Submittal Review Response

Project Name:	***Hilo WWTP Rehabilitation and Replacement Project Phase 1***
Submittal No.:	***11395 E&F-001.0***
Date:	***9/9/2025***

Client:	County of Hawai‘i	**Carollo Project No.:**	203975
Contractor:	Nan, Inc.		
Submittal Name:	Solids Odor Control System		
Reviewed By:	Khalil Kairouz		

SUBMITTAL REVIEW		
Review is for general compliance with contract documents. No responsibility is assumed by Carollo for correctness of quantities, dimensions, and details. No deviation or variation is approved unless specifically addressed in these review comments. Refer to Section 01330 for additional requirements. The Contractor shall assume full responsibility for coordination with all other trades and deviations from contract requirements.		
Approved	☐	No Exceptions
	☒	Make Corrections Noted - See Comments
	☐	Make Corrections Noted - Confirm
Not Approved	☐	Correct and Resubmit
	☐	Rejected - See Remarks
Receipt Acknowledged	☐	Filed for Record
	☐	With Comments - Resubmit

Review Comments:

1. Provide pressure gages with 31/2” size instead of the submitted 2.5” size.
2. Fan selection for the I-BOX 5000 is too close at the tip of the curve at 7” w.c. and shutoff head at 7.5”. Select the fan with a minimum of 2”-3” between the design pressure and shutoff pressure. This is to account for any future pressure drop as the media gets exhausted.

☐ High Priority

CONTRACTOR SUBMITTAL TRANSMITTAL FORM REV. A

Owner:	County of Hawaii		
Contractor:	Nan, Inc.	**Project No.:**	WW-4705R
Project Name:	Hilo WWTP Phase 1	**Submittal Number:**	11395F-001.0
Submittal Title:	11395F-001.0 Solids Odor Control System	☐ For Information Only	
TO:	County		
From:	Nan Inc.		

Specification No. and Subject of Submittal / Equipment Supplier			
Spec:	11395F	**Paragraph:**	2.0
Authored By:	Integrity Municipal Systems	**Date Submitted:**	9/2/2025

Submittal Certification

Check Either (A) or (B):

☑ (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.

☐ (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

General Contractor's Reviewer's Signature: _____

Printed Name and Title: Mark McCarthy QC

In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.

Firm: **Signature:** **Date Returned:**

PM/CM Office Use

Date Received GC to PM/CM:

Date Received PM/CM to Reviewer:

Date Received Reviewer to PM/CM:

Date Sent PM/CM to GC:

Nan, Inc

PROJECT: HILO WWTP REHABILITATION AND REPLACEMENT PROJECT - PHASE 1

JOB NO. WW-4705R

THIS SUBMITTAL HAS BEEN CHECKED BY THIS CONTRACTOR. IT IS CERTIFIED CORRECT, COMPLETE, AND IN COMPLIANCE WITH CONTRACT DRAWINGS AND SPECIFICATIONS. ALL AFFECTED CONTRACTORS AND SUPPLIERS ARE AWARE OF, AND WILL INTEGRATE THIS SUBMITTAL (UPON APPROVAL) INTO THEIR OWN WORK.

DATE RECEIVED 7/5/2025
SPECIFICATION SECTION # 11395F
SPECIFICATION Solids Odor Control System
PARAGRAPH 2.0
DRAWING
SUBCONTRACTOR
SUPPLIER Integrity Municipal Systemss
MANUFACTURER

CERTIFIED BY CQCM or Designee : _____

SECTION 11395F

SOLIDS ODOR CONTROL SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. The work specified shall include furnishing all labor, design, materials, equipment, incidentals and testing of all equipment and materials necessary to provide the OWNER with two (2) completely operational 2-stage packaged biological Odor Control Systems of unitary construction, including requirements for system construction, components, materials, functional testing, quality and use for removal of hydrogen sulfide (H_2S) from the solids handling Building as specified herein and indicated on the plans.

B. All materials, products, or devices shall be new and unused.

C. Unit responsibility: The contractor shall assign the scope of the odor control systems to an Odor Control Supplier (OCS) who shall have the single source responsibilities for providing the components described herein including design, fabrication, assembly, delivery, supervision of installation, startup and testing of the system and related accessories and appurtenances. However, the contractor shall have overall responsibilities of the odor control system and shall provide any other components and services that are not provided by the OCS but required for a complete operable system as specified and indicated on the drawings.

D. The OCS scope responsibilities shall include but no limited to the following components for each odor control system:
   1. FRP vessel with extended deck along with associated internal and external appurtenances.
   2. Inorganic biological media (stage 1).
   3. Activated carbon media (stage 2).
   4. Irrigation spray nozzles and associated system assemblies.
   5. FRP fan and associated VFD.
   6. Nutrient system including nutrient pump and tank with piping appurtenances and controls.
   7. Instruments, including pressure gauges, and flowmeter.
   8. Interconnecting FRP ductwork, dampers, flexible connections, and other components from the inlet damper at the odor control fan up to and including the final exhaust stacks.
   9. All interconnecting piping external to the vessel including the piping, valves, supports, and instruments associated with irrigation, and nutrient systems.
   10. Each odor control system shall have One local Vendor Water Control Panel (VWCP), free standing with associated 316 stainless steel supports that house all components necessary for the controls and monitoring of the irrigation and nutrient systems. If the VWCP is located on vessel, then all electrical components and control panel enclosure shall be rated for Class 1, Division 2, Group D meeting NFPA 820 requirements. The VWCP shall include

instruments, nutrient pump, piping, and equipment components that will provide as a minimum, an irrigation system capable of on/off timing of intermittent once through water system.

11. Each odor control system shall have One Free standing Vendor Master Control Panel (VMCP) with 316 stainless steel supports that houses the PLC, LOI, and the controls related to the processes including but not limited to the fan, vessel, nutrient, and irrigation systems. If the VMCP is located on vessel, then all electrical components and control panel enclosure shall be rated for Class 1, Division 2, Group D meeting NFPA 820 requirements.
12. All other associated and required accessories as specified herein and elsewhere in these Specifications.

E. Electrical requirements: See Section 16050 - Common Work Results for Electrical and Division 16, Electrical Requirements, which contains information and requirements that apply to the work specified herein and are mandatory for this project.

F. Reference Sections:
1. 17050 - Common Work Results for Process Control and Instrumentation Systems.
2. 17100 - Control Strategies.
3. 17101E - Specific Control Strategies- Headwords Odor Control.
4. 17710 - Control Systems: Panels, Enclosures, and Panel Components.
5. 17712 - Control Systems: Uninterruptible Power Supplies 10kVA and Below.
6. 17720 - Control Systems: Programmable Logic Controllers.
7. 17721 - Control Systems: Local Operator Interface (LOI).
8. 17733 - Control Systems: Network Materials and Equipment.
9. 17765 - Control Systems: Programming Requirements.
10. 17950 - Commissioning for Instrumentation and Controls.

1.02 PROCESS DESCRIPTION

A. Each biological odor control system shall consist of an exhaust fan, FRP vessel, inorganic biological media, activated carbon media, air and irrigation system, control panel, exhaust stacks, dampers, valves, piping and all other equipment and accessories for a complete system.

B. Each complete odor control system shall be packaged and of unitary construction design. All components of the system shall be mounted on the vessel except for the water control panel and electrical master control panel. No exception to this requirement is allowed.

C. Each packaged biological odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the foul air from the process areas into the biological odor control system for treatment. The biological odor control system shall be a two-stage system. Stage 1 shall utilize an inert, porous, mineral, expanded clay material designed to remove hydrogen sulfide (H2S) and resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide. Stage 2 shall utilize a pelletized coal

activated virgin carbon media to remove any remaining hydrogen sulfide as well as other odorous organic compounds.

D. The first stage shall operate with an independently controlled irrigation process to provide Stage 1 media with adequate moisture to sustain bacterial growth and to remove toxic byproducts. The irrigation process shall be controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Nutrients shall trickle down over the media to enhance and sustain the biological activity. The nutrients shall be housed in a tank and shall be dosed into the system by a nutrient pump. A pre-wired control panel shall be provided to ensure proper control and operation of the system. The cleaned air is discharged to the atmosphere through the stack (s) at the top of the unit.

1.03 REFERENCES

A. ASTM International (ASTM):
   1. ASTM D-883: "Definition of Terms Relating to Plastics."
   2. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."
   3. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."
   4. ASTM D-4097-82: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."
   5. ASTM E679: “Standard Practice of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits.”
   6. ASTM C582: “Revision of C582-02 Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.”
   7. ASTM D-3299: “Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.”
   8. ASTM D-3982: “Standard Specification for Contact Molded Fiberglass Ducts.”

B. National Fire Protection Association (NFPA):
   1. The system and its components shall meet the requirements of NFPA 820 and other relevant codes and standards.

1.04 SUBMITTALS

A. Submit shop drawings and literature describing the equipment and associated components for evaluation and approval. Fabrication of odor control system shall not begin until a written approval and notice to proceed is provided. If the selected manufacturer’s equipment layout, configuration, and/or piping requires changes from the bid documents, it is the responsibility of the manufacturer to clearly submit all proposed changes in the submittals at no additional cost to OWNER or Engineer. All exceptions and/or deviations shall be fully identified and described.

B. General: Provide Shop Drawings, samples, administrative, quality control, and contract closeout submittals in accordance with the requirements of Section 01330 - Submittal Procedures, and as listed below.

C. Provide shop drawings and items as specified herein for review prior to approval:

1. Detailed structural and mechanical layout drawings showing system fabrication, dimensions, size, and locations of connections to other work.
2. Complete basis of design calculations for the FRP vessels, ladders, and media supports. Structural calculations and drawings for the vessel, shall include wind and seismic load calculations and anchor bolt sizing. The design of structural and wind calculations shall be according to the current Hawaii Building code, Section 01850 - Design Criteria of the specifications, and shall be sealed by applicable registered Professional Engineer in the state of Hawaii.
3. Description of the laminate and the type of reinforcing to be used and a letter from the manufacturer stating the laminate reinforcing material used will provide chemical resistance at least equal to the published chemical resistance for the resin for the intended application, and the resin will meet the performance requirements stated and is suitable for the service conditions specified herein and the fabrication technique proposed. Manufacturer shall also submit certification of applicable wind load design in accordance with current edition of the Hawaii Building Code and applicable specifications.
4. Furnish a list of recommended spare parts for each piece of equipment in the scope of supply.
5. Process control narrative. Include irrigation system summary of the operation mode of irrigation.
6. Description of control system operation to demonstrate compliance with the Specifications.
7. Equipment offloading and installation instructions with enough detail to allow the Contractor to complete the mechanical and electrical installation of all System components.
8. Annual utility and nutrient usage calculations.
9. Information on hazards associated with the System and appropriate safety precautions, including applicable Material Safety Data Sheets (MSDS).
10. Installation guidelines for the Contractor.
11. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction. Provide a detailed bill of materials.
12. Manufacturer's Information on the biological and activated carbon media such as:
    a. Pressure drop data through media.
    b. Media physical characteristics, including:
        1) Media volume.
        2) Media depth for each bed/layer.
        3) Specific surface area.
        4) Void ratio.
        5) Media sieve analysis (if applicable).
        6) Carbon H_2S removal capacity.
        7) Weight per cubic foot.
    c. Information on expected settling rates of the media per year (if applicable).
    d. Odor control system pressure drop calculations to include from suction ductwork connection at fan to the final discharge of the odor unit.
    e. Operating data from previous installations to substantiate media performance claims.

13. Manufacturer’s information on spray nozzle, mist eliminator and all other mechanical components as applicable.
14. External utility requirements.
15. Complete instrumentation, control, logic, and power wiring diagrams in sufficient details to allow installation of the instrumentation, controls, and electrical components.
16. VWCP and VMCP external layouts, internal layouts, bill of materials, logic diagrams, HMIs, power and control wirings, PLC I/O, network connections, calculations, thermal management including air conditioners and heaters.
17. Coating systems: Including manufacturer's descriptive technical catalog literature and Specifications per Section 09960 - High-Performance Coatings.
18. Field-testing plan for meeting system performance requirements.

D. Provide quality control submittals per Sections 01330 - Submittal Procedures and 01756 - Commissioning, and as follows:
1. Manufacturer’s Certification of Compliance that the factory finish system is identical to the requirements specified herein.
2. Manufacturer’s Certificate of Installation and Functionality Compliance.
3. Manufacturer’s training program.
4. Equipment Testing and Field Start-Up Report.

E. Submit certification indicating the quality control, testing, and inspection has been completed and standards specified herein have been met prior to shipment to the jobsite.

F. Furnish three (3) bound copies and two (2) electronic copies of the Operation and Maintenance instructions for each odor control unit. The information shall be sufficient to instruct personnel who are unfamiliar with such equipment in the operation and maintenance of the system. It shall include diagnostic procedures to be used in the event of system shutdown or malfunction. Comply also with Section 01782 - Operation and Maintenance Manuals.

G. Submit the performance guarantee and warranty for the system.

H. Submit results of all performance testing procedures and results.

1.05 WARRANTY AND PERFORMANCE GUARANTEE

A. As specified in Section 01783 - Warranties and Bonds.

B. Special Warranty: The biological odor control system and all associated components shall carry a 3-year “Full Replacement Warranty” that shall begin once the unit has been started, accepted by OWNER, and met all performance requirements. The synthetic/inert biological media, vessels, and support gratings shall carry a 10-year non-pro-rated full replacement warranty. Cost of removal and replacement of media shall be by OWNER.

C. Performance guarantee: The contractor and OCS shall guarantee the performance of each biological odor control system for 2 years from the final acceptance by the owner. If, within the 2-year guarantee period, the system fails to meet the performance requirements specified herein, the contractor and OCS shall make all

corrective actions necessary to improve system performance at no additional cost to the OWNER. The corrective actions may include replacing equipment or parts, making operational adjustments, or replacing the entire system and all associated components.

1.06 SHIPPING, DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

A. The odor control systems manufacturer referred herein as the Odor Control Supplier (OCS) shall be experienced in the design, fabrication, construction, and successful operation of biological odor control systems for the removal of hydrogen sulfide gas and other odor producing compounds from air ventilated from wastewater treatment systems. All equipment shall be furnished by a single manufacturer/OCS with single-source responsibility.

B. Systems utilizing organic, lava rock, or stone media shall not be accepted.

C. Manufacturers: The following or approved equal.
   1. Evoqua Water Technologies, LLC, ZABOCS series, San Diego, California.
   2. Integrity Municipal Systems, I-Box series, Poway California.

2.02 DESIGN CRITERIA

A. Each facility odor control system shall be designed to meet the following criteria and shall meet or exceed the minimum performance requirements listed. Systems not meeting minimum EBRT (Empty Bed Residence Time) will not be accepted.

B. Design Criteria

Solids Odor Control System		
Bioscrubber Tags	14-BIS-2610	14-BIS-2620
Each Vessel configuration Minimum Dimensions (not including stack and overall dimensions)	Rectangular Horizontal Upflow 31ft-6in L X 9 ft-0in W X 8ft-10in SSH	Rectangular Horizontal Upflow 31ft-6in L X 9 ft-0in W X 8ft-10in SSH
Number of local water control panels, also referred to as solids Water Control Panel (VWCP)	1 Tag: 14-VCP2-2610	1 Tag: 14-VCP2-2620
Number of master electrical control panels, also referred to as solids Odor Control Master Control Panel (VMCP)	1 Tag: 14-VCP1-2610	1 Tag: 14-VCP1-2620

Solids Odor Control System		
Total design air flow rate per vessel	4300 cfm	4300 cfm
Solids odor control fans	14-FAN-2610	14-FAN-2620
Maximum pressure loss per vessel including mist eliminator	5.0-inch w.c.	5.0-inch w.c.
Total number of media beds per vessel	2 Inorganic media (Stage 1) Carbon media (Stage 2)	2 Inorganic media (Stage 1) Carbon media (Stage 2)
Minimum biological media EBRT per vessel	12 seconds	12 seconds
Minimum carbon media EBRT per vessel	3.7 seconds	3.7 seconds
Inlet hydrogen sulfide Average Peak	 5 PPM 10 PPM	 5 PPM 10 PPM
Minimum H_2S removal performance/24 hrs Average	99% or 0.1 ppm for inlet H_2S between 1-10 ppm, 99% or 0.5 ppm for inlet H_2S >10 ppm	99% or 0.1 ppm for inlet H_2S between 1-10 ppm, 99% or 0.5 ppm for inlet H_2S >10 ppm

2.03 SYSTEM COMPONENTS

A. Vessel:

1. The Bioscrubber vessel shall be made of fiberglass reinforced plastic (FRP) material. Vessel and accessories shall be contact molded manufactured in accordance with NBS PS15-69, ASTM 4097 for contact molding. Resin used in fabrication shall be a premium vinyl ester resin fire retardant such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010. Any material of construction other than FRP with premium grade resin shall not be acceptable.
2. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
3. Fabrication: General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D3299 and ASTM D4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.
4. Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.
5. Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven roving

applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultraviolet light inhibitors.

6. Access Manways: The vessel shall be provided with access manways to allow access to the internals of the odor control system. As a minimum, access manways shall be provided between stages.
7. Media support and screen: The system vessel shall be provided with an HDPE and FRP support system with polypropylene screen to accommodate the biological media and carbon media beds.
8. Vessel Accessories: The system shall be provided with all piping, valves and internals. Air inlet, air outlet, spray headers, drain and all vessel fittings shown on the drawings shall be provided by the Manufacturer.
9. Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8-inch thick, full face, EPDM, suitable for the intended service.
10. Neoprene Pad: A 1/4-inch thick, 60 durometer neoprene pad must be placed underneath the scrubber vessel during installation.

B. Vessel components shall be preassembled at the point of fabrication. Preassembly will not require all joints to be factory assembled, but all joints shall be prepared for field fabrication and square. Assemble the components at the factory to the extent possible to minimize and facilitate installation in the Field.

C. Odor Control Media:

1. The media in stage 1 shall be one of the followings:
   a. Inorganic expanded clay biological media as the support substrate for selectively growing sulfur-oxidizing autotrophic bacteria. The media shall be randomly dumped in the vessel to allow a low pressure drop. The media shall be porous and is resistant to hydrogen sulfide (H_2S) and acidic conditions. The media shall be non-proprietary and commercially available.
   b. A lightweight foamed glass media of minimum 50 percent porosity manufactured from recycled glass, highly resistant to sulfuric acid (e.g., Evoqua Bioglas). The system supplier must have a minimum 5 years proven installation experience with the proposed media.

2 2. The system shall use in stage 2 a coconut based granular activated carbon media to adsorb residual H2S and other odor compounds. This stage shall provide final removal of odors to specified level.

3. Overall media depth shall be a minimum of 60 inches. Minimum biological media depth shall be 48 inches. Minimum carbon media depth shall be 18 inches.
4. Provide each vessel with differential pressure gages sized and selected and mounted on the vessel or remotely by the OCS to measure the differential pressure across vessel. Provide FRP or 316 SS supports for the sample and instrumentation piping as required whether shown or not on the drawings.

D. Exhaust Fan:

1. General. Fan shall be centrifugal design manufactured of FRP with airfoil blade backward inclined or radial blade wheel. No other material of construction is acceptable. The wheel shall be statically and dynamically balanced. The fan inlet shall be slip type or flanged type and the fan outlet

shall have a flanged nozzle. The fan will be provided with a double lip type shaft seal.

2. Provide pressure gages for the fan as shown on the drawings.
3. Fan shall be supplied with a TEFC motor rated for Class 1, Division 2 with 1.15 service factor suitable for 3ph/60Hz/480V service. The fan shall be direct driven. The motor shall be inverter-duty driven by a variable frequency drive supplied by the OCS.
    a. All variable frequency drives shall comply with 16262 - Variable Frequency Drives 0.50 - 50 horsepower and 16265 – Reduced Harmonic Variable Frequency Drives
1 4. Performance. The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal.
5. The fan shall be New York Blower, Hartzell or equal.
6. The fan shall be designed for the following specifications:
    a. Airflow Rate: 4300 cfm.
    b. Total Pressure Drop: 11.5 in w.c.
    c. Motor: 20 hp, 460v, 3ph.
    d. VFD: Vendor supplied.

E. The scrubber system shall be provided with ~~exhaust stacks~~no-loss exhaust stacks[AD9] manufactured of FRP as indicated on the drawings.

F. The exhaust stacks shall be contact molded and manufactured in accordance with NBS PS15-69 and ASTM D-4097 for contact molding. The resin used in the fabrication of the exhaust stacks shall be fire retardant and of the same as that used for the main vessel such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal.

G. An independent media irrigation system for each odor control system is incorporated into Stage 1 to provide the biological media with adequate moisture. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles. Potable water or plant effluent water can be used provided that residual chlorine concentrations are less than 3 ppm. Vessel spray bars shall be easily removed from the outside of the vessel for cleaning and descaling. Minimum of 2 each, 8" sight ports shall be provided to view the even distribution of spray water.

H. Piping: All make-up water, sample, and drain piping shall be SCH 80 PVC, unless noted otherwise on the drawings. OCS and shall provide sample piping for sampling and for the instruments as specified and shown on the drawings. Piping that run along vessel walls shall be supported from vessel walls whether shown or not on drawings. Sample and instrument piping shall run along vessel and be located at 4 feet of the ground for accessibility and legibility.

I. Integrated Nutrient Reservoir and Nutrient Pump:
1. Nutrient Addition: Each packaged biological odor control system uses a non-proprietary, commercially available liquid fertilizer to provide essential nutrients to optimize the growth of sulfur-oxidizing bacteria. Nutrients supplied as a coating to the support media or proprietary nutrients shall not be allowed. The system shall be equipped with a nutrient addition system that provides a

controlled dosage of nutrients that is automatically fed to the irrigation water during each irrigation cycle with the help of a nutrient pump.

2. The Nutrient reservoir shall be integral to the system and mounted on the system deck. The nutrient reservoir shall be made of FRP. The nutrient reservoir shall have a float-type level switch to detect a low level. Loose nutrient tanks shall not be acceptable.
3. The Nutrient pump shall be corrosion resistant metering type and shall be mounted in the water cabinet, sized and selected by the vendor.

J. NFPA 820:
1. The system shall be designed and fabricated in compliance with National Fire and Protection Agency Code 820. As a minimum, all equipment installed on the system shall be rated for Class 1, Division 2, Group D.
2. All motors and equipment within 3 feet of the foul airstream shall be rated for Class 1, Division 2, Group D.
3. The local control panels shall be remote as shown on the plans. The installation and wiring of the control panels to the fan, nutrient pump and solenoid valve shall be the responsibility of the contractor and supplier. Use of intrinsic safety barriers shall be as needed for instrumentation sending signals back to master control panel.

K. Vessel shall be provided with a permanently attached, 16-gauge stainless steel equipment identification plate or label laminated into the final fiberglass coat. The label shall state the following in 1/4-inch die-stamped lettering for the plate or 1-inch letter for the laminated label:
1. Equipment identification (tag) number shown on submittals and vessel name.
2. Manufacturers' name and address.
3. Model number and serial number.
4. Date of manufacture.
5. Material of construction.
6. Design pressure (vacuum).
7. Operating weight.
8. Vessel dimensions.

2.04 CONTROL SYSTEM

A. General:
1. Refer to the electrical and P&IDs drawings for additional information as well as specified herein.
2. The OCS shall provide one (1) Vendor Master/Local Control Panel (VMCP) and one (1) Vendor Local Water Control Panel (VLCP) for each odor control unit. Refer to the tag numbers in the design criteria table of section 2.02 of this specification. Components for a complete package control system include but are not limited to OITs, PLCs, Motorized Valves and Actuator Controls, Timers, Relays, Nutrient Feed Pump Controls, Odor Control Fan Controls, level control interlocks in the Nutrient Tank, Local Operators, and Indicators, and as specified to meet the requirements and operational functionality of the vendor system.
3. Control panels shall carry a UL label certifying the assembled industrial control panel complies with UL 508A.

4. Labels shall be fixed to the face of the panel in such a manner that the function of each component shall be easily ascertained. Label terminal strips shall be provided to facilitate wiring of external devices such as switches, sensors, meters, and controllers. No more than two conductors shall be located in each termination point.
5. All conductors shall be labeled with wire numbers and those numbers shall correspond with those provided in a wiring and panel layout diagram. All components shall be labeled with the same symbol reference shown in the electrical wiring and instrument list.
6. Provide panel components suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, humidity, and process and ambient temperatures. Operating relative humidity range: 60 to 95 percent.
7. Vendor Master Control Panel:
    a. The VMCP shall house all required controls for the entire system, pre-assembled and pre-wired at the factory, and shipped loose to be remote mounted as a free standing on a concrete pad with 316 Stainless steel supports. Provide anchoring calculations meeting the local and state seismic zone requirements.
    b. The VMCP enclosure shall be rated NEMA 4X and shall be made of FRP or 316 Stainless steel. However, if the VMCP is located on vessel, then all electrical components and control panel enclosure shall be rated for Class 1, Division 2, Group D meeting NFPA 820 requirements. The VMCP shall be factory tested to full operation with all other components prior to shipment.
    c. Power supply to the VMCP shall be 480 V, 3ph.
    d. Communicate with the plant control system over EtherNet/IP.
    e. An Ethernet Switch shall be provided in accordance with Section 17733 - Control Systems: Network Materials and Equipment. A fiber patch panel shall be provided and accept the incoming 12 strand multimode fiber optic cable, for communicating back to the Plant PLC/SCADA system.
    f. Provide a surge protection device for incoming power. Provide surge protection for all power and control signals that are connected to devices outside a building.
    g. The VMCP shall provide electrical control for the entire system with as a minimum the following switches, alarms, and accessories:
        1) “On-Off” switch for Exhaust Fan.
        2) “Exhaust Fan Running” indicator light.
        3) VFD for exhaust fan.
        4) “Hand-Off-Auto” switch for Nutrient Pump.
        5) “Nutrient Pump Running” indicator light.
        6) “Nutrient Tank Low” indicator light.
        7) Push button switch with status lights for water valve.
        8) Timer relay for on/off control of water valve.
        9) Control Transformer (480V to 120V).
        10) The power supply shall be 480V, 3 ph, 60 Hz.
        11) Control panel shall be provided with terminal strip as required for easy wiring connections by the contractor.

8. Instrumentation and water controls:
    a. The VLCP shall house all required controls for the water and nutrient system, pre-assembled and pre-wired ad piped at the factory and shipped loose to be remote mounted as a free standing on a concrete pad.
    b. Power supply: 120 V, 1ph from the VMCP.
    c. The VLCP controls and equipment enclosure shall be FRP NEMA 4X or 316 Stainless Steel and shall consist of the following components:
    d. Ball valves.
    e. Pressure reducing valve.
    f. Pressure gauge.
    g. Solenoid valve.
    h. Gate control valve.
    i. Rotameter- Variable area type with a Teflon float, EPR O-rings and PVC fittings. The rotameter shall have a direct reading scale.
    j. Nutrient injection connection.
    k. Water fill piping for nutrient.
    l. Nutrient pump.

B. System Control Philosophy:
1. General:
    a. Hardwired interlocks to shut down the equipment in all modes of operation and activates Fail Alarms. Refer also to the P&IDs and electrical drawings for additional information.
2. Operating Modes:
    a. Odor Control fan:
        1) The fan is started and stopped manually at the VMCP via the on-off switch. Once started the fan runs continuously until it is stopped by the off switch.
        2) The speed of the fan will be manually adjusted via the speed potentiometer at the VMCP.
    b. Once-Through intermittent irrigation mode system operation:
        1) The solenoid makeup or supply water valve will open and close the valve intermittently based on adjustable time cycle to irrigate the media periodically as programmed by the PLC.
        2) If the nutrient pump HOA selector switch is set to Auto position, the controls will interlock the nutrient feed pump with the water supply valve to feed nutrient into the irrigation pipe when the makeup water supply valve opens.
        3) If the nutrient pump HOA selector switch is set to Hand position, the nutrient pump will continuously run until is it manually stopped by the off switch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Refer to Section 15050 - Common Work Results for Mechanical Equipment.

3.02 FIELD FINISHING

A. Coat equipment and piping per Section 09960 - High-Performance Coatings.

B. Field touch up in accordance with Section 09960 - High-Performance Coatings.

C. Damage to pigmented gel coat and/or exterior laminate on any FRP component shall be repaired in accordance with equipment fabricator's recommendations. Exposed surfaces will be restored to a uniform texture and color-matched appearance. Color selection shall be subject to the Owner's approval.

3.03 INSTALLATION

A. General: Follow manufacturer's written instructions for installation and adjustment of components.

B. FRP fans and duct: Airflow to each biological odor control system shall be dynamically tested and balanced in accordance with ASTM D-4167. Field balancing shall be done by the Contractor by qualified and certified air balancing contractor and in accordance with the air testing and balancing specifications.

C. As far as is reasonably possible, all equipment should be pre-assembled prior to shipment, to minimize the need for on-site assembly. Media can be pre-installed by the Manufacturer and certified to meet the specified performance requirements.

D. Installation of all equipment will be performed by the Contractor and must be in accordance with OCS/Manufacturer's written installation and startup instructions and by workers experienced in the handling of fiberglass vessels, electrical work, plumbing, and instrumentation. The final installation must be certified by the Manufacturer/OCS as complete and correct.

E. The Manufacturer/OCS shall provide the Contractor with required clearances, tolerances, and limitations, such as smoothness/flatness of concrete pad and shall be available to answer questions prior to and during the installation of the equipment.

F. It is the contractor's (or owner's) responsibility to provide:
   1. FRP inlet ductwork from pick-up point source to fan inlet connection.
   2. Wiring to/from system control panel to remote-mounted equipment, plant SCADA, etc.
   3. Power to system control panel (480V, 3 ph, 60 Hz, 25 Amps minimum).
   4. Suitable concrete mounting pads and other incidentals as necessary to complete the installation.
   5. Drain - a minimum of 3 inches PVC gravity drain to sewer with a 12-inch seal water depth barometric trap.
   6. Water Supply - a water supply with backflow preventer is required. The nominal water requirements are at a rate of 6.0 gpm and a pressure of 30 psi. Hardness shall not exceed 200 mg/L as calcium carbonate. Free chlorine concentration shall not exceed 3 ppm.

3.04 FACTORY ACCEPTANCE TEST

A. Odor Control System:
   1. The odor control system shall hall be inspected and tested at the factory prior to shipping for conformance to the following:
      a. Damage or imperfections to paint or fiberglass work, including cracking/crazing are minimal and in accordance with FRP specifications.
      b. VMCP and VLCP shall be inspected prior to shipping for conformance to the following:
         1) NEMA rating and UL508A label.
         2) PLC program and LOI shall be tested for proper communication and functionality between VLCP and PLC/SCADA as appropriate.
         3) All wiring between panel components and terminal strips shall be checked for proper labeling and connection.

B. Engineer and/or Owner reserve the right to be present at the manufacturer's testing facility to witness the factory functional testing. Engineer and/or Owner shall provide intent to witness functional testing at the time of the design submittal review and approval, and manufacturer shall provide notice to Engineer and/or Owner regarding the scheduled time of the functional testing at least five business days in advance of the proposed functional testing.

C. Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.

3.05 FIELD TEST AND START-UP

A. OCS System's services:
   1. The OCS system's representative for the equipment specified shall be present at the jobsite and/or classroom designated by the Owner for the minimum man-days listed for the following services, travel time excluded:
      a. Provide 2 man-day for installation assistance, inspection, and certification of the installation.

B. Functional testing:
   1. Test all system components for proper adjustment and operation in both the manual and automatic operating modes. Also, the air balancing contractor shall be present on site and shall have make any necessary corrections for proper air flow rates and pumping flows.
   2. Allow the bioscrubber irrigation system to operate for a 48-hour period with the moisture control system in AUTO mode and adjust as necessary for proper irrigation moisture system operation.
   3. All testing, adjusting, and balancing of the fan and VFD shall have been completed and approved.

C. Performance testing:
   1. Performance testing shall not commence until the entire air conveyance system has been properly tested and balanced and the air flow rate to the vessel is confirmed. Also, the odor control system has been satisfactorily

started up and enough time has been allowed for the acclimation of the bacteria.

2. After the odor control system has been satisfactorily started-up and switched to normal operation, the Odor Control Supplier shall conduct a performance test to verify that the system meets or exceeds the performance criteria. The testing shall be witnessed by the Owner and Engineer.
3. The Contractor shall provide the Owner with a written test protocol for review by the Owner and Engineer.
4. The Contractor shall supply, install, and operate all equipment, sensors, and instrumentation required to complete the performance test.
5. H_2S Testing procedure:
    a. Measure airflow to the odor control unit and, if necessary, adjust dampers and fan speed to obtain the specified design airflow in each scrubber vessel (+/- 10 percent). Airflow shall be measured at the beginning of the test period. The set position on the damper(s) will be marked or noted. Airflow should not change if damper(s) remain in position.
    b. Measure pressures drop across each bioscrubber at beginning of test period.
    c. Measure temperature and humidity of the inlet, outlet, and ambient air.
    d. Performance test period to begin at a noted time and last for 24 hours. H_2S data from the inlet location of unit and from the outlet of each bioscrubber will be measured and logged once every 10 minutes to demonstrate performance during test period. Performance test shall be conducted using the naturally occurring H_2S provided by the plant processes.
    e. The inlet H_2S data will be logged with a pre-calibrated OdaLog or acrulog gas data logger with appropriate range and accuracy for the inlet air stream (0.0 to 200.0 ppmv range, 0.1 ppmv display resolution).
    f. The outlet H_2S data will be measured with a recently calibrated Acrulog PPB H2S Low-range monitor/ Analyzer with appropriate range and accuracy for the outlet air stream. Outlet readings shall be measured at 10-minute intervals.
    g. Include in the bid a minimum of 2 Tedlar bag tests where 1 bags test shall be collected at the inlet and 1 Tedlar bag samples shall be collected at the outlet of each odor control vessel. The Tedlar bag samples shall be sent to approved independent test lab for the analysis of 20 reduced sulfur compounds. The Tedlar bags samples shall be taken at 2 different time intervals during the 24 -hour testing period as directed by Engineer and Owner.

D. Odorous compounds removal Acceptance criteria:
    1. The odor control system's removal efficiency shall be determined by calculating the average inlet concentration and the average outlet concentration using the following formula: Removal efficiency (percent) = (1 – average outlet concentration/average inlet concentration) x 100. The system shall have passed the odorous compounds performance test if the removal efficiency meets or exceeds the specified removal criteria listed in Article 2.02.

3.06 TRAINING

A. Require manufacturer's representative to perform the following services in a minimum of two separate trips as described below and as specified in Section 01756 - Commissioning. Specified durations are the minimum required time on the job site. Additional services and/or longer durations shall be provided as needed at no cost to Owner to meet the required quality of work: Work to be done in a minimum of 2 trips:
   1. Installation assistance: As required.
      a. Advise/observe the Contractor on the installation of the equipment.
      b. Provide additional assistance as required.
   2. Installation inspection: 2 workdays.
   3. Start-up/performance testing assistance: 2 workdays:
      a. Prior to start-up, the equipment shall be inspected for proper alignment, operation, and satisfactory performance.
      b. Provide additional start-up/testing assistance as required.
      c. Provide Certificate of Installation and Functionality Compliance per Section 01756 - Commissioning.
   4. Training: As defined in Specification Section 01756 - Commissioning. Provide training as follows for each facility odor control system:
      a. Operations Training: 2-hour class, 2 sessions.
      b. Mechanical Maintenance Training: 4 hours, 1 session.
      c. Electrical and Controls Maintenance Training: 4 hours of training, 1 session.
   5. Final acceptance checkout: 1 workday (trip may be combined with training).
   6. Specified durations are the minimum required time on job site and do not include travel time.

END OF SECTION

[AD9] Addendum No. 9 - August 2024

Integrity Municipal Systems LLC
13135 Danielson Street, Suite 204
Ph.: (858) 486-1620
Poway, CA 92064

DESIGN SUBMITTAL

SECTION 11395E: BLEND TANKS ODOR CONTROL SYSTEM AND

SECTION 11395F: SOLIDS ODOR CONTROL SYSTEM

FOR

HILO WWTP REHAB AND REPLACEMENT PROJECT

PHASE 1

WAIAKEA, HILO, HAWAI'I

For

Hilo WWTP, HI

IMS Project No.: 40243

Submitted on: August 22, 2025

Submitted To:

NAN, Inc.
Marshall Rucknagel
636 Laumaka Street
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Email: mrucknagel@nanhawaii.com

Prepared By:

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STATEMENT OF CONFIDENTIALITY

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8/22/2025

NAN, Inc.
Marshall Rucknagel
636 Laumaka Street
Honolulu, HI 96819
Email: mrucknagel@nanhawaii.com
IMS Project No.: 40243

Re: Packaged Biological Odor Systems
Hilo WWTP, HI

Dear Marshall,

Enclosed please find an electronic copy of the design submittal of three (3) biological odor control systems for your review and approval. The design submittal has been prepared in accordance with specification Section 11395E and Section 11395F.

We have made a sincere attempt to provide all required data for the equipment. We would be pleased to provide any additional information or clarifications as necessary. Please refer to section 2.0 for our exceptions and clarifications.

Thank you again for your trust and confidence in us.

Respectfully,

Trevor Till
Project Engineer

SECTION 1.0 SCOPE OF WORK

1.1 Scope of Work Provided by IMS

1.2 Scope of Work Provided by Others

1.1 Scope of Work Provided by IMS

All equipment will be manufactured in accordance with specification section 11395E and all other applicable plans and technical specifications and installed in a Class 1, Division 2, Group D hazardous area.

PART 1-SECTION 11395E: BLEND TANKS ODOR CONTROL SYSTEM

No.	Description	Quantity
1.	**FACTORY ASSEMBLED I-BOx® 5000** Each system includes the following: • FRP Exhaust Fan with TEFC Motor and Variable Frequency Drive • FRP Transition Piece from Fan Outlet to Vessel Inlet with Sample Port • FRP Dual-Stage Odor Control Vessel with Extended Deck, including: a) Inorganic Expanded Clay Media (Stage 1) b) Carbon Media (Stage 2) c) Internal Irrigation System, Nozzles and Piping d) Polypropylene Screens e) Removable top and Access Manway f) Drain Valve g) Outlet Sample Port h) Differential Pressure Gauge i) Differential Pressure Switch j) All Connection Hardware (nuts, bolts) • FRP Exhaust Stack (1-ft above vessel) • FRP No-loss Exhaust Stack	1
2.	Remote Control Panel, Water Cabinet and Nutrient Tank Skid, including: • NEMA 4X FRP Electrical Control Panel (10-VCP1-2230) with AB CompactLogix 5380 PLC and per Specification Section 11395E Part 2.04 • FRP Water Cabinet (10-VCP2-2230) including Nutrient Pump, Ball Valves, Pressure Reducing Valve, Pressure Gauge, Solenoid Valve, Gate Control Valve, Rotameter, Nutrient Injection Connection, and Water Filling Piping for Nutrient • Nutrient Reservoir • FRP Sunshade • To be Installed by the Contractor at the Jobsite at least 3 feet from any Class 1, Division 2, Group D Hazardous Area	1
3.	Neoprene Pad for Placement underneath the Vessel	Included
4.	System Anchor Bolts	Included
5.	Initial Nutrient Supply (for start-up)	Included
6.	PE Stamped Structural Calculations for Equipment	Included
7.	Design Submittal and Operation and Maintenance Manuals	Included
8.	Manufacturer's Services at the Jobsite for Installation Check-out, System Start-up, Functional Testing, Performance Testing, and Operator Training (2 Trips; Up to 6 Days Total at the Jobsite)	Included
9.	FOB Factory, Poway, CA with Full Freight Allowed to Jobsite, Hilo, HI	Included

PART 2-SECTION 11395F: SOLIDS ODOR CONTROL SYSTEM

No.	Description	Quantity
10.	**FACTORY ASSEMBLED I-BOx® 8025** Each system includes the following: • FRP Exhaust Fan with TEFC Motor and Variable Frequency Drive • FRP Transition Piece from Fan Outlet to Vessel Inlet with Sample Port • FRP Dual-Stage Odor Control Vessel with Extended Deck, including: a) Inorganic Expanded Clay Media (Stage 1) b) Carbon Media (Stage 2) c) Internal Irrigation System, Nozzles and Piping d) Polypropylene Screens e) Removable top and Access Manway f) Drain Valve g) Outlet Sample Port h) Differential Pressure Gauge i) Differential Pressure Switch j) All Connection Hardware (nuts, bolts) • FRP Exhaust Stack (1-ft above vessel)	2
11.	Remote Control Panel, Water Cabinet and Nutrient Tank Skid, including: • NEMA 4X FRP Electrical Control Panel (14-VCP1-2610/2620) with AB CompactLogix 5380 PLC and per Specification Section 11395F Part 2.04 • FRP Water Cabinet (14-VCP2-2610/2620) including Nutrient Pump, Ball Valves, Pressure Reducing Valve, Pressure Gauge, Solenoid Valve, Gate Control Valve, Rotameter, Nutrient Injection Connection, and Water Filling Piping for Nutrient • Nutrient Reservoir • FRP Sunshade • To be Installed by the Contractor at the Jobsite at least 3 feet from any Class 1, Division 2, Group D Hazardous Area	2
12.	Neoprene Pad for Placement underneath the Vessel	Included
13.	System and remote skid Anchor Bolts	Included
14.	Initial Nutrient Supply (for start-up)	Included
15.	FRP Header Ductwork from Vessel Outlet Onwards including Damper (Shipped Loose for Installation by the Contractor)	2
16.	PE Stamped Structural Calculations for Equipment	Included
17.	Design Submittal and Operation and Maintenance Manuals	Included
18.	Manufacturer's Services at the Jobsite for Installation Check-out, System Start-up, Functional Testing, Performance Testing, and Operator Training (2 Trips; Up to 6 Days Total at the Jobsite)	Included
19.	FOB Factory, Poway, CA with Full Freight Allowed to Jobsite, Hilo, HI	Included

1.2 Scope of Work Provided By Others

1. Equipment unloading, storage, installation, and installation supervision.
2. All civil works and concrete pad for equipment
3. Installation of remote-mounted control panel, water cabinet and nutrient tank skid at least 3 feet from Class 1, Division 2, Group D hazardous area
4. Electrical power to system control panel (480V/3 ph/60Hz)
5. All electrical conduit, wiring, electrical material, etc. from remote control panel to system mounted exhaust fan, plant SCADA, etc.
6. Interconnecting water/nutrient solution piping from water cabinet to system connection
7. Design, supply, and installation of all odor control system ductwork and associated fasteners and gaskets including all ducting, dampers, fan inlet damper, flexible connectors, and transitions up to fan inlet.
8. Loading of system media for I-BOx®8025 for Section 11395F. Media is shipped in supersacks along with the odor control systems. Media to be loaded after equipment installation at time of start-up (There will be a total of ~twenty-four (24) 2,000 lb biological media bags for each system and a total of ~ten (10) 1,000 lb carbon media bags for each system).
9. Design, supply, and installation of all duct supports and any required wall penetrations and flashing
10. Drain piping and "P-trap"
11. Pressurized water supply to remote skids
12. Any external uninterruptible power supply, if required
13. Any required ladders, if any (None should be required)
14. Any Ethernet testing services
15. Any required spare parts including electrical spares
16. Any PLC and OIT programming software
17. All configuration, programming, and modifications of SCADA system, integration of system PLC/OIT graphics into SCADA network and all interface programming and communications from system control panel to SCADA system
18. Any required field painting
19. Any vibration balancing services
20. All FRP field joining of I-BOx®8025 header assembly
21. Airflow balancing services
22. Recording of any training session, if required
23. Any costs for witnessing factory testing including for travel, lodging, food, transportation, etc., if required
24. Any equipment maintenance (if required) during the construction phase after start-up
25. Any bonds
26. Any items not explicitly listed under Integrity Municipal Systems LLC's scope of work

SECTION 2.0 CLARIFICATIONS AND EXCEPTIONS

Clarifications:

1 The fan will be provided with an AMCA seal for performance & sound; only vibration testing at the factory will be performed.

The current specification calls for a single FRP header connecting five independent discharge points. Each discharge is equipped with a volume control damper to ensure equal distribution of exhaust from the five sections of the biological scrubber. The second stage of the scrubber consists of a carbon media bed, which whenever you need to remove the header for maintenance or access it would be a tedious process and would require a crane. We recommend installing five individual no-loss exhaust stacks, each equipped with a volume control damper. This configuration will simplify access to the top of each scrubber section. A drawing showing both design options is attached for your review.

Exceptions

2 Pelletized standard virgin carbon will be used in leu of coconut granular carbon, virgin carbon has a lower pressure drop and similar performance.

Drawing No. 14-M-01-302 Sheet 502 of 1000 calls for a vertical flex connection between the vessel top and the header. If Option A is chosen, IMS will take exception to this as the header needs more structural support.

Notes:

1. The concrete pad for the I-BOx® system must have a downward slope of 1/16” per foot (5.2 mm per meter) from fan to drain (fan on the higher side).
2. The system’s drain is to be equipped with a 6” [152 mm] minimum P-trap to prevent odor leakage out of the drain (by others). See Fig. 1 for details.

LEGENDS:

1. Ø2" PVC PIPE (LOT)
2. Ø2" PVC TEE (SXSXS) (X2)
3. Ø2" 90 DEG ELBOW (SXS) (X2)
4. Ø2" X Ø1" REDUCER BUSHING (SXT) (X2)
5. Ø1" PLUG (T) (X2)

NOTE:
FAN STATIC PRESSURE: 5" W.C.
TEE IS REPLACEABLE WITH ELBOW, IF REQUIRED

BLOW-THRU TYPE - CONFIGURATION TABLE		
FAN STATIC PRESSURE, H	A	B
5" W.C.	6"	5"

Figure 1: Recommended Blow-Thru Type Drain P-Trap

SECTION 3.0 SCHEDULE

Please keep in mind that fabrication of the biological odor control system will require up to twenty-four (24) weeks from submittal approval and release for fabrication. Therefore, we ask for your assistance in expediting correspondence regarding the design submittal approval. We will inform you of the scheduled ship date when we have received official approval of the submittal. Please do not hesitate to call us if there is anything we can do to facilitate the technical review process.

We look forward to working with you and we are ready to offer whatever assistance possible to assure successful and timely completion of the project.

SECTION 4.0 TECHNICAL INFORMATION

4.1 Process Description

4.2 Table 1: Design Criteria & Major System Components

4.3 Table 2: Utilities Requirements

4.4 Odor Control Media & SDS

4.5 Vessel I.D., Carbon Caution, and Nutrient Mixing Tags

4.6 Structural Calculations

4.1 Process Description

The biological odor control system (I-BOx®) is designed to treat hydrogen sulfide (H_2S) and other odorous compounds found in municipal wastewater collection systems and treatment processes.

The fan operates continuously and pulls foul air from the process area into the biological odor control system for treatment prior to release to the atmosphere.

The system is comprised of two distinct process stages.

Stage 1 is designed to remove primarily hydrogen sulfide (H_2S) by providing an environment promoting the growth of acidophilic, sulfur-oxidizing bacteria (Thiobacillus thioxidans). The first stage media is an inert, porous, mineral material designed to resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide.

Stage 2 is used to remove any remaining hydrogen sulfide as well as other odorous organic compounds. The second stage media is virgin activated carbon.

A media irrigation system is incorporated into the biological system design to provide the Stage 1 media with adequate moisture. The irrigation process is controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Frequency, duration and start times are adjustable. Stage 1 is intermittently irrigated by either potable water or treated plant effluent water at 30 psi (provided residual chlorine concentration is less than 5 ppm). The water is sprayed over the top of the media while air is being pulled countercurrent through the media. As the air passes over the moist media, H_2S and other compounds dissolve into the water film on the surface of the media and become available to the bacteria residing in the water film for oxidation to release energy used by the bacteria to grow. As bacteria grow, they populate the wetted surfaces on the media.

Additionally, the water that trickles down through the media rinses away the acidic byproducts of the biological reaction. Nutrients are also trickled over the media to enhance and sustain the biological activity. The nutrients are housed in a tank and they are dosed into the system by a metering pump. The nutrients are commercially available fertilizers.

Water and acidic sulfate byproducts washed from the media leave the system through the drain piping at the bottom of the vessel and are returned to the wet well or wastewater stream. A water trap ("P-Trap") on the drain line prevents odorous air from escaping through the drain.

The cleaned air is then discharged to the atmosphere.

Utilities and Connection Requirements:

Utilities and connection requirements for the I-BOx® system are as follows:

- Concrete pad for the system and skid
- FRP ducting from process area to fan inlet
- 480V/3 Phase/60 Hz power to odor control system remote electrical control panel
- Wiring connections from remote electrical control panel to local system instruments and motor
- Water at pressure of 30 psi (200 kPA) when the solenoid valve is opened
- Water supply piping to remote nutrient skid
- Nutrient solution discharge piping from remote nutrient skid to vessel

TABLE 1:
DESIGN CRITERIA & MAJOR SYSTEM COMPONENTS
File No.:
Date:

I. DESIGN CRITERIA

Model No.	I-BOx®-5000	I-BOx®-8025
Air Flow Rate, cfm	400	4,300
Average Inlet H_2S Concentration, ppm	10	5
Peak Inlet H_2S Concentration, ppm	30	10
Minimum H_2S Removal Efficiency*	99.0%	99.0%

*The minimum H_2S removal efficiency will be 99.0% or 0.1 ppm, whichever is greater.

II. MAJOR SYSTEM COMPONENTS

A. Air Supply Fan

	I-BOx®-5000	I-BOx®-8025
Air Flow Capacity, scfm	400	4,300
SP @ Biofilter Inlet, in WC	3.0	6.0
Pressure Drop across Biofilter, in WC	4.0	5.5
Total SP, in WC	7.0	11.5
Brake HP	1.30	11.21
Motor HP	1.5	15.0
Motor RPM	3,480	1,800

B. Biological Odor Control System

	I-BOx®-5000	I-BOx®-8025
Overall Length, ft	7.50	29.75
Overall Width, ft	5.00	8.00
Overall Height (without Stack), ft	7.33	8.33
Shipping Weight, lb	8,312	57,300
Operating Weight, lb	9,000	62,900
Expanded Clay Biological Media Bed Height, ft	3.5	4.5
Expanded Clay Biological Media Residence Time, sec	13.1	12.6
Virgin Activated Carbon Media Bed Height, ft	1.5	1.5
Virgin Activated Carbon Media Residence Time, sec	5.6	4.2
Nutrient Reservoir Capacity, gal	15	80
Nutrient Storage Life, days	268	266

C. Exhaust Stack

	I-BOx®-5000	I-BOx®-8025
Diameter, ft	1.00	1.00
Number of Stacks	1	5
Height above System, ft.	2.6	2.6
Overall System Height, ft.	9.93	10.93
Exit Velocity, fpm	509	1,095

D. Controls and Instrumentation

Water Control Panel
Irrigation Solenoid Valve
Water Rotameter
Control Valves
Water Pressure Regulator
Pressure Gauge
Nutrient Feed Pump

Electrical Control Panel
Fan Controls
Nutrient Feed Pump Controls
Water Valve Pushbutton
Water Valve Timer Relay

TABLE 2:
UTILITIES REQUIREMENTS
File No.:
Date:

I. UTILITIES REQUIREMENTS

A. Water	I-BOx®-5000	I-BOx®-8025
Water Feed, gpm	6.0	18.0
Water Feed Cycle Time, min per 1/2 hour	0.2	0.3
Total Water Needed per Day, gal	56	301

B. Nutrients	I-BOx®-5000	I-BOx®-8025
Nutrient Feed, ml/min	22.7	68.1
Total Nutrient Needed per Day, gal	0.1	0.3

C. Electricity	I-BOx®-5000	I-BOx®-8025
Fan Motor BHP	1.30	11.21
Nutrient Feed Pump Motor BHP	0.3	0.3

D. Media	I-BOx®-5000	I-BOx®-8025
Total Biological Media, lbs.	6,083	60,663

ODOR CONTROL MEDIA

Biological Media

Type:	Expanded Shale Clay Media
Appearance	Aggregate
Average size:	3 ~ 6 mm
Bulk Density:	0.80 g/cc (50 lbs/ft³)

Virgin Activated Carbon Media

Type	Pellet
Surface Area, minimum	900 m²/gm
Apparent Density, minimum	0.48 g/cc (30 lbs/ft³)
Moisture Content, maximum (ASTM D-2867)	3%
Hardness, minimum (ASTM D-3802)	98
Iodine No., minimum	900 mg/gm
Butane Activity, minimum (ASTM D-5742)	23.3
Mean Particle Diameter	4 mm (Typ.)

VIRGIN ACTIVATED CARBON MEDIA

SAFETY DATA SHEET

SECTION 1 – IDENTIFICATION

Chemical Name: Carbon
CAS Number: 7440-44-0 (Carbon)
Common Name: Activated Carbon
Type: Coal Base Activated Carbon (4 mm mesh)
Chemical Formula: C

SECTION 2 – HAZARDOUS INGREDIENTS

Chemical	%	PEL (OSHA)	TLV (ACGIH)	OTHER
Carbon	100	N/A	N/A	N/A

Caution should be taken for a respirable dust.
The ACGIH TWA for respirable dust is 1.0 mg/m^3.
Carcinogenic Properties: NONE

SECTION 3 – PHYSICAL DATA

Description: Odorless Black Solid Granules
Vapor Pressure: N/A
Apparent Density: 0.3 to 0.6 g/cc
Solubility: Stable
Melting Point: 6,656 F (3,680 C)
Boiling Point: 7,592 F (4,200 C)

Emphasize protection against repetitive or long-term exposure to carbon dust inhalation.

SECTION 4 – FIRE AND EXPLOSION DATA

Flash Point: N/A
Extinguishing Media: Water, Foam, CO_2, or Dry Chemical
Special Precautions: NONE
Unusual Hazards: Contact with strong oxidizers may result in fire.

SECTION 5 – REACTIVITY DATA

Stability: Stable
Condition to Avoid: NONE
Hazardous Decomposition Product: Carbon monoxide may be formed in fire.

SECTION 6 – HEALTH DATA

Routes of Entry

Ingestion:	Non-toxic through ingestion. Oral LD50 (Rat) is >10 g/kg.
Inhalation:	May irritate the respiratory system. Acute LC5 (rat) is >64.4 mg/L.
Dermal Exposure:	Non-toxic through skin absorption

Activated carbon is not a primary skin irritant.
No sensitization effects are known.
May produce eye irritation.

First Aid:	In case of eye contact, flush with water for at least 15 minutes.
Other:	The effects of chronic and subchronic exposure have not been determined. Safe handling on a long-term basis should emphasize protection against repetitive or long-term exposure to carbon dust inhalation.

SECTION 7 – SPILL OR LEAK PROCEDURE

If the material is released or spilled, unused product should be swept up and discarded or repackaged.

Unused carbon may be disposed of by any appropriate means. Used carbon products may contain hazardous chemicals or exhibit hazardous properties that may have to be examined to determine appropriate disposal method. This product must be disposed of in accordance with all federal, state, and local regulations.

SECTION 8 – HANDLING AND STORAGE

Eye Protection:	Safety glasses or goggles recommended
Protective Gloves:	Recommended
Other Protective Clothing:	None required
Respiratory Protection:	A high efficiency particulate filter is recommended
Ventilation:	Local exhaust recommended
Work/Hygienic:	Wash thoroughly after handling

SECTION 9 – TRANSPORTATION DATA

Proper Shipping Name:	Steam-Activated Carbon, Non-Regulated Carbon, Activated
DOT Classification:	NMFC 40560
DOT Marking:	N/A
DOT Placard:	N/A

SECTION 10 – DANGEROUS GOODS REGULATION

Activated carbon is not classified as a dangerous good as per UN No. 1362, Class or Division 4.2, Packing Group III, Special Provision 925.

Emergency accident Precautions and Procedures:

To be taken in Transportation:	NONE
Other:	Wet activated carbon removes oxygen from the air causing a severe hazard to workers in required space. Sampling and work procedures for low-oxygen levels should be taken whenever workers may be entering enclosed carbon vessels or confined spaces. All federal, state, and local regulations should be observed.

Miracle Gro By
The Scotts Co.

(OR)

Vigoro by Spectrum Grp.

All Purpose Plant
Fertilizer*
(Concentrated)
(0.95 L/1 qt./bottle)

Qty. (2) of 5 gal Bucket
Filled with water

10 gal of water
(~8 inches)

Nutrient
Solution for
Biological Odor
Control System

Nutrient
Solution for
Biological Odor
Control System

* Available at Home Depot, Walmart, Lowe's or any nursery place

Blend Tanks I-BOx® 5000

Temperature:	Ambient
Resin:	Derakane 411
Corrosion Barrier:	100 Mil
Vessel Dimensions:	7'-6" L x 5'-0" W x 7'-4" SSH
System Airflow Rate:	400 cfm
Operation Weight:	~9,000 lbs
Date of Manufacturing:	TBD
IMS Proj. Number:	40243
Serial Number:	5000-018
Application:	Odor Control System For Hilo WWTP, HI

Integrity Municipal Systems LLC
Poway, California, U.S.A
Phone: +1 (858) 486-1620
www.integrityms.net

Solids I-BOx® 8025

Temperature:	Ambient
Resin:	Derakane 411
Corrosion Barrier:	100 Mil
Vessel Dimensions:	30'-0" L x 7'-10" W x 8'-4" SSH
System Airflow Rate:	4300 cfm
Operation Weight:	~62,900 lbs
Date of Manufacturing:	TBD
IMS Proj. Number:	40243
Serial Number:	8025-006
Application:	Odor Control System For Hilo WWTP, HI

Integrity Municipal Systems LLC
Poway, California, U.S.A
Phone: +1 (858) 486-1620
www.integrityms.net

Solids I-BOx® 8025

Temperature:	Ambient
Resin:	Derakane 411
Corrosion Barrier:	100 Mil
Vessel Dimensions:	30'-0" L x 7'-10" W x 8'-4" SSH
System Airflow Rate:	4300 cfm
Operation Weight:	~62,900 lbs
Date of Manufacturing:	TBD
IMS Proj. Number:	40243
Serial Number:	8025-007
Application:	Odor Control System For Hilo WWTP, HI

Integrity Municipal Systems LLC
Poway, California, U.S.A
Phone: +1 (858) 486-1620
www.integrityms.net

CAUTION

SYSTEM CONTAINS ACTIVATED CARBON MEDIA THAT MAY CAUSE EYE AND SKIN IRRITATIONS.

DO NOT EXPOSE THE ACTIVATED CARBON MEDIA TO STRONG OXIDIZERS SUCH AS OZONE, CHLORINE, PERMANGANATE, ETC.

REQUIRED PROTECTIVE EQUIPMENT MUST BE WORN WHEN HANDLING THE MEDIA AND ENTERING THE VESSEL. CONFINED SPACE ENTRY FOR LOW OXYGEN LEVELS PROCEDURES SHOULD BE FOLLOWED BEFORE ENTERING INTO THE VESSEL.

READ THOROUGHLY AND UNDERSTAND THE OPERATION AND MAINTENANCE MANUAL INSTRUCTIONS PROVIDED WITH THIS EQUIPMENT BEFORE ATTEMPTING TO OPERATE THE SYSTEM.

STRUCTURAL CALCULATIONS
FOR

Integrity
MUNICIPAL SYSTEMS

HILO WWTP
MISC. EQUIPMENT ANCHORAGE
2021 IBC

BROOKS RANSOM ASSOCIATES

STRUCTURAL ENGINEERS CIVIL ENGINEERS
WWW.BROOKSRANSOM.COM

1975 - 2025
50th ANNIVERSARY
BROOKS RANSOM ASSOCIATES

7415 NORTH PALM, SUITE 100
FRESNO, CALIFORNIA 93711
OFFICE: (559)449-8444
FAX: (559) 449-8404

JOB#25357
8 AUGUST 2025

GAYLORD RANSOM
LICENSED PROFESSIONAL ENGINEER
No. 11036-S
HAWAII U.S.A.

HILO WWTP

DESIGN PARAMETERS:

- CONCRETE $t = 24"$
  $F'_c = 4500$ PSI
- EDGE DIST. FOR G1 & G2 = 13½"
  FOR G2 & G3 = 6"
- SPECIAL WIND REGION - HURRICANE
- WIND SPEED = 145 MPH
- SEISMIC SDC = 'D'

SITE CLASS 'C'

$S_s = 1.50$ $S_1 = .60$

$F_a = 1.20$ $F_v = 1.40$

$S_{M_s} = 1.80$ $S_{M_1} = .84$

$S_{d_s} = 1.20$ $S_{d_1} = .56$

G1 EQUIPMENT

12 BOLTS PER SIDE

DL = 8,100 + 47,000# = 55,100#

USE $R = 3$ $\Omega_0 = 2$ $C_d = 2$

WIND EXPOSURE N-S ≈ 8.33' × 26' = 217 FT²

E-W ≈ 8.33' × 8.08' = 68 FT²

RISK CAT. III, $I = 1.25$

$$C_s = \frac{1.25 \times 1.20}{3} = .50g$$

$$E_v = .2 \times 1.20 \times D = .24g$$

FROM WIND LOAD ANALYSIS,

N-S = 11.3^k

E-W = 2.8^k

FOR SEISMIC LOAD EQUATIONS,

N-S = E-W = 55.1^k × .5 = 27.55^k > WIND

E_v = .24 × 55.1^k = 13.22^k

M_o = 27.55^k × 4.2' = 115,710'#

$.9 M_R = (.9(55{,}100^\#) - .24(55{,}100))\,4.042' = 146{,}991'^\#$

$M_o < M_R$ So No BOLT TENSION

No. BOLTS = 12

$v = V/12 = 27.55^k/12 \times 1000 = 2{,}296^\#$

T = ~~0~~

INPUT 3 BOLTS SPACED @ 25" o.c. AND USE (3 × 2296#) LOAD TO CHECK FOR BOLT INTERACTION.

USE (24) - 5/8" ⌀ HILTI - HY200V3 + HAS-R 304/316 SS
EMBEDMENT = 6"

REFER TO CALCS FOLLOWING FOR DETAILS.

BROOKS-RANSOM ASSOCIATES
STRUCTURAL ENGINEERS
CIVIL ENGINEERS
7415 NORTH PALM, SUITE 100
FRESNO, CALIFORNIA 93711
(559) 449-8444 FAX (559) 449-8404

By:
Date:
Job no.
Sheet 2 Of:

WIND LOADING

In accordance with ASCE7-16

Using the directional design method

Tedds calculation version 2.1.11

Building data

Type of roof	Flat
Length of building	b = **26.00** ft
Width of building	d = **8.08** ft
Height to eaves	H = **8.33** ft
Mean height	h = **8.33** ft

General wind load requirements

Basic wind speed	V = **145.0** mph
Risk category	III
Velocity pressure exponent coef (Table 26.6-1)	K_d = **0.85**
Ground elevation above sea level	z_{gl} = **0** ft
Ground elevation factor	$K_e = \exp(-0.0000362 \times z_{gl}/1ft)$ = **1.00**
Exposure category (cl 26.7.3)	D
Enclosure classification (cl.26.12)	Enclosed buildings
Internal pressure coef +ve (Table 26.13-1)	GC_{pi_p} = **0.18**
Internal pressure coef –ve (Table 26.13-1)	GC_{pi_n} = **-0.18**
Gust effect factor	G_f = **0.85**
Minimum design wind loading (cl.27.1.5)	p_{min_r} = **8** lb/ft^2

Topography

Topography factor not significant	$K_{zt} = 1.0$
Velocity pressure equation	$q = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times 1psf/mph^2$

Velocity pressures table

z (ft)	K_z (Table 26.10-1)	q_z (psf)
8.33	1.03	47.12

Peak velocity pressure for internal pressure

Peak velocity pressure – internal (as roof press.)	q_i = **47.12** psf

Pressures and forces

Net pressure	$p = q \times G_f \times C_{pe} - q_i \times GC_{pi}$
Net force	$F_w = p \times A_{ref}$

3

Roof load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	8.33	-1.29	47.12	-60.27	108.29	-6.53
B (-ve)	8.33	-0.70	47.12	-36.52	101.79	-3.72

Total vertical net force $F_{w,v}$ = **-10.24** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	8.33	0.80	47.12	23.56	216.58	5.10
B	8.33	-0.50	47.12	-28.51	216.58	-6.17
C	8.33	-0.70	47.12	-36.52	67.31	-2.46
D	8.33	-0.70	47.12	-36.52	67.31	-2.46

Overall loading

Projected vertical plan area of wall $A_{vert_w_0} = b \times H$ = **216.58** ft^2

Projected vertical area of roof $A_{vert_r_0}$ = **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_0} + p_{min_r} \times A_{vert_r_0}$ = **3.47** kips

Leeward net force $F_l = F_{w,wB}$ = **-6.2** kips

Windward net force $F_w = F_{w,wA}$ = **5.1** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **11.3** kips

Roof load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	8.33	-0.18	47.12	1.27	108.29	0.14
B (+ve)	8.33	-0.18	47.12	1.27	101.79	0.13

Total vertical net force $F_{w,v}$ = **0.27** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	8.33	0.80	47.12	40.53	216.58	8.78
B	8.33	-0.50	47.12	-11.55	216.58	-2.50
C	8.33	-0.70	47.12	-19.56	67.31	-1.32
D	8.33	-0.70	47.12	-19.56	67.31	-1.32

Overall loading

Projected vertical plan area of wall $A_{vert_w_0} = b \times H$ = **216.58** ft^2

Projected vertical area of roof $A_{vert_r_0}$ = **0.00** ft^2

4

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_0} + p_{min_r} \times A_{vert_r_0}$ = **3.47** kips

Leeward net force $F_l = F_{w,wB}$ = **-2.5** kips

Windward net force $F_w = F_{w,wA}$ = **8.8** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **11.3** kips

Roof load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	8.33	-0.90	47.12	-44.53	33.65	-1.50
B (-ve)	8.33	-0.90	47.12	-44.53	33.65	-1.50
C (-ve)	8.33	-0.50	47.12	-28.51	67.31	-1.92
D (-ve)	8.33	-0.30	47.12	-20.50	75.47	-1.55

Total vertical net force $F_{w,v}$ = **-6.46** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	8.33	0.80	47.12	23.56	67.31	1.59
B	8.33	-0.24	47.12	-18.06	67.31	-1.22
C	8.33	-0.70	47.12	-36.52	216.58	-7.91
D	8.33	-0.70	47.12	-36.52	216.58	-7.91

Overall loading

Projected vertical plan area of wall $A_{vert_w_90} = d \times H$ = **67.31** ft^2

Projected vertical area of roof $A_{vert_r_90}$ = **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_90} + p_{min_r} \times A_{vert_r_90}$ = **1.08** kips

Leeward net force $F_l = F_{w,wB}$ = **-1.2** kips

Windward net force $F_w = F_{w,wA}$ = **1.6** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **2.8** kips

Roof load case 4 - Wind 90, GC_{pi} -0.18, $+c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	8.33	-0.18	47.12	1.27	33.65	0.04
B (+ve)	8.33	-0.18	47.12	1.27	33.65	0.04
C (+ve)	8.33	-0.18	47.12	1.27	67.31	0.09
D (+ve)	8.33	-0.18	47.12	1.27	75.47	0.10

Total vertical net force $F_{w,v}$ = **0.27** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 4 - Wind 90, GC_{pi} -0.18, $+c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	8.33	0.80	47.12	40.53	67.31	2.73
B	8.33	-0.24	47.12	-1.10	67.31	-0.07
C	8.33	-0.70	47.12	-19.56	216.58	-4.24
D	8.33	-0.70	47.12	-19.56	216.58	-4.24

Overall loading

Projected vertical plan area of wall $A_{vert_w_90} = d \times H = \mathbf{67.31}\ ft^2$

Projected vertical area of roof $A_{vert_r_90} = \mathbf{0.00}\ ft^2$

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_90} + p_{min_r} \times A_{vert_r_90} = \mathbf{1.08}$ kips

Leeward net force $F_l = F_{w,wB} = \mathbf{-0.1}$ kips

Windward net force $F_w = F_{w,wA} = \mathbf{2.7}$ kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min}) = \mathbf{2.8}$ kips

Plan view - Flat roof

Tekla Tedds Brooks Ransom Associates 7415 N. Palm, Suite 100 Fresno, California 93711 Ph (559)449-8444	Project G1 EQUIPMENT WIND LOADS				Job Ref.	
	Section				Sheet no./rev. 5	
	Calc. by RANSOM	Date 8/7/2025	Chk'd by	Date	App'd by	Date

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Company:	Brooks Ransom Associates	Page:	1
Address:	7415 N Palm, Suite 100	Specifier:	Gaylord R Ransom
Phone I Fax:	559-449-8444 | 559-449-8404	E-Mail:	rick@brooksransom.com
Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HAS-R 304/316 SS 5/8**
Item number:	2045007 HAS-R 316 SS 5/8"x7 5/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Specification text:	Hilti ∅ 5/8 in HIT-HY 200 V3 + HAS-R 304/316 SS with 6 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII,
Effective embedment depth:	$h_{ef,act}$ = 6.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2024 | 11/1/2026
Proof:	Design Method ACI 318-14 / Chem
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-14 Fig. R.17.5.2.1b)
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[R] :	l_x x l_y x t = 52.677 in. x 6.000 in. x 0.500 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 24.000 in., Temp. short/long: 32/32 °F
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: > No. 4 bar

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, ft.lb]

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Company:	Brooks Ransom Associates	Page:	2
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Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 0$; $V_x = 0$; $V_y = 6{,}888$; $M_x = 0.000$; $M_y = 0.000$; $M_z = 0.000$; $N_{sus} = 0$; $M_{x,sus} = 0.000$; $M_{y,sus} = 0.000$;	no	29

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	2,296	0	2,296
2	0	2,296	0	2,296
3	0	2,296	0	2,296

Max. concrete compressive strain: - [‰]
Max. concrete compressive stress: - [psi]
Resulting tension force in (x/y)=(-/-): 0 [lb]
Resulting compression force in (x/y)=(-/-): 0 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	N/A	N/A	N/A	N/A
Bond Strength**	N/A	N/A	N/A	N/A
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	2,296	8,136	29	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	6,888	60,678	12	OK
Concrete edge failure in direction x+**	6,888	36,840	19	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-4868
ϕ $V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.23	100,000

Calculations

V_{sa} [lb]
13,560

Results

V_{sa} [lb]	ϕ_{steel}	ϕ V_{sa} [lb]	V_{ua} [lb]
13,560	0.600	8,136	2,296

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Phone I Fax:	559-449-8444 | 559-449-8404	E-Mail:	rick@brooksransom.com
Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

4.2 Pryout Strength (Bond Strength controls)

$V_{cpg} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \Psi_{ec1,Na}\ \Psi_{ec2,Na}\ \Psi_{ed,Na}\ \Psi_{cp,Na}\ N_{ba}\right]$ — ACI 318-14 Eq. (17.5.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ — ACI 318-14 Table 17.3.1.1

A_{Na} see ACI 318-14, Section 17.4.5.1, Fig. R 17.4.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ — ACI 318-14 Eq. (17.4.5.1c)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ — ACI 318-14 Eq. (17.4.5.1d)

$\Psi_{ec,Na} = \left(\frac{1}{1 + \frac{e'_N}{c_{Na}}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.3)

$\Psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.4b)

$\Psi_{cp,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.5b)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ — ACI 318-14 Eq. (17.4.5.2)

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	2,327	0.625	6.000	13.500	1,226

$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	c_{ac} [in.]	λ_a
0.000	0.000	10.219	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\Psi_{ed,Na}$
9.049	982.62	327.54	1.000

$\Psi_{ec1,Na}$	$\Psi_{ec2,Na}$	$\Psi_{cp,Na}$	N_{ba} [lb]
1.000	1.000	1.000	14,447

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
86,682	0.700	60,678	6,888

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Company:	Brooks Ransom Associates	Page:	5
Address:	7415 N Palm, Suite 100	Specifier:	Gaylord R Ransom
Phone I Fax:	559-449-8444 | 559-449-8404	E-Mail:	rick@brooksransom.com
Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \Psi_{ed,V} \Psi_{c,V} \Psi_{h,V} \Psi_{parallel,V} V_b$ — ACI 318-14 Eq. (17.5.2.1a)

$\phi V_{cb} \geq V_{ua}$ — ACI 318-14 Table 17.3.1.1

A_{Vc} see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)*

$A_{Vc0} = 4.5 c_{a1}^2$ — ACI 318-14 Eq. (17.5.2.1c)

$\Psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.5.2.6b)

$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-14 Eq. (17.5.2.8)

$V_b = \left(7 \left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c} c_{a1}^{1.5}$ — ACI 318-14 Eq. (17.5.2.2a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\Psi_{c,V}$	h_a [in.]	l_e [in.]
13.500	13.500	1.200	24.000	5.000

λ_a	d_a [in.]	f'_c [psi]	$\Psi_{parallel,V}$
1.000	0.625	4,000	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
683.44	820.12	1.000	1.000	26,314

Results

V_{cb} [lb]	$\phi_{concrete}$	ϕV_{cb} [lb]	V_{ua} [lb]
52,628	0.700	36,840	6,888

*Anchor row defined by: Anchor 3; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Fastening point:			

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-14, Section 17.8.1.

Fastening meets the design criteria!

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Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

6 Installation data

Profile: no profile

Hole diameter in the fixture: d_f = 0.687 in.

Plate thickness (input): 0.500 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HAS-R 304/316 SS 5/8

Item number: 2045007 HAS-R 316 SS 5/8"x7 5/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 60.000 ft.lb

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 6.000 in.

Minimum thickness of the base material: 7.500 in.

Hilti ∅ 5/8 in HIT-HY 200 V3 + HAS-R 304/316 SS with 6 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII

6.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Torque wrench

Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-25.000	0.000	-	63.500	-	13.500
2	0.000	0.000	-	38.500	-	13.500
3	25.000	0.000	-	13.500	-	13.500

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Design:	Concrete - Aug 7, 2025	Date:	8/7/2025
Fastening point:			

7 Remarks; Your Cooperation Duties

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Input data and results must be checked for conformity with the existing conditions and for plausibility!
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NOTES:
1. ALL INLET DUCT SUPPORT, HANGERS, AND HARDWARE BY OTHERS.
2. WALL/ROOF PENETRATION, FLASHING, & SEALS TO BE PROVIDED BY OTHERS, IF REQUIRED.
3. FIELD JOINTS TO BE PROVIDED AND INSTALLED BY OTHERS, IF REQUIRED.
4. ALL DUCT FLANGES SHALL BE DRILLED PER NBS PS 15-69.
5. INLET DUCT BY OTHERS.
6. INSTALL SCRUBBER VESSEL ON 1/4" NEOPRENE PAD, 60 DUROMETER [PROVIDED BY IMS]
7. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
8. ALL LIQUID NOZZLES AND FLANGES LESS THAN Ø6" SHALL HAVE 1/4" FLAT PLATE GUSSETS.
9. ALL BOLT HOLES ARE TO STRADDLE THE TANK'S NATURAL CENTERLINES.
10. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
11. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
12. ALL PIPING AND VALVES ARE PVC.
13. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
14. 6" MINIMUM BAROMETRIC P-TRAP ON DRAIN, PROVIDED AND INSTALLED BY OTHERS.

SHIPPING COMPONENTS:
1. SYSTEM VESSEL W/ ANCHORING HARDWARE
2. EXHAUST STACK TRANSITION W/ HARDWARE (5X)
3. NEOPRENE PAD (X2)
4. EXPANDED CLAY MEDIA
5. CARBON MEDIA
6. HEADER DUCTWORK

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER FROM REMOTE ELECTRICAL CONTROL PANEL TO FAN MOTOR.
2. ELECTRICAL CONNECTION FROM DIFFERENTIAL PRESSURE SWITCH TO REMOTE ELECTRICAL CONTROL PANEL.
3. TUBING CONNECTION FROM FAN INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
5. ANY REQUIRED FILL AND DRAIN PIPING.
6. DUCTWORK CONNECTION TO SYSTEM FAN INLET AND FROM EXHAUST STACK FLANGE.
7. DUCTWORK CONNECTION FROM EXHAUST STACK TO HEADER DUCTING.

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER FT. FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT PAD ON TOP OF A 1/4" NEOPRENE PAD. MAKE SURE THAT THE PAD IS CLEAN AND ANY PEBBLES OR IMPERFECTIONS IN THE CONCRETE HAVE BEEN REMOVED.
4. REMOVE THE GRATING AND INSTALL THE CLAY MEDIA.
   CLAY MEDIA DEPTH - 54"
5. REINSTALL ALL THE GRATING AND THE SUPPORT SCREEN ON TOP OF THE GRATING.
6. INSTALL THE CARBON MEDIA ON TOP OF THE GRATING W/ SCREEN.
   CARBON MEDIA DEPTH - 18"
7. SET AND SECURE EXHAUST STACK TRANSITION PIECES.
8. CONNECT HEADER DUCTWORK TO TOP EXHAUST STACKS.
9. CONNECT PIPING FROM REMOTE SKID TO SYSTEM INLET.
10. CONNECT DRAIN PIPING TO SYSTEM.
11. CONNECT DUCTWORK TO FAN INLET.
12. COMPLETE ALL REQUIRED WIRING.

PLAN VIEW

ISOMETRIC VIEW

P-TRAP
INSTALLED BY OTHERS.
2" PIPE AND FITTINGS.

ELEVATION VIEW

END VIEW

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 8025)

AIR FLOW RATE	4,300 CFM
H2S CAPACITY	50 PPM (AVG); 100 PPM (MAX)
DIMENSIONS	30'-0" L X 7'-10" W 6'-10" SSH
VESSEL APPROX. SHIPPING WEIGHT	8,100 LB
MEDIA APPROX. SHIPPING WEIGHT	47,000 LB
INLET DUCT DIA.	19-3/8" SLIP

EQUIPMENT PAD SLOPE DETAILS

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS:

FABRICATION	MACHINE
.XX +/- .06	.XXX +/-.005
.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

STD. BORDER-11X17MI

BAR = 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/14/25	TT			

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DESIGNER	TrevorTil	DATE 7/11/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE	40243_G1.iam	
SCALE	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM
GENERAL ARRANGEMENT DRAWING (I-BOx® 8025 TALL)

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_G1	1 OF 1	A

G2 EQUIPMENT:

PLAN
1" = 3"

WIND A = 5' x 7.83' = 39.15 FT² → USE 40 FT²

N-S = E-W = 2.0^K

OPERATING WT = 9,400#

SEISMIC N-S = E-W = 9,400 x .5 = 4,700#

E_v = .24 x 9400 = 2,256#

M_o = 4,700# x 3.5' = 16,450'#

M_R = ((.9 x 9400) - 2,256) x 2.792' = 17,322'# > M_o

∴ NO BOLT TENSION

V = 4,700#

v = V/4 = 1,175#/BOLT x Ω_o = 2,350#

EDGE DISTANCE = 13½"

USE (4) - 5/8" ø HILTI HIT-HY 200 V3 + HAS-R 304/316 SS
EMBEDMENT = 6"

REFER TO CALCS FOLLOWING FOR DETAILS.

BROOKS-RANSOM ASSOCIATES
STRUCTURAL ENGINEERS
CIVIL ENGINEERS
7415 NORTH PALM, SUITE 100
FRESNO, CALIFORNIA 93711
(559) 449-8444 FAX (559) 449-8404

By:
Date:
Job no.
Sheet 17 Of:

WIND LOADING

In accordance with ASCE7-16

Using the directional design method

Tedds calculation version 2.1.11

Plan Elevation

Building data

Type of roof	Flat
Length of building	b = **5.00** ft
Width of building	d = **5.00** ft
Height to eaves	H = **7.83** ft
Mean height	h = **7.83** ft

General wind load requirements

Basic wind speed	V = **145.0** mph
Risk category	III
Velocity pressure exponent coef (Table 26.6-1)	K_d = **0.85**
Ground elevation above sea level	z_{gl} = **0** ft
Ground elevation factor	$K_e = \exp(-0.0000362 \times z_{gl}/1\text{ft})$ = **1.00**
Exposure category (cl 26.7.3)	D
Enclosure classification (cl.26.12)	Enclosed buildings
Internal pressure coef +ve (Table 26.13-1)	GC_{pi_p} = **0.18**
Internal pressure coef –ve (Table 26.13-1)	GC_{pi_n} = **-0.18**
Gust effect factor	G_f = **0.85**
Minimum design wind loading (cl.27.1.5)	p_{min_r} = **8** lb/ft^2

Topography

Topography factor not significant	K_{zt} = 1.0

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Velocity pressure equation $q = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times 1psf/mph^2$

Velocity pressures table

z (ft)	K_z (Table 26.10-1)	q_z (psf)
7.83	1.03	47.12

Peak velocity pressure for internal pressure

Peak velocity pressure – internal (as roof press.) q_i = **47.12** psf

Pressures and forces

Net pressure $p = q \times G_f \times C_{pe} - q_i \times GC_{pi}$

Net force $F_w = p \times A_{ref}$

Roof load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	7.83	-1.30	47.12	-60.55	19.58	-1.19
B (-ve)	7.83	-0.70	47.12	-36.52	5.43	-0.20

Total vertical net force $F_{w,v}$ = **-1.38** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	7.83	0.80	47.12	23.56	39.15	0.92
B	7.83	-0.50	47.12	-28.51	39.15	-1.12
C	7.83	-0.70	47.12	-36.52	39.15	-1.43
D	7.83	-0.70	47.12	-36.52	39.15	-1.43

Overall loading

Projected vertical plan area of wall $A_{vert_w_0} = b \times H$ = **39.15** ft^2

Projected vertical area of roof $A_{vert_r_0}$ = **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_0} + p_{min_r} \times A_{vert_r_0}$ = **0.63** kips

Leeward net force $F_l = F_{w,wB}$ = **-1.1** kips

Windward net force $F_w = F_{w,wA}$ = **0.9** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **2.0** kips

Roof load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	7.83	-0.18	47.12	1.27	19.58	0.02
B (+ve)	7.83	-0.18	47.12	1.27	5.43	0.01

Total vertical net force $F_{w,v}$ = **0.03** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

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Walls load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	7.83	0.80	47.12	40.53	39.15	1.59
B	7.83	-0.50	47.12	-11.55	39.15	-0.45
C	7.83	-0.70	47.12	-19.56	39.15	-0.77
D	7.83	-0.70	47.12	-19.56	39.15	-0.77

Overall loading

Projected vertical plan area of wall $A_{vert_w_0} = b \times H =$ **39.15** ft^2

Projected vertical area of roof $A_{vert_r_0} =$ **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_0} + p_{min_r} \times A_{vert_r_0} =$ **0.63** kips

Leeward net force $F_l = F_{w,wB} =$ **-0.5** kips

Windward net force $F_w = F_{w,wA} =$ **1.6** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min}) =$ **2.0** kips

Roof load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	7.83	-1.30	47.12	-60.55	19.58	-1.19
B (-ve)	7.83	-0.70	47.12	-36.52	5.43	-0.20

Total vertical net force $F_{w,v} =$ **-1.38** kips

Total horizontal net force $F_{w,h} =$ **0.00** kips

Walls load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	7.83	0.80	47.12	23.56	39.15	0.92
B	7.83	-0.50	47.12	-28.51	39.15	-1.12
C	7.83	-0.70	47.12	-36.52	39.15	-1.43
D	7.83	-0.70	47.12	-36.52	39.15	-1.43

Overall loading

Projected vertical plan area of wall $A_{vert_w_90} = d \times H =$ **39.15** ft^2

Projected vertical area of roof $A_{vert_r_90} =$ **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_90} + p_{min_r} \times A_{vert_r_90} =$ **0.63** kips

Leeward net force $F_l = F_{w,wB} =$ **-1.1** kips

Windward net force $F_w = F_{w,wA} =$ **0.9** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min}) =$ **2.0** kips

Roof load case 4 - Wind 90, GC_{pi} -0.18, $+c_{pe}$

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Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	7.83	-0.18	47.12	1.27	19.58	0.02
B (+ve)	7.83	-0.18	47.12	1.27	5.43	0.01

Total vertical net force $F_{w,v}$ = **0.03** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 4 - Wind 90, GC_{pi} -0.18, +c_{pe}

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	7.83	0.80	47.12	40.53	39.15	1.59
B	7.83	-0.50	47.12	-11.55	39.15	-0.45
C	7.83	-0.70	47.12	-19.56	39.15	-0.77
D	7.83	-0.70	47.12	-19.56	39.15	-0.77

Overall loading

Projected vertical plan area of wall $A_{vert_w_90} = d \times H$ = **39.15** ft^2

Projected vertical area of roof $A_{vert_r_90}$ = **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_90} + p_{min_r} \times A_{vert_r_90}$ = **0.63** kips

Leeward net force $F_l = F_{w,wB}$ = **-0.5** kips

Windward net force $F_w = F_{w,wA}$ = **1.6** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **2.0** kips

Plan view - Flat roof

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Plan view - Flat roof

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Address:	7415 N Palm, Suite 100	Specifier:	Gaylord R Ransom
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Design:	Concrete - Aug 7, 2025	Date:	8/8/2025
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HAS-R 304/316 SS 5/8**
Item number:	2045007 HAS-R 316 SS 5/8"x7 5/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Specification text:	Hilti ∅ 5/8 in HIT-HY 200 V3 + HAS-R 304/316 SS with 6 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII,
Effective embedment depth:	$h_{ef,act}$ = 6.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2024 | 11/1/2026
Proof:	Design Method ACI 318-19 / Chem
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-19 Fig. R.17.7.2.1b)
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 24.000 in., Temp. short/long: 32/32 °F
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: > No. 4 bar
Seismic loads (cat. C, D, E, or F)	Tension load: no Shear load: yes (17.10.6.3 (c))

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Geometry [in.] & Loading [lb, ft.lb]

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Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 0$; $V_x = 2{,}350$; $V_y = 0$; $M_x = 0.000$; $M_y = 0.000$; $M_z = 0.000$;	yes	37

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	2,350	2,350	0

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	N/A	N/A	N/A	N/A
Bond Strength**	N/A	N/A	N/A	N/A
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (anchors in tension)

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	2,350	6,509	37	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	2,350	20,024	12	OK
Concrete edge failure in direction x+**	2,350	22,104	11	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

$V_{sa,eq}$ = ESR value refer to ICC-ES ESR-4868
ϕ $V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]	$\alpha_{V,seis}$
0.23	100,000	0.800

Calculations

$V_{sa,eq}$ [lb]
10,848

Results

$V_{sa,eq}$ [lb]	ϕ_{steel}	$\phi_{nonductile}$	ϕ $V_{sa,eq}$ [lb]	V_{ua} [lb]
10,848	0.600	1.000	6,509	2,350

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Fastening point:			

4.2 Pryout Strength (Bond Strength controls)

$V_{cp} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ — ACI 318-19 Eq. (17.7.3.1a)

$\phi\ V_{cp} \geq V_{ua}$ — ACI 318-19 Table 17.5.2

A_{Na} see ACI 318-19, Section 17.6.5.1, Fig. R 17.6.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ — ACI 318-19 Eq. (17.6.5.1.2a)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ — ACI 318-19 Eq. (17.6.5.1.2b)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.5.4.1b)

$\psi_{cp,Na} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.5.5.1b)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \alpha_{N,seis} \cdot \pi \cdot d_a \cdot h_{ef}$ — ACI 318-19 Eq. (17.6.5.2.1)

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	2,327	0.625	6.000	13.500	1,226

c_{ac} [in.]	λ_a	$\alpha_{N,seis}$
10.219	1.000	0.990

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
9.049	327.54	327.54	1.000

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	14,303

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
28,605	0.700	1.000	1.000	20,024	2,350

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V}\ \Psi_{parallel,V}\ V_b$ — ACI 318-19 Eq. (17.7.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ — ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)*

$A_{Vc0} = 4.5\ c_{a1}^2$ — ACI 318-19 Eq. (17.7.2.1.3)

$\Psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.7.2.4.1b)

$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ — ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\Psi_{c,V}$	h_a [in.]	l_e [in.]
13.500	-	1.200	24.000	5.000

λ_a	d_a [in.]	f'_c [psi]	$\Psi_{parallel,V}$
1.000	0.625	4,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
820.12	820.12	1.000	1.000	26,314

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi_{seismic}$	$\phi_{nonductile}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
31,577	0.700	1.000	1.000	22,104	2,350

*Anchor row defined by: Anchor 1; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- An anchor design approach for structures assigned to Seismic Design Category C, D, E or F is given in ACI 318-19, Chapter 17. The connection design (shear) shall satisfy the provisions of Section 17.10.6.3 (a), Section 17.10.6.3 (b), or Section 17.10.6.3 (c).
- Section 17.10.6.3 (a) require the attachment the anchors are connecting to the structure be designed to undergo ductile yielding at a load level corresponding to anchor forces no greater than the controlling design strength. Section 17.10.6.3 (b) waive the ductility requirements and requires that the anchors shall be designed for the maximum shear that can be transmitted to the anchors by a non-yielding attachment. Section 17.10.6.3 (c) waives the ductility requirements and requires the design strength of the anchors to equal or exceed the maximum shear obtained from design load combinations that include E, with E increased by ω_0.
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

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Fastening point:			

6 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HAS-R 304/316 SS 5/8

Item number: 2045007 HAS-R 316 SS 5/8"x7 5/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 60.000 ft.lb

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 6.000 in.

Minimum thickness of the base material: 7.500 in.

Hilti ∅ 5/8 in HIT-HY 200 V3 + HAS-R 304/316 SS with 6 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII

6.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Torque wrench

Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	0.000	-	13.500	-	-

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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7 Remarks; Your Cooperation Duties

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NOTES:
1. ALL INLET DUCT SUPPORT, HANGERS, AND HARDWARE BY OTHERS.
2. WALL/ROOF PENETRATION, FLASHING, & SEALS TO BE PROVIDED BY OTHERS, IF REQUIRED.
3. FIELD JOINTS TO BE PROVIDED AND INSTALLED BY OTHERS, IF REQUIRED.
4. ALL DUCT FLANGES SHALL BE DRILLED PER NBS PS 15-69.
5. INLET DUCT BY OTHERS.
6. INSTALL SCRUBBER VESSEL ON 1/4" NEOPRENE PAD, 60 DUROMETER [PROVIDED BY IMS]
7. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
8. ALL LIQUID NOZZLES AND FLANGES LESS THAN Ø6" SHALL HAVE 1/4" FLAT PLATE GUSSETS.
9. ALL BOLT HOLES ARE TO STRADDLE THE TANK'S NATURAL CENTERLINES.
10. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
11. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
12. ALL PIPING AND VALVES ARE PVC.
13. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
14. 6" MINIMUM BAROMETRIC P-TRAP ON DRAIN, PROVIDED AND INSTALLED BY OTHERS.

