MANUAL SUPPLEMENT

Multiple ratings for ABB ACH580-01 drives

Introduction to the supplement

The National Electric Code (NEC) requires that drive input conductors are based on the drive nameplate information and the output conductors are based on the motor current. There are several scenarios where this sizing procedure is not optimal including multi-motor systems, applications where a larger replacement drive is substituted in an emergency breakdown, and cases where a motor is undersized for the drive. In these situations, power distribution components are often oversized to comply with NEC requirements.

Applicability

This manual supplement applies to ACH580-01 UL NEMA Type 1 & 12.

Target audience

This manual supplement is intended for people who plan the installation and install the drive. Read this supplement before you work on the drive. You are expected to know the fundamentals of electricity, wiring, electrical components, and electrical schematic symbols.

Purpose of the supplement

This document is a manual supplement for the ACH580-01 drive. It is related to the sizing of the input and output conductors for Variable Frequency Drive (VFD) installations. This manual supplement provides multiple ratings tables for ACH580-01; R1 through R9 frame sizes. Information in this document supersedes corresponding information in the ACH580-01 Drives Hardware Manual (3AXD50000044839).

Background

NEC requires that the input conductors are sized at 125% of the maximum rated input current of the drive and that the output conductors are sized at 125% of the motor full-load current. In cases where a larger drive is running a smaller motor, following the 125% sizing of the drive's maximum input current results in unnecessary oversizing of the input conductors. To correct this unnecessary oversizing issue, the UL 61800-5-1 standard used for listing ABB drives allows multiple ratings of a single drive. A smaller scaled input current can be used for sizing input conductors and allows the input conductor size to be based on the application.

This document provides a list of tables that specify multiple ratings of the ACH580-01 drives. ABB takes no responsibility for selecting power distribution devices, branch circuit protection devices, or conductors. This is the responsibility of the system design engineer.

How to use this information

Determine the total Full Load Amps (FLA) motor current required for all the motors powered by the drive in the system. Determine the total hp of all motors in the system. Using the total system FLA motor current and total hp to determine the allowed drive input current from the Multiple Rating tables (Tables 1A, 2A, 3A) in this document. (See Appendix: *Fan Array, calculation example No. 1* for details on how to use these tables.)

The ACH580-01 hardware manual provides UL fuse requirements for typical drive applications. Smaller fuses can be selected for a drive application by determining the system's full load value and selecting the appropriate fuses. The maximum fuse size cannot be greater than four times the selected output rating of the drive or larger than the maximum fuse allowed in the ACH580 hardware manual.

Drawing on application experience in a standard installation ambient environment, i.e. 20 or 30 °C, the minimum fuse or breaker size should be not less than 125% of the drive input current.
It is the responsibility of the installer to determine the size of the fuses which will operate in the installation environment. i.e., elevated temperatures and/or elevations can play a major role in fuse selection. Please consult the fuse specification before choosing a smaller fuse.

