INNOVAS TECHNOLOGIES™

Helios Tube Cleaning System®
Application Engineering Guide

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INTRODUCTION

The Helios Tube Cleaning System® provides continuous, in-situ, preventative tube cleaning of up to five (5) heat exchangers.

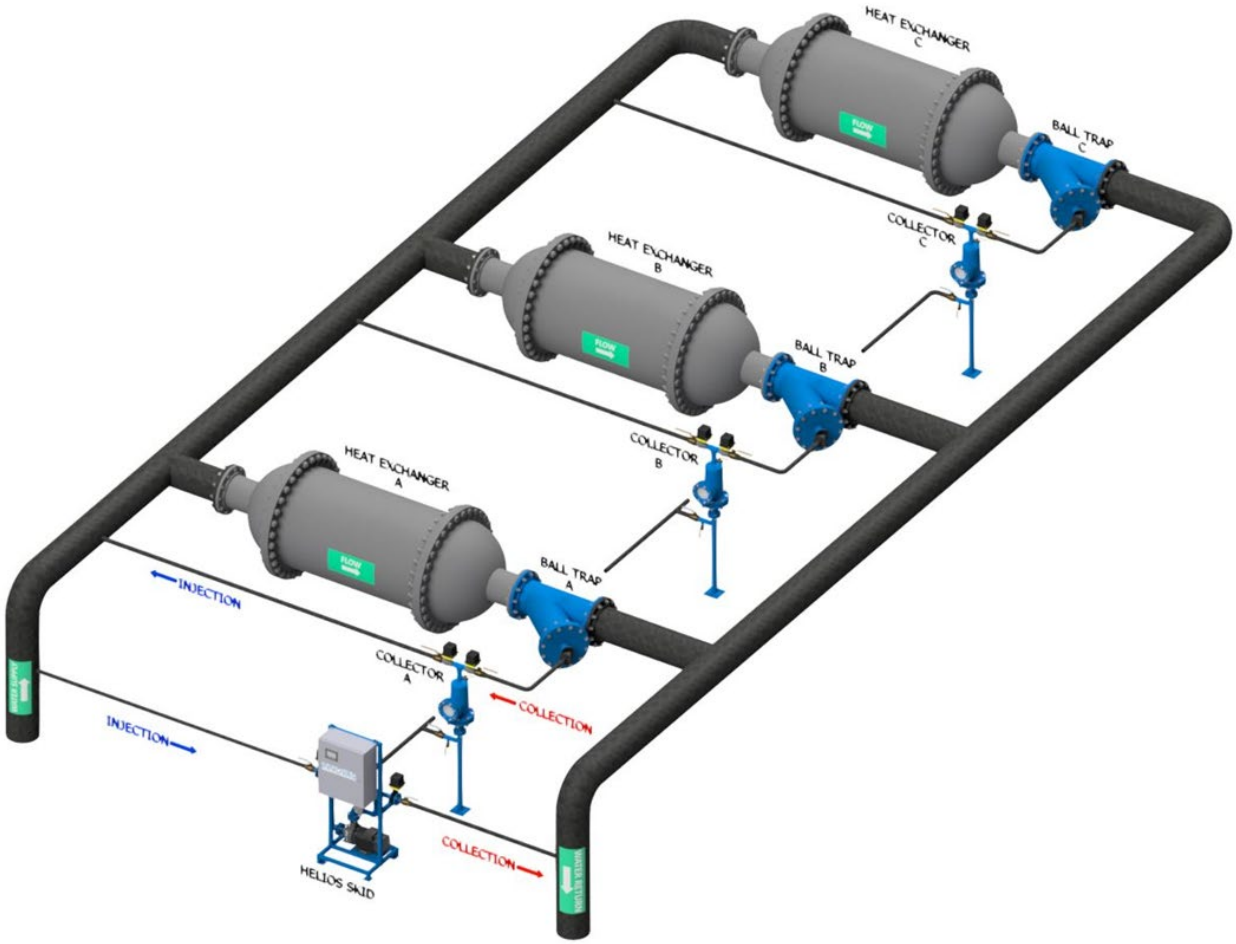
Helios Tube Cleaning System Process Description

The Helios tube cleaning system includes multiple sub-components, including:

Helios Skid
Collectors (Qty. 1-5)
Ball Traps (Qty. 1-5)

The Helios Skid is shared between the Collectors. Ball Traps are installed in the heat exchanger piping at the outlet of each heat exchanger.

The Helios Controller will periodically inject and collect the cleaning balls to the heat exchangers in series, using the pre-programmed timers and settings in the Helios Controller.



APPLICATIONS

The Helios Tube Cleaning System® (Helios) is applicable to any shell and tube heat exchanger with sufficient tube-side water flow. Minimum flow requirements vary based on the size and type of heat exchanger tube, with a general minimum tube flow velocity requirement of 4 ft/s. Consult your Innovas sales representative for details or specific application questions.

Common applications of Helios tube cleaning systems include:

Water-Cooled Chiller Condensers	Chiller Evaporators
Industrial Overheads Condensers	Steam Turbine Surface Condensers

A Helios system can be used to prevent fouling in smooth tubes or internally-enhanced heat transfer tubes, and with a wide range of standard operating temperatures (30 – 194 F) the Helios tube cleaning system is the go-to standard for optimized heat transfer performance in district cooling, power generation, or oil and gas industries.

While Helios systems can benefit any shell and tube heat exchanger, indicators for excellent Helios applications with rapid financial returns include:

High Approach Temperatures
High approach temperatures (sometimes called “Small Temp. Difference” on chiller control panel) are an indication of fouled tubes and wasted energy. Due to off-design operating conditions, not every exchanger with fouled tubes will exhibit a markedly high approach temperature, but when high approach is identified it is a direct indication of savings opportunity.

Cooling Systems with High Tube-Fouling Potential
Cooling systems employing open-loop cooling water systems, reclaimed or greywater cooling tower make-up, cooling towers located in poor air quality or dusty environments, or non-chemical water treatment strategies are prime candidates for extremely rapid financial returns.

Large Chilled Water Distribution Networks
District cooling facilities often have miles of chilled water piping, which inevitably have large piping-dead legs where water stagnates and chemical treatment effectivity is compromised. These conditions lead to corrosion and biological growth that rapidly fouls evaporator tubes.

FEATURE BENEFITS

Specify a Helios Tube Cleaning System when the following feature benefits are desired:

Proven and Ultra-Reliable Performance

The proven leader in heat exchanger tube fouling prevention, the Helios tube cleaning system is the preferred solution for the world's most demanding and sophisticated district cooling system operators. With millions of cleaning cycles completed over the last decade and operational reliability above 99.97% with zero cooling process interruption, the Helios system is the tried-and-true solution required by the district cooling, utility, and petrochemical industries.

Optimized Chiller Energy Efficiency

When optimized energy efficiency is the goal. Regardless of other energy conservation measures, a Helios system will further improve the performance and energy efficiency of any water-cooled chiller across all operating conditions.

Reduced Maintenance Hours

By utilizing Helios systems, facility operators relieve themselves of the burden manually brushing heat exchanger tubes, which can require thousands of man-hours each year. Instead, skilled mechanics and technicians can be freed up to tackle higher-value maintenance tasks.

Increased Cooling Capacity

When exchanger tubes get fouled, less heat can be extracted from the building or process, especially when outside air temperatures climb and condenser water temperatures approach or exceed full-load design conditions. Installing a Helios tube cleaning system ensures that your water-cooled chiller delivers maximum cooling when you need it most. With traditional tube cleaning (e.g. manually cleaning once per year) chiller tubes are often fouled and compromised by the time the hottest days of summer occur, and cooling output can be reduced by up to 10%.

Maximum Chilled Water Plant Availability

Particularly important for process-cooling applications (e.g. data centers, industrial or manufacturing process cooling, etc.) installation of Helios systems prevents the need to take chillers out of service for manual tube cleaning, ensuring n+1 operation is possible even when chiller mechanical failures occur elsewhere.

Modular Expansion for Complete Flexibility

A single Helios skid and controls package can service up to five (5) heat exchangers. After the first Helios system is installed, expanding the system to additional chillers is as easy as adding a dedicated Collector and Ball Trap for each chiller. This also enables a single Helios skid to easily service chillers of varying sizes or tube configurations, and the small footprint and flexible siting of Helios equipment ensures even the most space-restricted physical plants can be served.

Engineered and Fabricated for Compliance & Longevity

Helios systems are designed and fabricated in the United States, and compliant with the most exacting engineering standards on the planet. Unparalleled reliability and a life cycle outlasting the critical performance equipment the Helios serves is the goal. A sample of engineering standards used include:

ASME B31.9 Building Services Piping Code
ASME B31.3 Process Piping Code
ASME B31.1 Power Piping Code
National Electric Code (NEC)

Customized Design Solutions for Applicability & Reduced Installation Cost

Custom design-build solutions are available in a wide range of materials, dimensions, and configurations for specialized applications including seawater, elevated pressures, customer-specific materials, and unique piping configurations.

