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THE STEAMGARD® VENTURI STEAM TRAP: An Overview

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Topics

- **Section 1**: Company Background
- **Section 2**: THE STEAMGARD® VENTURI TRAP: Technology Overview
- **Section 3**: STEAMGARD® Venturi Technology: Case Studies

COMPANY BACKGROUND

Background

- STEAMGARD, L.L.C. (SG) was founded in 1977. Our corporate office is located outside of Chicago, Illinois, U.S.A.

- Representative offices are in the U.S.A and in Brazil, Korea, Indonesia and Malaysia.

- We offer full spectrum services for steam and condensate system optimization including ASHRAE investment grade audits and turnkey project delivery.

Background

Milestones

1977 SG begins operation with trial installations utilizing nozzles for condensate removal in order to develop effective replacements for traditional steam traps.

1980 SG files its first patent application for a design utilizing a "modified Venturi" nozzle.

1985 SG expands its international operations with the retrofit of a petrochemical plant in South Africa.

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Background

Milestones(continued)

1990 STEAMGARD® units are installed for the first time in a nuclear powered electrical generation facility.

1993 Bechtel Corporation and the U.S. Army Corps of Engineers retains SG to conduct training related to environmental protection and steam technology in the Middle East.

1996 The first STEAMGARD® units are tested, approved and installed on the USS Theodore Roosevelt, a Nimitz class super carrier.

Background

Milestones (continued)

2003 Following the conversion of the Hunter Holmes McGuire Medical Center, a Veteran Administration (U.S. Military) Facility in Richmond, Virginia, to THE STEAMGARD SYSTEM®, the Facility is awarded the Energy Star Building Award for superior performance in energy efficiency.

2008 The U.S. Department of Energy (DOE) assesses our Venturi nozzle technology and cites its reliability, design and performance compared to other type of traps.

2019 The Gas Technology Research Institute (GTRI) conducts a detailed study, which was sponsored by major utility companies (i.e., Nicor and Peoples Gas), to validate the operation of THE STEAMGARD SYSTEM® under variable load conditions.

Background

We are currently working with some of the leading companies and institutions in the U.S. and globally.

STEAMGARD® VENTURI TECHNOLOGY

Topics

- Steam System Efficiency
- Operating Principles of THE STEAMGARD SYSTEM®
- Advantages

Steam System Efficiency

- One of the primary reasons for lower steam system efficiency is due to the fact the steam systems are not being maintained in the "as built" or "design" specifications.
- SG offers robust solutions to condensate removal by integrating a comprehensive Steam System Evaluation into steam trap retrofits/upgrades.
- One of the objectives of the Evaluation is to identify the areas of the facility where deviations from the design specifications are significant.

What is a steam trap?

"...a ***self-contained valve*** which automatically drains the condensate from a steam containing enclosure while remaining tight to live steam, or if necessary, allowing steam to flow at a controlled or adjusted rate. Most steam traps will also pass non-condensable gases while remaining tight to live steam."

ANSI/FCI 69-1-1989

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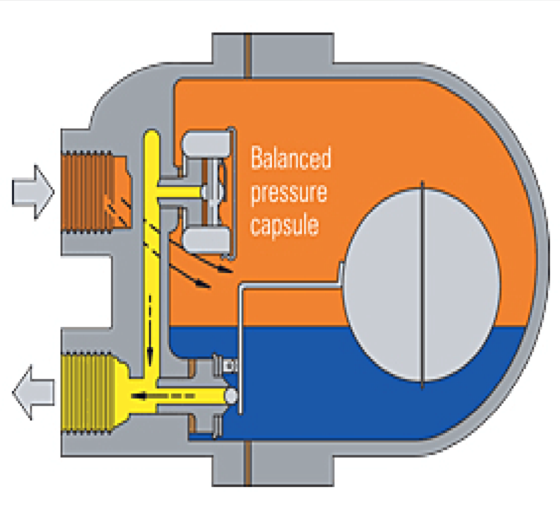
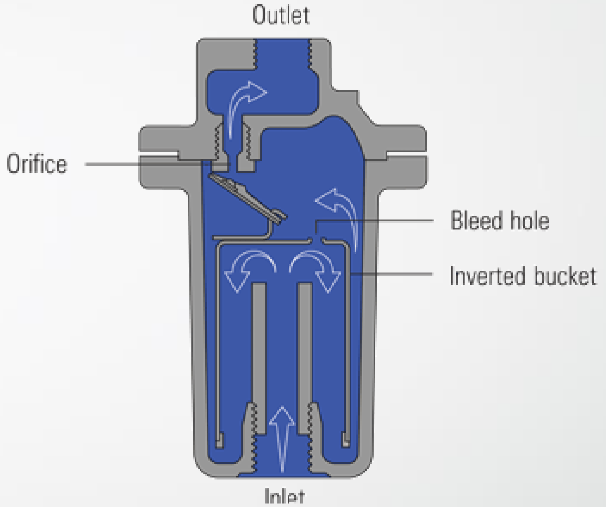
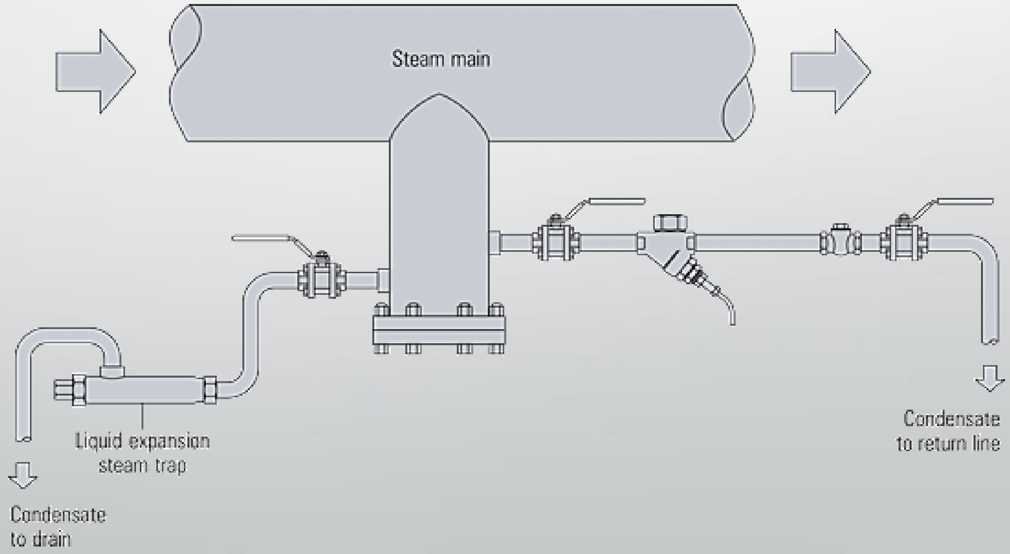
Conventional Traps: F&T and Inverted Bucket







