11.4)	3/32 (2.4)	3.0 (11.4)	300 (20.7)	3/32 (2.4)	1220 (555)

1 Trap inlet pressure minus static pack pressure, if any.
2 For capacity in lbs/hr., multiply by 500 x Specific Gravity.
3 All capacities shown are for maximum pressure. For lower operating pressures, consult factory.

PIPING SPECIALTIES

NICHOLSON manufactures a wide range of piping specialties to suit a broad spectrum of applications.

- STV Test & Block Valve
- Noise Diffuser
- Pneumatic Muffler
- NicFix Radiator Trap Repair Kits
- Y Strainers

NICHOLSON innovations set the standard.

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STV Series Combination Trap Test & Blocking Steam Valve

Pressures To 250 PSIG (17.2 barg)
Temperatures to 406°F (208°C)

Visual Steam Trap Test — Provides for quick visual examination of steam trap discharge.

Compact Body — Small size facilitates installation and operation in tight spaces.

Stainless Steel Internals — High quality materials provide long service life and protection against corrosion.

Repairable — All parts are easily replaceable.

Large Size Test Vent — Vent passage in ball is large enough to provide true determination of trap discharge.

Safety Designed — Bottom loaded, pressure retaining stem and packing nut threaded to body provides extra margin of safety.

Reduces Labor Costs — Eliminates need to install and maintain separate blocking and test valves.

Minimizes Risk of Connection Leaks — Eliminates the need for numerous fittings.

Applications

- Test Steam Traps
- Sample Fluids or Gases from Process Lines

Options

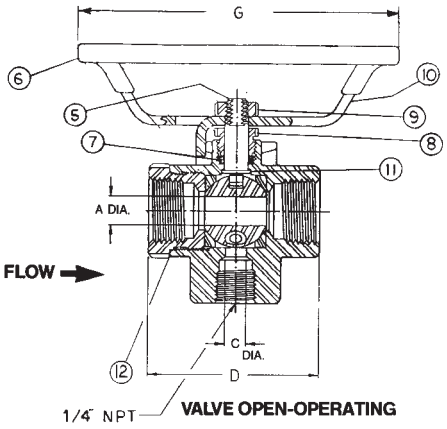
- Stainless Steel Latch-lok Handle
- High Profile Handle

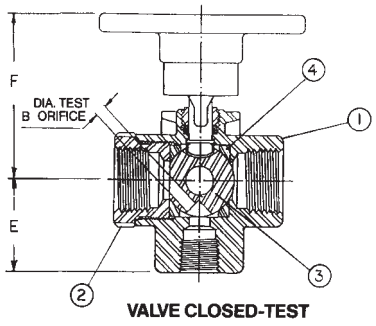
Operation

STV test/block valve is installed on downstream side of steam trap. During normal operation, valve is in open position with unrestricted flow through trap into the return system.

One quarter turn (90°) of STV blocks flow from return and vents trap discharge to atmosphere. Provides quick, visual check of trap operation.

STV Series Combination Trap Test & Blocking Steam Valve





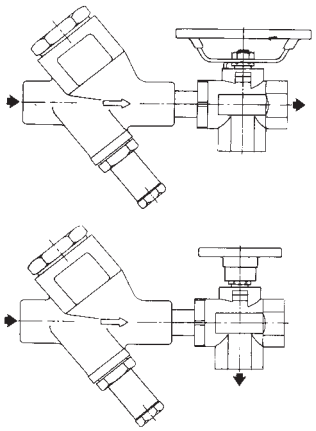
Connections: 12/" and 3/4" NPT

Maximum Operation Conditions

PMO: Max. Operating Pressure	250 psig	(17 barg)
TMO: Max. Operating Temperature	406°F	(208°C)
PMA: Max. Allowable Pressure	250 psig	(17 barg)
TMA: Max. Allowable Temperature	406°F	(208°C)

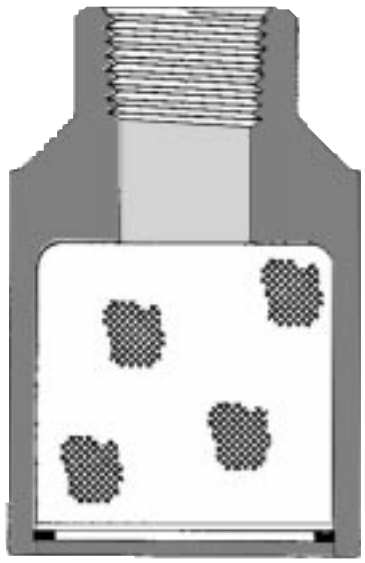
Materials of Construction

Body:	ASTM A216 WCB Carbon Steel (Blk oxide & oil coat)
Adapter:	#12L14C.R.S. (Blk oxide & oil coat)
Ball:	#316 Stainless Steel
Seat:	25% Mineral Fill Virgin Teflon
Stem:	#316 Stainless Steel
Insulator:	Plastisol (Vinyl grip)
Packing Gland:	Carbon Reinforced Teflon
Packing Nut:	#12L14 C.R.S. (Blk oxide & oil coat)
Handle Nut:	Steel (Zinc plated)
Handle:	#11 Ga. C.R.S. (Zinc plated)
Thrust Washer:	Glass Reinforced Teflon
Body Seal:	Virgin Teflon



DIMENSIONS

Size	A	B	C	D	E	F	G	Thread Size
1/2"	.375	.156	.281	2.26	1.20	2.17	4.25	1/2" NPT
3/4"	.531	.218	.281	2.83	1.49	2.45	4.25	3/4" NPT



SS600 Series Noise Diffuser

Pressures To 600 PSIG (41.3 barg) Temperatures to 750°F (400°C)

Diffuses Blast Discharge — Diffuses the high velocity discharge from steam traps.

Reduces Noise — Dampens the level of noise associated with steam trap cycles.

Corrosion Resistant — All stainless steel construction provides excellent protection from corrosion.

Causes No Back Pressure — Porous stainless steel baffle allows condensate discharge without back pressure.

Compressed Air Capabilities — Diffuser works as a muffler for compressed air exhaust.

Repairable in-line — Snap ring design allows for easy element replacement.

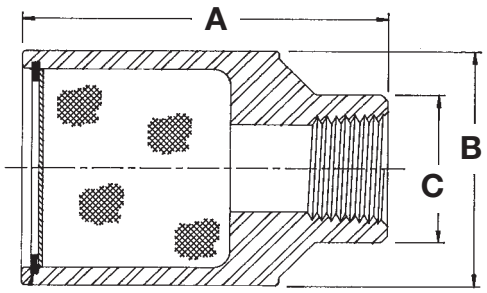
Applications

- Steam Traps
- Blowdown Valves
- Air Cylinders

Operation

The SS600 Diffuser is installed on the outlet side of steam traps, valves or other equipment that discharges high velocity steam, condensate or air to the atmosphere. The baffle is constructed of a fine stainless steel wire mesh, similar to steel wool. This porous mesh breaks down the high velocity discharge which dampens the sound significantly.

SS600 Series Noise Diffuser



Connections: 3/8" – 3/4" NPT

Maximum Operating Conditions

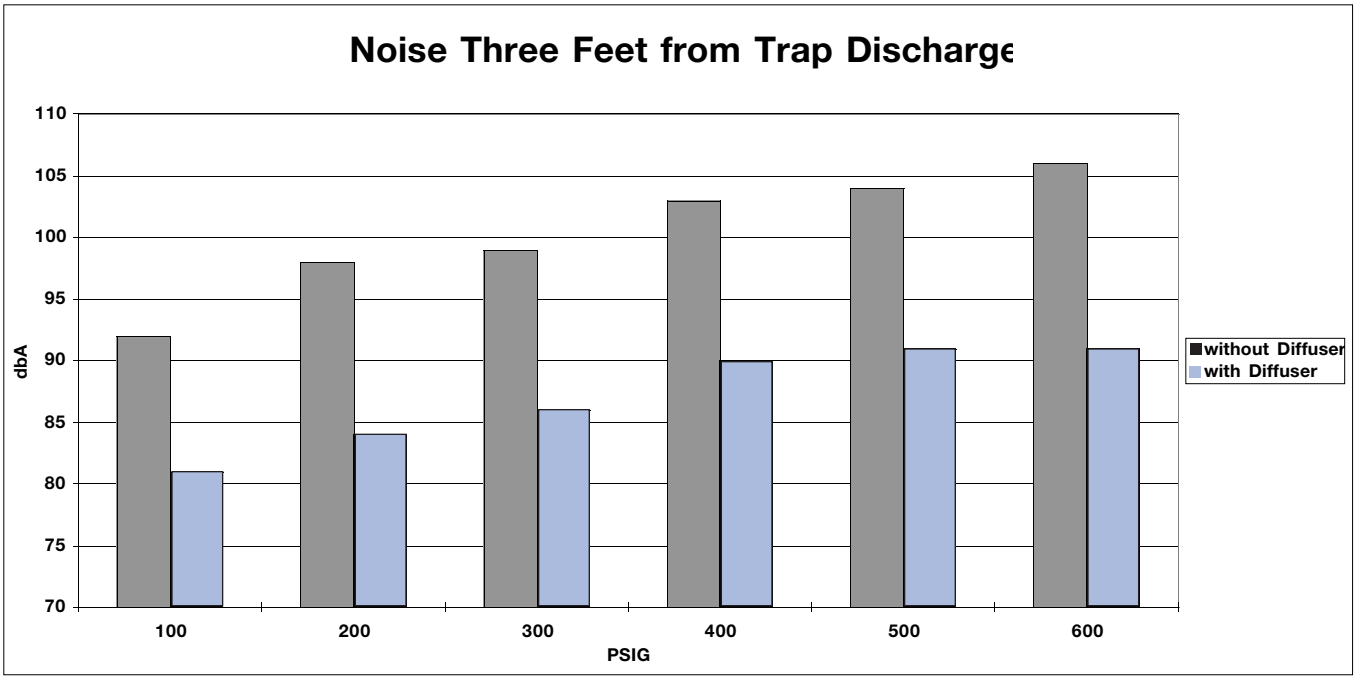
PMO: Max. Operating Pressure	600 psig	(41.3 barg)
TMO: Max. Operating Temperature	750°F	(400°C)
PMA: Max. Allowable Pressure	600 psig	(41.3 barg)
TMA: Max. Allowable Temperature	750°F	(400°C)
CWP: Max. Cold Working Pressure	1,000 psig	(69 barg)

Materials of Construction

Body:	ASTM A351 Grade CF3M (316L)
Retaining Ring:	302 Stainless Steel
Element:	304Stainless Steel

Dimensions

NPT Size	Inches A	Inches B	Inches C	Weight Lbs.
3/8"	2 3/4	1 25/32	1 1/8	.85 lbs
1/2"	2 3/4	1 25/32	1 1/8	.81 lbs
3/4"	2 25/32	1 25/32	1 5/16	.88 lbs



Pneumatic Mufflers

Pressures To 600 PSIG (41.4 barg)
Temperatures to 220°F (104°C)

Reduces Noise to Acceptable Levels — Specifically designed to reduce the noise of exhaust.

Compact and Lightweight — Adds minimal space and weight to installation.

Durable Construction — Will provide years of service.

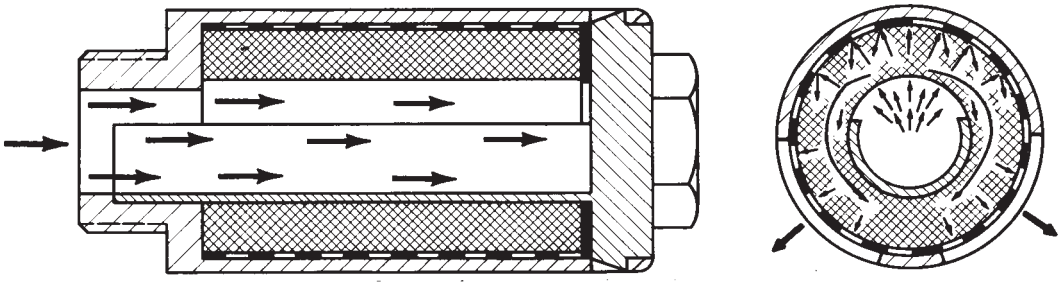
Corrosion Proof — Nylon and felt construction will not corrode in most services.

Applications

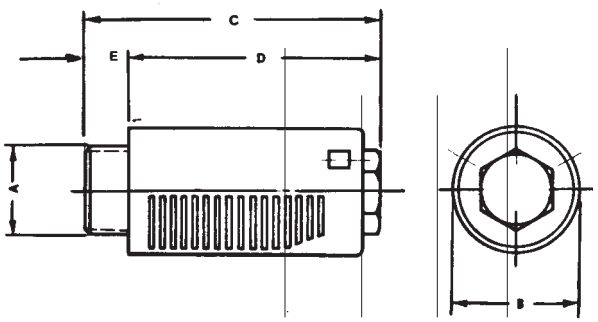
- 2, 3 and 4-way Valves
- Pneumatic Cylinders
- Air Motors
- Air Tools
- Instrumentation
- Bench Fixtures
- Test Panels
- Relief Valves

Operation

The muffler housing and plug are made of nylon. compressed exhaust air enters the muffler as shown by the flow arrows. It is then diverted by a plastic insert sleeve through a packing of sound deadening felt and out through exit slots. A fine mesh screen shields the felt packing and retains it in position.



PNEUMATIC MUFFLERS



Maximum Operating Conditions

PMO: Max. Operating Pressure	600 psig	(41.3 barg)
TMO: Max. Operating Temperature	220°F	(104°C)
PMA: Max. Allowable Pressure	600 psig	(41.3 barg)
TMA: Max. Allowable Temperature	220°F	(104°C)

Materials of Construction

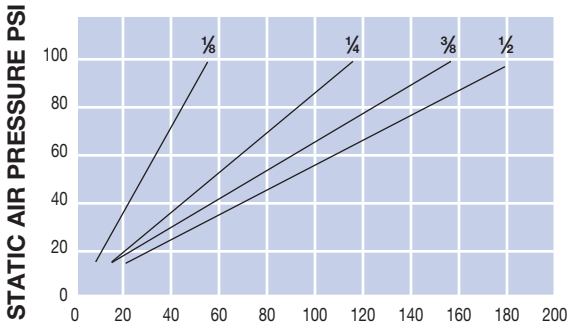
Housing:	Nylon
Screen:	Aluminum
Media:	Felt

Connections: 1.8" – 1/2" NPT

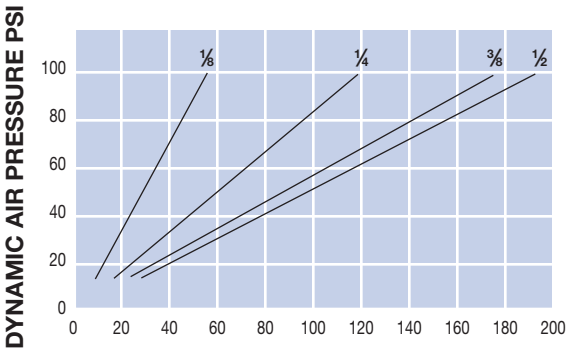
Dimensions

A NPT Size	Inches			
	B	C	D	E
1/8"	.63	1.72	1.38	.34
1/4"	.83	2.06	1.66	.40
3/8"	.99	2.43	2.03	.40
1/2"	1.18	2.90	2.37	.53

AIR FLOW AND SOUND MEASUREMENTS OF NICHOLSON PNEUMATIC MUFFLERS

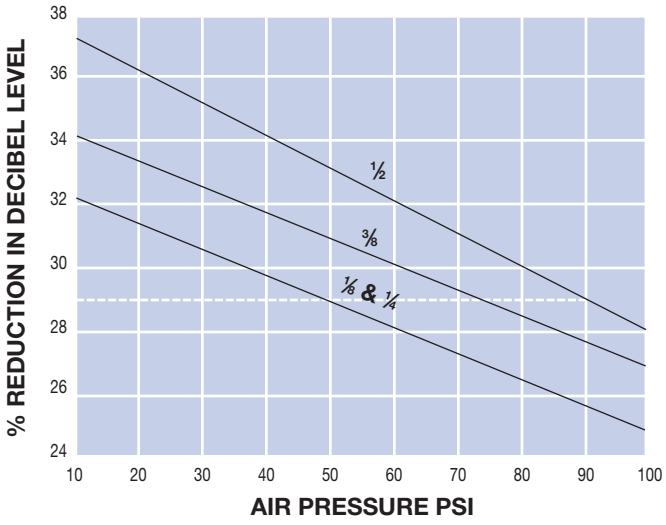


AIR FLOW CUBIC FEET/MINUTE
STATIC AIR FLOW = FLOW FROM CLOSED CHAMBER



AIR FLOW CUBIC FEET/MINUTE
DYNAMIC AIR FLOW = FLOW THRU WORKING LINE

SOUND LEVELS ON A WEIGHING SCALE



AIR PRESSURE PSI

USING GRAPH

Condition: Exhaust of air at 90 PSI produces a noise level of 100 dbA. Noise must be reduced to an acceptable level.

Solution: 1/2" Muffler will reduce level 29%. Muffled discharge will be at 71 dbA.

NIC-FIX STAINLESS STEEL RADIATOR STEAM TRAP REPLACEMENT KITS

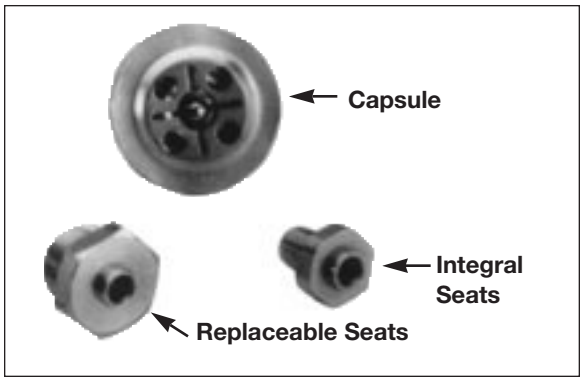
Pressures To 15 PSIG (1.03 barg)
Temperatures to 250°F (121°C)

Nic-Fix for Traps with Removable Seat

Nic-Fix for Traps with Integral Seat

Features:

- Quick,Easy, Economical
- Simplifies/Reduces Inventory
- Upgrades Old Traps Instantly
- 3 Year Warranty
- Adapts to Most Existing Traps
- Uses Existing Cover



Applications

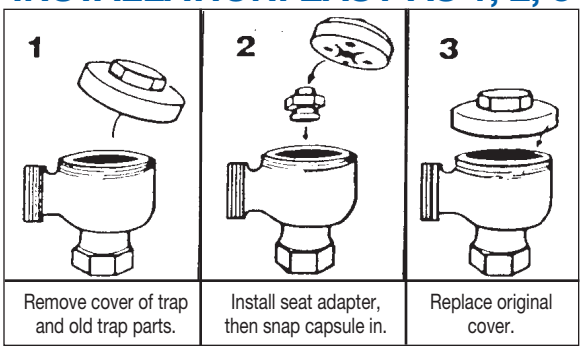
- Replace working parts in Low Pressure Thermostatic Radiator Traps

Operation

Thermostatic capsule is filled with a liquid having a lower boiling point than water. As assembled, valve is normally open to vent air on start-up. When steam enters trap, thermostatic capsule fill vaporizes to a pressure higher than line pressure; this forces valve into seat orifice to prevent any further flow. As condensate collects, it takes heat from thermostatic capsule, lowering internal pressure. Line pressure will then compress thermostatic capsule to open valve and discharge condensate. Valve opening automatically adjusts to load conditions.

NIC-FIX STAINLESS STEEL RADIATOR STEAM TRAP REPLACEMENT KITS

INSTALLATION: EASY AS 1, 2, 3



Remove cover of trap and old trap parts.	Install seat adapter, then snap capsule in.	Replace original cover.

Maximum Operating Conditions

PMO: Max. Operating Pressure	15 psig	(1.03 barg)
TMO: Max. Operating Temperature	250°F	(121°C)

Materials of Construction

Capsule: Stainless Steel

Adapter: Stainless Steel

NIC-FIX Kits – Replaceable Seat/Adapters with Thermal Capsules (Pack of six sets)			
MANUFACTURER	**1/2" TRAPS**	**3/4" TRAPS**	**NUMBER**
Warren Webster	02H, 02V, 502, 502V-1, 702, 702V-1, 712, 902V	503, 703, 713	5858101
Warren Webster	512, 512H-1, 512G-1, 522, 522H, 522HB 712HB, 722HB	513, 533, 523A, 523H-1†, 5236-1† 713HB, 733, 733HB, 723A	5858102
Warren Webster	902H		5858103
Warren Webster		913A, 913H	5858104
Sarco Erwel Illinois Trane Marsh Monash-Younker	S65, E, H, TB25, TS25, T65 R30 1G B1* 1 30	E, H, S65, TB25, TS25, T65 3GH	5858105
Hoffman	17C	8C	5858106
Marsh		2-4, 2-7	5858114
Sterling	7-50A		5858115
Trane Dunham-Bush		B3 TH2A	5858116
NIC-FIX Kits – Traps with Integral Seats (Pack of six sets)			
Dunham-Bush Trane Sarco	1B, 1C, 1E, V1B B2	 T25	5858107
Sarco Hoffman	T25 8		5858108
Illinois	1T, 2T		5858109
Barnes & Jones	122A, 122S, 3045		5858110
Barnes & Jones		134A, 134S	5858111
Trane	B1*		5858112
Trane		B3	5858113
REPLACEMENT AIR VENTS FOR F&T TRAPS (15 and 30 psi)			
Sarco		Series FT 3/4"–2"	5858125
Trane		686/55AL 3/4"–1"	5858126
NIC-FIX Kits – Thermal Capsules only (Pack of six)			
ALL	ALL	ALL	5858110

* Except vertical models.

†For traps made prior to 1931, "-1" will be omitted from markings on body.

TYPE 77SI
CAST IRON STRAINERS

Pressures To 250 PSIG (17.2 barg)
Temperatures to 406°F (207°C)

Features

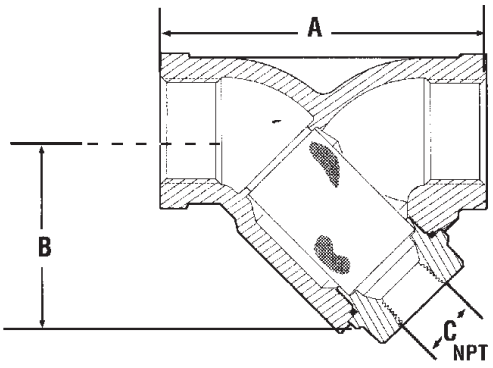
- **ASTM A-126 Class B Cast Iron Body**
- **304 SS ASTM A-276 Screen**
- **Iron Retainer Cap and Gasket**
- **Tapped for Closure Plug (not included)**

Ratings

Ends ASME/ANSI	Pressure PSIG (barg)		Temperature °F (°C)
WSP			
B16.4 Class 250 NPT	250 (17.2)	@	406 (207)
WOG			
B16.4 Class 250 NPT	400 (27.6)	@	100 (38)

Options

- Other perforated screens and mesh liners



Connections: 1/4" – 3" NPT

DIMENSIONS inches (mm)
AND WEIGHTS pounds (kg)

SIZE	A	B	C	WT.
1/4 (6)	3 3/16 (81)	2 (50)	1/4 (6)	1.4 (.6)
3/8 (10)	3 3/16 (81)	2 (50)	1/4 (6)	1.4 (.6)
1/2 (13)	3 3/16 (81)	2 (50)	1/4 (6)	1.8 (.8)
3/4 (19)	3 3/4 (95)	2 11/16 (68)	3/8 (10)	2.5 (1.1)
1 (25)	4 (102)	3 (76)	3/8 (10)	4.0 (1.8)
1 1/4 (32)	5 (127)	3 7/16 (87)	3/4 (19)	6.7 (3)
1 1/2 (38)	5 3/4 (146)	3 13/16 (973)	3/4 (19)	8.3 (3.8)
2 (50)	7 (178)	4 5/16 (117)	1 (25)	13.5 (6.1)
2 1/2 (64)	9 1/4 (235)	6 1/8 (156)	1 (25)	21.0 (9.5)
3 (76)	10 (254)	7 1/2 (191)	1 1/4 (32)	26.0 (11.8)

SCREEN OPENINGS

SIZE	STANDARD SCREEN OPENINGS	MATERIALS
1/4" – 2"	20 mesh	Stainless
2 1/2" – 3"	3/64 Perf.	Stainless

TYPE 77F-D FLANGED CAST IRON STRAINERS

Pressures To 500 PSIG (34.5 barg)
Temperatures to 406°F (207°C)

Features

- **ASTM A-126 Class B Cast Iron Body**
- **304 SS ASTM A-276 Screen**
- **Bolted Iron Retainer Cap and Gasket**
- **Tapped for Closure Plug (included)**

Ratings

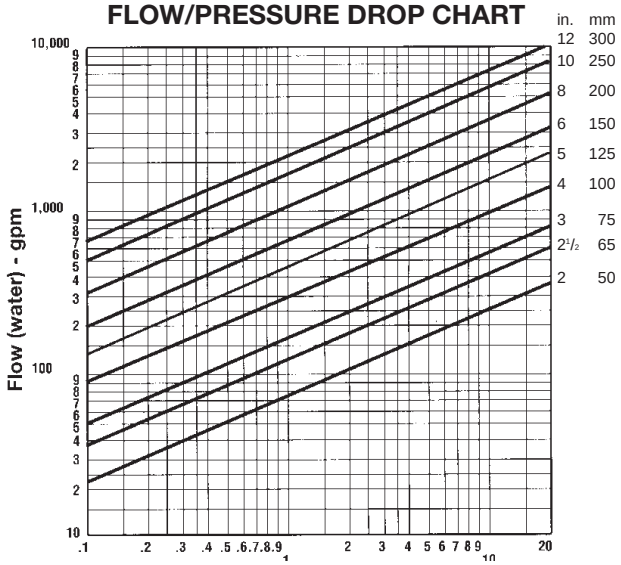
Ends ASME/ANSI	Pressure PSIG (barg)		Temperature °F (°C)
WSP			
B16.1 Class 125 Flanged	125 (8.6)	@	353 (178)
B16.1 Class 250 Flanged	250 (17.2)	@	406 (207)
WOG			
B16.1 Class 125 Flanged	200 (13.8)	@	210 (99)
B16.1 Class 250 Flanged	500 (34.5)	@	150 (66)

Options

- Other perforated screens and mesh liners

Connections: 2" – 12" NPT

FLOW/PRESSURE DROP CHART



***Conversions:** For gpm to lpm, multiply 3.785
For psi to atmospheres, multiply by .068

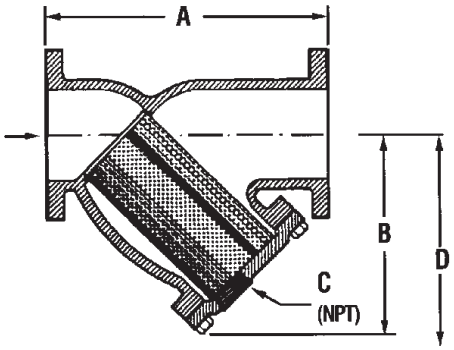
DIMENSIONS inches (mm) AND WEIGHTS pounds (kg)

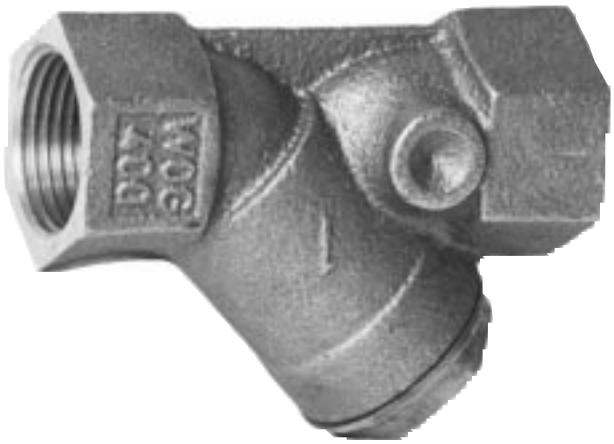
SIZE	A		B		C		D		WEIGHT	
	125 lb.	250 lb.	125 lb.	250 lb.	125 lb.	250 lb.	125 lb.	250 lb.	125 lb.	250 lb.
2 (50)	7⅞ (200)	9⁵⁄₁₆ (244)	5¼ (133)	6 (152)	½ (13)	1/2 (13)	7 (178)	7 (178)	18 (8.2)	26 (11.3)
2½ (63)	10 (254)	11¹⁄₁₆ (281)	6½ (165)	7⅛ (181)	1 (25)	1 (25)	9¾ (248)	9¾ (248)	28 (12)	40 (18.2)
3 (76	10⅛ (257)	12⅝ (321)	7 (178)	9⅛ (232)	1 (23)	1¼ (32)	10 (254)	10 (254)	34 (15.4)	59 (26.8)
4 (102)	12⅛ (308)	15⅝ (397)	8¼ (210)	10⅞ (276)	1½ (38)	1½ (38)	12 (305)	12 (305)	60 (27.3)	93 (42.3)
5 (127)	15⅝ (397)	18¼ (463)	11¼ (210)	12¹⁵⁄₁₆ (329)	2 (50)	2 (50)	17 (432)	17 (432)	95 (43.7)	146 (66.4)
6 (152)	— —	20³⁄₁₆ (513)	— —	14½ (368)	— —	2 (50)	— —	20 (508)	— —	194 (88.2)
8 (203)	— —	25⅛ (638)	— —	16⁷⁄₁₆ (418)	— —	2 (50)	— —	22¾ (578)	— —	316 (144)
10 (254)	— —	29⅛ (714)	— —	19¼ (489)	— —	2 (50)	— —	28 (711)	— —	475 (215)
12 (305)	— —	33¾ (857)	— —	22⅞ (581)	— —	2 (50)	— —	30 (762)	— —	750 (340)

SCREEN OPENINGS

SIZE	STANDARD*	MATERIALS
2" – 5"	1/16 Perf.	Stainless
6" – 8"	1/8 Perf.	Stainless
10" – 12"	3/16 Perf.	Stainless
SIZE	STEAM SERVICE	MATERIALS
2" – 10"	3/64 Perf.	Stainless
12"	1/16 Perf.	Stainless

*For Water, Oil and Gas.