NOMENCLATURE

Standard Helios Tube Cleaning Systems are identified via the nomenclature below.

Example: H / P150 N / RC6 / BT12 Y F1 SP

System Type
H: Base System (Skid/Collector/Ball Trap)
E: Expansion Kit (Collector and Ball Trap only)

Skid Size
P150: 1-1/2" conn., 3.35hp pump, for traps up to 14"
P200: 2" conn., 3.35hp pump, for traps 16" – 20"
P210: 2" conn., 5.5hp pump, for traps 24'

Skid Options
N: none
B: BACnet MS/TP, BACnet IP comms module
M: MODBUS RTU RS232/485 comms module
H: High pressure (max. operating pressure 232 psig)
C: Custom configuration

Collector Size
RC6: 6" diameter Collector
RC8: 8" diameter Collector

Collector Options
None: standard
H: High pressure (max. operating pressure 232 pisg)
C: Custom configuration

Ball Trap Options
(add appropriate digits if needed)
SP: Ball Trap Service Port
LL: Ball Trap Cover Lifting Lugs
C: Custom

Ball Trap End Connections
F1: ANSI Class 150 RF Flange
BW: Butt-weld
G: Grooved (Victaulic)
C: Custom

Ball Trap Body Style
Y: Wye-style
E: Elbow-style

Ball Trap Body Size
(nominal pipe diameter)

BT6:	6"	BT12:	12"	BT18:	18"
BT8:	8"	BT14:	14"	BT20:	20
BT10:	10"	BT16:	16"	BT24:	24"

Example: H/P150B/RC6/BT12YF1SP
Base Helios Tube Cleaning System including Helios Skid, Remote Collector, and Ball Trap.
Helios P150N skid, carbon steel epoxy-coated piping, integrated 3.35hp pump with standard 145 psig operating pressure, PLC controller, optional BACnet communications module included.
Remote Collector RC6, 6" collector, standard epoxy-coated carbon steel, 145 psig max operating pressure.
Ball Trap BT12YF1SP, 12" Y-Style Ball Trap, standard epoxy-coated carbon steel, ANSI Class 150 RF end connections, optional ball trap service port included on ball trap cover.

Custom design-build solutions are available in a wide range of materials, dimensions, and configurations for specialized applications including seawater, elevated pressures, customer-specific materials, larger ball traps and unique piping configurations. Contact your Innovas sales representative for details on customized requests.

EQUIPMENT OVERVIEW

This section gives a short description of each major component in a Helios system.

Helios Skid - The Helios Skid is comprised of the Controls Enclosure, Pump, Application Controller with associated piping and valves.

Ball Trap - Installed in the heat exchanger outlet pipe, the strainer inside the Ball Trap prevents balls from escaping downstream of the Ball Trap.

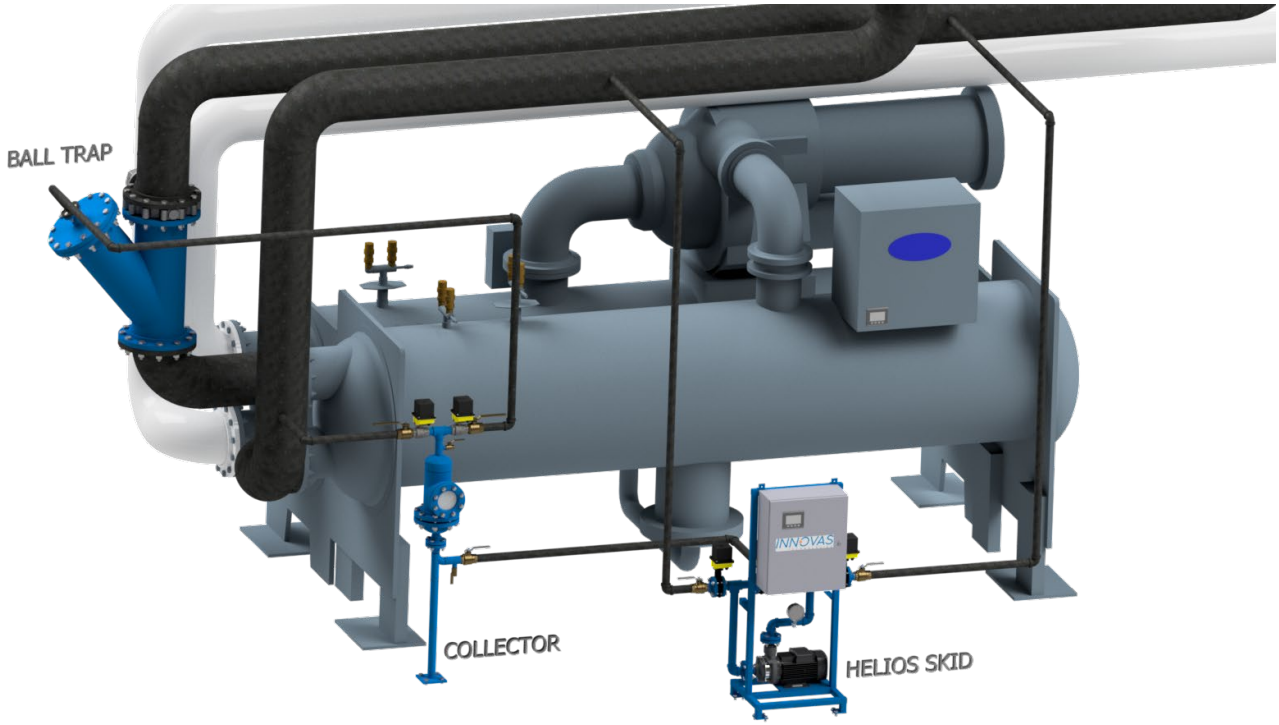
Collector -This is where the balls are staged between injection cycles. The sight glass on the Collector enables the operator to observe the number and condition of the sponge balls. In addition, it permits the operator to observe the balls during manual operation of the system.

Helios Pump - The Helios Pump provides the flow needed to inject and collect the balls. The balls do not flow through the pump. The actuated valves direct the water flow in the desired directions for cleaning ball injection and collection.

Helios Controller - The controller directs all system functions by operating the actuated valves and Helios Pump. All system operations and timers may be adjusted via the controller touchscreen.

Actuated Valves - The actuated valves are operated by the Helios Controller in automatic mode during normal operation.

Cleaning Balls - The sponge cleaning balls are slightly larger in diameter than the heat exchanger or condenser tubes, so while flowing through the tubes they wipe the tubes clean. The number of balls in the system is equal to 30-40% of the number of tubes in one pass.



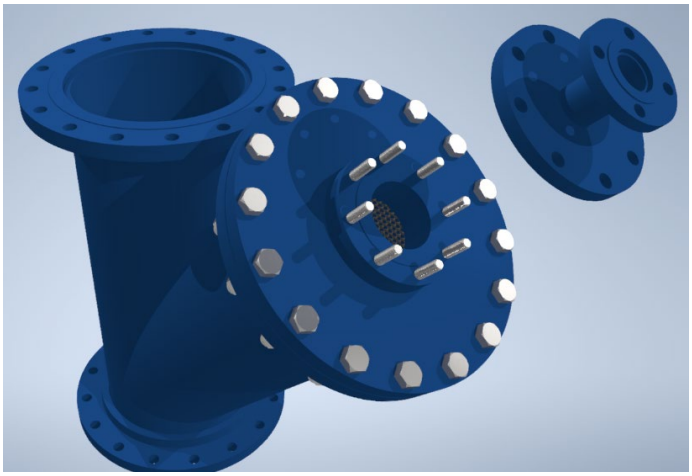
ACCESSORIES AND OPTIONS

Below are available accessories and options for configuring a Helios system.

Helios Skid Communications Module
A plug-in communications module may be selected for the Helios skid microprocessor controller, and is available for either BACnet MS/TP BACNet IP protocol or MODBUS RTU RS232/485 protocol. The communications modules enable seamless communication with the facility control room for alarm notifications, monitoring, and control of the Helios system. A complete list of available communications points is available – please contact your Innovas sales representative to ensure you have the most updated points list.

High Pressure Components
The standard Helios skid and Collector may be upgraded to a high-pressure version, which increases the maximum allowable operating pressure from 145 psig to 232 psig.

Ball Trap Service Port
Available for ball traps sized 10" diameter and larger, the Ball Trap Service Port option converts the standard ball outlet connection on the ball trap cover to a service port, providing a 5" diameter inspection port and hand-hole for quick inspection and light cleaning of the ball trap internal screens without the need to remove the entire ball trap cover flange.



