

**Raychem**

# SKIN-EFFECT HEAT-TRACING SYSTEM (STS)

## ENGINEERED SOLUTIONS

Pentair Thermal Management offers innovative integrated technologies under our market leading brand, Raychem STS, to offer unique customized solutions for longline heat management systems and other specialized heating requirements. Our proven proprietary engineering design program offers optimized designs and engineered solutions for a variety of applications. Our global engineering network and regional knowledge centers combined with office presence in over 48 countries position us to handle heat management systems for many types of applications throughout the world.

## THE HEART OF THE SOLUTION

As the inventor of self-regulating heat tracing and other heat management system solutions, our Raychem brand is recognized for technology leadership in the industries we serve. The Raychem STS system is a versatile Heat Management System (HMS) designed to deliver heat for pipelines that can be hundreds of kilometers long. Applications include: material transfer lines, snow and ice melting, tank foundation heating, structural heating, sub-sea transfer lines and prefabricated, pre-insulated lines. As the industry leader in offering single source responsibility for heat management, Pentair Thermal Management and the Raychem brand are uniquely qualified to offer Skin Effect Heating Systems that combine system engineering expertise with proven procurement, construction, and quality assurance capabilities.

## GLOBAL LEADERSHIP

The Raychem STS Heat Management System occupies a unique position in the industry as the preferred choice for critical applications. With over 600 installations spread over several continents and geographical regions we provide safe and reliable solutions for the most demanding applications.

We have successfully managed applications ranging from long sulphur pipelines spread over hundreds of kilometers in the hot deserts of the Middle East to maintaining the flow of products through the pipelines in the coldest parts of Canada. We've designed various long crude oil pipelines in Russia including one pipeline over 160 km long and the world's longest 700 km underground heated pipeline in India. We've also successfully delivered heat for a large LNG concrete structure located in the Adriatic Sea. These are just a few testimonials highlighting our ability to meet our customer's critical expectations throughout the world.

Pole to pole, a unique engineered system solution partner in Heat Management Systems.

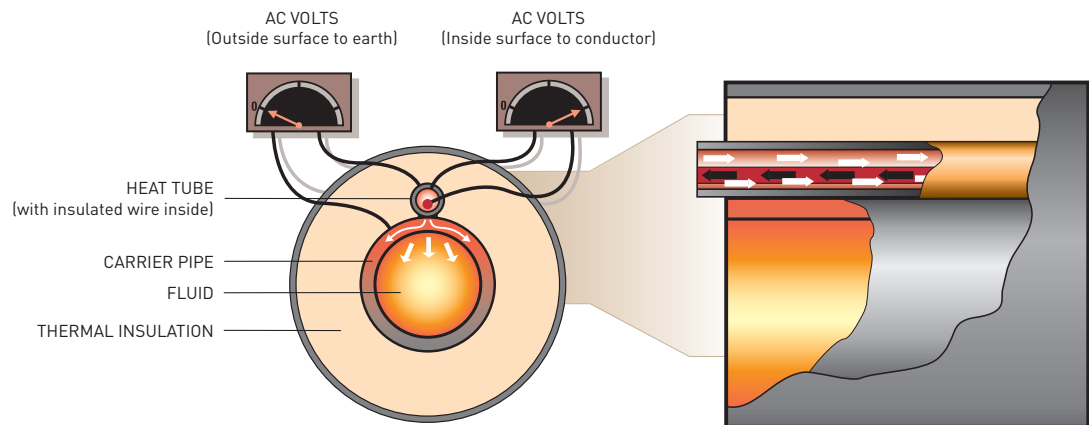
# ENGINEERED SOLUTIONS FOR OPTIMUM SYSTEM PER

## EACH STS SYSTEM IS CUSTOM ENGINEERED TO MEET THE HIGHEST PERFORMANCE STANDARDS

Raychem STS Systems can be designed for:

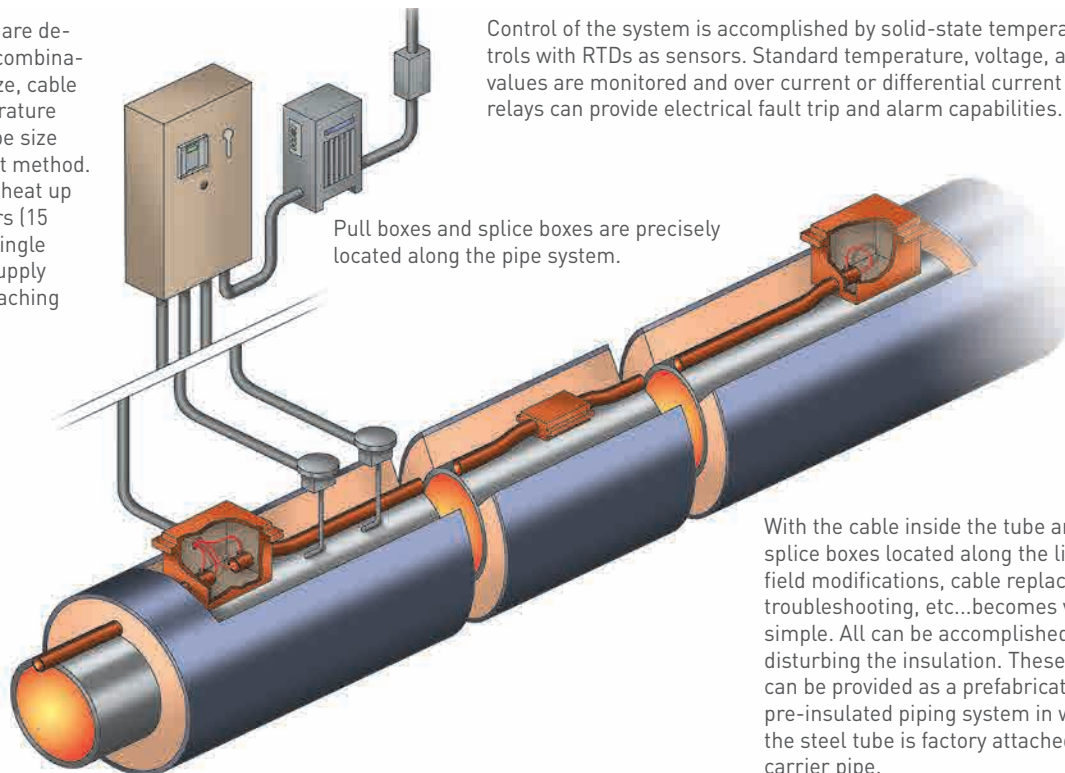
- Circuit lengths up to 25 kilometers (15 miles)
- Power outputs up to 150 W/m (49.2 W/ft)
- Maintain temperatures up to 200°C (392°F)
- Exposure temperatures up to 250°C (482°F)

### STS TECHNOLOGY



### STS SYSTEM

Circuit lengths are determined by a combination of cable size, cable voltage, temperature rating, heat tube size and attachment method. It is feasible to heat up to 25 Kilometers (15 miles) from a single source using supply voltages approaching 5,000 volts.



Control of the system is accomplished by solid-state temperature controls with RTDs as sensors. Standard temperature, voltage, and current values are monitored and over current or differential current protection relays can provide electrical fault trip and alarm capabilities.

With the cable inside the tube and pull/splice boxes located along the line, any field modifications, cable replacements, troubleshooting, etc...becomes very simple. All can be accomplished without disturbing the insulation. These systems can be provided as a prefabricated and pre-insulated piping system in which the steel tube is factory attached to the carrier pipe.

# PERFORMANCE

The Raychem STS System consists of a thermally rated, electrically insulated wire installed inside a ferromagnetic heat tube. The insulated wire is connected to the heat tube at the end termination, and an AC voltage source is connected between the heat tube and insulated wire at the power connection. AC current flows down the wire, returning on the inside surface of the tube. The STS System is electrically safe and produces heat in the ferromagnetic tube through the effects of two well-known electrical phenomena: Skin Effect and Proximity Effect. These phenomena cause the current flowing in the heat tube to be concentrated on the inner surface; the current concentration is so complete there is virtually no measurable voltage on the outer wall of the heat tube. Heat is also generated due to the resistance of the heat tube and STS wire, and through eddy currents and hysteresis in the heat tube. Since the heat tube is attached to the process pipe and completely within the thermal insulation system, heat is efficiently transferred into the process pipe.

