AS/SVE PILOT WORK PLAN

PRIDE SOLVENTS AND CHEMICAL COMPANY

78-88 LAMAR STREET

WEST BABYLON, NEW YORK

SITE#: 1-52-025

Prepared For:

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

New York State - Department of Environmental Conservation
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1.0 INTRODUCTION

This document represents the work plan for the installation, start-up, and operation of an Air Sparge (AS) and Soil Vapor Extraction (SVE) pilot system (collectively, AS/SVE) at the Pride Solvents & Chemical Company site, New York State Department of Environmental Conservation (NYSDEC) Site No. 1-52-025.

The site is located at 78-88 Lamar Street in West Babylon, NY. A site location map is provided as Figure 1. The site features two occupied buildings on an approximately 1.3 acre parcel bounded by Lamar Street to the east and commercial/industrial properties to the north, south, and west. Land use is commercial. Pride Solvents and Chemical Company (Pride), which occupied the site from 1960 to (approximately) early 2000's, received, stored, and reclaimed waste solvents. Both the 78 and 88 Lamar Street buildings are currently occupied by automotive service companies.

The scope of work at this site will include the construction and installation of an AS/SVE pilot system along with associated piping and wells. Once installed, the system will be tested and started. The pilot testing period will consist of the initial four weeks of system operations during which the system will be extensively monitored and proofed. As requested, the AS/SVE pilot system is to remain active beyond the initial four week pilot testing period, during the data review process.

This work plan has been prepared in accordance with the scope of work for AS/SVE pilot study prepared by CDM Smith, as well as subsequent site information provided by CDM Smith, NYSDEC, and gathered during site visits. An itemized cost estimate for completion of the tasks detailed in this work plan is provided as Appendix A.

All EAR personnel to be engaged on this project have completed the 40-hour OSHA HAZWOPER training and are current with the annual 8-hour refresher courses. All EAR field personnel receive training in basic First Aid and CPR. Onsite health & safety measures will be implemented according to both the CDM Smith site Health & Safety Plan (HASP) and Environmental Assessment & Remediations' (EAR) corporate HASP.

2.0 SITE PREPARATION/MOBILIZATION

In preparation for the work activities detailed herein, EAR personnel have visited the site in order to determine a practical site plan including AS/SVE system location, piping layout, and electrical service layout. These proposed layouts are identified in the site plan provided as Figure 2.

Following NYSDEC and CDM Smith (CDM) approval of the proposed work plan, a private utility locator will be retained to locate and mark any subsurface utilities or structures using both conductive and non-conductive methodologies. A request for public utility mark outs along the right of way (ROW) near 68-78 Lamar Street will be made as well. Once utilities have been located, marked, and reviewed, EAR will conduct an evaluation of the proposed site plan against existing utilities and other below grade features. Based on this evaluation, the locations of the AS/SVE wells and pipe trenches may be adjusted as necessary to avoid utilities and/or maximize distance from drywells/infiltration drains.

Following utility location, a pre-construction survey will be conducted by a licensed New York State land surveyor. In addition to providing property details for 78-88 Lamar Street and the existing well network, the property bounds between 68 and 78 Lamar Street will be determined and marked.

As all ground-intrusive work will be conducted on private property, no road-opening permits will be required. Following NYSDEC and CDM approval of the proposed work plan, EAR will obtain a building permit from the Town of Babylon. The permit is required for all construction aspects including electrical H-frame installation, equipment shed installation, installation of conveyance piping across rooftop of 78 Lamar Street, and trenching & piping activities.

Access to the site will be arranged with the NYSDEC and/or CDM, and the property owners. NYSDEC, CDM, and the property owners will be notified of any site work prior to its execution. A proposed schedule of implementation is included as Appendix B. Upon approval and property access arrangements, this schedule will be updated accordingly.

2.1 ELECTRICAL SERVICE AND INSTALLATION

An onsite meeting with the local electric utility company (Public Service Enterprise Group (PSEG)) was conducted on September 2, 2015 to discuss available options to provide a dedicated electrical service to the AS/SVE system. Following PSEG directives, an electrical service layout was developed.

An H-frame with a utility service meter cabinet and a main electric disconnect switch will be installed in the immediate vicinity of the PSEG-owned utility pole located in the front of the 78 Lamar Street property (see Figure 2).

Installation of the H-frame, meter pan, disconnect, riser, and all internal wiring will be completed by an electrician authorized to do work in Suffolk County. All connections will be made with equipment and materials in accordance with PSEG requirements. Service will be three-phase, 200 Amp, 120/208 volt. EAR will be onsite to oversee and document all site activities conducted by the subcontracted electrician.

Conduit and wiring from the H-frame to the system will be installed below grade following trenching & piping guidance detailed in Section 5.0. The proposed conduit run is illustrated in Figure 2. Please

note that the proposed conduit layout may be altered based on the locations of existing utilities or other sub-grade features.

3.0 WELL INSTALLATIONS

After all subsurface utilities/features have been marked, and following approval, EAR will begin installation of the AS/SVE wells and vacuum monitoring points (VMP). Well installations will include:

- Thirteen (13) AS wells
- Three (3) SVE wells
- Four (4) VMP wells

Prior to installation, all well locations shall be confirmed by NYSDEC and/or CDM. Locations, as proposed by NYSDEC and CDM, are provided in Figure 2.

All drilling activities will be overseen by a qualified EAR geologist. The geologist will be responsible for adherence to specifications, measurement and recording of quantities/depths of well construction materials used, logging of lithology, and generation of drill logs. Drilling personnel will accurately measure and mix all bentonite products in order to minimize air entrainment.

All wells will be identified using an approved, standard, sequential naming convention (example: AS-1, AS-2, AS-3, etc). Wells will be identified by etched/engraved metal name plates installed adjacent to the respective well.

Auger cuttings which do not evidence contamination (via visual, olfactory, or PID headspace analysis), will be re-used as backfill. Contaminated and surplus auger cuttings will be containerized in USDOT approved 55-gallon drums, properly labeled, and staged onsite for waste characterization testing, transport, and disposal. Sections 9 & 10 provide further details of the waste handling/disposal procedures.

To ensure adequate spatial representation, all installed wells will be surveyed by a licensed New York surveyor. The casing elevations will be determined to the nearest 0.010 foot.

During well installation activities, air monitoring will be conducted as outlined in EAR's Community Air Monitoring Plan (CAMP), included here as Appendix C.

3.1 AIR SPARGE WELLS

The AS wells will be installed utilizing hollow-stem auger drilling techniques. Soil samples shall be collected from the auger flights at a rate of 1 composite sample per 5-feet of advancement. Upon collection, each sample will be logged for lithology and screened for volatile organic compounds with a Photo-Ionization Detector (PID) by an on-site geologist. Prior to each use, the PID will be calibrated using a 100 ppm isobutylene standard and ambient air.

Augers capable of providing a minimum 4.25-inch diameter borehole will be advanced to 28 feet below grade surface (BGS). Prior to setting well materials, a predetermined quantity of filter pack (#1 Filpro® sand pack or equivalent) will be added to bring the borehole depth to 27 feet BGS. An onsite geologist will confirm the depth using a weighted tape measure. The well screen will be constructed of a 2-foot long section of 0.020" slot, schedule 40, 2-inch diameter PVC. The casing will be constructed of schedule 40, 2-inch diameter, flush-joint PVC riser extending up to just below grade surface.

After setting the well screen and casing, a geologist will confirm total depth using a weighted tape measure to ensure that the well formation has not collapsed. A predetermined quantity of filter pack (#1 Filpro® sand pack or equivalent) will be poured into the borehole by hand. The geologist will measure the depth to the filter pack using a weighted tape measure in order to ensure that the filter pack is uniformly installed from end of the boring to 1-foot above the screened section of the well.

After the filter pack is installed, a 1-foot bentonite seal will be installed to approximately 23-feet BGS. Prior to hydrating the seal, the onsite geologist will measure depth to the bentonite pellets to ensure adherence to specification and confirm that the pellets did not bridge. The bentonite will be hydrated according to the manufacturer's specifications using potable water.

A cement/bentonite grout mixture will then be installed from approximately 4-23 feet BGS. The mixture will be prepared onsite using the following standard mix ratio:

- (1) 94-lb bag of Type 1 Portland Cement;
- 3.9 lbs powdered bentonite; and
- 7.8 gallons potable water

The wells will be temporarily capped with a PVC dome cap to prevent any debris from entering the well, and the borehole will be backfilled to grade with RCA. Well heads will be completed with a pressure gauge (0-15 psi, liquid filled, back-mount) during the lateral piping connections and manholes will be installed upon completion. The AS wells will each be finished with an 8x12 inch, flush-mount, bolt down, H20 rated, gasketed, steel manhole (Pemco model 103 or equivalent). The manholes will each be encased in a concrete pad, which will be formed and poured by EAR.

A schematic of the proposed AS well design is provided as Figure 3.

3.2 SOIL VAPOR EXTRACTION WELLS

The SVE wells will be installed using hollow-stem auger drilling techniques. Soil samples shall be collected from the auger flights at a rate of 1 composite sample per 5-feet of advancement. Upon collection, each sample will be logged for lithology and screened for volatile organic compounds with a PID by an on-site geologist. Prior to each use, the PID will be calibrated using a 100 ppm isobutylene standard and ambient air.

Augers capable of providing a minimum 7-inch diameter borehole will be advanced to 13 feet BGS. Prior to setting well materials, a predetermined quantity of filter pack (#1 Filpro® sand pack or equivalent) will be added to bring the borehole depth to 12 feet BGS. An onsite geologist will confirm the depth using a weighted tape measure. The well screen will be constructed of a 7-foot long section of 0.020" slot, schedule 40, 4-inch diameter, PVC. The casing will be constructed of schedule 40, 4-inch diameter, flush-joint PVC pipe extending up to just below grade surface.

After setting each SVE well screen and casing, a geologist will confirm total depth using a weighted tape measure to ensure that the well formation has not collapsed. A predetermined quantity of filter pack (#1 Filpro® sand pack or equivalent) will be poured into the borehole by hand. The geologist will measure the depth to the filter pack using a weighted tape measure in order to ensure that the filter pack is uniformly installed from end of the boring to 0.5-foot above the screened section of the well.

After the filter pack is installed, a 1-foot bentonite seal will be installed to approximately 3.5-4.5 feet BGS. Prior to hydrating the seal, the onsite geologist will measure depth to the bentonite pellets to ensure adherence to specification and confirm that the pellets did not bridge. The bentonite will be hydrated according to the manufacturer's specifications using potable water.

The wells will be temporarily capped with a PVC dome cap to prevent any debris from entering well, and the borehole will be backfilled to grade with RCA. Well heads will be completed with a vacuum gauge (-15 – 0"WC, back-mount) and sample port during the lateral piping connections and manholes will be installed upon completion. The SVE wells will each be finished with an 8x12 inch, flush-mount, bolt down, H20 rated, gasketed, steel manhole (Pemco model 103 or equivalent). The manholes will each be encased in a concrete pad, which will be formed and poured by EAR.

A schematic of the proposed SVE well design is provided as Figure 4.

3.3 VACUUM MONITORING POINTS

The VMP wells will be installed to the specification provided by CDM utilizing direct-push techniques. At each location, a Geoprobe truck mounted system will be utilized to install a 6-inch soil vapor implant (Geoprobe AT86 series) to approximately 2.0-feet BGS. The implant will be connected to 0.375-inch diameter Teflon tubing which shall extend to just below grade where it will be fitted with a PVC ball valve.

A filter pack consisting of 60-100 mesh glass beads will be poured into the borehole by hand. An onsite geologist will measure the depth to the filter pack using a weighted tape measure in order to ensure that the filter pack is uniformly installed from end of the boring to 0.5-foot above the implant. After the filter pack is installed, a 0.5-foot bentonite seal will be installed to approximately 0.5-foot BGS. The bentonite will be hydrated according to the manufacturer's specifications using potable water.

The VMP wells will each be finished with a 6-inch diameter, flush-mount, bolt-down, H20 rated, gasketed, steel manhole (Emco Wheaton model A0721-105 or equivalent). The manholes will each be encased in a concrete pad, which will be formed and poured by EAR.

A schematic of the proposed VMP well design is provided as Figure 5. A product cut sheet for the vapor implants is included in Appendix D.

3.4 EQUIPMENT DECONTAMINATION

Drill rig augers and down-hole tooling shall be decontaminated between each well installation location. Decontamination shall be via mechanical removal of dirt, followed by an Alconox/water wash, followed by a potable water rinse.

All rinsate shall be containerized in 55-gallon drums and staged onsite (at a pre-determined & approved location) for transport and disposal.

4.0 AS/SVE SYSTEM

The system shall consist of a combined AS/SVE system housed in a single steel shed, wherein all hardware, equipment, and controls (unless noted otherwise) shall be mounted and plumbed. Equipment layouts are provided as Figures 6 & 7. The proposed location of the system shed is illustrated in Figure 2. As discussed with the property owner, NYSDEC, and CDM, situating the equipment shed behind the 78 Lamar building is ideal in minimizing impact to the high-traffic parking lot.

Please note that the proposed location for the system enclosure is currently occupied by a sea container, which will need to be relocated prior to trenching activities and system installation activities. If, upon relocation of the sea container, the grade surface is found to be unsuitable, EAR will install a concrete pad. Dimensions of the pad shall be 20.5-feet long by 7.5-feet wide, with a thickness of 0.5-feet. Concrete shall be a 4,000 psi mix reinforced with 6x6 welded wire mesh.

System performance objectives are as follows:

- Maintain a minimum of 30 CFM at each of the three SVE wells, effecting a minimum vacuum of 0.1 "WC at the perimeter VMP wells and targeted radius of influence (ROI) of 60 feet.
- Treat recovered vapors such that SVE exhaust remains below 3 ppm total VOC's.
- Maintain a minimum of 10 CFM at each of the thirteen AS wells at pressures sufficient for breakout, with a targeted ROI of 20 feet.

4.1 SYSTEM ENCLOSURE

The system shall be enclosed in a steel shed (7 x 20, 26 gauge steel, Manproducts or equivalent) with a galvannealed finish. The shed will be delivered and assembled onsite by the manufacturer. The shed shall be anchored to the existing surface (or concrete pad, if installed).

EAR shall install foamboard insulating sheathing, overlaid with 0.25" plywood, over all interior walls and ceiling as a soundproofing and insulation measure. The shed shall be equipped with interior lighting, heating, and ventilation, also to be installed by EAR. Heating and ventilation shall be sized to maintain temperatures in the range of 50-100°F within the system shed. All conduit, wiring, controls, piping, and equipment shall be installed by EAR.

4.2 SVE SYSTEM

The SVE system shall operate by inducing a vacuum at extraction wells SVE-1, SVE-2, and SVE-3 utilizing a 5 horsepower (HP), inverter duty rated, regenerative blower (Ametek Rotron DR6D89 or approved equal). Captured soil vapors shall be transported, via subsurface piping, to the system compound. Moisture in the airstream shall be removed at a 60-gallon moisture separator tank prior to reaching the blower. A 0.5 HP centrifugal pump piped from the moisture separator shall provide transfer of accumulated condensate from the separator. Exhaust from the blower shall be treated at two 400 lb granular activated carbon (GAC) vessels prior to discharge to the atmosphere (see Section 4.2.1). The exhaust stack shall extend through the roof of the shed and terminate at approximately 20 feet above grade (approximate height of the 78 Lamar building's roofline). The exhaust stack shall be finished with a "tee." The exhaust "tee" shall be equipped with screen or appropriately sized flapper valves to help reduce rainwater and/or animal intrusion. All SVE distribution piping and fittings shall be Schedule 40 PVC.

The SVE manifold shall be constructed inside the equipment shed. Each well header pipe shall include the following:

- Gate valve
- Sample port (1/4-inch nipple & ball valve, with 1/8-inch hose barb)
- Vacuum gauge (low pressure diaphragm, -15 – 0 "WC)

Pitot tube/differential pressure gauge (Magnehelic 2000 series or similar) combinations shall provide instant read data for velocity/flow calculations for the combined SVE influent and SVE exhaust locations.

The SVE system shall be equipped with a fourth, auxiliary SVE header pipe, extending from the SVE manifold to a terminus (See Figure 2) where it shall be capped below grade. Should an additional SVE well ever be required[1], this will help minimize future trenching and piping activities. The blower has been sized to accommodate a fourth well in the event such is deemed necessary.

A process & instrumentation diagram (P&ID) is provided as Figure 8. Technical specification sheets for major system components are provided in Appendix D.

4.2.1 GRANULAR ACTIVATED CARBON SYSTEM

The SVE blower effluent airstream shall be treated at two 400 lb GAC vessels (General Carbon Corp., 110 gallon Air Pollution Control Barrel, 4x8S mesh size, virgin carbon) piped in series prior to discharge to the atmosphere. The vessels will be piped with flex hose and cam-lock fittings in order to facilitate carbon changeouts and configuration changes. Carbon system specifications are provided in Appendix D.

4.3 AS SYSTEM

The AS system shall consist of a 15 HP rotary lobe blower (Roots 33URAI) which shall draw ambient air from inside the system shed. Blower package shall include an 85dBA sound enclosure, inlet/outlet silencers, pressure relief valve, and inlet filter. The AS blower effluent airstream shall be piped via 2-inch diameter schedule 40 galvanized steel piping to a finned-tube type heat exchanger mounted on the roof of the equipment building. The heat exchanger shall consist of 27 linear feet of 2-inch diameter, galvanized steel, finned tube, to be assembled by EAR. Discharge from the heat exchanger shall be 2-inch diameter schedule galvanized steel piping which shall convey the airstream to a manifold prior to distribution to the 13 AS wells. The AS manifold shall be constructed of schedule 40 CPVC. AS conveyance piping from the manifold to each of the wells shall consist of 2-inch diameter schedule 40 PCV.

The AS manifold shall be constructed inside the equipment shed. Each well header pipe shall include the following:

- Gate valve
- Air flow meter (Dwyer VFC flow meter or equivalent, 4-25 SCFM)
- Liquid-filled pressure gauge (0-10 psi)

A P&ID is provided as Figure 8. Technical specification sheets for major system components are provided in Appendix D.

[1] Based on the proposed AS & SVE well layout, optimal placement of a fourth SVE well (if required) would likely be equidistant between SVE-2 & SVE-3.

4.4 COMMUNICATION & CONTROL SYSTEMS

Controls/motor starters will be housed in an appropriately sized NEMA 4 panel mounted inside the system shed. Each blower/pump will be equipped with an hour meter, off/hand/auto switch, and status and alarm indicator lights mounted on the exterior door of the control panel. Switches will be spring loaded to ensure system/components are not in "hand" continuously.

SVE blower airflow will be maintained via a variable frequency drive (Fuji FRN005F1S-2U or approved equal).

4.4.1 ALARMS / ALARM NOTIFICATION

Pressure/vacuum switches, flow switches, temperature switches, and float switches, shall initiate alarm conditions as summarized below:

Condition	System Response	Panel Indicator Light	Alarm Notification	Alarm Set Point
Moisture Separator High Liquid Level	AS/SVE Shutdown	Yes	Yes	35 gallons
SVE Blower Influent Low Air Flow	AS/SVE Shutdown	Yes	Yes	38 SCFM (approx.)
SVE Blower Effluent High Temperature	AS/SVE Shutdown	Yes	Yes	125°F
AS Blower Low Pressure	AS Shutdown Only	Yes	Yes	2 psi
AS Blower High Temperature (post heat exchanger)	AS Shutdown Only	Yes	Yes	125°F
VFD Fault / General System Failure	AS/SVE Shutdown	Yes	Yes	n/a

Switch locations are illustrated in the P&ID (Figure 8).

The system shall be equipped with a Sensaphone® Cell682 cellular autodialer. This unit provides alarm notifications via phone/voice, email, and text, and can be accessed via web portal for remote monitoring and programming changes. The autodialer shall be programmed to notify EAR, CDM, and NYSDEC personnel, following a tiered callout plan, in the event of any of the above listed alarm conditions.

5.0 TRENCHING & PIPING

Following well installations and initial surveying activities, EAR will proceed with trenching and piping activities. The proposed trench runs are illustrated in Figure 2. Please note that the proposed pipe layout may be altered based on the locations of utilities or other sub-grade features. A finalized trenching plan will be submitted for NYSDEC and CDM approval following utility markouts.

During all trenching & backfilling activities, air monitoring will be conducted as outlined in EAR's CAMP, included here as Appendix C.

5.1 EXCAVATION

Prior to excavation, EAR will sawcut as necessary along the trenchlines. Sawcuts will be made to a depth of approximately 6-inches below grade surface (BGS) using a sawcutter with an appropriately sized, circular blade. As the blade will need to be continuously wetted during operation, EAR will utilize a nearby fire hydrant. A hydrant use permit will be acquired prior to the start of field activities. For trenches in grass areas, a sodcutter may be utilized to maintain clean trench cuts and help minimize total restoration costs.

Trenches will be excavated to approximately 2.5 feet BGS at approximately 1-3.5 feet in width using an excavator (see Figures 9-10). The trench bottoms will be scarified using the excavator bucket and compacted using a vibratory plate compactor prior to placement of piping and clean fill.

Excavated soils will be staged onsite in a designated area(s) and used for backfill where applicable and pending approval by NYSDEC and/or CDM. In order to minimize dust and prevent erosion/runoff, any stockpiled soil left onsite overnight will be covered and secured with plastic sheeting. High visibility temporary fencing will be utilized as necessary to delineate the work zone and provide an additional measure of protection for pedestrian and vehicular traffic.

5.2 PIPING & BACKFILLING

Each remedial system well will be constructed with a dedicated lateral pipe for air conveyance. All SVE line piping will be 4-inch diameter, schedule 40 PVC. All AS piping will be 2-inch diameter schedule 40 PVC. Electrical conduit shall be 2.5-inch diameter schedule 40 PVC. Where feasible (as per length of straight piping runs), EAR may use "bell-ended" piping rather than straight pipe & couplings. In all cases, piping will be connected using PVC primer and glue. The required pitch and elevation of the SVE lines will be determined following the initial site survey.

Following compaction of the trench base, a minimum of 2-3 inches of clean sand fill will be added and compacted prior to placing the piping. A minimum horizontal spacing of 2-3 inches between all pipes will be maintained. Clean sand fill will then be added to approximately 0.5-feet above the piping. Where trenches are shared, 2-3 inch vertical spacing will be maintained between all pipes. For electrical conduit, a minimum burial depth of 24 inches below grade shall be maintained. Trench cross-sectional details are illustrated in Figures 9-10.

The excavation will then be backfilled with the native excavated soils (and/or an offsite common borrow, if necessary) to approximately 6-inches BGS. Trenches through asphalted areas will be finished to grade using Type 4 aggregate. This will be applied in single 6-inch lifts and compacted using a vibratory-plate type compactor. This layer will be dug out (to required depth) by the asphalt subcontractor during installation of bituminous paving. Trenches through grass areas will be

finished to grade using a clean top soil. This layer will be adjusted as necessary prior to installation of sod.

A magnetic loading strip or similar protective measure will be placed in each trench, for the complete length of the run(s), at a depth recommended by the manufacturer. Backfilling will be completed in stages as the trench run progresses, allowing for access by survey crews (confirmation of piping pitch, location, inverts, elevations) while minimizing impact to the property's business operations. As is feasible, all open trenches will be backfilled prior to the end of each day. Where such is not feasible, steel road plates will be utilized to secure open trenches and allow vehicular traffic. All compaction will be conducted in no greater than 6-inch lifts using vibratory plate devices.

Pre-cast, H20 rated, electrical pull boxes will be installed along the electrical conduit trench as necessary.

5.2.1 LEAK TESTING

Prior to any backfilling each day, all lengths of installed SVE and AS header pipe will be leak tested via a negative pressure test at each pipe run. An appropriately sized regenerative blower will be utilized to induce a vacuum of -3 to -5 inches of mercury ("Hg) in each pipe run. The pipe run will then be sealed and the vacuum within the pipe monitored for 15 minutes.

If no indication of pipe fracture or incomplete seal (loss of vacuum, inability of piping to maintain vacuum, audible vacuum loss) is observed, trenching and piping activities may continue. Should any evidence of pipe fracture or incomplete seal be observed, trenching and piping activities are to be stopped. The piping and connections will be investigated and testing procedures repeated (if necessary) to determine the location of the pipe fracture or incomplete seal. The defect will be removed, and a new length of piping and/or fitting will be installed. The piping will then be retested to ensure that the defect was corrected.

5.3 ROOFTOP PIPING

AS and SVE header piping from the AS/SVE equipment building to AS-1 and SVE-1 will be advanced above grade and across the rooftop of the 78 Lamar Street building as illustrated in Figure 2.

Above grade piping shall be secured to walls and along the rooftop using stainless-steel Kindorf support systems. Bollards will be installed near the subsurface-to-above grade transition point in order to prevent potential damage to system piping.

6.0 SURFACE RESTORATION

Following trenching & piping activities, an EAR subcontractor will furnish and install bituminous paving within all excavation limits. The paving shall consist of at least 4-inches of base coarse followed by a tack coat and 2-inches of surface coarse. Any traffic and parking marks disturbed by the trenching & piping activities will be repainted as necessary by the subcontractor. An EAR foreman will be onsite to oversee the surface restoration and ensure adherence to the specifications.

Grass areas disturbed by trenching/conduit installation in the front of the property will be restored by EAR to match surrounding conditions using top soil and sod.

7.0 AS/SVE SYSTEM START-UP

The initial two-week period of system operations shall be considered the "start-up" period. During this time, the system will be extensively monitored, with adjustments made as necessary, in order to demonstrate the proper installation and adequate performance of the system.

7.1 SYSTEM INSPECTION & TESTING

Prior to system start-up, the proper installation and operation of the AS/SVE system components shall be verified via systematic inspection and testing.

Visual inspection activities shall be conducted while the system is NOT energized. The main power should be in the "off" position and locked & tagged. A qualified electrician will check that all electrical circuit breakers for the process equipment are locked and tagged.

Visually inspections shall include the following:

- Interior and exterior of the system container/shed. This shall include integrity of mountings.
- Verification that all components are present, configured properly, and securely piped.
- Verification that all process piping and connections are true and free of cracks or other visible damage/defects.
- Inspection of control panel interiors and all other electrical cabinets to ensure proper connections and ensure cabinets are free of dirt, debris, or water.
- Inspection of all wiring for insulation flaws or defects. This includes visual inspection of all conduit, junction boxes, control/alarm features, and equipment connections.

Prior to system start-up, the system will be tested in order to demonstrate that all equipment, sensors, controls, and programming are properly installed and coordinated to perform satisfactorily as a complete system. Testing will be conducted using non-impacted, ambient air.

In the event damages and/or defects are observed, EAR will complete a deficiency report form and immediately notify CDM and NYSDEC, so that a proper corrective action(s) can be determined and implemented. Equipment testing and system testing is not to be conducted until all corrective actions have been executed.

Once inspections and testing have been satisfactorily completed and any deficiencies have been corrected, the system can be started with all AS & SVE wells "online."

7.2 MONITORING

During the first two weeks of the start-up period, a technician will visit the site daily (Monday-Friday) in order to monitor the system, collect system performance/operational readings, collect samples as necessary, and make any required and/or requested system adjustments. The technician will have a minimum 2 years of experience as an operator of a similar system. During each site visit, monitoring data (collected both before and after any system adjustments) will be recorded on a site data information sheet (SDI).

System monitoring requirements during the "Start-Up" period are summarized as follows:

Location	Number of Locations	Parameters	Frequency
SVE Wells (at manifold)	3	Air flow rate, air temperature, air pressure, Total VOCs (via PID)	No less than 4 readings daily*
Intake filter influent/effluent	2	Air pressure	No less than 4 readings daily*
SVE blower influent	1	Air pressure	No less than 4 readings daily*
SVE blower effluent	1	Air pressure, air temperature, air flow rate	No less than 4 readings daily*
Vapor-phase carbon influent	1	Air flow rate, air temperature, air pressure, Total VOCs (via PID)	No less than 4 readings daily*
Vapor-phase carbon mid-point	1	Air pressure, air temperature, Total VOCs (via PID)	No less than 4 readings daily*
Vapor-phase carbon effluent	1	Air pressure, air temperature, Total VOCs (via PID)	No less than 4 readings daily*
AS Wells (at manifold)	13	Air flow rate, air pressure, air temperature (pre-manifold)	No less than 4 readings daily*

* - Collected hourly

Where gauges or other indicating instruments are not present/applicable, system data will be measured using the following instruments (model indicated, or similar):

Parameter	Instrument	Model
Air flow	Air Velocity Meter	VelociCalc® 8345
Vacuum	Digital Manometer	Digimano® 2000
Volatile Organic Compounds (VOC)	Photo-Ionization Detector	PhotoVac® 2220 Pro / Pro Plus or Minirae® 2000
Temperature	Air Velocity Meter	VelociCalc® 8345

7.3 AIR SAMPLE COLLECTION

Air samples are to be collected from the SVE system during the Start-Up period as follows:

Location	Number of Locations	Frequency	Turnaround Time
SVE Wells	3	Baseline[2] (prior to starting system), and	Baseline: 72 Hour Remainder: 10 Day

[2] Baseline samples shall be collected prior to starting the system. Provided radius of influent testing is conducted prior to system startup as proposed in Section 7.5, the samples shall be collected prior to the test. Baseline samples shall be grab samples, collected at the wellheads.

		Thursday of week 1 and week 2	
Vapor Phase Carbon Influent	1	4 days per week (M,T,W,Th)	Day 1: 72 Hour Remainder: 10 Day
Vapor Phase Carbon Mid-Point	1	4 days per week (M,T,W,Th)	24 Hour TAT

Air samples will be collected using passivated Summa Canisters. On the day of collection, samples will be shipped via overnight service (or lab courier) to Test America, Inc. for analysis of VOC's via EPA Method TO-15 at the analytical turnaround times listed above, with NYSDEC ASP Category B deliverables requested. EAR acknowledges that sampling frequencies are subject to change during system operation.

7.4 CARBON CHANGEOUT

In the event that field monitoring of the mid-GAC airstream yields a reading of 3 ppm or greater, the lag vessel shall replace the lead vessel, and a new 400lb vessel shall be installed in the lag position. During the system start-up period, EAR will maintain a 400 lb reserve vessel onsite to ensure immediate replacement of spent carbon should the need arise. Only virgin carbon is to be used. Spent carbon drums shall be collected by a subcontractor for disposal or reactivation following characterization.

7.5 RADIUS OF INFLUENCE ASSESSMENT

In an effort to evaluate and ensure adequate vent coverage, EAR proposes to conduct the radius of influence (ROI) test prior to system start-up. The test would be conducted following system inspection and testing (see Section 7.1) at a date to be coordinated with CDM and the property owners.

Within five business days of completion of the test, EAR will submit a letter report to NYSDEC and CDM summarizing the test procedures and results.