Ball Trap Lifting Lugs
Lifting lugs can be added to the ball trap cover to ease in removal of the cover for cleaning or inspection. Lifting lugs can also be added to the ball trap body upon request.

Customized Design Solutions for Increased Applicability
In addition to the options listed above, custom design-build solutions are available in a wide range of materials, dimensions, and configurations for specialized applications including seawater, elevated pressures, customer-specific materials, and unique piping configurations. Contact your Innovas sales representative for details and to discuss your requirements.

APPLICATION NOTES AND CONSIDERATIONS

The following provides details, guidelines, and best practices for planning a Helios installation.

Helios Skid - The Helios Skid is comprised of the Controls Enclosure, Pump, Micro-processor based Application Controller with associated piping and actuated and manual isolation valves. For maximum flexibility and ease of installation, the skid can be located anywhere in the mechanical room. The Helios skid includes a four-color touchscreen HMI on the front of the controls enclosure, and the skid should be positioned to allow for easy access to the screen. The Helios skid frame elevates and fully supports the injection/collection pump, and the frame is equipped with mounting feet complete with anchor bolt holes. A concrete housekeeping pad is not required.

Ball Trap - Installed in the heat exchanger outlet piping, the strainer inside the Ball Trap prevents balls from escaping downstream. The ball trap may be installed in any position, and may be located in vertical or horizontal pipe runs. A Y-style trap is best suited for straight pipe runs and provides the lowest possible pressure drop. When necessary due to available space or existing piping configuration, an elbow-style ball trap can replace a 90-degree piping elbow.

Collector -This is where the balls are staged between injection cycles. The sight glass on the Collector enables the operator to observe the number and condition of the sponge balls. In addition, it permits the operator to observe the balls during manual operation of the system. The collector should be positioned so that an operator has unobstructed access to the sight glass to change the cleaning balls. Locating the collector close to the heat exchanger reduces the length of piping runs through which cleaning balls need to flow and reduces the Helios pump run time requirements. The collector stand is equipped with a mounting foot complete with anchor bolt holes, and a concrete housekeeping pad is not required.

Debris Filtration -The Helios tube cleaning system performance is reliant on clear access to get cleaning balls through the heat exchanger tubes. If large debris (sticks, tower fill media, chip scale) blocks the entrance to heat exchanger tubes, the cleaning balls will not be able to enter the tubes to effectively prevent fouling. If excessive debris is a concern, the water system should have a debris filter upstream of the heat exchanger with a straining element sized to protect the heat exchanger tubes (strainer openings approximately half the diameter of the exchanger tubes). A strainer element with openings of ¼" diameter is typically sufficient.

Tube Bundles with Different Sized Tubes – Some chiller manufacturers produce condensers that have 1" nominal tubes for the main condenser and ¾" nominal tubes for the condenser sub-cooler. For Helios applications, it is easiest and preferred to specify a chiller wherein all the condenser tubes are the same nominal size. The Helios system can be supplied with tube

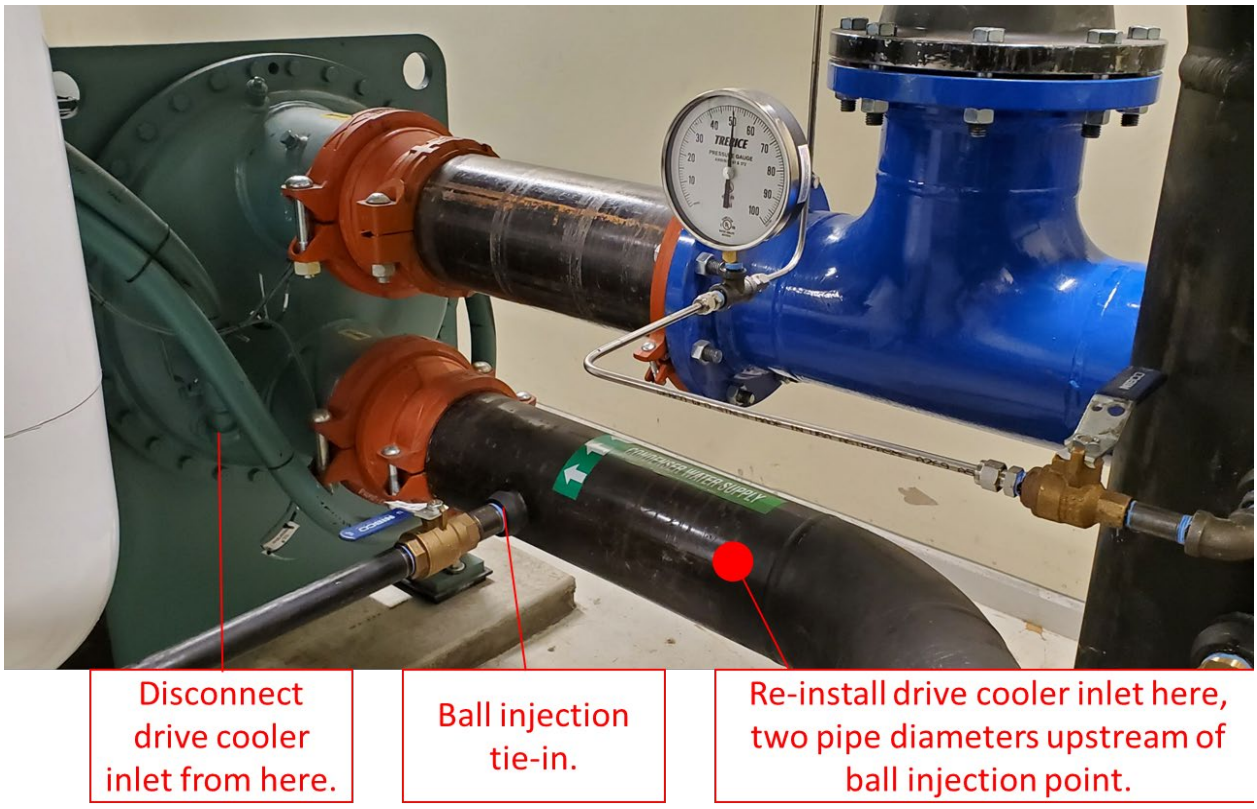
inserts that are installed in the ¾" sub-cooler tubes and allow normal water flow and function through the sub-cooler while the main bundle receives the full benefit of Helios tube cleaning.

Ball Injection Piping Tie-In

The ball injection tie-in is the location where the balls are injected into the cooling water inlet pipe, located upstream of the heat exchanger inlet on the heat exchanger inlet piping. The injection point tap should be at least 2 pipe diameters downstream from the skid water supply tap.

It is recommended that the location of the injection point be as close as possible to the water box or tube sheet of the heat exchanger. This is in order to prevent balls from passing through fittings such as control valves, filters, etc., which can negatively affect the efficacy of the tube cleaning system.

Verify no piping connections that could siphon off cleaning balls are between the ball injection tie-in and the Ball Trap. If the Helios system is installed on a chiller with a variable speed drive (VSD) cooler, the supply piping tie-in for the VSD cooler must be relocated to the heat exchanger inlet piping at least two (2) pipe diameters upstream of the cleaning ball injection tie-in.



Once the injection point has been designated, an injection pipe and customer-supplied manual isolation valve (full-port ball valve for 2" and smaller, 4" and larger may be butterfly valve) are added as a branch connection to the cooling water inlet pipe.

Electrical & Controls Installation

Power Supply Wiring: The Helios Skid requires facility power for operation. Power conductors and conduit or raceway should be installed from a facility power panel to the Helios electrical enclosure. Power supply terminals are provided inside the skid enclosure. Refer to the system electrical wiring diagrams for details.

Permissive Signal Wiring (hardwired): The Helios Skid is equipped as standard with terminals for a dedicated permissive signal for each heat exchanger to be cleaned. The permissive is utilized to indicate that sufficient water flow is present in the heat exchanger tubes prior to cleaning ball injection. A normally open dry contact should be provided from a customer-supplied device (condenser water pump, VFD, flow meter, differential pressure transmitter, etc.) and wired to the terminals provided in the Helios enclosure. Refer to the system electrical wiring diagram for details.

