SUPERLON®

Quality NBR Insulation

Thickness Guide for Condensation Control

Recommended Thickness (mm) for Condensate, Chilled Water and Refrigeration Systems

Ambient Temperature	26 °C				30 °C				35 °C			
Relative Humidity	**75%**	**80%**	**85%**	**90%**	**75%**	**80%**	**85%**	**90%**	**75%**	**80%**	**85%**	**90%**
Condensate +18 °C												
Pipe Up to 38 mm OD	6	10	10	19	10	10	13	25	10	13	19	32
Pipe 42 – 89 mm OD	6	10	10	19	10	13	19	25	10	19	25	38
Pipe above 102 mm OD	10	10	13	25	10	13	19	32	13	19	25	38
Chilled Water +5 °C												
Pipe Up to 38 mm OD	13	19	25	38	19	19	32	51	19	25	32	51
Pipe 42 – 89 mm OD	19	19	32	51	19	25	32	51	19	25	38	64
Pipe above 102 mm OD	19	25	32	51	19	25	32	51	25	32	38	64
Refrigeration 0 °C												
Pipe Up to 38 mm OD	19	25	32	51	19	25	32	51	25	25	38	64
Pipe 42 – 89 mm OD	19	25	32	51	25	32	38	64	25	32	38	64
Pipe above 102 mm OD	25	25	38	64	25	32	38	64	25	32	50	76
Refrigeration -15 °C												
Pipe Up to 38 mm OD	25	32	51	64	25	32	51	76	32	38	51	76
Pipe 42 – 89 mm OD	32	38	51	76	32	38	51	89	32	51	64	89
Pipe above 102 mm OD	32	38	51	89	32	51	64	89	38	51	64	102

Recommended Thickness (mm) for ducting

Ambient Temperature	26 °C				30 °C				35 °C			
Relative Humidity	**75%**	**80%**	**85%**	**90%**	**75%**	**80%**	**85%**	**90%**	**75%**	**80%**	**85%**	**90%**
Air Ducting +15 °C	6	10	16	32	10	16	25	38	13	19	32	51

At Superlon condensation prevention is our utmost priority. As a safety to prevent condensation, calculated figures are based on dew point temperature adding +0.5 °C with a external surface coefficient of 9 W/M2-K. Thickness should be recalculated if there is any use of jacketing such as aluminium as the external surface coefficient will be changed.

Note: Recommended thickness are to be used as a guide. Results are obtained under typical conditions. Superlon does not guarantee it will be prevent condensation. Other factors such as proper installation is crucial in condensation prevention. Please consult with our technical staff for more precise calculations.

SUPERLON WORLDWIDE SDN. BHD. (252355-U)

Lot 2736, Jalan Raja Nong, 41200 Klang, Selangor, Malaysia. Tel: +60 3 5161 7778 Fax: +60 3 5162 7778
Email: inquiry@superlon.com.my Website: www.superlon.com.my

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Superlon Insulation R-Values

"R" value or thermal resistance is a measure of the ability of a material to retard heat flow. The higher the R-value the higher the insulating value. The R-value is generally calculated by dividing the insulation by its K-value.

