LIBERTY ELECTRIC PRODUCTS

Industrial Heat Trace

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Agenda

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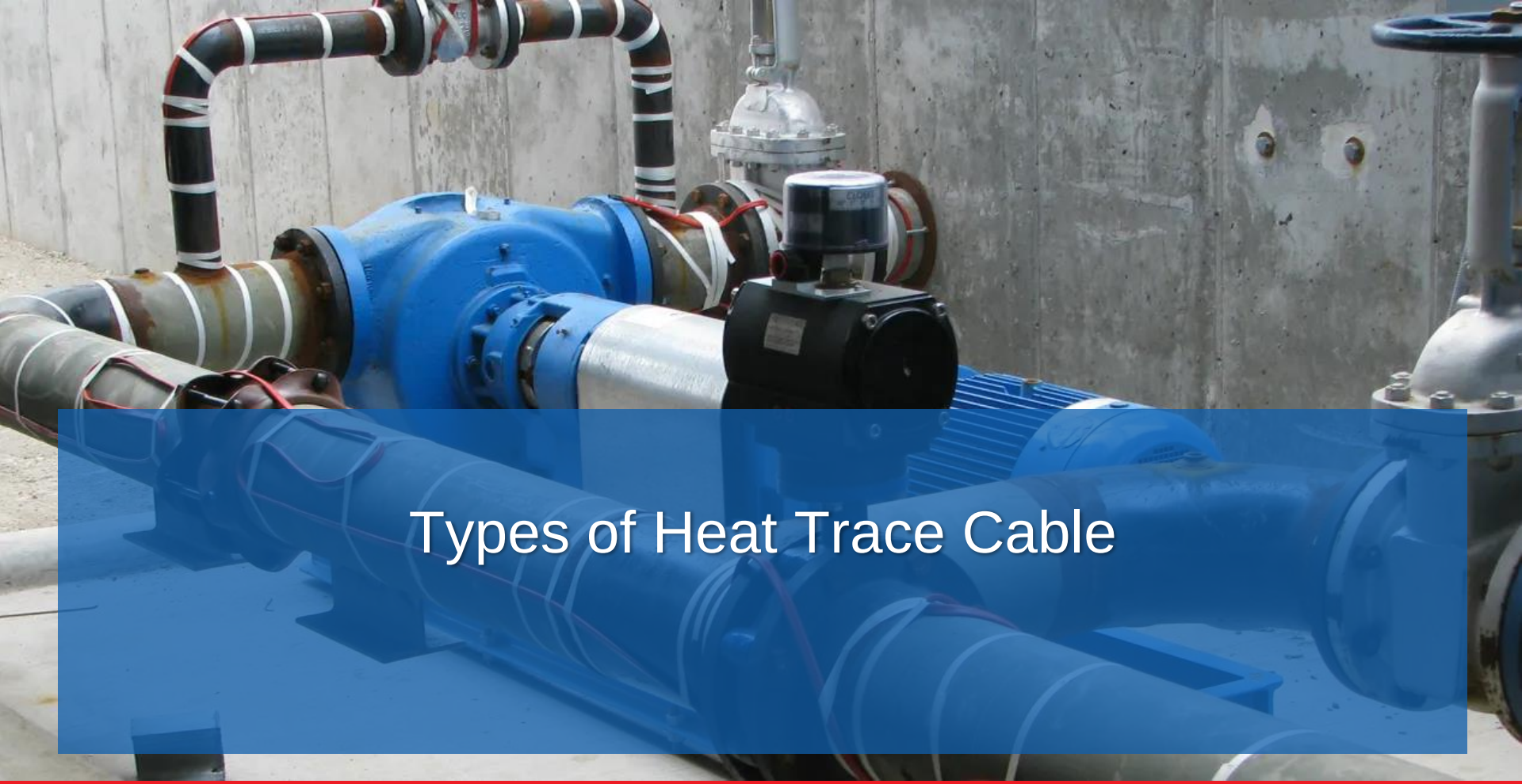
  - Cable On Pipe Installation Tips