TYPE 777SI BRONZE STRAINERS

Pressures To 400 PSIG (27.6 barg) Temperatures to 353°F (178°C)

Features

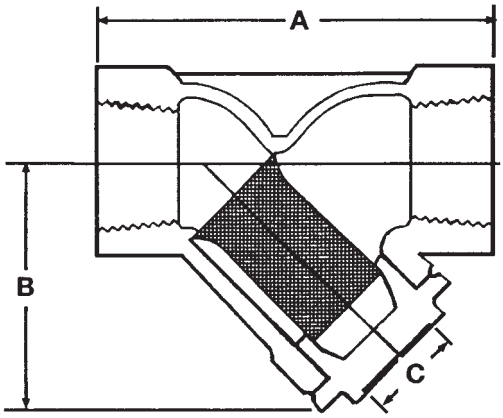
- **Bronze ASTM B62 Body**
- **Machined seat in body and tapered seat in cap for accurate screen alignment**
- **NPT blow-off connections (plug not provided)**
- **Standard 20 mesh perforated 304 Stainless Steel Screen**
- **Special flared screen opening on upstream end provides unrestricted flow**
- **PTFE Teflon Gasket**

Ratings

Ends ASME/ANSI	Pressure PSIG (barg)		Temperature °F (°C)
WSP			
B16.4 Class 125NPT	125 (8.6)	@	353 (178)
WOG			
B16.4 Class 125NPT	400 (27.6)	@	210 (99)

Options

- Other perforated screens and mesh liners

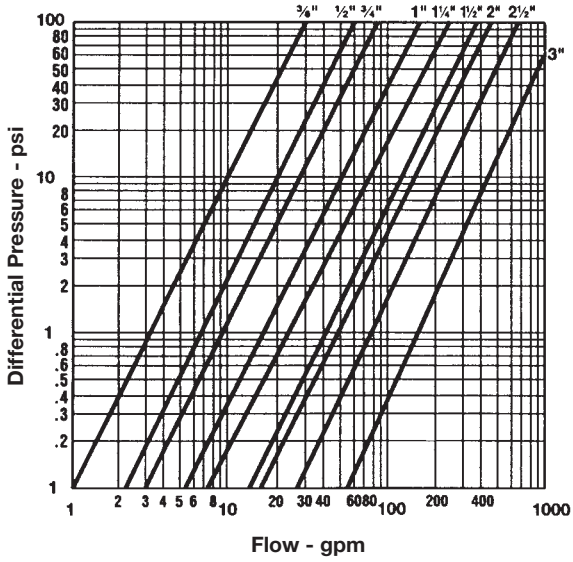


Connections: 3/8" – 3" NPT

DIMENSIONS inches (mm) AND WEIGHTS pounds (kg)

SIZE	A	B	C	WT.
⅜ (10)	2⅜ (60)	1 5/16 (33)	¼ (6)	.4 (.18)
½ (13)	2¾ (70)	1⅜ (35)	¼ (6)	.5 (.23)
¾ (19)	3 3/16 (81)	1⅝ (42)	¼ (6)	.6 (.27)
1 (25)	3¾ (95)	2⅛ (54)	½ (13)	1.1 (.50)
1¼ (32)	4 7/16 (113)	2½ (64)	½ (13)	1.9 (.86)
1½ (38)	4⅞ (124)	3 (76)	¾ (19)	2.4 (1.09)
2 (50	5 15/16 (151)	3 9/16 (91)	1 (25)	4.4 (2.00)
2½ (64)	9 1/16 (230)	5⅞ (149)	½ (13)	9.8 (4.44)
3 (76)	10 3/16 (259)	6¼ (159)	½ (13)	13.2 (5.99)

FLOW/PRESSURE DROP CHART



SCREEN OPENINGS

SIZE	STANDARD SCREEN OPENINGS	MATERIALS
⅜" – 3"	20 mesh	Stainless

TYPE 88S STAINLESS STEEL STRAINERS

Pressures To 1440 PSIG (99.3 barg)
Temperatures to 489°F (254°C)

Features

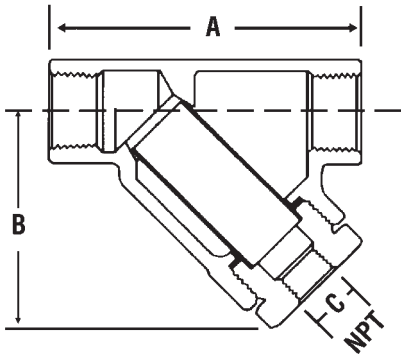
- **Stainless Steel ASTM A-351 Grade CF8M Body**
- **Built for long service life in corrosive, high pressure and high temperature applications**
- **Threaded cap is mated to body with straight threads and sealed off from flow**
- **Cap tapped for closure plug (not provided)**

Ratings

Ends ASME/ANSI	Pressure PSIG (barg)	Temperature °F (°C)
WSP		
B16.34 Class 600 NPT	600 (41.4) @	489 (254)
WOG		
B16.34 Class 600 NPT	1440 (99.3) @	100 (38)

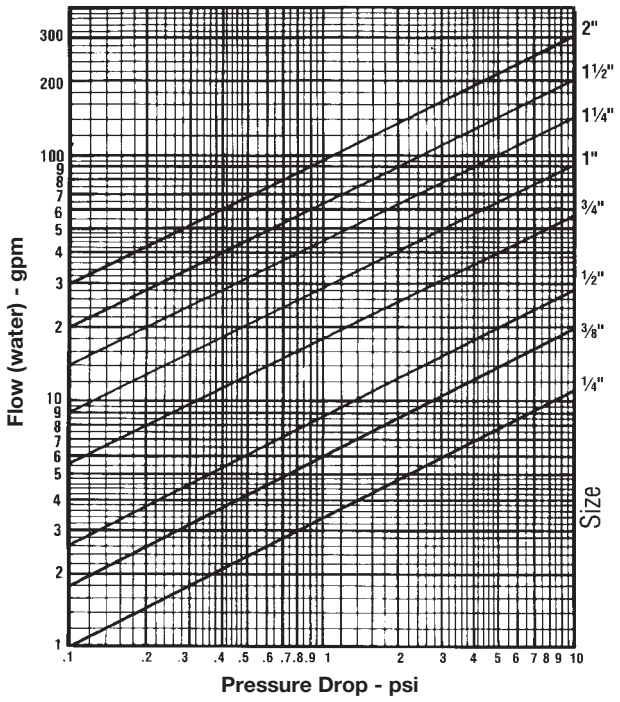
Options

- Other perforated screens and mesh liners



Connections: 1/4"– 2" NPT

FLOW/PRESSURE DROP CHART



DIMENSIONS inches (mm), WEIGHTS pounds (kg) AND Cv

Size	Dimensions			Weight	Cv Rating
	A	B	C		
¼ (6)	3 (76)	2¼ (57)	¼ (6)	1.3 (.6)	3.5
⅜ (10)	3 (76)	2¼ (57)	¼ (6)	1.3 (.6)	6
½ (13)	3 13/16 (97)	2⅝ (67)	¼ (6)	2.1 (.9)	10.5
¾ (19)	4⅜ (136)	3 3/16 (86)	⅜ (10)	3 (1.4)	17
1 (25)	5 3/16 (137)	3¾ (95)	½ (13)	4.5 (2)	28
1¼ (32)	5⅝ (143)	4⅞ (124)	¾ (19)	5.8 (2.6)	45
1½ (38)	6¼ (159)	5 (127)	¾ (19)	7 (3.2)	60
2 (50	7½ (190)	6⅛ (156)	1 (25)	10 (4.5)	100

SCREEN OPENINGS

SIZE	STANDARD SCREEN OPENINGS	MATERIALS
¼" – 2"	1/16 Perf.	Stainless

STEAM TRAPPING PRIMER

Steam Trapping Primer – NICHOLSON has been known throughout the 20th Century as a pioneer and engineering leader in the Steam Trapping industry. Our line of Steam Traps includes the four major types: Mechanical, Thermodynamic, Thermostatic and Drain Orifice.

NICHOLSON Steam Traps are available for use at temperatures to 800° F, and pressures from vacuum to 3000 PSIG.

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

BASICS OF STEAM TRAPS

WHY DO WE NEED STEAM TRAPS?

In order to operate economically and efficiently, all steam systems must be protected against 3 factors:

* CONDENSATE
* AIR
* NON-CONDENSIBLES

Condensate is formed in a system whenever steam gives up its useable heat. And, since condensate interferes with the efficiency of the operation of a steam system, it must be removed.

Air, one of natures finest insulators, when mixed with steam, will lower its temperature and hinder the the overall effectiveness of an entire system. For example: A film of air 1/1000th of an inch thick offers as much resistance to heat transfer as 13" of copper or 3" of steel. For that reason, air MUST be continuously bled from a system by steam traps to have it operate efficiently and to conserve energy.

Non-condensibles, such as carbon dioxide promote corrosion and other deterioration of equipment and inhibit their function.

WHAT IS A STEAM TRAP?

A steam trap is basically an automatic valve which discharges condensate, undesirable air and non-condensibles from a system while trapping, or holding in, steam. They fall into 4 major categories; ***Thermostatic, Mechanical, Thermodynamic*** and ***Drain Orifice***. Each type will be discussed in detail in this section.

In every steam system, there are four phases of operation in which traps play a vital role:

1) ***Start-up*** – During "start-up", when the system is initially activated, air and non-condensibles must be discharged.

2) ***Heat-up*** – During "heat-up", as the system works to achieve the desired temperature and pressure, condensate is discharged.

3) ***At Temperature*** – "At temperature", when the desired levels are reached, the valve must close to retain the steam.

4) ***Using Heat*** – At the "using heat" level, the valve's job is to stay closed unless and until condensate occurs; then the valve must open, discharge the condensate and close quickly and positively, without allowing valuable steam to escape.

WHAT ARE THE QUALITIES OF A GOOD STEAM TRAP?

A good steam trap should:

- Discharge condensate, air and non-condensibles.
- Be equal to the load over a wide range of pressures and temperatures.
- Be freeze-proof where necessary.
- Be simple and rugged.
- Have few moving parts.
- Require low maintenance and spare parts inventory.
- Have a long life.

A good steam trap should not:

- Discharge live steam.
- Fail or malfunction if pressure changes.
- Respond slowly or hesitantly.
- Open too often, too briefly or for too long.
- Require constant adjustment or frequent repair.
- Require a wide variety of models, spare parts or orifice sizes for different pressures.

THERMOSTATIC STEAM TRAPS

Thermostatic steam traps, as their name implies, operate in direct response to the temperature within the trap. There are two primary types: *BELLOWS* and *BIMETALLIC.*

BELLOWS TRAPS

Of all actuating devices, the bellows trap most nearly approaches ideal operation and efficiency and is most economical. It is positive in both directions, is fast acting and does not require adjustment.

Bellows traps employ only one moving part - a liquid filled metal bellows - which responds quickly and precisely to the presence or absence of steam.

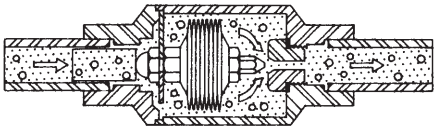
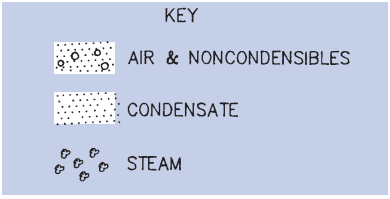


FIGURE 13

During startup and warmup, a vacuum in the bellows keeps it retracted, with the valve lifted well clear of the seat permitting air and non-condensibles to be freely discharged (**Figure 13**).



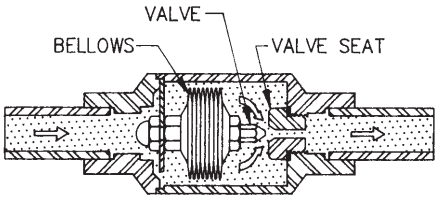


FIGURE 14

Next, condensate is discharged (**Figure 14**). Then heat from arriving steam will cause the liquid in the bellows to vaporize and close the valve (**Figure 15**).

At temperature, the valve will remain closed indefinitely opening only when condensate, air or other non-condensibles cause it to retract and open.

When live steam re-enters the trap housing, the bellows extends immediately, trapping the steam (**Figure 15**).

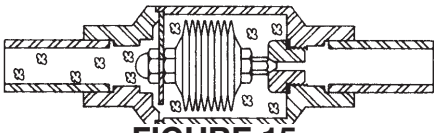


FIGURE 15

The bellows, unlike a disc trap, is a temperature sensitive rather than a time cycle device. There is no way that air can be mistaken for steam and cause binding, since bellows react to temperature only. And unlike bucket traps, bellows traps do not require a variety of sizes for valves and seats for various pressures.

BIMETALLIC TRAPS

Bimetallic traps work like the differential metal strip in a thermostat, using the unequal expansion of two different metals to produce movement which opens and closes a valve.

Figure 16: When the cooler condensate contacts the bimetallic discs, the discs relax. Inlet pressure forces the valve away from its seat and permits flow.

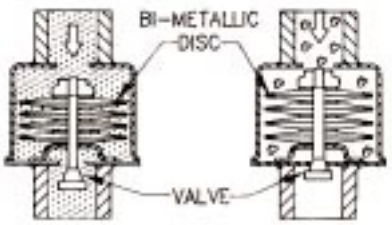


FIGURE 16 **FIGURE 17**

Figure 17: When steam enters the trap and heats the bimetallic discs, the discs expand forcing the valve against its seat preventing flow.

Bimetallic traps are simple and positive in both directions. However, they have a built-in delay factor which makes them inherently sluggish. Moreover; they do not maintain their original settings because the elements tend to take a permanent set after use, which requires repeated adjustment to maintain efficiency.

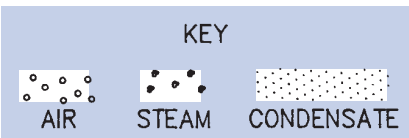
MECHANICAL STEAM TRAPS

There are two basic types of mechanical steam traps:

1) FLOAT & THERMOSTATIC
2) INVERTED BUCKET

Inverted bucket traps, as their name suggests, operate like an upside down bucket in water.

Figure 1: During startup, the trap is filled with water, with the bucket (A) at the bottom and the valve (B) fully open to allow condensate to flow out freely.



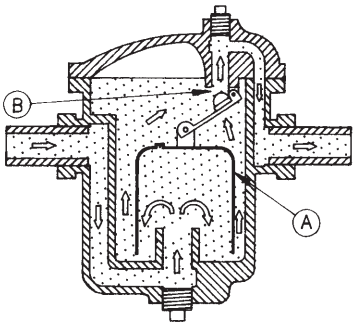


FIGURE 1

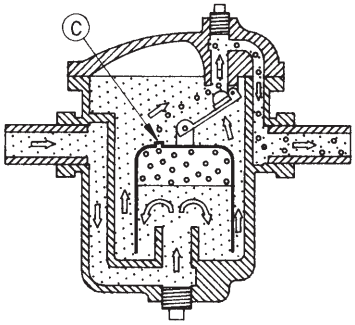


FIGURE 2

Figure 2: Air trapped in the bucket escapes through a vent hole (C). On

MECHANICAL STEAM TRAPS CONT'D.

some buckets, an additional vent hole is controlled by a bimetallic strip which is kept closed by the steam. Therefore, the vent only operates during startup. This limits bucket trap air handling capacity.

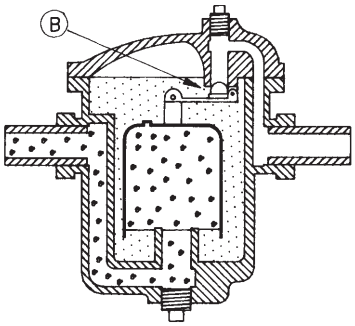


FIGURE 3

Figure 3: At temperature, steam enters under the bucket and causes it to float up and close the valve (B). During heat use, any condensate entering the line is forced up into the bucket. The bucket looses buoyancy and drops down, reopening the valve and discharging the condensate. (see Figure 1)

Bucket traps are rugged and reliable, however, air building up in the bucket can bind them closed causing condensate to back up in the line. Also, they can waste steam if they lose their prime

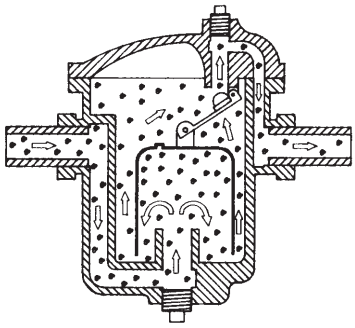


FIGURE 4

(see Figure 4). Bucket traps require priming water in the trap which makes them vulnerable to freeze up unless expensive insulation is added.

Because bucket traps rely on a fixed force, the weight of the bucket, discharge orifices must be sized by pressure. For example, a trap sized to operate at 50 PSIG will not open at 150 PSIG.

Float traps are manufactured in a variety of sizes, shapes and configurations. The most commonly used (for steam service) is the float and thermostatic, or F & T. F & T traps combine the excellent air venting capabilities of a thermostatic trap with the liquid level controlling capabilities of a float trap.

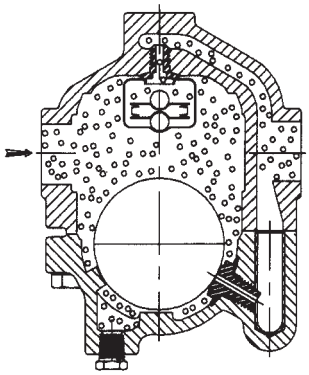


FIGURE 5

Figure 5: During startup, before condensate reaches the trap, the thermostatic element is fully open to discharge air. The float rests on the lower seat.

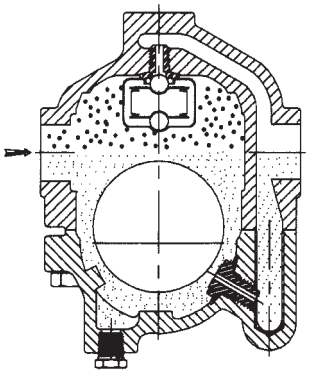


FIGURE 6

Figure 6: As hot condensate and steam reach the trap, the thermostatic element expands, closing the air vent. Condensate lifts the float, allowing condensate to flow out of the trap.

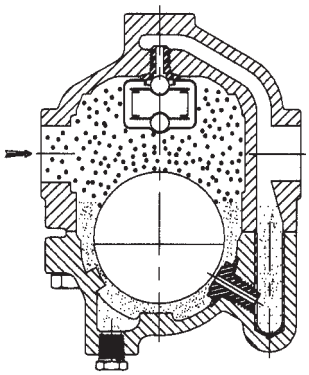


FIGURE 7

Figure 7: As the condensing rate decreases, the float lowers, reducing flow through the trap. The buoyancy of the float will maintain a liquid level seal above the lower seat ring, preventing the escape of steam. As with inverted bucket traps, float and thermostatic traps rely on a fixed force (the buoyancy of the float). Discharge orifices must be sized by differential pressure. Placing a low pressure float and thermostatic trap in high pressure service will result in the trap locking up. A contrasting characteristic of both the float and thermostatic and inverted bucket is the discharge cycle. A float & thermostatic trap tends to continuously discharge condensate while the inverted bucket trap discharges condensate in cycles.

THERMODYNAMIC STEAM TRAPS

Essentially, a thermodynamic steam trap is a time cycle device which responds to imbalances of pressure applied to a valving device, usually a disc.

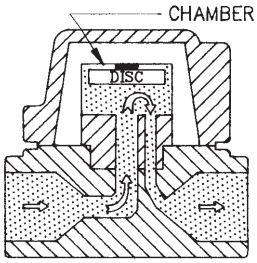


FIGURE 9

Figure 9: Pressure caused by air or condensate lifts the disc permitting flow through the trap.

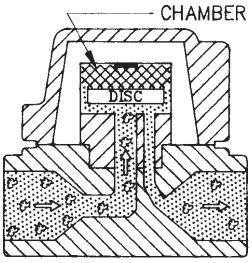


FIGURE 10

Figure 10: When steam arrives at the inlet port, blowby at a high velocity creates low pressure under the disc. Some of the flashing condensate is blown past the disc into the upper chamber, forcing the disc downward.

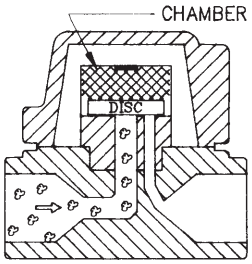


FIGURE 11

Figure 11: Further flow is stopped when sufficient pressure is trapped in the chamber above the disc. During operation, a decrease in chamber pressure permits inlet pressure to lift the disc and open the trap (**Figure 9**).

The decrease in the chamber pressure should only be caused by the presence of cooler condensate. Due to the design of most thermodynamic traps, especially in cold or wet conditions, the chamber may be prematurely cooled causing improper or frequent cycling as well as steam loss and increased wear. Advanced TD designs have a steam jacket which surrounds the chamber and prevents ambient conditions affecting the operation of the disc.

This type of trap is also subject to water binding. If water pressure is trapped above disc, trap will fail closed.

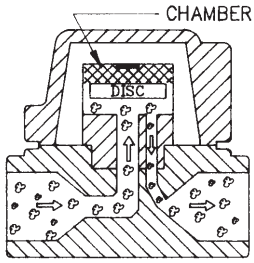
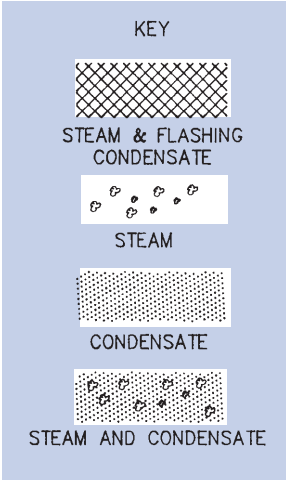


FIGURE 12

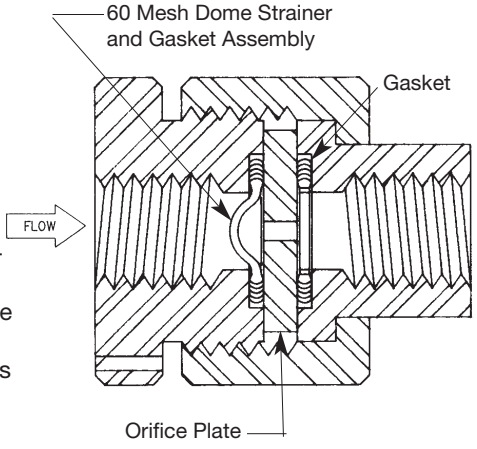
Figure 12: Trap is easily affected by dirt and/or other foreign matter which will cause trap to fail open.



ORIFICE STEAM TRAPS

Orifice type traps are engineered continuous flow devices. Orifice traps discharge air, condensate and all other non-condensible gases with minimal live steam loss.

The fixed orifice size is calculated, for a given application, to discharge the condensate load at maximum thermal efficiency. Approximately 10 to 25 percent of discharging hot condensate flashes to steam at the downstream side of the orifice, at a constant pressure drop. This flashing effect further restricts the flow of saturated steam. In actual conditions, a minimum percentage of steam, by weight, is discharged with condensate, since the specific volume of steam is relatively large compared to that of the condensate.



1/2", 3/4" and 1" FNPT, or Socket Weld End Connections available

The velocity through the orifice is highly turbulent. The initial calculated steam loss can be expected to remain relatively constant over the expected trap life of 10 plus years.

The major factor for energy efficient performance is based on initial orifice sizing for the application. Properly sized, thermal efficiencies of 98 percent plus can be attained.

While Orifice Traps can be applied at all pressures, they are ideally suited for use on saturated or superheated steam 250 PSIG or greater.

SIZING STEAM TRAPS

HOW TO DETERMINE THE PROPER SIZE TRAP

Capacity tables that follow show maximum discharge rates in pounds per hour. To select the correct size trap from these tables, the normal condensing rate should be converted to a "pounds per hour" basis and multiplied by a safety factor.

REASON FOR SAFETY FACTORS

For steam applications, the condensation rate varies with:

(1) The starting or warming-up condition.

(2) The normal operating condition.

(3) Any abnormal operating condition.

Of these, the condensing rate for the normal condition is occasionally known, or it can be estimated with sufficient accuracy for trap selection; the loads imposed by warm-up and abnormal conditions are seldom known and practically impossible to predict.

During warm-up the trap load is heavy, since air as well as large quantities of condensate must be discharged. Condensate forms at a rapid rate as the cold equipment and connecting piping are brought up to temperature. This usually results in pressure drop at the trap inlet, thereby reducing its capacity during the period when the load is maximum.

Safety factors are therefore necessary, to compensate for start-up conditions, variation of steam pressure and product initial temperature, the process cycle speed required, and discrepancies between assumed and actual conditions which determine the normal condensing rate.

The selection of a safety factor depends on the type of trap and the operating conditions. If the known or calculated normal condensing rate is multiplied by the recommended factor from the pages which follow, efficient trapping will be assured.

EFFECT OF BACK PRESSURE ON TRAP CAPACITY

Most trap installations include piping the outlet into a common return system or to an available disposal location. In either case a constant static back pressure may exist, against which the trap must discharge. This back pressure may be unintentional or deliberately produced.

Unintentional back pressure in condensate return piping is caused by lifting the condensate to a higher level, piping which is too small for the volume of liquid conveyed, piping with insufficient or no pitch in the direction of flow, pipe and fittings clogged with rust, pipe scale or other debris, leaking steam traps, etc. In steam service an intentional back pressure is instigated by means of a pressure regulating or spring-loaded valve in the discharge system, when a supply of flash steam at a pressure less than the trap pressure is needed.

If very hot condensate is discharged to a pressure less than that existing in the trap body, some of it will flash into steam, with a tremendous increase in volume and consequent choking and build-up of pressure in the trap's discharge orifice and the passages and piping adjacent thereto. For condensate at or close to steam temperature, this flash pressure is quite high, usually considerably higher than any static back pressure existing in the trap outlet piping.

For this reason, capacity tables for thermostatic and thermodynamic traps are based on gage pressure at the trap inlet, instead of on the difference between trap inlet and discharge pressures. Experiments have shown that, for the temperatures applying to these tables, unless the static back pressure in the return piping exceeds 25% of the trap inlet pressure, no reduction of the trap capacity results. For back pressures greater than 25% of the trap inlet pressure there is a progressive decrease of trap capacity.

Thus, if the return piping static pressure is less than 25% of the trap inlet pressure, the capacities shown in these tables should be utilized for trap selection. If the return piping pressure is greater than 25% of the trap inlet pressure, reduce the table capacities by the percentage indicated in second line of Table A on page 4 before determining trap size required.

Above data does not apply to float and thermostatic traps, capacities are based on differential pressure, obtained by subtracting any static back pressure from trap inlet pressure.

WHEN THE NORMAL CONDENSING RATE IS KNOWN

Normal condensing rate means the pounds of steam condensed per hour by the average conditions which prevail when the equipment drained is at operating temperature.

If this amount is known, simply multiply by the safety factor recommended for the service and conditions, obtained from the pages which follow, and determine size directly from the capacity tables for the type of trap selected.

Example: 4000 pounds per hour normal condensing rate from heat exchanger with submerged single coil, gravity drained, 80 PSIG constant steam pressure. What size thermostatic bellows trap to use?

Solution:

1. On page 3 recommended safety factor for single coil, gravity drained is 2. Multiplying, 4000 x 2 = 8000.
2. In Table G, page 5, the 3/4 Types B and C traps have a rated capacity of 8895 pounds per hour at 80 pounds pressure, and one of these should be specified.

WHEN THE NORMAL CONDENSING RATE IS UNKNOWN

Determine by utilizing proper formula from pages 2 thru 4 for the service and equipment to be trapped. Multiply the result by safety factor recommended for the operating conditions. See examples on the following pages.

SIZING STEAM TRAPS CONT'D.

EXPLANATION OF SYMBOLS USED IN NORMAL CONDENSING RATE FORMULAS

A = Heating surface area, square feet (see Table B)

B = Heat output of coil or heater, BTU per hour

C = Condensate generated by submerged heating surfaces, lbs/hr/sq ft (Table F)

D = Weight of material processed per hour after drying, pounds

F = Steam flow, lbs/hr

G= Gallons of liquid heated per unit time

H = Heat loss from bare iron or steel heating surface, BTU/sq ft/°F/hr

L = Latent heat of steam at pressure utilized, BTU/lb (see Table C or obtain from Steam Table)

M = Metal weight of autoclave, retort or other pressure vessel, pounds

Qh = Condensate generated, lbs/hr

Qu = Condensate generated, lbs/unit time (Always convert to lbs/hr before applying safety factor. See Examples using formulas 7 and 10 on next page).

