SECTION 26 2923

VARIABLE-Frequency MOTOR Controllers

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LANL MASTER SPECIFICATION SECTION

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| --- |
| Rev. 5 Summary of changes   1. Major rework of specification section directed at reducing submittal requirements for most applications. 2. Clarification that drives with Multiple Input Ratings can and should be used. 3. Specification section reworked to encourage the use of preapproved LANL standards drive types. 4. Updated seismic mounting requirements to simplify field mounting of drives using standard mounting details and/or exceptions. Clarified who is responsible for mounting details when engineering design is required. 5. Updated code references. 6. Added new labeling requirement for drives installed using multiple input ratings. |

Word file at <http://engstandards.lanl.gov>

This template must be edited for each project. In doing so, specifier must add job-specific requirements. Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer. Once the choice is made or text supplied, remove the brackets. The specification section must also be edited to delete requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these. Additional tailoring requirements are contained in ESM [Chapter 1](http://engstandards.lanl.gov/ESM_Chapters.shtml#esm1) Section Z10 Att. F, Specifications. This template is tailored to meet requirements contained in the LANL Engineering Standards Manual (ESM). To seek a variance from applicable requirements in this section, contact the Engineering Standards Manual Electrical[POC](http://engstandards.lanl.gov/POCs.shtml#elec) and I&C [POC](https://engstandards.lanl.gov/POCs.shtml#ic). Please contact POCs with suggestions for improvement as well.

When assembling a specification package, include applicable specification sections from all Divisions, especially Division 1, General Requirements.  
This template is developed for ML-4 projects. For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1 Section Z10 Specifications and Quality Sections.

For drives specified as safety related (ML-1 or ML-2) on the design documents, only Option A is available to the Constructor (no substitutions allowed). Commercial grade dedication is also required in this case.  
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1. GENERAL
   1. SECTION INCLUDES
      1. Configured Variable-Frequency Drives (VFDs) for use with NEMA B design, squirrel-cage induction motors.
      2. To reduce the number of submittals required, reduce Title III engineering support and give the Constructor maximum flexibility in device selections the following three options are allowed for VFDs:
         1. Option A: (Exact Model Numbers Provided) – When the design documents provide exact model numbers for drives, the Constructor may elect to provide drive(s) based on those exact model numbers. This minimizes submittals and additional design work required.
         2. Option B: (LANL Pre-approved Models) – When the design documents do not provide exact model numbers for drives, the Constructor may elect to select the required drives from a list of pre-approved model numbers. This minimizes submittals required but may require addition design work to ensure correct mounting.
         3. Option C: (Constructor Selected Drive) – When Option A or B are not available, the Constructor may elect to provide a drive meeting all the requirements provided in PART 2 of this section. This option requires a complete set of submittals for the drives and places the burden of engineering to accommodate the selected drive on the constructor.
   2. RELATED SECTIONS
      1. Section 01 3300, *Submittal Procedures*
      2. Section 01 2500, *Substitution Procedures*
      3. Section 01 8734, *Seismic Qualification of Nonstructural Components (IBC)*, for requirements.
      4. Section 25 5000, *Integrated Automated Facility Controls*
      5. Section 26 0526, *Grounding and Bonding for Electrical Systems*
      6. Section 26 0529, *Hangers and Supports for Electrical Systems*
      7. Section 26 0548.16, *Seismic Controls for Electrical Systems*, for [seismic-design criteria,] submittal requirements, devices for seismic restraint, and installation requirements for these devices.
      8. Section 26 0553, *Identification for Electrical Systems*
      9. Section 26 0813, *Electrical Acceptance Testing*
   3. REFERENCES
      1. ACH 580, Multiple Drive Rating Manual Supplement
      2. ASCE 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
      3. ASHRAE 135, BACnet – A Data Communication Protocol for Building Automation and Control Networks
      4. 47 CFR, Chapter I, Subchapter A, Part 15, Radio Frequency Devices (FCC Part 15)
      5. IEC 61800-3, Adjustable Speed Electrical Power Drive Systems – Part 3: EMC Requirements and specific Test Methods for PDS and Machine Tools
      6. IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
      7. IEEE 519, Standard for Harmonic Control in Electric Power Systems
      8. ISO 16484-5, Building Automation and Control Systems (BACS) – Part 5: Data Communication Protocol
      9. NECA 1, Standard for Good Workmanship in Electrical Construction
      10. NEMA ICS 2, Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts
      11. NEMA ISC 3.1, Guide for the Application, Handling, Storage, Installation, and Maintenance of Medium-Voltage AC Contactors, Controllers, and Control Centers
      12. NEMA ICS 6, Industrial Control and Systems: Enclosures
      13. NEMA ISC 7, Industrial Control and Systems: Adjustable Speed Drives
      14. NEMA MG 1, Motors and Generators
      15. NFPA 70, National Electric Code
      16. UL 486A-486B, Wire Connectors
      17. UL 508, Industrial Control Equipment
      18. UL 508A, Industrial Control Panels
      19. UL 1995, Heating and Cooling Equipment
      20. UL 61800-5-1, Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy
   4. ACRONYMS AND DEFINITIONS
      1. For definitions and acronyms, refer to [COE Glossary of Terms](https://engstandards.lanl.gov/_assets/GLOS-COE-1.pdf). Definitions exist for the following terms (and others): Constructor, Design Agency, EOR, ESM.
      2. VFD: Variable Frequency Drive.
   5. SUBMITTALS
      1. Submit the following in accordance with Section 01 3300, *Submittal Procedures*.
      2. Action submittals: Required action submittals are based on the Option selected per paragraph [1.1.B] and the following table:

Table 1: Required Action Submittals based on Selected Option

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Option** | **Required Action Submittals** | | | | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| A | X |  |  |  |  |  |  |  | O |  |  |  | X |
| B |  | X |  |  |  |  |  |  | X |  |  |  | X |
| C |  |  | X | X | X | X | X | X |  | X | X | X | X |
| X = Required Submittal  O = Optional Submittal (required submittal if mounting details not included in design documents) | | | | | | | | | | | | | |

* + - 1. Submittal Waiver: Submit 01 3300 FM01-W stating that the drive(s) specified in the design documents will be used and mounted per the design documents and that no further submittals are required.
      2. Submittal Selection Notice: Submit a written notice that indicates which drive(s) from the LANL pre-approved model list will be used. Indicate which drives will be used for each location by designations called out in design documents.
      3. Catalog Data: Submit catalog data describing each type of VFD. Include data substantiating that materials comply with specified requirements. Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
      4. Startup Certification: Submit certification by manufacturer’s field technical representative that the Constructor has installed, adjusted, and tested each VFD according to the manufacturer’s recommendations.
      5. Shop Drawings: Submit shop drawings for each VFD including dimensioned plans and elevations and component lists. Include front and side views of enclosure showing overall dimensions, enclosure type, enclosure finish, unit locations, and conduit entrances.
      6. Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, installation, and starting of Product.
      7. Operation and Maintenance Instructions: Submit operation and maintenance instructions.
      8. Test Reports: Submit results of required factory tests.
      9. Mounting Design (Design Agency provided): Submit a written notice in the form of an RFI stating that standard LANL mounting details will be used for drive mounting OR when standard LANL mounting details cannot be used, indicate that Engineer of Record must provide additional mounting details. When project is a design-build, the constructor is required to provide mounting design details.
      10. Mounting Design (Constructor provided):
          1. Drive(s) meeting seismic exemption requirements: Submit a written notice that indicates the drive(s) meet seismic exemption requirements and no further engineering is required.
          2. Drive(s) not meeting seismic exemption requirements: Submit a detailed engineered design package to indicate how the drives will be mounted to meet seismic requirements. Provide calculations as required to support engineered design.
      11. A detailed point description and address map of all points available via the RS-485 communication port. Provide details of available BAUD rates and communication settings for the port.
      12. Provide a calculation showing the de-rating of the drive based on operating at 7500 feet above sea level using the manufacturer’s recommended procedure. Drives that do not have a recommended procedure for altitude derating shall not be used.
          1. If altitude derating of the drive requires the use of a larger drive than specified in the design, additionally submit updated conductor and overcurrent sizes, if necessary, based on the NEC for the upsized drive. The cost of upsizing input feeders is responsibility of the constructor.
      13. Special Certification from Manufacturer (only applicable if VFD is a Designated Seismic System if required by LANL).
    1. Informational Submittals (applies to Options A, B and C):
       1. Parameter Settings: For each VFD, provide a listing of all drive parameter settings that were changed from the manufacturer’s default settings.
       2. If programming parameters provided in design documents, submit certification that drive has been programmed per design document.
  1. QUALITY ASSURANCE
     1. Provide products that are listed and labeled by a Nationally Recognized Testing Laboratory (NRTL).
     2. Comply with NFPA 70 (also referred to as NEC) for installation requirements.
     3. Comply with the applicable requirements of the latest NEMA ICS 3.1, IEEE 519, and FCC Part 15 Subpart J.

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Edit the following to match project requirements. Delete if not applicable. In most cases, paragraph below will be deleted.