Types of Heat Trace Cable

Heat Cable

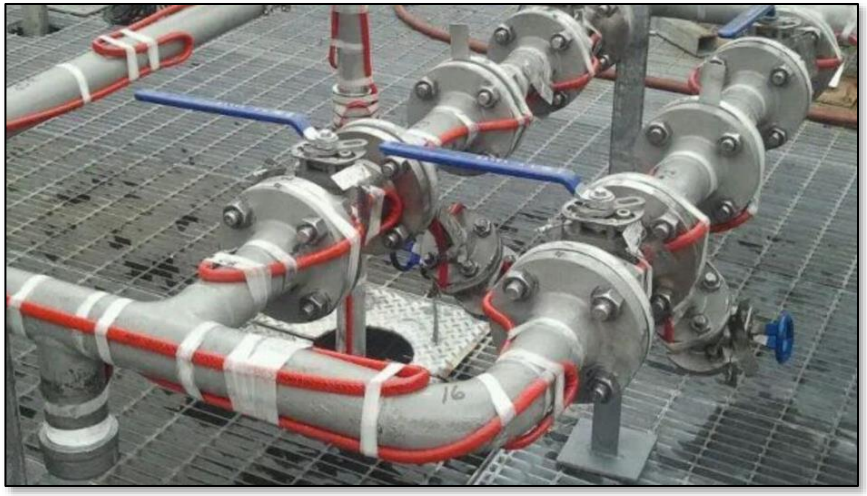
- Heat cables are a versatile heating product primarily used in the industrial setting for pipe temperature maintenance and freeze protection.
- “Temperature maintenance” refers to keeping fluid at the same, consistent temperature while it moves from location to location through the pipe.
- “Freeze protection” doesn’t have to be @ 32°F. There are many chemicals, petroleum products, syrups, etc., that endure different viscosity challenges.

Heat Cable

- Heat tracing cable is not meant to add any heat to the pipe - it is used to counter heat losses (per foot) off the pipe.
- Calculating heat losses off the pipe skin is directly related to its diameter, thickness of insulation being used, and the temp. range required for heating.

Heat Cable

- Heat losses are referred to in “watts per foot” terms. And, heat cables are constructed for specific wattage outputs, and for “self-regulating” performance.
- Heat cable is useless without insulation, which also needs heat cable to withstand extended periods of time under lower-temperature conditions.



3 Main Types of Heat Cable

- **Self-Regulating**
  - Variable wattage output, highly versatile, and very easy to work with, self-regulating is the most commonly used heat cable.
- **Constant-Watt**
  - Malleable and easy to work with, constant-watt cable output is consistent. It has a similar life expectancy and can be a great alternative to self-regulating.
- **Mineral-Insulated**
  - Available in copper and stainless sheath, this cable is highly robust, has a constant wattage output, capable of high watt density, and has a very long life expectancy.

Self-Regulating Cable

- **Low Temp Self-Regulating** cable is extremely versatile, relatively easy to work with, and usually the least expensive, making it the most commonly used heat cable for most commercial/industrial applications.
- **SR cable works through expansion and contraction between the buss wires to vary, *or "self-regulate" its wattage* output based on the temperature it is up against.**

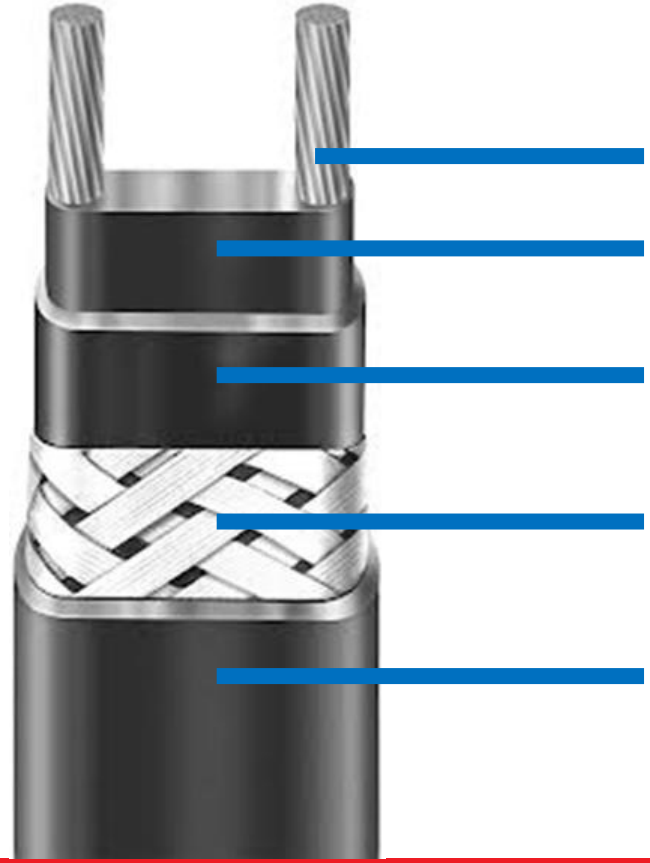
- **3, 5, 8, 10, 12, typical wattage outputs.**
- **Output is determined by irradiated carbon content and surface temp.**
- **Cable can crossover/touch itself without burning through.**
- **Most energy-efficient cable choice.**
- **Low temp SR cable good to 150°F/180°F max.**
- **Class 1, Div. 1 available.**

Self-Regulating Cable

- **Process and medium temp SR cables** run hotter than low-temp SR, and therefore cannot be used on anything other than metallic pipe.
- Otherwise, they behave exactly like they're low-temp counterparts.
- Class 1, Div. 1, groups B, C, D.