Table 1A

Type Code	Frame Size	3 ~ 208-240 Vac											
		Input/output Drive Current Rating Scaled by the Motor FLA											
		I_{1n}	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	Smaller size drive
ACH580-01-04A6-2	R1	4.6	4.4	4.1	3.9	3.7	3.5	3.2	3.0	2.8	2.5	2.3	-
ACH580-01-06A6-2	R1	6.6	6.3	5.9	5.6	5.3	5.0	4.6	4.3	4.0	3.6	3.3	4.6
ACH580-01-07A5-2	R1	7.5	7.1	6.8	6.4	6.0	5.6	5.3	4.9	4.5	4.1	3.8	6.6
ACH580-01-10A6-2	R1	10.6	10.1	9.5	9.0	8.5	8.0	7.4	6.9	6.4	5.8	5.3	7.5
ACH580-01-017A-2	R1	16.7	15.9	15.0	14.2	13.4	12.5	11.7	10.9	10.0	9.2	8.4	10.6
ACH580-01-024A-2	R2	24.2	23.0	21.8	20.6	19.4	18.2	16.9	15.7	14.5	13.3	12.1	16.7
ACH580-01-031A-2	R2	30.8	29.3	27.7	26.2	24.6	23.1	21.6	20.0	18.5	16.9	15.4	24.2
ACH580-01-046A-2	R3	46.2	43.9	41.6	39.3	37.0	34.7	32.3	30.0	27.7	25.4	23.1	30.8
ACH580-01-059A-2	R3	59.4	56.4	53.5	50.5	47.5	44.6	41.6	38.6	35.6	32.7	29.7	46.2
ACH580-01-075A-2	R4	74.8	71.1	67.3	63.6	59.8	56.1	52.4	48.6	44.9	41.1	37.4	59.4
ACH580-01-076A-2	R4	76	72.2	68.4	64.6	60.8	57.0	53.2	49.4	45.6	41.8	38.0	74.8
ACH580-01-088A-2	R5	88	83.6	79.2	74.8	70.4	66.0	61.6	57.2	52.8	48.4	44.0	76.0
ACH580-01-114A-2	R5	114	108.3	102.6	96.9	91.2	85.5	79.8	74.1	68.4	62.7	57.0	89.0
ACH580-01-143A-2	R6	143	135.9	128.7	121.6	114.4	107.3	100.1	93.0	85.8	78.7	71.5	115.0
ACH580-01-169A-2	R7	169	160.6	152.1	143.7	135.2	126.8	118.3	109.9	101.4	93.0	84.5	143.0
ACH580-01-211A-2	R7	211	200.5	189.9	179.4	168.8	158.3	147.7	137.2	126.6	116.1	105.5	169.0
ACH580-01-273A-2	R8	273	259.4	245.7	232.1	218.4	204.8	191.1	177.5	163.8	150.2	136.5	211.0
ACH580-01-343A-2	R9	343	325.9	308.7	291.6	274.4	257.3	240.1	223.0	205.8	188.7	171.5	273.0
ACH580-01-396A-2	R9	396	376.2	356.4	336.6	316.8	297.0	277.2	257.4	237.6	217.8	198.0	343.0

Rerating the larger drive, to match the rating of the smaller drive may have a limitation on wire size due to the UL acceptable lug wire range. Refer to Table 1B for the minimum allowed wire size that can be used with lugs provided with the drive.

Table 1B

Drive type code	Minimum allowed wire size (wire solid/stranded, Cu, 75C)	Frame size
ACH580-01-169A-2	3/0 AWG	R7
ACH580-01-211A-2	3/0 AWG	R7

Table 2A

Type code	Frame Size	3 ~ 380-480 Vac											
		Input/Output Drive Current Rating Scaled by the Motor FLA											
		I_{1n}	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	Smaller size drive
ACH580-01-02A1-4	R1	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	-
ACH580-01-03A0-4	R1	3	2.9	2.7	2.6	2.4	2.3	2.1	2.0	1.8	1.7	1.5	2.1
ACH580-01-03A5-4	R1	3.5	3.3	3.2	3.0	2.8	2.6	2.5	2.3	2.1	1.9	1.8	3.0
ACH580-01-04A8-4	R1	4.8	4.6	4.3	4.1	3.8	3.6	3.4	3.1	2.9	2.6	2.4	3.5
ACH580-01-06A0-4	R1	6	5.7	5.4	5.1	4.8	4.5	4.2	3.9	3.6	3.3	3.0	4.8
ACH580-01-07A6-4	R1	7.6	7.2	6.8	6.5	6.1	5.7	5.3	4.9	4.6	4.2	3.8	6.0
ACH580-01-012A-4	R1	12	11.4	10.8	10.2	9.6	9.0	8.4	7.8	7.2	6.6	6.0	7.6
ACH580-01-014A-4	R2	14	13.3	12.6	11.9	11.2	10.5	9.8	9.1	8.4	7.7	7.0	12.0
ACH580-01-023A-4	R2	23	21.9	20.7	19.6	18.4	17.3	16.1	15.0	13.8	12.7	11.5	14.0
ACH580-01-027A-4	R3	27	25.7	24.3	23.0	21.6	20.3	18.9	17.6	16.2	14.9	13.5	23.0
ACH580-01-034A-4	R3	34	32.3	30.6	28.9	27.2	25.5	23.8	22.1	20.4	18.7	17.0	27.0
ACH580-01-044A-4	R3	44	41.8	39.6	37.4	35.2	33.0	30.8	28.6	26.4	24.2	22.0	34.0
ACH580-01-052A-4	R4	52	49.4	46.8	44.2	41.6	39.0	36.4	33.8	31.2	28.6	26.0	44.0
ACH580-01-065A-4	R4	65	61.8	58.5	55.3	52.0	48.8	45.5	42.3	39.0	35.8	32.5	52.0
ACH580-01-077A-4	R4	77	73.2	69.3	65.5	61.6	57.8	53.9	50.1	46.2	42.4	38.5	65.0
ACH580-01-096A-4	R5	96	91.2	86.4	81.6	76.8	72.0	67.2	62.4	57.6	52.8	48.0	77.0
ACH580-01-124A-4	R6	124	117.8	111.6	105.4	99.2	93.0	86.8	80.6	74.4	68.2	62.0	96.0
ACH580-01-156A-4	R7	156	148.2	140.4	132.6	124.8	117.0	109.2	101.4	93.6	85.8	78.0	124.0
ACH580-01-180A-4	R7	180	171.0	162.0	153.0	144.0	135.0	126.0	117.0	108.0	99.0	90.0	156.0
ACH580-01-240A-4	R8	240	228.0	216.0	204.0	192.0	180.0	168.0	156.0	144.0	132.0	120.0	180.0
ACH580-01-302A-4	R9	302	286.9	271.8	256.7	241.6	226.5	211.4	196.3	181.2	166.1	151.0	240.0
ACH580-01-361A-4	R9	361	343.0	324.9	306.9	288.8	270.8	252.7	234.7	216.6	198.6	180.5	302.0
ACH580-01-414A-4	R9	414	393.3	372.6	351.9	331.2	310.5	289.8	269.1	248.4	227.7	207.0	361.0