S = Specific heat of material processed, BTU/lb/°F

Ta = Ambient air temperature, °F

Tf = Final temperature of material processed, °F

Ti = Initial temperature of material processed, °F

Ts = Temperature of steam at pressure utilized, °F (see Table C or obtain from Steam Table)

U = Overall coefficient of heat transfer, BTU/sq ft/°F/hr (see Table E)

V = Volume of air heated, cubic feet/minute

Wg= Liquid weight, lbs/gallon

Wh = Weight of material processed per hour, lbs

Wu = Weight of material processed per unit time, lbs

X = Factor for $\frac{Tf-Ti}{L}$ (obtain from Table D)

Y = Factor for $\frac{H(Ts-Ta)}{L}$, lbs/hr/sq ft (obtain from Table C)

AIR HEATING

Steam Mains; Pipe Coil Radiation; Convectors; Radiators; etc. (Natural Air Circulation)

(1) Qh = A Y

Recommended Safety Factors

For Steam Mains

Ambient Air Above Freezing:

1st Trap After Boiler..... 3
At End of Main..... 3
Other Traps 2

Ambient Air Below Freezing:

At End of Main 4
Other Traps 3

Steam mains should be trapped at all points where condensate can collect, such as at loops, risers, separators, end of mains, ahead of valves, where mains reduce to smaller diameters, etc., regardless of the condensate load. Installation of traps at these locations usually provides ample capacity.

For Pipe Coil Radiation, Convectors and Radiators

Single Continuous Coil 2
Multiple Coil 4

Damp Space Pipe Coil Radiation; Dry Kilns; Greenhouses; Drying Rooms; etc. (Natural Air Circulation)

(2) Qh = 2.5 A Y

Recommended Safety Factors

Single Continuous Coil 2
Multiple Coil 4

Steam Line Separators; Line Purifiers

(3) Qh = .10 F

Recommended Safety Factors

Indoor Pipe Line 2
Outdoor Pipe Line 3
If Boiler Carry-Over Anticipated... 4 to 6
(Depending on probable severity of conditions)

Unit Heaters; Blast Coils (Forced Air Circulation)

(4) When BTU Output is Known:

$$Qh = \frac{B}{L}$$

(5) When BTU Output is Unknown, Heat Transfer Area is Known:

Qh = 5 A Y

(6) When Volume of Air Heated is Known:

Qh = 1.09 V X

Recommended Safety Factors

Intake Air Above Freezing - Constant Steam Pressure 3
Intake Air Above Freezing - Variable Steam Pressure 4
Intake Air Below Freezing - Constant Steam Pressure 4
Intake Air Below Freezing - Variable Steam Pressure 5

Example: 11,500 cubic feet of air per minute heated by blast coil from 50°F to 170°F with 50 PSIG constant steam pressure.

Solution: By formula (6), Qh = 1.09 x 11,500 x .132 = 1655 lbs/hr. Recommended safety factor, 3 for intake air above freezing and constant steam pressure. 3 x 1655 = 4965 lbs/hr trap capacity required.

SIZING STEAM TRAPS CONT'D.

LIQUID HEATING

Submerged Coils; Heat Exchangers; Evaporators; Stills; Vats; Tanks; Jacketed Kettles; Cooking Pans; etc.

(7) When Quantity of Liquid to be Heated in a Given Time is Known:

$$Qu = G\ Wg\ S\ X$$

(8) When Quantity of Liquid to be Heated is Unknown:

$$Qh = A\ U\ X$$

(9) When Heating Surface Area is Larger than Required to Heat Known Quantity of Liquid in a Given Time:

$$Qh = A\ C$$

When maximum heat transfer efficiency is desired, or when in doubt, use formula (9) in preference to formulas (7) and (8).

Recommended Safety Factors

For Submerged Coil Equipment; Heat Exchangers; Evaporators; etc.

Constant Steam Pressure:

Single Coil, Gravity Drainage 2
Single Coil, Siphon Drainage 3
Multiple Coil, Gravity Drainage 4

Variable Steam Pressure:

Single Coil, Gravity Drainage 3
Single Coil, Siphon Drainage 4
Multiple Coil, Gravity Drainage 5

For Siphon Drained Equipment, specify traps with "Steam Lock Release Valve".

For Jacketed Equipment; Cooling Kettles; Pans; etc.

Slow Cooking:
Gravity Drainage 3
Siphon Drainage 4
Moderately Fast Cooking:
Gravity Drainage 4
Siphon Drainage 5
Very Fast Cooking:
Gravity Drainage 5
Siphon Drainage 6

For Siphon Drained Equipment, specify traps with "Steam Lock Release Valve".

Example: Heat exchanger with single submerged coil, gravity drained, heating 1250 gallons of petroleum oil of 0.51 specific heat, weighing 7.3 lbs/gal, from 50°F to 190°F in 15 minutes, using steam at 100 PSIG.

Solution: By formula (7), Qu = 1250 X 7.3 x .51 x .159 = 740 pounds of condensate in 15 minutes, or 4 x 740 = 2960 lbs/hr. Recommended safety factor is 2 for single coil, gravity drained. 2 x 2960 = 5920 lbs/hr trap capacity required.

DIRECT STEAM CONTACT HEATING

Autoclaves; Retorts; Sterilizers; Reaction Chambers; etc.

(10) $Qu = Wu\ S\ X + .12\ M\ X$

Recommended Safety Factors

Slow Warm-up Permissible 3
Fast Warm-up Desired 5

Example: An autoclave which weighs 400 pounds before loading is charged with 270 pounds of material having a specific heat of .57 and an initial temperature of 70°F. Utilizing steam at 50 PSIG, it is desired to bring the temperature up 250°F in the shortest possible time.

Solution: By formula (10), Qu = (270 x .57 x .198) + .12(400 x .198) = 40 pounds of condensate. Using safety factor of 5 recommended for fast warm-up and assuming 5 minutes as the time required to complete the reaction, a trap capacity of 40 x 12 x 5 = 2400 lbs/hr is required.

INDIRECT STEAM CONTACT HEATING

Cylinder Dryers, Drum Dryers, Rotary Steam Tube Dryers, Calenders; etc.

(11) $Qh = \frac{970\ (W - D)}{L} + Wh\ X$

Recommended Safety Factors

For Siphon or Bucket Drained Rotating Cylinder, Drum and Steam Tube Dryers; Cylinder Ironers; etc.

Small or medium Size,
Slow Rotation 4
Small or Medium Size,
Fast Rotation 6
Large Size, Slow Rotation 6
Large Size, Fast Rotation 8

For Siphon or Bucket Drained Equipment, specify traps with "Steam Lock Release Valve". Each cylinder should be individually trapped.

For Gravity Drained Chest Type Dryers and Ironers

Each Chest Individually Trapped... 2
Entire Machine Drained By Single Trap ..... 4 to 6
Depending on number of Chests

For Platen Presses

Each Platen Individually Trapped ... 2
*Entire Press Drained by Single Trap, Platens Piped in Series 3
*Entire Press Drained by Single Trap, Platens Piped in Parallel ..... 4 to 6
Depending on number of Platens

Example: A medium size rotary steam tube dryer with condensate lifted to a discharge passage in the trunion, dries 4000 lbs/hr of granular material to 3300 pounds, with 15 PSIG steam, initial temperature of material 70°F, final temperature 250°F.

Solution: By formula (11) Qh =

$$\frac{970\ (4000 - 3300)}{945} + (4000 \times .191)$$

= 1483 lbs/hr. Using safety factor of 4 recommended for medium size, slow rotation: 4 x 1483 = 5932 lbs/hr trap capacity required.

**A separate trap for each heating surface (coil, chest, platen, etc.) is recommended for maximum heating efficiency. Sluggish removal of condensate and air is certain when more than one unit is drained by a single trap, resulting in reduced temperatures, slow heating and possible water-hammer damage.*

TABLE A — EFFECT OF BACK PRESSURE ON STEAM TRAP CAPACITY

Back Pressure as Percent of Inlet Pressure	10	20	25	30	40	50	60	70	80	90
Percent Reduction of Trap Capacity	0	0	0	2	5	12	20	30	40	55

TABLE B – SQUARE FEET OF SURFACE PER LINEAL FOOT OF PIPE

Nominal Pipe Size (In.)	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"
Area, Sq. Ft. per Lineal Foot	.22	.28	.35	.44	.50	.63	.76	.92	1.18	1.46	1.74	2.26	2.81	3.34	3.67	4.19	4.71	5.24	6.28

TABLE C - FACTOR Y - H(Ts-Ta)/L - APPROXIMATE CONDENSING RATE FOR BARE IRON AND STEEL PIPE*

Steam Pressure - PSIG	1	2	5	10	15	20	25	50	75	100	150	200	250	300	350	400	450	500	600
Steam Temperature - °F	215	219	227	239	250	259	267	298	320	338	366	388	406	422	436	448	460	470	489
Latent Heat - BTU/lb	968	966	961	952	945	939	934	911	895	879	856	839	820	804	790	776	764	751	728
Factor Y Cond - lbs/hr/sq. ft	0.45	0.46	0.49	0.53	0.56	0.59	0.71	0.84	1.02	1.10	1.34	1.47	1.58	1.80	1.91	2.00	2.35	2.46	2.65

*Based on still air at 60F, recommended safety factors compensate for air at other temperatures. Used for steam trap selection only.

TABLE D — FACTOR X = (Tf–Ti)/L

Tf-Ti	STEAM PRESSURE - PSIG																		
°F	1	2	5	10	15	20	25	50	75	100	150	200	250	300	350	400	450	500	600
40	.041	.041	.042	.042	.042	.043	.043	.044	.045	.045	.047	.048	.049	.050	.051	.052	.052	.053	.055
60	.062	.062	.062	.063	.064	.064	.064	.066	.067	.068	.070	.072	.073	.075	.076	.077	.079	.080	.082
80	.083	.083	.083	.084	.085	.085	.086	.087	.089	.091	.093	.096	.098	.100	.101	.103	.105	.106	.110
100	.103	.103	.104	.105	.106	.106	.107	.110	.112	.114	.117	.120	.122	.124	.127	.129	.131	.133	.137
120	.124	.124	.125	.126	.127	.128	.129	.132	.134	.136	.140	.144	.146	.149	.152	.155	.157	.160	.165
140	.145	.145	.146	.147	.148	.149	.150	.154	.156	.159	.163	.167	.171	.174	.177	.180	.183	.186	.192
160	.165	.166	.167	.168	.169	.170	.172	.176	.179	.182	.187	.191	.195	.199	.203	.206	.210	.213	.220
180			.187	.189	.191	.192	.193	.198	.201	.204	.210	.215	.220	.224	.228	.232	.236	.240	.248
200				.211	.212	.213	.214	.219	.224	.227	.234	.239	.244	.249	.253	.258	.262	.266	.275
220						.235	.236	.242	.246	.250	.257	.262	.268	.274	.279	.283	.288	.293	.303
240								.263	.268	.273	.280	.286	.292	.299	.304	.309	.314	.319	.330
260									.290	.296	.304	.310	.317	.324	.329	.335	.340	.346	.357
280									.313	.319	.327	.334	.342	.349	.354	.361	.367	.373	.385
300											.350	.358	.366	.373	.380	.387	.393	.400	.412

TABLE E — FACTOR U, HEAT TRANSFER COEFFICIENTS BTU/HR/SQ FT/°F TEMP. DIFFERENTIAL

TYPE OF HEAT EXCHANGER	AVERAGE DESIGN VALUES	
	NATURAL CIRCULATION	FORCED CIRCULATION
STEAM TO WATER	125	300
STEAM TO OIL	20	45
STEAM TO MILK	125	300
STEAM TO PARAFFIN WAX	25	80
STEAM TO SUGAR & MOLASSES SOLUTIONS	75	150

Coefficients shown are suggested average design values. Higher or lower figures will be realized for many conditions. Use for

TABLE F — FACTOR C, APPROXIMATE CONDENSING RATE FOR SUBMERGED SURFACES, LBS/HR/SQ FT

HEATING SURFACE	DIFFERENCE BETWEEN STEAM TEMPERATURE AND MEAN WATER TEMPERATURE*											
	25	50	75	100	125	150	175	200	225	250	275	300
IRON OR STEEL	1.6	5	10	17	25	34	45	57	70	84	99	114
BRASS	2.6	8	16	27	40	54	72	91	112	134	158	182
COPPER	3.2	10	20	34	50	68	90	114	140	168	198	228

* Mean water temperature is 1/2 the sum of inlet temperature plus outlet temperature. Table based on heating surfaces submerged in water with natural circulation. Safety factor of 50% has been included to allow for moderate scaling. If surface will remain bright, multiply above figures by 2. Use for steam trap selection only.

SIZING STEAM LINES

Selecting the correct size for steam lines is just as important as selecting and sizing the most efficient steam trap. Undersized steam lines lead to steam starvation at the user which is often mistaken for a faulty or incorrectly sized steam trap. Oversized steam lines are very costly due to waste by radiation.

EXPLANATION OF TABLES A AND B

TABLE A: The left hand column (F) is a series of factors based on the pressure drop per foot of pipe. It is used in conjunction with the formula (P1 - P2) ÷ L.

The body is the X and Y values corresponding to the size of pipe. The X value is the steam capacity in lbs./hr.. Y is the velocity in ft./sec. It should be noted that the velocities in this table are true velocities when the volume in cu.ft./lb. of steam equals 10. However, a simple correction factor can be used to obtain the true velocity. TRUE VELOCITY = Y(cu.ft./lb. ÷ 10) where Y is the velocity listed in Table A. Cu.ft./lb. can be obtained from Table B using the applicable steam pressure.

TABLE B lists the volume of steam in cu.ft./lb. and a steam pressure factor corresponding to the pressure of steam.

EXPLANATION OF SYMBOLS

P1 = the pressure factor from Table B corresponding to the steam pressure at the steam source.

P2 = the pressure factor from Table B corresponding to the steam pressure at the steam user

p1 = pressure in PSIG at the steam source

p2 = pressure in PSIG at the steam user.

L = the lineal footage of pipe including the equivalent length of pipe for head loss for fittings, valves, etc...

Q = quantity of steam in lbs./hr.

d = diameter of pipe

F = constant factor for pressure drop in Table A

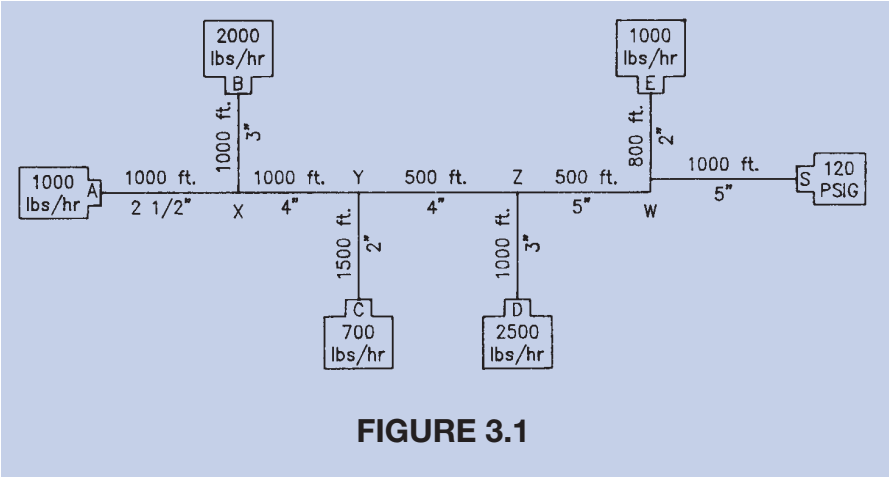


FIGURE 3.1

SIZING A STEAM SYSTEM

In sizing a line to transfer a set quantity of steam there are three (3) variables:

a) the size of the line

b) the velocity of the steam

c) the pressure drop through the line

One of these factors must be preset to properly size the line. The most common preset variable is the pressure drop because the steam pressure at the end user has generally been set by the user itself. It is also possible to assume the velocity, in which case the tables will give you the pressure drop.

Figure 3.1 illustrates a simplified steam distribution diagram. In this exercise, you will size each header segment and branch line with the given information and by setting the pressure drop.

From S (steam source) in figure 3.1, steam is available at 120 PSIG. Steam is required at users A, B, C, D and E at a pressure not less than 107 PSIG. Given this, we will first size the header, S to A, in segments.

The formula to use the charts is as follows:

$$\frac{P1 - P2}{L} = F$$

From figure 3.1, we know the pressure at S is 120 PSIG, therefore p1 = 120 and P1 = 13370. Knowing that the required pressure at A is 107 PSIG min., preset that pressure at 107 which allows p2 = 107 and P2 = 10980. Also known from figure 3.1 is that L = 4000 feet (including footage for head loss), therefore:

$$\frac{P1 - P2}{L} = \frac{13370 - 10980}{4000} = 0.6 = F \text{ (table A)}$$

The resultant 0.6 is the constant factor of pressure drop for the entire header S to A.

To size header segment X to A: Noting from figure 3.1 that a minimum of 1000 lbs/hr of steam is required, find 0.6 in column F on table A, then across to the capacity of 1000 or the next higher. 1150 lbs/hr is the closest, then, looking up to the corresponding pipe size, you will find it to be 2 1/2". It is also noted that the velocity factor is 95. Using the velocity correction factor discussed earlier, 95(3.7/10) = 35 ft/sec at A. This velocity seems low to the normal velocities of 80 to 120 ft/sec due to a required pressure drop of only 13 PSIG in 4000 lineal feet of pipe. Having checked the velocity, we will now proceed with sizing the remaining header segments and branches.

SIZING STEAM LINES CONT'D.

Header segment Y to X: $\frac{P1 - P2}{L}$ = 0.6, load = 3000 lbs/hr From Table A, size = 4"

Header segment Z to Y: $\frac{P1 - P2}{L}$ = 0.6, load = 3700 lbs/hr From Table A, size = 4"

Header segment W to Z: $\frac{P1 - P2}{L}$ = 0.6, load = 6200 lbs/hr From Table A, size = 5"

Header segment S to W: $\frac{P1 - P2}{L}$ = 0.6, load = 7200 lbs/hr From Table A, size = 5"

To size branches W to E, Z to D, Y to C, and X to B, we need to know the pressures at W, Z, Y and X. To calculate these pressures, consider header segment S to W, a 5" main carrying 7200 lbs/hr:

From Table A, you can determine F to be 0.55 because 7200 lbs/hr is halfway between 6800 (0.5) and 7600 (0.6) Having determined F, use the following formula and solve for P2:

$$\frac{P1 - P2}{L} = 0.55$$

Having found P2 = 12800, use Table B to determine p1 = 117 PSIG.

Branch W to E:

$$\frac{P1 - P2}{L} = \frac{12800 - 10980}{800} = F = 2.28$$ From Table A, 2.28 and 1000 lb/hr load = 2"

Branch Z to D: First, solve for P2 using header segment W to Z;

$$\frac{12800 - P2}{500} = 0.42$$ Resultant P2 = 12590 (p2 = 116 PSIG)

$$\frac{P1 - P2}{L} = \frac{12800 - 10980}{1000} = F = 1.82$$ From Table A, 1.82 and 2500 lb/hr load = 3"

Branch Y to C: First, solve for P2 using header segment Z to Y;

$$\frac{12590 - P2}{500} = 0.48$$ Resultant P2 = 12350 (p2 = 115 PSIG)

$$\frac{P1 - P2}{L} = \frac{12350 - 10980}{1500} = F = 0.91$$ From Table A, 0.91 and 700 lb/hr load = 2"

Branch X to B: First, solve for P2 using header segment Y to X;

$$\frac{12350 - P2}{1000} = 0.33$$ Resultant P2 = 12020 (p2 = 113 PSIG)

$$\frac{P1 - P2}{L} = \frac{12020 - 10980}{1000} = F = 1.04$$ From Table A, 1.04 and 2500 lb/hr load = 3"

NOTES:

1) The lengths given have been taken as the effective length after allowing for the head loss in fittings and in-line piping components. A simple, but practical rule for deciding the effective length is:

Add 10% to the true length of a line longer than 300' and reasonable straight.
Add 20% to the true length of a line less than 300'.

2) No consideration has been given to condensation in the lines. In practice, the line sizes should be checked to insure they are adequate to carry a total load of condensable steam plus the requirements of each user.

3) The tables in this section are based on the work developed by Wierz of Charlottenburg in conjunction with Brabbee. The tables have been simplified for everyday use. The various constants were settled by experimental work at Charlottenburg. The method and tables have been proven by consistently successful use. The original equation is:

$$\frac{p1^{1.9375} - p2^{1.9375}}{L} = 0.00012 \frac{Q^{1.853}}{d^{4.987}}$$

F		PIPE SIZE													
		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6	8	10	12
0.008	X						62	113	185	406	735	1220	2600	4750	7750
	Y						8	9	10	12	16	18	20	23	28
0.010	X					33	70	128	210	460	830	1350	2930	5350	8720
	Y					8	8	10	12	14	18	20	23	26	31
0.013	X				23	38	81	147	240	530	955	1560	3560	6160	10000
	Y				8	9	10	12	14	16	20	22	26	30	36
0.016	X				26	42	91	165	270	590	1070	1750	3770	6900	11200
	Y				8	10	11	14	16	18	22	24	30	35	40
0.020	X			16	29	48	102	187	303	665	1210	1970	4250	7800	12600
	Y			8	10	10	12	16	18	20	24	27	33	40	45
0.025	X		8.2	18	33	53	115	210	342	755	1370	2220	4800	8800	14200
	Y		8	10	11	12	14	18	20	23	26	30	36	44	51
0.030	X		9.0	20	36	59	127	231	380	830	1500	2450	5300	9650	15700
	Y		8	10	12	14	16	19	22	26	30	33	40	48	56
0.035	X		9.8	21	39	64	137	250	410	900	1625	2650	5700	10500	17000
	Y		8	10	13	14	18	20	24	29	33	36	45	53	61
0.040	X		10.6	23	42	69	148	270	442	970	1750	2860	6170	11250	18200
	Y		10	12	14	16	20	23	26	31	36	40	50	56	65
0.050	X	4.0	11.9	26	48	78	167	303	500	1100	1975	3220	6900	12700	20500
	Y	8.0	10	14	16	18	21	25	28	34	40	45	55	63	73
0.060	X	4.4	13.2	29	52	81	184	335	550	1220	2090	3560	7650	14000	22500
	Y	8.8	12	14	17	20	23	26	30	38	43	50	60	70	80
0.070	X	4.8	14.3	31	57	93	200	365	598	1320	2370	3880	8300	15200	24300
	Y	9.6	12	16	18	21	25	30	33	40	47	55	65	76	87
0.080	X	5.2	16	33	61	100	215	390	642	1420	2550	4150	8900	16300	26100
	Y	10.4	14	18	20	23	27	33	36	45	50	60	70	82	93
0.10	X	5.8	17.5	38	69	115	241	440	725	1600	2960	4700	10000	18300	30500
	Y	11.6	16	20	23	26	30	36	40	50	60	70	80	92	109
0.13	X	6.7	20.1	44	79	130	280	510	830	1870	3300	5400	11500	21400	35000
	Y	13.4	18	23	26	30	36	40	45	60	70	80	90	107	125
0.16	X	7.5	22.5	49	88	145	312	570	935	2050	3700	6020	13200	24000	39200
	Y	15	20	26	30	33	40	45	50	70	80	90	100	120	140
0.20	X	8.5	25.5	55	99	165	353	640	1050	2300	4160	6790	14700	27000	44100
	Y	17	23	30	33	36	45	50	60	75	90	100	115	135	158
0.25	X	9.6	28.8	62	112	184	400	722	1180	2600	4700	7600	16700	30300	49900
	Y	19.2	26	30	37	40	50	60	70	80	97	110	130	152	178
0.30	X	10.7	32	73	123	202	440	800	1320	2880	5200	8460	18500	33600	55000
	Y	21.4	30	36	41	45	55	65	74	90	105	120	145	168	196
0.35	X	11.5	34.8	74	133	220	478	840	1420	3110	5630	9180	20000	36300	59500
	Y	23	30	36	45	50	60	70	80	100	115	130	160	182	212
0.40	X	12.4	37.4	80	143	237	513	930	1530	3360	6070	9950	21500	39100	64000
	Y	24.8	33	40	47	54	65	80	90	110	125	140	175	195	228
0.50	X	14	42.1	90	162	266	579	1050	1725	3800	6800	11200	24200	44000	72000
	Y	28	36	45	54	66	70	90	100	120	140	155	190	220	257
0.60	X	15.4	46.6	99	177	292	638	1150	1900	4180	7600	12200	26800	48500	79500
	Y	30.8	40	50	59	70	80	95	105	130	155	170	210	242	284
0.70	X	16.8	50.7	108	185	320	690	1250	2060	4530	8220	13400	29000	52700	86300
	Y	33.6	45	54	62	70	90	100	120	140	165	185	230	260	308
0.80	X	18	54.4	116	208	342	744	1350	2220	4850	8800	14400	31000	56500	92700
	Y	36	50	60	70	80	95	115	130	160	180	200	260	280	331
1.00	X	20	61.5	130	234	386	840	1550	2500	5500	10000	16300	35000	64000	103000
	Y	40	60	70	79	90	100	125	140	180	200	230	280	320	375
1.3	X	23.3	71	150	270	445	975	1770	2900	6300	11500	18700	41000	73700	120000
	Y	46.6	60	80	90	100	120	140	160	200	230	260	330	370	4000
1.6	X	26.1	80	168	300	500	1090	2000	3220	7100	12800	21300	45500	82000	136000
	Y	52.2	70	90	100	120	140	160	180	230	260	300	360	410	487
2.0	X	29.5	90	190	345	570	1225	2230	3650	8000	14500	23700	51500	93000	153000
	Y	59	80	100	115	125	160	180	200	260	300	330	400	465	547
2.5	X	33.5	101	213	390	640	1380	2510	4120	9000	16400	26600	58000	105000	173000
	Y	67	90	100	130	140	180	200	230	300	330	360	445	525	618
3.0	X	37	108	236	430	700	1530	2800	4500	9900	18000	29300	64000	117000	
	Y	74	100	120	143	160	195	230	260	330	360	410	495	585	
3.5	X	40	117	255	469	765	1660	3000	4920	10700	19500	31800	69500		
	Y	80	100	140	156	180	205	255	290	350	400	455	535		
4.0	X	43	127	275	500	820	1780	3250	5300	11600	20900	34000	74500		
	Y	86	120	140	167	180	230	265	310	380	435	490	575		
5.0	X	49	143	310	565	930	2000	3680	6000	13100	23500	38500			
	Y	98	140	160	188	200	260	300	335	420	490	550			
6.0	X	53	158	342	625	1020	2200	4050	6600	14500	25900	42500			
	Y	106	140	180	208	230	290	330	360	460	540	610			
7.0	X	57.6	171	371	680	1120	2400	4400	7200	15700	28100				
	Y	115.2	160	200	226	260	300	360	400	500	590				
8.0	X	62	183	400	727	1200	2600	4700	7600	16900					
	Y	124	160	200	242	280	330	400	435	540					
10.0	X	70	208	450	820	1350	2910	5300	8600	19000					
	Y	140	180	230	273	300	360	425	490	610					
13.0	X	80	239	520	950	1560	3320	6100	9900						
	Y	160	200	260	317	360	415	490	565						
16.0	X	90	267	580	1060	1750	3720	6800	11000						
	Y	180	230	300	353	400	465	540	630						
20.0	X	101	300	660	1200	1960	4200	7600							
	Y	202	260	330	400	450	525	610							
25.0	X	114	340	740	1360	2220	4720								
	Y	228	300	400	453	500	590								
30.0	X	127	378	820	1500	2450									
	Y	254	330	410	500	560									
35.0	X	137	410	890	1630	2660									
	Y	274	360	450	543	600									
40.0	X	147	440	950	1750										
	Y	294	400	480	583										
50.0	X	166	495	1080											
	Y	332	450	540											
60.0	X	183	550												
	Y	366	500												
70.0	X	200	595												
	Y	400	540												
80.0	X	215	640												
	Y	430	580												
100.0	X	242													
	Y	484													
130.0	X	280													
	Y	560													
160.0	X	315													
	Y	630													
200.0	X	354													
	Y	708													

SIZING STEAM LINES

TABLE A

X = Steam Capacity in lbs/hr
Y = Velocity in ft/sec (only when steam volume is equal to 10 cu ft/lb)

SIZING STEAM LINES TABLE B

Ins. of Vac.	Volume in cu.ft/lb	Press. Factor
26	173	4
24	118	9
22	91	15
20	74.8	22
18	62	31
16	53	41
14	47.5	54
12	43	67
10	39	83
9	36.8	92
8	35.3	100
7	34	110
6	32.8	120
5	31.6	130
4	30.4	140
3	29.3	150
2	28.2	160
1	27.3	170
0.5	27	176
PSIG		
0	26.7	183
1	25.1	210
2	23.7	235
3	22.4	265
4	21.3	295
5	20.3	325
6	19.4	355
7	18.6	390
8	17.8	425
9	17.1	460
10	16.5	500
11	15.9	540
12	15.3	580
13	14.8	625
14	14.3	670
15	13.9	715
16	13.5	760
17	13.1	810
18	12.7	860
19	12.4	910
20	12.1	965
21	11.7	1020
22	11.4	1075
23	11.1	1135
24	10.8	1195
25	10.6	1255
26	10.4	1315
27	10.1	1385
28	9.9	1445
29	9.7	1525
30	9.5	1595
31	9.3	1665
32	9.1	1735
33	8.9	1805