- **Medium temperature SR cable**
  - Up to 300°F temp. maintenance.
  - Up to 420°F jacket exposure temp. max.
  - Single or dual monitor wires optional.
  - 5, 8, 10, 15, 20 w/ft. choices.
  - Metallic pipe only!
- **Process temperature SR cable**
  - Up to 230°F temp. maintenance.
  - Up to 275°F jacket exposure temp. max.
  - For use on Metallic pipe only.
  - 5, 10, 15, w/ft. choices.

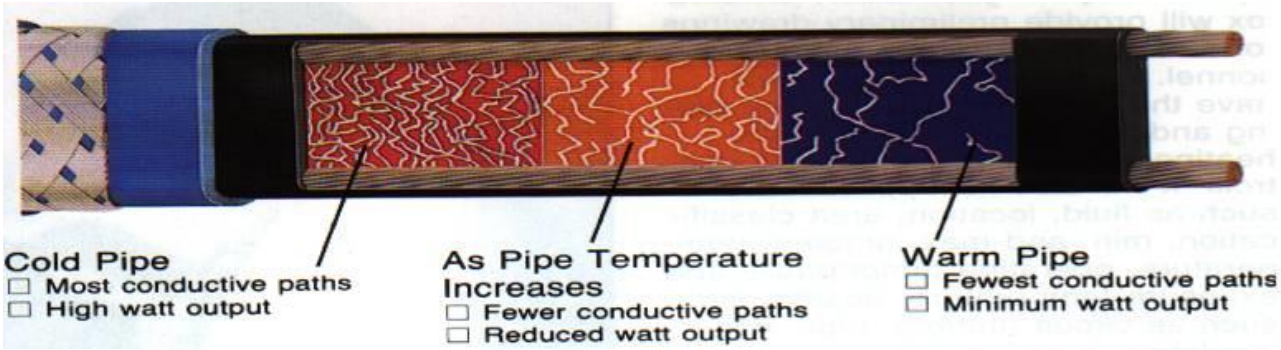
Self-Regulating Cable



- Buss wire
- Irradiated Carbon matrix (Carbon Black)
- Primary over-jacket
- Tinned copper over-braid
- UV or chemical resistant over-jacket

Self-Regulating Cable

- Carbon black suspended in polymer matrix is used to conduct current between parallel buss wires.
- Expansion and contraction of polymer matrix versus temperature causes output variation.
- Output wattage and temperature controlled by mix of polymer and carbon black.



Self-Regulating Cable

- **Recommended circuit lengths for 5w/ft. cable (not to exceed)**

30A 2-pole breaker:

120V – 270ft.

208V – 400’

240V – 450’

277V – 540’

- Has a limited life expectancy. Wattage output diminishes over time and conditions (10-15 yrs. on avg. with controls).
- **120-277 single phase only – in stock.**
- Limited circuit lengths based on total **POTENTIAL** wattage draw/voltage: **Use max wattage output per ft. divided by voltage for sizing 30A 2-pole breaker.**

Constant-Watt Cable

- Constant-watt cable is versatile, easy to work with, and priced similarly to SR cable.
- **Constant-watt cable delivers a predictable, consistent wattage output.**
- **Typically used for metal pipe/vessel/container tracing and frost heave prevention applications.**
  - **It cannot be used for non-metal pipe tracing.**

- **12 AWG buss wires.**
- **4, 8, and 12 watt/ft. outputs.**
- **Ni-Chrome resistance wire.**
- **120 – 480V range.**
- **Can perform up to 320°F/390°F max.**
- **Class 1, Div. 2, groups A, B, C, D.**

Constant-Watt Cable

- Buss Wire(s)
- Primary Buss Over-jacket
- Resistance Wire
- Primary Over-jacket
- Tinned Copper Over-braid
- UV or Chemical Resistant Over-jacket

Constant-Watt Cable

Advantages:

- Operate Standard Voltages; 120V to 480V
- No Start-Up Current
- Cut-to-Length Flexible - Easy to Install
- CID2 & Zone 1 & 2 Certifications

Limitations:

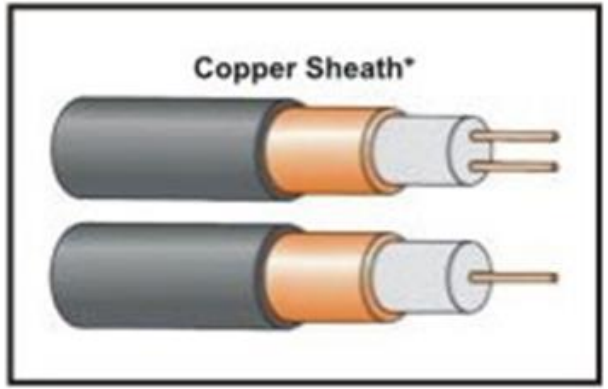
- **Can’t overlap/touch itself**
- Medium-length circuits
- Use on metallic only
- Installation - cutting cable produces no heat to the next node