SHIPPING COMPONENTS:
1. SYSTEM VESSEL W/ ANCHORING HARDWARE
2. EXHAUST STACK TRANSITION W/ HARDWARE
3. NEOPRENE PAD
4. NUTRIENT
5. NO-LOSS EXHAUST STACK

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER FROM REMOTE ELECTRICAL CONTROL PANEL TO FAN MOTOR.
2. ELECTRICAL CONNECTION FROM DIFFERENTIAL PRESSURE SWITCH TO REMOTE ELECTRICAL CONTROL PANEL.
3. TUBING CONNECTION FROM FAN INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
5. ANY REQUIRED FILL AND DRAIN PIPING.
6. DUCTWORK CONNECTION TO SYSTEM FAN INLET AND FROM EXHAUST STACK. (IF REQ.)

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER 12" FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT PAD ON TOP OF A 1/4" NEOPRENE PAD. MAKE SURE THAT THE PAD IS CLEAN AND ANY PEBBLES OR IMPERFECTIONS IN THE CONCRETE HAVE BEEN REMOVED.
4. SET AND SECURE EXHAUST STACK TRANSITION PIECE AND NO-LOSS EXHAUST STACK.
5. CONNECT PIPING FROM REMOTE SKID TO SYSTEM INLET.
6. CONNECT DRAIN PIPING TO SYSTEM.
7. CONNECT DUCTWORK TO FAN INLET.
8. COMPLETE ALL REQUIRED WIRING.

EQUIPMENT PAD SLOPE DETAILS

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 5000 TALL)

AIR FLOW RATE	400 CFM
H2S CAPACITY	50 PPM (AVG.); 100 PPM (MAX)
DIMENSIONS	7'-6" L X 5'-0" W X 6'-10" SSH
EST. SHIPPING WEIGHT	8,700 LB
OPERATING WEIGHT	~9,400 LB
INLET DUCT DIA.	7-3/8" SLIP INLET

PLAN VIEW

P-TRAP PROVIDED AND INSTALLED BY OTHERS. 1" PIPE AND FITTINGS.

ISOMETRIC VIEW

ELEVATION VIEW

END VIEW

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM
DIMENSIONS IN [mm] ARE MILLIMETERS
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS

FABRICATION	MACHINE
.XX +/- .06	.XXX +/- .005
.X +/- .13	.XX +/- .01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/15/25	TT			

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DESIGNER	Trevor/TB	DATE 7/15/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	40243_G2.iam	
SCALE:	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM
GENERAL ARRANGEMENT DRAWING (I-BOx® 5000 TALL)

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1820

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_G2	1 OF 1	A

STD: BORDER-11X17MI BAR = 1" AT PLOT SCALE

G3 & G4 EQUIPMENT

WIND AREA = 6.83' x 2' = 13.66 FT²

HT. = 6.2'

N-S WIND = 2.2^K

E-W WIND = .5^K

SEISMIC:

WT. =

V = .5 x WT = .5 x 500# = 250#

E_V = .24 x WT = .24 x 500# = 120#

WIND GOVERNS!

N = V/4 = 2,200/4 = 550#/BOLT

T-C = 2,200# x 3.1' / 1.167' x 2 BOLTS = 2,922#

TRY SAME 5/8" ø BOLTS USE FOR OTHER EQUIPMENT.

YES THEY WORK!

USE (4) 5/8" ø HILTI 200 V3 + HAS-R 304/316 SS

REFER TO CALCS FOLLOWING FOR DETAILS.

WIND LOADING

In accordance with ASCE7-16

Using the directional design method

Tedds calculation version 2.1.11

Plan Elevation

Building data

Type of roof	Flat
Length of building	b = **6.83** ft
Width of building	d = **2.00** ft
Height to eaves	H = **6.20** ft
Mean height	h = **6.20** ft

General wind load requirements

Basic wind speed	V = **145.0** mph
Risk category	III
Velocity pressure exponent coef (Table 26.6-1)	K_d = **0.85**
Ground elevation above sea level	z_{gl} = **0** ft
Ground elevation factor	$K_e = \exp(-0.0000362 \times z_{gl}/1\text{ft})$ = **1.00**
Exposure category (cl 26.7.3)	D
Enclosure classification (cl.26.12)	Enclosed buildings
Internal pressure coef +ve (Table 26.13-1)	GC_{pi_p} = **0.18**
Internal pressure coef –ve (Table 26.13-1)	GC_{pi_n} = **-0.18**
Gust effect factor	G_f = **0.85**
Minimum design wind loading (cl.27.1.5)	p_{min_r} = **8** lb/ft^2

Topography

Topography factor not significant	K_{zt} = 1.0

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Velocity pressure equation $q = 0.00256 \times K_z \times K_{zt} \times K_d \times V^2 \times 1psf/mph^2$

Velocity pressures table

z (ft)	K_z (Table 26.10-1)	q_z (psf)
6.20	1.03	47.12

Peak velocity pressure for internal pressure

Peak velocity pressure – internal (as roof press.) q_i = **47.12** psf

Pressures and forces

Net pressure $p = q \times G_f \times C_{pe} - q_i \times GC_{pi}$

Net force $F_w = p \times A_{ref}$

Roof load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	6.20	-1.30	47.12	-60.55	13.66	-0.83

Total vertical net force $F_{w,v}$ = **-0.83** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 1 - Wind 0, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	6.20	0.80	47.12	23.56	42.35	1.00
B	6.20	-0.50	47.12	-28.51	42.35	-1.21
C	6.20	-0.70	47.12	-36.52	12.40	-0.45
D	6.20	-0.70	47.12	-36.52	12.40	-0.45

Overall loading

Projected vertical plan area of wall $A_{vert_w_0} = b \times H$ = **42.35** ft^2

Projected vertical area of roof $A_{vert_r_0}$ = **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_0} + p_{min_r} \times A_{vert_r_0}$ = **0.68** kips

Leeward net force $F_l = F_{w,wB}$ = **-1.2** kips

Windward net force $F_w = F_{w,wA}$ = **1.0** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **2.2** kips

Roof load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	6.20	-0.18	47.12	1.27	13.66	0.02

Total vertical net force $F_{w,v}$ = **0.02** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 2 - Wind 0, GC_{pi} -0.18, $-0c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	6.20	0.80	47.12	40.53	42.35	1.72
B	6.20	-0.50	47.12	-11.55	42.35	-0.49
C	6.20	-0.70	47.12	-19.56	12.40	-0.24
D	6.20	-0.70	47.12	-19.56	12.40	-0.24

Overall loading

Projected vertical plan area of wall $A_{vert_w_0} = b \times H =$ **42.35** ft^2

Projected vertical area of roof $A_{vert_r_0} =$ **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_0} + p_{min_r} \times A_{vert_r_0} =$ **0.68** kips

Leeward net force $F_l = F_{w,wB} =$ **-0.5** kips

Windward net force $F_w = F_{w,wA} =$ **1.7** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min}) =$ **2.2** kips

Roof load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (-ve)	6.20	-1.23	47.12	-57.60	6.20	-0.36
B (-ve)	6.20	-0.74	47.12	-38.00	6.20	-0.24
C (-ve)	6.20	-0.66	47.12	-35.04	1.26	-0.04

Total vertical net force $F_{w,v} =$ **-0.64** kips

Total horizontal net force $F_{w,h} =$ **0.00** kips

Walls load case 3 - Wind 90, GC_{pi} 0.18, $-c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	6.20	0.80	47.12	23.56	12.40	0.29
B	6.20	-0.23	47.12	-17.66	12.40	-0.22
C	6.20	-0.70	47.12	-36.52	42.35	-1.55
D	6.20	-0.70	47.12	-36.52	42.35	-1.55

Overall loading

Projected vertical plan area of wall $A_{vert_w_90} = d \times H =$ **12.40** ft^2

Projected vertical area of roof $A_{vert_r_90} =$ **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_90} + p_{min_r} \times A_{vert_r_90} =$ **0.20** kips

Leeward net force $F_l = F_{w,wB} =$ **-0.2** kips

Windward net force $F_w = F_{w,wA} =$ **0.3** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min}) =$ **0.5** kips

Roof load case 4 - Wind 90, GC_{pi} -0.18, $+c_{pe}$

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A (+ve)	6.20	-0.18	47.12	1.27	6.20	0.01
B (+ve)	6.20	-0.18	47.12	1.27	6.20	0.01
C (+ve)	6.20	-0.18	47.12	1.27	1.26	0.00

Total vertical net force $F_{w,v}$ = **0.02** kips

Total horizontal net force $F_{w,h}$ = **0.00** kips

Walls load case 4 - Wind 90, GC_{pi} -0.18, +c_{pe}

Zone	Ref. height (ft)	Ext pressure coefficient c_{pe}	Peak velocity pressure q_p (psf)	Net pressure p (psf)	Area A_{ref} (ft^2)	Net force F_w (kips)
A	6.20	0.80	47.12	40.53	12.40	0.50
B	6.20	-0.23	47.12	-0.70	12.40	-0.01
C	6.20	-0.70	47.12	-19.56	42.35	-0.83
D	6.20	-0.70	47.12	-19.56	42.35	-0.83

Overall loading

Projected vertical plan area of wall $A_{vert_w_90} = d \times H$ = **12.40** ft^2

Projected vertical area of roof $A_{vert_r_90}$ = **0.00** ft^2

Minimum overall horizontal loading $F_{w,total_min} = p_{min_w} \times A_{vert_w_90} + p_{min_r} \times A_{vert_r_90}$ = **0.20** kips

Leeward net force $F_l = F_{w,wB}$ = **0.0** kips

Windward net force $F_w = F_{w,wA}$ = **0.5** kips

Overall horizontal loading $F_{w,total} = \max(F_w - F_l + F_{w,h}, F_{w,total_min})$ = **0.5** kips

Plan view - Flat roof

A
6.2 ft
6.8 ft
Windward face
C
6.2 ft
B
6.2 ft
2 ft
Side face
6.8 ft
Leeward face

6.8 ft
Wind - 90°
A
B
C
2 ft
3.1 ft
3.1 ft
0.6 ft
Plan view - Flat roof

C
6.2 ft
6.8 ft
Side face
A
6.2 ft
2 ft
Windward face
B
6.2 ft
2 ft
Leeward face

NOTES:
1. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
2. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
3. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
4. ALL PIPING AND VALVES ARE PVC.
5. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
6. SUPPLY WATER PRESSURE SHALL BE BETWEEN 30-60 PSI AND A FLOW RATE OF AT LEAST 18 GPM.

SHIPPING COMPONENTS:
1. SYSTEM SKID W/ ANCHORING HARDWARE
2. NUTRIENT SUPPLY

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER TO ELECTRICAL CONTROL PANEL.
2. ELECTRICAL CONNECTION FROM ELECTRICAL CONTROL PANEL TO FAN MOTOR.
3. ELECTRICAL CONNECTION FROM REMOTE ELECTRICAL CONTROL PANEL TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM WATER SUPPLY TO WATER INLET FLANGE.
5. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
6. WIRING CONNECTIONS FROM ELECTRICAL CONTROL PANEL TO PLANT SCADA

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER FT. FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT.
4. CONNECT ALL REQUIRED PIPING.
5. COMPLETE ALL REQUIRED WIRING.

ISOMETRIC VIEW

END VIEW

ELEVATION VIEW

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

STD: BORDER-11X17MI

BAR = 1" AT PLOT SCALE

DRAWN PER ASME Y14.5M
UNLESS OTHERISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS

FABRICATION	MACHINE
.XX +/- .06	.XXX +/-.005
.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/15/25	TT			

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		DATE
DESIGNER	Trevor/TB	7/15/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:		
SCALE: DNS		

TITLE: HILO WWTP
REMOTE NUTRIENT SKID (8025) GENERAL ARRANGEMENT

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_G3	1 OF 1	A

NOTES:
1. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
2. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
3. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
4. ALL PIPING AND VALVES ARE PVC.
5. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
6. SUPPLY WATER PRESSURE SHALL BE BETWEEN 30-60 PSI AND A FLOW RATE OF AT LEAST 6 GPM.

SHIPPING COMPONENTS:
1. SYSTEM SKID W/ ANCHORING HARDWARE
2. NUTRIENT SUPPLY

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER TO ELECTRICAL CONTROL PANEL.
2. ELECTRICAL CONNECTION FROM ELECTRICAL CONTROL PANEL TO FAN MOTOR.
3. ELECTRICAL CONNECTION FROM REMOTE ELECTRICAL CONTROL PANEL TO DIFFERENTIAL PRESSURE SWITCH.
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INSTALLATION INSTRUCTIONS:
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3. SET AND BOLT VESSEL TO THE EQUIPMENT.
4. CONNECT ALL REQUIRED PIPING.
5. COMPLETE ALL REQUIRED WIRING.

ISOMETRIC VIEW

END VIEW

ELEVATION VIEW

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM. DIMENSIONS IN [mm] ARE MILLIMETERS. DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M UNLESS OTHERISE SPECIFIED
ALL DIMENSIONS ARE INCHES AND TOLERANCES TO BE AS FOLLOWS

FABRICATION	MACHINE
.XX +/- .06	.XXX +/- .005
.X +/- .13	.XX +/- .01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

STD: BORDER-11X17MI

BAR = 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/16/25	TT			

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		DATE
DESIGNER	TrevorT⊕	7/15/2025
CHECKER		
ENGINEER		
MANAGER		
FILE:		
SCALE: DNS		

TITLE: REMOTE NUTRIENT SKID (8025) GENERAL ARRANGEMENT

CLIENT: HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
		40243_G4	1 OF 1	A

40

Company:	Brooks Ransom Associates	Page:	1
Address:	7415 N Palm, Suite 100	Specifier:	Gaylord R Ransom
Phone I Fax:	559-449-8444 | 559-449-8404	E-Mail:	rick@brooksransom.com
Design:	Concrete - Aug 8, 2025	Date:	8/8/2025
Fastening point:			

Specifier's comments:

1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HAS-R 304/316 SS 5/8**
Item number:	2045007 HAS-R 316 SS 5/8"x7 5/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Specification text:	Hilti ∅ 5/8 in HIT-HY 200 V3 + HAS-R 304/316 SS with 6 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII,
Effective embedment depth:	$h_{ef,act}$ = 6.000 in. ($h_{ef,limit}$ = - in.)
Material:	ASTM F 593
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2024 | 11/1/2026
Proof:	Design Method ACI 318-14 / Chem
Shear edge breakout verification:	Row closest to edge (Case 3 only from ACI 318-14 Fig. R.17.5.2.1b)
Stand-off installation:	
Profile:	
Base material:	cracked concrete, 4000, f_c' = 4,000 psi; h = 24.000 in., Temp. short/long: 32/32 °F
Installation:	**Hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: condition B, shear: condition B; no supplemental splitting reinforcement present edge reinforcement: > No. 4 bar

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Geometry [in.] & Loading [lb, ft.lb]

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Design:	Concrete - Aug 8, 2025	Date:	8/8/2025
Fastening point:			

1.1 Design results

Case	Description	Forces [lb] / Moments [ft.lb]	Seismic	Max. Util. Anchor [%]
1	Combination 1	$N = 2{,}922$; $V_x = 550$; $V_y = 0$; $M_x = 0.000$; $M_y = 0.000$; $M_z = 0.000$; $N_{sus} = 0$; $M_{x,sus} = 0.000$; $M_{y,sus} = 0.000$;	no	32

2 Load case/Resulting anchor forces

Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2,922	550	550	0

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	2,922	14,690	20	OK
Bond Strength**	2,922	9,391	32	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	2,922	10,271	29	OK

* highest loaded anchor **anchor group (anchors in tension)

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Design:	Concrete - Aug 8, 2025	Date:	8/8/2025
Fastening point:			

3.1 Steel Strength

N_{sa} = ESR value — refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ — ACI 318-14 Table 17.3.1.1

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.23	100,000

Calculations

N_{sa} [lb]
22,600

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
22,600	0.650	14,690	2,922

3.2 Bond Strength

$N_a = \left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}$ — ACI 318-14 Eq. (17.4.5.1a)

$\phi\ N_a \geq N_{ua}$ — ACI 318-14 Table 17.3.1.1

A_{Na} see ACI 318-14, Section 17.4.5.1, Fig. R 17.4.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ — ACI 318-14 Eq. (17.4.5.1c)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ — ACI 318-14 Eq. (17.4.5.1d)

$\psi_{ed,Na} = 0.7 + 0.3 \left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.4b)

$\psi_{cp,Na} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.5b)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ — ACI 318-14 Eq. (17.4.5.2)

Variables

$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\alpha_{overhead}$	$\tau_{k,c}$ [psi]
2,327	0.625	6.000	12.000	1.000	1,226

c_{ac} [in.]	λ_a
10.219	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
9.049	327.54	327.54	1.000

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	14,447

Results

N_a [lb]	ϕ_{bond}	$\phi\ N_a$ [lb]	N_{ua} [lb]
14,447	0.650	9,391	2,922

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Design:	Concrete - Aug 8, 2025	Date:	8/8/2025
Fastening point:			

3.3 Concrete Breakout Failure

$N_{cb} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-14 Eq. (17.4.2.1a)

$\phi\ N_{cb} \geq N_{ua}$ — ACI 318-14 Table 17.3.1.1

A_{Nc} see ACI 318-14, Section 17.4.2.1, Fig. R 17.4.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-14 Eq. (17.4.2.1c)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.2.5b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.2.7b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-14 Eq. (17.4.2.2a)

Variables

h_{ef} [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
6.000	12.000	1.000	10.219	17	1.000	4,000

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
324.00	324.00	1.000	1.000	15,802

Results

N_{cb} [lb]	$\phi_{concrete}$	$\phi\ N_{cb}$ [lb]	N_{ua} [lb]
15,802	0.650	10,271	2,922

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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Company:	Brooks Ransom Associates	Page:	6
Address:	7415 N Palm, Suite 100	Specifier:	Gaylord R Ransom
Phone I Fax:	559-449-8444 | 559-449-8404	E-Mail:	rick@brooksransom.com
Design:	Concrete - Aug 8, 2025	Date:	8/8/2025
Fastening point:			

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	550	8,136	7	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)**	550	20,226	3	OK
Concrete edge failure in direction x+**	550	18,524	3	OK

* highest loaded anchor **anchor group (relevant anchors)
When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-4868
ϕ $V_{steel} \geq V_{ua}$ ACI 318-14 Table 17.3.1.1

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.23	100,000

Calculations

V_{sa} [lb]
13,560

Results

V_{sa} [lb]	ϕ_{steel}	ϕ V_{sa} [lb]	V_{ua} [lb]
13,560	0.600	8,136	550

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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4.2 Pryout Strength (Bond Strength controls)

$V_{cp} = k_{cp}\left[\left(\frac{A_{Na}}{A_{Na0}}\right) \psi_{ed,Na}\ \psi_{cp,Na}\ N_{ba}\right]$ — ACI 318-14 Eq. (17.5.3.1a)

$\phi\ V_{cp} \geq V_{ua}$ — ACI 318-14 Table 17.3.1.1

A_{Na} see ACI 318-14, Section 17.4.5.1, Fig. R 17.4.5.1(b)

$A_{Na0} = (2\ c_{Na})^2$ — ACI 318-14 Eq. (17.4.5.1c)

$c_{Na} = 10\ d_a \sqrt{\frac{\tau_{uncr}}{1100}}$ — ACI 318-14 Eq. (17.4.5.1d)

$\psi_{ed,Na} = 0.7 + 0.3\left(\frac{c_{a,min}}{c_{Na}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.4b)

$\psi_{cp,Na} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{c_{Na}}{c_{ac}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.4.5.5b)

$N_{ba} = \lambda_a \cdot \tau_{k,c} \cdot \pi \cdot d_a \cdot h_{ef}$ — ACI 318-14 Eq. (17.4.5.2)

Variables

k_{cp}	$\alpha_{overhead}$	$\tau_{k,c,uncr}$ [psi]	d_a [in.]	h_{ef} [in.]	$c_{a,min}$ [in.]	$\tau_{k,c}$ [psi]
2	1.000	2,327	0.625	6.000	12.000	1,226

c_{ac} [in.]	λ_a
10.219	1.000

Calculations

c_{Na} [in.]	A_{Na} [in.^{2}]	A_{Na0} [in.^{2}]	$\psi_{ed,Na}$
9.049	327.54	327.54	1.000

$\psi_{cp,Na}$	N_{ba} [lb]
1.000	14,447

Results

V_{cp} [lb]	$\phi_{concrete}$	$\phi\ V_{cp}$ [lb]	V_{ua} [lb]
28,894	0.700	20,226	550

Input data and results must be checked for conformity with the existing conditions and for plausibility!
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4.3 Concrete edge failure in direction x+

$V_{cb} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \Psi_{ed,V}\ \Psi_{c,V}\ \Psi_{h,V}\ \Psi_{parallel,V}\ V_b$ — ACI 318-14 Eq. (17.5.2.1a)

$\phi\ V_{cb} \geq V_{ua}$ — ACI 318-14 Table 17.3.1.1

A_{Vc} see ACI 318-14, Section 17.5.2.1, Fig. R 17.5.2.1(b)*

$A_{Vc0} = 4.5\ c_{a1}^2$ — ACI 318-14 Eq. (17.5.2.1c)

$\Psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ — ACI 318-14 Eq. (17.5.2.6b)

$\Psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ — ACI 318-14 Eq. (17.5.2.8)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f'_c}\ c_{a1}^{1.5}$ — ACI 318-14 Eq. (17.5.2.2a)

Variables

c_{a1} [in.]	c_{a2} [in.]	$\Psi_{c,V}$	h_a [in.]	l_e [in.]
12.000	-	1.200	24.000	5.000

λ_a	d_a [in.]	f'_c [psi]	$\Psi_{parallel,V}$
1.000	0.625	4,000	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\Psi_{ed,V}$	$\Psi_{h,V}$	V_b [lb]
648.00	648.00	1.000	1.000	22,052

Results

V_{cb} [lb]	$\phi_{concrete}$	$\phi\ V_{cb}$ [lb]	V_{ua} [lb]
26,463	0.700	18,524	550

*Anchor row defined by: Anchor 1; Case 3 controls

When the input edge distance is set to "infinity", edge breakout verification is not performed in that direction

5 Combined tension and shear loads

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.311	0.068	5/3	16	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- The equations presented in this report are based on imperial units. When inputs are displayed in metric units, the user should be aware that the equations remain in their imperial format.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://viewer.joomag.com/profis-design-guide-us-en-summer-2021/0841849001625154758?short&/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-14, Section 17.8.1.

Fastening meets the design criteria!

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7 Installation data

Profile: -

Hole diameter in the fixture: -

Plate thickness (input): -

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HAS-R 304/316 SS 5/8

Item number: 2045007 HAS-R 316 SS 5/8"x7 5/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 60.000 ft.lb

Hole diameter in the base material: 0.750 in.

Hole depth in the base material: 6.000 in.

Minimum thickness of the base material: 7.500 in.

Hilti ∅ 5/8 in HIT-HY 200 V3 + HAS-R 304/316 SS with 6 in nominal embedment depth per ICC-ES ESR-4868 , Hammer drill bit installation per MPII

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• Compressed air with required accessories to blow from the bottom of the hole • Proper diameter wire brush	• Dispenser including cassette and mixer • Torque wrench

Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	0.000	-	12.000	-	-

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8 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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DIVISION: 03 00 00—CONCRETE Section: 03 16 00—Concrete Anchors DIVISION: 05 00 00—METALS Section: 05 05 19—Post-installed Concrete Anchors	REPORT HOLDER: HILTI, INC.	EVALUATION SUBJECT: HILTI HIT-HY 200 V3 ADHESIVE ANCHORS AND POST INSTALLED REINFORCING BAR CONNECTIONS IN CONCRETE	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015, and 2012 *International Building Code®* (IBC)
- 2021, 2018, 2015, and 2012 *International Residential Code* (IRC)

Property evaluated:

Structural

2.0 USES

Adhesive anchors and reinforcing bars installed using the Hilti HIT-HY 200 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System are used to resist static, wind and earthquake (Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight or lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchor system complies with anchors as described in Section 1901.3 of the 2021, 2018 and 2015 IBC, and Section 1909 of the 2012 IBC and is an alternative to cast-in-place anchors described in Section 1908 of the 2012 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

The post-installed reinforcing bar system is an alternative to cast-in-place reinforcing bars governed by ACI 318 and IBC Chapter 19.

3.0 DESCRIPTION

3.1 General:

The Hilti HIT-HY 200 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System are comprised of the following components:

- Hilti HIT-HY 200 V3 adhesive packaged in foil packs (either Hilti HIT-HY 200-A V3 or Hilti HIT-HY 200-R V3)
- Adhesive mixing and dispensing equipment
- Equipment for hole cleaning and adhesive injection

The Hilti HIT-HY 200 V3 Adhesive Anchoring System may be used with continuously threaded rod, Hilti HIT-Z(-R) anchor rods, Hilti HIS-(R)N internally threaded inserts or deformed steel reinforcing bars as depicted in

Figure 1. The Hilti HIT-HY 200 V3 Post-Installed Reinforcing Bar System may only be used with deformed steel reinforcing bars as depicted in Figure 2. The primary components of the Hilti Adhesive Anchoring and Post-Installed Reinforcing Bar Systems, including the Hilti HIT-HY 200 V3 Adhesive, HIT-RE-M static mixing nozzle and steel anchoring elements, are shown in Figure 5 of this report.

The manufacturer's printed Installation instructions (MPII), as included with each adhesive unit package, are replicated as Figure 6.

3.2 Materials:

3.2.1 Hilti HIT-HY 200 V3 Adhesive: Hilti HIT-HY 200 V3 Adhesive is an injectable, two-component hybrid adhesive. The two components are separated by means of a dual-cylinder foil pack attached to a manifold. The two components combine and react when dispensed through a static mixing nozzle attached to the manifold. Hilti HIT-HY 200 V3 is available in 11.1-ounce (330 mL) and 16.9-ounce (500 mL) foil packs. The manifold attached to each foil pack is stamped with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened foil pack stored in a dry, dark environment and in accordance with Figure 6.

Hilti HIT-HY 200 V3 Adhesive is available in two options, Hilti HIT-HY 200-A V3 and Hilti HIT-HY 200-R V3. Both options are subject to the same technical data as set forth in this report. Hilti HIT-HY 200-A V3 will have shorter working times and curing times than Hilti HIT-HY 200-R V3. The packaging for each option employs a different color, which helps the user distinguish between the two adhesives.

3.2.2 Hole Cleaning Equipment:

3.2.3.1 Standard Equipment: Standard hole cleaning equipment, comprised of steel wire brushes and air nozzles, is described in Figure 6 of this report.

3.2.3.2 Hilti Safe-Set™ System: The Hilti Safe-Set™ with Hilti HIT-HY 200 V3 consists of one of the following:

- For the Hilti HIT-Z and HIT-Z-R anchor rods, hole cleaning is not required after drilling the hole, except if the hole is drilled with a diamond core drill bit.
- For the elements described in Sections 3.2.4.2 through 3.2.4.4 and Section 3.2.5, the Hilti TE-CD or TE-YD hollow carbide drill bit with a carbide drilling head conforming to ANSI B212.15. Used in conjunction with a Hilti vacuum with a minimum value for the maximum volumetric flow rate of 129 CFM (61 ℓ/s), the Hilti TE-CD or TE-YD drill bit will remove the drilling dust, automatically cleaning the hole.

3.2.3 Hole Preparation Equipment:

3.2.3.3 Hilti Safe-Set™ System: TE-YRT Roughening Tool: For the elements described in Sections 3.2.5.2 through 3.2.5.4 and Tables 12, 13, 15, 18, 19, 21, 24, 25, 28 and 29, the Hilti TE-YRT roughening tool with a carbide roughening head is used for hole preparation in conjunction with holes core drilled with a diamond core bit as illustrated in Section 4.1.4.2 of this report.

3.2.4 Dispensers: Hilti HIT-HY 200 V3 must be dispensed with manual or electric dispensers provided by Hilti.

3.2.5 Anchor Elements:

3.2.5.1 Hilti HIT-Z and HIT-Z-R Anchor Rods: Hilti HIT-Z and HIT-Z-R anchor rods have a conical shape on the embedded section and a threaded section above the concrete surface. Mechanical properties for the Hilti HIT-Z and HIT-Z-R anchor rods are provided in Table 2. The rods are available in diameters as shown in Table 7 and Figure 1. Hilti HIT-Z anchor rods are produced from carbon steel and furnished with a 0.005-millimeter-thick (5 μm) zinc electroplated coating. Hilti HIT-Z-R anchor rods are fabricated from grade 316 stainless steel.

3.2.5.2 Threaded Steel Rods: Threaded steel rods must be clean, continuously threaded rods (all-thread) in diameters as described in Tables 11 and 17 and Figure 1 of this report. Steel design information for common grades of threaded rods is provided in Table 3. Carbon steel threaded rods may be furnished with a 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633 SC 1 or must be hot-dipped galvanized complying with ASTM A153, Class C or D. Stainless steel threaded rods must comply with ASTM F593 or ISO 3506 A4. Threaded steel rods must be straight and free of indentations or other defects along their length. The ends may be stamped with identifying marks and the embedded end may be blunt cut or cut on the bias to a chisel point.

3.2.5.3 Steel Reinforcing Bars for use in Post-Installed Anchor Applications: Steel reinforcing bars are deformed bars as described in Table 4 of this report. Tables 11A, 17, and 23 and Figure 1 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust, mud, oil and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation except as set forth in ACI 318-19 Section 26.6.3.2(b) ACI 318-14 Section

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26.6.3.1(b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.5.4 Hilti HIS-N and HIS-RN Inserts: Hilti HIS-N and HIS-RN inserts have a profile on the external surface and are internally threaded. Mechanical properties for Hilti HIS-N and HIS-RN inserts are provided in Table 5. The inserts are available in diameters and lengths as shown in Table 27 and Figure 1. Hilti HIS-N inserts are produced from carbon steel and furnished with a 0.005-millimeter-thick (5 µm) zinc electroplated coating complying with ASTM B633 SC 1. The stainless-steel Hilti HIS-RN inserts are fabricated from X5CrNiMo17122 K700 steel conforming to DIN 17440. Specifications for common bolt types that may be used in conjunction with Hilti HIS-N and HIS-RN inserts are provided in Table 6. Bolt grade and material type (carbon, stainless) must be matched to the insert. Strength reduction factors, ▱, corresponding to brittle steel elements must be used for Hilti HIS-N and HIS-RN inserts.

3.2.5.5 Ductility: In accordance with ACI 318-19 and ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, in order for a steel element to be considered ductile, the tested elongation must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a tested elongation of less than 14 percent or a reduction of area of less than 30 percent, or both, are considered brittle. Values for various steel materials are provided in Tables 2, 3, and 6 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

3.2.6 Steel Reinforcing Bars for Use in Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections are deformed bars (rebar) as depicted in Figures 2 and 3. Tables 30, 31, 32, and Figure 6 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be straight, and free of mill scale, rust and other coatings that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation, except as set forth in Section 26.6.3.2(b) of ACI 318-19, Section 26.6.3.1(b) of ACI 318-14 or Section 7.3.2 of ACI 318-11, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.3 Concrete:

Normal-weight and lightweight concrete must comply with Sections 1903 and 1905 of the IBC, as applicable. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design of Post-Installed Anchors:

Refer to Table 1 for the design parameters for specific installed elements, and refer to Section 4.1.4.2 for a table to determine the applicable design bond strength or pullout strength.

4.1.1 General: The design strength of anchors under the 2021 IBC, as well as the 2021 IRC, must be determined in accordance with ACI 318-19 and this report. The design strength of anchors under the 2018 and 2015 IBC and 2018 and 2015 IRC must be determined in accordance with ACI 318-14 and this report. The design strength of anchors under the 2012 IBC, as well as the 2012 IRC must be determined in accordance with ACI 318-11 and this report.

Design parameters are based on ACI 318-19 for use with the 2021 IBC, ACI 318-14 for use with the 2018 and 2015 IBC, and ACI 318-11 for use with the 2012 IBC unless noted otherwise in Sections 4.1.1 through 4.1.11 of this report.

The strength design of anchors must comply with ACI 318-19 17.5.1.2 or ACI 318-14 17.3.1 or ACI 318-11 D.4.1 as applicable, except as required in ACI 318-19 17.10 or ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Design parameters are provided in Table 7 through Table 29. Strength reduction factors, ϕ, as given in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable must be used for load combinations calculated in accordance with Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015 and 2012 IBC or ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-19 17.6.1.2, ACI 318-14 17.4.1.2 or ACI 318-11 Section D.5.1.2, as applicable and the associated strength reduction factors, ϕ, in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 Section D.4.3, as applicable, are provided in the tables outlined in Table 1 for the anchor element types included in this report.

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4.1.3 Static Concrete Breakout Strength in Tension: The nominal concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-19 17.6.2.2, ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable using the values of $k_{c,cr}$, and $k_{c,uncr}$ as described in this report. Where analysis indicates no cracking in accordance with ACI 318-19 17.6.2.5, ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. See Table 1. For anchors in lightweight concrete, see ACI 318-19 17.2.4, ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength/Static Pullout Strength in Tension:

4.1.4.1 Static Pullout Strength In Tension: Hilti HIT-Z and HIT-Z-R Anchor Rods: The nominal static pullout strength of a single anchor in accordance with ACI 318-19 17.6.3.1 and 17.6.3.2.1, ACI 318-14 17.4.3.1 and 17.4.3.2 or ACI 318-11 D.5.3.1 and D.5.3.2, as applicable, in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, is given in Table 10. For all design cases $\Psi_{c,P}$ = 1.0.

Pullout strength values are a function of the concrete compressive strength, whether the concrete is cracked or uncracked, the drilling method (hammer drill, including Hilti hollow drill bit, diamond core drill) and installation conditions (dry or water-saturated). The resulting characteristic pullout strength must be multiplied by the associated strength reduction factor ϕ_{nn} as follows:

HILTI HIT-Z AND HIT-Z-R THREADED RODS				
DRILLING METHOD	**CONCRETE TYPE**	**PERMISSIBLE INSTALLATION CONDITIONS**	**PULLOUT STRENGTH**	**ASSOCIATED STRENGTH REDUCTION FACTOR**
Hammer-drill (or Hilti TE-CD or TE-YD Hollow Drill Bit) or Diamond Core Bit	Uncracked	Dry	$N_{p,uncr}$	ϕ_d
		Water saturated	$N_{p,uncr}$	ϕ_{ws}
	Cracked	Dry	$N_{p,cr}$	ϕ_d
		Water saturated	$N_{p,cr}$	ϕ_{ws}

Section 4.1.4.2 of this report presents a pullout strength design selection table. Strength reduction factors for determination of the bond strength are given in the tables referenced in Table 1 of this report.

4.1.4.2 Static Bond Strength in Tension: Threaded Rod, Steel Reinforcing Bars, and Hilti HIS-N and HIS-RN Inserts: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated in accordance with ACI 318-19 17.6.5, ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable. Bond strength values are a function of the concrete compressive strength, whether the concrete is cracked or uncracked, the concrete temperature range, and the installation conditions (dry or water-saturated concrete). The resulting characteristic bond strength shall be multiplied by the associated strength reduction factor ϕ_{nn} as follows:

DRILLING METHOD	**CONCRETE TYPE**	**PERMISSIBLE INSTALLATION CONDITIONS**	**BOND STRENGTH**	**ASSOCIATED STRENGTH REDUCTION FACTOR**
Hammer-drill (or Hilti TE-CD or TE-YD Hollow Drill Bit) or Diamond Core Bit with Hilti TE-YRT roughening tool	Uncracked	Dry	$\tau_{k,uncr}$	ϕ_d
		Water saturated	$\tau_{k,uncr}$	ϕ_{ws}
	Cracked	Dry	$\tau_{k,cr}$	ϕ_d
		Water saturated	$\tau_{k,cr}$	ϕ_{ws}
Hammer-drill (or Hilti TE-CD or TE-YD Hollow Drill Bit)	Uncracked	Water-filled	$\tau_{k,uncr}$	ϕ_{wf}
	Cracked		$\tau_{k,cr}$	ϕ_{wf}

Strength reduction factors for determination of the bond strength are outlined in Table 1 of this report. Adjustments to the bond strength may also be made for increased concrete compressive strength as noted in the footnotes to the bond strength tables. For anchors in lightweight concrete see ACI 318-19 17.2.4, ACI 318-14 17.2.6, or ACI 318-11 D.3.6, as applicable.

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4.1.5 Static Steel Strength in Shear: The nominal static strength of a single anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-19 17.7.1.2, ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable and strength reduction factors, ϕ, in accordance with ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in the tables outlined in Table 1 for the anchor element types included in this report.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, must be calculated in accordance with ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, based on information given in the tables outlined in Table 1. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-19 17.7.2.2, ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of d given in the tables as outlined in Table 1 for the corresponding anchor steel in lieu of d_a (2021, 2018, 2015, and 2012 IBC). In addition, h_{ef} must be substituted for ℓ_e. In no case must ℓ_e exceed $8d$. The value of f'_c must be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-19 17.3.1, ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.7 Static Concrete Pryout Strength in Shear: The nominal static pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, must be calculated in accordance with ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

4.1.8 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-19 17.8, ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Minimum Member Thickness, h_{min}, Anchor Spacing, s_{min} and Edge Distance, c_{min}:

4.1.9.1 Hilti HIT-Z and HIT-Z-R Anchor Rods: In lieu of ACI 318-19 17.9.2, ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of s_{min} and c_{min} described in Table 9 of this report must be observed for anchor design and installation. The minimum member thicknesses, h_{min}, given in Table 9 of this report must be observed for anchor design and installation.

4.1.9.2 Threaded Rod, Steel Reinforcing Bars, and Hilti HIS-N and HIS-RN Inserts: In lieu of ACI 318-19 17.9.2, ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of c_{min} and s_{min} described in this report must be observed for anchor design and installation. Likewise, in lieu of ACI 318-19 17.9.4, ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, the minimum member thicknesses, h_{min}, described in this report must be observed for anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-19 17.9.3, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable, applies.

For edge distances c_{ai} and anchor spacing s_{ai}, the maximum torque T_{max} shall comply with the following requirements:

REDUCED MAXIMUM INSTALLATION TORQUE $T_{max,red}$ FOR EDGE DISTANCES c_{ai} < (5 x d_a)		
EDGE DISTANCE, c_{ai}	**MINIMUM ANCHOR SPACING, s_{ai}**	**MAXIMUM TORQUE, $T_{max,red}$**
1.75 in. (45 mm) ≤ c_{ai} < 5 x d_a	5 x d_a ≤ s_{ai} < 16 in.	0.3 x T_{max}
	s_{ai} ≥ 16 in. (406 mm)	0.5 x T_{max}

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$:

4.1.10.1 Hilti HIT-Z and HIT-Z-R Anchor Rods: In lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, for the calculation of N_{cb} and N_{cbg} in accordance with ACI 318-19 17.6.2.6.1, ACI 318-14 17.4.2.7 or ACI 318-11 D.5.2.7, as applicable and Section 4.1.3 of this report, the critical edge distance, c_{ac}, must be determined as follows:

i. $c_{ac} = 1.5.h_{ef}$ *for* $h/h_{ef} \geq 2.35$

ii. $c_{ac} = 3.5.h_{ef}$ *for* $h/h_{ef} \leq 1.35$

For definitions of h and h_{ef}, see Figure 1.

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Linear interpolation is permitted to determine the ratio of c_{ac}/h_{ef} for values of h/h_{ef} between 2.35 and 1.35 as illustrated in the graph above.

4.1.10.2 Threaded Rod, Steel Reinforcing Bars, and Hilti HIS-N and HIS-RN Inserts: The modification factor $\psi_{cp,Na}$, must be determined in accordance with ACI 318-19 17.6.5.5, ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

For all cases where $c_{Na}/c_{ac}<1.0$, $\psi_{cp,Na}$ determined from ACI 318-19 Eq. 17.6.5.5.1b, ACI 318-14 Eq. 17.4.5.5b or ACI 318-11 Eq. D-27, as applicable, need not be taken less than c_{Na}/c_{ac}. For all other cases, $\psi_{cp,Na}$ shall be taken as 1.0.

The critical edge distance, c_{ac} must be calculated according Eq. 17.6.5.5.1c for ACI 318-19, to Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-19 17.9.5, ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

$$c_{ac}=h_{ef}\cdot\left(\frac{\tau_{k,uncr}}{1160}\right)^{0.4}\cdot\left[3.1-0.7\frac{h}{h_{ef}}\right]$$

(Eq. 17.6.5.5.1c for ACI 318-19, Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11)

where

$\left[\frac{h}{h_{ef}}\right]$ need not be taken as larger than 2.4; and

$\tau_{k,uncr}$ is the characteristic bond strength in uncracked concrete, h is the member thickness, and h_{ef} is the embedment depth.

$\tau_{k,uncr}$ need not be taken as greater than:

$$\tau_{k,uncr}=\frac{k_{uncr}\sqrt{h_{ef}f'_c}}{\pi\cdot d} \qquad \text{Eq. (4-1)}$$

4.1.11 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchors must be designed in accordance with ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, except as described below:

Modifications to ACI 318-19 17.10 and ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2021, 2018 and 2015 IBC, as applicable. For the 2012 IBC, Section 19.5.1.9 shall be omitted. The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in the tables summarized in Table 1 for the anchor element types included in this report. For tension, the nominal pullout strength $N_{p,cr}$ or bond strength τ_{cr} must be adjusted by $\alpha_{N,seis}$. See Tables 10, 13, 14, 15, 16, 19, 20, 21, 22, 25, 26 and 29.

As an exception to ACI 318-11 D.3.3.4.2:

Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy ACI 318-11 D.3.3.4.3(d). Under ACI 318-11 D.3.3.4.3(d), in lieu of requiring the anchor design tensile strength to satisfy the tensile strength requirements of ACI 318-11 D.4.1.1, the anchor design tensile strength shall be calculated from ACI 318-11 D.3.3.4.4.

The following exceptions apply to ACI 318-11 D.3.3.5.2:

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or non-bearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3 need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:
   - 1.1. The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.
   - 1.2. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).
   - 1.3. Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).
   - 1.4. Anchor bolts are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.
   - 1.5. Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.
   - 1.6. The sill plate is 2-inch or 3-inch nominal thickness.
2. For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or non-bearing walls of light-frame construction to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3, need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

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2.1. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

2.2. Anchors are embedded into concrete a minimum of 7 inches (178 mm).

2.3. Anchors are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the track.

2.4. Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.

2.5. The track is 33 to 68 mil designation thickness.

Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.3. In light-frame construction, bearing or nonbearing walls, shear strength of concrete anchors less than or equal to 1 inch [25 mm] in diameter attaching a sill plate or track to foundation or foundation stem wall need not satisfy ACI 318-11 D.3.3.5.3(a) through (c) when the design strength of the anchors is determined in accordance with ACI 318-11 D.6.2.1(c).

4.2 Strength Design of Post-Installed Reinforcing Bars:

4.2.1 General: The design of straight post-installed deformed reinforcing bars must be determined in accordance with ACI 318 rules for cast-in place reinforcing bar development and splices and this report.

Examples of typical applications for the use of post-installed reinforcing bars are illustrated in Figure 3 of this report.

4.2.2 Determination of bar development length l_d: Values of l_d must be determined in accordance with the ACI 318 development and splice length requirements for straight cast-in place reinforcing bars.

Exceptions:

1. *For uncoated and zinc-coated (galvanized) post-installed reinforcing bars, the factor Ψ_e shall be taken as 1.0. For all other cases, the requirements in* ACI 318-19 25.4.2.5, *ACI 318-14 25.4.2.4 or ACI 318-11 Section 12.2.4 (b) shall apply.*
2. *When using alternate methods to calculate the development length (e.g., anchor theory), the applicable factors for post-installed anchors generally apply.*

4.2.3 Minimum Member Thickness, h_{min}, Minimum Concrete Cover, $c_{c,min}$, Minimum Concrete Edge Distance, $c_{b,min}$, Minimum Spacing, $s_{b,min}$,: For post-installed reinforcing bars, there is no limit on the minimum member thickness. In general, all requirements on concrete cover and spacing applicable to straight cast-in bars designed in accordance with ACI 318 shall be maintained.

For post-installed reinforcing bars installed at embedment depths, h_{ef}, larger than 20d (h_{ef} > 20d), the minimum concrete cover shall be as follows:

REBAR SIZE	MINIMUM CONCRETE COVER, $c_{c,min}$
$d_b \leq$ No. 6 (16mm)	$1^3/_{16}$ in.(30mm)
No. 6 < $d_b \leq$ No.10 (16mm < $d_b \leq$ 32mm)	$1^9/_{16}$ in. (40mm)

The following requirements apply for minimum concrete edge and spacing for h_{ef} > 20d:

Required minimum edge distance for post-installed reinforcing bars (measured from the center of the bar):

$cb,min = d0/2 + cc,min$

Required minimum center-to-center spacing between post-installed bars:

$s_{b,min} = d_0 + c_{c,min}$

Required minimum center-to-center spacing from existing (parallel) reinforcing:

$s_{b,min} = d_b/2$ *(existing reinforcing)* $+ d_0/2 + c_{c,min}$

4.2.4 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Category C, D, E or F under the IBC or IRC, design of straight post-installed reinforcing bars must take into account the provisions of ACI 318-19 or ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable.

4.3 Installation:

Installation parameters are illustrated in Figure 1. Installation must be in accordance with ACI 318-19 26.7.2, ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2, as applicable. Anchor and post-installed reinforcing bar locations must comply with this report and the plans and specifications approved by the code official. Installation of the Hilti HIT-HY 200 V3 Adhesive Anchor and Post-Installed Reinforcing Bar Systems must conform to the manufacturer's printed installation instructions (MPII) included in each unit package as

provided in Figure 6 of this report. The MPII contains additional requirements for combinations of drill hole depth, diameter, drill bit type, and dispensing tools.

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2021, 2018, 2015 and 2012 IBC, and this report. The special inspector must be on the jobsite initially during anchor or post-installed reinforcing bar installation to verify anchor or post-installed reinforcing bar type and dimensions, concrete type, concrete compressive strength, adhesive identification and expiration date, hole dimensions, hole cleaning procedures, spacing, edge distances, concrete thickness, anchor or post-installed reinforcing bar embedment, tightening torque and adherence to the manufacturer's printed installation instructions.

The special inspector must verify the initial installations of each type and size of adhesive anchor or post-installed reinforcing bar by construction personnel on site. Subsequent installations of the same anchor or post-installed reinforcing bar type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor or post-installed reinforcing bar product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

Continuous special inspection of adhesive anchors or post-installed reinforcing bar installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed in accordance with ACI 318-19 26.13.3.2e and 26.7.1(j), ACI 318-14 17.8.2.4, 26.7.1(h), and 26.13.3.2(c) or ACI 318-11 D.9.2.4, as applicable.

Under the IBC, additional requirements as set forth in Sections 1705, 1706, and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE:

The Hilti HIT-HY 200 V3 Adhesive Anchor System and Post-Installed Reinforcing Bar System described in this report complies with, or is a suitable alternative to what is specified in, the codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 Hilti HIT-HY 200 V3 Adhesive anchors and post-installed reinforcing bars must be installed in accordance with the manufacturer's printed installation instructions (MPII) as included in the adhesive packaging and provided in Figure 6 of this report.

5.2 The anchors and post-installed reinforcing bars must be installed in cracked and uncracked normal-weight or lightweight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.3 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.1 MPa) except as noted in Sections 4.2.2 and 4.2.4 of this report.

5.4 The concrete shall have attained its minimum design strength prior to installation of the adhesive anchors.

5.5 Anchors and post-installed reinforcing bars must be installed in concrete base materials in holes predrilled in accordance with the instructions in Figure 6, using carbide-tipped masonry drill bits manufactured with the range of maximum and minimum drill-tip dimensions specified in ANSI B212.15-1994. The Hilti HIT-Z(-R) anchor rods may be installed in holes predrilled using diamond core drill bits. Threaded rods, reinforcing bars, and the Hilti HIS-(R)N inserts may be installed in holes predrilled using diamond core bits and roughened with the Hilti TE-YRT roughening tool as detailed in Figure 6.

5.6 Loads applied to the anchors must be adjusted in accordance with Section 1605.1 of the 2021 IBC or Section 1605.2 of the 2018, 2015 and 2012 IBC for strength design and in accordance with Section 1605.1 of the 2021 IBC or Section 1605.3 of the 2018, 2015, and 2012 IBC for allowable stress design.

5.7 Hilti HIT-HY 200 V3 adhesive anchors and post-installed reinforcing bars are recognized for use to resist short- and long-term loads, including wind and earthquake, subject to the conditions of this report.

5.8 In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchor strength must be adjusted in accordance in accordance with Section 4.1.11 of this report, and post-installed reinforcing bars must comply with section 4.2.4 of this report.

5.9 Hilti HIT-HY 200 V3 adhesive anchors and post-installed reinforcing bars are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

5.10 Anchor strength design values must be established in accordance with Section 4.1 of this report.

5.11 Post-installed reinforcing bar development and splice length is established in accordance with Section 4.2 of this report.

5.12 Minimum anchor spacing and edge distance as well as minimum member thickness must comply with the values noted in this report.

5.13 Post-installed reinforcing bar spacing, minimum member thickness, and cover distance must be in accordance with the provisions of ACI 318 for cast-in place bars and section 4.2.3 of this report.

5.14 Prior to anchor installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.15 Anchors and post-installed reinforcing bars are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, Hilti HIT-HY 200 V3 adhesive anchors and post-installed reinforcing bars are permitted for installation in fire-resistive construction provided that at least one of the following conditions is fulfilled:

- Anchors and post-installed reinforcing bars are used to resist wind or seismic forces only.
- Anchors and post-installed reinforcing bars that support gravity load–bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors and post-installed reinforcing bars are used to support nonstructural elements.

5.16 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors and post-installed reinforcing bars subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.17 Use of zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.

5.18 Use of hot-dipped galvanized carbon steel and stainless steel rods is permitted for exterior exposure or damp environments.

5.19 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood must be of zinc-coated carbon steel or stainless steel. The minimum coating weights for zinc-coated steel must comply with ASTM A153.

5.20 Periodic special inspection must be provided in accordance with Section 4.4 of this report. Continuous special inspection for anchors and post-installed reinforcing bars installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.

5.21 Installation of anchors and post-installed reinforcing bars in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with ACI 318-19 26.7.2(e), ACI 318-14 17.8.2.2 or 17.8.2.3, or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.22 Hilti HIT-HY 200 V3 adhesive anchors and post-installed reinforcing bars may be used to resist tension and shear forces in floor, wall, and overhead installations only if installation is into concrete with a temperature between 14°F and 104°F (-10°C and 40°C) for threaded rods, rebar, and Hilti HIS-(R)N inserts, or between 41°F and 104°F (5°C and 40°C) for Hilti HIT-Z(-R) anchor rods. (For post-installed reinforcing bars with embedment depth greater than 20d refer to additional temperature limitations in the MPII as provided in Figure 6 of this report). Overhead installations for hole diameters larger than $^{7}/_{16}$-inch or 10mm require the use of piston plugs (HIT-SZ, -IP) during injection to the back of the hole. $^{7}/_{16}$-inch diameter holes may be injected directly to the back of the hole with the use of extension tubing on the end of the nozzle. The anchor or post-installed reinforcing bars must be supported until fully cured (i.e., with Hilti HIT-OHW wedges, or other suitable means). Where temporary restraint devices are used, their use shall not result in impairment of the anchor shear resistance. Installations in concrete temperatures below 32°F require the adhesive to be conditioned to a minimum temperature of 32°F.

5.23 Anchors and post-installed reinforcing bars when installed at temperatures below 40°F shall not be used for applications where the concrete temperature can rise from 40°F or less to 80°F or higher within a 12-hour period. Such applications may include, but are not limited to, anchorage of building façade systems and other applications subject to direct sun exposure.

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5.24 Hilti HIT-HY 200-A V3 and Hilti HIT-HY 200-R V3 adhesives are manufactured by Hilti GmbH, Kaufering, Germany, under a quality control program with inspections by ICC-ES.

5.25 Hilti HIT-Z and HIT-Z-R rods are manufactured by Hilti AG, Schaan, Liechtenstein, under a quality-control program with inspections by ICC-ES.

5.26 Hilti HIS-N and HIS-RN inserts are manufactured by Hilti (China) Ltd., Guangdong, China, under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements (AC308), dated February 2023, which incorporates requirements in ACI 355.4-11, and Table 3.8 for evaluating post-installed reinforcing bars.

7.0 IDENTIFICATION

7.1 Product labeling shall include, the name of the report holder or listee, and the ICC-ES mark of conformity. The listing or evaluation report number (ICC-ES ESR-4868) may be used in lieu of the mark of conformity. Hilti HIT-HY 200 A V3 and Hilti HIT HY 200 R V3 adhesive is identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, product name, lot number, expiration date, and evaluation report number (ESR-4868).

7.2 Hilti HIT-Z and HIT-Z-R rods are identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, anchor name, and evaluation report number (ESR-4868).

7.3 Hilti HIS-N and HIS-RN inserts are identified by packaging labeled with the manufacturer's name (Hilti Corp.) and address, anchor name and size, and evaluation report number (ESR-4868).

7.4 Threaded rods, nuts, washers, bolts, cap screws, and deformed reinforcing bars are standard elements and must conform to applicable national or international specifications.

7.5 The report holder's contact information is the following:

HILTI, INC.
7250 DALLAS PARKWAY, SUITE 1000
PLANO, TEXAS 75024
(800) 879-8000
www.hilti.com
HiltiTechEng@us.hilti.com

HILTI HIT-Z AND HIT-Z-R ANCHOR ROD

FRACTIONAL HIT-Z AND HIT-Z-R ANCHOR ROD

Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	T_{inst} [ft-lb]		T_{inst} [Nm]	
			HIT-Z	HIT-Z-R	HIT-Z	HIT-Z-R
3/8	7/16	2 3/8 ... 4 1/2	15	30	20	40
1/2	9/16	2 3/4 ... 6	30	65	40	90
5/8	3/4	3 3/4 ... 7 1/2	60	125	80	170
3/4	7/8	4 ... 8 1/2	110	165	150	220

METRIC HIT-Z AND HIT-Z-R ANCHOR ROD

Ø d [mm]	Ø d_0 [mm]	h_{nom} [mm]	T_{inst} [Nm]	
			HIT-Z	HIT-Z-R
M10	12	60...120	25	55
M12	14	70...144	40	75
M16	18	96...192	80	155
M20	22	100...220	150	215

Name and Size	ℓ Anchor Length		ℓ_{helix} Helix Length		Smooth Shank Length		Total Thread Length		Usable Thread Length	
	in	(mm)	in	(mm)	in	(mm)	In	(mm)	in	(mm)
HIT-Z(-R) 3/8"x3 3/8"	3 3/8	(85)	2 1/4	(57)	3/8	(6)	13/16	(21)	5/16	(8)
HIT-Z(-R) 3/8" x 4 3/8"	4 3/8	(111)	2 1/4	(57)	5/16	(8)	1 13/16	(46)	1 5/16	(33)
HIT-Z(-R) 3/8" x 5 1/8"	5 1/8	(130)	2 1/4	(57)	5/16	(8)	2 9/16	(65)	2 1/16	(52)
HIT-Z(-R) 3/8" x 6 3/8"	6 3/8	(162)	2 1/4	(57)	5/16	(8)	3 13/16	(97)	3 5/16	(84)
HIT-Z(-R) 1/2" x 4 1/2"	4 1/2	(114)	2 1/2	(63)	5/16	(8)	1 11/16	(43)	1	(26)
HIT-Z(-R) 1/2" x 6 1/2"	6 1/2	(165)	2 1/2	(63)	5/16	(8)	3 11/16	(94)	3 1/16	(77)
HIT-Z(-R) 1/2" x 7 3/4"	7 3/4	(197)	2 1/2	(63)	5/16	(8)	4 15/16	(126)	4 5/16	(109)
HIT-Z(-R) 5/8" x 6"	6	(152)	3 5/8	(92)	7/16	(11)	1 15/16	(49)	1 1/8	(28)
HIT-Z(-R) 5/8" x 8"	8	(203)	3 5/8	(92)	7/16	(11)	3 15/16	(100)	3 1/8	(79)
HIT-Z(-R) 5/8" x 9 1/2"	9 1/2	(241)	3 5/8	(92)	1 15/16	(49)	3 15/16	(100)	3 1/8	(79)
HIT-Z(-R) ¾"x 6½"	6½"	(165)	4	(102)	5/16	(8)	2	(51)	1	(26)
HIT-Z(-R) 3/4" x 8 1/2"	8 1/2	(216)	4	(102)	7/16	(12)	4	(102)	3 1/16	(77)
HIT-Z(-R) 3/4" x 9 3/4"	9 3/4	(248)	4	(102)	1 11/16	(44)	4	(102)	3 1/16	(77)
HIT-Z(-R) M10x95	3 3/4	(95)	1 15/16	(50)	11/16	(18)	1 1/8	(27)	9/16	(14)
HIT-Z(-R) M10x115	4 1/2	(115)	1 15/16	(50)	11/16	(18)	1 7/8	(47)	1 5/16	(34)
HIT-Z(-R) M10x135	5 5/16	(135)	1 15/16	(50)	11/16	(18)	2 5/8	(67)	2 1/8	(54)
HIT-Z(-R) M10x160	6 5/16	(160)	1 15/16	(50)	11/16	(18)	3 5/8	(92)	3 1/8	(79)
HIT-Z(-R) M12x105	4 1/8	(105)	2 3/8	(60)	5/16	(8)	1 1/2	(37)	13/16	(21)
HIT-Z(-R) M12x140	5 1/2	(140)	2 3/8	(60)	5/16	(8)	2 7/8	(72)	2 3/16	(56)
HIT-Z(-R) M12x155	6 1/8	(155)	2 3/8	(60)	5/16	(8)	3 3/8	(87)	2 13/16	(71)
HIT-Z(-R) M12x196	7 3/4	(196)	2 3/8	(60)	5/16	(8)	5	(128)	4 7/16	(112)
HIT-Z(-R) M16x155	6 1/8	(155)	3 11/16	(93)	7/16	(11)	2	(51)	1 3/16	(30)
HIT-Z(-R) M16x175	6 7/8	(175)	3 11/16	(93)	7/16	(11)	2 13/16	(71)	1 15/16	(50)
HIT-Z(-R) M16x205	8 1/16	(205)	3 11/16	(93)	7/16	(11)	4	(101)	3 1/8	(80)
HIT-Z(-R) M16x240	9 7/16	(240)	3 11/16	(93)	1 1/4	(32)	4 1/2	(115)	3 11/16	(94)
HIT-Z(-R) M20x215	8 1/2	(215)	3 15/16	(100)	1/2	(13)	4	(102)	3 1/16	(78)
HIT-Z(-R) M20x250	9 13/16	(250)	3 15/16	(100)	1 7/8	(48)	4	(102)	3 1/16	(78)

FIGURE 1—INSTALLATION PARAMETERS FOR POST-INSTALLED ADHESIVE ANCHORS

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DEFORMED REINFORCMENT

US REBAR

d	Ø d_0 [inch]	$h_{ef\ std}$ [inch]	h_{ef} [inch]
#3	½	3⅜	2⅜...7½
#4	⅝	4½	2¾...10
#5	¾	5⅝	3⅛...12½
#6	⅞	6¾	3½...15
#7	1	7⅞	3½...17½
#8	1⅛	9	4...20
#9	1⅜	10⅛	4½...22½
#10	1½	11¼	5...25

CANADIAN REBAR

d	Ø d_0 [inch]	$h_{ef\ std}$ [mm]	h_{ef} [mm]
10 M	9/16	115	70...226
15 M	¾	145	80...320
20 M	1	200	90...390
25 M	1¼	230	101...504
30 M	1½	260	120...598

EUROPEAN REBAR

Ø d [mm]	Ø d_0 [mm]	$h_{ef\ std}$ [mm]	h_{ef} [mm]
10	14	90	60...200
12	16	110	70...240
14	18	125	75...280
16	20	125	80...320
20	25	170	90...400
25	32	210	100...500
28	35	270	112...560
32	40	300	128...640

THREADED ROD

FRACTIONAL THREADED ROD

Ø d [inch]	Ø d_0 [inch]	$h_{ef\ std}$ [inch]	h_{ef} [inch]	T_{max} [ft-lb]	T_{max} [Nm]
⅜	7/16	3⅜	2⅜...7½	15	20
½	9/16	4½	2¾...10	30	41
⅝	¾	5⅝	3⅛...12½	60	81
¾	⅞	6¾	3½...15	100	136
⅞	1	7⅞	3½...17½	125	169
1	1⅛	9	4...20	150	203
1¼	1⅜	11¼	5...25	200	271

METRIC THREADED ROD

Ø d [mm]	Ø d_0 [mm]	$h_{ef\ std}$ [mm]	h_{ef} [mm]	T_{max} [Nm]
M10	12	90	60...200	20
M12	14	110	70...240	40
M16	18	125	80...320	80
M20	22	170	90...400	150
M24	28	210	96...480	200
M27	30	240	108...540	270
M30	35	270	120...600	300

HILTI HIS-N AND HIS-RN THREADED INSERTS

FRACTIONAL HILTI HIS-N AND HIS-RN THREADED INSERTS

Ø d [inch]	Ø d_0 [inch]	h_{ef} [inch]	Ø d_f [inch]	h_s [inch]	T_{max} [ft-lb]	T_{max} [Nm]
⅜	11/16	4⅜	7/16	⅜...15/16	15	20
½	⅞	5	9/16	½...1 3/16	30	41
⅝	1⅛	6¾	11/16	⅝...1½	60	81
¾	1¼	8⅛	13/16	¾...1⅞	100	136

METRIC HILTI HIS-N AND HIS-RN THREADED INSERTS

Ø d [mm]	Ø d_0 [mm]	h_{ef} [mm]	Ø d_f [mm]	h_s [mm]	T_{max} [Nm]
M8	14	90	9	8...20	10
M10	18	110	12	10...25	20
M12	22	125	14	12...30	40
M16	28	170	18	16...40	80
M20	32	205	22	20...50	150

FIGURE 1—INSTALLATION PARAMETERS FOR POST INSTALLED ADHESIVE ANCHORS (Continued)

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FIGURE 2—INSTALLATION PARAMATERS FOR POST-INSTALLED REINFORCING BARS

FIGURE 3—APPLICATION EXAMPLES FOR POST-INSTALLED REINFORCING BARS: (A) TENSION LAP SPLICE WITH EXISTING FLEXURAL REINFORCEMENT; (B) TENSION DEVELOPMENT OF COLUMN DOWELS; (C) DEVELOPMENT OF SHEAR DOWELS FOR NEWLY THICKENED SHEAR WALL

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TABLE 1—DESIGN TABLE INDEX

Design Table		Fractional		Metric	
		Table	Page	Table	Page
Hilti HIT-Z and HIT-Z-R Anchor Rod	Steel Strength - N_{sa}, V_{sa}	7	14	7	14
	Concrete Breakout - N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	8	15	8	15
	Pullout Strength – N_p	10	19	10	19
Standard Threaded Rod	Steel Strength - N_{sa}, V_{sa}	11	20	17	27
	Concrete Breakout - N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	12	22	18	28
	Bond Strength - N_a, N_{ag}	15 & 16	25 & 26	21 & 22	31 & 32
Hilti HIS-N and HIS-RN Internally Threaded Insert	Steel Strength - N_{sa}, V_{sa}	27	36	27	36
	Concrete Breakout - N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	28	37	28	37
	Bond Strength - N_a, N_{ag}	29	38	29	38

Design Table		Fractional		EU Metric		Canadian	
		Table	Page	Table	Page	Table	Page
Steel Reinforcing Bars	Steel Strength – N_{sa}, V_{sa}	11A	21	17	27	23	33
	Concrete Breakout – N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	12	22	18	28	24	33
	Bond Strength – N_a, N_{ag}	13 & 14	23& 24	19 & 20	29 & 30	25 & 26	34 & 35
	Determination of development length for post-installed reinforcing bar connections	30	39	31	40	32	40

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF FRACTIONAL AND METRIC HIT-Z AND HIT-Z RODS

HIT-Z AND HIT-Z-R ROD SPECIFICATION			Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength 0.2 percent offset, f_{ya}	f_{uta}/f_{ya}	Elongation, min. percent	Reduction of Area, min. percent	Specification for nuts[2]
CARBON STEEL	3/8-in. to 5/8-in. and M10 to M12 - AISI 1038 3/4-in. - AISI 1038 or 18MnV5	psi (MPa)	94,200 (650)	75,300 (520)	1.25	8	20	ASTM A563 Grade A
CARBON STEEL	M16 - AISI 1038	psi (MPa)	88,400 (610)	71,000 (490)	1.25	8	20	ASTM A563 Grade A
CARBON STEEL	M20 - AISI 1038 or 18MnV5	psi (MPa)	86,200 (595)	69,600 (480)	1.25	8	20	ASTM A563 Grade A
STAINLESS STEEL	3/8-in. to 3/4-in. and M10 to M12 Grade 316 DIN-EN 10263-5 X5CrNiMo 17-12-2+AT	psi (MPa)	94,200 (650)	75,300 (520)	1.25	8	20	ASTM F594 Type 316
STAINLESS STEEL	M16 Grade 316 DIN-EN 10263-5 X5CrNiMo 17-12-2+AT	psi (MPa)	88,400 (610)	71,000 (490)	1.25	8	20	ASTM F594 Type 316
STAINLESS STEEL	M20 Grade 316 DIN-EN 10263-5 X5CrNiMo 17-12-2+AT	psi (MPa)	86,200 (595)	69,600 (480)	1.25	8	20	ASTM F594 Type 316

[1] Steel properties are minimum values and maximum values will vary due to the cold forming of the rod.

[2] Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.

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TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON AND STAINLESS STEEL THREADED ROD MATERIALS[1]

	THREADED ROD SPECIFICATION		Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength 0.2 percent offset, f_{ya}	f_{uta}/f_{ya}	Elongation, min. percent[7]	Reduction of Area, min. percent	Specification for nuts[8]
CARBON STEEL	ASTM A193[2] Grade B7 ≤ 2½ in. (≤ 64 mm)	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A563 Grade DH
CARBON STEEL	ASTM F568M[3] Class 5.8 M5 (¼ in.) to M24 (1 in.) (equivalent to ISO 898-1)	psi (MPa)	72,500 (500)	58,000 (400)	1.25	10	35	ASTM A563 Grade DH[9] DIN 934 (8-A2K)
CARBON STEEL	ASTM F1554, Grade 36[7]	psi (MPa)	58,000 (400)	36,000 (248)	1.61	23	40	ASTM A194 or ASTM A563
CARBON STEEL	ASTM F1554, Grade 55[7]	psi (MPa)	75,000 (517)	55,000 (379)	1.36	21	30	ASTM A194 or ASTM A563
CARBON STEEL	ASTM F1554, Grade 105[7]	psi (MPa)	125,000 (862)	105,000 (724)	1.19	15	45	ASTM A194 or ASTM A563
CARBON STEEL	ISO 898-1[4] Class 5.8	MPa (psi)	500 (72,500)	400 (58,000)	1.25	22	-	DIN 934 Grade 6
CARBON STEEL	ISO 898-1[4] Class 8.8	MPa (psi)	800 (116,000)	640 (92,800)	1.25	12	52	DIN 934 Grade 8
STAINLESS STEEL	ASTM F593[5] CW1 (316) ¼-in. to ⅝-in.	psi (MPa)	100,000 (689)	65,000 (448)	1.54	20	-	ASTM F594
STAINLESS STEEL	ASTM F593[5] CW2 (316) ¾-in. to 1½-in.	psi (MPa)	85,000 (586)	45,000 (310)	1.89	25	-	ASTM F594
STAINLESS STEEL	ASTM A193 Grade 8(M), Class 1[2] - 1 ¼-in.	psi (MPa)	75,000 (517)	30,000 (207)	2.50	30	50	ASTM F594
STAINLESS STEEL	ISO 3506-1[6] A4-70 M8 – M24	MPa (psi)	700 (101,500)	450 (65,250)	1.56	40	-	ISO 4032
STAINLESS STEEL	ISO 3506-1[6] A4-50 M27 – M30	MPa (psi)	500 (72,500)	210 (30,450)	2.38	40	-	ISO 4032

[1] Hilti HIT-HY 200 V3 adhesive may be used in conjunction with all grades of continuously threaded carbon or stainless steel rod (all-thread) that comply with the code reference standards and that have thread characteristics comparable with ANSI B1.1 UNC Coarse Thread Series or ANSI B1.13M M Profile Metric Thread Series. Values for threaded rod types and associated nuts supplied by Hilti are provided here.
[2] *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service*
[3] *Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners*
[4] *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs*
[5] *Standard Steel Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs*
[6] *Mechanical properties of corrosion-resistant stainless steel fasteners – Part 1: Bolts, screws and studs*
[7] Based on 2-in. (50 mm) gauge length except for A 193, which are based on a gauge length of 4d and ISO 898, which is based on 5d.
[8] Nuts of other grades and styles having specified proof load stresses greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
[9] Nuts for fractional rods.

TABLE 4—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL REINFORCING BARS

REINFORCING BAR SPECIFICATION		Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength, f_{ya}
ASTM A615[1] Gr. 60	psi (MPa)	80,000 (550)	60,000 (414)
ASTM A615[1] Gr. 40	psi (MPa)	60,000 (414)	40,000 (276)
ASTM A706[2] Gr. 60	psi (MPa)	80,000 (550)	60,000 (414)
DIN 488[3] BSt 500	MPa (psi)	550 (79,750)	500 (72,500)
CAN/CSA-G30.18[4] Gr. 400	MPa (psi)	540 (78,300)	400 (58,000)

[1] *Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement*
[2] *Standard Specification for Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement*
[3] *Reinforcing steel; reinforcing steel bars; dimensions and masses*
[4] *Billet-Steel Bars for Concrete Reinforcement*

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TABLE 5—SPECIFICATIONS AND PHYSICAL PROPERTIES OF FRACTIONAL AND METRIC HIS-N AND HIS-RN INSERTS

HILTI HIS-N AND HIS-RN INSERTS		Minimum specified ultimate strength, f_{uta}	Minimum specified yield strength, f_{ya}
Carbon Steel DIN EN 10277-3 11SMnPb30+c or DIN 1561 9SMnPb28K $^3/_8$-in. and M8 to M10	psi	71,050	59,450
	(MPa)	(490)	(410)
Carbon Steel DIN EN 10277-3 11SMnPb30+c or DIN 1561 9SMnPb28K $^1/_2$ to $^3/_4$-in. and M12 to M20	psi	66,700	54,375
	(MPa)	(460)	(375)
Stainless Steel EN 10088-3 X5CrNiMo 17-12-2	psi	101,500	50,750
	(MPa)	(700)	(350)

TABLE 6—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON BOLTS, CAP SCREWS AND STUDS FOR USE WITH HIS-N AND HIS-RN INSERTS[1,2]

BOLT, CAP SCREW OR STUD SPECIFICATION		Minimum specified ultimate strength f_{uta}	Minimum specified yield strength 0.2 percent offset f_{ya}	f_{uta}/f_{ya}	Elongation, min.	Reduction of Area, min.	Specification for nuts[6]
SAE J429[3] Grade 5	psi	120,000	92,000	1.30	14	35	SAE J995
	(MPa)	(828)	(634)				
ASTM A325[4] $^1/_2$ to 1-in.	psi	120,000	92,000	1.30	14	35	A563 C, C3, D, DH, DH3 Heavy Hex
	(MPa)	(828)	(634)				
ASTM A193[5] Grade B8M (AISI 316) for use with HIS-RN	psi	110,000	95,000	1.16	15	45	ASTM F594[7] Alloy Group 1, 2 or 3
	(MPa)	(759)	(655)				
ASTM A193[5] Grade B8T (AISI 321) for use with HIS-RN	psi	125,000	100,000	1.25	12	35	ASTM F594[7] Alloy Group 1, 2 or 3
	(MPa)	(862)	(690)				

[1] Minimum Grade 5 bolts, cap screws or studs must be used with carbon steel HIS inserts.

[2] Only stainless steel bolts, cap screws or studs must be used with HIS-RN inserts.

[3] *Mechanical and Material Requirements for Externally Threaded Fasteners*

[4] *Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength*

[5] *Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service*

[6] Nuts must have specified minimum proof load stress equal to or greater than the specified minimum full-size tensile strength of the specified stud.

[7] Nuts for stainless steel studs must be of the same alloy group as the specified bolt, cap screw, or stud.

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Fractional and Metric HIT-Z and HIT-Z-R Anchor Rod

Steel Strength

TABLE 7—STEEL DESIGN INFORMATION FOR FRACTIONAL AND METRIC HIT-Z AND HIT-Z-R ANCHOR RODS

DESIGN INFORMATION		Symbol	Units	Nominal Rod Dia. (in.) Fractional				Units	Nominal Rod Dia. (mm) Metric			
				3/8	1/2	5/8	3/4		10	12	16	20
Rod O.D.		d	in. (mm)	0.375 (9.5)	0.5 (12.7)	0.625 (15.9)	0.75 (19.1)	mm (in.)	10 (0.39)	12 (0.47)	16 (0.63)	20 (0.79)
Rod effective cross-sectional area		A_{se}	in.^{2} (mm^2)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3340 (216)	mm^2 (in.^{2})	58.0 (0.090)	84.3 (0.131)	157.0 (0.243)	245.0 (0.380)
CARBON STEEL	Nominal strength as governed by steel strength[1]	N_{sa}	lb (kN)	7,306 (32.5)	13,377 (59.5)	21,306 (94.8)	31,472 (140.0)	kN (lb)	37.7 (8,475)	54.8 (12,318)	95.8 (21,529)	145.8 (32,770)
		V_{sa}	lb (kN)	3,215 (14.3)	5,886 (26.2)	9,375 (41.7)	13,848 (61.6)	kN (lb)	16.6 (3,729)	24.1 (5,420)	42.2 (9,476)	64.2 (14,421)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.65				-	0.65			
	Strength reduction factor for tension[2]	ϕ	-	0.65				-	0.65			
	Strength reduction factor for shear[2]	ϕ	-	0.60				-	0.60			
STAINLESS STEEL	Nominal strength as governed by steel strength[1]	N_{sa}	lb (kN)	7,306 (32.5)	13,377 (59.5)	21,306 (94.8)	31,472 (140.0)	kN (lb)	37.7 (8,475)	54.8 (12,318)	95.8 (21,529)	145.8 (32,770)
		V_{sa}	lb (kN)	4,384 (19.5)	8,026 (35.7)	12,783 (56.9)	18,883 (84.0)	kN (lb)	22.6 (5,085)	32.9 (7,391)	57.5 (12,922)	87.5 (19,666)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.79	0.75	0.65		-	0.79	0.75	0.65	
	Strength reduction factor for tension[2]	ϕ	-	0.65				-	0.65			
	Strength reduction factor for shear[2]	ϕ	-	0.60				-	0.60			

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Steel properties are minimum values and maximum values will vary due to the cold forming of the rod.
[2] For use with the load combinations of ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3.

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Fractional and Metric HIT-Z and HIT-Z-R Anchor Rod

Concrete Breakout Strength

Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit

TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT HIT-Z AND HIT-Z-R ANCHOR ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR A CORE DRILL[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Dia. (in.) Fractional				Units	Nominal Rod Dia. (mm) Metric			
			3/8	1/2	5/8	3/4		10	12	16	20
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7.1)				SI (in-lb)	7.1 (17)			
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)				SI (in-lb)	10 (24)			
Minimum embedment depth[3]	$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 3/4 (95)	4 (102)	mm (in.)	60 (2.4)	70 (2.8)	96 (3.8)	100 (3.9)
Maximum embedment depth[3]	$h_{ef,max}$	in. (mm)	4 1/2 (114)	6 (152)	7 1/2 (190)	8 1/2 (216)	mm (in.)	120 (4.7)	144 (5.7)	192 (7.6)	220 (8.7)
Min. anchor spacing	s_{min}	-	See Section 4.1.9.1 of this report. Pre-calculated combinations of anchor spacing and edge distance are given in Table 9 of this report.				-	See Section 4.1.9.1 of this report. Pre-calculated combinations of anchor spacing and edge distance are given in Table 9 of this report.			
Min. edge distance	c_{min}	-					-				
Minimum concrete thickness Hole condition 1[3]	$h_{min,1}$	in. (mm)	h_{ef} + 2 1/4 (h_{ef} + 57)		h_{ef} + 4 (h_{ef} + 102)		mm (in.)	h_{ef} + 60 (h_{ef} + 2.4)		h_{ef} + 100 (h_{ef} + 3.9)	
Minimum concrete thickness Hole condition 2[3]	$h_{min,2}$	in. (mm)	h_{ef} + 1 1/4 ≥ 4 (h_{ef} + 32 ≥ 100)		h_{ef} + 1 3/4 (h_{ef} + 45)		mm (in.)	h_{ef} + 30 ≥ 100 (h_{ef} + 1.25 ≥ 3.9)		h_{ef} + 45 (h_{ef} + 1.8)	
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10.1 of this report				-	See Section 4.1.10.1 of this report			
Strength reduction factor for tension, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.65				-	0.65			
Strength reduction factor for shear, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.70				-	0.70			

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Additional setting information is described in Figure 6, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.[3] Borehole condition is described in Figure 4 below.

FIGURE 4—BOREHOLE SETTING CONDITIONS FOR HILTI HIT-Z AND HIT-Z-R ANCHOR RODS

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TABLE 9—PRE-CALCULATED EDGE DISTANCE AND SPACING COMBINATIONS FOR HILTI HIT-Z AND HIT-Z-R RODS

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (in.) – Fractional								
Rod O.D.		d	in. (mm)	3/8 (9.5)								
Effective embedment		h_{ef}	in. (mm)	2 3/8 (60)			3 3/8 (86)			4 1/2 (114)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	in. (mm)	4 (102)	4 5/8 (117)	5 3/4 (146)	4 5/8 (117)	5 5/8 (143)	6 3/8 (162)	5 3/4 (146)	6 3/4 (171)	7 3/8 (187)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	3 1/8 (79)	2 3/4 (70)	2 1/4 (57)	2 3/4 (70)	2 1/4 (57)	2 (51)	2 1/4 (57)	1 7/8 (48)	1 7/8 (48)
		$s_{min,1}$	in. (mm)	9 1/8 (232)	7 3/4 (197)	6 1/8 (156)	7 3/4 (197)	6 1/2 (165)	5 5/8 (143)	6 1/8 (156)	5 3/8 (137)	4 1/2 (114)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	5 5/8 (143)	4 3/4 (121)	3 3/4 (95)	4 3/4 (121)	3 7/8 (98)	3 1/4 (83)	3 3/4 (95)	3 1/8 (79)	2 3/4 (70)
		$s_{min,2}$	in. (mm)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	2 1/8 (54)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)
		$s_{min,1}$	in. (mm)	6 3/8 (162)	5 1/2 (140)	4 1/4 (108)	5 1/2 (140)	3 1/2 (89)	2 5/8 (67)	3 1/4 (83)	2 (51)	1 7/8 (48)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	3 5/8 (92)	3 1/8 (79)	2 3/8 (60)	3 1/8 (79)	2 1/2 (64)	2 1/8 (54)	2 3/8 (60)	2 (51)	1 7/8 (48)
		$s_{min,2}$	in. (mm)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)	1 7/8 (48)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (in.) – Fractional								
Rod O.D.		d	in. (mm)	1/2 (12.7)								
Effective embedment		h_{ef}	in. (mm)	2-3/4 (70)			4 1/2 (114)			6 (152)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	in. (mm)	4 (102)	5 (127)	7 1/8 (181)	5 3/4 (146)	6 3/4 (171)	8 1/4 (210)	7 1/4 (184)	8 1/4 (210)	9 3/4 (248)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	5 1/8 (130)	4 1/8 (105)	2 7/8 (73)	3 5/8 (92)	3 (76)	2 1/2 (64)	2 7/8 (73)	2 1/2 (64)	2 1/2 (64)
		$s_{min,1}$	in. (mm)	14 7/8 (378)	11 7/8 (302)	8 5/8 (219)	10 1/4 (260)	9 (229)	7 1/4 (184)	8 1/8 (206)	7 1/4 (184)	5 (127)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	9 1/4 (235)	7 1/4 (184)	4 7/8 (124)	6 1/4 (159)	5 1/4 (133)	4 1/8 (105)	4 3/4 (121)	4 1/8 (105)	3 3/8 (86)
		$s_{min,2}$	in. (mm)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	3 5/8 (92)	3 (76)	2 1/2 (64)	2 5/8 (67)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)
		$s_{min,1}$	in. (mm)	10 7/8 (276)	8 1/2 (216)	6 (152)	7 3/8 (187)	5 1/2 (140)	3 1/8 (79)	4 1/2 (114)	3 1/8 (79)	2 1/2 (64)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	6 1/2 (165)	5 (127)	3 1/4 (83)	4 1/4 (108)	3 1/2 (89)	2 3/4 (70)	3 1/4 (83)	2 3/4 (70)	2 1/2 (64)
		$s_{min,2}$	in. (mm)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)	2 1/2 (64)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (in.) – Fractional								
Rod O.D.		d	in. (mm)	5/8 (15.9)								
Effective embedment		h_{ef}	in. (mm)	3 3/4 (95)			5 5/8 (143)			7 1/2 (191)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	in. (mm)	5 1/2 (140)	7 3/4 (197)	9 3/8 (238)	7 3/8 (187)	9 5/8 (244)	10 1/2 (267)	9 1/4 (235)	11 1/2 (292)	12 1/4 (311)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	6 1/4 (159)	4 1/2 (114)	3 3/4 (95)	4 5/8 (117)	3 5/8 (92)	3 1/4 (83)	3 3/4 (95)	3 1/8 (79)	3 1/8 (79)
		$s_{min,1}$	in. (mm)	18 3/8 (467)	12 7/8 (327)	10 5/8 (270)	13 7/8 (352)	10 3/8 (264)	9 3/4 (248)	10 7/8 (276)	8 3/8 (213)	7 3/8 (187)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	11 3/8 (289)	7 3/4 (197)	6 1/4 (159)	8 1/4 (210)	6 1/8 (156)	5 1/2 (140)	6 3/8 (162)	4 7/8 (124)	4 5/8 (117)
		$s_{min,2}$	in. (mm)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	4 5/8 (117)	3 3/8 (86)	3 1/8 (79)	3 1/2 (89)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)
		$s_{min,1}$	in. (mm)	13 7/8 (352)	9 1/2 (241)	8 3/4 (222)	10 1/8 (257)	6 1/2 (165)	5 3/8 (137)	7 1/8 (181)	3 7/8 (98)	3 1/8 (79)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	8 1/4 (210)	5 1/2 (140)	4 3/8 (111)	5 7/8 (149)	4 1/4 (108)	3 7/8 (98)	4 1/2 (114)	3 3/8 (86)	3 1/8 (79)
		$s_{min,2}$	in. (mm)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)	3 1/8 (79)

For **SI**: 1 inch ≡ 25.4 mm

[1] See Figure 4 for description of drilled hole condition.

[2] Linear interpolation is permitted to establish an edge distance and spacing combination between case 1 and case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacing, s, as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

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TABLE 9—PRE-CALCULATED EDGE DISTANCE AND SPACING COMBINATIONS FOR HILTI HIT-Z AND HIT-Z-R RODS (Continued)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (in.) – Fractional								
Rod O.D.		d	in. (mm)	3/4 (19.1)								
Effective embedment		h_{ef}	in. (mm)	4 (102)			6 3/4 (171)			8 1/2 (216)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	in. (mm)	5 3/4 (146)	8 (203)	11 1/2 (292)	8 1/2 (216)	10 3/4 (273)	13 1/8 (333)	10 1/4 (260)	12 1/2 (318)	14 1/2 (368)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	9 3/4 (248)	7 (178)	5 (127)	6 5/8 (168)	5 1/4 (133)	4 1/4 (108)	5 1/2 (140)	4 1/2 (114)	4 (102)
		$s_{min,1}$	in. (mm)	28 3/4 (730)	20 5/8 (524)	14 (356)	19 3/8 (492)	15 1/4 (387)	12 5/8 (321)	16 (406)	13 1/4 (337)	11 (279)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	18 1/8 (460)	12 5/8 (321)	8 1/2 (216)	11 7/8 (302)	9 1/8 (232)	7 1/4 (184)	9 5/8 (244)	7 3/4 (197)	6 1/2 (165)
		$s_{min,2}$	in. (mm)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	in. (mm)	7 1/4 (184)	5 1/4 (133)	4 1/8 (105)	5 (127)	4 (102)	3 3/4 (95)	4 1/8 (105)	3 3/4 (95)	3 3/4 (95)
		$s_{min,1}$	in. (mm)	21 3/4 (552)	15 1/2 (394)	12 1/4 (311)	14 1/2 (368)	11 3/8 (289)	9 (229)	12 1/8 (308)	8 3/4 (222)	6 1/2 (165)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	in. (mm)	13 1/4 (337)	9 1/4 (235)	6 (152)	8 5/8 (219)	6 5/8 (168)	5 1/8 (130)	7 (178)	5 1/2 (140)	4 1/2 (114)
		$s_{min,2}$	in. (mm)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)	3 3/4 (95)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (mm) – Metric								
Rod O.D.		d	mm (in.)	10 (0.39)								
Effective embedment		h_{ef}	mm (in.)	60 (2.36)			90 (3.54)			120 (4.72)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	mm (in.)	100 (3.94)	120 (4.72)	156 (6.14)	120 (4.72)	150 (5.91)	176 (6.91)	150 (5.91)	180 (7.09)	197 (7.74)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	99 (3.90)	83 (3.27)	64 (2.52)	83 (3.27)	66 (2.60)	57 (2.24)	66 (2.60)	55 (2.17)	51 (2.01)
		$s_{min,1}$	mm (in.)	295 (11.61)	244 (9.61)	187 (7.36)	244 (9.61)	197 (7.76)	166 (6.54)	197 (7.76)	164 (6.46)	148 (5.83)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	181 (7.13)	148 (5.83)	110 (4.33)	148 (5.83)	115 (4.53)	96 (3.78)	115 (4.53)	93 (3.66)	84 (3.31)
		$s_{min,2}$	mm (in.)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	71 (2.80)	59 (2.32)	52 (2.05)	59 (2.32)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)
		$s_{min,1}$	mm (in.)	209 (8.23)	174 (6.85)	150 (5.91)	174 (6.85)	131 (5.16)	106 (4.17)	131 (5.16)	84 (3.31)	66 (2.60)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	124 (4.88)	101 (3.98)	74 (2.91)	101 (3.98)	77 (3.03)	64 (2.52)	77 (3.03)	62 (2.44)	55 (2.17)
		$s_{min,2}$	mm (in.)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)	50 (1.97)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (mm) – Metric								
Rod O.D.		d	mm (in.)	12 (0.47)								
Effective embedment		h_{ef}	mm (in.)	70 (2.76)			108 (4.25)			144 (5.67)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	mm (in.)	100 (3.94)	130 (5.12)	184 (7.24)	138 (5.43)	168 (6.61)	209 (8.21)	174 (6.85)	204 (8.03)	234 (9.21)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	139 (5.47)	107 (4.21)	76 (2.99)	101 (3.98)	83 (3.27)	67 (2.64)	80 (3.15)	68 (2.68)	60 (2.36)
		$s_{min,1}$	mm (in.)	416 (16.38)	320 (12.60)	225 (8.86)	300 (11.81)	247 (9.72)	199 (7.83)	239 (9.41)	204 (8.03)	176 (6.93)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	258 (10.16)	194 (7.64)	131 (5.16)	181 (7.13)	146 (5.75)	114 (4.49)	140 (5.51)	116 (4.57)	99 (3.90)
		$s_{min,2}$	mm (in.)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	101 (3.98)	78 (3.07)	62 (2.44)	74 (2.91)	61 (2.40)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)
		$s_{min,1}$	mm (in.)	303 (11.93)	232 (9.13)	186 (7.32)	217 (8.54)	178 (7.01)	126 (4.96)	168 (6.61)	117 (4.61)	79 (3.11)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	182 (7.17)	136 (5.35)	90 (3.54)	127 (5.00)	101 (3.98)	77 (3.03)	96 (3.78)	79 (3.11)	67 (2.64)
		$s_{min,2}$	mm (in.)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)	60 (2.36)

For **SI**: 1 inch ≡ 25.4 mm

[1] See Figure 4 for description of drilled hole condition.