Ins. of Vac.	Volume in cu.ft/lb	Press. Factor
34	8.7	1875
35	8.6	1945
36	8.4	2020
37	8.2	2100
38	8.1	2180
39	8	2260
40	7.8	2340
41	7.7	2420
42	7.6	2500
43	7.4	2590
44	7.3	2680
45	7.2	2770
46	7.1	2860
47	7	2950
48	6.9	3040
49	6.8	3130
50	6.7	3225
51	6.6	3325
52	6.5	3425
53	6.4	3525
54	6.3	3625
55	6.2	3725
56	6.1	3825
57	6.1	3935
58	6	4045
59	5.9	4155
60	5.8	4265
61	5.8	4370
62	5.7	4485
63	5.6	4600
64	5.6	4720
65	5.5	4840
66	5.4	4960
67	5.4	5080
68	5.3	5200
69	5.2	5320
70	5.2	5440
71	5.1	5560
72	5.1	5690
73	5	5820
74	5	5950
75	4.9	6080
76	4.9	6210
77	4.8	6350
78	4.8	6490
79	4.7	6630
80	4.7	6770
81	4.6	6910
82	4.6	7050
83	4.6	7190
84	4.5	7330
85	4.5	7470
86	4.4	7610
87	4.4	7760

Ins. of Vac.	Volume in cu.ft/lb	Press. Factor
88	4.4	7910
89	4.3	8060
90	4.3	8210
91	4.2	8360
92	4.2	8510
93	4.2	8660
94	4.1	8820
95	4.1	8980
96	4.1	9140
97	4	9300
98	4	9460
99	4	9620
100	3.9	9790
101	3.9	9960
102	3.9	10130
103	3.8	10300
104	3.8	10470
105	3.8	10640
106	3.7	10810
107	3.7	10980
108	3.7	11155
109	3.6	11335
110	3.6	11515
111	3.6	11695
112	3.6	11875
113	3.5	12055
114	3.5	12235
115	3.5	12420
116	3.5	12610
117	3.4	12800
118	3.4	12990
119	3.4	13180
120	3.4	13370
121	3.3	13560
122	3.3	13750
123	3.3	13940
124	3.3	14140
125	3.3	14340
126	3.2	14540
127	3.2	14740
128	3.2	14940
129	3.2	15140
130	3.1	15350
131	3.1	15560
132	3.1	15770
133	3.1	15980
134	3.1	16190
135	3	16400
136	3	16620
137	3	16840
138	3	16960
139	3	17240
140	2.9	17470
141	2.9	17680

Ins. of Vac.	Volume in cu.ft/lb	Press. Factor
142	2.9	17910
143	2.9	18130
144	2.9	18360
145	2.8	18580
146	2.8	18790
147	2.8	19020
148	2.8	19250
149	2.8	19480
150	2.8	19710
151	2.8	19950
152	2.7	20180
153	2.7	20510
154	2.7	20650
155	2.7	20890
156	2.7	21130
157	2.7	21380
158	2.7	21610
159	2.6	21850
160	2.6	22110
161	2.6	22350
162	2.6	22590
163	2.6	22850
164	2.6	23150
165	2.6	23350
166	2.5	23600
167	2.5	23840
168	2.5	24110
169	2.5	24350
170	2.5	24620
171	2.5	24880
172	2.5	25140
173	2.5	25400
174	2.4	25670
175	2.4	25930
176	2.4	26200
177	2.4	26450
178	2.4	26730
179	2.4	27010
180	2.4	27280
181	2.4	27540
182	2.4	27830
183	2.3	28090
184	2.3	28380
185	2.3	28650
186	2.3	28920
187	2.3	29200
188	2.3	29480
189	2.3	29770
190	2.3	30040
191	2.2	30340
192	2.2	30630
193	2.2	30910
194	2.2	31200
195	2.2	31490

Ins. of Vac.	Volume in cu.ft/lb	Press. Factor
196	2.2	31770
197	2.2	32070
198	2.2	32370
199	2.2	32660
200	2.2	32810
201	2.2	32960
202	2.1	33560
203	2.1	33860
204	2.1	34170
205	2.1	34450
206	2.1	34760
207	2.1	35080
208	2.1	35390
209	2.1	35700
210	2.1	35990
211	2.1	36320
212	2.1	36630
213	2	36940
214	2	37260
215	2	37570
216	2	37880
217	2	38210
218	2	38550
219	2	38880
220	2	39160
221	2	39510
222	2	39830
223	2	40150
224	2	40490
225	1.9	40820
226	1.9	41110
227	1.9	41440
228	1.9	41780
229	1.9	42100
230	1.9	42450
231	1.9	42790
232	1.9	43100
233	1.9	43470
234	1.9	43810
235	1.9	44150
236	1.9	44490
237	1.9	44830
238	1.8	45200
239	1.8	45530
240	1.8	45870
241	1.8	46220
242	1.8	46580
243	1.8	46935
244	1.8	47272
245	1.8	47632
246	1.8	47995
247	1.8	48362
248	1.8	48707
249	1.8	49079

SIZING CONDENSATE LINES

INTRODUCTION

Sizing condensate lines is very much different than other fluid conveying pipes. Although condensate is hot water, if you were to size a condensate line as if it were hot water, the results would be an undersized line. This would create an excessive back-pressure at the trap. There are two major differences between condensate and hot water. The first is the air which is discharged from the steam trap with the condensate. The second is flash steam. It is also incorrect to size a condensate line as you would a steam or compressed air line. This would result in having a much larger pipe than you need, which adds unnecessary cost to a project. Therefore, the correct size of a condensate line lies somewhere between the hot water line and the steam line - but no one knows exactly where.

Nevertheless, condensate lines must be sized! The Engineers at NICHOLSON have selected the method in this section. There is at least some justification in theory; it has been used over a period of many years, found to be satisfactory, and does not produce a greatly oversized pipe.

THE THEORY

The theory in general is based on the differential pressure between the steam trap and the termination point of the line. In more detail: All lines should be sloped in the direction of flow. If a water line is sloped so that the fall per foot is equal to or greater than the head lost in friction per foot, then the water will flow freely, without requiring pressure to move it, or without causing back pressure.

If, however, the line is horizontal, the back pressure set up to cause flow will be equal to the loss of head in friction per foot multiplied by the length of pipe.

If the line must rise, then pressure must be available to move the water. This pressure, which is back pressure on the trap, must equal the head of the lift plus the frictional head per foot multiplied by the length of the pipe.

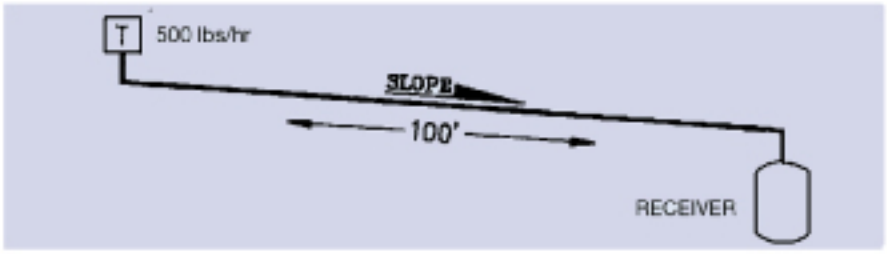
Table C: this section is used in conjunction with the theory, and gives you the following information:

1) The loss of head, in inches of water, due to the friction of water through one foot of pipe.
2) The slope of line required to balance the friction loss.
3) The flow rates of pipe in pounds of water per hour.

THE METHOD

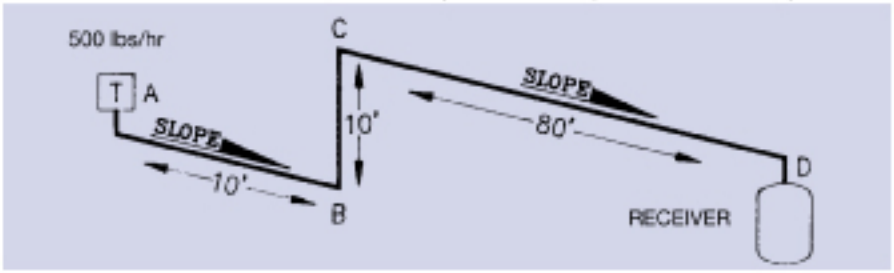
The following examples demonstrate the method of applying ***Table C*** for sizing the condensate lines.

Example 1 - To size a condensate line which has to carry 500 lbs/hr of condensate 100' to a receiver:



From ***Table C***, note that a 1/2" line will be sufficient provided you have a slope of 1" in 2.5' (or a 40" drop). Also note that a 3/4" line requires a slope of 1" in 20' (or a 5" fall), a 1" line requires a slope of 1" in 50' (or a 2" fall), etc.. .

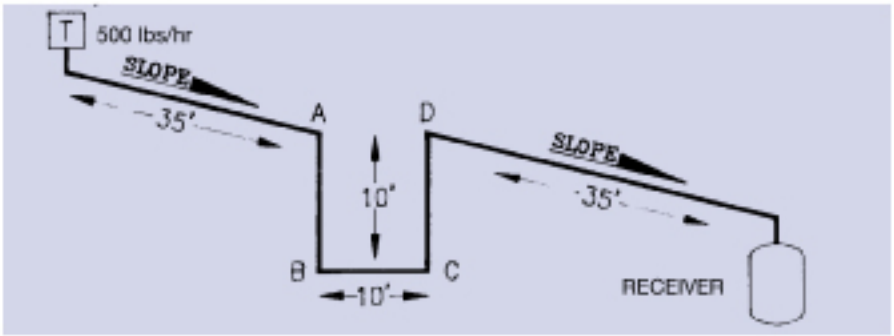
Suppose you want to use a 1/2" line, but only have an available fall of 10" this means the other 30" of frictional head imposes a back pressure at the trap of 30" of water (approximately 1 PSIG).



Example 2 - Condition: Same as example 1 except condensate has to be lifted 10'.

First of all, the 10' rise in the line exerts a back pressure of 10' of water, or approximately 4.5 PSIG, on the trap, therefore, there must be 4.5 PSIG pressure upstream of the trap to overcome the back pressure. Apart from this, the problem is the same as example 1.

If a slope of 1" in 2.5' can be maintained in AB and CD, a 1/2" pipe will be sufficient. If that slope is not possible, then either use a 3/4" pipe or allow for the back pressure at the trap to make up the difference between the required 40" fall and what is available.



Example 3 - Condition: Same as example 1 except the line has to be looped due to layout conditions. Physics has proven that water will not flow from D until ABCD is filled with water. The 10' lift, CD, will be balanced by the fall of AB. All that is required to cause flow from D is a head equal to the frictional loss in ABCD. In other

SIZING CONDENSATE LINES CONT'D.

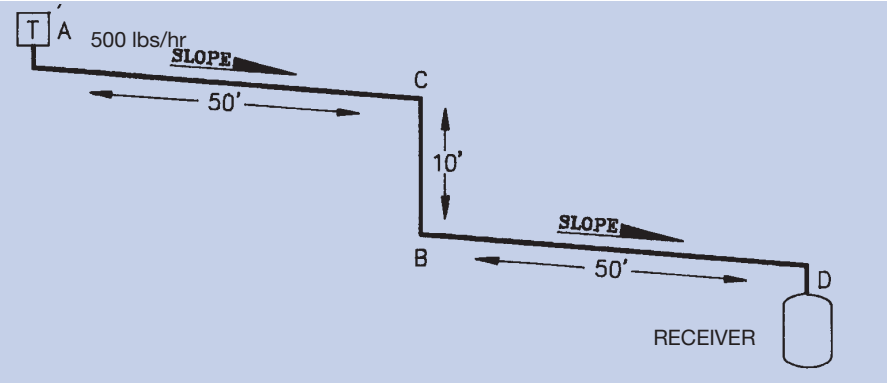
Should A and D be required to the same elevation, the back pressure on the trap would be increased by 12" of water (less than 1/2 PSIG) using a 1/2" pipe, or 1 1/2" of water using a 3/4" pipe.

A point worth noting: Gases may become trapped at point A. There are two solutions to this problem:

1) Install an air vent at point A.

2) Install a smaller overhead line from A to D.

Example 4 - Condition: Same as example 1, except there is a vertical drop of 10' in the line.



In theory, this problem is completely insoluble. What is the effect of the 10' drop? If it were a system with the line full of water, the drop would represent a gain of the full 10' in the head available to cause flow, however, condensate lines are not full of water all the time (if ever).

Does the flow of the drop exert a suction on the upstream pipe thus causing flow? If the line was full, it certainly would. When the line is not full, the gases in the condensate will create some vacuum, but it is impossible to calculate exactly how much.

Suggested solution: Ignore the 10' drop for the present. From example 1 we know that a 1/2" pipe will be sufficient with either a 1" in 2.5' slope, or a back pressure of 1 PSIG at the trap, or 3/4" pipe if the slope cannot be obtained or if the back pressure cannot be tolerated.

Let us now suggest that the vertical drop will make enough difference to make the 1/2" pipe large enough without causing a back pressure and without having to maintain the required 1" in 2.5' slope.

In other words, when you encounter a layout similar to this, as a first approximation, ignore the effect of the drop, size the line as we did In example 1, then, when you come to making your decision, remember you have a safety factor in hand and act accordingly.

TABLE C

Frictional Resistance in Inches of Water	Slope Required to Overcome Friction	HEADER SIZE										
		1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6
		CAPACITY IN POUNDS OF WATER PER HOUR										
.02	1" in 50'	105	310	670	1280	2000	4300	7800	12800	27800	50500	82200
.03	1" in 33'	130	390	840	1530	2500	5400	9800	16000	34570	63000	102500
.04	1" in 25'	155	455	980	1780	2910	6300	11400	18700	40400	73400	120000
.05	1" in 20'	175	510	1110	2000	3280	7100	12900	21000	45500	82900	135000
.06	1" in 17'	190	565	1220	2220	3620	7830	14200	23300	50200	92200	148900
.07	1" in 14'	205	615	1320	2410	3920	8550	15500	25400	54700	101400	162200
.08	1" in 12.5'	225	660	1430	2600	4240	9190	16670	27400	58700	109000	174000
.09	1" in 11'	235	705	1520	2765	4500	9750	17800	29000	62600	114000	186000
.10	1" in 10'	250	745	1610	2930	4780	10300	18800	30700	66300	120600	197000
.15	1" in 6.6'	310	925	2000	3650	5940	12900	23400	38200	82500	150000	245000
.20	1" in 5'	365	1080	2340	4260	6950	15000	27300	44500	96400	175000	286000
.25	1" in 4'	410	1220	2640	4800	7840	16900	30800	50200	108700	197800	323000
.30	1" in 3.4'	455	1350	2920	5300	8650	18700	34000	55500	120000	218300	356000
.35	1" in 2.9'	495	1460	3165	5765	9390	20300	37000	60500	131500	237000	387000
.40	1" in 2.5'	530	1575	3400	6200	10100	21800	39700	64700	142300	255000	416600

STEAM TRACING DESIGN GUIDELINES

V.1.1 INTRODUCTION

Steam tracing is one of many ways to preheat, add heat and prevent heat loss from piping systems and their components. Some other ways are:

- ☛ Jacketed piping
- ☛ Hot water and oil tracing
- ☛ Dowtherm tracing

Jacketed piping systems are used primarily to maintain a constant high temperature. Due to its high cost of construction, jacketed systems are seldom used except where temperature control is critical. Hot water and oil must be pumped at a high velocity to maintain a desired temperature, and must have a separate return header as does Dowtherm. Hot water, oil or dowtherm are also an additional system which add to the cost of a plant.

Steam tracing is most often selected because:

- ☛ There is generally available a surplus of low and/or medium pressure steam.
- ☛ Steam has a high latent heat and heat-transfer-coefficient.
- ☛ Steam condenses at a constant temperature.
- ☛ Steam flows to end-point without the aid of pumps (when designed correctly).
- ☛ A small amount of return piping is needed due to existing condensate headers.

V.1.2 USES

Freeze Protection (winterizing)

- ☛ Adding sufficient heat to above-grade piping systems and equipment which are exposed to ambient temperatures below the freezing point of their media prevents freezing.

Maintaining A Desired Temperature

- ☛ The viscosity of some liquids becomes higher as their temperatures become lower causing more difficult and costly pumping and leading to down-time for cleaning.
- ☛ Condensation may occur in some gases if the ambient temperature falls below the dewpoint which is harmful and expensive in such systems as:

-Natural Gas where control valves freeze up and burners malfunction.

-Compressor Suction Lines where compressors can be damaged.

V.1.3 MATERIAL

Steam tracing material is normally as follows:

-Use the material specified for steam piping from the steam header (through the distribution manifold, if applicable) to and including the tracer block valve.

-Use 1/4” through 7/8” O.D. copper or stainless steel tubing (depending on the design conditions) from the block valve to the steam trap. Though sizes may vary with different applications, 3/8” and 1/2” O.D. are the most often used. Tube fittings and adapters are normally flareless compression type or 37 degree flared type.

-Use the material specified for condensate piping from the steam trap (through the collection manifold, if applicable) to the condensate header or end-point (drain or grade).

V.1.4 DESIGN GUIDELINES

1. Steam piping should be run within 12” of the line or equipment being traced to minimize exposed tubing.

2. Spiral tracing should be limited to vertical piping using multiple tracers on horizontal lines which require more heat.

3. Tracers should be designed so that the flow is always down. ***Avoid pockets! !*** Where vertical flow is unavoidable, steam pressure should be a minimum of 25 PSIG for every 10’ of rise.

4. Tracers should be a maximum of 100' long and continuous from the supply to the collection manifold or endpoint. For lines over 100’ long, provide another tracer and overlap the two 3 inches to avoid cold spots.

5. Tracers should have no branch tees except as indicated in *Section V.3.*

6. Provide each tracer with a separate strainer and steam trap.

7. Manifolds can be horizontal or vertical depending upon the design conditions.

8. Tracers should be attached to the pipe at 8” to 10” maximum intervals with stainless steel wire. Wire tension should be sufficient to hold the tracer secure and flush against the pipe.

9. Some piping materials, such as lined pipe, might require spacer blocks to avoid “hot spots”.

10. Tracer loops with unions are necessary:

- ☛ when joining tubing lengths.
- ☛ at all break flanges and unions.
- ☛ at all flanged valves.

11. Tracer discharge lines should be as short as possible since long discharge lines can freeze even with a fully functioning steam trap.

Clean Steam Design Guidelines

Clean Steam is a general term used to describe a range of steam pureness. It may be generated by such methods as:

- Filtration of plant steam typically requiring the removal of particles larger than 5 microns
- An independent steam generator. E.g. Stainless steel reboiler fed with distilled water.
- One stage of a multi-effect still within the overall water purification system.

Uses for Clean Steam vary by industry, however typical applications include:

- In-line sterilization of storage tanks and equipment
- Powering sterilizers and autoclaves
- Cleaning and sterilizing process piping systems without disassembling the piping system - commonly known as CIP (Clean in Place)
- Pasteurization utilizing Ultra High Temperature Processing (UHT)

The highest quality clean steam however, is typically used by the Pharmaceutical and Biotechnical industries. This steam, occasionally referred to as "Pure Steam", is most often supplied by an independent steam generator utilizing Water for Injection (WFI) as feed water. WFI is typically produced by a Reverse Osmosis (RO) generator and then distilled thus removing any traces of organics, bacteria, and pyrogens. Pure steam is required for the sterilization of cell culture processing equipment such as incubators where contaminants could adversely affect cell growth. Other uses include pharmaceutical manufacture and direct steam injection pasteurization where contaminants could collect in products intended for human consumption.

Clean steam produced from high purity make up water is highly corrosive due to the minimal ion content. High purity water, pure steam and the resultant condensate will aggressively attempt to absorb or leach ions from their environment to achieve a more natural balance. Additionally, chemicals used to passivate steam and condensate in conventional systems are generally prohibited from clean steam system as such chemicals could contaminate or alter sensitive end products. Should corrosion begin, the oxidation byproducts may travel through the steam system catalyzing corrosion throughout in a process known as 'rouging'.

To combat the corrosive nature of clean steam, design practices require piping, fittings and valving to be comprised of corrosion resistant materials. Current industry accepted materials include 304L, 316 and 316L stainless steel and higher alloys such as Inconel. While these materials have proven themselves in practice, it should be noted that there are currently no U.S. governmental standards specifying materials for clean steam service. Regulatory agencies concern themselves with the purity and quality of the product, leaving the design standards entirely up to the manufacturer.

In addition to the use of corrosion resistant materials in sanitary systems, features designed to inhibit bacterial growth are often required. Piping, valves and fittings should be free draining and maintain industry standard surface finishes. Free draining valves and fittings are designed not to retain or 'Puddle' condensate when installed correctly. After shut down of the steam system, any puddled condensate could potentially promote bacterial growth. Inadequate surface finishes reduce the effectiveness of system sterilization techniques, increasing the possibility of bacterial contamination. Industry standard surface finishes are measured in micro inches, the lower the number the smoother, and are expressed as an arithmetic average (Ra). Typical industry specified surface finishes range from 32 to 10 µ in. Ra.

Piping & Trapping Design Guidelines

1. Extra care should be taken for expansion stresses due to the higher coefficient of expansion for stainless steel.
2. Branch connections are to be made from the top of headers with the block valve as close as possible to the header.
3. The recommended types of branch connections are tees and reducing tees.
4. Steam lines should slope down to traps (recommended 1% min.).
5. A dirt leg with trap station is recommended at every change of elevation (no undrainable pockets).
6. Extra care should be taken in pipe supports to eliminate sagging.
7. Instruments in general should be kept to a minimum. However, where required, it is recommended that:
   A) All are installed in tees.
   B) Pressure gauges be installed with diaphragm seals.
   C) Flow meters be installed in the vertical flow-up position to eliminate pockets
   D) Pressure reducing stations be kept to a minimum.
8. Traps should be installed in the vertical flow-down position to eliminate pockets.
9. Trap block valves should be located as close as possible to the user.
10. Condensate lines should be sloped (recommended 1% min.) to the end point. Note that contaminated condensate should always be piped to a process sewer. Uncontaminated condensate (from drip legs) may be recovered, if cost effective, and used elsewhere in the plant (not as Clean Steam make-up).
11. Condensate terminal points should contain an air break (2" or 2 pipe diameters, whichever is greater) between the end of the pipe and the drain, floor or grade.
12. Test connections for traps are recommended-trap efficiency is essential for Clean Steam.

TECHNICAL REFERENCE

914.778.4044 ● Fax: 914.778.7123 ● www.nicholsonsteamtrap.com

PROPERTIES OF SATURATED STEAM - TABLE 1

Pressure		Temperature	Specific Volume		Heat	Enthalpy - BTU/lb	
Gage PSIG	Absolute PSIA	Saturation Deg. F	Water vf	Steam vg	Liquid hf	Latent Heat hfg	Total Steam Heat hg
0	14 .7	212.00	0.016713	26.789	180.33	970.0	1150.3
1	15.7	215.34	0.016738	25.191	183.70	967.9	1151.6
2	16.7	218.51	0.016761	23.779	186.89	966.0	1152.9
3	17.7	221.53	0.016784	22.522	189.93	964.1	1154.0
4	18.7	224.40	0.016806	21.394	192.83	962.3	1155.1
5	19.7	227.15	0.016827	20.378	195.61	960.5	1156.1
6	20.7	229.79	0.016848	19.456	198.28	958.8	1157.1
7	21.7	232.33	0.016867	18.617	200.84	957.2	1158.0
8	22.7	234.77	0.016886	17.849	203.31	955.6	1158.9
9	23.7	237.13	0.016905	17.144	205.69	954.1	1159.8
10	24 .7	239.40	0.016923	16.494	207.99	952.6	1160.6
11	25.7	241.60	0.016941	15.892	210.21	951.2	1161.4
12	26.7	243.74	0.016958	15.335	212.37	949.8	1162.1
13	27.7	245.80	0.016974	14.816	214.46	948.4	1162.8
14	28.7	247.81	0.016991	14.332	216.50	947.0	1163.5
15	29.7	249.76	0.017006	13.880	218.47	945.7	1164.2
16	30.7	251.66	0.017022	13.456	220.40	944.5	1164.9
17	31.7	253.51	0.017037	13.058	222.27	943.2	1165.5
18	32.7	255.31	0.017052	12.684	224.10	942.0	1166.1
19	33.7	257.06	0.017067	12.331	225.88	940.8	1166.7
20	34.7	258.78	0.017081	11.998	227.62	939.6	1167.3
21	35.7	260.45	0.017095	11.682	229.32	938.5	1167.8
22	36.7	262.09	0.017109	11.384	230.99	937.4	1168.4
23	37.7	263.69	0.017123	11.100	232.61	936.3	1168.9
24	38.7	265.25	0.017136	10.831	234.21	935.2	1169.4
25	39.7	266.79	0.017149	10.575	235.77	934.1	1169.9
26	40.7	268.29	0.017162	10.331	237.30	933.1	1170.4
27	41.7	269.76	0.017175	10.098	238.80	932.0	1170.8
28	42.7	271.21	0.017188	9.876	240.27	931.0	1171.3
29	43.7	272.63	0.017200	9.664	241.71	930.0	1171.7
30	44.7	274.02	0.017212	9.461	243.13	929.0	1172.2
31	45.7	275.38	0.017224	9.266	244.53	928.1	1172.6
32	46.7	276.73	0.017236	9.080	245.89	927.1	1173.0
33	47.7	278.05	0.017248	8.901	247.24	926.2	1173.4
34	48.7	279.34	0.017260	8.729	248.57	925.3	1173.8
35	49.7	280.62	0.017271	8.564	249.87	924.3	1174.2
36	50.7	281.87	0.017283	8.405	251.15	923.4	1174.6
37	51.7	283.11	0.017294	8.252	252.41	922.6	1175.0
38	52.7	284.33	0.017305	8.104	253.66	921.7	1175.3
39	53.7	285.52	0.017316	7.962	254.88	920.8	1175.7
40	54.7	286.71	0.017327	7.825	256.09	919.9	1176.0
41	55.7	287.87	0.017338	7.693	257.28	919.1	1176.4
42	56.7	289.02	0.017349	7.565	258.46	918.3	1176.7
43	57.7	290.15	0.017359	7.442	259.62	917.4	1177.1
44	58.7	291.26	0.017370	7.323	260.76	916.6	1177.4
45	59.7	292.36	0.017380	7.207	261.89	915.8	1177.7
46	60.7	293.45	0.017391	7.095	263.00	915.0	1178.0
47	61.7	294.52	0.017401	6.987	264.10	914.2	1178.3
48	62.7	295.58	0.017411	6.882	265.18	913.4	1178.6
49	63.7	296.62	0.017421	6.780	266.26	912.7	1178.9
50	64.7	297.65	0.017431	6.682	267.31	911.9	1179.2
51	65.7	298.67	0.017441	6.586	268.36	911.1	1179.5
52	66.7	299.68	0.017451	6.493	269.39	910.4	1179.8
53	67.7	300.67	0.017461	6.402	270.42	909.6	1180.0
54	68.7	301.65	0.017470	6.314	271.43	908.9	1180.3
55	69.7	302.62	0.017480	6.229	272.42	908.2	1180.6

PROPERTIES OF SATURATED STEAM CONT'D.

Pressure		Temperature	Specific Volume		Heat	Enthalpy - BTU/lb	
Gage PSIG	Absolute PSIA	Saturation Deg. F	Water vf	Steam vg	Liquid hf	Latent Heat hfg	Total Steam Heat hg
56	70.7	303.58	0.017490	6.146	273.41	907.4	1180.8
57	71.7	304.53	0.017499	6.065	274.39	906.7	1181.1
58	72.7	305.47	0.017509	5.987	275.35	906.0	1181.4
59	73.7	306.40	0.017518	5.910	276.31	905.3	1181.6
60	74.7	307.32	0.017528	5.835	277.26	904.6	1181.9
61	75.7	308.23	0.017532	5.763	278.19	903.9	1182.1
62	76.7	309.12	0.017541	5.692	279.12	903.2	1182.3
63	77.7	310.01	0.017550	5.623	280.04	902.5	1182.6
64	78.7	310.89	0.017560	5.555	280.94	901.9	1182.8
65	79.7	311.76	0.017569	5.490	281.84	901.2	1183.0
66	80.7	312.63	0.017578	5.425	282.73	900.5	1183.3
67	81.7	313.48	0.017587	5.363	283.62	899.9	1183.5
68	82.7	314.33	0.017596	5.302	284.49	899.2	1183.7
69	83.7	315.16	0.017605	5.242	285.36	898.6	1183.9
70	84.7	315.99	0.017614	5.184	286.21	897.9	1184.1
71	85.7	316.82	0.017623	5.126	287.06	897.3	1184.3
72	86.7	317.63	0.017631	5.071	287.91	896.6	1184.5
73	87.7	318.44	0.017640	5.016	288.74	896.0	1184.7
74	88.7	319.24	0.017649	4.963	289.57	895.4	1184.9
75	89.7	320.03	0.017657	4.911	290.39	894.8	1185.1
76	90.7	320.81	0.017666	4.860	291.20	894.1	1185.3
77	91.7	321.59	0.017674	4.810	292.01	893.5	1185.5
78	92.7	322.37	0.017683	4.761	292.81	892.9	1185.7
79	93.7	323.13	0.017691	4.713	293.60	892.3	1185.9
80	94.7	323.89	0.017700	4.666	294.39	891.7	1186.1
81	95.7	324.64	0.017708	4.620	295.17	891.1	1186.3
82	96.7	325.39	0.017716	4.575	295.95	890.5	1186.5
83	97.7	326.13	0.017724	4.531	296.71	889.9	1186.6
84	98.7	326.86	0.017732	4.487	297.48	889.3	1186.8
85	99.7	327.59	0.017740	4.445	298.23	888.8	1187.0
86	100.7	328.31	0.017748	4.401	298.98	888.2	1187.2
87	101.7	329.03	0.017756	4.360	299.73	887.6	1187.3
88	102.7	329.74	0.017764	4.320	300.47	887.0	1187.5
89	103.7	330.45	0.017772	4.280	301.20	886.5	1187.7
90	104.7	331.15	0.017780	4.242	301.93	885.9	1187.8
91	105.7	331.84	0.017788	4.204	302.66	885.4	1188.0
92	106.7	332.53	0.017796	4.167	303.37	884.8	1188.2
93	107.7	333.22	0.017804	4.130	304.09	884.2	1188.3
94	108.7	333.90	0.017811	4.094	304.80	883.7	1188.5
95	109.7	334.57	0.017819	4.059	305.50	883.1	1188.6
96	110.7	335.24	0.017827	4.024	306.20	882.6	1188.8
97	111.7	335.91	0.017834	3.990	306.89	882.1	1188.9
98	112.7	336.57	0.017842	3.957	307.58	881.5	1189.1
99	113.7	337.22	0.017849	3.924	308.26	881.0	1189.2
100	114.7	337.87	0.017857	3.891	308.94	880.4	1189.4
101	115.7	338.52	0.017864	3.859	309.62	879.9	1189.5
102	116.7	339.16	0..017872	3.828	310.29	879.4	1189.7
103	117.7	339.80	0.017879	3.797	310.96	878.9	1189.8
104	118.7	340.43	0.017886	3.767	311.62	878.3	1190.0
105	119.7	341.06	0.017894	3.737	312.28	877.8	1190.1
106	120.7	341.69	0.017901	3.708	312.93	877.3	1190.2
107	121.7	342.31	0.017908	3.679	313.58	876.8	1190.4
108	122.7	342.93	0.017915	3.650	314.23	876.3	1190.5
109	123.7	343.54	0.017922	3.622	314.87	875.8	1190.6
110	124.7	344.15	0.017930	3.595	315.51	875.3	1190.8
111	125.7	344.76	0.017937	3.568	316.14	874.8	1190.9

PROPERTIES OF SATURATED STEAM CONT'D.