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Background: Types of Steam Traps

- Cyclical traps open and close depending upon the condensate load, application and operating variables.

- Typically, they open and close three times each minute or approximately 1.5 million times a year.

  (Based on 8,400 Operating Hours Each Year)

- The cyclical operation causes rapid wear and tear in the moving parts (i.e., linkage, lever, seat etc.) of a trap.

- This wear and tear results in failures of 15 to 25% each year in facilities which do not have a proactive preventive maintenance program.

  (U.S. DOE Percentages)

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The Challenge

Conventional steam traps utilize moving parts (i.e., linkages, pivots, seals, etc.) in a harsh corrosive environment

- The wear and tear due to the opening/closing actions, which can occur 3 times per minute or 4,320 times each day, causes them to fail randomly due to clogging or pivot wear.
- The U.S. DOE estimates the failure rates to be 15 to 20% fail each year.

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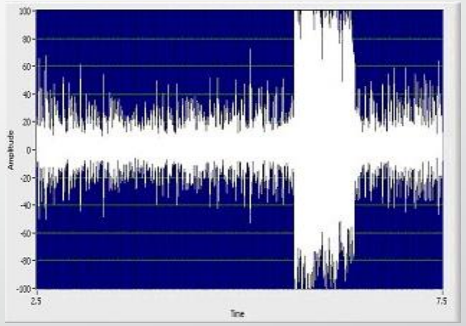
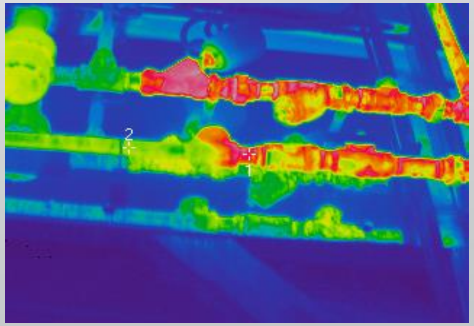
Steam Trap Testing Guidelines: U.S. DOE

Steam Trap Application	Testing Frequency
Process	Every 3 Months
Medium to High Pressure Drip	Every 6 Months
Low Pressure Drip	Annually





Aggressive/pro-active testing and maintenance is required to prevent high failure rates and energy losses from mechanical steam traps .

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Effect of Steam Trap Failures

Failed Open Traps Will:

- Increase fuel bills.
- Pressurize the condensate return headers and cause erosion.
- Result in higher greenhouse gas (GHG) emissions at the boiler.
- Cause water hammer.

Failed Closed Traps Will:

- Result in poor quality (i.e., wet) steam.
- Cause water hammer.

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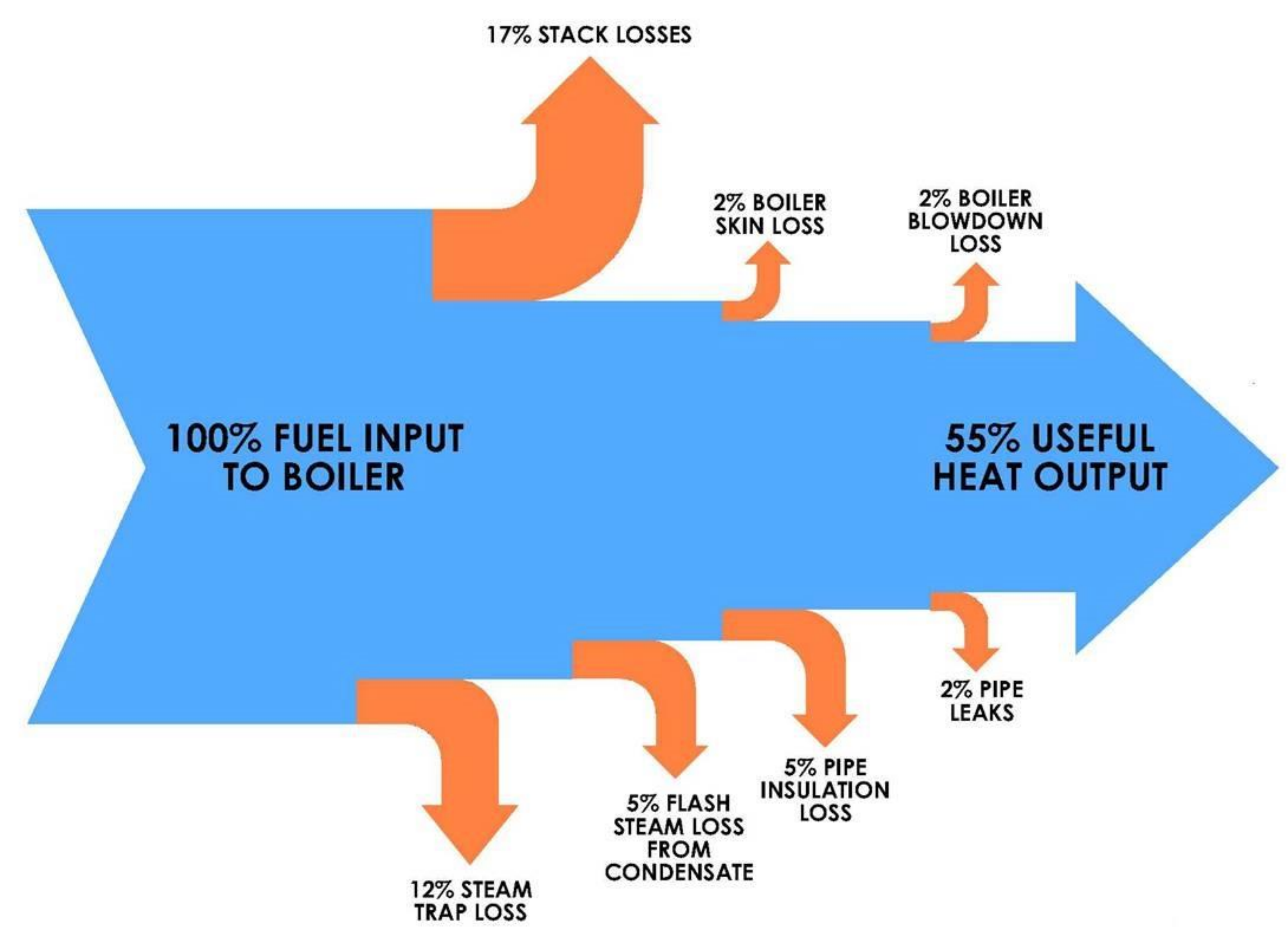
Steam Boiler: Gross Energy Balance



