



When you look in the mirror and see wrinkles generally that would be considered to be a negative, however, when you look at a properly installed geomembrane, wrinkles are not only a positive they are a necessary design feature. This is due to the extreme amount of expansion and contraction inherent to the polymers used for geomembranes. Plastics in general expand and contract 7 to 10 times the amount metals do. For example, High Density Polyethylene (HDPE) has a coefficient of thermal expansion of 203×10^{-6} mm/mm/°C, so for every degree Celsius temperature change, HDPE expands or contracts 0.000203 mm over every mm. This may not seem like a very large number but when you factor this by the temperature swings we see here in northern climates (-40°C to +35°C) an HDPE geomembrane liner, which is 33 meters long will move over 50cm or half a meter over that temperature range. The expansion/contraction is so noticeable that our crews can feel the geomembrane move under them when the sun goes behind a cloud.

What this means to the geomembrane designer is that if a liner is installed on a warm summer day and is installed under tension or with no slack, once the temperature decreases that liner will contract, shrinking in size potentially pulling out of its anchor trench or even worse, tearing. Depending on the size of the installation the liner dimensions should be increased by as much as 10-15%, and installed with this slack evenly distributed over the entire surface area as wrinkles. While this obviously has an economic impact on the project, it is a necessary requirement of a successful geomembrane design.

Contain Enviro has found that all too often a factor of safety is not included in slack calculations. In fact, many installers install lining materials with a complete disregard for thermal slack. Not placing slack in a liner may be suitable in other temperate climates, but in northern climates it is essential. We strongly recommend using a factor of safety of about 1.5. The table shown lists the required amount of slack for an exposed geomembrane in a range of factors of safety from 1.0 to 1.5.

In order to accurately measure thermal slack we use the actual temperature of the geomembrane, not ambient air temperature. Solar heating has been shown to raise the temperature of black lining materials to as much as 80°C (176°F) on a hot, clear day.

Polyethylene Slack Allowances			
Installation Sheet Temperature	Design Low Temperature	Slack Required over 23 ft	Slack Required over 100 ft
80°C (176°F)	-40°C (-40°F)	2.6" - 4.0"	12" - 17"
70°C (158°F)	-40°C (-40°F)	2.4" - 3.6"	11" - 16"
60°C (140°F)	-40°C (-40°F)	2.2" - 3.3"	9.6" - 14"
50°C (122°F)	-40°C (-40°F)	2.0" - 3.0"	8.6" - 13"
40°C (104°F)	-40°C (-40°F)	1.8" - 2.6"	7.7" - 12"
30°C (86°F)	-40°C (-40°F)	1.5" - 2.3"	6.7" - 10"
20°C (68°F)	-40°C (-40°F)	1.3" - 2.0"	5.8" - 8.6"
10°C (50°F)	-40°C (-40°F)	1.1" - 1.7"	4.8" - 7.2"
0°C (32°F)	-40°C (-40°F)	0.9" - 1.3"	3.8" - 5.8"
-10°C (14°F)	-40°C (-40°F)	0.7" - 1.0"	2.9" - 4.3"
-20°C (-4°F)	-40°C (-40°F)	0.4" - 0.7"	1.9" - 2.9"
-30°C (-22°F)	-40°C (-40°F)	0.2" - 0.3"	1.0" - 1.4"
-40°C (-40°F)	-40°C (-40°F)	0	0

It is also important to understand the operating conditions of the lining material. If a liner is backfilled, or has a permanent liquid level the amount of thermal slack required can be reduced. The more of the liner that is exposed, the more thermal slack must be incorporated. A pond that has a 3 foot (1m) minimum liquid level will almost never have the submerged lining material go below 0°C (32°F) on the base. The requirement for slack in a backfilled liner is also reduced. Backfill "cushions" thermal shocks and prevents liners from reaching extreme low temperatures due to wind chill or other means. Alternately, in landfills, the backfilled liner can be subject to heating due to the decomposition of the landfill contents. In most cases a backfilled liner requires less slack. The flexibility of a lining material also affects the amount of slack used. Flexible, unsupported materials such as PVC and PP require less slack than stiff materials such as HDPE or supported materials. This is because the flexible, unsupported materials can stretch locally (up to 100%) to accommodate thermal contraction without damage, while very low extensions (as low as 2% at low temperatures) will damage both HDPE or supported materials. Slack perpendicular to the seaming direction is installed by adjusting the amount of overlap while seaming. Slack can be incorporated in the longitudinal direction at toe tie-in seams, or in a center tie-in seam. Slack can also be released from the anchor trench prior to backfilling. It is important to prepare tie-in seams, or to backfill anchor trenches, at the coolest part of the day. The worst possible condition for a lining material is to be exposed, with no fluid in the pond. Typical slack placement methods do not include enough slack for a temperature of -40°C (-40°F) in an empty pond. In all cases a minimum water level (or backfill) would be required for a pond that must over-winter prior to operation.

Contain Enviro Services has over 15 years of geomembrane installation experience and can help guide you through the process. With access to the complete range of Geomembrane materials, Contain Enviro Services Ltd. will suggest the most cost-effective liner material while still meeting the timing, environmental and safety requirements of your project.

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