

Date 12-Nov-2009
 Description Freezing times given different thicknesses of Armaflex
 Calculated by Stuart Allely

Calculation Options	
Application Area	Air Conditioning & Refrigeration
Calculation Option	insulation thickness is known
Object	Pipe
Medium	Liquid
Calculate ...	Prevention of freezing of standing water in pipes

Customer Input	
Insulation thickness	0 mm
Ambient temperature	-6 °C
Line temperature	7 °C
Outer Diameter	10.2 mm
Inner diameter	6.0 mm
Surface coefficient of heat transfer external	9.0 W/(m ² · K)
Surface coefficient of heat transfer internal	1000.0 W/(m ² · K)
Specific heat capacity [object]	0.381 KJ/(kg · K)
Density [object]	8960.0 kg/m ³
Percentage of water frozen	50 %

CLASS O ARMAFLEX- Professional Insulation that Prevents Condensation and Energy Losses						
Pipe Cu EN 1057		Calculated				
Outer Diameter mm	Inner Diameter mm	Time to Zero h	Freezing Time h	Total Time until Freezing h	Thermal Conductivity λ W/(m·K)	
6.0	4.0	0.137	0.534	0.671	0.034	
8.0	6.0	0.187	0.9	1.087	0.034	
10.0	8.0	0.237	1.279	1.516	0.034	
12.0	10.0	0.288	1.664	1.952	0.034	
15.0	13.0	0.363	2.249	2.613	0.034	
18.0	16.0	0.439	2.839	3.278	0.034	
22.0	20.0	0.541	3.628	4.169	0.034	
28.0	25.0	0.685	4.455	5.139	0.034	
35.0	32.0	0.862	5.838	6.7	0.034	
42.0	39.0	1.04	7.225	8.264	0.034	
54.0	50.0	1.335	9.236	10.572	0.034	
64.0	60.0	1.589	11.221	12.81	0.034	
76.1	72.1	1.896	13.625	15.521	0.034	
88.9	84.9	2.221	16.171	18.392	0.034	
108.0	103.0	2.697	19.592	22.289	0.034	
133.0	127.0	3.323	24.187	27.51	0.034	
159.0	153.0	3.983	29.361	33.345	0.034	
219.0	213.0	5.507	41.311	46.818	0.034	
267.0	261.0	6.726	50.874	57.601	0.034	

For further advice on how to apply Armacell products please consult the relevant application manual.

Calculation Options	
Application Area	Air Conditioning & Refrigeration
Calculation Option	insulation thickness is known
Object	Pipe
Medium	Liquid
Calculate ...	Prevention of freezing of standing water in pipes

Customer Input	
Insulation thickness	9 mm
Ambient temperature	-6 °C
Line temperature	7 °C
Outer Diameter	10.2 mm
Inner diameter	6.0 mm
Surface coefficient of heat transfer external	9.0 W/(m ² · K)
Surface coefficient of heat transfer internal	1000.0 W/(m ² · K)
Specific heat capacity [object]	0.381 KJ/(kg · K)
Density [object]	8960.0 kg/m ³
Percentage of water frozen	50 %

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Pipe Cu EN 1057		Calculated			
Outer Diameter mm	Inner Diameter mm	Time to Zero h	Freezing Time h	Total Time until Freezing h	Thermal Conductivity λ W/(m·K)
6.0	4.0	0.184	0.718	0.902	0.034
8.0	6.0	0.289	1.392	1.681	0.034
10.0	8.0	0.405	2.187	2.592	0.034
12.0	10.0	0.53	3.069	3.599	0.034
15.0	13.0	0.729	4.514	5.244	0.034
18.0	16.0	0.939	6.067	7.006	0.034
22.0	20.0	1.231	8.256	9.486	0.034
28.0	25.0	1.664	10.831	12.495	0.034
35.0	32.0	2.21	14.97	17.18	0.034
42.0	39.0	2.769	19.244	22.013	0.034
54.0	50.0	3.72	25.729	29.449	0.034
64.0	60.0	4.543	32.079	36.622	0.034
76.1	72.1	5.548	39.863	45.411	0.034
88.9	84.9	6.618	48.177	54.795	0.034
108.0	103.0	8.195	59.523	67.717	0.034
133.0	127.0	10.275	74.789	85.065	0.034
159.0	153.0	12.476	91.958	104.434	0.034
219.0	213.0	17.568	131.778	149.346	0.034
267.0	261.0	21.649	163.74	185.389	0.034