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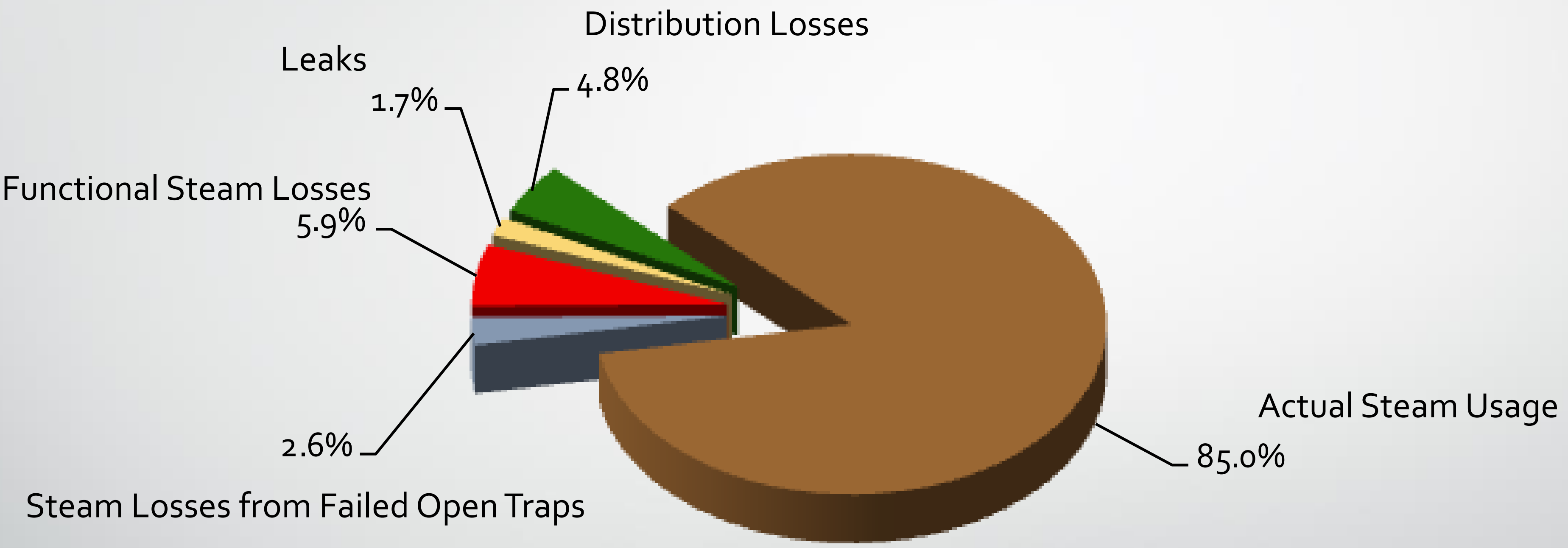
Evaluation Report: Example of a Steam Demand Analysis