Rerating the larger drive, to match the rating of the smaller drive may have a limitation on wire size due to the UL acceptable lug wire range. Refer to Table 2B for the minimum allowed wire size that can be used with lugs provided with the drive.

Table 2B

Drive type code	Minimum allowed wire size (wire solid/stranded, Cu, 75C)	Frame size
ACH580-01-156A-4	3/0 AWG	R7
ACH580-01-180A-4	3/0 AWG	R7

Table 3A

Type Code	Frame Size	3 ~ 525...600 Vac											
		Input/Output Drive Current Rating Scaled by the Motor FLA											
		I_{2ld}	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%	Smaller size drive
ACH580-01-02A7-6	R2	2.7	2.6	2.4	2.3	2.2	2.0	1.9	1.8	1.6	1.5	1.4	-
ACH580-01-03A9-6	R2	3.9	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.3	2.1	2.0	2.7
ACH580-01-06A1-6	R2	6.1	5.8	5.5	5.2	4.9	4.6	4.3	4.0	3.7	3.4	3.1	3.9
ACH580-01-09A0-6	R2	9	8.6	8.1	7.7	7.2	6.8	6.3	5.9	5.4	5.0	4.5	6.1
ACH580-01-011A-6	R2	11	10.5	9.9	9.4	8.8	8.3	7.7	7.2	6.6	6.1	5.5	9
ACH580-01-017A-6	R2	17	16.2	15.3	14.5	13.6	12.8	11.9	11.1	10.2	9.4	8.5	11
ACH580-01-022A-6	R3	22	20.9	19.8	18.7	17.6	16.5	15.4	14.3	13.2	12.1	11.0	17
ACH580-01-027A-6	R3	27	25.7	24.3	23.0	21.6	20.3	18.9	17.6	16.2	14.9	13.5	22
ACH580-01-032A-6	R3	32	30.4	28.8	27.2	25.6	24.0	22.4	20.8	19.2	17.6	16.0	27
ACH580-01-041A-6	R5	41	39.0	36.9	34.9	32.8	30.8	28.7	26.7	24.6	22.6	20.5	32
ACH580-01-052A-6	R5	52	49.4	46.8	44.2	41.6	39.0	36.4	33.8	31.2	28.6	26.0	41
ACH580-01-062A-6	R5	62	58.9	55.8	52.7	49.6	46.5	43.4	40.3	37.2	34.1	31.0	52
ACH580-01-077A-6	R5	77	73.2	69.3	65.5	61.6	57.8	53.9	50.1	46.2	42.4	38.5	62
ACH580-01-099A-6	R7	99	94.1	89.1	84.2	79.2	74.3	69.3	64.4	59.4	54.5	49.5	77
ACH580-01-125A-6	R7	125	118.8	112.5	106.3	100.0	93.8	87.5	81.3	75.0	68.8	62.5	99
ACH580-01-144A-6	R8	144	136.8	129.6	122.4	115.2	108.0	100.8	93.6	86.4	79.2	72.0	125
ACH580-01-192A-6	R9	192	182.4	172.8	163.2	153.6	144.0	134.4	124.8	115.2	105.6	96.0	144
ACH580-01-242A-6	R9	242	229.9	217.8	205.7	193.6	181.5	169.4	157.3	145.2	133.1	121.0	192
ACH580-01-271A-6	R9	271	257.5	243.9	230.4	216.8	203.3	189.7	176.2	162.6	149.1	135.5	242