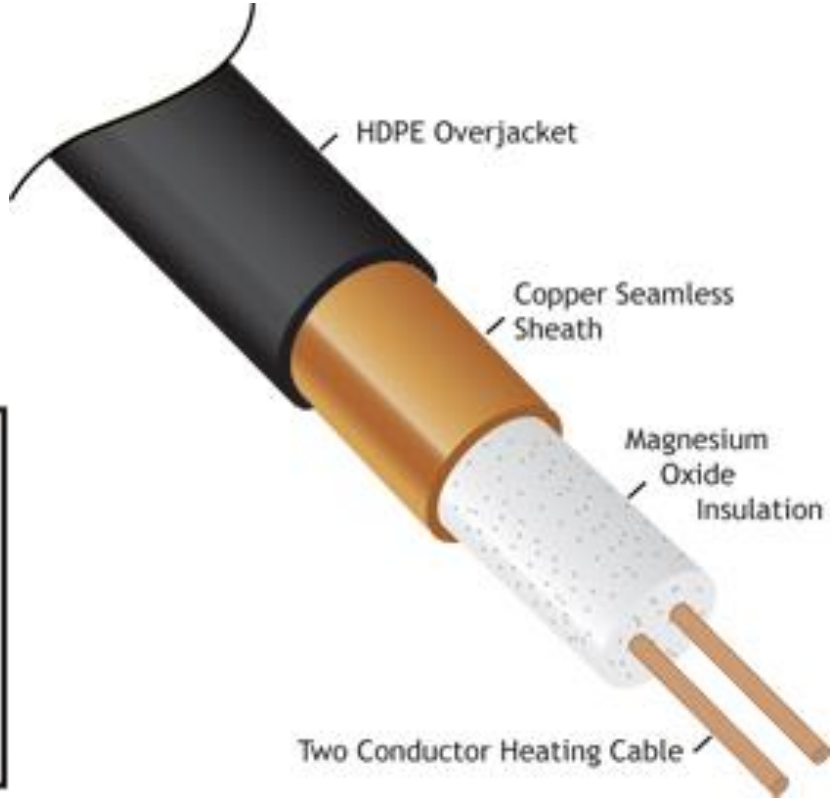
Mineral-Insulated (M.I.) Cable

- M.I. cable is rigid, heavy, and typically produced in runs under 400’.
- Capable of carrying higher voltages, and high watt densities, M.I. cable is engineered and manufactured to specification.
- **M.I. cable can be constructed as a single, or 2-conductor cable. It’s delivered pre-terminated and cannot be field spliced or easily repaired.**
- It’s typically used for “permanent” style installations, or where an extremely robust cable is needed.

- **Constant wattage output.**
- **Copper and stainless-steel sheath types.**
- **Robust, durable, and high life expectancy.**
- **120 – 600V range.**
- **Can perform up to 1100F/1400F max.**
- **Class 1, Div. 2, groups A, B, C, D.**

Mineral-Insulated (M.I.) Cable





Mineral-Insulated (M.I.) Cable

Advantages:

- High Exposure Temperature Capabilities (1100° F), (593°C)
- High Maintenance Temperature (up to 800° F), (426°C)
- High Watt Densities (up to 80 w/ft.), (266 w/m)
- Long Circuit Lengths (up to 4,000 ft.), (1220 m)
- Rugged
- Easy to Monitor
- CID1/CID2 and Zone 1/Zone 2 Certifications

Limitations:

- Exact Measurements Required
- Difficult Repair
- Relatively Inflexible – More Difficult to Install
- **CANNOT** Overlap/Touch Itself

Industrial Applications

Freeze Protection

- Freeze protection is a very common application at industrial facilities from moving water, fluids, chemicals, etc. between buildings, emergency eyewash and shower stations, and managing drainage/waste flow.

- Freeze protection is a less exact application vs. process temperature maintenance. Typically, this application has a range of temperatures that are acceptable to keep fluids viscous and moving vs. the finite range of process heating.

- With water, we typically use a temperature range of protection that spans 40°F down to -20°F. Depending on your conditions, that can change accordingly.