7.5.1 SVE

Each SVE well will be individually tested with applied air flow steps of 15, 30, and 45 CFM. Each air flow step will be maintained until stabilization of parameters monitored at the VMP wells is achieved (not to exceed 4 hours, but no less than 1 hour). During each test, the following readings shall be collected continuously during the first 30 minutes, and every 10 minutes thereafter:

- Air flow (CFM) at manifold
- Vacuum ("WC) at manifold
- Total VOC's (ppm) at manifold
- Differential pressure at ("WC) at VMP-1, VMP-2, VMP-3, VMP-4

Following testing at the individual SVE wells, the tests will be repeated with all SVE wells simultaneously open/operating. Again, each air flow step will be maintained until stabilization of parameters monitored at the VMP wells is achieved (not to exceed 4 hours). During each step, the following readings shall be collected every 5 minutes during the first 30 minutes, and every 10 minutes thereafter:

- Air flow per SVE well (CFM) at manifold
- System influent airflow (CFM)
- Vacuum per SVE well ("WC) at manifold

- System influent vacuum ("WC)
- Total VOC's per SVE well (ppm) at manifold
- Combined Total VOC's (ppm)
- Differential pressure at ("WC) at VMP-1, VMP-2, VMP-3, VMP-4

7.5.2 AS/SVE

Following completion of the SVE tests, the AS system shall be tested with applied total air flow steps of 70, 130, and 150 CFM, or approximately 5.3, 10, and 11.5 CFM per well. During all steps of the AS test, an airflow of 30 CFM shall be maintained at each of the three SVE wells. Each AS air flow step will be maintained until stabilization of parameters monitored at the VMP wells is achieved (not to exceed 4 hours, but no less than 1 hour). During each test, the following readings shall be collected continuously during the first 30 minutes, and every 10 minutes thereafter:

- SVE and AS air flow (CFM) readings per AS & SVE well at manifolds
- Pressure and vacuum ("WC) readings per AS & SVE well at manifolds
- Total VOC's (ppm) per SVE well at manifold
- Differential pressure at ("WC) at VMP-1, VMP-2, VMP-3, VMP-4
- Manual depth-to-water readings at wells MW-06, MW-08, MW-09, ERM-MW-06D, ERM-MW-01S, ERM-MW-07D

Pressure transducers[3] (In-Situ Inc. Level Troll 500/700 or similar) installed at MW-01, MW-02, MW-05, MW07, and MW-07SM shall be programmed to log water levels at 1 second intervals throughout the duration of the tests. Vented transducers/cables shall be utilized to compensate for changes in barometric pressure, with a secondary check of barometric changes to be provided via deployment of a barometric pressure data logger (Barotroll). Prior to the start of the tests, manual depth to water readings shall be collected at wells MW-06, MW-08, MW-09, ERM-MW-06D, ERM-MW-01S, ERM-MW-07D. Well locations are illustrated in Figure 11.

[3] EAR maintains a number of currently available NYSDEC-owned pressure transducers that can be utilized for this project.

8.0 AS/SVE SYSTEM OPERATION & MAINTENANCE

Once the operation & maintenance (O&M) period has begun, an EAR technician will conduct routine monitoring & maintenance activities at a minimum frequency of once per week[4]. The technician will have a minimum of 2 years experience as an operator of a similar system.

During the weekly site visits, system operating parameters will be reviewed and recorded (see Section 8.1).

Condensate will be drained as necessary from the moisture separator and drummed (see Section 10.0 for disposal details). All adjustments, readings, monitoring data, and observations will be compiled in a Microsoft Excel formatted report and submitted to NYSDEC and its engineers on a weekly basis along with any recommendations. NYSDEC and its engineers will be notified immediately in the event of catastrophic system failures, imminent repair or maintenance, and any exceedances of air discharge limitations (3.0 ppm total VOC as measured by PID).

8.1 SYSTEM MONITORING

During each site visit, monitoring data (both before and after any system adjustments) shall be collected and recorded on a site data information sheet (SDI). System monitoring requirements are summarized as follows:

Location	Number of Locations	Parameters
SVE Wells (at manifold)	3	Air flow rate, air temperature, air pressure, Total VOCs (via PID)
Intake filter influent/effluent	2	Air pressure
SVE blower influent	1	Air pressure
SVE blower effluent	1	Air pressure, air temperature, air flow rate
Vapor-phase carbon influent	1	Air flow rate, air temperature, air pressure, Total VOCs (via PID)
Vapor-phase carbon mid-point	1	Air pressure, air temperature, Total VOCs (via PID)
Vapor-phase carbon effluent	1	Air pressure, air temperature, Total VOCs (via PID)
AS Wells (at manifold)	13	Air flow rate, air pressure, air temperature

8.2 SAMPLE COLLECTION AND ANALYSIS

Air samples are to be collected on a weekly basis from the following locations:

- SVE-1, SVE-2, SVE-3 influent airstreams
- Vapor-phase carbon influent
- Vapor-phase carbon treatment mid-point (lead vessel effluent)

[4] Frequencies may be adjusted at the discretion of the NYSDEC

Air samples will be collected using passivated Summa Canisters. On the day of collection, samples will be shipped via overnight service (or lab courier) to Test America, Inc. for analysis of VOC's via EPA Method TO-15 at a standard, 10-day turnaround time, with NYSDEC ASP Category B deliverables requested. EAR acknowledges that sampling frequencies are subject to change during system operation.

8.3 INSPECTION & MAINTENANCE

Regular AS/SVE system inspection, maintenance, and lubrication items and their required frequencies shall be determined once AS/SVE equipment selections have been finalized. Such inspection, maintenance, and lubrication tasks will be conducted during the routine, weekly site visits. An AS/SVE System Management Plan, to be prepared and submitted following system installation, shall provide detail of the inspection, maintenance, and lubrication tasks, and their required frequencies.

8.4 ALARM RESPONSE

In the event an alarm notification has been received, EAR will dispatch personnel to the site in order to investigate the cause and restart the system within 24 hours of receiving the notification. Following system assessment, EAR shall notify CDM and NYSDEC of the findings. The notification shall be transmitted via email and include the date/time of shutdown, reason for shutdown, corrective action(s), and anticipated duration of shutdown.

8.5 CARBON CHANGEOUTS

Carbon changeouts will be performed as necessary (following guidance set forth in Section 7.4) to ensure air discharge requirements are being met. EAR will maintain a 400 lb reserve vessel onsite to ensure immediate replacement of spent carbon should the need arise. Only virgin carbon is to be used. Spent carbon drums will be collected by a subcontractor for disposal or reactivation.

8.6 DOCUMENTATION & REPORTING

A "project folder" (three-ring binder) is to be kept onsite, within the system container/shed, at all times. The project folder shall include:

- Testing logs
- Inspection, maintenance, and lubrication logs
- Copies of any permits
- Documentation of carbon change-outs and pickup/disposal of any condensate
- Boring logs
- AS/SVE System Management Plan

A separate log book will be kept onsite which will contain all system data as observed during each site visit, as well as details of any system adjustments made. The log book will be updated during each site visit, prior to departure from the site.

Monthly reports will be submitted to NYSDEC and CDM in both a *.pdf and tabular format (*.xls) within three weeks of the end of the reporting month. The monthly reports will provide the observed system data, detail any system adjustments, and maintenance activities, and provide estimated vapor recovery and emissions rates.

9.0 MATERIALS HANDLING

In order to minimize contact between personnel and potentially contaminated soils & liquids, materials handling will be conducted primarily with powered equipment (ie. excavator bucket for soils, pumps for SVE system-generated condensate) and hand tools (ie. shovel). Field personnel will follow guidelines set forth in the CDM HASP and EAR Corporate HASP to further minimize contact with potentially contaminated materials via the use of appropriate personal protective equipment (PPE).

9.1 AUGER CUTTINGS & EXCAVATED SOIL

Auger cuttings which do not evidence contamination (via visual, olfactory, or PID headspace analysis), will be re-used as backfill. Contaminated and surplus auger cuttings will be containerized in USDOT approved 55-gallon drums, properly labeled, and staged onsite pending waste characterization testing.

Excavated soil which does not evidence contamination (via visual, olfactory, or PID headspace analysis), will be re-used as backfill. Excavated soils will be placed on plastic sheeting and inspected prior to re-use as backfill. Excavated soils which evidence contamination, or are otherwise unsatisfactory, will be containerized in USDOT approved 55-gallon drums, properly labeled, and staged onsite pending waste characterization testing.

Should the quantity of excavated soils identified for disposal prove too large for containerization in 55-gallon drums, the soil will be stockpiled at a separate, designated onsite location or in a roll-off. This stockpile/roll-off is to be kept covered and secured with plastic sheeting at all times to prevent erosion/runoff and offsite migration of dusts. These soils will be loaded onto transport vehicles using an appropriately sized excavator or backhoe.

Drum dollies, hand drum trucks, or similar purpose-built conveyance will be used for all onsite movement of drums.

9.2 BACKFILL MATERIALS

Backfill materials will be transported to the site in stages, as required, so as to minimize stockpiling of materials onsite. All backfill materials will be covered during transportation. Any and all onsite material stockpiles are to be kept sufficiently separated to prevent accidental misidentification and cross-contamination / mixing. Should any quantity of stockpiled materials remain onsite after each day's activities, the stockpile is to be covered and secured with plastic sheeting to prevent erosion/runoff and offsite migration of dusts. Onsite movement of these materials from transport vehicle to stockpile to placement will be conducted using appropriately sized equipment such as an excavator, backhoe, skid-steer, or any combination thereof.

Backfill materials will include:

- Pipe/Conduit Bedding
- Native Fill
- Item 4/Aggregate

9.3 PVC PIPING & FITTINGS

Piping and fittings will be handled in such a way as to prevent damage. During transport, pipes and fittings are to be secured in truck beds. The driver will ensure no large items can fall onto piping and fittings during transport. Piping shall be carried at the work place (no dragging pipes). Pipes and fittings will be examined for cleanliness and any evidence of damage prior to placement.

During trenching and piping activities, all pipe openings shall be capped and clearly labeled prior to any backfilling measures. Once uncovered, piping shall be inspected and cleaned of any debris prior to resumption of piping.

9.4 CONDENSATE & RINSATE

SVE system generated condensate is to be pumped from the moisture separator directly to a USDOT approved 55-gallon drum using the moisture separator transfer pump. The drum will be properly labeled, sealed, and stored within the AS/SVE system enclosure for characterization, pickup, transport, and disposal.

Rinsate generated during any decontamination activities will be pumped into DOT approved 55-gallon drums using a dedicated sump pump. The drums will be properly labeled, sealed, and staged in a designated area for sampling and transport & disposal.

Onsite movement of drums will be conducted using a "drum-dolly" or similar conveyance purpose-built for the movement of drums.

9.5 CONSTRUCTION DEBRIS

9.5.1 BITUMINOUS PAVING

Bituminous asphalt debris generated during field activities will be loaded into an onsite roll-off or similar container supplied by a carting subcontractor. Depending on sizing and quantity, these materials may be loaded by field personnel using hand tools as well as powered equipment (ie. excavator).

Once capacity of the container is reached, or upon completion of field activities (well installations, trenching & piping, final hookup of SVE system), the container will covered, and then will be picked up by the subcontractor for disposal via municipal waste streams.

Should the site's business activities and/or layout preclude the use of a roll-off, bituminous asphalt debris will be loaded into an EAR dump truck for daily transport to a municipal waste facility.

9.5.2 GENERAL DEBRIS

Because the quantity of general construction debris generated is anticipated to be small, this material will be hand loaded (prior to the end of the work day) onto EAR vehicles for transport to a designated municipal waste facility.

10.0 WASTE TRANSPORTATION & DISPOSAL

10.1 AUGER CUTTINGS/EXCAVATED SOIL/RINSATE/CONDENSATE

Transportation for wastes identified for disposal will be arranged with a NYSDEC Region 1 Response Contractor (Island Pump & Tank (IPT), East Northport, NY). A copy of IPT's Waste Transporter Permit (Part 364) is included as Appendix E.

Prior to transportation offsite, a composite sample will be collected from the soil or aqueous waste identified for transport & disposal. The sample will be collected by an EAR technician and submitted to Test America, Inc. for characterization analysis. The disposal facility will be selected by IPT based on the waste media and nature of the contaminants identified in the characterization.

At the time of pickup, IPT shall provide a manifest that provides the following information:

- Contact information
- Vehicle license number
- Destination
- Description & quantity of materials

All drum pickups will be via a closed box-truck or similar closed/covered vehicle. All drums will be sealed and secured. Drums will be loaded onto transport vehicles using either a lift-gate or winch operated lift. EAR personnel will confirm that project details are listed on the manifest for disposal, that quantity and type of materials are correctly listed on manifest, and that license plate of vehicle to be used for transport is listed on the Part 364 permit. NYSDEC will be listed as generator of waste. EAR personnel will sign off on manifest as "AGENT for NYSDEC."

10.2 CONSTRUCTION DEBRIS

Roll-off containers will be picked up by the providing carting subcontractor. EAR personnel will oversee pickup of the container to ensure that the load is secured.

PVC cuttings, personnel generated trash, and other miscellaneous trash/debris items are to be collected at the end of each day in contractor-quality garbage bags. Bags will be tied and secured in vehicle beds prior to leaving site. Large, unbagged items shall be covered or otherwise secured prior to leaving the site.

All construction debris will be disposed of via appropriate municipal waste/recycling streams.

11.0 SUBMITTALS REGISTER

The following submittals shall be applicable to this work plan:

Submittal	NYSDEC/CDM Approval Required For:	Comments
Final Work Plan	OK to proceed	Required if draft is altered
Pre-Construction Survey	-	-
Final Trench & Well Location Plan	Well installation, trenching & piping, electrical service installation	AS/SVE/Electrical
Drill Logs	-	-
Final technical specification/cut sheets for system components (if altered)	Purchase and installation	-
Post Construction Survey	-	Details final grades, pipe locations/elevations, well locations
AS/SVE System As-Builts	-	-
AS/SVE Management Plan	Transition to General O&M Phase	-
ROI Assessment Report	-	-

System start-up and O&M reports will be submitted as detailed in previous sections of this work plan. Waste manifests and disposal certificates for all (non-municipal waste stream) transportation and disposal events will be submitted to NYSDEC.

FIGURES

not to scale

modified from 2015, Europa Technologies, Google

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

Figure 1

Site Location Map

Pride Solvents & Chemical Co.
78-88 Lamar Street
West Babylon, NY
Site No. 152025

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

Figure 2

SITE PLAN

PRIDE SOLVENTS AND CHEMICAL COMPANY
78-88 LAMAR STREET
WEST BABYLON, NEW YORK
SITE NO. 152025

Figure 3

PROPOSED AIR SPARGE WELL DESIGN

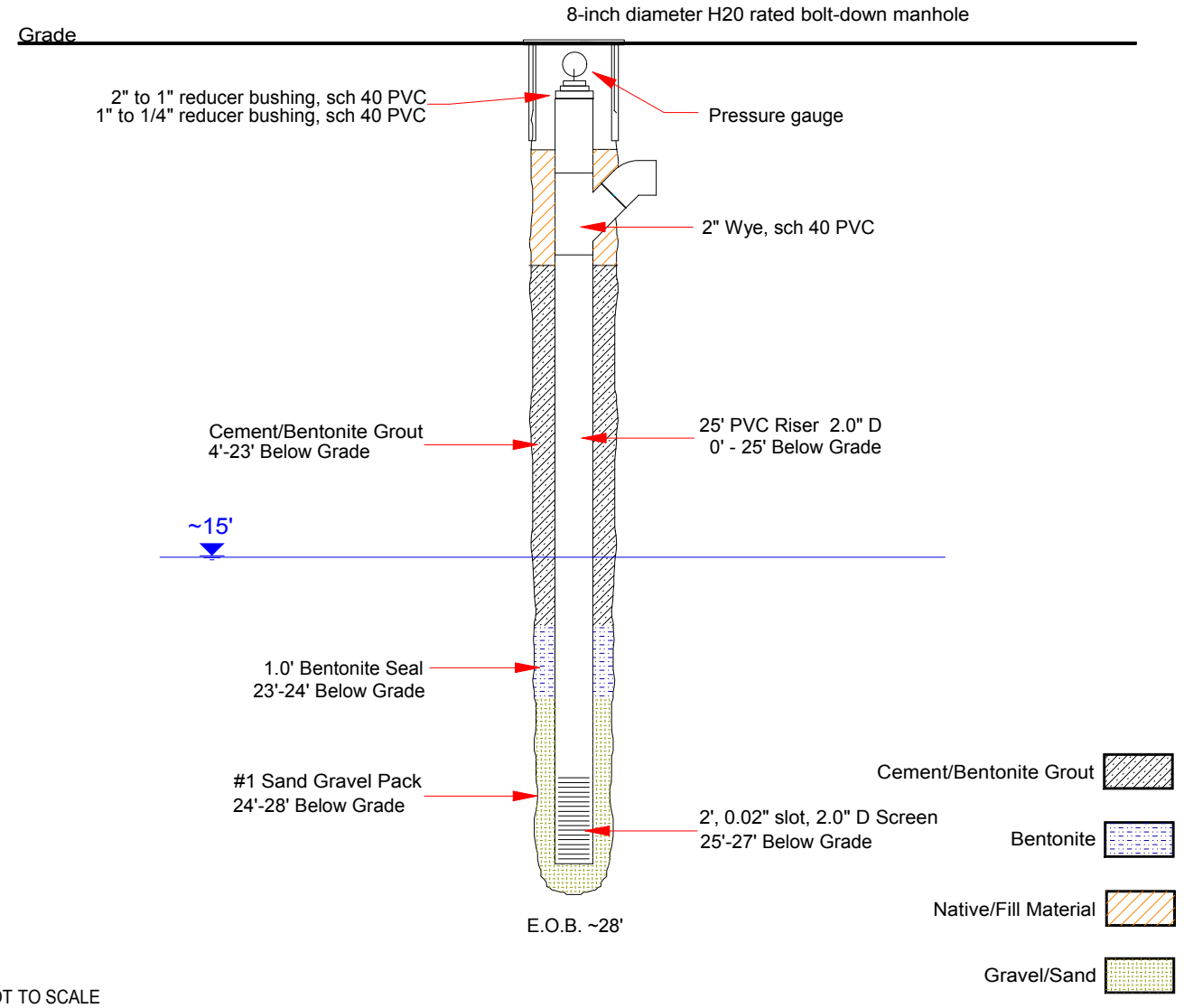
PROJECT DETAILS

PROJECT/SITE NAME: DEC-WESTBABYLON78
SITE ADDRESS: Pride Solvents
78-88 Lamar Street
West Babylon, NY
SITE NUMBER: 152025
DRILLING METHOD: Hollow Stem Auger
BOREHOLE DIAMETER: 4.25 "
COMMENTS:

WELL CONSTRUCTION

CASING
Type PVC Diameter 2.0" Length 25'
Type ____ Diameter ____ Length ____ Sch 40
SCREEN
Type PVC Diameter 2.0" Slot 0.020" Length 2'
Sch 40
BOTTOM SUMP
Type n/a Diameter ____ Length ____ Sch ____
GRAVEL PACK: #1 Gravel pack
CASING SEAL: Bentonite seal
SECURITY: Locking Well Cap / J-plug
FINISH: H20 Bolt Down Manhole

WELL DESIGN



NOT TO SCALE

Figure 4

PROPOSED SOIL VAPOR EXTRACTION WELL DESIGN

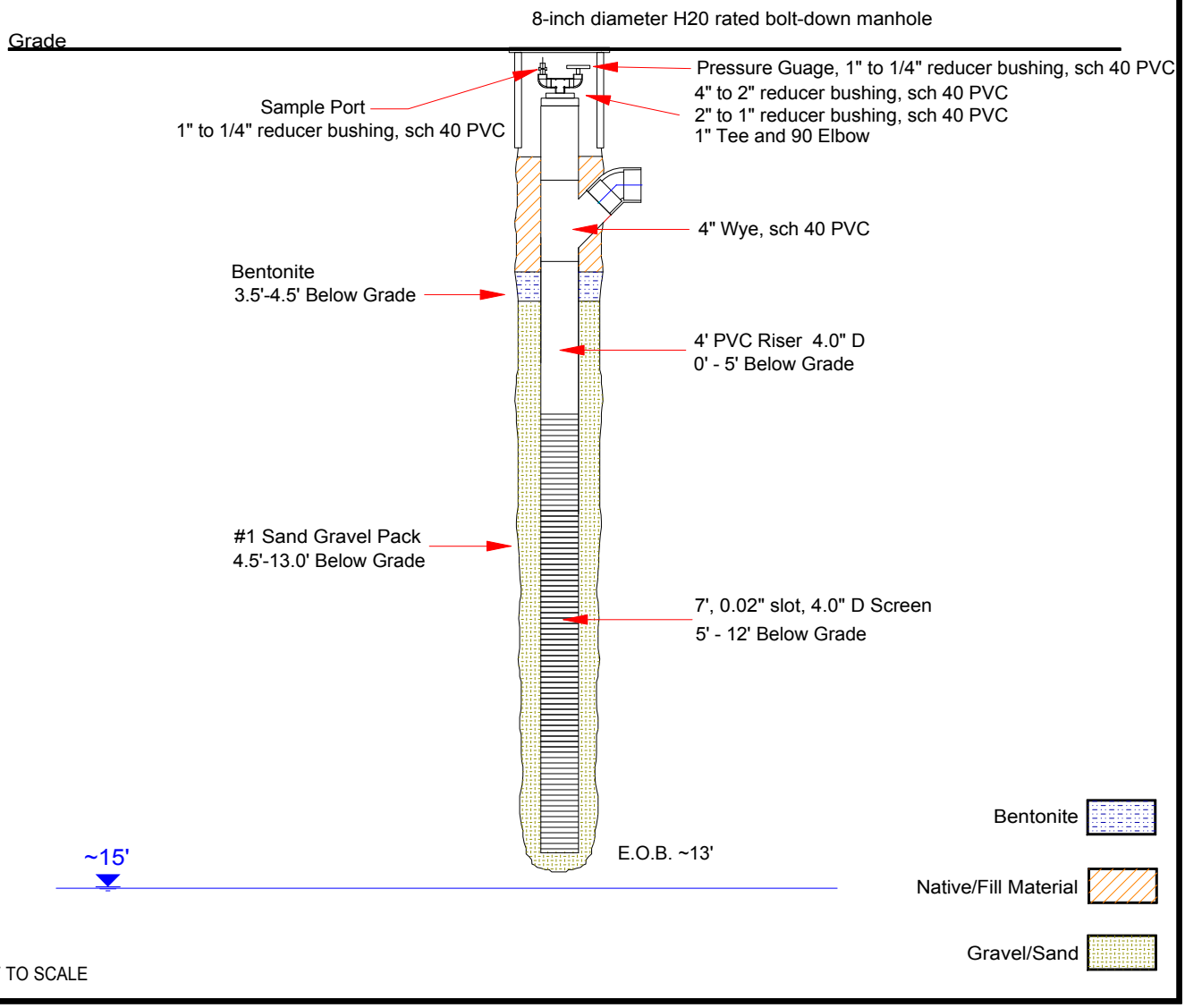
PROJECT DETAILS

PROJECT/SITE NAME: DEC-WESTBABYLON78
SITE ADDRESS: Pride Solvents
78-88 Lamar Street
West Babylon, NY
SITE NUMBER: 152025
DRILLING METHOD: Hollow Stem Auger
BOREHOLE DIAMETER: 7 "
COMMENTS:

WELL CONSTRUCTION

CASING
Type PVC Diameter 4.0" Length 5'
Type ____ Diameter ____ Length ____ Sch 40
SCREEN
Type PVC Diameter 4.0" Slot 0.020" Length 7'
Sch 40
BOTTOM SUMP
Type n/a Diameter ____ Length ____ Sch ____
GRAVEL PACK: #1 gravel pack
CASING SEAL: Bentonite seal
SECURITY:
FINISH: H20 Bolt Down Manhole

WELL DESIGN



NOT TO SCALE

Figure 5

PROPOSED VAPOR MONITORING WELL DESIGN

PROJECT DETAILS

PROJECT/SITE NAME	DEC-WESTBABYLON78
SITE ADDRESS	Pride Solvents 78-88 Lamar Street West Babylon, NY
SITE NUMBER	152025
DRILLING METHOD	Direct Push
BOREHOLE DIAMETER	1.25 "
COMMENTS	capped teflon riser w/ valve

WELL CONSTRUCTION

CASING
Type Teflon Diameter 0.375" Length 1.5'
Type _____ Diameter _____ Length _____ Sch _____

SCREEN
Type S/S Diameter 0.375" Slot 0.15mm mesh Length 6"
Sch _____

BOTTOM SUMP
Type n/a Diameter _____ Length _____ Sch _____

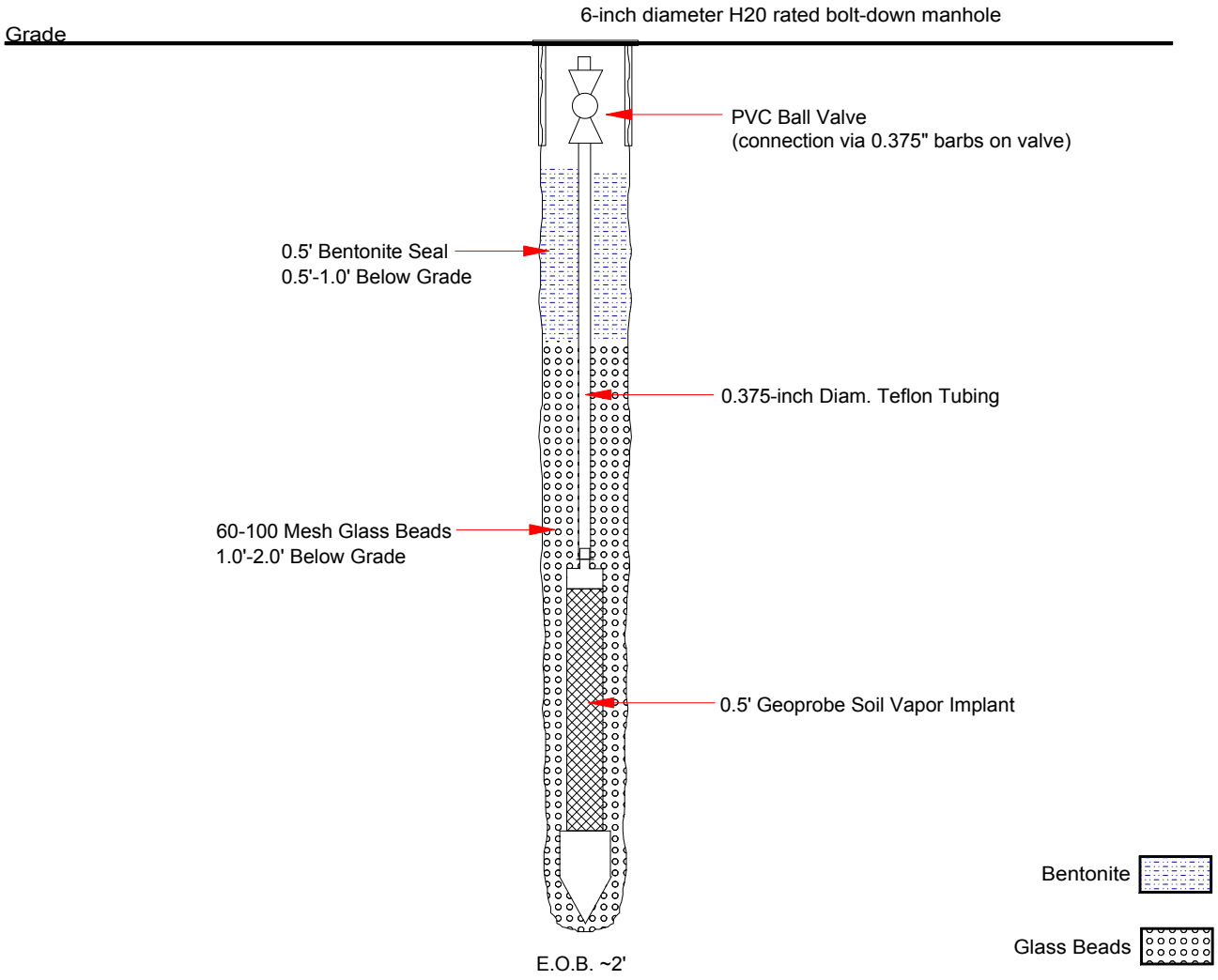
GRAVEL PACK Glass Bead - 60-100 Mesh (1'-2' BGS)

CASING SEAL Bentonite Seal (0.5'-1.0' BGS)

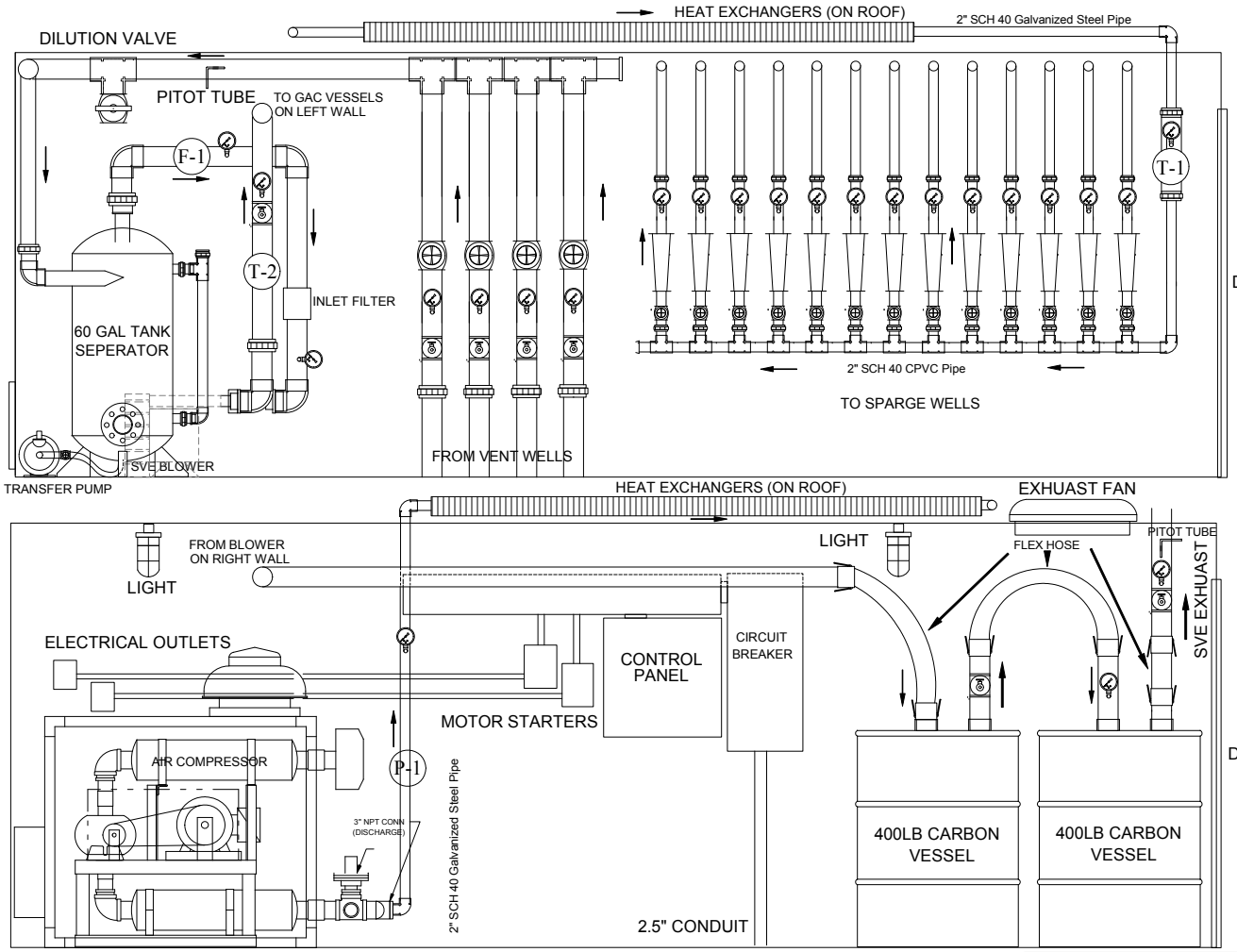
SECURITY _____

FINISH H20 Bolt Down Manhole

WELL DESIGN



NOT TO SCALE



GATE VALVE

BALL VALVE

PRESSURE/ VACUUM/ TEMPERATURE GAUGE

LOCAL INSTRUMENT

FLOW METER

SAMPLE PORT

CAMLOCK COUPLER

UNION

0 3

SCALE IN FEET

REVISION:	DESCRIPTION:	DATE:	APPROVED:

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

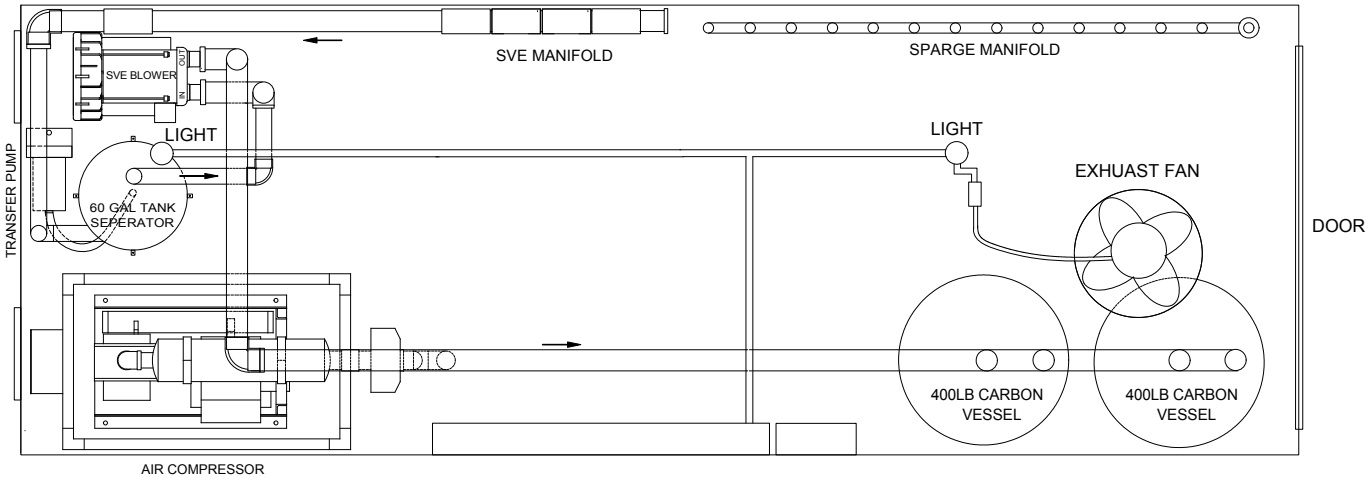
JOB SITE IDENTIFICATION:
Pride Solvent and Chemical Company
78-88 Lamar Street
West Babylon, NY

DRAWING IDENTIFICATION:

Figure 6
Equipment Layout

DESIGNED BY:	Daniel Cornacchiulo	DATE:	9/21/15
DRAWN BY:	Daniel Cornacchiulo	DRAWING NO:	
CHECKED BY:			
APPROVED BY:		REVISION:	

TOP VIEW OF INSIDE OF SHED



0 3

SCALE IN FEET

REVISION:	DESCRIPTION:	DATE:	APPROVED:

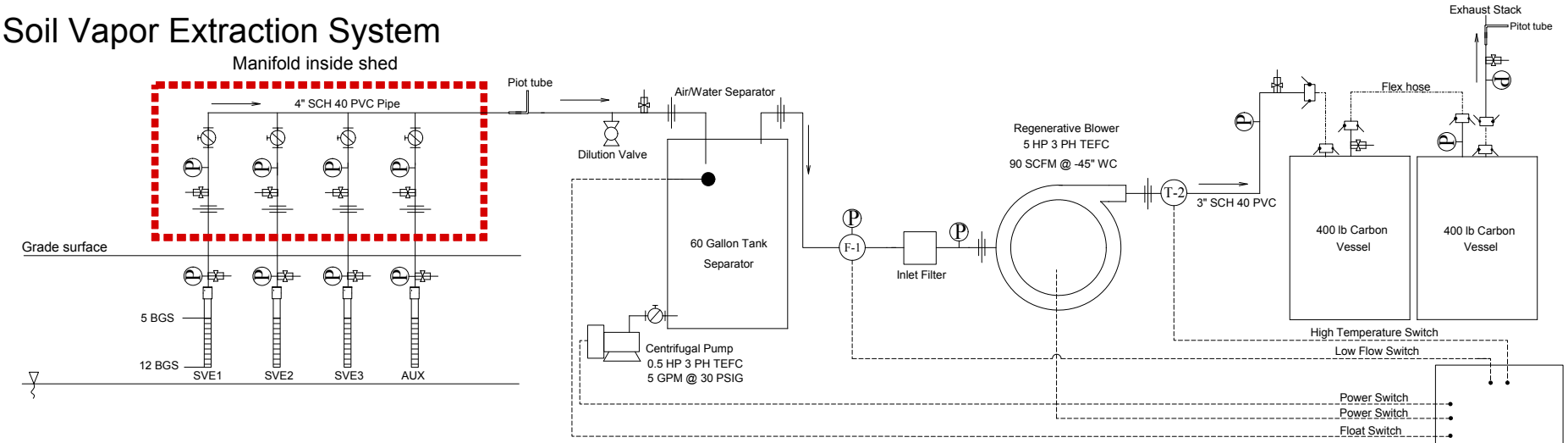
ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

JOB SITE IDENTIFICATION:
Pride Solvent and Chemical Company
78-88 Lamar Street
West Babylon, NY

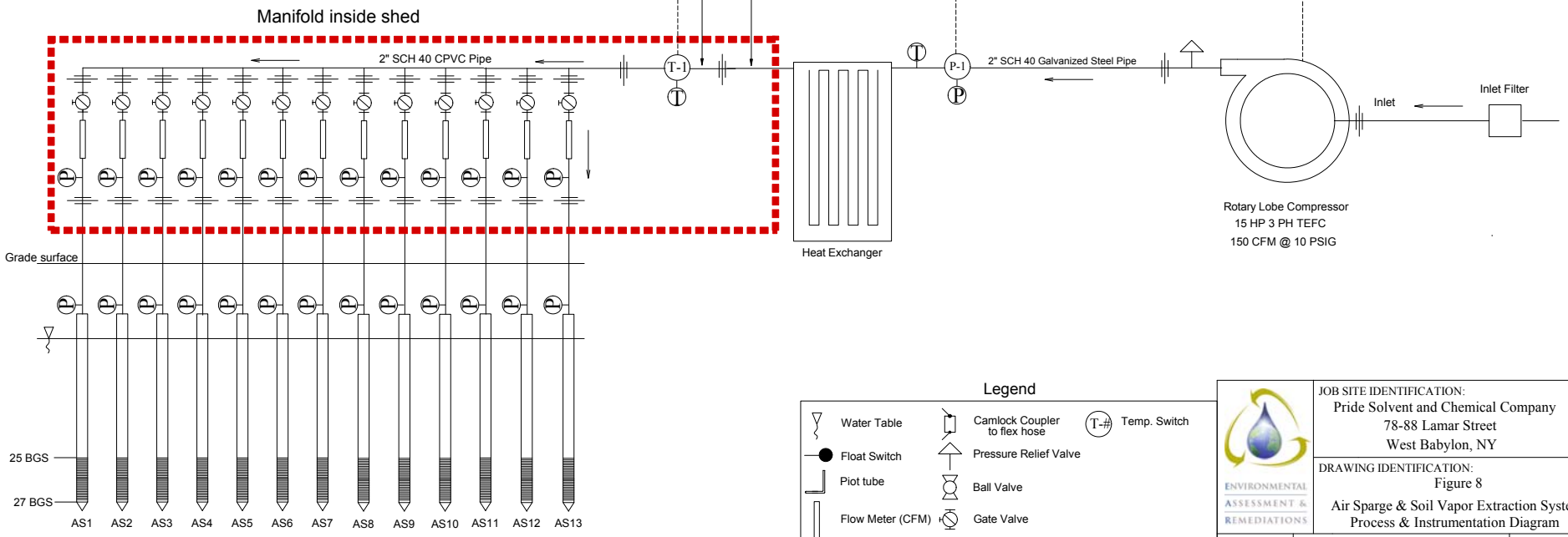
DRAWING IDENTIFICATION:
Figure 7
Equipment Layout (plan view)

DESIGNED BY:	Daniel Cornacchiulo	DATE: 9/21/15
DRAWN BY:	Daniel Cornacchiulo	DRAWING NO:
CHECKED BY:		
APPROVED BY:		REVISION:

Soil Vapor Extraction System



Air Sparge System



Legend

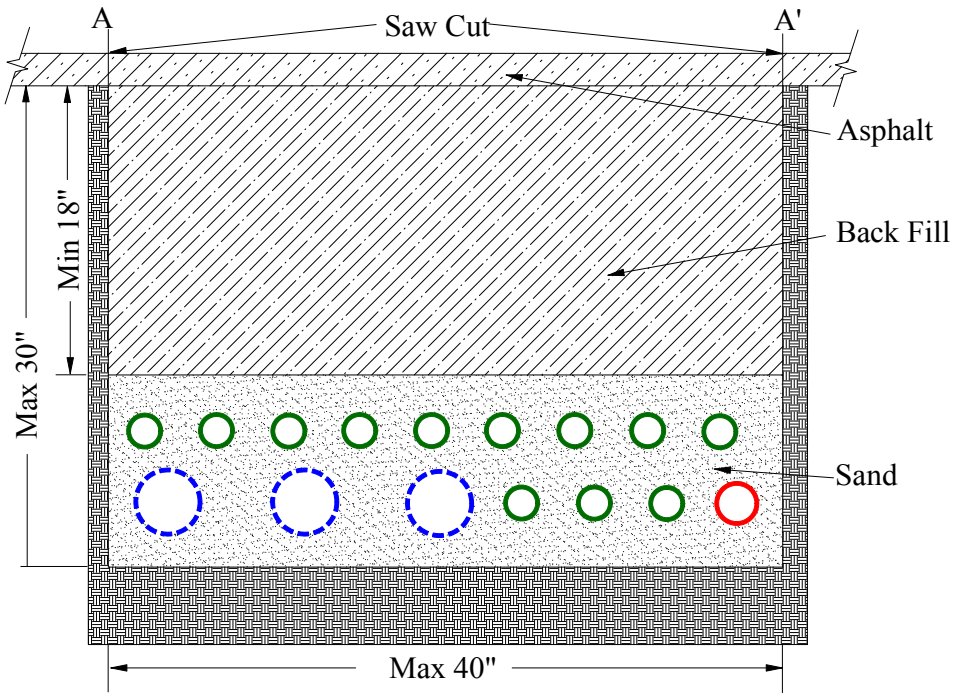
- Water Table
- Float Switch
- Piot tube
- Flow Meter (CFM)
- Union
- Sample Port
- Camlock Coupler to flex hose
- Pressure Relief Valve
- Ball Valve
- Gate Valve
- Pressure Gauge
- Temperature Gauge
- P-# Press./Vac. Switch
- T-# Temp. Switch

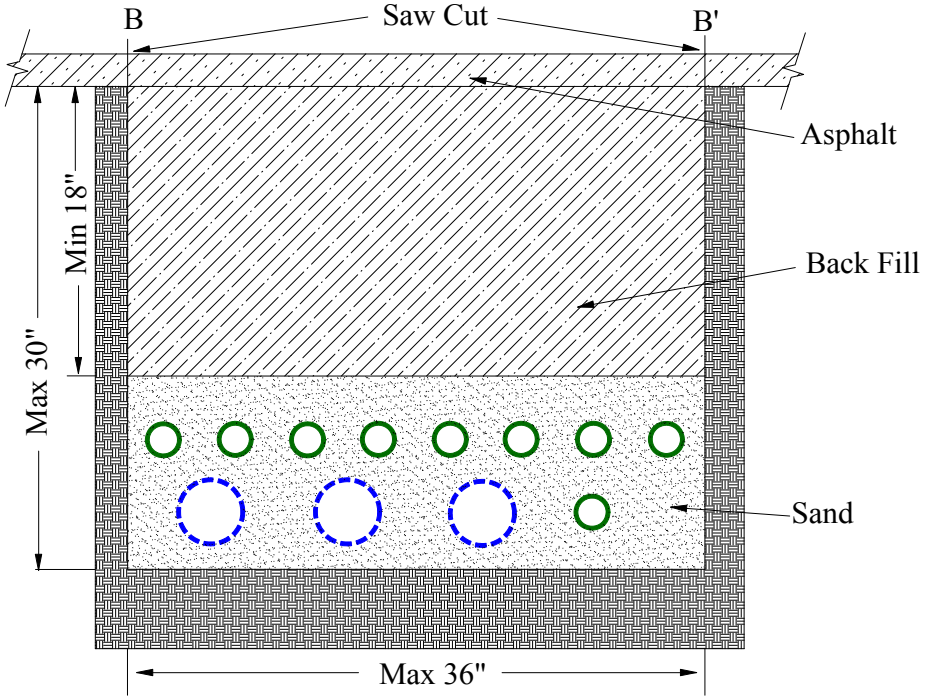
ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

JOB SITE IDENTIFICATION:
Pride Solvent and Chemical Company
78-88 Lamar Street
West Babylon, NY

DRAWING IDENTIFICATION:
Figure 8
Air Sparge & Soil Vapor Extraction System
Process & Instrumentation Diagram

DESIGNED BY:	D. Cornacchiulo	DATE:	/15
DRAWN BY:	D. Cornacchiulo	DRAWING NO:	
CHECKED BY:			
APPROVED BY:		REVISION:	A





2 1/2" PVC Electrical Conduit Pipe
Minimum depth of 24" must be maintained

Soil Vapor Extraction
4" Sch 40 PVC Pipe
Distance between SVE Points Must be 4"

Sparge 2" Sch 40 PVC Pipe
Distance between Sparge Points Must be 2"

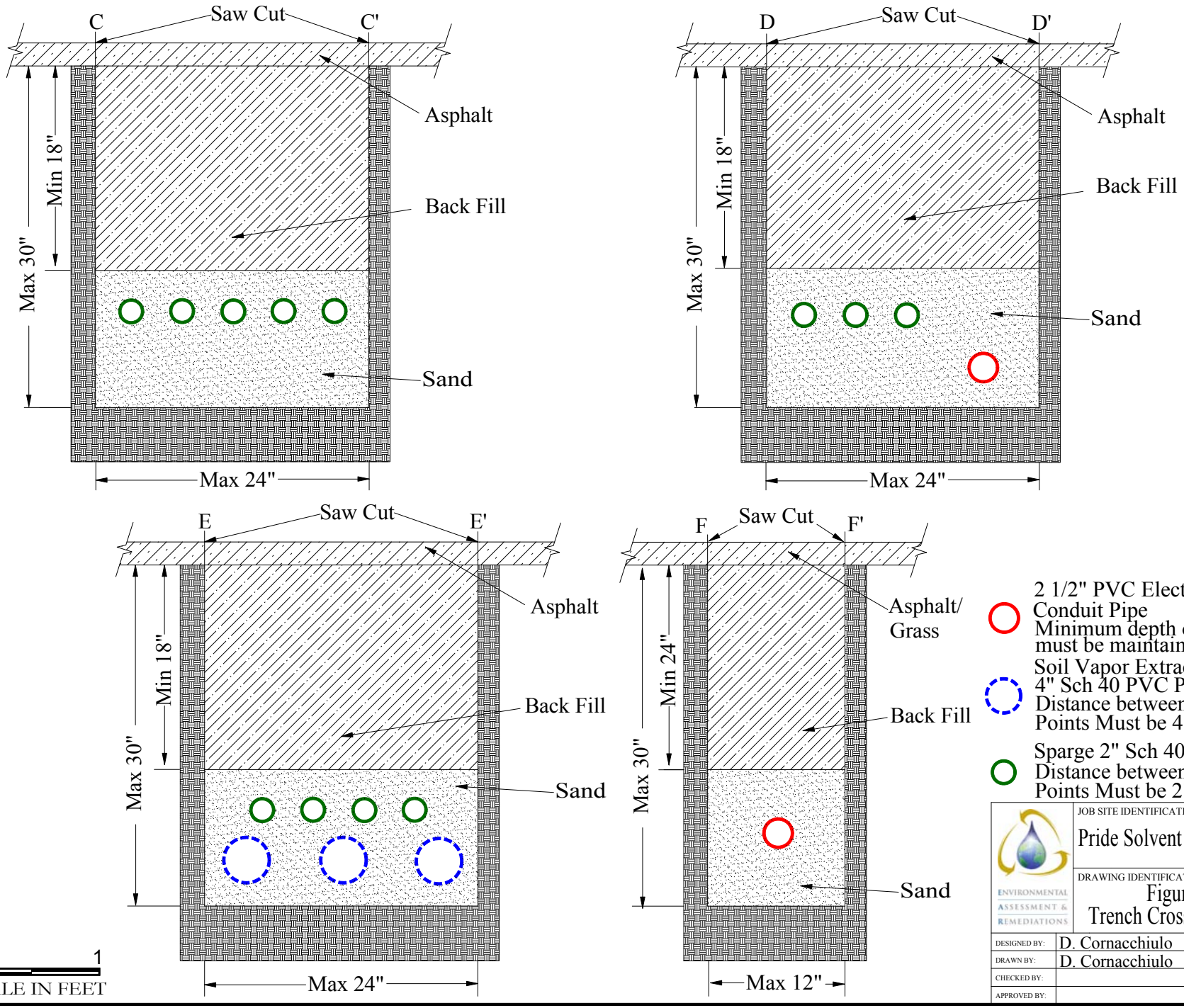
0 1
SCALE IN FEET

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

JOB SITE IDENTIFICATION:
Pride Solvent & Chemical Co.

DRAWING IDENTIFICATION:
Figure 9
Trench Cross Sections (A-B)

DESIGNED BY:	D. Cornacchiulo	DATE:	9/14/15
DRAWN BY:	D. Cornacchiulo	DRAWING NO:	
CHECKED BY:			
APPROVED BY:		REVISION:	A



ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

JOB SITE IDENTIFICATION:
Pride Solvent & Chemical Co.

DRAWING IDENTIFICATION:
Figure 10
Trench Cross Sections (C-F)

DESIGNED BY:	D. Cornacchiulo	DATE:	9/14/15
DRAWN BY:	D. Cornacchiulo	DRAWING NO:	
CHECKED BY:			
APPROVED BY:		REVISION:	A

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

Figure 11

Monitoring Well Locations

PRIDE SOLVENTS AND CHEMICAL COMPANY
78-88 LAMAR STREET
WEST BABYLON, NEW YORK
SITE NO. 152025

APPENDIX A: AS/SVE INSTALLATION ITEMIZED ESTIMATED COSTS

Pride Solvent & Chemical Co.
78-88 Lamar Avenue
West Babylon, NY
NYSDEC Site No. 152025

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

AS-SVE Pilot
Itemized Estimate

Preparation/Site Preparation						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	40	$2,997.12
Foreman	L-10	per hour	$59.47	1.05	24	$1,498.64
Markouts	subcontractor	lot	$1,500.00	1.1	1	$1,650.00
Foreman - oversee markouts/survey	L-10	per hour	$59.47	1.05	24	$1,498.64
LD Vehicle - oversee markouts/survey	E-002	per hour	$19.97	1.05	24	$503.24
Survey Services (pre/mid/post construction)	subcontractor	lot	$11,100.00	1.1	1	$12,210.00
Building Permit *	T&M	lot	$1,000.00	1.1	1	$1,100.00
Hydrant Permit	T&M	lot	$300.00	1.1	1	$330.00
Technician (permitting)	L-22	per hour	$49.59	1.05	16	$833.11
Sedan (permitting)	E-001	per hour	$15.88	1.05	16	$266.78
Low Value Equipment	LVE	per hour	$1.35	1.05	24	$34.02
					Sub-total	**$22,921.57**

Electrical Service Installation (Estimated 4 days. Includes subcontractor installation o H-frame and oversight, plus 2 days of piping and trenching from H-frame to shared trench, restoration of grass area)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	16	$1,198.85
Foreman	L-10	per hour	$59.47	1.05	32	$1,998.19
Equipment Operator x2	L-9	per hour	$53.82	1.05	32	$1,808.35
Skilled Laborer	L-20	per hour	$44.00	1.05	24	$1,108.80
HD Vehicle	E-003	per hour	$24.80	1.05	32	$833.28
Dump Truck	E-022	per hour	$53.07	1.05	16	$891.58
Excavator	E-033	per hour	$115.27	1.05	16	$1,936.54
Skid Steer	E-038	per hour	$35.14	1.05	16	$590.35
Flat Bed	E-005	per hour	$43.60	1.05	16	$732.48
Compactor	E-067	per hour	$8.92	1.05	16	$149.86
Sodcutter	T&M	lot	$370.00	1.1	1	$407.00
Sawcutter	E-053	per hour	$16.88	1.05	8	$141.79
Conduit - 2.5-inch PVC	T&M	per foot	$2.02	1.1	250	$555.50
Pull Boxes	T&M	ea	$300.00	1.1	3	$990.00
Clean Backfill	T&M	per ton	$21.00	1.1	8	$184.80
RCA	T&M	per ton	$9.00	1.1	5	$49.50
Misc T&M	T&M	per day	$150.00	1.1	2	$330.00
Retoration Materials (sod, topsoil)	T&M	lot	$150.00	1.1	1	$165.00
Electrician	subcontractor	lot	$5,000.00	1.1	1	$5,500.00
PSEG Fee**	T&M	lot	$1,676.93	1.1	1	$1,844.62
CAMP Technician	L-22	per hour	$49.59	1.05	16	$833.11
LD Vehicle (CAMP)	E-002	per hour	$19.97	1.05	16	$335.50
PID's (x2)	E-055	per hour	$19.03	1.05	32	$639.41
Air Particulate Monitors (X2)	T&M	per week	$1,052.00	1.1	1	$1,157.20
Low Value Equipment	LVE	per hour	$1.35	1.05	88	$124.74
					Sub-total	**$24,506.44**

Well Installation (13x AS, 4x VMP, 3x SVE - estimated 5 days)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	24	$1,798.27
CME Mobilization (AS/SVE Wells)	A-01	ea	$415.89	1.05	1	$436.68
Drill Rig w/ Crew	A-03	per day	$2,328.53	1.05	5	$12,224.78
Driller's Helper	L-5	per hour	$46.51	1.05	40	$1,953.42
Support Vehicle	E-003	per hour	$24.80	1.05	40	$1,041.60
Probe Mobilization (VMP Wells)	SP1	ea	$187.37	1.05	1	$196.74
Probe w/ Crew	SP4	per day	$1,338.63	1.05	1	$1,405.56
Geologist	L-11	per hour	$70.17	1.05	48	$3,536.57
Water Level Meter	E-074	per hour	$10.43	1.05	40	$438.06
4" PVC Screen Installation	B-16	per foot	$47.71	1.05	21	$1,052.01
4" PVC Riser Installation	B-09	per foot	$42.23	1.05	15	$665.12
2" Screen Installation	B-15	per foot	$40.85	1.05	26	$1,115.21
2" Riser Installation	B-08	per foot	$35.62	1.05	325	$12,155.33
Vapor Implant Materials (implants, glass beads, etc)	T&M	ea	$100.00	1.1	4	$440.00
Steel Protective Flush Mount Vaults	SP-18	ea	$85.56	1.05	20	$1,796.76
55 Gallon Drums	M-22	ea	$56.43	1.05	40	$2,370.06
Misc. T&M	T&M	per day	$125.00	1.1	5	$687.50
CAMP Technician	L-22	per hour	$49.59	1.05	48	$2,499.34
LD Vehicle (CAMP)	E-002	per hour	$19.97	1.05	48	$1,006.49
PID's (x2)	E-055	per hour	$19.03	1.05	96	$1,918.22
Air Particulate Monitors (X2)	T&M	per week	$1,052.00	1.1	1.2	$1,388.64
Low Value Equipment	LVE	per hour	$1.35	1.05	176	$249.48
Geologist (prepare drilling logs)	L-11	per hour	$70.17	1.05	12	$884.14
					Sub-total	**$51,259.98**

Pride Solvent & Chemical Co.
78-88 Lamar Avenue
West Babylon, NY
NYSDEC Site No. 152025

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

AS-SVE Pilot
Itemized Estimate

Trenching & Piping (estimated 18 days)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	40	$2,997.12
Foreman	L-10	per hour	$59.47	1.05	144	$8,991.86
Equipment Operator (x2)	L-9	per hour	$53.82	1.05	232	$13,110.55
Skilled Laborer	L-20	per hour	$44.00	1.05	140	$6,468.00
Excavator	E-033	per hour	$115.27	1.05	104	$12,587.48
Skid Steer	E-038	per hour	$35.14	1.05	104	$3,837.29
Flat Bed	E-005	per hour	$43.60	1.05	104	$4,761.12
Dump Truck	E-022	per hour	$53.07	1.05	104	$5,795.24
HD Vehicle	E-003	per hour	$24.80	1.05	264	$6,874.56
Sawcutter	E-053	per hour	$16.88	1.05	24	$425.38
Compactor	E-067	per hour	$8.92	1.05	208	$1,948.13
Aerial Lift (including delivery & pickup)	T&M	lot	$600.00	1.1	1	$660.00
3 Phase Generator (vac testing pipe)	T&M	per week	$1,400.00	1.1	3	$4,620.00
4-inch diameter Sched 40 PVC (SVE)	T&M	per foot	$2.00	1.1	450	$990.00
2-inch diameter Sched 40 PVC (AS)	T&M	per foot	$0.81	1.1	1645	$1,465.70
Bollards	T&M	ea	$145.00	1.1	2	$319.00
AS/SVE Manholes	T&M	ea	$46.00	1.1	16	$809.60
Clean fill	T&M	per ton	$21.00	1.1	44	$1,016.40
RCA	T&M	per ton	$9.00	1.1	24	$237.60
Roll-Offs (includes disposal)	T&M	ea	$560.00	1.1	3	$1,848.00
Asphalt Restoration	subcontractor	lot	$8,000.00	1.1	1	$8,800.00
Misc PVC (couplings, primer, cement)	T&M	lot	$500.00	1.1	1	$550.00
Misc T&M	T&M	per day	$150.00	1.1	18	$2,970.00
CAMP Technician	L-22	per hour	$49.59	1.05	104	$5,415.23
LD Vehicle (CAMP)	E-002	per hour	$19.97	1.05	104	$2,180.72
PID's (x2)	E-055	per hour	$19.03	1.05	208	$4,156.15
Air Particulate Monitors (X2)	T&M	per week	$1,052.00	1.1	3	$3,471.60
Low Value Equipment	LVE	per hour	$1.35	1.05	620	$878.85
					Sub-total	**$108,185.59**

System Installation (estimated 15 days)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	16	$1,198.85
Engineer	L-7	per hour	$70.17	1.05	8	$589.43
Foreman	L-10	per hour	$59.47	1.05	80	$4,995.48
Plumber	L-16	per hour	$53.70	1.05	80	$4,510.80
Electrician	L-6	per hour	$52.65	1.05	40	$2,211.30
Skilled Laborers	L-20	per hour	$44.00	1.05	120	$5,544.00
HD Vehicle x2	E-003	per hour	$24.80	1.05	200	$5,208.00
Equipment Shed	T&M	lot	$2,960.00	1.1	1	$3,256.00
AS Compressor	T&M	lot	$7,800.00	1.1	1	$8,580.00
Heat Exchanger	T&M	lot	$800.00	1.1	1	$880.00
SVE Blower	T&M	lot	$3,700.00	1.1	1	$4,070.00
Variable Frequency Drive (SVE)	T&M	lot	$700.00	1.1	1	$770.00
Carbon Vessels¥	T&M	ea	$1,375.00	1.1	3	$4,537.50
Moisture Separator	T&M	lot	$2,225.00	1.1	1	$2,447.50
Transfer Pump	T&M	lot	$700.00	1.1	1	$770.00
Cellular Autodialer	T&M	unit	$1,360.00	1.1	1	$1,496.00
Control Panel	T&M	lot	$400.00	1.1	1	$440.00
CPVC (AS Manifold)	T&M	per foot	$4.33	1.1	80	$381.04
Misc T&M (fittings, consumables, gauges, starters, etc)	T&M	lot	$7,000.00	1.1	1	$7,700.00
Low Value Equipment	LVE	per hour	$1.35	1.05	320	$453.60
					Sub-total	**$60,039.50**

Concrete Pad Foundation (if required)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$70.17	1.05	8	$589.43
Foreman	L-10	per hour	$59.47	1.05	16	$999.10
Equipment Operator	L-9	per hour	$53.82	1.05	8	$452.09
Skilled Laborer	L-20	per hour	$44.00	1.05	16	$739.20
HD Vehicle	E-003	per hour	$24.80	1.05	16	$416.64
Dump Truck	E-022	per hour	$53.07	1.05	8	$445.79
Flat Bed	E-005	per hour	$43.60	1.05	8	$366.24
Excavator	E-033	per hour	$115.27	1.05	8	$968.27
Sawcutter	E-053	per hour	$16.88	1.05	8	$141.79
Compactor	E-067	per hour	$8.92	1.05	8	$74.93
4000 psi Ready Mix Delivery	T&M	per yard	$150.00	1.1	3	$495.00
Misc T&M (forms, wire mesh, debris disposal, etc)	T&M	lot	$500.00	1.1	1	$550.00
Low Value Equipment	LVE	per hour	$1.35	1.05	40	$56.70
					Sub-total	**$6,295.17**

Pride Solvent & Chemical Co.
78-88 Lamar Avenue
West Babylon, NY
NYSDEC Site No. 152025

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

AS-SVE Pilot
Itemized Estimate

ROI Assessment (3 days)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	8	$599.42
Foreman	L-10	per hour	$59.47	1.05	24	$1,498.64
Technicians	L-22	per hour	$49.59	1.05	48	$2,499.34
HD Vehicle	E-003	per hour	$24.80	1.05	24	$624.96
LD Vehicle	E-002	per hour	$19.97	1.05	24	$503.24
PID (x3)	E-055	per hour	$19.03	1.05	72	$1,438.67
Water Level Meter (x2)	E-074	per hour	$10.51	1.05	16	$176.57
Barotroll	T&M	per week	$120.00	1.1	1	$132.00
Transducer Cables (4@25')	T&M	per week	$360.00	1.1	1	$396.00
Transducer Maintenance & Re-Calibration	T&M	each	$219.00	1.1	5	$1,204.50
Low Value Equipment	LVE	per hour	$1.35	1.05	72	$102.06
Misc T&M	T&M	per day	$50.00	1.1	3	$165.00
Project Manager (reporting)	L-19	per hour	$71.36	1.05	24	$1,798.27
					Sub-total	**$11,138.68**

System Startup (2 weeks)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	16	$1,198.85
Foreman	L-10	per hour	$59.47	1.05	8	$499.55
Technician	L-22	per hour	$49.59	1.05	80	$4,165.56
Foreman (contingency)	L-10	per hour	$59.47	1.05	24	$1,498.64
Electrician (contingency)	L-6	per hour	$52.65	1.05	32	$1,769.04
LD Vehicle	E-002	per hour	$19.97	1.05	80	$1,677.48
HD Vehicle (contingency)	E-003	per hour	$24.80	1.05	56	$1,458.24
PID	E-055	per hour	$19.03	1.05	80	$1,598.52
Misc T&M	T&M	per day	$50.00	1.1	10	$550.00
Low Value Equipment	LVE	per hour	$1.35	1.05	144	$204.12
Project Manager (reporting)	L-19	per hour	$32.00	1.05	8	$268.80
					Sub-total	**$14,888.80**

General Operation (1 month)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$71.36	1.05	16	$1,198.85
Foreman	L-10	per hour	$59.47	1.05	8	$499.55
Technician	L-22	per hour	$49.59	1.05	16	$833.11
LD Vehicle	E-002	per hour	$19.97	1.05	16	$335.50
HD Vehicle	E-003	per hour	$24.80	1.05	8	$208.32
PID	E-055	per hour	$19.03	1.05	16	$319.70
Electrical Usage Fees	T&M	per month	$2,000.00	1.1	1	$2,200.00
Misc T&M	T&M	per day	$50.00	1.1	4	$220.00
Low Value Equipment	LVE	per hour	$1.35	1.05	24	$34.02
					Sub-total	**$5,849.05**

Contingency (Alarm response, carbon changeout, misc)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Project Manager	L-19	per hour	$70.17	1.05	16	$1,178.86
Foreman	L-10	per hour	$59.47	1.05	16	$999.10
Technician	L-22	per hour	$49.59	1.05	16	$833.11
HD Vehicle	E-003	per hour	$24.80	1.05	16	$416.64
Misc T&M	T&M	lot	$250.00	1.1	1	$275.00
Carbon changeout (1 vessel, if required)	T&M	lot	$1,800.00	1.1	1	$1,980.00
Low Value Equipment	LVE	per hour	$1.35	1.05	32	$45.36
					Sub-total	**$5,728.06**

Professional Services (Submittals/As-built completion, reporting)						
	Billing Type	**Units**	**Unit Price**	**Multiplier**	**Qty**	**Cost**
Engineer	L-7	per hour	$70.17	1.05	40	$2,947.14
Project Manager (reporting, final submittals)	L-19	per hour	$71.36	1.05	40	$2,997.12
Hydrogeologist	L-12	per hour	$77.90	1.05	24	$1,963.08
Data Processor	L-2	per hour	$20.03	1.05	40	$841.26
					Sub-total	**$8,748.60**

TOTAL	**$319,561.42**

Notes:
Laboratory analytical costs are not included
Costs for transport/disposal of contaminated wastes are not included. EAR will utilize a NYSDEC contracted response vendor for all transport/disposal of contaminated wastes.
* - Cost for building permit is estimated. Actual costs will be based on final approved work plan.
** - Includes $1080 deposit equivalent to 2 months estimated billing and new service charge of $596.93.
¥ - pricing includes third/spare vessel

APPENDIX B: ANTICIPATED SCHEDULE

Pride Solvent & Chemical Co.
78-88 Lamar Avenue
West Babylon, NY
NYSDEC Site No. 152025

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

AS/SVE Pilot
Anticipated Schedule

TASK	WEEK (from notice to proceed)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Permitting	●	●	●	●										
Markouts	●													
Pre-Construction Survey		●												
Well Installations			●											
Trench & Pipe					●	●	●	●						
Electrical Service Installation						●								
System Installation									●	●	●			
ROI Assessment												●		
System Startup												●	●	●
Post-Construction Survey													●	
Begin General O&M														●

APPENDIX C: COMMUNITY AIR MONITORING PROGRAM

COMMUNITY AIR MONITORING PLAN

PRIDE SOLVENTS AND CHEMICAL COMPANY

78-88 LAMAR STREET

WEST BABYLON, NEW YORK

SITE#: 1-52-025

Prepared For:

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

New York State - Department of
Environmental Conservation
Division of Environmental Remediation
625 Broadway
Albany, NY 12233

Prepared By:

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

225 Atlantic Avenue
Patchogue, NY 11772

TABLE OF CONTENTS

1.0 INTRODUCTION

This document represents the Community Air Monitoring Plan (CAMP) for the Pride Solvents and Chemical Company site (Pride) located in West Babylon, New York; Site Identification Number 1-52-025. This CAMP was planned with systematic actions necessary to provide a measure of protection for downwind, offsite receptors from airborne contamination during ground-intrusive activities. This document will be communicated to, understood by, and implemented by all related personnel involved in the scope of the work either electronically and/or by hard copy.

