

Product Information Bulletin 1009

PlastiSpan HD Utility Pipe Insulation

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PlastiSpan HD Utility Line Insulation

Pipe Covering System

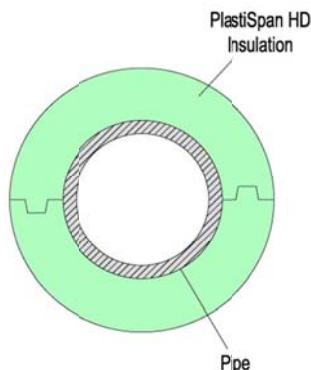
Utility lines are usually placed below the expected depth of frost penetration into the soil in order to prevent freezing of water in the lines. However, sometimes it is not possible to bury lines deep enough due to high water table, rocky outcrops, or soil conditions. Water lines for snow making equipment inevitably end up partly in a freezing environment. Lines may also be in the active layer of permafrost, or for other reasons it is known they will be in a freeze zone. Under these conditions the pipe can be insulated with PlastiSpan® HD pipe insulation covering at the time of installation to increase the time the pipe can store still water before freezing.

Utility lines may freeze after installation due to underestimation of frost penetration or due to removal of some of the protective soil covering. It is possible to eliminate the problem next season by placing a layer of PlastiSpan HD insulation above the utility line but under the ground level to raise the frost line above the utility line. This system is not usable where the utility line is installed in the active layer of permafrost.

Design Principles

The design principles to be used in determining the thickness of the pipe covering can be quite complex. Factors affecting the design are:

1. Minimum temperature of soil or air around the pipe.
2. Temperature and rate of flow of water through the pipe.
3. Size of pipe and material from which pipe is made.



In order to provide a greater period of time before the pipes freeze, the following modifications can be made in utility lines in addition to the installation of insulation on the pipe:

1. Increase the diameter of the pipe (particularly service lines to houses).
2. Provide a heating plant at the pumping station so that the water enters the system at a higher temperature than from the reservoir.
3. Loop all mains in the system so there is recirculation back to the pumps and still water in the mains is avoided.
4. Trace lines with heating cable in combination with insulation of the line.

Recommended Insulation Thicknesses

The tables on the following pages indicate the time (in hours) that still water can remain in the pipe without the pipe freezing. The assumption is made that if half the cross section is frozen to slush the line will plug at a restriction such as a fitting or a stop. The tables assume that PlastiSpan HD insulation is used. The low temperature in the soil minimizes decreases the mean temperature within the pipe insulation and minimizes water absorption into the insulation.

Time (in hours) required to freeze still water in pipe

The chart below assumes a thermal conductivity of 0.039 W/m²·°C for the PlastiSpan HD insulation. The design is based on pipe buried in the soil but is conservative for pipe exposed to the atmosphere to the extent of thermal resistance of the surface air film. (See Page 6 for representative soil temperatures.)