## STS WITH BUNDLED TECHNOLOGIES

The Raychem STS System combined with state of the art complementary technologies has revolutionized Heat Management System (HMS) performance

- Fiber optic based distributed temperature sensing system (DTS) has significantly enhanced the safety and reliability
- Pre-insulated/pre-fabricated piping systems has proven to be a major factor in the thermal performance of the pipelines with homogenous temperature for the pipelines
- FEA / CFD modeling has become a critical tool in designing optimized systems and predictable system performance

## WHY RAYCHEM STS?

**Safe:** Fully grounded system with zero electrical potential on pipe surfaces

**Accurate Control:** A closed loop control system includes redundant temperature sensing

**Engineered:** Systems are custom engineered in accordance with ANSI/IEEE 844, NEC 426/427 and plant standards

**Maintainable:** Pull/splice boxes simplify access to the system without disturbing insulation

**Rugged & Reliable:** Entire circuit is encapsulated within rugged heat tubes and steel boxes

**Longline Capability:** Circuit lengths up to 25 kilometers (15 miles) from a single power source

**Simulation Studies:** Temperature profile plotting capability

**Computerized Design:** Runaway temperature, dynamic static heat-up/cool-down calculations available

**Flexibility:** Ideal for either factory fabricated, pre-insulated or field installed system

# APPLICATIONS

## MATERIAL TRANSFER LINES

Whether from dock to tank farm or direct to a process unit, the long circuit capabilities of the Raychem STS System provides the lowest cost and safest heat management system available.



## SNOW & ICE PREVENTION

Sidewalks, people-moving platforms and airport ramps are examples of large critical areas demanding snow and ice prevention. By minimizing the number of circuits, the Raychem STS System provides a cost-effective solution to common snow and ice problems.



## TANK FOUNDATION HEATING

The Raychem STS System can be used in Class 1 Division 2 and Zone 2 hazardous areas creating a technically superior, commercially-attractive solution to prevent frost heave damage of LNG, LPG, ethylene, propylene and ammonia tanks.



## SUBSEA/SUBMERGED LINES

Emerging subsea technologies, including the development of integrated production umbilical (IPU) and submerged pipelines, demand a precise solution to heating underwater transfer lines. With the Raychem STS System pre-inserted wire/heat tube configuration, long lengths of wires are pulled in the heat tubes without having to use conventional pull/splice boxes or field splices.



## PREFABRICATED PRE-INSULATED LINES

The Raychem STS System is ideally suited for use with prefabricated, pre-insulated piping installations. These factory-fabricated systems offer energy efficiency improvements to the thermal envelope and facilitate field erection to significantly reduce total installed cost, improve system performance and compress critical project schedules.





[WWW.THERMAL.PENTAIR.COM](http://WWW.THERMAL.PENTAIR.COM)

**NORTH AMERICA**

Tel: +1.800.545.6258  
Fax: +1.800.527.5703  
Tel: +1.650.216.1526  
Fax: +1.650.474.7711  
[thermal.info@pentair.com](mailto:thermal.info@pentair.com)

**EUROPE, MIDDLE EAST, AFRICA**

Tel: +32.16.213.511  
Fax: +32.16.213.603  
[thermal.info@pentair.com](mailto:thermal.info@pentair.com)

**ASIA PACIFIC**

Tel: +86.21.2412.1688  
Fax: +86.21.5426.2917  
[cn.thermal.info@pentair.com](mailto:cn.thermal.info@pentair.com)

**LATIN AMERICA**

Tel: +55.11.2588.1400  
Fax: +55.11.2588.1410  
[thermal.info@pentair.com](mailto:thermal.info@pentair.com)

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