[2] Linear interpolation is permitted to establish an edge distance and spacing combination between case 1 and case 2.
Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacing, s, as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

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TABLE 9—PRE-CALCULATED EDGE DISTANCE AND SPACING COMBINATIONS FOR HILTI HIT-Z AND HIT-Z-R RODS (Continued)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (mm) – Metric								
Rod O.D.		d	mm (in.)	16 (0.63)								
Effective embedment		h_{ef}	mm (in.)	96 (3.78)			144 (5.67)			192 (7.56)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	mm (in.)	141 (5.55)	196 (7.72)	237 (9.33)	189 (7.44)	244 (9.61)	269 (10.57)	237 (9.33)	292 (11.50)	312 (12.28)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	158 (6.22)	114 (4.49)	94 (3.70)	118 (4.65)	92 (3.62)	83 (3.27)	94 (3.70)	80 (3.15)	80 (3.15)
		$s_{min,1}$	mm (in.)	473 (18.62)	339 (13.35)	281 (11.06)	352 (13.86)	271 (10.67)	248 (9.76)	281 (11.06)	217 (8.54)	188 (7.40)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	289 (11.38)	201 (7.91)	161 (6.34)	209 (8.23)	156 (6.14)	139 (5.47)	161 (6.34)	126 (4.96)	116 (4.57)
		$s_{min,2}$	mm (in.)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	116 (4.57)	83 (3.27)	80 (3.15)	86 (3.39)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)
		$s_{min,1}$	mm (in.)	343 (13.50)	248 (9.76)	211 (8.31)	258 (10.16)	160 (6.30)	129 (5.08)	171 (6.73)	94 (3.70)	81 (3.19)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	204 (8.03)	139 (5.47)	111 (4.37)	146 (5.75)	107 (4.21)	95 (3.74)	111 (4.37)	85 (3.35)	80 (3.15)
		$s_{min,2}$	mm (in.)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)	80 (3.15)

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (mm) – Metric								
Rod O.D.		d	mm (in.)	20 (0.79)								
Effective embedment		h_{ef}	mm (in.)	100 (3.94)			180 (7.09)			220 (8.66)		
Drilled hole condition[1]		-	-	2	1 or 2		2	1 or 2		2	1 or 2	
Minimum concrete thickness		h	mm (in.)	145 (5.71)	200 (7.87)	282 (11.08)	225 (8.86)	280 (11.02)	335 (13.17)	265 (10.43)	320 (12.60)	370 (14.57)
UNCRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	235 (9.25)	170 (6.69)	121 (4.76)	152 (5.98)	122 (4.80)	103 (4.06)	129 (5.08)	107 (4.21)	100 (3.94)
		$s_{min,1}$	mm (in.)	702 (27.64)	511 (20.12)	362 (14.25)	451 (17.76)	363 (14.29)	301 (11.85)	383 (15.08)	317 (12.48)	252 (9.92)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	436 (17.17)	307 (12.09)	209 (8.23)	269 (10.59)	210 (8.27)	170 (6.69)	224 (8.82)	180 (7.09)	151 (5.94)
		$s_{min,2}$	mm (in.)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)
CRACKED CONCRETE	Minimum edge and spacing Case 1 [2]	$c_{min,1}$	mm (in.)	176 (6.93)	128 (5.04)	102 (4.02)	114 (4.49)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)
		$s_{min,1}$	mm (in.)	526 (20.71)	380 (14.96)	298 (11.73)	337 (13.27)	246 (9.69)	163 (6.42)	277 (10.91)	178 (7.01)	113 (4.45)
	Minimum edge and spacing Case 2 [2]	$c_{min,2}$	mm (in.)	318 (12.52)	222 (8.74)	148 (5.83)	193 (7.60)	149 (5.87)	119 (4.69)	159 (6.26)	126 (4.96)	105 (4.13)
		$s_{min,2}$	mm (in.)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)	100 (3.94)

For **SI**: 1 inch ≡ 25.4 mm

[1] See Figure 4 for description of drilled hole condition.

[2] Linear interpolation is permitted to establish an edge distance and spacing combination between case 1 and case 2. Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$, will determine the permissible spacing, s, as follows:

$$s \geq s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

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Fractional and Metric HIT-Z and HIT-Z-R Anchor Rod

Pullout Strength

Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit

TABLE 10—PULLOUT STRENGTH DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIT-Z AND HIT-Z-R RODS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR A CORE DRILL[1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Dia. (in.) Fractional				Units	Nominal Rod Dia. (mm) Metric			
				3/8	1/2	5/8	3/4		10	12	16	20
Minimum embedment depth		$h_{ef,min}$	in.	2 3/8	2 3/4	3 3/4	4	mm	60	70	96	100
			(mm)	(60)	(70)	(95)	(102)	(in.)	(2.4)	(2.8)	(3.8)	(3.9)
Maximum embedment depth		$h_{ef,max}$	in.	4 1/2	6	7 1/2	8 1/2	mm	120	144	192	220
			(mm)	(114)	(152)	(190)	(216)	(in.)	(4.7)	(5.7)	(7.6)	(8.7)
Temperature range A[2]	Pullout strength in cracked concrete	$N_{p,cr}$	lb	7,952	10,936	21,391	27,930	kN	39.1	43.8	98.0	127.9
			(kN)	(35.4)	(48.6)	(95.1)	(124.2)	(lb)	(8,790)	(9,847)	(22,032)	(28,754)
	Pullout strength in uncracked concrete	$N_{p,uncr}$	lb	7,952	11,719	21,391	28,460	kN	39.1	46.9	98.0	130.3
			(kN)	(35.4)	(52.1)	(95.1)	(126.6)	(lb)	(8,790)	(10,545)	(22,028)	(29,293)
Temperature range B[2]	Pullout strength in cracked concrete	$N_{p,cr}$	lb	7,952	10,936	21,391	27,930	kN	39.1	43.8	98.0	127.9
			(kN)	(35.4)	(48.6)	(95.1)	(124.2)	(lb)	(8,790)	(9,847)	(22,032)	(28,754)
	Pullout strength in uncracked concrete	$N_{p,uncr}$	lb	7,952	11,719	21,391	28,460	kN	39.1	46.9	98.0	130.3
			(kN)	(35.4)	(52.1)	(95.1)	(126.6)	(lb)	(8,790)	(10,545)	(22,028)	(29,293)
Temperature range C[2]	Pullout strength in cracked concrete	$N_{p,cr}$	lb	7,182	9,877	19,321	25,227	kN	35.3	39.5	88.5	115.5
			(kN)	(31.9)	(43.9)	(85.9)	(112.2)	(lb)	(7,936)	(8,880)	(19,897)	(25,967)
	Pullout strength in uncracked concrete	$N_{p,uncr}$	lb	7,182	10,585	19,321	25,705	kN	35.3	42.4	88.5	117.7
			(kN)	(31.9)	(47.1)	(85.9)	(114.3)	(lb)	(7,936)	(9,532)	(19,897)	(26,461)
Permissible installation conditions	Dry concrete, water saturated concrete	Anchor Category	-	1				-	1			
		ϕ_d, ϕ_{ws}	-	0.65				-	0.65			
Reduction for seismic tension		$\alpha_{N,seis}$	-	0.94	1.0			-	1.0	0.89	1.0	

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Fractional Threaded Rod

Steel Strength

TABLE 11—STEEL DESIGN INFORMATION FOR FRACTIONAL THREADED ROD

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)[1]						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Rod O.D.		d	in. (mm)	0.375 (9.5)	0.5 (12.7)	0.625 (15.9)	0.75 (19.1)	0.875 (22.2)	1 (25.4)	1.25 (31.8)
Rod effective cross-sectional area		A_{se}	in.^{2} (mm^2)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33,470 (148.9)	43,910 (195.3)	70,260 (312.5)
		V_{sa}	lb (kN)	3,370 (15.0)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,345 (117.2)	42,155 (187.5)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	1.00						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60						
ASTM A193 B7	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lb (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	1.00						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.65						
ASTM F1554 Gr. 36	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lb (kN)	- -	4,940 (22.0)	7,865 (35.0)	11,640 (51.8)	16,070 (71.5)	21,080 (93.8)	33,725 (150.0)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	0.6						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.65						
ASTM F1554 Gr. 55	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -	10,645 (47.4)	16,950 (75.4)	25,090 (111.6)	34,630 (154.0)	45,430 (202.1)	72,685 (323.3)
		V_{sa}	lb (kN)	- -	6,385 (28.4)	10,170 (45.2)	15,055 (67.0)	20,780 (92.4)	27,260 (121.3)	43,610 (194.0)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	1.00						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.65						
ASTM F1554 Gr. 105	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -	17,740 (78.9)	28,250 (125.7)	41,815 (186.0)	57,715 (256.7)	75,715 (336.8)	121,135 (538.8)
		V_{sa}	lb (kN)	- -	10,645 (47.4)	16,950 (75.4)	25,090 (111.6)	34,630 (154.0)	45,430 (202.1)	72,680 (323.3)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	1.00						
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.75						
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.65						
ASTM F593, CW Stainless	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,435 (126.5)	39,245 (174.6)	51,485 (229.0)	- -
		V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	- -
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	0.80						-
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65						-
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60						-
ASTM A193, Gr. 8(M), Class 1 Stainless	Nominal strength as governed by steel strength	N_{sa}	lb (kN)	- -						55,240 (245.7)
		V_{sa}	lb (kN)	- -						33,145 (147.4)
	Reduction factor, seismic shear	$\alpha_{V,seis}$	-	-						0.80
	Strength reduction factor ϕ for tension[2]	ϕ	-	-						0.75
	Strength reduction factor ϕ for shear[2]	ϕ	-	-						0.65

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf

[1] Values provided for common rod material types are based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq (17.7.1.2b), ACI 318-14 Eq. (17.4.1.2) and Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers must be appropriate for the rod.

[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

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Fractional Reinforcing Bars

Steel Strength

TABLE 11A—STEEL DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS

DESIGN INFORMATION		Symbol	Units	Nominal Reinforcing bar size (Rebar)							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal bar diameter		d	in.	3/8	1/2	5/8	3/4	7/8	1	1.128	1.270
			(mm)	(9.5)	(12.7)	(15.9)	(19.1)	(22.2)	(25.4)	(28.7)	(32.3)
Bar effective cross-sectional area		A_{se}	in.^{2}	0.11	0.2	0.31	0.44	0.6	0.79	1.0	1.27
			(mm^2)	(71)	(129)	(199)	(284)	(387)	(510)	(645)	(819)
ASTM A615 Grade 40	Nominal strength as governed by steel strength	N_{sa}	lb	6,600	12,000	18,600	26,400	36,000	47,400	60,000	76,200
			(kN)	(29.4)	(53.4)	(82.7)	(117.4)	(160.1)	(210.9)	(266.9)	(339.0)
		V_{sa}	lb	3,960	7,200	11,160	15,840	21,600	28,440	36,000	45,720
			(kN)	(17.6)	(32.0)	(49.6)	(70.5)	(96.1)	(126.5)	(160.1)	(203.4)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ASTM A615 Grade 60	Nominal strength as governed by steel strength	N_{sa}	lb	8,800	16,000	24,800	35,200	48,000	63,200	80,000	101,600
			(kN)	(39.1)	(71.2)	(110.3)	(156.6)	(213.5)	(281.1)	(355.9)	(451.9)
		V_{sa}	lb	5,280	9,600	14,880	21,120	28,800	37,920	48,000	60,960
			(kN)	(23.5)	(42.7)	(66.2)	(93.9)	(128.1)	(168.7)	(213.5)	(271.2)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.65							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength	N_{sa}	lb	8,800	16,000	24,800	35,200	48,000	63,200	80,000	101,600
			(kN)	(39.1)	(71.2)	(110.3)	(156.6)	(213.5)	(281.1)	(355.9)	(452.0)
		V_{sa}	lb	5,280	9,600	14,880	21,120	28,800	37,920	48,000	60,960
			(kN)	(23.5)	(42.7)	(66.2)	(94.0)	(128.1)	(168.7)	(213.5)	(271.2)
	Reduction for seismic shear	$\alpha_{V,seis}$		0.70							
	Strength reduction factor ϕ for tension[2]	ϕ		0.75							
	Strength reduction factor ϕ for shear[2]	ϕ		0.65							

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf

[1] Values provided for common rod material types are based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq (17.7.1.2b), ACI 318-14 Eq. (17.4.1.2) and Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers must be appropriate for the rod.

[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

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Fractional Threaded Rod and Reinforcing Bars

Concrete Breakout Strength

Carbide Bit or
Hilti Hollow Carbide Bit or
Diamond Core Bit with Roughening Tool

TABLE 12—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL THREADED ROD AND REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION	Symbol	Units	Nominal rod diameter (in.) / Reinforcing bar size							
			$^3/_8$ or #3	$^1/_2$ or #4	$^5/_8$ or #5	$^3/_4$ or #6	$^7/_8$ or #7	1 or #8	#9	$1^1/_4$ or #10
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7.1)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)							
Minimum Embedment	$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)	5 (127)
Maximum Embedment	$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	$12^1/_2$ (318)	15 (381)	$17^1/_2$ (445)	20 (508)	$22^1/_2$ (572)	25 (635)
Min. anchor spacing[3]	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Min. edge distance (Threaded rods)	c_{min}	in. (mm)	1¾ (45)	1¾ (45)	2 (3) (50) (3)	$2^1/_8$ (3) (55) (3)	2¼ (3) (60) (3)	2¾ (3) (70) (3)	n/a	$3^1/_8$ (3) (80) (3)
Min. edge distance (Reinforcing bars)[3]	c_{min}	-	5d; or see Section 4.1.9.2 of this report for design with reduced minimum edge distances							
Minimum concrete thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$(4)					
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10.2 of this report.							
Strength reduction factor for tension, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.70							

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Additional setting information is described in Figure 6, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3] For installations with $1^3/_4$-inch edge distance, refer to Section 4.1.9.2 for spacing and maximum torque requirements.
[4] d_0 = hole diameter.

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Fractional Reinforcing Bars

Bond Strength

Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit with Roughening Tool

Dry and Water Saturated Concrete

TABLE 13—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION		Symbol	Units	Nominal reinforcing bar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum Embedment		$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)	5 (127)
Maximum Embedment		$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	$12^1/_2$ (318)	15 (381)	$17^1/_2$ (445)	20 (508)	$22^1/_2$ (572)	25 (635)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,080 (7.4)	1,080 (7.4)	1,090 (7.5)	1,090 (7.5)	835 (5.7)	840 (5.8)	850 (5.9)	850 (5.9)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,080 (7.4)	1,080 (7.4)	1,090 (7.5)	1,090 (7.5)	835 (5.7)	840 (5.8)	850 (5.9)	850 (5.9)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)	1,560 (10.8)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	885 (6.1)	890 (6.1)	895 (6.2)	895 (6.2)	685 (4.7)	690 (4.8)	700 (4.8)	700 (4.8)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,280 (8.8)	1,280 (8.8)	1,280 (8.8)	1,280 (8.8)	1,280 (8.8)	1,280 (8.8)	1,280 (8.8)	1,280 (8.8)
Permissible installation conditions	Dry concrete and water saturated concrete	Anchor Category	-	1							
		ϕ_d, ϕ_{ws}	-	0.65							
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.80				0.85	0.90	0.95	1.0
	Core drilled + roughening	$\alpha_{N,seis}$	-	N/A		0.71	0.77	0.82	0.95	0.79	0.83

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Fractional Reinforcing Bars

Bond Strength

Carbide Bit or
Hilti Hollow Carbide Bit

Water-filled Holes

TABLE 14—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)

DESIGN INFORMATION		Symbol	Units	Nominal reinforcing bar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum Embedment		$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	$4^1/_2$	5
			(mm)	(60)	(70)	(79)	(89)	(89)	(102)	(114)	(127)
Maximum Embedment		$h_{ef,max}$	in.	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	$22^1/_2$	25
			(mm)	(191)	(254)	(318)	(381)	(445)	(508)	(572)	(635)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	1,050	1,050	1,070	1,070	820	820	830	830
			(MPa)	(7.2)	(7.2)	(7.4)	(7.4)	(5.7)	(5.7)	(5.7)	(5.7)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,520	1,520	1,520	1,520	1,520	1,520	1,520	1,520
			(MPa)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	1,050	1,050	1,070	1,070	820	820	830	830
			(MPa)	(7.2)	(7.2)	(7.4)	(7.4)	(5.7)	(5.7)	(5.7)	(5.7)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,520	1,520	1,520	1,520	1,520	1,520	1,520	1,520
			(MPa)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	865	865	875	875	670	680	680	680
			(MPa)	(6.0)	(6.0)	(6.1)	(6.1)	(4.6)	(4.7)	(4.7)	(4.7)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
			(MPa)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)
Permissible installation conditions	Water-filled Holes	Anchor Category	-	3							
		ϕ_{wf}	-	0.45							
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.80				0.85	0.90	0.95	1.0

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Fractional Threaded Rod

Bond Strength

Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit with Roughening Tool

Dry and Water Saturated Concrete

TABLE 15—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum Embedment		$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	5 (127)
Maximum Embedment		$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,045 (7.2)	1,135 (7.8)	1,170 (8.1)	1,260 (8.7)	1,290 (8.9)	1,325 (9.1)	1,380 (9.5)
Temperature range A[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	1,045 (7.2)	1,135 (7.8)	1,170 (8.1)	1,260 (8.7)	1,290 (8.9)	1,325 (9.1)	1,380 (9.5)
Temperature range B[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)	2,220 (15.3)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	855 (5.9)	930 (6.4)	960 (6.6)	1,035 (7.1)	1,055 (7.3)	1,085 (7.5)	1,130 (7.8)
Temperature range C[2]	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,820 (12.6)	1,820 (12.6)	1,820 (12.6)	1,820 (12.6)	1,820 (12.6)	1,820 (12.6)	1,820 (12.6)
Permissible installation conditions	Dry and water saturated concrete	Anchor Category	-	1						
Permissible installation conditions	Dry and water saturated concrete	ϕ_d, ϕ_{ws}	-	0.65						
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.88	0.99	0.99	1.0	1.0	0.95	0.99
Reduction for seismic tension	Core drilled + roughening	$\alpha_{N,seis}$	-	N/A		0.88	0.96	0.96	1.0	0.82

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Fractional Threaded Rod

Bond Strength

Carbide Bit or
Hilti Hollow Carbide Bit

Water-filled hole

TABLE 16—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (in.)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum Embedment		$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	5 (127)
Maximum Embedment		$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	825 (5.7)	875 (6.0)	865 (6.0)	910 (6.3)	890 (6.1)	885 (6.1)	840 (5.8)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,755 (12.1)	1,710 (11.8)	1,645 (11.3)	1,600 (11)	1,535 (10.6)	1,490 (10.3)	1,355 (9.3)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	825 (5.7)	875 (6.0)	865 (6.0)	910 (6.3)	890 (6.1)	885 (6.1)	840 (5.8)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,755 (12.1)	1,710 (11.8)	1,645 (11.3)	1,600 (11.0)	1,535 (10.6)	1,490 (10.3)	1,355 (9.3)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (MPa)	675 (4.7)	715 (4.9)	710 (4.9)	745 (5.1)	730 (5.0)	730 (5.0)	690 (4.8)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (MPa)	1,440 (9.9)	1,405 (9.7)	1,350 (9.3)	1,310 (9.0)	1,260 (8.7)	1,220 (8.4)	1,110 (7.7)
Permissible installation conditions	Water-filled hole	Anchor Category	-	3						
		ϕ_{wf}	-	0.45						
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.88	0.99	0.99	1.0	1.0	0.95	0.99

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short-term temperature = 130°F (55°C), Maximum long-term temperature = 110°F (43°C).

Temperature range B: Maximum short-term temperature = 176°F (80°C), Maximum long-term temperature = 110°F (43°C).

Temperature range C: Maximum short-term temperature = 248°F (120°C), Maximum long-term temperature = 162°F (72°C).

short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. long-term concrete temperatures are roughly constant over significant periods of time.

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Metric Threaded Rod and EU Metric Reinforcing Bars

Steel Strength

TABLE 17—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD AND EU METRIC REINFORCING BARS

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)[1]						
				10	12	16	20	24	27	30
Rod Outside Diameter		d	mm	10	12	16	20	24	27	30
			(in.)	(0.39)	(0.47)	(0.63)	(0.79)	(0.94)	(1.06)	(1.18)
Rod effective cross-sectional area		A_{se}	mm²	58.0	84.3	157	245	353	459	561
			(in.²)	(0.090)	(0.131)	(0.243)	(0.380)	(0.547)	(0.711)	(0.870)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength	N_{sa}	kN	29.0	42.0	78.5	122.5	176.5	229.5	280.5
			(lb)	(6,519)	(9,476)	(17,647)	(27,539)	(39,679)	(51,594)	(63,059)
		V_{sa}	kN	14.5	25.5	47.0	73.5	106.0	137.5	168.5
			(lb)	(3,260)	(5,685)	(10,588)	(16,523)	(23,807)	(30,956)	(37,835)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	1.00						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength	N_{sa}	kN	46.5	67.5	125.5	196.0	282.5	367.0	449.0
			(lb)	(10,431)	(15,161)	(28,236)	(44,063)	(63,486)	(82,550)	(100,894)
		V_{sa}	kN	23.0	40.5	75.5	117.5	169.5	220.5	269.5
			(lb)	(5,216)	(9,097)	(16,942)	(26,438)	(38,092)	(49,530)	(60,537)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	1.00						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ISO 3506-1 Class A4 Stainless[3]	Nominal strength as governed by steel strength	N_{sa}	kN	40.6	59.0	109.9	171.5	247.1	183.1	223.8
			(lb)	(9,127)	(13,266)	(24,706)	(38,555)	(55,550)	(41,172)	(50,321)
		V_{sa}	kN	20.3	35.4	65.9	102.9	148.3	109.9	134.3
			(lb)	(4,564)	(7,960)	(14,824)	(23,133)	(33,330)	(24,703)	(30,192)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.80						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						

DESIGN INFORMATION		Symbol	Units	Reinforcing bar size							
				10	12	14	16	20	25	28	32
Nominal bar diameter		d	mm	10.0	12.0	14.0	16.0	20.0	25.0	28.0	32.0
			(in.)	(0.394)	(0.472)	(0.551)	(0.630)	(0.787)	(0.984)	(1.102)	(1.260)
Bar effective cross-sectional area		A_{se}	mm²	78.5	113.1	153.9	201.1	314.2	490.9	615.8	804.2
			(in.²)	(0.122)	(0.175)	(0.239)	(0.312)	(0.487)	(0.761)	(0.954)	(1.247)
DIN 488 BSt 550/500	Nominal strength as governed by steel strength	N_{sa}	kN	43.0	62.0	84.5	110.5	173.0	270.0	338.5	442.5
			(lb)	(9,711)	(13,984)	(19,034)	(24,860)	(38,844)	(60,694)	(76,135)	(99,441)
		V_{sa}	kN	26.0	37.5	51.0	66.5	103.0	162.0	203.0	265.5
			(lb)	(5,827)	(8,390)	(11,420)	(14,916)	(23,307)	(36,416)	(45,681)	(59,665)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Values provided for common rod material types are based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2) and Eq (17.7.1.2b), ACI 318-14 Eq. (17.4.1.2) and Eq (17.5.1.2b) or ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers must be appropriate for the rod.
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3] A4-70 Stainless (M8- M24); A4-502 Stainless (M27- M30)

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Metric Threaded Rod and EU Metric Reinforcing Bars

Concrete Breakout Strength

Carbide Bit or
Hilti Hollow Carbide Bit or
Diamond Core Bit with Roughening Tool

TABLE 18—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD AND EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION	Symbol	Units	Nominal rod diameter (mm)						
			10	12	16	20	24	27	30
Minimum Embedment	$h_{ef,min}$	mm	60	70	80	90	96	108	120
		(in.)	(2.4)	(2.8)	(3.1)	(3.5)	(3.8)	(4.3)	(4.7)
Maximum Embedment	$h_{ef,max}$	mm	200	240	320	400	480	540	600
		(in.)	(7.9)	(9.4)	(12.6)	(15.7)	(18.9)	(21.3)	(23.6)
Min. anchor spacing[3]	s_{min}	mm	50	60	80	100	120	135	150
		(in.)	(2.0)	(2.4)	(3.2)	(3.9)	(4.7)	(5.3)	(5.9)
Min. edge distance[3]	c_{min}	-	5d; or see Section 4.1.9.2 of this report for design with reduced minimum edge distances						
Minimum concrete thickness	h_{min}	mm	h_{ef} + 30	$h_{ef} + 2d_o$[4]					
		(in.)	(h_{ef} + 1 1/4)						

DESIGN INFORMATION	Symbol	Units	Reinforcing bar size							
			10	12	14	16	20	25	28	32
Minimum Embedment	$h_{ef,min}$	mm	60	70	75	80	90	100	112	128
		(in.)	(2.4)	(2.8)	(3.0)	(3.1)	(3.5)	(3.9)	(4.4)	(5.0)
Maximum Embedment	$h_{ef,max}$	mm	200	240	280	320	400	500	560	640
		(in.)	(7.9)	(9.4)	(11.0)	(12.6)	(15.7)	(19.7)	(22.0)	(25.2)
Min. anchor spacing[3]	s_{min}	mm	50	60	80	100	120	135	140	160
		(in.)	(2.0)	(2.4)	(3.2)	(3.9)	(4.7)	(5.3)	(5.5)	(6.3)
Min. edge distance[3]	c_{min}	-	5d; or see Section 4.1.9 of this report for design with reduced minimum edge distances							
Minimum concrete thickness	h_{min}	mm	h_{ef} + 30	$h_{ef} + 2d_o$[4]						
		(in.)	(h_{ef} + 1 1/4)							
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10.2 of this report.							
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI	7.1							
		(in-lb)	(17)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI	10							
		(in-lb)	(24)							
Strength reduction factor for tension, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B(supplemental reinforcement not present)[2]	ϕ	-	0.70							

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Additional setting information is described in Figure 6, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3] For installations with 1 3/4-inch edge distance, refer to Section 4.1.9.2 for spacing and maximum torque requirements.
[4] d_o = hole diameter.

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EU Metric Reinforcing Bars

Bond Strength

Carbide Bit or
Hilti Hollow Carbide Bit or
Diamond Core Bit with Roughening Tool

Dry and Water Saturated Concrete

TABLE 19—BOND STRENGTH DESIGN INFORMATION FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION		Symbol	Units	Reinforcing bar size							
				10	12	14	16	20	25	28	32
Minimum Embedment		$h_{ef,min}$	mm	60	70	75	80	90	100	112	128
			(in.)	(2.4)	(2.8)	(3.0)	(3.1)	(3.5)	(3.9)	(4.4)	(5.0)
Maximum Embedment		$h_{ef,max}$	mm	200	240	280	320	400	500	560	640
			(in.)	(7.9)	(9.4)	(11.0)	(12.6)	(15.7)	(19.7)	(22.0)	(25.2)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.4	7.5	7.5	7.5	7.5	5.8	5.8	5.9
			(psi)	(1,075)	(1,080)	(1,085)	(1,090)	(1,095)	(840)	(845)	(850)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
			(psi)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.4	7.5	7.5	7.5	7.5	5.8	5.8	5.9
			(psi)	(1,075)	(1,080)	(1,085)	(1,090)	(1,095)	(840)	(845)	(850)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
			(psi)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.1	6.1	6.1	6.2	6.2	4.8	4.8	4.8
			(psi)	(885)	(885)	(890)	(895)	(900)	(690)	(695)	(700)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.8	8.8	8.8	8.8	8.8	8.8	8.8	8.8
			(psi)	(1,280)	(1,280)	(1,280)	(1,280)	(1,280)	(1,280)	(1,280)	(1,280)
Permissible Installation Conditions	Dry and water saturated concrete	Anchor Category	-	1							
		ϕ_d, ϕ_{ws}	-	0.65							
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.80					0.85	0.90	1.00
	Core drilled + roughening	$\alpha_{N,seis}$	-	N/A			0.71	0.77	0.86	0.78	0.86

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature =110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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EU Metric Reinforcing Bars

Bond Strength

Carbide Bit or Hilti Hollow Carbide Bit

Water-filled Concrete

TABLE 20—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)

DESIGN INFORMATION		Symbol	Units	Nominal reinforcing bar size							
				10	12	14	16	20	25	28	32
Minimum Embedment		$h_{ef,min}$	in.	$2^3/_8$	$2^3/_4$	$3^1/_8$	$3^1/_2$	$3^1/_2$	4	$4^1/_2$	5
			(mm)	(60)	(70)	(79)	(89)	(89)	(102)	(114)	(127)
Maximum Embedment		$h_{ef,max}$	in.	$7^1/_2$	10	$12^1/_2$	15	$17^1/_2$	20	$22^1/_2$	25
			(mm)	(191)	(254)	(318)	(381)	(445)	(508)	(572)	(635)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	(7.2)	(7.2)	(7.2)	(7.4)	(7.4)	(5.7)	(5.7)	(5.7)
			(psi)	1,050	1,050	1,050	1,070	1,070	820	820	830
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)
			(psi)	1,520	1,520	1,520	1,520	1,520	1,520	1,520	1,520
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	(7.2)	(7.2)	(7.2)	(7.4)	(7.4)	(5.7)	(5.7)	(5.7)
			(psi)	1,050	1,050	1,050	1,070	1,070	820	820	830
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)	(10.5)
			(psi)	1,520	1,520	1,520	1,520	1,520	1,520	1,520	1,520
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	(6.0)	(6.0)	(6.0)	(6.1)	(6.1)	(4.7)	(4.7)	(4.7)
			(psi)	865	865	865	875	875	680	680	680
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)	(8.6)
			(psi)	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Permissible installation conditions	Water-filled Hole	Anchor Category	-	3							
		ϕ_{wf}	-	0.45							
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.80				0.85	0.90	0.95	1.0

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).

Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).

Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).

Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Metric Threaded Rod | Bond Strength | Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit with Roughening Tool | Dry and Water Saturated Concrete

TABLE 21—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)						
				10	12	16	20	24	27	30
Minimum Embedment		$h_{ef,min}$	mm	60	70	80	90	96	108	120
			(in.)	(2.4)	(2.8)	(3.1)	(3.5)	(3.8)	(4.3)	(4.7)
Maximum Embedment		$h_{ef,max}$	mm	200	240	320	400	480	540	600
			(in.)	(7.9)	(9.4)	(12.6)	(15.7)	(18.9)	(21.3)	(23.6)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.3	7.6	8.1	8.8	9.0	9.2	9.4
			(psi)	(1,055)	(1,105)	(1,170)	(1,270)	(1,305)	(1,340)	(1,365)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	15.3	15.3	15.3	15.3	15.3	15.3	15.3
			(psi)	(2,220)	(2,220)	(2,220)	(2,220)	(2,220)	(2,220)	(2,220)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.3	7.6	8.1	8.8	9.0	9.2	9.4
			(psi)	(1,055)	(1,105)	(1,170)	(1,270)	(1,305)	(1,340)	(1,365)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	15.3	15.3	15.3	15.3	15.3	15.3	15.3
			(psi)	(2,220)	(2,220)	(2,220)	(2,220)	(2,220)	(2,220)	(2,220)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.0	6.3	6.6	7.2	7.4	7.6	7.7
			(psi)	(865)	(905)	(960)	(1,040)	(1,070)	(1,095)	(1,120)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.6	12.6	12.6	12.6	12.6	12.6	12.6
			(psi)	(1,820)	(1,820)	(1,820)	(1,820)	(1,820)	(1,820)	(1,820)
Permissible Installation Conditions	Dry and water saturated concrete	Anchor Category	-	1						
		ϕ_d, ϕ_{ws}	-	0.65						
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.88	0.88	0.99	1.0	0.95	0.95	0.95
	Core drilled + roughening	$\alpha_{N,seis}$	-	N/A		0.88	0.96	0.96	0.82	0.82

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Metric Threaded Rod

Bond Strength

Carbide Bit or Hilti Hollow Carbide Bit

Water-filled hole

TABLE 22—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)

DESIGN INFORMATION		Symbol	Units	Nominal rod diameter (mm)						
				10	12	16	20	24	27	30
Minimum Embedment		$h_{ef,min}$	mm	60	70	80	90	96	108	120
			(in.)	(2.4)	(2.8)	(3.1)	(3.5)	(3.8)	(4.3)	(4.7)
Maximum Embedment		$h_{ef,max}$	mm	200	240	320	400	480	540	600
			(in.)	(7.9)	(9.4)	(12.6)	(15.7)	(18.9)	(21.3)	(23.6)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	5.8	5.9	6.0	6.2	6.1	6.0	5.9
			(psi)	(835)	(850)	(865)	(900)	(885)	(870)	(860)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.1	11.8	11.3	10.9	10.4	10.0	9.7
			(psi)	(1755)	(1710)	(1645)	(1580)	(1510)	(1445)	(1400)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	5.8	5.9	6.0	6.2	6.1	6.0	5.9
			(psi)	(835)	(850)	(865)	(900)	(885)	(870)	(860)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	12.1	11.8	11.3	10.9	10.4	10.0	9.7
			(psi)	(1755)	(1710)	(1645)	(1580)	(1510)	(1445)	(1400)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	4.7	4.8	4.9	5.1	5.0	4.9	4.9
			(psi)	(685)	(700)	(710)	(740)	(725)	(715)	(705)
	Characteristic bond strength in	$\tau_{k,uncr}$	MPa	9.9	9.7	9.3	8.9	8.5	8.2	7.9
			(psi)	(1440)	(1405)	(1350)	(1295)	(1240)	(1185)	(1150)
Permissible Installation Conditions	Water-filled hole	Anchor Category	-	3						
		ϕ_{wf}	-	0.45						
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.88	0.88	0.99	1.0	0.95	0.95	0.95

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.

For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short-term temperature = 130°F (55°C), Maximum long-term temperature = 110°F (43°C).

Temperature range B: Maximum short-term temperature = 176°F (80°C), Maximum long-term temperature = 110°F (43°C).

Temperature range C: Maximum short-term temperature = 248°F (120°C), Maximum long-term temperature = 162°F (72°C).

short-term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. long-term concrete temperatures are roughly constant over significant periods of time.

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Canadian Reinforcing Bars **Steel Strength**

TABLE 23—STEEL DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS

DESIGN INFORMATION		Symbol	Units	Bar size				
				10 M	15 M	20 M	25 M	30 M
Nominal bar diameter		d	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Bar effective cross-sectional area		A_{se}	mm² (in.²)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463)	498.8 (0.773)	702.2 (1.088)
CSA G30	Nominal strength as governed by steel strength	N_{sa}	kN (lb)	54.0 (12,175)	108.5 (24,408)	161.5 (36,255)	270.0 (60,548)	380.0 (85,239)
		V_{sa}	kN (lb)	32.5 (7,305)	65.0 (14,645)	97.0 (21,753)	161.5 (36,329)	227.5 (51,144)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.70				
	Strength reduction factor for tension[1]	ϕ	-	0.65				
	Strength reduction factor for shear[1]	ϕ	-	0.60				

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1] For use with the load combinations of ACI 318-19 and ACI 318-14 5.3 or ACI 318-11 9.2, as set forth in ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3. Values correspond to a brittle steel element.

Canadian Reinforcing Bars **Concrete Breakout Strength** **Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit with Roughening Tool**

TABLE 24—CONCRETE BREAKOUT DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION	Symbol	Units	Bar size				
			10 M	15 M	20 M	25 M	30 M
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7.1 (17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)				
Minimum Embedment	$h_{ef,min}$	mm (in.)	70 (2.8)	80 (3.1)	90 (3.5)	101 (4.0)	120 (4.7)
Maximum Embedment	$h_{ef,max}$	mm (in.)	226 (8.9)	320 (12.6)	390 (15.4)	504 (19.8)	598 (23.5)
Min. bar spacing[3]	s_{min}	mm (in.)	57 (2.2)	80 (3.1)	98 (3.8)	126 (5.0)	150 (5.9)
Min. edge distance[3]	c_{min}	mm (in.)	5d; or see Section 4.1.9.2 of this report for design with reduced minimum edge distances				
Minimum concrete thickness	h_{min}	mm (in.)	h_{ef} + 30 (h_{ef} + 1¹/₄)	$h_{ef} + 2d_o$[4]			
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10.2 of this report.				
Strength reduction factor for tension, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.70				

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi
[1] Additional setting information is described in Figure 6, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3] For installations with 1³/₄-inch edge distance, refer to Section 4.1.9.2 for spacing and maximum torque requirements.
[4] d_o = hole diameter.

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Canadian Reinforcing Bars

Bond Strength

Carbide Bit or
Hilti Hollow Carbide Bit or
Diamond Core Bit with Roughening Tool

Dry and Water Saturated Concrete

TABLE 25—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION		Symbol	Units	Bar size				
				10 M	15 M	20 M	25 M	30 M
Minimum Embedment		$h_{ef,min}$	mm	70	80	90	101	120
			(in.)	(2.8)	(3.1)	(3.5)	(4.0)	(4.7)
Maximum Embedment		$h_{ef,max}$	mm	226	320	390	504	598
			(in.)	(8.9)	(12.6)	(15.4)	(19.8)	(23.5)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.4	7.5	7.5	5.8	5.9
			(psi)	(1,075)	(1,085)	(1,095)	(840)	(850)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.8	10.8	10.8	10.8	10.8
			(psi)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.4	7.5	7.5	5.8	5.9
			(psi)	(1,075)	(1,085)	(1,095)	(840)	(850)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.8	10.8	10.8	10.8	10.8
			(psi)	(1,560)	(1,560)	(1,560)	(1,560)	(1,560)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.1	6.2	6.2	4.8	4.8
			(psi)	(885)	(895)	(900)	(690)	(700)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.8	8.8	8.8	8.8	8.8
			(psi)	(1,280)	(1,280)	(1,280)	(1,280)	(1,280)
Permissible installation conditions	Dry and water saturated concrete	Anchor Category	-	1				
		ϕ_d, ϕ_{ws}	-	0.65				
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.80			0.85	0.97
	Core drilled + roughening	$\alpha_{N,seis}$	-	N/A	0.71	0.77	N/A	

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Canadian Reinforcing Bars

Bond Strength

Carbide Bit or
Hilti Hollow Carbide Bit

Water-filled
Holes

TABLE 26—BOND STRENGTH DESIGN INFORMATION FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)

DESIGN INFORMATION		Symbol	Units	Bar size				
				10 M	15 M	20 M	25 M	30 M
Minimum Embedment		$h_{ef,min}$	mm	70	80	90	101	120
			(in.)	(2.8)	(3.1)	(3.5)	(4.0)	(4.7)
Maximum Embedment		$h_{ef,max}$	mm	226	320	390	504	598
			(in.)	(8.9)	(12.6)	(15.4)	(19.8)	(23.5)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.3	7.4	7.4	5.7	5.8
			(psi)	(1,050)	(1,070)	(1,070)	(820)	(830)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.5	10.5	10.5	10.5	10.5
			(psi)	(1,520)	(1,520)	(1,520)	(1,520)	(1,520)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	7.3	7.4	7.4	5.7	5.8
			(psi)	(1,050)	(1,070)	(1,070)	(820)	(830)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	10.5	10.5	10.5	10.5	10.5
			(psi)	(1,520)	(1,520)	(1,520)	(1,520)	(1,520)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	MPa	6.0	6.1	6.1	4.7	6.0
			(psi)	(865)	(875)	(875)	(680)	(865)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	MPa	8.6	8.6	8.6	8.6	8.6
			(psi)	(1,250)	(1,250)	(1,250)	(1,250)	(1,250)
Permissible installation conditions	Water-filled Holes	Anchor Category	-	3				
		ϕ_{wf}	-	0.45				
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.80			0.85	0.97

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ [For SI: $(f'_c / 17.2)^{0.1}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature = 110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert

Steel Strength

TABLE 27—STEEL DESIGN INFORMATION FOR FRACTIONAL AND METRIC HIS-N AND HIS-RN THREADED INSERTS[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bolt/Cap Screw Diameter (in.) Fractional				Units	Nominal Bolt/Cap Screw Diameter (mm) Metric				
				3/8	1/2	5/8	3/4		8	10	12	16	20
HIS Insert O.D.		D	in.	0.65	0.81	1.00	1.09	mm	12.5	16.5	20.5	25.4	27.6
			(mm)	(16.5)	(20.5)	(25.4)	(27.6)	(in.)	(0.49)	(0.65)	(0.81)	(1.00)	(1.09)
HIS insert length		L	in.	4.33	4.92	6.69	8.07	mm	90	110	125	170	205
			(mm)	(110)	(125)	(170)	(205)	(in.)	(3.54)	(4.33)	(4.92)	(6.69)	(8.07)
Bolt effective cross-sectional area		A_{se}	in.^{2}	0.0775	0.1419	0.2260	0.3345	mm^2	36.6	58	84.3	157	245
			(mm^2)	(50)	(92)	(146)	(216)	(in.^{2})	(0.057)	(0.090)	(0.131)	(0.243)	(0.380)
HIS insert effective cross-sectional area		A_{insert}	in.^{2}	0.178	0.243	0.404	0.410	mm^2	51.5	108	169.1	256.1	237.6
			(mm^2)	(115)	(157)	(260)	(265)	(in.^{2})	(0.080)	(0.167)	(0.262)	(0.397)	(0.368)
ASTM A193 B7	Nominal steel strength – ASTM A193 B7[3] bolt/cap screw	N_{sa}	lb	9,690	17,740	28,250	41,815	kN	-	-	-	-	-
			(kN)	(43.1)	(78.9)	(125.7)	(186.0)	(lb)	-	-	-	-	-
		V_{sa}	lb	5,815	10,645	16,950	25,090	kN	-	-	-	-	-
			(kN)	(25.9)	(47.3)	(75.4)	(111.6)	(lb)	-	-	-	-	-
	Nominal steel strength – HIS-N insert	N_{sa}	lb	12,650	16,195	26,925	27,360	kN	-	-	-	-	-
			(kN)	(56.3)	(72.0)	(119.8)	(121.7)	(lb)	-	-	-	-	-
ASTM A193 Grade B8M SS	Nominal steel strength – ASTM A193 Grade B8M SS bolt/cap screw	N_{sa}	lb	8,525	15,610	24,860	36,795	kN	-	-	-	-	-
			(kN)	(37.9)	(69.4)	(110.6)	(163.7)	(lb)	-	-	-	-	-
		V_{sa}	lb	5,115	9,365	14,915	22,075	kN	-	-	-	-	-
			(kN)	(22.8)	(41.7)	(66.3)	(98.2)	(lb)	-	-	-	-	-
	Nominal steel strength – HIS-RN insert	N_{sa}	lb	17,165	23,430	38,955	39,535	kN	-	-	-	-	-
			(kN)	(76.3)	(104.2)	(173.3)	(175.9)	(lb)	-	-	-	-	-
ISO 898-1 Class 8.8	Nominal steel strength – ISO 898-1 Class 8.8 bolt/cap screw	N_{sa}	lb	-	-	-	-	kN	29.5	46.5	67.5	125.5	196.0
			(kN)	-	-	-	-	(lb)	(6,582)	(10,431)	(15,161)	(28,236)	(44,063)
		V_{sa}	lb	-	-	-	-	kN	17.5	28.0	40.5	75.5	117.5
			(kN)	-	-	-	-	(lb)	(3,949)	(6,259)	(9,097)	(16,942)	(26,438)
	Nominal steel strength – HIS-N insert	N_{sa}	lb	-	-	-	-	kN	25.0	53.0	78.0	118.0	110.0
			(kN)	-	-	-	-	(lb)	(5,669)	(11,894)	(17,488)	(26,483)	(24,573)
ISO 3506-1 Class A4-70 Stainless	Nominal steel strength – ISO 3506-1 Class A4-70 Stainless bolt/cap screw	N_{sa}	lb	-	-	-	-	kN	25.5	40.5	59.0	110.0	171.5
			(kN)	-	-	-	-	(lb)	(5,760)	(9,127)	(13,266)	(24,706)	(38,555)
		V_{sa}	lb	-	-	-	-	kN	15.5	24.5	35.5	66.0	103.0
			(kN)	-	-	-	-	(lb)	(3,456)	(5,476)	(7,960)	(14,824)	(23,133)
	Nominal steel strength – HIS-RN insert	N_{sa}	lb	-	-	-	-	kN	36.0	75.5	118.5	179.5	166.5
			(kN)	-	-	-	-	(lb)	(8,099)	(16,991)	(26,612)	(40,300)	(37,394)
Reduction for seismic shear		$\alpha_{V,seis}$	-	0.94				-	0.94				
Strength reduction factor for tension[2]		ϕ	-	0.65				-	0.65				
Strength reduction factor for shear[2]		ϕ	-	0.60				-	0.60				

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. (17.6.1.2), ACI 318-14 Eq. (17.4.1.2), ACI 318-11 Eq. (D-2) and Eq. (D-29). Nuts and washers must be appropriate for the rod.

[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.

[3] For the calculation of the design steel strength in tension and shear for the bolt or screw, the ϕ factor for ductile steel failure according to ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3 can be used.

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Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert

Concrete Breakout Strength

Carbide Bit or
Hilti Hollow Carbide Bit or
Diamond Core Bit with Roughening Tool

TABLE 28—CONCRETE BREAKOUT DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT) OR CORE DRILLED WITH A DIAMOND CORE BIT AND ROUGHENED WITH A HILTI ROUGHENING TOOL[1]

DESIGN INFORMATION	Symbol	Units	Nominal Bolt/Cap Screw Diameter (in.) Fractional				Units	Nominal Bolt/Cap Screw Diameter (mm) Metric				
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$		8	10	12	16	20
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb	17				SI	7.1				
		(SI)	(7.1)				(in-lb)	(17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb	24				SI	10				
		(SI)	(10)				(in-lb)	(24)				
Effective embedment depth	h_{ef}	in.	$4^3/_8$	5	$6^3/_4$	$8^1/_8$	mm	90	110	125	170	205
		(mm)	(110)	(125)	(170)	(205)	(in.)	(3.5)	(4.3)	(4.9)	(6.7)	(8.1)
Min. anchor spacing[3]	s_{min}	in.	$3^1/_4$	4	5	$5^1/_2$	mm	63	83	102	127	140
		(mm)	(83)	(102)	(127)	(140)	(in.)	(2.5)	(3.25)	(4.0)	(5.0)	(5.5)
Min. edge distance[3]	c_{min}	in.	$3^1/_4$	4	5	$5^1/_2$	mm	63	83	102	127	140
		(mm)	(83)	(102)	(127)	(140)	(in.)	(2.5)	(3.25)	(4.0)	(5.0)	(5.5)
Minimum concrete thickness	h_{min}	in.	5.9	6.7	9.1	10.6	mm	120	150	170	230	270
		(mm)	(150)	(170)	(230)	(270)	(in.)	(4.7)	(5.9)	(6.7)	(9.1)	(10.6)
Critical edge distance – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10.2 of this report				-	See Section 4.1.10.2 of this report				
Strength reduction factor for tension, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.65				-	0.65				
Strength reduction factor for shear, concrete failure modes, Condition B (supplemental reinforcement not present)[2]	ϕ	-	0.70				-	0.70				

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Additional setting information is described in Figure 6, Manufacturers Printed Installation Instructions (MPII).
[2] The strength reduction factor applies when the load combinations from the IBC or ACI 318 are used and the requirements of ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are met. If the load combinations of ACI 318-11 Appendix C are used, the appropriate strength reduction factor must be determined in accordance with ACI 318-11 D.4.4.
[3] For installations with $1^3/_4$-inch edge distance, refer to Section 4.1.9.2 for spacing and maximum torque requirements.

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Fractional and Metric HIS-N and HIS-RN Internal Threaded Insert

Bond Strength

Carbide Bit or Hilti Hollow Carbide Bit or Diamond Core Bit with Roughening Tool

Dry and Water Saturated Concrete

TABLE 29—BOND STRENGTH DESIGN INFORMATION FOR FRACTIONAL AND METRIC HILTI HIS-N AND HIS-RN INSERTS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT (OR HILTI HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bolt/Cap Screw Diameter (in.) Fractional				Units	Nominal Bolt/Cap Screw Diameter (mm) Metric				
				3/8	1/2	5/8	3/4		8	10	12	16	20
Effective embedment depth		h_{ef}	in.	4 3/8	5	6 3/4	8 1/8	mm	90	110	125	170	205
			(mm)	(110)	(125)	(170)	(205)	(in.)	(3.5)	(4.3)	(4.9)	(6.7)	(8.1)
HIS Insert O.D.		D	in.	0.65	0.81	1.00	1.09	mm	12.5	16.5	20.5	25.4	27.6
			(mm)	(16.5)	(20.5)	(25.4)	(27.6)	(in.)	(0.49)	(0.65)	(0.81)	(1.00)	(1.09)
Temperature range A[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	870	890	910	920	MPa	5.9	6.0	6.1	6.3	6.3
			(MPa)	(6.0)	(6.1)	(6.3)	(6.3)	(psi)	(850)	(870)	(890)	(910)	(920)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,950	1,950	1,950	1,950	MPa	13.5	13.5	13.5	13.5	13.5
			(MPa)	(13.5)	(13.5)	(13.5)	(13.5)	(psi)	(1,950)	(1,950)	(1,950)	(1,950)	(1,950)
Temperature range B[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	870	890	910	920	MPa	5.9	6.0	6.1	6.3	6.3
			(MPa)	(6.0)	(6.1)	(6.3)	(6.3)	(psi)	(850)	(870)	(890)	(910)	(920)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,950	1,950	1,950	1,950	MPa	13.5	13.5	13.5	13.5	13.5
			(MPa)	(13.5)	(13.5)	(13.5)	(13.5)	(psi)	(1,950)	(1,950)	(1,950)	(1,950)	(1,950)
Temperature range C[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi	715	730	750	755	MPa	4.8	4.9	5.0	5.2	5.2
			(MPa)	(4.9)	(5.0)	(5.2)	(5.2)	(psi)	(695)	(715)	(730)	(750)	(755)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi	1,600	1,600	1,600	1,600	MPa	11.0	11.0	11.0	11.0	11.0
			(MPa)	(11.0)	(11.0)	(11.0)	(11.0)	(psi)	(1,600)	(1,600)	(1,600)	(1,600)	(1,600)
Permissible installation conditions	Dry and water saturated conc.	Anchor Category	-	1				-	1				
		ϕ_d, ϕ_{ws}	-	0.65				-	0.65				
Reduction for seismic tension	Hammer drilled	$\alpha_{N,seis}$	-	0.92				-	0.92				
	Core drilled + roughening	$\alpha_{N,seis}$	-	0.81	0.88	0.92	0.76	-	N/A	0.81	0.88	0.92	0.76

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi (17.2 MPa) and 8,000 psi (55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.1}$ for uncracked concrete, [For SI: $(f'_c / 17.2)^{0.1}$] and $(f'_c / 2{,}500)^{0.3}$ for cracked concrete, [For SI: $(f'_c / 17.2)^{0.3}$]. See Section 4.1.4 of this report for bond strength determination.

[2] Temperature range A: Maximum short term temperature = 130°F (55°C), Maximum long term temperature =110°F (43°C).
Temperature range B: Maximum short term temperature = 176°F (80°C), Maximum long term temperature = 110°F (43°C).
Temperature range C: Maximum short term temperature = 248°F (120°C), Maximum long term temperature = 162°F (72°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g., as a result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.

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HILTI HIT-HY 200 V3 FOIL PACK AND MIXING NOZZLE

HILTI DISPENSER

HILTI TE-CD OR TE-YD HOLLOW CARBIDE DRILL BIT

HILTI TE-YRT ROUGHENING TOOL

ANCHORING ELEMENTS

FIGURE 5—HILTI HIT-HY 200 V3 ANCHORING SYSTEM

TABLE 30—DEVELOPMENT LENGTH FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT OR HILTI HOLLOW CARBIDE BIT[1, 2, 4]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar size							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal reinforcing bar diameter	d_b	ASTM A615/A706	in.	0.375	0.500	0.625	0.750	0.875	1.000	1.128	1.270
			(mm)	(9.5)	(12.7)	(15.9)	(19.1)	(22.2)	(25.4)	(28.7)	(32.3)
Nominal bar area	A_b	ASTM A615/A706	in^2	0.11	0.20	0.31	0.44	0.60	0.79	1.00	1.27
			(mm^2)	(71)	(129)	(199)	(284)	(387)	(510)	(645)	(819)
Development length for f_y = 60 ksi and f'_c = 2,500 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	in.	12.0	14.4	18.0	21.6	31.5	36.0	40.6	45.7
			(mm)	(304.8)	(365.8)	(457.2)	(548.6)	(800.1)	(914.4)	(1031.4)	(1161.3)
Development length for f_y = 60 ksi and f'_c = 4,000 psi (normal weight concrete)[3]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	in.	12.0	12.0	14.2	17.1	24.9	28.5	32.1	36.1
			(mm)	(304.8)	(304.8)	(361.4)	(433.7)	(632.5)	(722.9)	(815.4)	(918.1)

For **SI:** 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2] Development lengths in SDC C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report.
[3] For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$.
[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, ψ_t = 1.0, ψ_e = 1.0, ψ_s = 0.8 for $d_b \le$ #6, 1.0 for $d_b >$ #6.

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TABLE 31—DEVELOPMENT LENGTH FOR EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT OR HILTI HOLLOW CARBIDE BIT [1, 2, 4]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar size						
				8	10	12	16	20	25	32
Nominal reinforcing bar diameter	d_b	BS 4449: 2005	mm	8	10	12	16	20	25	32
			(in.)	(0.315)	(0.394)	(0.472)	(0.630)	(0.787)	(0.984)	(1.260)
Nominal bar area	A_b	BS 4449: 2005	mm^2	50.3	78.5	113.1	201.1	314.2	490.9	804.2
			(in^2)	(0.08)	(0.12)	(0.18)	(0.31)	(0.49)	(0.76)	(1.25)
Development length for f_y = 72.5 ksi and f'_c = 2,500 psi (normal weight concrete) [3]	l_d	ACI 318-19 25.4.2.4[5] ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	305	348	417	556	871	1087	1392
			(in.)	(12.0)	(13.7)	(16.4)	(21.9)	(34.3)	(42.8)	(54.8)
Development length for f_y = 72.5 ksi and f'_c = 4,000 psi (normal weight concrete) [3]	l_d	ACI 318-19 25.4.2.4[5] ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	305	305	330	439	688	859	1100
			(in.)	(12.0)	(12.0)	(13.0)	(17.3)	(27.1)	(33.8)	(43.3)

For **SI:** 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1]Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2] Development lengths in SDC C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and section 4.2.4 of this report.
[3] For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$.

[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, $\psi_t = 1.0$, $\psi_e = 1.0$, $\psi_s = 0.8$ for $d_b < 20$mm, 1.0 for $d_b \geq 20$mm.

[5] l_d must be increased by 9.5% to account for ψ_g in ACI 318-19 25.4.2.4. ψ_g has been interpolated from Table 25.4.2.5 of ACI 318-10 for fy = 72.5 ksi.

TABLE 32—DEVELOPMENT LENGTH FOR CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT OR HILTI HOLLOW CARBIDE BIT [1, 2, 4]

DESIGN INFORMATION	Symbol	Criteria Section of Reference Standard	Units	Bar size				
				10M	15M	20M	25M	30M
Nominal reinforcing bar diameter	d_b	CAN/CSA-G30.18 Gr. 400	mm	11.3	16.0	19.5	25.2	29.9
			(in.)	(0.445)	(0.630)	(0.768)	(0.992)	(1.177)
Nominal bar area	A_b	CAN/CSA-G30.18 Gr. 400	mm^2	100.3	201.1	298.6	498.8	702.2
			(in^2)	(0.16)	(0.31)	(0.46)	(0.77)	(1.09)
Development length for f_y = 58 ksi and f'_c = 2,500 psi (normal weight concrete) [3]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	315	445	678	876	1041
			(in.)	(12.4)	(17.5)	(26.7)	(34.5)	(41.0)
Development length for f_y = 58 ksi and f'_c = 4,000 psi (normal weight concrete) [3]	l_d	ACI 318-19 25.4.2.4 ACI 318-14 25.4.2.3 ACI 318-11 12.2.3	mm	305	353	536	693	823
			(in.)	(12.0)	(13.9)	(21.1)	(27.3)	(32.4)

For **SI:** 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa.
For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi

[1] Development lengths valid for static, wind, and earthquake loads (SDC A and B).
[2] Development lengths in SDC C through F must comply with ACI 318-19 and ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21 and Section 4.2.4 of this report.
[3] For sand-lightweight concrete, increase development length by 33%, unless the provisions of ACI 318-19 25.4.2.5, ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d) are met to permit $\lambda > 0.75$.

[4] $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, $\psi_t = 1.0$, $\psi_e = 1.0$, $\psi_s = 0.8$ for $d_b < 20$M, 1.0 for $d_b \geq 20$M.

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HILTI

English
Français
Español
Português

Hilti HIT-HY 200-A V3
Hilti HIT-HY 200-R V3

ICC ES
ICC ESR 4868
ICC ESR 4876

Warning

Contains: hydroxypropylmethacrylate (A) 2,2'-(m-tolylimino)diethanol (A) 1,4-Butandiol-dimethacrylat (A) dibenzoyl peroxide (B) May cause an allergic skin reaction. (A, B) Causes serious eye irritation. (B) Very toxic to aquatic life with long lasting effects. (B)

Hilti HIT-HY 200-A/R V3

Rebar: h_{ef} > 20d

			h_{ef}		
HIT-HY 200-A HIT-HY 200-R V3	HDM, HDE	≤ US #5 ≤ EU 16mm ≤ CAN 15M	12 1/2 ... 37 1/2 [inch] 320 ... 960 [mm] 320 ... 960 [mm]	14°F...104°F -10°C...40°C	50°F...86°F 10°C...30°C
HIT-HY 200-A HIT-HY 200-R V3	HDE	≤ US #5 ≤ EU 16mm ≤ CAN 15M	12 1/2 ... 37 1/2 [inch] 320 ... 960 [mm] 320 ... 960 [mm]	14°F...104°F -10°C...40°C	32°F...86°F 0°C...30°C
HIT-HY 200-R V3	HDE	≤ US #8 ≤ EU 25mm ≤ CAN 25M	20 ... 60 [inch] 500 ... 1500 [mm] 504 ... 1512 [mm]	32°F...104°F 0°C...40°C	32°F...86°F 0°C...30°C
HIT-HY 200-R V3	HDE	≤ US #10 ≤ EU 32mm ≤ CAN 30M	25 ... 75 [inch] 640 ... 1920 [mm] 598 ... 1794 [mm]	50°F...86°F 10°C...30°C	50°F...68°F 10°C...20°C

			h_{ef}		
HIT-HY 200-A HIT-HY 200-R V3	HDM, HDE	≤ US #5 ≤ EU 16mm ≤ CAN 15M	12 1/2 ... 37 1/2 [inch] 320 ... 960 [mm] 320 ... 960 [mm]	14°F...104°F -10°C...40°C	50°F...86°F 10°C...30°C
HIT-HY 200-A HIT-HY 200-R V3	HDE	≤ US #5 ≤ EU 16mm ≤ CAN 15M	12 1/2 ... 37 1/2 [inch] 320 ... 960 [mm] 320 ... 960 [mm]	14°F...104°F -10°C...40°C	32°F...86°F 0°C...30°C
HIT-HY 200-R V3	HDE	≤ US #8 ≤ EU 25mm ≤ CAN 25M	20 ... 39 3/8 [inch] 500 ... 1000 [mm] 504 ... 1000 [mm]	32°F...104°F 0°C...40°C	32°F...86°F 0°C...30°C

Hilti HIT-HY 200-A/R V3

HY 200-A V3

[°C]	[°F]	HIT-V, HAS-U, HAS, HAS-E, HIS-N, Rebar: t_{work}	t_{cure}	HIT-Z: t_{work}	t_{cure}
-10...-5	14...23	1,5 h	7 h	⊘	⊘
-4...0	24...32	50 min	4 h	⊘	⊘
1...5	33...41	25 min	2 h	⊘	⊘
6...10	42...50	15 min	75 min	15 min	75 min
11...20	51...68	7 min	45 min	7 min	45 min
21...30	69...86	4 min	30 min	4 min	30 min
31...40	87...104	3 min	30 min	3 min	30 min

HY 200-R V3

[°C]	[°F]	HIT-V, HAS-U, HAS, HAS-E, HIS-N, Rebar: t_{work}	t_{cure}	HIT-Z: t_{work}	t_{cure}
-10...-5	14...23	3 h	20 h	⊘	⊘
-4...0	23...32	90 min	8 h	⊘	⊘
1...5	32...41	45 min	4 h	⊘	⊘
6...10	41...50	30 min	2,5 h	30 min	2,5 h
11...20	50...68	15 min	1,5 h	15 min	1,5 h
21...30	69...86	9 min	1 h	9 min	1 h
31...40	87...104	6 min	1 h	6 min	1 h

h_{ef} [inch]	h_{ef} [mm]	$t_{roughen\ max}$	$t_{blowing\ min}$
0 ...4	0 ... 100	10 sec	30 sec
4.01 ...8	101 ... 200	20 sec	40 sec
8.01 ...12	201 ... 300	30 sec	50 sec
12.01 ...16	301 ... 400	40 sec	60 sec
16.01 ...20	401 ... 500	50 sec	70 sec
20.01 ...25	501 ... 600	60 sec	80 sec

$t_{roughen}$ [sec] = h_{ef} [inch] / 2.5 $t_{roughen}$ [sec] = h_{ef} [mm] / 10

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Hilti HIT-HY 200-A/R V3 — Fractional/Imperial

US Rebar d [inch]	HY 200-A V3 h_{ef} [inch]	HY 200-R V3 h_{ef} [inch]	HY 200-A V3 / HY 200-R V3 h_{ef} [inch]	CA Rebar d [mm]	HY 200-A V3 h_{ef} [mm]	HY 200-R V3 h_{ef} [mm]
#3	2 3/8 ... 22 1/2		3 3/8			
-	-			10 M	75 ... 570	
#4	2 3/4 ... 30		4 1/2			
#5	3 1/8 ... 37 1/2		5 5/8	15 M	80 ... 960	
#6	3 1/2 ... 45		6 3/4			
#7	3 1/2 ... 52 1/2			20 M	90 ... 390	90 ... 1170
#7	4 ... 60					
#8	-	20 ... 60		25 M	101 ... 504	101 ... 1512
#9	4 1/2 ... 67 1/2					
#10	5 ... 75			30 M	120 ... 598	120 ... 1794

HIS-N, -RN d [inch]	h_{ef} [inch]	h_{ef} [inch]	d [inch]	h_{ef} [inch]	T_{inst} [lbf]	d_h [inch]
						1/2
						9/16
						5/8
3/8	4 3/8	4 3/8	7/16	3/8 ... 15/16	≤16	11/16
						3/4
1/2	5	5	9/16	1/2 ... 1 3/16	≤30	7/8
						1
5/8	6 3/4		11/16	5/8 ... 1 1/2	≤60	1 1/8
3/4	8 1/8		13/16	3/4 ... 1 7/8	≤100	1 1/4
						1 3/8
						1 1/2

ø d_h [inch]	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
HIT-RB	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
HIT-SZ	-	1/2	9/16	5/8	11/16	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
HIT-DI	-	1/2	9/16	5/8	11/16	3/4	7/8	1	1	1	1 3/8	1 3/8
HIT-OHC	387551						387552					
TE-YRT	-	-	-	-	-	3/4	7/8	1	1 1/8	-	1 3/8	

HIT-DI: h_{ef} > 10" HIT-RB: h_{ef} > 20d

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FIGURE 6—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII)

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Fractional/Imperial — Hilti HIT-HY 200-A/R V3

HAS / HAS-E / HIT-V						HIT-Z, HIT-Z-R							
d [inch]	h_{ef} [inch]	h_{ef} [inch]	T_{inst} [lb-ft]	d_f [inch]	d_h [inch]	d [inch]	h_{ef} [inch]	h_{ef} [inch]	T_{inst} HIT-Z [lb-ft]	T_{inst} HIT-Z-R [lb-ft]	d_f [inch]	d_h [inch]	d_0 [inch]
3/8	2 3/8 ... 7 1/2	3 3/8	≤15	1/2	7/16	3/8	2 3/8 ... 4 1/2	3 3/8	15	30	1/2	7/16	7/16
1/2	2 3/4 ... 10	4 1/2	≤30	9/16	9/16	1/2	2 3/4 ... 6	4 1/2	30	65	9/16	9/16	9/16
5/8	3 1/8 ... 12 1/2	5 5/8	≤50	13/16"	11/16	5/8	3 3/4 ... 7 1/2	5 5/8	60	125	13/16"	11/16	3/4
3/4	3 1/2 ... 15	6 3/4	≤100	15/16	13/16	3/4	4 ... 8 1/2	6 3/4	110	185	15/16"	13/16	7/8
7/8	3 1/2 ... 17 1/2	6 3/4	≤125	1 1/8"	15/16								1
1	4 ... 20	-	≤150	1 1/4"	1 1/8								1 1/8
													1 1/4
1 1/4	5 ... 25	-	≤200	1 1/2"	1 3/8								1 3/8
													1 1/2

HIT-RE-M			HIT-OHW
Art. No.			Art. No.
337111	HDM 330/500 HDE 500	VC 140/150/300	387550

Ø			
d_0 [inch]	[inch]	Art. No. 381215	
7/16"...1 1/8"	2 3/4"...20"	✔	≥ 6 bar/90 psi @ 6 m³/h
1 1/4"...1 1/2"	4"...25"	–	≥ 140 m³/h/ ≥82 CFM

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Hilti HIT-HY 200-A/R V3 — Metric Values

Rebar

HIS-N, -RN

Rebar		HIS-N, -RN					HAS-U / HIT-V					
d [mm]	h_{ef} [mm]	d [mm]	h_{ef} [mm]	d_f [mm]	h_s [mm]	T_{inst} [Nm]	d [mm]	h_{ef} [mm]	T_{inst} [Nm]	d_f [mm]	d_h [mm]	ø d_0 [mm]
							M6	60-160	≤10	11	9	10
8	60...480						M10	60-200	≤20	14	12	12
10	60...600	M8	90	9	8-20	≤10	M12	70-240	≤40	16	14	14
12	70...720											16
14	75...1000	M10	110	12	10-25	≤20	M16	80-320	≤80	20"	18	18
16	80...1000											20
18	85...1000	M12	125	14	12-30	≤40	M20	90-400	≤150	24"	22	22
20	90...1000											25
22	95...1000	M16	170	18	16-40	≤80	M24	96-480	≤200	30"	26	28
							M27	108-540	≤270	32"	30	30
24/25	96/100...1000	M20	205	22	20-50	≤150						32
28/28	104/112...1000						M30	120-600	≤300	37"	33	35
30	120...1000											37
32	126...1000											40

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Metric Values — Hilti HIT-HY 200-A/R V3

HAS-U / HIT-V / HAS / HAS-E

HIT-Z, -R

HIT-DL: h_{ef} > 250mm HIT-RB: h_{ef} > 20d

HIT-Z / HIT-Z-R											
d [mm]	h_{nom} [mm]	T_{inst} HIT-Z [Nm]	T_{inst} HIT-Z-R [Nm]	d_f [mm]	d_h [mm]	ø d_0 [mm]	HIT-RB	HIT-SZ	HIT-DL	HIT-OHC	TE-YRT
M8	60-96	10	30	11	9	10	10				
M10	60-120	25	55	14	12	12	12	12	12		
M12	60-144	40	75	16	14	14	14	14	14	387551	
						16	16	16	16		
M16	96-192	80	155	20"	18	18	18	18	18		18
						20	20	20	20		20
M20	100-220	150	215	24"	22	22	22	22	20		22
						25	25	25	25		25
						28	28	28	25		28
						30	30	30	25	387552	30
						32	32	32	32		32
						35	35	35	32		35

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FIGURE 6—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

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Hilti HIT-HY 200-A/R V3

EN **Adhesive anchoring system for rebar and anchor fastenings in concrete.**

Hilti HIT-HY 200-A/-R V3

Contains: Hydroxypropylmethacrylat (A), 1,4-Butandiol-dimethacrylat (A), Dibenzoylperoxid (B) 2,2'-(m-tolylimino)diethanol (A)

Warning May cause an allergic skin reaction. (A, B) | Causes serious eye irritation. (B) | Very toxic to aquatic life with long lasting effects. (B) | Do not get in eyes, on skin or on clothing. | Wear eye protection, protective clothing, protective gloves. | IF ON SKIN: Wash with plenty of water. | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. | If skin irritation or rash occurs: Get medical advice/attention. | If eye irritation persists: Get medical advice/attention.

Disposal considerations: Empty packs: Leave the mixer attached and dispose of via the local Green Dot recovery system or EAK waste material code: 150102 plastic packaging **Full or partially emptied packs:** Must be disposed of as special waste in accordance with official regulations. EAK waste material code: 08 04 09* waste adhesives and sealants containing organic solvents or other dangerous substances. or EAK waste material code: 20 01 27* paint, inks, adhesives and resins containing dangerous substances.

Product information: Always keep these instructions together with the product even when given to other persons. **Material Safety Data Sheet:** Review the MSDS before use. **Check expiration date:** See imprint on foil pack manifold (month/year). Do not use expired product. **Foil pack temperature during usage:** 0 °C to 40 °C / 32 °F to 104 °F. **Base material temperature at time of installation: HAS-U, HIT-V, HIS, Rebar:** between -10 °C and 40 °C / 14 °F and 104 °F; **HIT-Z:** between +5°C and 40°C / 41°F and 104°F. **Conditions for transport and storage:** Keep in a cool, dry and dark place between 5 °C and 25 °C / 41 °F and 77 °F. For any application not covered by this document / beyond values specified, please contact Hilti. **Partly used foil packs must remain in the cassette** and has to be used within **4 weeks**. Leave the mixer attached on the foil pack manifold and **store within the cassette** under the recommended storage conditions. If reused, attach a new mixer and discard the initial quantity of anchor adhesive.

Failure to observe these installation instructions, use of non-Hilti anchors, poor or questionable concrete conditions, or unique applications may affect the reliability or performance of the fastenings.

⚠ NOTICE

⚠ The surface of the HIT-Z anchor rod must not be altered in any way.

⚠ The thread of HIT-Z must stay free from dirt and dust during the installation procedure and its cones must be fully embedded into mortar (especially at minimum embedment). Torque moment must always be applied on HIT-Z nut and washer installed above a solid baseplate laying on concrete.

⚠ Improper handling may cause mortar splashes. Always wear safety glasses, gloves and protective clothes during installation. | Never start dispensing without a mixer properly screwed on. | Attach a new mixer prior to dispensing a new foil pack (ensure snug fit). | Use only the type of mixer (HIT-RE-M) supplied with the adhesive. Do not modify the mixer in any way. | Never use damaged foil packs and/or damaged or unclean foil pack holders (cassettes).

⚠ Poor load values / potential failure of fastening points due to inadequate borehole cleaning. Hilti hollow drill bits TE-CD, TE-YD must be used in conjunction with a properly maintained Hilti vacuum cleaner with model and suction capacity (volumetric flow rate) as specified in the accessory table. | The boreholes must be free of debris, dust, water, ice, oil, grease and other contaminants prior to adhesive injection. | For blowing out the borehole – blow out with oil free air until return air stream is free of noticeable dust. | For flushing the borehole – flush with water line pressure until water runs clear. | For brushing the borehole – only use specified wire brush. The brush must resist insertion into the borehole – if not the brush is too small and must be replaced. | Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application). | Do not exceed the roughening time when roughening the drilled hole!

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⚠ Ensure that boreholes are filled from the back of the borehole without forming air voids. If necessary use the accessories / extensions to reach the back of the borehole. | For overhead applications use the overhead accessories HIT-SZ and take special care when inserting the fastening element. Excess adhesive may be forced out of the borehole. Make sure that no mortar drips onto the installer. | In water saturated concrete it is required to set the anchor immediately after cleaning the borehole.

⚠ Not adhering to these setting instructions can result in failure of fastening points!

FIGURE 6—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

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4.1 Ø d_0 [mm]	TE-YRT
18	TE-YRT 18/320
20	TE-YRT 20/320
22	TE-YRT 22/400
25	TE-YRT 25/400
28	TE-YRT 28/480
30	TE-YRT 30/540
32	TE-YRT 32/500
35	TE-YRT 35/600
Ø d_0 [inch]	TE-YRT
3/4"	TE-YRT 3/4" / 12 1/2"
7/8"	TE-YRT 7/8" / 15"
1"	TE-YRT 1" / 17 1/2"
1 1/8"	TE-YRT 1 1/8" / 20"
1 3/8"	TE-YRT 1 3/8" / 25"

6 TE-YRT	(i) RTG
TE-YRT 18/320	RTG 18
TE-YRT 20/320	RTG 20
TE-YRT 22/400	RTG 22
TE-YRT 25/400	RTG 25
TE-YRT 28/480	RTG 28
TE-YRT 30/540	RTG 30
TE-YRT 32/500	RTG 32
TE-YRT 35/600	RTG 35
TE-YRT	(i) RTG
TE-YRT 3/4" / 12 1/2"	RTG 3/4"
TE-YRT 7/8" / 15"	RTG 7/8"
TE-YRT 1" / 17 1/2"	RTG 1"
TE-YRT 1 1/8" / 20"	RTG 1 1/8"
TE-YRT 1 3/8" / 25"	RTG 1 3/8"

9.1 h_{ef} [mm]	$t_{roughen}$ (= h_{ef} / 10)
0 ... 100	10 sec
101 ... 200	20 sec
201 ... 300	30 sec
301 ... 400	40 sec
401 ... 500	50 sec
501 ... 600	60 sec
h_{ef} [inch]	$t_{roughen}$ (= h_{ef} / 2.5)
0 ... 4	10 sec
4.01 ... 8	20 sec
8.01 ... 12	30 sec
12.01 ... 16	40 sec
16.01 ... 20	50 sec
20.01 ... 25	60 sec

12 Ø d_0 [mm]	TE-YRT
17,9 ... 18,2	TE-YRT 18/320
19,9 ... 20,2	TE-YRT 20/320
21,9 ... 22,2	TE-YRT 22/400
24,9 ... 25,2	TE-YRT 25/400
27,9 ... 28,2	TE-YRT 28/480
29,9 ... 30,2	TE-YRT 30/540
31,9 ... 32,2	TE-YRT 32/500
34,9 ... 35,2	TE-YRT 35/600
Ø d_0 [inch]	TE-YRT
0.764 ... 0.776	TE-YRT 3/4" / 12 1/2"
0.862 ... 0.874	TE-YRT 7/8" / 15"
1.008 ... 1.020	TE-YRT 1" / 17 1/2"
1.146 ... 1.157	TE-YRT 1 1/8" / 20"
1.374 ... 1.386	TE-YRT 1 3/8" / 25"

FIGURE 6—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII) (Continued)

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI HIT-HY 200 V3 ADHESIVE ANCHORS AND POST INSTALLED REINFORCING BAR CONNECTIONS IN CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti HIT HY 200 Adhesive Anchoring System and Post-Installed Reinforcing Bar System for cracked and uncracked concrete, described in ICC-ES evaluation report ESR-4868, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2023 *City of Los Angeles Building Code* (LABC)
- 2023 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Hilti HIT-HY 200 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the evaluation report ESR-4868, complies with the LABC Chapter 19, and the LARC, and is subjected to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Hilti HIT HY 200 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-4868.
- The design, installation, conditions of use and identification of the Hilti HIT-HY 200 V3 Adhesive Anchoring System and Post-Installed Reinforcing Bar System are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-4868.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the evaluation report and tables are for the connection of the adhesive anchors and post-installed reinforcing bars to the concrete. The connection between the adhesive anchors or post-installed reinforcing bars and the connected members shall be checked for capacity (which may govern).
- For use in wall anchorage assemblies to flexible diaphragm, anchors shall be designed per the requirements of City of Los Angeles Information Bulletin P/BC 2020-071.

This supplement expires concurrently with the evaluation report, reissued November 2024.

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ICC-ES Evaluation Report

ESR-4868 FL Supplement w/ HVHZ

Reissued November 2024

This report is subject to renewal November 2026.

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

HILTI, INC.

EVALUATION SUBJECT:

HILTI HIT-HY 200 V3 ADHESIVE ANCHORS AND POST INSTALLED REINFORCING BAR CONNECTIONS IN CONCRETE

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Hilti HIT-HY 200 V3 Adhesive Anchors and Post-Installed Reinforcing Bar System in Concrete, described in ICC-ES evaluation report ESR-4868, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2023 *Florida Building Code—Building*
- 2023 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Hilti HIT-HY 200 V3 Adhesive Anchor System and Post-Installed Reinforcing Bar System, described in Sections 2.0 through 7.0 of the ICC-ES evaluation report ESR-4868, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design requirements are in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4868 for the 2021 *International Building Code®* meet the requirements of the *Florida Building Code—Building* or the *Florida Building Code—Residential.*

Use of the Hilti HIT-HY 200 V3 Adhesive Anchor System and Post-Installed Reinforcing Bar System have also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential*, with the following condition:

a) For anchorage of wood members, the connection subject to uplift must be designed for no less than 700 pounds (3114 N).

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued November 2024.

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SECTION 5.0 EQUIPMENT

5.1 Biological Odor Control System (I-BOx®)

5.2 Exhaust Fan

5.3 Nutrient Injection System

5.1 Biological Odor Control System (I-BOx®)

- General Layout Drawings
- General Arrangement Drawings
- Process and Instrumentation Diagrams (P&ID)
- FRP material data sheets

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 8025)

AIR FLOW RATE	4,300 CFM
H2S CAPACITY	50 PPM (AVG); 100 PPM (MAX)
DIMENSIONS	30'-0" L X 7'-10" W 8'-4" SSH
VESSEL APPROX. SHIPPING WEIGHT	8,100 LB
MEDIA APPROX. SHIPPING WEIGHT	49,200 LB
MEDIA APPROX. SHIPPING WEIGHT	49,200 LB
INLET DUCT DIA.	19-3/8" SLIP

PLAN VIEW
OPTION A

EQUIPMENT PAD SLOPE DETAILS

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS.

FABRICATION	MACHINE
.XX +/- .06	.XXX +/-.005
.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

STD: BORDER-11X17MI

BAR = 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/18/25	TT			

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MANAGER		
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SCALE:	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM OPTION A
GENERAL LAYOUT DRAWING

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
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TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_L1	1 OF 6	A

SECTION B-B
NTS

SECTION C-C
NTS

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS.

FABRICATION	MACHINE
.XX +/- .06	.XXX +/-.005
.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

STD: BORDER-11X17MI

BAR = 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/18/25	TT			

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DESIGNER	TrevorTill	DATE 7/17/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	40243_L1.iam	
SCALE:		

TITLE HILO WWTP
DETAIL VIEW OPTION A
GENERAL LAYOUT DRAWING

CLIENT NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_L1	2 OF 6	A

PIPE AND FITTINGS TO CONFORM TO:

RESIN: DERAKANE 411
SURFACING VEIL: NEXUS 111-00010
TOTAL MINIMUM LINER THICKNESS: 100 MIL
MAT: 3 OZ E-GLASS
FINISH: GELCOAT 12M, WHITE
PRESSURE RATING: 15" WC
VACUUM RATING: 8" WC

IBOX 8025 EXHAUST HEADER DUCTWORK
QTY 2

GENERAL NOTES:

1. FABRICATION SHALL BE IN ACCORDANCE WITH NBS PS 15-69
2. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563
3. ALL FLANGES SHALL BE DRILLED PER NBS PS 15-69
4. ALL LIQUID NOZZLES LESS THAN 6" DIAMETER SHALL HAVE 1/4" THK FLAT PLATE GUSSETS
5. EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR. COLOR TO BE WHITE
6. ALL DRAWINGS ARE TO SCALE, HOWEVER, SHEETS MAY CONTAIN VIEWS WITH DIFFERING SCALES
7. AN EXTRA 3" HAS BEEN ADDED TO AN END OF SOME DUCT FIELD JOINTS. IF AN ITEM IS DIMENSIONED OFF A FIELD JOINT END, THAT 3" IS ADDED TO THE LOCATING DIMENSION FOR THAT ITEM ALSO.
8. HOLD BACK GEL COAT APPROPRIATELY ON EACH FIELD JOINT. GEL COAT TO BE FIELD APPLIED ON FIELD JOINTS.
9. **FIELD JOINT KITS ARE TO BE PROVIDED BY THE FRP FABRICATOR, ONE PER FIELD JOINT.**
10. UNLESS OTHERWISE SPECIFIED, ALL DUCT WALL THICKNESS SHALL BE 1/8"
11. REFER TO SHEET 4 FOR MARK DETAIL

THIRD ANGLE PROJECTION

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DESIGNER	TrevorTill	DATE 7/18/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	F5717.iam	
SCALE:		

TITLE: HILO WWTP
OPTION A LAYOUT DRAWING
IBOX 8025 HEADER DUCTWORK

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		F5717	3 OF 6	A

NOTE:
AN EXTRA 3" HAS BEEN ADDED AND GELCOAT IS HELD BACK 6" WHERE "TRIM TO FIT" IS INDICATED.
GELCOAT IS HELD BACK AN APPROPRIATE DISTANCE WHERE "FIELD JOINT" IS INDICATED.

MARK 1
QTY 5

MARK 2
QTY 2

MARK 3
QTY 2

MARK 4
QTY 2

MARK 5
QTY 1

DAMPER
QTY 5

THIRD ANGLE PROJECTION

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FILE:	F5717.iam	
SCALE:		

TITLE: HILO WWTP
OPTION A MARK DETAIL
IBOX 8025 HEADER DUCTWORK

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		F5717	4 OF 6	A

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 8025)

AIR FLOW RATE	4,300 CFM
H2S CAPACITY	50 PPM (AVG); 100 PPM (MAX)
DIMENSIONS	30'-0" L X 7'-10" W 8'-4" SSH
VESSEL APPROX. SHIPPING WEIGHT	8,100 LB
MEDIA APPROX. SHIPPING WEIGHT	49,200 LB
INLET DUCT DIA.	19-3/8" SLIP

PLAN VIEW
OPTION B

EQUIPMENT PAD SLOPE DETAILS

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
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DESIGNER	TrevorTill	7/17/2025
CHECKER		
ENGINEER		
MANAGER		
FILE:	40243_L1.iam	
SCALE:	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM OPTION B
GENERAL LAYOUT DRAWING

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_L1	5 OF 6	A

SECTION D-D

SECTION E-E

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
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DESIGNER	TrevorTill	DATE 7/17/2025
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ENGINEER		DATE
MANAGER		DATE
FILE:	40243_L1.iam	
SCALE:	DNS	

TITLE HILO WWTP
DETAIL VIEW OPTION B
GENERAL LAYOUT DRAWING

CLIENT NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_L1	6 OF 6	A

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 5000 TALL)

AIR FLOW RATE	400 CFM
H2S CAPACITY	50 PPM (AVG.); 100 PPM (MAX)
DIMENSIONS	7'-6" L X 5'-0" W X 7'-4" SSH
EST. SHIPPING WEIGHT	8,312 LB
OPERATING WEIGHT	~9,000 LB
INLET DUCT DIA.	7-3/8" SLIP INLET

PLAN VIEW

THIRD ANGLE PROJECTION

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DESIGNER	TrevorTill	7/23/2025
CHECKER		
ENGINEER		
MANAGER		
FILE:	40243_L2.iam	
SCALE:	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM
GENERAL LAYOUT DRAWING

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_L2	1 OF 2	A

ELEVATION VIEW

THIRD ANGLE PROJECTION

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TITLE: HILO WWTP
DETAIL VIEW
GENERAL LAYOUT DRAWING

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_L2	2 OF 2	A

NOTES:
1. ALL INLET DUCT SUPPORT, HANGERS, AND HARDWARE BY OTHERS.
2. WALL/ROOF PENETRATION, FLASHING, & SEALS TO BE PROVIDED BY OTHERS, IF REQUIRED.
3. FIELD JOINTS TO BE PROVIDED AND INSTALLED BY OTHERS, IF REQUIRED.
4. ALL DUCT FLANGES SHALL BE DRILLED PER NBS PS 15-69.
5. INLET DUCT BY OTHERS.
6. INSTALL SCRUBBER VESSEL ON 1/4" NEOPRENE PAD, 60 DUROMETER [PROVIDED BY IMS]
7. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
8. ALL LIQUID NOZZLES AND FLANGES LESS THAN ⌀6" SHALL HAVE 1/4" FLAT PLATE GUSSETS.
9. ALL BOLT HOLES ARE TO STRADDLE THE TANK'S NATURAL CENTERLINES.
10. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
11. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
12. ALL PIPING AND VALVES ARE PVC.
13. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
14. 6" MINIMUM BAROMETRIC P-TRAP ON DRAIN, PROVIDED AND INSTALLED BY OTHERS.

SHIPPING COMPONENTS:
1. SYSTEM VESSEL W/ ANCHORING HARDWARE
2. EXHAUST STACK TRANSITION W/ HARDWARE (5X)
3. NEOPRENE PAD (X2)
4. EXPANDED CLAY MEDIA
5. CARBON MEDIA
6. HEADER DUCTWORK

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER FROM REMOTE ELECTRICAL CONTROL PANEL TO FAN MOTOR.
2. ELECTRICAL CONNECTION FROM DIFFERENTIAL PRESSURE SWITCH TO REMOTE ELECTRICAL CONTROL PANEL.
3. TUBING CONNECTION FROM FAN INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
5. ANY REQUIRED FILL AND DRAIN PIPING.
6. DUCTWORK CONNECTION TO SYSTEM FAN INLET AND FROM EXHAUST STACK FLANGE.
7. DUCTWORK CONNECTION FROM EXHAUST STACK TO HEADER DUCTING.

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER FT. FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT PAD ON TOP OF A 1/4" NEOPRENE PAD. MAKE SURE THAT THE PAD IS CLEAN AND ANY PEBBLES OR IMPERFECTIONS IN THE CONCRETE HAVE BEEN REMOVED.
4. REMOVE THE GRATING AND INSTALL THE CLAY MEDIA.
   CLAY MEDIA DEPTH - 54"
5. REINSTALL ALL THE GRATING AND THE SUPPORT SCREEN ON TOP OF THE GRATING.
6. INSTALL THE CARBON MEDIA ON TOP OF THE GRATING W/ SCREEN.
   CARBON MEDIA DEPTH - 18"
7. SET AND SECURE EXHAUST STACK TRANSITION PIECES.
8. CONNECT HEADER DUCTWORK TO TOP EXHAUST STACKS.
9. CONNECT PIPING FROM REMOTE SKID TO SYSTEM INLET.
10. CONNECT DRAIN PIPING TO SYSTEM.
11. CONNECT DUCTWORK TO FAN INLET.
12. COMPLETE ALL REQUIRED WIRING.

PLAN VIEW

ISOMETRIC VIEW

P-TRAP
INSTALLED BY OTHERS.
2" PIPE AND FITTINGS.

ELEVATION VIEW

END VIEW

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 8025)

AIR FLOW RATE	4,300 CFM
H2S CAPACITY	50 PPM (AVG); 100 PPM (MAX)
DIMENSIONS	30'-0" L X 7'-10" W 8'-4" SSH
VESSEL APPROX. SHIPPING WEIGHT	8,100 LB
MEDIA APPROX. SHIPPING WEIGHT	49,200 LB
INLET DUCT DIA.	19-3/8" SLIP

EQUIPMENT PAD SLOPE DETAILS

THIRD ANGLE PROJECTION

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DESIGNER	TrevorTill	DATE 7/11/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	40243_G1.iam	
SCALE:	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM
GENERAL ARRANGEMENT DRAWING (I-BOx® 8025 TALL)

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_G1	1 OF 1	A

NOTES:
1. ALL INLET DUCT SUPPORT, HANGERS, AND HARDWARE BY OTHERS.
2. WALL/ROOF PENETRATION, FLASHING, & SEALS TO BE PROVIDED BY OTHERS, IF REQUIRED.
3. FIELD JOINTS TO BE PROVIDED AND INSTALLED BY OTHERS, IF REQUIRED.
4. ALL DUCT FLANGES SHALL BE DRILLED PER NBS PS 15-69.
5. INLET DUCT BY OTHERS.
6. INSTALL SCRUBBER VESSEL ON 1/4" NEOPRENE PAD, 60 DUROMETER [PROVIDED BY IMS]
7. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
8. ALL LIQUID NOZZLES AND FLANGES LESS THAN ⌀6" SHALL HAVE 1/4" FLAT PLATE GUSSETS.
9. ALL BOLT HOLES ARE TO STRADDLE THE TANK'S NATURAL CENTERLINES.
10. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
11. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
12. ALL PIPING AND VALVES ARE PVC.
13. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
14. 6" MINIMUM BAROMETRIC P-TRAP ON DRAIN, PROVIDED AND INSTALLED BY OTHERS.

SHIPPING COMPONENTS:
1. SYSTEM VESSEL W/ ANCHORING HARDWARE
2. EXHAUST STACK TRANSITION W/ HARDWARE
3. NEOPRENE PAD
4. NUTRIENT
5. NO-LOSS EXHAUST STACK

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER FROM REMOTE ELECTRICAL CONTROL PANEL TO FAN MOTOR.
2. ELECTRICAL CONNECTION FROM DIFFERENTIAL PRESSURE SWITCH TO REMOTE ELECTRICAL CONTROL PANEL.
3. TUBING CONNECTION FROM FAN INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
5. ANY REQUIRED FILL AND DRAIN PIPING.
6. DUCTWORK CONNECTION TO SYSTEM FAN INLET AND FROM EXHAUST STACK. (IF REQ.)

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER 12" FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT PAD ON TOP OF A 1/4" NEOPRENE PAD. MAKE SURE THAT THE PAD IS CLEAN AND ANY PEBBLES OR IMPERFECTIONS IN THE CONCRETE HAVE BEEN REMOVED.
4. SET AND SECURE EXHAUST STACK TRANSITION PIECE AND NO-LOSS EXHAUST STACK.
5. CONNECT PIPING FROM REMOTE SKID TO SYSTEM INLET.
6. CONNECT DRAIN PIPING TO SYSTEM.
7. CONNECT DUCTWORK TO FAN INLET.
8. COMPLETE ALL REQUIRED WIRING.

EQUIPMENT PAD SLOPE DETAILS

BIOLOGICAL ODOR CONTROL SYSTEM (I-BOx® 5000 TALL)

AIR FLOW RATE	400 CFM
H2S CAPACITY	50 PPM (AVG.); 100 PPM (MAX)
DIMENSIONS	7'-6" L X 5'-0" W X 7'-4" SSH
EST. SHIPPING WEIGHT	8,312 LB
OPERATING WEIGHT	~9,000 LB
INLET DUCT DIA.	7-3/8" SLIP INLET

PLAN VIEW

ISOMETRIC VIEW

P-TRAP PROVIDED AND INSTALLED BY OTHERS. 1" PIPE AND FITTINGS.

ELEVATION VIEW

END VIEW

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM. DIMENSIONS IN [mm] ARE MILLIMETERS. DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M UNLESS OTHERISE SPECIFIED ALL DIMENSIONS ARE INCHES AND TOLERANCES TO BE AS FOLLOWS.

FABRICATION	MACHINE
.XX +/- .06	.XXX +/-.005
.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

STD: BORDER-11X17MI BAR = 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/15/25	TT			

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DESIGNER	TrevorTill	DATE 7/15/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	40243_G2.iam	
SCALE:	NTS	

TITLE: HILO WWTP
BIOLOGICAL ODOR CONTROL SYSTEM
GENERAL ARRANGEMENT DRAWING (I-BOx® 5000 TALL)

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
SAN DIEGO, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_G2	1 OF 1	A

NOTES:
1. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
2. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
3. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
4. ALL PIPING AND VALVES ARE PVC.
5. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
6. SUPPLY WATER PRESSURE SHALL BE BETWEEN 30-60 PSI AND A FLOW RATE OF AT LEAST 18 GPM.