Pipe Material	Metric Values		Soil Temperature (°C)					
	Nominal Pipe Size	PlastiSpan HD Insulation Thickness	-40°	-29°	-18°	-12°	-7°	-1°
Plastic, Steel or Cast Iron	25 mm	38 mm	3.0	4.2	6.5	9.1	15.2	45.7
		51 mm	3.6	4.9	7.7	10.8	18.0	54.0
		76 mm	4.4	6.0	9.4	13.2	22.0	66.1
		102 mm	5.0	6.9	10.8	15.1	25.2	75.7
	38 mm	38 mm	5.7	7.8	12.3	17.2	28.6	85.8
		51 mm	6.9	9.4	14.7	20.6	34.4	103.1
		76 mm	8.6	11.8	18.5	25.9	43.1	129.3
	51 mm	102 mm	10.0	13.7	21.5	30.1	50.1	150.4
		38 mm	8.1	11.1	17.4	24.3	40.5	121.6
		51 mm	9.8	13.4	21.1	29.5	49.2	147.7
		76 mm	12.5	17.1	26.9	37.6	62.7	188.0
	64 mm	102 mm	14.7	20.1	31.5	44.2	73.6	220.8
		38 mm	10.1	13.8	21.7	30.4	50.7	152.0
		51 mm	12.4	16.9	26.6	37.3	62.1	186.3
	76 mm	76 mm	16.0	21.8	34.3	48.0	80.0	240.1
		102 mm	19.0	25.9	40.7	56.9	94.9	284.6
		38 mm	13.6	18.5	29.1	40.7	67.9	203.7
	102 mm	51 mm	16.8	22.9	36.0	50.4	84.0	252.1
		76 mm	21.9	29.9	47.0	65.8	109.7	329.0
		102 mm	26.2	35.8	56.2	78.7	131.2	393.7
		38 mm	19.3	26.3	41.4	58.0	96.6	289.8
	127 mm	51 mm	24.2	33.0	51.8	72.5	120.9	362.7
		76 mm	32.1	43.7	68.7	96.2	160.4	481.1
		102 mm	38.9	53.0	83.3	116.6	194.3	582.8
		38 mm	25.5	34.7	54.6	76.4	127.4	382.2
	152 mm	51 mm	32.2	43.9	69.0	96.6	160.9	482.8
		76 mm	43.3	59.0	92.8	129.9	216.5	649.4
		102 mm	53.0	72.3	113.6	159.0	265.0	795.1
		38 mm	31.9	43.5	68.4	95.8	159.6	478.8
	178 mm	51 mm	40.6	55.4	87.0	121.8	203.0	609.0
		76 mm	55.2	75.2	118.2	165.5	275.9	827.7
		102 mm	68.1	92.9	146.0	204.3	340.6	1021.7
		38 mm	38.1	51.9	81.5	114.2	190.3	570.8
	203 mm	51 mm	48.7	66.3	104.3	146.0	243.3	729.8
		76 mm	66.7	90.9	142.8	200.0	333.3	999.9
		102 mm	82.8	112.9	177.5	248.5	414.1	1242.3
		38 mm	44.3	60.3	94.8	132.8	221.3	663.8
	254 mm	51 mm	56.8	77.5	121.7	170.4	284.1	852.2
		76 mm	78.4	106.9	167.9	235.1	391.8	1175.4
		102 mm	97.9	133.5	209.8	293.7	489.5	1468.5
		38 mm	57.6	78.5	123.4	172.7	287.8	863.5
	305 mm	51 mm	74.4	101.5	159.5	223.3	372.1	1116.3
		76 mm	103.8	141.5	222.4	311.4	519.0	1557.0
		102 mm	130.9	178.5	280.5	392.7	654.6	1963.7
		38 mm	70.9	96.7	151.9	212.7	354.5	1063.4
	356 mm	51 mm	92.1	125.6	197.4	276.3	460.5	1381.5
		76 mm	129.5	176.6	277.5	388.4	647.4	1942.2
		102 mm	164.4	224.2	352.3	493.3	822.1	2466.3
		38 mm	79.5	108.3	170.3	238.4	397.3	1191.8
	356 mm	51 mm	103.5	141.1	221.7	310.4	517.3	1552.0
		76 mm	146.1	199.2	313.0	438.2	730.3	2190.8
	356 mm	102 mm	186.1	253.8	398.8	558.4	930.6	2791.9

Time (in hours) required to freeze still water in pipe

The chart below assumes a thermal conductivity of 0.27 BTU•in/(ft²•h•°F) for the PlastiSpan HD insulation. The design is based on pipe buried in the soil but is conservative for pipe exposed to the air to the extent of thermal resistance of the surface air film. (See Page 6 for representative soil temperatures.)