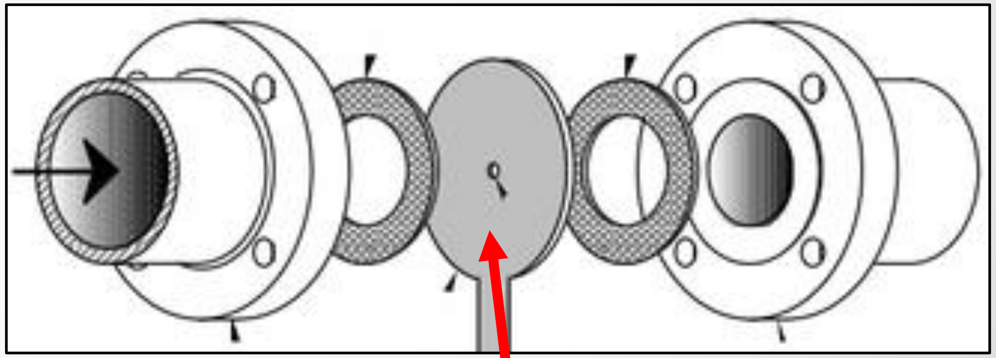


Orifice Plate Steam Trap

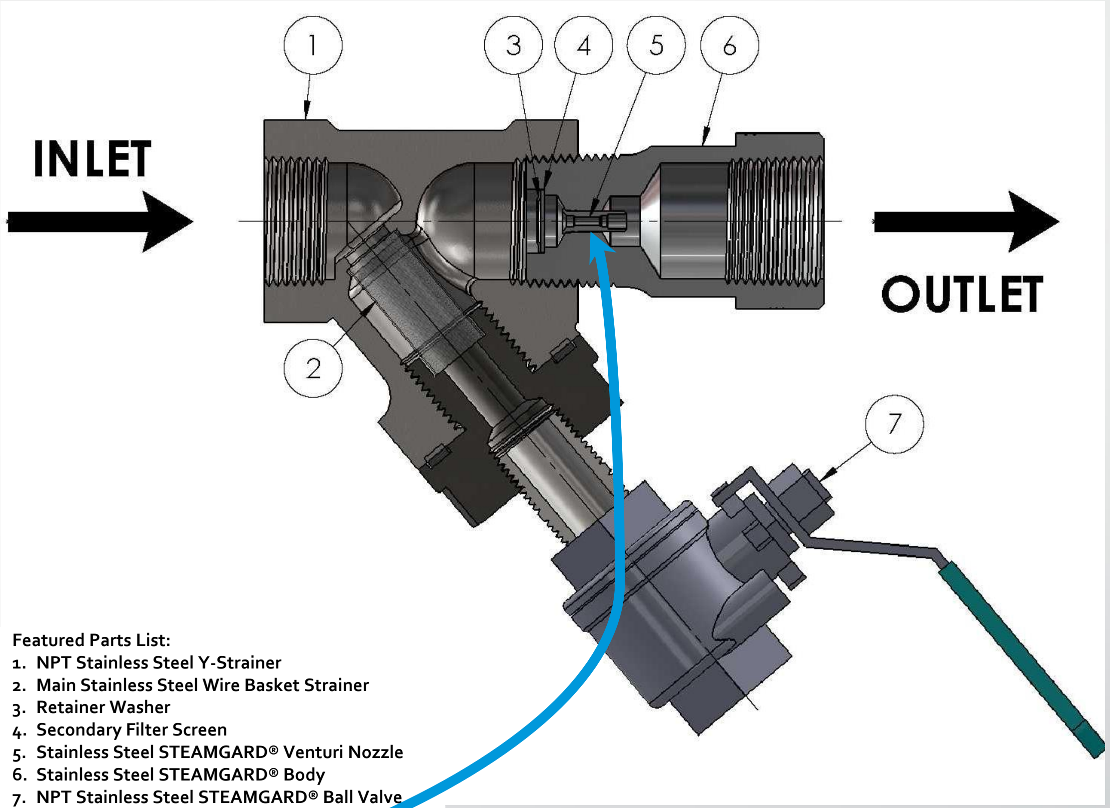
An orifice plate steam trap:

- Can only drain a specific amount of condensate at a fixed pressure differential.
- Is susceptible to wire draw.
- Is prone to plugging.

A STEAMGARD® unit is **not an orifice plate steam trap**. Instead it utilizes a modified Venturi nozzle.

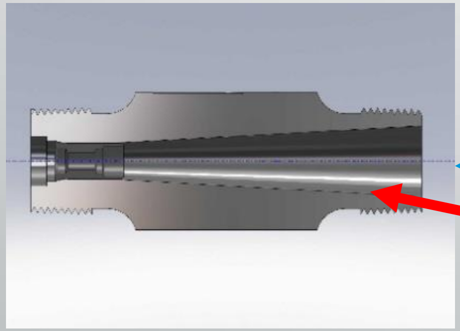


THE STEAMGARD SYSTEM®



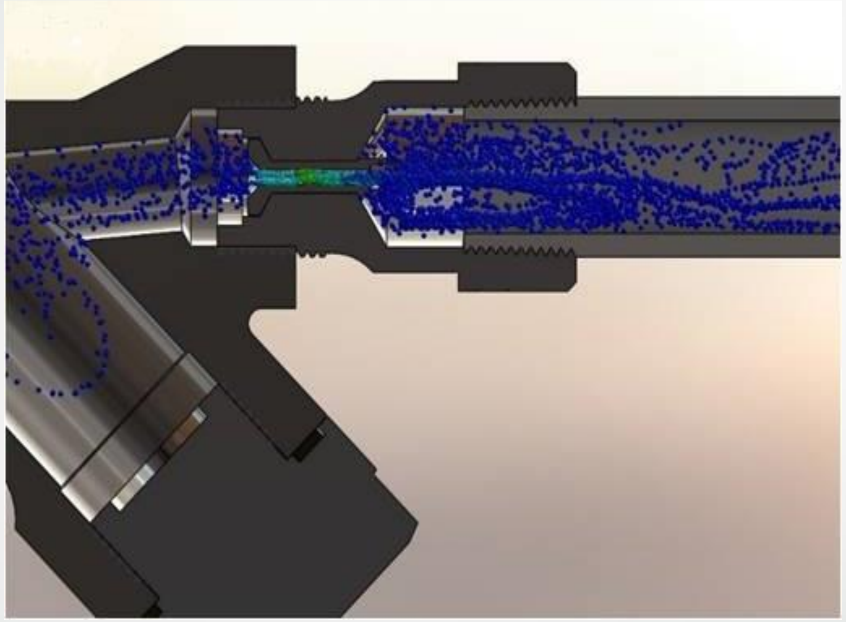
Featured Parts List:

1. NPT Stainless Steel Y-Strainer
2. Main Stainless Steel Wire Basket Strainer
3. Retainer Washer
4. Secondary Filter Screen
5. Stainless Steel STEAMGARD® Venturi Nozzle
6. Stainless Steel STEAMGARD® Body
7. NPT Stainless Steel STEAMGARD® Ball Valve



Modified Venturi Nozzle

How STEAMGARD® Works



- Continuous Two Phase Flow
- No Mechanical Seal/Moving Parts
- Dissolved Particulates (<5 micron) Pass Through

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How STEAMGARD® Works

How does a STEAMGARD® unit regulate the flow of condensate?