Pressure		Temperature	Specific Volume		Heat	Enthalpy - BTU/lb	
Gage PSIG	Absolute PSIA	Saturation Deg. F	Water vf	Steam vg	Liquid hf	Latent Heat hfg	Total Steam Heat hg
112	126.7	345.36	0.017944	3.541	316.77	874.3	1191.0
113	127.7	345.95	0.017951	3.514	317.40	873.8	1191.2
114	128.7	346.55	0.017958	3.489	318.02	873.3	1191.3
115	129.7	347.14	0.017965	3.463	318.64	872.8	1191.4
116	130.7	347.73	0.017972	3.438	319.26	872.3	1191.5
117	131.7	348.31	0.017979	3.413	319.87	871.8	1191.7
118	132.7	348.89	0.017986	3.388	320.48	871.3	1191.8
119	133.7	349.47	0.017993	3.364	321.09	870.8	1191.9
120	134.7	350.04	0.018000	3.341	321.69	870.3	1192.0
121	135.7	350.61	0.018006	3.317	322.29	869.9	1192.1
122	136.7	351.18	0.018013	3.294	322.88	869.4	1192.3
123	137.7	351.74	0.018020	3.271	323.48	868.9	1192.4
124	138.7	352.30	0.018027	3.249	324.07	868.4	1192.5
125	139.7	352.86	0.018033	3.227	324.65	868.0	1192.6
126	140.7	353.41	0.018040	3.205	325.23	867.5	1192.7
127	141.7	353.96	0.018047	3.183	325.81	867.0	1192.8
128	142.7	354.51	0.018053	3.162	326.39	866.6	1192.9
129	143.7	355.05	0.018060	3.141	326.96	866.1	1193.1
130	144.7	355.60	0.018067	3.120	327.54	865.6	1193.2
131	145.7	356.13	0.018073	3.100	328.10	865.2	1193.3
132	146.7	356.67	0.018080	3.080	328.67	864.7	1193.4
133	147.7	357.20	0.018086	3.060	329.23	864.2	1193.5
134	148.7	357.73	0.018093	3.040	329.79	863.8	1193.6
135	149.7	358.26	0.018099	3.021	330.35	863.3	1193.7
136	150.7	358.79	0.018106	3.002	330.90	862.9	1193.8
137	151.7	359.31	0.018112	2.983	331.45	862.4	1193.9
138	152.7	359.83	0.018119	2.964	332.00	862.0	1194.0
139	153.7	360.34	0.018125	2.946	332.54	861.5	1194.1
140	154.7	360.86	0.018132	2.928	333.09	861.1	1194.2
.141	155.7	361.37	0.018138	2.910	333.63	860.7	1194.3
142	156.7	361.88	0.018144	2.892	334.17	860.2	1194.4
143	157.7	362.38	0.018151	2.874	334.70	859.8	1194.5
144	158.7	362.89	0.018157	2.857	335.23	859.3	1194.6
145	159.7	363.39	0.018163	2.840	335.77	858.9	1194.7
146	160.7	363.89	0.018169	2.823	336.29	858.5	1194.8
147	161.7	364.38	0.018176	2.806	336.82	858.0	1194.9
148	162.7	364.88	0.018182	2.790	337.34	857.6	1194.9
149	163.7	365.37	0.018188	2.773	337.86	857.2	1195.0
150	164.7	365.86	0.018194	2.757	338.38	856.7	1195.1
152	166.7	366.83	0.018207	2.726	339.41	855.9	1195.3
154	168.7	367.79	0.018219	2.695	340.43	855.1	1195.5
156	170.7	368.74	0.018231	2.664	341.44	854.2	1195.7
158	172.7	369.69	0.018243	2.635	342.45	853.4	1195.8
160	174.7	370.62	0.018255	2.606	343.44	852.5	1196.0
162	176.7	371.55	0.018267	2.577	344.43	851.7	1196.2
164	178.7	372.47	0.018279	2.550	345.41	850.9	1196.3
166	180.7	373.38	0.018291	2.523	346.38	850.1	1196.5
168	182.7	374.29	0.018303	2.496	347.34	849.3	1196.6
170	184.7	375.18	0.018314	2.470	348.30	848.5	1196.8
172	186.7	376.07	0.018326	2.445	349.24	847.7	1196.9
174	188.7	376.95	0.018338	2.420	350.18	846.9	1197.1
176	190.7	377.82	0.018349	2.395	351.12	846.1	1197.2
178	192.7	378.69	0.018361	2.371	352.04	845.3	1197.4
180	194.7	379.55	0.018372	2.348	352.96	844.6	1197.5
182	196.7	380.40	0.018383	2.325	353.87	843.8	1197.7
184	198.7	381.25	0.018395	2.302	354.78	843.0	1197.8
186	200.7	382.09	0.018406	2.280	355.68	842.9	1198.6

PROPERTIES OF SATURATED STEAM CONT'D.

Pressure		Temperature	Specific Volume		Heat	Enthalpy - BTU/lb	
Gage PSIG	Absolute PSIA	Saturation Deg. F	Water vf	Steam vg	Liquid hf	Latent Heat hfg	Total Steam Heat hg
188	202.7	382.92	0.018417	2.258	356.57	842.2	1198.7
190	204.7	383.75	0.018428	2.237	357.45	841.4	1198.9
192	206.7	384.57	0.018439	2.216	358.33	840.6	1199.0
194	208.7	385.38	0.018450	2.196	359.21	839.9	1199.1
196	210.7	386.19	0.018461	2.175	360.07	839.1	1199.2
198	212.7	386.99	0.018472	2.156	360.94	838.4	1199.3
200	214.7	387.79	0.018483	2.136	361.79	837.7	1199.4
205	219.7	389.75	0.018510	2.089	363.91	835.8	1199.7
210	224.7	391.68	0.018537	2.044	365.99	834.0	1200.0
215	229.7	393.58	0.018563	2.001	368.03	832.2	1200.2
220	234.7	395.44	0.018590	1.960	370.05	830.4	1200.5
225	239.7	397.28	0.018616	1.920	372.03	828.7	1200.7
230	244.7	399.08	0.018641	1.882	373.99	826.9	1200.9
235	249.7	400.86	0.018667	1.845	375.92	825.2	1201.1
240	254.7	402.61	0.018692	1.810	377.82	823.5	1201.3
245	259.7	404.33	0.018717	1.776	379.69	821.8	1201.5
250	264.7	406.03	0.018742	1.743	381.54	820.2	1201.7
255	269.7	407.70	0.018767	1.711	383.36	818.5	1201.9
260	274.7	409.35	0.018791	1.681	385.16	816.9	1202.1
265	279.7	410.97	0.018816	1.652	386.94	815.3	1202.2
270	284.7	412.58	0.018840	1.623	388.69	813.7	1202.4
275	289.7	414.16	0.018864	1.596	390.42	812.1	1202.5
280	294.7	415.72	0.018887	1.569	392.14	810.5	1202.7
285	299.7	417.26	0.018911	1.544	393.83	809.0	1202.8
290	304.7	418.78	0.018934	1.519	395.50	807.5	1203.0
295	309.7	420.28	0.018958	1.495	397.15	805.9	1203.1
300	314.7	421.76	0.018981	1.471	398.79	804.4	1203.2
310	324.7	424.67	0.019027	1.427	402.01	801.4	1203.4
320	334.7	427.51	0.019072	1.385	405.15	798.5	1203.6
330	344.7	430.29	0.019117	1.345	408.24	795.6	1203.8
340	354.7	433.00	0.019161	1.308	411.26	792.7	1204.0
350	364.7	435.66	0.019205	1.272	414.22	789.9	1204.1
360	374.7	438.26	0.019248	1.239	417.13	787.1	1204.2
370	384.7	440.80	0.019291	1.207	419.99	784.3	1204.3
380	394.7	443.30	0.019334	1.177	422.80	781.6	1204.4
390	404.7	445.75	0.019376	1.148	425.25	779.0	1204.2
400	414.7	448.15	0.019418	1.120	427.94	776.3	1204.2
410	424.7	450.51	0.019459	1.094	430.59	773.7	1204.3
420	434.7	452.82	0.019500	1.068	433.20	771.1	1204.3
430	444.7	455.09	0.019541	1.044	435.77	768.5	1204.3
440	454.7	457.33	0.019582	1.021	438.30	766.0	1204.3
450	464.7	459.52	0.019622	0.999	440.80	763.5	1204.3
460	474.7	461.68	0.019662	0.978	443.25	761.0	1204.3
470	484.7	463.81	0.019702	0.957	445.68	758.5	1204.2
480	494.7	465.90	0.019741	0.938	448.07	756.1	1204.2
490	504.7	467.97	0.019781	0.919	450.43	753.7	1204.1
500	514.7	470.00	0.019820	0.901	452.76	751.3	1204.1
510	524.7	472.00	0.019859	0.883	455.06	748.9	1204.0
520	534.7	473.97	0.019897	0.866	457.33	746.6	1203.9
530	544.7	475.91	0.019936	0.850	459.58	744.2	1203.8
540	554.7	477.82	0.019974	0.834	461.79	741.9	1203.7
550	564.7	479.71	0.020012	0.819	463.99	739.6	1203.6
560	574.7	481.57	0.020050	0.805	466.15	737.3	1203.5
570	584.7	483.41	0.020088	0.790	468.30	735.0	1203.3
580	594.7	485.23	0.020126	0.777	470.42	732.8	1203.2
590	604.7	487.02	0.020164	0.763	472.52	730.5	1203.1
600	614.7	488.79	0.020201	0.751	474.59	728.3	1202.9

Pressure to Vacuum Table 2

Gage Indicated		Absolute Pressure		
PSIG	Inches of Hg	PSIA	Inches of Hg	Torricelli
-14.70000	29.92000	0.0	0.0	0.0
-14.69998	29.91996	0.00002	0.00004	0.001
-14.69996	29.91992	0.00004	0.00008	0.002
-14.69994	29.91988	0.00006	0.00012	0.003
-14.69992	29.91984	0.00008	0.00016	0.004
-14.69990	29.91980	0.00010	0.00020	0.005
-14.69981	29.91961	0.00019	0.00039	0.010
-14.69961	29.91921	0.00039	0.00079	0.020
-14.69942	29.91882	0.00058	0.00118	0.030
-14.69923	29.91843	0.00077	0.00157	0.040
-14.69903	29.91803	0.00097	0.00197	0.050
-14.69806	29.91606	0.00194	0.00394	0.100
-14.69613	29.91212	0.00387	0.00788	0.200
-14.69449	29.90818	0.00551	0.01182	0.300
-14.69226	29.90424	0.00774	0.01576	0.400
-14.69032	29.90030	0.00968	0.01970	0.500
-14.68066	29.88063	0.01934	0.03937	1.000
-14.66698	29.84126	0.03302	0.07874	2.000
-14.64197	29.80189	0.05803	0.11811	3.000
-14.62262	29.76252	0.07738	0.15748	4.000
-14.60329	29.72315	0.09671	0.19685	5.000
-14.50658	29.52630	0.19342	0.39370	10.000
-14.40980	29.32940	0.29020	0.59060	15.000
-14.31320	29.13260	0.38680	0.78740	20.000
-14.21840	28.93570	0.48160	0.98430	25.000
-14.20870	28.920	0.49130	1.000	25.400
-14.11970	28.740	0.58030	1.181	30.000
-13.75700	28.000	0.94330	1.920	48.770
-12.28300	25.000	2.41700	4.920	124.970
-10.31800	21.000	4.38200	8.920	226.570
-8.84400	18.000	5.85600	11.920	302.770
-7.37000	15.000	7.320	14.920	378.970
-5.89600	12.000	8.804	17.920	455.770
-4.91300	10.000	9.787	19.920	505.970
-3.93000	8.000	10.770	21.920	556.770
-2.94800	6.000	11.752	23.920	607.570
-1.96500	4.000	12.735	25.920	658.370
-0.98300	2.000	13.732	27.920	709.170
-0.49100	1.000	14.209	28.920	733.570
-0.24600	0.500	14.454	29.420	747.270
		ATMOSPHERIC		
0.0	0.0	14.700	29.920	760.000
+ 0.30		15.000	30.540	775.720
+ 1.00		15.700	31.970	811.910
+ 2.00		16.700	34.000	863.630
+ 10.00		24.700	50.290	277.35

Properties of Water Table 3

Water Temp.	Saturation Pressure	Weight	Weight Density	Specific Volume
Deg. F	PSIA	lbs/Gallon	lbs/Cu.Ft.	Cu.Ft./lb
32	0.0886	8.344	62.414	0.016022
40	0.1216	8.345	62.426	0.016019
50	0.1780	8.343	62.410	0.016023
60	0.2561	8.338	62.371	0.016033
70	0.3629	8.329	62.305	0.016050
80	0.5068	8.318	62.220	0.016072
90	0.6981	8.304	62.116	0.016099
100	0.9492	8.288	61.996	0.016130
110	1.2750	8.270	61.862	0.016165
120	1.6927	8.250	61.713	0.016204
130	2.2230	8.228	61.550	0.016247
140	2.8892	8.205	61.376	0.016293
150	3.7184	8.180	61.188	0.016343
160	4.7414	8.154	60.994	0.016395
170	5.9926	8.126	60.787	0.016451
180	7.5110	8.097	60.569	0.016510
190	9.340	8.067	60.343	0.016572
200	11.526	8.035	60.107	0.016637
210	14.123	8.002	59.862	0.016705
212	14.696	7.996	59.812	0.016719
220	17.186	7.969	59.613	0.016775
240	24.968	7.898	59.081	0.016926
260	35.427	7.823	58.517	0.017089
280	49.200	7.743	57.924	0.017264
300	67.005	7.661	57.307	0.01745
350	134.604	7.431	55.586	0.01799
400	247.259	7.172	53.648	0.01864
450	422.55	6.880	51.467	0.01943
500	680.86	6.543	48.948	0.02043
550	1045.43	6.143	45.956	0.02176
600	1543.2	5.655	42.301	0.02364
650	2208.4	4.999	37.397	0.02674
700	3094.3	3.651	27.307	0.03662

NOTE:
Weight of water per gallon is based on 7.48052 gallons per cubic foot.

Specific gravity of water @ 60°F = 1.00

CONDENSATION WARM-UP LOADS - TABLE 4

Steam Pressure PSIG	HEADER SIZE														0°F* Correct Factor
	2"	2½"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"	
1	6.4	10.2	13.3	19.0	25.7	33.3	50	71	94	111	145	184	216	301	1.50
5	7.2	11.4	14.9	21.2	28.7	37.2	56	80	105	124	163	206	241	336	1.45
10	7.8	12.4	16.2	23.0	31.2	40.5	61	86	114	135	177	224	262	365	1.41
20	8.8	14.0	18.3	26.0	35.2	45.7	69	98	129	153	200	253	296	413	1.37
40	10.3	16.4	21.4	30.5	41.3	53.6	81	114	151	179	234	296	347	484	1.32
60	11.5	18.2	23.9	34.0	46.0	59.7	90	127	169	200	261	330	387	539	1.29
80	12.5	19.8	25.9	36.9	50.0	64.8	98	138	183	217	283	358	420	585	1.27
100	13.3	21.1	27.7	39.4	53.4	69.3	104	148	195	231	302	383	449	625	1.26
125	14.3	22.6	29.6	42.2	57.2	74.2	112	158	209	248	324	410	481	670	1.25
150	15.1	24.0	31.4	44.7	60.6	78.6	118	168	222	263	343	434	509	709	1.24
175	15.9	25.2	33.0	47.0	63.7	82.7	124	176	233	276	361	457	536	746	1.23
200	16.6	26.4	34.5	49.1	66.6	86.4	130	184	244	289	377	477	560	779	1.22
250	17.9	28.5	37.3	53.0	71.9	93.3	140	199	263	312	407	515	604	842	1.21
300	26.3	40.2	53.8	78.6	109.0	150.0	228	338	464	557	716	896	1096	1555	1.20
400	29.3	44.8	59.9	87.7	121.5	167.0	254	376	517	620	798	998	1221	1733	1.19
500	32.1	48.9	65.5	95.7	132.8	182.5	277	411	566	678	872	1091	1335	1894	1.18
600	34.6	52.9	70.7	103.4	143.4	197.1	299	444	611	732	942	1179	1441	2045	1.17

Condensation loads are in pounds per hour per 100 feet of insulated steam main with ambient temperature of 70°F and an insulation efficiency of 80%.

Loads are based on Schedule 40 pipe for pressures up to and including 250 PSIG and on schedule 80 pipe for pressures above 250 PSIG.

CONDENSATION LOADS - TABLE 5

Steam Pressure PSIG	HEADER SIZE														0°F* Correct Factor
	2"	2½"	3"	4"	5"	6"	8"	10"	12"	14"	16"	18"	20"	24"	
1	4.6	5.5	6.6	8.3	10.1	11.8	15.1	18.6	21.8	23.8	26.9	30.1	33.2	39.4	1.40
5	5.1	6.1	7.3	9.3	11.3	13.3	16.9	20.8	24.4	26.6	30.1	33.7	37.2	44.1	1.37
10	5.7	6.8	8.2	10.3	12.6	14.8	18.9	23.2	27.2	29.7	33.7	37.6	41.5	49.3	1.34
20	6.7	8.0	9.7	12.2	14.8	17.4	22.3	27.4	32.1	35.1	39.7	44.4	49.0	58.2	1.29
40	8.4	10.0	12.0	15.1	18.4	21.7	27.7	34.1	40.0	43.6	49.5	55.3	61.0	72.5	1.24
60	9.7	11.6	13.9	17.6	21.4	25.2	32.2	39.6	46.5	50.7	57.5	64.3	71.0	84.3	1.22
80	10.9	13.0	15.6	19.7	24.0	28.2	36.2	44.4	52.2	57.0	64.6	72.2	79.7	94.7	1.20
100	11.9	14.3	17.1	21.6	26.4	31.0	39.7	48.9	57.4	62.6	71.0	79.4	87.7	104.2	1.18
125	13.2	15.7	18.9	23.8	29.1	34.2	43.8	53.9	63.3	69.1	78.4	87.6	96.8	115.0	1.17
150	14.3	17.1	20.5	25.9	31.6	37.2	47.6	58.6	68.8	75.2	85.3	95.3	105.3	125.2	1.16
175	15.3	18.3	22.0	27.8	33.9	40.0	51.2	63.0	74.0	80.9	91.7	102.6	113.3	134.7	1.15
200	16.3	19.5	23.4	29.7	36.2	42.6	54.6	67.2	78.9	86.2	97.8	109.4	120.8	143.7	1.14
250	18.2	21.8	26.2	33.1	40.4	47.6	61.1	75.2	88.3	96.5	109.5	122.4	135.3	160.8	1.13
300	20.0	23.9	28.8	36.4	44.4	52.4	67.1	82.7	97.1	106.1	120.5	134.7	148.9	177.1	1.12
400	23.4	27.9	33.6	42.5	51.9	61.2	78.6	96.8	113.8	124.3	141.1	157.8	174.5	207.6	1.11
500	26.5	31.7	38.2	48.4	59.1	69.7	89.4	110.2	129.5	141.6	160.8	179.8	198.8	236.6	1.10
600	29.6	35.4	42.6	54.0	66.0	77.8	100.0	123.2	144.9	158.4	179.8	201.2	223.5	264.8	1.09

Condensation loads are in pounds per hour per 100 feet of insulated steam main with ambient temperature of 70°F and an insulation efficiency of 80%.

Chart loads represent losses due to radiation and convection for saturated steam.

CONVERSION TABLES

LIQUID WEIGHTS and MEASURES

To Convert	To	Multiply By
Gallons	Liters	3.7853
Gallons	Cu. Inches	231
Gallons	Cu. Feet	0.1337
Gallons	Cu. Meters	0.00379
Gallons	Lbs. of Water	8.339
Liters	Gallons	0.26418
Liters	Cu. Inches	61.025
Liters	Cu. Feet	0.0353
Liters	Cu. Meters	0.001
Liters	Lbs. of Water	2.202
Cu. Inches	Gallons	0.00433
Cu. Inches	Liters	0.01639
Cu. Inches	Cu. Feet	0.00058
Cu. Inches	Cu. Meters	0.000016
Cu. Inches	Lbs. of Water	0.0362
Cu. Feet	Gallons	7.48052
Cu. Feet	Liters	28.316
Cu. Feet	Cu. Inches	1728
Cu. Feet	Cu. Meters	0.0283
Cu. .Feet	Lbs. of Water	62.371
Cu. Meters	Gallons	264.17
Cu. Meters	Liters	999.972
Cu. Meters	Cu. Inches	61023.74
Cu. Meters	Cu. Feet	35.3145
Cu. Meters.	Lbs. of Water	2202.61
Lbs. of Water	Gallons	0.11992
Lbs. of Water	Liters	0.45419
Lbs. of Water	Cu. Inches	27.643
Lbs. of Water	Cu. Feet	0.01603
Lbs. of Water	Cu. Meters	0.000454

LINEAL MEASURES

Inches	mm	25.4
Inches	cm	2.54
Inches	Meters	0.0254
Feet	cm	30.48
Feet	Meters	0.3048
mm	Inches	0.03937
mm	Feet	0.00328
cm	Inches	0.3937
cm	Feet	0.03281
Meters	Feet	3.28

AREA

Sq. Inches	Sq. Feet	0.006944
Sq. Inches	Sq. cm	6.4516
Sq. Feet	Sq. Inches	144
Sq. Feet	Sq. cm	929.03
Sq. Feet	Sq. Meters	0.0929
Sq. cm	Sq. Inches	0.155
Sq. cm	Sq. Feet	0.00108
Sq. cm	Sq. Meters	0.0001
Sq. Meter	Sq. Inches	1550
Sq. Meter	Sq. Feet	10.76

CONVERSIONS of PRESSURE AND HEAD

To Convert	To	Multiply By
Lbs .per Sq .In.	Lbs. per Sq. Ft.	144
Lbs. per Sq. In.	Atmospheres	0.06805
Lbs. per Sq. In.	Ins. of Water	27.728
Lbs. per Sq. In.	Ft. of Water	2.3106
Lbs. per Sq. In.	Ins. of Mercury	2.03602
Lbs. per Sq. In.	mm of Mercury	51.715
Lbs. per Sq. In.	Bar	0.06895
Lbs. per Sq. In.	kg per Sq. cm	0.070307
Lbs. per Sq. In.	kg per Sq. M	703.070
Lbs. per Sq. Ft.	Lbs. per Sq. In.	0.0069445
Lbs. per Sq. Ft.	Atmospheres	0.000473
Lbs. per Sq. Ft.	Ins. of Water	0.1926
Lbs. per Sq. Ft.	Ft. of Water	0.01605
Lbs. per Sq. Ft.	Ins. of Mercury	0.014139
Lbs. per Sq. Ft.	mm of Mercury	0.35913
Lbs. per Sq. Ft.	Bar	0.000479
Lbs. per Sq. Ft.	kg per Sq. cm	0.000488
Lbs. per Sq. Ft.	kg per Sq. M	4.88241
Atmospheres	Lbs. per Sq. In.	14.696
Atmospheres	Lbs. per Sq. Ft.	2116.22
Atmospheres	Ins. of Water	407.484
Atmospheres	Ft. of Water	33.957
Atmospheres	Ins. of Mercury	29.921
Atmospheres	mm of Mercury	760
Atmospheres	Bar	1.01325
Atmospheres	kg per Sq. cm	1.0332
Atmospheres	kg per Sq. M	10332.27
Ins. of Water	Lbs. per Sq. In.	0.03609
Ins. of Water	Lbs. per Sq. Ft.	5.1972
Ins. of Water	Atmospheres	0.002454
Ins.of Water	Ft. of Water	0.08333
Ins. of Water	Ins. of Mercury	0.07343
Ins. of Water	mm of Mercury	1.8651
Ins. of Water	Bar	0.00249
Ins. of Water	kg per Sq. cm	0.00253
Ins. of Water	kg per Sq. M	25.375
Ft. of Water	Lbs. per Sq. In.	0.432781
Ft. of Water	Lbs. per Sq. Ft.	63.3205
Ft. of Water	Atmospheres	0.029449
Ft. of Water	Ins. of Water	12
Ft. of Water	Ins. of Mercury	0.88115
Ft. of Water	mm of Mercury	22.3813
Ft. of Water	Bar	0.029839
Ft. of Water	kg per Sq. cm	0.03043
Ft. of Water	kg per Sq. M	304.275
Ins. of Mercury	Lbs. per Sq. In.	0.491154
Ins. of Mercury	Lbs. per Sq. Ft.	70.7262
Ins. of Mercury	Atmospheres	0.033421
Ins. of Mercury	Ins. of Water	13.6185
Ins. of Mercury	Ft. of Water	1.1349
Ins. of Mercury	mm of Mercury	25.40005
Ins. of Mercury	Bar	0.033864
Ins. of Mercury	kg per Sq. cm	0.03453
Ins. of Mercury	kg per Sq. M	345.316
mm of Mercury	Lbs. per Sq. In.	0.019337
mm of Mercury	Lbs. per Sq. Ft.	2.7845
mm of Mercury	Atmospheres	0.001316
mm of Mercury	Ins. of Water	0.53616
mm of Mercury	Ft. of Water	0.04468
mm of Mercury	Ins. of Mercury	0.03937
mm of Mercury	Bar	0.00133
mm of Mercury	kg per Sq. cm	0.00136
mm of Mercury	kg per Sq. M	13.59509
kg per Sq. cm	Lbs. per Sq. In.	14.2233
kg per Sq. cm	Lbs. per Sq. Ft.	2048.155
kg per Sq. cm	Atmospheres	0.96784
kg per Sq. cm	Ins. of Water	394.38
kg per Sq. cm	Ft. of Water	32.865
kg per Sq. cm	Ins. of Mercury	28.959
kg per Sq. cm	mm of Mercury	735.559
kg per Sq. cm	Bar	0.98067
kg per Sq. cm	kg per Sq. M	10000

Note: All weights and measures of water are based on temperature of 60°F.

Note: Temperature of Water and Mercury is 68°F and 32°F respectively.