Process Temperature Maintenance

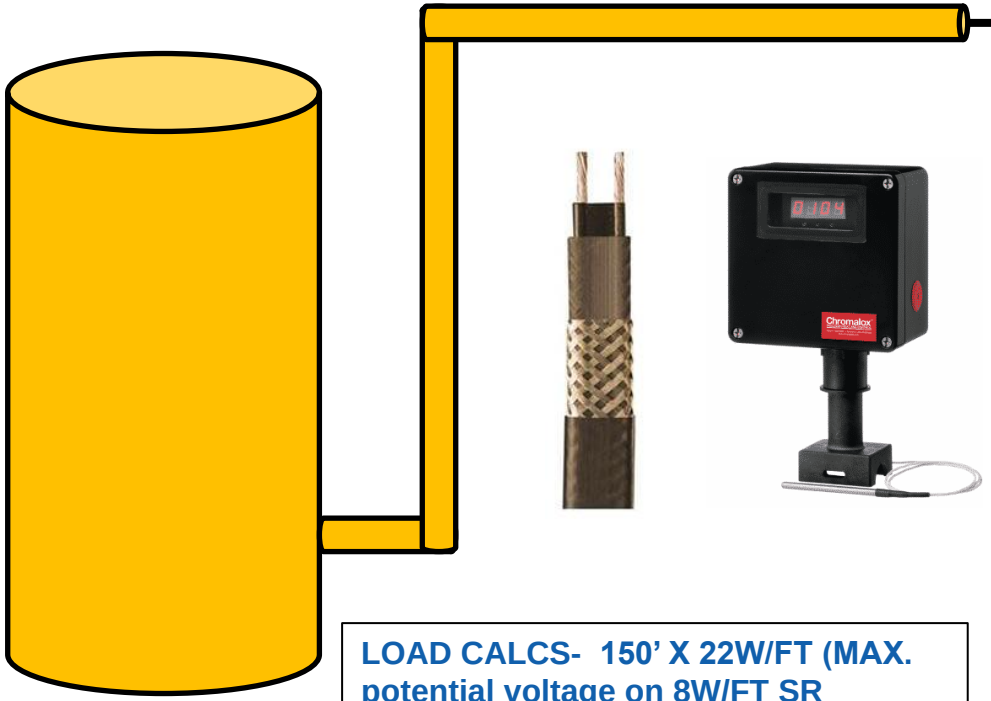
- Process temp. maintenance is about offsetting literally all or most of the losses from the skin of the pipe while moving fluid from one location to another because the fluid needs to be kept at a specific temp. range.
- Process temp. calculations are based on the temperature of the fluid leaving the tank, and what range of ambient temperatures the pipe is subject to. If you have 150°F fluid leaving a tank and its 60°F ambient temp. inside the plant, your calculations are based on a 90°F delta T.
- Because process temp. maintenance can often require higher temp. set points, heating cables with higher temp. rated jacketing can come into play.

Process Temperature Maintenance

- Process temperature maintenance also applies to COP processes also- ensuring water temperatures remain high/at desired from its source to the cleaning application.

- Process temperature maintenance also applies to recovering/returning condensate to steam systems, retaining more heat means less energy is needed by the boiler to reheat and re-convert to steam.

Process Temp. Sample Design



LOAD CALCS- 150’ X 22W/FT (MAX. potential voltage on 8W/FT SR CABLE) = 3300 Watts

3300W/240 Single Phase = 13.75A

- **To process:**
  - Fluid is 140°F leaving tank and must be kept at 140°F.
  - Process equipment is 150’ away.
  - Pipe is schedule 40, 2” dia.
  - 1” foam insulation.
  - 240V power.
- **Calculation:**
  - Inside plant ambient temp. 60°F.
  - 80f delta T (140°F fluid temp. minus ambient temp.).
  - 0.069 insulation factor based on 2” dia. pipe.
  - 5.5-watt loss per ft.
- **Recommendation:**
  - 6-8 w/ft. self reg. cable/single circuit control.
  - 6-8 w/ft. CW cable/single circuit control.

Controls

Controls

- Controls can range from basic, single point to multi-circuit panels capable of full PLC/HMI control, circuit mapping, remote alarms, and highest levels of information, monitoring, and safety. There are also base level, lower capability, and more price-competitive models available.

- These panels are built to order, and GFI breaker-integrated, so installation can take considerably less time. Typically range from 4-72 circuits, along with expansion capability.

