Technical Note 016

Sizing a drive
Using amps and HP to size a drive

The following technical note reviews how to size a drive. A variable frequency drive is selected after a motor has been chosen. A motor has a current (amp) and horsepower (HP) rating. For many years, the general guidance from drive manufactures has been to size a drive based on the motor's nameplate full load current rating. This guidance was originated from applications with a single drive operating a single induction motor. Over time, induction motors became more efficient and were applied in new ways, such as multiple motors fed from a single drive. Other motor technologies also continued to develop, resulting in highly efficient AC motor designs using magnets. The application of multiple motors on a single drive, along with the new motor designs, requires a fresh look at how drives should be sized.

ABB Technical Note 013 describes in detail the power conversion process within a drive. That technical note shows that drives are designed based on a motor's full load current and horsepower (HP) rating. Using a motor with a HP rating greater than the drive's HP rating, even if the motor is within the drive's output current rating, puts additional loading on drive components that may or may not be sized to handle this additional loading. Or in other words, if the motor's HP rating exceeds the HP rating of the drive, the drive may or may not be able to run that motor at full load.

ABB has a long history of designing drives in a robust manner, designing in a little extra capacity for the most demanding applications. That extra capacity allows 580 Series drives, such as the ACH580, to be sized based on amps alone, when the drive is sized for a single induction motor[1] application. However, in the case of multiple motor applications, or applications that use permanent magnet motors, ABB recommends also considering the motor's HP rating as part of the drive sizing process.

The first step to size a drive for multiple motor applications is to add the full load current and HP ratings of all the individual motors together. Once the combined amp and HP ratings are determined, there are two possible approaches to size the drive:

1. Size the drive based on amps and HP. Size the drive so its HP and output current ratings are equal to, or greater than, the combined motor HP and amp ratings.

   or

2. Size the drive based on amps, and check HP. Size the drive so its output current rating is equal to, or greater than, the combined motor amp rating. If the combined motor HP is greater than the drive's HP rating, then check with the drive manufacturer to determine if that specific drive can support the total motor HP load of that application. In the case of the ACH580 drive, in most but not all scenarios, the drive will have enough capacity to support the total power requirements of the combined motor HP. ABB has a tool available to quickly check whether a motor load of greater HP can be used on a drive with a lower HP rating. This tool looks at low line voltage to the drive along with the motor's HP, current, and efficiency ratings.

Sizing a drive for a single permanent magnet motor, or any other motor design that is more efficient than an induction motor, has the same two options as previously listed for the multiple motor application. Either:

1. Size the drive based on amps and HP.

   or

2. Size the drive based on full load motor current, and double check with the drive manufacturer on any situations where the motor HP exceeds the drive HP.

Whether sizing a drive for multiple motors or for permanent magnet motors, sizing method #1 is the simplest way to size the drive. Sizing method #1 works with all ABB drives and most drives from other manufacturers. Sizing method #2 requires a quick check in some cases to verify the drive will be handle the power requirements of the load. Sizing method #2 may result in a drive size selection that is more optimized than method #1. Note that sizing method #2 should not be used for drive packages that include a full speed bypass, as the bypass contactor is a HP rated component. Bypass packages must use sizing method #1.

The following examples look at an HVAC application, a 2×2 fan array with 7.5 HP motors. Each example uses a slightly different Baldor TEAO 7.5 HP motor. To compare the two sizing methods, both sizing method #1 and method #2 will be used for each example. In each case, one must determine whether to use an ACH580-01-075A-2 drive rated 25 HP & 74.8 A, or an ACH580-01-088A-2 drive rated 30 HP & 88 A.

Example 1

A 2×2 fan array, operating in a building with 240 V available. The 91.7% efficient motors are rated at 230 V, 7.5 HP, 19 A, 1770 RPM each. This array results in a total motor load of 30 HP at 76 A.

- Following method #1 indicates the drive must be rated 30 HP and at least 76 A. The resulting drive is an ACH580-01-088A-2 drive rated at 30 HP, 88 A.
- Following method #2 starts with a drive selected based on amps, and with a check on the HP if needed. This initially results in an ACH580-01-088A-2 drive rated at 30 HP, 88 A. Based on the drive's 30 HP rating matching the combined 30 HP motor rating, there is no need to check it against a drive sizing tool.
- Note that in this example, both sizing methods immediately resulted in the same drive size. That will not be the case in the following examples.

Example 2

A 2×2 fan array, operating in a building with 240 V available. The 91% efficient motors are rated at 230 V, 7.5 HP, 17.2 A, 3525 RPM each. This array results in a total motor load of 30 HP at 68.8 A.

- Following method #1 indicates the drive must be rated 30 HP and at least 68.8 A. The resulting drive is an ACH580-01-088A-2 drive rated at 30 HP, 88 A.
- Following method #2 starts with a drive selected based on amps, and with a check on the HP if needed. This initially results in an ACH580-01-075A-2 drive rated at 25 HP, 74.8 A. Based on the drive's 25 HP rating being less than the combined 30 HP motor rating, now it must be checked against a drive sizing tool to verify if the 25 HP drive fed from 240 V input can handle a 68.8 A, 30 HP load. In this case, the drive sizing tool indicates the 25 HP drive has the capacity to run the combined 30 HP motor load, based on the variables of 240 V line, 91% efficient motors, and a total of 68.8 Amps.
- Note that in this example, both drives can run the fan array. Method #2 allows for an optimally sized drive.

Example 3

A 2×2 fan array, operating in a building with 208 V available. The 91% efficient motors are rated at 208 V, 7.5 HP, 18.6 A, 3525 RPM each. This array results in a total motor load of 30 HP at 74.4 A.

- Following method #1 indicates the drive must be rated 30 HP and at least 74.4 A. The resulting drive is an ACH580-01-088A-2 drive rated at 30 HP, 88 A. This is the correct drive for the application.
- Following method #2 starts with a drive selected based on amps, and with a check on the HP if needed. This initially results in an ACH580-01-075A-2 drive rated at 25 HP, 74.8 A. Based on the drive's 25 HP rating being less than the combined 30 HP motor rating, now it must be checked against a drive sizing tool to verify if the 25 HP drive fed from 208 V input can handle a 74.4 A, 91% efficient, 30 HP load. In this case, the drive sizing tool indicates the drive is undersized, and instead recommends an ACH580-01-088A-2 drive rated at 30 HP, 88 A.
- Note that in this example, sizing a drive based only on total amps, would have resulted in an undersized drive.

In summary, drives should not be sized solely on amps for multiple motor or high-efficient motor applications. Two sizing methods exist for these applications. Sizing based on method #1 is the fastest and easiest, but occasionally will result in a drive that is oversized for the application. Sizing method #2 involves additional verification with the drive supplier but may result in a more optimized drive selection.

[1] The Baldor Super-E motors (2-pole and 4-pole) were used as the basis for this statement. Motors with a FLA rating lower than the equivalent Baldor motor may be verified using the drive sizing tool.