



**GNG 1103 [F]**  
**Engineering Design**  
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**Deliverable C - Design Criteria and Benchmarking**

Prepared by Group: # 4

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**Date:** January 31st, 2021

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## Introduction

The purpose of the deliverable is to first briefly introduce the design and requirements of the sidewalk and explain important and necessary design factors such as product materials, energy consumption and price issues. It will also provide benchmarks of related products and the team's product insights and evaluations to be closer to customer needs and better achieve goals. The benchmarking section will introduce the three products that our team examined based on meeting customer needs, as well as a brief discussion and comparison of their research results, which will allow us to plan for the development of our product using certain target specifications.

### 1.0 Design Criteria

Table 1. Design Criteria

#	Needs	Importance	Design Criteria
1	Heat up to about 2°C	5	Heating range (°C )
2	Can operate in temperatures around -25°C	3	Operating range (°C )
3	Controls the direction of where the water runoff travels	3	Volume of water left on the surface (mL)
4	Quickly heats sidewalks to melt snow and ice as soon as possible	5	Snow Melting Rate (cm per hour)
5	Have a grip to walk on while also being accessible to those with wheelchairs or other transportation tools	5	Surface Material
6	Minimal usage of power	2	Voltage (V) Energy Consumption (W)
7	Any alterations to the sidewalk abide by the Ontario Building Code	5	Follows all regulations (Yes or No)
8	The heated sidewalk has a low cost	5	Cost (\$CAD)
9	Prevents waterlogging	4	Operating conditions: snow, water, and ice
10	Easy access to internal components for repairing and maintaining quality performance	5	Ease of access (client perceives it on a scale of 1 to 5, 5 being the best)
11	Lasts about a decade	3	Product life (years)
12	Cost-effective maintenance	5	Cost to replace and repair components (\$CAD)

13	Can attach or extend the solution to increase the area of use and to optimize storage	5	Number of connection points
14	Simple and easy to build design	4	Time to set-up (min)
15	Compact in size for storage	4	The ratio of stored size to deployed size Weight (kg)

## 2.0 Technical Benchmarking

Table 2. Research into products to benchmark

<b>Specification / Product</b>	<b>Heated Snow Melting Walkway Mat - Long</b>	<b>Scotts Elite Spreader</b>	<b>Outdoor Heating Mat</b>
<b>Company</b>	<b>HeatTrak</b>	<b>Scotts</b>	<b>Radiant Heating Systems</b>
<b>Heating Range</b>	7 to 10 °C	None	12.8-18.3 °C
<b>Operating Range</b>	Up to -20.5°C	Results vary on the type of salt used, calcium chloride melts ice as cold as -31.7°C	None
<b>Snow Melting Rate</b>	5 cm per hour	~ 9.5 cm per hour	5.08 cm per hour
<b>Surface Material</b>	Customized Thermoplastic, Flame Retardant	Spreader is made of plastic	Unspecified anti-slip, double-sided
<b>Voltage</b>	120 V	None	120 V
<b>Energy Consumption</b>	300 W	None	320 W
<b>Cost</b>	\$179.61 (CAD)	\$131.20 (CAD)	\$159.95 (CAD)
<b>Operating Conditions</b>	Snow, ice, water	Any season	Snow, ice, water
<b>Connection Type</b>	Watertight connector cable	None	Cable (unspecified construction)
<b>Deployed Size (LxWxH)</b>	152.4 x 50.8 x 1.27 cm	49.53 x 58.166 x 56.5404 cm	121.92 x 60.96 x 0.3 cm
<b>Weight</b>	5.17 kg	8.9584493 kg	3.63 kg

The three products identified for benchmarking have been compared on their measurable traits and given a score of 1 (the lowest score) to 3 (the highest score) for each product specification, multiplied by its importance, as seen in Table 3. The scores will be represented by colour code (Green=3, Yellow=2, Red=1). The product with the highest total score will be the main source we compare our final design to.

Table 3. Comparing benchmarking

Specification/Product	Importance (weight)	Heated Snow Melting Walkway Mat - Long	Scotts Elite Spreader	Outdoor Heating Mat
Company		HeatTrak	Scotts	Radiant Heating Systems
Heating Range (°C )	5	2	1	3
Operating Range (°C )	3	2	3	1
Snow Melting Rate	5	1	3	2
Surface Material	5	3	1	2
Voltage (V)	2	3	1	3
Energy Consumption (W)	2	3	1	2
Cost (\$CAD)	5	1	3	2
Operating Conditions	4	2	3	2
Connection Type	5	3	1	2
Deployed Size (LxWxH)	4	3	1	2
Weight (kg)	4	2	1	3
Total		96	78	96

Thus from Table 3, we can conclude that the two products we should focus on being competitive with are HeatTrak and Radiant Heating Systems heated mat designs. The analysis of the various metrics and standards in the market were also used to then create a list of target specifications as seen in Table 4.

### 3.0 Target Specifications

Table 4. Target Specifications

#	Design Specifications	Relation (=, < or >)	Value	Units	Verification Method
	<b>Functional Requirements</b>				
1	Snow Melting Rate	>	5	Cm per hour	Test
2	Heating range	=	2 to 7	°C	Analysis, test
3	Operating range	=	-25 to 0	°C	Analysis, test
4	Voltage	=	120	V	Analysis, test
5	Energy Consumption	<	300	W	Test
6	Number of connection points	>	1	N/A	Design check
	<b>Constraints</b>				
1	Time to set-up	<	30	min	Test
2	Volume of water left on the surface	<	250	mL	Analysis, test
3	Cost	<	100	(\$CAD)	Estimate, final check
4	Operating conditions: snow, water, and ice	=	Yes	N/A	Analysis test
5	The ratio of stored size to deployed size	<	0.75	N/A	Analysis
6	Weight	<	4	kg	Analysis
	<b>Non-Functional Requirements</b>				
1	Follows all regulations	=	Yes	N/A	Analysis
2	Product life	>/=	10	years	Estimate, analysis
3	Ease of access	>	4	The client perceives it on a scale of 1 to 5, 5 being the best	User test
4	Cost to replace/repair components	<	20	\$CAD	Estimate, Analysis

## **Conclusion**

To sum up, customers can clearly understand the standard priority design list, minimizing the use of energy resources (such as electricity consumption) is undoubtedly the most necessary demand for a product, because it is the most basic method that can reduce environmental pollution and save costs, and it can also make people use it more assured. Other design requirements, for example, that the product is lightweight and easy to use, has a high work efficiency and is safe to use are also indispensable traits for the product. Then, to conduct a product benchmark study, our team conducted a comprehensive analysis of the three products from the customer's focus, including the materials used in the products, the temperature range that can be achieved, the level of energy consumption and the cost of the product. From this analysis, we have given reasonable research answers and comparisons, while also offering a stricter scope and more detailed verification methods for its various requirements.