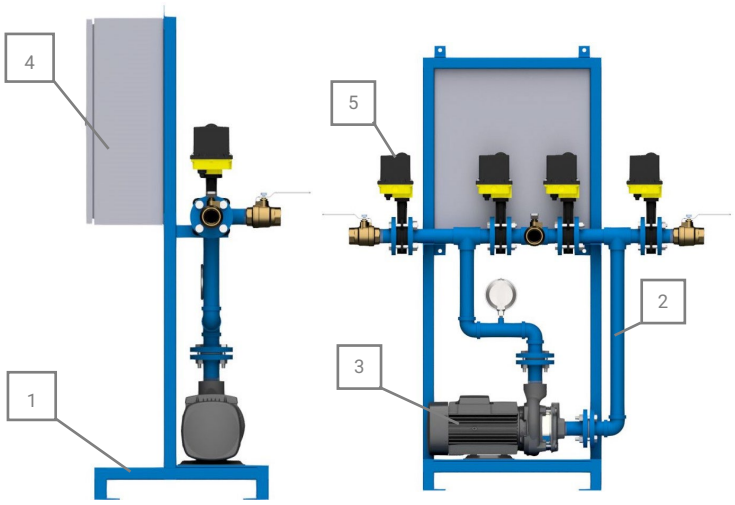
Permissive Signal Over BACnet or MODBUS: If the Helios Skid is equipped with an optional BACnet or MODBUS communications module, the permissive signal may be sent from the Building Automation System (BAS) or Distributed Control System (DCS) to the Helios Controller. Contact your Innovas sales representative for the most recent BACnet or MODBUS points list and consult the specific sales order and wiring diagrams for connectivity details.

Control Wiring To/From Actuated Valves on Remote Collectors: Each Remote Collector is provided with two (2) actuated valves. Each actuator requires six (6) appropriately sized conductors. Customer-provided control conductors and conduit or raceway should be installed from the Helios Skid to each installed Remote Collector. Refer to the system electrical wiring diagrams for termination details

APPLICATION DATA

Helios Skids Technical Datasheet

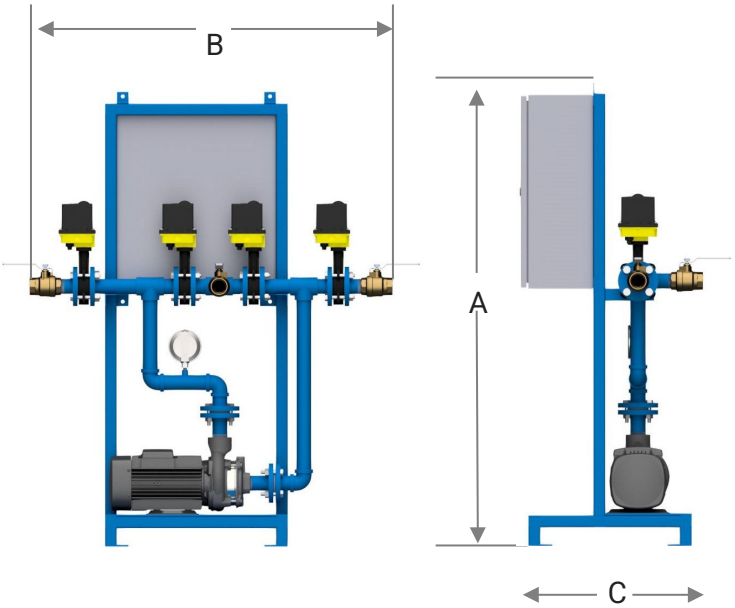
Assembly Detail



Item No.	DESCRIPTION	HELIOS SKID MODEL		
		P150	P200	P210
1	Frame Assembly	Carbon Steel, Epoxy Coated		
2	Skid Piping	Carbon Steel Sch. 40, Epoxy Coated		
3	Skid Pump/Motor	Horizontal centrifugal, TEFC motor		
	Pump Casing	Cast Iron		
	Pump Impeller	Stainless Steel		
	Pump Seal Rubber	EPDM		
	Motor Enclosure	TEFC Class IP55		
	Motor Voltage / Frequency	3PH 208-230/440-480V 60 HZ		
	Motor Rated Power	3.35 hp	3.35 hp	5.5 hp
	Panel Full Load Amps (FLA):	4.9 A @ 480 V	4.9 A @ 480 V	7.6 A @ 480 V
4	Control Panel	Integrated pre-programmed & pre-wired on skid		
	Enclosure	NEMA 12		
	Controller	Microprocessor-based PLC		
	HMI	4-Color Touchscreen GUI		
	Communications (optional)	BACnet MS/TP BACnetIP; or MODBUS RTU RS232/485		
5	Actuated Valves	24V AC/DC, 1/4 Turn Full Port Ball Valves		

Helios Skids Technical Datasheet

Mechanical Specifications

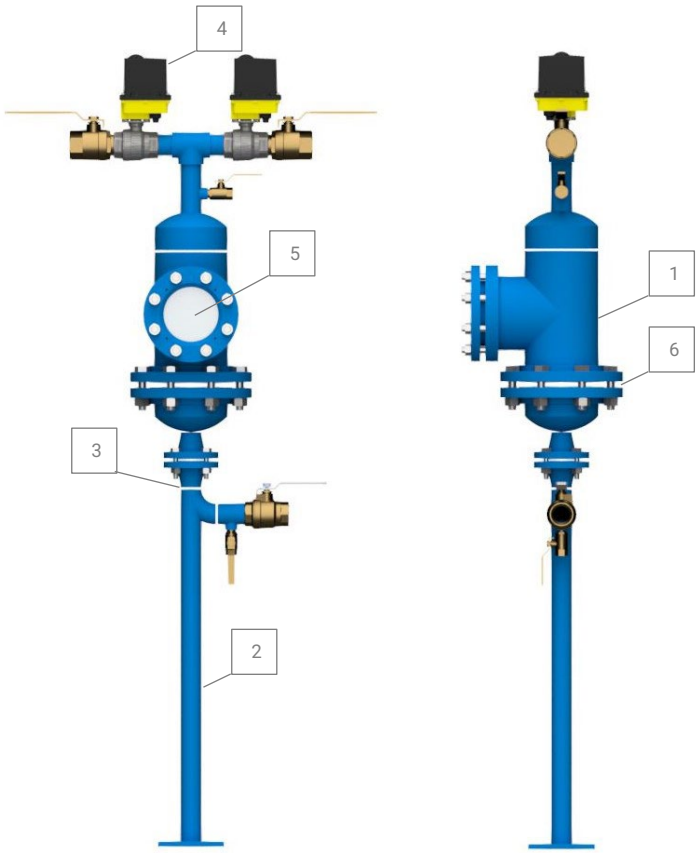


* Dimensions are approximate and for reference only. Dimensions are subject to change.

MECHANICAL SPECIFICATIONS	HELIOS SKID MODEL		
	P150	P200	P210
Height Dimension A	57"	57"	57"
Width Dimension B	46"	53"	53"
Depth Dimension C	22"	25"	25"
Max. Operating Pressure	145 psi		
Max. Operating Temp	194 F		
Skid Water Inlet Connection	1-1/2" FNPT	2" FNPT	2" FNPT
Skid Water Outlet Connection	1-1/2" FNPT	2" FNPT	2" FNPT
To/From Remote Collectors Connection	1-1/2" FNPT	2" FNPT	2" FNPT
Shipping Weight	230 lbs.	260 lbs.	270 lbs.
Operating Weight	250 lbs.	280 lbs.	290 lbs.

Remote Collectors Technical Datasheet

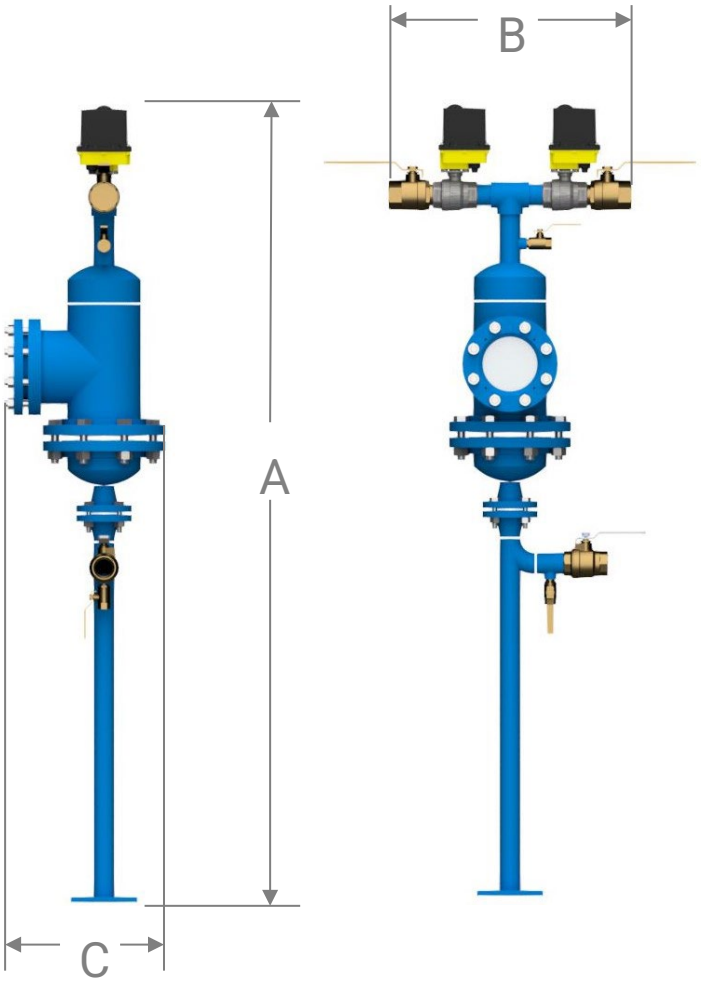
Assembly Detail



Item No.		REMOTE COLLECTOR MODEL	
	DESCRIPTION	RC-6	RC-8
1	Collector	6" x 6" NPS Sch. STD Carbon Steel, Epoxy Coated	8"x6" NPS Sch. STD Carbon Steel, Epoxy Coated
2	Stand Assembly	Carbon Steel, Epoxy Coated	
3	Collector Piping	Carbon Steel, Sch. 40, Epoxy Coated	
4	Actuated Valves	24V AC/DC, 1/4 Turn Full Port Ball Valves	
5	Sight Glass	Tempered Borosilicate	
6	Internal Strainer Plate	Type 304 Stainless Steel, 1/4" Rd Holes, 40% Open	