Pipe Insulation								
Nominal ID		Insulation Wall Thickness						
Inches	mm	3/8" 10	1/2" 13	3/4" 19	1" 25	1 1/4" 32	1 1/2" 38	2" 50
1/4"	6	0.462	0.744	1.218	1.737	-	-	-
3/8"	10	0.400	0.640	1.046	1.493	-	-	-
1/2"	13	0.374	0.595	0.968	1.381	-	-	-
5/8"	16	0.356	0.563	0.912	1.299	1.788	2.235	3.192
3/4"	19	0.342	0.539	0.870	1.236	1.700	2.124	3.032
7/8"	22	0.332	0.520	0.836	1.186	1.628	2.033	2.903
1"	25	0.324	0.505	0.809	1.144	1.570	1.959	2.794
1 1/8"	28	0.317	0.493	0.786	1.110	1.520	1.895	2.702
1 1/4"	32	0.310	0.479	0.761	1.072	1.465	1.825	2.598
1 3/8"	35	0.305	0.471	0.745	1.048	1.430	1.779	2.531
1 1/2"	38	0.302	0.463	0.732	1.026	1.399	1.739	2.472
1 5/8"	42	0.297	0.455	0.716	1.002	1.363	1.693	2.402
1 7/8"	47	0.293	0.446	0.699	0.976	1.325	1.643	2.328
2"	51	0.290	0.441	0.688	0.959	1.299	1.609	2.276
2 1/8"	54	0.288	0.437	0.681	0.947	1.281	1.586	2.241
2 3/8"	60	0.284	0.430	0.668	0.926	1.250	1.546	2.180
2 5/8"	67	0.281	0.424	0.655	0.906	1.220	1.506	2.118
2 7/8"	73	0.279	0.419	0.646	0.891	1.198	1.477	-
3"	76	0.278	0.417	0.642	0.885	1.188	1.463	-
3 1/8"	80	0.276	0.414	0.637	0.877	1.176	1.447	-
3 1/2"	89	0.274	0.409	0.627	0.861	1.151	1.415	-
4"	101	0.271	0.404	0.617	0.843	-	-	-

Sheet Insulation		
Thickness		R-Value
Inches	mm	
1/8"	3	0.083
1/4"	6	0.167
3/8"	10	0.278
1/2"	13	0.361
5/8"	16	0.444
3/4"	19	0.528
1"	25	0.694
1 1/4"	32	0.889
1 1/2"	38	1.056
2"	50	1.417

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Condensation Control

Condensation or sweating on the insulation is a big problem for installers. Upon condensation, the cost of repair and replacement of water damaged ceiling and spoilt goods is considerably higher than actual cost of the insulation. This is why the correct thickness, proper installation and good understanding of the relationship between ambient temperature, relative humidity (RH) and dew point are extremely important to prevent condensation.

Insulating Environment

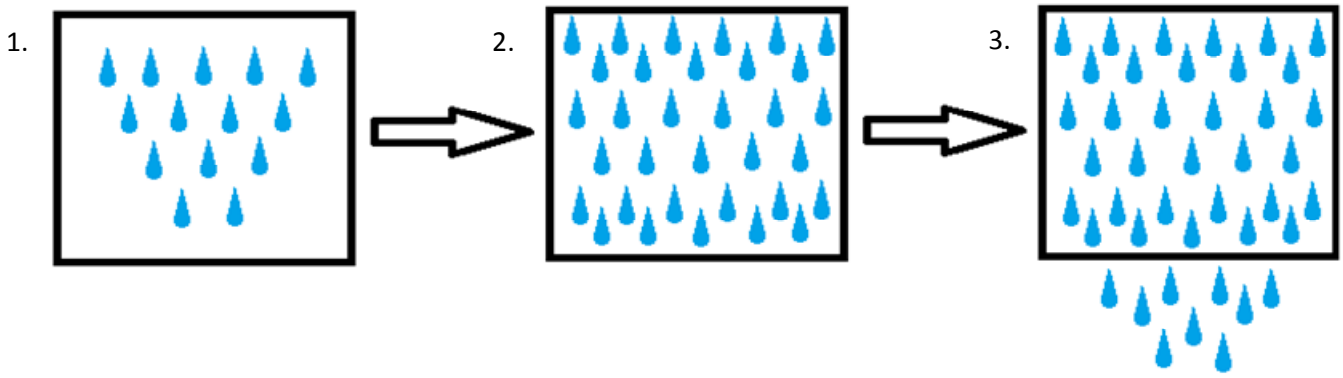
Knowing what sort of environment the insulation will be installed at is very important in determining the thickness of your insulation. This greatly depends on the temperature and humidity of the environment and how close the dew point is to the ambient temperature.