2.0 PARTICULATE MONITORING

Continuous monitoring of airborne particulates will be conducted during all outdoor, ground-intrusive activities. Ground-intrusive activities at this site will include well installations and trenching & piping activities.

2.1 METHODOLOGY

Prior to beginning ground intrusive activities each day, wind direction will be determined onsite using an air current test kit (smoke tubes). Onsite observation of wind direction will be confirmed by checking a real-time local weather reports provided by an online weather service. Monitoring of wind direction using smoke tubes will be conducted at a minimum of once every two hours (greater frequency may be required depending upon weather conditions).

Continuous particulate monitoring will be conducted at both downwind and upwind locations of the work zone. Field observations will be made continuously throughout the day in order to relocate the monitoring equipment as necessary. Monitoring will be conducted using a Thermo-Scientific DataRam 4000 or similar device capable of meeting the performance requirements put forth in DER-10 / Technical Guidance for Site Investigation and Remediation[1]. The devices will be equipped with an audible and/or visual alarm system and will be programmed to provide 15-minute time weighted averages and instantaneous concentration readings of airborne particulate concentrations.

In addition, particulate migration will be visually assessed during all ground-intrusive activities.

Figure 1 illustrates the possible monitoring locations at a given boring location in a westerly wind. Note that the monitoring locations are subject to change based on actual wind direction and location of the ground-intrusive work being conducted.

2.2 RESPONSE LEVELS & REQUIRED ACTIONS

Should the downwind particulate concentration (particulate matter less than or equal to 10 micrometers) be greater than 100 micrograms per cubic meter (ug/M^3) of the upwind particulate concentration for any 15-minute period, an approved dust suppression technique is to be employed.

Should airborne dust be visually observed migrating out of the work area, an approved dust suppression technique is to be employed.

Should particulate concentrations greater than 150 ug/M^3 of the upwind concentrations be observed following implementation of dust suppression techniques, work is to be stopped pending re-evaluation of work methods and dust suppression methods. Work is not to resume until suppression methods successfully reduce the downwind particulate concentration to within 150 ug/M3 of the upwind concentration and no visual observation of migrating dust is reported.

2.2.1 DUST SUPPRESSION TECHNIQUES

Dust suppression techniques at this site can include the following:

- Wetting of equipment and/or work area

[1] NYSDEC, DER-10/Technical Guidance for Site Investigation and Remediation, May 3, 2010

These techniques would be employed pending necessity and prior approval. Water used for wetting equipment and/or work area will be obtained from a potable water source. Water would be applied in such a manner as to provide uniform wetting of the materials, and prevent excessive mud, pooling, and runoff.

3.0 VOLATILE ORGANIC COMPOUND MONITORING

Continuous monitoring of volatile organic compounds (VOC) will be conducted during all outdoor, ground-intrusive activities.

3.1 METHODOLOGY

Prior to beginning ground intrusive activities each day, wind direction will be determined onsite using an air current test kit (smoke tubes). Onsite observation of wind direction will be confirmed by checking a real-time local weather reports provided by an online weather service. Monitoring of wind direction using smoke tubes will be conducted at a minimum of once every two hours (greater frequency may be required depending upon weather conditions).

VOC monitoring at the upwind and downwind perimeters of the work zone will be conducted continuously throughout the workday. Both upwind and downwind perimeters will be monitored using a PhotoVac® 2020 photo-ionization detector (PID) (or similar device) capable of meeting the performance requirements put forth in DER-10 / Technical Guidance for Site Investigation and Remediation. The upwind and downwind devices will be programmed to provide 15-minute Short Term Exposure Limits (STEL), 8-hour Time Weighted Averages, and peak concentrations of VOC concentrations.

Prior to use each day, the PID will be calibrated using a 100 parts per million (ppm) isobutylene standard.

3.2 RESPONSE LEVELS AND REQUIRED ACTIONS

Should the downwind VOC concentrations for any 5-minute period be greater than 5 ppm of the upwind concentration, work is to be stopped. If VOC concentrations readily drop to within 5 ppm of upwind, work shall resume.

Should downwind concentrations persist at concentrations greater than 5 ppm (but less than 25 ppm) of the upwind concentration, work is to be stopped pending source identification and appropriate corrective action(s). Work may resume provided VOC concentrations at the midway distance between the work zone and any commercial or residential structure (or 200 feet downwind of the work zone, whichever is less) are within 5 ppm of upwind concentrations, and workers are equipped with appropriate respiratory PPE.

Work is to be halted should VOC concentrations at any perimeter exceed 25 ppm.

4.0 DATA REVIEW

All monitoring data will be recorded by an EAR technician and will be available onsite for review by the NYSDEC and CDM Smith. A sample CAMP field log is provided as Appendix A.

FIGURES

FIGURE 1: SITE MAP – AIR MONITORING PLAN

ENVIRONMENTAL ASSESSMENT & REMEDIATIONS

Figure 1
Air Monitoring Plan

PRIDE SOLVENTS AND CHEMICAL COMPANY
78-88 LAMAR STREET
WEST BABYLON, NEW YORK
SITE NO. 152025

APPENDIX A: SAMPLE CAMP FIELD LOG

Community Air Monitoring Plan (CAMP)

Site ______________________________ Part. Monitor ID ______________________________

Date ______________________________ PID ID ______________________________

Station ______________________________ Activity ______________________________

Particulate Monitor (ug/m^3)

Clock Time	Unit Time	Elasped	Conc.	TWA/15 min

PID (ppm)

Clock Time	Unit Time	Elapsed	STEL/15 min	Peak	TWA/8 hours

Conc. - Instantanous Concentration
Particulate Monitor TWA - Time Weighted Average (run time of 15 minutes)
PID TWA - Time Weighted Average (current sum/8 hours if less than 8 hours of data recorded)
STEL - Short Term Exposure Limit (15 minute moving average)

APPENDIX D: AS/SVE SYSTEM EQUIPMENT CUT SHEETS/TECHNICAL SPECIFICATIONS

Vapor Implants

Geoprobe® owners have been using permanent implants for a number of years; for soil gas sampling, air sparging, and groundwater sampling. Geoprobe® implants are stainless steel screens that can be inserted down the bore of a probe rod and anchored at depth.

Geoprobe® implants are unique in their ability to be "Post Run"... they are not carried in the rod during probe driving, but rather inserted down the bore when the appropriate depth has been reached. Once the implant is slid down the bore, it is simply rotated to attach it to the anchor point used during driving. As probe rods are removed from the hole, the implant and associated tubing remain firmly anchored at the bottom.

Geoprobe® implants are constructed of double woven stainless steel wire screen. All end fittings are stainless steel as well. Implants are available in 6-in. (152 mm) lengths with the AT86 series, 21-in. (533 mm) lengths with the AT87 series, or 12-in. (356 mm) lengths with the latest AT96 series. The user can also connect multiple 21-in. (533 mm) lengths together using the AT89 series implants. Geoprobe® implants have a pore diameter of 0,0057 inch (0.145 mm).

The bottom end of Geoprobe® implants use our standard "PRT" style thread, the same fitting style used with our popular PRT vapor sampling tools. The AT89 implant uses a PRT socket thread at its top end, allowing multiple lengths to be

coupled together.

Geoprobe® Permanent Implants Advantages...

- Placed through bore after rods have been driven to depth.
- Variety of implant lengths to suit the application.
- Designed to fit a wide array of tubing materials and sizes.
- Can be set at any depth attainable by soil probe (100+ ft. [30 m]).
- Convenient and inexpensive devices for both long-term soil gas monitoring, air sparging, and groundwater sampling.
- Screens made entirely of stainless steel.
- 0.0057-in. (0,15 mm) pore screen size.
- For use with 5/8-in. and 1/2-in. ID rods.

Geoprobe's stainless steel implants for the 1.25-in. probe rod system. PRT fitting at the base attaches to Implant Anchor. Top end fits poly tubing with 0.5-in. OD x 0.375 ID.

The taper screw on the AT96 series implant forms an incredibly strong connection. As shown here, TB25L tubing fails in tension before it will pull away from the connection.

SPECIFICATIONS

ALL-STEEL UTILITY BUILDINGS

- **PRE-FAB SECTIONS:** All buildings are made of pre-fabricated sections, 5' wide by 6' high, manufactured from 26 gauge steel, struck with a deep "V" every 4 inches. The "V" strikes add superior strength and rigidity to each section. Channel ribs are spot-welded around all the edges and down the center at the back of each section. Because of the channel ribs, equipment can be hung inside the building without puncturing the outer wall. The final result is rigid and strong, a building made to last.

- **ALL-STEEL FLOOR:** ~~FREE with all utility buildings. Made from heavy 14 gauge steel plate. Example: a 5' x 10' floor weighs 150 lbs. Heavy weight steel channel ribs are welded around all edges and spaced every 22" through the center. The result is an amazingly strong foundation floor which sits off the ground just enough to allow for air circulation.~~

- **FINISHING PROCESS:** ~~All products are coated with red oxide oil-based primer~~ Galvanealed. The result is ready for your oil based finish paint of choice. ✓

- **PRE-HUNG DOORS:** ~~All buildings come with a 3' wide pre-hung piano-hinged door. The door is built into the pre-fabricated section and comes supplied with a lock and two keys.~~

- **DOUBLE DOORS:** 6' and ~~8'~~ wide double doors are available in place of the 3' wide single door. The double doors are completely pre-hung and welded into one pre-fabricated section. These swing-out doors are equipped with spring-loaded latches and a chain lock system, which locks to the top and bottom frame and allows the door on the right to remain stationary while the left-hand door can be opened independently. When both doors are opened, the entrance is a full, unobstructed 6' or 8' wide.

  6' Double Door [redacted] ~~8' Double Door~~ [redacted]

- **SLIDING WINDOW:** ~~Sliding glass windows with screen (19" x 32") are available for $149.00 per window. The windows are secured by heavy channel ribs which are spot-welded all around the window opening, which reinforces the structural integrity of the section. Windows may be placed in any location.~~

- **BUILDING HEIGHT:** Our standard buildings are 6' high at the side wall, and 6' 10" at the peak. Other heights are available for an extra charge:
  7' side wall with 7' 10" peak is 30% extra. 8' side wall with 8' 10" peak is 50% extra.

- **VENTS:** All buildings come with vented openings on the front and back gables, for a total of 8 vented louvres on each side. The vents face downwards to prevent any outside elements from entering the building.

- **ROOF LOAD:** The buildings roof load is 40 lbs. per square foot, which meets New York State specifications.

MAN PRODUCTS INC.
IT'S MADE BETTER IF "MAN" MADE

MAN PRODUCTS™

It's Made Better If "Man" Made

All Buildings are Prime Painted Meets Govt. Spec. TTP636D
All MAN products meet the requirements of U.S. Govt. Specifications
Contract No. GS-08F-37275

FACTORY & SHOWROOM
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AMITYVILLE, NY 11701

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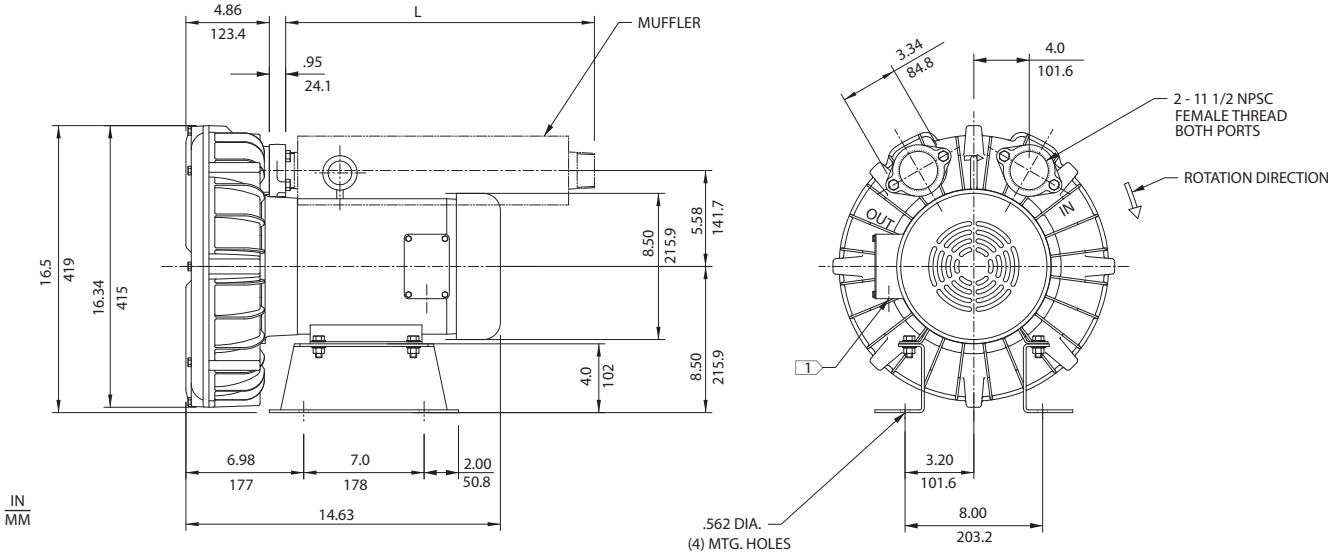
VISIT US ON THE WEB AT WWW.MANPRODUCTS.COM

DR 6 & CP 6

ROTRON®

3.0 / 5.0 HP Regenerative Blower



NOTES
1. TERMINAL BOX CONNECTOR HOLE 1.06 (26.9) DIA.
2. DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3. CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

MODEL	L (IN/MM)
DR6D89	18.00/457.2
DR6K72	18.00/457.2

HiE6D89A: inverter duty rating, thermal overloads →

		Part/Model Number					
		DR6D89	DR6D5	DR6D86	DR6K72	CP6FF72LR	HiE6D89
Specification	Units	027578	036212	027579	027600	038253	038071
Motor Enclosure - Shaft Mtl.	-	TEFC-CS	TEFC-CS	TEFC-CS	TEFC-CS	Chem TEFC-SS	TEFC-CS
Horsepower	-	5.0	5.0	5.0	3.0	5.0	5.0
Voltage	AC	230/460	230	575	230/460	230/460	230/460
Phase - Frequency	-	Three - 60 Hz	Single - 60 Hz	Three - 60 Hz	Three - 60 Hz	Three - 60 Hz	Three - 60 Hz
Insulation Class	-	F	F	F	F	F	F
NEMA Rated Motor Amps	Amps (A)	17.3-15.6/7.8	21	4.8	13.3-12/6	17.3-15.6/7.8	17.3-15.6/7.8
Service Factor	-	1.15	1.0	1.15	1.15	1.15	1.15
Max. Blower Amps	Amps (A)	15-14.8/7.4	25	5.4	12/6	15-14.8/7.4	15-14.8/7.4
Locked Rotor Amps	Amps (A)	165-155/76	124	60	106/53	165-155/76	165-155/76
NEMA Starter Size	-	1/1	1.5	1	1/0	1/1	1/1
Shipping Weight	Lbs	148	156	148	132	148	148
	Kg	67.1	70.8	67.1	59.9	67.1	67.1

Voltage - ROTRON motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

Operating Temperatures - Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

Maximum Blower Amps - Corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

AMETEK TECHNICAL & INDUSTRIAL PRODUCTS
75 North Street, Saugerties, NY 12477
USA: +1 215-256-6601 - Europe: +44 (0) 845 366 9664 - Asia: +86 21 5763 1258
Customer Service Fax: +1 215.256.1338
www.ametektip.com

Industrial / Chemical Processing Blowers

DR 6 & CP 6

3.0 / 5.0 HP Regenerative Blower

ROTRON®

FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- CE compliant - Declaration of Conformity on file
- Maximum flow: 210 SCFM
- Maximum pressure: 110 IWG
- Maximum vacuum: 91.2 IWG
- Standard motor: 5.0 HP, TEFC
- Cast aluminum blower housing, impeller & cover; cast iron flanges (threaded)
- UL & CSA approved motor with permanently sealed ball bearings
- Inlet muffler
- Quiet operation within OSHA standards - 1 muffler included

MOTOR OPTIONS

- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS

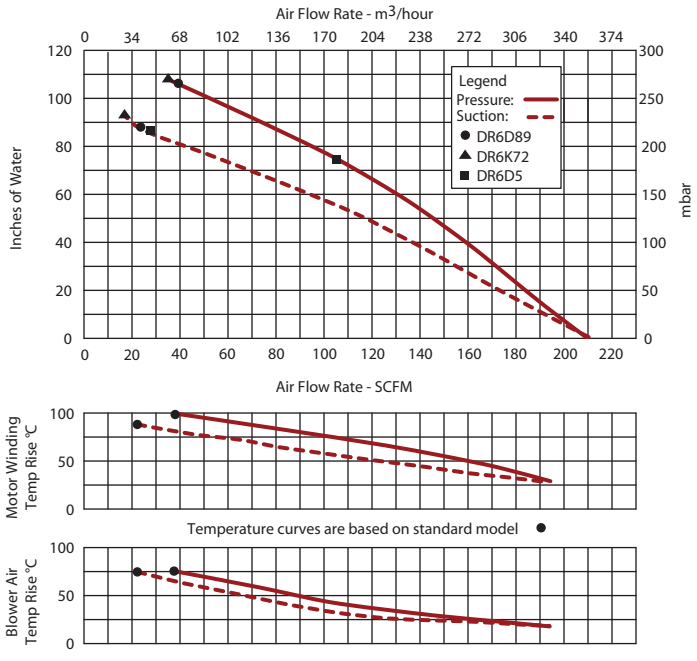
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

ACCESSORIES

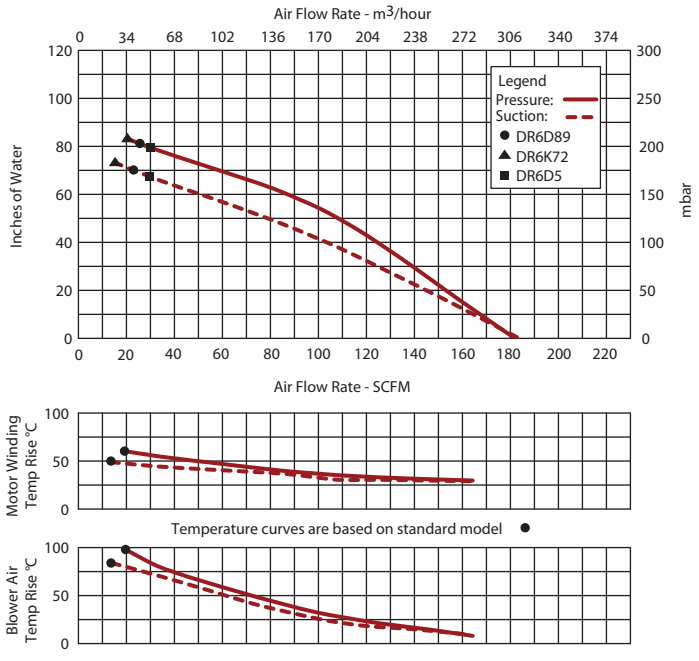
- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges, & relief valves
- Switches - air flow, pressure, vacuum, or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

Blower Performance at Standard Conditions

60 Hz



50 Hz



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AMETEK®
TECHNICAL & INDUSTRIAL PRODUCTS

MOISTURE SEPARATOR

GENERAL THEORY

The moisture separator removes liquids from the process stream in soil venting applications to help protect the blower from corrosion and mineral deposits caused by water.

DESIGN INFORMATION

NES moisture separators operate on the principles of cyclonic section aided by velocity reduction. The moisture separator inlet pipe is set tangential to the tank wall, a stringer pipe extends down past the separator inlet is placed in the center of the tank. The moisture laden air stream is forced into a cyclonic rotation. The centrifugal force produced throws the water droplets to the outer wall of the separator where they fall and collect at the bottom. Additional efficiency is produced when the velocity is reduced to values between 1500 fpm and 6000 fpm. For a separator of this type, moisture separation efficiency is typically 95% or greater for moisture droplets greater than 10 micron.

CONSTRUCTION

NES moisture separators are constructed of carbon steel with bronze drain valves, removable lid with EPDM gasket, mechanical ball and float assembly standard for drum style separators. Sight glass, emergency high-level switch and pump out switches are optional. Tank style separators are standard with carbon steel construction, bronze drain valves, flanged clean-out port, sight glass and emergency high level switch. Pump-out switches and mist eliminator are optional. All separators are primed and coated with a rust inhibitor to prevent corrosion.

National Environmental Systems
Phone 508-226-1100 Fax 508-226)-1180 84 Dunham Street Attleboro, MA 02703
www.nes-inc.biz

DRUM STYLE SEPARATOR

TANK STYLE SEPARATOR

NORMAL SERIES OF OPERATION FOR MOISTURE SEPARATOR LEVEL SWITCHES

1. Water level rises and actuates low level switch (wired normally open).
2. Switch closes and sends signal to controller.
3. Water level continues to rise and actuates high level switch (wired normally open).
4. Switch closes and sends signal to controller to activate moisture sepaator transfer pump.
5. Water level drops when pump activates.
6. De-energizes high switch.
7. Continues to drop.
8. De-energizes low switch.
9. Controller calls off pump.
10. Series repeats.

ACTIVATION OF EMERGENCY HIGH LEVEL SWITCH

1. Water level rises and actuates low level switch (wired normally open).
2. Switch closes and sends signal to controller.
3. Water level continues to rise and actuates high level switch (wired normally open).
4. Switch closes and sends signal to controller to activate moisture separator transfer pump.
5. Problem with pump, level switch or down stream process, water level does not drop.
6. Water level rises until emergency high switch (wired normally closed) is actuated.
7. Appropriate process equipment is de-energized (i.e. pump, SVE blower)

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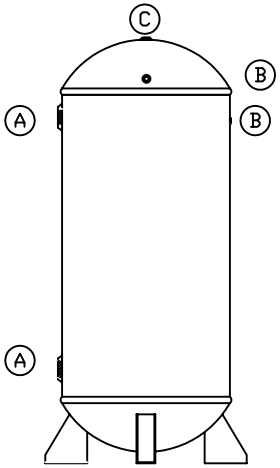
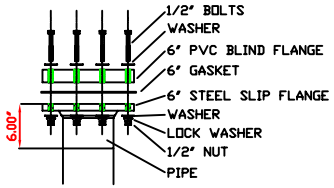
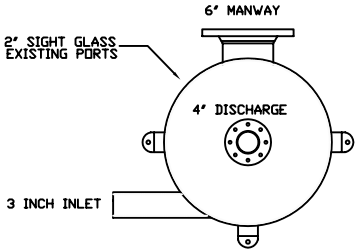
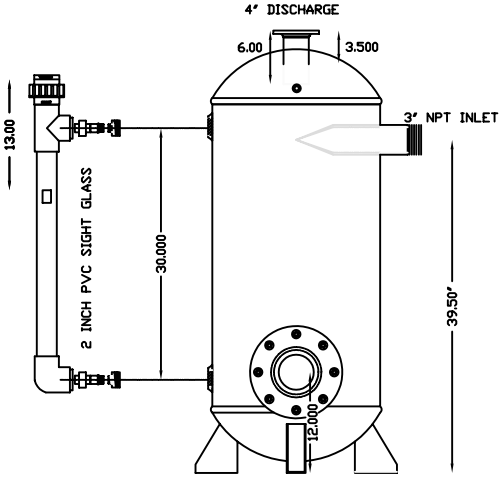
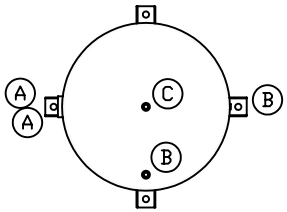
REVISIONS			
REV	DESCRIPTION	DATE	APPR











					LIQUID CAPACITY GALLONS +/-			
					LOW	HIGH	E HIGH	PUMP-OUT
					XX GLN	XX GLN	XX GLN	XX

					OPENINGS (NPT) IN INCHES						
P/N	PSI	GALLON	DIA	HEIGHT	A	B	C				
A10043	200	60	20	49	2.00"	0.25"	0.75"				

DRWN BY	DATE
CJJ	07-12-11
CHK BY	DATE
APPR BY	DATE

NES™
NATIONAL ENVIRONMENTAL SYSTEMS
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508-226-1100 (Phone) / 508-226-1180 (Fax)

TITLE: Moisture Separator
60 Gallon

Environmental Assessment & Remediations
NYSDEC Site No. 1-30-107 Farmingdale Plaza Cleaners

JOB NO.	SCALE	SIZE	DWG NO.	SHEET	REV
11-177	1"=10"	C	11-177-L2	1 OF 2	

ITT

Commercial Water

Goulds Pumps

G&L Series NPE

316L SS

NPE Series End Suction Centrifugal Pumps

Bombas Centrífugas de Succión Final Serie NPE

GOULDS PUMPS

Goulds Pumps is a brand of ITT Residential and Commercial Water.

Goulds Pumps es una marca de fábrica de ITT Agua Residencial y Comercial.

www.goulds.com

Engineered for life

A Full Range of Product Features
Una Gama Total de Características del Producto

Superior Materials of Construction: Complete AISI 316L stainless steel liquid handling components and mounting bracket for corrosion resistance, quality appearance, and improved strength and ductility.

Materiales Superiores de Construcción: *Componentes completos para manejo de líquidos en acero inoxidable AISI 316L y consola para el montaje para resistencia a la corrosión, apariencia de calidad, y fuerza y ductilidad mejoradas.*

High Efficiency Impeller: Enclosed impeller with unique floating seal ring design maintains maximum efficiencies over the life of the pump without adjustment.

Impulsor de Eficiencia Superior: *El impulsor encerrado con un diseño único de anillo del sello flotante, mantiene sin ajustes, la eficiencia máxima sobre la vida de la bomba.*

Casing and Adapter Features: Stainless steel construction with NPT threaded, centerline connections, easily accessible vent, prime and drain connections with stainless steel plugs. Optional seal face vent/flush available.

Características de la Carcasa y del Adaptador: *Construcción en acero inoxidable con NPT roscado, conexiones centrales, válvulas de fácil acceso, conexiones de cebado y drenaje con enchufes de acero inoxidable. Cara del sello válvula/chorro opcional disponible.*

Mechanical Seal: Standard John Crane Type 21 with carbon versus silicon-carbide faces, Viton elastomers, and 316 stainless metal parts. Optional high temperature and chemical duty seals available.

Sello Mecánico: *Estándar John Crane Tipo 21 con carbón en contraste con caras de silicón-carbide, elastómeros de Viton, y partes metálicas de acero inoxidable 316. Sellos de alta temperatura y productos químicos están disponibles.*

Motors: NEMA standard open drip-proof, totally enclosed fan cooled or explosion proof enclosures. Rugged ball bearing design for continuous duty under all operating conditions.

Motores: *Estándar NEMA a prueba de goteo, ventilador totalmente encerrado o recintos a prueba de explosión. Diseño robusto de balineras de bolas para trabajo continuo en todas las condiciones de funcionamiento.*

Model: 1ST1C5E4

The various versions of the NPE are identified by a product code number on the pump label. This number is also the catalog number for the pump. The meaning of each digit in the product code number is shown at left.

Las diferentes versiones de la NPE se identifican con un número de código del producto en la etiqueta de la bomba. Este número es también el número del catálogo para la bomba. El significado de cada dígito en el número de código del producto se muestra a la izquierda.

NPE Product Line Numbering System
Línea de Producto NPE Sistema de Numeración

Example Product Code,
Ejemplo Código del Producto

1 ST 2 C 1 A 4 F

Seal Vent/Flush Option,
Opción de Sello Válvula/ChorroSeal Ven

Mechanical Seal and O-ring
4 = Pre-engineered standard
For optional mechanical seal modify catalog order no. with seal code listed below.

Sello Mecánico y Anillo 'O'
4 = Estándar aprobado
Para sello mecánico opcional modificar el número de orden del catálogo con el código del sello anotado abajo.

John Crane Type 21 Mechanical Seal (⅝" seal),
Sello Mecánico John Crane Tipo 21 (sello de ⅝")

Seal Code, *Código del Sello*	Rotary, *Rotativo*	Stationary, *Estacionario*	Elastomers, *Elastómeros*	Metal Parts, *Partes Metálicas*	Part No., *Pieza Número*
[redacted]	Carbon	Silicon Carbide	[redacted]	316 SS	[redacted]
4			Viton		10K55
[redacted]	Silicon Carbide		[redacted]		[redacted]
6			Viton		10K62

Impeller Option . . . No Adder Required
For optional impeller diameters modify catalog order no. with impeller code listed. Select optional impeller diameter from pump performance curve.

Código del Impulsor Opcional
Para impulsores con diámetros opcionales modificar el número de orden del catálogo con el código del impulsor anotado. Escoger el impul con diámetro opcional de la curva de funcionamiento de la bomba.