Remote Collectors Technical Datasheet

Mechanical Specifications

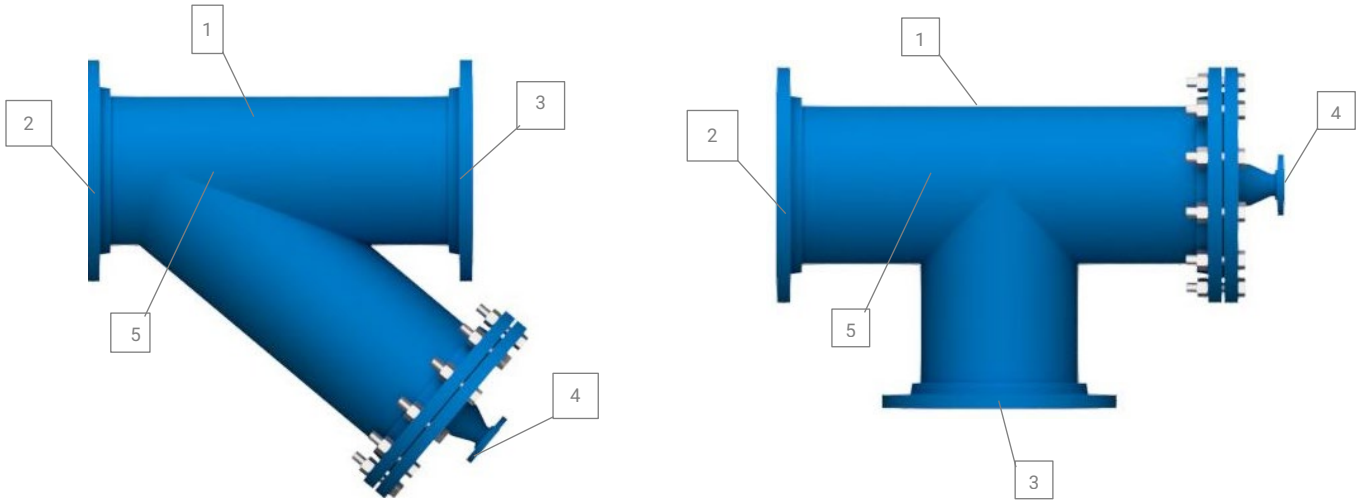


* Dimensions are approximate and for reference only. Dimensions are subject to change.

Mechanical Specifications	REMOTE COLLECTOR MODEL	
	RC-6	RC-8
Height Dimension A	71"	73"
Width Dimension B	22"	27"
Depth Dimension C	14"	16"
Max. Operating Pressure	145 psig	
Max. Operating Temp	194 F	
Injection Connection	1-1/2" FNPT	2" FNPT
Collection Connection	1-1/2" FNPT	2" FNPT
To/From Skid Connection	1-1/2" FNPT	2" FNPT
Shipping Weight	180 lbs	240 lbs
Operating Weight	225 lbs	285 lbs

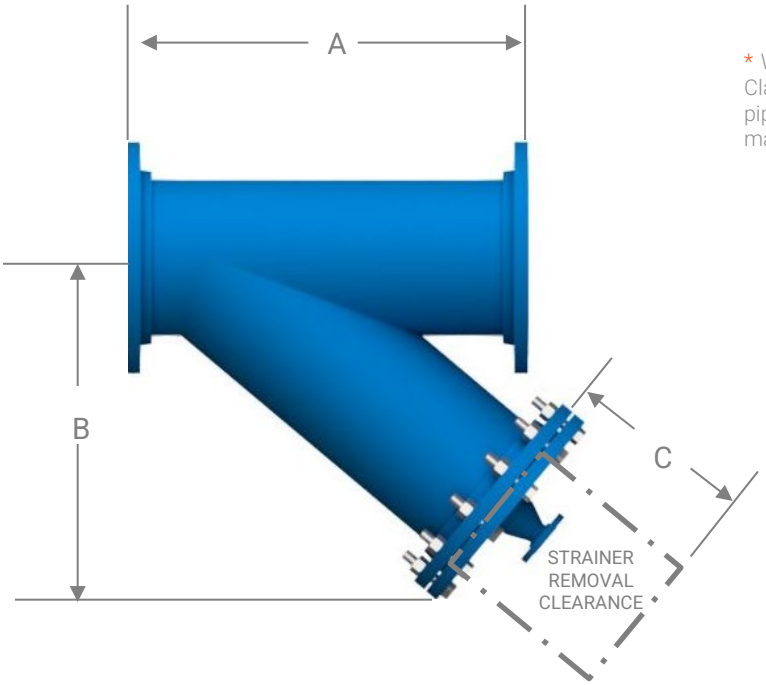
Assembly Detail

Ball Trap Technical Datasheet



COMPONENT LIST		
Item No.	DESCRIPTION	MATERIAL
1	Ball Trap Body	Carbon Steel Sch. STD A53 Gr B
2	Water Inlet Connection	ANSI Class 150 RF Flange CS A105
3	Water Outlet Connection	ANSI Class 150 RF Flange CS A105
4	Ball Outlet Connection	ANSI Class 150 RF Flange CS A105
5	Straining Element	SS304 Perforated Stainless Steel

Y Style Ball Trap Technical Datasheet



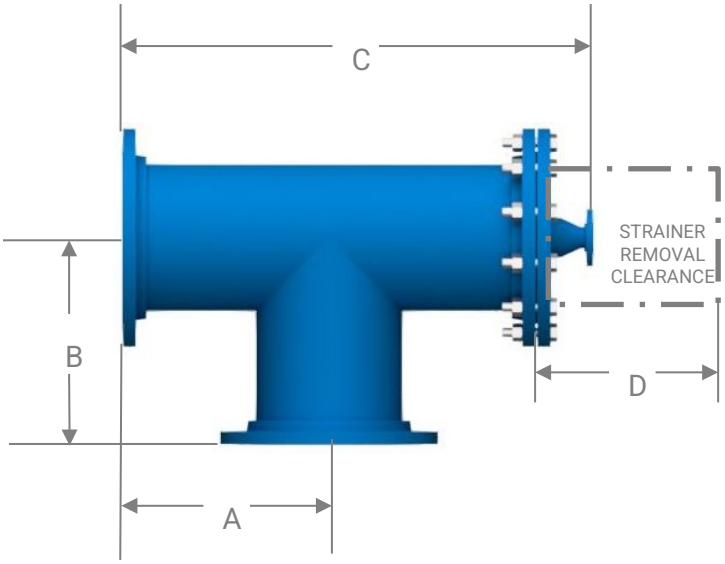
* Weights indicated are for traps with ASME B16.5 Class 150 Flanges and schedule STD carbon steel pipe. Weights may vary for other types of flanges or materials.

Notes:

1. Dimensions and weights are subject to change without notice. Upon request, certified dimensional drawings will be submitted for client approval prior to start of fabrication.
2. Standard materials shown. Consult factory for other material options.
3. Flanged end connections shown. Consult factory for end connection options including flanged, grooved end, or butt-weld.

