Feasibility Study

Freeze Mitigation Study

North Shore Road
Low Pressure Force Main

Prepared For The

VILLAGE OF
EPHRAIM

DOOR COUNTY | WISCONSIN

DRAFT

NOVEMBER 4, 2016

McM. No. E0035-9-16-00780

Prepared By:

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McMAHON
ENGINEERS ARCHITECTS

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I. BACKGROUND

The Village of Ephraim is located along Green Bay in the northern portion of Door County, Wisconsin. A low pressure force main transfers residents' wastewater from North Shore Road to the sewer main at North Water Street. Flow in the force main is from privately-owned, individual grinder pump stations. The low pressure force main has experienced freezing in the past during winter. To prevent potential freezing, the Village currently unloads 250-gallons of water to the private pump station at the head of the force main three (3) times per week.

The Village of Ephraim retained McMAHON to evaluate alternatives for freeze mitigation for the North Shore low pressure force main. The purpose of this Feasibility Study is to summarize the alternatives evaluated, prepare an Opinion Of Probable Construction Cost for each alternative, and provide a schedule for design and construction of the recommended freeze mitigation alternative.

The freeze mitigation alternatives evaluated in this report are as follows.

- **Alternative #1:** Construct a well and pump system at the beginning of the force main (Christopher Schmeltz Property).
- **Alternative #2:** Construct a well and pump system on property adjacent to the beginning of the force main (Kristine Diekman Property).
- **Alternative #3:** Continue hauling water to the beginning of the force main.
- **Alternative #4:** Heat trace the force main and air relief valve manhole piping previously affected by freezing.
- **Alternative #5:** Provide additional insulation for the area previously affected by freezing.

II. EXISTING CONDITIONS

A low pressure sewer line follows North Shore Road in the Village of Ephraim. Small on-site grinder pumps transfer wastewater through service laterals to the pressurized main. The pressurized main is installed below the frost line and follows ground surface contours. An air relief valve is installed on a high point on the low pressure force main to allow air pockets to be relieved from the pressurized line. Figure #1 shows an aerial of the North Shore Road.

Figure #1: North Shore Road Aerial

The Village currently experiences occasional freezing of the low pressure force main that follows the North Shore Road south of the air relief valve manhole. In the past, over 300-feet of force main south of the air relief valve has frozen. Not all of the residences in this area are occupied during the winter, causing less flow in the low pressure force main and potential stagnation in the line. The stretch of force main with freezing occurrences is located beneath paved road and a bluff located approximately 15-feet to the west. As a result, the sewer is exposed to frozen soil from above and from the side.

To prevent the potential of freezing of the force main, the Village currently unloads 250-gallons of water into the private pump station at the beginning of the force main on Mondays, Wednesdays and Fridays during the winter. This keeps flow through the pipe, preventing water stagnation / freezing.

III. FREEZE MITIGATION ALTERNATIVES

Alternatives for freeze mitigation for the low pressure force main along North Shore Road have been evaluated for the Village of Ephraim. Each alternative is summarized in more detail, as follows.

A. Alternative #1: Construct A Well & Pump System At The Beginning Of The Force Main (Christopher Schmeltz Property)

The first freeze mitigation alternative considered is to construct a well and pump system at the beginning of the low pressure force main. The system would consist of a simplex pump station to pump well water into the low pressure force main, keeping water flowing and preventing stagnation in the line. A new well and pump would be installed to operate on timers during the winter season. The well would discharge to the new simplex pump station. The submersible pump would operate based on floats installed within the wet well. A local control panel would be installed with the pump station. Refer to Figure #2 for a typical diagram of a simplex pump station.

The new well would need to be constructed in accordance with Wisconsin Administrative Code, Chapter NR 812 standards. This alternative would also require a back flow prevention system between the simplex pump station discharge and the wastewater low pressure force main. The specific installation details for back flow prevention would be established by the Wisconsin Department of Natural Resources (DNR) private well water Staff and the Wisconsin DNR Wastewater Engineer serving the Village of Ephraim.

For this alternative, the simplex pump station and groundwater well would be installed on the Christopher Schmeltz property or within the existing right-of-way, if possible. The system would be isolated from the Schmeltz property's existing wastewater pump system and would require no maintenance or operation from the property owner. Refer to Appendix 1 for details regarding the simplex pump station.

B. Alternative #2: Construct A Well & Pump System On The Property Adjacent To The Beginning Of The Force Main (Kristine Diekman Property)

Alternative #2 is similar to Alternative #1, but would be to construct a new well and simplex pump station on the Kristine Diekman property, located south of the Schmeltz property and adjacent to the low pressure force main. The system would also consist of a simplex pump station and a new groundwater well used to pump water to the force main during the winter season, preventing stagnation in the line. Refer to Figure #2 for a typical layout of a simplex pump station.

This new well would also need to be constructed in accordance with Wisconsin Administrative Code Chapter NR 812 standards and require a back flow prevention system in between the simplex pump station discharge and the wastewater low pressure force main as noted previously.

However, this alternative would require the relocation of the existing force main on the property to allow the owner to construct a new garage, adding additional costs for this alternative. The new system would be isolated from the Diekman property's existing wastewater pump system and would require no maintenance or operation from the property owner.