Pipe Material	Imperial Values		Soil Temperature (°F)					
	Nominal Pipe Size	PlastiSpan HD Insulation Thickness	-40°	-20°	0°	10°	20°	30°
Plastic, Steel or Cast Iron	1"	1-1/2"	3.1	4.2	6.5	9.2	15.3	45.8
		2"	3.6	4.9	7.7	10.8	18.0	53.9
		3"	4.4	6.0	9.5	13.2	22.1	66.2
		4"	5.0	6.9	10.8	15.1	25.2	75.6
	1-1/2"	1-1/2"	5.7	7.8	12.3	17.2	28.7	86.0
		2"	6.9	9.4	14.7	20.6	34.3	102.9
		3"	8.6	11.8	18.5	25.9	43.2	129.5
		4"	10.0	13.6	21.4	30.0	50.0	150.1
	2"	1-1/2"	8.1	11.1	17.4	24.4	40.6	121.8
		2"	9.8	13.4	21.1	29.5	49.1	147.4
		3"	12.6	17.1	26.9	37.7	62.8	188.3
		4"	14.7	20.0	31.5	44.1	73.5	220.5
	2-1/2"	1-1/2"	10.2	13.8	21.8	30.5	50.8	152.3
		2"	12.4	16.9	26.6	37.2	62.0	185.9
		3"	16.0	21.9	34.4	48.1	80.2	240.6
		4"	18.9	25.8	40.6	56.8	94.7	284.1
	3"	1-1/2"	13.6	18.6	29.2	40.8	68.1	204.2
		2"	16.8	22.9	35.9	50.3	83.8	251.5
		3"	22.0	30.0	47.1	65.9	109.9	329.7
		4"	26.2	35.7	56.1	78.6	131.0	392.9
	4"	1-1/2"	19.4	26.4	41.5	58.1	96.8	290.5
		2"	24.1	32.9	51.7	72.4	120.6	361.8
		3"	32.1	43.8	68.9	96.4	160.7	482.2
		4"	38.8	52.9	83.1	116.3	193.9	581.6
	5"	1-1/2"	25.5	34.8	54.7	76.6	127.7	383.2
		2"	32.1	43.8	68.8	96.3	160.5	481.6
		3"	43.4	59.2	93.0	130.2	217.0	650.9
		4"	52.9	72.1	113.3	158.7	264.5	793.4
	6"	1-1/2"	32.0	43.6	68.6	96.0	160.0	480.0
		2"	40.5	55.2	86.8	121.5	202.4	607.3
		3"	55.3	75.4	118.5	165.9	276.5	829.6
		4"	68.0	92.7	145.6	203.9	339.8	1019.4
	7"	1-1/2"	38.2	52.0	81.8	114.5	190.8	572.3
		2"	48.5	66.2	104.0	145.6	242.6	727.8
		3"	66.8	91.1	143.2	200.5	334.1	1002.3
		4"	82.6	112.7	177.0	247.9	413.1	1239.3
	8"	1-1/2"	44.4	60.5	95.1	133.1	221.9	665.6
		2"	56.7	77.3	121.4	170.0	283.3	849.8
		3"	78.6	107.1	168.3	235.7	392.8	1178.3
		4"	97.7	133.2	209.3	293.0	488.3	1464.9
	10"	1-1/2"	57.7	78.7	123.7	173.2	288.6	865.8
		2"	74.2	101.2	159.0	222.6	371.0	1113.0
		3"	104.1	141.9	223.0	312.2	520.3	1561.0
		4"	130.6	178.1	279.8	391.7	652.9	1958.6
	12"	1-1/2"	71.1	96.9	152.3	213.3	355.5	1066.4
		2"	91.8	125.2	196.8	275.5	459.1	1377.3
		3"	129.8	177.0	278.2	389.4	649.1	1947.2
		4"	164.0	223.6	351.4	491.9	819.9	2459.6
14"	1-1/2"	79.7	108.7	170.7	239.0	398.4	1195.2	
	2"	103.2	140.7	221.0	309.5	515.8	1547.3	
	3"	146.4	199.7	313.8	439.3	732.2	2196.6	
	4"	185.6	253.1	397.7	556.8	928.1	2784.2	

Time (in hours) required to freeze still water in copper tube

The charts assume a thermal conductivity of 0.039 W/m²•°C for the PlastiSpan HD insulation. The design is based on pipe buried in the soil but is conservative for pipe exposed to the atmosphere to the extent of thermal resistance of the surface air film. (See Page 6 for representative soil temperatures.)

Metric Values			Soil Temperature (°C)					
Copper Tubing	Nominal Pipe Size	PlastiSpan HD Insulation Thickness	-40°	-29°	-18°	-12°	-7°	-1°
Copper Type k	19 mm	38 mm	1.9	2.6	4.1	5.8	9.6	28.8
		51 mm	2.2	3.0	4.8	6.7	11.1	33.4
		76 mm	2.7	3.6	5.7	8.0	13.3	40.0
		102 mm	3.0	4.1	6.4	9.0	15.0	45.1
	25 mm	38 mm	3.0	4.1	6.4	9.0	15.0	44.9
		51 mm	3.5	4.8	7.5	10.5	17.6	52.7
		76 mm	4.3	5.8	9.1	12.8	21.3	64.0
		102 mm	4.9	6.6	10.4	14.6	24.3	72.8
	38 mm	38 mm	5.4	7.3	11.5	16.1	26.8	80.3
		51 mm	6.4	8.7	13.7	19.1	31.9	95.7
		76 mm	7.9	10.8	17.0	23.8	39.6	118.8
		102 mm	9.1	12.5	19.6	27.4	45.7	137.2
	51 mm	38 mm	7.8	10.7	16.8	23.5	39.2	117.6
		51 mm	9.5	12.9	20.3	28.4	47.4	142.1
		76 mm	12.0	16.3	25.7	35.9	59.9	179.6
		102 mm	14.0	19.1	30.0	42.0	70.0	209.9
	64 mm	38 mm	10.5	14.3	22.5	31.5	52.5	157.5
		51 mm	12.8	17.5	27.5	38.5	64.1	192.3
		76 mm	16.4	22.4	35.2	49.3	82.1	246.4
		102 mm	19.4	26.4	41.5	58.2	96.9	290.8
	76 mm	38 mm	13.2	18.0	28.4	39.7	66.2	198.5
		51 mm	16.3	22.2	34.9	48.9	81.4	244.3
		76 mm	21.1	28.8	45.2	63.3	105.5	316.6
		102 mm	25.1	34.2	53.8	75.3	125.6	376.7
	89 mm	38 mm	16.1	21.9	34.5	48.3	80.4	241.3
		51 mm	19.9	27.2	42.7	59.8	99.7	299.2
		76 mm	26.1	35.6	55.9	78.3	130.5	391.4
		102 mm	31.3	42.6	67.0	93.8	156.4	469.1
	102 mm	38 mm	18.9	25.8	40.6	56.8	94.7	284.2
		51 mm	23.6	32.2	50.6	70.9	118.1	354.3
		76 mm	31.2	42.5	66.8	93.5	155.8	467.5
		102 mm	37.6	51.3	80.6	112.8	188.0	563.9
	127 mm	38 mm	24.8	33.8	53.2	74.4	124.1	372.2
		51 mm	31.2	42.6	66.9	93.7	156.2	468.5
		76 mm	41.8	57.0	89.5	125.3	208.9	626.7
		102 mm	50.9	69.5	109.1	152.8	254.7	760.0
	152 mm	38 mm	30.5	41.6	65.4	91.5	152.5	457.6
		51 mm	38.7	52.7	82.9	116.0	193.4	580.2
		76 mm	52.3	71.4	112.1	157.0	261.7	785.0
		102 mm	64.4	87.8	137.9	193.1	321.8	965.5