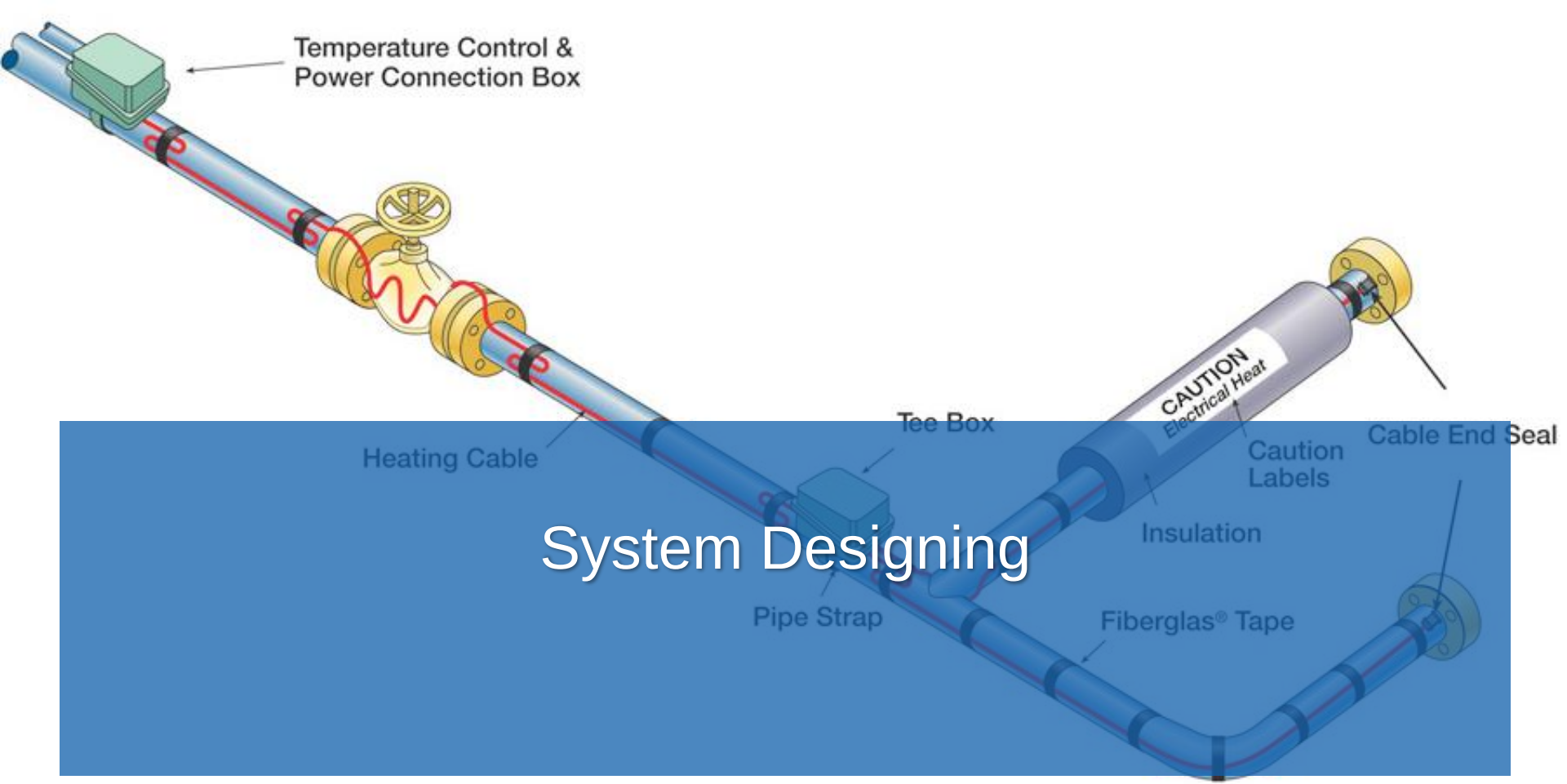
- Single and dual circuit panels are also available based on similar technology. These panels offer a high level of monitoring and information for competitive prices.

Controls

- GFI contactor relay panels with controller + sensor are also very popular control packages. These are roughly half the cost of full breaker integrated panels and meet GFI code requirements. These panels can be set up with 30, 40, or 50A contactors and typically range from 2-12 circuits in a single-panel box.
- These panels will typically have contacts to allow for simple on/off monitoring or GFI alarm. They are easy to install and have a smaller footprint than fully integrated panels.
- Controllers are needed to open the contactors, and controllers must have sensors. RTDs, and moisture/temp. sensors are the most popular based on application.

Controls

- Single-point controls are the most basic controls, but even they have levels of complexity. Digital, RTD-integrated, alarm-capable, and C1D2-compliant down to simple bi-metal bulb and capillary stats can be employed for pipe tracing applications.
- Ambient air-sensing single-point controls can also be used for pipe tracing.
- These are 120-277V rated and have a contactor within to allow power to pass. Some have GFI capability and can manage up to 40A.