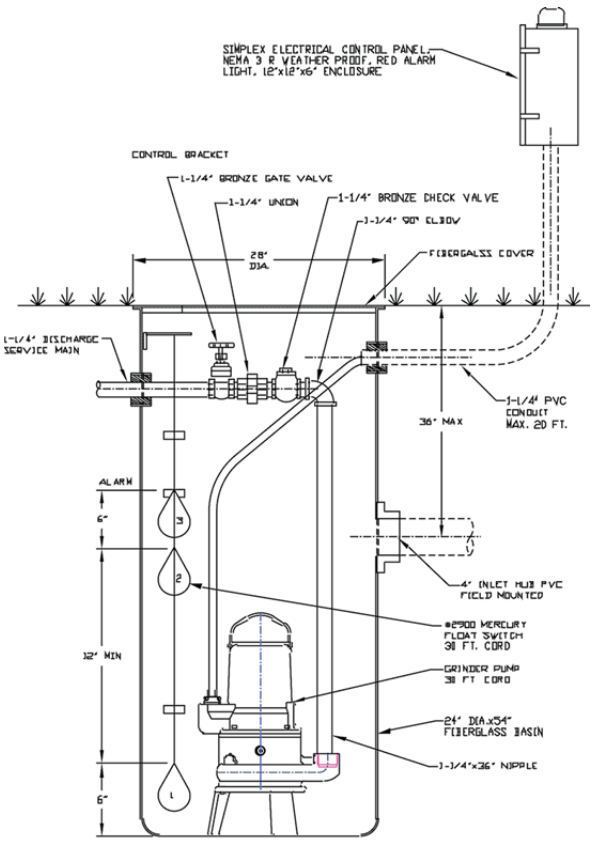

Figure #2: Simplex Pump Station Diagram

C. Alternative #3: Continue Hauling Water To The Beginning Of The Force Main

Alternative #3 consists of the Village continuing to haul 250-gallons of water Mondays, Wednesdays and Fridays to the pump station at the beginning of the force main. The Village of Ephraim currently does this during the winter to prevent freezing in the low pressure force main. The hauled-in water allows flow to run through the low pressure force main, preventing stagnation in the line that can lead to freezing.

D. Alternative #4: Heat Trace The Force Main & Air Relief Valve Manhole Piping Previously Affected By Freezing

Installing a heat tracing system was the fourth alternative evaluated to address the freeze issues for the North Shore low pressure force main. This option consists of installing heat tracing along the force main section that was affected in previous years. In the past, over 300-feet of force main was frozen, south of the air relief valve manhole. Figure #3 illustrates the approximate location of the air relief valve manhole, and the area that experienced freezing.

Figure #3: Low Pressure Force Main Location With Freezing Issues

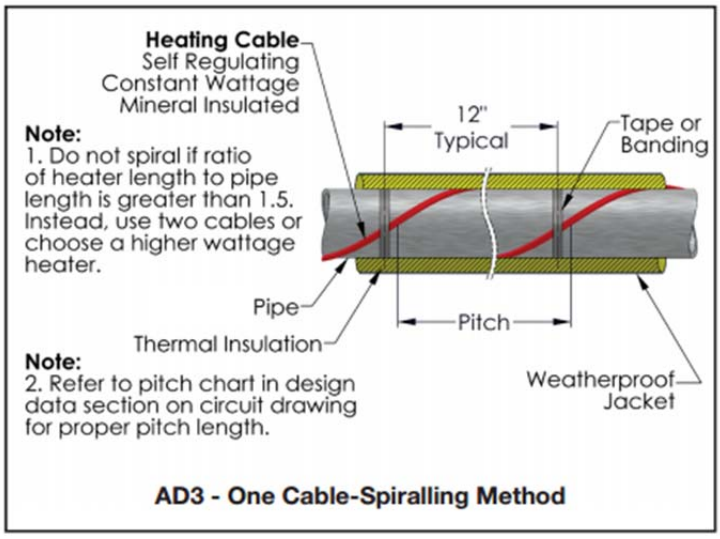

Figure #4: One Cable Spiral Heat Trace Pipe Typical Detail

Heat tracing is an electrical heating system consisting of a heating element running in physical contact along the pipe. The heat generated from the element maintains a warm temperature on the pipe. Heat tracing also involves covering the pipe with thermal insulation to reduce heat losses from the pipe. A typical diagram of a one-cable spiral heat traced pipe is shown in Figure #4.

The heat tracing along the low pressure force main requires a 240V power supply. This alternative also includes installing a line heating system in the air relief manhole.

The air relief manhole is illustrated in Figure #5. The piping within the air relief manhole has also experienced freezing issues in the past. The heat tracing for the piping in the air relief requires a 120V power supply.

This alternative would not include an automated control system for the heat tracing along the force main or the piping in the air relief manhole. The heat tracing would have to be turned on from a breaker panel as compared to operating automatically from a thermostat. Refer to Appendix 2 for additional information regarding heat tracing.

Figure #5: Air Relief Manhole

E. Alternative #5: Provide Additional Insulation For The Area Previously Affected By Freezing

Providing insulation around the affected area was evaluated as the fifth alternative for the low pressure force main. This option involves installing 3-inches of insulation on the portion of force main previously affected by freezing.

IV. OPINION OF PROBABLE CONSTRUCTION COSTS [1]

An Opinion Of Probable Construction Costs was prepared for each freeze mitigation alternative for the low pressure force main following North Shore road. The preliminary designs and Opinion Of Probable Construction Costs are discussed in more detail as follows.

A. Alternative #1: Construct A Well & Pump System At The Beginning Of The Force Main (Christopher Schmeltz Property)

The first alternative evaluated was to construct a new well and pump station on the Christopher Schmeltz property, located at the beginning point of the force main. The equipment costs for this alternative include a simplex pump station, process piping and valves, process instrumentation, and a new well and well pump. Construction cost would also include a concrete slab at the base of the pump station and the associated site work required.

- Freeze Mitigation Alternative #1..... $49,750

Refer to Table #1 for the detailed Opinion Of Probable Construction Cost.

B. Alternative #2: Construct A Well & Pump System On Property Adjacent To The Beginning Of The Force Main (Kristine Diekman Property)

The second alternative evaluated was to construct a new well and pump station on the Kristine Diekman property, located at the beginning point of the force main. The equipment costs for this alternative included a simplex pump station, process piping and valves, process instrumentation, and a new well pump. Construction costs would also include a concrete slab at the base of the pump station and associated site work. This alternative would also require a fee for relocating the existing force main installed on the property to allow the property owner to construct a new garage.

- Freeze Mitigation Alternative #2..... $70,500

Refer to Table #2 for the detailed Opinion Of Probable Construction Cost.

C. Alternative #3: Continue Hauling Water To The Beginning Of The Force Main

The third alternative evaluated was to have the Village of Ephraim continue to haul water to the pump station at the terminal point of the force main Mondays, Wednesdays and Fridays. This alternative would not require immediate capital and construction costs. However, this option would require the annual operation requirements including plowing, hauling fees, and Staff hauling time requirements. This alternative would also require maintaining the cooperation of the owner for continued seasonal hauling to their pump station.

