Yaskawa MV1000 Series Medium Voltage air cooled drives have one of the highest guaranteed power conversion efficiency values at 97% which includes transformer losses. Air cooled drives have gained significant popularity due to very low maintenance requirements compared to water cooled technology. Even so, heat dissipated into the environment from power conversion can be difficult to manage in various physical installations.

**DATA AND GENERAL CONCERNS**

1. When calculating heat dissipated into the MV drive installation space, it is important to recognize that motors applied to the drive may be smaller capacity than the drive rating. Therefore, the worst case heat loss will be proportional to the actual power being converted. For instance, a fully loaded 750HP motor applied to a 1000HP drive will dissipate the heat load of a 750HP drive. If the drive is larger than the motor and it is intended to run at the service factor of the motor, use the service factor level as the basis of the heat calculation. A 1000HP motor with a 1.15 service factor is an 1115HP motor when run continuously at the service factor. The simple formula below will allow you to calculate the watts that a drive will dissipate.

(Motor power rating in HP x 0.746 x 0.03) = kilowatts dissipated by the drive

|  |  |  |
| --- | --- | --- |
| MotorPower Rating | | Heat loss |
| HP | kW | kW |
| 500 | 375 | 11.19 |
| 1000 | 750 | 22.38 |
| 2000 | 1500 | 44.76 |
| 3000 | 2150 | 67.14 |
| 4000 | 3000 | 89.52 |
| 5000 | 3750 | 111.9 |
| 6000 | 4500 | 134.28 |

As can be seen above, a 6000HP drive is a 4.5mW power converter and will have 134kW of heat generated into the environment.

1. If it is intended to maintain the MV drive in a closed environment location (i.e. no outside air), some type of refrigerated cooling will be required. For instance, 3.5kW of heat can be cooled by one ton of refrigerated cooling or 12,000BTU. To calculate the cooling requirement for the drive, use the formula below

kW dissipated by the drive/3.5 = Tons/hr required to cool losses

or

kW dissipated by the drive x 3412 = BTU/hr required to cool losses

Be aware that the calculations above do not account for any other heat load in the room or solar heating. Cooling costs from refrigeration are fairly insignificant compared to the actual motor load. Typical efficiency cooling systems cost 200W to remove the losses of 1000W from the drive. When calculating drive conversion efficiency including refrigeration power cost, we now use 96.4% drive efficiency instead of 97% which is still better than published efficiency of most competitors.

1. It is very common to exhaust heated air to the outside ambient instead of refrigeration cooling. In those cases, clean make up air at 40֯C or cooler must be supplied to the drive filter intakes. A properly designed system should take into account the following:
2. Exhaust air exits the top of the drive **18֯C hotter than the intake air.**
3. Drive exhaust air cannot have any additional significant pressure drop or restriction. The mechanical ducting or air flow system must be designed to handle the drive rated air flow with an absolute maximum of 50 pa pressure over atmosphere at the cooling fan exhaust location.
4. Most successful designs allow the drive to circulate air internal to the room with outside exhaust and return air fan systems independently operated.
5. A properly designed system will replace air in the room at the same or greater CFM listed in the chart below:

|  |  |  |  |
| --- | --- | --- | --- |
| **FRAME SIZE** | **POWER RATING** | AIRFLOW REQUIRED | |
| Frame 1 a & b | 300 to 800HP | 1,907 CFM | 3,240 M^3/Hr |
| Frame 1c | 900 to 1000 HP | 2,331 CFM | 3,960 M^3/Hr |
| Frame 2 | 1250 to 2000 HP | 3,602 CFM | 6,120 M^3/Hr |
| Frame 3 | 2250 to 3000 HP | 7,946 CFM | 13,500 M^3/Hr |
| Frame 4 | 3500 to 6000 HP | 15,900 CFM | 27,000 M^3/Hr |

1. Properly designed systems should direct replacement air to drive air intake filters and exhaust air should be removed near the top of the drive.
2. Replacement air from outside, should be clean, free of condensing moisture and any corrosive gasses

Drives can be rated for 50֯C ambient cooling with reduction in load. Consult the factory if you have any questions or need addition information for ratings greater than 6000HP or higher ambient temperatures.