Time (in hours) required to freeze still water in copper tube

The charts assume a thermal conductivity of 0.27 BTU·in/(ft²·h·°F) for the PlastiSpan HD insulation. The design is based on pipe buried in the soil but is conservative for pipe exposed to the atmosphere to the extent of thermal resistance of the surface air film. (See Page 6 for representative soil temperatures.)

Imperial Values			Soil Temperature (°F)					
Copper Tubing	Nominal Tube Size	PlastiSpan HD Insulation Thickness	-40°	-20°	0°	10°	20°	30°
Copper Type K	3/4"	1-1/2"	1.9	2.6	4.1	5.8	9.6	28.9
		2"	2.2	3.0	4.8	6.7	11.1	33.4
		3"	2.7	3.6	5.7	8.0	13.4	40.1
		4"	3.0	4.1	6.4	9.0	15.0	45.1
	1"	1-1/2"	3.0	4.1	6.4	9.0	15.0	45.0
		2"	3.5	4.8	7.5	10.5	17.5	52.6
		3"	4.3	5.8	9.2	12.8	21.4	64.1
		4"	4.8	6.6	10.4	14.5	24.2	72.7
	1-1/2"	1-1/2"	5.4	7.3	11.5	16.1	26.8	80.5
		2"	6.4	8.7	13.6	19.1	31.8	95.5
		3"	7.9	10.8	17.0	23.8	39.7	119.0
		4"	9.1	12.5	19.6	27.4	45.7	137.0
	2"	1-1/2"	7.9	10.7	16.8	23.6	39.3	117.9
		2"	9.5	12.9	20.3	28.4	47.3	141.8
		3"	12.0	16.4	25.7	36.0	60.0	179.9
		4"	14.0	19.1	29.9	41.9	69.9	209.6
	2-1/2"	1-1/2"	10.5	14.4	22.6	31.6	52.6	157.9
		2"	12.8	17.4	27.4	38.4	64.0	191.9
		3"	16.5	22.4	35.3	49.4	82.3	246.8
		4"	19.4	26.4	41.5	58.1	96.8	290.3
	3"	1-1/2"	13.3	18.1	28.4	39.8	66.3	198.9
		2"	16.3	22.2	34.8	48.8	81.3	243.8
		3"	21.1	28.8	45.3	63.4	105.7	317.2
		4"	25.1	34.2	53.7	75.2	125.4	376.1
	3-1/2"	1-1/2"	16.1	22.0	34.6	48.4	80.6	241.9
		2"	19.9	27.1	42.6	59.7	99.5	298.5
		3"	26.1	35.7	56.0	78.4	130.7	392.2
		4"	31.2	42.6	66.9	93.6	156.1	468.2
	4"	1-1/2"	19.0	25.9	40.7	57.0	95.0	284.9
		2"	23.6	32.1	50.5	70.7	117.8	353.5
		3"	31.2	42.6	66.9	93.7	156.2	468.5
		4"	37.5	51.2	80.4	112.6	187.6	562.8
	5"	1-1/2"	24.9	33.9	53.3	74.6	124.4	373.2
		2"	31.2	42.5	66.8	93.5	155.8	467.3
		3"	41.9	57.1	89.7	125.6	209.4	628.1
		4"	50.8	69.3	108.9	152.5	254.1	762.4
	6"	1-1/2"	30.6	41.7	65.5	91.8	152.9	458.8
		2"	38.6	52.6	82.7	115.7	192.9	578.7
		3"	52.5	71.5	112.4	157.4	262.3	786.8
		4"	64.2	87.6	137.6	192.7	321.1	963.3