D. **Alternative #4:** Heat Trace Force Main & Air Relief Valve Manhole Piping Previously Affected By Freezing

The fourth alternative evaluated was to install heat tracing and insulation along the portion of force main that was previously affected by freezing. The costs associated with this alternative include site work required, new pavement on North Shore Road, approximately 400-feet of heat tracing, 1.5-inch thick piping insulation with jacket, and the electrical installation requirements.

- Freeze Mitigation Alternative #4.....$90,500

Refer to Table #3 for the detailed Opinion Of Probable Construction Cost.

E. **Alternative #5:** Provide Additional Insulation For The Area Previously Affected By Freezing

The fifth alternative evaluated was to install insulation along the stretch of force main that was previously affected by freezing. The costs associated with this alternative include the site work required, new pavement on North Shore Road, and approximately 400-feet of 3-inch insulated pipe with jacket.

- Freeze Mitigation Alternative #6.....$67,125

Refer to Table #4 for the detailed Opinion Of Probable Construction Cost.

V. RECOMMENDED ALTERNATIVE

A recommended alternative has been established based on the Opinion Of Probable Construction Costs and the advantages of the freeze mitigation alternatives. Table #5 summarizes the Opinion Of Probable Construction Cost for each alternative.

Based on the Opinion Of Probable Constructions Cost, Alternative #3 was determined to be the best option to address the freezing in the low pressure force main along North Shore Road. This was the least expensive alternative evaluated, as it has no new construction or related capital costs associated with it. With this option, however, a long-term agreement should be developed between the owner and the Village of Ephraim to ensure the Village can haul water to the beginning of the force main for a long-term period. Currently, the Village is relying on the owner's cooperation. Connecting to the property owner's well or utilizing their grinder station is not recommended for the following reasons:

A. In the event the property is sold, a new owner may not be as cooperative as Mr. Schmeltz.

B. The reliability of the existing well and grinder station are unknown.

C. In the event of a failure of the well or grinder station, its cause and cost to repair would likely be the responsibility of the Village, from the perspective of the property Owner.

D. There will be legal matters to resolve, even if all parties are in agreement, with unknown costs and time commitments.

Alternative #5, which only provides insulation, will mitigate the potential for freezing, but does not provide the degree of freeze protection as the other alternatives, and is not recommended.

REFERENCES

Chromalox Advanced Thermal Technologies. "*Installation Instructions Industrial Heating Cable Products*" chromalox.com. N.p. 2014. Web. September 22, 2016.

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(1) The Opinion Of Probable Cost was prepared for use by the Owner in planning for future costs of the project. In providing Opinions Of Probable Cost, the Owner understands the Design Professional has no control over costs or the price of labor, equipment or materials, or over Construction Professionals' method of pricing, and that the Opinions Of Probable Cost provided herewith are made on the basis of the Design Professional's qualifications and experience. It is not intended to reflect actual costs, and is subject to change with the normal rise and fall of the local area's economy. This Opinion must be revised after every change made to the project or after every 30-day lapse in time from the original submittal by the Design Professional.

Table #1

ALTERNATIVE #1 - OPINION OF PROBABLE CONSTRUCTION COST [1]
Construct A Well & Pump System At The Beginning Of the Force Main
(Christopher Schmeltz Property)

VILLAGE OF EPHRAIM
Feasibility Study | Freeze Mitigation Study - North Shore Road Low Pressure Force Main
November 2016 | McM. No. E0035-9-16-00780

Capital Cost Breakdown	Cost
SITE WORK	
▪ Excavation & Backfill	$2,500
EQUIPMENT	
▪ Simplex Pump Package	$5,300
• Pump	
• Simplex Control Panel	
• Three (3) Level Floats	
• Fiberglass Basin With Cover & Rail System	
• Stainless Steel Lifting Cable	
▪ New Groundwater Well	$10,500
▪ Piping & Mechanical Installation	$10,000
CONSTRUCTION	
▪ Concrete Base Slab For Simplex Pump Station	$1,000
ELECTRICAL COSTS	
▪ Electrical Installation	$2,500
SUBTOTAL	$31,800
Contractor General Conditions (10%)	$3,180
Engineering & Design Services	$10,000
Contingencies (15% of Total Capital Cost)	$4,770
TOTAL CAPITAL COST	**$49,750**

Table #2

ALTERNATIVE #2 - OPINION OF PROBABLE CONSTRUCTION COST [1]
Construct A Well & Pump System On Property Adjacent To The Beginning Of the Force Main
(Kristine Diekman Property)

VILLAGE OF EPHRAIM

Feasibility Study | Freeze Mitigation Study - North Shore Road Low Pressure Force Main

November 2016 | McM. No. E0035-9-16-00780

Capital Cost Breakdown	Cost
SITE WORK	
▪ Excavation & Backfill	$3,500
EQUIPMENT	
▪ Simplex Pump Package	$5,300
• Pump	
• Simplex Control Panel	
• Three (3) Level Floats	
• Fiberglass Basin With Cover & Rail System	
• Stainless Steel Lifting Cable	
▪ New Groundwater Well	$10,500
▪ Piping & Mechanical Installation	$10,000
CONSTRUCTION	
▪ Concrete Base Slab For Simplex Pump Station	$1,000
ELECTRICAL COSTS	
▪ Electrical Installation	$3,500
MISCELLANEOUS	
▪ Existing Force Main Relocation	$13,000
SUBTOTAL	$46,800
Contractor General Conditions (10%)	$4,680
Engineering & Design Services	$12,000
Contingencies (15% of Total Capital Cost)	$7,020
TOTAL CAPITAL COST	**$70,500**

Table #3

ALTERNATIVE #4 - OPINION OF PROBABLE CONSTRUCTION COST [1]
Heat Trace Force Main & Air Relief Valve Manhole Piping Previously Affected By Freezing

VILLAGE OF EPHRAIM

Feasibility Study | Freeze Mitigation Study - North Shore Road Low Pressure Force Main

November 2016 | McM. No. E0035-9-16-00780

Capital Cost Breakdown	Cost
SITE WORK	
▪ Excavation & Backfill	$23,000
▪ Pavement Replacing (3-inch Thick Pavement)	$15,000
EQUIPMENT	
▪ Heat Tracing System (400-feet of Pipe)	$3,800
• Self-Regulating Heater Cable	
• Power Connection Kit With End Seal & Clamps	
• Fiberglass Tape	
▪ Insulation & Jacket (400-feet of Pipe, 1.5-inch Thermal Insulation	$3,900
▪ Mechanical Installation	$6,000
ELECTRICAL COSTS	
▪ Electrical Installation	$3,500
▪ Electrical Service (240V Power Supply)	$10,000
SUBTOTAL	$65,200
Contractor General Conditions (10%)	$6,520
Engineering & Design Services	$9,000
Contingencies (15% of Total Capital Cost)	$9,780
TOTAL CAPITAL COST	**$90,500**