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* + 1. If testing is specified or Option “C” is selected, perform the following factory tests on each VFD:
       1. Test all VFD door mounted pilot devices (if present) to verify proper function.
       2. Functionally test all options.
  1. COORDINATION
     1. Coordinate the features of each VFD with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, load, the pilot device, and control circuit affecting controller functions. Furnish VFDs rated to suit the motor controlled in the specified conditions.
     2. Coordinate the communications protocol with the building automation system; refer to Section 25 5000, *Integrated Automated Facility Controls*.
  2. SERVICE CONDITIONS
     1. VFDs shall perform satisfactorily in the following conditions without mechanical or electrical damage or degradation of operating characteristics:
        1. Operating elevation of 7500 feet above sea level.
        2. Seismic Performance Requirements: Refer to Article [2.2] *Seismic Performance Requirements.*
        3. Indoor Use (NEMA 1):
           1. Operating ambient temperature extremes of 32 to 104 degrees F.
           2. Operating relative humidity: 0 to 80 percent, without condensation.
        4. Outdoor Use (NEMA 3R):
           1. Operating ambient temperature extremes of -20 to 104 degrees F.
           2. Operating relative humidity: 0 to 100 percent, exterior condensation possible.
           3. Maximum solar heat gain: 110 W/sq ft.
  3. RECEIVING, STORING AND PROTECTING
     1. Receive, store, and protect, and handle products according to NECA 1.

1. PRODUCTS
   1. PRODUCT OPTIONS AND SUBSTITUTIONS
      1. When ABB drives are used, if conflict exists between this section and the manufacturer’s specification section, the ABB specification section shall take precedence.
   2. SEISMIC PERFORMANCE REQUIREMENTS

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The seismic exemptions noted below are based on ASCE 7-16. If the Code of Record for the project refers to a different version of ASCE 7, the designer is responsible to check the seismic design requirements per that applicable edition.

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* + 1. Note to Constructor: Component importance factor of 1.0 is default unless noted otherwise in design documents. If VFD is a Designated Seismic System (DSS), component importance factor is 1.5 and the Engineer of Record must provide mounting details for the VFD and follow paragraph [2.2.C] below.
    2. The following nonstructural components (VFDs) are seismically exempt per ASCE 7, Section 13.1.4, but shall be positively attached to the structure provided that:
       1. Component weighs 400 lbs or less with center of mass located 4 ft or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping and conduit, and component importance factor is equal to 1.0 or
       2. Component weighs 20 lbs or less.

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For VFDs that are not seismically exempt, if Project Specification package includes 26 0548.16, and if mounting and/or anchorage devices are to be used that differ from those specified in 26 0548.16, they must be described herein (in PART 2).

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* + 1. For components not meeting the above exemptions, Constructor to consult Engineer of Record for seismic support design requirements per ESM Chapter 5, Section II, if supports not designed during detailed design phase of project. I&C standard drawing [ST-F1033-1](https://engstandards.lanl.gov/Dwgs_Details.shtml#IC) available on the [LANL Engineering Standards Website](https://engstandards.lanl.gov/Dwgs_Details.shtml) may be used within the limits noted on the drawing. If VFD is a DSS, manufacturer shall provide special certification per ASCE 7, Section 13.2.2.
  1. VARIABLE FREQUENCY DRIVE
     1. Constructor shall provide drives per Options A, B or C as selected in PART 1.
     2. Option A (Exact Model Numbers Provided): When exact model numbers for drives are specified on the design drawings, Constructor shall provide drives based on these model numbers. When selecting this option, minimal submittals are required per Table 1.
     3. Option B (LANL Pre-approved Models): Based on the installed location of the drive, Constructor shall select drives from the LANL Pre-approved list shown in the following tables based on motor HP, voltage and environment:

Table 2: NEMA 1, 208V – Drives for Indoor Use Only

| NEMA 1, 208V – Drives for Indoor Use Only  -PDR Option Includes Packaged Drive with Input Fuses and Disconnect +J405 Option Includes Non-Bluetooth Keypad Option | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Motor HP | ABB Model | NEC Full Load Amps1 | Derated Max Output Amps2 | Drive Input Amp Rating3 | Drive Rating4 | Weight (lbs.) |
| ≤ 0.75 | ACH580-PDR-04A6-2 + J405 | 3.22 | 4.01 | 4.10 | 90% | 19 |
| 1 | ACH580-PDR-06A6-2 + J405 | 4.14 | 5.75 | 4.30 | 65% | 19 |
| 1.5 | ACH580-PDR-07A5-2 + J405 | 5.98 | 6.54 | 6.00 | 80% | 19 |
| 2 | ACH580-PDR-10A6-2 + J405 | 7.82 | 8.80 | 8.00 | 75% | 19 |
| 3 | ACH580-PDR-017A-2 + J405 | 11.0 | 14.6 | 11.7 | 70% | 19 |
| 5 | ACH580-PDR-024A-2 + J405 | 17.5 | 21.1 | 18.2 | 75% | 23 |
| 7.5 | ACH580-PDR-031A-2 + J405 | 25.3 | 26.4 | 26.2 | 85% | 23 |
| 10 | ACH580-PDR-046A-2 + J405 | 32.2 | 40.3 | 32.3 | 70% | 40 |
| 15 | ACH580-PDR-059A-2 + J405 | 48.3 | 51.8 | 50.5 | 85% | 40 |
| 20 | ACH580-PDR-075A-2 + J405 | 62.1 | 65.2 | 63.6 | 85% | 60 |
| 25 | ACH580-PDR-088A-2 + J405 | 78.2 | 76.7 | 79.2 | 90% | 359 |
| 30 | ACH580-PDR-114A-2 + J405 | 92.0 | 99.4 | 96.9 | 85% | 359 |
| 40 | ACH580-PDR-143A-2 + J405 | 120 | 124.7 | 121.6 | 85% | 359 |
| 50 | ACH580-PDR-169A-2 + J405 | 150 | 147.3 | 152.1 | 90% | 359 |
| 60 | ACH580-PDR-211A-2 + J405 | 177 | 183.9 | 179.4 | 85% | 359 |
| 75 | ACH580-PDR-273A-2 + J405 | 221 | 237.9 | 232.1 | 85% | 359 |
| Notes: 1 Per NEC Table 430.250 (for motor) 2 Derating based on 100% drive rating, operation at 7500ft above sea level, and ambient temperature of no greater than 104°F per ABB *“ACH580-01 Drives Hardware Manual - 3AXD50000044839 Rev B”* 3 Use this amperage for VFD input conductor sizing. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”. Conductor must have an ampacity at least 125% of this number.* 4 Selected input/output ratio to best match NEC FLA ratings. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”* | | | | | | |

