Sizing ambient vaporizers for particular applications has been a question of rule of thumb interpretations , mostly based on past experiences . In northern parts of the USA and most of Canada , some companies use the quarter rule of thumb ; divide the vaporizer s rated capacity by four to obtain the actual mid-winter capacity . Others divide by 5 , while in the southern states , the rated capacity is multiplied by 1.5 for intermittent use and divided by 2 for continuous applications .

While this rule of thumb method is okay for different locations , applications and climates , it can be misleading because each is specific only to that user . Furthermore , it is based on the vaporizer manufacturer s rated capacity, which is subject to question . A more general method of determining a vaporizers capacity requires the input of several key parameters that are usually easily determined . These are :

1. Product type
2. Product pressure
3. Average and peak flow rate ; duration and frequency
4. Climate conditions
5. Location of vaporizer
6. Vaporizer design ; fin size ; number of fins (i.e. heat transfer area)

The first five parameters are usually known to the person specifying this type of equipment . The sixth factor can be obtained by contacting the potential vaporizer manufacturer . If they cannot provide this figure then it is likely that the rated capacity is inaccurate and thus the rule of thumb method would also be quite inaccurate .

With few exceptions , an ambient vaporizer is only as good as the amount of external surface area available to conduct , convect and radiate heat transfer . For steady-state heat transfer the capacity of the vaporizer can easily be calculated and that would make the job of the vaporizer designer very easy . However, most applications are not steady-state , there are usually many variations in the heat transfer formula . Therefore, it is common to size a vaporizer for the worst case performance scenario .

For instance , during the summer months in northern locations , an ambient vaporizer may achieve results four to five times greater than in mid-winter conditions when the temperature is consistently below freezing and there is no melting even while the vaporizer is idle .

Other factors somewhat significant to vaporizer performance are :

7.	Ground clearance	Very significant to areas where snow can accumulate and block the ability of air to flow in and around the bottom of the vaporizer .
8.	Wind	It is obvious that a windy location will increase the heat transferred by convection around a vaporizer , however conversely , a northern windy location in mid-winter can decrease a vaporizers capacity to thaw during idle periods (wind chill effect) .
9.	Sun	Whenever possible , locate ambient vaporizers to obtain as much southern sun exposure as possible .

To best illustrate how most of these factors affect an ambient vaporizer s rating , follow the example below :

An ambient vaporizer is required to vaporize liquid oxygen from a bulk tank at 150 psig . The flow rate is constant at 1900 scfh for 8 hours per day with peaks up to 2900 scfh for durations of 15 minutes , twice per day . The vaporizer will be installed in Northern Illinois State and will be located on a concrete pad 12 feet from the building .

1. Since most ambient vaporizers are rated for nitrogen , we must account for the different characteristics of the actual gas , in this case oxygen . From the gas product list (see table next page) , oxygen would vaporize at a rate 15% less than nitrogen , thus the product factor would be $F_G = 0.85$

2. The vaporizer will be operated at 150 psig , thus the pressure factor will be , $F_p = 0.89$

3. To determine the overall flow rating for the vaporizer , we can calculate as follows :

   $Q_O = Q_A$ * Duration + Q_P * Duration * Frequency per 8 hr. operating period

   $Q_O = Q_A$ * # hrs./24 hr.period + Q_P * #hrs./peak *Frequency of peaks per 24 hr.period / 8

   $Q_O = 1900 * 8 + 2900 * 15/60 * 2 /8$

   $Q_O = 2082$ scfh

4. The climate factor is determined by the geographical location where the vaporizer will be installed . Referring to the corresponding table , the climate factor for this example would be $F_C = 0.70$

5. This vaporizer will be installed in a relatively open area , therefore the location factor will be $F_L = 1.00$.

6. This factor is specific to each vaporizer make and model . For this example we will use the area based on *Cryotronix* model VFA ambient vaporizer . The heat transfer rate is 53 scfh per foot of vaporizer length , $F_H = 53$

   Putting all these factors together , we can calculate the size required :

   Vaporization length required = $Q_O / (F_G * F_P * F_C * F_L * F_H)$
   = $2082 / (0.85 * 0.89 * 0.70 * 1.00 * 53)$
   = 74 feet of finned length

For a vaporizer having 6' fins , this application would require 12 fins , usually in a matrix of 3 x 4.

For a vaporizer having 9' fins , this application would require 9 fins , usually in a matrix of 3 x 3.

Parameter factors for estimating ambient vaporizer capacity

Product	factor , F_G	Pressure (psig) *	factor , F_P
Nitrogen , N_2	1.00	450	1.00
Oxygen , O_2	0.85	400	0.98
Argon , Ar	1.20	350	0.95
Hydrogen , H_2	1.45	300	0.93
Helium , He	1.85	250	0.91
Carbon dioxide , CO_2	0.75	200	0.90
Methane , CH_4	0.85	150	0.89
Ethane or ethylene	0.77	100	0.88
Propane	0.65	50	0.86
Nitrous oxide , N_2O	0.55		

Climate **	factor , F_C	Location	factor , F_L
Less than 10 latitude	1.10	Open area	1.00
Between 10 & 20 latitude & 25 coastal	1.05	Closed one side	0.85
Between 20 & 25 latitude & 30 coastal	1.00	Closed two sides	0.75
Between 25 & 30 latitude & 35 coastal	0.90	Closed three sides	0.60
Between 30 & 35 latitude & 40 coastal	0.85	Totally closed	0.45
Between 35 & 40 latitude & 45 coastal	0.70		
Between 40 & 45 latitude & 50 coastal	0.55		
Between 45 & 50 latitude & 55 coastal	0.35		
Between 50 & 55 latitude	0.30		
Above 55 latitude	0.20		

* Ambient vaporizers ratings are sometimes based on system pressures of 3000 psig . These factors are based on 450 psig as the design pressure .

** These climate factors may vary depending on specific locations . For instance Las Vegas is almost 36 latitude but an ambient vaporizer installed there will behave as if it were 25 or 30 latitude due to the dry desert-like conditions .