SHIPPING COMPONENTS:
1. SYSTEM SKID W/ ANCHORING HARDWARE
2. NUTRIENT SUPPLY

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER TO ELECTRICAL CONTROL PANEL.
2. ELECTRICAL CONNECTION FROM ELECTRICAL CONTROL PANEL TO FAN MOTOR.
3. ELECTRICAL CONNECTION FROM REMOTE ELECTRICAL CONTROL PANEL TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM WATER SUPPLY TO WATER INLET FLANGE.
5. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
6. WIRING CONNECTIONS FROM ELECTRICAL CONTROL PANEL TO PLANT SCADA

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER FT. FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT.
4. CONNECT ALL REQUIRED PIPING.
5. COMPLETE ALL REQUIRED WIRING.

ISOMETRIC VIEW

END VIEW

ELEVATION VIEW

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERISE SPECIFIED
ALL DIMENSIONS ARE INCHES
AND TOLERANCES TO BE AS FOLLOWS.

FABRICATION	MACHINE
.XX +/- .06	.XXX +/-.005
.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
< +/- .5	[X +/- .05]

STD: BORDER-11X17MI

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DESIGNER	TrevorTill	DATE 7/15/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:		
SCALE:	DNS	

TITLE: HILO WWTP
REMOTE NUTRIENT SKID (8025) GENERAL ARRANGEMENT

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243		40243_G3	1 OF 1	A

NOTES:
1. QUALITY ASSURANCE SHALL BE IN ACCORDANCE WITH ASTM D2563.
2. FABRICATION SHALL BE IN ACCORDANCE WITH ASTM 4097 & NBS PS 15-69.
3. TANK EXTERIOR TO BE GELCOATED WITH UV-A ULTRAVIOLET LIGHT INHIBITOR, COLOR TO BE WHITE.
4. ALL PIPING AND VALVES ARE PVC.
5. BACKFLOW PREVENTER, IF REQUIRED, TO BE PROVIDED AND INSTALLED BY OTHERS.
6. SUPPLY WATER PRESSURE SHALL BE BETWEEN 30-60 PSI AND A FLOW RATE OF AT LEAST 6 GPM.

SHIPPING COMPONENTS:
1. SYSTEM SKID W/ ANCHORING HARDWARE
2. NUTRIENT SUPPLY

CONNECTIONS BY INSTALLER:
1. 480VAC / 60 HZ / 3 PHASE POWER TO ELECTRICAL CONTROL PANEL.
2. ELECTRICAL CONNECTION FROM ELECTRICAL CONTROL PANEL TO FAN MOTOR.
3. ELECTRICAL CONNECTION FROM REMOTE ELECTRICAL CONTROL PANEL TO DIFFERENTIAL PRESSURE SWITCH.
4. PIPING FROM WATER SUPPLY TO WATER INLET FLANGE.
5. PIPING FROM REMOTE SKID NUTRIENT SOLUTION DISCHARGE TO SYSTEM INLET FLANGE.
6. WIRING CONNECTIONS FROM ELECTRICAL CONTROL PANEL TO PLANT SCADA

INSTALLATION INSTRUCTIONS:
1. REMOVE VESSEL USING APPROPRIATE SIZED FORKLIFT.
2. EQUIPMENT PAD TO BE SLOPED AT 1/16" PER FT. FROM FAN (HIGH SIDE) TO DRAIN (LOW SIDE).
3. SET AND BOLT VESSEL TO THE EQUIPMENT.
4. CONNECT ALL REQUIRED PIPING.
5. COMPLETE ALL REQUIRED WIRING.

ISOMETRIC VIEW

END VIEW

ELEVATION VIEW

THIRD ANGLE PROJECTION

ALL WELD SYMBOL DIMENSIONS ARE MINIMUM.
DIMENSIONS IN [mm] ARE MILLIMETERS.
DO NOT SCALE DRAWING

DRAWN PER ASME Y14.5M
UNLESS OTHERISE SPECIFIED
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FABRICATION	MACHINE
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.X +/- .13	.XX +/-.01
[X +/- .25]	.X +/- .03
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DESIGNER	TrevorTill	DATE 7/16/2025
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:		
SCALE:	DNS	

TITLE
REMOTE NUTRIENT SKID (8025) GENERAL ARRANGEMENT

CLIENT
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
		40243_G4	1 OF 1	A

INSTRUMENT SOCIETY OF AMERICA TABLE: IDENTIFICATION LETTERS

	FIRST LETTER		SUCCEEDING LETTER		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY		CONTROL	CONTROL	
D	USER'S CHOICE	DIFFERENTIAL			
E	VOLTAGE		SENSORY (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE	CONTROL STATION	CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	USER'S CHOICE	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	OPERATING		ORIFICE (RESTRICTION)		
P	PRESSURE, VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE, TOTAL			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY	SWITCH	SWITCH	
T	TEMPERATURE		TRANSMIT	TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V			VALVE, DAMPER, LOUVER	VALVE, LOUVER, DAMPER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X-AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y-AXIS	RELAY, COMPUTE, CONVERT	RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z-AXIS	DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

ABBREVIATION

AC ALTERNATING CURRENT
AI ANALOG INPUT
AL ALARM
AM AUTO-MANUAL
AMR AUTO-MANUAL-REMOTE
AO ANALOG OUTPUT
AVG AVERAGE
C CLOSE
CA COMMON ALARM
CL CENTERLINE
CCS CENTRAL CONTROL STATION
CSP CONSTANT SPEED PUMP
DC DIRECT CURRENT
DI DISCRETE INPUT
DO DISCRETE OUTPUT
DIA DIAMETER
EL ELEVATION
ETM ELAPSED TIME METER
FA FOULED AIR
GAL GALLON
GPD GALLON PER DAY
GPH GALLON PER OUR
GPM GALLON PER MINUTE
HP HORSE POWER
HOA HAND-OFF-AUTO
I/O INPUT/OUTPUT
ICP INSTRUMENT CONTROL PANEL
LCP LOCAL CONTROL PANEL
LR LOCAL-REMOTE
MCC MOTOR CONTROL CENTER
NC NORMALLY CLOSED
NO NORMALLY OPENED
O OPEN
OAC OPEN-AUTO-CLOSE
OO ON-OFF
OOR ON-OFF-REMOTE
ORO OFF-RESET-ON
OSC OPEN-STOP-CLOSE
SEL SELECT
P PROPORTIONAL
PA PLANT AIR
P/A PULSE TO ANALOG
PC PARTICLE COUNTER
PC PERSONAL COMPUTER
PID PROP-INTE-DERI
PLC PROGRAMMABLE LOGIC CONTROLLER
PSI POUND PER SQUARE INCH
RED REDUCER
RPM REVOLUTION PER MINUTE
RTU REMOTE TERMINAL UNIT
RSP REMOTE SET POINT
SCS SUPERVISOR CONTROL STATION
SP SET POINT
SCFM STANDARD CUBIC FEET PER MINUTE
SS START-STOP
TA TREATED AIR
TDH TOTAL DYNAMIC HEAD
TOT TOTALIZATION
TPC TIME PROPORTIONAL CONTROL
TSR TWISTED SHIELD PAIR
TTR TONE TELEMETRY RECEIVER
TTT TONE TELEMETRY TRANSMITTER
TURB TURBIDITY
VSP VARIABLE SPEED PUMP
VFD VARIABLE SPEED DRIVE
WC WATER COLUMN

PIPING AND TUBING MATERIALS

ABS ACRYLONTRILE BUTADIENE STYRENE TRUSS PIPE
AL ALUMINIUM PIPE OR TUBING
ARP ALUMINIUM REINFORCED PLASTIC PIPE
BL BLACK IRON PIPE
BPT BRAIDED PLASTIC TUBING - PVC
CI CAST IRON PIPE
CISP CAST IRON SOIL PIPE
CMCP CORRUGATED METAL CULVERT PIPE
CMH CHEMICAL HOSE
CMP CORRUGATED METAL PIPE
COP COPPER PIPE
CPVC CHLORINATED POLYVINYL CHLORIDE PIPE
CS CARBON STEEL PIPE
DI DUCTILE CAST IRON PIPE
ERP EPOXY RESIN PIPE
FRP FIBERGLASS REINFORCED PLASTIC PIPE
GS GALVANIZED STEEL PIPE
HOSE FLEXIBLE HOSE
HSI HIGH SILICON IRON PIPE
KLS PVDF LINED STEEL PIPE (KYNAR(r) LINED PIPE)
KYN PVDF(KYNAR) TYP.
MI CARON STEEL PIPE W/ MALLEABLE IRON FITTINGS
NEO NEOPRENE HOSE
NI NICKEL ALLOY PIPE
NLS NEOPRENE LINED STEEL PIPE
PEP POLYETHYLENE PIPE
PETB POLYETHYLENE TUBING
PLS POLYPROPYLENE
LINED STEEL PIPE
POP POLYPROPYLENE PIPE
PRP PHENOLIC RESIN PIPE
PVC POLYVINYL CHLORIDE PIPE
PVCH PVC HOSE
PVDF POLYVINYLIDENE FLUORIDE PIPE
RBR RUBBER HOSE
RCCP REINFORED CONCRETE CULVERT PIPE
CRP REINFORCED CONCRETE PIPE
SAR SARAN TUBING
SLH SLUDGE HOSE
SLS SARAN LINED STEEL PIPE
SS STAINLESS STEEL TUBING OR PIPE
TEF TEFLON TUBING
TI TITANIUM ALLOY PIPE
TLS TEFLON LINDED STEEL PIPE
TYP TYGON(R) TUBING-BRAIDED
TYG TYGON(R) TUBING-UNBRAIDED

INSTRUMENT IDENTIFICATION

PLC CONTROL
PILOT LIGHT
INSTRUMENT
RESET BUTTON
INTERLOCK

PIPING ACCESSORIES

CONCENTRIC REDUCER
FLANGE
ANNUBAR TUBE
CAP
VENT
PLUG
UNION
EJECTOR EDUCTOR
HOSE CONNECTOR

VALVES & GATES

BUTTERFLY VALVE
CHECK VALVE
DIAPHRAGM VALVE
GLOBE VALVE
BACK PRESSURE REGULATOR VAVLE
PRESSURE RELIEF VAVLE
FLEXIBLE CONNECTOR
MANUAL VALVE
REDUCER
INSULATION

PUMP, FAN & COMPRESSORS

CENTRIFUGAL FAN
MAGNETIC FLOWMETER
ROTAMETER
ROTARY PUMP
MIXER
CENTRIFUGAL PUMP
HORIZONTAL PUMP
METERING PUMP
INLINE PUMP

PRIMARY ELEMENTS

FLOAT TYPE LEVEL ACTUATOR
SENSOR & ANALYZER

INSTRUMENT LINES & SYMBOLS

NEW MAIN FLOW
EXISTING MAIN FLOW
FUTURE MAIN FLOW
MATERIAL SPECIFICATION CHANGE
PAGE CONNECTION CONTINUATION DRAWING NUMBER
CAPILLARY TUBING
ELECTRICAL
DIGITAL SIGNAL
ANALOG SIGNAL
HYDRAULIC LINE
PNEUMATIC LINE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/24/25	TT			

Rev A

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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DESIGNER	TT	DATE 7/24/25
CHECKER		DATE
ENGINEER		DATE
MANAGER		DATE
FILE:	I1	
SCALE:	NTS	

TITLE HILO WWTP
BLEND TANKS BIOLOGICAL ODOR CONTROL SYSTEM
P&ID LEGEND

CLIENT NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	—	I1	1 OF 4	A

BLEND TANKS ODOR CONTROL I-BOx® 5000
INTEGRITY BIOLOGICAL ODOR CONTROL SYSTEM
MATERIAL: FIBERGLASS

F-101
FIBERGLASS EXHAUST FAN

NT-101
NUTRIENT TANK

PMP-101
SOLENOID METERING PUMP

NOTES:
1. INLET DUCT FROM ODOR SOURCE(S) TO I-BOx® FAN INLET TO BE PROVIDED AND INSTALLED BY OTHERS.
2. TUBING FROM INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH BY OTHERS.
3. ALL UTILITIES TO BE PROVIDED BY OTHERS. WATER LINE TO HAVE MINIMUM OF 30 PSI (SV OPEN), STANDING PRESSURE MIN. OF 60 PSI.
4. SYSTEM INSTALLATION BY OTHERS.
5. THE REMOTE SKID TO BE INSTALLED BY OTHERS MIN. 3. FT. AWAY FROM SYSTEM TO COMPLY WITH NFPA 820.
6. POWER SUPPLY TO ECP BY OTHERS.
7. SYSTEM DRAIN TO BE CONNECTED TO EXTERNAL P-TRAP BY OTHERS.
8. THE INTERCONNECTION FROM REMOTE SKID TO I-BOx® SYSTEM BY OTHERS (FAN POWER & SYSTEM SPRAY NOZZLES CONNECTION)

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN	REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/24/25	TT					Rev A					

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DESIGNER	TT	7/24/25
CHECKER		
ENGINEER		
MANAGER		
FILE:	I1	
SCALE:	NTS	

TITLE: HILO WWTP
BLEND TANKS BIOLOGICAL ODOR CONTROL SYSTEM
PROCESS AND INSTRUMENTATION DIAGRAM

CLIENT: NAN, INC.
HILO, HI

Integrity Municipal Systems
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	–	I1	2 OF 4	A

Company Confidential

SOLIDS 1 ODOR CONTROL I-BOx® 8025
INTEGRITY BIOLOGICAL ODOR CONTROL SYSTEM
MATERIAL: FIBERGLASS

F-201
FIBERGLASS EXHAUST FAN

NT-201
NUTRIENT TANK

PMP-201
SOLENOID METERING PUMP

NOTES:
1. INLET DUCT FROM ODOR SOURCE(S) TO I-BOx® FAN INLET TO BE PROVIDED AND INSTALLED BY OTHERS.
2. TUBING FROM INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH BY OTHERS.
3. ALL UTILITIES TO BE PROVIDED BY OTHERS. WATER LINE TO HAVE MINIMUM OF 30 PSI (SV OPEN), STANDING PRESSURE MIN. OF 60 PSI.
4. SYSTEM INSTALLATION BY OTHERS.
5. THE REMOTE SKID TO BE INSTALLED BY OTHERS MIN. 3. FT. AWAY FROM SYSTEM TO COMPLY WITH NFPA 820.
6. POWER SUPPLY TO ECP BY OTHERS.
7. SYSTEM DRAIN TO BE CONNECTED TO EXTERNAL P-TRAP BY OTHERS.
8. THE INTERCONNECTION FROM REMOTE SKID TO I-BOx® SYSTEM BY OTHERS (FAN POWER & SYSTEM SPRAY NOZZLES CONNECTION)

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN	REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/24/25	TT					Rev A					

STD: BORDER–11X17CA–0A BAR = 1" AT PLOT SCALE

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		DATE
DESIGNER	TT	7/24/25
CHECKER		
ENGINEER		
MANAGER		
FILE:	I1	
SCALE:	NTS	

TITLE: HILO WWTP
SOLIDS 1 BIOLOGICAL ODOR CONTROL SYSTEM
PROCESS AND INSTRUMENTATION DIAGRAM

CLIENT: NAN, INC.
HILO, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858–486–1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	–	I1	3 OF 4	A

Company Confidential

SOLIDS 2 ODOR CONTROL I-BOx® 8025
INTEGRITY BIOLOGICAL ODOR CONTROL SYSTEM
MATERIAL: FIBERGLASS

F-301
FIBERGLASS EXHAUST FAN

NT-301
NUTRIENT TANK

PMP-301
SOLENOID METERING PUMP

NOTES:
1. INLET DUCT FROM ODOR SOURCE(S) TO I-BOx® FAN INLET TO BE PROVIDED AND INSTALLED BY OTHERS.
2. TUBING FROM INLET DUCT TO DIFFERENTIAL PRESSURE SWITCH BY OTHERS.
3. ALL UTILITIES TO BE PROVIDED BY OTHERS. WATER LINE TO HAVE MINIMUM OF 30 PSI (SV OPEN), STANDING PRESSURE MIN. OF 60 PSI.
4. SYSTEM INSTALLATION BY OTHERS.
5. THE REMOTE SKID TO BE INSTALLED BY OTHERS MIN. 3. FT. AWAY FROM SYSTEM TO COMPLY WITH NFPA 820.
6. POWER SUPPLY TO ECP BY OTHERS.
7. SYSTEM DRAIN TO BE CONNECTED TO EXTERNAL P-TRAP BY OTHERS.
8. THE INTERCONNECTION FROM REMOTE SKID TO I-BOx® SYSTEM BY OTHERS (FAN POWER & SYSTEM SPRAY NOZZLES CONNECTION).

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL	7/24/25	TT			

Rev A

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SOLIDS 2 BIOLOGICAL ODOR CONTROL SYSTEM
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CLIENT: NAN, INC.
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PROJECT	CODE	DRAWING	SHEET	REV
40243	–	I1	4 OF 4	A

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

Technical Datasheet

Ashland Performance Materials

DERAKANE® EPOXY VINYL ESTER

DERAKANE® MOMENTUM 411-350 Epoxy Vinyl Ester Resin

DERAKANE MOMENTUM 411-350 epoxy vinyl ester resin is based on bisphenol-A epoxy resin and provides resistance to a wide range of acids, alkalis, bleaches, and organic compounds for use in many chemical processing industry applications. DERAKANE MOMENTUM resins are a new generation of resins that can be used to improve fabrication efficiency and product quality. Their lighter color makes defects easier to see and correct while the resin is still workable. The resin's improved reactivity properties often permit an increase in the lay-up thickness per session. The longer stability provides additional flexibility to fabricators in storage and handling.

- Holds up in corrosive environments*, postponing the need for equipment replacement
- Tolerates heavy design loads without causing failure due to resin damage therefore can work with large weight-bearing equipment with confidence
- Superior elongation and toughness provides FRP equipment with better impact resistance and less cracking due to cyclic temperature, pressure fluctuations, and mechanical shocks providing a safety factor against damage during process upsets or during shipping installation
- When properly formulated and cured, complies with FDA regulation 21 CFR 177.2420, covering materials intended for repeated use in contact with food

Note: Contact us before using thixotropic agents and fillers. Addition of thixotropic agents and fillers can compromise corrosion resistance.

APPLICATIONS AND USE

This resin is suitable for fabricating FRP storage tanks, vessels, ducts, and on-site maintenance projects, particularly in chemical processing and pulp and paper operations. DERAKANE MOMENTUM 411-350 resin is designed for ease of fabrication using hand lay-up, spray-up, filament winding, compression molding and resin transfer molding techniques, pultrusion and molded grating applications. An alternate viscosity, optimized for some vacuum infusion processes, is available as DERAKANE MOMENTUM 411-200 resin.

Recommendations for specific services and environments can be provided by contacting us at derakane@ashland.com.

TYPICAL LIQUID RESIN PROPERTIES

Property[1] at 25°C (77°F)	Value	Unit
Dynamic Viscosity	370	mPa·s (cps)
Kinematic Viscosity	350	cSt
Styrene Content	45	%
Density	1.046	g/ml

Responsible Care*

Ashland is committed to the continuous evolution of technology and service solutions that promote health, safety and environmental protection around the world.

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With good chemistry great things happen.™

Technical Datasheet
Ashland Performance Materials

DERAKANE® MOMENTUM 411-350 Epoxy Vinyl Ester Resin

(1) Properties are typical values, based on material tested in our laboratories. Results may vary from sample to sample. Typical values should not be construed as a guaranteed analysis of any specific lot or as specification items.

TYPICAL CURING CHARACTERISTICS

The following tables provide typical(1) geltimes for methylethylketone peroxide (MEKP). This and other information are available at www.derakane.com.

Warning: Addition levels of less than 0.05% cobalt 6% may cause undercure under certain conditions. Please contact Ashland Technical Service for further details or if such low levels are envisaged.

MEKP Cure System

Typical geltimes(2) using NOROX(3) MEKP-925H(4) catalyst (MEKP) and Cobalt Naphthenate or Octoate-6%(5) (Cobalt6%), Diethylaniline(7) (DEA) and 2,4-Pentanedione (2,4-P).

Geltime at 15°C (59°F)	MEKP (phr)(6)	Cobalt6% (phr)	DEA(7) (phr)
15 +/- 5 minutes	1.50	0.30	0.60
30 +/- 10 minutes	1.50	0.20	-
60 +/- 15 minutes	1.50	0.05	-

Geltime at 20°C (68°F)	MEKP (phr)	Cobalt6% (phr)	2,4-P (phr)
15 +/- 5 minutes	1.50	0.30	-
30 +/- 10 minutes	1.00	0.10	-
60 +/- 15 minutes	1.00	0.10	0.02

Geltime at 25°C (77°F)	MEKP (phr)	Cobalt6% (phr)	2,4-P (phr)
15 +/- 5 minutes	1.00	0.20	-
30 +/- 10 minutes	1.00	0.05	-
60 +/- 15 minutes	1.00	0.05	0.015

Geltime at 30°C (86°F)	MEKP (phr)	Cobalt6% (phr)	2,4-P (phr)
15 +/- 5 minutes	1.00	0.05	-
30 +/- 10 minutes	1.0	0.05	0.015
60 +/- 15 minutes	1.0	0.05	0.035

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Technical Datasheet
Ashland Performance Materials

DERAKANE® EPOXY VINYL ESTER

DERAKANE® MOMENTUM 411-350 Epoxy Vinyl Ester Resin

Geltime at 35°C (95°F)	MEKP (phr)	Cobalt6% (phr)	2,4-P (phr)
15 +/- 5 minutes	1.00	0.05	0.01
30 +/- 10 minutes	1.00	0.05	0.03
60 +/- 15 minutes	1.00	0.05	0.06

(2) Thoroughly test any other materials in your applications before full-scale use. Geltimes may vary due to the reactive nature of these materials. Always test a small quantity before formulating large quantities.
(3) Registered trademark of Norac Inc.
(4) Norox MEKP-925H or equivalent low hydrogen peroxide content MEKP. Use of other MEKP catalysts or additives may result in different gel times.
(5) Use of cobalt octoate, especially in combination with 2,4-P can result in 20-30% slower gel times.
(6) phr = parts per hundred resin molding compound
(7) For pre-acceleration for prolonged storage (e.g. formulation of lining or flooring systems) either avoid DMA or DEA, or use DEAA (DiEthyl-AcetoAcetamide). For further information, please contact ASHLAND.

TYPICAL MECHANICAL PROPERTIES

Typical properties(1) of a cured casting(8) at 25°C (77°F).

Property of casting	Value (SI)	Method	Value (US)	Method
Tensile Strength	86 MPa	ISO 527	12,000 psi	ASTM D638
Tensile Modulus	3200 MPa	ISO 527	4.6×10^5 psi	ASTM D638
Tensile Elongation at Yield	5-6%	ISO 527	5-6%	ASTM D638
Flexural Strength	150 MPa	ISO 178	22,000 psi	ASTM D790
Flexural Modulus	3400 MPa	ISO 178	4.9×10^5 psi	ASTM D790
Density	1.14 g/cm³	ISO 1183		ASTM D792
Volume Shrinkage	7.8%			
Heat Distortion Temperature(9)	105°C	ISO 75	220°F	ASTM D648
Glass Transition Temperature, Tg^2	120°C	ISO 11357	250°F	ASTM D3418
Barcol Hardness	35	EN 59	35	ASTM D2583

(8) Cure schedule: 24 hours at room temperature and 2 hours at 120°C (250°F).
(9) Maximum stress: 1.8 MPa (264 psi)

Typical properties(1) of a postcured 6 mm (1/4") laminate(10) at 25°C (77°F).

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Technical Datasheet
Ashland Performance Materials

DERAKANE® EPOXY VINYL ESTER

DERAKANE® MOMENTUM 411-350 Epoxy Vinyl Ester Resin

Property of laminate	Value (SI)	Method	Value (US)	Method
Tensile Strength	150 MPa	ISO 527	22,000 psi	ASTM D3039
Tensile Modulus	12,000 MPa	ISO 527	1700 kpsi	ASTM D3039
Flexural Strength	210 MPa	ISO 178	30,000 psi	ASTM D790
Flexural Modulus	8100 MPa	ISO 178	1200 kpsi	ASTM D790
Glass Content	40%	ISO 1172	40%	ASTM D2584

(10) Cure schedule: 24 hours at room temperature and 6 hours at 80°C (175°F). Laminate construction of 6mm (1/4") is V/M/M/Wr/M/Wr/M where V=Continuous veil glass, M=Chopped strand mat 450 g/m^2 (1.5 oz/ft^2) and Wr=Woven roving 800 g/m^2 (24 oz/yd^2).

CERTIFICATES AND APPROVALS

The manufacturing, quality control and distribution of products, by Ashland Performance Materials, comply with one or more of the following programs or standards: Responsible Care, ISO 9001, ISO 14001 and OHSAS 18001 by .

STANDARD PACKAGE

208 Liter (55 Gallon) Non-Returnable Drum
Net Wt. 205 Kgs (452 Lbs.)
DOT Label Required: Flammable Liquid

STORAGE

This resin contains ingredients which could be harmful if mishandled. Contact with skin and eyes should be avoided and necessary protective equipment and clothing should be worn.

Drums - It is highly recommended that all material is stored at stable temperatures below 25°C (77°F). Avoid exposure to heat sources such as direct sunlight or steam pipes. To avoid contamination of product with water, do not store outdoors. Keep sealed to prevent moisture pick-up and monomer loss. Rotate stock.

Bulk - See Ashland's Bulk Storage and Handling Manual for Polyesters and Vinyl Esters. A copy of this may be obtained from Ashland at +1.614.790.3333 or 800.523.6963.

All things being equal, higher storage temperature will reduce product stability and lower storage temperature will extend product stability.

COMMERCIAL WARRANTY

Twelve months from date of manufacture, when stored in accordance with the conditions stated above.

Responsible Care*

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Technical Datasheet
Ashland Performance Materials

DERAKANE® MOMENTUM 411-350 Epoxy Vinyl Ester Resin

Notice

All information presented herein is believed to be accurate and reliable, and is solely for the user's consideration, investigation and verification. The information is not to be taken as an express or implied representation or warranty for which Ashland assumes legal responsibility. Any warranties, including warranties of merchantability or non-infringement of intellectual property rights of third parties, are herewith expressly excluded.

Since the user's product formulations, specific use applications and conditions of use are beyond the control of Ashland, Ashland makes no warranty or representation regarding the results which may be obtained by the user. It shall be the responsibility of the user to determine the suitability of any of the products mentioned for the user's specific application.

Ashland requests that the user reads, understands and complies with the information contained herein and the current Material Safety Data Sheet.

Responsible Care*

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ASHLAND
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Chopped Strand Mat: 1 ½ ounce

Part # - 250, 1250

1-1/2 oz/sq Ft. Mat, 38" & 50" Wide, .045" Thick
Mat can be used alone or in conjunction with fiberglass fabrics or woven roving in larger fabrications. Mat is commonly used for buildup such as plywood decking and between layers of fabric when molding. Our mats both meet MIL-M-43248C, Type 1, Class 2, Grade A. Chopped strand mat contains a binder which prevents proper bonding with any epoxy resins. Use our polyester or vinyl ester resins with chopped strand mat.

(38" Typical full roll length is 80 yards)
(50" Typical full roll length is 87 yards)

Product Properties	
Weave Pattern	Mat
Weight	1.5 oz / ft^2
Thickness	0.045 in
Roll Width	38” or 50”
Loss of Ignition (%)	3.15

Visual Characteristics

- Excellent dry handling characteristics for consistent unrolling, part/kit cutting and manipulation
- Superior wet tensile strength for pre-wetting processes and easier placement and adjustment
- Exceptional roll density for fewer roll changes and reduced handling
- Superior mechanical properties and resin compatibility
- Lloyd’s Register, Det Norske Veritas and Germanischer Lloyds

Description

Chopped Strand Mat is a medium-fine fiber, rapid wetting chopped strand mat and is composed of silane sized multi-length (one to two inch) chopped glass filament bundles that average 16,500 yards/pound (30 tex or g/km). It is bonded together with a small amount of highly soluble powdered polyester binder and is designed to be randomly oriented and multi-resin compatible.

This product combines the excellent mechanical and electrical properties of traditional E-glasses with the acid resistance of E-CR glasses.

General Properties for Chopped Strand Mat:

- Quick wetting and rapid air release, which allows for maximum molding productivity and reduced cost.
- Excellent weight uniformity allows consistent customer part quality.
- Fine strand and superior chemistry minimizes print-through, resulting in attractive surface finishes with excellent laminate clarity.
- Superb dry mat integrity enhances productivity and reduces material losses during unrolling, cutting and piece handling.
- Small diameter, very dense rolls are safer and allow for more efficient material handling.

Resin Compatibility:

250 & 1250 1 ½ ounce Chopped Strand Mat, is compatible with Polyester and Vinyl Ester Resin.

Information present herein has been compiled from sources considered to be dependable and is accurate and reliable to the best of our knowledge and belief but is not guaranteed to be so. Nothing herein is to be construed as recommending any practice or any product violation of any patent or in violation of any law or regulation. It is the user’s responsibility to determine for himself the suitability of any material for a specific purpose and to adopt such safety precautions as may be necessary. We make no warranty as to the results to be obtained in using any material and, since conditions of use are not under our control, we must necessarily disclaim all liability with respect to the use of any material supplied by us.
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www.fibreglast.com

PDCT-PDS-00348-A-09/10-DA

NEXUS®

Surfacing Veils for Reinforced Plastics

Characteristics

- 100% high melt polyester
- Excellent appearance and surface smoothness
- Hand can be customized to processing preference
- Superior chemical and corrosion resistance
- High tensile and tear strength
- Widths from 1" to 170"

Industry Standard Synthetic Surfacing Veil for the FRP Industry

Benefits:

Pultrusion:

- Improves cosmetics and surface smoothness
- Improves fade and corrosion resistance
- Superior abrasion and impact resistance
- Reduces die wear and production shutdowns
- Reduces fiber blooming
- Fast wet-out / Processing speeds
- Excellent conformability to complex shapes

Benefits:

Filament Winding/Open and Closed Molding:

- Superior corrosion and stress corrosion resistance
- Winds readily with less web breakage
- Improves cyclic pressure strength of piping systems
- Superior direct and reverse impact strength
- Fast wet-out
- Designed for optimum neck-down properties
- Print blocker

Style	Unit	111-00010	100-00010	039-00694	100-00000	115-00005	700-00005
Shade:		Natural White	Natural White	Natural White	Natural White	Natural White	Natural White
Basis Weight	(oz/y²)	1.1	1.3	1.1	1.2	1.6	2.0
(ASTM D3776)	(g/m²)	37	44	37	40	54	68
Caliper	(mil)	11	12	11	10	14	20
(ASTM D1777)	(mm)	.27	.30	.27	.25	.36	.50
Grab Tensile Machine Direction	(lb)	24	28	23	28	46	51
(ASTM D5034)	(kg)	11	13	10	13	21	23
Cross Direction	(lb)	15	15	15	15	29	26
	(kg)	7	7	7	7	13	12
Fiber Elongation @ Break	%	25	25	25	25	25	25
Fiber Melting Point	°F	483	483	483	483	483	483
(PFG Method)	°C	250	250	250	250	250	250
Standard Roll Length	(lin yd.)	500	500	500	600	600	600
3 in / 76 mm ID Core Tube	(lin mtr.)	457	457	457	548	548	548
Standard Roll Width	(in)	57	57	57	47	47	47
	(cm)	145	145	145	115	115	115
U.V. Resistance Comment		Good	Good	Good	Good	Good	Good
Recommended Process		P	C	P	P	P	C
P = Pultrusion		C			C	C	
C = Open and Closed Molding							

For more information, Contact:
Precision Fabrics Group, Inc.
301 N. Elm Street Suite 600
Greensboro, NC 27401
Ph: 336-510-8063
Email: Info@Nexusveil.com
www.precisionfabrics.com
www.nexusveil.com

PRECISION FABRICS GROUP

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NEXUS®

Surfacing Veils for Reinforced Plastics

The Proven Synthetic Surfacing Veil for the FRP Industry

PRECISION FABRICS GROUP

Custom weights and widths available
Minimum order quantities apply

Style 111-00010
1.1 oz./yd² / 37 gr/mtr²
Apertured

Style 100-00010
1.3 oz/yd2 / 44 gr/mtr²
Apertured

Style 039-00694
1.1 oz./yd² / 37 gr/mtr²
Apertured

Style 100-00000
1.2 oz/yd² / 40 gr/mtr²
Non-apertured

Style 115-00005
1.6 oz/yd² / 54 gr/mtr²
Non-apertured

Style 700-00005
2.0 oz/yd² / 68 gr/mtr²
Non-apertured

DURA-KOTE POLYESTER GEL COATS

Advantage Low VOC Color Gel Coat

300 Series All Colors
Available in Drums and 5 Gallon Pails

Dura-kote Advantage gel coat "all colors" is an ISO/NPG polyester gel coat. Dura-kote Advantage gel coats offer excellent UV stability and chemical resistance and are suitable for a wide range of applications including boats, recreational vehicles and a variety of industrial applications.

PERFORMANCE BENEFITS

- Good sag resistance
- Excellent flow and leveling
- Resistance to pinholing
- Superior air release
- Excellent uv stability
- Good impact resistance

TYPICAL LIQUID GEL COAT PROPERTIES

- Gel time @77°f, 2% mekp.....8 minutes
- Interval gel to peak.....12 minutes
- Peak exotherm.....360°f
- Viscosity @ 77°f, 20rpm #4 spindle.....5,000cps
- Viscosity @77°f, 2 rpm, #4 spindle.....40,000cps
- Thixotropic index .....6 minimum
- Weight per gallon ..... 10+lbs/gal (color dependent)
- Maximum voc .....<37% by weight volatile for colors
  <30% By weight for whites and off whites

(Local regulations vary. Consult your local aqmd to determine actual voc in use)

USAGE GUIDELINES

- Mix this product for at least 5 minutes at low speed prior to use
- Mekp levels should be kept at 2%
- Do not apply gel coats below 64°f
- Apply using airless spray at a the lowest possible pressure
- Film thickness must be between 15mils and 25mils in 2-3 passes with a short flash off time between passes

SHELF LIFE

This product is stable for three months from date of production when stored away from sunlight at no more than 77f. Extended storage will result in some drift in gel times and viscosity. Elevated temperatures will reduce shelf life further

REVCHEM Composites

Our Products are intended for sale to industrial and commercial customers. We request that Customers inspect and test our products before use and satisfy themselves as to contents and suitability. Nothing herein shall constitute a warranty, expressed or implied, including any warranty or merchantability or fitness, nor is protection from any law of patent to be inferred. All patent rights are reserved. The exclusive remedy for all proven claims is replacement of our materials and in no event shall we be liable for special , incidental or consequential damages
9/9/2015 ISO 9001:2000 Registered Company

Corporate Office: 2720 South Willow Avenue #B | Bloomington, CA 92316 | 800.281.4975 Toll Free | sales@revchem.com | www.Revchem.com

5.2 Exhaust Fan

- Fan Specification Sheets
- Fan Performance Curve & Drawings
- Motor Data Sheet & Drawings

BLEND TANKS EXHAUST FAN & MOTOR

Fan:

Manufacturer:	Hartzell
Model:	Series 42 Arrangement 4 Size 12
Material of Construction:	FRP Fan
Arrangement:	CW, Bottom Angular Down
Flow Rate:	400 cfm
Total Static Pressure:	7 in. w.c
Fan RPM:	2,963 RPM
Inlet:	Slip
Outlet:	Flanged, undrilled
Accessories:	Hartkoate marine coating, AMCA air and sound test certification
Quantity:	One (1)

Fan shall be AMCA Certified for Air Performance

Motor:

Power:	1.5 HP @ 480V, 3Ph, 60 Hz
Motor RPM:	3,480 RPM
Service Duty:	1.25
Temperature Rating:	40 Deg C
Enclosure:	TEFC
Mounting:	Foot Mounted
Accessories:	Motor space heater
Quantity:	One (1)

SOLIDS EXHAUST FAN & MOTOR

Fan:

Manufacturer:	Hartzell
Model:	Series 41P Arrangement 10 Size 18
Material of Construction:	FRP Fan
Arrangement:	CW, Top Angular Down
Flow Rate:	4300 cfm
Total Static Pressure:	11.5 in. w.c
Fan RPM:	3,326 RPM
Inlet:	Slip
Outlet:	Flanged, undrilled
Accessories:	Hartkoate marine coating, AMCA air and sound test certification
Quantity:	Two (2)

Fan shall be AMCA Certified for Air Performance

Motor:

Power:	15 HP @ 480V, 3Ph, 60 Hz
Motor RPM:	1,800 RPM
Service Duty:	1.15
Temperature Rating:	40 Deg C
Enclosure:	TEFC
Mounting:	Foot Mounted
Accessories:	Motor space heater
Quantity:	Two (2)

Hartzell AIR MOVEMENT

Quality • Value • Commitment

Hartzell-FLOW™ v1.0.18 / February 2019

A42-4-12--F100FGFQI2

Fan Tag#:

Vol Flow Rate	400
Pressure	7
Density (lbs/ft³)	0.075
Oper. Temp. (°F)	70
Fan RPM	2963
Max Safe RPM	4167
Operating Power	1.27
Standard Power	1.27
Static Efficiency	0.347
Outlet Velocity (fpm)	2703
Fan Efficiency Grade (FEG)	FEG57

Discharge Sound Power Levels referred to 10^-12 watts							
1	2	3	4	5	6	7	8
107	105	100	99	88	82	78	81

Radiated Sound Power Levels referred to 10^-12 watts							
1	2	3	4	5	6	7	8
103	98	90	88	76	69	65	68
Radiated Sound is not AMCA Licensed							

Hartzell Air Movement certifies that the model shown is licensed to bear the AMCA Seal.
The ratings shown are based on tests and procedures performed in accordance with AMCA publication 211 and comply with the requirements of the AMCA Certified Ratings Program.
The AMCA Certified Range Seal applies to air performance rating only.
Power rating BHP excludes transmission losses.
Performance certified is for Installation Type D: Ducted Inlet, Ducted Outlet.
AMCA Licensed for Air Performance.
Performance ratings do not include the effects of appurtenances (Accessories).
Sound ratings are based on sound level data obtained in accordance with AMCA Standard 300. The sound power level ratings shown are in decibels, referred to 10^-12 watts, calculated per AMCA Standard 301. Fan Outlet Sound Testing. Values shown are for outlet Lwo sound power levels for:
Installation Type D: Ducted Inlet, Ducted Outlet.
Ratings include the effects of duct end correction.

Discharge Sound Pressure = 87 dBA @ 5ft

Radiated Sound Pressure = 77 dBA @ 5ft

Discharge Sound Power = 99 LwA

Radiated Sound Power = 89 LwA

The A-weighted sound pressure level (dBA) is based on Hartzell Laboratory sound power tests, and is calculated in accordance with AMCA standard 303.

The FEG, dBA, LwA and radiated values are not AMCA International Licensed.

The calculation assumes a free field condition with a directivity factor for hemi-spherical radiation (Q=2).

The installed sound pressure levels are influenced by the installation and acoustic environment, and cannot be guaranteed. Use of this estimate level along for field acceptability test is not recommended.

Although the calculation can be done for any stated distance, the free field does not start until 20 to 50 ft from the equipment in most installations.

Contact Hartzell Air Movement for more information concerning dBA values.

Hartzell AIR MOVEMENT

Quality • Value • Commitment

Hartzell-FLOW™ v1.0.18 / February 2019

A41P0-182FA-66FGFCO3

System Curve — Static Pressure (in.wg) — Do Not Select — 15 HP — 10 HP — FEI=1.2 — FEI=1.3 — FEI=1.4 — FEI=1.5 — AMCA Certified

Fan Tag#:

Vol Flow Rate	4300
Pressure	11.5
Density (lbs/ft³)	0.075
Oper. Temp. (°F)	70
Fan RPM	3326
Max Safe RPM	3613
Operating Power	11.213
Standard Power	11.213
Static Efficiency	0.694
Outlet Velocity (fpm)	2590
Fan Energy Index (FEI)	1.2
Fan Efficiency Grade (FEG)	FEG75

Discharge Sound Power Levels referred to 10^-12 watts							
1	2	3	4	5	6	7	8
107	109	103	99	97	93	89	87

Radiated Sound Power Levels referred to 10^-12 watts							
1	2	3	4	5	6	7	8
103	102	93	88	85	80	76	74
Radiated Sound is not AMCA Licensed							

Hartzell Air Movement certifies that the model shown is licensed to bear the AMCA Seal.
The ratings shown are based on tests and procedures performed in accordance with AMCA publication 211 and AMCA publication 311 and comply with the requirements of the AMCA Certified Ratings Program.
FEI values are calculated in accordance with ANSI/AMCA Standard 208 and are based on four-pole TEFC motors of the size shown.
Power rating BHP excludes transmission losses.
Performance certified is for Installation Type D: Ducted Inlet, Ducted Outlet.
AMCA Licensed for Sound and Air Performance.
Performance ratings do not include the effects of appurtenances (Accessories).
Sound ratings are based on sound level data obtained in accordance with AMCA Standard 300. The sound power level ratings shown are in decibels, referred to 10^-12 watts, calculated per AMCA Standard 301. Fan Outlet Sound Testing. Values shown are for outlet Lwo sound power levels for:
Installation Type D: Ducted Inlet, Ducted Outlet.
Ratings include the effects of duct end correction.

Discharge Sound Pressure = 91 dBA @ 5ft

Radiated Sound Pressure = 81 dBA @ 5ft

Discharge Sound Power = 103 LwA

Radiated Sound Power = 92 LwA

The A-weighted sound pressure level (dBA) is based on Hartzell Laboratory sound power tests, and is calculated in accordance with AMCA standard 303.

The FEG, dBA, LwA and radiated values are not AMCA International Licensed.

The calculation assumes a free field condition with a directivity factor for hemi-spherical radiation (Q=2).

The installed sound pressure levels are influenced by the installation and acoustic environment, and cannot be guaranteed. Use of this estimate level along for field acceptability test is not recommended.

Although the calculation can be done for any stated distance, the free field does not start until 20 to 50 ft from the equipment in most installations.

Contact Hartzell Air Movement for more information concerning dBA values.

Fiberglass Pressure Blower

Series 42

Arrangement 4

Hartzell Fan, Inc. certifies that the Series 42, Fiberglass Pressure Blower, shown hereon is licensed to bear the AMCA Seal. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Ratings Program.

Type F Wheel (Series 42)

Blowers available in SWSI only

Particularly suited for lab hood installations, the corrosive resistant direct drive pressure blower moves air at static pressures up to 12". The housing is constructed with a special corrosion resistant polyester resin having a Class I flame spread rate of 25 or less. The wheel is made using a special corrosion resistant vinylester resin having a Class I flame spread rate of 30 or less. There are no metal parts exposed in the airstream. All internal hardware is 300 series stainless steel encapsulated.

Features

- **Sizes –** 10", 12" and 14" wheel diameters.
- **Arrangement –** available in Arrangements 4 or 10.
- **Temperature Limitations –** suitable for temperatures up to 200° F. See Table 3, page 12 for maximum safe speed correction factors at high temperatures.
- **FRP Materials –** solid fiberglass wheel molded with Dow Derakane 510-A vinylester resin. Other standard FRP components constructed of fiberglass and Ashland Hetron 693 resin. See Corrosion Resistance Guide on page 13 for resin characteristics. Other resins are available.
- **Rotation – clockwise rotation standard.** Counterclockwise rotation available.
- **Discharges –** available discharges shown on page 5. **Rotatable in field.**
- **Easy installation and maintenance –** motors are readily accessible for ease in wiring, installation, adjustment and lubrication.
- **Wheel –** flat blade radial design of one-piece construction, die formed of individual laminations of fiberglass. **Wheel Type F.**
- **Motors –** are available to your specifications, mounted and test run at the factory prior to shipment.
- **Drive Assembly (Belt Drive Fans) –** belts are oil, heat and static resistant type, oversized for continuous duty. Shafts are turned, ground and polished, keyed at both ends.
- **Bearings (Belt Drive Fans) –** heavy-duty, self-aligning, pillow block bearings are standard.
- **Shafts (Belt Drive Fans) –** turned, ground and polished. Fiberglass enclosed in the airstream. Stainless steel (304 or 316) or monel shafting is available as an option at extra cost.
- **Shaft Seal (Belt Drive Fans) –** a fiberglass and neoprene shaft seal is placed where the shaft leaves the housing along with a neoprene shaft slinger between the seal and wheel on belt drive units. Seal is not gas tight.
- **Flanged outlets are standard.** Inlet flanges are optional. Drilling of flanges is optional.
- **Bases –** heavy gauge hot rolled steel, epoxy coated.
- **All units are test run** and **electronically balanced** before shipment.
- **Accessories –** See pages 14 and 15.

Series 42 - Arrangement 10

Principal Dimensions – Arrangement 10

Fan Size	A	B	C	D	E	F	G	H	J	L	M	N	P	R
10	18 1/16	10 5/8	9	9 5/8	10 1/8	13 7/8	9 1/8	8 5/8	8 1/8	21 1/4	6 15/16	3/4	9 7/8	6
12	18 1/16	11 5/8	10	10 5/8	11 1/8	15 5/16	10 1/8	9 5/8	9 1/8	21 1/4	7 5/16	3/4	9 7/8	7
14	18 1/16	12 5/8	11	11 5/8	12 1/8	16 3/4	11 1/8	10 5/8	10 1/8	21 1/4	7 9/16	3/4	9 7/8	8

Fan Size	S	T	U	V	W	X	Y	Z	AA	BB	CC	Max. Motor Frame*	Max. Wgt. is Less Motor Wgt. & Accessories
10	7 7/16	19 3/4	9/16	4	12	2	30 1/16	7	3 3/4	4 3/16	4 1/4	182T	85
12	8 1/4	19 3/4	9/16	4	12	2	30 7/16	7 3/4	4 1/2	5	4 5/8	182T	90
14	9 1/4	19 3/4	9/16	4	12	2	31 5/16	8 1/4	5	6	4 7/8	182T	100

NOTE: Dimensions and specifications are subject to change. Certified prints are available.
*** For motor frame sizes larger than standard 182T, contact factory.**

Series 42 - Arrangement 4

Principal Dimensions – Arrangement 4

Fan Size	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R
10	12 1/8	10 5/8	9	9 5/8	10 1/8	13 7/8	9 1/8	8 5/8	8 1/8	1 7/8	13	5 3/8	1	5 1/2	6
12	14 1/8	11 5/8	10	10 5/8	11 1/8	15 5/16	10 1/8	9 5/8	9 1/8	1 3/8	14 1/2	5 3/4	1	6 1/4	7
14	16 1/8	12 5/8	11	11 5/8	12 1/8	16 3/4	11 1/8	10 5/8	10 1/8	7/8	15 1/2	5 3/8	1	6 3/4	8

Fan Size	S	T	U	V	W	X	Y	Z	AA	BB	CC	Min. Motor Frame	Max. Motor Frame	Max. Wgt. is Less Motor Wgt. & Accessories
10	7 7/16	11	7/16	4	4 7/8	1"	15 11/16	7	3 3/4	4 3/16	4 1/4	56	143T	63
12	8 1/4	12 1/2	7/16	4	5 3/8	1"	16 15/16	7 3/4	4 1/2	5	4 5/8	56	184T	78
14	9 1/4	13 1/2	7/16	4	7 3/4	1"	19 3/16	8 1/4	5	6	4 7/8	145T	213T	97

NOTE: Dimensions and specifications are subject to change. Certified prints are available.

Fan Discharges

Series 41P Backward Curved Centrifugal Fan, Packaged, Type FA

Series 41P Hartzell Fiberglass Backward Curved Centrifugal Fan, Packaged, offers **non-overloading, high efficiency, low noise**, and economy for corrosive atmospheres in a c**ompact packaged Class II design**. This fan is unique in the fan and blower industry. The fan incorporates the proven, highly efficient, backward curved, airfoil-bladed, solid fiberglass, Type FA wheel in a solid fiberglass housing. This design incorporates the airfoil centrifugal wheel, centrifugal fan housing, and inlet cone to produce a compact, highly efficient unit with low noise characteristics.

- **Applications** – Developed to perform throughout the entire **Class II Performance Range** for compatible corrosive applications where it is advantageous to have fiberglass materials and have the motor out of the airstream with the versatility of a belt drive fan.
- **Performance** – Type FA fiberglass airfoil wheel with inlet cone and aerodynamically designed housing produces from **800 CFM to 30,000 CFM** at pressures from **free delivery** to **12" W.G. at high efficiencies** with non-overloading horsepower, low noise, and low RPM. Max. temperature capability is 250°F.

Series 41P
Shown with optional accessories

Hartzell Fan, Inc. certifies that the Series 41P, Fiberglass Backward Curved Centrifugal Fan, Packaged, shown herein is licensed to bear the AMCA seal for air and sound performance. The ratings shown are based on tests and procedures performed in accordance with AMCA Publication 211 and Publication 311 and comply with the requirements of the AMCA Certified Ratings Program.

Sound Performance data is available upon request. Please contact the factory and ask for Engineering Publication #SD-160.

Type FA Wheel

Features

- **Sizes** – 12" through 36" wheel diameters. Packaged Class II construction, Arrangement #10 Belt Drive with weather cover. Available in both 100% and 66% widths.
- **FRP Materials** – Solid fiberglass wheel molded with Ashland Derakane 510-A corrosion resistant vinylester resin having a Class II flame spread rate of 30 or less. The housing and other standard FRP components are constructed of fiberglass and Ashland Hetron 693 corrosive resistant polyester resin having a Class I flame spread rate of 25 or less. No metal parts are exposed in the airstream. See Corrosion Resistance Guide on page 5 for resin characteristics. Other resins are available.
- **Type FA Wheel** – **High efficiency, airfoil design with one-piece, solid fiberglass construction.** Tapered inlet side design efficiently moves large volumes of air at high pressures. Wheel has non-overloading horsepower characteristic curve.
- **Rotation and Discharge Positions** – Available in both clockwise and counter-clockwise rotations and in all standard discharge positions. Housing discharge position can be changed on fan sizes 12" through 36".
- **Easy Installation and Maintenance** – Motor, drives and bearings are readily accessible for ease in wiring, installation, adjustment, and lubrication. Weather cover and guards are available.
- **Shafts** – Shafts are turned ground and polished, keyed at both ends with fiberglass sleeve in the airstream and sized to operate well below critical speed.
- **Bearings** – Bearings are heavy duty, self-aligning, ball or roller type, in cast iron pillow block housings, selected for long life at maximum Class II construction limits, and include extended lubrication fittings as standard.
- **Standard Shaft Seal** – A fiberglass and neoprene shaft seal is placed where the shaft leaves the housing along with a neoprene shaft slinger between the seal and wheel. Seal is not gas tight.
- **Hardware** – Airstream hardware is Type 304 stainless steel and encapsulated.
- **Motor Out of the Airstream** – Exterior mounting of Drip-Proof Protected motor on an adjustable motor pivot base is standard. Motors can be furnished as TEFC, Mill and Chemical Duty, or to specifications upon request. Motor HP and frame size limits are identified in Dimensions and Material Specifications table.
- **Drives (Belt Drive Fans)** – V-Belt Drives are oversized for long life and continuous duty and are fixed pitch as standard. Variable pitch drives for sizes 24" through 36" are available upon request. Belts are oil, heat, and static resistant type.
- **Balancing** – The fan is electronically statically and dynamically balanced to the requirements of Fan Application Category BV-3 of AMCA/ANSI Std. 204-96. All fans receive an inspection prior to shipment and, whenever possible, a vibration test.
- **Flanged Duct Connections** – Outlet flange is standard, inlet flange is optional. Flange bolt holes are optional.
- **Bases** – Heavy gauge, welded, hot rolled steel with epoxy coating are standard. **Base is sized to accept maximum motor frame size required for Class II operation.**
- **Options and Accessories** – See pages 22 and 23.
- **Spark Resistant Construction and Protective Coatings** – Spark resistant construction for fiberglass equipment is optional, and for abrasive environments or extremely corrosive environments, special construction is available, see page 23.

Dimensions – Series 41P, Arrangement 10

SERIES 41P, Type FA
Sizes 12" Through 36", Rotatable Housing
Standard Construction – Class II, Maximum Temperature – 250°F.

Principal Dimensions (Inches) – Sizes 12" – 36"

Fan Size	A	B	C	D	E	F	G	H	J	L	M 100% Width	M 66% Width	N
12	17	15 1/2	13	11 1/2	12 3/8	20 1/8	10 7/8	10 1/8	11 1/16	20 3/4	7 15/16	7 5/8	5/8
15	17	18 5/8	16 3/16	14 1/2	15 7/16	24 5/8	13 9/16	12 5/8	13 1/4	20 3/4	9 3/16	8 7/16	5/8
18	20	21 15/16	19	17 1/2	18 5/8	28 15/16	16 3/8	15 1/4	15 1/4	24 3/4	9 5/16	8 1/2	5/8
22	24 3/4	26 1/4	21 1/8	21 5/16	22 11/16	33 1/2	19 15/16	18 9/16	17 3/16	29 3/4	10 7/8	9 7/8	5/8
24	27	28 5/16	23	23 1/8	24 5/8	36 5/16	21 11/16	20 3/16	18 11/16	31 1/8	11 5/8	10 1/2	5/8
27	28 1/2	32 1/2	24	26	27 11/16	39 15/16	24 5/16	22 5/8	20 15/16	34 3/8	13 1/16	11 3/16	13/16
30	30 1/2	35	28 1/2	28 1/4	30 1/16	44 15/16	26 3/8	24 9/16	22 3/4	37 5/8	14	12 5/8	13/16
33	37	38 3/16	28 11/16	31	33	47 1/4	29	27	24 15/16	41 5/8	15 1/8	13 5/8	13/16
36	37	41 5/16	31 1/4	33 3/4	36	51 5/16	31 5/8	29 3/8	27 3/16	44 1/8	16 1/4	14 5/8	13/16

Fan Size	P	R	S	T	U	V	W	X 100% Width	X 66% Width	Y	Z	AA 100% Width	AA 66% Width
12	9 3/4	12 1/4	12 7/8	19 1/2	20 3/4	9/16 x 1	6	36 11/16	36	19 5/8	–	14 1/16	13 3/8
15	9 3/4	16 3/8	16 1/8	19 1/2	20 3/4	9/16 x 1	6	39 1/16	37 5/8	19 5/8	–	16 7/16	15
18	10 1/2	19 3/8	19 3/8	21	22 1/4	9/16 x 1	6	46 1/8	44 3/8	25 1/4	–	17 7/8	16 1/8
22	11 1/8	23 3/4	23 11/16	22 1/4	23 1/2	9/16 x 1	6	49 1/4	47 1/8	25 1/4	–	21	18 7/8
24	10 1/2	25 3/4	25 3/4	21	22 1/4	9/16 x 1	6	50 3/4	48 1/2	25 1/4	–	22 1/2	20 1/4
27	13 3/16	28 5/8	29	26 3/8	28	11/16 x 1 1/2	8	58	55 7/16	29 5/8	14 13/16	25 3/8	22 13/16
30	13 7/8	31 1/16	31 1/2	27 3/4	29 3/8	11/16 x 1 1/2	8	63 3/16	60 7/16	33	16 1/2	27 3/16	24 7/16
33	13 7/8	34 1/16	34 11/16	27 3/4	29 3/8	11/16 x 1 1/2	8	65 9/16	62 1/2	33	16 1/2	29 9/16	26 1/2
36	13 7/8	37 1/16	37 13/16	27 3/4	29 3/8	11/16 x 1 1/2	8	67 13/16	64 1/2	33	16 1/2	31 13/16	28 1/2

Fan Size	BB 100% Width	BB 66% Width	CC 100% Width	CC 66% Width	DD 100% Width	DD 66% Width	EE	FF 100% Width	FF 66% Width
12	37 5/8	37	9 5/16	8 11/16	8 1/8	7 13/16	18 1/8	14 3/8	13 1/2
15	40 1/8	38 5/8	11 11/16	10 5/16	9 5/16	8 1/2	21 1/16	16 5/8	15 1/4
18	47 1/16	45 3/8	14	12 5/16	10 9/16	9 11/16	24 1/2	19 1/16	17 3/8
22	50 3/16	48 1/8	17 1/8	15 1/16	12 1/8	11 1/16	28 3/4	22 1/4	20 3/16
24	51 3/4	49 1/2	18 11/16	16 3/8	12 15/16	11 3/4	30 13/16	23 11/16	21 1/2
27	59	56 1/2	21	18 1/2	14 5/16	13 1/16	36	28	25 1/2
30	64 3/16	61 1/2	22 13/16	20 1/8	15 1/4	13 7/8	38 1/2	29 13/16	27 1/8
33	66 9/16	63 9/16	25 1/8	22 1/8	16 7/16	14 15/16	41 5/8	32 1/8	29 1/8
36	68 13/16	65 9/16	27 7/16	24 1/8	17 9/16	15 15/16	44 13/16	34 3/8	31 1/8

Dimensions and specifications are subject to change. Clockwise Rortatiom is shown. Certified prints are available.

Fan Discharges

Scrolls are rotatable. BH and BAU rotations require a height adjusting sub-base. TAD, BAD and DB discharge must have discharge extension. Contact factory.

DATA SHEET

Three Phase Induction Motor - Squirrel Cage

WITH 30W SPACE HEATER

Customer	:

Product line	: W22 NEMA Premium Efficiency Three-Phase	Product code :	12438231
		Catalog # :	00156ET3E143T-W22

Frame	: 143/5T	Locked rotor time	: 37s (cold) 21s (hot)
Output	: 1.5 HP (1.1 kW)	Temperature rise	: 80 K
Poles	: 2	Duty cycle	: Cont.(S1)
Frequency	: 60 Hz	Ambient temperature	: -20°C to +40°C
Rated voltage	: 230/460 V	Altitude	: 1000 m.a.s.l.
Rated current	: 3.92/1.96 A	Protection degree	: IP55
L. R. Amperes	: 34.9/17.4 A	Cooling method	: IC411 - TEFC
LRC	: 8.9x(Code L)	Mounting	: F-1
No load current	: 1.66/0.830 A	Rotation¹	: Both (CW and CCW)
Rated speed	: 3480 rpm	Noise level²	: 68.0 dB(A)
Slip	: 3.33 %	Starting method	: Direct On Line
Rated torque	: 2.26 ft.lb	Approx. weight³	: 44.5 lb
Locked rotor torque	: 310 %		
Breakdown torque	: 370 %		
Insulation class	: F		
Service factor	: 1.25		
Moment of inertia (J)	: 0.0470 sq.ft.lb		
Design	: B		

Output	25%	50%	75%	100%
Efficiency (%)	81.1	81.5	84.0	84.0
Power Factor	0.43	0.68	0.78	0.84

Foundation loads	
Max. traction	: 51 lb
Max. compression	: 96 lb

		Drive end	Non drive end
Bearing type	:	6205 ZZ	6204 ZZ
Sealing	:	V'Ring	V'Ring
Lubrication interval	:	-	-
Lubricant amount	:	-	-
Lubricant type	:	Mobil Polyrex EM	

Notes
USABLE @208V 4.20A SF 1.15 SFA 4.83A

This revision replaces and cancel the previous one, which must be eliminated.
(1) Looking the motor from the shaft end.
(2) Measured at 1m and with tolerance of +3dB(A).
(3) Approximate weight subject to changes after manufacturing process.
(4) At 100% of full load.

These are average values based on tests with sinusoidal power supply, subject to the tolerances stipulated in NEMA MG-1.

Rev.	Changes Summary	Performed	Checked	Date

Performed by			
Checked by		Page	Revision
Date	15/01/2021	1 / 1	

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W22
CC029A
NEMA Premium
Inverter Duty Motor
Severe Duty
12438231
MADE IN MEXICO MODEL 00156ET3E143T-W22
PH 3 | FR 143/5T | HP(kW) 1.5(1.1) | Hz 60 | SF 1.25 | PF 0.84
V 230/460 | A 3.92/1.96 | RPM 3480 | INS. CL. F | ΔT 80 K | IP55
NEMA NOM EFF 84.0 % | DES B | DUTY CONT. | AMB 40°C
ENCL TEFC | SFA 4.90/2.45 | USABLE @208V 4.20 A SF 1.15 SFA 4.83
1.5HP 1.1kW 50Hz 380V 2.36A 2835RPM SF1.25 EFF 81.5% (IE2) | CODE L
208-230V
T4 T5 T6
T7 T8 T9
T1 T2 T3
YY L1 L2 L3
460/380V
T4 T5 T6
T7 T8 T9
T1 T2 T3
Y L1 L2 L3
6205-ZZ
6204-ZZ
MOBIL POLYREX EM
ALT 1000 m.a.s.l.
44 Lbs
For 60Hz: Class I, Div 2, Gr. A, B, C and D – T3
Class I, Zone 2, IIC – T3
Class II, Div 2, Gr. F and G – T5
For use on PWM, Gr. A, B, C, D, F and G
VT1000:1, CT20:1, 1.0SF, T4A
C US
Energy Verified
C UL US
3PT9
LISTED
FOR SAFE AREA
MOD.TE1BFOXON

Color RAL 5009
Painting plan 207A
Mounting B3R(D)

1.5 HP 02 Poles 60Hz | A

ECM	LOC	SUMMARY OF MODIFICATIONS	EXECUTED	CHECKED	RELEASED	DATE	VER

EXECUTED	PIRWBUSER	THREE PHASE W22 MOTOR - NEMA PREMIUM EFF	PREVIEW
CHECKED		FRAME 143/5T IP55 TEFC	WDD
RELEASED			
REL DT.		WMO Jaragua do Sul Product Engineering	SHEET 1 / 1

Dimensions in inches

XME A3

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WITH 65W SPACE HEATER

TECO Westinghouse

ISSUED	PERFORMANCE DATA	ENCLOSURE
8/29/2014	3-PHASE INDUCTION MOTOR	TEFC
TYPE		CATALOG#
AEHH8P		NP0154

NAMEPLATE INFORMATION

OUTPUT HP	OUTPUT KW	POLE	FRAME SIZE	VOLTAGE	HZ	RATED AMBIENT	INS. CLASS	NEMA DESIGN	TIME RATING	SERVICE FACTOR
15	11.2	4	254T	230/460	60	40°C	F	B	CONT.	1.15

VARIABLE FREQUENCY DRIVE SERVICE

VARIABLE TORQUE			
HZ	HP	RPM	TORQUE (lb-ft)
3~60	0.0019~15	90~1800	0.111~44.62

OHMS/PHASE EQUIVALENT WYE CIRCUIT (AT RATED OPERATING TEMPERATURE 25°C)				
R1	R2	X1	X2	X_m
0.2605	0.4003	1.373	1.8687	47.992

CONSTANT TORQUE				CONSTANT HORSEPOWER			
HZ	HP	RPM	TORQUE (lb-ft)	HZ	HP	RPM	TORQUE (lb-ft)
6~60	1.5~15	180~1800	44.62	60~120	15	1800~3600	44.62~22.31

TYPICAL PERFORMANCE

FULL LOAD RPM	EFFICIENCY FULL LOAD MIN.%	EFFICIENCY FULL LOAD NOM.%	EFFICIENCY 3/4 LOAD %	EFFICIENCY 1/2 LOAD %	POWER FACTOR FULL LOAD %	POWER FACTOR 3/4 LOAD %	POWER FACTOR 1/2 LOAD %	SOUND PRESSURE LEVEL @ 3 FT Db(A)
1765	91	92.4	93	92.4	88	85	77	64

CURRENTS NO LOAD AT 208 VOLT	NO LOAD AT 230 VOLT	NO LOAD AT 460 VOLT	FULL LOAD AT 208 VOLT	FULL LOAD AT 230 VOLT	FULL LOAD AT 460 VOLT	LOCKED ROTOR AT 208 VOLT	LOCKED ROTOR AT 230 VOLT	LOCKED ROTOR AT 460 VOLT	NEMA KVA CODE LETTER	SAFE STALL TIME IN SECONDS COLD	SAFE STALL TIME IN SECONDS HOT
9.63	12.08	6.04	38.20	34.50	17.30	209.8	232.0	116	G	32	22

TORQUE FULL LOAD (lb-ft)	TORQUE LOCKED ROTOR %FLT	TORQUE PULL UP %FLT	TORQUE BREAK DOWN %FLT	INERTIA ROTOR WR^2 ($lb\text{-}ft^2$)	INERTIA NEMA LOAD WK^2 ($lb\text{-}ft^2$)	INERTIA MAX ALLOWABLE WK^2 ($lb\text{-}ft^2$)	ACCEL TIME (DOL) NEMA LOAD WK^2 Sec	ACCEL TIME (DOL) MAX ALLOWABLE WK^2 Sec	ALLOWABLE STARTS PER HOUR COLD	ALLOWABLE STARTS PER HOUR HOT
44.62	245	180	270	2.179	75	220	4.25	12.23	2	1

APPROVED:	M. PRATER	DRAWING NO.	31057NP0154	REVISION:	1

DATE: December 6, 2010	CONNECTION DIAGRAM	CATALOG NO.: NP0154

SCHEMATIC - Δ / Y CONNECTION

ACROSS THE LINE CONNECTION

LINE **230 VOLT CONNECTION**	**LINE** **460 VOLT CONNECTION**

***CONTACT TWMC IF YOU HAVE ANY QUESTIONS REGARDING THE MOTOR CONNECTION.**
PH: 1-800-873-8326

TECO Westinghouse	DWG NO. DAC-1565-5

DATE March. 25, 2020	OUTLINE DIMENSIONS	MOTOR TYPE: AEHH8P
DATE NP0154	3-PHASE INDUCTION MOTOR	FRAME NO. 254T

Pole	HP	kW	Hz	VOLT	r/min(rpm)
4	15	11	60	230/460	1800

Ins	Rating	Dimension in	Approx Weight	Bearings
F	CONT.	inch	291 lbs	DE: 6309ZZ NDE: 6307ZZ

Totally Enclosed Fan Cooled Squirrel Cage Rotor.

1	01.16.20	Enlarge T-BOX volume.	Z.L.LEE

DWG.	H.C.YANG	07·12·19	TECO Westinghouse	DWG NO. 31057M088061
CHKD.	M.C.JENG	07·16·19		
APPD.	M.C.JENG	07·16·19		

5.3 Nutrient Injection System

- Pump Specification Sheet
- Pump Data Sheet
- Nutrient SDS

NUTRIENT METERING PUMP

Manufacturer:	Pulsafeeder
Pump Type:	Diaphragm Solenoid Metering Pump
Model:	LB03-SA-PTC1-XXX
Capacity:	0.50 GPH
Pressure Rating:	150 PSI
Liquid (Long Term):	Fertilizer
Specific Gravity:	1.22
Maximum Speed:	125 spm
Housing Construction:	Polypropylene
Pump Head:	GFPPl
Diaphragm:	PTFE O-rings with Ceramic Ball
Process Connection:	1/4" ID x 3/8" OD Tube Connection
Accessories:	GFPPL fittings, Bleed valve, Injection Valve and Foot Valve Assembly
Power Connection:	115V, 1 Ph, 60 Hz
Power rating:	130 W
Quantity:	One (1) per system
IMS Part No.:	P70176

The Pulsatron Series A Plus offers manual function controls over stroke length and stroke rate as standard with the option to select external pace for automatic control.

Ten distinct models are available, having pressure capabilities to 250 PSIG (17 BAR) @ 12 GPD (1.9 lph), and flow capacities to 58 GPD (9.1 lph) @ 100 PSIG (7.0 BAR), with a standard turndown ratio of 100:1, and optional ratio of 1000:1. Metering performance is reproducible to within ± 3% of maximum capacity.

Features

- Manual Control by on-line adjustable stroke rate and stroke length.
- Highly Reliable timing circuit.
- Circuit Protection against voltage and current upsets.
- Solenoid Protection by thermal overload with auto-reset.
- Water Resistant, for outdoor and indoor applications.
- Internally Dampened To Reduce Noise.
- Guided Ball Check Valve Systems, to reduce back flow and enhance outstanding priming characteristics.
- Few Moving Parts and Wall Mountable.
- Safe & Easy Priming with durable leak-free bleed valve assembly (standard).
- Optional Control: External pace with auto/manual selection.

Controls

Manual Stroke Rate

Manual Stroke Length

External Pacing - Optional

Controls Options		
Feature	Standard Configuration	Optional Configuration[1]
External Pacing	---	Auto / Manual Selection[2]
Manual Stroke Rate	10:1 Ratio	100:1 Ratio
Manual Stroke Length	10:1 Ratio	10:1 Ratio
Total Turndown Ratio	100:1 Ratio	1000:1 Ratio

Note 1: On S2, S3 & S4 sizes only.
Note 2: Not available on 1000:1 turndown pumps.

Operating Benefits

- Reliable metering performance.
- Rated “hot” for continuous duty.
- High viscosity capability.
- Leak-free, sealless, liquid end.

Aftermarket

- KOPkits
- Gauges
- Dampeners
- Pressure Relief Valves
- Tanks
- Pre-Engineered Systems
- Process Controllers (PULSAblue, MicroVision)

PULSAtron® Series A Plus Electronic Metering Pumps

PULSAtron® Series A Plus

Specifications and Model Selection

MODEL			LBC2	LB02	LBC3	LB03	LB04	LB64	LBC4	LBS2	LBS3	LBS4
Capacity nominal (max.)		GPH	0.25	0.25	0.42	0.50	1.00	1.25	2.00	0.50	1.38	2.42
		GPD	6	6	10	12	24	30	48	12	33	58
		LPH	0.9	0.9	1.6	1.9	3.8	4.7	7.6	1.9	5.2	9.14
Pressure[3] (max.)	GFPP, PVDF, 316SS or PVC (W code) w/TFE Seats)	PSIG (Bar)	250 (17)	150 (10)	250 (17)	150 (10)	100 (7)	100 (7)	50 (3.3)	250 (17)	150 (10)	100 (7)
	PVC (V code) Viton or CSPE Seats / Degas Liquid End		150 (10)							150 (10)		
Connections:		Tubing	1/4" ID X 3/8" OD						3/8" ID X 1/2" OD	1/4" ID X 3/8" OD		
		Piping	1/4" FNPT									
Strokes/Minute		SPM	125							250		

Note 3: Pumps with rated pressure above 150 PSI will be de-rated to 150 PSI Max. when selecting certain valve options, see Price Book for details.

Engineering Data

Pump Head Materials Available: GFPPL, PVC, PVDF, 316 SS

Diaphragm: PTFE-faced CSPE-backed

Check Valves Materials Available:

Seats/O-Rings: PTFE, CSPE, Viton

Balls: Ceramic, PTFE, 316 SS, Alloy C

Fittings Materials Available: GFPPL, PVC, PVDF

Bleed Valve: Same as fitting and check valve selected, except 316SS

Injection Valve & Foot Valve Assy: Same as fitting and check valve selected

Tubing: Clear PVC, White PE

Important: Material Code - GFPPL=Glass-filled Polypropylene, PVC=Polyvinyl Chloride, PE=Polyethylene, PVDF=Polyvinylidene Fluoride, CSPE=Generic formulation of Hypalon, a registered trademark of E.I. DuPont Company. Viton is a registered trademark of E.I. DuPont Company. PVC wetted end recommended for sodium hypochlorite.

Engineering Data

Reproducibility: +/- 3% at maximum capacity

Viscosity Max CPS: 1000 CPS

Stroke Frequency Max SPM: 125 / 250 by Model

Stroke Frequency Turn-Down Ratio: 10:1 /100:1 by Model

Stroke Length Turn-Down Ratio: 10:1

Power Input: 115 VAC/50-60 HZ/1 ph, 230 VAC/50-60 HZ/1 ph

Average Current Draw:

@ 115 VAC; Amps: 0.6 Amps

@ 230 VAC; Amps: 0.3 Amps

Peak Input Power: 130 Watts

Average Input Power @ Max SPM: 50 Watts

Custom Engineered Designs – Pre-Engineered Systems

Pre-Engineered Systems

Pulsafeeder's Pre-Engineered Systems are designed to provide complete chemical feed solutions for all electronic metering applications. From stand alone simplex pH control applications to full-featured, redundant sodium hypochlorite disinfection metering, these rugged fabricated assemblies offer turn-key simplicity and industrial-grade durability. The UV-stabilized, high-grade HDPE frame offers maximum chemical compatibility and structural rigidity. Each system is factory assembled and hydrostatically tested prior to shipment.

Dimensions

Series A PLUS Dimensions (inches)						
Model No.	A	B	C	D	E	Shipping Weight
LB02 / S2	5.0	9.6	9.5	6.5	8.2	10
LBC2	5.0	9.9	9.5	6.5	8.5	10
LBC3	5.0	9.9	9.5	6.5	8.5	10
LB03 / S3	5.0	9.9	9.5	6.5	8.5	10
LB04 /S4	5.0	9.9	9.5	6.5	8.5	10
LB64	5.0	9.9	9.5	6.5	8.5	10
LBC4	5.0	9.9	9.5	6.5	8.5	10

NOTE: Inches X 2.54 = cm

MATERIAL SAFETY DATA SHEET

Date stamp: 29-Jul-2005 **MSDS Ref. No.:** 100150 **Revision Number:** 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product name: Miracle-Gro® Liquid All Purpose Plant Food, 12-4-8
Description: Liquid Fertilizer

Company
The Scotts Company
14111 Scottslawn Road
Marysville, OH 43041

24-HOUR EMERGENCY TELEPHONE NUMBERS:
CHEMTREC (U.S.): 1-800-424-9300
CHEMTREC (International): 1-703-527-3887
Non-Emergency Calls: 1-937-644-0011

Formula No.: S10659

2. HAZARDS IDENTIFICATION

OSHA Regulatory Status: This material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Labelling
Signal word: No signal word.
Precautionary Statement Keep out of reach of children.
Potential health effects
Eye contact: Contact with eyes may cause irritation.
Skin contact: Irritation not expected.
Ingestion: Considered practically non-toxic. Possible gastrointestinal tract irritation.
Inhalation: May cause irritation of respiratory tract.

Aggravated Medical Conditions: Inhalation may aggravate asthma.
Principle routes of exposure: Skin, Inhalation, Eyes, Ingestion

3. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS-No	Weight %
Urea	57-13-6	15-40
Potassium Phosphate	7778-77-0	7-13
Potassium chloride, KCl	7447-40-7	3-7

4. FIRST AID MEASURES

Eye contact: Hold eye open and rins slowly and gently with water for 15-20 minutes. Remove contact lenses, if present after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice

Skin contact: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice

Ingestion: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so be a poison control center or doctor. Do not give anything by mouth to an unconscious person

Inhalation: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferabley by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice

5. FIRE-FIGHTING MEASURES

Flammable properties: Non-flammable.
Suitable extinguishing media: Water spray, carbon dioxide, dry chemical, chemical foam
Explosion potential: Closed containers may rupture violently under fire conditions.
Hazardous combustion products: Toxic fumes may be produced.
Fire fighting procedures: Flood with water to cool containers. Select appropriate method to surround and extinguish fire. Contain run-off as ingredients may be toxic to aquatic organisms.
Special protective equipment for firefighters: In the event of fire, wear self-contained breathing apparatus

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Wear personal protective equipment
Environmental precautions: Prevent product from entering drains
Methods for containment: Control spill with dykes and absorb with inert absorbant material.
Methods for cleaning up: If material is uncontaminated, collect and reuse as recommended for product.

7. HANDLING AND STORAGE

Handling: Avoid container breakage

Storage: Keep containers tightly closed in a cool, well-ventilated place

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Components	ACGIH:	OSHA:
Potassium chloride, KCl	Not Listed	Not Listed
Urea	Not Listed	Not Listed
Potassium Phosphate	Not Listed	Not Listed

Engineering controls Use adequate ventilation to keep the airborne concentrations of this material below the recommended exposure standard

Personal Protective Equipment

Eye/face protection: Eye/face protection is not required, but is recommended in manufacturing situations where contact may occur.
Skin and body protection: Wear suitable protective clothing if contact is anticipated during manufacturing. Imervious gloves.
Respiratory protection: If airborne levels are high or product does not remain intact, use a combination of engineering controls (e.g. ventilation) and personal protection (e.g. NIOSH/MSHA approved respirator for dusts, mists, and fumes

General hygiene considerations: Wash hands before breaks and immediately after handling the product.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid
Color: Green
pH: 6.7 - 7.1
Density: 1.20 g/cc
Appearance: Clear
Odor: None
Solubility: Water solubility, Completely soluble
Flash point: Does not flash

10. STABILITY AND REACTIVITY

Chemically Stable: Yes
Conditions to avoid: Extreme heat.
Materials to avoid: Strong oxidizing agents (permanganate, dichromate, chlorine, etc.). Reducing agents (sodium nitrite, etc.). Chlorine compounds (sodium hypochlorite, sodium chlorate, pool chemicals, household bleach and other cleaning products). Fuels. Active metals such as aluminum and magnesium.
Hazardous decomposition products: Toxic fumes and gases may be generated. Metal oxides possible.
Possibility of hazardous reactions: Poses little or no immediate hazard.

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Eye effects: Contact with eyes may cause irritation
Skin effects: May cause skin irritation and/or dermatitis

Chronic toxicity
Carcinogenic effects: The table below indicates whether each agency has listed any indgredient as a carcinogen.

Components	NTP:	IARC:	OSHA:
Potassium chloride, KCl	Not listed	Not listed	Not listed
Urea	Not listed	Not listed	Not listed
Potassium Phosphate	Not listed	Not listed	Not listed

General Information Very low toxicity for humans and animals
Ingestion: Health injuries are not known or expected under normal use
Inhalation: Health injuries are not known or expected under normal use

12. ECOLOGICAL INFORMATION

Ecotoxicity effects: No data is available on the product itself.
Persistence and degradability: Inherently biodegradable. Non-persistent.
Bioaccumulative potential: Does not bioaccumulate.
Mobility: Water contaminating.
Aquatic toxicity: May be beneficial to plant life.
Additional ecological information: Do not apply directly to lakes, streams, or ponds.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods: Dispose of in accordance with local regulations and national regulations.
Contaminated packaging: Do not re-use empty containers. If empty, place in trash or offer for recycling if available.

14. TRANSPORT INFORMATION

The description shown may not apply to all situations. Consult 49 CFR, or appropriate dangerous goods regulations for additional description requirements (e.g. technical name) and mode-specific or quantity-specific shipping requirements.

DOT
Proper shipping name: Not regulated

15. REGULATORY INFORMATION

Components	CAS-No	CERCLA/SARA 313	CERCLA/SARA 302
Potassium chloride, KCl	7447-40-7	Not Listed	Not Listed
Urea	57-13-6	Not Listed	Not Listed
Potassium Phosphate	7778-77-0	Not Listed	Not Listed

General Information Contact local authorities for disposal of large quantities of product

16. OTHER INFORMATION

NFPA: **Health:** 1 **Flammability:** 0 **Reactivity:** 0

HMIS: **Health:** 1 **Flammability:** 0 **Reactivity:** 0

Hazard Rating: 0=Least; 1-Slight; 2=Moderate; 3=High; 4=Severe

General comment: This document contains health, safety, and environmental information useful to emergency response agencies, health care providers, manufacturers, and workers/employees. It does not replace the precautionary language, use directions, or the storage and disposal information found on the product label.

Revision date: 23-Jun-2005

Additional Information: This information contained herein is, to the best of Scott's knowledge and belief, accurate and reliable as of the date of preparation of this document. However, no warranty or guarantee, express or implied, is made as to the accuracy or reliability, and Scotts shall not be liable for any loss or damage arising out of the use thereof. No authorization is given or implied to use any patented invention without a license. In addition, Scotts shall not be liable for any damage or injury resulting from abnormal use, from any failure to adhere to recommended practices or from any hazards inherent in the nature of the product.

SECTION 6.0 INSTRUMENTATION AND CONTROLS

6.1 Electrical Control Panel

6.2 Instrumentation

6.1 Electric Control Panel

I-BOx 5000

- Electrical Control Panel Layout
- Ladder Logic Diagram
- Interconnection Diagram
- Electrical Parts List
- Electrical Parts Cut Sheets

I-BOx 8025

- Electrical Control Panel Layout
- Ladder Logic Diagram
- Interconnection Diagram
- Electrical Parts List
- Electrical Parts Cut Sheets

FRONT VIEW

ELECTRICAL PANEL SPECIFICATION:

CONSTRUCTION:

1. ENCLOSURE: NEMA 4X, FRP
2. WIRING: 14 AWG CLASS MTW OR THHN MINIMUM
3. DASHED LINES INDICATE WIRING EXTERNAL TO CONTROL PANEL

HARDWARE:

1. 316 SS

INTRINSICALLY SAFE CONSTRUCTION:

1. ALL INTRINSICALLY SAFE CIRCUITS TO BE RUN IN SEPARATE CONDUIT AND SEPARATED FROM NON-INTRINSICALLY SAFE CIRCUITS ACCORDING TO NEC ARTICLES 500 AND 504.
2. ALL WIRE DUCTS CONTAINING INTRINSICALLY SAFE CIRCUITS SHALL BE LABELED AS SUCH.

LABELS AND NAMEPLATES

1. NAMEPLATES SHALL BE BLACK SELF-ADHESIVE LAMICOID WITH WHITE LETTERING.
   SYSTEM NAMEPLATE: 9" W X 2" H WITH 3/8" LETTERING
   COMPONENT NAMEPLATE: 3" W X 3" H WITH 1/4" LETTERING
2. ALL COMPONENTS SHALL BE LABELED WITH PRINTED STICKERS PLACED ABOVE COMPONENT ON BACK PANEL. LETTER TO BE 1/16" IN HEIGHT.
3. ALL WIRES/CABLES LABELS TO BE MACHINE PRINTED, WRAP TYPE.
4. ALL TERMINAL BLOCK LABELS TO BE MACHINE PRINTED.
5. 10% OF EXTRA SPARE TERMINALS SHALL BE PROVIDED WITH EACH SYSTEM.
6. WIRING TO TERMINAL BLOCKS TO BE DONE SUCH THAT ALL FIELD WIRING IS ON A COMMON SIDE OF THE TERMINAL STRIP.

RELEVANT ELECTRICAL CODES:

1. PANEL TO BE CERTIFIED IN COMPLIANCE WITH UL-508A (UL LISTED).

ELECTRICAL PARTS LIST:

1. ELECTRICAL PARTS LIST DETAILS, SEE E1-SHEET 3.

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

Rev A

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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		DATE
DESIGNER	VC	6/5/25
CHECKER		DATE
ENGINEER	KAL	DATE
MANAGER	KR	DATE
FILE:	F5636-E1	
SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL LAYOUT

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	1 OF 12	A

ELECTRICAL PANEL SPECIFICATION:

CONSTRUCTION:

1. ENCLOSURE: NEMA 4X, FRP
2. WIRING: 14 AWG CLASS MTW OR THHN MINIMUM
3. DASHED LINES INDICATE WIRING EXTERNAL TO CONTROL PANEL

HARDWARE:

1. 316 SS

INTRINSICALLY SAFE CONSTRUCTION:

1. ALL INTRINSICALLY SAFE CIRCUITS TO BE RUN IN SEPARATE CONDUIT AND SEPARATED FROM NON-INTRINSICALLY SAFE CIRCUITS ACCORDING TO NEC ARTICLES 500 AND 504.
2. ALL WIRE DUCTS CONTAINING INTRINSICALLY SAFE CIRCUITS SHALL BE LABELED AS SUCH.

LABELS AND NAMEPLATES

1. NAMEPLATES SHALL BE BLACK SELF-ADHESIVE LAMICOID WITH WHITE LETTERING.
   SYSTEM NAMEPLATE: 9" W X 2" H WITH 3/8" LETTERING
   COMPONENT NAMEPLATE: 3" W X 3" H WITH 1/4" LETTERING
2. ALL COMPONENTS SHALL BE LABELED WITH PRINTED STICKERS PLACED ABOVE COMPONENT ON BACK PANEL. LETTER TO BE 1/16" IN HEIGHT.
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4. ALL TERMINAL BLOCK LABELS TO BE MACHINE PRINTED.
5. 10% OF EXTRA SPARE TERMINALS SHALL BE PROVIDED WITH EACH SYSTEM.
6. WIRING TO TERMINAL BLOCKS TO BE DONE SUCH THAT ALL FIELD WIRING IS ON A COMMON SIDE OF THE TERMINAL STRIP.

RELEVANT ELECTRICAL CODES:

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ELECTRICAL PARTS LIST:

1. ELECTRICAL PARTS LIST DETAILS, SEE E1-SHEET 3.

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SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
	Rev A					

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DESIGNER	VC	DATE 6/5/25
CHECKER		DATE
ENGINEER	KAL	DATE
MANAGER	KR	DATE
FILE:	F5636-E1	
SCALE:	NTS	

TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL LAYOUT

CLIENT: NAN, INC.
HONOLULU, HI

Integrity Municipal Systems
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	2 OF 12	A

ITEM	QTY.	PART NO.	DESCRIPTION	MFG. NAME	MFG. PART NO.
651	1	–	VENT FAN, NEMA 4X, 115VAC, 92CFM	KOOLTRONICS	KNP60FLV
650	1	–	FILTER HOOD ASSEMBLY	KOOLTRONICS	KNPA60FLV
632	1		HINGED COVER WINDOW PROP	ALLIED MOULDED	AMHMIPROP142
631	1		HINGED COVER WINDOW	ALLIED MOULDED	AMHMI142CCL
630	1		OIT, 10" COLOR, TFT, PANELVIEW PLUS 7 STANDARD	ALLEN-BRADLEY	2711P-T10C21D8S
562	1		YELLOW ESTOP RING, 22MM	ALLEN-BRADLEY	800F-15YSE112
546	1		CONTACT BLOCK, 1NO/1NC	ALLEN-BRADLEY	800F-X11D
545	1		LATCH, 22MM PLASTIC	ALLEN-BRADLEY	800F-ALP
544	1		LED MODULE	ALLEN-BRADLEY	800F-NUR
543	1		ESTOP PUSHBUTTON, ILLUM., 4X, 22MM, PULL-TO-RELEASE	ALLEN-BRADLEY	800FP-LMP44
510	1	–	MAIN DISCONNECT HANDLE, RED/YEL	SIEMENS	LBRH4
506	1	–	LABEL, 4-1/8" x 1-1/8"	BRADY	102307
501	1	–	ENCLOSURE, FRP, NEMA 4X, 40" X 32" X 12"	HOFFMAN	UU1008030

SEE DRAWING
E1-07
FOR ENCLOSURE
CUTOUT DIMENSIONS

ITEM	QTY.	PART NO.	DESCRIPTION	MFG. NAME	MFG. PART NO.
217	A/R	–	TERMINAL BLOCK PARTITION, UT 4	PHOENIX CONTACT	3047167
216	A/R	–	TERMINAL LABEL, WHITE, SNAP-IN FOR UT4 TERMINALS	PHOENIX CONTACT	UCT-TM6
215	A/R	–	TERMINAL BLOCK JUMPER, FIXED BRIDGE 10-POSITION	PHOENIX CONTACT	3030271
214	A/R	–	TERMINAL BLOCK ANCHOR	PHOENIX CONTACT	800886
213	A/R	–	TERMINAL END COVER, FOR 3044102, 3044128	PHOENIX CONTACT	3047028
212	A/R	–	TERMINAL, UT4, SCREW, 10-26 AWG, 32A, GN/YL	PHOENIX CONTACT	3044128
210	A/R	–	TERMINAL, UT4, SCREW, 10-26 AWG, 32A, 1000V, GRAY	PHOENIX CONTACT	3044102
208	A/R	–	DIN RAIL	PHOENIX CONTACT	801733 OR EQUAL
201	A/R	–	WIRING DUCT COVER, WHITE, 1"	ANY	
200	A/R	–	WIRING DUCT, WHITE, 1" x 3"	ANY	
150	1	–	SIGNAL ISOLATION SWITCH AMPLIFIER	PHOENIX CONTACT	2865984
141	2	–	ETHERNET CABLE, CAT6 PIN TO PIN, 1FT	ANY	–
140	1	–	ETHERNET CABLE, CAT6 PIN TO PIN, 7FT	ANY	–
110	1	–	TRANSFORMER, 500VA, 480/120VAC 1-PHASE	SIEMENS	MT0500A
105	1	–	POWER SUPPLY, 120VAC SUPPLY, 24VDC@5A	IDEC	PS5R-VF24
100	1	–	VFD, POWERFLEX 523, 2HP, 380-480V	ALLEN BRADLEY	25A-D4P0N104
85	3	–	PLC, TERMINAL ADAPTOR, IO CARD	ALLEN BRADLEY	5069-RTB18-SPRING RTB
84	1	–	PLC CARD, 4 ANALOG OUTPUT, CURRENT/VOLTAGE	ALLEN BRADLEY	5069-OF4
82	1	–	PLC, 16 RO CARD	ALLEN BRADLEY	5069-OW16
81	1	–	PLC, 16 DI CARD, 24VDC	ALLEN BRADLEY	5069-IB16
80	1	–	PLC, CPU 5380, 1MB	ALLEN BRADLEY	5069-L310ER
76	1	–	ETHERNET SWITCH, 5 PORT, AUTOCROSSING, 24VDC	PHOENIX CONTACT	2891152
75	1	–	MEDIA CONVERTER, FIBER OPTIC TO ETHERNET	PHOENIX CONTACT	1330611
68	1	–	MOTOR CIRCUIT PROTECTOR, 4 – 6.3A	ALLEN BRADLEY	140MT-C3E-B63
65	4	–	CONTROL RELAY, 24VDC, 1P, 10A	ALLEN BRADLEY	700-HLT1Z24
64	1	–	MASTER CONTROL RELAY, 24VDC, 4NO, 15A	ALLEN BRADLEY	700-CFM400EJ
61	1	–	RECEPTACLE	PHOENIX CONTACT	0804155
45	1	–	1-POLE CIRCUIT BREAKER, 3 A	ALLEN BRADLEY	1489-M1D030
44	1	–	1-POLE CIRCUIT BREAKER, 5 A	ALLEN BRADLEY	1489-M1D050
43	3	–	1-POLE CIRCUIT BREAKER, 0.5 A	ALLEN BRADLEY	1489-M1D005
42	2	–	1-POLE CIRCUIT BREAKER, 2 A	ALLEN BRADLEY	1489-M1D020
41	1	–	1-POLE CIRCUIT BREAKER, 7 A	ALLEN BRADLEY	1489-M1D070
40	1	–	2-POLE CIRCUIT BREAKER, 4 A	ALLEN BRADLEY	1489-M2D040
22	1	–	LABEL, GROUND SYMBOL, 3/4" DIA.	PANDUIT	PLD-57 OR EQUAL
20	1	–	GROUND LUG, 1-HOLE, 14-4AWG, COPPER	BURNDY	KA4C
10	1	–	MAIN DISCONNECT SWITCH, 32A	SIEMENS	3LD2217-0TK13
1	1	–	BACK PANEL, 40x30	HOFFMAN	A40P30

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

Rev A

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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DESIGNER VC	DATE 6/5/25	
CHECKER	DATE	
ENGINEER ZA	DATE	
MANAGER KR	DATE	
FILE: F5636-E1		
SCALE: NTS		

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL BOM

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	3 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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A	RELEASE FOR SUBMITTAL					

Rev A

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SCALE:	NTS	

TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL LADDER LOGIC DIAGRAM

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	4 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL LADDER LOGIC DIAGRAM

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	5 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL LADDER LOGIC DIAGRAM

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	6 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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A	RELEASE FOR SUBMITTAL					

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SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL LADDER LOGIC DIAGRAM

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	7 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

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A	RELEASE FOR SUBMITTAL					

Rev A

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STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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MANAGER	KR	DATE
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SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL NETWORK

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	8 OF 12	A

GENERAL INSTRUCTION			
STEP	PARAMETER	SELECTION	NOTES
1	-	ESC	PRESS ONCE TO DISPLAY GRP AND PARAMETER # WILL FLASH
2	-	ESC	PRESS AGAIN TO ENTER GROUP MENU AND GROUP MENU WILL FLASH
3	-	UP OR DOWN ARROW	USE ARROW TO NAVIGATE TO DESIRED GROUP
4	-	ENTER OR SELECT	PRESS EITHER KEY TO ENTER INTO GROUP
5	-	UP OR DOWN ARROW	USE ARROW TO NAVIGATE TO DESIRED PARAMETER WITHIN GROUP
6	-	ESC	WILL CANCEL THE CHANGE (OR) ENTER WILL SAVE CHANGE
7	-	ESC,ESC	PRES ESC TWICE TO GET OUT OF THE PROGRAMMING MENU

PROGRAMMING GUIDE			
1	P031	480V	MOTOR NP VOLTS (380V)
2	P032	60 HZ	MOTOR NP HERTZ (50HZ)
3	P033	AS REQUIRED	MOTOR OVER-LOAD CURRENT (DRIVE RATED CURRENT X 2 NORMALLY)
4	P034	AS REQUIRED	MOTOR NAMEPLATE FLA
6	P036	AS REQUIRED	MOTOR NP RPM
7	P037	1.5000	MOTOR NP POWER
8	P041	30	ACCEL TIME (30 SEC)
9	P042	30	DECEL TIME (30 SEC)
10	P043	0	MINIMUM FREQ (0HZ)
11	P044	60	MAX FREQ (60HZ)
12	P046	2	START SOURCE (DIGITAL TERMINAL BLOCK)
13	P047	6	SPEED REFERENCE (4-20mA)
14	T062	48	DIGIN TERM BLK 2 (2-WIRE FWD, DEFAULT)
15	T063	50	DIGIN TERM BLK 3 (2-WIRE REV, DEFAULT)
16	T076	2	RELAY OUT1 SEL (MOTOR RUNNING)
17	A541	9	AUTO RESTART TRIES (MAX 9 TIMES)
18	A542	30	AUTO RESTART INTERVAL (30 SEC)

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

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TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL VFD PROGRAMMING

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	9 OF 12	A

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

PANEL WIRING

IS | 24VDC | 120V | 480V

TB4

Terminal	Signal
216	TANK LEVEL SWITCH
216A	
217	DIFFERENTIAL PRESSURE SWITCH
217A	
206	SPARE DI
207	SPARE DI
208	SPARE DI
209	SPARE DI
222	SPARE DI
223	SPARE DI
224	SPARE DI
225	SPARE DI
226	SPARE DI
227	SPARE DI
228	SPARE DI
229	SPARE DI
305	SPARE RO
306	SPARE RO
307	SPARE RO
308	SPARE RO
309	SPARE RO
323	SPARE RO
324	SPARE RO
325	SPARE RO
326	SPARE RO
327	SPARE RO
328	SPARE RO
329	SPARE RO
404	SPARE AO
405	SPARE AO
406	SPARE AO
407	SPARE AO
408	SPARE AO
409	SPARE AO

TB2

Terminal	Signal
118A	FAN HEATER
123A	PUMP POWER
125A	SOLENOID VALVE POWER
L1	120VAC
L1	120VAC
L1	120VAC
N	120VAC NEUTRAL
N	120VAC NEUTRAL
N	120VAC NEUTRAL
N	120VAC NEUTRAL
N	120VAC NEUTRAL
GND	GROUND
GND	GROUND
GND	GROUND
GND	GROUND
GND	GROUND
SP	NO CONNECTION
SP	NO CONNECTION
SP	NO CONNECTION

TB1

Terminal	Signal
103A	MOT103-PHASE A
104A	MOT103-PHASE B
105A	MOT103-PHASE C
GND	GROUND

FIELD WIRING

)

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

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REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
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STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL CUSTOMER TERMINALS

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	10 OF 12	A

DETAIL A

22mm OPERATOR CUTOUT

DETAIL C
NOT TO SCALE

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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Rev A

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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DESIGNER	VC	DATE 6/5/25
CHECKER		DATE
ENGINEER		DATE
MANAGER	KR	DATE
FILE:	F5636-E1	
SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 5000)
ELECTRICAL CONTROL PANEL HOLE LAYOUT

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	11 OF 12	A

LABEL ALL DOOR DEVICES ON DOOR INTERIOR
WITH MYLAR LABELS

DO NOT PLACE LABELS WITHIN 1"
FROM EDGE OF DOOR

2 QTY. BLACK LAMICOID/WHITE LETTERING
7" x 1", .25" TEXT

I-BOx® BIOLOGICAL ODOR CONTROL SYSTEM

10-VCP1-2230 BLEND TANKS

BLACK LAMICOID/WHITE LETTERING
3" x 3/4", .125 TEXT

MAIN DISCONNECT

ITEMS 1 THRU 2 TO BE INSTALLED
ON THE INSIDE OF THE DOOR.