Table 3: NEMA 1, 480V – Drives for Indoor Use Only

| NEMA 1, 480V – Drives for Indoor Use Only  -PDR Option Includes Packaged Drive with Input Fuses and Disconnect +J405 Option Includes Non-Bluetooth Keypad Option | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Motor HP | ABB Model | NEC Full Load Amps1 | Derated Max Output Amps2 | Drive Input Amp Rating3 | Drive Rating4 | Weight (lbs.) |
| ≤ 0.75 | ACH580-PDR-02A1-4 + J405 | 1.4 | 1.83 | 1.4 | 65% | 19 |
| 1 | ACH580-PDR-02A1-4 + J405 | 1.8 | 1.83 | 1.9 | 90% | 19 |
| 1.5 | ACH580-PDR-03A0-4 + J405 | 2.6 | 3.05 | 2.6 | 85% | 19 |
| 2 | ACH580-PDR-04A8-4 + J405 | 3.4 | 4.19 | 3.4 | 70% | 19 |
| 3 | ACH580-PDR-06A0-4 + J405 | 4.8 | 5.23 | 4.8 | 80% | 19 |
| 5 | ACH580-PDR-012A-4 + J405 | 7.6 | 10.46 | 7.8 | 65% | 19 |
| 7.5 | ACH580-PDR-014A-4 + J405 | 11 | 12.21 | 11.2 | 80% | 23 |
| 10 | ACH580-PDR-023A-4 + J405 | 14 | 20.06 | 15 | 65% | 23 |
| 15 | ACH580-PDR-027A-4 + J405 | 21 | 23.54 | 21.6 | 85% | 40 |
| 20 | ACH580-PDR-034A-4 + J405 | 27 | 29.65 | 27.2 | 85% | 40 |
| 25 | ACH580-PDR-044A-4 + J405 | 34 | 38.37 | 35.2 | 80% | 40 |
| 30 | ACH580-PDR-52A-4 + J405 | 40 | 45.34 | 41.6 | 80% | 60 |
| 40 | ACH580-PDR-065A-4 + J405 | 52 | 56.68 | 82 | 80% | 60 |
| 50 | ACH580-PDR-077A-4 + J405 | 65 | 67.14 | 65.5 | 85% | 60 |
| 60 | ACH580-PDR-096A-4 + J405 | 77 | 83.71 | 81.6 | 85% | 359 |
| 75 | ACH580-PDR-124A-4 + J405 | 96 | 180.13 | 99.2 | 80% | 359 |
| 100 | ACH580-PDR-156A-4 + J405 | 124 | 136.03 | 124.8 | 80% | 359 |
| Notes: 1 Per NEC Table 430.250 (for motor) 2 Derating based on operation at 7500ft above sea level and ambient temperature of no greater than 104°F per ABB *“ACH580-01 Drives Hardware Manual - 3AXD50000044839 Rev B”* 3 Use this amperage for VFD input conductor sizing. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”. Conductor must have an ampacity at least 125% of this number.* 4 Selected input/output ratio to best match NEC FLA ratings. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”* | | | | | | |