Impeller Code, *Código del Impulsor*	Pump Size, *Tamaño de la Bomba*		
	1 x 1¼ – 6	1¼ x 1½ – 6	1½ x 2 – 6
	Diameter	Diameter	Diameter
K	–	6⅛	–
G	–	5 15/16	5⅜
H	–	5½	5
A	6⅛	5¼	4¾
B	5¾	5 1/16	4⅝
C	5 3/16	4⅞	4⅜
[redacted]	[redacted]	[redacted]	[redacted]
E	4 7/16	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

Driver, *Conductor*
1 = 1 PH, ODP
2 = 3 PH, ODP
3 = 575 V, ODP
[redacted]
5 = 3 PH, TEFC
[redacted]
7 = 3 PH, XP
8 = 575 V, XP
9 = 3 PH, TEFC
[redacted]

HP Rating, *HP Potencia*
C = ½ HP
[redacted]

Driver: Hertz/Pole/RPM,
Conductor: Hercios/Polo/RPM
1 = 60 Hz, 2 pole, 3500 RPM
[redacted]
3 = 60 Hz, 6 pole, 1150 RPM
4 = 50 Hz, 2 pole, 2900 RPM
5 = 50 Hz, 4 pole, 1450 RPM

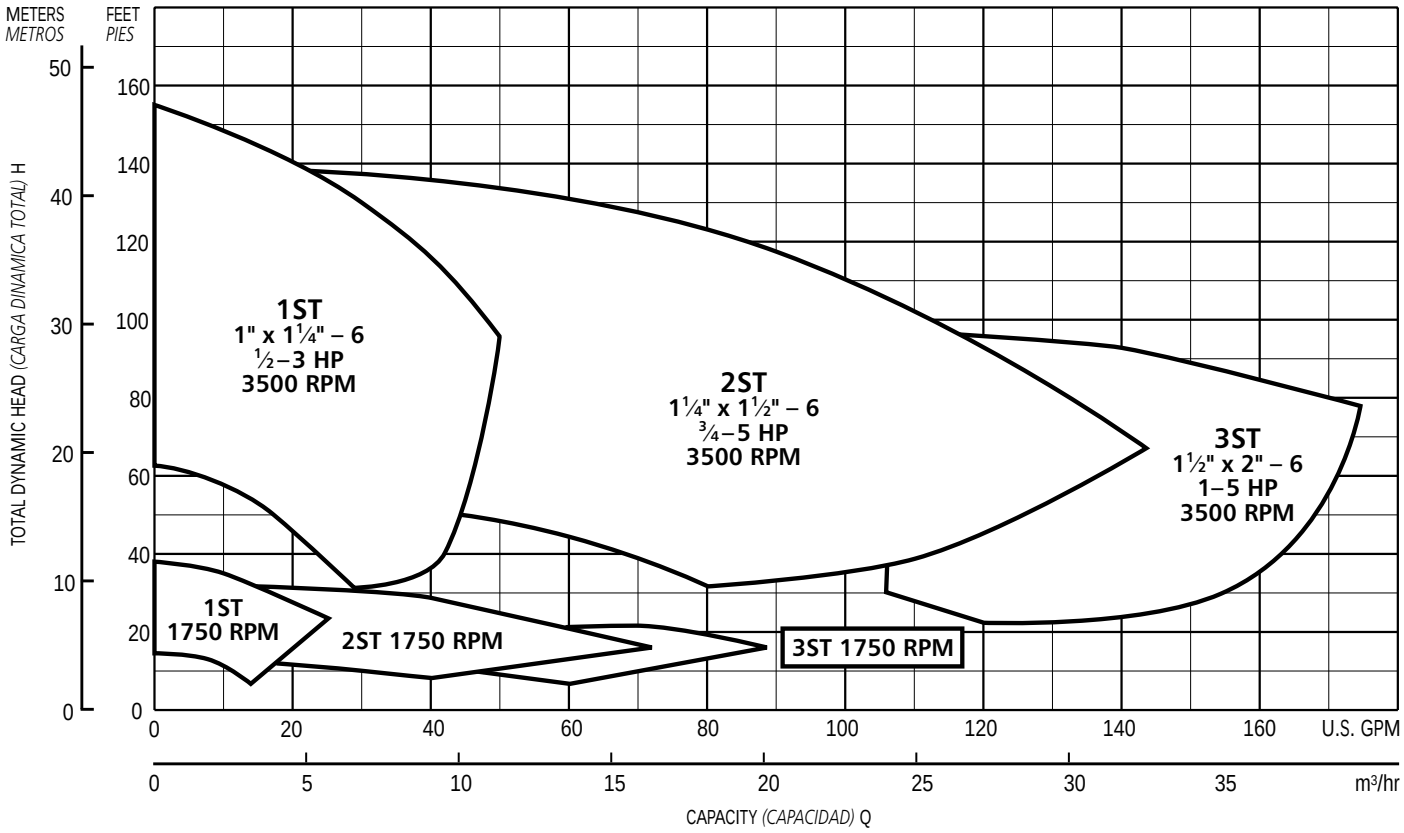
For frame mounted version, substitute the letters "FRM" in these positions.
Para la versión con el armazón montado, sustituya las letras "FRM" en estas posiciones.

Material
ST = Stainless steel, *Acero inoxidable*

Pump Size, *Tamaño de la Bomba*
1 = 1 x 1¼ – 6
[redacted]

Motor Voltage: 230/460

Performance Coverage (60 Hz)
Alcance de Funcionamiento (60 Hz)



NOTES:

Not recommended for operation beyond printed H-Q curve.

For critical application conditions consult factory.

Not all combinations of motor, impeller and seal options are available for every pump model. Please check with G&L on non-cataloged numbers.

All standard 3500 RPM ODP and TEFC motors supplied by Goulds, have minimum of 1.15 service factor. Standard catalog units may utilize available service factor. Any motors supplied other than Goulds check available service factor.

NOTAS:

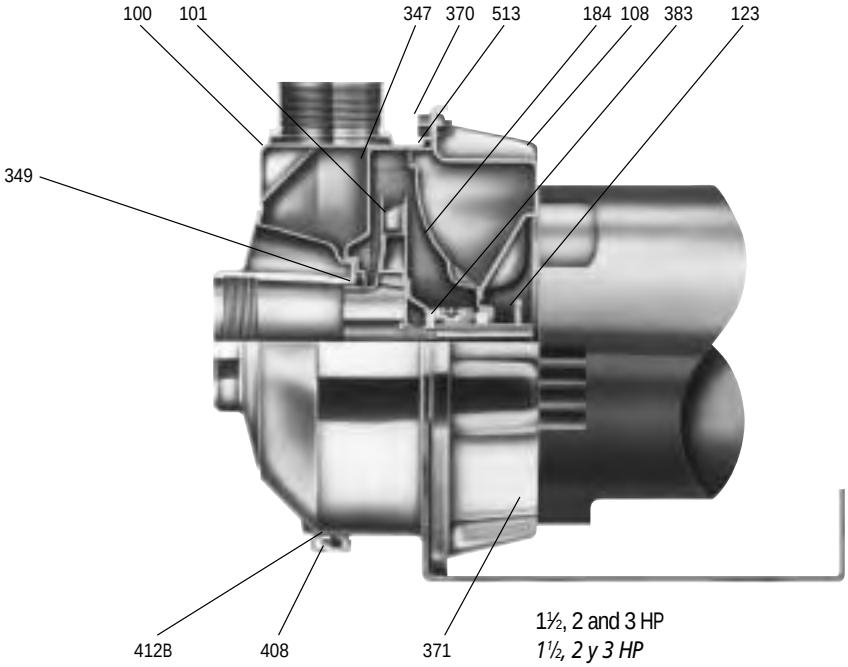
No se recomienda para funcionamiento superior al impreso en la curva H-Q.

Para condiciones de aplicaciones críticas consultar con la fábrica.

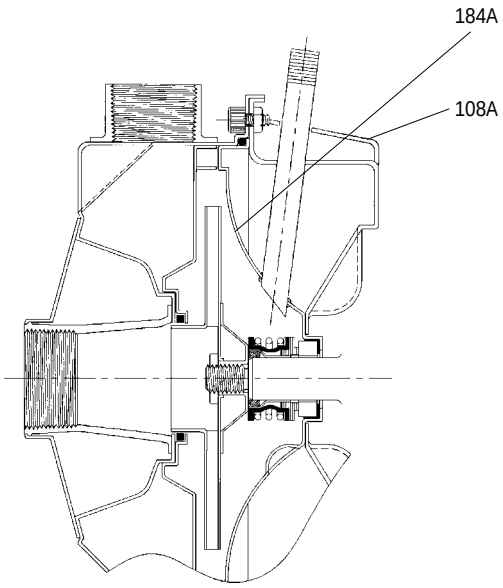
No todas las combinaciones de las opciones de motor, impulsor y sello están disponibles para cada modelo de bombas. Por favor verifique con G&L en los números no catalogados.

Todos los motores estándar de 3500 RPM, ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado) provistos por Goulds tienen un factor mínimo de servicio de 1,15. Las unidades estándar de catálogo pueden utilizar el factor de servicio disponible. Verificar el factor de servicio disponible de todo motor no provisto por Goulds.

NPE Close Coupled Pump Major Components: Materials of Construction
Bomba Cerrada Acoplada NPE Componentes Principales: Materiales de Construcción



1½, 2 and 3 HP
1½, 2 y 3 HP



Seal Face Vent/Flush Option,
Opción Cara del Sello Válvula/Chorro

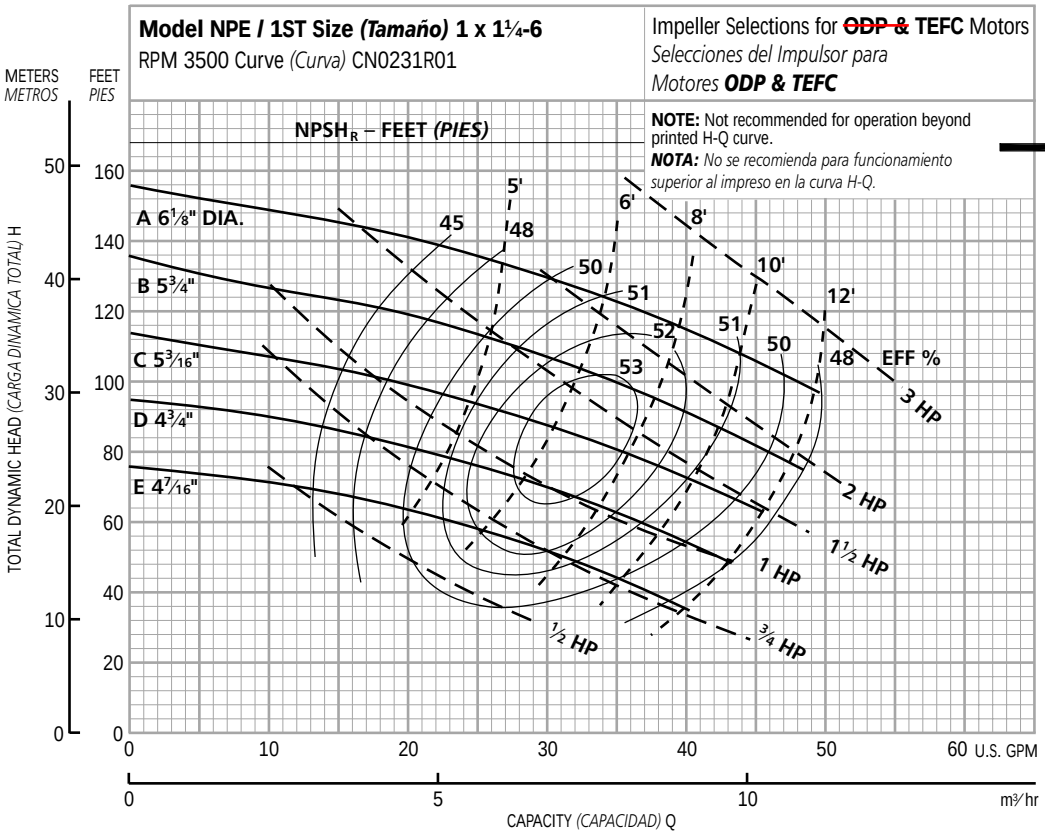
Item No., ***Parte No.***	**Description,** ***Descripción***	**Materials,** ***Materiales***
100	Casing, *Carcasa*	AISI 316L SS, *AISI 316L Acero inoxidable*
101	Impeller, *Impulsor*	
108	Motor adapter, *Adaptador del motor*	
108A	Motor adapter seal vent/flush, *Sello válvula/chorro del adaptador del motor*	
123	Deflector, *Deflector*	BUNA-N
184	Seal housing, *Alojamiento del sello*	AISI 316L SS, *AISI 316L Acero inoxidable*
184 A	Seal housing seal vent/flush, *Sello válvula/chorro del alojamiento del sello*	
347	Guidevane, *Difusor*	
349	Seal ring, guidevane; *Anillo del sello, difusor*	Viton
370	Socket head screws, casing; *Encajes cabezas de tornillos, carcasa*	AISI 410 SS, *AISI 410 Acero inoxidable*
371	Bolts, motor; *Tornillos, motor*	Plated steel, Acero chapeado
383	Mechanical seal, *Sello mecánico*	**see chart, *ver tabla*
408	Drain and vent plug, casing; *Enchufes de drenaje y válvula, carcasa*	AISI 316L SS, *AISI 316L Acero inoxidable*
412B	O-ring, drain and vent plug; *Anillo 'O', enchufe de drenaje y válvula*	Viton
513	O-ring, casing; *Anillo 'O', carcasa*	
Motor *Motor*	NEMA standard, 56J flange; *NEMA estándar, brida 56J*	

½, ¾ and 1 HP
½, ¾ y 1 HP

Footed motor for 1750 RPM and 5 HP ODP and TEFC, all explosion proof see page 13.

Motor con pie para 1750 RPM, 5 HP ODP y TEFC, a prueba de explosiones en la página 13.

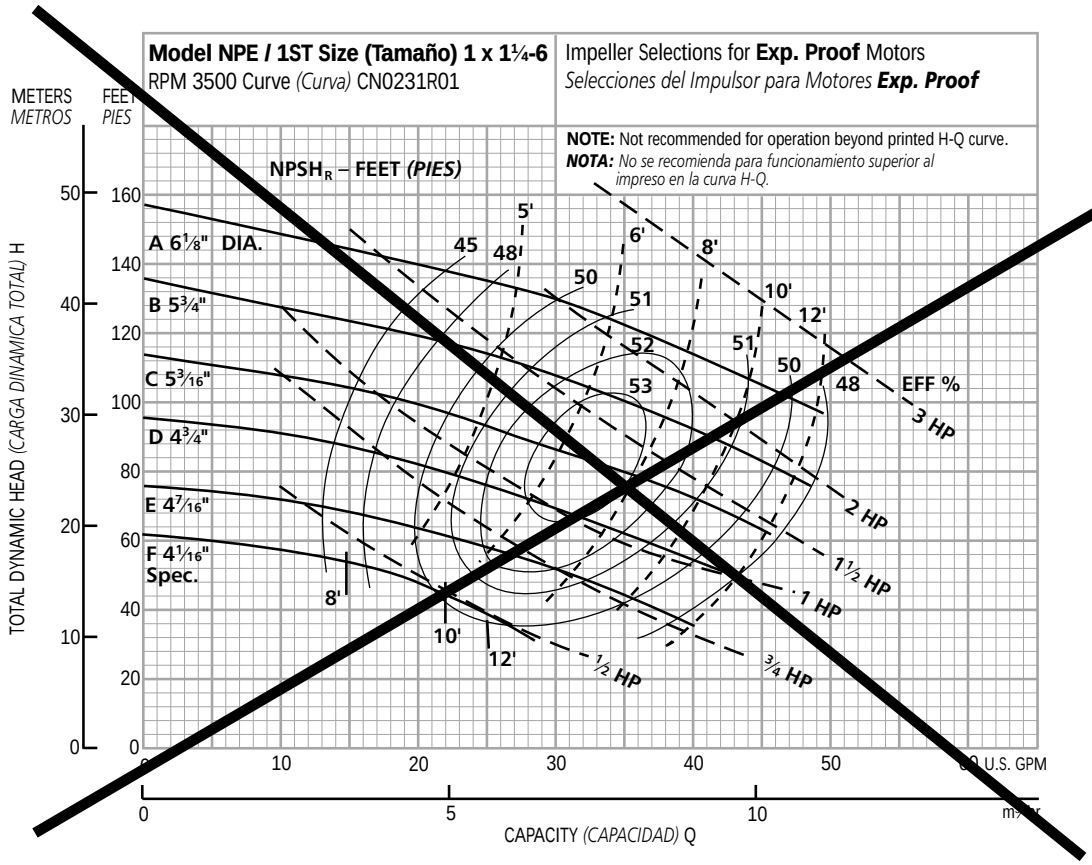
Performance Curves – 60 Hz, 3500 RPM
Curvas de Funcionamiento – 60 Hz, 3500 RPM



Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
E	½	4⁷⁄₁₆"
D	¾	4¾
C	1	5³⁄₁₆
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a ⅛" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ⅛".*



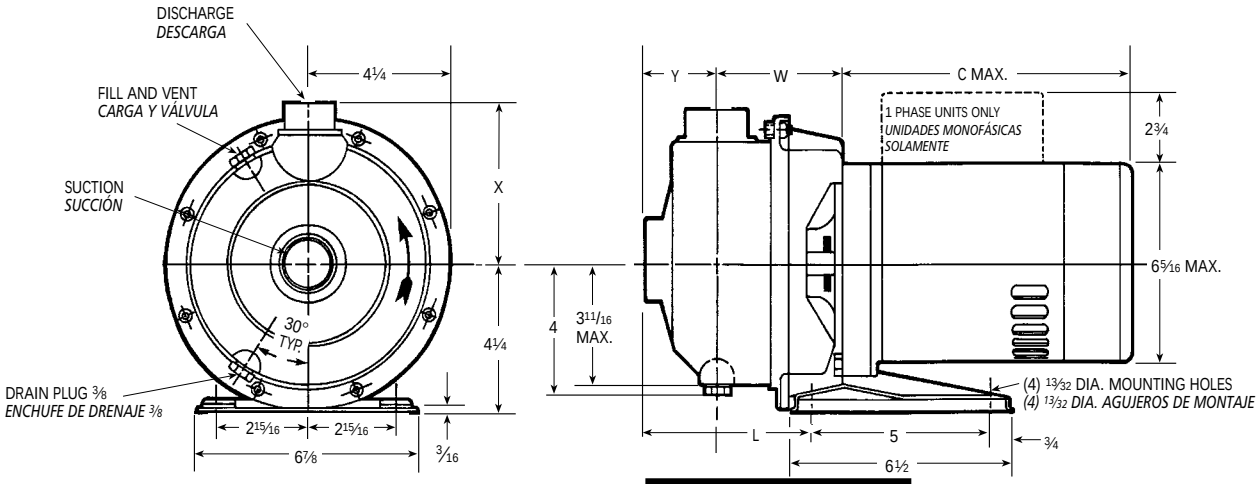
Ordering Code, *Código de Pedido*	Standard HP Rating, *Estándar HP Potencia*	Imp. Dia.
F	½	4¹⁄₁₆" spec.
E	¾	4⁷⁄₁₆
D	1	4¾
C	1½	5³⁄₁₆
B	2	5¾
A	3	6⅛

NOTE: Although not recommended, the pump may pass a ⅛" sphere.

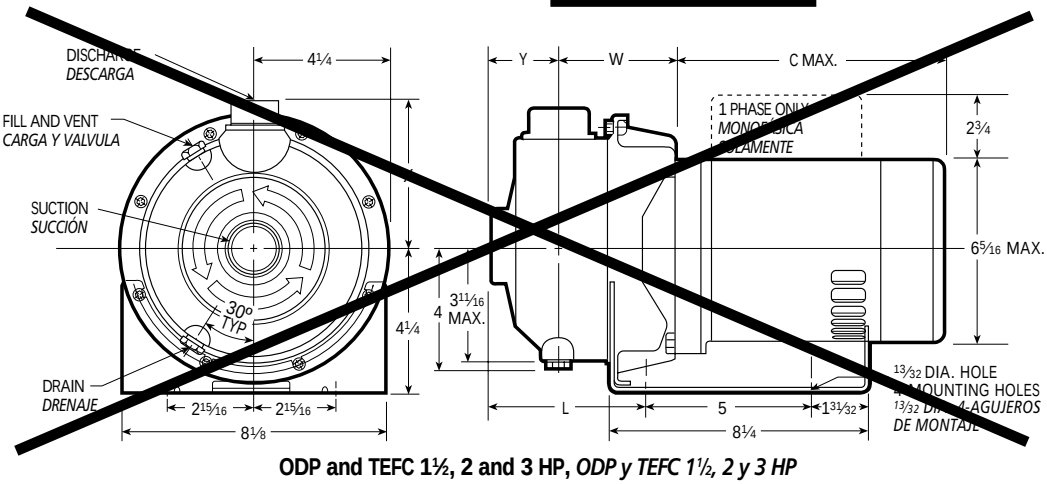
NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ⅛".*

NPE Close Coupled – Dimensions, Weights and Specifications
NPE Acople Cerrado – Dimensiones, Pesos y Especificaciones

Clockwise Rotation Viewed from Drive End
Rotación en Dirección de las Agujas del Reloj Visto desde el Extremo del Motor



ODP and TEFC ½, ¾ and 1 HP, [redacted]



ODP and TEFC 1½, 2 and 3 HP, ***ODP y TEFC 1½, 2 y 3 HP***

Specifications
Especificaciones

Capacities to:
75 GPM (283L/min) at 1750 RPM
150 GPM (550L/min) at 3500 RPM

Heads to:
39 feet (12 m) at 1750 RPM
150 feet (46 m) at 3500 RPM

Working pressures to:
125 PSIG (9 bars)

Maximum temperatures to:
212°F (100°C) with standard seal or 250°F (121°C) with optional high temperature seal.

Direction of rotation:
Clockwise when viewed from motor end.

Motor specifications:
NEMA 56J frame, 1750 RPM, ½ HP. 3500 RPM ½ through 5 HP. Open drip-proof, totally enclosed fan-cooled or 2 HP explosion proof enclosures. Stainless steel shaft with ball bearings.

Single phase: Voltage 115/230 ODP and TEFC. (3 HP model – 230 V only) Built-in overload with auto-reset provided.

Three phase: Voltage 208-230/460 ODP, TEFC and EX PROOF.

NOTE: For three phase motors, overload protection must be provided in starter unit. Starter and heaters must be ordered separately.

Capacidades:
75 GPM (283L/min) a 1750 RPM
150 GPM (550L/min) a 3500 RPM

Cargas:
39 pies (12 m) a 1750 RPM
150 pies (46 m) a 3500 RPM

Presión de trabajo:
125 PSIG (9 baras)

Temperatura máxima:
212°F (100°C) con sello estándar o 250°F (121°C) con sello opcional para alta temperatura.

Dirección de rotación:
En dirección de las agujas del reloj visto desde el extremo final del motor.

Motores:
Armazón 56J NEMA, 1750 RPM ½ HP. 3500 RPM ½ a 5 HP. Cubiertas abiertas resguardadas, totalmente encerradas enfriadas por ventilador o a prueba de explosiones de 2 HP. Eje de acero inoxidable con balineras de bolas.

Monofásicos: *Voltaje 115/230 ODP y TEFC. (modelo 3 HP – 230 voltios solamente) Se proporciona protección térmica contra sobrecarga construida con reseteo automático.*

Trifásicos: *Voltaje 208-230/460 ODP, TEFC y EX PROOF.*

NOTA: *Para motores trifásicos se debe de proporcionar la protección térmica contra sobrecarga en la unidad de arranque. El arrancador y los calentadores se deben pedir por separado.*

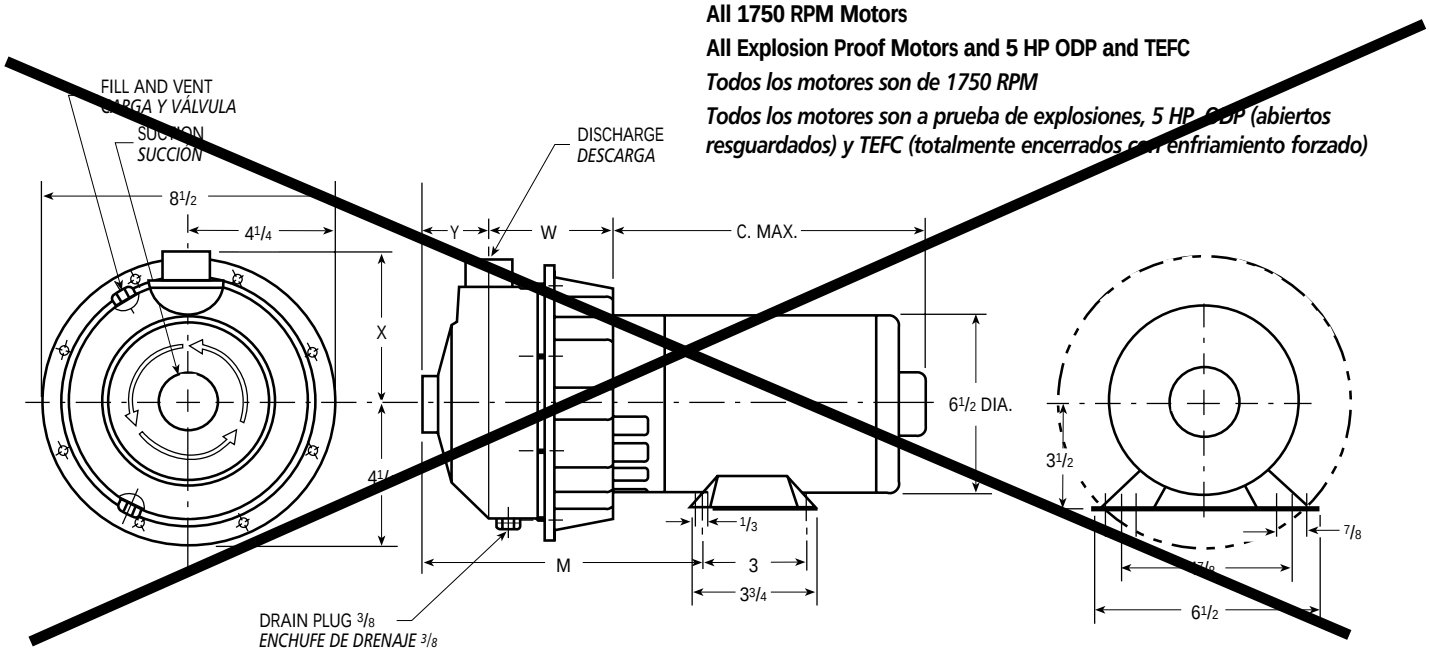
NPE Close Coupled with Footed Motor, 1750 RPM and Explosion-proof Motors
NPE Acople Cerrado con Motor con Patas, 1750 RPM y Motores a Prueba de Explosión

All 1750 RPM Motors

All Explosion Proof Motors and 5 HP ODP and TEFC

Todos los motores son de 1750 RPM

Todos los motores son a prueba de explosiones, 5 HP ODP (abiertos resguardados) y TEFC (totalmente encerrados con enfriamiento forzado)



Dimensions – Determined by Pump,
Dimensiones – Determinadas por la Bomba

Pump, *Bomba*	Suction, *Succión*	Discharge, *Descarga*	HP	W	X	Y	L	M
1ST	1¼	1	½ – 3	3 5/16	4 3/8	2	4 9/16	7 5/16

Available Motor Weights and Dimensions,
Pesos y Dimensiones Disponibles del Motor

HP	Motor Weights, *Pesos del Motor*						C Max. Length, *(Longitud)*
	1 Phase, *Monofásicos*			3 Phase, *Trifásicos*			
	ODP	TEFC	EXP	ODP	TEFC	EXP	
½	[illegible]	[illegible]	[illegible]	[illegible]	18	[illegible]	9 15/16
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	22	26	49	23	21	30	11
1½	28	35	56	27	27	37	11 5/16
2	33	39	60	32	33	44	12 1/16
3	40	43	—	41	37	—	12 7/16
5	42	—	—	42	45	—	14¼

Dimensions in inches, weights in pounds.
Dimensiones en pulgadas, pesos en libras.

NOTES:

1. Pump will be shipped with top vertical discharge position as standard. For other orientations, remove casing bolts, rotate discharge to desired position, replace and tighten 6mm bolts to 5 – 6 lbs.-ft.
2. Motor dimensions may vary with motor manufacturers.
3. Dimensions in inches, weights in pounds.
4. For explosion proof motor dimensions consult factory for information.
5. Not to be used for construction purposes unless certified.

NOTAS:

1. Las bombas se transportarán con la descarga vertical superior como estándar. Para otras orientaciones, retirar los tornillos de la carcasa, rotar la descarga a la posición deseada, y reemplazar y apretar los tornillos de 6mm a 5 – 6 libras-pies.

2. Las dimensiones del motor puede que varíen con los fabricantes.

3. Dimensiones en pulgadas, pesos en libras.

4. Para las dimensiones de los motores a prueba de explosión consultar con la fábrica para información.

5. No usar para propósitos de construcción sin certificar.

e-Front runners

Variable Torque Load Inverters for Fans and Pumps

FRENIC-Eco Series

FRENIC Eco

FUJI HVAC INVERTERS

GREAT PERFORMANCE THROUGH DEDICATED DESIGNS
WELCOME TO NEW GENERATION OF INVERTER
FOR HEATING, VENTILATING & AIR CONDITIONING.

c UL us LISTED

CE

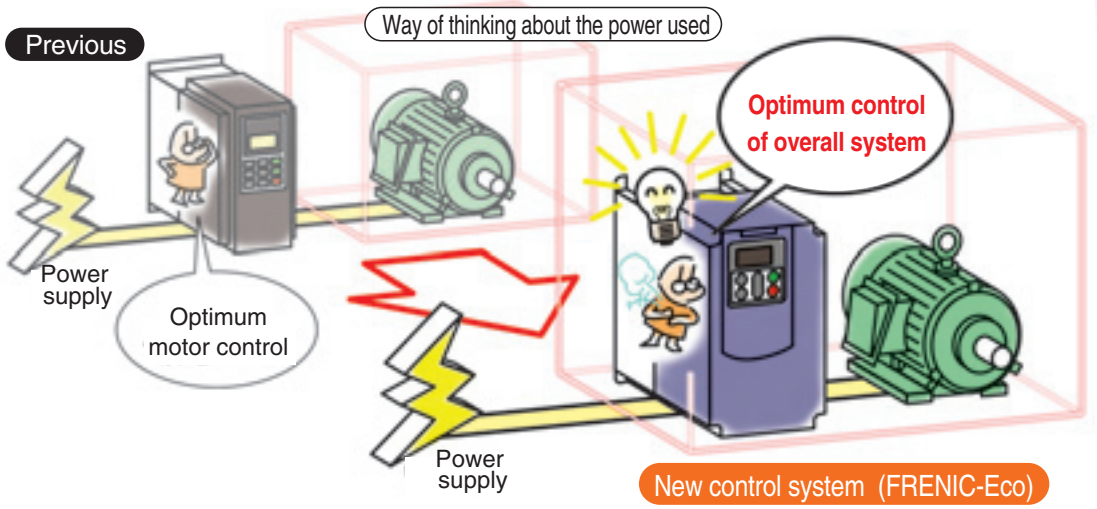
MEH532a

Variable Torque AC Drives for Fans and Pumps!

Enhanced Energy Savings !

Optimizing Energy-Savings for the complete system

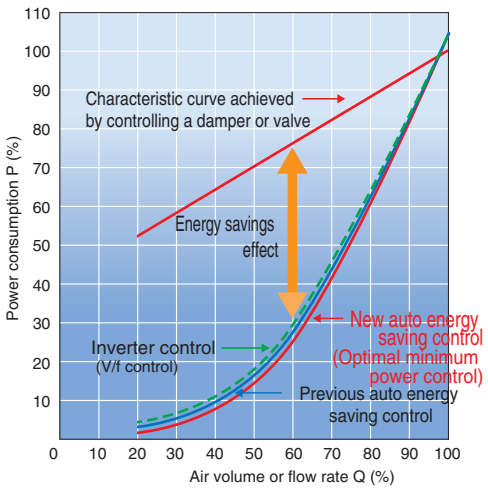
In addition to optimizing the control of the applied motor for Energy-Savings, FRENIC-Eco series drives also optimizes power consumption of the drive for maximizing Energy-Savings for the complete system. With regulations expected to call for a reduction of 1% or more in annual energy consumption, Fuji Electric is aiming to optimize energy-savings as a complete system approach and not focusing only on reducing energy consumed by the motor.