1 QTY. WHITE MYLAR/BLACK LETTERING

MAINTAIN A COMPLETE SET OF PRINTS (1)

1 QTY. WHITE MYLAR/BLACK LETTERING

UL TYPE 4X/NEMA 4X (2)

LABEL ALL SUBPANEL DEVICES AS SHOWN
(DS101, XF114, MS102, ETC.)
LABEL ALL TERMINAL BLOCKS

1 QTY. ADHESIVE-BACKED PRINTED LABEL

TIGHTEN TERMINAL SCREWS TO 25..40 IN.-LB. FOR GROUND LUG

1 QTY. ADHESIVE-BACKED PRINTED LABEL

TIGHTEN TERMINAL SCREWS TO 6..7 IN.-LB. FOR PHOENIX 3004362 TERMINAL BLOCKS

1 QTY. ADHESIVE-BACKED PRINTED LABEL

USE COPPER CONDUCTOR 90 DEG. C INSULATION ONLY FOR TERMINAL BLOCKS

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

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PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E1	12 OF 12	A

Hoffman
Manufaturer#: UU1008030

nVent HOFFMAN

We connect and protect

ULTRX, Type 4X

INDUSTRY STANDARDS

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A Listed; Type 3, 3R, 4, 4X, 12, 13; File No. E61997
cUL Listed per CSA C22.2 No 94; Type 3, 3R, 4, 4X, 12, 13; File No. E619977
Enclosure flammability evaluated per UL 508A
Window flammability evaluated per UL 508A

NEMA/EEMAC Type 3, 3R, 4, 4X, 12, 13
IEC 60529, IP66

Meets NEMA Type 3RX requirements

APPLICATION

Providing outstanding protection against corrosion and the elements, the clean lines and molded, embossed design of ULTRX fiberglass enclosures make them the most stylish and aesthetically pleasing of their class. These enclosures feature hidden hinges, a padlocking capability for security, and flexible internal mounting options.

FINISH

Standard exterior surface painted light-gray acrylic enamel for enhanced UV protection. Optional steel panels are painted white. Optional stainless steel, aluminum, conductive and composite panels are unpainted.

FEATURES

- Compression-molded fiberglass material has excellent temperature and chemical resistance qualities and exhibits outstanding physical properties, including high-impact resistance
- Exterior surface is painted for enhanced UV protection
- Fiberglass is easily punched, drilled, filed or sawed
- Gasket assures watertight and dust-tight seal
- Enclosure may be rotated 180 degrees for left and right hinging
- Molded-in drip shields are standard with each enclosure
- Impact-resistant polycarbonate window is permanently bonded in place
- Fiberglass mounting brackets and stainless steel attachment screws are provided with each enclosure
- Unique hinge design allows for standard 180-degree door opening with a maximum opening of 270 degrees
- Door hinges are replaceable
- Type 316 stainless steel quarter-turn latch. Optional keylocking or padlocking handle available.
- Molded-in DIN bosses
- Molded bosses on door provide additional mounting provisions
- Integral mounting rails provide infinite panel adjustment front to back
- Optional data pocket is high-impact thermoplastic
- Material is halogen free

ACCESSORIES

See also Accessories.

H2OMIT Vent Drains, Type 4X
H2OMIT Thermoelectric Dehumidifier
HOL-SEALERS Non-Metallic Hole Seals
Panels for Type 3R, 4, 4X, 12 and 13 Enclosures
Rack Angles (Type RA)

MODIFICATION AND CUSTOMIZATION

nVent HOFFMAN excels at modifying and customizing products to your specifications. Contact your local nVent HOFFMAN sales office or distributor for complete information.

Bulletin: UX1

Standard Product

Catalog Number	Door Style	External Dimensions L x W mm/in	Internal Dimensions A x B x C mm/in	Panel	Conductive Panel	Panel Size D x E mm/in	Mounting G x H mm/in	Window Size M x N mm/in	F mm/in	J mm/in	K mm/in	S mm/in	T mm/in
UU504020	Solid	513 x 413 20.20 x 16.26	496 x 396 x 220 19.53 x 15.59 x 8.66	A20P16	A20P16G	432 x 330 17.00 x 12.99	359 x 459 14.13 x 18.07	– –	186 7.32	297 11.69	19 0.75	286 11.26	387 15.24
UU504020W	Window	513 x 413 20.20 x 16.26	496 x 396 x 220 19.53 x 15.59 x 8.66	A20P16	A20P16G	439 x 330 17.00 x 12.99	359 x 459 14.13 x 18.07	386 x 286 15.20 x 11.26	186 7.32	297 11.69	19 0.75	286 11.26	387 15.24
UU606020	Solid	625 x 612 24.61 x 24.09	608 x 595 x 220 23.94 x 23.43 x 8.66	A24P24	A24P24G	533 x 533 20.98 x 20.98	559 x 572 22.01 x 22.52	– –	186 7.32	500 19.68	21 0.83	489 19.25	489 19.25
UU606020W	Window	625 x 612 24.61 x 24.09	608 x 595 x 220 23.94 x 23.43 x 8.66	A24P24	A24P24G	533 x 533 20.98 x 20.98	559 x 572 22.01 x 22.52	498 x 486 19.61 x 19.13	186 7.32	500 19.68	21 0.83	489 19.25	489 19.25
UU605025	Solid	625 x 513 24.61 x 20.20	608 x 496 x 270 23.94 x 19.53 x 10.63	A24P20	A24P20G	533 x 432 20.98 x 17.00	457 x 570 17.99 x 22.44	– –	239 9.41	400 15.75	21 0.83	387 15.24	489 19.25
UU605025W	Window	625 x 513 24.61 x 20.20	608 x 496 x 270 23.94 x 19.53 x 10.63	A24P20	A24P20G	533 x 432 20.98 x 17.00	457 x 570 17.99 x 22.44	498 x 386 19.61 x 15.20	239 9.41	400 15.75	21 0.83	387 15.24	489 19.25
UU504030	Solid	513 x 412 20.20 x 16.22	496 x 395 x 321 19.53 x 15.55 x 12.64	A20P16	A20P16G	432 x 330 17.00 x 12.99	355 x 455 13.98 x 17.91	– –	287 11.30	300 11.81	19 0.75	286 11.26	387 15.24
UU504030W	Window	513 x 412 20.20 x 16.22	496 x 395 x 321 19.53 x 15.55 x 12.64	A20P16	A20P16G	432 x 330 17.00 x 12.99	355 x 455 13.98 x 17.91	386 x 286 15.20 x 11.26	287 11.30	300 11.81	19 0.75	286 11.26	387 15.24
UU606030	Solid	625 x 612 24.61 x 24.09	608 x 595 x 321 23.94 x 23.43 x 12.64	A24P24	A24P24G	533 x 533 20.98 x 20.98	555 x 568 21.85 x 22.36	– –	287 11.30	500 19.68	21 0.83	489 19.25	489 19.25
UU606030W	Window	625 x 612 24.61 x 24.09	608 x 595 x 321 23.94 x 23.43 x 12.64	A24P24	A24P24G	533 x 533 20.98 x 20.98	555 x 568 21.85 x 22.36	498 x 486 19.61 x 19.13	287 11.30	500 19.68	21 0.83	489 19.25	489 19.25
UU756030	Solid	775 x 612 30.51 x 24.09	758 x 595 x 321 29.84 x 23.43 x 12.64	A30P24	A30P24G	686 x 533 27.01 x 20.98	555 x 718 21.85 x 28.27	– –	287 11.30	500 19.68	21 0.83	489 19.25	641 25.24
UU756030W	Window	775 x 612 30.51 x 24.09	758 x 595 x 321 29.84 x 23.43 x 12.64	A30P24	A30P24G	686 x 533 27.01 x 20.98	555 x 718 21.85 x 28.27	648 x 486 25.51 x 19.13	287 11.30	500 19.68	21 0.83	489 19.25	641 25.24
UU1008030	Solid	1025 x 825 40.35 x 32.48	1008 x 808 x 321 39.68 x 31.81 x 12.64	A40P30	A40P30G	940 x 737 37.01 x 29.02	768 x 968 30.24 x 38.11	– –	287 11.30	700 27.56	23 0.91	692 27.24	895 35.24
UU1008030W	Window	1025 x 825 40.35 x 32.48	1008 x 808 x 321 39.68 x 31.81 x 12.64	A40P30	A40P30G	940 x 737 37.01 x 29.02	768 x 968 30.24 x 38.11	898 x 698 35.35 x 27.48	287 11.30	700 27.56	23 0.91	692 27.24	895 35.24

Purchase panels separately.

Note: When installing enclosures in a right-hand hinge application that involves vibration, nVent HOFFMAN recommends the use of pad-locking or key-locking quarter-turn latch accessories for door securement (UUHPL, UUHKL).

FRONT VIEW

FRONT VIEW WITH DOOR REMOVED

BACK VIEW

SECTION X-X

Siemens
Manufaturer#: LBRH4

Non-fusible disconnect switch accessories

Handles

Catalog number	Used on rotary switches	UL listed NEMA type	Mounting	Marking	Color	Cover interlock supplied [1]	Padlockable
LBRH2	All	1	Door	ON/OFF	Black	No	No
LBRH3	All	1, 3R, 12, 13, 4X	Door	I/O, ON/OFF	Black	Yes [2]	Yes
LBRH4	All	1, 3R, 12, 13, 4X	Door	I/O, ON/OFF	Red/Yel	Yes [2]	Yes
LBRH5	25 amps	1	Direct mount	I/O	Black	—	Yes
LBRH6	3-pole, 40-60 amps	1	Direct mount	I/O	Black	—	Yes
LBRH7	3-pole, 80-100 amps	1	Direct mount	I/O	Black	—	Yes
LBRH8	4-pole, 40 amps	1	Direct mount	I/O	Black	—	Yes
LBRH9	All (pistol grip type)	1, 3R, 12, 4X	Door	I/O, ON/OFF	Black	Yes	Yes
LBRH10	All (pistol grip type)	1, 3R, 12, 4X	Door	I/O, ON/OFF	Red/Yel	Yes	Yes

Note: If a replacement collar is required for the 25 amp rotary switch, order LBRC1. For 40-100 amp rotary switch, order LBRC2.

Rotary switch door handles

Rotary switch direct mount handles

Auxiliary switch kits

Toggle switch cover plates

Rotary shafts

Catalog number	Length inches (mm)	Enclosure depth – inches (mounting pan surface to O.D. of door minimum and maximum without cutting)					
		With std. rotary handle			With pistol grip handle		
		25A	40-60A	80-100A	25A	40-60A	80-100A
LBRS040	1.57 (40)	—	—	3.35-3.50	—	—	—
LBRS050	1.97 (50)	—	—	3.35-3.55	—	—	—
LBRS055	2.17 (55)	3.35-3.55	3.35-3.55	3.50-3.70	—	—	3.35-3.56
LBRS080	3.15 (80)	4.41-4.56	4.46-4.65	4.49-4.68	4.09-4.25	4.21-4.37	4.36-4.54
LBRS120	4.72 (120)	5.98-6.13	6.03-6.22	6.06-6.25	5.66-5.82	5.78-5.94	5.93-6.11
LBRS180	7.09 (180)	8.35-8.50	8.40-8.59	8.43-8.62	8.03-8.19	8.15-8.31	8.30-8.48
LBRS305	12.00 (305)	13.26-13.41	13.31-13.50	13.34-13.52	12.94-13.10	13.06-13.22	13.21-13.39

25 amp, 4th pole

Used on catalog number	Catalog number
LBR3025	LBRP25
LBR3025D	LBRP25D

Rotary switch door mounting kit

Used on rotary switch	Catalog number
40-100 amps	LBRD1

Auxiliary switch kits

Used on rotary switch	Catalog number	Contact arrangement
LBR3025	LBRA25	1 NO/1NC
LBR3025D	LBRA25D	1 NO/1 NC
LBR3040, LBR3060	LBRA1	1 NO/1NC with common point
LBR3080, LBR3100	LBRA2	1 NO/1 NC with common point

Toggle switch cover plate

Used on toggle switch	Catalog number	Padlockable
LBT3040, LBT3060	LBTCP1	Yes
LBT3080, LBT3100	LBTCP2	Yes
LBT3040	LBTCP3	No

1) With no defeat mechanism.
2) If required to open the enclosure door when the switch is ON, order additional catalog LBRDC1. For heavy duty handles with a defeatable cover interlock, use CFS type handles and 5 mm shafts listed in section 4 of the SPEEDFAX.

Specifications

Front-of-Panel (Operators)★

Mechanical Ratings			
Description		**Plastic (Bulletin 800FP)**	**Metal (Bulletin 800FM)**
Vibration (assembled to panel)		Tested at 10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. for 3 hr duration, no damage	
Shock		Tested at 1/2 cycle sine wave for 11 ms; no damage at 100 G	
Degree of protection‡		IP65/66 (Type 3/3R/4/4X/12/13)	IP65/66 (Type 3/3R/4/12/13)
Mechanical durability per EN 60947-5-1 (Annex C)	10 000 000 Cycles	Momentary push buttons, momentary mushroom	
	1 000 000 Cycles	Multi-function, selector switch, key selector switch, selector jog, SensEject™ key selector switch	
	500 000 Cycles	Non-illuminated push-pull E-stop§	
	300 000 Cycles	Twist-to-release E-stop, illuminated push-pull E-stop§, alternate action push buttons	
	100 000 Cycles	Potentiometer, toggle switch	
Operating forces (typical with one contact block)		Flush/extended = 5 N, E-stop = 36 N Mushroom = 9 N	
Operating torque (typical application with one contact block)		Selector switch = 0.25 N•m (2.2 lb•in)	
Mounting torque	Plastic	1.7 N•m (15 lb•in)	
	Metal	4.4 N•m (40 lb•in)	
Environmental			
Temperature range (operating)		-25…+70 °C (-13…+158 °F)♣	
Temperature range (short term storage)		-40…+85 °C (-40…+185 °F)	
Humidity		50…95% RH from 25…60 °C (77…140 °F)	

★ **Performance Data** — Performance data given in this publication is provided only as a guide for the user in determining suitability and do not constitute a performance warranty of any kind. Such data may represent the results of accelerated testing at elevated stress levels, and the user is responsible for correlating the data to actual application requirements. ALL WARRANTIES AS TO ACTUAL PERFORMANCE, WHETHER EXPRESS OR IMPLIED, ARE EXPRESSLY DISCLAIMED.

‡ Momentary mushroom operators are IP65. Plastic keyed operators are IP66, Type 4/13; not Type 4X.

§ Limit of four contact blocks max. for these devices.

♣ Operating temperatures below 0 °C (32 °F) are based on the absence of freezing moisture and liquids, UL Recognized to 55 °C (131 °F) - Incandescent module max. 40 °C (104 °F).

Standards Compliance and Certifications

Certifications	UR/UL, CSA, CCC, CE
Standards Compliance — CE Marked	NEMA ICS-5; UL 508, EN ISO 13850, EN 60947-1, EN 60947-5-1, EN 60947-5-5
Terminal Identification	EN/IEC 60947-1
Shipping Approvals	ABS
RoHS	✓

Back-of-Panel Components★

Electrical Ratings				
Standard contact block ratings		**Screw Termination**	**Spring Clamp Termination**	
		A600, Q600 600V AC	A300, Q300 300V AC	
		AC 15, DC 13 to IEC/EN 60947-5-1 and UL 508, 17V, 5 mA min.		
Low voltage contact block ratings‡		5V, 1 mA DC min. C300, R150, AC 15, DC 13 to EN 60947-5-1 and UL 508		
	Nominal Voltage	**Range**	**Current Draw**	**Frequency**
LED Module Ratings	24…120V AC/DC 24V AC 24V DC 120V AC 240V AC	20…132V AC/DC 10…29V AC 10…30V DC 102…132V AC 204…264V AC	15 mA (AC), 12 mA (DC) 31 mA 24 mA 6 mA 6 mA	50/60 Hz, DC 50/60 Hz DC 50/60 Hz 50/60 Hz
Thermal current		10 A max. enclosed (40 °C ambient) to UL508, EN 60947-5-1		
Insulation voltage (U_i)		Screw terminal = 690V, spring-clamp = 300V		
Wire capacity (screw terminal)§		#18…12 AWG (0.75…2.5 mm^2) Max. (2) #14 AWG or (1) #12 AWG		
Wire capacity (spring-clamp terminal)		#18…14 AWG (0.75…1.5 mm^2) One per spring clamp, two spring clamps per terminal		
Recommended tightening torque on screw terminals		0.7…0.9 N•m (6…8 lb•in)		
Dielectric strength (minimum)		2500V for one minute		
External short circuit protection	Standard blocks	10 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 248-4)		
	Low voltage contact blocks	6 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 248-4)		
Electrical shock protection		Finger-safe conforming to IP2X		
Mechanical Ratings				
Vibration (assembled to panel)		Tested at 10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. 6 hr		
Shock		Tested at 1/2 cycle sine wave for 11 ms and no damage at 100 G max.		
Contact durability per EN 60947-5-1 (Annex C)		10 000 000 cycles		
Contact operation	N.O.	Slow double make and break		
	N.C. & S.M.C.B.	Slow double make and break — positive opening ⊖		
	N.O.E.M.	Double break / double make, early make		
	N.C.L.B.	Double break / double make, late break — positive opening ⊖		
	N.C.E.B.	Double break / double make, early break — positive opening ⊖		
Push button travel to change electrical state		N.C. and N.O.E.M.	1.5 mm (0.060 in.)	
		N.O. and N.C.L.B.	2.5 mm (0.1 in.)	
Operating forces (typical)	Single circuit contact block	3.4 N		
	Dual circuit contact block	5…6.5 N		
Illumination				
LED Dominant Wavelength	Green Red White	525 nm 629 nm —		
LED Luminous Intensity	Green Red White	780 mcd 780 mcd 360 mcd		
Incandescent maximum wattage		2.6 W		
Materials				
Springs		Stainless steel and zinc coated music wire		
Electrical contacts	Standard	Silver-nickel		
	Low voltage	Gold-plated over silver		
Terminals	Screw	Brass		
	Spring-clamp	Silver-plated brass		

★ Performance Data — see note on page 3.
‡ Low voltage contacts are recommended for applications below 17V, 5 mA.
§ Wires less than #18 AWG (0.75 mm^2) may not hold in terminal securely.

2-Position Push-Pull Operators, Illuminated — Twist-to-Release (Trigger Action), Push-Pull (Trigger Action)★‡▽

40 mm Illuminated Twist-to-Release
Cat. No. 800FP-LMT44

40 mm Mushroom Push/Pull
Cat. No. 800FM-LMP44

90 mm Half-Dome
Cat. No. 800FP-LMP94

800F P – LMP4 3

a *b* *c*

a

Operator Construction	
Code	Description
P	Round plastic operator (IP66, Type 4/4X/13)
M	Round metal operator (IP66, Type 4/13)

b

Operator Type	
Push, Twist-to-Release§♣	
Code	Type
LMT4	40 mm color cap
LMT6	60 mm color cap
Push-Pull&	
Code	Type
LMP3	30 mm color cap
LMP4	40 mm color cap
LMP6	60 mm color cap
Half-Dome Push-Pull&	
Code	Type
LMP9	90 mm color cap♠

c

Lens Cap Color	
Code	Color
3	Green
4	Red
5	Yellow♦
6	Blue∆♦

★ LED module required for illumination, can not use incandescent module.
‡ All emergency stop operators are EN ISO 13850 compliant with standard NC, NCLB, or self-monitoring contact blocks.
▽ E-Stop operators, latch, and contact block combinations have been third-party tested for B10d values. B10d values can be found in publication SAFETY-SR001_-EN-E.
§ Only available with red color cap.
♣ 60 mm version has black arrows; 30 and 40 mm versions have white arrows.
♦ Use of a white LED is recommended.
∆ Only available with 40 mm Push-Pull color cap (**LMP4** from Table b).
♠ Half-dome operators only available with red and yellow lens cap colors.
& Limit of four contact blocks max. for these devices.

Back-of-Panel Components

Contact Blocks with Latch — Composite

800F –	P	X	0	1	E
	a	*b*	*c*	*d*	*e*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Contact Block(s) Termination Style★	
Code	Description
X	Screw termination
Q	Spring-clamp termination

★ Six circuits maximum allowable.

c

N.O. (Normally Open) Circuits	
Code	Description
0	No contact
1	1 N.O.
2	2 N.O.
3	3 N.O.
4	4 N.O.
5	5 N.O.
6	6 N.O.

d

N.C. (Normally Closed) Circuits	
Code	Description
0	No contact
1	1 N.C.
2	2 N.C.
3	3 N.C.
4	4 N.C.
5	5 N.C.
6	6 N.C.

e

Specialty Contact Block(s)	
Code	Description
Blank	Standard blocks
V	Low voltage — QuadCONNECT™
E	N.O. early make
L	N.C. late break
B	N.C. early break
S	N.C. self-monitoring

Power Modules with Latch — Composite

800F –	M	N	3	G
	a	*b*	*c*	*d*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Power Module Type§♣	
Code	Description
D	Incandescent module, screw termination
N	Integrated LED module, screw termination
Q	Integrated LED module, spring-clamp termination

c

Voltage	
Code	Description
0	No bulbΔ
1	6V AC/DCΔ
2	12V AC/DCΔ
3	24V AC/DC
4	48V AC/DCΔ
5	120V AC
7	240V AC♦

d

Lamp Color♠	
Code	Description
C	Incandescent
R	Red LED
G	Green LED
W	White LED

§ LED modules for use with all illuminated operators. Incandescent module for use with pilot lights, momentary push buttons, and momentary mushroom operators only.
♣ Four circuits maximum allowable when power module is used. Contact blocks cannot be stacked on power module.
Δ Only available for incandescent module.
♦ Only available for integrated LED module.
♠ For best illumination results, LED color should match lens color. For yellow operator, select a white LED.

Back-of-Panel Components, Continued

Power Modules with Contact Blocks and Latch — Composite

800F –	P	N	5	R	X	1	0	E
	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Power Module Type★‡	
Code	Description
D	Incandescent module, screw termination
N	Integrated LED module, screw termination
Q	Integrated LED module, spring-clamp termination

c

Voltage	
Code	Description
0	No bulb§
1	6V AC/DC§
2	12V AC/DC§
3	24V AC/DC
4	48V AC/DC§
5	120V AC
7	240V AC♣

d

Lamp Color∆	
Code	Description
C	Incandescent
R	Red LED
G	Green LED
W	White LED

e

Contact Block(s) Termination Style	
Code	Description
X	Screw termination
Q	Spring-clamp termination

f

N.O. (Normally Open) Circuits	
Code	Description
0	No contact
1	1 N.O.
2	2 N.O.
3	3 N.O.
4	4 N.O.

g

N.C. (Normally Closed) Circuits	
Code	Description
0	No contact
1	1 N.C.
2	2 N.C.
3	3 N.C.
4	4 N.C.

h

Specialty Contact Block(s)	
Code	Description
Blank	Standard blocks
V	Low voltage — QuadCONNECT™
E	N.O. early make
L	N.C. late break
B	N.C. early break
S	N.C. self-monitoring

★ Four circuits maximum allowable when power module is used. Contact blocks cannot be stacked on power module.
‡ LED modules for use with all illuminated operators. Incandescent module for use with pilot lights, push buttons, and momentary mushroom operators only.
§ Only available for incandescent module.
♣ Only available for integrated LED module.
∆ For best illuminated results, LED should match lens color. For yellow operator, select a white LED.

Allen-Bradley
Manufaturer#: 800f-15YSE112

Two-Color Molded Legend Caps — Non-Illuminated Push Buttons

800F – AF 3 01
a b c

Cat. No. 800F-15YSE112c

a

Button Cap Type	
Code	Description
AF	Flush
AE	Extended

b

Color Cap	
Code	Description
1	White
2	Black
3	Green
4	Red
5	Yellow
6	Blue

Legend Text‡§	
English	
Code	Description
01	START
02	STOP
05	O
06	I
08	→
09	FORWARD★
10	REVERSE★
11	R

★ Available in flush only.
‡ White and yellow caps have black text. All other color caps have white text.
§ Valid color cap text codes include:

Color	Text	
	Flush Caps	Extended Caps
White	FORWARD, REVERSE, START, I, →, R	→, R
Black	FORWARD, REVERSE, →, R	STOP, O, →, R
Green	FORWARD, REVERSE, START, I, →	→
Red	FORWARD, REVERSE, STOP, O, →	STOP, O, →
Yellow	FORWARD, REVERSE, →	→
Blue	FORWARD, REVERSE, →, R	→, R

Emergency Stop Legend Plates ♣

800F – 15YS
a b

a

Size/Color (Yellow)	
Code	Description
15Y	60 mm round (30.5 mm mounting hole)
15YS	60 mm round (22.5 mm mounting hole)♦
16Y	90 mm round (22.5 mm mounting hole)♦

b

Text	
Code	Description
Blank	No text
E112	EMERGENCY STOP
F112	ARRÊT D'URGENCE♠
S112	PARO DE EMERGENCIA
G112	NOT HALT
T112	ARRESTO EMERGENZA
N112	NÖDSTOPP, EMERGENCY STOP♠
P112	PARADA DE EMERGENCIA

b (cont'd)

Text	
Code	Description
W112	NØDSTOPP, EMERGENCY STOP♠
A112	NØDSTOP
B112	EMERGENCY STOP, ARRÊT D'URGENCE, PARADA DE EMERGENCIA♠
D112	NOODSTOP♠
M112	NOT HALT, ARRESTO EMERGENZA, ARRÊT D'URGENCE▽
	EMERGENCY STOP, ARRÊT D'URGENCE, NOT HALT&
L112	NEYÐARSTOPP, NEYÐARSTOPP♠
H112	NÖD-STOP, HÄTÄ-SEIS, NÖD-STOP♠

♣ Sold only multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.
♦ Not for use with base mounted contact blocks.
♠ Not available on 15YS version.
▽ Text printed on the 15Y version only.
& Text printed on the 15YS & 16Y versions only.

Push Button, Multi-Function Caps

800F – A F 1 C
a b

a

Type	
Code	Description
E	Push button extended cap
F	Push button flush cap
FA	Alternate action cap
FAU	Multi-function flush cap (for position A)
EAU	Multi-function extended cap (for position A)
FCU	Multi-function flush cap (for position C)
ECU	Multi-function extended cap (for position C)

b

Color	
Code	Description
0	Amber
1	White
2	Black
3	Green
4	Red
5	Yellow
6	Blue

Table 4 - PanelView Plus 7 Standard 7-in., 9-in., and 10-in. Terminals

Attribute	7-in. Touch 2711P-T7C21D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S, 2711P-T7C22D8S-B	9-in. Touch 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S, 2711P-T9W22D8S-B	10-in. Touch 2711P-T10C21D8S, 2711P-T10C21D8S-B, 2711P-T10C22D8S, 2711P-T10C22D8S-B
Operator input	Touch	Touch	Touch
Display type	Color TFT LCD	Color TFT LCD	Color TFT LCD
Display size, diagonal	6.5 in.	9 in. widescreen	10.4 in.
Viewing area	132 x 99 mm	196 x 118 mm	211 x 158 mm
Display resolution	640 x 480 VGA, 18-bit color graphics	800 x 480 WVGA, 18-bit color graphics	800 x 600 SVGA, 18-bit color graphics
Aspect ratio	4:3	5:3	4:3
Brightness, typical	300 nits		
Backlight life	50,000 hr life, min at 40° C (104 °F) to half-brightness. Backlight is not replaceable.		
Touch screen	Analog resistive Actuation rating: 1 million presses Operating force: 100 grams		
Battery (real-time clock backup)	Accuracy: ±2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell (Allen-Bradley part number 2711P-RY2032)		
Memory System User	 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications		
Secure Digital (SD) card slot	One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB), 1784-SD2 (2 GB), 1784-SDHC8 (8 GB), and 1784-SDHC32 (32 GB)		
USB ports Host Device	 One USB 2.0 high-speed host port (type A) support removal flash drives for storage One high-speed 1.0 device port (type B) supports connection to host computer		
Ethernet port Cat. Nos. with 21 Cat. Nos. with 22	 One 10/100Base-T, Auto MDI/MDI-X Ethernet port with IEEE1588 support Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports supporting star, linear, or DLR network topology		
Operating system	Windows CE includes FTP, VNC client server, ActiveX controls, PDF reader, third-party device support		
Software	FactoryTalk View Studio for Machine Edition, version 8.0 or later, FactoryTalk ViewPoint, version 2.6 or later		
Electrical			
Input voltage, DC	24V DC nom (18…30V DC), nonisolated DC power supply		
Power consumption, DC	50 W max (2.1A at 24V DC)		
Power supply	DIN-rail power supply, AC-to-DC, 85…265V AC, 47…63 Hz Recommended Replacement: Allen-Bradley part number 2711P-RSACDIN		
Mechanical			
Weight, approx	0.85 kg (1.86 lb)	1.29 kg (2.84 lb)	1.82 kg (4.0 lb)
Dimensions, HxWxD, approx	170 x 212 x 56.5 mm (6.69 x 8.35 x 2.22 in.)	190 x 280 x 56.5 mm (7.48 x 11.02 x 2.22 in.)	252 x 297 x 56.5 mm (9.92 x 11.69 x 2.22 in.)
Cutout dimensions, HxW, approx.	142 x 184 mm (5.59 x 7.24 in.)	162 x 252 mm (6.38 x 9.92 in.)	224 x 269 mm (8.82 x 10.59 in.)

Product Dimensions

The table provides product dimensions. The 5.7-in. and 10.4-in. touch-screen terminals are shown for illustrative purposes. All other terminal sizes look similar. For information on proper mounting clamp installation, refer to the PanelView Plus 7 Standard Terminals User Manual, publication 2711P-UM007.

Figure 1 - PanelView Plus 7 Standard Terminals, Front View

Figure 2 - PanelView Plus 7 Standard Terminals with Single Ethernet Port, Bottom View

Figure 3 - PanelView Plus 7 Standard Terminals with Dual Ethernet Ports, Bottom View

Table 6 - PanelView Plus 7 Standard Terminals Dimensions

Terminal Size	Input Type	Height (a) mm (in.)	Width (b) mm (in.)	Overall Depth (c) mm (in.)	Mounted Depth (d) mm (in.)
4.3 in.	Touch	110 (4.33)	135 (5.31)	56.5 (2.22)	50.14 (1.97)
5.7 in.	Touch	152 (5.98)	176 (6.93)	56.5 (2.22)	50.14 (1.97)
6.5 in.	Touch	170 (6.69)	212 (8.35)	56.5 (2.22)	50.14 (1.97)
9 in.	Touch	190 (7.48)	280 (11.02)	56.5 (2.22)	50.14 (1.97)
10.4 in.	Touch	252 (9.92)	297 (11.69)	56.5 (2.22)	50.14 (1.97)
12.1 in.	Touch	246 (9.69)	340 (13.39)	56.5 (2.22)	50.14 (1.97)
15 in.	Touch	318 (12.52)	381 (15.00)	56.5 (2.22)	50.14 (1.97)

TIP When mounted in a panel, the front of the bezel extends less than 6.36 mm (0.25 in.) from the front of the panel.

HMI Software

All PanelView Plus 7 terminals are configured with FactoryTalk View Studio software and have an integrated runtime system called FactoryTalk View Machine Edition Station.

Machine Edition Station runs projects developed with FactoryTalk View Studio software and is included on all PanelView Plus 7 terminals.

Two versions of FactoryTalk View Studio software support application development for PanelView Plus 7 terminals.

Cat. No.(1)	Description
9701-VWSTMENE	FactoryTalk View Studio for Machine Edition software - Configuration software for developing and testing machine level human machine interface (HMI) applications. Includes RSLinx® Enterprise and KEPServer Enterprise software.
9701-VWSTENE	FactoryTalk View Studio software - Configuration software for developing and testing machine level and supervisory level human machine interface (HMI) applications.

(1) Order localized versions of the software by replacing EN in the catalog number with DE for German, FR for French, JP for Japanese, or ZH for Chinese.

You can import PanelView Standard/PanelBuilder™32 and PanelView *e* applications into FactoryTalk View Studio software as Machine Edition applications by using the Machine Edition Import Wizard. The Import Wizard steps you through a few options such as scaling to a new screen resolution size, and then converts objects, text, tags, and communication configurations to ones that are available in Machine Edition.

FactoryTalk ViewPoint software, an add-on to FactoryTalk View Studio software, allows plant managers, production supervisors, system integrators, and other key stakeholders to view and control real-time plant floor operations remotely from a web browser. FactoryTalk ViewPoint enabled displays are fully scalable and animated in the browser. The remote user can also view displays that are not the active display of the terminal.

Each PanelView Plus 7 terminal contains one license supporting a single client connection to the terminal. No additional software is required.

For a complete list of available HMI software, visit http://www.rockwellautomation.com/rockwellsoftware.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
PanelView Plus 7 Standard Terminals User Manual, publication 2711P-UM007	Provides details on how to install, configure, and operate the PanelView Plus 7 Standard terminals.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Allied Moulded
Manufaturer#: AMHMI142CCL

ALLIED MOULDED PRODUCTS, Inc.

419-636-4217
222 N. Union St.
Bryan, OH 43506

AMHMI142CCL

14"x12" HMI Cover Kit with hinged clear cover and stainless-steel snap latch

Availability:
For up-to-date delivery on this product, please contact us at 1-800-722-2679 or sales@alliedmoulded.com

Cover Type: Clear Polycarbonate

Closure Type: Metal Snap Latch

Mounting Description: 10 Screws

Height: 13.95 in

Width: 12.07 in

Depth: .96 in

Usable Depth: 2.2 in

Volume: 370 cu in

Product Info

UPC: 85339991960

UNSPSC: 39121302

Carton Quantity: 1

Carton Weight: 5 lbs

Carton Length: 5 in

Carton Width: 16 in

Carton Height: 16 in

Country of Origin: United States of America

Color: Gray (RAL 7035) with clear cover

Material: Polycarbonate frame and clear polycarbonate cover

Additional Materials: 316 stainless steel external hardware, Polyurethane (FIP) Formed-In-Place gasket system

Features:

Non-corrosive, non-conductive, light weight with lower installation cost and longer life cycle cost compared to steel. Rigid design with a gasket system encased in a continuous channel on the cover and frame. Open back frame design with an opening size of 12.49″ x 10.71″ and is a UL recognized component for use with NEMA 4X enclosures.Â *Will fit Allied Moulded enclosure sizes 16â?x14â? and larger.

Application:

Cover and protect electrical and electronic controls including HMI (Human Machine Interface) instruments, touch pad controllers and pushbuttons mounted on the surface of NEMA 4X enclosures. No need to open the enclosure to view electronics or perform maintenance, decreasing arc flash risks and safety hazards.

Standards:

Meets Requirements: ANSI/UL50, ANSI/UL50E, and ANSI/UL508A; File No. E487574

UL® listed and recognized component for use with enclosure products Types 1, 2, 3, 3R, 4, 4X, 12 and 13.

Complies With:
1. EN / IEC 60204-1 and 60529 Type IP66
2. RoHS directive

Allied Moulded
Manufaturer#: AMHMIPROP142

ALLIED MOULDED PRODUCTS, Inc.

419-636-4217
222 N. Union St.
Bryan, OH 43506

AMHMIPROP142

HMI Cover Prop Arm Kit for use with 14"x12" HMI Covers

Availability:
For up-to-date delivery on this product, please contact us at 1-800-722-2679 or sales@alliedmoulded.com

Mounting Description: 4 Screws

Height: 16.3 in

Width: 0.8 in

Depth: 0.6 in

Product Info

UPC: 85339978626

UNSPSC: 39121302

Carton Quantity: 1

Carton Weight: 1 lbs

Carton Length: 1 in

Carton Width: 10 in

Carton Height: 12 in

Country of Origin: United States of America

Color: Silver

Material: 306 Stainless Steel

Additional Materials: 18-8 Stainless Steel Hardware, 316 stainless steel external hardware, Plated carbon steel fasteners, Silicone Rubber

Features:

The stainless steel prop arm and hardware is durable and the silicone rubber tip will prevent the support arm from slipping once in the open position.

Application:

When used with any of the AMHMI88 HMI cover kits, end-user can hold the HMI cover kit in an open position for easy access to protected instruments,
touchpad controllers or pushbuttons mounted on the surface of Type 4X enclosures.

GUARDIAN/GUARDIANX SERIES FILTER FANS FILTER-HOOD ASSEMBLIES

Kooltronics
Manufaturer#: KNPA60FLV

KNPA60FL

DESCRIPTION

These Filter-Hood Assemblies can be used in conjunction with the Guardian/GuardianX Series Filter Fans for enclosure cooling. In a typical mounting orientation the motorized Filter Fan pulls air into an enclosure while the Filter-Hood Assembly functions as an outlet. Alternatively, if the reverse airflow option is chosen for the filter fan, the fan exhausts the enclosure and the Filter-Hood Assembly functions as an intake. These Filter-Hood Assemblies feature filters that are easily removed for cleaning or replacement.

NEMA
TYPE 4 OR 4X MAINTAINED

STANDARD FEATURES

Baked Powder Finish
Filter
Integrated Sealing Gasket
IP55 Filter Protection
NEMA 4 or 4X Rating Maintained (If used with provided filter)
Secure Mounting
Stainless Steel Shell (NEMA 4X models)
Ul/CUL Listed
Washable, Reuseable Filter

ACCESSORIES AND OPTIONS

Replacement Filters (P/N: 0429-01-01)

MOUNTING PLAN

KNPA60FL

TYPICAL MOUNTING ORIENTATIONS

(Left) Filter Fan pressurizes cabinet. Filter-Hood Assembly exhausts cabinet. (Right) Filter Fan with Reverse Option chosen. Blue arrows show direction of airflow. Boxes represent side view of electronics/electrical enclosure.

knpa60-40fl.qxd 8/18/17

GUARDIAN/GUARDIANX SERIES
NEMA 4 or 4X FILTER FANS KNP60FL

NEMA
TYPE 4/4X
MAINTAINED

TECHNICAL DATA

Model	Nema Rating	Normally In Stock	Voltage	Frequency Hz	Input Amps	Input Watts	Fan Airflow CFM*	Fan w/Grille Airflow CFM**	Noise db(A)	Operating Temp. ºF		Approx. Weight	
										Min.	Max	Lbs.	Kg.
KNP60FL	4	Yes	115 VAC	50/60	.42/.34	43/37	270/290	84/92	59/61	-40	158	11.3	5.1
KNP60FLV	4X		115 VAC	50/60	.42/.34	43/37	270/290	84/92	59/61	-40	158	11.3	5.1
K2NP60FL	4		230 VAC	50/60	.20/.17	37/36	270/290	70/80	59/61	-40	158	11.3	5.1
K2NP60FLV	4X		230 VAC	50/60	.20/.17	37/36	270/290	70/80	59/61	-40	158	11.3	5.1
K6NP60FL	4		12 VDC	-	.52	6.2	225	72	67	-4	176	11.3	5.1
K6NP60FLV	4X		12 VDC	-	.52	6.2	225	72	67	-4	176	11.3	5.1
K7NP60FL	4		24 VDC	-	.60	14.4	230	72	54	-40	158	11.3	5.1
K7NP60FLV	4X		24 VDC	-	.60	14.4	230	72	54	-40	158	11.3	5.1
K8NP60FL	4		48 VDC	-	.36	16.8	240	40	58	-40	158	11.3	5.1
K8NP60FLV	4X		48 VDC	-	.36	16.8	240	40	58	-40	158	11.3	5.1

* Fan airflow without filter and grille.
** NEMA Rated if installed with provided filter.

For general ventilating use only. Do not use these fans to exhaust hazardous or explosive material or vapors.
NOT ALL SYSTEMS ARE SUITABLE FOR UTILIZING OUTSIDE AIR. To protect sensitive components against condensation an enclosure heater or closed-loop cooling is recommended. To protect sensitive components against corrosive elements closed-loop cooling is recommended.

STANDARD FEATURES

Baked Powder Finish
Integrated Fan Guards
Integrated Sealing Gasket
IP55 Filter Protection
NEMA 4 or 4X Rating Maintained (if used with provided filter)
Secure Mounting
Six foot [1.8m] (minimum) 3-wire power cord
Stainless Steel Shell (NEMA 4X models)
UL/CSA Shielded Ball Bearing Motors
UL/CUL Listed
Washable, Reuseable Filter

ACCESSORIES AND OPTIONS

Filter-Hood Assembly - (Recommended) - (P/N: KNPA60FL)
Other voltages, both AC and DC
Replacement Filters (P/N: 0429-01-01)
Reversed Airflow Direction

"like" us on facebook

DRAWINGS

MOUNTING PLAN

Find additional information on this model at kooltronic.com, or use the Technical Documents QR code below.

Technical Documents

Dimensions, inches [mm], are for reference only and are subject to change.

knp60fl.qxd 2/24/16

Kooltronic, Inc., 30 Pennington-Hopewell Road, P.O. Box 240, Pennington, NJ 08534-0240
Tel: (609) 466-3400 Fax: (609) 466-1114 kooltronic.com sales@kooltronic.com

Hoffman
Manufaturer#: A40P30

connect and protect

Panel for Type 3R 4 4X 12 13 Enclosure, fits 40x30, White, Steel

CATALOG NUMBER

A40P30

Use these panels in Wall-Mount and Free-stand/Floor-Mount Enclosure. Available in various materials to meet various application requirements. Stainless steel and aluminum panels are protected on one side with a plastic film.

FEATURES

Panel mounting hardware is furnished with all enclosures which accept these panels

PRODUCT ATTRIBUTES

Article Number: 11800
Height: 37in
Width: 27in
Material: Mild Steel
Finish: Powder Coated
Color: White
Thickness: 12ga
Edge Flange Quantity: 4
Hole Quantity: 4
Weight: 36lb

WARNING

nVent products shall be installed and used only as indicated in nVent's product instruction sheets and training materials. Instruction sheets are available at www.nvent.com and from your nVent customer service representative. Improper installation, misuse, misapplication or other failure to completely follow nVent's instructions and warnings may cause product malfunction, property damage, serious bodily injury and death and/or void your warranty.

SIEMENS

Allied Moulded
Manufaturer#: 3LD2217-0TK13

Data sheet 3LD2217-0TK13

SENTRON, switch disconnector 3LD, EMERGENCY OFF switch, 3-pole, Iu: 32 A, Operating power / at AC-23 A at 400 V: 11.5 kW, floor mounting with door coupling, defeatable knob-operated mechanism, red/yellow, 4-hole mounting of the handle

Model	
product brand name	SENTRON
product designation	Switch disconnector
design of the product	EMERGENCY-STOP switch
display version for switch position indicator manual operation	1 ON - 0 OFF
type of switch	Floor mounting with door coupling
design of the actuating element	selector switch
color of the actuating element	red
design of handle	knob-operated mechanism, red/yellow
type of the driving mechanism motor drive	No
General technical data	
number of poles	3
size of switch disconnector	2
mechanical service life (operating cycles) typical	100 000
electrical endurance (operating cycles)	
• at AC-23 A at 690 V	6 000
operating frequency maximum	50 1/h
degree of pollution	3
Voltage	
insulation voltage rated value	690 V
surge voltage resistance rated value	6 kV
operating voltage	
• at AC rated value	690 V
operating frequency rated value	
• minimum	50 Hz
• maximum	60 Hz
Protection class	
protection class IP	IP65
degree of protection NEMA rating	1, 3R, 4X, 12
protection class IP on the front	IP65
Dissipation	
power loss [W] for rated value of the current at AC in hot operating state per pole	1.8 W
Main circuit	
operational current	
• at AC-21 at 690 V rated value	32 A
• at AC-21 A at 240 V rated value	32 A
• at AC-21 A at 400 V rated value	32 A
• at AC-21 A at 440 V rated value	32 A
• at AC-23 A at 400 V rated value	22 A

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operating power	
● at AC-23 A at 240 V rated value	6 kW
● at AC-23 A at 400 V rated value	12 kW
● at AC-23 A at 440 V rated value	11.5 kW
● at AC-23 A at 690 V rated value	12 kW
● at AC-3 at 240 V rated value	5.5 kW
● at AC-3 at 400 V rated value	10 kW
● at AC-3 at 690 V rated value	9.5 kW
Auxiliary circuit	
number of CO contacts for auxiliary contacts	0
number of NC contacts for auxiliary contacts	0
number of NO contacts for auxiliary contacts	0
operating voltage of auxiliary contacts at AC maximum	500 V
continuous current of the auxiliary contact rated value	10 A
insulation voltage of the auxiliary switch rated value	500 V
Suitability	
suitability for use	
● main switch	Yes
● switch disconnector	Yes
● EMERGENCY OFF switch	Yes
● safety switch	Yes
● maintenance/repair switch	Yes
Product details	
product feature can be locked into OFF position	Yes
accessories	
product extension optional	
● motor drive	No
● voltage trigger	No
number of connectable NC contacts for auxiliary contacts attachable maximum	3
number of connectable NO contacts for auxiliary contacts attachable maximum	5
number of connectable CO contacts for auxiliary contacts attachable maximum	0
number of bracket locks maximum	3
hasp thickness of the bracket locks	4 ... 6 mm
Short circuit	
conditional short-circuit current with line-side fuse protection	
● at 690 V by gG fuse rated value	50 kA
let-through current with closed switch	
● at 240 V for combination switch + gG fuse maximum	4.5 kA
● at 440 V for combination switch + gG fuse maximum	4.5 kA
● at 690 V for combination switch + gG fuse maximum permissible	5 kA
I2t value with closed switch	
● at 240 V for combination switch + gG fuse maximum	9 kA2.s
● at 440 V for combination switch + gG fuse maximum	9 kA2.s
● at 690 V for combination switch + gG fuse maximum	9 kA2.s
design of the fuse link	
● for short-circuit protection of the main circuit required	fuse gL/gG: 40 A
● for short-circuit protection of the auxiliary switch required	fuse gL/gG: 10 A
operational current of upstream fuse rated value	40 A
according UL	
operational current at AC according to UL 508/UL 60947-4-1 rated value	32 A
operating voltage at AC at 50/60 Hz according to UL 508/UL 60947-4-1 rated value	600 V
active power [hp] at AC at 480 V according to UL 508/UL 60947-4-1 rated value	20
active power [hp] at AC at 600 V according to UL 508/UL 60947-4-1 rated value	20
short-time withstand current (SCCR) at 600 V according to UL 508/UL 60947-4-1	5 kA

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continuous current of upstream fuse according to UL rated value	80 A
type of fuse according to UL	RK5
Connections	
AWG number as coded connectable conductor cross section solid	
• maximum	8
• minimum	14
type of connectable conductor cross-sections for copper conductor	
• solid	1x (1,5...16mm²)
• finely stranded with core end processing	1x (1,5...10mm²)
• stranded	1x (1,5...16mm²)
type of connectable conductor cross-sections for auxiliary contacts	
• solid	lateral auxiliary switch 2x (0,75 ... 2,5mm²), 1x 4mm²; front auxiliary switch 1x (0,75 ... 2,5mm²)
• finely stranded with core end processing	lateral auxiliary switch 2x (0,75 ... 1,5mm²), 1x 2,5mm²; front auxiliary switch 1x 2,5mm²
• stranded	lateral auxiliary switch 2x (0,75 ... 2,5mm²), 1x 4mm²; front auxiliary switch 1x (0,75 ... 2,5mm²)
type of electrical connection	
• for main current circuit	box terminal
• for auxiliary contacts	connection terminals
Mechanical Design	
height	79 mm
width	67 mm
depth	385 mm
type of device	fixed mounting
fastening method	Built-in unit fixed-mounted version
fastening method	
• 4-hole front mounting	Yes
• front mounting with central attachment	No
• rail mounting	Yes
net weight	391 g
Environmental conditions	
ambient temperature during operation	
• minimum	-25 °C
• maximum	55 °C
ambient temperature during storage	
• minimum	-25 °C
• maximum	55 °C

General Product Approval

CSA	CCC	Confirmation	UL	VDE	Miscellaneous

General Product Approval	Declaration of Conformity		Test Certificates	Marine / Shipping	other
EAC	UKCA	CE EG-Konf.	Special Test Certificate	LRS	Miscellaneous

other	Environment
Confirmation	Environmental Confirmations

On Line Catalog

Burndy
Manufaturer#: KA4C

BURNDY Catalog Number	KA4C
UPC Number	7818103614055
Description	14-4 CU LUG ST SCR 1H
Status	Active

Web Use
BURNDY Product Line

Dimensional	
Size (Hex) or Size (Bolt)	5/16
Length (in)	1.11
Thickness (in)	1/10
Height (in)	0.77
B Length (Fraction)	8/17
Hole Size (Fraction)	9/32
Stud Size (in)	1/4
Thickness	0.10
Size (Hex) or Size (Bolt) - in	0.31
B Length (in)	0.47
Pad Width (in)	0.54
N (Fraction)	1/4
N (in)	0.25
Hole Size (in)	0.28
Length (Fraction)	1-1/8
Height (Fraction) (in)	3/4
General	
Product Description	Copper Terminal, 1 Hole, 14 AWG (Sol)-4 AWG (Str), 1/4" Stud, 1 Screw
Conductor(s)	
Copper Solid Size (Range)	14 AWG-4 AWG
Copper Stranded (Range)	14 AWG-4 AWG
Physical	
Screw Type	Slot
Type of Hardware	5 / 16 "
Installation Torque	45
Type of Plating	Unplated
Connector Type	Terminal
Plated (Yes or No)	N
Product Material	Copper
Approvals / Certifications	
UL Listed	Y
CSA Certified	Y
ROHS Compatible	Compliant
UL Recognized	N
CULUS	N
Industry Standards	UL468A-468B

Documentation

For further technical assistance, please contact us

BURNDY LLC - USA

47 East Industrial Park Drive
Manchester NH 03109

BURNDY Technical Services

47 East Industrial Park Drive
Manchester NH 03109

Hours: 8:00 AM - 5:00 PM
Monday - Friday
Phone: 800-346-4175

Specifications

Allen-Bradley
Manufaturer#: 1489-M1D030; 1489-M1D050
1489-M1D005; 1489-M1D020; 1489-M1D070

Electrical Ratings					
Poles					1, 2, 3
Tripping characteristics					C, D
Rated current (I_n)					0.5...63 A
Rated frequency [f]					50/60 Hz
Rated insulation voltage U_i per IEC/EN 60664-1					250V AC (phase to ground) 440V AC (phase to phase)
Overvoltage category					III
Pollution degree					3
Data per UL/CSA					
Rated voltage	AC	1-pole	C Curve	0.5...40 A	277V AC
				50...63 A	240V AC
			D Curve	0.5...35 A	277V AC
				40...63 A	240V AC
		2-, 3-pole	C Curve	0.5...40 A	480Y/277V AC
				50...63 A	240V AC
			D Curve	0.5...35 A	480Y/277V AC
				40...63 A	240V AC
	DC	1-pole			48V DC
		2-pole			96V DC (2-pole in series)
Rated interrupting capacity per UL 489					10 kA
Reference temperature for tripping characteristics					40 °C (104 °F)
Electrical endurance					6,000 operations (AC and DC); 1 cycle (1s - ON, 9s - OFF)
Data per IEC/EN 60947-2					
Rated operational voltage (U_e)	1-pole				230V AC
	2-, 3-pole				400V AC
Highest supply or utilization voltage (U_{max})	AC	1-pole			253/440V AC
		2-, 3-pole			440V AC
	DC (1)	1-pole			48V DC
		2-pole			96V DC
Min. operating voltage					12V AC, 12V DC
Rated ultimate short-circuit breaking capacity (I_{cu})					15 kA
Rated service short-circuit breaking capacity (I_{cs})					≤ 40 A: 11.25 kA > 40 A: 7.5 kA
Rated impulse withstand voltage $U_{imp.}$ (1.2/50 µs)					4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)
Dielectric test voltage					2 kV (50/60Hz, 1 min.)
Reference temperature for tripping characteristics					30 °C (86 °F)
Electrical endurance 1 cycle (2s - ON, 13s - OFF, I_n ≤ 32 A), 1 cycle (2s - ON, 28s - OFF, I_n > 32 A)					I_n < 30 A: 20,000 ops. (AC) I_n ≥ 30 A: 10,000 ops. (AC) 1,000 ops. (DC)

(1) Self-declared IEC DC ratings.

Mechanical Data	
Housing	Insulation group II, RAL 7035
Indicator window	red ON/green OFF
Protection degree per EN 60529	IP20, IP40 in enclosure with cover
Mechanical endurance	20,000 operations
Shock resistance per IEC/EN 60068-2-27	25 g - 2 shocks - 13 ms
Vibration resistance per IEC/EN 60068-2-6	5g - 20 cycles at 5...150...5 Hz with load 0.8 x I_n
Environmental	
Environmental conditions (damp heat) per IEC/EN 60068-2-30	28 cycles with 55 °C/90-96% and 25 °C/95-100%
Ambient temperature(1)	-25...+55 °C (-13...+131 °F)
Storage temperature	-40...+70 °C (-40...+158 °F)
Installation	
Terminal	Dual terminal
Cross-section of wire (2)- solid, stranded (front/back terminal slot)	35/35 mm²
	18...4/18...10 AWG
Cross-section of wire - flexible (front/back terminal slot)	25/10 mm²
Multi-wire rating per UL, CSA	1 wire, 18...4 AWG
	2-4 wires (3), 18...10 AWG
Cross-section of bus bars (back terminal slot)	10 mm²
Tightening torque — IEC	2.8 N•m
Tightening torque — UL/CSA	AWG 18...16: 13.3 lb•in, AWG 14...10: 17.7 lb•in, AWG 8...4: 39.8 lb•in
Screwdriver	No. 2 Pozidriv
Mounting	DIN Rail (EN 60715, 35 mm) with fast clip
Mounting position	Any
Supply	Optional
Approximate Dimensions and Weight	
Pole dimension (H x D x W)	111 x 69 x 17.5 mm (4.37 x 2.72 x 0.69")
Pole weight	125 g (4.4 oz.)
Combination with Auxiliary Elements	
Auxiliary contact	Yes
Signal contact	Yes
Shunt trip	Yes

(1) See Table 1 and Table 2 for ambient temperature derating values.
(2) 35 mm self-declared, not included in IEC/EN approval.
(3) Wires must be of like size and stranding. Up to two wires per terminal slot.

Power Loss Due to Current

Rated Current [A]	Power Loss Per Pole [W]	Rated Current [A]	Power Loss Per Pole [W]
0.5	1.4	15	2.4
1	1.4	16	2.5
1.6	1.8	20	2.5
2	1.8	25	3.2
3	1.6	30	3.5
4	1.8	32	3.7
5	1.9	35	4.1
6	2.0	40	4.5
7	1.1	50	4.5
8	1.5	60	4.9
10	2.1	63	5.4
13	2.3	–	–

The installation of several devices side by side with rated current on all poles requires a correction factor to the rated current (not required if spacers are used).

Zero-stack Derating

No. of Adjacent Devices	Correction Factor
1	1
2,3	0.9
4,5	0.8
≥ 6	0.75

Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Figure 1 - Bulletin 1489-M 1-Pole Devices

Figure 2 - Bulletin 1489-M 2- and 3-Pole Devices

Catalog Number Explanation

Examples that are given in this section are not intended to be used for product selection. Not all combinations generate a valid catalog number. Use ProposalWorks™ software to configure the PC. ProposalWorks software is available from rok.auto/systemtools.

1489	-	M	1	C	005
		a	b	c	d

a

Voltage Type	
Code	**Description**
M	AC Circuit Breaker

b

Poles	
Code	**Description**
1	1-Pole
2	2-Pole
3	3-Pole

c

Trip Curve	
Code	**Description**
C	Trip Curve C
D	Trip Curve D

d

Rated Current (I_n)	
Code	**Current [A]**
005	0.5
010	1
016	1.6
020	2
030	3
040	4
050	5
060	6
070	7
080	8
100	10
130	13
150	15
160	16
200	20
250	25
300	30
320	32
350	35
400	40
500	50
600	60
630	63

EO-AB/UT/LED/15 - Socket

0804155

https://www.phoenixcontact.com/us/products/0804155

Phoenix Contact
Manufaturer#: 0804155

Technical data

Product properties

Product type	Socket
Country ID	USA
	Canada

Connection data

Screw thread	M3
Tightening torque	0.5 ... 0.6 Nm
Stripping length	8 mm
Internal cylindrical gage	A3
	B3
Conductor cross section rigid	0.2 mm² ... 4 mm²
Cross section AWG	24 ... 12 (converted acc. to IEC)
Conductor cross section flexible	0.25 mm² ... 2.5 mm²
Conductor cross section, flexible [AWG]	24 ... 14 (converted acc. to IEC)
Conductor cross-section flexible (ferrule without plastic sleeve)	0.25 mm² ... 2.5 mm²
Flexible conductor cross section (ferrule with plastic sleeve)	0.25 mm² ... 2.5 mm²
Conductor cross-section flexible (2 conductors with the same cross-section, with TWIN ferrule and plastic sleeve)	0.2 mm² ... 4 mm²
Nominal current	15 A
Nominal voltage	125 V AC (60 Hz)

Signaling

Status display	yes

Dimensions

Width	45 mm
Height	75 mm
Depth	58.9 mm
Depth on NS 35/7,5	60 mm
Depth on NS 35/15	67.5 mm
Hole diameter	4.4 mm

Material specifications

Color	gray (RAL 7042)
Flammability rating according to UL 94	V0
Insulating material	PA
Contact material	CuZn38
Static insulating material application in cold	-60 °C
Temperature index of insulation material (DIN EN 60216-1 (VDE 0304-21))	130 °C
Relative insulation material temperature index (Elec., UL 746 B)	130 °C

Fire protection for rail vehicles (DIN EN 45545-2) R22	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R23	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R24	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R26	HL 1 - HL 3
Surface flammability NFPA 130 (ASTM E 162)	passed
Specific optical density of smoke NFPA 130 (ASTM E 662)	passed
Smoke gas toxicity NFPA 130 (SMP 800C)	passed

Connector

Type of plug	Pin connector pattern type AB 15A

Environmental and real-life conditions

Ambient conditions

Degree of protection	IP20
Ambient temperature (operation)	-5 °C ... 40 °C (Average value over a period of 24 hours not above +35°C)
Ambient temperature (storage/transport)	-25 °C ... 60 °C (for a short time, not exceeding 24 h, -60 °C to +70 °C)
Permissible humidity (storage/transport)	30 % ... 70 %

Standards and regulations

Standards

Standards/regulations	UL 508
	IEC 60884-1

Mounting

Mounting type	for mounting on a DIN rail in the service interface or direct mounting

Bulletin 700-CF — Control Relay

- IEC industrial relays
- Mechanically linked contact performance per IEC 60947-5-1
- Gold plated, bifurcated version for low level switching applications
- Master control relay version rated 15 A (AC-15)
- Solid-state and pneumatic timing modules
- 4-…10 Poles

Certifications

cULus Listed (File No. E14840, Guide NKCR/NKCR7)
CE Marked
CCC Certified

Table of Contents

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Standards Compliance

UL 508
CSA C22.2 No. 14
EN/IEC 60947-1, -5-1
Meets the material restrictions for European Directive 2002/95/EC - EU-RoHS

4-Pole AC Coil Voltage (Ratings for 700-CF Only)

AC-12		AC-15								Contacts				
I_{th} [A]		I_e [A]							Connection Diagrams	N.O.	N.C.	Standard Contacts Cat. No.❄	Gold Plated Bifurcated Contacts Cat. No.∗	Master Contacts Cat. No.∗
40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V						
20	20	10	10	10	6	2.5	1	1		2	2	700-CF220⊗	700-CFB220⊗	**700-CFM220⊗**
										3	1	700-CF310⊗	700-CFB310⊗	**700-CFM310⊗**
										4	0	700-CF400⊗	700-CFB400⊗	**700-CFM400⊗**
										0	4	**700-CF040⊗**	**700-CFB040⊗**	—

❄ For spring clamp terminals, insert **R** after 700-C. Example: **Cat. No. 700-CRF220D.**

⊗ AC Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. Example: **Cat. No. 700-CF220⊗** becomes **Cat. No. 700-CF220D** for 120V, 60 Hz

[V]	12	24	32	36	42	48	100	100 ... 110	110	120	127	200	200 ... 220	208	208 ... 240	220 ... 230	230	230 ... 240	240	277	347	380	380 ... 400	400	400 ... 415	440	480	500	550	600
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

4-Pole DC Coil Voltage (Ratings for 700-CF Only)

AC-12		AC-15								Contacts				
I_{th} [A]		I_e [A]							Connection Diagrams	N.O.	N.C.	Standard Contacts Cat. No.‡	Gold Plated Bifurcated Contacts Cat. No.∗	Master Contacts Cat. No.∗
40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V						
20	20	10	10	10	6	2.5	1	1		2	2	700-CF220⊗	700-CFB220⊗	**700-CFM220⊗**
										3	1	700-CF310⊗	700-CFB310⊗	**700-CFM310⊗**
										4	0	700-CF400⊗	700-CFB400⊗	**700-CFM400⊗**

‡For spring clamp terminals, insert **R** after 700-C. Example: **Cat. No. 700-CRF220ZJ.**

∗ Ratings for Bulletin 700-CFB and 700-CFM are on page 9-159

⊗ DC Coil Voltage Code§

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. example: **Cat. No. 700-CF220⊗** becomes Cat. No. **700-CF220ZJ for 24V DC**

[V]	9	12	24	36	48	48... 72	60	64	72	80	110	110... 125	115	125	220	220... 250	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	—	ZZ	ZB	ZG	ZE	ZD	—	ZP	ZS	ZA	—	ZF	ZT
Standard diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Electronic with diode	—	EQ	EJ	—	—	EY	—	—	—	—	—	ED	—	—	—	EA	—	—

§ When ordering DJ coil with built-in surge suppression, the DJ is not polarity sensitive. Drop out time: 14…20 ms.

Allen-Bradley
Manufaturer#: 700-HLT1Z24

700-HL Terminal Block Relay

- Relay and socket assembled interface modules for high-density interposing or isolation applications
- Screw terminal and spring-clamp bases
- 6 A relay, choice of silver or gold contacts
- 2 A solid-state relay – DC output
- 2 A solid-state relay – AC output
- SPDT (relay), 1 N.O. (solid-state)
- Built-in retainer clip and snap-in marker lever
- Standard LED, reverse polarity protection, and surge protection
- Externally replaceable relay modules
- Unique leakage current suppression version to address industry concerns of nuisance coil turn-on or contact non-drop out when connecting to PLCs with leakage current
- Available with hazardous location certification

Product Selection

Terminal Block Relays

Standard built-in Features: • LED • Reverse Polarity Protection for DC Inputs • Coil Surge Protection[1]				
	Cat. No. 700-HLT1Z24	**Cat. No. 700-HLT2Z24**	**Cat. No. 700-HLS1Z24**	**Cat. No. 700-HLS11Z24**
Specifications			(2)	
Output Type	SPDT (1 C/O); I_{th} = 6 A[3]		1 N.O. solid-state: I_{th} = 2 A, 24V DC or I_{th} = 2 A, 240V AC	
Recommended Tightening Torque	0.5 N•m max (4.4 lb•in)			
Wire Range – Screw Terminal	0.14 mm²...2.5 mm² (#26...#14 AWG)			
Wire Range – Spring Terminal	0.2 mm²...2.5 mm² (#24...#14 AWG)			
Certifications	UL, cULus, cURus, ABS, CE			

(1) Diode surge protection provided.
(2) Reverse polarity on the output terminals of the solid-state relay results in the output being "ON" regardless of the state of the input voltage.
(3) For Gold-plated contacts: Add the letter "**X**" at the end of the catalog number. For example: if Cat. No. 700-HLT1Z24 is required with gold plating, the new cat. no. is 700-HLT1Z24X.

Terminal Block Relay Selection

Input Voltage	Pkg. Qty.	Cat. No.		Pkg. Qty.	Cat. No.		
		Screw Terminals	Spring Clamp Terminals		Screw Terminals (DC Output)	Spring Clamp Terminals (DC Output)	Screw Terminals (AC Output)
12V DC	10	700-HLT1Z12[1]	700-HLT2Z12	–	–	–	–
24V DC	10	700-HLT1Z24[1]	700-HLT2Z24	10	700-HLS1Z24[1]	700-HLS2Z24	700-HLS11Z24
48V DC	10	700-HLT1Z48[1]	700-HLT2Z48	10	700-HLS1Z48[1]	700-HLS2Z48	700-HLS11Z48
12V AC/DC	10	700-HLT1U12	700-HLT2U12	–	–	–	–
24V AC/DC	10	700-HLT1U24	700-HLT2U24	–	–	–	–
48V AC/DC	10	700-HLT1U48	700-HLT2U48	–	–	–	–
110/125V AC/DC	10	700-HLT1U1	700-HLT2U1	10	700-HLS1U1[1]	700-HLS2U1	700-HLS11U1
220...240V AC/DC	10	700-HLT1U2	700-HLT2U2	10	700-HLS1U2[1]	700-HLS2U2	700-HLS11U2
240V AC	10	700-HLT1A2	–	–	–	–	–

Specifications

Cat. No. 700-HLT... (Relay Output)

Table 36 - Electrical Ratings

Attribute				Cat. No. 700-HLT... (Relay Output)	
Pilot Duty Rating				B 300, R 300	
Rated Thermal Current (I_{th})				1-Pole – 6 A	
Rated Insulation Voltage (U_i)			IEC	250V	
			UL/CSA	300V	
Contacts	Inductive	1-Pole	Contact Type	**Make**	**Break**
				►][◄	◄][►
			24V AC, 1-phase	30 A	5 A
			120V AC, 1-phase	30 A	3 A
			240V AC, 1-phase	15 A	1.5 A
			24V DC	DC-13, 1.0 A	–
			125V DC	DC-13, 0.2 A	
			240V DC	DC-13, 0.1 A	
		Resistive Make, Break, and Continuous	24V DC	6.0 A	
			250V AC	6.0 A	
			240V DC	0.1 A	
Inductive Load			AC-15	250V, 3 A N.O. Contact, 1.5 A N.C. Contact	
			DC-13	24V, 1 A N.O., and N.C. Contact	
Min Permissible Contact Ratings			Silver Contacts	12V, 6 mA (72 mW)	
			Gold Contacts	8V, 2.5 mA (20 mW)	
Permissible Coil Voltage Variation		Pickup	50 Hz	85...110% of Nominal Voltage	
			60 Hz	85...110% of Nominal Voltage	
			DC	80...110% of Nominal Voltage	
		Must Dropout	AC	10% of Nominal Voltage	
			DC	5% of Nominal Voltage	
Power Consumption ±10%			AC	0.3VA	
			DC	0.2 W	
Design Specification/Test Requirements	Dielectric Withstand Voltage		Pole to Pole (VRMS)	1000V	
			Contact to Coil (VRMS)	4000V	
	Impedance at input voltage:		12V AC/DC	1 kΩ	
			24V AC/DC	2 kΩ	
			48V AC/DC	6 kΩ	
			120V AC/DC	26 kΩ	
			240V AC/DC	56 kΩ	
			120V LCSC	16 kΩ	
			240V LCSC	35 kΩ	

Product Selection

Allen-Bradley
Manufaturer#: 140MT-C3E-1B63

Selection Using Current and Hp/kW Ratings

Table 27 - Motor Protective Switching Devices

Rated Operational Current (I_e) [A]	Motor Current Adjustment Range [A]	Nominal Magnetic Trip Current [A]	Max Short-circuit Current [kA]		Max. 3-phase Hp Ratings[1]				Max. kW, 3-Phase – AC-3[1]				Cat. No.
			400V (I_{cu})	480V (group motor)	200V	230V	460V	575V	230V	400/415V	500V	690V	
C-Frame, Adjustable Thermal/Fixed Magnetic (14 x I_n)													
0.16	0.10...0.16	2.2	100	65	–	–	–	–	–	0.02	0.06	0.06	140MT-C3E-A16
0.25	0.16...0.25	3.5	100	65	–	–	–	–	–	0.04	0.09	0.09	140MT-C3E-A25
0.4	0.25...0.40	5.6	100	65	–	–	–	–	0.06	0.09	0.12	0.18	140MT-C3E-A40
0.63	0.40...0.63	8.8	100	65	–	–	–	–	0.09	0.18	0.18	0.25	140MT-C3E-A63
1	0.63...1.0	14	100	65	–	–	0.5	0.5	0.18	0.25	0.37	0.55	140MT-C3E-B10
1.6	1.0...1.6	22	100	65	–	–	0.75	–	0.25	0.55	0.75	1.1	140MT-C3E-B16
2.5	1.6...2.5	35	100	65	0.5	0.5	1	1.5	0.37	0.75	1.1	1.8	140MT-C3E-B25
4	2.5...4.0	56	100	65	0.75	0.75	2	3	0.75	1.5	2.2	3	140MT-C3E-B40
6.3	4.0...6.3	88	100	65	1	1.5	3	5	1.5	2.2	3	4	140MT-C3E-B63
10	6.3...10	140	100	65	2	2	5	7.5	2.2	4	6.3	7.5	140MT-C3E-C10
16	10...16	224	65	30	3	5	10	10	4	7.5	10	13	140MT-C3E-C16
20	14.5...20	280	50	30	5	5	10	15	5.5	10	11	17	140MT-C3E-C20
25	18...25	350	15	30	5	7.5	15	20	5.5	11	15	22	140MT-C3E-C25
29	23...29	406	15	30	7.5	10	20	25	7.5	13	18.5	25	140MT-C3E-C29
32	26.5...32	448	15	30	7.5	10	20	30	7.5	15	20	25	140MT-C3E-C32
D-Frame, Adjustable Thermal/Fixed Magnetic (14 x I_n)													
0.63	0.40...0.63	8.8	100	65	–	–	–	–	0.09	0.18	0.18	0.25	140MT-D9E-A63
1	0.63...1.0	14	100	65	–	–	0.5	0.5	0.18	0.25	0.37	0.55	140MT-D9E-B10
1.6	1.0...1.6	22	100	65	–	–	0.75	–	0.25	0.55	0.75	1.1	140MT-D9E-B16
2.5	1.6...2.5	35	100	65	0.5	0.5	1	1.5	0.37	0.75	1.1	1.8	140MT-D9E-B25
4	2.5...4.0	56	100	65	0.75	0.75	2	3	0.75	1.5	2.2	3	140MT-D9E-B40
6.3	4.0...6.3	88	100	65	1	1.5	3	5	1.5	2.2	3	4	140MT-D9E-B63
10	6.3...10	140	100	65	2	2	5	7.5	2.2	4	6.3	7.5	140MT-D9E-C10
16	10...16	224	100	65	3	5	10	10	4	7.5	10	13	140MT-D9E-C16
20	14.5...20	280	100	65	5	5	10	15	5.5	10	11	17	140MT-D9E-C20
25	18...25	350	65	50	5	7.5	15	20	5.5	11	15	22	140MT-D9E-C25
29	23...29	406	50	50	7.5	10	20	25	7.5	13	18.5	25	140MT-D9E-C29
32	26.5...32	448	50	50	7.5	10	20	30	7.5	15	20	25	140MT-D9E-C32
36	30...36	432	50	30	10	10	25	30		18.5	20	25	140MT-D9E-C36[2]
40	34...40	480	50	30	10	10	30	30	11	20	24	30	140MT-D9E-C40[2]
D-Frame, Fixed Magnetic (application at output of VFD multi-motor)													
1.6	1.0...1.6	88	100	65	–	–	0.75	–	0.25	0.55	0.75	–	140MT-D9V-B16
2.5	1.6...2.5	88	100	65	0.5	0.5	1	–	0.37	0.75	1.1	–	140MT-D9V-B25
4	2.5...4.0	88	100	65	0.75	0.75	2	–	0.75	1.5	2.2	–	140MT-D9V-B40
6.3	4.0...6.3	88	100	65	1	1.5	3	–	1.5	2.2	3	–	140MT-D9V-B63
10	6.3...10	140	100	65	2	2	5	–	2.2	4	6.3	–	140MT-D9V-C10
16	10...16	224	100	65	3	5	10	–	4	7.5	10	–	140MT-D9V-C16
20	14.5...20	280	100	65	5	5	10	–	5.5	10	11	–	140MT-D9V-C20
25	18...25	350	65	50	5	7.5	15	–	5.5	11	15	–	140MT-D9V-C25
29	23...29	406	50	50	7.5	10	20	–	7.5	13	18.5	–	140MT-D9V-C29
32	26.5...32	448	50	50	7.5	10	20	–	7.5	15	20	–	140MT-D9V-C32
36	30...36	432	50	30	10	10	25	–	–	18.5	20	–	140MT-D9V-C36[2]
40	34...40	480	50	30	10	10	30	–	11	20	24	–	140MT-D9V-C40[2]

Specifications

MPCB Specifications

Table 9 - General Ratings

Attribute		Value
Standards compliance	IEC	IEC/EN 60947-2, IEC/EN 60947-4-1, IEC/EN 60947-1
	cULus	UL 60947-1, UL 60947-4-1, CSA C22.2, No. 60947-4-1
Certifications	Global	RINA (Marine)
	Regional	CCC, KC, EAC, CE, IEC, cULus, CB Scheme
Rated operating voltage U_e		690V AC
Maximum operating voltage (UL)		600V
Rated Frequency		50/60 Hz
Trip Class		10A
Number of operations	Mechanical	100.000 Cycles
	Electrical	100,000 Cycles (0.1...16 A); 50,000 Cycles (20...32 A)
Rated impulse withstand voltage U_{imp}		6 kV
Rated insulation voltage U_i		690V
Pollution Degree		3
Phase loss sensitivity		Yes
Disconnect function per IEC/EN 60947-2		Yes
Resistance to shock per IEC 60068-2-27		25 G/11 ms
Resistance to vibrations per IEC 60068-2-6		5 G /3 ... 150 Hz
Mounting		DIN Rail (EN 60715)
Group mounting (side by side)		up to 40 °C (104 °F)
Minimum distance to other units same type	Horizontal	0 mm (0 in.)
	Vertical	150 mm (5.9 in.)
Minimum distance to electrical conductive board	Horizontal, up to 400V	0 mm (0 in.)
	Horizontal, up to 690V	> 1.5 mm (0.06 in.)
	Vertical	75 mm (2.95 in.)
Degree of Protection	Housing	IP20
	Main Terminals	IP10
Short-circuit ratings	@230V, 400V, 440V, 500V, and 690V	See Table 2
	@480V and 600V—for motor disconnect	See Table 14
	@480V and 600V—for group motor installation	
Utilization Category	IEC 60947-2 (Circuit breaker)	A
	IEC 60947-4-1 (Motor Starter)	AC-3

Table 10 - Power Loss

Power Loss		Rated Operating Current [A]				
		0.16...1.6	2.5...6.3	10...12	16...25	32
Power Loss in all 3 Poles up to:	[W]	5.1	5.4	7.2	8.4	9.3

Table 11 - Environmental Ratings

Attribute		Value
Operating Ambient air temperature	Open—compensated	-25 ... +55 °C (-13...+131 °F)(1)
	Open	-25 ... +70 °C (-13...+158 °F)(1)
	Enclosed	0 ... +40 °C (32...104 °F)
Storage Ambient air temperature		-50 ... +80 °C (-58...+176 °F)
Maximum operating altitude permissible		2000 m (6561 ft)

(1) With derating. See Table 12.

MC 1000E-MM LC - FO converters

1330611

https://www.phoenixcontact.com/us/products/1330611

Phoenix Contact
Manufaturer#: 1330611

Technical data

Notes

Note on application

Note on application	Only for industrial use

Product properties

Product type	Media converter
Product family	MC 1000E
MTTF	68.5 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%)
	508.3 Years ()
	331.4 Years (Telcordia standard, temperature 25 °C, operating cycle 100 % (7 days a week, 24 hours a day))

Electrical properties

Supply

Supply voltage range	12 V DC ... 57 V DC
Nominal supply voltage	24 V DC
	48 V DC
Typical current consumption	20 mA (24 V DC)
Max. current consumption	170 mA

Output data

Signal

Voltage output signal	12 V DC ... 48 V DC (depending on the input voltage)
Current output signal	100 mA

Connection data

Supply

Connection method	Push-in spring connection
Conductor cross section, flexible	0.20 mm² ... 2.50 mm²
Conductor cross section, rigid	0.20 mm² ... 2.50 mm²
Conductor cross section, flexible [AWG]	24 ... 12
Conductor cross section AWG	24 ... 12
Stripping length	10.00 mm

Interfaces

Signal	Ethernet

Data: optical FO

Transmit capacity, minimum	-20 dBm (62.5/125 µm, multimode fiberglass)
	-23.5 dBm (50/125 µm, multimode fiberglass)

Transmit capacity, maximum	-14 dBm
Transmission length incl. 3 dB system reserve	2 km
Connection method	LC duplex
Wavelength	1310 nm
Minimum receiver sensitivity	-31 dBm
Maximum receiver sensitivity	-8 dBm
Transmission medium	Multi-mode fiberglass

Data: Ethernet interface, 100Base-Tx in acc. with IEEE 802.3u

Transmission speed	10/100 Mbps
Connection method	RJ45 jack, shielded
No. of channels	1
Transmission length	100 m (twisted pair, shielded)
Transmission medium	Copper
Signal LEDs	LNK/ACT, SPD, Err, US, US2
Auto-negotiation modes	Auto
Link through	Link fault pass through
MDI-/MDI-X switchover	Auto-MDI(X)

Dimensions

Width	22.5 mm
Height	125 mm
Depth	90 mm

Material specifications

Housing material	Polyamide fiber reinforced
	Aluminum / steel sheet DC01

Cable/line

FO cable

Fiber types	50/125 µm
	62.5/125 µm
	Fiberglass

Mechanical tests

Vibration resistance in accordance with EN 60068-2-6/IEC 60068-2-6	: 5g, 150 Hz, Criterion 3
Shock in accordance with EN 60068-2-27/IEC 60068-2-27	: 30g, 11 ms half-sine shock pulse

Environmental and real-life conditions

Ambient conditions

Degree of protection	IP30
Ambient temperature (operation)	-40 °C ... 75 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C

FL SWITCH SFN 5TX - Industrial Ethernet Switch

2891152

https://www.phoenixcontact.com/us/products/2891152

Phoenix Contact
Manufaturer#: 2891152

Technical data

Dimensions

Width	30 mm
Height	120 mm
Depth	70 mm

Notes

Note on application

Note on application	Only for industrial use

Material specifications

Housing material	Aluminum

Mounting

Mounting type	DIN rail mounting

Interfaces

Ethernet (RJ45)

Connection method	RJ45
Note on the connection method	Auto negotiation and autocrossing
Transmission speed	10/100 Mbps
Transmission physics	Ethernet in RJ45 twisted pair
No. of channels	5 (RJ45 ports)

Product properties

Product type	Switch
Product family	Unmanaged Switch SFN
Type	Block design
MTTF	192.9 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%)

Insulation characteristics

Protection class	III (IEC 61140, EN 61140, VDE 0140-1)

Switch functions

Basic functions	Unmanaged switch / auto negotiation, complies with IEEE 802.3, store and forward switching mode
Status and diagnostic indicators	LEDs: U_S, link and activity per port
Additional functions	Autonegotiation

Security functions

Basic functions	Unmanaged switch / auto negotiation, complies with IEEE 802.3, store and forward switching mode

Electrical properties

Local diagnostics	US Supply voltage Green LED
	LNK/ACT Link status/data transmission Green LED
	100 Data transmission speed Yellow LED
Maximum power dissipation for nominal condition	2.16 W
Test section	500 V DC 1 min
Transmission medium	Copper

Supply

Supply voltage (DC)	24 V DC
Supply voltage range	9 V DC ... 32 V DC
Power supply connection	Via COMBICON, max. conductor cross section 2.5 mm²
Residual ripple	3.6 V_{PP} (within the permitted voltage range)
Max. current consumption	205 mA (at 9 V DC)
Typical current consumption	90 mA (at U_S = 24 V DC)

Connection data

Connection technology

Connection name	Power supply
pluggable	yes

Power supply

Connection method	Screw connection
Conductor cross section, rigid	0.2 mm² ... 2.5 mm²
Conductor cross section, flexible	0.2 mm² ... 2.5 mm²
Conductor cross section AWG	24 ... 12
Stripping length	7 mm

Environmental and real-life conditions

Ambient conditions

Degree of protection	IP20
Ambient temperature (operation)	0 °C ... 60 °C
Ambient temperature (storage/transport)	-20 °C ... 70 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	5 % ... 95 % (non-condensing)
Vibration (operation)	in acc. with IEC 60068-2-6: 5g, 150 Hz
Air pressure (operation)	86 kPa ... 5 kPa (up to 1500 m above sea level)
Air pressure (storage/transport)	66 kPa ... 108 kPa (up to 3500 m above sea level)
Resistance to gases that may endanger the functions, in acc. with DIN 40046-36, DIN 40046-37	Sulfur dioxide (SO_2) 10 ±0.3 cm^3/m^3, hydrogen sulfide (H_2S) 1 ±0.3 cm^3/m^3, at 25°C and 75% humidity and exposure of four days

Standards and regulations

Free from substances that could impair the application of coating	In acc. with VW specification

CompactLogix 5380 Controllers

Allen-Bradley
Manufaturer#: 5069-RTB18-SPRING RTB; 5069-OF4; 5069-OW16; 5069-IB16; 5069-L310ER

CompactLogix 5380 controllers are part of the Logix 5000® family of controllers. The controllers provide a scalable controller solution to address a wide variety of applications. The applications range from standalone systems to more complex systems with devices that are connected to the controller via an EtherNet/IP™ network.

The controllers are mounted on a DIN rail. They can monitor and control local and remote I/O modules, and other devices connected to an EtherNet/IP network. The CompactLogix 5380 controllers support this functionality:

- Use of Compact 5000™ I/O module as local I/O and remote I/O modules.
- Use Compact 5000 I/O modules, and other I/O modules, as remote I/O modules.
- Support for Integrated Motion over an EtherNet/IP network (not all controllers).
- Use of Dual-IP mode or Linear/DLR mode.
- Use of two Ethernet ports that let the controller connect to EtherNet/IP device-level and enterprise-level networks.
- Use of 1784-SD1, 1784-SD2, 1784-SDHC8, 1784-SDHC32, 9509-CMSDCD4 Secure Digital (SD) card for nonvolatile memory.
- USB programming port for temporary connection.
- CompactLogix 5380 Process controllers (5069-L320ERP, 5069-L340ERP) support PlantPAx® 5.0, and are conformal coated to add a layer of protection when exposed to harsh, corrosive environments. For more information, see the PlantPAx DCS Configuration and Implementation User Manual, publication PROCES-UM100.

Features - CompactLogix 5380 Controllers

Feature	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Controller tasks Continuous Periodic Event	32 tasks 1000 programs/task All event triggers							
Built-in communication ports	1 - USB port 2 - Ethernet ports **IMPORTANT**: Consider the following: When the controller operates in Dual-IP mode, each Ethernet port requires a unique IP address. When the controller operates in Linear/DLR mode, the controller uses only one IP address.							
USB port communication	USB 2.0, Type B Full speed (12 Mbps) Programming, configuration, firmware update, and online edits only							
Ethernet performance	10 Mbps, 100 Mbps, 1 Gbps Full-duplex only							
I/O Capacity (Class 0/1) (1)	• 128,000 without CIP Security™ • 40,000 with integrity • 20,000 with integrity and confidentiality							
Message Rate Capacity HMI/MSG (Class 3) (1)	• 2000 without CIP Security • 1500 with integrity • 900 with integrity and confidentiality							
EtherNet/IP modes supported	Dual-IP mode (Available with the Studio 5000 Logix Designer® application, version 29.00.00 or later) Linear/DLR mode							
EtherNet/IP network topologies supported	DLR Star Linear							
EtherNet/IP nodes supported, max(2)	16	24	40	60	90	120	150	180
Socket interfaces supported, max	32							

Features - CompactLogix 5380 Controllers (Continued)

Feature	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Integrated motion(3)	5069-L306ERM	5069-L310ERM, 5069-L310ERMK	5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ERM, 5069-L330ERMK	5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Number of axes supported, max(4)	256							
Number of Integrated Motion on EtherNet/IP™ drive axes (Position loop-configured) supported, max(5)	5069-L306ERM: 2	5069-L310ERM: 4	5069-L320ERM, 5069-L320ERMK, 5069-L320ERP: 8	5069-L330ERM, 5069-L330ERMK: 16	5069-L340ERM, 5069-L340ERP: 20	24	28	32
Programming languages	Ladder Diagram (LD) Structured Text (ST) Function Block Diagram (FBD) Sequential Function Chart (SFC)							

(1) I/O numbers are maximums; they assume no HMI/MSG. HMI/MSG numbers are maximums, they assume no I/O. Maximums assume that the processor is the target, not the originator. Packet rates vary depending on packet size. For more details, see Troubleshoot EtherNet/IP Application Technique, publication ENET-AT003, and the EDS file for a specific catalog number.
(2) The maximum number of nodes that are listed represents when the controller is used with the Logix Designer application, version 31 or later. Some controllers can be used with earlier Logix Designer application versions. The maximum number of nodes that a controller supports can be fewer in Logix Designer application, versions 30 or earlier.
(3) Only CompactLogix 5380 controllers that have an M or P in their catalog number support Integrated Motion on EtherNet/IP networks.
(4) Any combination of Integrated Motion on EtherNet/IP drive, Virtual, Consumed, Regenerative AC/DC Converter and Non-Regenerative AC/DC Converter axis types.
(5) The maximum number of Integrated Motion on EtherNet/IP drive axes (configured for Position Loop) that can be included in the total integrated motion axes count for a controller.