Soil Temperatures¹

Average Temperature of Coldest Month (Metric Values - °C)

Location	DEPTH OF BURY				
	200 mm	500 mm	1,000 mm	1,500 mm	3,000 mm
Prince George, B.C.	-0.6	1.3	–	4.2	–
Saanichton, B.C.	4.4	5.3	6.7	7.8	–
Summerland, B.C.	0.8	1.5	2.8	5.5	–
Vancouver, B.C. (UBC)	4.0	5.5	6.7	7.5	–
Haines Jct., Yukon	-5.0	-3.1	-1.0	0.1	–
Baker Lake, NWT	-25.2	-21.0	-18.0	-17.1	–
Fort Simpson, NWT	-7.8	-4.7	-1.7	-0.3	–
Resolute, NWT	-20.9	-20.1	-19.3	-18.4	–
Beaverlodge, Alberta	-2.9	-1.7	0.1	0.8	–
Ellersie, Alberta (Edmonton)	-4.3	-2.5	-1.2	-0.6	2.0
Fort Vermillion, Alberta	-3.8	-2.2	-0.1	1.0	–
Lethbridge, Alberta	-2.7	-0.8	1.5	2.9	4.2
Peace River, Alberta	-3.8	-3.7	-1.6	0.2	2.7
Calgary, Alberta (U of C)	-4.0	-2.3	-0.6	0.7	3.6
Vauxhall, Alberta	-4.1	-1.5	0.5	1.8	–
Vegreville, Alberta	-4.9	-2.7	-0.3	0.7	1.9
Broadview, Saskatchewan	-3.9	-2.4	-0.7	0.3	–
Estevan, Saskatchewan	-5.3	-1.6	1.4	0.8	3.0
Hudson Bay, Saskatchewan	-2.1	-1.1	0.6	1.2	–
La Ronge, Saskatchewan	-1.4	-0.6	0.4	0.7	2.0
Outlook, Saskatchewan	-8.1	-5.7	-2.2	0.2	3.4
Regina, Saskatchewan	-6.2	-3.9	-1.2	-0.4	2.1
Saskatoon, Saskatchewan	-7.9	-4.1	-0.9	0.5	2.1
Swift Current, Saskatchewan	-2.5	-1.6	-0.5	0.7	2.6
Wynard, Saskatchewan	-5.6	-4.2	-1.4	0.3	1.8
Glenlea Sta., Manitoba	-4.5	-2.7	-1.2	0.5	2.7
Winnipeg (Airport), Manitoba	-3.5	-2.2	-0.3	0.8	3.4
Atikokan, Ontario	0.0	0.6	1.6	2.5	4.6
Guelph, Ontario	0.0	1.1	2.1	3.0	–
Harrow, Ontario	-0.2	0.9	2.5	3.6	6.9
Kapuskasing, Ontario	-0.1	0.0	1.6	2.2	3.3
Ottawa, Ontario	-0.2	1.0	1.3	3.5	4.6
Toronto, Ontario	-1.1	0.5	2.0	4.2	6.5
Vineland, Ontario	0.7	1.9	2.8	3.9	5.2
Caplan, Quebec	-0.6	0.6	1.6	2.0	3.9
La Pocatiere, Quebec	-0.4	0.4	1.6	2.5	5.4
Montreal-Mirabel, Quebec	-4.0	-0.6	1.0	0.9	2.9
Normandin, Quebec	-0.2	0.2	0.6	2.0	3.2
St. Augustine, Quebec	-0.2	0.7	2.0	2.6	4.6
Val D'or, Quebec	-0.5	-0.1	0.6	1.2	3.4
Fredrickton, New Brunswick	-1.7	-0.3	1.8	2.5	4.6
Kentville, Nova Scotia	0.2	0.9	2.0	2.8	4.3
Truro, Nova Scotia	0.0	0.8	1.9	2.6	4.2
Charlottetown, P.E.I.	0.2	0.8	1.8	2.4	3.9

Note: Soil temperatures in Imperial - °F = °C x 1.8 + 32.

¹ Canadian Climate Normals, Volume 9, 1951-1980.