Using this new system, energy savings is several percent improved over that of the previous models.

Kyoto Agreement, which was studied at the Conference on Prevention of Global Warming (COP3), was ratified by Russia in October 2004, and thereby put into effect on February 16, 2005. In the future, the related regulations are calling for a reduction in energy consumption of 1% or more each succeeding year, and therefore, we are aiming to build energy saving features into equipment as a whole.**FRENIC-Eco is the inverter equipped with the industry's highest level of efficiency (low power loss).**

■Energy saving effect compared with Fuji's previous models



(The effect varies dependent on the motor's characteristics.)

Power Monitor

Power-related data can be checked via the inverter unit's keypad.

Items
Power (kW)
Cumulative power (kWh)
Cumulative power rates ($/kWh)

* Cumulative values can be reset. Cumulative power rates are shown with the power rate set at so much per kWh (display coefficient). Rates in other currency can also be displayed.

Long life design that meets your expectation !

Built with longer lasting replaceable components to give a longer service life!

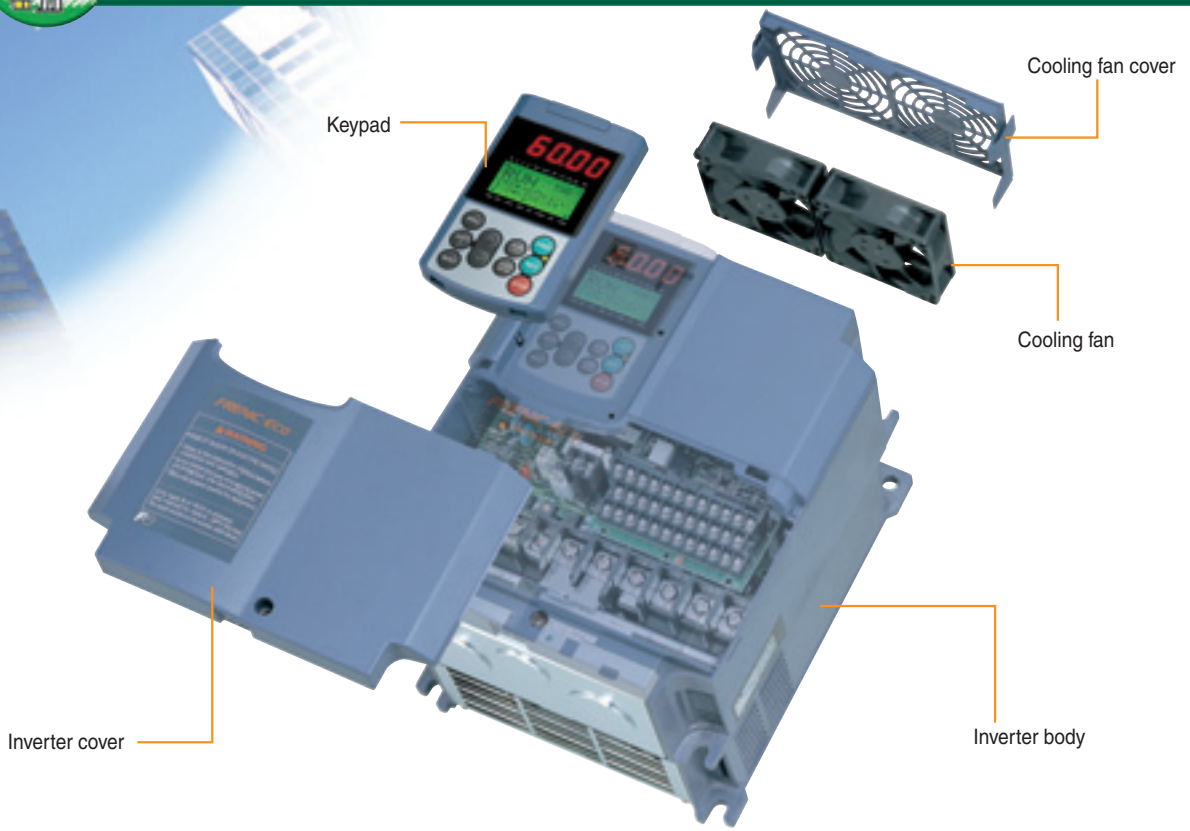
The design life of replaceable components in each inverter model has been extended to **10 years**. In addition, the capacity of the main circuit capacitors is measured and temperature compensation carried out to match the cumulative operating time of the electrolytic capacitors on the printed circuit board.

Life-limited component name	Designed life
Main circuit capacitors	10 years
Electrolytic capacitors on printed circuit board	10 years
Cooling fan (Note)	10 years

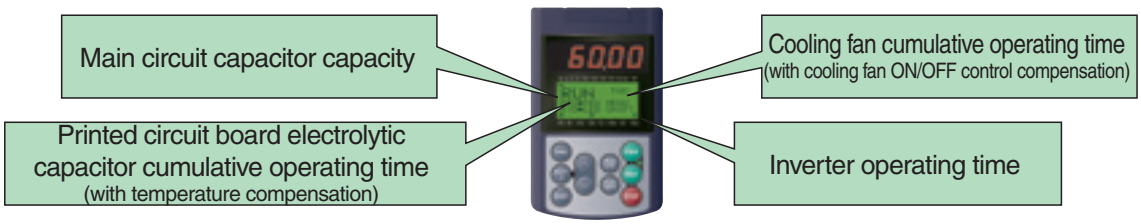
Note: 7 years for 50HP or larger models
[Conditions] Ambient temperature: 40˚C (104˚F), Load factor: 80% of inverter's rated current
•The life may be shorter depending on surrounding conditions.

Saves energy and cuts costs.

Maintenance is simplified for both the drive and equipment !



The service life information for replaceable inverter components is displayed.



Simple replacement of replaceable components

Cooling fan replacement procedure

●20HP model

Cooling cover can be removed with one touch.

Disconnect the power connector and change the cooling fan cartridge.

●60HP model

The inverter's mounting screws and power connector can be removed from the front.

The cooling fan cartridge can be replaced by sliding the holder out to the front

Industry first Information is displayed with equipment maintenance in mind.

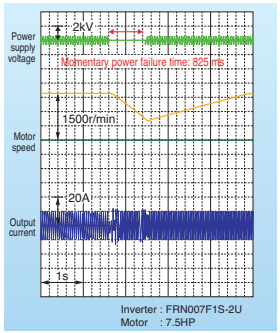
In addition to maintenance information for the inverter unit, information related to equipment maintenance is also displayed.

Item	Purpose
Motor cumulative operating time (hours)	The cumulative operating time of the equipment the inverter is used with is calculated. Example of Use If the inverter is used for fan control, this time can be used as a criterion for replacing the belts used on pulleys.
Number of starts (times)	The number of times the inverter is run and stopped can be counted. Example of Use The number of times the equipment is started and stopped is recorded, so this can be used as a criterion for replacing parts in equipment where starting and stopping is a burden on the machine.

Equipped with the optimum functions for HVAC (Air conditioning systems)

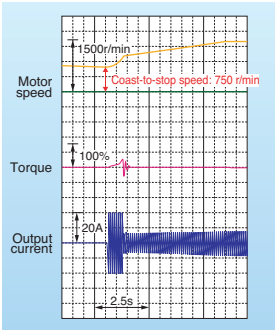
Operation is continued even after the momentary power failure thanks to the auto-restart function.

Even if a momentary power failure occurs, load inertia of a fan or blower, etc. is used to maintain the motor's operation while the motor's operating speed gradually drops, and enables the motor to restart operation without stopping. (The motor may stop on occasion due to the load's inertia.)



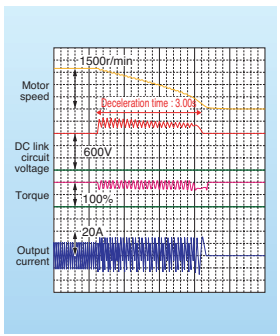
A pick-up function provides smooth starts.

If you desire to run a fan which the inverter is not currently running and which is turning free. This function will pick up on its motion regardless of the direction it is turning and take operation. Momentary switching is performed in the inverter from the commercial power supply and provides a convenient function when starting motors, etc.



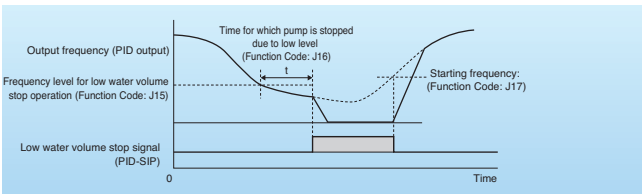
Tripless operation through regenerated current avoidance control

Deceleration time is controlled to match the internal energy level generated in the inverter, and so deceleration and stopping is accomplished without tripping due to overload.



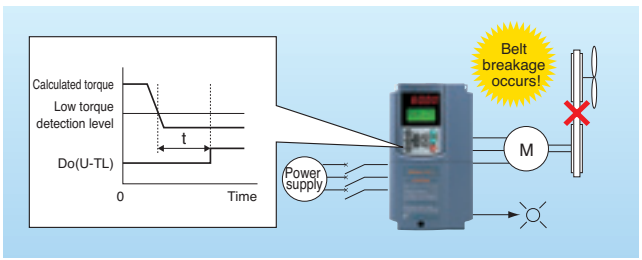
Even greater energy savings through the low water volume stop function

When there is pump operation accompanying "pressure drop" that occurs due to pressure loss or leakage, etc. in the piping, etc., or at times when the pump runs repeatedly to obtain a small volume of water, this function controls the pump's operation, preventing it from being driven with the water volume below a predetermined level, and thus reducing wasteful pump operation and saving even more energy.



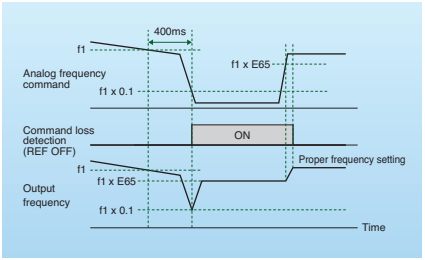
The equipment's operating condition is determined by the low torque detection function.

The inverter determines the load state of the connected motor and if it drops below a predetermined level, it judges that a "Low Torque" state exists and outputs a signal to that effect. In this way, any trouble that occurs in the equipment (such as a belt on a pulley breaking) can be detected by the inverter.



Also avoids operation signal trouble through the command loss detection function.

If the frequency signals (0 to 10V, 4 to 20mA, multi-step speed operation signals, communications, etc.) that are connected to the inverter are lost, signals are output as a "command loss," indicating that a frequency command was lost. In addition, output frequency when the command loss occurred can be set in advance, so even if a frequency signal line to equipment is broken due to machine vibration, etc., machine operation can be continued uninterrupted.



Simple circuit configuration using the commercial line switching sequence

Inverters are equipped with the commercial line start function that enables switching between the commercial line and the inverter by an external sequence. In addition, inverters are equipped with two types of built-in sequence for operation with commercial line; i.e., Fuji's standard sequence and the automatic switching sequence to the commercial line activated when the inverter alarm occurs.

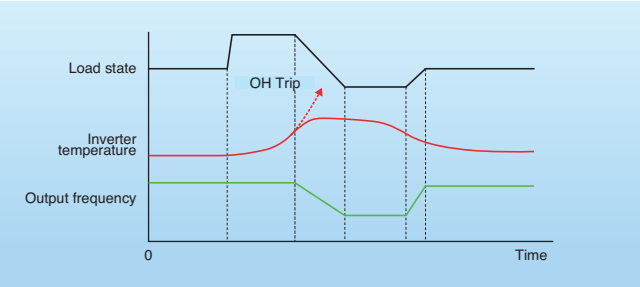
Note: The latter sequence differs from the one for forcible switching to the commercial line during inverter breakdown.

Inverters are equipped with full PID control functions.

Low water level stop function, deviation alarm and absolute value alarm outputs have been added to the PID regulator which performs such tasks as temperature, pressure and flow rate control. In addition, an anti-reset windup function that prevents PID control overshoot as well as a PID output limiter and integral hold/reset signal provide easy-to-adjust PID control functions.

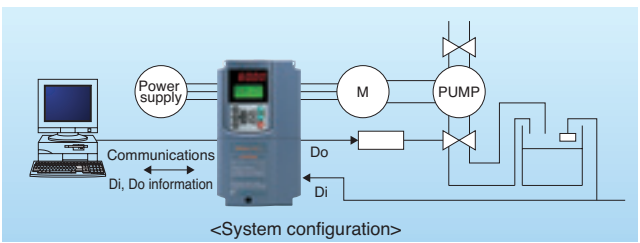
Continuous equipment operation through overload avoidance control

If the load on a fan or pulley increases due some foreign object overloading around the shaft, etc., and the inverter's internal temperature rises suddenly or the ambient temperature rises to an abnormal level, etc., causing an inverter overload state, the motor's speed is lowered, reducing the load and enabling operation to continue.



Simple Sequences through Universal DI/DO

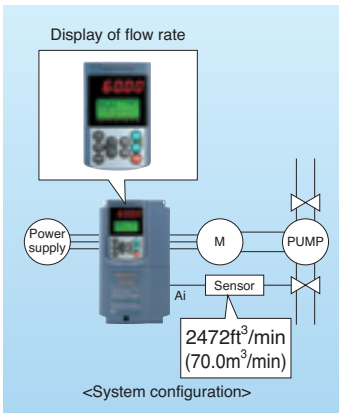
Signals can be transmitted to a higher level controller or PC by connecting digital signals to an inverter from different types of sensors, such as a float switch used to judge the level in a water storage tank, which serve as peripheral devices to the inverter. In the case of small-scale equipment, even if a programmable logic controller (PLC) is not used, information can be sent to a higher-level system easily.



<System configuration>

Elimination of display devices by use of the analog input monitor

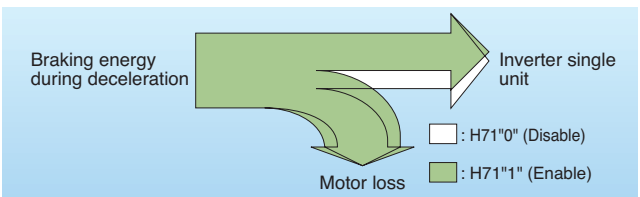
Using the display coefficient of signals from devices such as flow rate or temperature sensors in air conditioning equipment, these signals can be converted into physical values such as temperature and pressure and displayed on the inverter's keypad without making the use of exclusive flow meters or air flow meters.



<System configuration>

Improved capability for handling regenerated energy

When the inverter slows down and stops the motor, if the braking energy regenerated by the motor exceeds the braking capacity of the inverter's main circuit capacitor, the inverter will trip. At such a time, if even a little excess energy trips the inverter, using this function you may be able to absorb the excess braking energy without connecting to a braking resistor.



Other convenient functions

●Motor condensation prevention function

Prevents condensation of the motor from occurring in cases where the surrounding temperature changes suddenly while the motor is stopped.

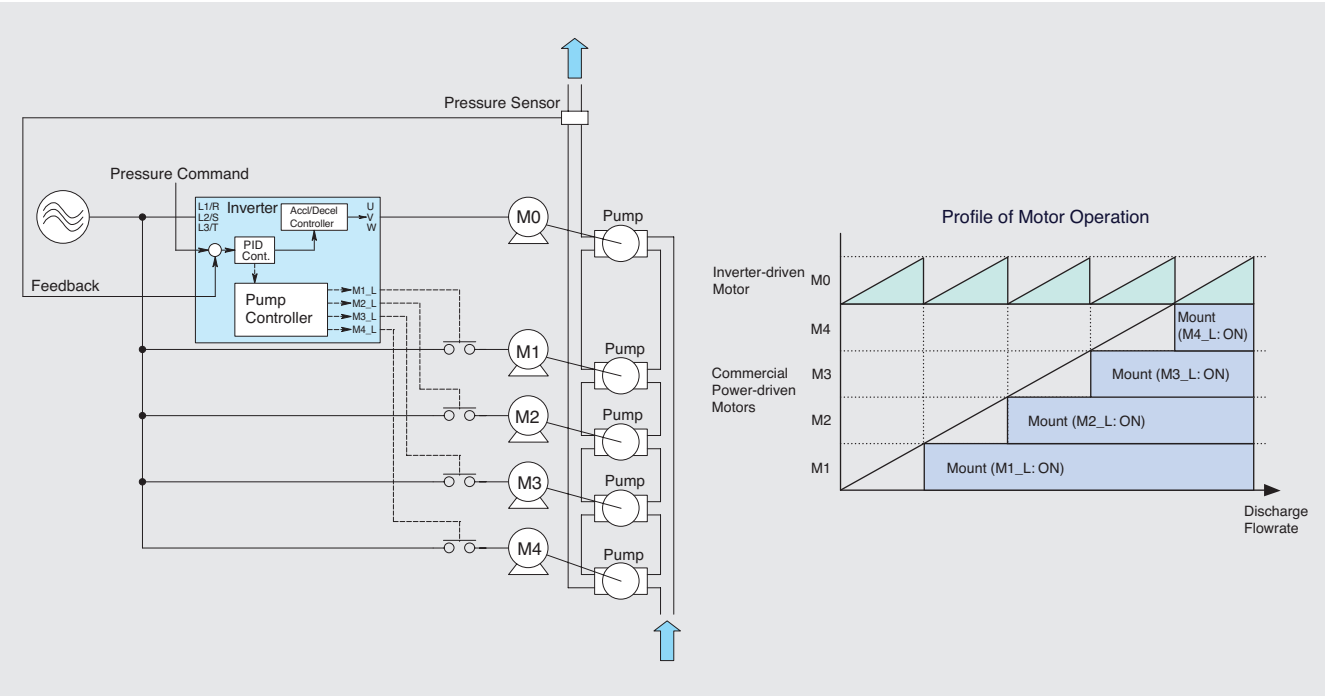
●Motor speed display with percent

The inverter's keypad displays the operating frequency (Hz) or the motor's rotational speed (r/min), but it can also display the maximum speed as 100%, so it is easy to get a grasp of the equipment's operating state.

Dynamic Rotation of Pump Motors

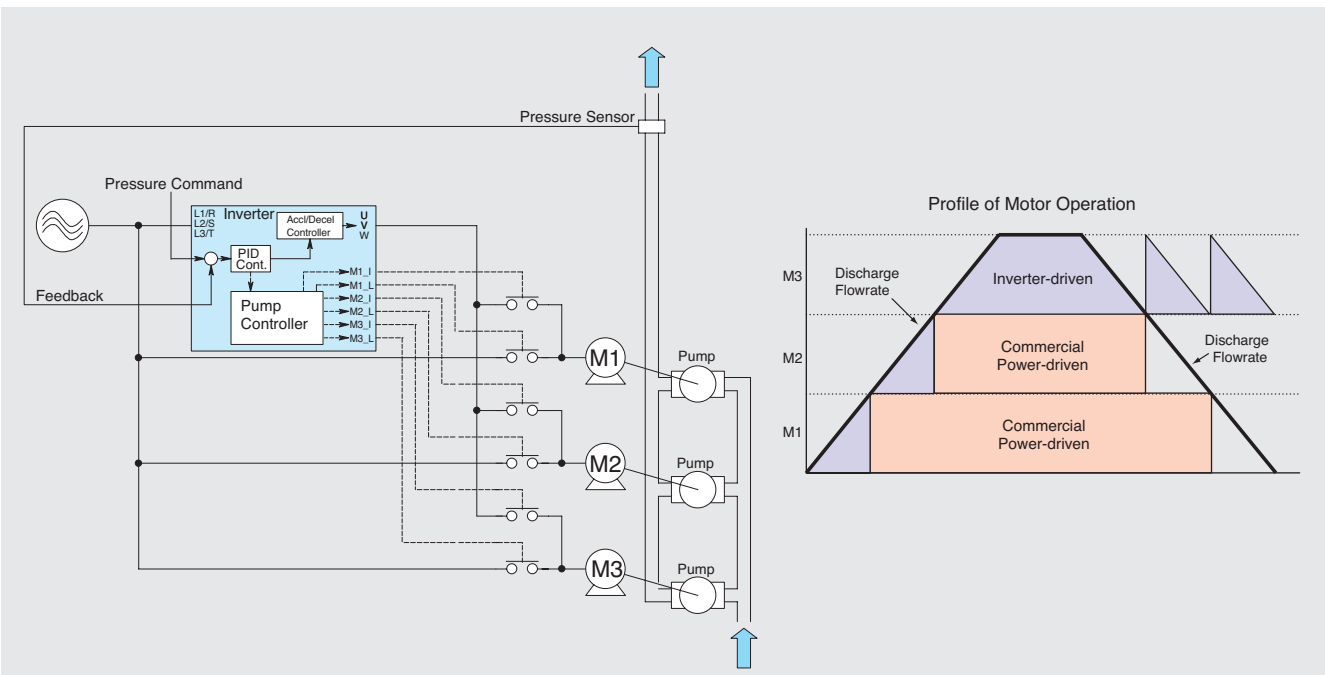
●With a fixed inverter-driven motor

This configuration consists of a motor driven by the inverter (M0) and motors driven by commercial power (M1 to M4).
The inverter-driven motor is fixed at M0 and is controlled for variable speed. When the inverter-driven motor M0 alone cannot sustain the desired discharge flowrate, the inverter starts one or more motors driven by commercial power as necessary.



●With a floating inverter-driven motor

In this configuration, all the motors can be driven by the inverter or commercial power. At the start of operation,
each motor is driven by the inverter and is controlled for varying speed. When the first motor alone cannot sustain the desired discharge flowrate, it is switched to commercial-power operation, and the inverter drives the second motor.



Consideration of the surrounding environment and panel design

Side-by-side installation saves space!

If multiple inverter units are to be used in a panel and the panel is designed accordingly, it is possible to mount these inverters side-by-side horizontally, so the panel can be designed to take up less space. (5HP for 208V,7.5HP for 460V or smaller capacity inverters)

Units: inch (mm)
Example: 3-phase 230V,
7.5HP devices are shown.

Built-in charging resistors (in rush current suppressing resistors) help reduce peripheral equipment sizing!

When the FRENIC-Eco series (Fuji's FRENIC-Mini Series and 11 Series) is used, the charging resistors (in rush current suppressing resistors) built into the inverter as standard equipment suppress in rush current when motors are started, so compared to operation of motors with direct input, peripheral equipment with reduced capacity can be selected.

Cooling outside the panel is made possible by an external cooling attachment!

Use of the external cooling attachment (optional on 30HP for 208V, 40HP for 460V or smaller inverters and standard on 40HP for 208V, 50HP for 460V or larger inverters) to cool the inverter outside the panel makes it possible to install a simple cooling system outside the panel.

Operator-friendly features !

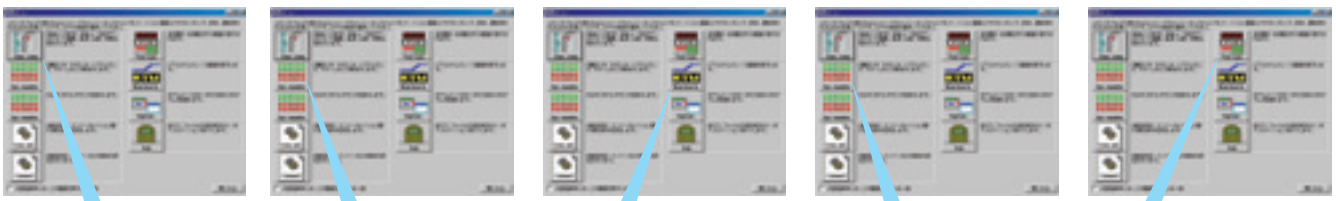
A multi-function keypad is available as standard.

- Includes an easier to see LCD with backlight.
- It has a large 7-segment, 5-digit LED display.
- It is possible to add and delete quick setup items.
- A remote/local key has been added.
- Copying up to 3 sets of data is possible.

A keypad that enables remote operation is standard equipment.

The standard keypad has a decorative cover on the bottom that can be slid sideways and removed. A LAN cable can be used to connect the panel, making it possible to use it as a remote operation keypad.

Personal computer loader software



Store, manage and verify settings data.

Monitoring

Real-time tracing

Maintenance Information

Operation

Network compatibility !

- RS-485 communication is standard. Selectable from Modbus-RTU, Metasys-N2, FLN P1.
- It is compatible with the following networks by inserting the option card.

• Device Net
• LonWorks Network
• PROFIBUS-DP
• BACnet (available soon)

Global compatibility !

European Union
EC Regulation (CE mark)

North America/Canada
UL Standards (cUL certified)

- Compliance with standards
- Synk/source switchable
- Wide voltage range
- Multi-function keypad displaying multiple languages (Japanese, English, German, French, Spanish, Italian)

Model List

Applicable motor rating (HP)	Standard type	
	Three-phase 208V	Three-phase 460V
1	FRN001F1S-2U	FRN001F1S-4U
2	FRN002F1S-2U	FRN002F1S-4U
3	FRN003F1S-2U	FRN003F1S-4U
5	FRN005F1S-2U	FRN005F1S-4U
7.5	FRN007F1S-2U	FRN007F1S-4U
10	FRN010F1S-2U	FRN010F1S-4U
15	FRN015F1S-2U	FRN015F1S-4U
20	FRN020F1S-2U	FRN020F1S-4U
25	FRN025F1S-2U	FRN025F1S-4U
30	FRN030F1S-2U	FRN030F1S-4U
40	FRN040F1S-2U	FRN040F1S-4U
50	FRN050F1S-2U	FRN050F1S-4U
60	FRN060F1S-2U	FRN060F1S-4U
75	FRN075F1S-2U	FRN075F1S-4U
100	FRN100F1S-2U	FRN100F1S-4U
125	FRN125F1S-2U	FRN125F1S-4U
150		FRN150F1S-4U
200		FRN200F1S-4U
250		FRN250F1S-4U
300		FRN300F1S-4U
350		FRN350F1S-4U
400		FRN400F1S-4U
450		FRN450F1S-4U
500		FRN500F1S-4U
600		FRN600F1S-4U
700		FRN700F1S-4U
800		FRN800F1S-4U
900		FRN900F1S-4U

How to read the model number

FRN 007 F 1 S - 2 U

Code	Series name
FRN	FRENIC series

Code	Applicable motor rating [HP]
001	1HP
002	2HP
003	3HP
005	5HP
007	7.5HP
010	10HP
015	15HP
020	20HP
↕	↕
700	700HP
800	800HP
900	900HP

Code	Application range
F	Fans and pumps (For variable torque load)

Code	Developed inverter series
1	1

Code	Structure
S	Standard type(IP20/IP00)

Code	Input power supply
2	3-phase 208V
4	3-phase 460V

Code	Version/Manual
U	USA/English

Caution Use the contents of this catalog only for selecting product types and models. When using a product, read the Instruction Manual beforehand to use the product correctly.

How does using an inverter save me energy?

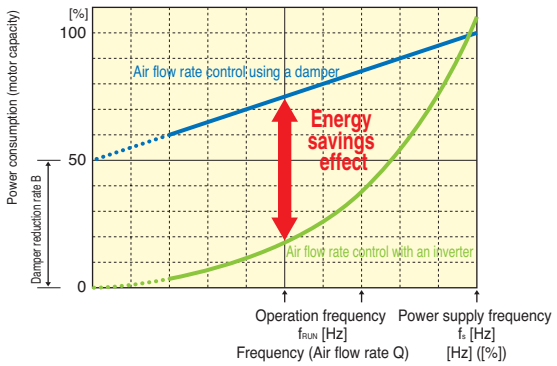
- If you run a fan or pump and you have damper (valve) control or control it with an inverter, the relation between the air flow (flow rate) and the required power, as well as the relation between the power supply frequency fs (Hz) and operating frequency with the inverter fINV (Hz) are as shown in the table at right.
- If the air flow rate is low, the energy saving effect is particularly great.

Item	Relation between f_s (Hz) and fINV (Hz) (Note 1)	Examples with actual numbers (Note 2)	
		f_{INV}=45[Hz] (10%DOWN)	f_{INV}=30[Hz] (40%DOWN)
Air flow or flow rate Q [m³/min]	$Q \propto \left(\frac{f_{INV}}{f_S}\right)$	$Q = \frac{45}{50} \cdot Q = 0.9 \cdot Q$	$Q = \frac{30}{50} \cdot Q = 0.6 \cdot Q$
Head H (m) or pressure H [Pa]	$H \propto \left(\frac{f_{INV}}{f_S}\right)^2$	$H = \left(\frac{45}{50}\right)^2 \cdot H = 0.81 \cdot H$	$H = \left(\frac{30}{50}\right)^2 \cdot H = 0.36 \cdot H$
Shaft power or power consumption P [W]	$P \propto \left(\frac{f_{INV}}{f_S}\right)^3$	$P = \left(\frac{45}{50}\right)^3 \cdot P = 0.729 \cdot P$	$P = \left(\frac{30}{50}\right)^3 \cdot P = 0.216 \cdot P$

Note 1: Power supply frequency fs (Hz); operating frequency with the inverter fINV (Hz) Note 2: When fs = 50 (Hz)

■Formula (theoretical) for calculating the energy savings effect achieved by an inverter

●Fan equipment



■Energy savings effect in monetary terms: Ms ($/year)

= Power charges [$/year] at the time the damper was used - Power charges MINV when an inverter is used [$/year]

■Power charges when a damper is used: Mo [$/year]

$$= (P \times (1 - B) \times Q + P \times B) \times \frac{1}{\eta_M} \times D \times H \times M$$

■Power charges when an inverter is used: MINV [$/year]

$$= \left(P \times \left(\frac{f_{RUN}}{f_S}\right)^3\right) \times \frac{1}{\eta_M} \times \frac{1}{\eta_{INV}} \times D \times H \times M$$

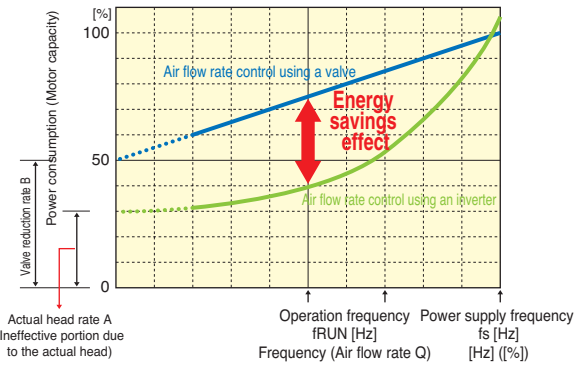
P: Motor capacity (kW)
B: Damper reduction rate (%)
Q: Air flow (%)
F_{RUN}: Inverter operating frequency (Hz)
F_S: Power supply frequency (Hz)
D: Annual operating days (day/year)
H: Operating hours per day (h/day)
M: Power charge unit price ($/kWh)
η_M: Motor efficiency (%)
η_{INV}: Inverter efficiency (%)

(Note 1) The air flow rate Q (%) shows the air flow when the damper is closed (%). The operating frequency f_{RUN} (Hz) when using an inverter is being proportional to the air flow Q (%), so decide on a f_{RUN} (Hz) value so that the relationship Q (%) = frun (Hz)/fs (Hz) is established.

For example, if air flow Q: 60 (%) = Power supply frequency fs: 50 (Hz)
Q (%) = f_{RUN} (Hz) / f_S (Hz)
60 (%) = f_{RUN} (Hz) / 50 (Hz) → f_{RUN} (Hz) = 50 (Hz) x 0.6 = 30 (Hz)

(Note 2) The air flow rate Q (%)does not show the damper's opening angle, but rather the air flow (%) at the point when the opening angle is adjusted from the damper's fully open state. Depending on the type of damper, there may not be a proportional relation between the opening angle and the air flow, so exercise caution.