Rerating the larger drive, to match the rating of the smaller drive may have a limitation on wire size due to the UL acceptable lug wire range. Refer to Table 3B for the minimum allowed wire size that can be used with lugs provided with the drive.

Table 3B

Drive type code	Minimum allowed wire size (wire solid/stranded, Cu, 75C)	Frame size
ACH580-01-041A-6	6 AWG	R5
ACH580-01-052A-6	6 AWG	R5
ACH580-01-062A-6	6 AWG	R5
ACH580-01-077A-6	6 AWG	R5
ACH580-01-099A-6	3/0 AWG	R7
ACH580-01-192A-6	3/0 AWG	R9
ACH580-01-242A-6	3/0 AWG	R9
ACH580-01-271A-6	3/0 AWG	R9

Appendix

Conductor Sizing Requirements

NEC 2017 and NEC 2020 Articles 430.122 (A) require that the input conductors are sized at not less than 125% of the maximum rated input current of the drive.

430.122 Conductors - Minimum Size and Ampacity.
Branch/Feeder Circuit Conductors. Circuit conductors supplying power conversion equipment included as part of an adjustable-speed drive system shall have an ampacity of not less than 125% of the rated input current to the power conversion equipment.

NEC 2017 and NEC 2020 Articles 430.122 (B) require that the output conductors are sized at 125% of the motor full-load current.

Output Conductors. The conductors between the power conversion equipment and the motor shall have an ampacity equal to or larger than 125% of the motor full load current as determined by 430.6 (A) or (B).

The challenge comes in cases where a drive is running a reduced load, or a large drive is running a smaller motor and we are forced to oversize incoming conductors for the application. To correct this issue, NEC Article 430.122 Informational Note No. 1 provides a suggestion on how to avoid this situation. It is a well-known fact that NEC informational notes are not enforceable, but they can provide helpful suggestions on how to resolve some challenges.

Informational Note No. 1: Power conversion equipment can have multiple power ratings and corresponding input currents.

Drives are allowed to have multiple ratings and have the input current scaled to the motor current. UL 61800-5-1 is the standard to which ABB drives are listed and this standard has a provision for this rating, see UL 61800-5-1 article 6.2DV.2.1.3.

6.2DV.2.1.3 For single motor operation only, when the equipment is intended for control of a range of motor ratings, the motor power rating and associated input current rating of the controller shall be provided for each intended motor.

While 6.2DV.2.1.3 references single motor operation, many other areas within UL61800-5-1 allow for multiple motor operations with drives.

The incoming and outgoing field conductors are selected based on the ampacities found in the NEC (NFPA 70), National Electrical Code Table 310.16.

There is a general confusion about the name of this table which is found in various releases of the NEC.

Here is the brief history of the table naming:
NEC 2008 and prior editions, this table was named Table 310.16
NEC 2011, NEC 2014, and NEC 2017, Table 310.16 was renamed to Table 310(B)(16)
NEC 2020, the name of this table went back to Table 310.16
NEC 2023, In this edition this table will continue to be named Table 310.16

Table 310.16

Table 310.16 Ampacities Of Insulated Conductors With Not More Than Three Current-carrying Conductors In Raceway, Cable, Or Earth (Directly Buried)							
Size AWG or kcmil	Temperature Rating Conductor [See Table 310.104(A).]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18**	—	—	14	—	—	—	—
16**	—	—	18	—	—	—	—
14**	15	20	25	—	—	—	—
12**	20	25	30	15	20	25	12**
10**	30	35	40	25	30	35	10**
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	350	420	475	285	340	385	600
700	385	460	520	315	375	425	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	445	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	525	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	555	665	750	470	560	630	2000
Source: NEC 2020							

This document outlines alternate ratings of the drives, starting with the maximum rated current (100%) and derating by decrements of 5% down to 50%. In cases where one size larger drive must be used to replace a smaller rated drive due to availability, we have added a smaller size drive input and output rating.