Refer animation video on www.STEAMGARD.com

- **By Utilizing the Density Difference between Steam and Condensate**
  - Heavy condensate squeezes out the steam at the unit's inlet and is preferentially discharged. The STEAMGARD® unit will always have a ***water seal at its inlet*** and can never loose live steam when condensate is present.

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How STEAMGARD® Works

- **By Utilizing the Local Back Pressure Created by the Formation of Flash Steam/ Two Phase Flow**

  - As the condensate load reduces, flash steam is produced closer to the throat of the Venturi nozzle and this creates localized back pressure, thus, reducing the capacity of the STEAMGARD® unit.

  - As the load increases, the flash steam is formed closer to the exit and the back pressure in the STEAMGARD® unit is lower compared to that at low load.

High Internal Back Pressure = Lower Condensate Discharge Capacity

Low Internal Back Pressure = High Condensate Discharge Capacity

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Variable Condensate Loads

- Turndown Ratio – 4:1 Constant Steam Pressure, 50:1 When Used With a Control Valve (THE STEAMGARD SYSTEM® is Not an Orifice Trap).
- Changes in Process Conditions
  - Where the steam flow is modulated by a control valve, a change in the condensate load is accompanied by a change in the steam pressure.
  - The actual condensate load remains a high percentage of the maximum capacity at the new pressure.
  - A Venturi nozzle is self-regulating (i.e., flash steam generation changes with the load).
- Efficient condensate removal under varying loads relies on the careful selection and proper application of THE STEAMGARD SYSTEM®.

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Advantages

- Eliminate Live Steam Losses from Failed Open Conventional Steam Traps
- Reduces Condensate Back Up and Water Hammer
- No Moving Parts = No Failed Open Traps
- Up to 20 Year Warranty
- 20+ Year Service Life
- Moisture Free Steam (i.e., High Quality Steam)
- Minimal Spare Parts Inventory Required
- Superior Performance Reliability and Longer Service Life
- Can be Utilized in Systems from 2 psig/Vacuum Return to 2,500 psig and 950 °F

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CASE STUDIES

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STEAMGARD® Retrofit Case Studies – East Coast

- **Federal Facility in Maryland:** Prestigious Tri-Service Military Medical Center
- **Hospital in Massachusetts:** World Class Teaching Hospital Located in the Heart of Boston
- **Industrial Plant in Massachusetts:** Leading Manufacturer of Canned Fruits and Vegetables, Frozen Fruits, Fruit Juices and Food Preparations
- **University in New Jersey:** Premier Ivy League Research University, Fourth Oldest Institution of Higher Education – Founded in 1746

Federal Facility in Maryland

- Replaced 850 conventional steam traps between 2012 and 2014 in designated buildings with THE STEAMGARD SYSTEM®.
- Annual Energy Savings Realized: 492,430 Therms
- Project had a simple payback of less than 2.0 years.
- Eliminated the water hammer related to steam trap failures and incorrect application and design.
- Improved the safety and reliability of the entire steam system including the steam equipment and condensate return equipment.

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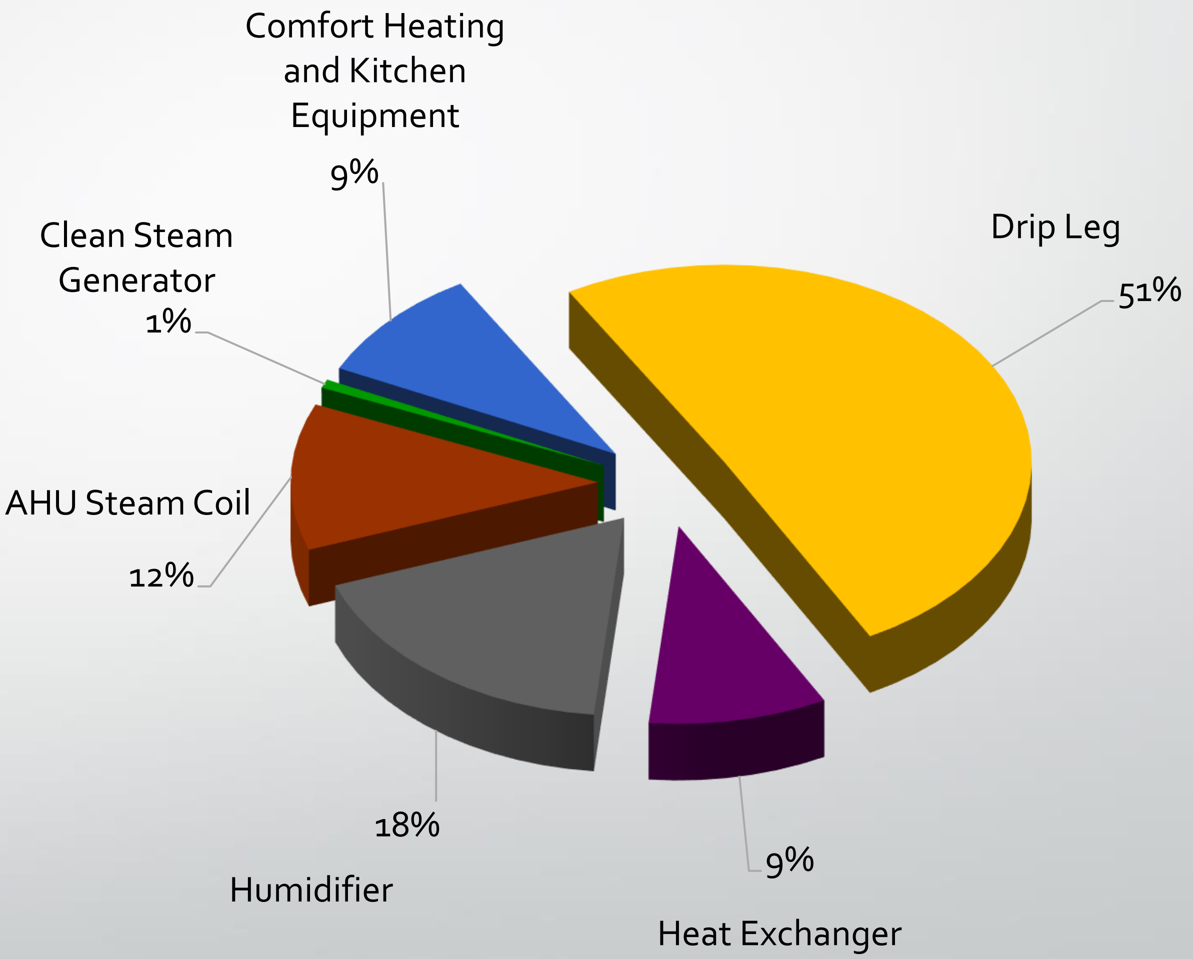
STEAMGARD® Retrofit Project