Air can only hold a certain amount of water vapors. In general, the hotter it is (higher temperature) the more water vapor the air can hold. If the water vapors exceed the amount that the air can hold, condensation occurs. This is where understanding the dew point is important. At the given temperature and humidity, the dew point is the temperature where humidity is 100%. **Therefore when the surface temperature of the insulating pipe reaches its dew point temperature or below, condensation occurs**. The diagram below explains this:

1. Temperature: 30 °C
Relative Humidity: 70%
Dew Point: 24 °C

2. Temperature: 25 °C
Relative HUmiduty: 97%
Dew Point: 24 °C

3. Temperature: 24 °C
Relative Humidity: 100%
Dew Point: 24 °C



This is why knowing the dew point of the installation environment is extremely important. The higher the humidity, the closer the ambient temperature is to its dew point temperature.

An example of a mild environment temperature of 25 °C with a RH 60% would have a dew point of 17 °C. When the dew point is further away from the ambient temperature the less likely condensation will occur.

Another example but an extreme environment with ambient temperature 35 °C and RH 85% the dew point would be 32 °C. The ambient temperature and dew point is very close, the likelihood of sweating is very high. This is why at high humidity environments Superlon always recommends to size up and use a greater thickness of insulation.

Dew Point Calculation:

$$T_D = \left(\frac{f}{100}\right)^{1/8} (112 + 0.9T) + 0.1T - 112$$

Where:
F = Relative Humidity
T = Ambient Temperature
T_D = Dew Point Temperature

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Insulation Thickness

Choosing the right insulation thickness is critical in preventing condensation. There are many things to consider when choosing the right insulation thickness. The following listed below is important for calculating the insulation thickness:

- **Maximum ambient temperature**
- **Maximum relative temperature**
- **Pipe line temperature**
- **Pipe line outer diameter (OD)**

As a basic rule the higher the humidity, the thicker the insulation is required. This is because when the humidity is high, the closer it is to its dew point. This is why for any installation environment, the maximum ambient temperature and the maximum relative humidity is crucial in the prevention of condensation.

Figure 2 demonstrates the comparison between insulation thickness and humidity. As the humidity increases, the insulation thickness required also increases with it. As shown, at a high humidity of 95%, an insulation thickness of 2" or 50 mm is required to prevent condensation.

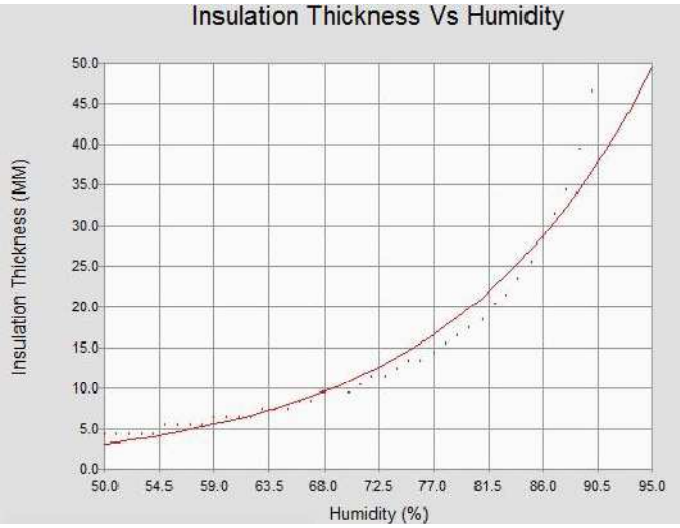

Figure 2: Thickness and humidity comparison example of a typical environment with ambient temperature of 30 °C and line temperature of 10 °C