Table #4

ALTERNATIVE #5 - OPINION OF PROBABLE CONSTRUCTION COST [1]
Provide Additional Insulation For Are Previously Affected By Freezing

VILLAGE OF EPHRAIM

Feasibility Study | Freeze Mitigation Study - North Shore Road Low Pressure Force Main

November 2016 | McM. No. E0035-9-16-00780

Capital Cost Breakdown	Cost
SITE WORK	
▪ Excavation & Backfill	$23,000
▪ Pavement Replacing (3-inch Thick Pavement)	$15,000
EQUIPMENT	
▪ Insulation & Jacket (400-feet of Pipe, 3-inch Thermal Insulation	$6,000
▪ Mechanical Installation	$4,500
SUBTOTAL	$48,500
Contractor General Conditions (10%)	$4,850
Engineering & Design Services	$6,500
Contingencies (15% of Total Capital Cost)	$7,275
TOTAL CAPITAL COST	**$67,125**

Table #5

OPINION OF PROBABLE CONSTRUCTION COST SUMMARY [1]

VILLAGE OF EPHRAIM

Feasibility Study | Freeze Mitigation Study - North Shore Road Low Pressure Force Main

November 2016 | McM. No. E0035-9-16-00780

Capital Cost Breakdown	Cost
ALTERNATIVE #1 -	
▪ Construct A Well & Pump System At The Beginning Of The Force Main (Christopher Schmeltz Property)	$49,750
ALTERNATIVE #2	
▪ Construct A Well & Pump System On Property Adjacent To The Beginning Of The Force Main (Kristine Diekman Property)	$70,500
ALTERNATIVE #3	
▪ Continue Hauling Water To The Beginning Of The Force Main	---
ALTERNATIVE #4	
▪ Heat Trace Force Main & Air Relief Valve Manhole Piping Previously Affected By Freezing	$90,500
ALTERNATIVE #5	
▪ Provide Additional Insulation For Area Previously Affected By Freezing	$67,125

Appendix 1

SIMPLEX PUMP STATION DETAILS

The Shark Model 840 Grinder Pumps

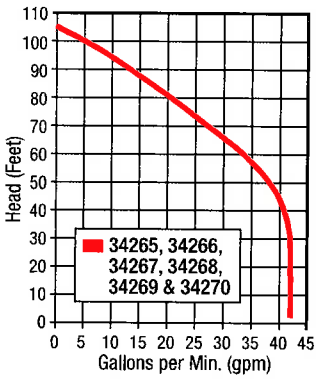
- **1-¼" NPT(F)**
- **Grinds and pumps in BOTH directions**

The 840 Shark Series grinder pump is constructed of durable heavy-duty cast iron with a stainless steel shaft and hardware, along with a bronze impeller. The 2 hp, 60 Hz, 3450 rpm motor with class "F" windings is available in multiple voltages.

The hardened stainless steel automatic reversing cutter assembly lets the pump grind and pump in BOTH directions. Every other cycle, the pump will run in the opposite direction (clockwise or counterclockwise), while still offering the same performance! This not only enhances cutter blade life expectancy, but also helps to eliminate a 'rope' effect from long stringy material and anything normally found in sanitary sewage.

The pump's tandem carbon/ceramic mechanical seals include seal leak detection for early indication of water entering the motor cavity. Both power cord and moisture sensor cord are 20' standard length.

Cutters reverse direction for extended life



Optional NEMA 4X control panels and reversing switches

The NEMA 4X simplex or duplex control panel includes all automatic reversing circuitry along with starting components for the pump. Each panel features a high water alarm light, internal seal leak indicator light and motor protection.

Shipping: Additional shipping fees may apply. Select models ship motor freight. Contact USABlueBook for more information.

Pump type:	submersible grinder pump, 2 hp, 230 volt, 1 phase
Construction:	heavy-duty finned cast-iron housing & volute, SS cutter blades
Impeller:	bronze
Seals:	carbon ceramic tandem seals
Motor:	oil-filled, continuous duty

				Grinder Pumps WITH 20' CORD		Control Panels (NEMA 4X w/ Reversing Circuitry) SIMPLEX PANELS		DUPLEX PANELS		Single Pump Reversing Switches† AUTOMATIC SWITCHES		MANUAL SWITCHES	
MODEL	VOLTS*	PH	AMPS	STOCK #	EACH	STOCK #	EACH	STOCK #	EACH	STOCK #	EACH	STOCK #	EACH
E840	230	1**	17.2	34265	$	38728	$	38732	$	34275	$	34280	$
I840	200/208	1**	20.0	34266		38728		38732		34275		34280	
F840	230	3	10.8	34267		38729		38733		34276		34281	
J840	200/208	3	12.3	34268		38729		38733		34276		34281	
G840	460	3	5.5	34269		38730		38734		34276		34281	
BA840	575	3	4.0	34270		38731		38735		—	—	—	—

***Alternate voltages available. Contact USABlueBook for more information.** †**Add to existing control panel (one switch required per pump).**

****Single phase units require starting components (stock # 34287) if not using a Zoeller control panel or reversing switch.**

Accessories

Model 840 Grinder will fit on Meyer's Rail No. RWG 125 and RWGD 125 (2 required) by using Zoeller Adapter #10-0381, stock # 34288 (2 required). Hydromatic Hydr-O-Rail bolts directly to Model 840.