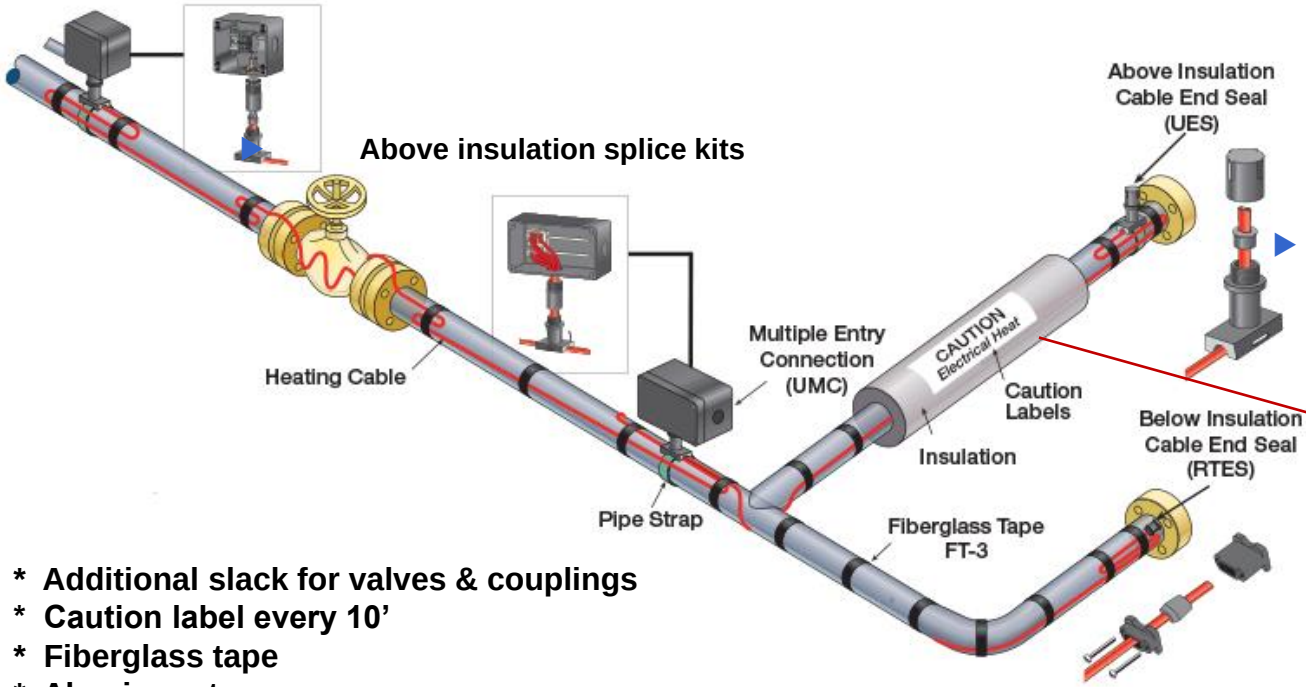
System Designing

System Design Basics

- Minimum information needed includes:
  - Voltage(s)/amperage available.
  - Pipe diameter, length, and layout.
  - Insulation thickness & type.
  - Temp. range/application:
    - Freeze protect? (usually not pressurized)
    - Process? (usually pressurized)

- Site/application info. to consider:
  - Confirm site voltage reading.
    - Voltage de-ration.
  - What other equipment is being fed from the same panel?
    - Any power conditioning/surge protection?
  - Tough pipe to get to?
    - Any justification for adding redundancy?
  - J-box and splice kit locations and controls.

System Design Basics



LED lighted end seal kits

Down & Back vs. Splice kit

* Additional slack for valves & couplings
* Caution label every 10’
* Fiberglass tape
* Aluminum tape

System Design Basics

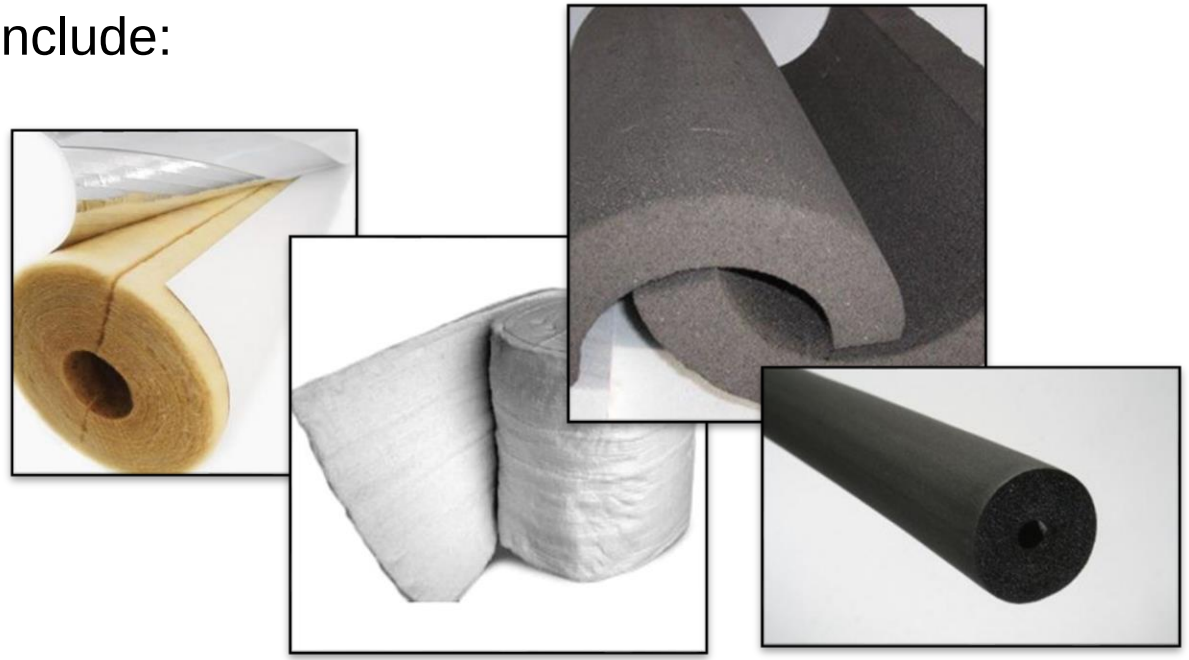
- Metal pipe gives you far more forgiveness vs. PVC/other.
- You can absolutely melt/deform plastic pipe with too much heat.
- The thicker the insulation, the less wattage cable you'll need.
- Linear cable runs; no reason to spiral wrap in most cases.
- Stay to the outside of radius bends.
- Using aluminum tape with PVC pipes, or larger dia. metal pipe helps spread heat/widen the footprint across the pipe surface.
- Always use the above insulation splice boxes and electrical connections.
- Less splicing is better; there's less chance for voltage drops, bad terminations.
- Figure circuits with 30A 2-pole breakers as standard if possible.