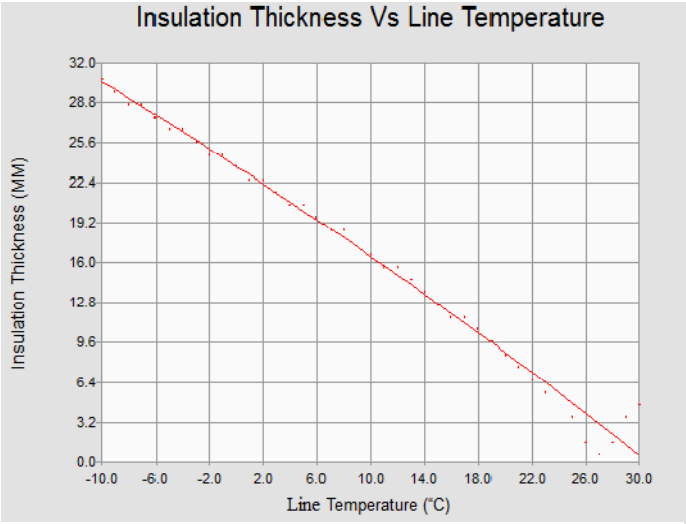

Figure 3: Thickness and line temperature comparison example of a typical environment with ambient temperature of 30 °C and humidity of 80%

Line temperature is also an important factor in determining the thickness of the insulation required. **As a rule of thumb, the lower the pipe line temperature, thicker the insulation needs to be used.** This is because when the line temperature decreases, it will be easier to penetrate the walls of the insulation. This means that the insulating surface will near or reach its dew point quicker causing it to condensate. Figure 3 is an example where the insulating thickness needs to be 1 1/4" (32 mm) at a line temperature of -10 °C compared to 3/4" (19 mm) at a line temperature of 10 °C.

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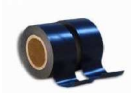
Common Causes of Condensation

Insulation thickness is the main reason why condensation occurs. Condensation could occur from high humidity environments where the thickness of the insulation used was not thick enough. There are many other reasons why, more specifically from installation.

Installers must remember that condensation occurs when **the INSULATION SURFACE TEMPERATURE REACHES ITS DEW POINT**. Installers can seal it very tightly without any air getting in but if the thickness is not enough the surface temperature **WILL** reach its dew point, which will result in condensation.

1. PVC Tape 

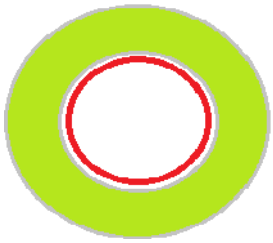
Many installers use PVC tape to try and seal joints for insulation materials together. The main reasons for this is that installers feel that since PVC tape is water proof it can protect joints without the use of glue. Usually installers will wrap the PVC tape very tightly to try and make the joints air tight and secure from outside environments. This actually makes things worse as the insulation thickness is severely compressed. Condensation will occur since the insulation thickness is now less than actual thickness.

PVC tape wrapped around joints without glue

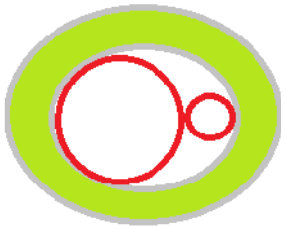
2. Two Copper Pipes for one tube

Some installers and contractors try to save time and the cost of insulation by inserting two copper pipes into one insulation tube. This method stretches the insulation tube which could result in the reduction of thickness.

Copper tubes may also damage due to friction. Since there is much more air inside the internal diameter of the insulation, this could cause the pipes to lose temperature and shorten the life span of the air conditioners.

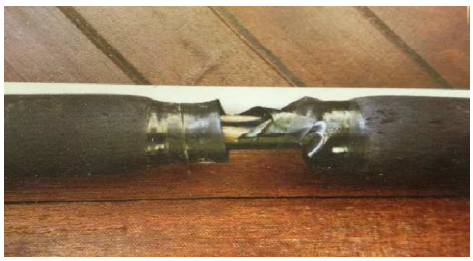


One copper pipe per insulation tube does not deform the insulation



Two copper pipes per insulation deforms and stretches the insulation

To the right is a picture of a bad installation job using PVC tape to improperly join the insulation tubes and also using two copper pipes for one insulation tube. Joints are easily exposed as it has not been glued using Superlon Insulation Glue, and the tightly wrapped PVC tape has made the insulation thickness much less than its prior thickness.