Y-Style						
Ball Trap Size [in]	A [in]	B [in]	C [in]	Ball Outlet Conn. Size [in]	Empty Weight [lb]	Working Weight [lb]
6	19.0	16.5	21.0	1.5	140	160
8	20.0	20.5	26.0	1.5	240	300
10	27.0	24.0	31.0	1.5	370	490
12	33.0	28.0	36.0	1.5	550	740
14	34.0	30.0	40.0	1.5	780	1170
16	39.0	34.0	45.0	2.0	980	1570
18	46.0	35.0	48.0	2.0	1250	1960
20	46.0	40.0	54.0	2.0	1300	2050
24	54.0	45.5	56.0	2.0	2000	3300

Elbow Style Ball Trap Technical Datasheet



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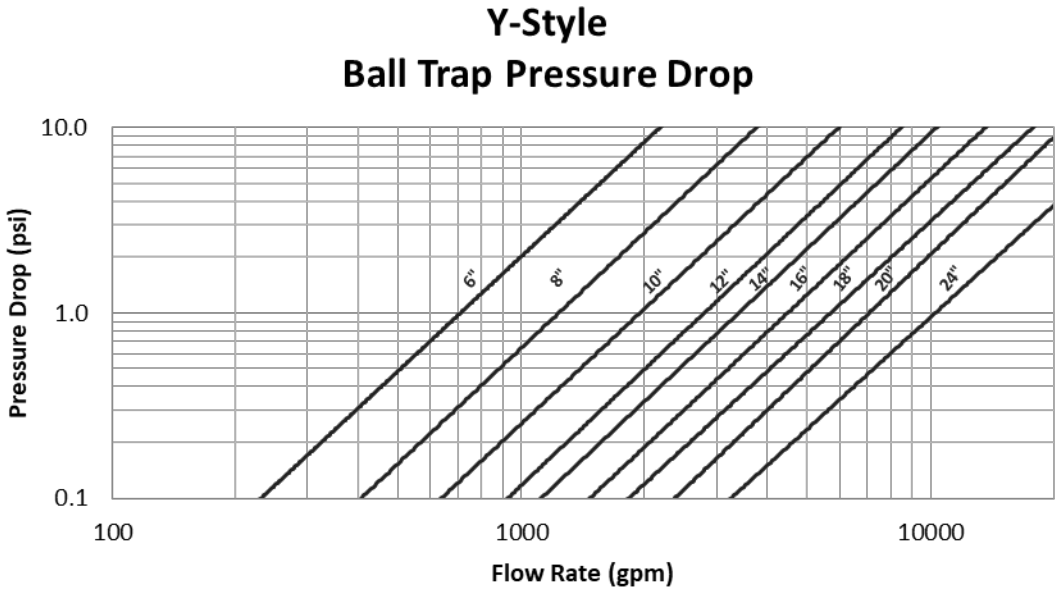
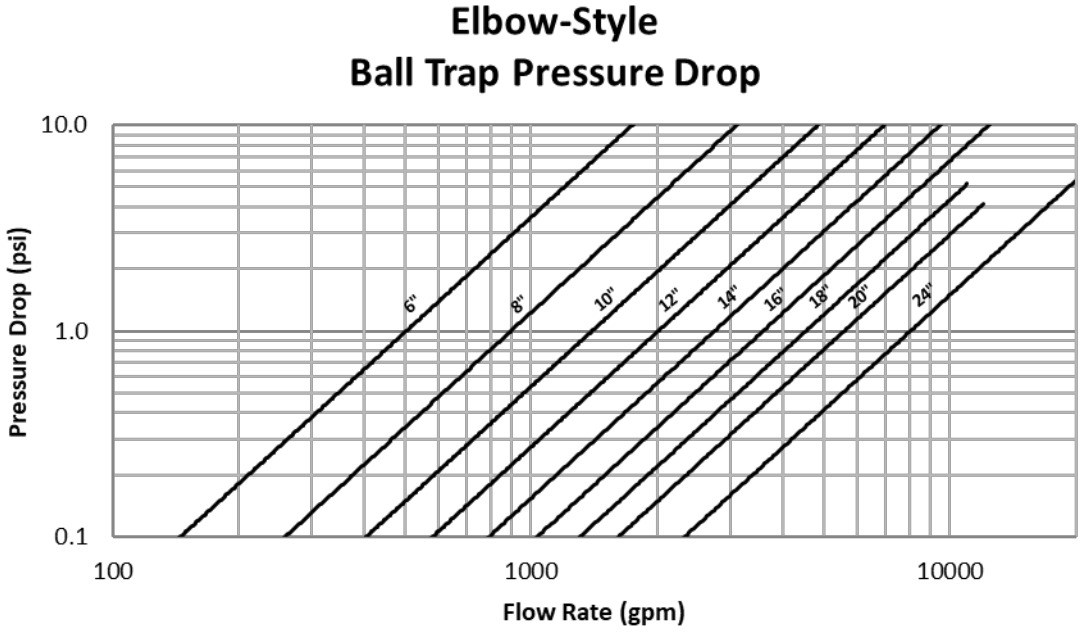
2. Standard materials shown. Consult factory for other material options.
3. Flanged end connections shown. Consult factory for end connection options including flanged, grooved end, or butt-weld.

Elbow Style							
Ball Trap Size [in]	A [in]	B [in]	C [in]	D [in]	Ball Outlet Conn. Size [in]	Empty Weight [lb]	Working Weight [lb]
6	9.0	9.0	23.0	17.0	1.5	140	160
8	12.0	12.0	29.0	23.0	1.5	240	300
10	15.0	15.0	35.5	29.0	1.5	380	510
12	18.0	18.0	41.0	35.0	1.5	580	790
14	21.0	21.0	47.5	40.0	1.5	690	970
16	24.0	24.0	54.0	47.0	2.0	840	1250
18	27.0	27.0	60.0	54.0	2.0	1150	1650
20	30.0	30.0	66.0	58.0	2.0	1200	1850
24	36.0	36.0	78.0	70.0	2.0	1900	3350

Ball Trap Pressure Drop Specifications





EXAMPLE DRAWINGS AND TECHNICAL RESOURCES

Below are example layout drawings, process flow diagrams, and resources to support planning and design for Helios installations.

Single-Line Mechanical Installation Diagrams
Single-line mechanical installation diagrams are available for Helios system installation on one through five heat exchangers. Please contact your Innovas sales representative to ensure that you receive the most recent drawing version.

Single-Line Electrical & Controls Installation Diagrams
Single-line electrical and controls installation diagrams are available for Helios system installation on one through five heat exchangers. Please contact your Innovas sales representative to ensure that you receive the most recent drawing version.

3D CAD Files and Equipment Drawings
Three-dimensional drawings of standard Helios Skids, Collectors, and Ball Traps are available in .stp file type. Please contact your Innovas sales representative to ensure that you receive the most recent drawing version.

Case Studies & White Papers
Case studies and customer testimonials demonstrating the effectiveness and impact of Helios installations can be found at this location: https://innovastechnologies.com/case-studies/

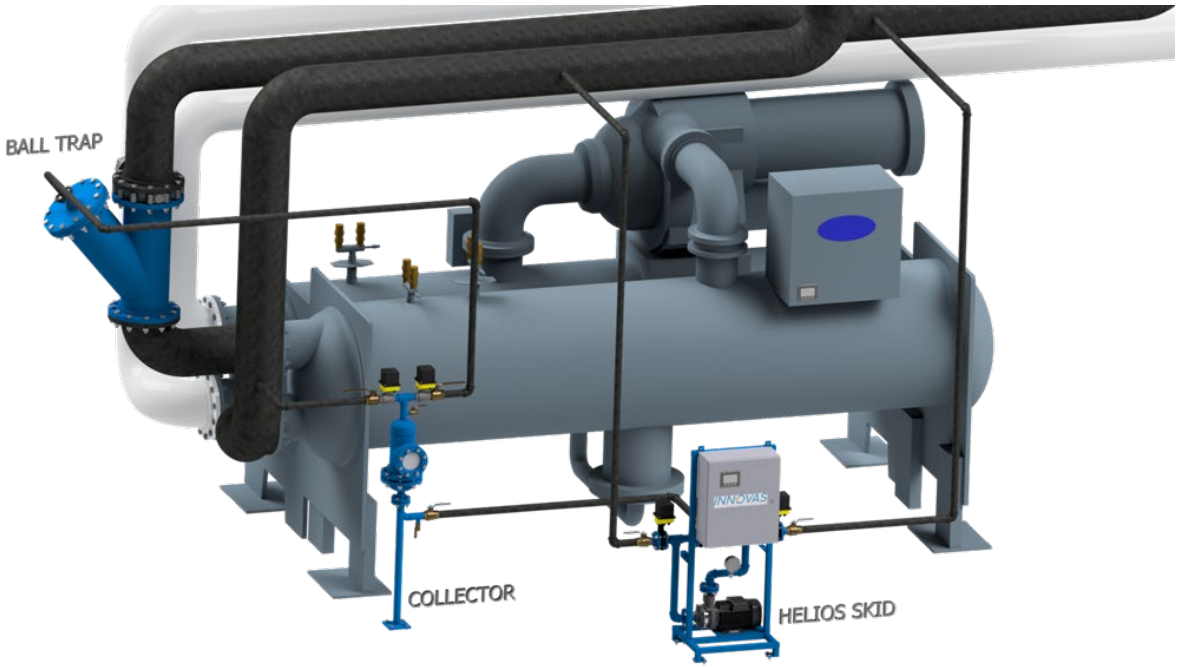


Figure 1. Typical Configuration for Helios Tube Cleaning System® on a Single Exchanger

