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WHITE PAPER

Mobile Heaters: How to Measure Output

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When cold weather moves in, work does not stop. Mobile heaters can play an important role in allowing critical work to continue or protecting equipment or assets. Heating may seem cut and dry, but if you don't select the proper unit, you may not have enough heat or too much heat that can waste money and resources. In addition to needing to understand the needs of your application, you need to know the type of heating solution as well as the features and specifications that will work best for the job.

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INTRODUCTION

On jobsites, heaters are sometimes required when a material needs to dry or cure. They may be also required to keep equipment or material from freezing or to help thaw frozen ground. Temporary heat can also keep workers warm and more productive. Depending on the location, codes or safety regulations require that workers have a supplementary heat source when temperatures drop below a certain level. The type of heat not only depends on the application, but location, safety regulations, codes, power and fuel availability.

TYPES OF HEATING SOLUTIONS

There are several different kinds of mobile heaters. Flameless, hydronic, indirect and direct heaters that are designed to meet a variety of needs on the job site.

Indirect

Indirect-fired heaters are the most common way to heat a space. The flame is enclosed in a heat exchanger that separates combustion byproducts from the air to be heated. This system is like a home furnace, in which combustion products are directed up a chimney and heat is transferred with a fan through a heat exchanger to supply heated, emissions-free air. With 100% clean and dry air, the workspace does not need to be ventilated. Indirect heaters are the jack-of-all-trades heater. They are used in a large variety of different operations from season long 24/7 applications to a short overnight need.

Direct

Direct heaters, commonly referred to as a torpedo, pushes air across the open flame. While direct heaters are the least expensive heater, ventilation can be a problem. Byproducts of these types of heaters are carbon monoxide (CO), carbon dioxide (CO2) and moisture that if not properly ventilated can cause serious health risks. Direct heaters are typically used on construction sites and for outdoor applications. Direct heaters typically have to have external power and have a limited fuel supply.

Flameless

Flameless heaters are needed when regulations or safety require no open flames like oil and gas drilling, coatings or grain dyring. Instead of an open flame, flameless heaters create heat by using the power of a diesel engine. They provide 100% clean and dry air from four heat sources: the engine, block, exhaust and using the torque of the engine to agitate a liquid. Flameless heaters cost more, but are the only choice in certain environments.

Hydronic

A hydronic heater is so called because it heats a fluid and pumps it through hoses to the location requiring heat. The unit consists of a heater, pump and heat transfer hose. It is very similar to in-floor heat in your house. Heat is transfered from the hose directly onto a surface, for ground thawing, concrete curing, insulating pipes, equipment warming and a variety of other applications.

Regardless of how they are used, mobile heaters are designed for outdoor use and should never be operated indoors, unless the manufacturer provides instructions for properly ventilating exhaust gases and the unit is operated in accordance with applicable codes. Mobile heaters can be a valuable tool when heat is needed on a job site. Always follow safety procedures and the manufacturer's guidelines to ensure safe operation throughout the coldest months of the year.

MEASUREMENTS FOR COMPARISONS

After you choose the type of heating solution that meets your application, there are still other factors to consider. There are several key heating measurements that will help you determine which unit will be best for your application.

BTU

British thermal unit (BTU) is a unit of heat and it is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahreneheit expressed per hour. While there is a standard measure for heat, there is not always a standard measurement for mobile heaters. The three ways to express the BTUs from a mobile heater;

1. The BTU equivalent of the fuel it is burning
2. The BTU equivalent of the fuel it is burning adjusted for the efficiency of the burner
3. The measured output

Fuel has a standard BTU conversion factor for one gallon and the burner in a mobile heater has a known fuel usage, so it is simple math.

Standard BTU Conversion	
Gasoline	120,286 BTU
Diesel	137,381 BTU
Propane	91,451 BTU
1 kilowatt-hour of electricity = 3,412 BTU	

An indirect heater that uses a diesel burner that consumes 5.8 gph then has an Input BTU of 796,810.