DESCRIPTION	STOCK #	EACH
Zoeller Adapter for Meyers Rail	34288	$
Starting Components	34287	

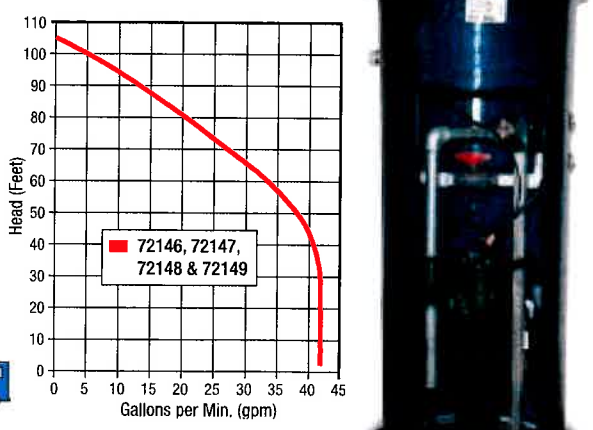
Zoeller® Simplex Grinder Pump Systems

- **Complete turnkey system**
- **Easy to order, install and operate**
- **Available with or without visual and audible alarms**

Zoeller grinder pump packages offer the most efficient way to set up your grinder pump system. The package is pre-assembled at the factory and includes everything you need for a complete system. All you need to do in the field is install the electrical and the inlet and discharge piping, and you're ready to pump. Custom packages are available as special order. Contact USABlueBook for more information.

Includes: 840 Series grinder pump, NEMA 4X simplex control panel with automatic reversing feature, J-box and three level floats, fiberglass basin with cover and rail system, 1-¼" PVC Sch. 40 piping, 8-ft SS lifting cable for pump removal and 1' pull rod. **Dual alarm packages also include:** audible and visual alarm.

Shipping: Ships motor freight.



DESCRIPTION	BASIN SIZE	PIPING	STOCK #	EACH
STANDARD PACKAGES				
Simplex Grinder System	24" x 60"	1¼"	72146	$
Simplex Grinder System	24" x 72"	1¼"	72147	
PACKAGES WITH DUAL ALARMS				
Simplex Grinder System	24" x 60"	1¼"	72148	$
Simplex Grinder System	24" x 72"	1¼"	72149	

You've heard of a great white shark. How about a great green Shark?

Your Peace of Mind is Our Top Priority®

Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

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Zoeller Family of Water Solutions

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(502) 778-2731 • 1 (800) 928-PUMP • FAX (502) 774-3624

SECTION: 2.25.073
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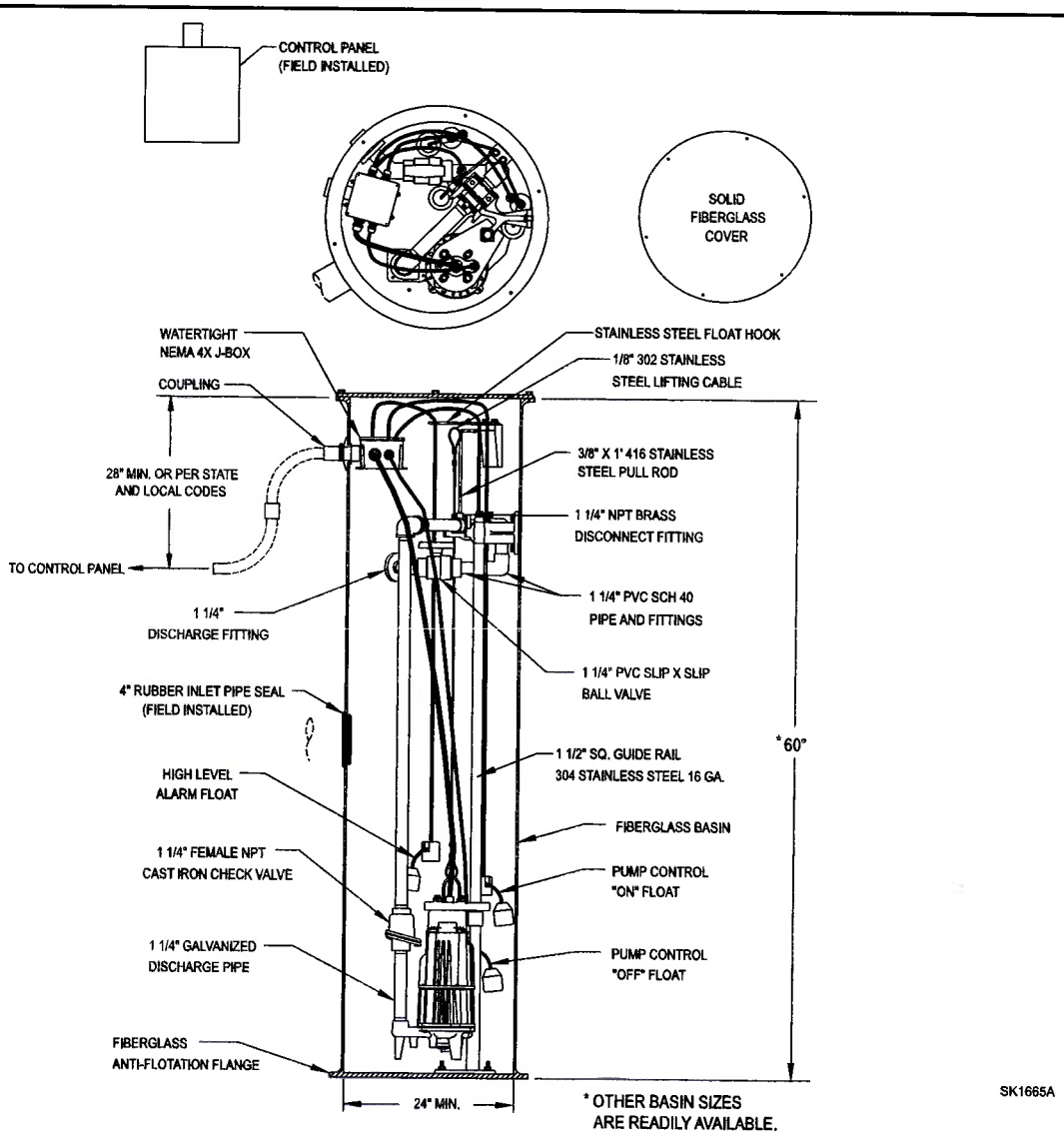
SIMPLEX 840 GRINDER SYSTEM

P/N 922-0006 OUTDOOR PREPACKAGED WITH SQUARE GUIDE RAIL SYSTEM



Complete System As Shown Above (P/N 922-0006) Includes:

Qty.	Part No.	Description
1	840-0004	230 Volt, 1 Ph, 2 HP Grinder Pump
1	10-0393	Nema 4X Simplex Control Panel with Automatic Reversing (Not Shown)
1	10-0329	Switch Assembly (3)
1	10-0331	J-Box for 3-Float System
1	33-0023*	24" X 60" Fiberglass Basin and Cover, Rail System, 8' SS Lifting Cable and 1' Pull Rod

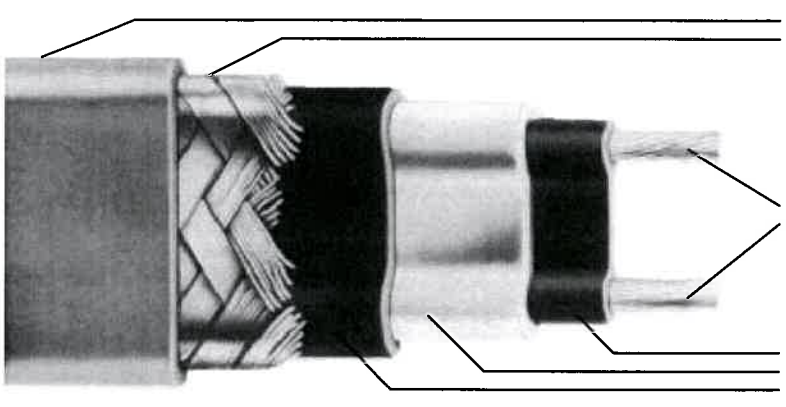
Approximate Weight: 390 lbs.

Appendix 2

HEAT TRACING DETAILS

NELSON™ TYPE LT
SELF-REGULATING HEATER CABLE

SPECIFICATION/APPLICATION INFORMATION



LT3-CB	LT23-CB
LT5-CB	LT25-CB
LT8-CB	LT28-CB
LT10-CB	LT210-CB

Description:

Nelson Type LT self-regulating heater cable is a parallel circuit electric heater strip. An irradiation cross-linked conductive polymer core material is extruded over the multi-stranded, tin-plated, 16-gauge copper bus wires. The conductive core material increases or decreases its heat output in response to temperature changes. Two jackets provide extra dielectric strength, moisture resistance, and protection from impact and abrasion damage. The inner thermoplastic jacket is extruded over and bonded to the core material. A thermoplastic elastomer outer jacket is then extruded over the inner jacket.

A stranded tinned copper metal braid is supplied on all heaters. An optional overjacket (fluoropolymer or modified polyolefin) can be specified when the heater cable is to be installed in wet or corrosive environments.

Principle of Operation:

The parallel bus wires apply voltage along the entire length of the heater cable. The conductive core provides an infinite number of parallel conductive paths permitting the cable to be cut to any length in the field with no dead or cold zones developing. The heater cable derives its self-regulating characteristic from the inherent properties of the conductive core material. As the core material temperature increases, the number of conductive paths in the core material decrease, automatically decreasing the heat output. As the temperature decreases, the number of conductive paths increase, causing the heat output to increase. This occurs at every point along the length of the cable, adjusting the power output to the varying conditions along the pipe.

The self-regulating effect allows the cable to be overlapped without creating hot spots or burnout. As the cable self-regulates its heat output, it provides for the efficient use of electric power, producing heat only when and where it is needed, and also limiting the maximum sheath temperature.

Application:

Nelson's Type LT self-regulating heater cable is ideal for use in maintaining fluid flow under low ambient conditions. Freeze protection and low watt density process temperature systems such as product pipelines, fire protection, process water, dust suppression systems, lube oil, condensate return, hot water and structure anti-icing are typical applications for this product.

The base product is supplied with a tinned copper metal braid that may be used in both general applications and in dry, non-corrosive hazardous (classified) areas. It is also used to provide a conductive ground path when cable is installed on non-conductive surfaces, such as plastic or painted pipe.

Options: (Delete -CB and add)

-JT A tinned copper metal braid with a modified polyolefin overjacket is available for use when the heater cable is exposed to aqueous solutions of inorganic chemicals (phosphate, dilute acids, chlorides, bases and carbonites). It is also recommended where mechanical abuse is a problem.

-J A tinned copper metal braid with a fluoropolymer overjacket is available for use when the heater is available for use when the heater cable is exposed to excessive moisture, organic chemicals, solvents, etc. in hazardous (classified) areas and ordinary areas.

D1- Approved for use in Class I, Division 1, Groups B, C, and D, Class II, Division 1, Groups E, F and G, Class III hazardous areas. D1 heating cable requires the use of HASK series connection kits.

NELSON™ TYPE LT SELF-REGULATING HEATER CABLE

SPECIFICATION/APPLICATION INFORMATION

Performance and Rating Data:

Catalog Number	Service Voltage	Maximum Length	Maximum Maintenance Temperature	Maximum Intermittent Exposure	T-Rating*
LT3	120	325	150°F (65°C)	185°F (85°C)	T6
LT23	240	650	150°F (65°C)	185°F (85°C)	T6
LT5	120	270	150°F (65°C)	185°F (85°C)	T6
LT25	240	540	150°F (65°C)	185°F (85°C)	T6
LT8	120	210	150°F (65°C)	185°F (85°C)	T5
LT28	240	420	150°F (65°C)	185°F (85°C)	T5
LT10	120	180	150°F (65°C)	185°F (85°C)	T5
LT210	240	360	150°F (65°C)	185°F (85°C)	T5

*Electrical equipment T-rating codes define the maximum surface temperature that equipment will reach. It is used in hazardous (classified) area applications.