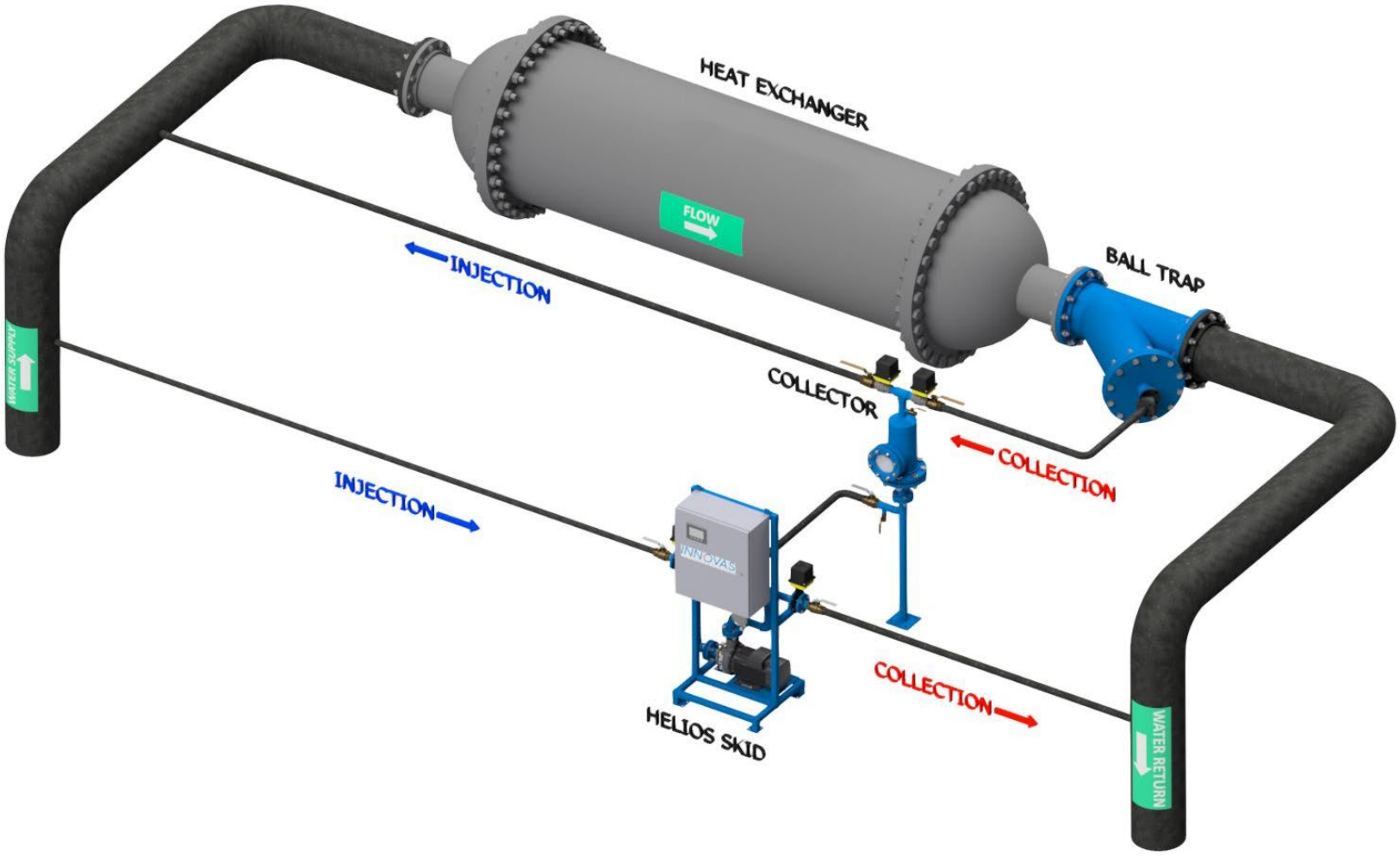


Figure 2. Typical Configuration for Helios Tube Cleaning System® on Multiple Exchangers

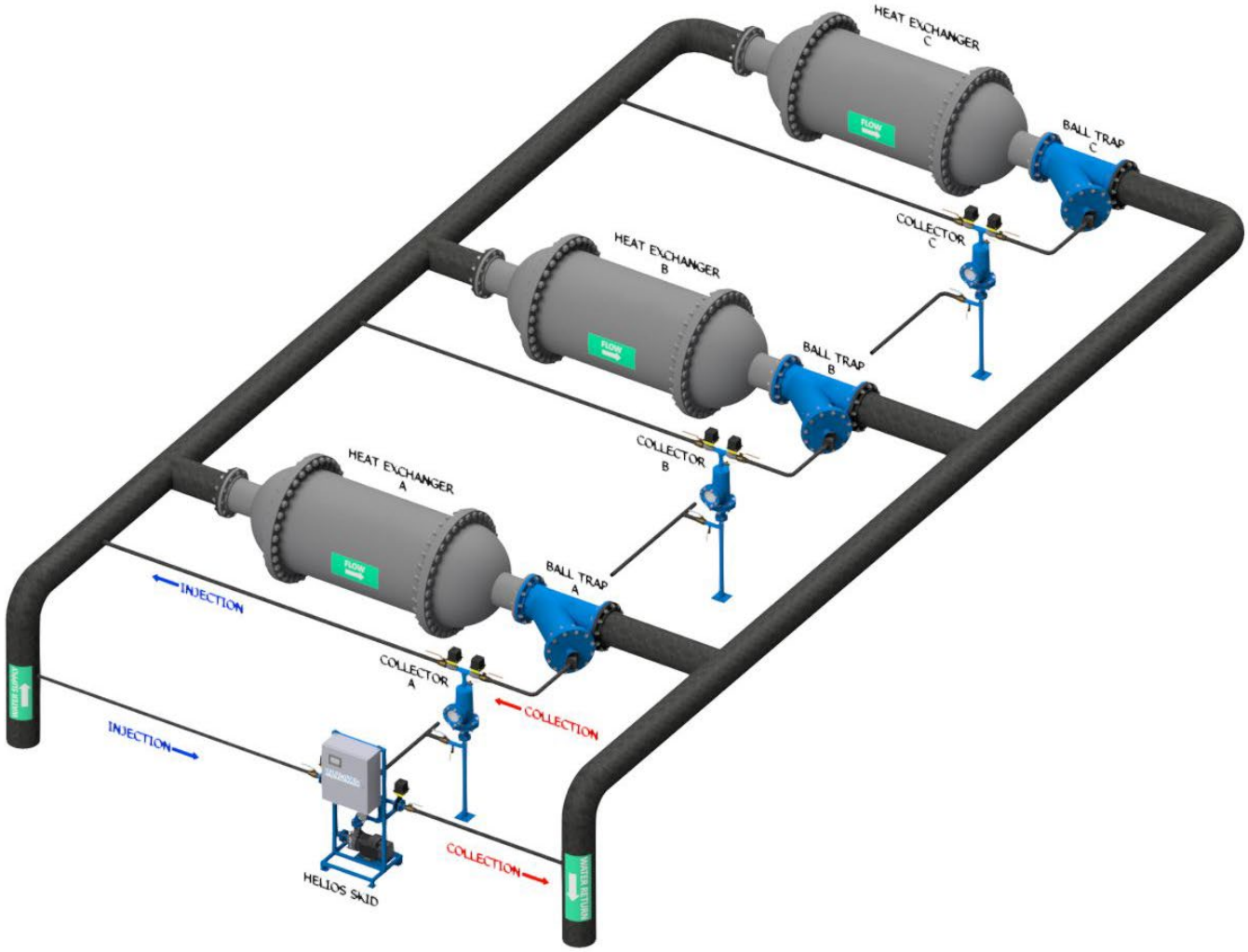
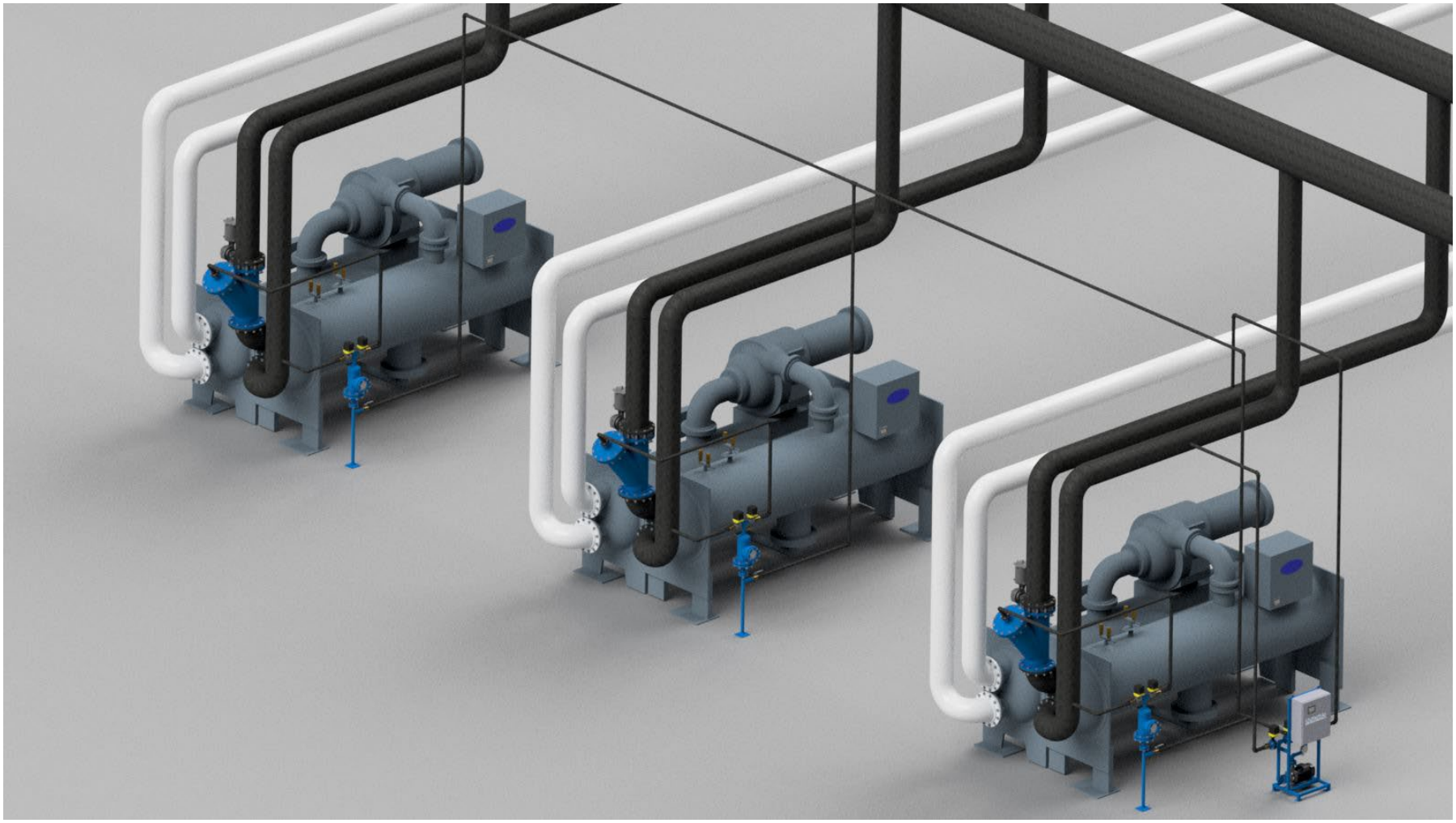


