

EXPANSION OF LONG LENGTH SHEETS

Any piece of metal, free to move, will increase in size with an increase in temperature, and will decrease in size with a decrease in temperature. The magnitude of this thermal expansion and contraction varies between different types of metal, but for each metal, the change in length is proportional to the change in temperature and the sheet length. The change in sheet length can be calculated as:

$$\Delta L = 12(\Delta T)(L)(E)$$

where:

ΔL	= change in sheet length, inches
ΔT	= change in temperature, degrees F
L	= total sheet length, feet
E	= coefficient of linear expansion,
	= 0.0000065 for Galvanized or Galvalume Steel
	= 0.0000128 for Aluminum
	= 0.0000099 for Stainless Steel
	= 0.0000093 for Copper

When designing a structure, the expansion of the sheeting must be considered, especially when aluminum panels (which expand twice as much as galvanized steel) are used.

Standing seam roof systems like Sentrigard Metal Roofing Systems' 1 1/2" SSR are designed to allow for thermal movement of the sheets. Careful attention must be paid to the ridge and gable details and any roof penetrations. All of these transitions must allow for expansion and contraction. If they do not, fastener holes will elongate and leaks will occur. Sentrigard Metal Roofing Systems' Standing Seam installation manuals provide recommended details.

In exposed fastener systems, the expansion/contraction of long length sheets may cause fastener hole elongations and eventually leaks. Therefore, the overall sheet lengths must be limited. Sentrigard Metal Roofing Systems recommends limiting exposed fastened aluminum panels to 16' long and steel panels to 40' or 45' maximum length. For run lengths longer than these, end laps with butyl sealant should be used.

The following tables illustrate the change in sheet length calculated using the equation presented above.



Table 1
Change in Panel Length (inches) for GALVANIZED AND GALVALUME STEEL panels

PANEL LENGTH	TOTAL CHANGE IN TEMPERATURE IN DEGREES FAHRENHEIT						
	60	80	100	120	140	160	180
10	0.047	0.062	0.078	0.094	0.109	0.125	0.140
15	0.070	0.094	0.117	0.140	0.164	0.187	0.211
20	0.094	0.125	0.156	0.187	0.218	0.250	0.281
25	0.117	0.156	0.195	0.234	0.273	0.312	0.351
30	0.140	0.187	0.234	0.281	0.328	0.374	0.421
40	0.187	0.250	0.312	0.374	0.437	0.499	0.562
50	0.234	0.312	0.390	0.468	0.546	0.624	0.702
60	0.281	0.374	0.468	0.562	0.655	0.749	0.842
80	0.374	0.499	0.624	0.749	0.874	0.998	1.123
100	0.468	0.624	0.780	0.936	1.092	1.248	1.404
150	0.702	0.936	1.170	1.404	1.638	1.872	2.106
200	0.936	1.248	1.560	1.872	2.184	2.496	2.808

Table 2
Change in Panel Length (inches) for ALUMINUM panels

PANEL LENGTH	TOTAL CHANGE IN TEMPERATURE IN DEGREES FAHRENHEIT						
	60	80	100	120	140	160	180
10	0.092	0.123	0.154	0.184	0.215	0.246	0.276
15	0.138	0.184	0.230	0.276	0.323	0.369	0.415
20	0.184	0.246	0.307	0.369	0.430	0.492	0.553
25	0.230	0.307	0.384	0.461	0.538	0.614	0.691
30	0.276	0.369	0.461	0.553	0.645	0.737	0.829
40	0.369	0.492	0.614	0.737	0.860	0.983	1.106
50	0.461	0.614	0.768	0.922	1.075	1.229	1.382
60	0.553	0.737	0.922	1.106	1.290	1.475	1.659
80	0.737	0.983	1.229	1.475	1.720	1.966	2.212
100	0.922	1.229	1.536	1.843	2.150	2.458	2.765
150	1.382	1.843	2.304	2.765	3.226	3.686	4.147
200	1.843	2.458	3.072	3.686	4.301	4.915	5.530



Table 3
Change in Panel Length (inches) for STAINLESS STEEL panels

PANEL LENGTH	TOTAL CHANGE IN TEMPERATURE IN DEGREES FAHRENHEIT						
	60	80	100	120	140	160	180
10	0.071	0.095	0.119	0.143	0.166	0.190	0.214
15	0.107	0.143	0.178	0.214	0.249	0.285	0.321
20	0.143	0.190	0.238	0.285	0.333	0.380	0.428
25	0.178	0.238	0.297	0.356	0.416	0.475	0.535
30	0.214	0.285	0.356	0.428	0.499	0.570	0.642
40	0.285	0.380	0.475	0.570	0.665	0.760	0.855
50	0.356	0.475	0.594	0.713	0.832	0.950	1.069
60	0.428	0.570	0.713	0.855	0.998	1.140	1.283
80	0.570	0.760	0.950	1.140	1.331	1.521	1.711
100	0.713	0.950	1.188	1.426	1.663	1.901	2.138
150	1.069	1.426	1.782	2.138	2.495	2.851	3.208
200	1.426	1.901	2.376	2.851	3.326	3.802	4.277

Table 4
Change in Panel Length (inches) for COPPER panels

PANEL LENGTH	TOTAL CHANGE IN TEMPERATURE IN DEGREES FAHRENHEIT						
	60	80	100	120	140	160	180
10	0.067	0.089	0.112	0.134	0.156	0.179	0.201
15	0.100	0.134	0.167	0.201	0.234	0.268	0.301
20	0.134	0.179	0.223	0.268	0.312	0.357	0.402
25	0.167	0.223	0.279	0.335	0.391	0.446	0.502
30	0.201	0.268	0.335	0.402	0.469	0.536	0.603
40	0.268	0.357	0.446	0.536	0.625	0.714	0.804
50	0.335	0.446	0.558	0.670	0.781	0.893	1.004
60	0.402	0.536	0.670	0.804	0.937	1.071	1.205
80	0.536	0.714	0.893	1.071	1.250	1.428	1.607
100	0.670	0.893	1.116	1.339	1.562	1.786	2.009
150	1.004	1.339	1.674	2.009	2.344	2.678	3.013
200	1.339	1.786	2.232	2.678	3.125	3.571	4.018