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Calculation Options	
Application Area	Air Conditioning & Refrigeration
Calculation Option	insulation thickness is known
Object	Pipe
Medium	Liquid
Calculate ...	Prevention of freezing of standing water in pipes

Customer Input	
Insulation thickness	13 mm
Ambient temperature	-6 °C
Line temperature	7 °C
Outer Diameter	10.2 mm
Inner diameter	6.0 mm
Surface coefficient of heat transfer external	9.0 W/(m ² · K)
Surface coefficient of heat transfer internal	1000.0 W/(m ² · K)
Specific heat capacity [object]	0.381 KJ/(kg · K)
Density [object]	8960.0 kg/m ³
Percentage of water frozen	50 %

CLASS O ARMAFLEX- Professional Insulation that Prevents Condensation and Energy Losses					
Pipe Cu EN 1057		Calculated			
Outer Diameter mm	Inner Diameter mm	Time to Zero h	Freezing Time h	Total Time until Freezing h	Thermal Conductivity λ W/(m·K)
6.0	4.0	0.206	0.805	1.012	0.034
8.0	6.0	0.328	1.58	1.908	0.034
10.0	8.0	0.465	2.506	2.971	0.034
12.0	10.0	0.613	3.548	4.161	0.034
15.0	13.0	0.852	5.275	6.127	0.034
18.0	16.0	1.107	7.153	8.26	0.034
22.0	20.0	1.466	9.831	11.296	0.034
28.0	25.0	2.005	13.05	15.055	0.034
35.0	32.0	2.691	18.228	20.919	0.034
42.0	39.0	3.4	23.626	27.025	0.034
54.0	50.0	4.615	31.921	36.536	0.034
64.0	60.0	5.673	40.058	45.732	0.034
76.1	72.1	6.97	50.083	57.054	0.034
88.9	84.9	8.356	60.833	69.189	0.034
108.0	103.0	10.406	75.583	85.988	0.034
133.0	127.0	13.117	95.47	108.586	0.034
159.0	153.0	15.988	117.85	133.838	0.034
219.0	213.0	22.646	169.873	192.518	0.034
267.0	261.0	27.989	211.693	239.682	0.034

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Calculation Options	
Application Area	Air Conditioning & Refrigeration
Calculation Option	insulation thickness is known
Object	Pipe
Medium	Liquid
Calculate ...	Prevention of freezing of standing water in pipes

Customer Input	
Insulation thickness	19 mm
Ambient temperature	-6 °C
Line temperature	7 °C
Outer Diameter	10.2 mm
Inner diameter	6.0 mm
Surface coefficient of heat transfer external	9.0 W/(m ² · K)
Surface coefficient of heat transfer internal	1000.0 W/(m ² · K)
Specific heat capacity [object]	0.381 KJ/(kg · K)
Density [object]	8960.0 kg/m ³
Percentage of water frozen	50 %

CLASS O ARMAFLEX- Professional Insulation that Prevents Condensation and Energy Losses					
Pipe Cu EN 1057		Calculated			
Outer Diameter mm	Inner Diameter mm	Time to Zero h	Freezing Time h	Total Time until Freezing h	Thermal Conductivity λ W/(m·K)
6.0	4.0	0.234	0.911	1.145	0.034
8.0	6.0	0.376	1.81	2.185	0.034
10.0	8.0	0.538	2.899	3.437	0.034
12.0	10.0	0.715	4.14	4.855	0.034
15.0	13.0	1.006	6.223	7.229	0.034
18.0	16.0	1.319	8.519	9.837	0.034
22.0	20.0	1.764	11.832	13.596	0.034
28.0	25.0	2.444	15.909	18.354	0.034
35.0	32.0	3.32	22.485	25.804	0.034
42.0	39.0	4.233	29.418	33.65	0.034
54.0	50.0	5.818	40.24	46.057	0.034
64.0	60.0	7.208	50.894	58.102	0.034
76.1	72.1	8.923	64.109	73.032	0.034
88.9	84.9	10.764	78.358	89.121	0.034
108.0	103.0	13.5	98.056	111.556	0.034
133.0	127.0	17.134	124.707	141.84	0.034
159.0	153.0	20.993	154.743	175.736	0.034
219.0	213.0	29.97	224.813	254.783	0.034
267.0	261.0	37.19	281.285	318.475	0.034

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Calculation Options	
Application Area	Air Conditioning & Refrigeration
Calculation Option	insulation thickness is known
Object	Pipe
Medium	Liquid
Calculate ...	Prevention of freezing of standing water in pipes

