

# SELF-REGULATING/POWER-LIMITING DESIGN WORKSHEET

## Thermal Design, Heating Cable, Component, and Accessory Selection

### DESIGN CRITERIA

| Location                   | Area classification | Area T-rating | Pipe maintain temp. ( $T_m$ ) | Minimum ambient temp. ( $T_a$ ) | Delta temp. ( $\Delta T = T_m - T_a$ ) | Start-up temp. | Process operation and limit temp. | System limit temp. |
|----------------------------|---------------------|---------------|-------------------------------|---------------------------------|--|----------------|-----------------------------------|--------------------|
| indoors                    |                     |               |                               |                                 |  |                |                                   |                    |
| outdoors                   |                     |               |                               |                                 |  |                |                                   |                    |
| <b>Example</b><br>Outdoors | Hazardous CID2      | T2 (300°C)    | 80°F                          | -20°F                           | 100°F                                  | 0°F            | 200°F                             | 500°F              |

### THERMAL DESIGN

| Line ID                    | Pipe size (inches) | $\Delta T = T_m - T_a$ | Insulation thickness (inches) | Base heat loss $Q_B$ (f=1) | Insulation type/f | Corrected heat loss $Q_T = Q_B \times f$ |
|----------------------------|--------------------|------------------------|-------------------------------|----------------------------|-------------------|--|
| <b>Example</b><br>example1 | 4                  | 100                    | 2                             | 6.6                        | Cal sil 1.5       | 9.8                                      |
|                            |                    |                        |                               |                            |                   |  |
|                            |                    |                        |                               |                            |                   |  |
|                            |                    |                        |                               |                            |                   |  |
|                            |                    |                        |                               |                            |                   |  |

### HEATING CABLE SELECTION

| Line ID                    | $Q_T$ heat loss (watts/ft) | $T_m$ maintain temperature | $T_{exp}$ maximum exposure temp. | Chemical exposure | Voltage | Pipe material | Heating cable selected |
|----------------------------|----------------------------|----------------------------|----------------------------------|-------------------|---------|---------------|------------------------|
| <b>Example</b><br>example1 | 9.8                        | 80                         | 200                              | organics          | 240     | CS            | 10QTVR2-CT             |
|                            |                            |                            |                                  |                   |         |               |                        |
|                            |                            |                            |                                  |                   |         |               |                        |
|                            |                            |                            |                                  |                   |         |               |                        |
|                            |                            |                            |                                  |                   |         |               |                        |

Self-Regulating/Power-Limiting Design Worksheet

CALCULATION OF HEATING CABLE LENGTH

| 1.                  | 2.           | 3.           | 4.                               | 5.  | 6.   | 7.  | 8.   |
|---------------------|--------------|--------------|----------------------------------|---|--|---|--|
| Line ID             | Feet of pipe | Spiral ratio | Feet for pipe<br>(col 2 x col 3) | Feet for valves<br>(# of valves x ft/<br>valve) | Feet for supports<br>(# of supports x<br>ft/support) | Extra cable for<br>connection kits<br>(3ft per kit) | Total heating<br>cable length<br>(Columns 4+5+6+7) |
| Example<br>example1 | 200          | 1            | 200                              | 2 x 4.3 = 8.6                                   | 10 x 1.5 = 15  | 6 x 3 = 18  | 241.6  |
|                     |              |              |                                  |   |  |   |  |
|                     |              |              |                                  |   |  |   |  |
|                     |              |              |                                  |   |  |   |  |
|                     |              |              |                                  |   |  |   |  |

CALCULATION OF CIRCUIT BREAKER SIZING

| Line ID             | Heater type | Total heating<br>cable length | Start-up temperature | Circuit breaker sizing |
|---------------------|-------------|-------------------------------|----------------------|------------------------|
| Example<br>example1 | 10QTVR2-CT  | 241.6                         | 0°F                  | 30 A 320 / 40 A 390    |
|                     |             |                               |                      |                        |
|                     |             |                               |                      |                        |
|                     |             |                               |                      |                        |
|                     |             |                               |                      |                        |