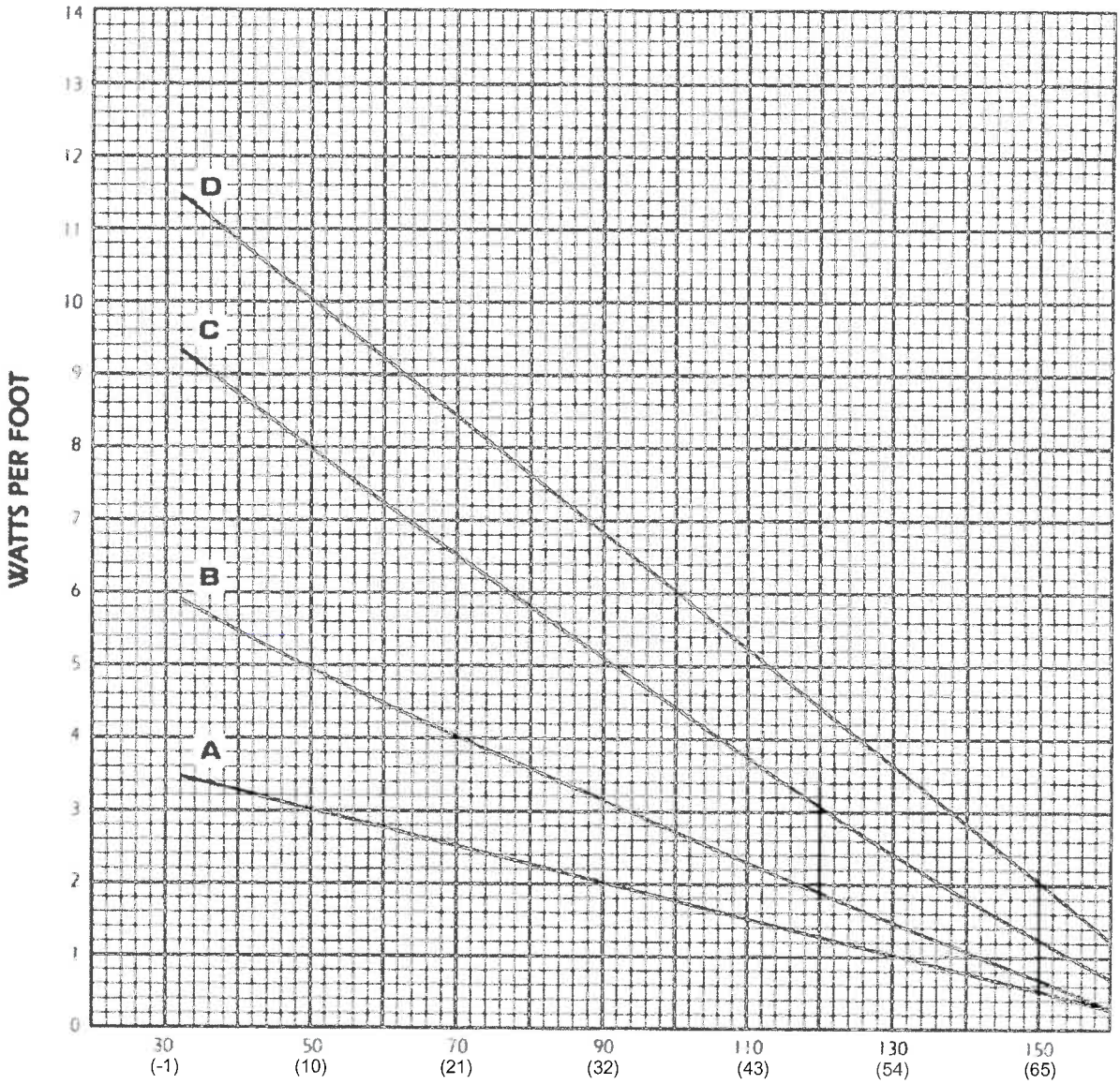
Circuit Breaker Selection:

Watts/Ft.	Start-Up Temp.	Max. Length (Feet) Vs. Circuit Breaker Size							
		120 Volt				240 Volt			
		15A	20A	30A	40A	15A	20A	30A	40A
3	50°F (10°C)	325				650			
	0°F (-18°C)	230	305	325		460	620	650	
	-20°F (-29°C)	205	275	325		410	550	650	
5	50°F (10°C)	225	270			460	540		
	0°F (-18°C)	155	205	270		310	415	540	
	-20°F (-29°C)	135	180	270		275	370	540	
8	50°F (10°C)	145	195	210		295	390	420	
	0°F (-18°C)	100	130	195	210	200	265	395	420
	-20°F (-29°C)	90	115	175	210	175	235	350	420
10	50°F (10°C)	115	150	180		230	305	360	
	0°F (-18°C)	85	110	155	180	165	220	325	360
	-20°F (-29°C)	75	100	145	180	150	195	290	360

NOTES:

1. Circuit breakers are sized per national electrical codes.
2. When using 240 volt product at 208, 220 or 277 volts, use the circuit adjustment factors shown in the Voltage Adjustment Table.
3. When using 2 or more heater cables of different wattage ratings in parallel on a single circuit breaker, use the 15A column amperage of 15 amps, divide it by the maximum footage to arrive at an amps/foot figure for each cable. You can then calculate circuit breaker sizes for these combination loads. These amps/foot factors include the 125% sizing factor.
4. National electrical codes require ground-fault equipment protection for each branch circuit supplying electric heating equipment. Exceptions to this requirement can be found in the 2002 N.E.C.
5. Heater cables with D1 optional construction require the use of ground fault interrupter/ground leakage device with a trip setting no greater than 30mA.

Power Output Rating:



A LT3, LT23 **B** LT5, LT25 **C** LT8, LT28 **D** LT10, LT210

WATTS PER FOOT x 3.28 = WATTS PER METER

PIPE TEMPERATURE °F CONVERSION TO °C = 5/9 (°F - 32)

NELSON™ TYPE LT
SELF-REGULATING HEATER CABLE

SPECIFICATION/APPLICATION INFORMATION

Catalog Numbers:

BASIC CATALOG NUMBERS				
Voltage	Watts Per Foot			
	3	5	8	10
120 VAC	LT3	LT5	LT8	LT10
240 VAC	LT23	LT25	LT28	LT210

Standard Feature Suffix:

-CB Tinned Copper Braid

Optional Features Suffix:

-J Tinned Copper Braid and Fluoropolymer Overjacket
-JT Tinned Copper Braid and Modified Polyolefin Overjacket
D1- Division 1 approved

Voltage Adjustment:

Use of Self-Regulating heater products at other than rated voltages require minor adjustments in power and maximum circuit lengths.

ADJUSTMENT MULTIPLIER							
	208 VAC		220 VAC		277 VAC		Absolute
Product	Power	Length	Power	Length	Power	Length	Max Length
LT23	.76	.93	.85	.96	1.27	1.07	650 ft.
LT25	.79	.93	.87	.96	1.24	1.07	540 ft.
LT28	.84	.93	.90	.96	1.19	1.08	420 ft.
LT210	.86	.93	.92	.96	1.16	1.09	360 ft.