Customer Input	
Insulation thickness	25 mm
Ambient temperature	-6 °C
Line temperature	7 °C
Outer Diameter	10.2 mm
Inner diameter	6.0 mm
Surface coefficient of heat transfer external	9.0 W/(m ² · K)
Surface coefficient of heat transfer internal	1000.0 W/(m ² · K)
Specific heat capacity [object]	0.381 KJ/(kg · K)
Density [object]	8960.0 kg/m ³
Percentage of water frozen	50 %

CLASS O ARMAFLEX- Professional Insulation that Prevents Condensation and Energy Losses					
Pipe Cu EN 1057		Calculated			
Outer Diameter	Inner Diameter	Time to Zero	Freezing Time	Total Time until Freezing	Thermal Conductivity λ

mm	mm	h	h	h	W/(m·K)
6.0	4.0	0.255	0.997	1.252	0.034
8.0	6.0	0.414	1.996	2.41	0.034
10.0	8.0	0.597	3.219	3.816	0.034
12.0	10.0	0.799	4.625	5.424	0.034
15.0	13.0	1.132	7.008	8.14	0.034
18.0	16.0	1.495	9.657	11.152	0.034
22.0	20.0	2.015	13.517	15.532	0.034
28.0	25.0	2.819	18.348	21.167	0.034
35.0	32.0	3.863	26.163	30.026	0.034
42.0	39.0	4.961	34.479	39.44	0.034
54.0	50.0	6.885	47.624	54.509	0.034
64.0	60.0	8.585	60.616	69.201	0.034
76.1	72.1	10.693	76.827	87.519	0.034
88.9	84.9	12.966	94.395	107.361	0.034
108.0	103.0	16.362	118.848	135.21	0.034
133.0	127.0	20.89	152.049	172.939	0.034
159.0	153.0	25.714	189.539	215.253	0.034
219.0	213.0	36.97	277.321	314.291	0.034
267.0	261.0	46.045	348.258	394.303	0.034

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Calculation Options	
Application Area	Air Conditioning & Refrigeration
Calculation Option	insulation thickness is known
Object	Pipe
Medium	Liquid
Calculate ...	Prevention of freezing of standing water in pipes

Customer Input	
Insulation thickness	32 mm
Ambient temperature	-6 °C
Line temperature	7 °C
Outer Diameter	10.2 mm
Inner diameter	6.0 mm
Surface coefficient of heat transfer external	9.0 W/(m ² · K)
Surface coefficient of heat transfer internal	1000.0 W/(m ² · K)
Specific heat capacity [object]	0.381 KJ/(kg · K)
Density [object]	8960.0 kg/m ³
Percentage of water frozen	50 %

CLASS O ARMAFLEX- Professional Insulation that Prevents Condensation and Energy Losses					
Pipe Cu EN 1057		Calculated			
Outer Diameter mm	Inner Diameter mm	Time to Zero h	Freezing Time h	Total Time until Freezing h	Thermal Conductivity λ W/(m·K)
6.0	4.0	0.276	1.079	1.355	0.034
8.0	6.0	0.452	2.175	2.626	0.034
10.0	8.0	0.655	3.53	4.184	0.034
12.0	10.0	0.881	5.098	5.978	0.034
15.0	13.0	1.257	7.778	9.034	0.034
18.0	16.0	1.669	10.782	12.451	0.034
22.0	20.0	2.265	15.194	17.459	0.034
28.0	25.0	3.196	20.801	23.997	0.034
35.0	32.0	4.415	29.903	34.318	0.034
42.0	39.0	5.709	39.673	45.381	0.034
54.0	50.0	7.996	55.305	63.3	0.034
64.0	60.0	10.03	70.822	80.852	0.034
76.1	72.1	12.568	90.304	102.872	0.034
88.9	84.9	15.32	111.53	126.85	0.034
108.0	103.0	19.451	141.287	160.738	0.034
133.0	127.0	24.986	181.859	206.845	0.034
159.0	153.0	30.902	227.783	258.685	0.034
219.0	213.0	44.763	335.778	380.541	0.034
267.0	261.0	55.972	423.335	479.307	0.034

For further advice on how to apply Armacell products please consult the relevant application manual.

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Armacell UK Ltd. · Mars Street · Oldham, Greater Manchester, OL9 6 LY · Tel +44 (0) 16 12 87 71 00 · Fax +44 (0) 16 16 33 26 85 · e-mail: info.uk@armacell.com · www.armacell.com/uk
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