CONNECTION KITS AND ACCESSORIES

| Line ID           | Heating<br>cable<br>selected | Area<br>classification | Number<br>of circuits | Power<br>connection kit/<br>quantity | Splice/<br>quantity | Tee/quantity | End seal kit/<br>quantity |
|-------------------|------------------------------|------------------------|-----------------------|--------------------------------------|---------------------|--------------|---------------------------|
| Example<br>1001   | 10QTVR2-CT                   | CID2                   | 1                     | JBS-100-A/1                          | S-150/0             | T-100/2      | E-100-L/3                 |
|                   |                              |                        |                       |                                      |                     |              |                           |
|                   |                              |                        |                       |                                      |                     |              |                           |
|                   |                              |                        |                       |                                      |                     |              |                           |
| Column<br>Totals: |                              |                        |                       |                                      |                     |              |                           |

Self-Regulating/Power-Limiting Design Worksheet

CALCULATION OF ACCESSORY PIPE STRAPS

| Line ID<br>Pipe straps       | Units | Straps<br>per kit | Total | Line ID<br>Pipe straps | Units | Straps<br>per kit | Total | Line ID<br>Pipe straps | Units | Straps<br>per kit | Total |
|------------------------------|-------|-------------------|-------|------------------------|-------|-------------------|-------|------------------------|-------|-------------------|-------|
| Example<br>Power connections | 1     | 1                 | 1     | Power connections      |       |                   |       | Power connections      |       |                   |       |
| Splice kits                  | 0     | 0                 | 0     | Splice kits            |       |                   |       | Splice kits            |       |                   |       |
| Tees                         | 2     | 2                 | 4     | Tees                   |       |                   |       | Tees                   |       |                   |       |
| End seals                    | 3     | 1                 | 3     | End seals              |       |                   |       | End seals              |       |                   |       |
| Total<br>straps              |       |                   | 8     | Total<br>straps        |       |                   |       | Total<br>straps        |       |                   |       |

| Line ID<br>Pipe straps | Units | Straps<br>per kit | Total | Line ID<br>Pipe straps | Units | Straps<br>per kit | Total | Line ID<br>Pipe straps | Units | Straps<br>per kit | Total |
|------------------------|-------|-------------------|-------|------------------------|-------|-------------------|-------|------------------------|-------|-------------------|-------|
| Power connections      |       |                   |       | Power connections      |       |                   |       | Power connections      |       |                   |       |
| Splice kits            |       |                   |       | Splice kits            |       |                   |       | Splice kits            |       |                   |       |
| Tees                   |       |                   |       | Tees                   |       |                   |       | Tees                   |       |                   |       |
| End seals              |       |                   |       | End seals              |       |                   |       | End seals              |       |                   |       |
| Total<br>straps        |       |                   |       | Total<br>straps        |       |                   |       | Total<br>straps        |       |                   |       |

ATTACHMENT TAPE REQUIREMENTS

| 1.              | 2.           | 3.                   | 4.                        | 5.                 | 6.   |
|-----------------|--------------|----------------------|---------------------------|--------------------|--|
| Line ID         | Feet of pipe | Adhesive tape chosen | Pipe diameter<br>(inches) | Rolls per 100 feet | Total rolls of tape<br>(col 2/100) x col 5 |
| Example<br>1001 | 200          | GT-66                | 4                         | 6                  | 12   |
|                 |              |                      |                           |                    |  |
|                 |              |                      |                           |                    |  |
|                 |              |                      |                           |                    |  |
|                 |              |                      |                           |                    |  |
| Total           |              |                      |                           |                    |  |

# Self-Regulating/Power-Limiting Design Worksheet

## ELECTRIC-TRACED LABEL AND CONTROLS

| 1. Line ID             | 2. Feet of pipe | 3. Electric-traced labels required (col 2/10) | 4. Control chosen |
|------------------------|-----------------|---|-------------------|
| <b>Example</b><br>1001 | 200             | 20  |                   |
|                        |                 |   |                   |
|                        |                 |   |                   |
|                        |                 |   |                   |
|                        |                 |   |                   |

**Total**

**Note:** For design of Factory Mutual CID1 systems, the Approval for Class I, Division 1 Hazardous Locations in USA form (H56897) and the Required Installation Record for Class I, Division 1 Hazardous Locations in USA form (H57426) must be completed.

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