Approvals:

FM
Ordinary Locations -
(-CB, -J or -JT options)
Hazardous (Classified) Locations
(-CB, -J or -JT options)
Class I, Division 2;
Groups B, C, D
Class II, Division 2
Groups G
Class III, Division 2
(-J option)
Class I, Zone 1
Group IIC

FM APPROVED

CSA
Ordinary Locations -
(-CB, -J or -JT options)
Hazardous (Classified) Locations
(-CB, -J or -JT options)
Class I, Division 2
Groups B, C, D
Class II, Division 2
Groups E, F, G
Class III, Division 2
(-J option)
Class 1, Division 1
Groups B, C, D
Class II, Division 1
Groups E, F, G
Class I, Zone 1
Group IIB + H2
Zone 1, Ex e II T6 (T5)

UL
Ordinary Locations -
(-CB, -J or -JT options)
Hazardous (Classified) Locations
(-CB, -J or -JT options)
Class I, Division 2;
Groups A, B, C, D
Class II, Division 2
Groups F, G
Class III, Division 2
(-J option)
Class I, Zone 1 and 2
Group IIC
(D1 option)
Class I, Division 1
Groups B, C, D
Class II, Division 1
Groups E, F, G
Class III

UL US LISTED

Accessories:

- Connection Kits for Power Connection, Tee Splice, Splices and End Seals (Nelson PLT and ALT Series)
- Thermostatic Controls (Nelson TA, TH, TE and HC Series)
- Junction Boxes, Tapes and Warning Signs
- Custom Control, Monitoring and Power Panels
- Division 1 Connection Kits for Power Connection, Tee Splice, Splice and End Connection (Nelson HASK Series)
- Zone 1 Connection Kits for Power Connection, Tee Splice, Splice and End Connection (Nelson Z1-PLT and Z1-ALT Series)

Nelson Heat Tracing Systems products are supplied with a limited warranty. Complete Terms and Conditions may be found on Nelson's website at www.nelsonheaters.com.

NELSON HEAT TRACE
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NELSON™
PLT SERIES CONNECTION KITS

SELECTION GUIDE

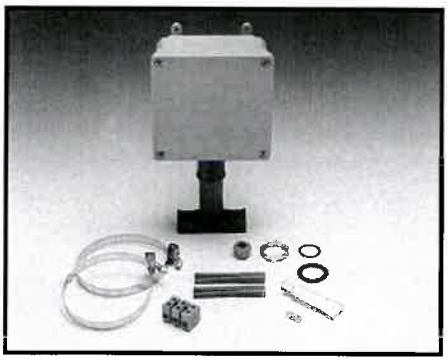
Nelson's PLT Series non-metallic connection kits are Factory Mutual, Underwriter's Laboratory and Canadian Standards Association approved for use in ordinary and Division 2 hazardous areas when used with approved Nelson heating cables. PLT Series connection kits are approved for use with all Nelson LT, HLT and NC Series field-fabricated heating cables. Enclosures supplied in PLT Series connection kits are rated NEMA 4X.

PLT-BC Power Connection Kit:

The PLT-BC Power Connection Kit is suitable for connecting up to two heating cables to customer supplied power wiring.

Kit Contents:

1 Universal Base, Box Adapter, Sealing Gasket, O-Ring and Locknut
1 Junction Box with Sealing Gasket and Cover
1 Sealing Grommet (Specify Cable Construction*)
1 Power Termination and Cable End Seal with Adhesive Sealant
1 3-Point Floating Terminal Block
1 Ground Connection Splice
2 Stainless Steel Pipe Clamps (Specify Pipe Size)
* Selection of -U grommet includes (1) additional power termination and (1) additional end seal for multiple cable entry.

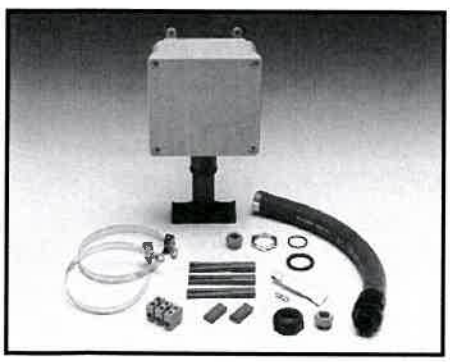


PLT-BS Splice Connection Kit:

The PLT-BS Splice Connection Kit is designed for connecting two heating cables in an in-line splice configuration.

Kit Contents:

1 Universal Base, Box Adapter, Sealing Gasket, O-Ring and Locknut
1 Junction Box with Sealing Gasket and Cover
1 Universal Sealing Grommet
2 Power Terminations with Adhesive Sealant
1 3-Point Floating Terminal Block
1 Ground Connection Splice
2 Stainless Steel Pipe Clamps (Specify Pipe Size)



PLT-BY Tee Connection Kit:

The PLT-BY Tee Connection Kit is designed for connecting three heating cables in a tee splice configuration.

Kit Contents:

1 Universal Base, Box Adapter, Sealing Gasket, O-Ring and Locknut
1 Junction Box with Sealing Gasket and Cover
1 Watertight Connection Fitting and Hi-Temp Flexible Tubing
1 Sealing Grommet (Specify Cable Construction)
* Power Terminations and Cable End Seals with Adhesive Sealant
1 3-Point Floating Terminal Block
1 Ground Connection Splice
2 Stainless Steel Pipe Clamps (Specify Pipe Size)
* Number of cable terminations based on standard usage of tee splice configuration; (3) power terminations and (2) end seals.

NELSON™
PLT SERIES CONNECTION KITS

SELECTION GUIDE

Nelson's PLT Series non-metallic connection kits include all components necessary to complete the installation of Nelson's full line of heat tracing cables. The selection tables below allow for the proper specifying of the complete connection kit assembly (example: PLT - BC - J - 12).

PLT-

	SPECIFY KIT CONFIGURATION
BC	Power Connection
BS	Splice Connection
BY	Tee Connection

	SPECIFY CABLE CONSTRUCTION
B	Braided Heater
J	Overjacketed Heater
U	Multiple (2) Cable Entry or Special Heater Constructions

	SPECIFY PIPE SIZE
3	.75 – 3.0
12	3.5 – 12.0
20	12.5 – 20.0

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