TEMPERATURE

To convert Fahrenheit to Celsius: $\frac{°F - 32}{1.8}$

To convert Celsius to Fahrenheit: (1.8 x °C) + 32

VELOCITY

1 Ft per Sec. = 0.3048 M Per Sec.

1 M per Sec. = 3.2808 Ft. per Sec.

PIPE DATA TABLES

Pipe Size (in.)	Outside Diameter (in.)	Weight Class	Carbon Steel Sched.	Stainless Steel Sched.	Wall Thickness (in.)	Inside Diameter (in.)	Circum. (Ext.) (in.)	Circum (Int.) (in.)	Flow Area (sq. in.)	Weight of Pipe (lbs/Ft.)	Weight of Water (lbs/Ft.)	Gallons of Water per Ft.	Section Modulus	Pipe Size (in.)
		—	—	10S	.049	.307		.96	.074	.19	.032	.004	.00437	
1/8	.405	STD	40	40S	.068	.269	1.27	.85	.057	.24	.025	.003	.00523	1/8
		XS	80	80S	.095	.215		.68	.036	.31	.016	.002	.00602	
		—	—	10S	.065	.410		1.29	.132	.33	.057	.007	.01032	
1/4	.540	STD	40	40S	.088	.364	1.70	1.14	.104	.42	.045	.005	.01227	1/4
		XS	80	80S	.119	.302		.95	.072	.54	.031	.004	.01395	
		—	—	10S	.065	.545		1.71	.233	.42	.101	.012	.01736	
3/8	.675	STD	40	40S	.091	.493	2.12	1.55	.191	.57	.083	.010	.0216	3/8
		XS	80	80S	.126	.423		1.33	.141	.74	.061	.007	.0255	
		—	—	5S	.065	.710		2.23	.396	.54	.172	.021	.0285	
		—	—	10S	.083	.674		2.12	.357	.67	.155	.019	.0341	
		STD	40	40S	.109	.622		1.95	.304	.85	.132	.016	.0407	
1/2	.840	XS	80	80S	.147	.546	2.64	1.72	.234	1.09	.102	.012	.0478	1/2
		—	160	—	.187	.466		1.46	.171	1.31	.074	.009	.0527	
		XXS	—	—	.294	.252		.79	.050	1.71	.022	.003	.0577	
		—	—	5S	.065	.920		2.89	.665	.69	.288	.035	.0467	
		—	—	10S	.083	.884		2.78	.614	.86	.266	.032	.0566	
		STD	40	40S	.113	.824	3.30	2.59	.533	1.13	.231	.028	.0706	
3/4	1.050	XS	80	80S	.154	.742		2.33	.433	1.47	.188	.022	.0853	3/4
		—	160	—	.219	.612		1.92	.296	1.94	.128	.015	.1004	
		XXS	—	—	.308	.434		1.36	.148	2.44	.064	.008	.1103	
		—	—	5S	.065	1.185		3.72	1.103	.87	.478	.057	.0760	
		—	—	10S	.109	1.097		3.45	.945	1.40	.409	.049	.1151	
		STD	40	40S	.133	1.049	4.13	3.30	.864	1.68	.375	.045	.1328	
1	1.315	XS	80	80S	.179	.957		3.01	.719	2.17	.312	.037	.1606	1
		—	160	—	.250	.815		2.56	.522	2.84	.230	.027	.1903	
		XXS	—	—	.358	.599		1.88	.282	3.66	.122	.015	.2136	
		—	—	5S	.065	1.530		4.81	1.839	1.11	.797	.096	.1250	
		—	—	10S	.109	1.442		4.53	1.633	1.81	.708	.085	.1934	
		STD	40	40S	.140	1.380		4.34	1.495	2.27	.649	.078	.2346	
1 1/4	1.660	XS	80	80S	.191	1.278	5.22	4.02	1.283	3.00	.555	.067	.2913	1 1/4
		—	160	—	.250	1.160		3.64	1.057	3.76	.458	.055	.3421	
		XXS	—	—	.382	.896		2.81	.630	5.21	.273	.033	.4110	
		—	—	5S	.065	1.770		5.56	2.461	1.28	1.066	.128	.1662	
		—	—	10S	.109	1.682		5.28	2.222	2.09	.963	.115	.2598	
		STD	40	40S	.145	1.610	5.97	5.06	2.036	2.72	.882	.106	.3262	
1 1/2	1.900	XS	80	80S	.200	1.500		4.71	1.767	3.63	.765	.092	.4118	1 1/2
		—	160	—	.281	1.338		4.20	1.406	4.86	.608	.073	.5078	
		XXS	—	—	.400	1.100		3.46	.950	6.41	.420	.049	.5977	
		—	—	5S	.065	2.245		7.05	3.958	1.61	1.72	.206	.2652	
		—	—	10S	.109	2.157		6.78	3.654	2.64	1.58	.190	.4204	
		STD	40	40S	.154	2.067		6.49	3.355	3.65	1.45	.174	.5606	
2	2.375	XS	80	80S	.218	1.939	7.46	6.09	2.953	5.02	1.28	.153	.7309	2
		—	160	—	.344	1.687		5.30	2.241	7.46	.97	.116	.9790	
		XXS	—	—	.436	1.503		4.72	1.774	9.03	.77	.092	1.1040	
		—	—	5S	.083	2.709		8.51	5.764	2.48	2.50	.299	.4939	
		—	—	10S	.120	2.635		8.28	5.453	3.53	2.36	.283	.6868	
		STD	40	40S	.203	2.469		7.76	4.788	5.79	2.07	.249	1.064	
2 1/2	2.875	XS	80	80S	.276	2.323	9.03	7.30	4.238	7.66	1.87	.220	1.339	2 1/2
		—	160	—	.375	2.125		6.68	3.546	10.01	1.54	.184	1.638	
		XXS	—	—	.552	1.771		5.56	2.464	13.69	1.07	.128	1.997	

PIPE DATA TABLES CONT'D.

Pipe Size (in.)	Outside Diameter (in.)	Weight Class	Carbon Steel Sched.	Stainless Steel Sched.	Wall Thickness (in.)	Inside Diameter (in.)	Circum. (Ext.) (in.)	Circum (Int.) (in.)	Flow Area (sq. in.)	Weight of Pipe (lbs/Ft.)	Weight of Water (lbs/Ft.)	Gallons of Water per Ft.	Section Modulus	Pipe Size (in.)
		—	—	5S	.083	3.334		10.47	8.730	3.03	3.78	.454	.744	
		—	—	10S	.120	3.260		10.24	8.347	4.33	3.62	.434	1.041	
		STD	40	40S	.216	3.068		9.64	7.393	7.58	3.20	.384	1.724	
3	3.500	XS	80	80S	.300	2.900	11.00	9.11	6.605	10.25	2.86	.343	2.225	3
		—	160	—	.438	2.624		8.24	5.408	14.32	2.35	.281	2.876	
		XXS	—	—	.600	2.300		7.23	4.155	18.58	1.80	.216	3.424	
		—	—	5S	.083	4.334		13.62	14.75	3.92	6.39	.766	1.249	
		—	—	10S	.120	4.260		13.38	14.25	5.61	6.18	.740	1.761	
		STD	40	40S	.237	4.026		12.65	12.73	10.79	5.50	.661	3.214	
4	4.500	XS	80	80S	.337	3.826	14.14	12.02	11.50	14.98	4.98	.597	4.271	4
		—	120	—	.438	3.624		11.39	10.31	19.00	4.47	.536	5.178	
		—	160	—	.531	3.438		10.80	9.28	22.51	4.02	.482	5.898	
		XXS	—	—	.674	3.152		9.90	7.80	27.54	3.38	.405	6.791	
		—	—	5S	.109	5.345		16.79	22.44	6.36	9.72	1.17	2.498	
		—	—	10S	.134	5.295		16.63	22.02	7.77	9.54	1.14	3.029	
		STD	40	40S	.258	5.047		15.86	20.01	14.62	8.67	1.04	5.451	
5	5.563	XS	80	80S	.375	4.813	17.48	15.12	18.19	20.78	7.88	.945	7.431	5
		—	120	—	.500	4.563		14.34	16.35	27.04	7.09	.849	9.250	
		—	160	—	.625	4.313		13.55	14.61	32.96	6.33	.759	10.796	
		XXS	—	—	.750	4.063		12.76	12.97	38.55	5.61	.674	12.090	
		—	—	5S	.109	6.407		20.13	32.24	7.60	13.97	1.68	3.576	
		—	—	10S	.134	6.357		19.97	31.74	9.29	13.75	1.65	4.346	
		STD	40	40S	.280	6.065		19.05	28.89	18.97	12.51	1.50	8.496	
6	6.625	XS	80	80S	.432	5.761	20.81	18.10	26.07	28.57	11.29	1.35	12.22	6
		—	120	—	.562	5.501		17.28	23.77	36.39	10.30	1.24	14.98	
		—	160	—	.719	5.187		16.30	21.15	45.35	9.16	1.10	17.81	
		XXS	—	—	.864	4.897		15.38	18.84	53.16	8.16	.978	20.02	
		—	—	5S	.109	8.407		26.41	55.51	9.93	24.06	2.88	6.131	
		—	—	10S	.148	8.329		26.17	54.48	13.40	23.61	2.83	8.212	
		—	20	—	.250	8.125		25.53	51.85	22.36	22.47	2.69	13.39	
		—	30	—	.277	8.071		25.36	51.16	24.70	22.17	2.66	14.69	
		STD	40	40S	.322	7.981		25.07	50.03	28.55	21.70	2.60	16.81	
		—	60	—	.406	7.813		24.55	47.94	35.64	20.77	2.49	20.58	
8	8.625	XS	80	80S	.500	7.625	27.10	23.95	45.66	43.39	19.78	2.37	24.51	8
		—	100	—	.594	7.437		23.36	43.46	50.95	18.83	2.26	28.14	
		—	120	—	.719	7.187		22.58	40.59	60.71	17.59	2.11	32.58	
		—	140	—	.812	7.001		21.99	38.50	67.76	16.68	2.00	35.65	
		XXS	—	—	.875	6.875		21.60	37.12	72.42	16.10	1.93	37.56	
		—	160	—	.906	6.813		21.40	36.46	74.69	15.80	1.89	38.48	
		—	—	5S	.134	10.482		32.93	86.29	15.19	37.39	4.48	11.71	
		—	—	10S	.165	10.420		32.74	85.28	18.65	36.95	4.43	14.30	
		—	20	—	.250	10.250		32.20	82.52	28.04	35.76	4.29	21.15	
		—	30	—	.307	10.136		31.84	80.69	34.24	34.96	4.19	25.57	
		STD	40	40S	.365	10.020		31.48	78.86	40.48	34.20	4.10	29.90	
10	10.750	XS	60	80S	.500	9.750	33.77	30.63	74.66	54.74	32.35	3.88	39.43	10
		—	80	—	.594	9.562		30.04	71.84	64.43	31.13	3.73	45.54	
		—	100	—	.719	9.312		29.25	68.13	77.03	29.53	3.54	53.22	
		—	120	—	.844	9.062		28.47	64.53	89.29	27.96	3.35	60.32	
		XXS	140	—	1.000	8.750		27.49	60.13	104.13	26.06	3.12	68.43	
		—	160	—	1.125	8.500		26.70	56.75	115.64	24.59	2.95	74.29	

PIPE DATA TABLES CONT'D.

Pipe Size (in.)	Outside Diameter (in.)	Weight Class	Carbon Steel Sched.	Stainless Steel Sched.	Wall Thickness (in.)	Inside Diameter (in.)	Circum. (Ext.) (in.)	Circum (Int.) (in.)	Flow Area (sq. in.)	Weight of Pipe (lbs/Ft.)	Weight of Water (lbs/Ft.)	Gallons of Water per Ft.	Section Modulus	Pipe Size (in.)
		—	—	5S	.156	12.438		39.08	121.50	20.98	52.65	6.31	19.2	
		—	—	10S	.180	12.390		38.92	120.57	24.17	52.25	6.26	22.0	
		—	20	—	.250	12.250		38.48	117.86	33.38	51.07	6.12	30.2	
		—	30	—	.330	12.090		37.98	114.80	43.77	49.74	5.96	39.0	
		STD	—	40S	.375	12.000		37.70	113.10	49.56	49.00	5.88	43.8	
		—	40	—	.406	11.938		37.50	111.93	53.52	48.50	5.81	47.1	
12	12.750	XS	—	80S	.500	11.750	40.06	36.91	108.43	65.42	46.92	5.63	56.7	12
		—	60	—	.562	11.626		36.52	106.16	73.15	46.00	5.51	62.8	
		—	80	—	.688	11.374		35.73	101.64	88.63	44.04	5.28	74.6	
		—	100	—	.844	11.062		34.75	96.14	107.32	41.66	4.99	88.1	
		XXS	120	—	1.000	10.750		33.77	90.76	125.49	39.33	4.71	100.7	
		—	140	—	1.125	10.500		32.99	86.59	139.67	37.52	4.50	109.9	
		—	160	—	1.312	10.126		31.81	80.53	160.27	34.89	4.18	122.6	
		—	—	5S	.156	13.688		43.00	147.15	23.07	63.77	7.64	23.2	
		—		10S	.188	13.624		42.80	145.78	27.73	63.17	7.57	27.8	
		—	10	—	.250	13.500		42.41	143.14	36.71	62.03	7.44	36.6	
		—	20	—	.312	13.376		42.02	140.52	45.61	60.89	7.30	45.0	
		STD	30	—	.375	13.250		41.63	137.88	54.57	59.75	7.16	53.2	
		—	40	—	.438	13.124		41.23	135.28	63.44	58.64	7.03	61.3	
14	14.000	XS	—	—	.500	13.000	43.98	40.84	132.73	72.09	57.46	6.90	69.1	14
		—	60	—	.594	12.812		40.25	128.96	85.05	55.86	6.70	80.3	
		—	80	—	.750	12.500		39.27	122.72	106.13	53.18	6.37	98.2	
		—	100	—	.938	12.124		38.09	115.49	130.85	50.04	6.00	117.8	
		—	120	—	1.094	11.812		37.11	109.62	150.79	47.45	5.69	132.8	
		—	140	—	1.250	11.500		36.13	103.87	170.28	45.01	5.40	146.8	
		—	160	—	1.406	11.188		35.15	98.31	189.11	42.60	5.11	159.6	
		—	—	5S	.165	15.670		49.23	192.85	27.90	83.57	10.02	32.2	
		—	—	10S	.188	15.624		49.08	191.72	31.75	83.08	9.96	36.5	
		—	10	—	.250	15.500		48.69	188.69	42.05	81.74	9.80	48.0	
		—	20	—	.312	15.376		48.31	185.69	52.27	80.50	9.65	59.2	
		STD	30	—	.375	15.250		47.91	182.65	82.58	79.12	9.49	70.3	
		XS	40	—	.500	15.000		47.12	176.72	82.77	76.58	9.18	91.5	
16	16.00	—	60	—	.656	14.688	50.27	46.14	169.44	107.50	73.42	8.80	116.6	16
		—	80	—	.844	14.312		44.96	160.92	136.61	69.73	8.36	144.5	
		—	100	—	1.031	13.938		43.79	152.58	164.82	66.12	7.93	170.5	
		—	120	—	1.219	13.562		42.61	144.50	192.43	62.62	7.50	194.5	
		—	140	—	1.438	13.124		41.23	135.28	233.64	58.64	7.03	220.0	
		—	160	—	1.594	12.812		40.26	128.96	245.25	55.83	6.70	236.7	
		—	—	5S	.165	17.67		55.51	245.22	31.43	106.26	12.74	40.8	
		—	—	10S	.188	17.62		55.37	243.95	35.76	105.71	12.67	46.4	
		—	10	—	.250	17.50		54.98	240.53	47.39	104.21	12.49	61.1	
		—	20	—	.312	17.38		54.59	237.13	58.94	102.77	12.32	75.5	
		STD	—	—	.375	17.25		54.19	233.71	70.59	101.18	12.14	89.6	
		—	30	—	.438	17.12		53.80	230.30	82.15	99.84	11.96	103.4	
		XS	—	—	.500	17.00		53.41	226.98	93.45	98.27	11.79	117.0	
18	18.00	—	40	—	.562	16.88	56.55	53.02	223.68	104.87	96.93	11.62	130.1	18
		—	60	—	.750	16.50		51.84	213.83	138.17	92.57	11.11	168.3	
		—	80	—	.938	16.12		50.66	204.24	170.92	88.50	10.61	203.8	
		—	100	—	1.156	15.69		49.29	193.30	207.96	83.76	10.04	242.3	
		—	120	—	1.375	15.25		47.91	182.66	244.14	79.07	9.49	277.6	
		—	140	—	1.562	14.88		46.73	173.80	274.22	75.32	9.03	305.5	
		—	160	—	1.781	14.44		45.36	163.72	308.50	70.88	8.50	335.6	

PIPE DATA TABLES CONT'D.

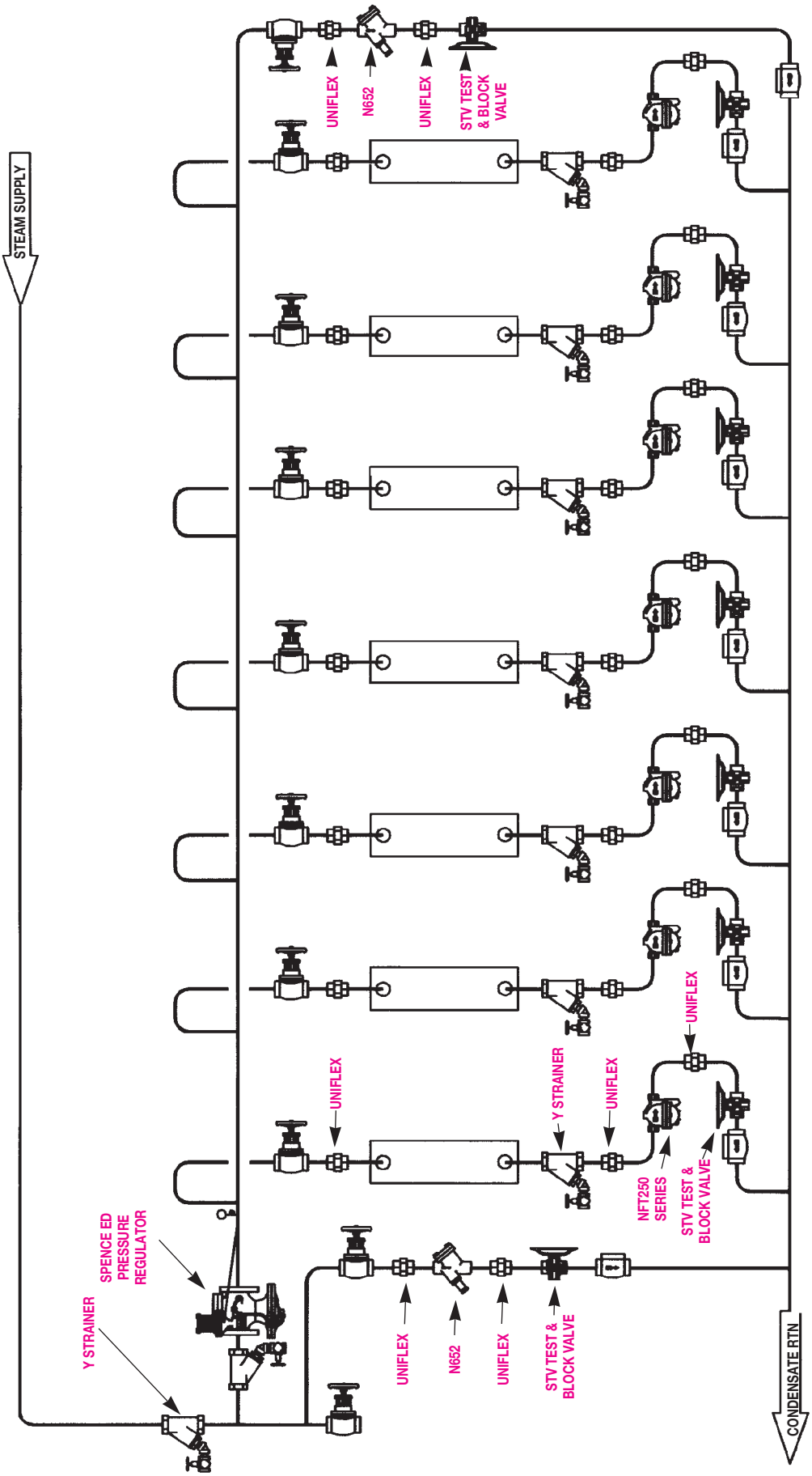
Pipe Size (in.)	Outside Diameter (in.)	Weight Class	Carbon Steel Sched.	Stainless Steel Sched.	Wall Thickness (in.)	Inside Diameter (in.)	Circum. (Ext.) (in.)	Circum (Int.) (in.)	Flow Area (sq. in.)	Weight of Pipe (lbs/Ft.)	Weight of Water (lbs/Ft.)	Gallons of Water per Ft.	Section Modulus	Pipe Size (in.)
		—	—	5S	.188	19.62		61.65	302.46	39.78	131.06	15.71	57.4	
		—	—	10S	.218	19.56		61.46	300.61	46.06	130.27	15.62	66.3	
		—	10	—	.250	19.50		61.26	298.65	52.73	129.42	15.51	75.6	
		—	20	—	.375	19.25		60.48	290.04	78.60	125.67	15.12	111.3	
		STD	30	—	.500	19.00		59.69	283.53	104.13	122.87	14.73	145.7	
		XS	40	—	.594	18.81		59.10	278.00	123.11	120.46	14.44	170.4	
20	20.00	—	60	—	.812	18.38	62.83	57.73	265.21	166.40	114.92	13.78	225.7	20
		—	80	—	1.031	17.94		56.35	252.72	208.87	109.51	13.13	277.1	
		—	100	—	1.281	17.44		54.78	238.83	256.10	103.39	12.41	331.5	
		—	120	—	1.500	17.00		53.41	226.98	296.37	98.35	11.79	375.5	
		—	140	—	1.750	16.50		51.84	213.82	341.09	92.66	11.11	421.7	
		—	160	—	1.969	16.06		50.46	202.67	379.17	87.74	10.53	458.5	
		—	—	5S	.188	21.62		67.93	367.25	43.80	159.14	19.08	69.7	
		—	—	10S	.218	21.56		67.75	365.21	50.71	158.26	18.97	80.4	
		—	10	—	.250	21.50		67.54	363.05	58.07	157.32	18.86	91.8	
		STD	20	—	.375	21.25		66.76	354.66	86.61	153.68	18.42	135.4	
		XS	30	—	.500	21.00		65.97	346.36	114.81	150.09	17.99	117.5	
22	22.00	—	60	—	.875	20.25	69.12	63.62	322.06	197.41	139.56	16.73	295.0	22
		—	80	—	1.125	19.75		62.05	306.35	250.81	132.76	15.91	366.4	
		—	100	—	1.375	19.25		60.48	291.04	302.88	126.12	15.12	432.6	
		—	120	—	1.625	18.75		58.90	276.12	353.61	119.65	14.34	493.8	
		—	140	—	1.875	18.25		57.33	261.59	403.00	113.36	13.59	550.3	
		—	160	—	2.125	17.75		55.76	247.45	451.06	107.23	12.85	602.4	
		—	—	5S	.218	23.56		74.03	436.10	55	188.98	22.65	96.0	
		—	10	10S	.250	23.50		73.83	433.74	63	187.95	22.53	109.6	
		STD	20	—	.375	23.25		73.04	424.56	95	183.95	22.05	161.9	
		XS	—	—	.500	23.00		72.26	415.48	125	179.87	21.58	212.5	
		—	30	—	.562	22.88		71.86	411.00	141	178.09	21.35	237.0	
24	24.00	—	40	—	.688	22.62	75.40	71.08	402.07	171	174.23	20.88	285.1	24
		—	60	—	.969	22.06		69.31	382.35	238	165.52	19.86	387.7	
		—	80	—	1.219	21.56		67.74	365.22	297	158.26	18.97	472.8	
		—	100	—	1.531	20.94		65.78	344.32	367	149.06	17.89	570.8	
		—	120	—	1.812	20.38		64.01	326.08	430	141.17	16.94	652.1	
		—	140	—	2.062	19.88		62.44	310.28	483	134.45	16.12	718.9	
		—	160	—	2.344	19.31		60.67	292.98	542	126.84	15.22	787.9	
		—	—	5S	.250	29.50		92.68	683.49	79	296.18	35.51	172.3	
		—	10	10S	.312	29.38		92.29	677.71	99	293.70	35.21	213.8	
30	30.00	STD	—	—	.375	29.25	94.25	91.89	671.96	119	291.18	34.91	255.3	30
		XS	20	—	.500	29.00		91.11	660.52	158	286.22	34.31	336.1	
		—	30	—	.625	28.75		90.32	649.18	196	281.31	33.72	414.9	

Application Drawings

This section contains drawings of typical industrial applications. Nicholson products have been highlighted to help illustrate their use and emphasize appropriate configurations. Although specific model traps have been called out, please understand that these are not necessarily the only choice. A N300, N650, or possibly a N125 could replace a TA or a FTN, Dura-Flo, or industrial thermostatic trap could replace a NFT. These decisions must be based on customer preference, system pressure and design and competitive influences. The following points should also guide trap selection:

- Appropriate length of cooling leg when specifying thermostatic traps.
- Specify SLR option when condensate must be lifted before trap.
- Trap capacity reduction due to return line back pressure.
- Matching not only capacity requirements but also pressure when selecting orifices for mechanical traps
- Being aware of air venting needs.
- Consider upstream controls such as temperature regulators that may vary pressure.
- Thermostatic traps used as air vents should utilize ISO fill and 5/16" orifices.