Table 4: NEMA 3R, 208V – Drives for Outdoor Use Only

| NEMA 3R, 208V – Drives for Outdoor Use Only  -PDR Option Includes Packaged Drive with Input Fuses and Disconnect + B058 Option Includes NEMA 3R Rated Enclosure, Heater/Cooling Fans +J405 Option Includes Non-Bluetooth Keypad Option | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Motor HP | ABB Model | NEC Full Load Amps1 | Derated Max Output Amps2 | Drive Input Amp Rating3 | Drive Rating4 | Weight (lbs.) |
| ≤ 0.75 | ACH580-PDR-04A6-2 + B058 + J405 | 3.22 | 4.01 | 4.10 | 90% | 78 |
| 1 | ACH580-PDR-06A6-2 + B058 + J405 | 4.14 | 5.75 | 4.30 | 65% | 78 |
| 1.5 | ACH580-PDR-07A5-2 + B058 + J405 | 5.98 | 6.54 | 6.00 | 80% | 78 |
| 2 | ACH580-PDR-10A6-2 + B058 + J405 | 7.82 | 8.80 | 8.00 | 75% | 78 |
| 3 | ACH580-PDR-017A-2 + B058 + J405 | 11.0 | 14.6 | 11.7 | 70% | 78 |
| 5 | ACH580-PDR-024A-2 + B058 + J405 | 17.5 | 21.1 | 18.2 | 75% | 78 |
| 7.5 | ACH580-PDR-031A-2 + B058 + J405 | 25.3 | 26.4 | 26.2 | 85% | 78 |
| 10 | ACH580-PDR-046A-2 + B058 + J405 | 32.2 | 40.3 | 32.3 | 70% | 176 |
| 15 | ACH580-PDR-059A-2 + B058 + J405 | 48.3 | 51.8 | 50.5 | 85% | 176 |
| 20 | ACH580-PDR-075A-2 + B058 + J405 | 62.1 | 65.2 | 63.6 | 85% | 176 |
| 25 | ACH580-PDR-088A-2 + B058 + J405 | 78.2 | 76.7 | 79.2 | 90% | 236 |
| 30 | ACH580-PDR-114A-2 + B058 + J405 | 92.0 | 99.4 | 96.9 | 85% | 236 |
| 40 | ACH580-PDR-143A-2 + B058 + J405 | 120 | 124.7 | 121.6 | 85% | 441 |
| 50 | ACH580-PDR-169A-2 + B058 + J405 | 150 | 147.3 | 152.1 | 90% | 441 |
| 60 | ACH580-PDR-211A-2 + B058 + J405 | 177 | 183.9 | 179.4 | 85% | 441 |
| 75 | ACH580-PDR-273A-2 + B058 + J405 | 221 | 237.9 | 232.1 | 85% | 441 |
| Notes: 1 Per NEC Table 430.250 (for motor) 2 Derating based on operation at 7500ft above sea level and ambient temperature of no greater than 104°F per ABB *“ACH580-01 Drives Hardware Manual - 3AXD50000044839 Rev B”* 3 Use this amperage for VFD input conductor sizing. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”. Conductor must have an ampacity at least 125% of this number.* 4 Selected input/output ratio to best match NEC FLA ratings. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”* | | | | | | |

Table 5: NEMA 3R, 480V – Drives for Outdoor Use Only

| NEMA 3R, 480V – Drives for Outdoor Use Only  -PDR Option Includes Packaged Drive with Input Fuses and Disconnect + B058 Option Includes NEMA 3R Rated Enclosure, Heater/Cooling Fans +J405 Option Includes Non-Bluetooth Keypad Option | | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| Motor HP | ABB Model | NEC Full Load Amps1 | Derated Max Output Amps2 | Drive Input Amp Rating3 | Drive Rating4 | Weight (lbs.) |
| ≤ 0.75 | ACH580-PDR-02A1-4 + B058 + J405 | 1.4 | 1.83 | 1.4 | 65% | 78 |
| 1 | ACH580-PDR-02A1-4 + B058 + J405 | 1.8 | 1.83 | 1.9 | 90% | 78 |
| 1.5 | ACH580-PDR-03A0-4 + B058 + J405 | 2.6 | 3.05 | 2.6 | 85% | 78 |
| 2 | ACH580-PDR-04A8-4 + B058 + J405 | 3.4 | 4.19 | 3.4 | 70% | 78 |
| 3 | ACH580-PDR-06A0-4 + B058 + J405 | 4.8 | 5.23 | 4.8 | 80% | 78 |
| 5 | ACH580-PDR-012A-4 + B058 + J405 | 7.6 | 10.46 | 7.8 | 65% | 78 |
| 7.5 | ACH580-PDR-014A-4 + B058 + J405 | 11 | 12.21 | 11.2 | 80% | 78 |
| 10 | ACH580-PDR-023A-4 + B058 + J405 | 14 | 20.06 | 15 | 65% | 78 |
| 15 | ACH580-PDR-027A-4 + B058 + J405 | 21 | 23.54 | 21.6 | 85% | 176 |
| 20 | ACH580-PDR-034A-4 + B058 + J405 | 27 | 29.65 | 27.2 | 85% | 176 |
| 25 | ACH580-PDR-044A-4 + B058 + J405 | 34 | 38.37 | 35.2 | 80% | 176 |
| 30 | ACH580-PDR-52A-4 + B058 + J405 | 40 | 45.34 | 41.6 | 80% | 176 |
| 40 | ACH580-PDR-065A-4 +B058 + J405 | 52 | 56.68 | 82 | 80% | 176 |
| 50 | ACH580-PDR-077A-4 + B058 + J405 | 65 | 67.14 | 65.5 | 85% | 176 |
| 60 | ACH580-PDR-096A-4 + B058 + J405 | 77 | 83.71 | 81.6 | 85% | 236 |
| 75 | ACH580-PDR-124A-4 + B058 + J405 | 96 | 180.13 | 99.2 | 80% | 441 |
| 100 | ACH580-PDR-156A-4 + B058 + J405 | 124 | 136.03 | 124.8 | 80% | 441 |
| Notes: 1 Per NEC Table 430.250 (for motor) 2 Derating based on operation at 7500ft above sea level and ambient temperature of no greater than 104°F per ABB *“ACH580-01 Drives Hardware Manual - 3AXD50000044839 Rev B”* 3 Use this amperage for VFD input conductor sizing. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”. Conductor must have an ampacity at least 125% of this number.* 4 Selected input/output ratio to best match NEC FLA ratings. Taken from “*ACH580 Multiple Drive Rating Manual Supplement - 3AXD50000952625 Rev A”* | | | | | | |