Technical Specifications - CompactLogix 5380 Controllers

Attribute	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
User memory	0.6 MB	1 MB	2 MB	3 MB	4 MB	5 MB	8 MB	10 MB
Optional nonvolatile memory	• 1784-SD1 (1 GB) • 1784-SD2 (2 GB), ships with controller • 1784-SDHC8 (8 GB) • 1784-SDHC32 (32 GB) • 9509-CMSDCD4 (4 GB) CodeMeter CmCard SD							
Local I/O modules, max	8	8	16	31(1)	31	31	31	31
Number of power cycles	80,000							
MOD Power voltage range	18...32V DC							
MOD Power current, max	450 mA							
MOD Power inrush	850 mA for 125 ms							
MOD Power passthrough(2)	9.55 A @ 18...32V DC							
MOD Power current rating, max	10 A Do not exceed 10 A current draw at the MOD Power RTB.							
SA Power voltage ranges(3)	0...32V DC 0...240V AC, 47...63 Hz EX, 125V AC max							
SA Power current, max(3)	10 mA (DC power) 25 mA (AC power)							
SA Power passthrough(3), (4)	9.95 A @ 0...32V DC 9.975 A @ 0...240V AC, 47...63 Hz EX, 125V AC max							
SA Power current rating, max (3)	10 A (AC or DC power) Do not exceed 10 A current draw at the SA Power RTB.							
Power dissipation, max	8.5 W							
Thermal dissipation, max	29 BTU/hr							
Isolation voltage	300V (continuous), Basic Insulation Type, SA, and MOD Power to Backplane 300V (continuous), Basic Insulation Type, SA to MOD Power 300V (continuous), Basic Insulation Type, Ethernet to Backplane 300V (continuous), Double Insulation Type, Ethernet to MOD Power 300V (continuous), Double Insulation Type, Ethernet to SA Power 50V (continuous), Functional Insulation Type, Ethernet to USB 300V (continuous), Basic Insulation Type, USB to Backplane 300V (continuous), Double Insulation Type, USB to MOD Power 300V (continuous), Double Insulation Type, USB to SA Power No isolation between Ethernet ports Type tested at 1500V AC for 60 s							
Weight, approx	0.768 kg (1.693 lb)							
Dimensions (HxWxD), approx	143.97 x 98.10 x 136.81 mm (5.67 x 3.86 x 5.39 in.)							

Technical Specifications - CompactLogix 5380 Controllers (Continued)

Attribute	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Location	DIN rail mount (horizontal mount only)							
DIN rail	Compatible zinc-plated, chromate steel DIN rail. EN50022 - 35 x 7.5 mm (1.38 x 0.30 in.)							
Removable terminal block	RTBs are available in separately ordered 5069 RTB kits. The MOD power connection uses a 4-point RTB, and the SA power connection uses a 6-point RTB. The following kits are available: • Kit catalog number 5069-RTB64-SCREW contains RTB catalog numbers 5069-RTB6-SCREW and 5069-RTB4-SCREW. • Kit catalog number 5069-RTB64-SPRING contains RTB catalog numbers 5069-RTB6-SPRING and 5069-RTB4-SPRING.							
Terminal block torque	5069-RTB4-SCREW & 5069-RTB6-SCREW: 0.4 N•m (3.5 lb•in) 5069-RTB4-SPRING & 5069-RTB6-SPRING: Torque does not apply							
Wire size	5069-RTB4-SCREW, 5069-RTB6-SCREW connections: 0.5...1.5 mm^2 (22...16 AWG) solid or stranded copper wire that is rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only 5069-RTB4-SPRING, 5069-RTB6-SPRING connections: 0.5...1.5 mm^2 (22...16 AWG) solid or stranded copper wire that is rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only Ethernet connections: Ethernet Cabling and Installation according to IEC 61918 and IEC 61784-5-2							
Insulation stripping length	5069-RTB4-SCREW, 5069-RTB6-SCREW connections: 12 mm (0.47 in.) 5069-RTB4-SPRING, 5069-RTB6-SPRING connections: 10 mm (0.39 in.)							
Wire category(5)	3 - on USB port 1 - on power ports 2 - on Ethernet ports							
Enclosure	None (open-style)							
North American temperature code	T4							
UKEX/ATEX temperature code	T4							
IECEx temperature code	T4							

(1) When you use these controllers with the Studio 5000 Logix Designer application, version 29.00.00, the application limits the number of local I/O modules in the project to 16. For more information, see the Rockwell Automation Knowledgebase article #942580, '5380 CompactLogix controllers limited to 16 local 5069 modules in V29 of Studio 5000©'. The document is available at rok.auto/knowledgebase.
With the Logix Designer application, version 30.00.00 or later, the controllers support as many as 31 local I/O modules.
(2) Maximum level of MOD Power current that the controller can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.
(3) SA power specifications are based on the number and type of Compact 5000 I/O modules that are used in the system. If the set of I/O modules that are used in the system require AC and DC voltage, you must install a 5069-FPD field potential distributor to separate the module types.
(4) Maximum level of SA Power current that the controller can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.
(5) Use this Conductor Category information to plan conductor routing. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - CompactLogix 5380 Controllers

Attribute	5069-L306ER, 5069-L306ERM, 5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK, 5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP, 5069-L330ER, 5069-L330ERM, 5069-L330ERMK, 5069-L340ER, 5069-L340ERM, 5069-L340ERP, 5069-L350ERM, 5069-L350ERMK, 5069-L380ERM, 5069-L3100ERM
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0 °C < Ta < +60 °C (+32 °F <Ta < +140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40...+85 °C (-40...+185 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	5 g @ 10...500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80...6000 MHz
EFT/B immunity IEC 61000-4-4	± 4 kV at 5 kHz on power ports ± 2 kV at 5 kHz on Ethernet ports

Specifications

For a list of all specifications, see the Compact 5000 I/O Modules and EtherNet/IP Adapters Technical Data, publication 5069-TD001.

Attribute	5069-IB16, 5069-IB16F, 5069-IB16K
Temperature, operating • IEC 60068-2-1 (Test Ad, Operating Cold) • IEC 60068-2-2 (Test Bd, Operating Dry Heat) • IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Enclosure type rating	None (open-style)
Voltage and current ratings	
Input ratings	4...7.4 mA per channel @ 10...32V DC
MOD power	75 mA @ 18...32V DC
MOD power (passthrough)(1)	9.55 A @ 18...32V DC
SA power	200 mA @ 10...32V DC
SA power (passthrough)(1)	9.95 A @ 10...32V DC
Do not exceed 10 A MOD or SA power (passthrough) current draw.	
Isolation voltage	250V (continuous), Basic Insulation Type No isolation between SA power and input ports No isolation between individual input ports
Wire size	
5069-RTB18-SCREW connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only.
5069-RTB18-SPRING connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only.
Insulation-stripping length	
5069-RTB18-SCREW connections	12 mm (0.47 in.)
5069-RTB18-SPRING connections	10 mm (0.39 in.)
RTB torque specifications (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)
DIN rail	Compatible zinc-plated, yellow-chromate steel DIN rail. You can use the following DIN rail sizes: • EN50022 - 35 x 7.5 mm (1.38 x 0.30 in.) • EN50022 - 35 x 15 mm (1.38 x 0.59 in.)
North American temp code	T4
UKEX/ATEX temp code	T4
IECEx temp code	T4

(1) Maximum level of MOD or SA power current that the module can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

Specifications

For a list of all specifications, see the Compact 5000 I/O and Specialty Modules Technical Data, publication 5069-TD001.

Attribute	5069-OW16 Series A and Series B	5069-OW16 Series C
Temperature, operating • IEC 60068-2-1 (Test Ad, Operating Cold), • IEC 60068-2-2 (Test Bd, Operating Dry Heat), • IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)	
Temperature, surrounding air, max	60 °C (140 °F)	
Enclosure type rating	None (open-style)	
Voltage and current ratings		
Relay ratings	2 A resistive per channel @ 5...30V DC 2 A resistive per channel @ 5...264V AC, 50/60 Hz 2 A general use per channel @ 5...250V AC, 50/60 Hz 2 A @ 5...125V AC, UKEX/ATEX/IECEx **Surge Suppression** - To extend the life of the module, connect surge suppressors across your external inductive load. For additional details, see the Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1.	
Output current, max	8 A per group 16 A per module	
MOD power	75 mA @ 18...32V DC	225 mA @ 18...32V DC
MOD power (passthrough)(1)	9.55 A @ 18...32V DC	
SA power	150 mA @ 18...32V DC	–
SA power (passthrough)(1)	9.95 A @ 18...32V DC	
Do not exceed 10 A MOD or SA power (passthrough) current draw. The 5069-OW16 module complies with UKEX/ATEX/IECEx when used at or below 125V AC or 30V DC.		
Isolation voltage	250V (continuous), Basic Insulation Type Type tested at 1800V AC for 60 s No isolation between individual channels	
Wire size		
5069-RTB18-SCREW connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only. Use minimum 18 AWG, 105 °C (221 °F) rated wire for load connections to relay output modules.	
5069-RTB18-SPRING connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only. Use minimum 18 AWG, 105 °C (221 °F) rated wire for load connections to relay output modules.	
Insulation-stripping length		
5069-RTB18-SCREW connections	12 mm (0.47 in.)	
5069-RTB18-SPRING connections	10 mm (0.39 in.)	
RTB torque specifications (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)	
Pilot duty rating	5...240V AC, 50/60 Hz, C300 pilot duty per channel 5...125V DC, R150 pilot duty per channel	
North American temp code	T4	
UKEX/ATEX temp code	T4	
IECEx temp code	T4	

(1) Maximum level of MOD or SA power current that the module can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

Specifications

For a list of all specifications, see the Compact 5000 I/O Modules and EtherNet/IP Adapters Technical Data, publication 5069-TD001.

5069-OF4 and 5069-OF8 Analog Current/Voltage Output Module Specifications

Attribute	5069-OF4, 5069-OF4K	5069-OF8
Temperature, operating • IEC 60068-2-1 (Test Ad, Operating Cold), • IEC 60068-2-2 (Test Bd, Operating Dry Heat), • IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)	
Temperature, surrounding air, max	60 °C (140 °F)	
Enclosure type rating	None (open-style)	
Voltage and current ratings		
Analog output ratings	+/-10V DC, 0...20 mA per channel	
MOD power	75 mA @ 18...32V DC	
MOD power (passthrough)(1)	9.55 A @ 18...32V DC	
SA power	150 mA @ 18...32V DC	250 mA @ 18...32V DC
SA power (passthrough)(1)	9.95 A @ 18...32V DC	
Do not exceed 10 A MOD or SA power (passthrough) current draw		
Isolation voltage	250V (continuous), Basic Insulation Type 50V Functional Isolation between SA power and output ports No isolation between individual output ports	
Wire size		
5069-RTB18-SCREW connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only.	
5069-RTB18-SPRING connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only.	
Insulation-stripping length		
5069-RTB18-SCREW connections	12 mm (0.47 in.)	
5069-RTB18-SPRING connections	10 mm (0.39 in.)	
RTB torque specifications (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)	
North American temp code	T4	
UKEX/ATEX temp code	T4	
IECEx temp code	T4	

(1) Maximum level of MOD or SA power current that the module can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

Catalog Number Explanation

Allen-Bradley
Manufaturer#: 25A-D4P0N104

1-3	4	5	6-8	9	10	11	12	13	14
25B	**–**	**B**	**2P3**	**N**	**1**	**1**	**4**	**–**	**–**
Drive	Dash	Voltage Rating	Rating	Enclosure	Reserved	Emission Class	Reserved	Dash	Dash

Code	Type
25A	PowerFlex 523
25B	PowerFlex 525

Code	Voltage	Phase
V	120V AC	1
A	240V AC	1
B	240V AC	3
D	480V AC	3
E	600V AC	3

Code	Enclosure
N	IP20 NEMA / Open

Code	Interface Module
1	Standard

Code	EMC Filter
0	No Filter
1	Filter

Code	Braking
4	Standard

Output Current @ 1 Phase, 100...120V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P6(1)	1.6	A	0.25	0.2	0.25	0.2
2P5	2.5	A	0.5	0.4	0.5	0.4
4P8	4.8	B	1.0	0.75	1.0	0.75
6P0	6.0	B	1.5	1.1	1.5	1.1

Output Current @ 1 Phase, 200...240V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P6(1)	1.6	A	0.25	0.2	0.25	0.2
2P5	2.5	A	0.5	0.4	0.5	0.4
4P8	4.8	A	1.0	0.75	1.0	0.75
8P0	8.0	B	2.0	1.5	2.0	1.5
011	11.0	B	3.0	2.2	3.0	2.2

Output Current @ 3Phase, 200...240V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P6(1)	1.6	A	0.25	0.2	0.25	0.2
2P5	2.5	A	0.5	0.4	0.5	0.4
5P0	5.0	A	1.0	0.75	1.0	0.75
8P0	8.0	A	2.0	1.5	2.0	1.5
011	11.0	A	3.0	2.2	3.0	2.2
017	17.5	B	5.0	4.0	5.0	4.0
024	24.0	C	7.5	5.5	7.5	5.5
032	32.2	D	10.0	7.5	10.0	7.5
048(2)	48.3	E	15.0	11.0	10.0	7.5
062(2)	62.1	E	20.0	15.0	15.0	11.0

Output Current @ 3 Phase, 380...480V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P4	1.4	A	0.5	0.4	0.5	0.4
2P3	2.3	A	1.0	0.75	1.0	0.75
4P0	4.0	A	2.0	1.5	2.0	1.5
6P0	6.0	A	3.0	2.2	3.0	2.2
010	10.5	B	5.0	4.0	5.0	4.0
013	13.0	C	7.5	5.5	7.5	5.5
017	17.0	C	10.0	7.5	10.0	7.5
024	24.0	D	15.0	11.0	15.0	11.0
030(2)	30.0	D	20.0	15.0	15.0	11.0
037(2)	37.0	E	25.0	18.5	20.0	15.0
043(2)	43.0	E	30.0	22.0	25.0	18.5

Output Current @ 3 Phase, 525...600V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
0P9	0.9	A	0.5	0.4	0.5	0.4
1P7	1.7	A	1.0	0.75	1.0	0.75
3P0	3.0	A	2.0	1.5	2.0	1.5
4P2	4.2	A	3.0	2.2	3.0	2.2
6P6	6.6	B	5.0	4.0	5.0	4.0
9P9	9.9	C	7.5	5.5	7.5	5.5
012	12.0	C	10.0	7.5	10.0	7.5
019	19.0	D	15.0	11.0	15.0	11.0
022(2)	22.0	D	20.0	15.0	15.0	11.0
027(2)	27.0	E	25.0	18.5	20.0	15.0
032(2)	32.0	E	30.0	22.0	25.0	18.5

(1) This rating is only available for PowerFlex 523 drives.
(2) Normal and Heavy Duty ratings are available for this drive.

Technical Specifications

Protection

Specifications	PowerFlex 523	PowerFlex 525
Bus Overvoltage Trip		
100...120V AC Input:	405V DC bus (equivalent to 150V AC incoming line)	
200...240V AC Input:	405V DC bus (equivalent to 290V AC incoming line)	
380...480V AC Input:	810V DC bus (equivalent to 575V AC incoming line)	
525...600V AC Input:	1005V DC bus (equivalent to 711V AC incoming line)	
Bus Undervoltage Trip		
100...120V AC Input:	190V DC bus (equivalent to 75V AC incoming line)	
200...240V AC Input:	190V DC bus (equivalent to 150V AC incoming line)	
380...480V AC Input:	390V DC bus (equivalent to 275V AC incoming line)	
525...600V AC Input		
P038 = 3 “600V”:	487V DC bus (equivalent to 344V AC incoming line)	
P038 = 2 “480V”:	390V DC bus (equivalent to 275V AC incoming line)	
Power Ride-Thru:	100 ms	
Logic Control Ride-Thru:	0.5 s minimum, 2 s typical	
Electronic Motor Overload Protection:	Provides class 10 motor overload protection according to NEC article 430 and motor over-temperature protection according to NEC article 430.126 (A) (2). UL 508C File 29572.	
Overcurrent:	200% hardware limit, 300% instantaneous fault	
Ground Fault Trip:	Phase-to-ground on drive output	
Short Circuit Trip:	Phase-to-phase on drive output	

Electrical

Specifications	PowerFlex 523	PowerFlex 525
Voltage Tolerance:	-15% / +10%	
Frequency Tolerance:	47...63 Hz	
Input Phases:	Three-phase input provides full rating. Single-phase input provides 35% rating on three-phase drives.	
Displacement Power Factor:	0.98 across entire speed range	
Maximum Short Circuit Rating:	100,000 Amps Symmetrical	
Actual Short Circuit Rating:	Determined by AIC Rating of installed fuse/circuit breaker	
Transistor Type:	Isolated Gate Bipolar Transistor (IGBT)	
Internal DC Bus Choke	Only for Frame E drive ratings	
200...240V AC Input:	11 kW (15 HP)	
380...480V AC Input:	15...18.5 kW (20...25 HP) – Heavy Duty	
525...600V AC Input:	15...18.5 kW (20...25 HP) – Heavy Duty	

Control

Specifications	PowerFlex 523	PowerFlex 525
Method	Sinusoidal PWM, Volts/Hertz, Sensorless Vector Control, Economizer SVC motor control, Closed Loop Velocity Vector Control, Surface Mount and Interior Permanent Magnet Motor (without encoder), Interior Permanent Magnet Motor (with encoder) (Closed Loop Velocity Vector Control and PM motor control are not applicable to PowerFlex 523 drives)	
Carrier Frequency	2...16 kHz, Drive rating based on 4 kHz	
Frequency Accuracy		
Digital Input:	Within ±0.05% of set output frequency	
Analog Input:	Within 0.5% of maximum output frequency, 10-Bit resolution	
Analog Output:	±2% of full scale, 10-Bit resolution	

Specifications	PowerFlex 523	PowerFlex 525
Performance		
V/Hz (Volts per Hertz):	±1% of base speed across a 60:1 speed range	
SVC (Sensorless Vector):	±0.5% of base speed across a 100:1 speed range	
SVC Economizer:	±0.5% of base speed across a 100:1 speed range	
	(Applicable to PowerFlex 525 drives only)	
VVC (Velocity Vector Control):	±0.5% of base speed across a 60:1 speed range	
PM Motor(1):	±0.5% of base speed, up to a 20:1 speed range	
Performance with Encoder	(Applicable to PowerFlex 525 drives only)	
SVC (Sensorless Vector):	±0.1% of base speed across a 100:1 speed range(2)	
SVC Economizer:	±0.1% of base speed across a 100:1 speed range(2)	
VVC (Velocity Vector Control):	±0.1% of base speed across a 1000:1 speed range(2)	
PM Motor (iPM motor, 10 HP rating and below)(1):	±0.1% of base speed, up to a 60:1 speed range	
Output Voltage Range:	0V to rated motor voltage	
Output Frequency Range:	0...500 Hz (programmable)	
Efficiency:	97.5% (typical)	
Stop Modes:	Multiple programmable stop modes including – Ramp, Coast, DC-Brake, and Ramp-to-Stop	
Accel/Decel:	Four independently programmable accel and decel times. Each time may be programmed from 0...600 s in 0.01 s increments.	
Intermittent Overload		
Normal Duty:	110% Overload capability for up to 60 s, 150% for up to 3 s Applies for power rating above 15 kW (20 HP) only. Based on 480V drive rating.	
Heavy Duty:	150% Overload capability for up to 60 s, 180% for up to 3 s (200% programmable)	

(1) For details on specific motor performance, see Knowledge Base article "PowerFlex 525 PM Motor Performance Testing Summary".
(2) For more information, see the PowerFlex 520-Series Adjustable Frequency AC Drive User Manual, publication 520-UM001.

Control Inputs

Specifications		PowerFlex 523	PowerFlex 525
Digital	Bandwidth:	10 Rad/s for open and closed loop	
	Quantity:	(1) Dedicated for stop (4) Programmable	(1) Dedicated for stop (6) Programmable
	Current:	6 mA	
	Type		
	Source Mode (SRC):	18...24V = ON, 0...6V = OFF	
	Sink Mode (SNK):	0...6V = ON, 18...24V = OFF	
	Pulse Train		
	Quantity:	(1) Shared with one of the programmable digital input terminals.	
	Input Signal:	Transistor contact (open collector)	
	Input Frequency:	0...100 kHz	
	Current Consumption:	7 mA @ 24V DC maximum	
Analog	Quantity:	(1) Isolated, 0-10V and 4-20 mA	(2) Isolated, -10-10V and 4-20 mA
	Specification		
	Resolution:	10-bit	
	0-10V DC Analog:	100k ohm input impedance	
	4-20 mA Analog:	250 ohm input impedance	
	External Pot:	1...10k ohm, 2 W minimum	

Control Outputs

Specifications		PowerFlex 523	PowerFlex 525
Relay	Quantity:	(1) Programmable Form C	(2) 1 Programmable Form A and 1 Programmable Form B
	Specification Resistive Rating: Inductive Rating:	 3.0 A @ 30V DC, 3.0 A @ 125V, 3.0 A @ 240V AC 0.5 A @ 30V DC, 0.5 A @ 125V, 0.5 A @ 240V AC	
Opto	Quantity:	–	(2) Programmable
	Specification:		30V DC, 50 mA Non-inductive
Analog	Quantity:	(1) Non-Isolated 0-10V or 4-20 mA(1)	
	Specification Resolution: 0-10V DC Analog: 4-20 mA Analog:	 10-bit 1 k ohm minimum 525 ohm maximum	

(1) Feature is not applicable to PowerFlex 523 series A drives.

Encoder

Specifications	PowerFlex 523	PowerFlex 525
Type:	–	Incremental, dual channel
Supply:		12V, 250 mA
Quadrature:		90°, ±27° @ 25 °C
Duty Cycle:		50%, +10%
Requirements:		Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 3.5...26V DC output, single-ended or differential and capable of supplying a minimum of 10 mA per channel. Allowable input is DC up to a maximum frequency of 250 kHz. The encoder I/O automatically scales to allow 5V, 12V and 24V DC nominal voltages.

Switching Power Supplies

Idec
Manufaturer#: PS5R-VF24

PS5R-V Series

STANDARDS COMPLIANCE

Applicable Standards	Mark	File No. or Organization
UL508 UL1310[1] ANSI/ISA 12.12.01 CSA C22.2 No.107.1 CSA C22.2 No.213 CSA C22.2 No.223[1]	c UL us	UL/c-UL Listed File No. E467154, E177168
EN60950-1 EN50178 EN61204-3 EN50581	TÜV	TÜV SÜD[2]
	CE	EU Low Voltage Directive, EMC Directive RoHS Directive
SEMI F47	—	EPRI

Note 1: PS5R-VA/VB/VC/VD/VE only
Note 2: EN60950-1, EN50178 only

PART NUMBERS

Output Capacity	Part Number	Input Voltage	Output Voltage	Output Current
7.5W	PS5R-VA05	100 to 240V AC (Voltage range: 85 to 264V AC / 100 to 370V DC)	5V	1.5A
	PS5R-VA12		12V	0.6A
	PS5R-VA24		24V	0.3A
10W	PS5R-VB05		5V	2.0A
15W	PS5R-VB12		12V	1.3A
	PS5R-VB24		24V	0.65A
30W	PS5R-VC12		12V	2.5A
	PS5R-VC24		24V	1.3A
60W	PS5R-VD24		24V	2.5A
90W	PS5R-VE24		24V	3.75A
120W	PS5R-VF24		24V	5.0A
240W	PS5R-VG24		24V	10.0A

Part Number Structure

PS5R - V □ □

Output Capacity
A: 7.5W
B: 10W/15W
C: 30W
D: 60W
E: 90W
F: 120W
G: 240W

Output Voltage
05: 5V[3]
12: 12V[4]
24: 24V

Note 3: PS5R-VA/VB only
Note 4: PS5R-VA/VB/VC only
Use only for interpreting part numbers.
Do not use for developing part numbers.

PRODUCT DESCRIPTION

DIN-rail mount switching power supplies with global approvals for both industrial and hazardous locations

KEY FEATURES

- Compact size preserves panel space
- Slim size (width):
  22.5mm (10W/15W/30W)
  36mm (60W/90W)
  46mm (120W)
  60mm (240W)
- Universal Voltage Input:
  85-264V AC/100-370V DC
- Wide operating temperature range
- Spring-up terminals accept ring & fork terminals
- Approved for use in Class I Division 2 hazardous locations
- Can be installed in 6 directions
- 10W ~ 90W meet NEC Class 2 output ratings
- Overcurrent protection with auto-reset
- Meets SEMI F47 Sag Immunity (208V AC input)
- RoHS compliant
- Five-year factory warranty

SPECIFICATIONS

Model		5V DC output	PS5R-VA05	PS5R-VB05	-	-	-	-	-
		12V DC output	PS5R-VA12	PS5R-VB12	PS5R-VC12	-	-	-	-
		24V DC output	PS5R-VA24	PS5R-VB24	PS5R-VC24	PS5R-VD24	PS5R-VE24	PS5R-VF24	PS5R-VG24
Output Capacity			7.5W	15W (5V Model is 10W)	30W	60W	90W	120W	240W
Input	Rated Input Voltage (Single-phase two-wire)[1]		100 to 240V AC (Voltage range: 85 to 264V AC/100 to 370V DC) (Load ≤ 80% at 100-105V DC)						
	Frequency		50/60 Hz						
	Input Current (Typ.)	100V AC	5V: 0.20A 12V, 24V: 0.18A	5V: 0.25A 12V, 24V: 0.35A	0.7A	1.3A	1.1A	1.4A	2.7A
		230V AC	5V: 0.12A 12V, 24V: 0.10A	5V: 0.14A 12V, 24V: 0.19A	0.3A	0.8A	0.6A	0.7A	1.2A
	Inrush Current (Typ.) (Ta=25°C, cold start)	100V AC	15A	18A					14A
		230V AC	36A	45A				41A	30A
	Leakage Current	120V AC	0.5mA max.						
		230V AC	1.0mA max.						
	Efficiency (Typ.) (at rated output)[2]	100V AC	5V: 74%, 12V: 79%, 24V: 80%	5V: 77%, 12V: 82%, 24V: 84%	12V: 83%, 24V: 85%	86%	88%		89%
		230V AC	5V: 73%, 12V: 77%, 24V: 76%	5V: 73%, 12V: 80%, 24V: 81%	12V: 85%, 24V: 87%	86%	89%		90%
	Power Factor (Typ.)	100V AC	—	—	—	—	0.99		
		230V AC	—	—	—	—	0.86	0.92	0.96
Output	Rated Voltage/Current		5V/1.5A, 12V/0.6A, 24V/0.3A	5V/2.0A[3], 12V/1.3A, 24V/0.65A	12V/2.5A, 24V/1.3A	24V/2.5A	24V/3.75A	24V/5A	24V/10A
	Adjustable Voltage Range		±10%				±5%	±10%	
	Output Holding Time (Typ.) (at rated output)	100V AC	45ms	5V: 53ms, 12V: 34ms, 24V: 36ms	12V: 13ms, 24V: 15ms	13ms	20ms	30ms	
		230V AC	285ms	5V: 330ms 12V: 215ms 24V: 230ms	12V: 110ms 24V: 110ms	105ms	30ms	33ms	40ms
	Start Time (at rated input and output)		500ms max.	500ms max.	600ms max.	800ms max.		700ms max.	800ms max.
	Rise Time (at rated input and output)		5V, 12V: 200ms max 24V: 250ms max	5V, 12V: 200ms max. 24V: 250ms max.	200ms max.				
	Regulation	Input Fluctuation	0.4% max.						
		Load Fluctuation	5V: 2.5% max. 12V, 24V: 1.0% max.		1.0% max.				
		Temperature Change	0.04%/°C max. (-10 to +65°C)	0.05%/°C max. (-10 to +65°C)	12V: 0.05%/°C max. (-10 to +50°C) 24V: 0.05%/°C max. (-10 to +55°C)	0.05%/°C max. (-10 to +55°C)	0.05%/°C max. (-10 to +50°C)	0.05%/°C max. (-25 to +55°C)	0.05%/°C max. (-25 to +50°C)
		Ripple (including noise)	5V: 8% p-p max. (-25 to -10°C) 12V: 6% p-p max. (-25 to -10°C) 24V: 4% p-p max. (-25 to -10°C)	5V: 8% p-p max. (-25 to -10°C) 12V: 6% p-p max. (-25 to -10°C) 24V: 4% p-p max. (-25 to -10°C)	12V: 6% p-p max. (-25 to -10°C) 24V: 4% p-p max. (-25 to -10°C)	4% p-p max. (-25 to -10°C)			
			5V: 5% p-p max. (-10 to +0°C) 12V: 2.5% p-p max. (-10 to +0°C) 24V: 1.5% p-p max. (-10 to +0°C)	5V: 5% p-p max. (-10 to +0°C) 12V: 2.5% p-p max. (-10 to +0°C) 24V: 1.5% p-p max. (-10 to +0°C)	12V: 2.5% p-p max. (-10 to +0°C) 24V: 1.5% p-p max. (-10 to +0°C)	1.5% p-p max. (-10 to +0°C)			
			5V: 2.5% p-p max. (0 to +65°C) 12V: 1.5% p-p max. (0 to +65°C) 24V: 1% p-p max. (0 to +65°C)	5V: 2.5% p-p max. (0 to +65°C) 12V: 1.5% p-p max. (0 to +65°C) 24V: 1% p-p max. (0 to +65°C)	12V: 1.5% p-p max. (0 to +50°C) 24V: 1% p-p max. (0 to +55°C)	1% p-p max. (0 to +55°C)	1% p-p max. (0 to +50°C)	1% p-p max. (0 to +55°C)	1% p-p max. (0 to +50°C)
Overcurrent Protection			105% min. (auto reset)				101% min. (auto reset)	105% min. (auto reset)	
Operation Indicator			LED (green)						
Dielectric Strength	Between input and output terminals		3,000V AC, 1 minute						
	Between input and ground terminals		2,000V AC, 1 minute						
	Between output and ground terminals		500V AC, 1 minute						
Insulation Resistance			Between input and output terminals: 100MΩ min. (500V DC megger) Between input and ground terminals: 100MΩ min. (500V DC megger)						
Operating Temperature[4] (No freezing)			-25 to +75°C		-25 to +70°C		-25 to +65°C		
Operating Humidity (no condensation)			20 to 90% RH						
Storage Temperature (No freezing)			-25 to +75°C						
Storage Humidity (no condensation)			20 to 90% RH						
Vibration Resistance			10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL6 end clips)			10 to 55Hz, amplitude 0.33mm, 2 hours each in 3 axes (when used with BNL6 end clips) 10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL8 end clips)		10 to 55Hz, amplitude 0.21mm, 2 hours each in 3 axes (when used with BNL6 end clips) 10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL8 end clips)	10 to 55 Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with part no. BNL6 mounting clips)
Shock Resistance			300 m/s^2 (30G), 3 times each in 6 directions						
Expected Life[5]			8 years minimum (at the rated input, 50% load, operating temperature +40°C, standard mounting direction)						
EMC	EMI		EN61204-3 (Class B)						
	EMS		EN61204-3 (industrial)						
Safety Standards			UL508 (Listing), UL1310 Class 2, ANSI/ISA-12.12.01 CSA C22.2 No. 107.1, 213, 223 EN60950-1, EN50178					UL508 (Listing) ANSI/ISA-12.12.01 CSA C22.2 No. 107.1, 213 EN60950-1, EN50178	
Other Standard			SEMI F47 (at 208V AC input only)						
Degree of Protection			IP20 (EN60529)						
Dimensions (mm)			75H × 45W × 70D	90H × 22.5W × 95D		95H × 36W × 108D		115H × 46W × 121D	125H × 60W × 125D
Weight (approx.)			130g	140g	150g	260g	310g	470g	960g
Terminal Screw			M3.5						

*At normal temperature and humidity unless otherwise specified.
Note 1: DC input voltage is not subject to safety standards. When using on DC input, connect a fuse to the input terminal for DC input protection.
Note 2: Under stable state.
Note 3: PS5R-VB05 (5V DC/2.0A) is 10W (Up to 3.0A at Ta = 0 to 40°C. Not subject to safety standards above 2.0A.)
Note 4: See the output derating curves.
Note 5: Calculation of the expected life is based on the actual life of the aluminum electrolytic capacitor. The expected life depends on operating conditions.

SIEMENS

Siemens
Manufaturer#: MT0500A

Data sheet

US2:MT0500A

Control Power Transformer, 500va, PRI 240x480 230x460 220 440v, SEC 120/115/110v, Domestic,

product brand name	Control Power Transformer
design of the product	Control power voltage
special product feature	Robust design
General technical data	
weight [lb]	19.2 lb
Height x Width x Depth [in]	5.69 × 5.25 × 5.92 in
ambient temperature [°F] during operation	-4 ... +104 °F
ambient temperature during operation	-20 ... +40 °C
country of origin	Mexico
operating apparent power rated value	500 VA
Enclosure	
design of the housing	Open
Mounting/wiring	
mounting position	Any
fastening method	Surface mounting
type of electrical connection at input for main current circuit	Screw-type terminals (touchsafe)
Inputs/ Outputs	
input variables of primary voltage	240x480,230x460,220x440vac
output dimensions of secondary voltage	120/115/110vac
design of fuse holder of the secondary section	touch-safe cover required
phase number of the inputs	1
electrical input frequency	50 ... 60 Hz
input voltage _1	240 V
input voltage _2	480 V
input voltage _3	230 V
input voltage _4	460 V
input voltage _5	220 V
input voltage _6	440 V
phase number of the outputs	1
electrical output frequency	60 ... 50 Hz
output voltage _1 rated value	120 V
output voltage _3 rated value	110 V
output voltage _2 rated value	115 V
certificate of suitability	UL / CSA

Further information

Industrial Controls - Product Overview (Catalogs, Brochures,…)
www.usa.siemens.com/iccatalog
Industry Mall (Online ordering system)
https://mall.industry.siemens.com/mall/en/us/Catalog/product?mlfb=US2:MT0500A
Service&Support (Manuals, Certificates, Characteristics, FAQs,...)
https://support.industry.siemens.com/cs/US/en/ps/US2:MT0500A
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...)

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MACX MCR-EX-SL-2NAM-R-UP - Isolation amplifier

2865984

https://www.phoenixcontact.com/us/products/2865984

Phoenix Contact
Manufaturer#: 2865984

Technical data

Product properties

Product type	Isolating switch transf.
Product family	MACX Analog
No. of channels	2
Type	Ex i signal conditioners with SIL functional safety
Configuration	DIP switches

Data management status

Article revision	12

System properties

Functionality

Configuration	DIP switches

Electrical properties

Electrical isolation	3-way isolation
Electrical isolation between input and output	yes
Maximum power dissipation for nominal condition	≤ 1.3 W
Step response (10-90%)	typ. 6 ms (N/O contact: OFF/ON)
	typ. 6 ms (N/O contact: ON/OFF)
	typ. 4 ms (N/C contact: ON/OFF)
	typ. 10 ms (N/C contact: OFF/ON)

Electrical isolation

Test voltage	2.5 kV AC (50 Hz, 60 s)

Electrical isolation Input/output IEC/EN 60079-11

Standards/regulations	IEC/EN 60079-11
Rated insulation voltage	375 V_{PP}
Overvoltage category	III
Pollution degree	2

Electrical isolation Input/power supply IEC/EN 60079-11

Standards/regulations	IEC/EN 60079-11
Rated insulation voltage	375 V_{PP}
Overvoltage category	II
Pollution degree	2

Electrical isolation Input/power supply IEC/EN 61010-1

Standards/regulations	IEC/EN 61010-1
Rated insulation voltage	300 V_{rms}
Overvoltage category	II
Pollution degree	2

Insulation	Safe isolation

Electrical isolation Output 1/output 2/input, power supply IEC/EN 61010-1

Standards/regulations	IEC/EN 61010-1
Rated insulation voltage	300 V_{rms}
Overvoltage category	III
Pollution degree	2
Insulation	Safe isolation

Supply

Nominal supply voltage range	24 V AC/DC ... 230 V AC/DC -20 % ... +10 % (50/60 Hz)
Supply voltage range	19.2 V AC/DC ... 253 V AC/DC (50/60 Hz)
Max. current consumption	< 80 mA
	< 42 mA (24 V DC)
Power dissipation	< 1.1 W
Power consumption	< 1.1 W

Input data

Signal: NAMUR

Description of the input	Intrinsically safe
Number of inputs	2
Available input sources	NAMUR proximity sensors (IEC/EN 60947-5-6)
	Floating switch contacts
	Switch contacts with resistance circuit
Switching threshold "0" signal current	< 1.2 mA (blocking)
Switching threshold "1" signal, current	> 2.1 mA (conductive)
Short-circuit current	8 mA
Switching hysteresis	< 0.2 mA
Line fault detection	< 0.05 mA ... 0.35 mA (Line break)
	< 100 Ω ... 360 Ω (Short circuit)
	Activated /deactivated via DIP switch
Non-load voltage	8 V DC

Output data

Switching: Relay

Contact switching type	1 changeover contact per channel
Contact material	$AgSnO_2$, hard gold-plated
Maximum switching voltage	250 V AC (2 A, 60 Hz)
	120 V DC (0.2 A)
	30 V DC (2 A)
Maximum switching capacity	500 VA
Recommended minimum load	5 V / 10 mA

Signal

Phoenix Contact
Manufaturer#: 0801733

DIN rail perforated - NS 35/ 7,5 PERF 2000MM - 0801733

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DIN rail perforated, Standard profile, width: 35 mm, height: 7.5 mm, in acc. with EN 60715: 2001, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

RoHS

Key Commercial Data

Packing unit	1 M
Minimum order quantity	5 M
GTIN	4 017918 006686
GTIN	4017918006686
Weight per Piece (excluding packing)	1.000 g
Custom tariff number	72166190
Country of origin	Germany

Technical data

Dimensions

Height	7.5 mm
Length	2000 mm
Width	35 mm
Hole width	15.00 mm
Hole height	6.20 mm
Drill hole spacing	25.00 mm

General

Material	Steel
Coating	galvanized, passivated with a thick layer
Color	silver

Phoenix Contact
Manufaturer#: 3044102

Feed-through terminal block - UT 4 - 3044102

Technical data

General

Nominal cross section	4 mm²
Color	gray
Insulating material	PA
Flammability rating according to UL 94	V0
Area of application	Railway industry
	Machine building
	Plant engineering
	Process industry
Rated surge voltage	8 kV
Degree of pollution	3
Overvoltage category	III
Insulating material group	I
Maximum power dissipation for nominal condition	1.02 W
Maximum load current	41 A (with 6 mm² conductor cross section)
Nominal current I_N	32 A (with 4 mm² conductor cross section)
Nominal voltage U_N	1000 V
Open side panel	Yes
Shock protection test specification	DIN EN 50274 (VDE 0660-514):2002-11
Back of the hand protection	guaranteed
Finger protection	guaranteed
Result of surge voltage test	Test passed
Surge voltage test setpoint	9.8 kV
Result of power-frequency withstand voltage test	Test passed
Power frequency withstand voltage setpoint	2.2 kV
Result of the test for mechanical stability of terminal points (5 x conductor connection)	Test passed
Result of bending test	Test passed
Bending test rotation speed	10 rpm
Bending test turns	135
Bending test conductor cross section/weight	0.14 mm² / 0.2 kg
	4 mm² / 0.9 kg
	6 mm^2 / 1.4 kg
Tensile test result	Test passed
Conductor cross section tensile test	0.14 mm²
Tractive force setpoint	10 N
Conductor cross section tensile test	4 mm²
Tractive force setpoint	60 N

Phoenix Contact
Manufaturer#: 3044128

Ground modular terminal block - UT 4-PE - 3044128

Technical data

General

	Machine building
	Plant engineering
	Process industry
Rated surge voltage	8 kV
Degree of pollution	3
Overvoltage category	III
Insulating material group	I
Open side panel	Yes
Oscillation, broadband noise test result	Test passed
Test specification, oscillation, broadband noise	DIN EN 50155 (VDE 0115-200):2008-03
Test spectrum	Service life test category 1, class B, body mounted
Test frequency	f_1 = 5 Hz to f_2 = 150 Hz
ASD level	1.857 $(m/s^2)^2$/Hz
Acceleration	0,8 g
Test duration per axis	5 h
Test directions	X-, Y- and Z-axis
Shock test result	Test passed
Test specification, shock test	DIN EN 50155 (VDE 0115-200):2008-03
Shock form	Half-sine
Acceleration	5 g
Shock duration	30 ms
Number of shocks per direction	3
Test directions	X-, Y- and Z-axis (pos. and neg.)
Relative insulation material temperature index (Elec., UL 746 B)	130 °C
Temperature index of insulation material (DIN EN 60216-1 (VDE 0304-21))	125 °C
Static insulating material application in cold	-60 °C
Behavior in fire for rail vehicles (DIN 5510-2)	Test passed
Flame test method (DIN EN 60695-11-10)	V0
Oxygen index (DIN EN ISO 4589-2)	>32 %
NF F16-101, NF F10-102 Class I	2
NF F16-101, NF F10-102 Class F	2
Surface flammability NFPA 130 (ASTM E 162)	passed
Specific optical density of smoke NFPA 130 (ASTM E 662)	passed
Smoke gas toxicity NFPA 130 (SMP 800C)	passed
Calorimetric heat release NFPA 130 (ASTM E 1354)	27,5 MJ/kg
Fire protection for rail vehicles (DIN EN 45545-2) R22	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R23	HL 1 - HL 3

Phoenix Contact
Manufaturer#: 3047028

End cover - D-UT 2,5/10 - 3047028

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End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

Key Commercial Data

Packing unit	1 pc
Minimum order quantity	50 pc
Weight per Piece (excluding packing)	2.4 g
Custom tariff number	85389099
Country of origin	Germany

Technical data

Product type	End cover

Classifications

eCl@ss

eCl@ss 4.0	27141111
eCl@ss 4.1	27141111
eCl@ss 5.0	27141133
eCl@ss 5.1	27141133
eCl@ss 6.0	27141133
eCl@ss 7.0	27141133
eCl@ss 8.0	27141133

ETIM

ETIM 2.0	EC000886
ETIM 3.0	EC000886
ETIM 4.0	EC000886
ETIM 5.0	EC000886

Phoenix Contact
Manufaturer#: 0800886

End clamp - E/NS 35 N - 0800886

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End clamp, width: 9.5 mm, color: gray

Product Features

- Large-surface labeling

Key commercial data

Packing unit	1 pc
GTIN	4 017918 129309
Weight per Piece (excluding packing)	14.8 GRM
Custom tariff number	39269097
Country of origin	Germany

Technical data

Dimensions

Height	32.8 mm
Length	48.6 mm
Width	9.5 mm

General

Material	PA
Color	gray
Tightening torque, min	0.4 Nm
Tightening torque max	0.5 Nm

FBS 10-6 - Plug-in bridge

3030271

https://www.phoenixcontact.com/us/products/3030271

Phoenix Contact
Manufaturer#: 3030271

Technical data

Product properties

Product type	Plug-in bridge
Number of positions	10
Pitch	6.2 mm

Electrical properties

Maximum load current	32 A (The current values for the jumpers can deviate when used in different modular terminal blocks. The precise values can be found in the accessories data for the respective modular terminal blocks.)

Connection data

Maximum load current	32 A (The current values for the jumpers can deviate when used in different modular terminal blocks. The precise values can be found in the accessories data for the respective modular terminal blocks.)

Dimensions

Width	60.3 mm
Height	23 mm
Depth	23 mm
Pitch	6.2 mm

Material specifications

Color	red (RAL 3001)
Material	Copper
Flammability rating according to UL 94	V0
Insulating material	PA

Environmental and real-life conditions

Ambient conditions

Ambient temperature (operation)	-60 °C ... 110 °C (Operating temperature range incl. self-heating; for max. short-term operating temperature, see RTI Elec.)
Ambient temperature (storage/transport)	-25 °C ... 60 °C (for a short time, not exceeding 24 h, -60 °C to +70 °C)
Ambient temperature (assembly)	-5 °C ... 70 °C
Ambient temperature (actuation)	-5 °C ... 70 °C
Permissible humidity (operation)	20 % ... 90 %
Permissible humidity (storage/transport)	30 % ... 70 %

Mounting

Mounting type	Plug-in mounting

ATP-UT - Partition plate

3047167

https://www.phoenixcontact.com/us/products/3047167

Phoenix Contact
Manufaturer#: 3047167

Technical data

Product properties

Product type	Partition plate

Dimensions

Width	2.2 mm
Height	53.4 mm
Depth	45.7 mm

Material specifications

Color	gray (RAL 7042)
Material	PA
Flammability rating according to UL 94	V0
Static insulating material application in cold	-60 °C
Relative insulation material temperature index (Elec., UL 746 B)	130 °C
Fire protection for rail vehicles (DIN EN 45545-2) R22	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R23	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R24	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R26	HL 1 - HL 3
Surface flammability NFPA 130 (ASTM E 162)	passed
Specific optical density of smoke NFPA 130 (ASTM E 662)	passed
Smoke gas toxicity NFPA 130 (SMP 800C)	passed

Environmental and real-life conditions

Ambient conditions

Ambient temperature (operation)	-60 °C ... 110 °C (Operating temperature range incl. self-heating; for max. short-term operating temperature, see RTI Elec.)
Ambient temperature (storage/transport)	-25 °C ... 60 °C (for a short time, not exceeding 24 h, -60 °C to +70 °C)
Ambient temperature (assembly)	-5 °C ... 70 °C
Ambient temperature (actuation)	-5 °C ... 70 °C
Permissible humidity (operation)	20 % ... 90 %
Permissible humidity (storage/transport)	30 % ... 70 %

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info@phoenixcon.com

FRONT VIEW

ELECTRICAL PANEL SPECIFICATION:

CONSTRUCTION:

1. ENCLOSURE: NEMA 4X, FRP
2. WIRING: 14 AWG CLASS MTW OR THHN MINIMUM
3. DASHED LINES INDICATE WIRING EXTERNAL TO CONTROL PANEL

HARDWARE:

1. 316 SS

INTRINSICALLY SAFE CONSTRUCTION:

1. ALL INTRINSICALLY SAFE CIRCUITS TO BE RUN IN SEPARATE CONDUIT AND SEPARATED FROM NON-INTRINSICALLY SAFE CIRCUITS ACCORDING TO NEC ARTICLES 500 AND 504.
2. ALL WIRE DUCTS CONTAINING INTRINSICALLY SAFE CIRCUITS SHALL BE LABELED AS SUCH.

LABELS AND NAMEPLATES

1. NAMEPLATES SHALL BE BLACK SELF-ADHESIVE LAMICOID WITH WHITE LETTERING.
   SYSTEM NAMEPLATE: 9" W X 2" H WITH 3/8" LETTERING
   COMPONENT NAMEPLATE: 3" W X 3" H WITH 1/4" LETTERING
2. ALL COMPONENTS SHALL BE LABELED WITH PRINTED STICKERS PLACED ABOVE COMPONENT ON BACK PANEL. LETTER TO BE 1/16" IN HEIGHT.
3. ALL WIRES/CABLES LABELS TO BE MACHINE PRINTED, WRAP TYPE.
4. ALL TERMINAL BLOCK LABELS TO BE MACHINE PRINTED.
5. 10% OF EXTRA SPARE TERMINALS SHALL BE PROVIDED WITH EACH SYSTEM.
6. WIRING TO TERMINAL BLOCKS TO BE DONE SUCH THAT ALL FIELD WIRING IS ON A COMMON SIDE OF THE TERMINAL STRIP.

RELEVANT ELECTRICAL CODES:

1. PANEL TO BE CERTIFIED IN COMPLIANCE WITH UL-508A (UL LISTED).

ELECTRICAL PARTS LIST:

1. ELECTRICAL PARTS LIST DETAILS, SEE E1-SHEET 3.

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

Rev A

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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CHECKER		DATE
ENGINEER	KAL	DATE
MANAGER	KR	DATE
FILE:	F5636-E2	
SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL LAYOUT

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	1 OF 12	A

HATCHED AREA INDICATES MINIMUM CLEARANCE REQUIRED FOR COOLING

AREA BELOW TERMINAL BLOCKS IS RESERVED FOR FIELD WIRING

ELECTRICAL PANEL SPECIFICATION:

CONSTRUCTION:

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INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
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DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
	Rev A					

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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		DATE
DESIGNER	VC	6/5/25
CHECKER		DATE
ENGINEER	KAL	DATE
MANAGER	KR	DATE
FILE:	F5636-E2	
SCALE:	NTS	

TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL LAYOUT

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	2 OF 12	A

ITEM	QTY.	PART NO.	DESCRIPTION	MFG. NAME	MFG. PART NO.
651	1	–	VENT FAN, NEMA 4X, 115VAC, 92CFM	KOOLTRONICS	KNP60FLV
650	1	–	FILTER HOOD ASSEMBLY	KOOLTRONICS	KNPA60FLV
632	1		HINGED COVER WINDOW PROP	ALLIED MOULDED	AMHMIPROP142
631	1		HINGED COVER WINDOW	ALLIED MOULDED	AMHMI142CCL
630	1		OIT, 10" COLOR, TFT, PANELVIEW PLUS 7 STANDARD	ALLEN–BRADLEY	2711P–T10C21D8S
562	1		YELLOW ESTOP RING, 22MM	ALLEN–BRADLEY	800F–15YSE112
546	1		CONTACT BLOCK, 1NO/1NC	ALLEN–BRADLEY	800F–X11D
545	1		LATCH, 22MM PLASTIC	ALLEN–BRADLEY	800F–ALP
544	1		LED MODULE	ALLEN–BRADLEY	800F–NUR
543	1		ESTOP PUSHBUTTON, ILLUM., 4X, 22MM, PULL–TO–RELEASE	ALLEN–BRADLEY	800FP–LMP44
510	1	–	MAIN DISCONNECT HANDLE, RED/YEL	SIEMENS	LBRH4
506	1	–	LABEL, 4–1/8" x 1–1/8"	BRADY	102307
501	1	–	ENCLOSURE, FRP, NEMA 4X, 40" X 32" X 12"	HOFFMAN	UU1008030

SEE DRAWING
E1–07
FOR ENCLOSURE
CUTOUT DIMENSIONS

ITEM	QTY.	PART NO.	DESCRIPTION	MFG. NAME	MFG. PART NO.
217	A/R	–	TERMINAL BLOCK PARTITION, UT 4	PHOENIX CONTACT	3047167
216	A/R	–	TERMINAL LABEL, WHITE, SNAP–IN FOR UT4 TERMINALS	PHOENIX CONTACT	UCT–TM6
215	A/R	–	TERMINAL BLOCK JUMPER, FIXED BRIDGE 10–POSITION	PHOENIX CONTACT	3030271
214	A/R	–	TERMINAL BLOCK ANCHOR	PHOENIX CONTACT	800886
213	A/R	–	TERMINAL END COVER, FOR 3044102, 3044128	PHOENIX CONTACT	3047028
212	A/R	–	TERMINAL, UT4, SCREW, 10–26 AWG, 32A, GN/YL	PHOENIX CONTACT	3044128
210	A/R	–	TERMINAL, UT4, SCREW, 10–26 AWG, 32A, 1000V, GRAY	PHOENIX CONTACT	3044102
208	A/R	–	DIN RAIL	PHOENIX CONTACT	801733 OR EQUAL
201	A/R	–	WIRING DUCT COVER, WHITE, 1"	ANY	
200	A/R	–	WIRING DUCT, WHITE, 1" x 3"	ANY	
150	1	–	SIGNAL ISOLATION SWITCH AMPLIFIER	PHOENIX CONTACT	2865984
141	2	–	ETHERNET CABLE, CAT6 PIN TO PIN, 1FT	ANY	–
140	1	–	ETHERNET CABLE, CAT6 PIN TO PIN, 7FT	ANY	–
110	1	–	TRANSFORMER, 500VA, 480/120VAC 1–PHASE	SIEMENS	MT0500A
105	1	–	POWER SUPPLY, 120VAC SUPPLY, 24VDC@5A	IDEC	PS5R–VF24
100	1	–	VFD, POWERFLEX 523, 15HP, 380–480V	ALLEN BRADLEY	25A–D024N104
85	3	–	PLC, TERMINAL ADAPTOR, IO CARD	ALLEN BRADLEY	5069–RTB18–SPRING RTB
84	1	–	PLC CARD, 4 ANALOG OUTPUT, CURRENT/VOLTAGE	ALLEN BRADLEY	5069–OF4
82	1	–	PLC, 16 RO CARD	ALLEN BRADLEY	5069–OW16
81	1	–	PLC, 16 DI CARD, 24VDC	ALLEN BRADLEY	5069–IB16
80	1	–	PLC, CPU 5380, 1MB	ALLEN BRADLEY	5069–L310ER
76	1	–	ETHERNET SWITCH, 5 PORT, AUTOCROSSING, 24VDC	PHOENIX CONTACT	2891152
75	1	–	MEDIA CONVERTER, FIBER OPTIC TO ETHERNET	PHOENIX CONTACT	1330611
68	1	–	MOTOR CIRCUIT PROTECTOR, 24 – 32A	ALLEN BRADLEY	140MT–F9E–C32
65	4	–	CONTROL RELAY, 24VDC, 1P, 10A	ALLEN BRADLEY	700–HLT1Z24
64	1	–	MASTER CONTROL RELAY, 24VDC, 4NO, 15A	ALLEN BRADLEY	700–CFM400EJ
61	1	–	RECEPTACLE	PHOENIX CONTACT	0804155
45	1	–	1–POLE CIRCUIT BREAKER, 3 A	ALLEN BRADLEY	1489–M1D030
44	1	–	1–POLE CIRCUIT BREAKER, 5 A	ALLEN BRADLEY	1489–M1D050
43	3	–	1–POLE CIRCUIT BREAKER, 0.5 A	ALLEN BRADLEY	1489–M1D005
42	2	–	1–POLE CIRCUIT BREAKER, 2 A	ALLEN BRADLEY	1489–M1D020
41	1	–	1–POLE CIRCUIT BREAKER, 7 A	ALLEN BRADLEY	1489–M1D070
40	1	–	2–POLE CIRCUIT BREAKER, 4 A	ALLEN BRADLEY	1489–M2D040
22	1	–	LABEL, GROUND SYMBOL, 3/4" DIA.	PANDUIT	PLD–57 OR EQUAL
20	1	–	GROUND LUG, 1–HOLE, 14–4AWG, COPPER	BURNDY	KA4C
10	1	–	MAIN DISCONNECT SWITCH, 32A	SIEMENS	3LD2217–0TK13
1	1	–	BACK PANEL, 40x30	HOFFMAN	A40P30

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

Rev A

STD: BORDER–11X17CA–0A BAR = 1" AT PLOT SCALE

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DESIGNER VC	DATE 6/5/25	TITLE HILO WWTP, HI BIOLOGICAL ODOR CONTROL (IBOX 8025) ELECTRICAL CONTROL PANEL BOM
CHECKER	DATE	CLIENT NAN, INC. HONOLULU, HI
ENGINEER ZA	DATE	Integrity MUNICIPAL SYSTEMS 13135 DANIELSON ST., SUITE 204 POWAY, CA 92064, USA TEL: 858–486–1620
MANAGER KR	DATE	
FILE: F5636–E2		
SCALE: NTS		

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	3 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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Rev A

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FILE:	F5636-E2	
SCALE:	NTS	

TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL LADDER LOGIC DIAGRAM

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	4 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

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ENGINEER	DATE	
MANAGER KR	DATE	
FILE: F5636-E2		
SCALE: NTS		

TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL VFD PROGRAMMING

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	5 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTHGROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL CUSTOMER TERMINALS

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	6 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL HOLE LAYOUT

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	7 OF 12	A

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL HOLE LAYOUT

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
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PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	8 OF 12	A

GENERAL INSTRUCTION			
STEP	PARAMETER	SELECTION	NOTES
1	-	ESC	PRESS ONCE TO DISPLAY GRP AND PARAMETER # WILL FLASH
2	-	ESC	PRESS AGAIN TO ENTER GROUP MENU AND GROUP MENU WILL FLASH
3	-	UP OR DOWN ARROW	USE ARROW TO NAVIGATE TO DESIRED GROUP
4	-	ENTER OR SELECT	PRESS EITHER KEY TO ENTER INTO GROUP
5	-	UP OR DOWN ARROW	USE ARROW TO NAVIGATE TO DESIRED PARAMETER WITHIN GROUP
6	-	ESC	WILL CANCEL THE CHANGE (OR) ENTER WILL SAVE CHANGE
7	-	ESC,ESC	PRES ESC TWICE TO GET OUT OF THE PROGRAMMING MENU

PROGRAMMING GUIDE			
1	P031	480V	MOTOR NP VOLTS (380V)
2	P032	60 HZ	MOTOR NP HERTZ (50HZ)
3	P033	AS REQUIRED	MOTOR OVER-LOAD CURRENT (DRIVE RATED CURRENT X 2 NORMALLY)
4	P034	AS REQUIRED	MOTOR NAMEPLATE FLA
6	P036	AS REQUIRED	MOTOR NP RPM
7	P037	AS REQUIRED	MOTOR NP POWER
8	P041	30	ACCEL TIME (30 SEC)
9	P042	30	DECEL TIME (30 SEC)
10	P043	0	MINIMUM FREQ (0HZ)
11	P044	60	MAX FREQ (60HZ)
12	P046	2	START SOURCE (DIGITAL TERMINAL BLOCK)
13	P047	6	SPEED REFERENCE (4-20mA)
14	T062	48	DIGIN TERM BLK 2 (2-WIRE FWD, DEFAULT)
15	T063	50	DIGIN TERM BLK 3 (2-WIRE REV, DEFAULT)
16	T076	2	RELAY OUT1 SEL (MOTOR RUNNING)
17	A541	9	AUTO RESTART TRIES (MAX 9 TIMES)
18	A542	30	AUTO RESTART INTERVAL (30 SEC)

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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FILE: F5636-E2		
SCALE: NTS		

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL HOLE LAYOUT

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	9 OF 12	A

PANEL WIRING

IS

24VDC

120V

480V

TB4

216	TANK LEVEL SWITCH
216A	
217	DIFFERENTIAL PRESSURE SWITCH
217A	
206	SPARE DI
207	SPARE DI
208	SPARE DI
209	SPARE DI
222	SPARE DI
223	SPARE DI
224	SPARE DI
225	SPARE DI
226	SPARE DI
227	SPARE DI
228	SPARE DI
229	SPARE DI
305	SPARE RO
306	SPARE RO
307	SPARE RO
308	SPARE RO
309	SPARE RO
323	SPARE RO
324	SPARE RO
325	SPARE RO
326	SPARE RO
327	SPARE RO
328	SPARE RO
329	SPARE RO
404	SPARE AO
405	SPARE AO
406	SPARE AO
407	SPARE AO
408	SPARE AO
409	SPARE AO

TB2

118A	FAN HEATER
123A	PUMP POWER
125A	SOLENOID VALVE POWER
L1	120VAC
L1	120VAC
L1	120VAC
N	120VAC NEUTRAL
N	120VAC NEUTRAL
N	120VAC NEUTRAL
N	120VAC NEUTRAL
N	120VAC NEUTRAL
GND	GROUND
GND	GROUND
GND	GROUND
GND	GROUND
GND	GROUND
SP	NO CONNECTION
SP	NO CONNECTION
SP	NO CONNECTION

TB1

103A	MOT103-PHASE A
104A	MOT103-PHASE B
105A	MOT103-PHASE C
GND	GROUND

FIELD WIRING

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
	Rev A					

STD: BORDER-11X17CA-0A BAR = 1" AT PLOT SCALE

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DESIGNER	VC	DATE 6/5/25
CHECKER		DATE
ENGINEER		DATE
MANAGER	KR	DATE
FILE:	F5636-E2	
SCALE:	NTS	

TITLE HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL HOLE LAYOUT

CLIENT NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	10 OF 12	A

22mm OPERATOR CUTOUT

DETAIL C
NOT TO SCALE

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

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REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
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Rev A

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TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL HOLE LAYOUT

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	11 OF 12	A

LABEL ALL DOOR DEVICES ON DOOR INTERIOR
WITH MYLAR LABELS

DO NOT PLACE LABELS WITHIN 1"
FROM EDGE OF DOOR

3 QTY. BLACK LAMICOID/WHITE LETTERING
7" x 1", .25" TEXT

I-BOx® BIOLOGICAL ODOR CONTROL SYSTEM

14-VCP1-2610 SOLIDS

14-VCP1-2620 SOLIDS

BLACK LAMICOID/WHITE LETTERING
3" x 3/4", .125 TEXT

MAIN DISCONNECT

LABEL ALL SUBPANEL DEVICES AS SHOWN
(DS101, XF114, MS102, ETC.)
LABEL ALL TERMINAL BLOCKS

1 QTY. ADHESIVE-BACKED PRINTED LABEL

TIGHTEN TERMINAL SCREWS TO 25..40 IN.-LB. — FOR GROUND LUG

1 QTY. ADHESIVE-BACKED PRINTED LABEL

TIGHTEN TERMINAL SCREWS TO 6..7 IN.-LB. — FOR PHOENIX 3004362 TERMINAL BLOCKS

1 QTY. ADHESIVE-BACKED PRINTED LABEL

USE COPPER CONDUCTOR 90 DEG. C INSULATION ONLY — FOR TERMINAL BLOCKS

ITEMS 1 THRU 2 TO BE INSTALLED
ON THE INSIDE OF THE DOOR.

1 QTY. WHITE MYLAR/BLACK LETTERING

MAINTAIN A COMPLETE SET OF PRINTS (1)

1 QTY. WHITE MYLAR/BLACK LETTERING

UL TYPE 4X/NEMA 4X (2)

WIRE COLORS TO BE AS FOLLOWS (PER UL SPECIFICATIONS):

SUPPLY VOLTAGE	BLACK
CONTROL VOLTAGE	RED
INTRINSICALLY SAFE	LIGHT BLUE
NEUTRAL	WHITE
EARTH/GROUND	GREEN
DRY CONTACTS	YELLOW
DC CONTROL CIRCUITS	BLUE
DC COM	WHITE WITH BLUE STRIPE

Company Confidential

REV	DESCRIPTION	DATE	DWN	CHKD	APVD	ECN
A	RELEASE FOR SUBMITTAL					

Rev A

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SCALE:	NTS	

TITLE: HILO WWTP, HI
BIOLOGICAL ODOR CONTROL (IBOX 8025)
ELECTRICAL CONTROL PANEL LABELS

CLIENT: NAN, INC.
HONOLULU, HI

Integrity MUNICIPAL SYSTEMS
13135 DANIELSON ST., SUITE 204
POWAY, CA 92064, USA
TEL: 858-486-1620

PROJECT	CODE	DRAWING	SHEET	REV
40243	F5636	E2	12 OF 12	A

Hoffman
Manufaturer#: UU1008030

nVent HOFFMAN

We connect and protect

ULTRX, Type 4X

INDUSTRY STANDARDS

Mounting brackets required to meet UL/CSA external mounting requirements.

UL 508A Listed; Type 3, 3R, 4, 4X, 12, 13; File No. E61997
cUL Listed per CSA C22.2 No 94; Type 3, 3R, 4, 4X, 12, 13; File No. E619977
Enclosure flammability evaluated per UL 508A
Window flammability evaluated per UL 508A

NEMA/EEMAC Type 3, 3R, 4, 4X, 12, 13
IEC 60529, IP66

Meets NEMA Type 3RX requirements

APPLICATION

Providing outstanding protection against corrosion and the elements, the clean lines and molded, embossed design of ULTRX fiberglass enclosures make them the most stylish and aesthetically pleasing of their class. These enclosures feature hidden hinges, a padlocking capability for security, and flexible internal mounting options.

FINISH

Standard exterior surface painted light-gray acrylic enamel for enhanced UV protection. Optional steel panels are painted white. Optional stainless steel, aluminum, conductive and composite panels are unpainted.

FEATURES

- Compression-molded fiberglass material has excellent temperature and chemical resistance qualities and exhibits outstanding physical properties, including high-impact resistance
- Exterior surface is painted for enhanced UV protection
- Fiberglass is easily punched, drilled, filed or sawed
- Gasket assures watertight and dust-tight seal
- Enclosure may be rotated 180 degrees for left and right hinging
- Molded-in drip shields are standard with each enclosure
- Impact-resistant polycarbonate window is permanently bonded in place
- Fiberglass mounting brackets and stainless steel attachment screws are provided with each enclosure
- Unique hinge design allows for standard 180-degree door opening with a maximum opening of 270 degrees
- Door hinges are replaceable
- Type 316 stainless steel quarter-turn latch. Optional keylocking or padlocking handle available.
- Molded-in DIN bosses
- Molded bosses on door provide additional mounting provisions
- Integral mounting rails provide infinite panel adjustment front to back
- Optional data pocket is high-impact thermoplastic
- Material is halogen free

ACCESSORIES

See also Accessories.

H2OMIT Vent Drains, Type 4X
H2OMIT Thermoelectric Dehumidifier
HOL-SEALERS Non-Metallic Hole Seals
Panels for Type 3R, 4, 4X, 12 and 13 Enclosures
Rack Angles (Type RA)

MODIFICATION AND CUSTOMIZATION

nVent HOFFMAN excels at modifying and customizing products to your specifications. Contact your local nVent HOFFMAN sales office or distributor for complete information.

Bulletin: UX1

Standard Product

Catalog Number	Door Style	External Dimensions L x W mm/in	Internal Dimensions A x B x C mm/in	Panel	Conductive Panel	Panel Size D x E mm/in	Mounting G x H mm/in	Window Size M x N mm/in	F mm/in	J mm/in	K mm/in	S mm/in	T mm/in
UU504020	Solid	513 x 413 20.20 x 16.26	496 x 396 x 220 19.53 x 15.59 x 8.66	A20P16	A20P16G	432 x 330 17.00 x 12.99	359 x 459 14.13 x 18.07	– –	186 7.32	297 11.69	19 0.75	286 11.26	387 15.24
UU504020W	Window	513 x 413 20.20 x 16.26	496 x 396 x 220 19.53 x 15.59 x 8.66	A20P16	A20P16G	439 x 330 17.00 x 12.99	359 x 459 14.13 x 18.07	386 x 286 15.20 x 11.26	186 7.32	297 11.69	19 0.75	286 11.26	387 15.24
UU606020	Solid	625 x 612 24.61 x 24.09	608 x 595 x 220 23.94 x 23.43 x 8.66	A24P24	A24P24G	533 x 533 20.98 x 20.98	559 x 572 22.01 x 22.52	– –	186 7.32	500 19.68	21 0.83	489 19.25	489 19.25
UU606020W	Window	625 x 612 24.61 x 24.09	608 x 595 x 220 23.94 x 23.43 x 8.66	A24P24	A24P24G	533 x 533 20.98 x 20.98	559 x 572 22.01 x 22.52	498 x 486 19.61 x 19.13	186 7.32	500 19.68	21 0.83	489 19.25	489 19.25
UU605025	Solid	625 x 513 24.61 x 20.20	608 x 496 x 270 23.94 x 19.53 x 10.63	A24P20	A24P20G	533 x 432 20.98 x 17.00	457 x 570 17.99 x 22.44	– –	239 9.41	400 15.75	21 0.83	387 15.24	489 19.25
UU605025W	Window	625 x 513 24.61 x 20.20	608 x 496 x 270 23.94 x 19.53 x 10.63	A24P20	A24P20G	533 x 432 20.98 x 17.00	457 x 570 17.99 x 22.44	498 x 386 19.61 x 15.20	239 9.41	400 15.75	21 0.83	387 15.24	489 19.25
UU504030	Solid	513 x 412 20.20 x 16.22	496 x 395 x 321 19.53 x 15.55 x 12.64	A20P16	A20P16G	432 x 330 17.00 x 12.99	355 x 455 13.98 x 17.91	– –	287 11.30	300 11.81	19 0.75	286 11.26	387 15.24
UU504030W	Window	513 x 412 20.20 x 16.22	496 x 395 x 321 19.53 x 15.55 x 12.64	A20P16	A20P16G	432 x 330 17.00 x 12.99	355 x 455 13.98 x 17.91	386 x 286 15.20 x 11.26	287 11.30	300 11.81	19 0.75	286 11.26	387 15.24
UU606030	Solid	625 x 612 24.61 x 24.09	608 x 595 x 321 23.94 x 23.43 x 12.64	A24P24	A24P24G	533 x 533 20.98 x 20.98	555 x 568 21.85 x 22.36	– –	287 11.30	500 19.68	21 0.83	489 19.25	489 19.25
UU606030W	Window	625 x 612 24.61 x 24.09	608 x 595 x 321 23.94 x 23.43 x 12.64	A24P24	A24P24G	533 x 533 20.98 x 20.98	555 x 568 21.85 x 22.36	498 x 486 19.61 x 19.13	287 11.30	500 19.68	21 0.83	489 19.25	489 19.25
UU756030	Solid	775 x 612 30.51 x 24.09	758 x 595 x 321 29.84 x 23.43 x 12.64	A30P24	A30P24G	686 x 533 27.01 x 20.98	555 x 718 21.85 x 28.27	– –	287 11.30	500 19.68	21 0.83	489 19.25	641 25.24
UU756030W	Window	775 x 612 30.51 x 24.09	758 x 595 x 321 29.84 x 23.43 x 12.64	A30P24	A30P24G	686 x 533 27.01 x 20.98	555 x 718 21.85 x 28.27	648 x 486 25.51 x 19.13	287 11.30	500 19.68	21 0.83	489 19.25	641 25.24
UU1008030	Solid	1025 x 825 40.35 x 32.48	1008 x 808 x 321 39.68 x 31.81 x 12.64	A40P30	A40P30G	940 x 737 37.01 x 29.02	768 x 968 30.24 x 38.11	– –	287 11.30	700 27.56	23 0.91	692 27.24	895 35.24
UU1008030W	Window	1025 x 825 40.35 x 32.48	1008 x 808 x 321 39.68 x 31.81 x 12.64	A40P30	A40P30G	940 x 737 37.01 x 29.02	768 x 968 30.24 x 38.11	898 x 698 35.35 x 27.48	287 11.30	700 27.56	23 0.91	692 27.24	895 35.24

Purchase panels separately.

Note: When installing enclosures in a right-hand hinge application that involves vibration, nVent HOFFMAN recommends the use of pad-locking or key-locking quarter-turn latch accessories for door securement (UUHPL, UUHKL).

FRONT VIEW

FRONT VIEW WITH DOOR REMOVED

BACK VIEW

SECTION X-X

Siemens
Manufaturer#: LBRH4

Non-fusible disconnect switch accessories

Handles

Catalog number	Used on rotary switches	UL listed NEMA type	Mounting	Marking	Color	Cover interlock supplied [1]	Padlockable
LBRH2	All	1	Door	ON/OFF	Black	No	No
LBRH3	All	1, 3R, 12, 13, 4X	Door	I/O, ON/OFF	Black	Yes [2]	Yes
LBRH4	All	1, 3R, 12, 13, 4X	Door	I/O, ON/OFF	Red/Yel	Yes [2]	Yes
LBRH5	25 amps	1	Direct mount	I/O	Black	—	Yes
LBRH6	3-pole, 40-60 amps	1	Direct mount	I/O	Black	—	Yes
LBRH7	3-pole, 80-100 amps	1	Direct mount	I/O	Black	—	Yes
LBRH8	4-pole, 40 amps	1	Direct mount	I/O	Black	—	Yes
LBRH9	All (pistol grip type)	1, 3R, 12, 4X	Door	I/O, ON/OFF	Black	Yes	Yes
LBRH10	All (pistol grip type)	1, 3R, 12, 4X	Door	I/O, ON/OFF	Red/Yel	Yes	Yes

Note: If a replacement collar is required for the 25 amp rotary switch, order LBRC1. For 40-100 amp rotary switch, order LBRC2.

Rotary switch door handles

Rotary switch direct mount handles

Auxiliary switch kits

Toggle switch cover plates

Rotary shafts

Catalog number	Length inches (mm)	Enclosure depth – inches (mounting pan surface to O.D. of door minimum and maximum without cutting)					
		With std. rotary handle			With pistol grip handle		
		25A	40-60A	80-100A	25A	40-60A	80-100A
LBRS040	1.57 (40)	—	—	3.35-3.50	—	—	—
LBRS050	1.97 (50)	—	—	3.35-3.55	—	—	—
LBRS055	2.17 (55)	3.35-3.55	3.35-3.55	3.50-3.70	—	—	3.35-3.56
LBRS080	3.15 (80)	4.41-4.56	4.46-4.65	4.49-4.68	4.09-4.25	4.21-4.37	4.36-4.54
LBRS120	4.72 (120)	5.98-6.13	6.03-6.22	6.06-6.25	5.66-5.82	5.78-5.94	5.93-6.11
LBRS180	7.09 (180)	8.35-8.50	8.40-8.59	8.43-8.62	8.03-8.19	8.15-8.31	8.30-8.48
LBRS305	12.00 (305)	13.26-13.41	13.31-13.50	13.34-13.52	12.94-13.10	13.06-13.22	13.21-13.39

25 amp, 4th pole

Used on catalog number	Catalog number
LBR3025	LBRP25
LBR3025D	LBRP25D

Rotary switch door mounting kit

Used on rotary switch	Catalog number
40-100 amps	LBRD1

Auxiliary switch kits

Used on rotary switch	Catalog number	Contact arrangement
LBR3025	LBRA25	1 NO/1NC
LBR3025D	LBRA25D	1 NO/1 NC
LBR3040, LBR3060	LBRA1	1 NO/1NC with common point
LBR3080, LBR3100	LBRA2	1 NO/1 NC with common point

Toggle switch cover plate

Used on toggle switch	Catalog number	Padlockable
LBT3040, LBT3060	LBTCP1	Yes
LBT3080, LBT3100	LBTCP2	Yes
LBT3040	LBTCP3	No

1) With no defeat mechanism.
2) If required to open the enclosure door when the switch is ON, order additional catalog LBRDC1. For heavy duty handles with a defeatable cover interlock, use CFS type handles and 5 mm shafts listed in section 4 of the SPEEDFAX.

Specifications

Front-of-Panel (Operators)★

Mechanical Ratings			
Description		**Plastic (Bulletin 800FP)**	**Metal (Bulletin 800FM)**
Vibration (assembled to panel)		Tested at 10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. for 3 hr duration, no damage	
Shock		Tested at 1/2 cycle sine wave for 11 ms; no damage at 100 G	
Degree of protection‡		IP65/66 (Type 3/3R/4/4X/12/13)	IP65/66 (Type 3/3R/4/12/13)
Mechanical durability per EN 60947-5-1 (Annex C)	10 000 000 Cycles	Momentary push buttons, momentary mushroom	
	1 000 000 Cycles	Multi-function, selector switch, key selector switch, selector jog, SensEject™ key selector switch	
	500 000 Cycles	Non-illuminated push-pull E-stop§	
	300 000 Cycles	Twist-to-release E-stop, illuminated push-pull E-stop§, alternate action push buttons	
	100 000 Cycles	Potentiometer, toggle switch	
Operating forces (typical with one contact block)		Flush/extended = 5 N, E-stop = 36 N Mushroom = 9 N	
Operating torque (typical application with one contact block)		Selector switch = 0.25 N•m (2.2 lb•in)	
Mounting torque	Plastic	1.7 N•m (15 lb•in)	
	Metal	4.4 N•m (40 lb•in)	
Environmental			
Temperature range (operating)		-25…+70 °C (-13…+158 °F)♣	
Temperature range (short term storage)		-40…+85 °C (-40…+185 °F)	
Humidity		50…95% RH from 25…60 °C (77…140 °F)	

★ **Performance Data** — Performance data given in this publication is provided only as a guide for the user in determining suitability and do not constitute a performance warranty of any kind. Such data may represent the results of accelerated testing at elevated stress levels, and the user is responsible for correlating the data to actual application requirements. ALL WARRANTIES AS TO ACTUAL PERFORMANCE, WHETHER EXPRESS OR IMPLIED, ARE EXPRESSLY DISCLAIMED.

‡ Momentary mushroom operators are IP65. Plastic keyed operators are IP66, Type 4/13; not Type 4X.

§ Limit of four contact blocks max. for these devices.

♣ Operating temperatures below 0 °C (32 °F) are based on the absence of freezing moisture and liquids, UL Recognized to 55 °C (131 °F) - Incandescent module max. 40 °C (104 °F).

Standards Compliance and Certifications

Certifications	UR/UL, CSA, CCC, CE
Standards Compliance — CE Marked	NEMA ICS-5; UL 508, EN ISO 13850, EN 60947-1, EN 60947-5-1, EN 60947-5-5
Terminal Identification	EN/IEC 60947-1
Shipping Approvals	ABS
RoHS	✓

Back-of-Panel Components★

Electrical Ratings				
Standard contact block ratings		**Screw Termination**	**Spring Clamp Termination**	
		A600, Q600 600V AC	A300, Q300 300V AC	
		AC 15, DC 13 to IEC/EN 60947-5-1 and UL 508, 17V, 5 mA min.		
Low voltage contact block ratings‡		5V, 1 mA DC min. C300, R150, AC 15, DC 13 to EN 60947-5-1 and UL 508		
	Nominal Voltage	**Range**	**Current Draw**	**Frequency**
LED Module Ratings	24…120V AC/DC	20…132V AC/DC	15 mA (AC), 12 mA (DC)	50/60 Hz, DC
	24V AC	10…29V AC	31 mA	50/60 Hz
	24V DC	10…30V DC	24 mA	DC
	120V AC	102…132V AC	6 mA	50/60 Hz
	240V AC	204…264V AC	6 mA	50/60 Hz
Thermal current		10 A max. enclosed (40 °C ambient) to UL508, EN 60947-5-1		
Insulation voltage (U_i)		Screw terminal = 690V, spring-clamp = 300V		
Wire capacity (screw terminal)§		#18…12 AWG (0.75…2.5 mm^2) Max. (2) #14 AWG or (1) #12 AWG		
Wire capacity (spring-clamp terminal)		#18…14 AWG (0.75…1.5 mm^2) One per spring clamp, two spring clamps per terminal		
Recommended tightening torque on screw terminals		0.7…0.9 N•m (6…8 lb•in)		
Dielectric strength (minimum)		2500V for one minute		
External short circuit protection	Standard blocks	10 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 248-4)		
	Low voltage contact blocks	6 A type gL/gG cartridge fuse to EN 60269-2-1 or gN (Class J to UL 248-8 or Class C to UL 248-4)		
Electrical shock protection		Finger-safe conforming to IP2X		
Mechanical Ratings				
Vibration (assembled to panel)		Tested at 10…2000 Hz, 1.52 mm displacement (peak-to-peak) max./10 G max. 6 hr		
Shock		Tested at 1/2 cycle sine wave for 11 ms and no damage at 100 G max.		
Contact durability per EN 60947-5-1 (Annex C)		10 000 000 cycles		
Contact operation	N.O.	Slow double make and break		
	N.C. & S.M.C.B.	Slow double make and break — positive opening ⊖		
	N.O.E.M.	Double break / double make, early make		
	N.C.L.B.	Double break / double make, late break — positive opening ⊖		
	N.C.E.B.	Double break / double make, early break — positive opening ⊖		
Push button travel to change electrical state		N.C. and N.O.E.M.	1.5 mm (0.060 in.)	
		N.O. and N.C.L.B.	2.5 mm (0.1 in.)	
Operating forces (typical)	Single circuit contact block	3.4 N		
	Dual circuit contact block	5…6.5 N		
Illumination				
LED Dominant Wavelength	Green	525 nm		
	Red	629 nm		
	White	—		
LED Luminous Intensity	Green	780 mcd		
	Red	780 mcd		
	White	360 mcd		
Incandescent maximum wattage		2.6 W		
Materials				
Springs		Stainless steel and zinc coated music wire		
Electrical contacts	Standard	Silver-nickel		
	Low voltage	Gold-plated over silver		
Terminals	Screw	Brass		
	Spring-clamp	Silver-plated brass		

★ Performance Data — see note on page 3.
‡ Low voltage contacts are recommended for applications below 17V, 5 mA.
§ Wires less than #18 AWG (0.75 mm^2) may not hold in terminal securely.

2-Position Push-Pull Operators, Illuminated — Twist-to-Release (Trigger Action), Push-Pull (Trigger Action)★‡▽

40 mm Illuminated Twist-to-Release
Cat. No. 800FP-LMT44

40 mm Mushroom Push/Pull
Cat. No. 800FM-LMP44

90 mm Half-Dome
Cat. No. 800FP-LMP94

800F P – LMP4 3

a *b* *c*

a

Operator Construction	
Code	Description
P	Round plastic operator (IP66, Type 4/4X/13)
M	Round metal operator (IP66, Type 4/13)

b

Operator Type	
Push, Twist-to-Release§♣	
Code	Type
LMT4	40 mm color cap
LMT6	60 mm color cap
Push-Pull&	
Code	Type
LMP3	30 mm color cap
LMP4	40 mm color cap
LMP6	60 mm color cap
Half-Dome Push-Pull&	
Code	Type
LMP9	90 mm color cap♠

c

Lens Cap Color	
Code	Color
3	Green
4	Red
5	Yellow♦
6	Blue∆♦

★ LED module required for illumination, can not use incandescent module.
‡ All emergency stop operators are EN ISO 13850 compliant with standard NC, NCLB, or self-monitoring contact blocks.
▽ E-Stop operators, latch, and contact block combinations have been third-party tested for B10d values. B10d values can be found in publication SAFETY-SR001_-EN-E.
§ Only available with red color cap.
♣ 60 mm version has black arrows; 30 and 40 mm versions have white arrows.
♦ Use of a white LED is recommended.
∆ Only available with 40 mm Push-Pull color cap (**LMP4** from Table b).
♠ Half-dome operators only available with red and yellow lens cap colors.
& Limit of four contact blocks max. for these devices.

Back-of-Panel Components

Contact Blocks with Latch — Composite

800F –	P	X	0	1	E
	a	*b*	*c*	*d*	*e*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Contact Block(s) Termination Style★	
Code	Description
X	Screw termination
Q	Spring-clamp termination

★ Six circuits maximum allowable.

c

N.O. (Normally Open) Circuits	
Code	Description
0	No contact
1	1 N.O.
2	2 N.O.
3	3 N.O.
4	4 N.O.
5	5 N.O.
6	6 N.O.

d

N.C. (Normally Closed) Circuits	
Code	Description
0	No contact
1	1 N.C.
2	2 N.C.
3	3 N.C.
4	4 N.C.
5	5 N.C.
6	6 N.C.

e

Specialty Contact Block(s)	
Code	Description
Blank	Standard blocks
V	Low voltage — QuadCONNECT™
E	N.O. early make
L	N.C. late break
B	N.C. early break
S	N.C. self-monitoring

Power Modules with Latch — Composite

800F –	M	N	3	G
	a	*b*	*c*	*d*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Power Module Type§♣	
Code	Description
D	Incandescent module, screw termination
N	Integrated LED module, screw termination
Q	Integrated LED module, spring-clamp termination

c

Voltage	
Code	Description
0	No bulb∆
1	6V AC/DC∆
2	12V AC/DC∆
3	24V AC/DC
4	48V AC/DC∆
5	120V AC
7	240V AC♦

d

Lamp Color♠	
Code	Description
C	Incandescent
R	Red LED
G	Green LED
W	White LED

§ LED modules for use with all illuminated operators. Incandescent module for use with pilot lights, momentary push buttons, and momentary mushroom operators only.
♣ Four circuits maximum allowable when power module is used. Contact blocks cannot be stacked on power module.
∆ Only available for incandescent module.
♦ Only available for integrated LED module.
♠ For best illumination results, LED color should match lens color. For yellow operator, select a white LED.

Back-of-Panel Components, Continued

Power Modules with Contact Blocks and Latch — Composite

800F –	P	N	5	R	X	1	0	E
	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*

a

Style	
Code	Description
P	Plastic latch
M	Metal latch

b

Power Module Type★‡	
Code	Description
D	Incandescent module, screw termination
N	Integrated LED module, screw termination
Q	Integrated LED module, spring-clamp termination

c

Voltage	
Code	Description
0	No bulb§
1	6V AC/DC§
2	12V AC/DC§
3	24V AC/DC
4	48V AC/DC§
5	120V AC
7	240V AC♣

d

Lamp Color∆	
Code	Description
C	Incandescent
R	Red LED
G	Green LED
W	White LED

e

Contact Block(s) Termination Style	
Code	Description
X	Screw termination
Q	Spring-clamp termination

f

N.O. (Normally Open) Circuits	
Code	Description
0	No contact
1	1 N.O.
2	2 N.O.
3	3 N.O.
4	4 N.O.

g

N.C. (Normally Closed) Circuits	
Code	Description
0	No contact
1	1 N.C.
2	2 N.C.
3	3 N.C.
4	4 N.C.

h

Specialty Contact Block(s)	
Code	Description
Blank	Standard blocks
V	Low voltage — QuadCONNECT™
E	N.O. early make
L	N.C. late break
B	N.C. early break
S	N.C. self-monitoring

★ Four circuits maximum allowable when power module is used. Contact blocks cannot be stacked on power module.
‡ LED modules for use with all illuminated operators. Incandescent module for use with pilot lights, push buttons, and momentary mushroom operators only.
§ Only available for incandescent module.
♣ Only available for integrated LED module.
∆ For best illuminated results, LED should match lens color. For yellow operator, select a white LED.

Allen-Bradley
Manufaturer#: 800f-15YSE112

Two-Color Molded Legend Caps — Non-Illuminated Push Buttons

800F – AF 3 01
a b c

Cat. No. 800F-15YSE112c

a

Button Cap Type	
Code	Description
AF	Flush
AE	Extended

b

Color Cap	
Code	Description
1	White
2	Black
3	Green
4	Red
5	Yellow
6	Blue

Legend Text‡§	
English	
Code	Description
01	START
02	STOP
05	O
06	I
08	→
09	FORWARD★
10	REVERSE★
11	R

★ Available in flush only.
‡ White and yellow caps have black text. All other color caps have white text.
§ Valid color cap text codes include:

Color	Text	
	Flush Caps	Extended Caps
White	FORWARD, REVERSE, START, I, →, R	→, R
Black	FORWARD, REVERSE, →, R	STOP, O, →, R
Green	FORWARD, REVERSE, START, I, →	→
Red	FORWARD, REVERSE, STOP, O, →	STOP, O, →
Yellow	FORWARD, REVERSE, →	→
Blue	FORWARD, REVERSE, →, R	→, R

Emergency Stop Legend Plates ♣

800F – 15YS
a b

a

Size/Color (Yellow)	
Code	Description
15Y	60 mm round (30.5 mm mounting hole)
15YS	60 mm round (22.5 mm mounting hole)♦
16Y	90 mm round (22.5 mm mounting hole)♦

b

Text	
Code	Description
Blank	No text
E112	EMERGENCY STOP
F112	ARRÊT D'URGENCE♠
S112	PARO DE EMERGENCIA
G112	NOT HALT
T112	ARRESTO EMERGENZA
N112	NÖDSTOPP, EMERGENCY STOP♠
P112	PARADA DE EMERGENCIA

b (cont'd)

Text	
Code	Description
W112	NØDSTOPP, EMERGENCY STOP♠
A112	NØDSTOP
B112	EMERGENCY STOP, ARRÊT D'URGENCE, PARADA DE EMERGENCIA♠
D112	NOODSTOP♠
M112	NOT HALT, ARRESTO EMERGENZA, ARRÊT D'URGENCE▽
	EMERGENCY STOP, ARRÊT D'URGENCE, NOT HALT&
L112	NEYÐARSTOPP, NEYÐARSTOPP♠
H112	NÖD-STOP, HÄTÄ-SEIS, NÖD-STOP♠

♣ Sold only multiples of 10. Order (quantity of) 10 to receive one package of 10 pieces.
♦ Not for use with base mounted contact blocks.
♠ Not available on 15YS version.
▽ Text printed on the 15Y version only.
& Text printed on the 15YS & 16Y versions only.