Steam Trap Population Retrofitted by Application

Application	Quantity
AHU Steam Coil	102
Clean Steam Generator	6
Comfort Heating and Kitchen Equipment	80
Drip Leg	430
Heat Exchanger	80
Humidifier	152
Total	**850**



Hospital in Massachusetts

- Prior to the STEAMGARD® retrofit, the Hospital's mechanical steam trap failure rate ranged from 11 to 16% despite a proactive annual trap maintenance and replacement program conducted by a third party.
- A total of 525 conventional steam traps were retrofitted in 16 buildings between 2017 and 2020.
- THE STEAMGARD SYSTEM® eliminated over 95% of the steam trap failures in the first two years.

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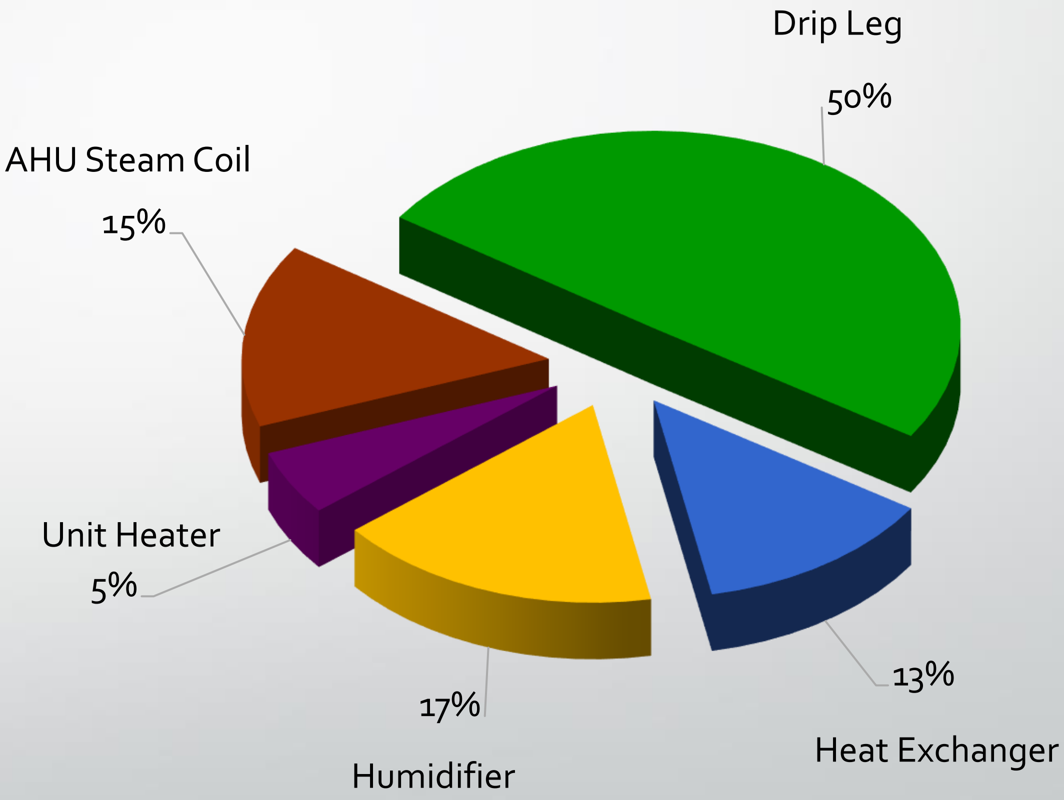
STEAMGARD® Retrofit Project

Steam Trap Population Retrofitted by Application

Application	Quantity
AHU Steam Coil	79
Drip Leg	261
Heat Exchanger	67
Humidifier	90
Unit Heater	28
Total	**525**



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Industrial Plant in Massachusetts

- The Industrial Plant is an American agricultural cooperative of growers of cranberries and grapefruit that is headquartered in Massachusetts. The cooperative employs approximately 2,000 people with sales of $1.3 billion and accounts for 70% of North America's cranberry production.

- The plant in Middleboro, Massachusetts processes fresh and frozen cranberries in order to produce sweetened dried cranberries throughout the year.

- The work conducted included:

  - An Investment Grade Steam System Evaluation
  - Turnkey Retrofit

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Highlights – Investment Grade Steam System Evaluation

- An Investment Grade Steam System Evaluation of the Plant's steam and condensate systems was performed in 2017. This included:
  - Steam trap inventorying and testing. A significant percentage of the Plant's trap population was either failed or not suitable for the application.
  - An analysis was conducted in order to identify the costs/savings associated with the installation of a stack gas economizer to capture the waste heat.
  - A cost benefit analysis was conducted for recovering the waste heat from the high pressure condensate from the dryers via a flash tank.

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Highlights – Investment Grade Steam System Evaluation

A detailed engineering analysis was conducted in order to identify the changes needed throughout the Plant's system such that the steam pressure could be increased from 110 psig to 135 psig.