No diesel burner is 100% efficient in burning all the fuel during combustion and no design is capable of converting all the heat from the flame into usable heat as some heat goes out the exhaust. The best home oil furnace has an efficiency rating of 90% and mobile heaters are less than that. Generally, they are in the 75 to 85% range. At 85% efficiency, the Output BTU would be 677,288 BTU. Input does not equal output.

CFM

CFM, which stands for cubic feet per minute, is an important measurement to tell the amount of air coming out of the heater. While it is a critical specification, there is no standard as to where this is measured. It could be the specification that came with the fan manufacturer, it could be measured at the heater outlets or it could be measured at the end of the duct hose.

A mobile heater can have a lot of resistance to airflow that reduces the CFM. First, the airflow goes through the heat exchanger then is disrupted by changing the flow of air coming out of the fan into the 12, 16, or 20" duct outlets. Then we connect flexible ducting with spiral wire design which introduces frictional losses which increase resistance as more and more ducts are added. Then we bend and squish the duct causing more resistance. So the CFM measurement that the fan manufacturer specified will be greater than the CFM measured at the machine which will be greater than measured at the end of the duct.

How do you measure CFM at the end of a duct

Air Flow in CFM = Flow Velocity in Feet Per Minute x Duct Cross-Sectional Area. You need an airflow meter Anemometer measure FPM.The equation for a round duct is: Duct Cross Sectional Area = π x r (radius of the duct in feet) ^{2}

12" duct would be .5" x .5" x 3.14159 = .785 ft2
16" = 1.398 ft2
20" = 2.18 ft2
CFM = FPM x Duct Cross Sectional Area

For two 16" ducts: CFM = 2,502 FPM x .1.398 ft2 = 3,498 per duct. Since this machine has two ducts, the total CFM would be 6,996 if both ducts were equal.

Static Pressure

Static pressure is important to overcome the resistance in the ducting, length of ducting and height of ducting. The static pressure rating on a heater is really a measure of the potential of the unit to push air and is one of the main factors in how far away air can be delivered. Static pressure is the amount of air pressure that can be produced by the fan in an enclosure and is measured in inches of water is defined as the pressure exerted by a column of water of 1 inch in height at defined conditions. Too little static pressure and the amount of heat that gets to the area wanting to be heated will be ineffective. Too much static press can overpressurize the area being heated and blow out temporary enclosures

We can compare static pressure by using the fan manufacturers data, but if you wanted to measure static pressure you need a specific piece of equipment called a manometer.

Temperature Rise

A common measurement used by manufacturers is the maximum temperature of the air at the duct outlet without any specifics on when that occurs. The important measurement is how much the air can be warmed, or temperature rise. If the machine can raise the air temperature 160 , that is fine at 20 when the outlet temp would then be 180 but at -20 , the outlet temp would be 140 which isn't that warm.

ΔT or Delta T, is the most common way of expressing temperature rise in the HVAC industry, meaning temperature difference. For mobile heaters, it is the difference between the ambient or input air temperature and the outlet temperature

Measuring Output

Now that we know CFM and the ΔT we can calculate the actual BTU output.

CFM x ΔT x Correction Factor = BTU

In the science behind the thermal content of moving streams of air, there is a constant of 1.085 that is added to the equation. It relates to the density of air and the fact we are measuring BTU per hour and CFM per minute. To keep it simple, we use 1.085 but in reality, that number changes slightly as we gain altitude or the temperature changes.

So, 6,996 CFM and 160º temperature rise is 6996 x 120 x 1.085 = 910,879 BTU.

CONCLUSION

Mobile heaters can play an important role in allowing work to continue or protecting assets. The type of heat not only depends on the application, but location, regulations and more. It is important for the success of your project to have the correct equipment on your jobsite. By having the wrong heater, you may not have the proper amount of heat that could cost you time and money. Generac Mobile works hard to provide dependable, heavy-duty options that can be used in any application. If you're searching for a secure heating solution for your desired location, look for no other name than Generac Mobile.