Figure 3. Example Layout for Helios Tube Cleaning System® on Multiple Chillers



GUIDE SPECIFICATIONS

AUTOMATIC TUBE CLEANING SYSTEM

PART 1 - GENERAL

1.1 Automatic tube cleaner shall be provided for the continuous online cleaning of the condenser tubes.

1.2 The automatic tube cleaning system shall utilize sponge balls injected under water pressure at preset intervals. Substitutes or systems using continuous flow of balls in heat exchangers will not be permitted. Each tube cleaning system shall have one ball collector and one ball trap serving one heat exchanger with the following characteristics.

1.3 Mechanical systems and piping components shall be designed and manufactured in accordance with relevant engineering standards for pressure piping systems, as specified on the sales order: ASME 31.1 Power Piping; ASME 31.3 Process Piping, and/or ASME B31.9 Building Services Piping.

1.4 Electrical and control systems and enclosures shall be designed and manufactured in accordance with National Electrical Code (NEC) requirements. Enclosures shall provide a minimum NEMA 12 protection level.

1.5 The automatic tube cleaning system supplier shall have a documented track record of designing, providing, commissioning, and servicing automatic tube cleaning systems meeting the requirements specified below for government agencies, public institutions of higher learning, or publicly-traded companies for a minimum period of 5 years. Customer references shall be made available by the automatic tube cleaning system supplier upon request.

1.6 Warranty: Manufacturer shall repair or replace any failure caused by defects in material and workmanship for a period of one (1) year from the date of first use or eighteen (18) months from date of shipment, whichever occurs first.

PART 2- PRODUCTS

2.1 Cleaning ball injection shall utilize a periodic cleaning ball injection system, with injections at programmed time intervals, and using a water pump to inject cleaning

balls into the heat exchanger water inlet piping. The injection and collection process shall ensure:

A. All balls shall be injected at once and reach heat exchanger tube sheet simultaneously.

B. Balls shall randomly disperse, cleaning both central and peripheral tubes and providing a ball cleaning run through each individual tube at least once per 24 hours of system run time.

C. The ball injection process shall not inhibit the heat exchanger cooling water flow. Systems that interrupt cooling water flow and/or change flow direction in the heat exchanger tubes will not be permitted.

D. Cleaning balls shall not travel through pump impellers where they may get sheared or damaged, resulting in frequent replacement or reduction of cleaning ball life.

E. The cleaning ball injection process shall be capable of interlocking with a permissive signal indicating sufficient cooling water flow is recognized in the heat exchanger prior to cleaning ball injection.

F. The cleaning ball collection process shall be accomplished via the same pump and controller as the cleaning ball injection process.

G. In order to maximize heat transfer process efficiency, the collection process shall not route heat exchanger outlet water back to the heat exchanger inlet during collection.

2.2 The Collector is the site for ball residence before and after ball injection. Each Collector shall be constructed of carbon steel with internal and external epoxy painting, and all materials and components shall be rated for cooling water system design pressure and temperature in accordance with the requirements of Section 1.2. Each Collector shall serve a single heat exchanger. The Collector shall provide an observation window for quick inspection of ball condition and provide access for replacement of cleaning balls.

2.3 The Controller shall be a micro-processor based, programmable application controller utilized to manage cleaning of heat exchangers, and shall be capable of communication with existing or new Building Automation Systems (BAS) and/or Direct

Digital Controls (DDC) at the installation site via BACnet or MODBUS communication protocols as specified on the sales order, without Protocol Translators, Communication Bridges, or Gateways.

The controller shall provide a local human machine interface (HMI) and shall provide a graphical user interface (GUI) touchscreen for local indication and control of operations.

The controller shall allow local control, presetting of ball injection times and frequency of cleaning each heat exchanger.

The controller shall provide alarms and notifications of the following conditions:

- System Fault - Pump Fault - Ball Change Required
- Valve Fault - Permissive Fault

2.4 The injection pump shall be of centrifugal design, close-coupled to a totally enclosed fan- cooled motor, and sized to inject cleaning balls and water into the heat exchanger inlet piping. Cleaning balls shall not be circulated through the pump impeller. One water pump will be used to inject balls into one heat exchanger at a time. The pump shall be installed in a manner that does not recirculate effluent water. A system allowing mixing of inlet and outlet heat exchanger cooling water shall not be permitted.

2.5 Pump Skid and Collector piping shall be designed and constructed in accordance with the applicable engineering standards referenced in Section 1.2.

2.6 A Ball Trap shall be installed in each heat exchanger's water outlet piping. Ball Traps shall have the following characteristics:

A. Ball traps shall be cylindrical shaped containing perforated stainless steel screens. Primary ball collection area shall be located outside the heat exchanger outlet pipe primary flow with ball collection at end of the ball trap.

B. Ball trap strainer open area shall be at minimum 3.0 times larger than the cross-

sectional area of the piping nominal size.

C. The ball trap may not have any moving parts, reducing wear and tear and associated maintenance requirement. Systems using mechanically actuated screens or slotted bars will not be permitted.

D. The ball trap shall guarantee 100% zero ball escape to downstream processes.

2.7 Equipment shall be as manufactured by Innovas or approved equal.

PART 3- EXECUTION

3.1 The tube cleaning system supplier shall provide factory-trained and authorized personnel to perform equipment commissioning and training of site maintenance staff.

3.2 The tube cleaning system supplier must be able to provide maintenance services by factory trained and authorized personnel.

END OF SECTION

For more information about Innovas Technologies' products and services please contact our Authorized Distributor:

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