This included:

- A rating verification for the entire high pressure header downstream from the boiler stop valve for 135 psig.
- A stress analysis.
- Piping thickness testing.
- A review of the condensate receiver and vent sizing (i.e., the 7 vented receivers that receive 110 psig condensate).

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Trap Testing Summary

Summary of the Quantity Tested

Trap Population	Quantity	Percentage (%)
Tested	149	64
Not Tested	85	36
Totals	**234**	**100**

Summary of the Testing Results

Condition	Quantity Tested	Percentage (%)
OK (Functional Steam Losses)	116	78
Blowing (Failed Open)	10	7
Leaking (Partially Failed Open)	17	11
Failed Closed or Backing Up	6	4
Totals	**149**	**100**

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Trap Testing – Summary of the Steam Losses

Trap Population	Type of Steam Losses	Hourly Steam Loss	Annual Steam Losses	
			Klb	Dollar Value
234	42 Failed Open Traps	2,584	16,488	$ 82,440

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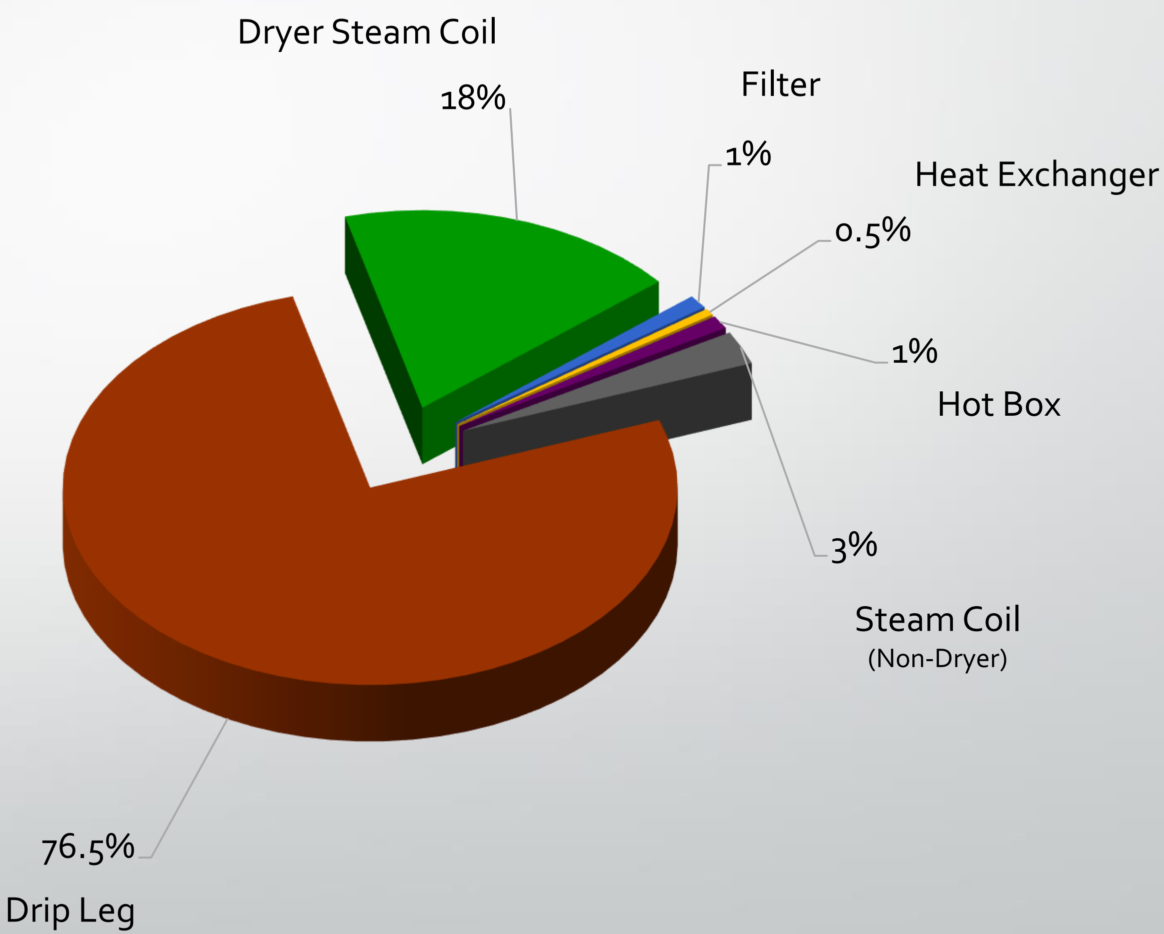
STEAMGARD® Retrofit Project

Steam Trap Population
Retrofitted by Application
(2018 Retrofit)

Application	Quantity
Drip Leg	140
Dryer Steam Coil	33
Filter	2
Heat Exchanger	1
Hot Box	2
Steam Coil (Non-Dryer)	5
Total	**183**



University in New Jersey

- A Premier Ivy League Research University on the East Coast with a student population of over 8,000.
- Over 150 campus buildings are supplied by a 200 psig steam loop (i.e., 8+ million ft^2 steam heated area).
- Approximately 5,000 conventional steam traps were retrofitted to THE STEAMGARD SYSTEM® between 2007 and 2015.
- Reduced the peak steam demand, excluding their chilled water systems, by 19.6% (i.e., from 255 to 205 Klb/hr) and their GHG emissions by 6.7%.