As outlined at the beginning of the appendix section, incoming conductors are sized at 125% of the incoming rating of the drive, the outgoing conductors are sized to the motor.

For a typical installation, conductors are sized using the NEC Table 310.16, 75°C column. The 75°C column is used since the rating of the drive terminals are labeled to be used for 75°C conductors. Also, conductors in Table 310.16 are rated for use in 30°C ambient. If the controller is installed in a 40°C ambient, then the derating factor of the conductors is 0.88.

For the application examples, a 30°C ambient rating is used when sizing conductors. Refer to NEC 2020 Table 310.15 B(1) for conductor ambient derating factors. In addition to the ambient derating, adjustment factors for more than three current carrying conductors in a conduit or raceway need to be considered. Refer to NEC 2020 Table 310.15 (C)(1) for details.

For the application examples below, a 30°C ambient and no more than three current carrying conductors in a conduit, or a raceway are assumed, and NEC 2020 tables are used. Since many factors are involved in conductor sizing and selection, it is the responsibility of the installer to select proper conductors based on the installation environment.

Branch Circuit Protection Sizing Requirements

From time to time, we have customers who use NEC Table 430.52 to size the branch circuit protection (fuse or circuit breaker) when installing ABB drives.

Table 430.52

Table 430.52 Maximum Rating Or Setting Of Motor Branch-circuit Short-circuit And Ground-fault Protective Devices				
Type Of Motor	Percentage Of	Full load Current		
	Nontime Delay Fuse	Dual Element (Time-delay) Fuse	Instantaneous Trip Breaker	Inverse Time Breaker
Single-phase motors	300	175	800	250
AC polyphase motors other than wound-rotor	300	175	800	250
Squirrel cage - other than Design B energy-efficient	300	175	800	250
Design B energy-efficient	300	175	1100	250
Synchronous	300	175	800	250
Wound rotor	150	150	800	150
Direct current (constant voltage)	150	150	250	150
Source: NEC 2020				

The NEC installation hierarchy is based on NEC Article 110.3 (B) which states:

“110.3 Examination, Identification, Installation, Use, and Listing (Product Certification) of Equipment.

(B) Installation and Use. Equipment that is listed, labeled, or both shall be installed and used per instructions included in the listing or labeling.”

This article requires that the manufacturer's recommendations are followed and that NEC rules should be followed if the manufacturer's installation instructions are not available.

Therefore, when installing ABB drives always follow ABB's user manuals when selecting branch circuit protection and other installation requirements.

Drive Sizing Requirements

NEC Article **430.83 (A)(1) Horsepower Ratings**, states that:
“Controllers … shall have horsepower ratings at the application voltage not lower than the horsepower rating of the motor.”

Since the VFD is interpreted as being a motor controller and it is rated in horsepower and current, this article is interpreted as requiring the selected VFD to have a horsepower rating that is not lower than the motor's horsepower rating.

VFDs are current-rated devices, and the maximum current rating is shown on the device nameplate. If the horsepower rating is not shown on the device nameplate, the respective horsepower rating can be assigned using NEC Table 430.250.

Table 430.250

Table 430.250 Full load Current, Three-phase Alternating-current Motors						
Horsepower	Induction-type Squirrel Cage And Wound Rotor (Amperes)					
	115 Volts	200 Volts	208 Volts	230 Volts	460 Volts	575 Volts
1/2	4.4	2.5	2.4	2.2	1.1	0.9
3/4	6.4	3.7	3.5	3.2	1.6	1.3
1	8.4	4.8	4.6	4.2	2.1	1.7
1 1/2	12.0	6.9	6.6	6.0	3.0	2.4
2	13.6	7.8	7.5	6.8	3.4	2.7
3	—	11.0	10.6	9.6	4.8	3.9
5	—	17.5	16.7	15.2	7.6	6.1
7 1/2	—	25.3	24.2	22	11	9
10	—	32.2	30.8	28	14	11
15	—	48.3	46.2	42	21	17
20	—	62.1	59.4	54	27	22
25	—	78.2	74.8	68	34	27
30	—	92	88	80	40	32
40	—	120	114	104	52	41
50	—	150	143	130	65	52
60	—	177	169	154	77	62
75	—	221	211	192	96	77
100	—	285	273	248	124	99
125	—	359	343	312	156	125
150	—	414	396	360	180	144
200	—	552	528	480	240	192
250	—	—	—	—	302	242
300	—	—	—	—	361	289
350	—	—	—	—	414	336
400	—	—	—	—	477	382
450	—	—	—	—	515	412
500	—	—	—	—	590	472