* + 1. **Option C** (Constructor Selected Drive): Provide drive(s) meeting the following criteria:
       1. NRTL-listed and labeled configured VFDs as indicated on the design drawings and specified in this section. Where required on design drawings, NEMA 1 enclosed VFDs shall be UL 1995 listed for mounting in plenums and compartments handling environmental air.
       2. Drives with Bluetooth/Wifi are required to have Bluetooth/Wifi disabled in hardware.

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Edit the following to match project requirements.

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* + - 1. Each configured VFD shall be an integrated assembly with an externally operated disconnect device, transient voltage surge suppression, current-limiting fuses, line input reactor, power converter, cooling fans, operator interface, control system interface, control power transformer, and a suitable enclosure.
      2. Provide fusible switch type externally operable disconnect. Disconnect handle shall have provisions for locking in the OFF position. Mechanical interlocks shall prevent opening the enclosure door with disconnect in the ON position and shall prevent moving disconnect to the ON position with enclosure door open, unless an interlock defeat mechanism is provided for use by qualified persons.
      3. The manufacturer’s instructions shall include a designated capacitor discharge wait time, or procedure, before opening cover.
      4. The VFD shall have a test point for the DC link such that zero voltage may be confirmed with the use of a voltmeter.
      5. Provide current-limiting drive branch circuit fuses in the disconnect switch. Select fuses to protect the input rectification circuit. Use manufacturer recommended fuses.
      6. Provide a three phase 3% minimum impedance input line reactor in the VFD cabinet to minimize drive harmonics on the AC line and protect the drive from damaging electrical system transients. Provide additional input filtering as required to limit line current total harmonic distortion (THD) to less than 10 percent.
      7. Provide power converter that is microprocessor based using insulated gate bipolar transistors and pulse width modulation (PWM) technology and is suitable for low-noise operation of adjustable torque loads such as centrifugal pumps and fans.
         1. Input voltage shall be either 200-230 or 380-480 VAC, as indicated on the design drawings.
         2. Power converter shall be able to withstand voltage variations of -15 percent to +10 percent and imbalance of 3 percent without tripping or affecting drive performance.
         3. Power converter shall operate with input frequency of 60 Hz and shall withstand a frequency variation of +5 percent to -5 percent.
         4. Power converter power factor shall be not less than 0.95 lagging under any speed or load condition.
         5. The efficiency of the VFD shall be not less than 96 percent at full speed and full load.
         6. Line notches, transients, and harmonics on incoming line shall not affect power converter performance.
         7. VFD shall include provisions for a DC link inductor. VFDs 100 HP and above shall be supplied with DC link inductor in addition to the input line reactor.
      8. VFD output shall be capable of continuously operating the connected variable torque motor load over the complete speed range at an elevation of 7500 feet in an ambient temperature of +40 degrees C (104 degrees F) operating at the specified carrier frequency.
         1. VFD output voltage shall vary with frequency to maintain a constant volts/hertz ratio up to 60 Hz output. Constant or linear voltage output shall be provided above 60 Hz.
         2. VFD rated output voltage shall be programmable to match motor nameplate voltage.
         3. The VFD one-minute overload rating shall be not less than 120 percent of rated current, adjusted for altitude.
         4. The VFD shall be able to operate with its output disconnected for troubleshooting and startup.
         5. PWM carrier frequency shall be field adjustable with a minimum range of 2 kHz to 6 kHz to minimize the level of audible motor noise.
         6. Motor acceleration and deceleration shall be programmable from one second to not less than 60 seconds.
         7. For fan service, provide controller with not less than 3 programmable critical frequencies that can be skipped to avoid mechanical resonances.
         8. VFD shall not generate damaging voltage pulses at the motor terminals when located within 200 feet of the motor. VFD shall comply with NEMA MG1.
      9. Supply the VFD with interface modules as required to provide the following control functions and external signals:

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Edit the following to match project requirements. Select the protocol that will be compatible with the building automation system or process control system. Coordinate with Section 25 5000, *Integrated Automated Facility Controls* and the LANL I&C Team.