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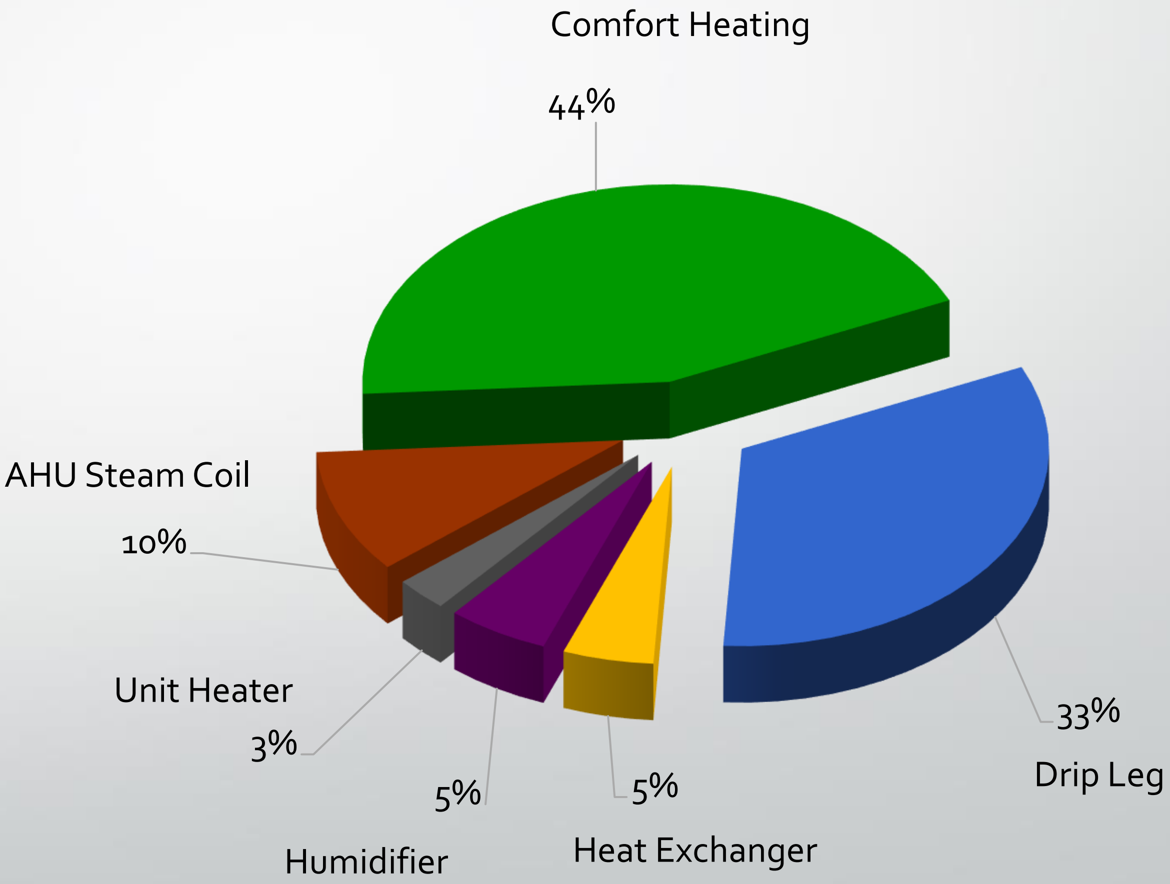
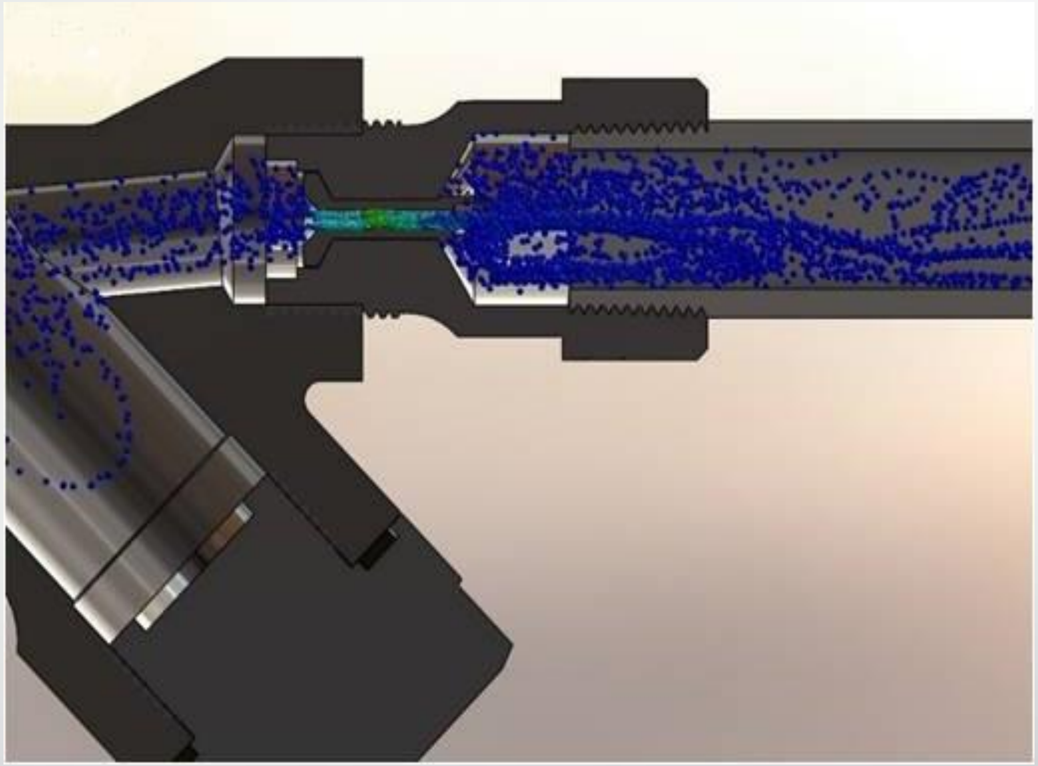
STEAMGARD® Retrofit Project

Steam Trap Population Retrofitted by Application

Application	Quantity
AHU Steam Coil	510
Comfort Heating Equipment (Radiators, Fin Tubes)	2,220
Drip Leg	1,645 (Includes 75 on 200 psig Super Heated Headers)
Heat Exchanger	240
Humidifier	270
Unit Heater	140
Total	**5,025**



Questions?



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