●Pump equipment



■Monetary amount of energy savings effect: Ms [$/year]

= Power charge Mv ($/year) when a valve is used - Power charge MINV [$/year] when an inverter is used

■Power charge when a valve is used: Mv [$/year]

$$= (P \times (1 - B) \times Q + P \times B) \times \frac{1}{\eta_M} \times D \times H \times M$$

■Power charge when an inverter is used: MINV [$/year]

$$= \left(\left(P - P \times A\right) \times \left(\frac{f_{RUN}}{f_S}\right)^3 + P \times A\right) \times \frac{1}{\eta_M} \times \frac{1}{\eta_{INV}} \times D \times H \times M$$

P: Motor capacity (kW)
A: Actual head rate (%)
B: Valve reduction rate (%)
Q: Flow rate (%)
F_{RUN}: Inverter operating frequency (Hz)
F_S: Power supply frequency (Hz)
D: Annual operating days (day/year)
H: Operating hours per day (h/day)
M: Power charge unit price ($/kWh)
η_M: Motor efficiency (%)
η_{INV}: Inverter efficiency (%)

(Note 1) The actual head rate A (%) is determined by the pump's load characteristics and is a rate that the power consumption (motor capacity) is multiplied by.
See the following calculation formula.
Actual head rate A (%) = Actual head (m) / Loss head (m)

(Note 2) The flow rate Q (%) value shows a volume (%) when the flow rate is restricted by the closing of the valve. The operating frequency when an inverter is used fRUN (Hz) is proportional to the flow rate Q (%), so decide on a fRUN (Hz) so that the relationship Q (%) = f_{RUN} (Hz) / f_S (Hz) can be established.
For example, if the flow rate Q: 50 (%) and the power supply frequency f_S is 50Hz, Q (%) = fRUN (Hz) / f_S (Hz)
60 (%) = f_{RUN} (Hz) / 50 (Hz) → f_{RUN} (Hz) = 50 (Hz) x 0.6 = 30 (Hz)

(Note 3) The flow rate Q (%) does not show the valve's opening angle, but rather the flow rate (%) at the point when the opening angle is adjusted from the valve's fully open state. Depending on the type of valve, there may not be a proportional relation between the opening angle and the flow rate, so exercise caution.

Energy Savings effect of replacing damper (valve) control with inverter control

Example: The energy savings effect on an office's air conditioning equipment if the operating pattern is as follows: Air flow: 85% for 2,000 hrs, and 60% for 2,000 hrs. Total 4,000 hrs/year. Motor output is 15kW x 1 unit.

●**Under damper (valve) control,** the required power is as follows:

(15kW x 91% x 2,000 hrs.) + (15kW x 76% x 2,000 hrs.) = 50,100kWh
Air flow rate 85% Air flow rate 60%

●**If an inverter is used** and the motor's rotational speed is controlled, the required power is as follows:

(15kW x 61% x 2,000 hrs.) + (15kW x 22% x 2,000hrs.) = 24,900kWh
Air flow rate 85% Air flow rate 60%

●**The power saving effect** when the power charges are $0.087/kWh is

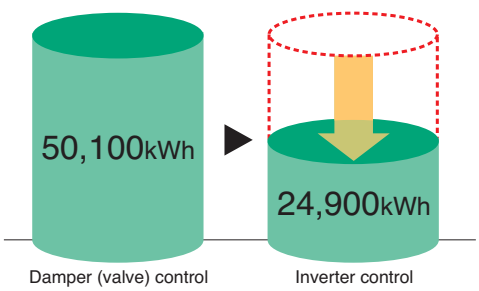
25,200kWh x $0.087 = $2,192/year

●**The amount of time** it takes to amortize the equipment cost if the inverter's cost is $2,348 is

$2,348 / $2,192 = 1.1 years

●Also, if we let the CO_2 emissions coefficient be 0.12 kg/kWh (environmental statistics from the Environmental Department of the Environmental Agency), **the annual CO_2 reduction** amounts to

25,200kWh x 0.12 kg/kWh = 3,024kg/year

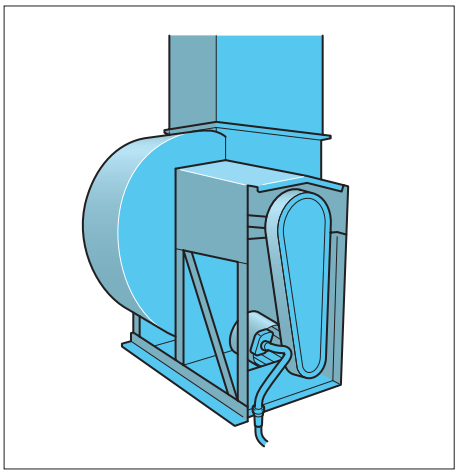


Energy savings effect

50,100kWh - 24,900kWh = 25,200kWh/year

Examples of measurements with actual equipment

■Exhaust fan (generating variable torque load)



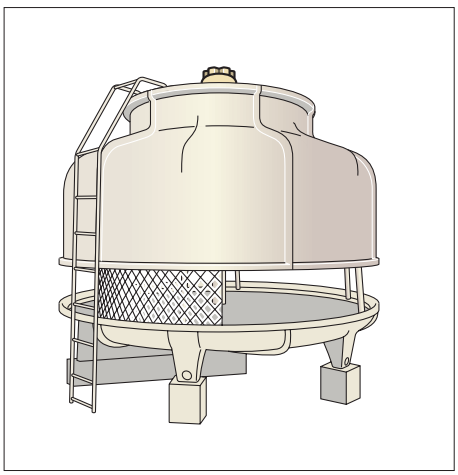
●Motor capacity and inverter capacity
- Motor capacity : 30HP
- Inverter model : FRN030F1S-2U
- DC REACTOR : DCR2-22A

●Power reduction rate and energy saving effect amount

Item	Operation using commercial power	Inverter-controlled operation		
Operation frequency (Hz)	50	45	40	35
Average power use (kW)	17.2	13.1	9.10	6.23
Power reduction rate (%)	-	▲30.7	▲47.1	▲63.8
Annual power charge ($)	11,133	8,479	5,890	4,032
Annual amount ($) of energy saving effect	-	**2,653**	**5,242**	**7,096**
Annual CO_2 reduction volume (kg/year)	-	3,660	7,232	9,794

●Operating conditions
- Annual operating days : 310 (days/year)
- Working hours per day : 24 (hrs/day)
- Power charge unit price : $0.087/kWh

■Cooling tower (generating variable torque load)



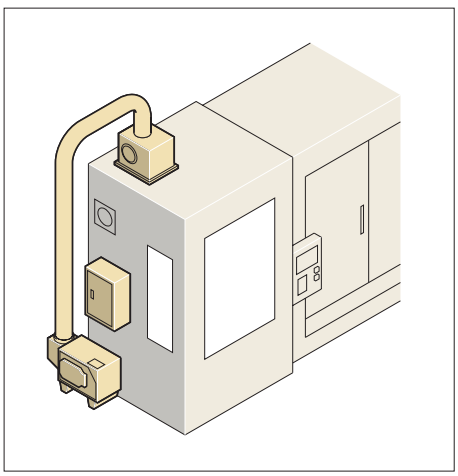
●Motor capacity and Inverter capacity
- Motor capacity : 7.5HP
- Inverter model : FRN007F1S-2U
- DC REACTOR : DCR2-5.5

●Power reduction rate and energy saving effect amount

Item	Operation using commercial power	Inverter-controlled operation		
Operation frequency (Hz)	60	45	40	35
Average power use (kW)	5.18	2.31	1.63	1.10
Power reduction rate (%)	-	▲55.4	▲68.5	▲78.8
Annual power charge ($)	2,703	1,205	850	574
Annual amount ($) of energy savings effect	-	**1,506**	**1,851**	**769**
Annual CO_2 reduction volume (kg/year)	-	2,066	2,556	2,938

●Operating conditions
- Annual operating days : 300 (days/year)
- Working hours per day : 20 (hrs/day)
- Power charge unit price : $0.087/kWh

■Mist collector (generating variable torque load)



●Motor capacity and Inverter capacity
- Motor capacity : 5HP
- Inverter Model : FRN005F1S-2U
- DC REACTOR : DCR2-3.7

●Power reduction rate and energy saving effect amount

Item	Operation using commercial power	Inverter-controlled operation		
Operation frequency (Hz)	60	45	40	35
Average power use (kW)	3.27	1.44	0.99	0.69
Power reduction rate (%)	-	▲56.0	▲69.7	▲78.9
Annual power charge ($)	1,479	651	447	312
Annual amount ($) of energy savings effect	-	**827**	**1,029**	**1,166**
Annual CO_2 reduction volume (kg/year)	-	1,142	1,423	1,610

●Operating conditions
- Annual operating days : 260 (days/year)
- Working hours per day : 20 (hrs/day)
- Power charge unit price : $0.087/kWh

Conduct a search. You can study energy savings with the following types of equipment.

Fan systems
- Air conditioning fans
- AHU
- Dust collectors
- Mist -collectors
- Exhaust fans
- Package air conditioners, etc.

Pump systems
- Cooling water pumps
- Circulating pumps
- Cleaning pump
- Roots blowers
- Coolant pumps
- Water cooler pumps, etc.

■ Three-phase 208V

Item				Specifications														
Type (FRN ＿＿＿ F1S-2U)				001	002	003	005	007	010	015	020	025	030	040	050	060	075	100	125
Nominal applied motor [HP]			*1	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75	100	125
Output ratings	Rated capacity [kVA]		*2	1.6	2.7	3.8	6.0	9.0	11	16	21	27	31	41	51	60	76	98	123
	Rated voltage [V]		*3	Three-phase, 200V to 240V (With AVR function)										Three-phase, 200V to 230V (With AVR function)					
	Rated current [A]		*4	4.6	7.5	10.6	16.7	25	31	47	60	75	88	114	143	169	211	273	343
	Overload capability			120% of rated current for 1min.															
	Rated frequency			50, 60 Hz															
Input ratings	Phases, voltage, frequency	Main power supply		Three-phase, 200 to 240V, 50/60Hz										Three-phase, 200 to 220V, 50Hz Three-phase, 200 to 230V, 60Hz					
		Auxiliary control power input		Single-phase, 200 to 240V, 50/60Hz										Single-phase, 200 to 230V, 50/60Hz					
		Auxiliary fan power input	*5	None											Single-phase, 200 to 220V, 50Hz Single-phase, 200 to 230V, 60Hz				
	Voltage/frequency variations			Voltage: +10 to -15% (Voltage unbalance 2% or less) *9, Frequency: +5 to -5%															
	Rated current [A]	(with DCR)	*6	3.1	5.8	8.7	14.5	20.6	27.5	41.3	55.1	68.8	82.6	109	134	160	199	270	333
		(without DCR)		5.1	9.1	12.9	21.5	30.8	40.8	59.4	76.6	94.0	110	144	179	215	—	—	—
	Required power supply capacity [kVA]		*7	1.2	2.2	3.2	5.3	7.5	10	15	20	25	30	40	49	58	72	98	120
Braking	Torque [%]		*8	20.0									10 to 15						
	DC injection braking			Starting frequency: 0.0 to 60.0Hz, Braking time: 0.0 to 30.0s, Braking level: 0 to 60%															
DC reactor (DCR)				Option													Standard		
Applicable safety standards				UL508C, C22.2 No.14, EN50178-1997															UL508C C22.2 No.14
Enclosure (IEC60529)				IP20, UL open type									IP00, UL open type						
Cooling method				Natural cooling	Fan cooling														
Mass [lbs(kg)]				7.1 (3.2)	7.3 (3.3)	7.3 (3.3)	7.5 (3.4)	13 (5.8)	13 (6.0)	15 (6.9)	21 (9.7)	21 (9.7)	25 (11.5)	51 (23)	73 (33)	75 (34)	90 (41)	90 (41)	265 (120)

*1 Standard 4-pole motor

*2 Rated capacity is calculated by assuming the output rated voltage as 208V for three-phase 208V.

*3 Output voltage cannot exceed the power supply voltage.

*4 An excessively low setting of the carrier frequency may result in the higher motor temperature or tripping of the inverter by its overcurrent limiter setting. Lower the continuous load or maximum load instead. (When setting the carrier frequency (F26) to 1kHz, reduce the load to 80% of its rating.)

*5 Use [R1,T1] terminals for driving AC cooling fans of an inverter powered by the DC link bus, such as by a high power factor PWM converter. (In ordinary operation, the terminals are not used.)

*6 Calculated under Fuji-specified conditions.

*7 Obtained when a DC reactor (DCR) is used.

*8 Average braking torque (Varies with the efficiency of the motor.)

*9 Voltage unbalance (%) = $\frac{\text{Max. voltage (V) - Min. voltage (V)}}{\text{Three-phase average voltage (V)}}$ x 67 (IEC61800-3 (5.2.3))

If this value is 2 to 3%, use an AC reactor (ACR).

■ Three-phase 460V

●1 to 75HP

Item				Specifications												
Type (FRN _ _ _ F1S-4U)				001	002	003	005	007	010	015	020	025	030	040	050	060	075
Nominal applied motor [HP]			*1	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75
Output ratings	Rated capacity [kVA]		*2	1.9	2.9	4.3	7.1	9.9	13	18	23	29	35	47	57	67	83
	Rated voltage [V]		*3	Three-phase, 380 to 480V (With AVR function)													
	Rated current [A]		*4	2.5	3.7	5.5	9.0	12.5	16.5	23	30	37	44	59	72	85	105
	Overload capability			120% of rated current for 1min.													
	Rated frequency			50, 60 Hz													
Input ratings	Phases, voltage, frequency	Main power supply		Three-phase, 380 to 480V, 50/60Hz											Three-phase, 380 to 440V,50Hz Three-phase, 380 to 480V,60Hz		
		Auxiliary control power input		Single-phase, 380 to 480V, 50/60Hz													
		Auxiliary fan power input	*5	None													Single-phase, 380 to 440V/50Hz, Single-phase, 380 to 480V/60Hz
	Voltage/frequency variations			Voltage: +10 to -15% (Voltage unbalance 2% or less) *9, Frequency: +5 to -5%													
	Rated current [A]	(with DCR)	*6	1.3	2.5	3.8	6.2	8.9	11.8	17.7	23.7	29.6	35.5	46.8	57.0	68.4	85.7
		(without DCR)		2.5	4.8	6.9	10.8	14.5	19.1	27.7	36.0	43.6	50.9	64.0	78.5	93.7	118
	Required power supply capacity [kVA]		*7	1.1	2.0	3.1	5.0	7.1	10	15	19	24	29	38	46	55	69
Braking	Torque [%]		*8	20										10 to 15			
	DC injection braking			Starting frequency: 0.0 to 60.0Hz, Braking time:0.0 to 30.0s, Braking level: 0 to 60%													
DC reactor (DCR)				Option													
Applicable safety standards				UL508C, C22.2 No.14, EN50178-1997													
Enclosure (IEC60529)				IP20, UL open type										IP00, UL open type			
Cooling method				Natural cooling		Fan cooling											
Mass [lbs(kg)]				6.8 (3.1)	7.1 (3.2)	7.3 (3.3)	7.5 (3.4)	7.5 (3.4)	13 (6.0)	13 (6.0)	15 (6.9)	22 (9.9)	22 (9.9)	25 (11.5)	51 (23)	53 (24)	73 (33)

●100 to 900HP

Item				Specifications												
Type (FRN _ _ _ F1S-4U)				100	125	150	200	250	300	350	400	450	500	600	700	800	900
Nominal applied motor [HP]			*1	100	125	150	200	250	300	350	400	450	500	600	700	800	900
Output ratings	Rated capacity [kVA]		*2	110	133	161	191	240	286	330	380	414	517	589	669	764	828
	Rated voltage [V]		*3	Three-phase, 380 to 480V (With AVR function)													
	Rated current [A]		*4	139	168	203	240	302	360	415	477	520	650	740	840	960	1040
	Overload capability			120% of rated current for 1min.													
	Rated frequency			50, 60 Hz													
Input ratings	Phases, voltage, frequency	Main power supply		Three-phase, 380 to 440V, 50Hz Three-phase, 380 to 480V, 60Hz													
		Auxiliary control power input		Single-phase, 380 to 480V, 50/60Hz													
		Auxiliary fan power input	*5	Single-phase, 380 to 440V/50Hz Single-phase, 380 to 480V/60Hz													
	Voltage/frequency variations			Voltage: +10 to -15% (Voltage unbalance 2% or less) *9, Frequency: +5% to -5%													
	Rated current [A]	(with DCR)	*6	113	140	169	222	275	330	382	440	495	545	652	756	869	981
		(without DCR)		—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Required power supply capacity [kVA]		*7	91	112	135	177	220	263	305	351	395	435	520	603	693	782
Braking	Torque [%]		*8	10 to 15													
	DC injection braking			Starting frequency: 0.0 to 60.0Hz, Braking time:0.0 to 30.0s, Braking level: 0 to 60%													
DC reactor (DCR)				Standard													
Applicable safety standards				UL508C, C22.2 No.14, EN50178-1997							UL508C, C22.2 No.14						
Enclosure (IEC60529)				IP00, UL open type													
Cooling method				Fan cooling													
Mass [lbs(kg)]				75 (34)	93 (42)	99 (45)	139 (63)	212 (96)	212 (96)	216 (98)	357 (162)	357 (162)	529 (240)	529 (240)	783 (355)	794 (360)	794 (360)

*1 Standard 4-pole motor
*2 Rated capacity is calculated by assuming the output rated voltage as 460V for three-phase 460V.
*3 Output voltage cannot exceed the power supply voltage.
*4 An excessively low setting of the carrier frequency may result in the higher motor temperature or tripping of the inverter by its overcurrent limiter setting. Lower the continuous load or maximum load instead. (When setting the carrier frequency (F26) to 1kHz, reduce the load to 80% of its rating.)
*5 Use [R1,T1] terminals for driving AC cooling fans of an inverter powered by the DC link bus, such as by a high power factor PWM converter. (In ordinary operation, the terminals are not used.)
*6 Calculated under Fuji-specified conditions.
*7 Obtained when a DC reactor (DCR) is used.
*8 Average braking torque (Varies with the efficiency of the motor.)
*9 Voltage unbalance (%) = $\frac{\text{Max. voltage (V) - Min. voltage (V)}}{\text{Three-phase average voltage (V)}}$ x 67 (IEC61800-3(5.2.3))
If this value is 2 to 3%, use an AC reactor (ACR).

Common specifications

Item			Explanation	Remarks	Related function code
Output frequency	Setting range	Maximum frequency	25 to 120Hz		F03
		Base frequency	25 to 120Hz		F04
		Starting frequency	0.1 to 60.0Hz		F23
		Carrier frequency	• 0.75 to 15kHz (208V/460V: 1 to 25HP for 208V and 1 to 30HP for 460V) • 0.75 to 10kHz (208V/460V: 30 to 100HP for 208V and 40 to 100HP for 460V) • 0.75 to 6kHz (208V/460V: 125HP for 208V and 125 to 900HP for 460V)	The carrier frequency may drop automatically according to the ambient temperature or output current to protect the inverter. This protective operation can be canceled by function code H98.	F26, F27, H98
	Accuracy (Stability)		• Analog setting: ±0.2% of maximum frequency (at 25±10°C (77±50°F)) • Keypad setting: ±0.01% of maximum frequency (at -10 to +50°C (14 to 122°F))		
	Setting resolution		• Analog setting: 1/1000 of maximum frequency (ex. 0.06Hz at 60Hz, 0.12Hz at 120Hz) • Keypad setting: 0.01Hz (99.99Hz or less), 0.1Hz (100.0Hz or more) • Link setting: Selectable from 2 types • 1/20000 of maximum frequency (ex. 0.003Hz at 60Hz, 0.006Hz at 120Hz) • 0.01Hz (fixed)	Setting with ∧ / ∨ keys	
Control	Control method		V/f control		
	Voltage/freq. characteristic (Non-linear V/f setting)		Possible to set output voltage at base frequency and at maximum output frequency (common spec.). AVR control can be turned ON or OFF.	Three-phase 208V: 80 to 240V Three-phase 460V: 160 to 500V	F03 to F05
			1 point (Arbitrary voltage and frequency can be set.)	Three-phase 208V: 0 to 240V/0 to 120Hz Three-phase 460V: 0 to 500V/0 to 120Hz	H50, H51
	Torque boost		Torque boost can be set with the function code F09.	Set when 0, 1, 3, or 4 is selected at F37.	F09, F37
	(Load selection)		Select application load type with the function code F37. 0: Variable torque load 1: Variable torque load (for high starting torque) 2: Auto-torque boost 3: Auto-energy-saving operation (variable torque load in acceleration/deceleration) 4: Auto-energy-saving operation (variable torque load (for high starting torque) for acceleration/deceleration) 5: Auto-energy-saving operation (auto-torque boost in acceleration/deceleration)		F09, F37
	Starting torque		50% or over		
	Start/stop	Keypad operation	Start and stop with FWD / RUN and STOP keys.		F02
		External signals (7 digital inputs)	: Forward (reverse) rotation, stop command(capable of 3-wire operation), second operation command,coast-to-stop command, external alarm, alarm reset, etc.		E01 to E05 E98, E99
			Link operation: Operation through RS-485 communication and Field Bus communication (option)		H30, y98
			Operation command switching: Remote/local switch, link switch, second operation command switch		
	Frequency command source		Keypad operation: Can be set with ∧ / ∨ keys.		F01, C30
			External potentiometer(1 to 5kΩ, 1/2W) : Prepared by users	Connected to analog input terminals 【13】, 【12】, 【11】.	
		Analog input	Can be set with external voltage/current input. 0 to +10V DC (0 to +5V DC)/0 to 100% (terminal [12],[V2]) 4 to 20mA DC/0 to 100% (terminal [C1])	E.g. : 0 to 5 VDC/1 to 5 VDC is applicable with bias/gain for analog input.	F18, C50, C32 to C34, C37 to C39, C42 to C44
		Multistep frequency	: Selectable from 8 steps (step 0 to 7)		C05 to C11
		UP/DOWN operation	: The frequency rises or lowers while the digital input signal is turned on.		F01, C30
		Link operation	: Can be set with RS-485 communications and field bus communications (option).		H30, y98
		Frequency setting change	: Two types of frequency settings can be switched with an external signal (digital input). Changeover between remote and local (keypad operation) or frequency setup through communication is also possible.		F01, C30
		Auxiliary frequency setting	: Inputs at terminal [12],[C1] or [V2] can be added to the main setting as auxiliary frequency settings.		E61 to E63
		Inverse operation	: The digital input signal and function code setting sets or switches between the normal and inverse operations. • +10 to 0V DC/0 to 100%(Terminal [12], [V2]) • 20 to 4mA DC/0 to 100%(Terminal [C1])		C53
	Acceleration/ deceleration time		0 to 3600s • Acceleration and deceleration pattern can be selected from 4 types: Linear, S-curve (weak), S-curve (strong), Curve (constant output max. capacity). • Shutoff of the operation command coasts the motor to decelerate and stop.		F07, F08 H07 H11
	Frequency limiter		High and low limiters can be set (setting range: 0 to 120Hz)	Selection can be made between continuation of operation and stopping at frequencies equal to or smaller than the lower limit.	F15, F16 H63
	Bias frequency		Bias of set frequency and PID command can be set in the range between 0 and ±100%.		F18, C50 to C52
	Gain for frequency setting		The analog input gain can be set in the range from 0 to 200%.	Voltage signals (terminal [12],[V2]) and current signal (terminal [C1]) can be set independently.	C32, C34, C37, C39, C42, C44
	Jump frequency setting		Three operation points and their common jump hysteresis width (0 to 30Hz) can be set.		C01 to C04
	Restart after momentary power failure		• The inverter restarts upon recovery from power failure without stopping the motor. • In the "operation continuation mode," recovery of the power supply is waited for while the output frequency slightly drops. • Selection can be made among starting at 0Hz, starting at the frequency immediately before the momentary power failure, and starting at the frequency specified in the starting mode after power recovery.		F14 H13 to H16, H92, H93
	Current limit		Keeps the current under the preset value during operation.		F43, F44
	Line/inverter switching		• Line/inverter switching (starting at line frequency) can be made with a digital input signal (SW50, SW60). • A built-in line/inverter switching sequence performs sequence control with a digital input signal (ISW50, ISW60) to output a signal (SW88, SW52-1, SW52-2) for controlling an external magnetic contactor (MC). As a built-in sequence, two types can be selected, including the one switching automatically to the line upon an inverter alarm.		J22
	PID control		Capable of PID regulator control for process		E61 to E63 J01 to J06 J10 to 0J19
			■ Process commands • Key operation (UP and DOWN keys): 0 to 100% • Analog input (terminal [12],[V2]): 0 to +10V DC/0 to 100% • Analog input (terminal [C1]): 4 to 20mA DC/0 to 100% • UP/DOWN (digital input): 0 to 100% • Communication (RS-485, bus option): 0 to 20,000/0 to 100%)		

	Item	Explanation	Remarks	Related function code
Control	PID control	■ Feedback value • Analog input (terminal [12],[V2]) :0 to +10V DC/0 to 100% • Analog input (terminal [C1]) : 4 to 20mA DC/0 to 100% ■ Accessory functions • Alarm output (absolute value alarm, deviation alarm) • Normal operation/inverse operation • Sleep function • Anti-reset wind-up function • PID output limiter • Integration reset/hold		E61 to E63, J01 to J06, J10 to J19
	Auto search for idling motor's speed	Starting at the preset frequency, the inverter automatically searches the idling motor speed to be harmonized and starts to drive it without stopping it.		
	Automatic deceleration	Upon a DC link voltage exceeding the overvoltage limit level during deceleration, the deceleration time automatically extends to avoid an OU trip.		H69, F08
	Deceleration characteristic	The motor loss increases during deceleration to reduce the load energy regenerating at the inverter to avoid an OU trip upon mode selection.		H71
	Automatic energy-saving operation	The output voltage is controlled to minimize the total sum of the motor loss and inverter loss at a constant speed.		F37,F09
	Overload protection control	The output frequency is automatically reduced to suppress the overload protection trip of the inverter caused by an increase in the ambient temperature or motor load, or by other operating conditions.		
	Auto-tuning	The motor parameters are automatically tuned.		P04
	Cooling fan ON/OFF control	Detects inverter internal temperature and stops cooling fan when the temperature is low.	An external output is issued in a transistor or relay output signal.	H06
	Pump control	An inverter controls multiple driving pumps at a time combining with driving sources of the inverter and commercial power. The inverter's integrated PID controller controls them in the flowrate, pressure and so on. The inverter controls each member of pump control sequences issuing the power source switching signal between the inverter output and commercial power. Two control modes are available. One is a fixed motor-driving mode where the inverter exclusively controls the single pump. Another is a cyclic motor-driving mode where the inverter cyclically controls a member of pumps. • Fixed motor-driving mode : Pumps under control = one inverter driven + four commercial power driven • Cyclic motor-driving mode : Pumps under control = three inverter /commercial power driven (In this mode, a relay output card option (OPC-F1S-RY) is required.) Furthermore, this control features a periodic switching function, an average time drive-switching function, a cumulative pump run time monitor, a cumulative relay activating times monitor and so on.		
Indication	Running/stopping	• Speed monitor, output current [A], output voltage [V], torque calculation value, input power [kW],PID reference value, PID feedback value, PID output, load factor, motor output • Slect the speed monitor to be displayed from the following. Output frequency [Hz], motor speed [r/min.], load shaft speed [r/min.], % indication		E43 E48
	Lifetime early warning	Shows the lifetime early warnings of the electrolytic capacitors on the printed circuit boards, the DC link bus capacitor, and the cooling fan.	An external output can be issued in a transistor or relay output signal.	
	Cumulative run time	Shows the cumulative running hours of the motor and inverter, and the input watt-hour.		
	Output	Transistor outputs - quantity 3 Relay outputs - quantity 1 from C and quantity 1 from A Voltage output - 0 - 10 Vdc Current output - 4-20 mA		
	Trip error code	Displays the cause of trip by codes. • OC 1 (Overcurrent during acceleration) • OC 2 (Overcurrent during deceleration) • OC 3 (Overcurrent at constant speed) • EF (Grounding fault) • L in (Input phase loss) • LU (Undervoltage) • OPL (Output phase loss) • OU 1 (Overvoltage during acceleration) • OU2 (Overvoltage during deceleration) • OU3 (Overvoltage at constant speed) • OH 1 (Overheating of the heat sink) • OH2 (External alarm) • OH3 (Inverter overheat) • OH4 (Motor protection (PTC thermistor)) • OL 1 (Motor overload) • OLU (Inverter overload) • FUS (Blown fuse) • PbF (Charging circuit fault) • Er 1 (Memory error) • Er 2 (Keypad communication error) • Er 3 (CPU error) • Er 4 (Optional communication error) • Er 5 (Option error) • Er 6 (Option action error) • Er 7 (Tuning error) • Er 8 (RS-485 communication error) • Er F (Data save error due to undervoltage) • Er P (RS-485 communication error (option)) • Er H (LSI error)		
	Trip history	Saves and displays the last 4 trip codes and their detailed description.		E52

Common specifications

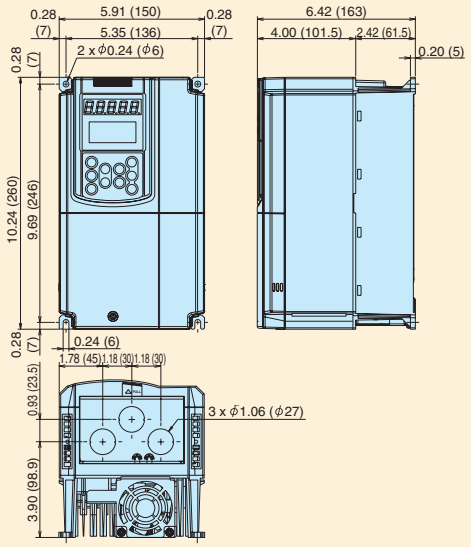
Item			Explanation	Remarks	Related function code
Protection	Overcurrent protection		The inverter is stopped upon an overcurrent caused by an overload.		
	Short-circuit protection		The inverter is stopped upon an overcurrent caused by a short-circuit in the output circuit.		
	Grounding fault protection		The inverter is stopped upon an overcurrent caused by a grounding fault in the output circuit.		
	Overvoltage protection		An excessive DC link circuit voltage is detected to stop the inverter.	3-phase 208V / 400VDC 3-phase 460V / 800VDC	
	Surge protection		The inverter is protected against surge voltages intruding across the main circuit power cable and ground.		
	Undervoltage		Stops the inverter by detecting voltage drop in DC link circuit.	3-phase 208V / 200VDC 3-phase 460V / 400VDC	F14
	Input phase loss		Stops or protects the inverter against input phase loss.	The protective function can be canceled with function code 98.	H98
	Output phase loss		Detects breaks in inverter output wiring at the start of running and during running, stopping the inverter output.	The protective function can be canceled with function code 98.	H98
	Overheating		The temperature of the heat sink of the inverter or that inside the inverter unit is detected to stop the inverter, upon a failure or overload of the cooling fan.		H43
	Overload		The inverter is stopped upon the temperature of the heat sink of the inverter or the temperature of the switching element calculated from the output current.		
	Motor protection	Electronic thermal	The inverter is stopped upon an electronic thermal function setting to protect the motor.	Thermal time constant can be adjusted (0.5 to 75.0min.).	F10 to F12, P99
		PTC thermistor	A PTC thermistor input stops the inverter to protect the motor.		H26, H27
		Overload early warning	Warning signal can be output based on the set level before the inverter trips.		F10, F12, E34, E35, P99
	Stall prevention		The output frequency decreases upon an output current exceeding the limit during acceleration or constant speed operation, to avoid overcurrent trip.		H12
	Momentary power failure protection		• A protective function (inverter stoppage) is activated upon a momentary power failure for 15msec or longer. • If restart upon momentary power failure is selected, the inverter restarts upon recovery of the voltage within the set time.		H13 to H16, F14
	Retry function		When the motor is tripped and stopped, this function automatically resets the tripping state and restarts operation.	Waiting time before resetting and the number of retry times can be set.	H04, H05
	Command loss detection		A loss (broken wire, etc.) of the frequency command is detected to output an alarm and continue operation at the preset frequency (set at a ratio to the frequency before detection		E65
Environment	Installation location		Shall be free from corrosive gases, flammable gases, oil mist, dusts, and direct sunlight. [Pollution degree 2 (IEC60664-1)] Indoor use only.		
	Ambient temperature		-10 to +50 °C (14 to 122˚F) -10 to +40 °C (14 to 104˚F) (IP54 series)	-10 to 40 °C (14 to 104˚F) when inverters are installed side-by-side without clearance.	
	5 to 95% (nocondensation)		5 to 95% (no condensation)		
	Altitude		Altitude [ft (m)] / Output derating Lower than 3300 (1000) / None 3301 to 6600 (1001 to 2000) / Decreases 6601 to 9800 (2001 to 3000) / Decreases*	* If the altitude exceeds 6600ft (2000m), insulate the interface circuit from the main power supply to conform to the Low Voltage Directives.	
	Vibration		[Smaller than 100HP] 3mm (vibration width) : 2 to less than 9Hz, 9.8m/s² : 9 to less than 20Hz 2m/s² : 20 to less than 55Hz 1m/s² : 55 to less than 200Hz [125HP or more]3mm (vibration width) : 2 to less than 9Hz 2m/s² : 9 to less than 55Hz 1m/s² : 55 to less than 200Hz		
	Storage	Amb. temp	-25 to +65 °C (-13 to 149˚F)		
		Amb. humidity	5 to 95%RH (no condensation)		