Push Button, Multi-Function Caps

800F – A F 1 C
a b

a

Type	
Code	Description
E	Push button extended cap
F	Push button flush cap
FA	Alternate action cap
FAU	Multi-function flush cap (for position A)
EAU	Multi-function extended cap (for position A)
FCU	Multi-function flush cap (for position C)
ECU	Multi-function extended cap (for position C)

b

Color	
Code	Description
0	Amber
1	White
2	Black
3	Green
4	Red
5	Yellow
6	Blue

Table 4 - PanelView Plus 7 Standard 7-in., 9-in., and 10-in. Terminals

Attribute	7-in. Touch 2711P-T7C21D8S, 2711P-T7C21D8S-B, 2711P-T7C22D8S, 2711P-T7C22D8S-B	9-in. Touch 2711P-T9W21D8S, 2711P-T9W21D8S-B, 2711P-T9W22D8S, 2711P-T9W22D8S-B	10-in. Touch 2711P-T10C21D8S, 2711P-T10C21D8S-B, 2711P-T10C22D8S, 2711P-T10C22D8S-B
Operator input	Touch	Touch	Touch
Display type	Color TFT LCD	Color TFT LCD	Color TFT LCD
Display size, diagonal	6.5 in.	9 in. widescreen	10.4 in.
Viewing area	132 x 99 mm	196 x 118 mm	211 x 158 mm
Display resolution	640 x 480 VGA, 18-bit color graphics	800 x 480 WVGA, 18-bit color graphics	800 x 600 SVGA, 18-bit color graphics
Aspect ratio	4:3	5:3	4:3
Brightness, typical	300 nits		
Backlight life	50,000 hr life, min at 40° C (104 °F) to half-brightness. Backlight is not replaceable.		
Touch screen	Analog resistive Actuation rating: 1 million presses Operating force: 100 grams		
Battery (real-time clock backup)	Accuracy: ±2 minutes per month. Battery life: 4 years min at 25 °C (77 °F) Replacement: CR2032 lithium coin cell (Allen-Bradley part number 2711P-RY2032)		
Memory System User	 512 MB RAM and 512 MB storage 80 MB nonvolatile storage for applications		
Secure Digital (SD) card slot	One SD card slot for storing application files Replacement: Allen-Bradley part number 1784-SD1 (1 GB), 1784-SD2 (2 GB), 1784-SDHC8 (8 GB), and 1784-SDHC32 (32 GB)		
USB ports Host Device	 One USB 2.0 high-speed host port (type A) support removal flash drives for storage One high-speed 1.0 device port (type B) supports connection to host computer		
Ethernet port Cat. Nos. with 21 Cat. Nos. with 22	 One 10/100Base-T, Auto MDI/MDI-X Ethernet port with IEEE1588 support Two 10/100Base-T, Auto MDI/MDI-X Ethernet ports supporting star, linear, or DLR network topology		
Operating system	Windows CE includes FTP, VNC client server, ActiveX controls, PDF reader, third-party device support		
Software	FactoryTalk View Studio for Machine Edition, version 8.0 or later, FactoryTalk ViewPoint, version 2.6 or later		
Electrical			
Input voltage, DC	24V DC nom (18…30V DC), nonisolated DC power supply		
Power consumption, DC	50 W max (2.1A at 24V DC)		
Power supply	DIN-rail power supply, AC-to-DC, 85…265V AC, 47…63 Hz Recommended Replacement: Allen-Bradley part number 2711P-RSACDIN		
Mechanical			
Weight, approx	0.85 kg (1.86 lb)	1.29 kg (2.84 lb)	1.82 kg (4.0 lb)
Dimensions, HxWxD, approx	170 x 212 x 56.5 mm (6.69 x 8.35 x 2.22 in.)	190 x 280 x 56.5 mm (7.48 x 11.02 x 2.22 in.)	252 x 297 x 56.5 mm (9.92 x 11.69 x 2.22 in.)
Cutout dimensions, HxW, approx.	142 x 184 mm (5.59 x 7.24 in.)	162 x 252 mm (6.38 x 9.92 in.)	224 x 269 mm (8.82 x 10.59 in.)

Product Dimensions

The table provides product dimensions. The 5.7-in. and 10.4-in. touch-screen terminals are shown for illustrative purposes. All other terminal sizes look similar. For information on proper mounting clamp installation, refer to the PanelView Plus 7 Standard Terminals User Manual, publication 2711P-UM007.

Figure 1 - PanelView Plus 7 Standard Terminals, Front View

Figure 2 - PanelView Plus 7 Standard Terminals with Single Ethernet Port, Bottom View

Figure 3 - PanelView Plus 7 Standard Terminals with Dual Ethernet Ports, Bottom View

Table 6 - PanelView Plus 7 Standard Terminals Dimensions

Terminal Size	Input Type	Height (a) mm (in.)	Width (b) mm (in.)	Overall Depth (c) mm (in.)	Mounted Depth (d) mm (in.)
4.3 in.	Touch	110 (4.33)	135 (5.31)	56.5 (2.22)	50.14 (1.97)
5.7 in.	Touch	152 (5.98)	176 (6.93)	56.5 (2.22)	50.14 (1.97)
6.5 in.	Touch	170 (6.69)	212 (8.35)	56.5 (2.22)	50.14 (1.97)
9 in.	Touch	190 (7.48)	280 (11.02)	56.5 (2.22)	50.14 (1.97)
10.4 in.	Touch	252 (9.92)	297 (11.69)	56.5 (2.22)	50.14 (1.97)
12.1 in.	Touch	246 (9.69)	340 (13.39)	56.5 (2.22)	50.14 (1.97)
15 in.	Touch	318 (12.52)	381 (15.00)	56.5 (2.22)	50.14 (1.97)

TIP When mounted in a panel, the front of the bezel extends less than 6.36 mm (0.25 in.) from the front of the panel.

HMI Software

All PanelView Plus 7 terminals are configured with FactoryTalk View Studio software and have an integrated runtime system called FactoryTalk View Machine Edition Station.

Machine Edition Station runs projects developed with FactoryTalk View Studio software and is included on all PanelView Plus 7 terminals.

Two versions of FactoryTalk View Studio software support application development for PanelView Plus 7 terminals.

Cat. No.(1)	Description
9701-VWSTMENE	FactoryTalk View Studio for Machine Edition software - Configuration software for developing and testing machine level human machine interface (HMI) applications. Includes RSLinx® Enterprise and KEPServer Enterprise software.
9701-VWSTENE	FactoryTalk View Studio software - Configuration software for developing and testing machine level and supervisory level human machine interface (HMI) applications.

(1) Order localized versions of the software by replacing EN in the catalog number with DE for German, FR for French, JP for Japanese, or ZH for Chinese.

You can import PanelView Standard/PanelBuilder™32 and PanelView *e* applications into FactoryTalk View Studio software as Machine Edition applications by using the Machine Edition Import Wizard. The Import Wizard steps you through a few options such as scaling to a new screen resolution size, and then converts objects, text, tags, and communication configurations to ones that are available in Machine Edition.

FactoryTalk ViewPoint software, an add-on to FactoryTalk View Studio software, allows plant managers, production supervisors, system integrators, and other key stakeholders to view and control real-time plant floor operations remotely from a web browser. FactoryTalk ViewPoint enabled displays are fully scalable and animated in the browser. The remote user can also view displays that are not the active display of the terminal.

Each PanelView Plus 7 terminal contains one license supporting a single client connection to the terminal. No additional software is required.

For a complete list of available HMI software, visit http://www.rockwellautomation.com/rockwellsoftware.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
PanelView Plus 7 Standard Terminals User Manual, publication 2711P-UM007	Provides details on how to install, configure, and operate the PanelView Plus 7 Standard terminals.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Allied Moulded
Manufaturer#: AMHMI142CCL

ALLIED MOULDED PRODUCTS, Inc.

419-636-4217
222 N. Union St.
Bryan, OH 43506

AMHMI142CCL

14"x12" HMI Cover Kit with hinged clear cover and stainless-steel snap latch

Availability:
For up-to-date delivery on this product, please contact us at 1-800-722-2679 or sales@alliedmoulded.com

Cover Type: Clear Polycarbonate

Closure Type: Metal Snap Latch

Mounting Description: 10 Screws

Height: 13.95 in

Width: 12.07 in

Depth: .96 in

Usable Depth: 2.2 in

Volume: 370 cu in

Product Info

UPC: 85339991960

UNSPSC: 39121302

Carton Quantity: 1

Carton Weight: 5 lbs

Carton Length: 5 in

Carton Width: 16 in

Carton Height: 16 in

Country of Origin: United States of America

Color: Gray (RAL 7035) with clear cover

Material: Polycarbonate frame and clear polycarbonate cover

Additional Materials: 316 stainless steel external hardware, Polyurethane (FIP) Formed-In-Place gasket system

Features:

Non-corrosive, non-conductive, light weight with lower installation cost and longer life cycle cost compared to steel. Rigid design with a gasket system encased in a continuous channel on the cover and frame. Open back frame design with an opening size of 12.49″ x 10.71″ and is a UL recognized component for use with NEMA 4X enclosures.Â *Will fit Allied Moulded enclosure sizes 16â?x14â? and larger.

Application:

Cover and protect electrical and electronic controls including HMI (Human Machine Interface) instruments, touch pad controllers and pushbuttons mounted on the surface of NEMA 4X enclosures. No need to open the enclosure to view electronics or perform maintenance, decreasing arc flash risks and safety hazards.

Standards:

Meets Requirements: ANSI/UL50, ANSI/UL50E, and ANSI/UL508A; File No. E487574

UL® listed and recognized component for use with enclosure products Types 1, 2, 3, 3R, 4, 4X, 12 and 13.

Complies With:
1. EN / IEC 60204-1 and 60529 Type IP66
2. RoHS directive

Allied Moulded
Manufaturer#: AMHMIPROP142

ALLIED MOULDED PRODUCTS, Inc.

419-636-4217
222 N. Union St.
Bryan, OH 43506

AMHMIPROP142

HMI Cover Prop Arm Kit for use with 14"x12" HMI Covers

Availability:
For up-to-date delivery on this product, please contact us at 1-800-722-2679 or sales@alliedmoulded.com

Mounting Description: 4 Screws

Height: 16.3 in

Width: 0.8 in

Depth: 0.6 in

Product Info

UPC: 85339978626

UNSPSC: 39121302

Carton Quantity: 1

Carton Weight: 1 lbs

Carton Length: 1 in

Carton Width: 10 in

Carton Height: 12 in

Country of Origin: United States of America

Color: Silver

Material: 306 Stainless Steel

Additional Materials: 18-8 Stainless Steel Hardware, 316 stainless steel external hardware, Plated carbon steel fasteners, Silicone Rubber

Features:

The stainless steel prop arm and hardware is durable and the silicone rubber tip will prevent the support arm from slipping once in the open position.

Application:

When used with any of the AMHMI88 HMI cover kits, end-user can hold the HMI cover kit in an open position for easy access to protected instruments,
touchpad controllers or pushbuttons mounted on the surface of Type 4X enclosures.

GUARDIAN/GUARDIANX SERIES FILTER FANS FILTER-HOOD ASSEMBLIES

Kooltronics
Manufaturer#: KNPA60FLV

KNPA60FL

DESCRIPTION

These Filter-Hood Assemblies can be used in conjunction with the Guardian/GuardianX Series Filter Fans for enclosure cooling. In a typical mounting orientation the motorized Filter Fan pulls air into an enclosure while the Filter-Hood Assembly functions as an outlet. Alternatively, if the reverse airflow option is chosen for the filter fan, the fan exhausts the enclosure and the Filter-Hood Assembly functions as an intake. These Filter-Hood Assemblies feature filters that are easily removed for cleaning or replacement.

NEMA
TYPE 4 OR 4X MAINTAINED

STANDARD FEATURES

Baked Powder Finish
Filter
Integrated Sealing Gasket
IP55 Filter Protection
NEMA 4 or 4X Rating Maintained (If used with provided filter)
Secure Mounting
Stainless Steel Shell (NEMA 4X models)
Ul/CUL Listed
Washable, Reuseable Filter

ACCESSORIES AND OPTIONS

Replacement Filters (P/N: 0429-01-01)

MOUNTING PLAN

KNPA60FL

TYPICAL MOUNTING ORIENTATIONS

(Left) Filter Fan pressurizes cabinet. Filter-Hood Assembly exhausts cabinet. (Right) Filter Fan with Reverse Option chosen. Blue arrows show direction of airflow. Boxes represent side view of electronics/electrical enclosure.

knpa60-40fl.qxd 8/18/17

GUARDIAN/GUARDIANX SERIES
NEMA 4 or 4X FILTER FANS KNP60FL

TECHNICAL DATA

Model	Nema Rating	Normally In Stock	Voltage	Frequency Hz	Input Amps	Input Watts	Fan Airflow CFM*	Fan w/Grille Airflow CFM**	Noise db(A)	Operating Temp. ºF		Approx. Weight	
										Min.	Max	Lbs.	Kg.
KNP60FL	4	Yes	115 VAC	50/60	.42/.34	43/37	270/290	84/92	59/61	-40	158	11.3	5.1
KNP60FLV	4X		115 VAC	50/60	.42/.34	43/37	270/290	84/92	59/61	-40	158	11.3	5.1
K2NP60FL	4		230 VAC	50/60	.20/.17	37/36	270/290	70/80	59/61	-40	158	11.3	5.1
K2NP60FLV	4X		230 VAC	50/60	.20/.17	37/36	270/290	70/80	59/61	-40	158	11.3	5.1
K6NP60FL	4		12 VDC	-	.52	6.2	225	72	67	-4	176	11.3	5.1
K6NP60FLV	4X		12 VDC	-	.52	6.2	225	72	67	-4	176	11.3	5.1
K7NP60FL	4		24 VDC	-	.60	14.4	230	72	54	-40	158	11.3	5.1
K7NP60FLV	4X		24 VDC	-	.60	14.4	230	72	54	-40	158	11.3	5.1
K8NP60FL	4		48 VDC	-	.36	16.8	240	40	58	-40	158	11.3	5.1
K8NP60FLV	4X		48 VDC	-	.36	16.8	240	40	58	-40	158	11.3	5.1

* Fan airflow without filter and grille.
** NEMA Rated if installed with provided filter.

NEMA
TYPE 4/4X
MAINTAINED

For general ventilating use only. Do not use these fans to exhaust hazardous or explosive material or vapors.
NOT ALL SYSTEMS ARE SUITABLE FOR UTILIZING OUTSIDE AIR. To protect sensitive components against condensation an enclosure heater or closed-loop cooling is recommended. To protect sensitive components against corrosive elements closed-loop cooling is recommended.

STANDARD FEATURES

Baked Powder Finish
Integrated Fan Guards
Integrated Sealing Gasket
IP55 Filter Protection
NEMA 4 or 4X Rating Maintained (if used with provided filter)
Secure Mounting
Six foot [1.8m] (minimum) 3-wire power cord
Stainless Steel Shell (NEMA 4X models)
UL/CSA Shielded Ball Bearing Motors
UL/CUL Listed
Washable, Reuseable Filter

ACCESSORIES AND OPTIONS

Filter-Hood Assembly - (Recommended) - (P/N: KNPA60FL)
Other voltages, both AC and DC
Replacement Filters (P/N: 0429-01-01)
Reversed Airflow Direction

"like" us on facebook

DRAWINGS

MOUNTING PLAN

Find additional information on this model at kooltronic.com, or use the Technical Documents QR code below.

Technical Documents

Dimensions, inches [mm], are for reference only and are subject to change.

knp60fl.qxd 2/24/16

Kooltronic, Inc., 30 Pennington-Hopewell Road, P.O. Box 240, Pennington, NJ 08534-0240
Tel: (609) 466-3400 Fax: (609) 466-1114 kooltronic.com sales@kooltronic.com

Hoffman
Manufaturer#: A40P30

connect and protect

Panel for Type 3R 4 4X 12 13 Enclosure, fits 40x30, White, Steel

CATALOG NUMBER

A40P30

Use these panels in Wall-Mount and Free-stand/Floor-Mount Enclosure. Available in various materials to meet various application requirements. Stainless steel and aluminum panels are protected on one side with a plastic film.

FEATURES

Panel mounting hardware is furnished with all enclosures which accept these panels

PRODUCT ATTRIBUTES

Article Number: 11800
Height: 37in
Width: 27in
Material: Mild Steel
Finish: Powder Coated
Color: White
Thickness: 12ga
Edge Flange Quantity: 4
Hole Quantity: 4
Weight: 36lb

WARNING

nVent products shall be installed and used only as indicated in nVent's product instruction sheets and training materials. Instruction sheets are available at www.nvent.com and from your nVent customer service representative. Improper installation, misuse, misapplication or other failure to completely follow nVent's instructions and warnings may cause product malfunction, property damage, serious bodily injury and death and/or void your warranty.

SIEMENS

Allied Moulded
Manufaturer#: 3LD2217-0TK13

Data sheet 3LD2217-0TK13

SENTRON, switch disconnector 3LD, EMERGENCY OFF switch, 3-pole, Iu: 32 A, Operating power / at AC-23 A at 400 V: 11.5 kW, floor mounting with door coupling, defeatable knob-operated mechanism, red/yellow, 4-hole mounting of the handle

Model	
product brand name	SENTRON
product designation	Switch disconnector
design of the product	EMERGENCY-STOP switch
display version for switch position indicator manual operation	1 ON - 0 OFF
type of switch	Floor mounting with door coupling
design of the actuating element	selector switch
color of the actuating element	red
design of handle	knob-operated mechanism, red/yellow
type of the driving mechanism motor drive	No
General technical data	
number of poles	3
size of switch disconnector	2
mechanical service life (operating cycles) typical	100 000
electrical endurance (operating cycles)	
• at AC-23 A at 690 V	6 000
operating frequency maximum	50 1/h
degree of pollution	3
Voltage	
insulation voltage rated value	690 V
surge voltage resistance rated value	6 kV
operating voltage	
• at AC rated value	690 V
operating frequency rated value	
• minimum	50 Hz
• maximum	60 Hz
Protection class	
protection class IP	IP65
degree of protection NEMA rating	1, 3R, 4X, 12
protection class IP on the front	IP65
Dissipation	
power loss [W] for rated value of the current at AC in hot operating state per pole	1.8 W
Main circuit	
operational current	
• at AC-21 at 690 V rated value	32 A
• at AC-21 A at 240 V rated value	32 A
• at AC-21 A at 400 V rated value	32 A
• at AC-21 A at 440 V rated value	32 A
• at AC-23 A at 400 V rated value	22 A

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operating power	
● at AC-23 A at 240 V rated value	6 kW
● at AC-23 A at 400 V rated value	12 kW
● at AC-23 A at 440 V rated value	11.5 kW
● at AC-23 A at 690 V rated value	12 kW
● at AC-3 at 240 V rated value	5.5 kW
● at AC-3 at 400 V rated value	10 kW
● at AC-3 at 690 V rated value	9.5 kW
Auxiliary circuit	
number of CO contacts for auxiliary contacts	0
number of NC contacts for auxiliary contacts	0
number of NO contacts for auxiliary contacts	0
operating voltage of auxiliary contacts at AC maximum	500 V
continuous current of the auxiliary contact rated value	10 A
insulation voltage of the auxiliary switch rated value	500 V
Suitability	
suitability for use	
● main switch	Yes
● switch disconnector	Yes
● EMERGENCY OFF switch	Yes
● safety switch	Yes
● maintenance/repair switch	Yes
Product details	
product feature can be locked into OFF position	Yes
accessories	
product extension optional	
● motor drive	No
● voltage trigger	No
number of connectable NC contacts for auxiliary contacts attachable maximum	3
number of connectable NO contacts for auxiliary contacts attachable maximum	5
number of connectable CO contacts for auxiliary contacts attachable maximum	0
number of bracket locks maximum	3
hasp thickness of the bracket locks	4 ... 6 mm
Short circuit	
conditional short-circuit current with line-side fuse protection	
● at 690 V by gG fuse rated value	50 kA
let-through current with closed switch	
● at 240 V for combination switch + gG fuse maximum	4.5 kA
● at 440 V for combination switch + gG fuse maximum	4.5 kA
● at 690 V for combination switch + gG fuse maximum permissible	5 kA
I2t value with closed switch	
● at 240 V for combination switch + gG fuse maximum	9 kA2.s
● at 440 V for combination switch + gG fuse maximum	9 kA2.s
● at 690 V for combination switch + gG fuse maximum	9 kA2.s
design of the fuse link	
● for short-circuit protection of the main circuit required	fuse gL/gG: 40 A
● for short-circuit protection of the auxiliary switch required	fuse gL/gG: 10 A
operational current of upstream fuse rated value	40 A
according UL	
operational current at AC according to UL 508/UL 60947-4-1 rated value	32 A
operating voltage at AC at 50/60 Hz according to UL 508/UL 60947-4-1 rated value	600 V
active power [hp] at AC at 480 V according to UL 508/UL 60947-4-1 rated value	20
active power [hp] at AC at 600 V according to UL 508/UL 60947-4-1 rated value	20
short-time withstand current (SCCR) at 600 V according to UL 508/UL 60947-4-1	5 kA

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continuous current of upstream fuse according to UL rated value	80 A
type of fuse according to UL	RK5
Connections	
AWG number as coded connectable conductor cross section solid	
• maximum	8
• minimum	14
type of connectable conductor cross-sections for copper conductor	
• solid	1x (1,5...16mm²)
• finely stranded with core end processing	1x (1,5...10mm²)
• stranded	1x (1,5...16mm²)
type of connectable conductor cross-sections for auxiliary contacts	
• solid	lateral auxiliary switch 2x (0,75 ... 2,5mm²), 1x 4mm²; front auxiliary switch 1x (0,75 ... 2,5mm²)
• finely stranded with core end processing	lateral auxiliary switch 2x (0,75 ... 1,5mm²), 1x 2,5mm²; front auxiliary switch 1x 2,5mm²
• stranded	lateral auxiliary switch 2x (0,75 ... 2,5mm²), 1x 4mm²; front auxiliary switch 1x (0,75 ... 2,5mm²)
type of electrical connection	
• for main current circuit	box terminal
• for auxiliary contacts	connection terminals
Mechanical Design	
height	79 mm
width	67 mm
depth	385 mm
type of device	fixed mounting
fastening method	Built-in unit fixed-mounted version
fastening method	
• 4-hole front mounting	Yes
• front mounting with central attachment	No
• rail mounting	Yes
net weight	391 g
Environmental conditions	
ambient temperature during operation	
• minimum	-25 °C
• maximum	55 °C
ambient temperature during storage	
• minimum	-25 °C
• maximum	55 °C

General Product Approval

CSA CCC Confirmation UL VDE Miscellaneous

General Product Approval	Declaration of Conformity		Test Certificates	Marine / Shipping	other
EAC	UKCA	CE EG-Konf.	Special Test Certificate	LRS	Miscellaneous

other	Environment
Confirmation	Environmental Confirmations

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On Line Catalog

Burndy
Manufaturer#: KA4C

BURNDY Catalog Number	KA4C
UPC Number	7818103614055
Description	14-4 CU LUG ST SCR 1H
Status	Active

Web Use
BURNDY Product Line

Dimensional	
Size (Hex) or Size (Bolt)	5/16
Length (in)	1.11
Thickness (in)	1/10
Height (in)	0.77
B Length (Fraction)	8/17
Hole Size (Fraction)	9/32
Stud Size (in)	1/4
Thickness	0.10
Size (Hex) or Size (Bolt) - in	0.31
B Length (in)	0.47
Pad Width (in)	0.54
N (Fraction)	1/4
N (in)	0.25
Hole Size (in)	0.28
Length (Fraction)	1-1/8
Height (Fraction) (in)	3/4
General	
Product Description	Copper Terminal, 1 Hole, 14 AWG (Sol)-4 AWG (Str), 1/4" Stud, 1 Screw
Conductor(s)	
Copper Solid Size (Range)	14 AWG-4 AWG
Copper Stranded (Range)	14 AWG-4 AWG
Physical	
Screw Type	Slot
Type of Hardware	5 / 16 "
Installation Torque	45
Type of Plating	Unplated
Connector Type	Terminal
Plated (Yes or No)	N
Product Material	Copper
Approvals / Certifications	
UL Listed	Y
CSA Certified	Y
ROHS Compatible	Compliant
UL Recognized	N
CULUS	N
Industry Standards	UL468A-468B

Documentation

For further technical assistance, please contact us

BURNDY LLC - USA

47 East Industrial Park Drive
Manchester NH 03109

BURNDY Technical Services

47 East Industrial Park Drive
Manchester NH 03109

Hours: 8:00 AM - 5:00 PM
Monday - Friday
Phone: 800-346-4175

Specifications

Allen-Bradley
Manufaturer#: 1489-M1D030; 1489-M1D050
1489-M1D005; 1489-M1D020; 1489-M1D070

Electrical Ratings	
Poles	1, 2, 3
Tripping characteristics	C, D
Rated current (I_n)	0.5...63 A
Rated frequency [f]	50/60 Hz
Rated insulation voltage U_i per IEC/EN 60664-1	250V AC (phase to ground) 440V AC (phase to phase)
Overvoltage category	III
Pollution degree	3

Data per UL/CSA					
Rated voltage	AC	1-pole	C Curve	0.5...40 A	277V AC
				50...63 A	240V AC
			D Curve	0.5...35 A	277V AC
				40...63 A	240V AC
		2-, 3-pole	C Curve	0.5...40 A	480Y/277V AC
				50...63 A	240V AC
			D Curve	0.5...35 A	480Y/277V AC
				40...63 A	240V AC
	DC	1-pole			48V DC
		2-pole			96V DC (2-pole in series)
Rated interrupting capacity per UL 489					10 kA
Reference temperature for tripping characteristics					40 °C (104 °F)
Electrical endurance					6,000 operations (AC and DC); 1 cycle (1s - ON, 9s - OFF)

Data per IEC/EN 60947-2			
Rated operational voltage (U_e)	1-pole		230V AC
	2-, 3-pole		400V AC
Highest supply or utilization voltage (U_{max})	AC	1-pole	253/440V AC
		2-, 3-pole	440V AC
	DC (1)	1-pole	48V DC
		2-pole	96V DC
Min. operating voltage			12V AC, 12V DC
Rated ultimate short-circuit breaking capacity (I_{cu})			15 kA
Rated service short-circuit breaking capacity (I_{cs})			≤ 40 A: 11.25 kA > 40 A: 7.5 kA
Rated impulse withstand voltage $U_{imp.}$ (1.2/50 µs)			4 kV (test voltage 6.2 kV at sea level, 5 kV at 2,000 m)
Dielectric test voltage			2 kV (50/60Hz, 1 min.)
Reference temperature for tripping characteristics			30 °C (86 °F)
Electrical endurance 1 cycle (2s - ON, 13s - OFF, I_n ≤ 32 A), 1 cycle (2s - ON, 28s - OFF, I_n > 32 A)			I_n < 30 A: 20,000 ops. (AC) I_n ≥ 30 A: 10,000 ops. (AC) 1,000 ops. (DC)

(1) Self-declared IEC DC ratings.

Mechanical Data	
Housing	Insulation group II, RAL 7035
Indicator window	red ON/green OFF
Protection degree per EN 60529	IP20, IP40 in enclosure with cover
Mechanical endurance	20,000 operations
Shock resistance per IEC/EN 60068-2-27	25 g - 2 shocks - 13 ms
Vibration resistance per IEC/EN 60068-2-6	5g - 20 cycles at 5...150...5 Hz with load 0.8 x I_n

Environmental	
Environmental conditions (damp heat) per IEC/EN 60068-2-30	28 cycles with 55 °C/90-96% and 25 °C/95-100%
Ambient temperature(1)	-25...+55 °C (-13...+131 °F)
Storage temperature	-40...+70 °C (-40...+158 °F)

Installation		
Terminal		Dual terminal
Cross-section of wire (2)- solid, stranded (front/back terminal slot)		35/35 mm²
		18...4/18...10 AWG
Cross-section of wire - flexible (front/back terminal slot)		25/10 mm²
Multi-wire rating per UL, CSA		1 wire, 18...4 AWG
		2-4 wires (3), 18...10 AWG
Cross-section of bus bars (back terminal slot)		10 mm²
Tightening torque	IEC	2.8 N•m
	UL/CSA	AWG 18...16: 13.3 lb•in, AWG 14...10: 17.7 lb•in, AWG 8...4: 39.8 lb•in
Screwdriver		No. 2 Pozidriv
Mounting		DIN Rail (EN 60715, 35 mm) with fast clip
Mounting position		Any
Supply		Optional

Approximate Dimensions and Weight	
Pole dimension (H x D x W)	111 x 69 x 17.5 mm (4.37 x 2.72 x 0.69")
Pole weight	125 g (4.4 oz.)

Combination with Auxiliary Elements	
Auxiliary contact	Yes
Signal contact	Yes
Shunt trip	Yes

(1) See Table 1 and Table 2 for ambient temperature derating values.
(2) 35 mm self-declared, not included in IEC/EN approval.
(3) Wires must be of like size and stranding. Up to two wires per terminal slot.

Power Loss Due to Current

Rated Current [A]	Power Loss Per Pole [W]	Rated Current [A]	Power Loss Per Pole [W]
0.5	1.4	15	2.4
1	1.4	16	2.5
1.6	1.8	20	2.5
2	1.8	25	3.2
3	1.6	30	3.5
4	1.8	32	3.7
5	1.9	35	4.1
6	2.0	40	4.5
7	1.1	50	4.5
8	1.5	60	4.9
10	2.1	63	5.4
13	2.3	–	–

The installation of several devices side by side with rated current on all poles requires a correction factor to the rated current (not required if spacers are used).

Zero-stack Derating

No. of Adjacent Devices	Correction Factor
1	1
2,3	0.9
4,5	0.8
≥ 6	0.75

Approximate Dimensions

Dimensions are shown in millimeters (inches). Dimensions are not intended for manufacturing purposes.

Figure 1 - Bulletin 1489-M 1-Pole Devices

Figure 2 - Bulletin 1489-M 2- and 3-Pole Devices

Catalog Number Explanation

Examples that are given in this section are not intended to be used for product selection. Not all combinations generate a valid catalog number. Use ProposalWorks™ software to configure the PC. ProposalWorks software is available from rok.auto/systemtools.

1489	-	M	1	C	005
		a	b	c	d

a

Voltage Type	
Code	**Description**
M	AC Circuit Breaker

b

Poles	
Code	**Description**
1	1-Pole
2	2-Pole
3	3-Pole

c

Trip Curve	
Code	**Description**
C	Trip Curve C
D	Trip Curve D

d

Rated Current (I_n)	
Code	**Current [A]**
005	0.5
010	1
016	1.6
020	2
030	3
040	4
050	5
060	6
070	7
080	8
100	10
130	13
150	15
160	16
200	20
250	25
300	30
320	32
350	35
400	40
500	50
600	60
630	63

EO-AB/UT/LED/15 - Socket

0804155

https://www.phoenixcontact.com/us/products/0804155

Phoenix Contact
Manufaturer#: 0804155

Technical data

Product properties

Product type	Socket
Country ID	USA
	Canada

Connection data

Screw thread	M3
Tightening torque	0.5 ... 0.6 Nm
Stripping length	8 mm
Internal cylindrical gage	A3
	B3
Conductor cross section rigid	0.2 mm² ... 4 mm²
Cross section AWG	24 ... 12 (converted acc. to IEC)
Conductor cross section flexible	0.25 mm² ... 2.5 mm²
Conductor cross section, flexible [AWG]	24 ... 14 (converted acc. to IEC)
Conductor cross-section flexible (ferrule without plastic sleeve)	0.25 mm² ... 2.5 mm²
Flexible conductor cross section (ferrule with plastic sleeve)	0.25 mm² ... 2.5 mm²
Conductor cross-section flexible (2 conductors with the same cross-section, with TWIN ferrule and plastic sleeve)	0.2 mm² ... 4 mm²
Nominal current	15 A
Nominal voltage	125 V AC (60 Hz)

Signaling

Status display	yes

Dimensions

Width	45 mm
Height	75 mm
Depth	58.9 mm
Depth on NS 35/7,5	60 mm
Depth on NS 35/15	67.5 mm
Hole diameter	4.4 mm

Material specifications

Color	gray (RAL 7042)
Flammability rating according to UL 94	V0
Insulating material	PA
Contact material	CuZn38
Static insulating material application in cold	-60 °C
Temperature index of insulation material (DIN EN 60216-1 (VDE 0304-21))	130 °C
Relative insulation material temperature index (Elec., UL 746 B)	130 °C

Fire protection for rail vehicles (DIN EN 45545-2) R22	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R23	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R24	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R26	HL 1 - HL 3
Surface flammability NFPA 130 (ASTM E 162)	passed
Specific optical density of smoke NFPA 130 (ASTM E 662)	passed
Smoke gas toxicity NFPA 130 (SMP 800C)	passed

Connector

Type of plug	Pin connector pattern type AB 15A

Environmental and real-life conditions

Ambient conditions

Degree of protection	IP20
Ambient temperature (operation)	-5 °C ... 40 °C (Average value over a period of 24 hours not above +35°C)
Ambient temperature (storage/transport)	-25 °C ... 60 °C (for a short time, not exceeding 24 h, -60 °C to +70 °C)
Permissible humidity (storage/transport)	30 % ... 70 %

Standards and regulations

Standards

Standards/regulations	UL 508
	IEC 60884-1

Mounting

Mounting type	for mounting on a DIN rail in the service interface or direct mounting

Bulletin 700-CF — Control Relay

- IEC industrial relays
- Mechanically linked contact performance per IEC 60947-5-1
- Gold plated, bifurcated version for low level switching applications
- Master control relay version rated 15 A (AC-15)
- Solid-state and pneumatic timing modules
- 4-…10 Poles

Certifications

cULus Listed (File No. E14840, Guide NKCR/NKCR7)
CE Marked
CCC Certified

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Standards Compliance

UL 508
CSA C22.2 No. 14
EN/IEC 60947-1, -5-1
Meets the material restrictions for European Directive 2002/95/EC - EU-RoHS

4-Pole AC Coil Voltage (Ratings for 700-CF Only)

AC-12		AC-15								Contacts				
I_{th} [A]		I_e [A]							Connection Diagrams	N.O.	N.C.	Standard Contacts Cat. No.❄	Gold Plated Bifurcated Contacts Cat. No.∗	Master Contacts Cat. No.∗
40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V						
20	20	10	10	10	6	2.5	1	1		2	2	700-CF220⊗	700-CFB220⊗	**700-CFM220⊗**
										3	1	700-CF310⊗	700-CFB310⊗	**700-CFM310⊗**
										4	0	700-CF400⊗	700-CFB400⊗	**700-CFM400⊗**
										0	4	**700-CF040⊗**	**700-CFB040⊗**	—

❄ For spring clamp terminals, insert **R** after 700-C. Example: **Cat. No. 700-CRF220D.**

⊗ AC Coil Voltage Code

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. Example: **Cat. No. 700-CF220⊗** becomes **Cat. No. 700-CF220D** for 120V, 60 Hz

[V]	12	24	32	36	42	48	100	100 ... 110	110	120	127	200	200 ... 220	208	208 ... 240	220 ... 230	230	230 ... 240	240	277	347	380	380 ... 400	400	400 ... 415	440	480	500	550	600
50 Hz	R	K	V	W	X	Y	KP	—	D	P	S	KG	L	—	—	F	—	VA	T	—	—	—	N	—	G	B	—	M	C	—
60 Hz	Q	J	—	V	—	X	—	KP	—	D	—	—	KG	H	L	—	—	—	A	T	I	E	—	—	—	N	B	—	—	C
50/60 Hz	—	KJ	—	—	—	KY	KP	—	KD	—	—	KG	KL	—	—	KL	KF	—	KA	—	—	—	—	KN	—	KB	—	—	—	—

4-Pole DC Coil Voltage (Ratings for 700-CF Only)

AC-12		AC-15								Contacts				
I_{th} [A]		I_e [A]							Connection Diagrams	N.O.	N.C.	Standard Contacts Cat. No.‡	Gold Plated Bifurcated Contacts Cat. No.∗	Master Contacts Cat. No.∗
40 °C	60 °C	24/48V	120V	240V	400V	500V	600V	690V						
20	20	10	10	10	6	2.5	1	1		2	2	700-CF220⊗	700-CFB220⊗	**700-CFM220⊗**
										3	1	700-CF310⊗	700-CFB310⊗	**700-CFM310⊗**
										4	0	700-CF400⊗	700-CFB400⊗	**700-CFM400⊗**

‡For spring clamp terminals, insert **R** after 700-C. Example: **Cat. No. 700-CRF220ZJ.**

∗ Ratings for Bulletin 700-CFB and 700-CFM are on page 9-159

⊗ DC Coil Voltage Code§

The cat. no. as listed is incomplete. Select a coil voltage code from the table below to complete the cat. no. example: **Cat. No. 700-CF220⊗** becomes Cat. No. **700-CF220ZJ for 24V DC**

[V]	9	12	24	36	48	48... 72	60	64	72	80	110	110... 125	115	125	220	220... 250	230	250
Standard	ZR	ZQ	ZJ	ZW	ZY	—	ZZ	ZB	ZG	ZE	ZD	—	ZP	ZS	ZA	—	ZF	ZT
Standard diode	—	—	DJ	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Electronic with diode	—	EQ	EJ	—	—	EY	—	—	—	—	—	ED	—	—	—	EA	—	—

§ When ordering DJ coil with built-in surge suppression, the DJ is not polarity sensitive. Drop out time: 14…20 ms.

Allen-Bradley
Manufaturer#: 700-HLT1Z24

700-HL Terminal Block Relay

- Relay and socket assembled interface modules for high-density interposing or isolation applications
- Screw terminal and spring-clamp bases
- 6 A relay, choice of silver or gold contacts
- 2 A solid-state relay – DC output
- 2 A solid-state relay – AC output
- SPDT (relay), 1 N.O. (solid-state)
- Built-in retainer clip and snap-in marker lever
- Standard LED, reverse polarity protection, and surge protection
- Externally replaceable relay modules
- Unique leakage current suppression version to address industry concerns of nuisance coil turn-on or contact non-drop out when connecting to PLCs with leakage current
- Available with hazardous location certification

Product Selection

Terminal Block Relays

Standard built-in Features: • LED • Reverse Polarity Protection for DC Inputs • Coil Surge Protection[1]				
	Cat. No. 700-HLT1Z24	**Cat. No. 700-HLT2Z24**	**Cat. No. 700-HLS1Z24**	**Cat. No. 700-HLS11Z24**
Specifications			(2)	
Output Type	SPDT (1 C/O); I_{th} = 6 A[3]		1 N.O. solid-state: I_{th} = 2 A, 24V DC or I_{th} = 2 A, 240V AC	
Recommended Tightening Torque	0.5 N•m max (4.4 lb•in)			
Wire Range – Screw Terminal	0.14 mm²...2.5 mm² (#26...#14 AWG)			
Wire Range – Spring Terminal	0.2 mm²...2.5 mm² (#24...#14 AWG)			
Certifications	UL, cULus, cURus, ABS, CE			

(1) Diode surge protection provided.
(2) Reverse polarity on the output terminals of the solid-state relay results in the output being "ON" regardless of the state of the input voltage.
(3) For Gold-plated contacts: Add the letter "**X**" at the end of the catalog number. For example: if Cat. No. 700-HLT1Z24 is required with gold plating, the new cat. no. is 700-HLT1Z24X.

Terminal Block Relay Selection

Input Voltage	Pkg. Qty.	Cat. No.		Pkg. Qty.	Cat. No.		
		Screw Terminals	Spring Clamp Terminals		Screw Terminals (DC Output)	Spring Clamp Terminals (DC Output)	Screw Terminals (AC Output)
12V DC	10	700-HLT1Z12[1]	700-HLT2Z12	–	–	–	–
24V DC	10	700-HLT1Z24[1]	700-HLT2Z24	10	700-HLS1Z24[1]	700-HLS2Z24	700-HLS11Z24
48V DC	10	700-HLT1Z48[1]	700-HLT2Z48	10	700-HLS1Z48[1]	700-HLS2Z48	700-HLS11Z48
12V AC/DC	10	700-HLT1U12	700-HLT2U12	–	–	–	–
24V AC/DC	10	700-HLT1U24	700-HLT2U24	–	–	–	–
48V AC/DC	10	700-HLT1U48	700-HLT2U48	–	–	–	–
110/125V AC/DC	10	700-HLT1U1	700-HLT2U1	10	700-HLS1U1[1]	700-HLS2U1	700-HLS11U1
220...240V AC/DC	10	700-HLT1U2	700-HLT2U2	10	700-HLS1U2[1]	700-HLS2U2	700-HLS11U2
240V AC	10	700-HLT1A2	–	–	–	–	–

Specifications

Cat. No. 700-HLT... (Relay Output)

Table 36 - Electrical Ratings

Attribute				Cat. No. 700-HLT... (Relay Output)	
Pilot Duty Rating				B 300, R 300	
Rated Thermal Current (I_{th})				1-Pole – 6 A	
Rated Insulation Voltage (U_i)			IEC	250V	
			UL/CSA	300V	
Contacts	Inductive	1-Pole	Contact Type	**Make**	**Break**
				►][◄	◄][►
			24V AC, 1-phase	30 A	5 A
			120V AC, 1-phase	30 A	3 A
			240V AC, 1-phase	15 A	1.5 A
			24V DC	DC-13, 1.0 A	–
			125V DC	DC-13, 0.2 A	
			240V DC	DC-13, 0.1 A	
		Resistive Make, Break, and Continuous	24V DC	6.0 A	
			250V AC	6.0 A	
			240V DC	0.1 A	
Inductive Load			AC-15	250V, 3 A N.O. Contact, 1.5 A N.C. Contact	
			DC-13	24V, 1 A N.O., and N.C. Contact	
Min Permissible Contact Ratings			Silver Contacts	12V, 6 mA (72 mW)	
			Gold Contacts	8V, 2.5 mA (20 mW)	
Permissible Coil Voltage Variation		Pickup	50 Hz	85...110% of Nominal Voltage	
			60 Hz	85...110% of Nominal Voltage	
			DC	80...110% of Nominal Voltage	
		Must Dropout	AC	10% of Nominal Voltage	
			DC	5% of Nominal Voltage	
Power Consumption ±10%			AC	0.3VA	
			DC	0.2 W	
Design Specification/Test Requirements	Dielectric Withstand Voltage		Pole to Pole (VRMS)	1000V	
			Contact to Coil (VRMS)	4000V	
	Impedance at input voltage:		12V AC/DC	1 kΩ	
			24V AC/DC	2 kΩ	
			48V AC/DC	6 kΩ	
			120V AC/DC	26 kΩ	
			240V AC/DC	56 kΩ	
			120V LCSC	16 kΩ	
			240V LCSC	35 kΩ	

Allen-Bradley
Manufaturer#: 140MT-F9E-C32

Table 27 - Motor Protective Switching Devices (Continued)

Rated Operational Current (I_e) [A]	Motor Current Adjustment Range [A]	Nominal Magnetic Trip Current [A]	Max Short-circuit Current [kA]		Max. 3-phase Hp Ratings(1)				Max. kW, 3-Phase — AC-3(1)				Cat. No.
			400V (I_{cu})	480V (group motor)	200V	230V	460V	575V	230V	400/415V	500V	690V	
F-Frame, Adjustable Thermal/Fixed Magnetic (15 x I_n)													
12	9...12	180	100	65	3	3	7.5	10	3	5.5	5.5	7.5	140MT-F9E-C12
16	12...16	240	100	65	3	5	10	10	4	7.5	10	11	140MT-F9E-C16
20	15...20	300	100	65	5	5	10	15	5.5	7.5	11	15	140MT-F9E-C20
25	19...25	375	100	65	5	7.5	15	20	5.5	11	15	22	140MT-F9E-C25
32	24...32	480	65	65	7.5	10	20	30	7.5	15	18.5	30	140MT-F9E-C32
38	30...38	570	65	65	10	10	25	30	11	18.5	22	30	140MT-F9E-C38
45	36...45	675	65	65	10	15	30	40	11	22	30	37	140MT-F9E-C45

(1) Hp/kW ratings shown are for reference. The final selection of the MPCB/MPSD depends on the actual motor full load current.
(2) Suitable for continuous operation at 90% current rating at 480V only if used in a minimum enclosure size of 250 x 175 x 150 mm (10 x 7 x 6 in).

Table 28 - High Inrush Motor Protection Switching Devices

Rated Operational Current (I_e) [A]	Motor Current Adjustment Range [A]	Nominal Magnetic Trip Current [A]	Max Short-circuit Current [kA]		Max. 3-phase Hp Ratings(1)				Max. kW, 3-Phase — AC-3(1)				Cat. No.
			400V (I_{cu})	480V (group motor)	200V	230V	460V	575V	230V	400/415V	500V	690V	
D-Frame, Adjustable Thermal/Fixed Magnetic (18...22 x I_n)													
0.16	0.10...0.16	3.5	100	65	—	—	—	—	—	0.02	0.06	0.06	140MT-D9T-A16
0.25	0.16...0.25	5.5	100	65	—	—	—	—	—	0.04	0.09	0.09	140MT-D9T-A25
0.4	0.25...0.40	8.8	100	65	—	—	—	—	0.06	0.09	0.12	0.18	140MT-D9T-A40
0.63	0.40...0.63	14	100	65	—	—	—	—	0.09	0.18	0.18	0.25	140MT-D9T-A63
1	0.63...1.0	22	100	65	—	—	0.5	0.5	0.18	0.25	0.37	0.55	140MT-D9T-B10
1.6	1.0...1.6	35	100	65	—	—	0.75	—	0.25	0.55	0.75	1.1	140MT-D9T-B16
2.5	1.6...2.5	55	100	65	0.5	0.5	1	1.5	0.37	0.75	1.1	1.8	140MT-D9T-B25
4	2.5...4.0	88	100	65	0.75	0.75	2	3	0.75	1.5	2.2	3	140MT-D9T-B40
6.3	4.0...6.3	139	100	65	1	1.5	3	5	1.5	2.2	3	4	140MT-D9T-B63
10	6.3...10	220	100	65	2	2	5	7.5	2.2	4	6.3	7.5	140MT-D9T-C10
16	10...16	320	100	65	3	5	10	10	4	7.5	10	13	140MT-D9T-C16
20	14.5...20	400	100	65	5	5	10	15	5.5	10	11	17	140MT-D9T-C20
25	18...25	450	65	50	5	7.5	15	20	5.5	11	15	22	140MT-D9T-C25
F-Frame, Adjustable Thermal/Fixed Magnetic (19...22 x I_n)													
25	19...25	550	65	65	5	7.5	15	20	5.5	11	15	22	140MT-F9T-C25
32	24...32	704	65	65	7.5	10	20	30	7.5	15	18.5	30	140MT-F9T-C32
38	30...38	836	65	65	10	10	25	30	11	18.5	22	30	140MT-F9T-C38
45	36...45	990	65	65	10	15	30	40	11	22	30	37	140MT-F9T-C45

(1) Hp/kW ratings shown are for reference. The final selection of the MPCB/MPSD depends on the actual motor full load current.

Specifications

MPCB Specifications

Table 9 - General Ratings

Attribute		Value
Standards compliance	IEC	IEC/EN 60947-2, IEC/EN 60947-4-1, IEC/EN 60947-1
	cULus	UL 60947-1, UL 60947-4-1, CSA C22.2, No. 60947-4-1
Certifications	Global	RINA (Marine)
	Regional	CCC, KC, EAC, CE, IEC, cULus, CB Scheme
Rated operating voltage U_e		690V AC
Maximum operating voltage (UL)		600V
Rated Frequency		50/60 Hz
Trip Class		10A
Number of operations	Mechanical	100.000 Cycles
	Electrical	100,000 Cycles (0.1...16 A); 50,000 Cycles (20...32 A)
Rated impulse withstand voltage U_{imp}		6 kV
Rated insulation voltage U_i		690V
Pollution Degree		3
Phase loss sensitivity		Yes
Disconnect function per IEC/EN 60947-2		Yes
Resistance to shock per IEC 60068-2-27		25 G/11 ms
Resistance to vibrations per IEC 60068-2-6		5 G /3 ... 150 Hz
Mounting		DIN Rail (EN 60715)
Group mounting (side by side)		up to 40 °C (104 °F)
Minimum distance to other units same type	Horizontal	0 mm (0 in.)
	Vertical	150 mm (5.9 in.)
Minimum distance to electrical conductive board	Horizontal, up to 400V	0 mm (0 in.)
	Horizontal, up to 690V	> 1.5 mm (0.06 in.)
	Vertical	75 mm (2.95 in.)
Degree of Protection	Housing	IP20
	Main Terminals	IP10
Short-circuit ratings	@230V, 400V, 440V, 500V, and 690V	See Table 2
	@480V and 600V—for motor disconnect	See Table 14
	@480V and 600V—for group motor installation	
Utilization Category	IEC 60947-2 (Circuit breaker)	A
	IEC 60947-4-1 (Motor Starter)	AC-3

Table 10 - Power Loss

Power Loss		Rated Operating Current [A]				
		0.16...1.6	2.5...6.3	10...12	16...25	32
Power Loss in all 3 Poles up to:	[W]	5.1	5.4	7.2	8.4	9.3

Table 11 - Environmental Ratings

Attribute		Value
Operating Ambient air temperature	Open—compensated	-25 ... +55 °C (-13...+131 °F)(1)
	Open	-25 ... +70 °C (-13...+158 °F)(1)
	Enclosed	0 ... +40 °C (32...104 °F)
Storage Ambient air temperature		-50 ... +80 °C (-58...+176 °F)
Maximum operating altitude permissible		2000 m (6561 ft)

(1) With derating. See Table 12.

MC 1000E-MM LC - FO converters

1330611

https://www.phoenixcontact.com/us/products/1330611

Phoenix Contact
Manufaturer#: 1330611

Technical data

Notes

Note on application

Note on application	Only for industrial use

Product properties

Product type	Media converter
Product family	MC 1000E
MTTF	68.5 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%)
	508.3 Years ()
	331.4 Years (Telcordia standard, temperature 25 °C, operating cycle 100 % (7 days a week, 24 hours a day))

Electrical properties

Supply

Supply voltage range	12 V DC ... 57 V DC
Nominal supply voltage	24 V DC
	48 V DC
Typical current consumption	20 mA (24 V DC)
Max. current consumption	170 mA

Output data

Signal

Voltage output signal	12 V DC ... 48 V DC (depending on the input voltage)
Current output signal	100 mA

Connection data

Supply

Connection method	Push-in spring connection
Conductor cross section, flexible	0.20 mm² ... 2.50 mm²
Conductor cross section, rigid	0.20 mm² ... 2.50 mm²
Conductor cross section, flexible [AWG]	24 ... 12
Conductor cross section AWG	24 ... 12
Stripping length	10.00 mm

Interfaces

Signal	Ethernet

Data: optical FO

Transmit capacity, minimum	-20 dBm (62.5/125 µm, multimode fiberglass)
	-23.5 dBm (50/125 µm, multimode fiberglass)

Transmit capacity, maximum	-14 dBm
Transmission length incl. 3 dB system reserve	2 km
Connection method	LC duplex
Wavelength	1310 nm
Minimum receiver sensitivity	-31 dBm
Maximum receiver sensitivity	-8 dBm
Transmission medium	Multi-mode fiberglass

Data: Ethernet interface, 100Base-Tx in acc. with IEEE 802.3u

Transmission speed	10/100 Mbps
Connection method	RJ45 jack, shielded
No. of channels	1
Transmission length	100 m (twisted pair, shielded)
Transmission medium	Copper
Signal LEDs	LNK/ACT, SPD, Err, US, US2
Auto-negotiation modes	Auto
Link through	Link fault pass through
MDI-/MDI-X switchover	Auto-MDI(X)

Dimensions

Width	22.5 mm
Height	125 mm
Depth	90 mm

Material specifications

Housing material	Polyamide fiber reinforced
	Aluminum / steel sheet DC01

Cable/line

FO cable

Fiber types	50/125 µm
	62.5/125 µm
	Fiberglass

Mechanical tests

Vibration resistance in accordance with EN 60068-2-6/IEC 60068-2-6	: 5g, 150 Hz, Criterion 3
Shock in accordance with EN 60068-2-27/IEC 60068-2-27	: 30g, 11 ms half-sine shock pulse

Environmental and real-life conditions

Ambient conditions

Degree of protection	IP30
Ambient temperature (operation)	-40 °C ... 75 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C

FL SWITCH SFN 5TX - Industrial Ethernet Switch

2891152

https://www.phoenixcontact.com/us/products/2891152

Phoenix Contact
Manufaturer#: 2891152

Technical data

Dimensions

Width	30 mm
Height	120 mm
Depth	70 mm

Notes

Note on application

Note on application	Only for industrial use

Material specifications

Housing material	Aluminum

Mounting

Mounting type	DIN rail mounting

Interfaces

Ethernet (RJ45)

Connection method	RJ45
Note on the connection method	Auto negotiation and autocrossing
Transmission speed	10/100 Mbps
Transmission physics	Ethernet in RJ45 twisted pair
No. of channels	5 (RJ45 ports)

Product properties

Product type	Switch
Product family	Unmanaged Switch SFN
Type	Block design
MTTF	192.9 Years (MIL-HDBK-217F standard, temperature 25°C, operating cycle 100%)

Insulation characteristics

Protection class	III (IEC 61140, EN 61140, VDE 0140-1)

Switch functions

Basic functions	Unmanaged switch / auto negotiation, complies with IEEE 802.3, store and forward switching mode
Status and diagnostic indicators	LEDs: U_S, link and activity per port
Additional functions	Autonegotiation

Security functions

Basic functions	Unmanaged switch / auto negotiation, complies with IEEE 802.3, store and forward switching mode

Electrical properties

Local diagnostics	US Supply voltage Green LED
	LNK/ACT Link status/data transmission Green LED
	100 Data transmission speed Yellow LED
Maximum power dissipation for nominal condition	2.16 W
Test section	500 V DC 1 min
Transmission medium	Copper

Supply

Supply voltage (DC)	24 V DC
Supply voltage range	9 V DC ... 32 V DC
Power supply connection	Via COMBICON, max. conductor cross section 2.5 mm²
Residual ripple	3.6 V_{PP} (within the permitted voltage range)
Max. current consumption	205 mA (at 9 V DC)
Typical current consumption	90 mA (at U_S = 24 V DC)

Connection data

Connection technology

Connection name	Power supply
pluggable	yes

Power supply

Connection method	Screw connection
Conductor cross section, rigid	0.2 mm² ... 2.5 mm²
Conductor cross section, flexible	0.2 mm² ... 2.5 mm²
Conductor cross section AWG	24 ... 12
Stripping length	7 mm

Environmental and real-life conditions

Ambient conditions

Degree of protection	IP20
Ambient temperature (operation)	0 °C ... 60 °C
Ambient temperature (storage/transport)	-20 °C ... 70 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	5 % ... 95 % (non-condensing)
Vibration (operation)	in acc. with IEC 60068-2-6: 5g, 150 Hz
Air pressure (operation)	86 kPa ... 5 kPa (up to 1500 m above sea level)
Air pressure (storage/transport)	66 kPa ... 108 kPa (up to 3500 m above sea level)
Resistance to gases that may endanger the functions, in acc. with DIN 40046-36, DIN 40046-37	Sulfur dioxide (SO_2) 10 ±0.3 cm^3/m^3, hydrogen sulfide (H_2S) 1 ±0.3 cm^3/m^3, at 25°C and 75% humidity and exposure of four days

Standards and regulations

Free from substances that could impair the application of coating	In acc. with VW specification

CompactLogix 5380 Controllers

Allen-Bradley
Manufaturer#: 5069-RTB18-SPRING RTB; 5069-OF4; 5069-OW16; 5069-IB16; 5069-L310ER

CompactLogix 5380 controllers are part of the Logix 5000® family of controllers. The controllers provide a scalable controller solution to address a wide variety of applications. The applications range from standalone systems to more complex systems with devices that are connected to the controller via an EtherNet/IP™ network.

The controllers are mounted on a DIN rail. They can monitor and control local and remote I/O modules, and other devices connected to an EtherNet/IP network. The CompactLogix 5380 controllers support this functionality:

- Use of Compact 5000™ I/O module as local I/O and remote I/O modules.
- Use Compact 5000 I/O modules, and other I/O modules, as remote I/O modules.
- Support for Integrated Motion over an EtherNet/IP network (not all controllers).
- Use of Dual-IP mode or Linear/DLR mode.
- Use of two Ethernet ports that let the controller connect to EtherNet/IP device-level and enterprise-level networks.
- Use of 1784-SD1, 1784-SD2, 1784-SDHC8, 1784-SDHC32, 9509-CMSDCD4 Secure Digital (SD) card for nonvolatile memory.
- USB programming port for temporary connection.
- CompactLogix 5380 Process controllers (5069-L320ERP, 5069-L340ERP) support PlantPAx® 5.0, and are conformal coated to add a layer of protection when exposed to harsh, corrosive environments. For more information, see the PlantPAx DCS Configuration and Implementation User Manual, publication PROCES-UM100.

Features - CompactLogix 5380 Controllers

Feature	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Controller tasks Continuous Periodic Event	32 tasks 1000 programs/task All event triggers							
Built-in communication ports	1 - USB port 2 - Ethernet ports **IMPORTANT**: Consider the following: When the controller operates in Dual-IP mode, each Ethernet port requires a unique IP address. When the controller operates in Linear/DLR mode, the controller uses only one IP address.							
USB port communication	USB 2.0, Type B Full speed (12 Mbps) Programming, configuration, firmware update, and online edits only							
Ethernet performance	10 Mbps, 100 Mbps, 1 Gbps Full-duplex only							
I/O Capacity (Class 0/1) (1)	• 128,000 without CIP Security™ • 40,000 with integrity • 20,000 with integrity and confidentiality							
Message Rate Capacity HMI/MSG (Class 3) (1)	• 2000 without CIP Security • 1500 with integrity • 900 with integrity and confidentiality							
EtherNet/IP modes supported	Dual-IP mode (Available with the Studio 5000 Logix Designer® application, version 29.00.00 or later) Linear/DLR mode							
EtherNet/IP network topologies supported	DLR Star Linear							
EtherNet/IP nodes supported, max(2)	16	24	40	60	90	120	150	180
Socket interfaces supported, max	32							

Features - CompactLogix 5380 Controllers (Continued)

Feature	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Integrated motion[3]	5069-L306ERM	5069-L310ERM, 5069-L310ERMK	5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ERM, 5069-L330ERMK	5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Number of axes supported, max[4]	256							
Number of Integrated Motion on EtherNet/IP™ drive axes (Position loop-configured) supported, max[5]	5069-L306ERM: 2	5069-L310ERM: 4	5069-L320ERM, 5069-L320ERMK, 5069-L320ERP: 8	5069-L330ERM, 5069-L330ERMK: 16	5069-L340ERM, 5069-L340ERP: 20	24	28	32
Programming languages	Ladder Diagram (LD) Structured Text (ST) Function Block Diagram (FBD) Sequential Function Chart (SFC)							

(1) I/O numbers are maximums; they assume no HMI/MSG. HMI/MSG numbers are maximums, they assume no I/O. Maximums assume that the processor is the target, not the originator. Packet rates vary depending on packet size. For more details, see Troubleshoot EtherNet/IP Application Technique, publication ENET-AT003, and the EDS file for a specific catalog number.
(2) The maximum number of nodes that are listed represents when the controller is used with the Logix Designer application, version 31 or later. Some controllers can be used with earlier Logix Designer application versions. The maximum number of nodes that a controller supports can be fewer in Logix Designer application, versions 30 or earlier.
(3) Only CompactLogix 5380 controllers that have an M or P in their catalog number support Integrated Motion on EtherNet/IP networks.
(4) Any combination of Integrated Motion on EtherNet/IP drive, Virtual, Consumed, Regenerative AC/DC Converter and Non-Regenerative AC/DC Converter axis types.
(5) The maximum number of Integrated Motion on EtherNet/IP drive axes (configured for Position Loop) that can be included in the total integrated motion axes count for a controller.

Technical Specifications - CompactLogix 5380 Controllers

Attribute	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
User memory	0.6 MB	1 MB	2 MB	3 MB	4 MB	5 MB	8 MB	10 MB
Optional nonvolatile memory	• 1784-SD1 (1 GB) • 1784-SD2 (2 GB), ships with controller • 1784-SDHC8 (8 GB) • 1784-SDHC32 (32 GB) • 9509-CMSDCD4 (4 GB) CodeMeter CmCard SD							
Local I/O modules, max	8	8	16	31[1]	31	31	31	31
Number of power cycles	80,000							
MOD Power voltage range	18...32V DC							
MOD Power current, max	450 mA							
MOD Power inrush	850 mA for 125 ms							
MOD Power passthrough[2]	9.55 A @ 18...32V DC							
MOD Power current rating, max	10 A Do not exceed 10 A current draw at the MOD Power RTB.							
SA Power voltage ranges[3]	0...32V DC 0...240V AC, 47...63 Hz EX, 125V AC max							
SA Power current, max[3]	10 mA (DC power) 25 mA (AC power)							
SA Power passthrough[3], [4]	9.95 A @ 0...32V DC 9.975 A @ 0...240V AC, 47...63 Hz EX, 125V AC max							
SA Power current rating, max [3]	10 A (AC or DC power) Do not exceed 10 A current draw at the SA Power RTB.							
Power dissipation, max	8.5 W							
Thermal dissipation, max	29 BTU/hr							
Isolation voltage	300V (continuous), Basic Insulation Type, SA, and MOD Power to Backplane 300V (continuous), Basic Insulation Type, SA to MOD Power 300V (continuous), Basic Insulation Type, Ethernet to Backplane 300V (continuous), Double Insulation Type, Ethernet to MOD Power 300V (continuous), Double Insulation Type, Ethernet to SA Power 50V (continuous), Functional Insulation Type, Ethernet to USB 300V (continuous), Basic Insulation Type, USB to Backplane 300V (continuous), Double Insulation Type, USB to MOD Power 300V (continuous), Double Insulation Type, USB to SA Power No isolation between Ethernet ports Type tested at 1500V AC for 60 s							
Weight, approx	0.768 kg (1.693 lb)							
Dimensions (HxWxD), approx	143.97 x 98.10 x 136.81 mm (5.67 x 3.86 x 5.39 in.)							

Technical Specifications - CompactLogix 5380 Controllers (Continued)

Attribute	5069-L306ER, 5069-L306ERM	5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK	5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP	5069-L330ER, 5069-L330ERM, 5069-L330ERMK	5069-L340ER, 5069-L340ERM, 5069-L340ERP	5069-L350ERM, 5069-L350ERMK	5069-L380ERM	5069-L3100ERM
Location	DIN rail mount (horizontal mount only)							
DIN rail	Compatible zinc-plated, chromate steel DIN rail. EN50022 - 35 x 7.5 mm (1.38 x 0.30 in.)							
Removable terminal block	RTBs are available in separately ordered 5069 RTB kits. The MOD power connection uses a 4-point RTB, and the SA power connection uses a 6-point RTB. The following kits are available: • Kit catalog number 5069-RTB64-SCREW contains RTB catalog numbers 5069-RTB6-SCREW and 5069-RTB4-SCREW. • Kit catalog number 5069-RTB64-SPRING contains RTB catalog numbers 5069-RTB6-SPRING and 5069-RTB4-SPRING.							
Terminal block torque	5069-RTB4-SCREW & 5069-RTB6-SCREW: 0.4 N•m (3.5 lb•in) 5069-RTB4-SPRING & 5069-RTB6-SPRING: Torque does not apply							
Wire size	5069-RTB4-SCREW, 5069-RTB6-SCREW connections: 0.5...1.5 mm^2 (22...16 AWG) solid or stranded copper wire that is rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only 5069-RTB4-SPRING, 5069-RTB6-SPRING connections: 0.5...1.5 mm^2 (22...16 AWG) solid or stranded copper wire that is rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only Ethernet connections: Ethernet Cabling and Installation according to IEC 61918 and IEC 61784-5-2							
Insulation stripping length	5069-RTB4-SCREW, 5069-RTB6-SCREW connections: 12 mm (0.47 in.) 5069-RTB4-SPRING, 5069-RTB6-SPRING connections: 10 mm (0.39 in.)							
Wire category(5)	3 - on USB port 1 - on power ports 2 - on Ethernet ports							
Enclosure	None (open-style)							
North American temperature code	T4							
UKEX/ATEX temperature code	T4							
IECEx temperature code	T4							

(1) When you use these controllers with the Studio 5000 Logix Designer application, version 29.00.00, the application limits the number of local I/O modules in the project to 16. For more information, see the Rockwell Automation Knowledgebase article #942580, '5380 CompactLogix controllers limited to 16 local 5069 modules in V29 of Studio 5000©'. The document is available at rok.auto/knowledgebase.
With the Logix Designer application, version 30.00.00 or later, the controllers support as many as 31 local I/O modules.
(2) Maximum level of MOD Power current that the controller can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.
(3) SA power specifications are based on the number and type of Compact 5000 I/O modules that are used in the system. If the set of I/O modules that are used in the system require AC and DC voltage, you must install a 5069-FPD field potential distributor to separate the module types.
(4) Maximum level of SA Power current that the controller can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.
(5) Use this Conductor Category information to plan conductor routing. See the Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1.

Environmental Specifications - CompactLogix 5380 Controllers

Attribute	5069-L306ER, 5069-L306ERM, 5069-L310ER, 5069-L310ER-NSE, 5069-L310ERM, 5069-L310ERMK, 5069-L320ER, 5069-L320ERM, 5069-L320ERMK, 5069-L320ERP, 5069-L330ER, 5069-L330ERM, 5069-L330ERMK, 5069-L340ER, 5069-L340ERM, 5069-L340ERP, 5069-L350ERM, 5069-L350ERMK, 5069-L380ERM, 5069-L3100ERM
Temperature, operating IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0 °C < Ta < +60 °C (+32 °F <Ta < +140 °F)
Temperature, nonoperating IEC 60068-2-1 (Test Ab, Unpackaged Nonoperating Cold), IEC 60068-2-2 (Test Bb, Unpackaged Nonoperating Dry Heat), IEC 60068-2-14 (Test Na, Unpackaged Nonoperating Thermal Shock)	-40...+85 °C (-40...+185 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Relative humidity IEC 60068-2-30 (Test Db, Unpackaged Damp Heat)	5...95% noncondensing
Vibration IEC 60068-2-6 (Test Fc, Operating)	5 g @ 10...500 Hz
Shock, operating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	30 g
Shock, nonoperating IEC 60068-2-27 (Test Ea, Unpackaged Shock)	50 g
Emissions	IEC 61000-6-4
ESD immunity IEC 61000-4-2	6 kV contact discharges 8 kV air discharges
Radiated RF immunity IEC 61000-4-3	10V/m with 1 kHz sine-wave 80% AM from 80...6000 MHz
EFT/B immunity IEC 61000-4-4	± 4 kV at 5 kHz on power ports ± 2 kV at 5 kHz on Ethernet ports

Specifications

For a list of all specifications, see the Compact 5000 I/O Modules and EtherNet/IP Adapters Technical Data, publication 5069-TD001.

Attribute	5069-IB16, 5069-IB16F, 5069-IB16K
Temperature, operating • IEC 60068-2-1 (Test Ad, Operating Cold) • IEC 60068-2-2 (Test Bd, Operating Dry Heat) • IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)
Temperature, surrounding air, max	60 °C (140 °F)
Enclosure type rating	None (open-style)
Voltage and current ratings	
Input ratings	4...7.4 mA per channel @ 10...32V DC
MOD power	75 mA @ 18...32V DC
MOD power (passthrough)(1)	9.55 A @ 18...32V DC
SA power	200 mA @ 10...32V DC
SA power (passthrough)(1)	9.95 A @ 10...32V DC
Do not exceed 10 A MOD or SA power (passthrough) current draw.	
Isolation voltage	250V (continuous), Basic Insulation Type No isolation between SA power and input ports No isolation between individual input ports
Wire size	
5069-RTB18-SCREW connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only.
5069-RTB18-SPRING connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only.
Insulation-stripping length	
5069-RTB18-SCREW connections	12 mm (0.47 in.)
5069-RTB18-SPRING connections	10 mm (0.39 in.)
RTB torque specifications (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)
DIN rail	Compatible zinc-plated, yellow-chromate steel DIN rail. You can use the following DIN rail sizes: • EN50022 - 35 x 7.5 mm (1.38 x 0.30 in.) • EN50022 - 35 x 15 mm (1.38 x 0.59 in.)
North American temp code	T4
UKEX/ATEX temp code	T4
IECEx temp code	T4

(1) Maximum level of MOD or SA power current that the module can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

Specifications

For a list of all specifications, see the Compact 5000 I/O and Specialty Modules Technical Data, publication 5069-TD001.

Attribute	5069-OW16 Series A and Series B	5069-OW16 Series C
Temperature, operating • IEC 60068-2-1 (Test Ad, Operating Cold), • IEC 60068-2-2 (Test Bd, Operating Dry Heat), • IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)	
Temperature, surrounding air, max	60 °C (140 °F)	
Enclosure type rating	None (open-style)	
Voltage and current ratings		
Relay ratings	2 A resistive per channel @ 5...30V DC 2 A resistive per channel @ 5...264V AC, 50/60 Hz 2 A general use per channel @ 5...250V AC, 50/60 Hz 2 A @ 5...125V AC, UKEX/ATEX/IECEx **Surge Suppression** - To extend the life of the module, connect surge suppressors across your external inductive load. For additional details, see the Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1.	
Output current, max	8 A per group 16 A per module	
MOD power	75 mA @ 18...32V DC	225 mA @ 18...32V DC
MOD power (passthrough)(1)	9.55 A @ 18...32V DC	
SA power	150 mA @ 18...32V DC	–
SA power (passthrough)(1)	9.95 A @ 18...32V DC	
Do not exceed 10 A MOD or SA power (passthrough) current draw. The 5069-OW16 module complies with UKEX/ATEX/IECEx when used at or below 125V AC or 30V DC.		
Isolation voltage	250V (continuous), Basic Insulation Type Type tested at 1800V AC for 60 s No isolation between individual channels	
Wire size		
5069-RTB18-SCREW connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only. Use minimum 18 AWG, 105 °C (221 °F) rated wire for load connections to relay output modules.	
5069-RTB18-SPRING connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only. Use minimum 18 AWG, 105 °C (221 °F) rated wire for load connections to relay output modules.	
Insulation-stripping length		
5069-RTB18-SCREW connections	12 mm (0.47 in.)	
5069-RTB18-SPRING connections	10 mm (0.39 in.)	
RTB torque specifications (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)	
Pilot duty rating	5...240V AC, 50/60 Hz, C300 pilot duty per channel 5...125V DC, R150 pilot duty per channel	
North American temp code	T4	
UKEX/ATEX temp code	T4	
IECEx temp code	T4	

(1) Maximum level of MOD or SA power current that the module can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

Specifications

For a list of all specifications, see the Compact 5000 I/O Modules and EtherNet/IP Adapters Technical Data, publication 5069-TD001.

5069-OF4 and 5069-OF8 Analog Current/Voltage Output Module Specifications

Attribute	5069-OF4, 5069-OF4K	5069-OF8
Temperature, operating • IEC 60068-2-1 (Test Ad, Operating Cold), • IEC 60068-2-2 (Test Bd, Operating Dry Heat), • IEC 60068-2-14 (Test Nb, Operating Thermal Shock)	0...60 °C (32...140 °F)	
Temperature, surrounding air, max	60 °C (140 °F)	
Enclosure type rating	None (open-style)	
Voltage and current ratings		
Analog output ratings	+/-10V DC, 0...20 mA per channel	
MOD power	75 mA @ 18...32V DC	
MOD power (passthrough)(1)	9.55 A @ 18...32V DC	
SA power	150 mA @ 18...32V DC	250 mA @ 18...32V DC
SA power (passthrough)(1)	9.95 A @ 18...32V DC	
Do not exceed 10 A MOD or SA power (passthrough) current draw		
Isolation voltage	250V (continuous), Basic Insulation Type 50V Functional Isolation between SA power and output ports No isolation between individual output ports	
Wire size		
5069-RTB18-SCREW connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 3.5 mm (0.14 in.) max diameter including insulation, single wire connection only.	
5069-RTB18-SPRING connections	0.5...1.5 mm^2 (22...16 AWG) solid or stranded shielded copper wire rated at 105 °C (221 °F), or greater, 2.9 mm (0.11 in.) max diameter including insulation, single wire connection only.	
Insulation-stripping length		
5069-RTB18-SCREW connections	12 mm (0.47 in.)	
5069-RTB18-SPRING connections	10 mm (0.39 in.)	
RTB torque specifications (5069-RTB18-SCREW RTB only)	0.4 N•m (3.5 lb•in)	
North American temp code	T4	
UKEX/ATEX temp code	T4	
IECEx temp code	T4	

(1) Maximum level of MOD or SA power current that the module can pass through to the next module in the system. The specific level of current passed through varies based on system configuration.

Catalog Number Explanation

Allen-Bradley
Manufaturer#: 25A-D4P0N104

1-3	4	5	6-8	9	10	11	12	13	14
25B	**–**	**B**	**2P3**	**N**	**1**	**1**	**4**	**–**	**–**
Drive	Dash	Voltage Rating	Rating	Enclosure	Reserved	Emission Class	Reserved	Dash	Dash

Code	Type
25A	PowerFlex 523
25B	PowerFlex 525

Code	Voltage	Phase
V	120V AC	1
A	240V AC	1
B	240V AC	3
D	480V AC	3
E	600V AC	3

Code	Enclosure
N	IP20 NEMA / Open

Code	Interface Module
1	Standard

Code	EMC Filter
0	No Filter
1	Filter

Code	Braking
4	Standard

Output Current @ 1 Phase, 100...120V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P6(1)	1.6	A	0.25	0.2	0.25	0.2
2P5	2.5	A	0.5	0.4	0.5	0.4
4P8	4.8	B	1.0	0.75	1.0	0.75
6P0	6.0	B	1.5	1.1	1.5	1.1

Output Current @ 1 Phase, 200...240V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P6(1)	1.6	A	0.25	0.2	0.25	0.2
2P5	2.5	A	0.5	0.4	0.5	0.4
4P8	4.8	A	1.0	0.75	1.0	0.75
8P0	8.0	B	2.0	1.5	2.0	1.5
011	11.0	B	3.0	2.2	3.0	2.2

Output Current @ 3Phase, 200...240V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P6(1)	1.6	A	0.25	0.2	0.25	0.2
2P5	2.5	A	0.5	0.4	0.5	0.4
5P0	5.0	A	1.0	0.75	1.0	0.75
8P0	8.0	A	2.0	1.5	2.0	1.5
011	11.0	A	3.0	2.2	3.0	2.2
017	17.5	B	5.0	4.0	5.0	4.0
024	24.0	C	7.5	5.5	7.5	5.5
032	32.2	D	10.0	7.5	10.0	7.5
048(2)	48.3	E	15.0	11.0	10.0	7.5
062(2)	62.1	E	20.0	15.0	15.0	11.0

Output Current @ 3 Phase, 380...480V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
1P4	1.4	A	0.5	0.4	0.5	0.4
2P3	2.3	A	1.0	0.75	1.0	0.75
4P0	4.0	A	2.0	1.5	2.0	1.5
6P0	6.0	A	3.0	2.2	3.0	2.2
010	10.5	B	5.0	4.0	5.0	4.0
013	13.0	C	7.5	5.5	7.5	5.5
017	17.0	C	10.0	7.5	10.0	7.5
024	24.0	D	15.0	11.0	15.0	11.0
030(2)	30.0	D	20.0	15.0	15.0	11.0
037(2)	37.0	E	25.0	18.5	20.0	15.0
043(2)	43.0	E	30.0	22.0	25.0	18.5

Output Current @ 3 Phase, 525...600V Input

Code	Amps	Frame	ND		HD	
			HP	kW	HP	kW
0P9	0.9	A	0.5	0.4	0.5	0.4
1P7	1.7	A	1.0	0.75	1.0	0.75
3P0	3.0	A	2.0	1.5	2.0	1.5
4P2	4.2	A	3.0	2.2	3.0	2.2
6P6	6.6	B	5.0	4.0	5.0	4.0
9P9	9.9	C	7.5	5.5	7.5	5.5
012	12.0	C	10.0	7.5	10.0	7.5
019	19.0	D	15.0	11.0	15.0	11.0
022(2)	22.0	D	20.0	15.0	15.0	11.0
027(2)	27.0	E	25.0	18.5	20.0	15.0
032(2)	32.0	E	30.0	22.0	25.0	18.5

(1) This rating is only available for PowerFlex 523 drives.
(2) Normal and Heavy Duty ratings are available for this drive.

Technical Specifications

Protection

Specifications	PowerFlex 523	PowerFlex 525
Bus Overvoltage Trip		
100...120V AC Input:	405V DC bus (equivalent to 150V AC incoming line)	
200...240V AC Input:	405V DC bus (equivalent to 290V AC incoming line)	
380...480V AC Input:	810V DC bus (equivalent to 575V AC incoming line)	
525...600V AC Input:	1005V DC bus (equivalent to 711V AC incoming line)	
Bus Undervoltage Trip		
100...120V AC Input:	190V DC bus (equivalent to 75V AC incoming line)	
200...240V AC Input:	190V DC bus (equivalent to 150V AC incoming line)	
380...480V AC Input:	390V DC bus (equivalent to 275V AC incoming line)	
525...600V AC Input		
P038 = 3 “600V”:	487V DC bus (equivalent to 344V AC incoming line)	
P038 = 2 “480V”:	390V DC bus (equivalent to 275V AC incoming line)	
Power Ride-Thru:	100 ms	
Logic Control Ride-Thru:	0.5 s minimum, 2 s typical	
Electronic Motor Overload Protection:	Provides class 10 motor overload protection according to NEC article 430 and motor over-temperature protection according to NEC article 430.126 (A) (2). UL 508C File 29572.	
Overcurrent:	200% hardware limit, 300% instantaneous fault	
Ground Fault Trip:	Phase-to-ground on drive output	
Short Circuit Trip:	Phase-to-phase on drive output	

Electrical

Specifications	PowerFlex 523	PowerFlex 525
Voltage Tolerance:	-15% / +10%	
Frequency Tolerance:	47...63 Hz	
Input Phases:	Three-phase input provides full rating. Single-phase input provides 35% rating on three-phase drives.	
Displacement Power Factor:	0.98 across entire speed range	
Maximum Short Circuit Rating:	100,000 Amps Symmetrical	
Actual Short Circuit Rating:	Determined by AIC Rating of installed fuse/circuit breaker	
Transistor Type:	Isolated Gate Bipolar Transistor (IGBT)	
Internal DC Bus Choke	Only for Frame E drive ratings	
200...240V AC Input:	11 kW (15 HP)	
380...480V AC Input:	15...18.5 kW (20...25 HP) – Heavy Duty	
525...600V AC Input:	15...18.5 kW (20...25 HP) – Heavy Duty	

Control

Specifications	PowerFlex 523	PowerFlex 525
Method	Sinusoidal PWM, Volts/Hertz, Sensorless Vector Control, Economizer SVC motor control, Closed Loop Velocity Vector Control, Surface Mount and Interior Permanent Magnet Motor (without encoder), Interior Permanent Magnet Motor (with encoder) (Closed Loop Velocity Vector Control and PM motor control are not applicable to PowerFlex 523 drives)	
Carrier Frequency	2...16 kHz, Drive rating based on 4 kHz	
Frequency Accuracy		
Digital Input:	Within ±0.05% of set output frequency	
Analog Input:	Within 0.5% of maximum output frequency, 10-Bit resolution	
Analog Output:	±2% of full scale, 10-Bit resolution	

Specifications	PowerFlex 523	PowerFlex 525
Performance		
V/Hz (Volts per Hertz):	±1% of base speed across a 60:1 speed range	
SVC (Sensorless Vector):	±0.5% of base speed across a 100:1 speed range	
SVC Economizer:	±0.5% of base speed across a 100:1 speed range	
	(Applicable to PowerFlex 525 drives only)	
VVC (Velocity Vector Control):	±0.5% of base speed across a 60:1 speed range	
PM Motor(1):	±0.5% of base speed, up to a 20:1 speed range	
Performance with Encoder	(Applicable to PowerFlex 525 drives only)	
SVC (Sensorless Vector):	±0.1% of base speed across a 100:1 speed range(2)	
SVC Economizer:	±0.1% of base speed across a 100:1 speed range(2)	
VVC (Velocity Vector Control):	±0.1% of base speed across a 1000:1 speed range(2)	
PM Motor (iPM motor, 10 HP rating and below)(1):	±0.1% of base speed, up to a 60:1 speed range	
Output Voltage Range:	0V to rated motor voltage	
Output Frequency Range:	0...500 Hz (programmable)	
Efficiency:	97.5% (typical)	
Stop Modes:	Multiple programmable stop modes including – Ramp, Coast, DC-Brake, and Ramp-to-Stop	
Accel/Decel:	Four independently programmable accel and decel times. Each time may be programmed from 0...600 s in 0.01 s increments.	
Intermittent Overload		
Normal Duty:	110% Overload capability for up to 60 s, 150% for up to 3 s Applies for power rating above 15 kW (20 HP) only. Based on 480V drive rating.	
Heavy Duty:	150% Overload capability for up to 60 s, 180% for up to 3 s (200% programmable)	

(1) For details on specific motor performance, see Knowledge Base article "PowerFlex 525 PM Motor Performance Testing Summary".
(2) For more information, see the PowerFlex 520-Series Adjustable Frequency AC Drive User Manual, publication 520-UM001.

Control Inputs

Specifications		PowerFlex 523	PowerFlex 525
Digital	Bandwidth:	10 Rad/s for open and closed loop	
	Quantity:	(1) Dedicated for stop (4) Programmable	(1) Dedicated for stop (6) Programmable
	Current:	6 mA	
	Type		
	Source Mode (SRC):	18...24V = ON, 0...6V = OFF	
	Sink Mode (SNK):	0...6V = ON, 18...24V = OFF	
	Pulse Train		
	Quantity:	(1) Shared with one of the programmable digital input terminals.	
	Input Signal:	Transistor contact (open collector)	
	Input Frequency:	0...100 kHz	
	Current Consumption:	7 mA @ 24V DC maximum	
Analog	Quantity:	(1) Isolated, 0-10V and 4-20 mA	(2) Isolated, -10-10V and 4-20 mA
	Specification		
	Resolution:	10-bit	
	0-10V DC Analog:	100k ohm input impedance	
	4-20 mA Analog:	250 ohm input impedance	
	External Pot:	1...10k ohm, 2 W minimum	

Control Outputs

Specifications		PowerFlex 523	PowerFlex 525
Relay	Quantity:	(1) Programmable Form C	(2) 1 Programmable Form A and 1 Programmable Form B
	Specification Resistive Rating: Inductive Rating:	 3.0 A @ 30V DC, 3.0 A @ 125V, 3.0 A @ 240V AC 0.5 A @ 30V DC, 0.5 A @ 125V, 0.5 A @ 240V AC	
Opto	Quantity:	–	(2) Programmable
	Specification:		30V DC, 50 mA Non-inductive
Analog	Quantity:	(1) Non-Isolated 0-10V or 4-20 mA(1)	
	Specification Resolution: 0-10V DC Analog: 4-20 mA Analog:	 10-bit 1 k ohm minimum 525 ohm maximum	

(1) Feature is not applicable to PowerFlex 523 series A drives.

Encoder

Specifications	PowerFlex 523	PowerFlex 525
Type:	–	Incremental, dual channel
Supply:		12V, 250 mA
Quadrature:		90°, ±27° @ 25 °C
Duty Cycle:		50%, +10%
Requirements:		Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 3.5...26V DC output, single-ended or differential and capable of supplying a minimum of 10 mA per channel. Allowable input is DC up to a maximum frequency of 250 kHz. The encoder I/O automatically scales to allow 5V, 12V and 24V DC nominal voltages.

Switching Power Supplies

Idec
Manufaturer#: PS5R-VF24

PS5R-V Series

STANDARDS COMPLIANCE

Applicable Standards	Mark	File No. or Organization
UL508 UL1310[1] ANSI/ISA 12.12.01 CSA C22.2 No.107.1 CSA C22.2 No.213 CSA C22.2 No.223[1]	c UL us	UL/c-UL Listed File No. E467154, E177168
EN60950-1 EN50178 EN61204-3 EN50581	TÜV	TÜV SÜD[2]
	CE	EU Low Voltage Directive, EMC Directive RoHS Directive
SEMI F47	—	EPRI

Note 1: PS5R-VA/VB/VC/VD/VE only
Note 2: EN60950-1, EN50178 only

PART NUMBERS

Output Capacity	Part Number	Input Voltage	Output Voltage	Output Current
7.5W	PS5R-VA05	100 to 240V AC (Voltage range: 85 to 264V AC / 100 to 370V DC)	5V	1.5A
	PS5R-VA12		12V	0.6A
	PS5R-VA24		24V	0.3A
10W	PS5R-VB05		5V	2.0A
15W	PS5R-VB12		12V	1.3A
	PS5R-VB24		24V	0.65A
30W	PS5R-VC12		12V	2.5A
	PS5R-VC24		24V	1.3A
60W	PS5R-VD24		24V	2.5A
90W	PS5R-VE24		24V	3.75A
120W	PS5R-VF24		24V	5.0A
240W	PS5R-VG24		24V	10.0A

Part Number Structure

PS5R - V □ □

Output Capacity
A: 7.5W
B: 10W/15W
C: 30W
D: 60W
E: 90W
F: 120W
G: 240W

Output Voltage
05: 5V[3]
12: 12V[4]
24: 24V

Note 3: PS5R-VA/VB only
Note 4: PS5R-VA/VB/VC only
Use only for interpreting part numbers.
Do not use for developing part numbers.

PRODUCT DESCRIPTION

DIN-rail mount switching power supplies with global approvals for both industrial and hazardous locations

KEY FEATURES

- Compact size preserves panel space
- Slim size (width):
  22.5mm (10W/15W/30W)
  36mm (60W/90W)
  46mm (120W)
  60mm (240W)
- Universal Voltage Input:
  85-264V AC/100-370V DC
- Wide operating temperature range
- Spring-up terminals accept ring & fork terminals
- Approved for use in Class I Division 2 hazardous locations
- Can be installed in 6 directions
- 10W ~ 90W meet NEC Class 2 output ratings
- Overcurrent protection with auto-reset
- Meets SEMI F47 Sag Immunity (208V AC input)
- RoHS compliant
- Five-year factory warranty

SPECIFICATIONS

Model		5V DC output	PS5R-VA05	PS5R-VB05	-	-	-	-	-
		12V DC output	PS5R-VA12	PS5R-VB12	PS5R-VC12	-	-	-	-
		24V DC output	PS5R-VA24	PS5R-VB24	PS5R-VC24	PS5R-VD24	PS5R-VE24	PS5R-VF24	PS5R-VG24
Output Capacity			7.5W	15W (5V Model is 10W)	30W	60W	90W	120W	240W
Input	Rated Input Voltage (Single-phase two-wire)[1]		100 to 240V AC (Voltage range: 85 to 264V AC/100 to 370V DC) (Load ≤ 80% at 100-105V DC)						
	Frequency		50/60 Hz						
	Input Current (Typ.)	100V AC	5V: 0.20A 12V, 24V: 0.18A	5V: 0.25A 12V, 24V: 0.35A	0.7A	1.3A	1.1A	1.4A	2.7A
		230V AC	5V: 0.12A 12V, 24V: 0.10A	5V: 0.14A 12V, 24V: 0.19A	0.3A	0.8A	0.6A	0.7A	1.2A
	Inrush Current (Typ.) (Ta=25°C, cold start)	100V AC	15A	18A					14A
		230V AC	36A	45A				41A	30A
	Leakage Current	120V AC	0.5mA max.						
		230V AC	1.0mA max.						
	Efficiency (Typ.) (at rated output)[2]	100V AC	5V: 74%, 12V: 79%, 24V: 80%	5V: 77%, 12V: 82%, 24V: 84%	12V: 83%, 24V: 85%	86%	88%		89%
		230V AC	5V: 73%, 12V: 77%, 24V: 76%	5V: 73%, 12V: 80%, 24V: 81%	12V: 85%, 24V: 87%	86%	89%		90%
	Power Factor (Typ.)	100V AC	—	—	—	—	0.99		
		230V AC	—	—	—	—	0.86	0.92	0.96
Output	Rated Voltage/Current		5V/1.5A, 12V/0.6A, 24V/0.3A	5V/2.0A[3], 12V/1.3A, 24V/0.65A	12V/2.5A, 24V/1.3A	24V/2.5A	24V/3.75A	24V/5A	24V/10A
	Adjustable Voltage Range		±10%				±5%	±10%	
	Output Holding Time (Typ.) (at rated output)	100V AC	45ms	5V: 53ms, 12V: 34ms, 24V: 36ms	12V: 13ms, 24V: 15ms	13ms	20ms	30ms	
		230V AC	285ms	5V: 330ms 12V: 215ms 24V: 230ms	12V: 110ms 24V: 110ms	105ms	30ms	33ms	40ms
	Start Time (at rated input and output)		500ms max.	500ms max.	600ms max.	800ms max.		700ms max.	800ms max.
	Rise Time (at rated input and output)		5V, 12V: 200ms max 24V: 250ms max	5V, 12V: 200ms max. 24V: 250ms max.	200ms max.				
	Regulation	Input Fluctuation	0.4% max.						
		Load Fluctuation	5V: 2.5% max. 12V, 24V: 1.0% max.		1.0% max.				
		Temperature Change	0.04%/°C max. (-10 to +65°C)	0.05%/°C max. (-10 to +65°C)	12V: 0.05%/°C max. (-10 to +50°C) 24V: 0.05%/°C max. (-10 to +55°C)	0.05%/°C max. (-10 to +55°C)	0.05%/°C max. (-10 to +50°C)	0.05%/°C max. (-25 to +55°C)	0.05%/°C max. (-25 to +50°C)
		Ripple (including noise)	5V: 8% p-p max. (-25 to -10°C) 12V: 6% p-p max. (-25 to -10°C) 24V: 4% p-p max. (-25 to -10°C)	5V: 8% p-p max. (-25 to -10°C) 12V: 6% p-p max. (-25 to -10°C) 24V: 4% p-p max. (-25 to -10°C)	12V: 6% p-p max. (-25 to -10°C) 24V: 4% p-p max. (-25 to -10°C)	4% p-p max. (-25 to -10°C)			
			5V: 5% p-p max. (-10 to +0°C) 12V: 2.5% p-p max. (-10 to +0°C) 24V: 1.5% p-p max. (-10 to +0°C)	5V: 5% p-p max. (-10 to +0°C) 12V: 2.5% p-p max. (-10 to +0°C) 24V: 1.5% p-p max. (-10 to +0°C)	12V: 2.5% p-p max. (-10 to +0°C) 24V: 1.5% p-p max. (-10 to +0°C)	1.5% p-p max. (-10 to +0°C)			
			5V: 2.5% p-p max. (0 to +65°C) 12V: 1.5% p-p max. (0 to +65°C) 24V: 1% p-p max. (0 to +65°C)	5V: 2.5% p-p max. (0 to +65°C) 12V: 1.5% p-p max. (0 to +65°C) 24V: 1% p-p max. (0 to +65°C)	12V: 1.5% p-p max. (0 to +50°C) 24V: 1% p-p max. (0 to +55°C)	1% p-p max. (0 to +55°C)	1% p-p max. (0 to +50°C)	1% p-p max. (0 to +55°C)	1% p-p max. (0 to +50°C)
Overcurrent Protection			105% min. (auto reset)				101% min. (auto reset)	105% min. (auto reset)	
Operation Indicator			LED (green)						
Dielectric Strength	Between input and output terminals		3,000V AC, 1 minute						
	Between input and ground terminals		2,000V AC, 1 minute						
	Between output and ground terminals		500V AC, 1 minute						
Insulation Resistance			Between input and output terminals: 100MΩ min. (500V DC megger) Between input and ground terminals: 100MΩ min. (500V DC megger)						
Operating Temperature[4] (No freezing)			-25 to +75°C		-25 to +70°C		-25 to +65°C		
Operating Humidity (no condensation)			20 to 90% RH						
Storage Temperature (No freezing)			-25 to +75°C						
Storage Humidity (no condensation)			20 to 90% RH						
Vibration Resistance			10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL6 end clips)			10 to 55Hz, amplitude 0.33mm, 2 hours each in 3 axes (when used with BNL6 end clips) 10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL8 end clips)		10 to 55Hz, amplitude 0.21mm, 2 hours each in 3 axes (when used with BNL6 end clips) 10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL8 end clips)	10 to 55 Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with part no. BNL6 mounting clips)
Shock Resistance			300 m/s^2 (30G), 3 times each in 6 directions						
Expected Life[5]			8 years minimum (at the rated input, 50% load, operating temperature +40°C, standard mounting direction)						
EMC	EMI		EN61204-3 (Class B)						
	EMS		EN61204-3 (industrial)						
Safety Standards			UL508 (Listing), UL1310 Class 2, ANSI/ISA-12.12.01 CSA C22.2 No. 107.1, 213, 223 EN60950-1, EN50178					UL508 (Listing) ANSI/ISA-12.12.01 CSA C22.2 No. 107.1, 213 EN60950-1, EN50178	
Other Standard			SEMI F47 (at 208V AC input only)						
Degree of Protection			IP20 (EN60529)						
Dimensions (mm)			75H × 45W × 70D	90H × 22.5W × 95D		95H × 36W × 108D		115H × 46W × 121D	125H × 60W × 125D
Weight (approx.)			130g	140g	150g	260g	310g	470g	960g
Terminal Screw			M3.5						

*At normal temperature and humidity unless otherwise specified.
Note 1: DC input voltage is not subject to safety standards. When using on DC input, connect a fuse to the input terminal for DC input protection.
Note 2: Under stable state.
Note 3: PS5R-VB05 (5V DC/2.0A) is 10W (Up to 3.0A at Ta = 0 to 40°C. Not subject to safety standards above 2.0A.)
Note 4: See the output derating curves.
Note 5: Calculation of the expected life is based on the actual life of the aluminum electrolytic capacitor. The expected life depends on operating conditions.