System Design Basics - Controls

- Pipe sensing vs. ambient - pipe sensing is the way to go. It's more accurate and more efficient.
- As basic and effective as it gets? Single circuit bulb and cap digital thermostat combined with an end seal light.
- Customer concerns and the age of service panel/breakers will help dictate how complex you want to design controls.
- DO NOT pull power from panels that have big motors/amp draws/lots of power fluctuation.
- When using digital controllers or advanced controls, surge protection is a must.
- 120 & 240V designed cable voltage; 277V runs hot, 208V runs lower.

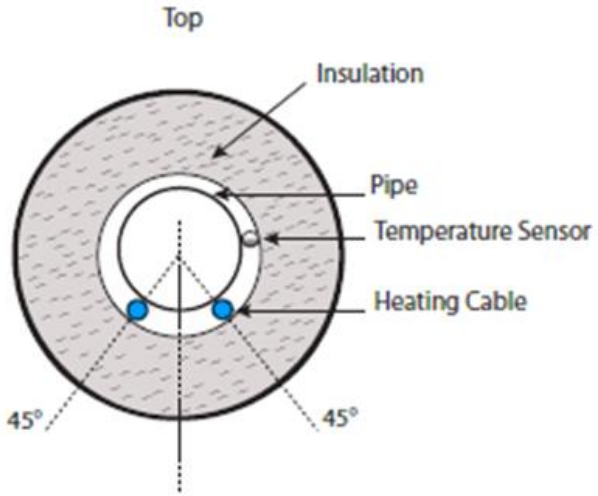
Insulation Types

- Insulation types differ in material, heat loss factor, price, etc.
- Some of the materials include:
  - Fiberglass
  - Foamglas®
  - Rubber
  - Calcium Silicate
  - Ceramic Blanket
  - Mineral Wool
  - Spray Foam



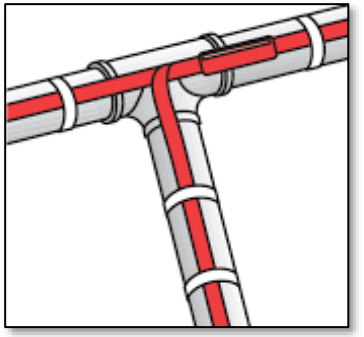
Installation Tips

- Linear runs vs. spiral wrapping
- Position cable at 5 or 7 o’clock
- Use extra cable slack for valves, couplings, etc.
- Use aluminum tape to help dissipate heat on the surface, ideal for PVC-based pipes, or over 4” diameter
- Use more than 1 linear run for pipe diameters over 4”
- Position sensing RTD opposite the heat cable run
- Resistance check cables and record MEGGER, MEGGER, MEGGER!



Installation Tips

- Proper installation and commissioning are recommended for a successful system and in most cases impact the system's success.
- **Improper terminations and lack of testing are the typical problem areas of most installations.** Water/liquid ingress can also create installation problems.
- Insulation testers (Megger test) are highly recommended to ensure the cable has not been damaged before, during, or after the installation.



Summary

- Electric heating cables are a versatile product that offers a wide variety of applications across the industrial spectrum. Considering they are all single-phase elements, installation is predictable and not very complex, and heat cables have a long service life expectation.

- For process, electric heating cables can maintain fluid temperatures more accurately and efficiently than most primary systems. Fluctuations in temp. can ruin products and cost more in primary utility costs trying to offset its own losses.

- Freeze protection is self-explanatory. The costs of frozen-burst pipes are very quickly (and expensively) realized.

Thank You

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