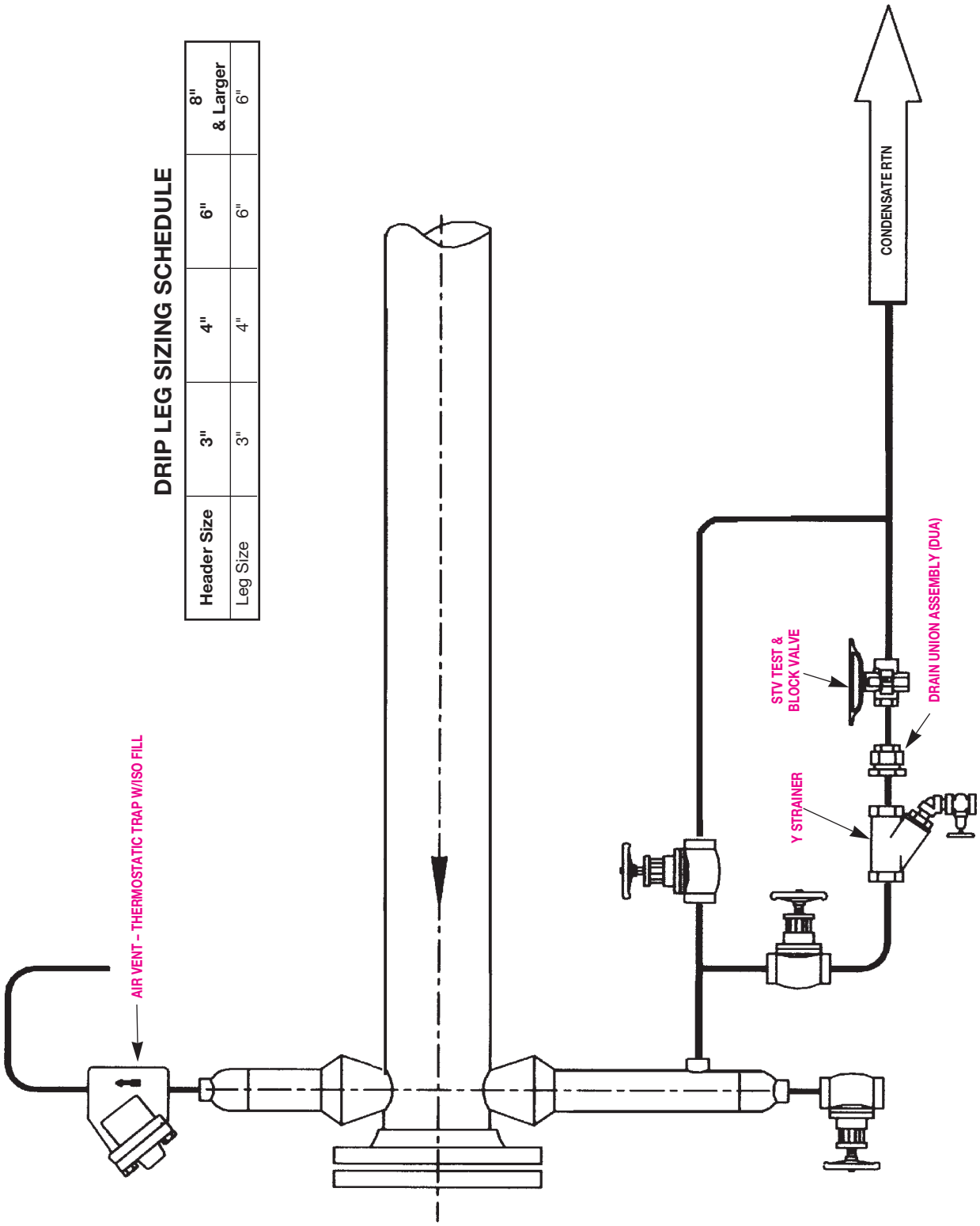
OVEN HEATING COILS



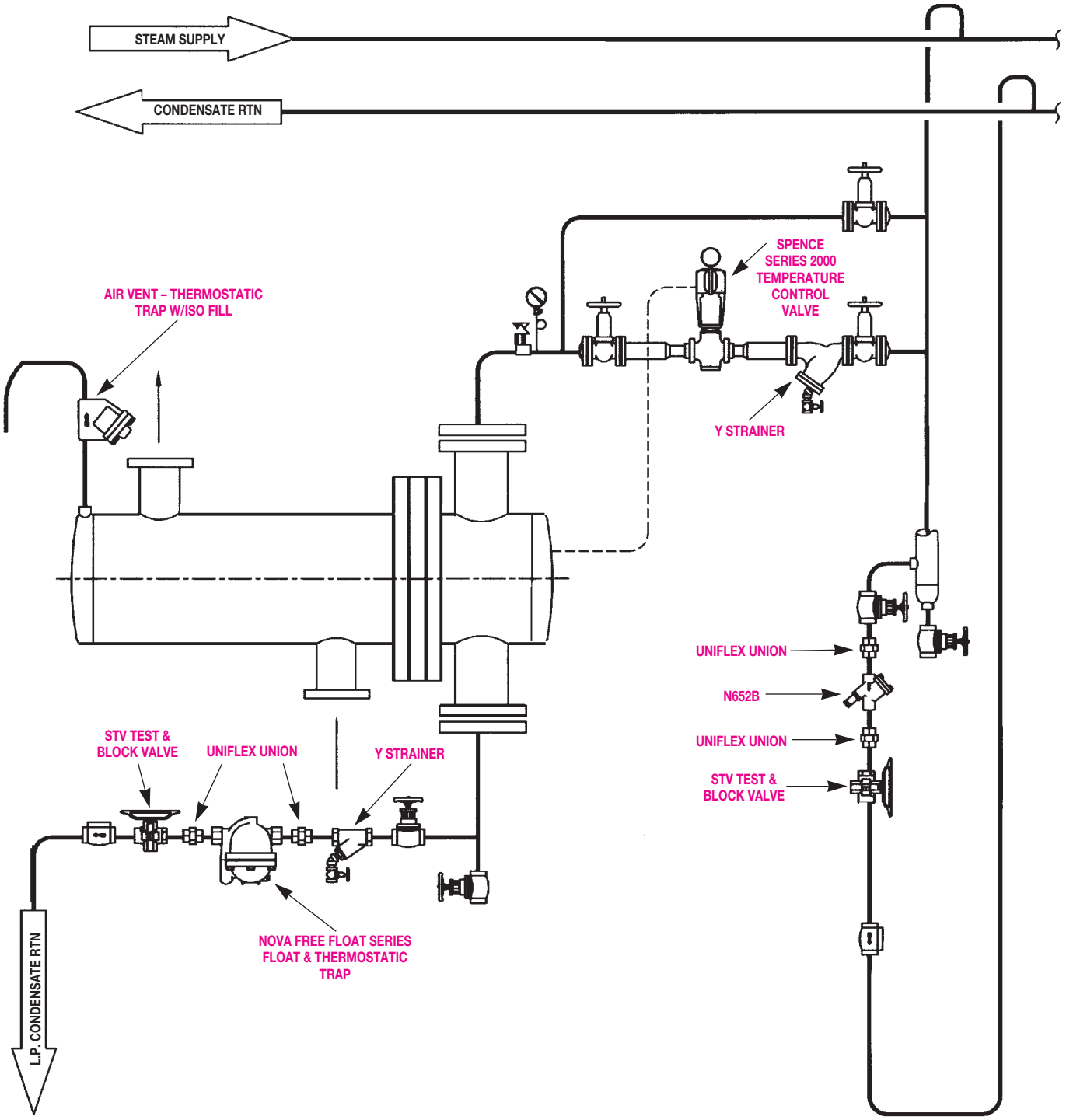
DRIP LEG/END OF MAIN LEG

DRIP LEG SIZING SCHEDULE

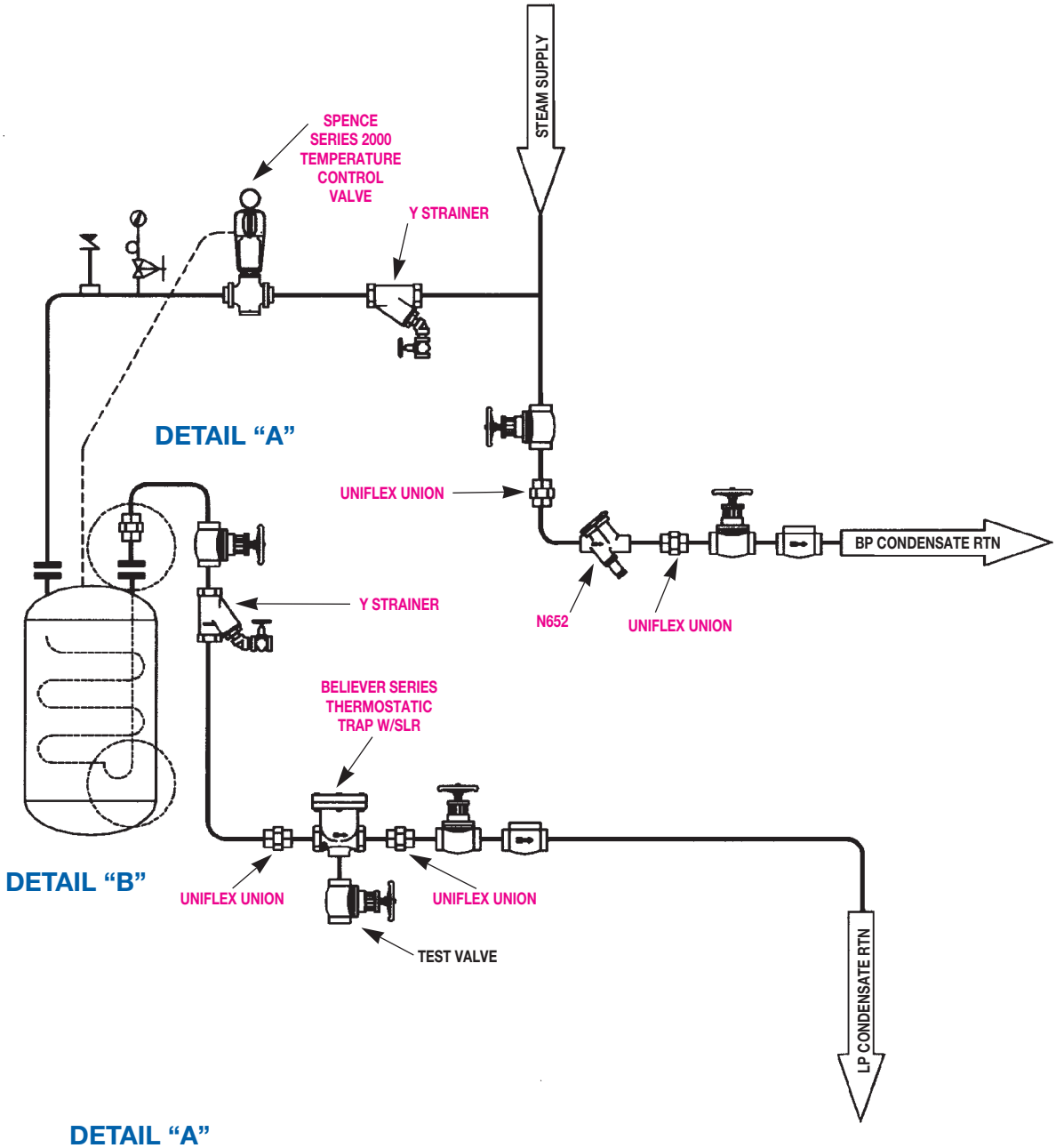
Header Size	3"	4"	6"	8" & Larger
Leg Size	3"	4"	6"	6"



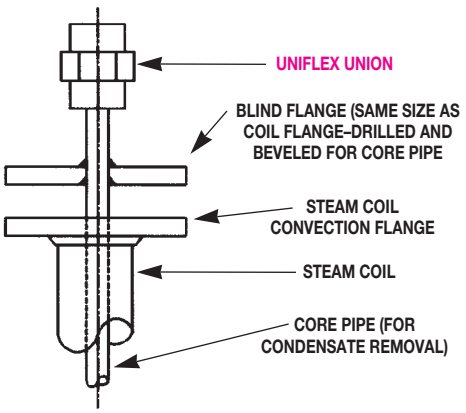
SHELL & TUBE HEAT EXCHANGER



VESSEL WITH STEAM COIL OUTLET AT TOP



DETAIL "A"



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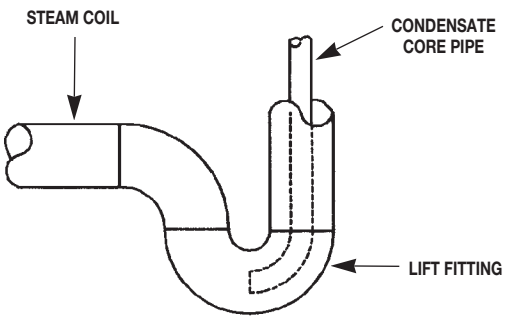
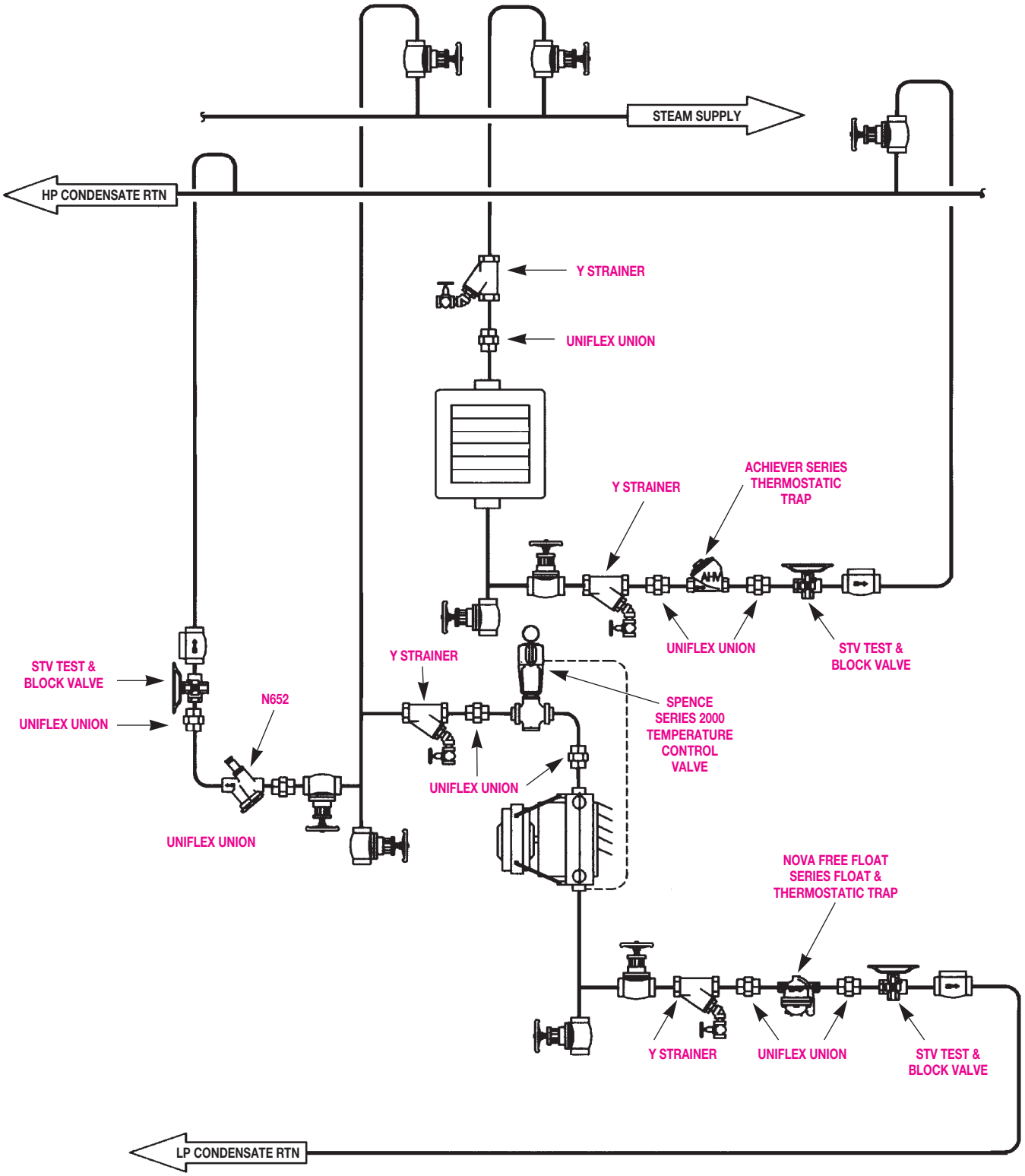
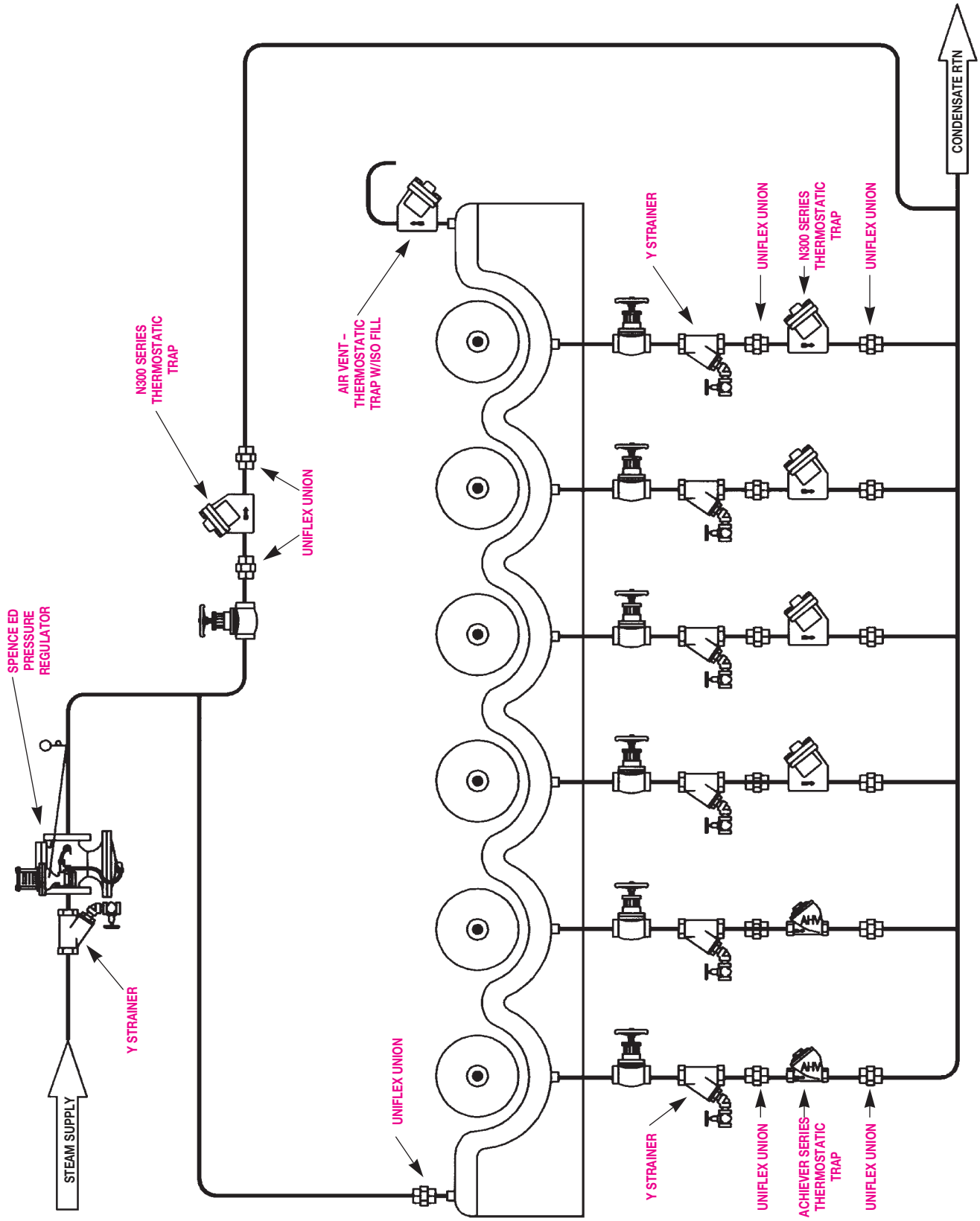


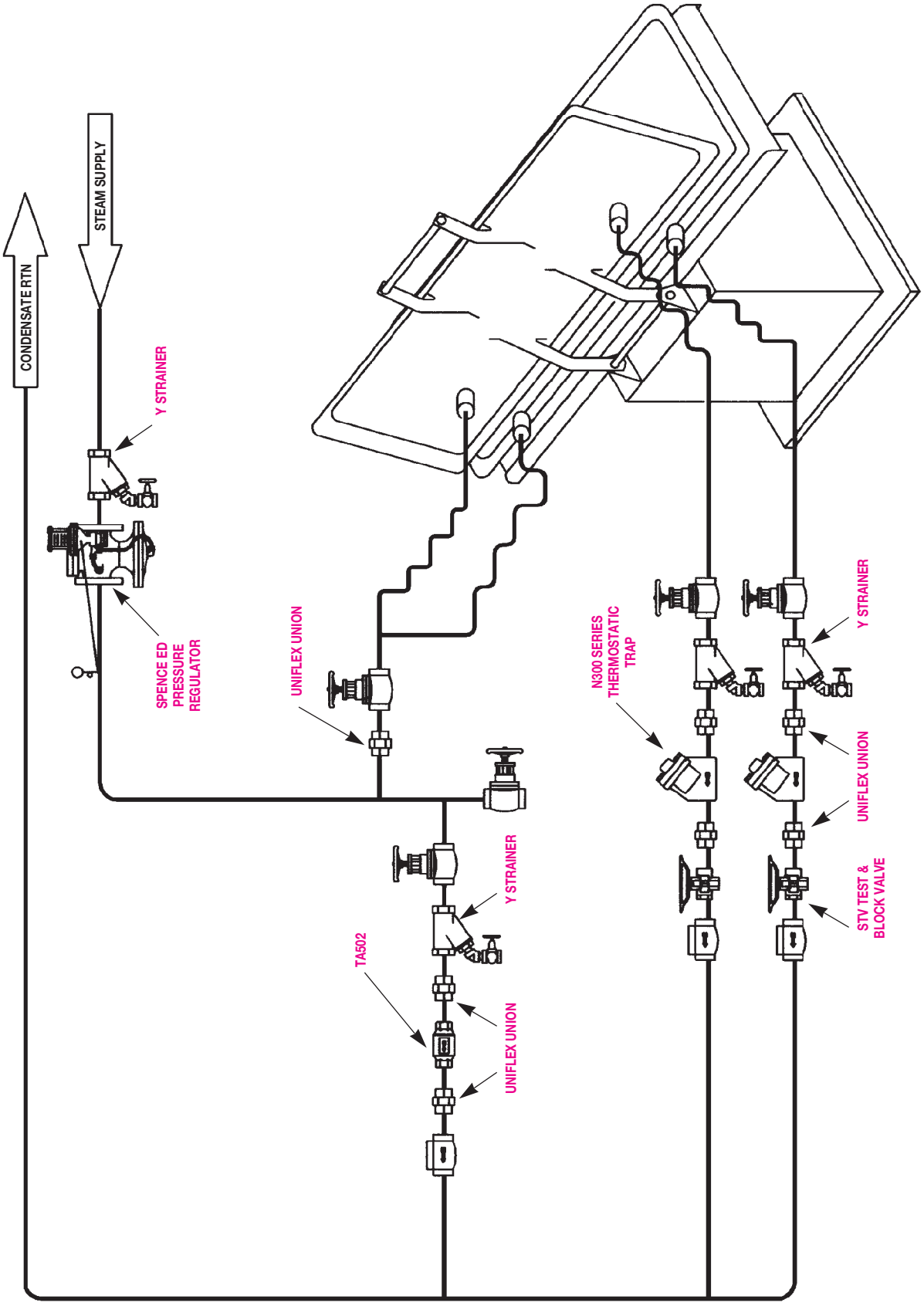
UNIT HEATER


STEAM SUPPLY
HP CONDENSATE RTN
Y STRAINER
UNIFLEX UNION
ACHIEVER SERIES THERMOSTATIC TRAP
Y STRAINER
UNIFLEX UNION
STV TEST & BLOCK VALVE
STV TEST & BLOCK VALVE
UNIFLEX UNION
N652
Y STRAINER
SPENCE SERIES 2000 TEMPERATURE CONTROL VALVE
UNIFLEX UNION
UNIFLEX UNION
NOVA FREE FLOAT SERIES FLOAT & THERMOSTATIC TRAP
Y STRAINER
UNIFLEX UNION
STV TEST & BLOCK VALVE
LP CONDENSATE RTN

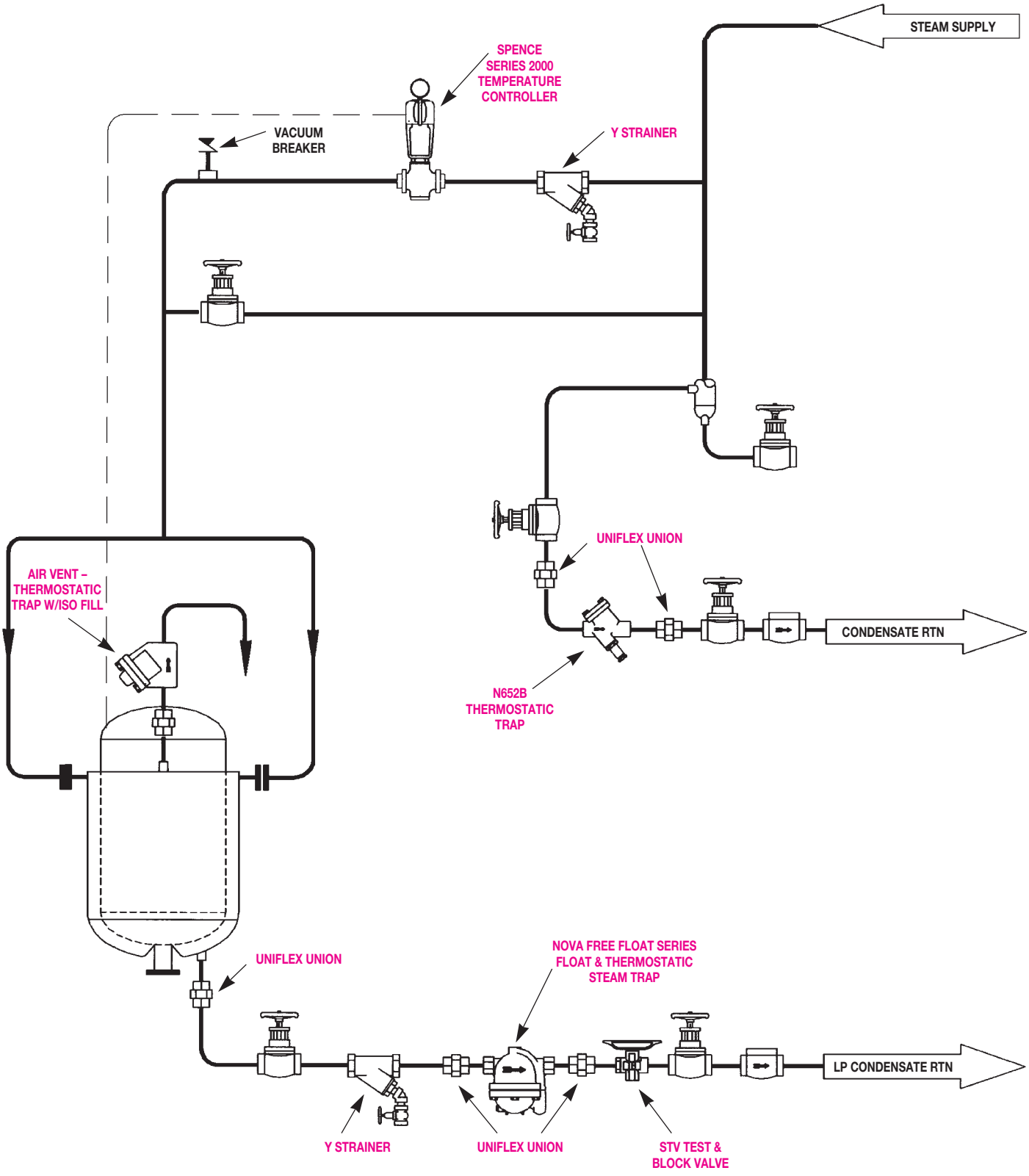
FLAT WORK IRONER



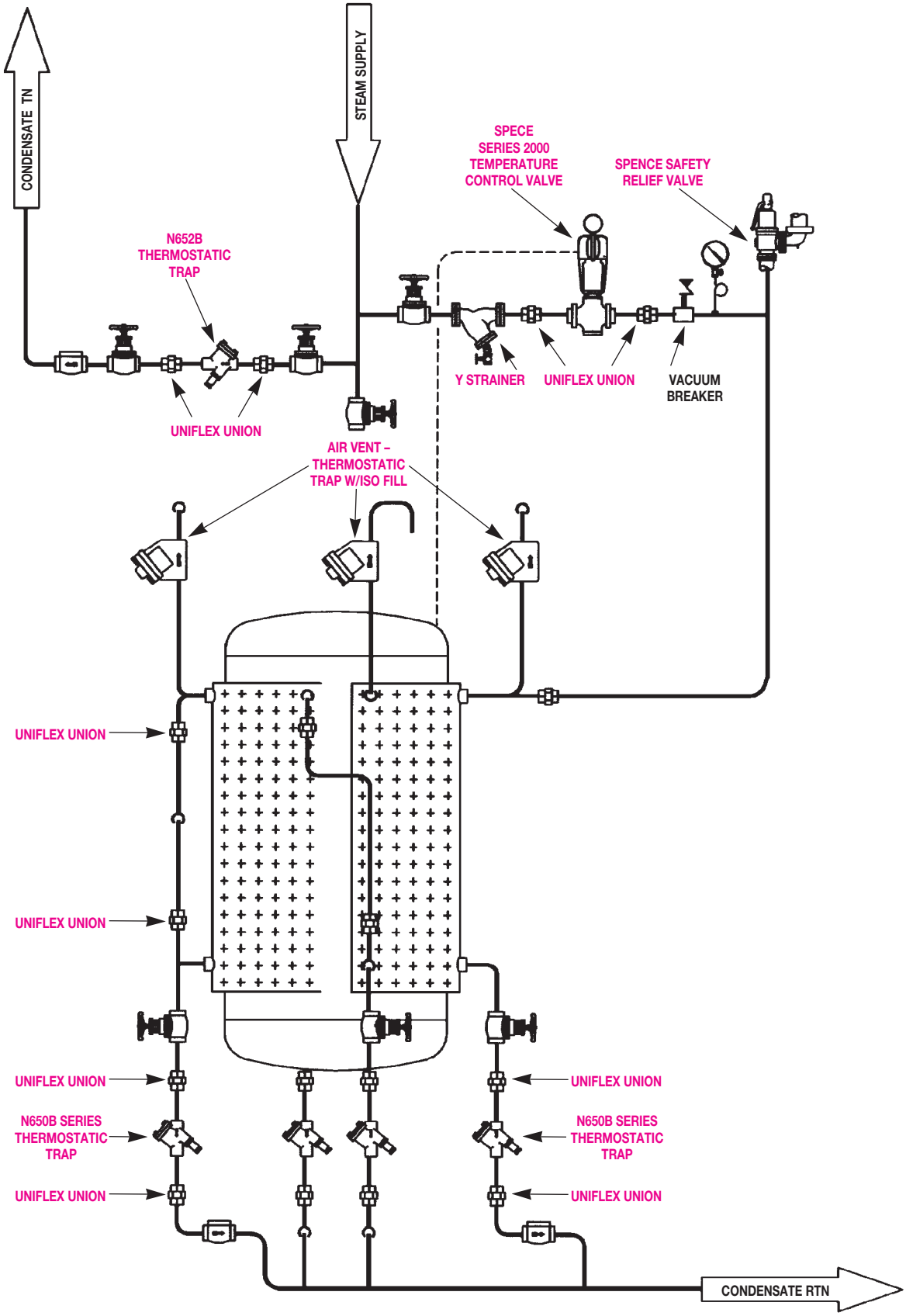
STEAM PRESS


CONDENSATE RTN
STEAM SUPPLY
Y STRAINER
SPENCE ED PRESSURE REGULATOR
UNIFLEX UNION
TA502
Y STRAINER
UNIFLEX UNION
N300 SERIES THERMOSTATIC TRAP
Y STRAINER
UNIFLEX UNION
STV TEST & BLOCK VALVE