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* + - * 1. Automatic control using [ModBus RTU compatible] [ANSI/ASHRAE 135, ISO 16484-5 approved BACnet compatible] network protocol over a multi-drop RS-485 communications system from the building automation system. This port shall provide direct communication between the drive microprocessor and the building automation system. All configuration and control functions shall be accessible through this port and fault diagnostics, start/stop, speed commands, and all drive feedback variables shall be available. Discrete signals such as Bypass Run or Interlock Open shall also be mapped through the drive terminal strip to the system for unitary control. The communications port shall have the ability to be used in a "monitor only" mode where control shall be from a digital controller directly hardwired to the drive. NOTE: Ethernet or RS-232 connection may not be substituted for required RS-485 connection.
        2. Communications to/from the drive shall be an integral part of the drive. External protocol converters, bridges or signal converters shall not be allowed.
        3. Six configurable digital inputs, factory pre-set for common HVAC control interface to minimize customization at start up. As a minimum the digital input points shall be capable of being programmed for the following functions:

1. Motor start/stop
2. VFD remote fault reset
3. Emergency stop

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Edit the following to match project requirements. Coordinate with the LANL I&C Team.

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* + - * 1. Two isolated analog inputs with 0-20 mA, 4-20 mA or 0-10 V selectable parameters. Both shall be capable of receiving a speed command to the drive or a feedback signal for internal PI (proportional integral) setpoint control loop. Either may be mapped to communication port for unitary control of temperature, pressure, or other analog control functions.
        2. Isolated 0-10 V, or 4-20mA output signal proportional to speed or load as required to interface with control system.
        3. The auxiliary control contacts shall be rated at no less than 1 amp at 24VAC. Not less than two sets of form C dry contacts to signal the following conditions:

Drive running.

Drive faulted.

* + - 1. Provide the VFD with the following protective features:
         1. Class 10 or 20 electronic overload circuit designed to protect AC motor operated by the VFD output from extended overload operation. No additional hardware such as motor overload relays or motor thermostats shall be required.
         2. Output phase-to-phase short circuit protection.
         3. Output ground fault protection.
         4. High input line voltage.
         5. Low input line voltage.
         6. Loss of input or output phase.
         7. Drive overcurrent.
         8. Drive over-temperature.
         9. Stall protection.
         10. Transient voltage surge suppression up to 6000 volts peak per IEEE C62.41.
    1. The VFD shall have the capability of riding though power dips up to 10 seconds without a controller trip depending on load and operating condition. The VFD shall automatically restart after a longer power interruption.
    2. Provide the following operator interfaces mounted on the cover of the unit:
       1. Touch keypad and LCD screen that digitally indicates:
          1. Frequency output
          2. Voltage output
          3. Current output
          4. Motor RPM
          5. Elapsed Time
          6. Time Stamped Fault Indication
          7. DC Bus Volts
          8. Faults (Including timestamp of event)
          9. PI running, PI setpoint
          10. Parameter settings
          11. Current time of day and date used for time-stamping events.
       2. Heavy duty, 22 mm or 30 mm, metal operator, oil-tight pilot devices as listed below with NEMA ICS 2, Form Z, A600 rated contacts:
          1. Push buttons: Mushroom head, maintained action, turn-to-release emergency STOP pushbutton.
          2. Push-to-test LED type indicating lights:

White POWER ON pilot light.

Yellow FAULT pilot light.

Red RUNNING pilot light.

Green STOPPED pilot light.