*For 90 and 80 percent power factor, the figures shall be multiplied by 1.1 and 1.25, respectively.
Source: NEC 2020

The values shown in Table 430.250 are full load currents for typical motors running at full speed with normal torque characteristics. Motors built for low speeds (less than 1200 RPM) or high torques may have higher full load currents in which case the nameplate current ratings shall be used. In case of retrofits where a multi-speed motor is replaced, the motor should be wired for high speed and the high-speed FLA of the motor nameplate rating should be used for VFD sizing. For more information on the recommendation on how to size a drive, please review Technical Note 016.

Fan Array applications

Recently, motors have been developed that do not use conventionally rated hp. For example, typical NEMA 3-phase standard motor ratings have been 1 hp, 1.5 hp, 3 hp, 5 hp, 7.5 hp 10 hp and 15 hp, but now there are expanded motor hp selections such as, 2 hp, 2.5 hp, 3.5 hp, 4 hp, 4.5 hp, 5.5 hp, 6 hp, 6.5 hp, 7 hp, 8 hp, 8.5 hp, 9 hp, 9.5 hp, 10.5 hp, 11.0 hp, 11.5 hp, and 12 hp. Please see Table 4 as an example.

Table 4: Typical and expanded motor table

Typical motor horsepower	Expanded motor horsepower	460V FLA
1	1	1.4
1.5	1.5	2
	2	2.7
	2.5	3.2
3	3	4
	3.5	4.7
	4	5
	4.5	5.9
5	5	6.5
	5.5	7
	6	7.5
	6.5	8
	7	8.5
7.5	7.5	9.5
	8	10
	8.5	10.5
	9	11
	9.5	11.5
10	10	12.5
	10.5	12.8
	11	13.4
	11.5	14.5
	12	14.5
15	15	19

The availability of the horsepower increments allows the user to choose a motor that is closely matched to the application load. This will reduce the sizing of the branch circuit protection, incoming and outgoing conductor sizing, transformer, and switchgear costs for the building.

Incremental horsepower motors support this design principle by allowing expanded motor selections within a given horsepower range versus what is traditionally available from motor manufacturers. For example, if a 2x2 fan array requires 18 hp (including safety factors), a designer would traditionally be required to select (4) 5 hp motors, resulting in 20 hp total. While the fan loading would only consume up to 18 hp maximum, the motor and building's electrical system (wiring, VFDs, and electrical components) would be sized for 20 hp. However, now the designer could select (4) 4.5 hp motors to achieve 18 hp total, thus contributing towards a reduction of wiring, branch circuit protection, and switchgear costs for the building.

The following examples are for illustration purposes only, please follow NEC and local codes when selecting conductors and branch circuit protection for your installation.

Fan Array, calculation example No. 1

Fan Array motor application with one drive controlling multiple motors in a 3 x 3 Fan Array. A single ACH580-01-156A-4 is running (9) 11.5 hp fans drawing 14.5 A each, for a total of 130.5 A. Referencing Table 2B, we can rerate this drive to its 85% (132.6 A) rating based on this application only requiring 130.5 A.

The traditional input conductor sizing using the drive's 156 A rating results in 3/0 AWG. However, leveraging the 85% (132.6 A) rating allows 2/0 AWG to be used.

Traditionally sizing of the fuses for 156 A rating results in a 225 A fuse, which uses a 400 A disconnect switch. However, leveraging the 85% (132.6 A) rating allows for a 200 A fuse, which allows for a 200 A disconnect switch, thus reducing the size and cost of both the fuse and disconnect switch.

Single motor using an expanded hp size

As described in the Fan Array application on *page 9*, there are more motors available today that fall between the traditional hp range. In many designs, the motor selection is “rounded up” to the next available motor size. In some applications, motor selection can be optimized by using one of these expanded sizes, one that limits how much the motor is oversized for the application.