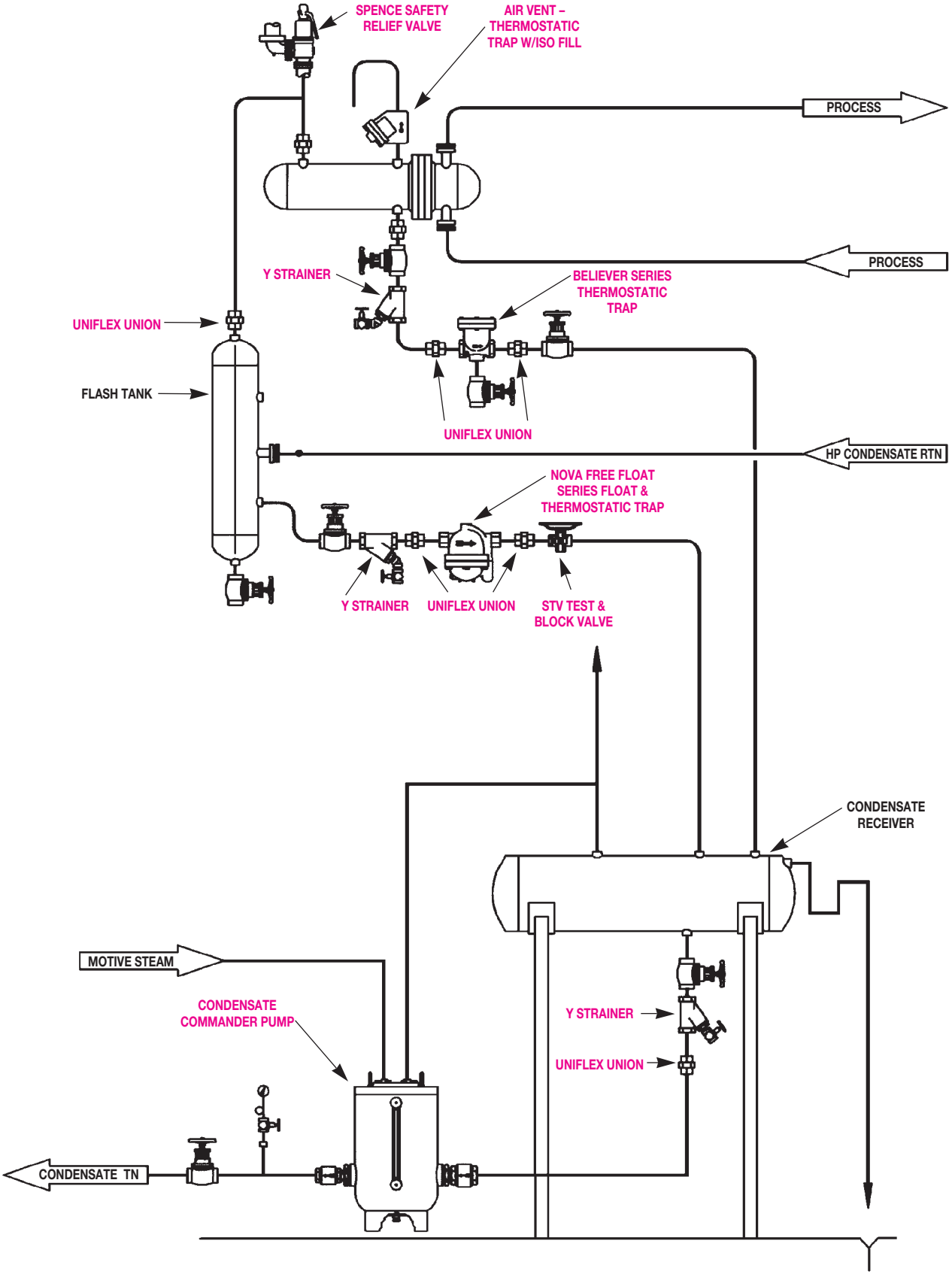
JACKETED PRESSURE VESSEL



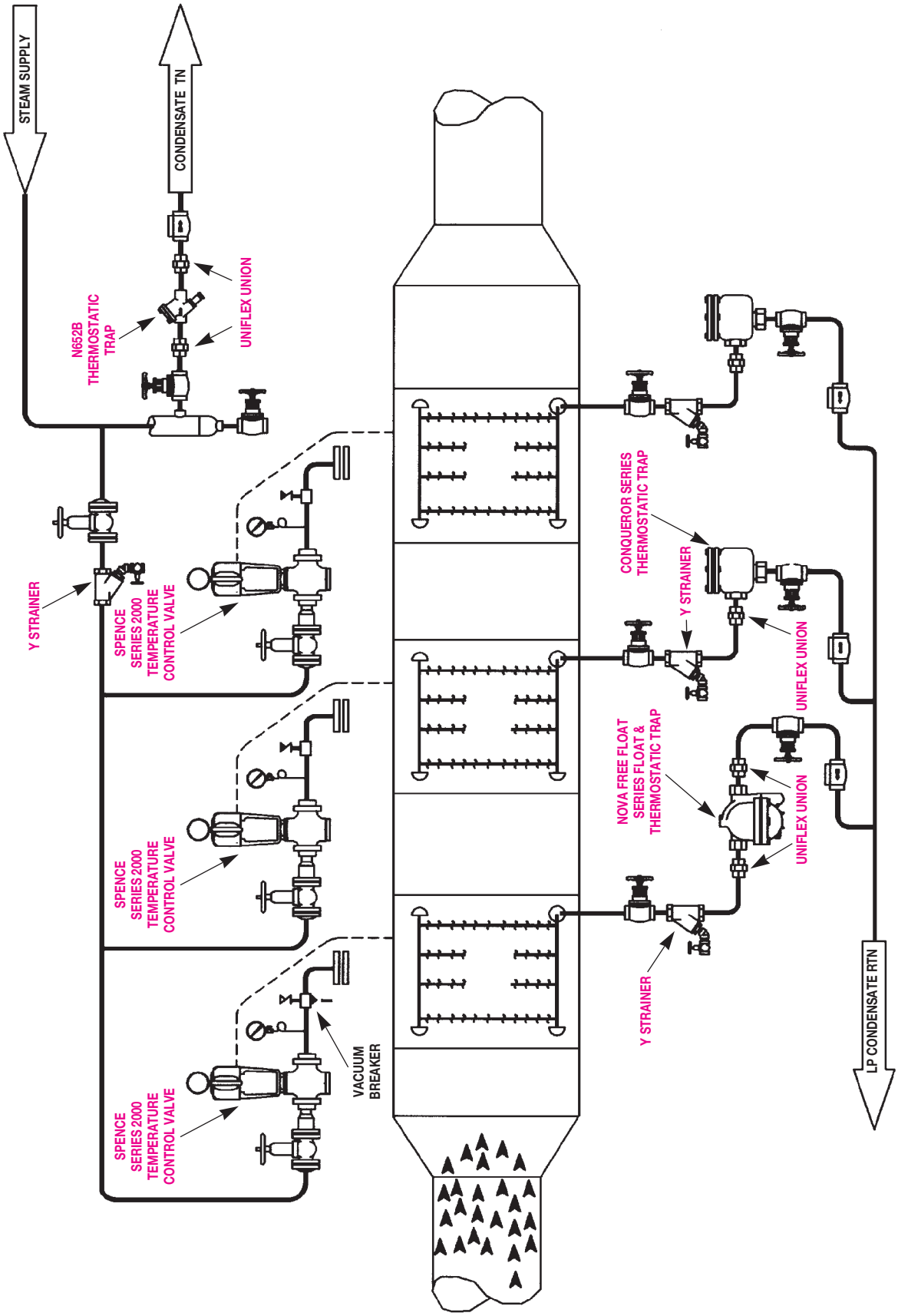
PRESSURE VESSEL WITH DIMPLE JACKET



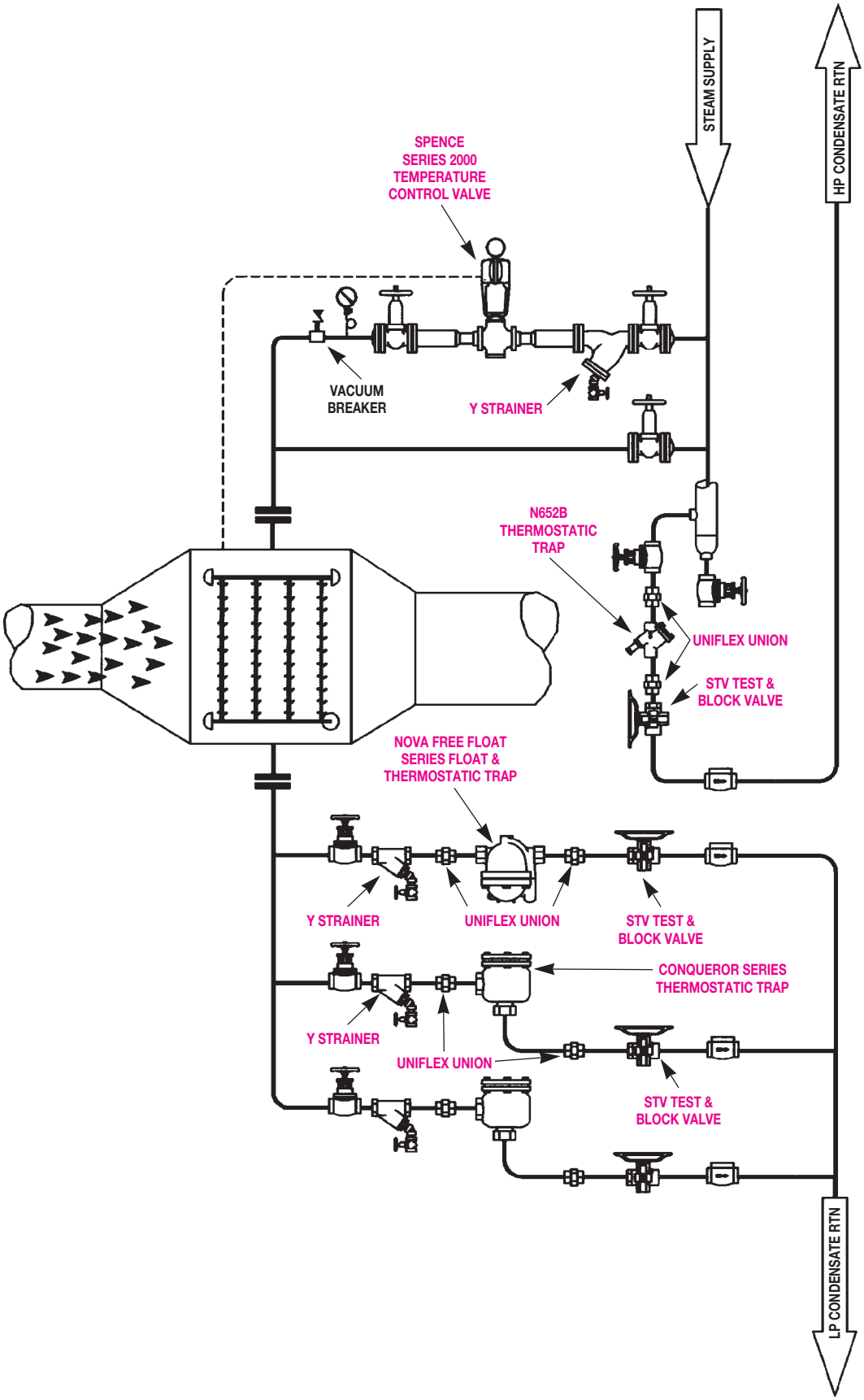
FLASH TANK WITH CONDENSATE BOOSTER PUMP



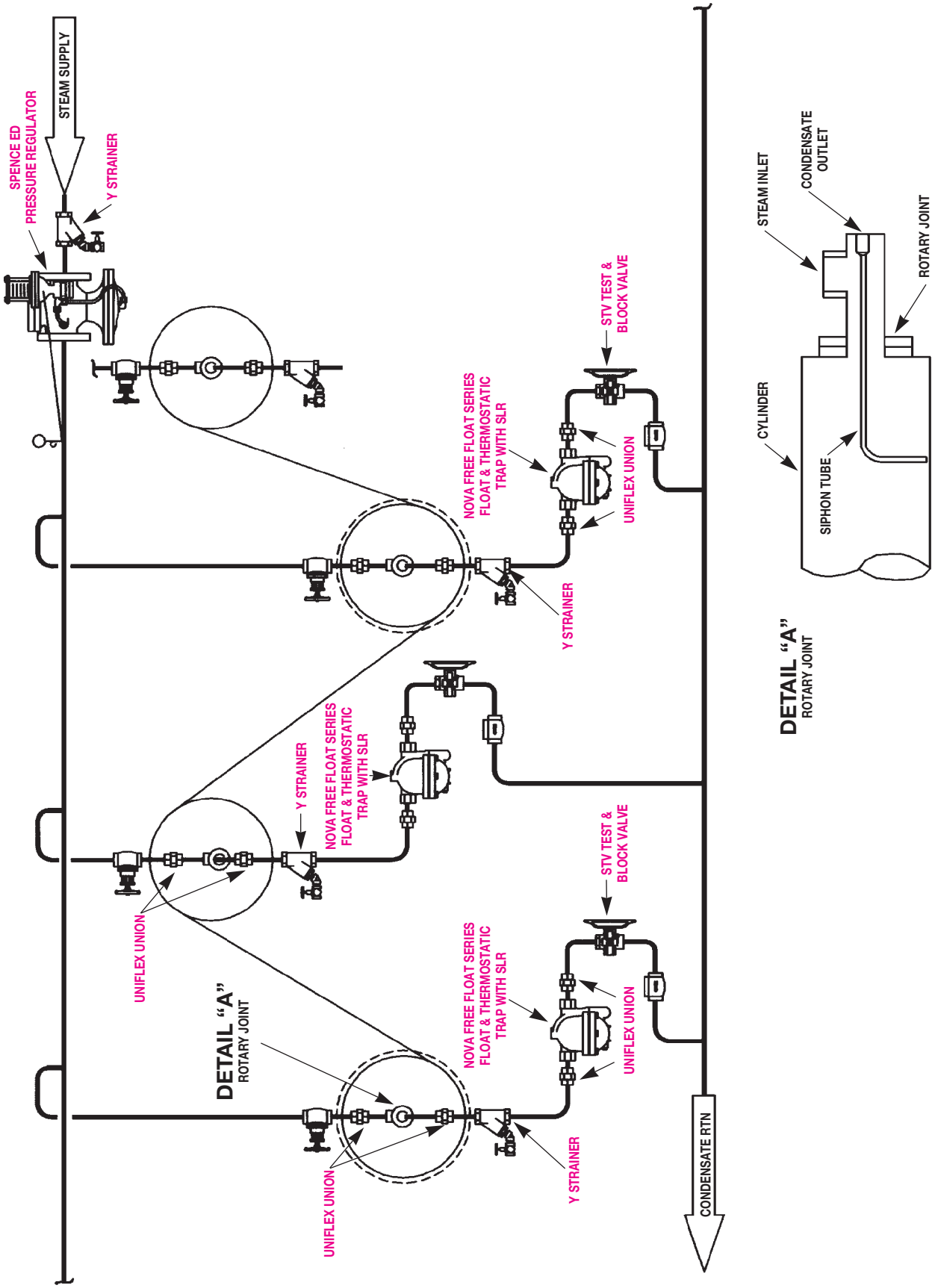
MULTI-COIL AIR HANDLER



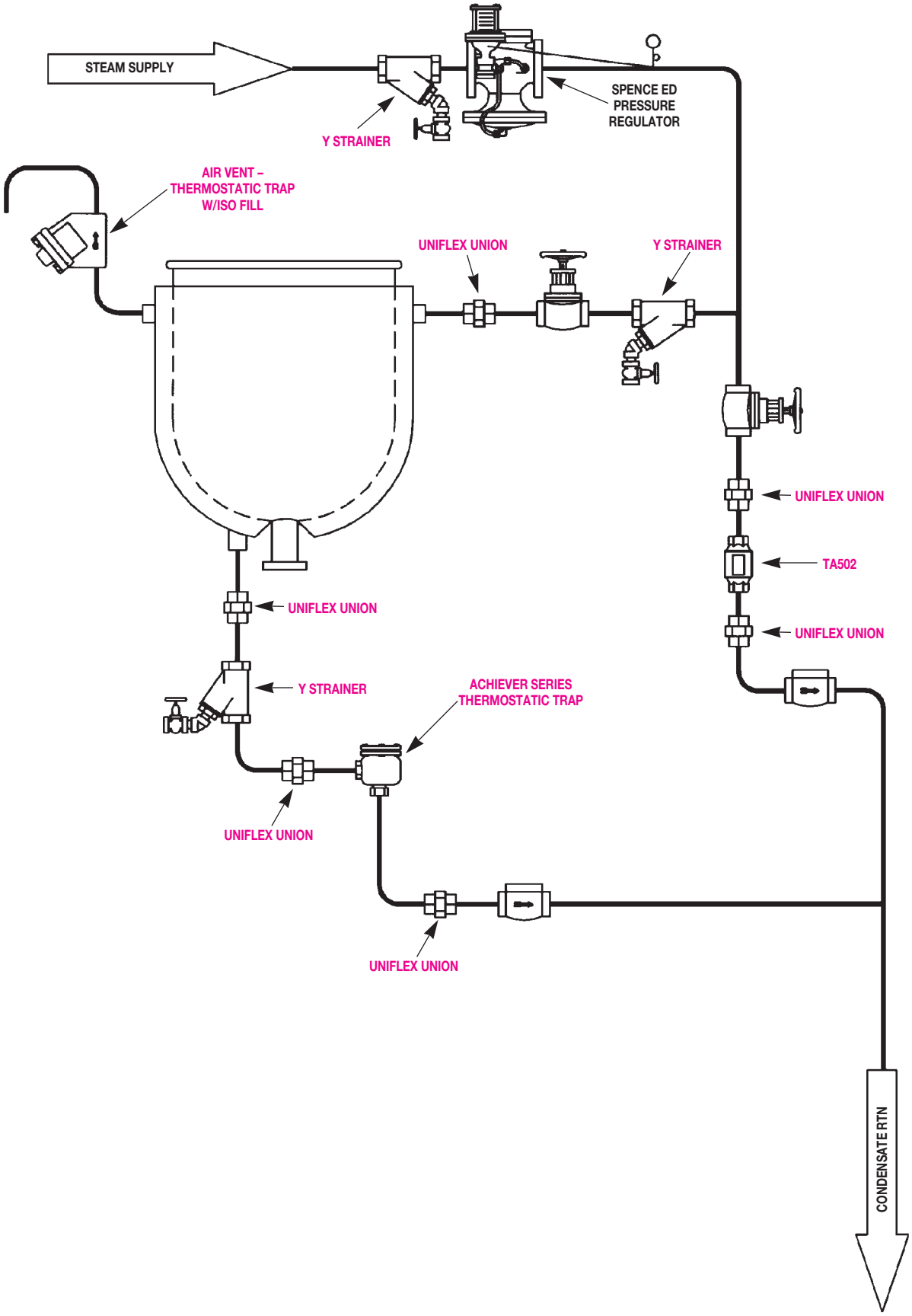
High Pressure Air Coil



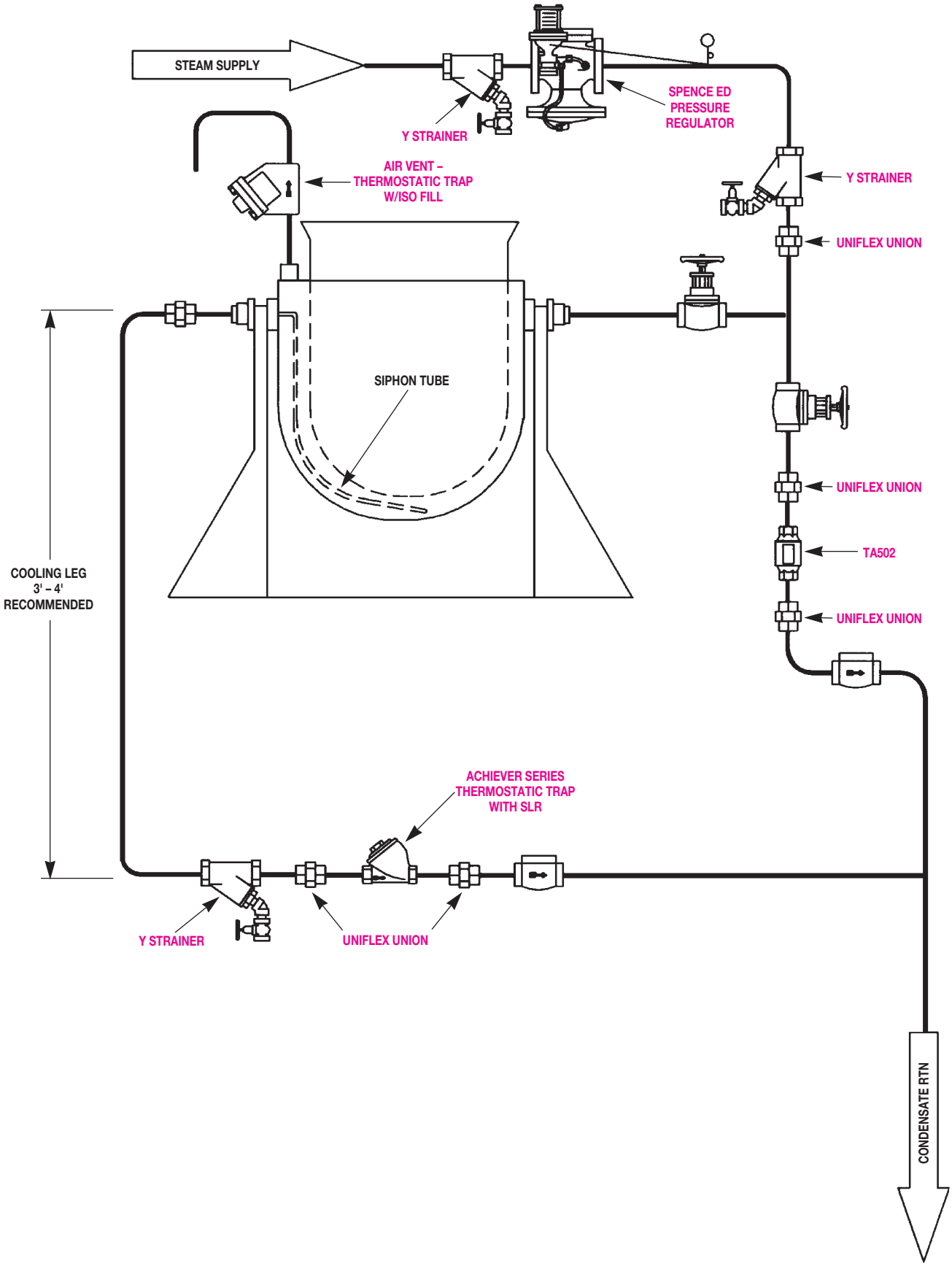
DRY CAN/CALENDER ROLL



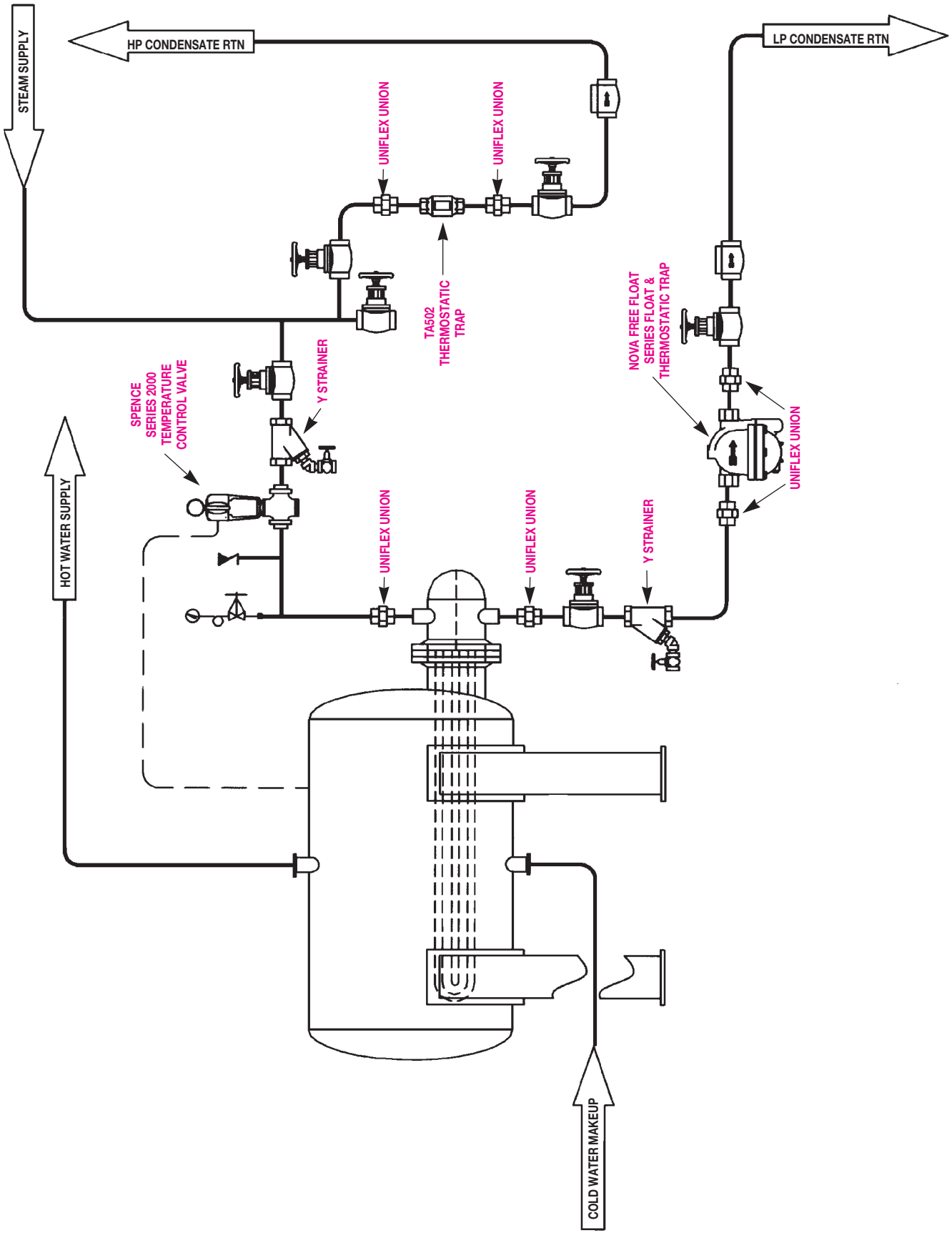
JACKETED KETTLE



TILTING JACKETED KETTLE



DOMESTIC HOT WATER



GLOSSARY OF TERMS

Celtron Capsule - The thermodynamic capsule comprising the operational components of most Nicholson thermodynamic traps.

Convoluted Bellows - Offered as the standard design actuator on Nicholson thermostatic traps, this bellows excels in sensitivity and value. Convoluted bellows tend to fail close in the event of bellows failure and should be specified if fail closed is desired. Convoluted bellows are available in monel and bronze depending on model. Nicholson traps equipped with the convoluted bellows are offered with a one-year warranty.

Differential Pressure - The pressure upstream of the steam trap less the pressure after the trap is referred to as differential pressure. When sizing Nicholson traps the capacity charts are based on the differential pressures across the trap.

HC - This is a suffix on some Nicholson thermostatic traps indicating a high capacity option. Sometimes called OS.

ISO - See Subcooling fill.

L - A suffix on some Nicholson thermostatic and thermodynamic traps indicating a low capacity option.

OS - See HC

R - A suffix on some Nicholson thermostatic traps indicating a reduced capacity option.

Saturated Temperature - The temperature at which water boils at a given pressure. Water changes phase into steam along a pressure temperature curve. These pressures and temperatures may be found in the steam tables.

Skirted Seat (SK) - This is an option employing a seat that diffuses the condensate discharge reducing the possibility of internal body erosion. This option, available on the N300 and N650, should be specified when the steam service pressure is in the top third of the trap's pressure rating.

Spiral Wound Gasket - This class of gasket is utilized throughout our higher pressure traps and the Uniflex union. It is characterized by utilizing a metal winding, often stainless steel, sandwiching a filler, often a graphite material. While relatively expensive, the sealing performance of this class of gasket is generally considered superior to most others.

Steam Lock Release (SLR) - This is an orifice from .0225 to .03125 inches dependent on model, added to a steam trap to prevent flash steam locking. This option is recommended when condensate piping must rise over an obstacle before draining to a trap. A typical application would be a coil in a kettle whose outlet must rise over the side before dropping to the steam trap. An alternate usage typically involves thermostatic traps in clean steam or sterilizer applications. The SLR is specified to increase sensitivity and minimize condensate backup.

Sterilizer Trim - This option typically employs an alternate seat. Internal geometries are altered in such a fashion that trap sensitivity is increased. The option takes its name from the service often requiring the most sensitive of thermostatic traps. Sterilizer trim is occasionally combined with high capacity and SLR options thus yielding a super sensitive high capacity steam trap.

Subcool - often associated with the sensitivity of a thermostatic trap this term indicates a temperature below the saturated steam curve. Thermostatic traps actuate at temperatures below saturated. Standard Nicholson Traps typically actuate in the 8° to 10°F subcool range i.e. they expel condensate 8° to 10°F below saturated steam temperature.

Subcooling Fill - An optional bellows utilizing an alternate fill enabling the trap to release condensate at 30° to 40°F below saturated temperature. This option should be specified when reducing the volume of flash steam created by condensate is desired or when pressures exceeding 500 psi are expected. Also referred to as ISO.

Welded Bellows - offered as an option on all Nicholson thermostatic traps, this bellows is more rugged yet may be less sensitive than the convoluted designs. Welded bellows tend to fail open in the event of bellows failure and should be specified if fail open is desired. Welded bellows are available in stainless steel and inconel depending on model. Nicholson traps equipped with the welded bellows are offered with a three-year warranty.

STEAM TABLE QUICK REFERENCE CHART

NICHOLSON STEAM TRAP, INC.

PRESS PSIG	TEMP °F	TEMP °C	PRESS PSIG	TEMP °F	TEMP °C	PRESS PSIG	TEMP °F	TEMP °C
0	212	100	85	328	164	290	419	215
1	215	102	90	331	166	300	422	217
3	219	104	95	335	168	320	428	220
5	227	108	100	338	170	340	433	223
8	235	113	110	344	173	360	438	226
10	239	115	120	350	177	380	443	229
15	250	121	130	356	180	400	448	231
20	259	126	140	361	183	420	453	234
25	267	130	150	366	186	440	457	236
30	274	134	160	371	188	460	462	239
35	281	138	170	375	191	480	466	241
40	287	142	180	380	193	500	470	243
45	292	145	190	384	195	520	474	246
50	298	148	200	388	198	540	478	248
55	303	150	215	394	201	560	482	250
60	307	153	230	399	204	580	485	252
65	312	155	245	404	207	600	489	254
70	316	158	250	406	208	620	492	256
75	320	160	260	409	210	640	496	258
80	324	162	275	414	212	660	499	259

NICHOLSON

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- **Red** text indicates a clickable link to another page in the document.
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