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3. Pipe Supports and Hangers

Improper use of pipe supports is also one of the major causes of condensation. Pipe supports are usually made to support hard and solid tubes and pipes and were not meant to use for foamed insulation materials as it could press against the insulation resulting in insulation thickness reduction. The reduction of thickness causes the insulation pipe to condensate as it is not suitable to the particular temperatures and humidity. The photos below are examples of how pipe supports could affect the insulation thickness.

Example of pipe support reducing thickness and crowded pipes thickness

Pipe support reducing insulation

4. Pipe Crowding

Too many insulation tubes crowded together can cause condensation. Crowding of pipes prevents air circulation which is critical in preventing condensation. Lack of air circulation increases the pipes humidity which can cause condensation. Examples of this are pictured above and to the right.

Example of crowded pipes

5. Outdoor use

Installing outdoors without the use of Superlon Weather Paint or Superlon Aluminium Jacketing can damage the insulation pipe. Prolonged exposures to the sun can cause the insulation material to crack.

Prolonged exposure to the sun and environment causes cracks

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Installation

Whilst choosing the correct thickness is critical, one of the most important aspects in preventing condensation is having a proper and sound installation. Before installing please take note of the points below:

- Before installing make sure that the Superlon insulation and the surface of pipes are dry and clean. The surface to be insulated must be free of debris and rust.

- Superlon insulation must never stretched, instead use a piece of insulation longer than the pipe itself. It is better to compress the insulation slightly than stretched as this can lose the insulation's thickness.

- Always use a proper size insulation ID to fit the OD of the pipe. Never put two pipes into one insulation tube as this can result the insulation being stretched and have the insulation lose its thickness and shape. The additional air inside the insulation tube can cause condensation.

- Do not crowd pipes together. Crowding pipes together prevents air circulation which results in surface condensation. Instead spacing out the pipes allows air movement in the pipes which is critical in areas with high temperatures and humidity.

- Proper sealing of all pipe insulation is the key to minimizing heat loss and control surface condensation. Cold pipe lines which are exposed due to poor installation can allow formation of condensation and may contribute to pipe corrosion. All joints should be properly coated with Superlon insulation glue and Superlon foam tape to properly seal the joints together.

- For outdoor applications, Superlon insulation pipes must be coated with two layers of weather paint. Falling to do so may result in surface cracking and erosion with time, which can lead to heat loss and condensation. Superlon recommends aluminium jacketing for high UV applications.

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Thickness Recommendation

Using the correct thickness in a particular operating environment can prevent condensation from occurring. Below are some typical conditions that are based in a more hot and humid environment. Please make sure that the conditions do not go over its maximum severity to ensure proper condensation control. Thickness recommended within the specified temperature and humidity range will control condensation if installed correctly.

	Piping Line Surface Temperature		
	15 °C	**5 °C**	**-18 °C**
Normal Conditions Based on the weather conditions experienced in tropical regions **Maximum severity of 29 °C and RH of 78%**	1/2" (13 mm)	1" (25 mm)	1 1/2" (32 mm)
Severe Conditions Confined and poorly ventilated areas with excessive moisture **Maximum severity of 35 °C and RH of 85%**	1" (25 mm)	1 1/2" (38 mm)	2" (50 mm)
Mild Conditions Well ventilated, low humidity conditions **Maximum severity of 26 °C and RH of 70%**	3/8" (10 mm)	1/2 (13 mm)	1" (25 mm)

For a more accurate calculation, Superlon's specially designed computer software can help calculate the specific insulation thickness in a particular environment. The following needs to be known for an accurate calculation: maximum temperature, maximum humidity, line temperature and pipe line size. Please refer to your local distributors for more information.

Superlon recommends sizing up thickness for pipe sizes above 3" (76 mm) IPS.

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