Single motor, calculation example No. 2

If we have a fan that requires 12 hp maximum, we can now select a 12 hp 460 VAC motor, which is rated at 14.5 A, instead of the next available traditional motor size of 15 hp, which is rated at 19 A. Drive sizing for a 12 hp 460 VAC motor is ACH580-01-023A-4. Traditional input conductor sizing using the drive's 23 A rating results in #10 wire. However, leveraging the 65% rating (15.0 A) allows for #14 to be used. The fuse size using the 23 A rating results in a 30 Amp fuse. However, leveraging the 65% (15 A) rating allows for a 20 A fuse, thus reducing the size and cost of the fuse.

Using one-size-larger drive

There are situations where a drive fails and requires a quick replacement. A similar, but larger drive, may be in local stock or have a shorter lead-time than the original failed drive's size. Physical size is typically the initial concern, will the larger hp drive fit into the existing space? However, another important concern is making sure existing wire and fuse sizes are still compliant with NEC requirements. Using traditional wire and fuse sizing techniques on the larger replacement drive often requires the fuse and wiring sizing to increase.

Replacing existing wires is rarely practical just so the larger, more readily available drive can be used. rerating the larger drive, to match the rating of the small drive, is the solution for this scenario. Now existing wire and fuse sizes are not impacted.

There is a dedicated column called “Smaller sized drive” in this document's tables, specifically for this scenario.

One-size-larger, calculation example No. 3

A 125 hp 480 VAC drive ACH580-01-156-4 has failed and needs to be replaced. The existing field conductors for this drive would have to be sized for 156 A, 3/0 AWG wire minimum. Locally an ACH580-01-180A-4 is in stock for the critical application.

Traditional input conductor sizing would have required 4/0 AWG wire to be installed to use the ACH580-01-180A-4. However, leveraging the “smaller size drive” rating (156 A) allows for the existing 3/0 wire and fuses to be reused.

The wire is too small for the drive lug

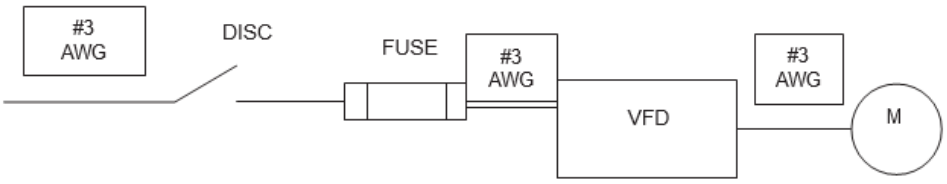
In some cases, the rerating of a drive leads to a wire size that can't be connected directly to the drive. The connection points (lugs) on a drive have a minimum size wire they can accept. An additional device, such as a fused disconnect, can be used in those cases where the desired wire size cannot be directly connected to the drive. This additional device effectively acts as a conversion device, with a smaller size wire on its primary side leading upstream, and a larger size wire on the secondary side leading to the drive.

The wire is too small, calculation example No. 4

If you are installing a drive on the wall and providing fuses to the drive, you would have to use the minimum wire size to connect from the load side of the fuse to the drive, however, because of the multiple ratings of the drive, you can use reduced current for sizing the conductors in the feeder.

A 50 hp 600 VAC drive ACH580-01-052A-6 must use a #6 wire minimum, due to the lug wire acceptance range for this frame (R5) drive. The application's motor only requires this drive to be applied at its 75% load (39 A), which results in input cabling of #8. However, #8 is not accepted by the drive's lugs so the nearby fused disconnect is used to convert the building's #8 to #6 to the drive, reference Figure 1. The wire from the disconnect to the drive must be minimum #6 to satisfy the drive's lugs requirements. However, wire to the feeder can be #8 as calculated based on the 75% load (39 A) rerating. This example allows the lower cost #8 wire to be used for the long run upstream of the fused disconnect, while the more expensive #6 wire be used for the short run between the fused disconnect and drive.

Figure 1



Smaller wire and disconnect, calculation example No. 5

A 144A, R8 Drive Type Code ACH580-01-144A-6 running at 50% load (72 A) can now use #3 AWG wire sized for 72A instead of 3/0 AWG wire sized for 144A throughout the circuit. The recommended fuse size of 250A for a 144A load can be reduced to 100A with the 72A load. This means that the size of the disconnect can now be reduced from 400A to 100A, reference Figure 2.

Figure 2