SIEMENS

Siemens
Manufaturer#: MT0500A

Data sheet

US2:MT0500A

Control Power Transformer, 500va, PRI 240x480 230x460 220 440v, SEC 120/115/110v, Domestic,

product brand name	Control Power Transformer
design of the product	Control power voltage
special product feature	Robust design
General technical data	
weight [lb]	19.2 lb
Height x Width x Depth [in]	5.69 × 5.25 × 5.92 in
ambient temperature [°F] during operation	-4 ... +104 °F
ambient temperature during operation	-20 ... +40 °C
country of origin	Mexico
operating apparent power rated value	500 VA
Enclosure	
design of the housing	Open
Mounting/wiring	
mounting position	Any
fastening method	Surface mounting
type of electrical connection at input for main current circuit	Screw-type terminals (touchsafe)
Inputs/ Outputs	
input variables of primary voltage	240x480,230x460,220x440vac
output dimensions of secondary voltage	120/115/110vac
design of fuse holder of the secondary section	touch-safe cover required
phase number of the inputs	1
electrical input frequency	50 ... 60 Hz
input voltage _1	240 V
input voltage _2	480 V
input voltage _3	230 V
input voltage _4	460 V
input voltage _5	220 V
input voltage _6	440 V
phase number of the outputs	1
electrical output frequency	60 ... 50 Hz
output voltage _1 rated value	120 V
output voltage _3 rated value	110 V
output voltage _2 rated value	115 V
certificate of suitability	UL / CSA

Further information

Industrial Controls - Product Overview (Catalogs, Brochures,…)
www.usa.siemens.com/iccatalog
Industry Mall (Online ordering system)
https://mall.industry.siemens.com/mall/en/us/Catalog/product?mlfb=US2:MT0500A
Service&Support (Manuals, Certificates, Characteristics, FAQs,...)
https://support.industry.siemens.com/cs/US/en/ps/US2:MT0500A
Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...)

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MACX MCR-EX-SL-2NAM-R-UP - Isolation amplifier

2865984

https://www.phoenixcontact.com/us/products/2865984

Phoenix Contact
Manufaturer#: 2865984

Technical data

Product properties

Product type	Isolating switch transf.
Product family	MACX Analog
No. of channels	2
Type	Ex i signal conditioners with SIL functional safety
Configuration	DIP switches

Data management status

Article revision	12

System properties

Functionality

Configuration	DIP switches

Electrical properties

Electrical isolation	3-way isolation
Electrical isolation between input and output	yes
Maximum power dissipation for nominal condition	≤ 1.3 W
Step response (10-90%)	typ. 6 ms (N/O contact: OFF/ON)
	typ. 6 ms (N/O contact: ON/OFF)
	typ. 4 ms (N/C contact: ON/OFF)
	typ. 10 ms (N/C contact: OFF/ON)

Electrical isolation

Test voltage	2.5 kV AC (50 Hz, 60 s)

Electrical isolation Input/output IEC/EN 60079-11

Standards/regulations	IEC/EN 60079-11
Rated insulation voltage	375 V_{PP}
Overvoltage category	III
Pollution degree	2

Electrical isolation Input/power supply IEC/EN 60079-11

Standards/regulations	IEC/EN 60079-11
Rated insulation voltage	375 V_{PP}
Overvoltage category	II
Pollution degree	2

Electrical isolation Input/power supply IEC/EN 61010-1

Standards/regulations	IEC/EN 61010-1
Rated insulation voltage	300 V_{rms}
Overvoltage category	II
Pollution degree	2

Insulation	Safe isolation

Electrical isolation Output 1/output 2/input, power supply IEC/EN 61010-1

Standards/regulations	IEC/EN 61010-1
Rated insulation voltage	300 V_{rms}
Overvoltage category	III
Pollution degree	2
Insulation	Safe isolation

Supply

Nominal supply voltage range	24 V AC/DC ... 230 V AC/DC -20 % ... +10 % (50/60 Hz)
Supply voltage range	19.2 V AC/DC ... 253 V AC/DC (50/60 Hz)
Max. current consumption	< 80 mA
	< 42 mA (24 V DC)
Power dissipation	< 1.1 W
Power consumption	< 1.1 W

Input data

Signal: NAMUR

Description of the input	Intrinsically safe
Number of inputs	2
Available input sources	NAMUR proximity sensors (IEC/EN 60947-5-6)
	Floating switch contacts
	Switch contacts with resistance circuit
Switching threshold "0" signal current	< 1.2 mA (blocking)
Switching threshold "1" signal, current	> 2.1 mA (conductive)
Short-circuit current	8 mA
Switching hysteresis	< 0.2 mA
Line fault detection	< 0.05 mA ... 0.35 mA (Line break)
	< 100 Ω ... 360 Ω (Short circuit)
	Activated /deactivated via DIP switch
Non-load voltage	8 V DC

Output data

Switching: Relay

Contact switching type	1 changeover contact per channel
Contact material	$AgSnO_2$, hard gold-plated
Maximum switching voltage	250 V AC (2 A, 60 Hz)
	120 V DC (0.2 A)
	30 V DC (2 A)
Maximum switching capacity	500 VA
Recommended minimum load	5 V / 10 mA

Signal

Phoenix Contact
Manufaturer#: 0801733

DIN rail perforated - NS 35/ 7,5 PERF 2000MM - 0801733

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DIN rail perforated, Standard profile, width: 35 mm, height: 7.5 mm, in acc. with EN 60715: 2001, material: Steel, galvanized, passivated with a thick layer, length: 2000 mm, color: silver

RoHS

Key Commercial Data

Packing unit	1 M
Minimum order quantity	5 M
GTIN	4 017918 006686
GTIN	4017918006686
Weight per Piece (excluding packing)	1.000 g
Custom tariff number	72166190
Country of origin	Germany

Technical data

Dimensions

Height	7.5 mm
Length	2000 mm
Width	35 mm
Hole width	15.00 mm
Hole height	6.20 mm
Drill hole spacing	25.00 mm

General

Material	Steel
Coating	galvanized, passivated with a thick layer
Color	silver

Phoenix Contact
Manufaturer#: 3044102

Feed-through terminal block - UT 4 - 3044102

Technical data

General

Nominal cross section	4 mm²
Color	gray
Insulating material	PA
Flammability rating according to UL 94	V0
Area of application	Railway industry
	Machine building
	Plant engineering
	Process industry
Rated surge voltage	8 kV
Degree of pollution	3
Overvoltage category	III
Insulating material group	I
Maximum power dissipation for nominal condition	1.02 W
Maximum load current	41 A (with 6 mm² conductor cross section)
Nominal current I_N	32 A (with 4 mm² conductor cross section)
Nominal voltage U_N	1000 V
Open side panel	Yes
Shock protection test specification	DIN EN 50274 (VDE 0660-514):2002-11
Back of the hand protection	guaranteed
Finger protection	guaranteed
Result of surge voltage test	Test passed
Surge voltage test setpoint	9.8 kV
Result of power-frequency withstand voltage test	Test passed
Power frequency withstand voltage setpoint	2.2 kV
Result of the test for mechanical stability of terminal points (5 x conductor connection)	Test passed
Result of bending test	Test passed
Bending test rotation speed	10 rpm
Bending test turns	135
Bending test conductor cross section/weight	0.14 mm² / 0.2 kg
	4 mm² / 0.9 kg
	6 mm^2 / 1.4 kg
Tensile test result	Test passed
Conductor cross section tensile test	0.14 mm²
Tractive force setpoint	10 N
Conductor cross section tensile test	4 mm²
Tractive force setpoint	60 N

Phoenix Contact
Manufaturer#: 3044128

Ground modular terminal block - UT 4-PE - 3044128

Technical data

General

	Machine building
	Plant engineering
	Process industry
Rated surge voltage	8 kV
Degree of pollution	3
Overvoltage category	III
Insulating material group	I
Open side panel	Yes
Oscillation, broadband noise test result	Test passed
Test specification, oscillation, broadband noise	DIN EN 50155 (VDE 0115-200):2008-03
Test spectrum	Service life test category 1, class B, body mounted
Test frequency	f_1 = 5 Hz to f_2 = 150 Hz
ASD level	1.857 $(m/s^2)^2$/Hz
Acceleration	0,8 g
Test duration per axis	5 h
Test directions	X-, Y- and Z-axis
Shock test result	Test passed
Test specification, shock test	DIN EN 50155 (VDE 0115-200):2008-03
Shock form	Half-sine
Acceleration	5 g
Shock duration	30 ms
Number of shocks per direction	3
Test directions	X-, Y- and Z-axis (pos. and neg.)
Relative insulation material temperature index (Elec., UL 746 B)	130 °C
Temperature index of insulation material (DIN EN 60216-1 (VDE 0304-21))	125 °C
Static insulating material application in cold	-60 °C
Behavior in fire for rail vehicles (DIN 5510-2)	Test passed
Flame test method (DIN EN 60695-11-10)	V0
Oxygen index (DIN EN ISO 4589-2)	>32 %
NF F16-101, NF F10-102 Class I	2
NF F16-101, NF F10-102 Class F	2
Surface flammability NFPA 130 (ASTM E 162)	passed
Specific optical density of smoke NFPA 130 (ASTM E 662)	passed
Smoke gas toxicity NFPA 130 (SMP 800C)	passed
Calorimetric heat release NFPA 130 (ASTM E 1354)	27,5 MJ/kg
Fire protection for rail vehicles (DIN EN 45545-2) R22	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R23	HL 1 - HL 3

Phoenix Contact
Manufaturer#: 3047028

End cover - D-UT 2,5/10 - 3047028

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End cover, Length: 47.7 mm, Width: 2.2 mm, Height: 48.4 mm, Color: gray

Key Commercial Data

Packing unit	1 pc
Minimum order quantity	50 pc
Weight per Piece (excluding packing)	2.4 g
Custom tariff number	85389099
Country of origin	Germany

Technical data

Product type	End cover

Classifications

eCl@ss

eCl@ss 4.0	27141111
eCl@ss 4.1	27141111
eCl@ss 5.0	27141133
eCl@ss 5.1	27141133
eCl@ss 6.0	27141133
eCl@ss 7.0	27141133
eCl@ss 8.0	27141133

ETIM

ETIM 2.0	EC000886
ETIM 3.0	EC000886
ETIM 4.0	EC000886
ETIM 5.0	EC000886

Phoenix Contact
Manufaturer#: 0800886

End clamp - E/NS 35 N - 0800886

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End clamp, width: 9.5 mm, color: gray

Product Features

- Large-surface labeling

Key commercial data

Packing unit	1 pc
GTIN	4 017918 129309
Weight per Piece (excluding packing)	14.8 GRM
Custom tariff number	39269097
Country of origin	Germany

Technical data

Dimensions

Height	32.8 mm
Length	48.6 mm
Width	9.5 mm

General

Material	PA
Color	gray
Tightening torque, min	0.4 Nm
Tightening torque max	0.5 Nm

FBS 10-6 - Plug-in bridge

3030271

https://www.phoenixcontact.com/us/products/3030271

Phoenix Contact
Manufaturer#: 3030271

Technical data

Product properties

Product type	Plug-in bridge
Number of positions	10
Pitch	6.2 mm

Electrical properties

Maximum load current	32 A (The current values for the jumpers can deviate when used in different modular terminal blocks. The precise values can be found in the accessories data for the respective modular terminal blocks.)

Connection data

Maximum load current	32 A (The current values for the jumpers can deviate when used in different modular terminal blocks. The precise values can be found in the accessories data for the respective modular terminal blocks.)

Dimensions

Width	60.3 mm
Height	23 mm
Depth	23 mm
Pitch	6.2 mm

Material specifications

Color	red (RAL 3001)
Material	Copper
Flammability rating according to UL 94	V0
Insulating material	PA

Environmental and real-life conditions

Ambient conditions

Ambient temperature (operation)	-60 °C ... 110 °C (Operating temperature range incl. self-heating; for max. short-term operating temperature, see RTI Elec.)
Ambient temperature (storage/transport)	-25 °C ... 60 °C (for a short time, not exceeding 24 h, -60 °C to +70 °C)
Ambient temperature (assembly)	-5 °C ... 70 °C
Ambient temperature (actuation)	-5 °C ... 70 °C
Permissible humidity (operation)	20 % ... 90 %
Permissible humidity (storage/transport)	30 % ... 70 %

Mounting

Mounting type	Plug-in mounting

ATP-UT - Partition plate

3047167

https://www.phoenixcontact.com/us/products/3047167

Phoenix Contact
Manufaturer#: 3047167

Technical data

Product properties

Product type	Partition plate

Dimensions

Width	2.2 mm
Height	53.4 mm
Depth	45.7 mm

Material specifications

Color	gray (RAL 7042)
Material	PA
Flammability rating according to UL 94	V0
Static insulating material application in cold	-60 °C
Relative insulation material temperature index (Elec., UL 746 B)	130 °C
Fire protection for rail vehicles (DIN EN 45545-2) R22	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R23	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R24	HL 1 - HL 3
Fire protection for rail vehicles (DIN EN 45545-2) R26	HL 1 - HL 3
Surface flammability NFPA 130 (ASTM E 162)	passed
Specific optical density of smoke NFPA 130 (ASTM E 662)	passed
Smoke gas toxicity NFPA 130 (SMP 800C)	passed

Environmental and real-life conditions

Ambient conditions

Ambient temperature (operation)	-60 °C ... 110 °C (Operating temperature range incl. self-heating; for max. short-term operating temperature, see RTI Elec.)
Ambient temperature (storage/transport)	-25 °C ... 60 °C (for a short time, not exceeding 24 h, -60 °C to +70 °C)
Ambient temperature (assembly)	-5 °C ... 70 °C
Ambient temperature (actuation)	-5 °C ... 70 °C
Permissible humidity (operation)	20 % ... 90 %
Permissible humidity (storage/transport)	30 % ... 70 %

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6.2 Instrumentation

- Instrumentation Specification Sheets
- Instrumentation Data Sheets

INSTRUMENTS AND ACCESSORIES

Spray Nozzle

Material:	PVC
Process Connection:	1/4" NPT
Quantity:	Four (4) per system (I-BOx® 5000)
	Twenty-seven (27) per system (I-BOx® 8025)
IMS Part No.:	P71152

Pressure Regulator (I-BOx® 5000)

Range:	15-75 psi
Process Connection:	3/4" Union
Quantity:	One (1) Per System
IMS Part No.:	P70567

Pressure Regulator (I-BOx® 8025)

Range:	15-75 psi
Process Connection:	1" Union
Quantity:	One (1) Per System
IMS Part No.:	P70574

Solenoid Valve (I-BOx® 5000)

Material:	Brass
Contact Type:	NC (Close when de-energize)
Power Rating:	110V @ 1.5 W
Enclosure Rating:	NEMA 4X
Process Connection:	3/4" NPT
Quantity:	One (1) Per System
IMS Part No.:	P70565

Solenoid Valve (I-BOx® 8025)

Material:	Brass
Contact Type:	NC (Close when de-energize)
Power Rating:	110V @ 1.5 W

Enclosure Rating:	NEMA 4X
Process Connection:	1" NPT
Quantity:	One (1) Per System
IMS Part No.:	P70573

Water Flow Control Valve (I-BOx® 5000)

Type:	Gate
Process Connection:	3/4" FNPT
Material:	PVC
O-ring:	EPDM
Quantity:	One (1) Per System
IMS Part No.:	P70569

Water Flow Control Valve (I-BOx® 8025)

Type:	Gate
Process Connection:	1" FNPT
Material:	PVC
O-ring:	EPDM
Quantity:	One (1) Per System
IMS Part No.:	P70570

Flow Meter (I-BOx® 5000)

Capacity:	0 ~ 10 gpm
Material:	Acrylic with EPR O-rings and PVC Fittings
Process Connection:	1" FNPT
Quantity:	One (1) Per System
IMS Part No.:	P71334

Flow Meter (I-BOx® 8025)

Capacity:	0 ~ 30 gpm
Material:	Acrylic with EPR O-rings and PVC Fittings
Process Connection:	1" FNPT
Quantity:	One (1) Per System
IMS Part No.:	P71335

Pressure Gauge

Manufacturer:	Ashcroft Instruments
Dia. Size:	2.5"
Housing:	304SST
Process Connection:	1/4" NPT
Quantity:	One (1) Per System
IMS Part No.:	P73026

Ball Valve (I-BOx® 5000)

Type:	Compact Ball Valve
O-ring Material:	EPDM
Body Material:	PVC
Process Connection	1"
Qty.:	One (1) Per System
IMS Part No.:	P71093

Ball Valve (I-BOx® 8025)

Type:	Compact Ball Valve
O-ring Material:	EPDM
Body Material:	PVC
Process Connection	2"
Qty.:	One (1) Per System
IMS Part No.:	P70583

Anchoring Bolt Assembly

Nominal Dims.:	5/8" Dia. X 6" L
Accessories:	(2) flat washers, (1) Lock Washer, (2) Hex Nut
Material of Construction:	316 SST
Chemical Adhesive:	Hilti HY200V3
Anchor Data:	Hilti HAS-R304-316 SS – 3/8" x 6" Embedment Length
Quantity:	Four (4) Anchors Per System (I-BOx® 5000)
	Four (4) Anchors Per System (Remote Skids)
	Twenty-four (24) Anchors Per System (I-BOx® 8025)

Differential Pressure Gauge

Manufacturer:	Dwyer
Range:	0-8” w.c. (I-BOx® 5000)
	0-12 w.c. (I-BOx® 8025)
Dia. Size:	4"
Housing:	Aluminum
Process Connection:	1/8˝ female NPT duplicate high and low pressure taps
Quantity:	One (1) Per System
IMS Part No.:	P72347

Differential Pressure switch

Manufacturer:	Dwyer
Range:	1.4-5.5” w.c. (I-BOx® 5000)
	3-11” w.c. (I-BOx® 8025)
Rating:	Explosion-proof, Weather-proof
Mounting:	Vertical Diaphragm
Electrical Connection:	Screw terminal
Process Connection:	1/8˝ NPT Female
Quantity:	One (1) Per System
IMS Part No.:	P71847

Nutrient Tank Low Level Switch

Type:	Single Pole, NC
Material:	Fortron / Hastelloy
Process Connection:	1/4" MPT
Quantity	One (1) Per System
IMS Part No.:	P71148

TF

Wide Range of Flows and Angles

60°, 90°, 120° Metal

DESIGN FEATURES

- The original spiral nozzle invented by BETE and continuously improved!
- High energy efficiency
- One-piece/no internal parts
- Clog-resistant performance
- High discharge velocity
- Male connection standard; female connection available by special order

SPRAY CHARACTERISTICS

- Wide range of flow rates and spray angles
- Fine atomization

Spray patterns: Full Cone.

For Hollow Cone, see page 45

Spray angles: 50° to 180°

Flow rates: 0.5 to 3320 gpm (Higher flow rates available)

Available with FM approval: N series (page 102), 1/4" TF8 NN, FCN in brass, 1/2" TF24-150 in multiple materials

Full Cone 60° (NN)

Full Cone 90° (FCN)

Full Cone 150°/170°

90°, 120°

150°, 170°

Dimensions are approximate. Check with BETE for critical dimension applications.

TF Full Cone Flow Rates and Dimensions

Full Cone, 60° (NN), 90° (FCN or FFCN), 120° (FC or FFC), 150°, and 170° Spray Angles, 1/8" to 4" Pipe Sizes

Male Pipe Size	Nozzle Number	Available Spray Angles 60°	90°	120°	150°	170°	K Factor	GALLONS PER MINUTE @ PSI 5 PSI	10 PSI	20 PSI	30 PSI	40 PSI	50 PSI	60 PSI	80 PSI	100 PSI	200 PSI	400 PSI	Approx. (in.) Orif. Dia.	Free Pass. Dia.	Dim. (in.) for Metal Only* A**	B	C	Wt. (oz.) 60° 90° 120° Metal	Plas.
															PTFE not recommended at pressures above red line		Metal ONLY at pressures above green line								
1/8	TF6	60°	90°	120°	150°	170°	0.221	0.495	0.70	0.99	1.21	**1.40**	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.69	0.56	1.69	1.00	0.20
	TF8	60°	90°	120°	150°	170°	0.411	0.919	1.30	1.84	2.25	**2.60**	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	1.69	0.56	2.19		
1/4	TF6	60°	90°	120°	150°	170°	0.221	0.495	0.70	0.99	1.21	**1.40**	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09	1.88	0.56	1.88	1.25	0.20
	TF8	60°	90°	120°	150°	170°	0.411	0.919	1.30	1.84	2.25	**2.60**	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13	1.88	0.56	2.38		
	TF10	60°	90°	120°	150°	170°	0.632	1.41	2.00	2.83	3.46	**4.00**	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13	1.88	0.56	2.38		
3/8	TF6	60°	90°	120°			0.221	0.495	0.70	0.99	1.21	**1.40**	1.57	1.71	1.98	2.21	3.13	4.43	0.09	0.09					
	TF8	60°	90°	120°			0.411	0.919	1.30	1.84	2.25	**2.60**	2.91	3.18	3.68	4.11	5.81	8.22	0.13	0.13					
	TF10	60°	90°	120°			0.632	1.41	2.00	2.83	3.46	**4.00**	4.47	4.90	5.66	6.32	8.94	12.6	0.16	0.13					
	TF12	60°	90°	120°	150°	170°	0.949	2.12	3.00	4.24	5.20	**6.00**	6.71	7.35	8.49	9.49	13.4	19.0	0.19	0.13	1.88	0.69	2.38	1.63	0.25
	TF14	60°	90°	120°	150°	170°	1.28	2.86	4.05	5.73	7.01	**8.10**	9.06	9.92	11.5	12.8	18.1	25.6	0.22	0.13					
	TF16	60°	90°	120°	150°	170°	1.68	3.75	5.30	7.50	9.18	**10.6**	11.9	13.0	15.0	16.8	23.7	33.5	0.25	0.13					
	TF20	60°	90°	120°	150°	170°	2.61	5.83	8.25	11.7	14.3	**16.5**	18.4	20.2	23.3	26.1	36.9	52.2	0.31	0.13					
1/2	TF24	60°	90°	120°	150°	170°	3.81	8.52	12.1	17.0	20.9	**24.1**	26.9	29.5	34.1	38.1	53.9	76.2	0.38	0.19	2.50	0.88	3.06	3.00	0.50
	TF28	60°	90°	120°	150°	170°	5.22	11.7	16.5	23.3	28.6	**33.0**	36.9	40.4	46.7	52.2	73.8	104	0.44	0.19					
3/4	TF32	60°	90°	120°	150°	170°	6.64	14.8	21.0	29.7	36.4	**42.0**	47.0	51.4	59.4	66.4	93.9	133	0.50	0.19	2.75	1.13	3.50	5.50	0.88
1	TF40	60°	90°	120°	150°	170°	10.6	23.7	33.5	47.4	58.0	**67.0**	74.9	82.1	94.8	106	150	212	0.63	0.25	3.63	1.38	4.38	8.50	2.50
	TF48	60°	90°	120°	150°	170°	15.0	33.6	47.5	67.2	82.3	**95.0**	106	116	134	150	212	300	0.75	0.25					
1 1/2	TF56	60°	90°	120°	150°	170°	20.4	45.6	64.5	91.2	112	**129**	144	158	182	204	288	408	0.88	0.31			5.38		
	TF64	60°	90°	120°	150°	170°	26.7	59.7	84.5	120	146	**169**	189	207	239	267	378	534	1.00	0.31	4.38	2.00	5.38	22.0	4.25
	TF72	60°	90°	120°	150°	170°	30.4	67.9	96.0	136	166	**192**	215	235	272	304	429	607	1.13	0.31			5.63		
2	TF88	60°	90°	120°	150°	170°	44.3	99.0	140	**198**	242	280	313	343	396	443	626	885	1.38	0.44	5.63	2.50	5.88	46.0	8.00
	TF96 [1]	60°	90°	120°	150°	170°	55.9	125	177	**250**	306	354	395	433	500	559	791	1120	1.50	0.44	6.88	2.50	7.00	54.0	9.00
3	TF112 [1]	60°	90°	120°	150°	170°	81.0	181	256	**362**	443	512	572	627	724	810	1150	1620	1.75	0.56	8.63	3.50	9.25	114	20.0
	TF128 [1]	60°	90°	120°	150°	170°	107	239	339	**480**	588	679	759	831	960	1070	1510	2150	2.00	0.56					
4	TF160 [1]	60°	90°	120°			166	371	**525**	742	909	1050	1170	1290	1480	1660	2350	3320	2.50	0.63	10.1	4.50		169	27.0

Flow Rate (GPM) $= K\sqrt{PSI}$ *Dimensions are for bar stock, cast sizes may vary. **60° nozzles slightly longer, consult BETE. [1] Three turn nozzles

Standard Materials: Brass, 316 Stainless Steel, PVC, Polypropylene, Cobalt Alloy 6, and PTFE (Poly. not available for TF6 thru TF10).

Spray angle performance varies with pressure. Contact BETE for specific data on critical applications.

***TO ORDER:** specify pipe size, connection type, nozzle number, spray angle, and material.*

Model 70XL

Water Pressure Reducing Valve

Application

Ideal for use where Lead-Free* valves are required. Designed for installation on potable water lines to reduce high inlet pressure to a lower outlet pressure. The unitized replaceable cartridge reduces time involved with cleaning and maintenance. The direct acting integral bypass design prevents buildup of excessive system pressure caused by thermal expansion. The balanced piston design enables the regulator to react in a smooth and responsive manner to changes in system flow demand, while at the same time, providing protection from inlet pressure changes.

Standards Compliance

- ASSE® Listed 1003
- IAPMO® Listed
- CSA® Certified
- City of Los Angeles Approved
- NSF® Listed, Standard 61, Annex G*
- Certified to NSF/ANSI 372* by IAPMO R&T

*(0.25% MAX. WEIGHTED AVERAGE LEAD CONTENT)

Materials

Body and bell	Cast bronze, ASTM B 584
Seat	Stainless Steel, 300 series
Stem & sleeve	Stainless Steel, 300 series
Elastomers	Buna nitrile, FDA (CFR) 21, 177.2600 EPDM, FDA (CFR) 21, 177.2600
Strainer screen	Stainless Steel, 300 series

Features

Sizes: 3/4", 1"

Maximum working water pressure	300 psi
Maximum working water temperature	140°F
Reduced pressure range	25 psi to 75 psi
Factory preset	50 psi
Threaded connections (FNPT)	ANSI B1.20.1
Copper connections (FC)	ANSI B16.22
CPVC tailpiece: Max. hot water temp.	180°F @ 100 psi
Cold water rated temp.	73.4°F @ 400 psi

Options

(Suffixes can be combined)

- ☐ - standard with single union FNPT connection and 20 mesh strainer screen
- ☐ C - with FC (copper sweat) union connection
- ☐ DM - double male meter tailpiece connection (3/4); 1" National Hose Thread fits 5/8" x 3/4" and 3/4" water meters (no union included)
- ☐ DU - with double union FNPT connection
- ☐ P - tapped & plugged for gauge
- ☐ SC - sealed cage bell housing and stainless steel adjusting screw
- ☐ SS - sealed cage bell housing with stainless steel adjusting screw and spring
- ☐ CPVC - CPVC tailpiece connection
- ☐ LP - low pressure outlet 10-35 psi available in 3/4" single union, & 3/4" double union
- ☐ CM - with male copper sweat union connection
- ☐ DUPF - with Z-Bite™ push fit tailpiece connection 250 psi max pressure
- ☐ DUPR - with Z-Press™ press fit tailpiece connection 250 psi max pressure

Accessories

- ☐ Repair kit
- ☐ Water thermal expansion tank (Model XT)
- ☐ Special in-line spacer nipple (34-70DUSPC & 1-70DUSPC)
- ☐ In-line strainer screen for DUSPC (SCR)
- ☐ Water hammer arrester (Model 1250XL)
- ☐ Z-Bite™ push fit Tailpiece kit (TPKXLPF) 250 psi max pressure
- ☐ Z-Press™ press fit Tailpiece kit (TPKXLPR) 250 psi max pressure

Dimensions & Weights (do not include pkg.)

SIZE		CONNECTIONS	DIMENSIONS (approximate)								WEIGHT	
			A		B		C		D			
in.	mm		in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kg.
3/4	20	SINGLE UNION	4 5/8	117	6	152	1	25	2 3/4	70	2.9	1.3
3/4	20	DOUBLE UNION	6	152	6	152	1 1/8	29	2 3/4	70	3.0	1.4
1	25	SINGLE UNION	5	127	6 11/16	170	1	25	3 3/8	86	4.1	1.9
1	25	DOUBLE UNION	5 7/8	149	6 11/16	170	1 1/8	29	3 3/8	86	4.5	2.0

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www.zurn.com

Rev. C
Date: 11/14
Document No. REG-70XL
Product No. Model 70XL

Flow Characteristics

Typical Installation

Local codes shall govern installation requirements. Unless otherwise specified, the assembly shall be mounted in accordance with the manufacturer's instructions and the latest edition of the Uniform Plumbing Code. The assembly shall be installed with sufficient side clearance for testing and maintenance. The Model 70XL may be installed in any position. If installed in a pit, vault or indoors, specify the "SC" sealed cage option. Multiple installations are recommended for wide demand variations or where the desired pressure reduction is more than 4 to 1 (i.e.: 200 psi inlet reduced to 50 psi outlet). CAUTION: Anytime a reducing valve is adjusted, a pressure gauge must be used downstream to verify correct pressure setting. Do not bottom adjustment bolt on bell housing.

Typical Installation

Specifications

The Pressure Reducing Valve shall be certified to NSF/ANSI 372, of the direct-acting type, and ASSE® 1003 Listed. The integral bypass check valve main body and bell housing shall be cast bronze (ASTM B 584). The pressure reducing valve shall be of the balanced piston design and shall reduce pressure in both flow and no-flow conditions using an adjusting bolt. All internal parts shall be corrosion resistant and included in a replaceable cartridge. The bronze bell housing shall be threaded to the body and shall not require the use of ferrous screws. The Pressure Reducing Valve shall be a ZURN WILKINS Model 70XL.

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www.zurn.com

Features

- Wide range of pressure ratings, sizes, and resilient materials provide long service life and low internal leakage
- High Flow Valves for liquid, corrosive, and air/inert gas service
- Industrial applications include:
  - Car wash
  - Laundry equipment
  - Air compressors
  - Industrial water control
  - Pumps

Construction

Valve Parts in Contact with Fluids		
Body	Brass	304 Stainless Steel
Seals and Discs	NBR or PTFE	
Disc-Holder	PA	
Core Tube	305 Stainless Steel	
Core and Plugnut	430F Stainless Steel	
Springs	302 Stainless Steel	
Shading Coil	Copper	Silver

Electrical

Standard Coil and Class of Insulation	Watt Rating and Power Consumption				Spare Coil Part Number			
	DC	AC			General Purpose		Explosionproof	
	Watts	Watts	VA Holding	VA Inrush	AC	DC	AC	DC
F	-	6.1	16	40	238210	-	238214	-
F	11.6	10.1	25	70	238610	238710	238614	238714
F	16.8	16.1	35	180	272610	97617	272614	97617
F	-	17.1	40	93	238610	-	238614	-
F	-	20	43	240	99257	-	99257	-
F	-	20.1	48	240	272610	-	272614	-
H	30.6	-	-	-	-	74073	-	74073
H	40.6	-	-	-	-	238910	-	238914

Standard Voltages: 24, 120, 240, 480 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz). 6, 12, 24, 120, 240 volts DC. Must be specified when ordering.
Other voltages available when required.

Solenoid Enclosures

Standard: RedHat II - Watertight, Types 1, 2, 3, 3S, 4, and 4X; RedHat - Type I.

Optional: RedHat II - Explosionproof and Watertight, Types 3, 3S, 4, 4X, 6, 6P, 7, and 9; Red-Hat - Explosionproof and Watertight, Types 3, 4, 4X, 7, and 9.

(To order, add prefix "EF" to catalog number, except Catalog Numbers 8210B057, 8210B058, and 8210B059, which are not available with Explosionproof enclosures.)
See Optional Features Section for other available options.

Nominal Ambient Temp. Ranges

RedHat II/
RedHat AC: 32˚F to 125˚F (0˚C to 52˚C)

RedHat II DC: 32˚F to 104˚F (0˚C to 40˚C)
RedHat DC: 32˚F to 77˚F (0˚C to 25˚C)
(104˚F/40˚C occasionally)

8210G227 AC: 32˚F to 130˚F (0˚C to 54˚C)
DC: 32˚F to 90˚F (0˚C to 32˚C)

Refer to Engineering Section for details.

Approvals

UL listed as indicated. CSA certified.
RedHat II meets applicable CE directives.
Refer to Engineering Section for details.

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Operating Pressure Differential (psi)							Max. Fluid Temp. ˚F		Brass Body			Stainless Steel Body			Watt Rating/ Class of Coil Insulation ⑦	
				Max. AC			Max. DC												
			Min.	Air-Inert Gas	Water	Light Oil @ 300 SSU	Air-Inert Gas	Water	Light Oil @ 300 SSU	AC	DC	Catalog Number	Const. Ref. ④	UL ⑤ Listing	Catalog Number	Const. Ref. ④	UL ⑤ Listing	AC	DC
NORMALLY CLOSED (Closed when de-energized), NBR or PTFE ② Seating																			
3/8	3/8	1.5	①	150	125	-	40	40	-	180	150	8210G073 ③	1P	●	8210G036 ③	1P	●	6.1/F	11.6/F
3/8	5/8	3	0	150	150	-	40	40	-	180	150	8210G093	5D	❍	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	200	150	135	125	100	100	180	150	8210G001	6D	❍	-	-	-	6.1/F	11.6/F
3/8	5/8	3	5	300	300	300	-	-	-	175	-	8210G006	5D	❍	-	-	-	17.1/F	-
1/2	7/16	2.2	①	150	125	-	40	40	-	180	150	8210G015 ③	2P	●	8210G037 ③	2P	●	6.1/F	11.6/F
1/2	5/8	4	0	150	150	-	40	40	-	180	150	8210G094	5D	❍	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	40	40	-	175	150	-	-	-	8210G087	7D	●	17.1/F	11.6/F
1/2	5/8	4	5	200	150	135	125	100	100	180	150	8210G002	6D	❍	-	-	-	6.1/F	11.6/F
1/2	5/8	4	5	300	300	300	-	-	-	175	-	8210G007	5D	❍	-	-	-	17.1/F	-
1/2	3/4	4	5	-	300	-	-	300	-	130	90	8210G227	5D	❍ †	-	-	-	17.1/F	40.6/H
3/4	5/8	4.5	0	150	150	125	40	40	-	175	150	-	-	-	8210G088	7D	●	17.1/F	11.6/F
3/4	3/4	5	5	125	125	125	100	90	75	180	150	8210G009	9D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	5	0	150	150	-	40	40	-	180	150	8210G095	8D	❍	-	-	-	10.1/F	11.6/F
3/4	3/4	6.5	5	250	150	100	125	125	125	180	150	8210G003	11D	❍	-	-	-	6.1/F	11.6/F
3/4	3/4	6	0	-	-	-	200	180	180	-	77	8210B026 ② ‡	10P	-	-	-	-	-	30.6/H
3/4	3/4	6	0	350	300	200	-	-	-	200	-	8210G026 ② ‡	40P	●	-	-	-	16.1F	-
1	1	13	0	-	-	-	100	100	80	-	77	8210B054 ‡	31D	-	8210D089	15D	-	-	30.6/H
1	1	13	0	150	125	125	-	-	-	180	-	8210G054	41D	●	8210G089	45D	●	16.1/F	-
1	1	13	5	150	150	100	125	125	125	180	150	8210G004	12D	❍	-	-	-	6.1/F	11.6/F
1	1	13.5	0	300	225	115	-	-	-	200	-	8210G027 ‡	42P	●	-	-	-	20.1/F	-
1	1	13.5	10	300	300	300	-	-	-	175	-	8210G078 ②	13P	-	-	-	-	17.1/F	-
1 1/4	1 1/8	15	0	-	-	-	100	100	80	-	77	8210B055 ‡	32D	-	-	-	-	-	30.6/H
1 1/4	1 1/8	15	0	150	125	125	-	-	-	180	-	8210G055	43D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	5	150	150	100	125	125	125	180	150	8210G008	16D	❍	-	-	-	6.1/F	11.6/F
1 1/2	1 1/4	22.5	0	-	-	-	100	100	80	-	77	8210B056 ‡	33D	-	-	-	-	-	30.6/H
1 1/2	1 1/4	22.5	0	150	125	125	-	-	-	180	-	8210G056	44D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	5	150	150	100	125	125	125	180	150	8210G022	18D	●	-	-	-	6.1/F	11.6/F
2	1 3/4	43	5	150	125	90	50	50	50	180	150	8210G100	20P	●	-	-	-	6.1/F	11.6/F
2 1/2	1 3/4	45	5	150	125	90	50	50	50	180	150	8210G101	21P	●	-	-	-	6.1/F	11.6/F
NORMALLY OPEN (Open when de-energized), NBR Seating (PA Disc-Holder, except as noted)																			
3/8	5/8	3	0	150	150	125	125	125	80	180	150	8210G033	23D	●	-	-	-	10.1/F	11.6/F
3/8	5/8	3	5	250	200	200	250	200	200	180	180	8210G011 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	4	0	150	150	125	125	125	80	180	150	8210G034	23D	●	-	-	-	10.1/F	11.6/F
1/2	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G030	37D	●	10.1/F	11.6/F
1/2	5/8	4	5	250	200	200	250	200	200	180	180	8210G012 ⑧ ⑨	39D	●	-	-	-	10.1/F	11.6/F
3/4	3/4	5.5	0	150	150	125	125	125	80	180	150	8210G035	25D	●	-	-	-	10.1/F	11.6/F
3/4	5/8	3	0	150	150	100	125	125	80	180	150	-	-	-	8210G038	38D	●	10.1/F	11.6/F
3/4	3/4	6.5	5	-	-	-	250	200	200	-	180	8210C013	24D	●	-	-	-	-	16.8/F
3/4	3/4	6.5	5	250	200	200	-	-	-	180	-	8210G013	46D	●	-	-	-	16.1/F	-
1	1	13	0	125	125	125	-	-	-	180	-	8210B057 ⑥ ⑩	34D	●	-	-	-	20/F	-
1	1	13	5	-	-	-	125	125	125	-	180	8210D014	26D	●	-	-	-	-	16.8/F
1	1	13	5	150	150	125	-	-	-	180	-	8210G014	47D	●	-	-	-	16.1/F	-
1 1/4	1 1/8	15	0	125	125	125	-	-	-	180	-	8210B058 ⑥ ⑩	35D	●	-	-	-	20/F	-
1 1/4	1 1/8	15	5	-	-	-	125	125	125	-	180	8210D018	28D	●	-	-	-	-	16.8/F
1 1/4	1 1/8	15	5	150	150	125	-	-	-	180	-	8210G018	48D	●	-	-	-	16.1/F	-
1 1/2	1 1/4	22.5	0	125	125	125	-	-	-	180	-	8210B059 ⑥ ⑩	36D	●	-	-	-	20/F	-
1 1/2	1 1/4	22.5	5	-	-	-	125	125	125	-	180	8210D032	29D	●	-	-	-	-	16.8/F
1 1/2	1 1/4	22.5	5	150	150	125	-	-	-	180	-	8210G032	49D	●	-	-	-	16.1/F	-
2	1 3/4	43	5	-	-	-	125	125	125	-	150	8210 103	30P	●	-	-	-	-	16.8/F
2	1 3/4	43	5	125	125	125	-	-	-	180	-	8210G103	50P	●	-	-	-	16.1/F	-
2 1/2	1 3/4	45	5	-	-	-	125	125	125	-	150	8210 104	27P	●	-	-	-	-	16.8/F
2 1/2	1 3/4	45	5	125	125	125	-	-	-	180	-	8210G104	51P	●	-			16.1/F	-

① 5 psi on Air; 1 psi on Water.
② Valve provided with PTFE main disc.
③ Valve includes UItem (G.E. trademark) piston.
④ Letter "D" denotes diaphragm construction; "P" denotes piston construction.
⑤ ❍ Safety Shutoff Valve; ● General Purpose Valve.
Refer to Engineering Section (Approvals) for details.

⑥ Valves not available with Explosionproof enclosures.
⑦ On 50 hertz service, the watt rating for the 6.1/F solenoid is 8.1 watts.
⑧ AC construction also has PA seating.
⑨ No disc-holder.
⑩ Stainless steel disc-holder.
‡ Must have solenoid mounted vertical and upright.

† UL listed for fire protection systems per UL429A.

Features – PVC, CPVC

This solid, proven design is well suited for a variety of chemical, industrial and irrigation applications. Spears® Gate Valves are feature-packed with a variety of end connector options. Individual special features are found in each size range 1/2" through 2", 2-1/2" & 3", and in the full featured Heavy Industrial 4" valve. See Spears® Plug Gate Valves for 6" size.

- Heavy Bodied PVC & CPVC Construction
- Tapered Wedge with Specially Designed Sealing Surface
- Non-Rising Stem Design
- Patented Strain-Equalizing Stem/Wedge Thread
- O-ring Stem Seals Instead of Packing - No Retightening Required
- Buna-N, EPDM, or FKM O-ring Seals
- Positive Grip, High Impact Polypropylene Handwheel Operator
- Fully Serviceable, Replaceable Components - Accessible Without Valve Removal
- EPDM Gate Valves NSF® Certified for Potable Water use
- Suitable for Vacuum Service
- Assembled with Silicone-Free, Water Soluble Lubricants
- Metric Socket and BSP Thread Available, 1/2" - 2"

1/2" - 2" PVC & CPVC Heavy Duty Gate Valves

- Available with socket, threaded or flanged end connectors.
- Pressure rated to 200 psi @ 73°F. Flanged Valve Pressure Rated to 150 psi @ 73°F

2-1/2" & 3" PVC & CPVC Heavy Duty Gate Valves

- Available with socket, SR Threaded (Special Reinforced) threaded or flanged end connectors.
- Pressure rated to 150 psi @ 73°F.
- Optional 2" Square/T-Style Operator Nut available.

Note: 2-1/2" size is a bushed down 3" valve.

4" PVC & CPVC Heavy Industrial Gate Valves

- Available with socket, SR Threaded (Special Reinforced) threaded or flanged end connectors.
- Pressure rated to 235 psi @ 73°F. Flanged Valve Pressure Rated to 150 psi @ 73°F
- SS 316 Exterior Bonnet & Hardware
- Built-in Quick-View Position Indicator
- Optional 2" Square/T-Style Operator Nut available.

Sample Engineering Specification

All thermoplastic Gate Valves shall be constructed from PVC Type I Cell Classification 12454 or CPVC Type IV Cell Classification 23447. All O-rings shall be Buna-N, EPDM or FKM. All EPDM valves shall be NSF® certified for potable water use. All valves shall have non-rising stem and Polypropylene handwheel. All valve gate wedges shall have Strain-Equalizing threads. PVC valves shall have Polypropylene wedge and CPVC valves shall have CPVC wedge. All valve components shall be replaceable. All 1/2" through 2" valves shall be pressure rated at 200 psi, all 2-1/2" through 3" and all flanged valves shall be pressure rated at 150 psi, and all 4" valves shall be pressure rated at 235 psi for water at 73°F, as manufactured by Spears® Manufacturing Company.

Quick-View Valve Selection Chart

Valve Size	O-ring Material	PVC Part Numbers[1] Socket	Threaded	Flanged	Pressure Rating
1/2	Buna-N	2012-005	2011-005	2013-005	
	EPDM	2022-005	2021-005	2023-005	
	FKM	2032-007	2031-005	2033-005	
3/4	Buna-N	2012-007	2011-007	2013-007	
	EPDM	2022-007	2021-007	2023-007	
	FKM	2032-007	2031-007	2033-007	200 psi Non-Shock Water @ 73°F
1	Buna-N	2012-010	2011-010	2013-010	
	EPDM	2022-010	2021-010	2023-010	
	FKM	2032-010	2031-010	2033-010	
1-1/4	Buna-N	2012-012	2011-012	2013-012	(Flanged 150 psi Non-Shock Water @ 73°F)
	EPDM	2022-012	2021-012	2023-012	
	FKM	2032-012	2031-012	2033-012	
1-1/2	Buna-N	2012-015	2011-015	2013-015	
	EPDM	2022-015	2021-015	2023-015	
	FKM	2032-015	2031-015	2033-015	
2	Buna-N	2012-020	2011-020	2013-020	
	EPDM	2022-020	2021-020	2023-020	
	FKM	2032-020	2031-020	2033-020	
2-1/2	Buna-N	2012-025[3]	2011-025[3]	2013-025[3]	
	EPDM	2022-025[3]	2021-025[3]	2023-025[3]	
	FKM	2032-025[3]	2031-025[3]	2033-025[3]	150 psi Non-Shock Water @ 73°F
3	Buna-N	2012-030	2011-030SR	2013-030	
	EPDM	2022-030	2021-030SR	2023-030	
	FKM	2032-030	2031-030SR	2033-030	
4	Buna-N	2012-040	2011-040SR	2013-040	235[2] psi Non-Shock Water @ 73°F
	EPDM	2022-040	2021-040SR	2023-040	
	FKM	2032-040	2031-040SR	2033-040	

1: For CPVC valves, add the letter "C" to the part numbers (e.g., 2031-005**C**).
2: Flanged end connectors have a Maximum Internal Pressure Rating of 150 psi @ 73°F.
3: Outlet sized with bushing.

C_V Values

Nominal Size	Cv[1] Gallons/Minute Socket/Threaded	Flanged
1/2	19	15
3/4	37	29
1	44	39
1-1/4	128	105
1-1/2	144	127
2	333	279
2-1/2	See Note 2	
3	335	323
4	583	566

Flanged valves calculated for additional laying length of flanged valve.
1: Gallons per minute at 1 psi pressure drop.
2: Size 2-1/2" is a reducer bushed down 3" valve, C_V not available.

Temperature Pressure Rating

System Operating Temperature °F (°C)			100 (38)	110 (43)	120 (49)	130 (54)	140 (60)	150 (66)	160 (71)	170 (77)	180 (82)	190 (88)	200 (93)	210 (99)
Valve Pressure Rating psi (MPa)	1/2"-2"	PVC	200 (1.38)	135 (.93)	120 (.83)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	200 (1.38)	155 (1.07)	140 (.97)	125 (.86)	110 (.76)	100 (.69)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)
	2-1/2"-3"	PVC	150 (1.03)	130 (.90)	110 (.76)	60 (.41)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	150 (1.03)	140 (.97)	130 (.90)	120 (.83)	110 (.76)	100 (.69)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)
	4"	PVC	235 (1.62)	140 (.97)	130 (.90)	90 (.62)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	235 (1.62)	219 (1.51)	170 (1.17)	145 (1.00)	130 (.90)	110 (.76)	95 (.66)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)

1/2" - 2" Replacement Parts

No.	Component	Qty.	Material
1	Handle	1	PP
2	Stem	1	PVC/CPVC
3	Stem O-ring	1	Buna-N/EPDM/FKM
4	Stem Bushing	1	PP
5	Stem Nut	1	PVC/CPVC
6	Stem Washer	1	PP
7	Wedge Washer/O-ring	1	Buna-N/EPDM/FKM
8	Wedge	1	PP/CPVC
9	Body (Socket/Threaded)	1	PVC/CPVC
10	Bonnet O-ring	1	Buna-N/EPDM/FKM
11	Bonnet	1	PVC/CPVC
12	Bonnet Nut	1	PVC/CPVC

2-1/2" & 3" Replacement Parts

No.	Component	Qty.	Material
1	Handle	1	PP
2	Stem	1	PVC/CPVC
3	Stem Bearing	1	PP
4	Stem O-ring	1	Buna-N/EPDM/FKM
5	Stem Nut	1	PVC
6	Stem Retaining Ring	1	SS 316
7	Split Washer	1	PP
8	Stem Bushing	1	PP
9	Bonnet Retainer	1	PVC/CPVC
10	Bonnet Half	2	PVC/CPVC
11	Seal Carrier	1	PVC/CPVC
12	Carrier O-ring	1	Buna-N/EPDM/FKM
13	Wedge	1	PP/CPVC
14	Body	1	PVC/CPVC

A real value in general purpose rotameters. Vertical connections are from 3/8" NPT to 2" NPT.

DESCRIPTION

Metering Tube	Machined cast acrylic
Internal Components	316L SS
Fitting Material	PVC (for water service only) 316 SS, brass, aluminum (for water and air service)
Inlet/Outlet Fittings	NPT, vertical
O-Ring	Standard: EPR Optional: Buna-N, Viton

PERFORMANCE

Capacities	Water 1 to 200 GPM Air 4 to 245 SCFM
Scale	127 mm (5") direct reading
Accuracy	± 3% to ± 6% of full scale flow See Specifications table
Turndown	10:1 unless otherwise indicated
Repeatability	1% to 2% See Specifications table
Maximum Temperature	Water 130° F (54° C) Air 100° F (38° C)
Maximum Pressure	Water 150 psig Air 100 psig
Ambient Temperature	33° F to 125° F (1° C to 52° C)

OPTIONS

Certified Calibrations	Conform to ISA RP 16.6
Scales	Any volumetric unit

CAUTION: *Meters used in gas service are designed to operate at 14.7 psia. Meters used in pressure gas service must be shielded using 3/8" polycarbonate to protect personnel and equipment in the event of tube failure.*

7200 Series Specifications

Acrylic Tube

Order Number	Flow GPM - Water	Flow SCFM - Air	F.S. Accuracy Repeatability	Press. Drop (In. / W.C.)	Actual Turndown	Connection Size	Dimensions A	Dimensions B
0051	1	4	3%/2%	2.9	10:1	3/8″ FNPT	1.375″	8.25″
0052	1	4	3%/2%	2.9	10:1	1/2″ FNPT	1.375″	8.25″
0061	2	8	3%/2%	5.2	10:1	3/8″ FNPT	1.375″	8.25″
0062	2	8	3%/2%	5.2	10:1	1/2″ FNPT	1.375″	8.25″
0071	3.5	14	3%/2%	9.5	10:1	3/8″ FNPT	1.375″	8.25″
0072	3.5	14	3%/2%	9.5	10:1	1/2″ FNPT	1.375″	8.25″
0081	5	20	3%/2%	13.1	10:1	3/8″ FNPT	1.375″	8.25″
0082	5	20	3%/2%	13.1	10:1	1/2″ FNPT	1.375″	8.25″
0151	5	20	3%/1%	10	10:1	1″ FNPT	2.000″	10 .25″
0161	10	43	3%/1%	12	10:1	1″ FNPT	2.000″	10 .25″
0171	15	62	3%/1%	18	10:1	1″ FNPT	2.000″	10.25″
0181	21	86	3%/1%	22	10:1	1″ FNPT	2.000″	10.25″
0191	30.5	—	3%/1%	26	10:1	1″ FNPT	2.000″	10.25″
0201	40	—	6%/2%	32	10:1	1 1/2″ MNPT	2.000″	12.06″
0211	50	—	6%/2%	38	10:1	1 1/2″ MNPT	2.000″	12.06″
0221	40	165	4%/1%	18	10:1	2″ FNPT	3.000″	13.25″
0231	60	245	4%/1%	25	10:1	2″ FNPT	3.000″	13.25″
0241	80	—	4%/1%	30	10:1	2″ FNPT	3.000″	13.25″
0251	100*	—	4%/1%	35	5:1	2″ FNPT	3.000″	13.25″
0261	120*	—	6%/2%	45	4:1	2″ FNPT	3.000″	13.25″
0271	160*	—	6%/2%	60	3.55:1	2″ FNPT	3.000″	13.25″
0281	200*	—	6%/2%	80	3.63:1	2″ FNPT	3.000″	13.25″

* These meters have less than 10:1 turndown.

DIMENSION DIAGRAM

ACTUAL TURNDOWN:

Order Number	Flow Range	Actual Turndown
0251	20-100 GPM	5:1
0261	30-120 GPM	4:1
0271	45-160 GPM	3.55:1
0281	55-200 GPM	3.63:1

ORDERING:

Use the following guide to determine the specific product number you require.

7 2 0 5	☐☐☐☐	☐	☐	☐
Meter Series	**Order Number**	**Fitting Material**	**O-ring Material**	**Fluid Metered**
	See Specification table above	Brass - 1	EPR - 1	GPM – Liquid - W
		316L SS - 2	Buna-N - 2	SCFM – Air - A
		PVC* - 3	Viton® - 3	
		Aluminum - 6		

** PVC for water service only*

PVC & CPVC COMPACT BALL VALVES

CB-2-0407

Industrial Grade Sealed Unit

This industrial grade, quarter turn shutoff valve is popular where maintenance-free installations are desired for a variety of chemical processing, industrial and OEM applications. IPS Sizes 1/2" - 4" available with socket, threaded or flanged end connectors, 6" size available with socket or flanged end connectors. 6" valve uses high-efficiency lever style handle for easier operation

Heavy Bodied PVC or CPVC

Construction, Silicone Free Assembly Spears® Compact Ball Valves never rust, scale, or pit, providing exceptional chemical and corrosion resistance. Assembled with water soluble, silicone free lubricant.

PTFE Ball Seats

Spears® PTFE floating seat design reduces seat wear for extended valve life, smooth operation, and bubble-tight shut-off. 100% factory tested.

EPDM or FKM O-ring Options

Choice of high grade, abrasion resistant EPDM or FKM elastomer O-rings allows application specific selection for optimum chemical resistance.

High Impact Polypropylene Handle

Features double-stop engagement and exhibits excellent resistance to most chemical environments.

Full Schedule 80 Bore

In full open position, full bore virtually eliminates pressure drop, providing optimum flow.

Sample Engineering Specifications

All thermoplastic ball valves shall be Compact sealed unit type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, Cell Classification 23447. All O-rings shall be EPDM or FKM. All valves shall have Safe-T-Shear® stem and Polypropylene handle. All EPDM valves shall be certified by NSF International for use in potable water service. All 1/2" - 2" valves shall be pressure rated at 235 psi, all 3" - 6" and all flanged valves shall be pressure rated at 150 psi for water at 73° F, as manufactured by Spears® Manufacturing Company.

Safe-T-Shear® Stem

Developed to help prevent line fluids from leaking out in the event of ball valve stem damage. Engineered for high strength, the stem incorporates a special shear point to control accidental breakage. Over-torquing breaks occur above the stem O-ring leaving the seal intact until replacement can be made.

Full Service Pressure Rating for Demanding Applications

1/2" - 2" valves pressure rated to 235 psi at 73° F. 3" - 6" & all flanged valves pressure rated to 150 psi at 73° F.

Suitable For Vacuum Service

Spears® Compact Ball Valves are tested at 26 in. Hg vacuum for one hour with less than 1 in. Hg loss.

NSF Listed for Potable Water

All EPDM Valves are NSF Listed for potable water use.

Optional Accessories

- Round Safety Handle
- Stem Extension Kit
- Mini-Mount Actuation Mounting Kit
- 2" Square/T-Style Operator Nut

For additional information, please refer to Spears® THERMOPLASTIC VALVES & ACCESSORIES PRODUCT GUIDE & ENGINEERING SPECIFICATIONS, V-4 and THERMOPLASTIC VALVES, STRAINERS & ACCESSORIES Price Schedule V-1.

MADE IN THE U.S.A. WITH PRIDE

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UKAS MANAGEMENT SYSTEMS 007

PROGRESSIVE PRODUCTS FROM SPEARS® INNOVATION & TECHNOLOGY

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Dimensions, Weight, Operation Torque & Cv Valves

Nominal Size	Dimension Reference (inches, ± 1/16)								Approx. Wt. (Lbs.)		Oper.[2] Torque (in.-lb.)	Cv[3] Values	
	A	B[1]		C	D	E[4]	F	G					
		Socket	Threaded						PVC	CPVC		Soc/Thd	Flanged
1/2	1-11/16	1-5/8	1-7/8	3-3/8	2-5/16	2-3/4	3-1/2	2-17/32	.31	.32	20	36	20
3/4	2-1/8	1-15/16	2-7/16	4-1/16	2-11/16	3-1/4	3-7/8	2-27/32	.49	.52	30	74	42
1	2-7/16	2-1/16	2-3/8	4-7/16	2-7/8	3-3/4	4-1/4	3-1/16	.64	.69	40	141	80
1-1/4	2-13/16	2-3/8	3	4-15/16	3-5/16	4-1/8	4-5/8	3-13/32	.93	.98	60	284	163
1-1/2	3-1/4	2-13/16	3-1/2	5-5/8	3-11/16	4-1/2	5	4	1.39	1.45	80	402	229
2	4-1/16	3-3/8	4-7/16	6-1/2	4-3/8	5-1/4	5-7/8	4-13/32	2.33	2.45	90	706	429
3	5-5/16	4-9/16	5-1/2	8-5/16	5-1/2	7-21/32	7-1/2	5-7/16	4.49	5.02	300	1660	1079
4	7-3/8	6-3/16	7-3/16	10-5/32	6-5/8	10-27/32	9-1/16	6-7/8	9.50	10.24	400	3104	2028
6[4]	10-3/16	8	10-3/4	14-1/8	8-1/16	14-5/16	11-1/4	8-21/32	21.48	23.41	900	7942	5268

1: Value Lay Length
2: Torque required at valve maximum internal pressure rating, 5 ft./sec. flow velocity.
3: Gallons per minute at 1 psi pressure loss. Values calculated from valve laying length, based on derivative of Hazen-Williams equation with surface roughness factor of C=150.
4: 6" valve has lever handle, dimension is from valve centerline (not illustrated).

Temperature Pressure Rating

System Operating Temperature ° F (° C)			100 (38)	110 (43)	120 (49)	130 (54)	140 (60)	150 (66)	160 (71)	170 (77)	180 (82)	190 (88)	200 (93)	210 (99)
Valve Pressure Rating psi (MPa)	1/2" - 2"	PVC	235 (1.62)	211 (1.45)	150 (1.03)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	235 (1.62)	219 (1.51)	170 (1.17)	145 (1.00)	130 (.90)	110 (.76)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)
	3" - 6"	PVC	150 (1.03)	135 (.93)	110 (.76)	75 (.52)	50 (.34)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)	-0- (-0-)
		CPVC	150 (1.03)	140 (.97)	130 (.90)	120 (.83)	110 (.76)	100 (.70)	90 (.62)	80 (.55)	70 (.48)	60 (.41)	50 (.34)	-0- (-0-)

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3.2.10 HVA Capsule Adhesive Anchoring System

3.2.10.1 Product Description

3.2.10.2 Material Specifications

3.2.10.3 Technical Data

3.2.10.4 Installation Instructions

3.2.10.5 Ordering Information

3.2.10.1 Product Description

HVU Adhesive Capsule

HAS Anchor Rod Assembly with nut and washer

HIS Internally Threaded Insert

Rebar (Not supplied by Hilti)

Listings/Approvals

NSF/ANSI Std 61
certification for use in potable water

European Technical approval
ETA-05/0255
ETA-05/0256
ETA-05/0257

Independent Code Evaluation

LEED®: Credit 4.1-Low Emitting Materials

The Leadership in Energy and Environmental Design (LEED®) Green Building Rating system™ is the nationally accepted benchmark for the design, construction and operation of high performance green buildings.

The Hilti HVA system is a heavy duty, two component adhesive anchor consisting of a self-contained adhesive capsule and either a threaded rod with nut and washer or an internally threaded insert.

Product Features

- High loading capacity
- Small edge distance and anchor spacing allowance
- Excellent dynamic load resistance
- Wide range of installation temperatures
- Excellent performance in holes cored using Hilti DD-B or DD-C diamond core bits
- Excellent elevated temperature performance
- Excellent performance in freezing and thawing conditions
- No hole brushing required—just blow out hole with compressed air—makes installation fast and easy

Guide Specifications

Master Format Section:

Previous	2004 Format	
03250	**03 16 00**	(Concrete Anchors)

Related Sections:

03200	**03 20 00**	(Concrete Reinforcing)
05050	**05 50 00**	(Metal Fabrications)
05120	**05 10 00**	(Structural Metal Framing)

Adhesive anchors shall consist of an all-thread anchor rod, nut, washer and adhesive capsule. Alternatively, adhesive anchors shall consist of a steel insert and an adhesive capsule.

Anchor Rod Shall be provided with 45 degree chisel or cut point to provide proper mixing of the adhesive components. Anchor rod shall be manufactured to meet the following requirements: **1.** ISO 898 Class 5.8; **2.** ASTM A 193 Grade B7; **3.** AISI 304 or AISI 316 stainless steel meeting the mechanical requirements of ASTM F 593 (Condition CW); **4.** Rebar with chisel or cut point.

Special order HAS Rod materials may vary from standard steel rod product.

Nuts and Washers Shall be furnished to meet the requirements of the above anchor rod specifications.

Adhesive Capsule Shall consist of a dual chamber foil capsule. The resin material shall be vinyl urethane methacrylate.

Steel Insert The internally threaded insert shall have a 45 degree (from central axis) chisel pointed end. The insert shall be carbon steel or stainless steel material which meets minimum ultimate tensile strengths of 66.7 and 101.5 ksi, respectively.

The adhesive anchoring system shall be the Hilti HVA anchoring system, consisting of the Hilti HVU adhesive capsule and the Hilti HAS anchor rod or HIS internally threaded insert.

Installation Adhesive anchors to be installed in holes drilled using the specified diameter of Hilti carbide tipped drill bit or matched tolerance Hilti DD-B or DD-C diamond core bit. Anchors shall be installed in strict accordance to section 3.2.10.4. Do not disturb until cure time has elapsed.

3.2.10.2 Material Specifications

Material	Mechanical Properties f_y ksi (MPa)		min. f_u ksi (MPa)	
Standard HAS-E rod material meets the requirements of ISO 898 Class 5.8	58	(400)	72.5	(500)
High Strength or 'Super HAS' rod material meets the requirements of ASTM A 193, Grade B7	105	(724)	125	(862)
Stainless HAS rod material meets the requirements of ASTM F 593 (304/316) Condition CW 3/8" to 5/8"	65	(448)	100	(689)
Stainless HAS rod material meets the requirements of ASTM F 593 (304/316) Condition CW 3/4" to 1-1/4"	45	(310)	85	(586)
HIS Insert 11SMnPb30+C Carbon Steel conforming to DIN 10277-3	54.4	(375)	66.7	(460)
HIS-R Insert X5CrNiMo17122 K700 Stainless Steel conforming to DIN EN 10088-3	50.8	(350)	101.5	(700)
HAS Super & HAS-E Standard Nut Material meets the requirements of SAE J995 Grade 5				
HAS Stainless Steel Nut material meets the requirements of ASTM F 594				
HAS Carbon Steel and Stainless Steel Washers meet dimensional requirements of ANSI B18.22.1 Type A Plain				
HAS Super & HAS-E Standard Washers meet the requirements of ASTM F 436				
All HAS-E & HAS Super Rods (except 7/8") & HAS-E Standard, HIS inserts, nuts & washers are zinc plated to ASTM B 633 SC 1				
7/8" Standard HAS-E & HAS Super rods hot-dip galvanized in accordance with ASTM A 153				
HVU Adhesive—Vinyl Urethane Methacrylate Resin with a Dibenzoyl Peroxide hardener				

Note: Special Order steel rod material may vary from standard steel rod materials.

3.2.10.3 Technical Data

HAS Rod Specification Table

Details \ HAS Rod Size		in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)	1 (25.4)	1-1/4 (31.8)
d_{bit}: nominal bit diameter[1]		in.	15/32	9/16	11/16	7/8	1	1-1/8	1-3/8
h_{ef} = h_{nom} std. depth of embed.[2] = capsule length		in. (mm)	3-1/2 (90)	4-1/4 (110)	5 (125)	6-5/8 (170)	6-5/8 (170)	8-1/4 (210)	12 (305)
t: max. thickness fastened[3]		in. (mm)	1 (25.4)	1-1/2 (38.1)	1-3/4 (44.5)	2 (50.8)	2-1/4 (57.2)	2-1/2 (63.5)	2-3/4 (69.9)
t_{max}: max. tightening torque	All HILTI Rods	ft-lb (Nm)	18 (24)	30 (41)	75 (102)	150 (203)	175 (237)	235 (319)	400 (540)
h: minimum base material thickness[4]	h_{ef} = h_{nom}	in. (mm)	5-1/2 (140)	6-1/4 (160)	7 (180)	8-1/2 (220)	8-1/2 (220)	10-1/2 (270)	15 (380)
	h_{ef} ≠ h_{nom}	in. (mm)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2 (51)	1.0 hef+ 2-1/4 (57)	1.0 hef+ 3 (76)
Recommended Hilti Rotary Hammer Drill			TE 1...30		TE 1...60	TE 50...60		TE 50...80	

1 Use matched tolerance carbide tipped bits or Hilti matched tolerance DD-B or DD-C diamond core bit.

2 Data available for varying embedments; see Load Tables.

3 When using standard length rods at standard embedment (h_{nom})

4 Minimum base material thickness given to minimize backside blowout from drilling. Ability of base material to withstand loads applied (e.g. bending of concrete slab) should be determined by design engineer.

3.2.10.4 Installation Instructions

HAS Rod, Rebar and Insert Installation Instructions

1a. Drilling the hole - Rotary hammer drill: Set the depth gauge to the correct drilling depth.

1b. Drilling the hole - Diamond coring: Mark the correct drilling depth on the height adjustment mechanism.

2. Clean the hole immediately before setting the anchor. Remove drilling dust and standing water from the base of the hole by blowing out well with at least 4 strokes of the blow-out pump, or using compressed air or an industrial vacuum cleaner. The anchor holes must be free of dust, water, ice, oil, bitumen, chemicals or any other foreign matter or contaminants. **Poorly-cleaned holes = poor hold.**

3. Ensure that the specified setting depth is marked on the anchor rod. If not, add an embedment mark, for example with tape or marker.

4. Caution! Check that the hole is drilled to the correct depth before setting the anchor. Hole depth is correct when the anchor rod contacts the base of the hole and the setting depth mark coincides with the concrete surface.

5. Push the anchor capsule into the drilled hole.

6. Use the setting tool at a speed of 250–1000 r.p.m. to drive the anchor rod into the hole, applying moderate pressure and with the hammering action switched on.

7. Switch off the rotary hammer drill immediately when the specified setting depth is reached (refer to mark on the anchor rod). After setting, adhesive mortar must fill the annular gap completely, right up to the concrete surface. Caution! Prolonged rotary action may cause mortar to be forced out of the hole, resulting in reduced anchor loading capacity.

8. The working time “t rel”, which depends on base material temperature, must be observed (see fig. 11). The screwed-on setting tool may be removed only after the time “t rel” has elapsed.

9. After reaching the end of the working time “t rel”, do not manipulate or disturb the anchor rod in any way until the curing time “t cure” has elapsed.

10. A load may be applied to the anchor only after the curing time “t cure” has elapsed.

11.

°C	°F	trel	tcure
min.-5°...0°	min.23°...32°	60'	5 h
0°...10°	32°...50°	30'	1 h
10°...20°	50°...68°	20'	30'
20°...max.40°	68°...max.104°	8'	20'

11. The working time “t rel” and curing time “t cure”, which depend on base material temperature, must be observed!

Type 1009SW Stainless Case Gauge with Stainless Steel System

MADE IN THE USA

Compliant · RoHS 2002/95/EC

FEATURES

- *Patented PowerFlex™ movement*
- *All stainless steel welded construction*
- *True Zero™ pointer indication*
- *NEW ventable plug*
- *NEW patent pending through-dial calibration*
- *NEW MSL helium leak tested to 1X10 $^{-6}$ ATM $^{-cc/sec}$*
- *Meets ASME B40.100 standard*
- *RoHS Compliant*
- *CRN Approved*
- *5 year limited warranty*

Ashcroft is pleased to reintroduce the 1009SW Duralife® pressure gauge. This gauge has been upgraded with many new features outlined above while maintaining the tried and true performance and quality you have come to expect.

Duralife 1009SW gauges provide significant features and benefits. New features include a ventable plug that can be sealed or vented depending on your environment and a patent pending through-dial recalibration that reduces recalibration time.

The combination of features including the patented Power*Flex*™ movement and optional *PLUS!*™ Performance dampening system in the 1009SW is the finest gauge technology for vibration, shock and pulsation applications. Available in pressure ranges from vacuum to 15,000 psi, including compound and metric ranges.

PRODUCT SPECIFICATIONS

Ashcroft Type No.:	1009SW
Sizes:	2½″, 3½″
Case:	304SS
Ring:	304SS polished bayonet
Window:	Polycarbonate
Dial:	Black figures on white background, aluminum
Pointer:	Friction adjust, black, aluminum
Bourdon Tube:	316L stainless steel C-Shaped (Vacuum-600 psi and compound) Helical (1000-15,000 psi)
Socket:	316L Stainless Steel
Movement:	300 series stainless steel, Power*Flex*™, polyester segment, overload/underload stops
Connections:	⅛ and ¼ NPT, lower or lower back, ½ NPT lower (3½″) only.
Ranges:	Vac-15,000 psi and compound
Accuracy:	1% full scale. ASME Grade 1A[1]
Fill Plug:	Ventable
Protection:	Nema 4X / IP65 plug sealed Nema 3 / IP54 plug vented
Ambient Temperature Limitations:	–40°F to 200°F dry +20°F to 150°F glycerin filled –40°F to 150°F silicone filled (based on standard polycarbonate window)

OPTIONAL FEATURES

Liquid fill:	Glycerin, Silicone, Halocarbon (includes throttle plug)
Dampening:	*PLUS!™* Performance (LL) (includes throttle plug)
Window:	Safety Glass (SG)
Pointer:	Micrometer (MP)
Connections:	Metric and SAE on request
Mounting:	U-clamp (UC), Front flange (FF), Back flange (FW)
Dials:	Receiver ranges, refrigerant ranges. Custom dials

[1] When these gauges are liquid filled the total gauge accuracy may be as much as 1.5%

HOW TO ORDER (Typical example)

35 1009 SW (L) 02L XXX 100#

Dial Size: 2½″ (25), 3½″ (35)
Case Type: 1009
Tube and Socket Material: 316L SS
Liquid Filled: (glycerin) leave blank if dry
Connection Size: ⅛ (01), ¼ (02), ½ (04) 3½″ only
Connection Location: Lower (L), Lower Back (B)
Options:
Range: 0/100 psi

ISO 9001
REGISTERED FIRM

All specifications are subject to change without notice.
All sales subject to standard terms and conditions.
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Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

Series 2000

Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%

RoHS

Select the Dwyer® Magnehelic® gage for high accuracy – guaranteed within 2% of full-scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® gage movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

The Magnehelic® gage is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Mounting

A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. Although calibrated for vertical position, many ranges above 1″ may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4-9/16″ hole is required for flush panel mounting. Complete mounting and connection fittings, plus instructions, are furnished with each instrument. See pages 6 and 7 for more information on mounting accessories.

Flush, Surface or Pipe Mounted

Enclosure Mounted

SPECIFICATIONS

Service: Air and non-combustible, compatible gases (natural gas option available).
Note: May be used with hydrogen. Order a Buna-N diaphragm. Pressures must be less than 35 psi.
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of FS (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on - 00, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20 in Hg to 15 psig† (-0.677 to 1.034 bar); MP option: 35 psig (2.41 bar); HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only. See Overpressure Protection Note on next page.
Temperature Limits: 20 to 140°F*
(-6.67 to 60°C). -20°F (-28°C) with low temperature option.
Size: 4″ (101.6 mm) diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8″ female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Standard Accessories: Two 1/8″ NPT plugs for duplicate pressure taps, two 1/8″ pipe thread to rubber tubing adapter, and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for three adapters in MP & HP gage accessories.)
Agency Approval: RoHS. **Note:** -SP models not RoHS approved.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

ACCESSORIES

Model A-432 Portable Kit
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft (2.7 m) of 3/16″ ID rubber tubing, standhang bracket and terminal tube with holder.

Model A-605 Air Filter Gage Accessory Kit
Adapts any standard Magnehelic® gage for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft (1.5 m) lengths of 1/4″ aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

A-605B Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two 4″ steel static tips, plastic tubing and mounting flange

A-605C Air Filter Gage Accessory Kit, Air filter kit with two plastic open/close valves, two plastic static tips, plastic tubing and mounting flange

Series 2000

Magnehelic® Gage Models & Ranges

Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

O-ring seal for cover assures pressure integrity of case.

OVERPRESSURE PROTECTION
Blowout plug is comprised of a rubber plug on the rear which functions as a relief valve by unseating and venting the gage interior when over pressure reaches approximately 25 psig (1.7 bar). To provide a free path for pressure relief, there are four spacer pads which maintain 0.023″ clearance when gage is surface mounted. Do not obstruct the gap created by these pads. The blowout plug is not used on models above 180″ of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm. The blowout plug should not be used as a system overpressure control. High supply pressures may still cause the gage to fail due to over pressurization, resulting in property damage or serious injury. Good engineering practices should be utilized to prevent your system from exceeding the ratings or any component.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

Model	Range Inches of Water
2000-00N†••	.05-0-.2
2000-00†••	0-.25
2000-0†•	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2012	0-12
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2120	0-120
2150	0-150
2160	0-160
2180*	0-180
2250*	0-250
Zero Center Ranges	
2300-00†••	0.125-0-0.125
2300-0†•	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model	Range PSI
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

Model	Range, CM of Water
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300
Zero Center Ranges	
2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

†These ranges calibrated for vertical scale position.
• Accuracy +/-3%
• • Accuracy +/-4%
*MP option standard
**HP option standard

Model	Range MM of Water
2000-6MM†••	0-6
2000-10MM†•	0-10
2000-15MM	0-15
2000-25MM	0-25
2000-30MM	0-30
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100
2000-125MM	0-125
2000-150MM	0-150
2000-200MM	0-200
2000-250MM	0-250
2000-300MM	0-300
Zero Center Ranges	
2300-6MM†••	3-0-3
2300-10MM†•	5-0-5
2300-20MM†•	10-0-10

Model	Range, Pa
2000-60NPA†••	10-0-50
2000-60PA†••	0-60
2000-100PA†•	0-100
2000-125PA†•	0-125
2000-250PA	0-250
2000-300PA	0-300
2000-500PA	0-500
2000-750PA	0-750
2000-1000PA	0-1000
Zero Center Ranges	
Model	**Range, Pa**
2300-60PA†••	30-0-30
2300-100PA†•	50-0-50
2300-120PA	60-0-60
2300-200PA	100-0-100
2300-250PA	125-0-125
2300-300PA	150-0-150
2300-500PA	250-0-250
2300-1000PA	500-0-500

Model	Range, kPa
2000-0.5KPA	0-0.5
2000-1KPA	0-1
2000-1.5KPA	0-1.5
2000-2KPA	0-2
2000-2.5KPA	0-2.5
2000-3KPA	0-3
2000-4KPA	0-4
2000-5KPA	0-5
2000-8KPA	0-8
2000-10KPA	0-10
2000-15KPA	0-15
2000-20KPA	0-20
2000-25KPA	0-25
2000-30KPA	0-30
Zero Center Ranges	
2300-1KPA	.5-0-.5
2300-2KPA	1-0-1
2300-2.5KPA	1.25-0-1.25
2300-3KPA	1.5-0-1.5

Dual Scale Air Velocity Units
For use with pitot tube

Model	Range in W.C./ Velocity F.P.M.
2000-00AV†••	0-.25/300-2000
2000-0AV†•	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2005AV	0-5.0/2000-8800
2010AV	0-10/2000-12500

Dual Scale English/Metric Models

Model	Range, in w.c.	Range, Pa or kPa
2000-00D†••	0-.25	0-62 Pa
2000-0D†•	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
2002D	0-2.0	0-500 Pa
2003D	0-3.0	0-750 Pa
2004D	0-4.0	0-1.0 kPa
2005D	0-5.0	0-1.25 kPa
2006D	0-6.0	0-1.5 kPa
2008D	0-8.0	0-2.0 kPa
2010D	0-10	0-2.5 kPa
2015D	0-15	0-3.7 kPa
2020D	0-20	0-5 kPa
2025D	0-25	0-6.2 kPa
2050D	0-50	0-12.4 kPa
2060D	0-60	0-15 kPa

VELOCITY AND VOLUMETRIC FLOW UNITS
Scales are available on the Magnehelic® that read in velocity units (FPM, m/s) or volumetric flow units (SCFM, m^3/s, m^3/h). Stocked velocity units with dual range scales in inches w.c. and feet per minute are shown above. For other ranges contact the factory.
When ordering volumetric flow scales please specify the maximum flow rate and its corresponding pressure. Example: 0.5 in w.c. = 16,000 CFM.

ACCESSORIES
A-321, Safety Relief Valve
A-448, 3-piece magnet kit for mounting Magnehelic® gage directly to magnetic surface
A-135, Rubber gasket for panel mounting

A-310A 3-Way Vent Valves
In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

Series 1950

Explosion-proof Differential Pressure Switches

Compact, Low Cost, Explosion-proof and Weatherproof

Model 1950 Explosion-Proof Differential Pressure Switch combines the best features of the popular Dwyer® Series 1900 Pressure Switch with an integral explosion-proof and weatherproof housing, making it an exceptional value for either application. It is CE, UL and CSA listed, FM approved for use in Class I, Div 1, Groups C and D, Class II Groups E, F, and G and Class III hazardous atmospheres (NEMA 7 & 9), Raintight NEMA 3 (IP54). Weatherproof features include a drain plug and O-ring seal in cover. Electrical connections are easily made by removing front cover. For convenience the set point adjustment screw is located on the outside of the housing. Twelve models offer set points from .03 to 20 in w.c. (7.5 to 5 kPa) and from .5 to 50 psi (0.035 to 3.5 bar). The unit is very light and compact – about half the weight and bulk of other explosion-proof or weather-proof switches with separate enclosures.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Temperature Limits: -40 to 140°F (-40 to 60°C); 0 to 140°F (-17.8 to 60°C) for 1950P-8, 15, 25, and 50. -30 to 130°F (-34.4 to 54.4°C) for 1950-02.
Pressure Limits: Continuous: 1950's - 45 in w.c. (0.11 bar); 1950P's - 35 psi (2.41 bar); 1950P-50 only - 70 psi (4.83 bar). Surge: 1950's - 10 psi (0.69 bar), 1950P's - 50 psi (3.45 bar), 1950P-50 only - 90 psi (6.21 bar).
Enclosure Rating: NEMA 3 (IP54), NEMA 7 & 9.
Switch Type: Single-pole double-throw (SPDT).
Electrical Rating: 15 A @, 125, 250, 480 VAC, 60 Hz. Resistive 1/8 HP @ 125 VAC, 1/4 HP @ 250 VAC, 60 Hz.
Electrical Connections: 3 screw type, common, normally open and normally closed.
Process Connections: 1/8˝ female NPT.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Set Point Adjustment: Screw type on top of housing.
Weight: 3.25 lb (1.5 kg); 1950-02 model, 4.4 lb (2 kg).
Agency Approvals: CE, CSA, FM, UL.

Series 1950 Switches - Operating Ranges and Dead Bands

Model	Range, in w.c.	Approximate Dead Band at Min. Set Point	Approximate Dead Band at Max. Set Point
1950-02-2S	.03 to .10	.025	.05
1950-00-2F	.07 to .15	.04	.05
1950-0-2F	.15 to .50	.10	.15
1950-1-2F	.4 to 1.6	.15	.20
1950-5-2F	1.4 to 5.5	.30	.40
1950-10-2F	3 to 11	.40	.50
1950-20-2F	4 to 20	.40	.60

Model*	Range, psid	Approximate Dead Band at Min. Set Point	Approximate Dead Band at Max. Set Point
1950P-2-2F	0.5 to 2	.3	.3
1950P-8-2F	1.5 to 8	1.0	1.0
1950P-15-2F	3 to 15	.9	.9
1950P-25-2F	4 to 25	.7	.7
1950P-50-2F	15 to 50	1.0	1.5

CAUTION: For use only with air or compatible gases. Applications with hazardous atmospheres and a single pole drive pressure may require special venting. *P=PSID range models

Company Confidential

LEVEL SWITCH

MODEL L-40N / L-40VCR

Side and Top Mount

Corrosion-resistant plastic with optional metal pivot pin (available in 316 stainless steel, Hastelloy C, Titanium, Tantalum, or Teflon).

10 times less sensitive from deposit and build-up of contaminants than sliding float models.

Each unit can be supplied with a special made to order 1¼" x ¼" x ½" reducer bushing for through wall mounting.

Output wire can be twisted pair 22 gauge or two conductor PVC heavy wall instrument cable.

STANDARD: SPST reed switch for 120/240VAC 50 Watt power or DC dry circuit for computer/PLC interface.

KEY FEATURES

Working Fluid Specific Gravity	**Top Mount: 0.8 | Side Mount: 0.7**
Working Temp	**32°–200°F (0°–93°C)**
Working Pressure	**250 psi (1.724 MPa)**
Process Connection	**¼" NPT**
Electrical Switch	**SPNO or SPNC, 0.5A**

TYPICAL USES

For use in particle contaminated fluids, such as:

≋ TYPICAL WORKING FLUIDS

Mild Acids	Seawater
Mild Bases	Filtered Sewage
Pure Water	Contaminated Ground Water
Process Water	

PRODUCT DIAGRAM

WEIGHT: 5 oz.
142 g

541 Kinetic Drive
Oxnard, CA 93030
www.harwil.com

Phone: (805) 988-6800
Fax: (805) 988-6804
Email: harwil@harwil.com

SPECIFIC GRAVITY COMPENSATING

MODEL **L-40N/SG** ALSO AVAILABLE

MODEL L-40N L-40VCR

Customer specified specific gravity sensitivity.

Unique design enhances specific gravity sensitivity.

Applications include fuel/water detection, oil/water detection, or detection of ground water contamination.

SAMPLE PART NUMBER

OPTION 1: L-40N	/ NO	/ HOR	/ 316
BASE MODEL	↑	↑	↑
SWITCH OPERATION			
MOUNTING POSITION			
PIVOT PIN MATERIAL			

INDUCTIVE LOADS

Switch contacts have been tested with small relays and 30A J-C relay inductive driving coils at 120/240VAC to 500,000 operations without failure. Steady state driving coil Volt/Amp rating should be 8VA or less.

DRY CIRCUIT OPERATION

Switch can interface with microprocessor based controllers and related computer circuits.

NOTE: Model L-40 employs magnetic coupling between float arm and switch body. Magnetic particles can accumulate on and around magnetic housing which may affect proper operation. Please conduct appropriate fluid magnetic particle evaluation and operational tests prior to and during installation and use.

TECHNICAL SPECIFICATIONS

ELECTRICAL (REED) SWITCH CHARACTERISTICS

SPNO
Contact Ratings:

AC Voltage (max. switching)	300VAC
DC Voltage (max. switching)	350VDC
Current (max. switching)	0.5A
Current (max. carrying)	2.5A
Power (max) (VA, W)	50 watts
Contact resistance (max. initial)	0.15 ohms
Insulation resistance	10^{10} ohms
Operating temperature	-40°F–240°F (-40°C–115°C)

OPTIONAL: SPNC or SPDT, 3 watt, 100VAC/VDC.

HYSTERESIS (Δ LIQUID LEVEL TO ACTIVATE/DEACTIVATE SWITCH)

≈ ⅜" (0.375") max. travel

L-40N (NORYL)

WORKING FLUID SPECIFIC GRAVITY:
Top Mount: 0.8 Side Mount: 0.7
WORKING PRESSURE: 200 psi max. continuous
WORKING TEMPERATURE: 180°F max. continuous.
WETTED MATERIALS: Body, Float and Bushing: Noryl (PPO) (10% glass fibers) Pivot Pin: 316 stainless steel

L-40VCR (FORTRON)

WORKING FLUID SPECIFIC GRAVITY:
Top Mount: 0.9 Side Mount: 0.7
WORKING PRESSURE: 200 psi max. continuous
WORKING TEMPERATURE: 200°F max. continuous.
WETTED MATERIALS: Body, Float and Bushing: Fortron (PPO) (40% glass fibers) Pivot Pin: Hastelloy C

INSTALLATION DIMENSIONS

- Installation drawing and a numbered parts list is supplied with each unit.
- Special one-day delivery is available.

SECTION 7.0 SHIPPING, HANDLING, STORAGE & INSTALLATION

Receiving Inspection:

Each shipment will be accompanied by a detailed packing list. Each shipment is complete and free of damage when it leaves the factory. The **shipment must be inspected for contents and damage within 48 hours** of receipt, and if any damage is discovered it must be reported **immediately in writing** to the freight carrier and to IMS in order to relieve the recipient of responsibility.

Prior to Installation:

A concrete equipment pad adequately sized for the system and the remote nutrient skid should be prepared. The equipment pad for the I-BOx® must have a slope of 1/16" per foot and must be carefully cleaned prior to installing the equipment.

A neoprene rubber pad, ¼" thick, must be placed between the concrete pad and the FRP vessel as a cushion.

If possible, the **inlet ducting** should be installed prior to or concurrently with the installation of the biological control system to ensure proper alignment and positioning of the equipment.

General Handling Recommendations:

The following general recommendations are offered regarding handling, movement, and storage of FRP (Fiberglass Reinforced Plastic) vessels and equipment:

- Operators of hoist equipment should follow proper rigging procedures at all times. Care should be taken to prevent the components from swinging out of control.
- **Lift and move the vessel using an appropriately sized nylon strap with a spreader bar attached to the hoist cable. The angle between the lifting lines and the top of the vessel must always be 60° or greater if using a crane.**
- **Appropriately sized forklifts may also be used for installation. The forks must extend completely under the vessel to prevent puncturing. 1" thick plywood may be used to protect the vessel's bottom from the forks. Forks should be spaced widely enough to safely balance the vessel.**
- Always lift, never drag or roll an FRP vessel or component.
- When moving a component, be careful not to drop or allow hard impact. Even though there may be no external sign of damage, impact may cause a fracture of the vessel, which will eventually lead to premature vessel failure.
- Never let tools strike or drop on the inside or outside of the vessel.
- Workmen entering the vessel should wear soft-soled shoes.
- Never use cables or chains around the vessel as they will rub and damage the vessel.

- When storing a vessel prior to installation, tie it down securely. Protect all fans and exposed instruments from the weather. Use plywood or plastic to cover all openings into the vessel.

Installation Instructions:

Preliminary Notes:

- ❑ The I-BOx® system has been factory assembled and wired to the maximum extent possible. All systems internals are installed prior to shipping. Installation required at the site includes attachment of inlet ducting, all plant control system connections, connection of electrical power, connection of water and drain piping, and anchoring of the system.

Mechanical Installation:

- ❑ The inlet duct should match the fan inlet connection exactly to ensure a smooth installation. See general arrangement drawing in section 5.1 for proper orientation and dimensions.
- ❑ Carefully **clean the surface of the equipment pad** before installation.
- ❑ Install the neoprene pad concurrently when setting the vessel. A skid mounted vessel has the pad pre-installed at the factory.
- ❑ Use a crane or appropriately sized forklift to move the system onto the equipment pad.
- ❑ **Anchor the system to the concrete pad** using the anchor bolts (provided by Integrity Municipal Systems).
- ❑ Set and anchor the skid per the instructions above using the anchor bolts (provided by Integrity Municipal Systems).

Piping:

- ❑ **Attach the water supply piping** to the water inlet connection on the system.
- ❑ **Install a 6" [152 mm] minimum P-trap on the drain piping to prevent odors from escaping through the drain piping.**
- ❑ **Attach piping to the P-trap on the drain** of the system to direct the drained water to the appropriate facility drain
- ❑ Run interconnecting plumbing from the remote skid solution outlet to the vessel solution inlet port.

Electrical:

- ❑ It is left to the facility electrician to **determine appropriate wire sizing, conduit runs**, grounding, and other aspects of the electrical installation as needed to be consistent with local electrical codes and regulations.
- ❑ The installer shall install the skid outside the 3 ft. envelope from any potential incoming foul airstream and run appropriate interconnecting conduit and wiring between the skid mounted control panel to the system mounted instruments as follows:
    - Exhaust Fan Motor (**480V**/3Ph/60hz, 4 wire)
- ❑ Connect power to the control panel. Refer to the electrical drawing set for design power.

DO NOT OPERATE THE BIOLOGICAL ODOR CONTROL SYSTEM UNTIL INTEGRITY MUNICIPAL SYSTEMS' STARTUP ENGINEER HAS BEEN CONSULTED OR INSPECTED THE INSTALLATION.