* + - * 1. Speed Control Selector Switch: Rotary type LOCAL - OFF - REMOTE.
      1. Provide legend plates for pushbuttons, pilot lights, potentiometer, and selector switch.
    1. Provide labeled terminal block connections for safety interlocks, fault contacts, normal operational functions such as run/stop, remote references, mode control, external emergency stop, and external emergency full-speed. Coordinate required input control signals with design documents.
    2. Provide a control power transformer in each enclosed VFD. The transformer shall have sufficient capacity to operate all connected cooling fans, pilot, indicating and control devices, plus 100 percent spare capacity. Provide fused primary and secondary. Bond un-fused leg of secondary to enclosure. Provide fuse blown indicating fuses.
    3. Provide auxiliary control relays where required to accomplish interlocks and control sequences. Coordinate required control relays with design documents.
    4. Provide the VFD with cooling air fan(s) and/or heat sink construction as required for maintaining the temperature of components within operating limits. Provide filtration for cooling air as required for the installation and operating environment.
    5. Cooling fans shall be easy to replace without disassembly of the drive unit. Fans shall be removable with no hand tools and provide a quick disconnect power connection.
    6. Provide internal heaters with temperature controllers when needed to allow drive operations at minimum expected ambient temperatures.
    7. Provide VFD enclosure in accordance with NEMA ICS 6 as required to meet conditions of installation and operation.
    8. VFDs shall meet the radio frequency energy emission limits of FCC Part 15 Class A and IEC 61800-3. Installation manual shall include instructions for installing the drive equipment so that it meets the specified emission limits as installed.
    9. Input current derating of drives shall only be allowed when the manufacture provides a NRTL listed method for multiple drive ratings. When input current ratings for the drive exceed the existing feeder ratings or the design document feeder ratings, the constructor is responsible for any cost incurred to correct the feeder sizes.

1. EXECUTION

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Delete this article when existing construction is not affected.

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* 1. EXISTING WORK
     1. Maintain access to existing VFDs and other installations that are to remain active and require access. Modify installation or provide access panel.
     2. Clean and repair existing VFDs, within the scope of the project, that are to remain or be reinstalled.
  2. EXAMINATION
     1. Examine surfaces to receive control equipment for compliance with installation tolerances and other conditions affecting performance of the control system. Do not proceed with installation until unsatisfactory conditions have been corrected.
  3. INSTALLATION
     1. Install VFDs indicated on the design drawings and according to manufacturer's instructions. Manufacturer’s installation instructions shall be available at the construction site.
     2. Mount with digital display panel approximately 5 feet above finished floor, or as indicated on the design drawings.
     3. Provide supports per Section 26 0529, *Hangers and Supports for Electrical Systems* [and Section 26 0548.16, *Seismic Controls for Electrical Equipment]*.
     4. Ground and bond motor controllers and control devices per Section 26 0526, *Grounding and Bonding for Electrical Systems.*
     5. Identify motor controllers and install warning signs per Section 26 0553, *Identification for Electrical Systems.*
     6. When drives with multiple input ratings are used, provide permanent labels on the drive(s) which indicate the alternate rating used. The markings shall include the new input current rating of the drive, and the document number used to derive the new rating. A typical label is shown below (adjust as needed):

NOTICE: This drive has been installed using the manufacturer’s multiple drive rating supplemental data. The new input current rating for this drive used for sizing input conductors and upstream protection devices is:

XXX.X Amps

See the *ACH580 Multiple Drive Rating Manual Supplement (3AXD50000952625 REV-A Effective: 10/12/2022) for more details.*

* + 1. Tighten electrical connectors and terminals according to manufacturers published torque‑tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A-486B, or use other approved method.
    2. Set overload parameters using the motor nameplate current and the manufacturer’s instructions.
    3. Provide neatly typed label inside each motor starter enclosure door identifying motor supplied, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
    4. Install flexible connections to VFDs, where specified on design documents.
  1. FIELD QUALITY CONTROL
     1. Clean, inspect, test, adjust, and energize VFDs in accordance with the manufacturer’s instructions.
        1. Inspect each VFD for physical damage, proper alignment, and proper anchorage.
        2. Ensure that any factory installed plastic wrap protection has been removed from the drive(s) cooling fan(s) and vent(s) prior to energizing the drive(s).
        3. Configure VFD parameters to match requirements of the supplied system.
        4. Keep records of inspections, tests, configurations, and adjustments for each VFD; submit them to the LANL STR.

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Edit the following paragraph to match project requirements. Delete if formal electrical acceptance testing is not required; refer to Section 26 0813, *Electrical Acceptance Testing*.

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* + 1. Coordinate inspections and tests with those required by Section 26 0813, *Electrical Acceptance Testing*.
    2. After completing installation, cleaning, and testing, touch-up scratches and mars on finish to match original finish.
  1. FIELD STARTUP SUPPORT SERVICE
     1. Only when Options “A” or “B” are selected does the following subparagraph apply:
        1. Coordinate with the LANL I&C Design team to support field equipment startup.
     2. Only when Option “C” is selected do the following subparagraphs apply:
        1. Provide the services of a factory trained representative from the VFD manufacturer to inspect and certify the installation and to oversee energizing and testing.
        2. Manufacturer’s representative shall certify in writing that each VFD has been installed, adjusted, and tested in accordance with the manufacturer’s recommendations.
        3. Provide one full workday of training for up to three LANL representatives at the project site. A manufacturer’s qualified representative shall conduct training session. The training program shall consist of instruction on the operation and maintenance of the VFD.

END OF SECTION

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Do not delete the following reference information.

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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification is based on LANL Master Specification Section 26 2923 Rev. 5 dated December 9, 2024.