Function	Description		LED indication	Alarm output (30A, B, C) Note)	Related function code
Overcurrent protection	Stops the inverter output to protect the inverter from an overcurrent resulting from overload.	During acceleration	OC1	○	
Short-circuit protection	Stops the inverter output to protect the inverter from overcurrent due to a short-circuiting in the output circuit.	During deceleration	OC2		
Ground fault protection	Stops the inverter output to protect the inverter from overcurrent due to a ground fault in the output circuit.This protection is effective only during startup of the inverter. If you turn ON the inverter without removing the ground fault, this protection may not work. (Applicable to inverters of 75HP for 208V, 100HP for 460V or below (3-phase 208 V) or 350HP or below (3-phase 460 V))	During running at constant speed	OC3		
	Upon detection of zero-phase current in the output power, this function stops the inverter output to protect the inverter from overcurrent due to a ground fault in the output circuit. (Applicable to inverters of 125HP for 208V and 125HP for 460V or above (3-phase 208 V) or 450HP or above (3-phase 460 V))		EF	○	
Overvoltage protection	The inverter stops the inverter output upon detection of an overvoltage condition (400 VDC for 3-phase 208V, 800 VDC for 3-phase 460V) in the DC link bus. This protection is not assured if extremely large AC line voltage is applied inadvertently.	During acceleration	OU1	○	
		During deceleration	OU2		
		During running at constant speed (when stopped)	OU3		
Undervoltage protection	Stops the inverter output when the DC link bus voltage drops below the undervoltage level (200 VDC for 3-phase 208V, 400 VDC for 3-phase 460 V). However, if data "3, 4, or 5" is selected for F14, no alarm is output even if the DC link bus voltage drops.		LU	△	F14
Input phase loss protection	Detects input phase loss, stopping the inverter output. This function prevents the inverter from undergoing heavy stress that may be caused by input phase loss or inter-phase voltage unbalance and may damage the inverter. If connected load is light or a DC reactor is connected to the inverter, this function will not detect input phase loss if any.		Lin	○	H98
Output phase loss protection	Detects breaks in inverter output wiring at the start of running and during running, stopping the inverter output.		OPL	○	H98
Overheating protection	- Stops the inverter output upon detecting excess heat sink temperature in case of cooling fan failure or overload. - Detects a failure of the internal air circulation DC fan and alarm-stops the inverter (For models of 50HP or above in 208 V, 75HP or above in 460 V)		OH1	○	H43, H98
	Stops the inverter output upon detecting an excessively high ambient temperature inside the inverter caused by a failure or an overload condition of the cooling fan.		OH3	○	
Overload protection	Stops the inverter output if the Insulated Gate Bipolar Transistor (IGBT) internal temperature calculated from the output current and temperature of inside the inverter is over the preset value.		OLU	○	
External alarm input	Places the inverter in alarm-stop state upon receiving digital input signal (THR).		OH2	○	E01 to E05 E98, E99
Blown fuse	Upon detection of a fuse blown in the inverter's main circuit, this function stops the inverter output. (Applicable to 125HP or above (for both 3-phase 208 V and 3-phase 460 V))		FUS	○	
Abnormal condition in charging circuit	Upon detection of an abnormal condition in the charging circuit inside the inverter, this function stops the inverter output. (Applicable to 50HP or above (3-phase 208 V) or 75HP or above (3-phase 460 V))		PbF	○	
Motor protection — Electronic thermal overload	In the following cases, the inverter stops running the motor to protect the motor in accordance with the electronic thermal overload protection setting. • Protects general-purpose motors over the entire frequency range (F10 = 1.) • Protects inverter motors over the entire frequency range (F10 = 2.) * The operation level and thermal time constant can be set by F11 and F12.		OL1	○	F10 F11,F12
Motor protection — PTC thermistor	A PTC thermistor input stops the inverter output for motor protection. Connect a PTC thermistor between terminals [V2] and [11] and set the function codes and slide switch on the control PCB accordingly.		OH4	○	H26,H27
Motor protection — Overload early warning	Outputs a preliminary alarm at a preset level before the motor is stopped by the electronic thermal overload protection for the motor.		–	–	E34,E35
Stall prevention	Operates when instantaneous overcurrent limiting is active. • Instantaneous overcurrent limiting: Operates if the inverter's output current exceeds the instantaneous overcurrent limit level, avoiding tripping of the inverter (during constant speed operation or during acceleration).		–	–	H12
Alarm relay output (for any fault)	• The inverter outputs a relay contact signal when the inverter issues an alarm and stops the inverter output. < Alarm reset > The alarm stop state is reset by pressing the key or by the digital input signal (RST). < Saving the alarm history and detailed data > The information on the previous 4 alarms can be saved and displayed.		–	○	E20,E27 E01 to E05 E98, E99
Memory error detection	The inverter checks memory data after power-on and when the data is written. If a memory error is detected, the inverter stops.		Er1	○	
Keypad communications error detection	The inverter stops by detecting a communications error between the inverter and the keypad during operation using the keypad.		Er2	○	F02
CPU error detection	If the inverter detects a CPU error or LSI error caused by noise or some other factors, this function stops the inverter		Er3	○	
Option communications error detection	Upon detection of an error in the communication between the inverter and an optional card, stops the inverter output.		Er4	–	
Option error detection	When an option card has detected an error, this function stops the inverter output.		Er5	–	
Operation error detection	STOP key priority	Pressing the key on the keypad forces the inverter to decelerate and stop the motor even if the inverter is running by any run command given via the terminals or communications link. After the motor stops, the inverter issues alarm Er6.	Er6	○	H96
	Start check function	The inverter prohibits any run operations and displays Er6 on the 7-segment LED monitor if any run command is present when: • Powering up • An alarm is released (the key is turned ON or an alarm reset (RST) is input.) • "Enable communications link (LE)" has been activated and the run command is active in the linked source.			
Tuning error detection	During tuning of motor parameters, the tuning has failed or has aborted, or an abnormal condition has been detected in the tuning result, the inverter stops its output.		Er7	○	P04
RS-485 communications error detection	When the inverter is connected to a communications network via the RS-485 port designed for the keypad, detecting a communications error stops the inverter output and displays an error code Er8.		Er8	○	
Data save error during undervoltage	If the data could not be saved during activation of the undervoltage protection function, the inverter displays the alarm code.		ErF	○	
RS-485 communications error detection	When the inverter is connected to a communications network via RS-485 communications card, detecting a communications error stops the inverter output and displays an error code ErP.		ErP	○	
LSI error detection (Power PCB)	When an error occurred in the LSI on the power printed circuit board (power PCB), this function stops the inverter. (Applicable to: 208 V 50HP or above, and 460 V 75HP or above)		ErH	○	
Retry	When the inverter has stopped because of a trip, this function allows the inverter to automatically reset itself and restart. (You can specify the number of retries and the latency between stop and reset.)		–	–	H04,H05
Surge protection	Protects the inverter against a surge voltage which might appear between one of the power lines for the main circuit and the ground.		–	–	
Command loss detected	Upon detecting a loss of a frequency command (because of a broken wire, etc.), this function issues an alarm and continues the inverter operation at the preset reference frequency (specified as a ratio to the frequency just before the detection).		–	–	E65
Protection against momentary power failure	Upon detecting a momentary power failure lasting more than 15 ms, this function stops the inverter output. If restart after momentary power failure is selected, this function invokes a restart process when power has been restored within a predetermined period.		–	–	F14 H13 to H16
Overload prevention control	In the event of overheating of the heat sink or an overload condition (alarm code: OH1 or OLU), the output frequency of the inverter is reduced to keep the inverter from tripping.		–	–	H70

Note : The item indicated with △ in the alarm output (30A, B, C) column may not be issued according to some function code settings.

Inverter Outline (5HP for 208V, 7.5HP for 460V or smaller)

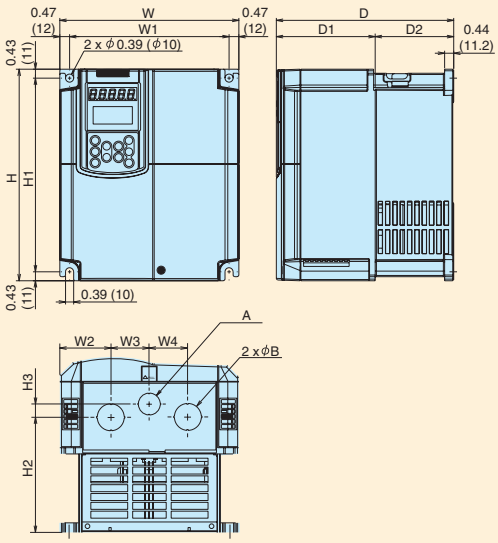
Unit:inch (mm)



Power supply voltage	Type
Three-phase 208V	FRN001F1S-2U
	FRN002F1S-2U
	FRN003F1S-2U
	FRN005F1S-2U
Three-phase 460V	FRN001F1S-4U
	FRN002F1S-4U
	FRN003F1S-4U
	FRN005F1S-4U
	FRN007F1S-4U

Inverter Outline (7.5HP to 30HP for 208V, 10HP to 40HP for 460V)

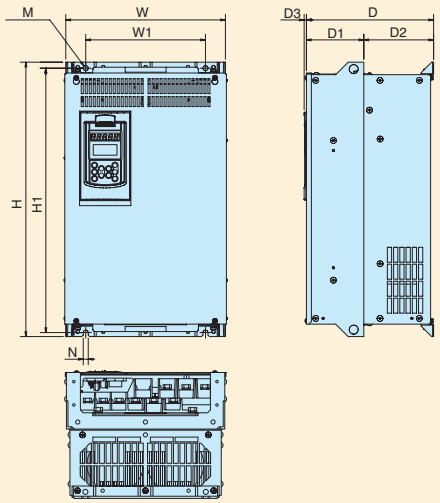
Unit:inch (mm)



Power supply voltage	Type	Dimensions [inch (mm)]												
		W	W1	W2	W3	W4	H	H1	H2	H3	D	D1	D2	ϕA	ϕB
Three-phase 208V	FRN007F1S-2U	8.66 (220)	7.72 (196)	2.50 (63.5)	1.83 (46.5)	1.83 (46.5)	10.24 (260)	9.37 (238)	5.58 (141.7)	0.63 (16)	8.46 (215)	4.67 (118.5)	3.80 (96.5)	1.06 (27)	1.34 (34)
	FRN010F1S-2U														
	FRN015F1S-2U								5.38 (136.7)	0.83 (21)				1.34 (34)	1.65 (42)
	FRN020F1S-2U	9.84 (250)	8.90 (226)	2.64 (67)	2.28 (58)	2.28 (58)	15.75 (400)	14.88 (378)	6.54 (166.2)	0.08 (2)		3.35 (85)	5.12 (130)		
	FRN025F1S-2U														
	FRN030F1S-2U			—	—	—			—	—				—	—
Three-phase 460V	FRN010F1S-4U	8.66 (220)	7.72 (196)	2.50 (63.5)	1.83 (46.5)	1.83 (46.5)	10.24 (260)	9.37 (238)	5.58 (141.7)	0.63 (16)	8.46 (215)	4.67 (118.5)	3.80 (96.5)	1.06 (27)	1.34 (34)
	FRN015F1S-4U														
	FRN020F1S-4U								5.38 (136.7)	0.83 (21)				1.34 (34)	1.65 (42)
	FRN025F1S-4U	9.84 (250)	8.90 (226)	2.64 (67)	2.28 (58)	2.28 (58)	15.75 (400)	14.88 (378)	6.54 (166.2)	0.08 (2)		3.35 (85)	5.12 (130)		
	FRN030F1S-4U														
	FRN040F1S-4U			—	—	—			—	—				—	—

Inverter Outline 40HP to 125HP for 208V, 50HP to 900HP for 460V

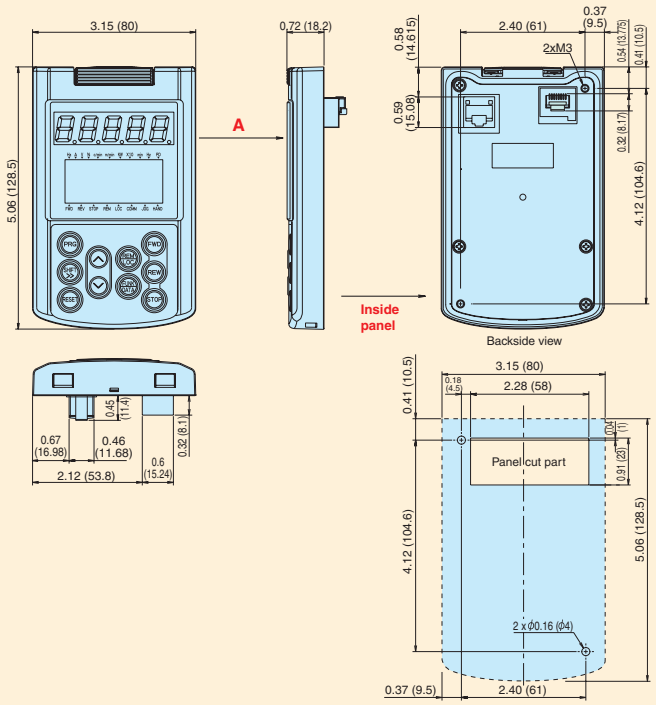
Unit:inch (mm)



Power supply voltage	Type	Dimensions [inch (mm)]									
		W	W1	H	H1	D	D1	D2	D3	M	N
Three-phase 208V	FRN040F1S-2U	12.6 (320)	9.45 (240)	21.65 (550)	20.87 (530)	10.04 (255)	4.53 (115)	5.51 (140)	0.18 (4.5)	2xϕ0.39 (2xϕ10)	0.39 (10)
	FRN050F1S-2U	13.98 (355)	10.83 (275)	24.21 (615)	23.43 (595)	10.63 (270)		6.10 (155)			
	FRN060F1S-2U										
	FRN075F1S-2U			29.13 (740)	28.35 (720)						
	FRN100F1S-2U										
	FRN125F1S-2U	26.77 (680)	22.83 (580)	34.65 (880)	33.46 (850)	15.55 (395)	10.04 (255)	5.51 (140)	0.24 (6)	3xϕ0.59 (3xϕ15)	0.59 (15)
Three-phase 460V	FRN050F1S-4U	12.60 (320)	9.45 (240)	21.65 (550)	20.87 (530)	10.04 (255)	4.53 (115)	5.51 (140)	0.18 (4.5)	2xϕ0.39 (2xϕ10)	0.39 (10)
	FRN060F1S-4U	13.98 (355)	10.83 (275)	24.21 (615)	23.43 (595)	10.63 (270)		6.10 (155)			
	FRN075F1S-4U										
	FRN100F1S-4U										
	FRN125F1S-4U			29.13 (740)	28.35 (720)	11.81 (300)	5.71 (145)	6.10 (155)	0.24 (6)	2xϕ0.39 (2xϕ10)	0.39 (10)
	FRN150F1S-4U										
	FRN200F1S-4U	20.87 (530)	16.93 (430)	29.13 (740)	27.95 (710)	12.40 (315)	5.31 (135)	7.09 (180)			
	FRN250F1S-4U					14.17 (360)	7.09 (180)	7.09 (180)			
	FRN300F1S-4U			39.37 (1000)	38.19 (970)						
	FRN350F1S-4U										
	FRN400F1S-4U	26.77 (680)	22.83 (580)	39.37 (1000)	38.19 (970)	14.96 (380)	7.87 (200)	7.09 (180)	0.24 (6)	3xϕ0.59 (3xϕ15)	0.59 (15)
	FRN450F1S-4U										
	FRN500F1S-4U			55.12 (1400)	53.94 (1370)	17.32 (440)	10.24 (260)				
	FRN600F1S-4U										
	FRN700F1S-4U	34.65 (880)	30.71 (780)							4xϕ0.59 (4xϕ15)	
	FRN800F1S-4U										
	FRN900F1S-4U										

Multi-function keypad (TP-G1) (standard accessory)

Unit:inch (mm)

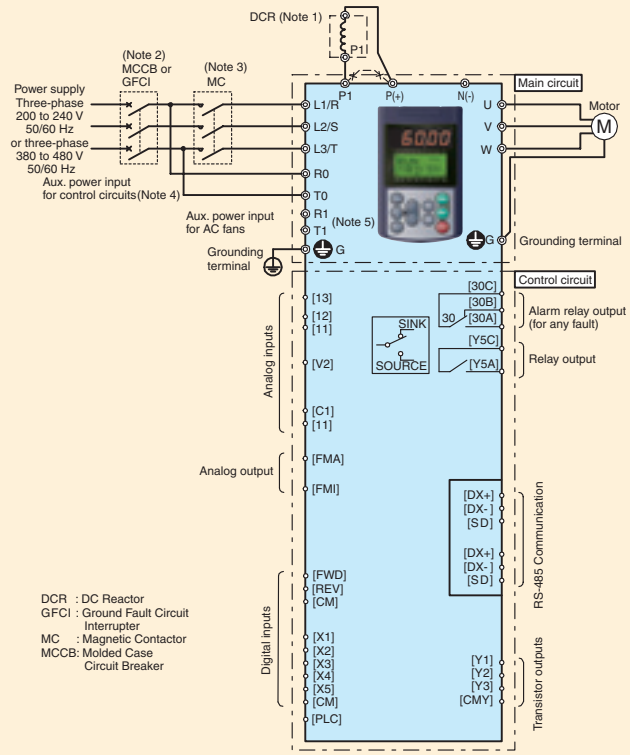


Dimensions of panel cutting (viewed from “A”)

External Dimensions

The following diagram is for reference only. For detailed wiring diagrams, refer to the Instruction Manual.

Keypad operation



■Run/Stop operation and frequency setting on the keypad

[Wiring procedure]

(1) Wire the inverter main power circuit.

[Operation method]

(1) Run/Stop : Press RUN or STOP key on the keypad.

(2) Setting frequency : Set the frequency with ▲ or ▼ key.

(Note 1) When connecting a DC reactor (DCR), first remove the jumper between terminals [P1] and [P+]. A DCR is optional for inverters below 75HP for 208V, 100HP for 460V but standard for inverters of 75HP for 208V,100HP for 460V or above. For inverters of 75HP for 208V, 100HP for 460V or above, be sure to connect a DCR.

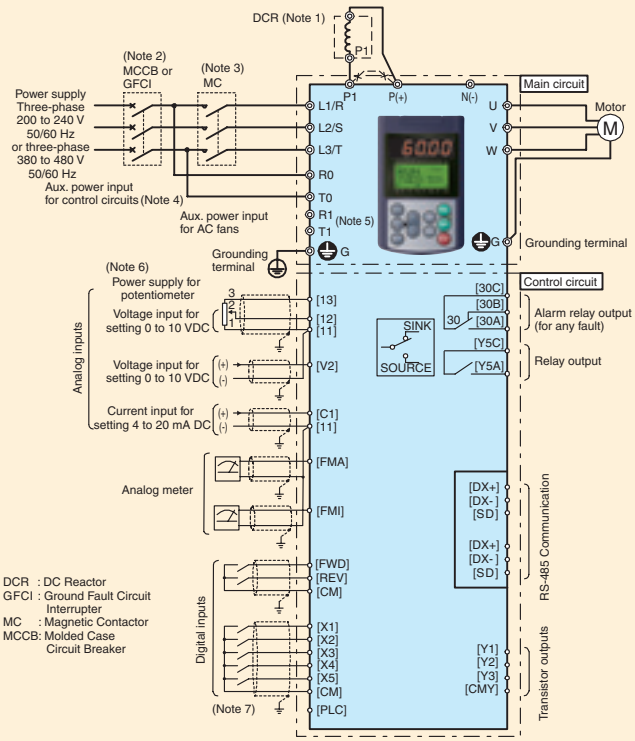
(Note 2) To protect wiring, insert a molded case circuit breaker (MCCB) or a ground fault circuit interrupter (GFCI) (with overcurrent protection) of the type recommended for the inverter between the commercial power supply and the inverter. Do not use a circuit breaker with a capacity exceeding the recommended capacity.

(Note 3) In addition to an MCCB or GFCI, insert, if necessary, a magnetic contactor (MC) of the type recommended for the inverter to cut off the commercial power supply to the inverter. Furthermore, if the coil of the MC or solenoid comes into close contact with the inverter, install a surge absorber in parallel.

(Note 4) To put the inverter on standby by making the control circuit only active with the main circuit power supply being opened, connect this pair of wires to terminals [R0] and [T0]. Without connecting this pair of wires to these terminals, you can still run the inverter as long as the main wires of the commercial power supply to the main circuit are properly connected.

(Note 5) Normally no need to connect. Use these terminals when the inverter is equipped with a high power factor PWM converter with a regenerative facility.

Operation by external signal inputs



■Run/Stop operation and frequency setting through external signals

[Wiring procedure]

(1) Wire both the inverter main power circuit and control circuit.

(2) Set 1 (external signal) at function code F02. Next, set 1 (voltage input (terminal 12) (0 to +10VDC)), 2 (current input (terminal C1) (+4 to 20mADC)), or other value at function code F01.

[Operation method]

(1) Run/Stop : Operate the inverter across terminals FDW and CM short-circuited, and stop with open terminals.

(2) Frequency setting : Voltage input (0 to +10VDC), current input (+4 to 20mADC)

(Note 1) When connecting a DC reactor (DCR), first remove the jumper between terminals [P1] and [P+]. A DCR is optional for inverters below 75HP for 208V, 100HP for 460V but standard for inverters of 75HP for 208V, 100HP for 460V or above. For inverters of 75HP for 208V, 100HP for 460V or above, be sure to connect a DCR.

(Note 2) To protect wiring, insert a molded case circuit breaker (MCCB) or a ground fault circuit interrupter (GFCI) (with overcurrent protection) of the type recommended for the inverter between the commercial power supply and the inverter. Do not use a circuit breaker with a capacity exceeding the recommended capacity.

(Note 3) In addition to an MCCB or GFCI, insert, if necessary, a magnetic contactor (MC) of the type recommended for the inverter to cut off the commercial power supply to the inverter. Furthermore, if the coil of the MC or solenoid comes into close contact with the inverter, install a surge absorber in parallel.

(Note 4) To put the inverter on standby by making the control circuit only active with the main circuit power supply being opened, connect this pair of wires to terminals [R0] and [T0]. Without connecting this pair of wires to these terminals, you can still run the inverter as long as the main wires of the commercial power supply to the main circuit are properly connected.

(Note 5) Normally no need to connect. Use these terminals when the inverter is equipped with a high power factor PWM converter with a regenerative facility.

(Note 6) You can select the frequency command source either electronically by supplying a DC voltage signal (within the range of 0 to 10 V, 0 to 5 V, or 1 to 5 V) between terminals [12] and [11], or manually by connecting a frequency command potentiometer to terminals [13], [12], and [11].

(Note 7) For the wiring of the control circuit, use shielded or twisted wires. When using shielded wires, connect the shields to earth. To prevent malfunction due to noise, keep the control circuit wires as far away as possible from the main circuit wires (recommended distance: 4 inch(10 cm) or longer), and never put them in the same wire duct. Where a control circuit wire needs to cross a main circuit wire, route them so that they meet at right angles.

Terminal Functions

Division	Symbol	Terminal name	Functions	Remarks	Related function code
Main circuit	L1/R,L2/S,L3/T	Power input	Connect a three-phase power supply.		
	R0,T0	Auxiliary control power input	Connect a single-phase power supply.		
	R1,T1	Auxiliary fan power input	There is no need to connect during normal operation. Use these terminals for applications combined with a high power-factor PWM converter with power regeneration function or the like.		
	U,V,W	Inverter output	Connect a three-phase motor.		
	P(+),P1	For DC REACTOR	Connect the DC reactor (DCR).		
	P(+),N(-)	For DC bus connection	Used for DC bus connection.		
	⏚G	Grounding	Terminal for inverter grounding	Two terminals are provided.	
Frequency setting	13	Potentiometer power supply	Used for frequency setting device power supply (variable resistance: 1 to 5kΩ) (10V DC 10mA DC max.)		
	12	Voltage input	Used as a frequency setting voltage input. 0 to +10V DC/0 to 100% (0 to +5V DC/0 to 100%) +10 to 0V DC/0 to 100%	Input impedance: 22kΩ Maximum input: +15V DC	F18 C32 to C34 E61
		(Inverse operation)			
		(PID control)	Used for setting signal (PID process command value) or feedback signal.		
		(Frequency aux. setting)	Used as additional auxiliary setting to various frequency settings.		
		(Analog input monitor)	The peripheral analog signal can be displayed on the keypad. (Displaying coefficient: valid)		
	C1	Current input	Used as a frequency setting current input. 4 to 20mA DC/0 to 100% 20 to 4mA DC/0 to 100%	Input impedance: 250Ω Maximum input: 30mA DC	F18 C37 to C39 E62
		(Inverse operation)			
		(PID control)	Used for setting signal (PID process command value) or feedback signal.		
		(Frequency aux. setting)	Used as additional auxiliary setting to various frequency settings.		
		(Analog input monitor)	The peripheral analog signal can be displayed on the keypad. (Displaying coefficient: valid)		
	V2	Analog setting voltage input	Used as a frequency setting voltage input. 0 to +10V DC/0 to 100% (0 to +5V DC/0 to 100%) +10 to 0V DC/0 to 100%	Input impedance: 22kΩ Maximum input: +15V DC	F18 C42 to C44 E63
		(Inverse operation)			
		(PID control)	Used for setting signal (PID process command value) or feedback signal.		
		(For PTC thermistor)	Connects PTC thermistor for motor protection.		
		(Frequency aux. setting)	Used as additional auxiliary setting to various frequency settings.		
		(Analog input monitor)	The peripheral analog signal can be displayed on the keypad. (Displaying coefficient: valid)		
	11	Analog common	Common terminal for frequency setting signals (12, 13, C1, V2, FMA)	Isolated from terminals CM and CMY. Two terminals are provided.	
Digital input	X1	Digital input 1	The following functions can be set at terminals X1 to X5, FWD and REV for signal input. <Common function> • Sink and source are changeable using the built-in sliding switch. • ON timing can be changed between short-circuit of terminals X1 and CM and open circuits of them. The same setting is possible between CM and any of the terminals among X2, X3, X4, X5, FWD, and REV.	ON state Source current: 2.5 to 5mA Voltage level: 2V OFF state Allowable leakage current: Smaller than 0.5mA Voltage: 22 to 27V	E01
	X2	Digital input 2			E02
	X3	Digital input 3			E03
	X4	Digital input 4			E04
	X5	Digital input 5			E05
	FWD	Forward operation command			E98
	REV	Reverse operation command			E99
	(FWD)	Forward operation command	The motor runs in the forward direction upon ON across (FWD) and CM.The motor decelerates and stops upon OFF.	This function can be set only for the terminals FWD and REV.	
	(REV)	Reverse operation command	The motor runs in the reverse direction upon ON across (REV) and CM.The motor decelerates and stops upon OFF.		
	(SS1) (SS2) (SS4)	Multistep freq. selection	8-step operation can be conducted with ON/OFF signals at (SS1) to (SS4).	Multistep frequency Digital input: 0 1 2 3 4 5 6 7 (SS1): - ON - ON - ON - ON (SS2): - - ON ON - - ON ON (SS4): - - - - ON ON ON ON	C05 to C11
	(HLD)	3-wire operation stop command	Used for 3-wire operation. ON across (HLD) and CM: The inverter self-holds FWD or REV signal. OFF across (HLD) and CM: The inverter releases self-holding.		
	(BX)	Coast-to-stop command	ON across (BX) and CM: The inverter output is shut off immediately and the motor coasts to a stop.	No alarm signal will be output.	
	(RST)	Alarm reset	ON across (RST) and CM: Faults are reset.	Alarm reset signal width: 0.1(s) or more	
	(THR)	Trip command (External fault)	OFF across (THR) and CM: The inverter output is shut off immediately and the motor coasts-to-stop.	Alarm signal 0H2 will be output.	
	(Hz2/Hz1)	Freq. set 2/Freq. set 1	ON across (Hz2/Hz1)and CM: Freq. set 2 is effective.		F01, F30
	(DCBRK)	DC braking command	ON across (DCBRK) and CM: Starts DC braking action.		F20 to F22
	(SW50)	Line/inverter switch(50Hz)	OFF across (SW50) and CM: Starts at 50Hz.		
	(SW60)	Line/inverter switch(60Hz)	OFF across (SW60) and CM: Starts at 60Hz		
	(UP)	UP command	The output frequency rises while the circuit across (UP) and CM is connected.		F01, C30
	(DOWN)	DOWN command	The output frequency drops while the circuit across (DOWN) and CM is connected.		J02
	(WE-KP)	Write enable for KEYPAD	The function code data can be changed from the keypad only when (WEE-KP) is ON.		F00
	(Hz/PID)	PID cancel	PID control can be canceled when the circuit across (Hz/PID) and CM is connected. (Operation proceeds according to the selected frequency setting method such as the multi-step frequency, keypad and analog input.)		J01 to J06 J10 to J19
	(IVS)	Inverse mode changeover	The frequency setting or PID control output signal (frequency setting) action mode switches between normal and inverse actions when the circuit across (IVS) and CM is connected.		C50, J01
	(IL)	Interlock	Connect an auxiliary contact of a switch installed between the inverter and motor. This signal is input upon momentary power failure to detect momentary power failure, and the inverter restarts upon power recovery.		F14
	(LE)	Link enable (RS-485, Bus)	Operation proceeds according to commands sent via RS-485 communication or field bus (option) when the circuit across (LE) and CM is connected.		H30, y98
	(U-DI)	Universal DI	An arbitrary digital input signal is transmitted to the host controller.		
	(STM)	Starting characteristic selection	ON across (STM) and CM: Starting at the pick-up frequency becomes valid.		H17, H09
	(STOP)	Forcible stop	OFF across (STOP) and CM: The inverter is forcibly stopped in the special deceleration time.		H56
	(PID-RST)	PID differentiation / integration reset	ON across (PID-RST) and CM: Resets differentiation and integration values of PID.		J01 to J06 J10 to J19
	(PID-HLD)	PID integral hold	ON across (PID-HLD) and CM: Holds integration values of PID.		
	(LOC)	Local (keypad) command selection	ON across (LOC) and CM: The operation commands and frequency settings given at the keypad become valid.		
	(RE)	Operation permission	After an operation command is input, operation starts upon activation of (RE).		
	(DWP)	Dew prevention	ON across (DWP) and CM: A current flows through the motor to avoid motor temperature drop during inverter stoppage so that condensation will not occur.		J21 F21, F22
	(ISW50)	Line/inverter switching sequence(50Hz)	OFF across (ISW50) and CM: Line operation starts according to the switching sequence built in the inverter. (For 50Hz commercial line)		J22
	(ISW60)	Line/inverter switching sequence(60Hz)	OFF across (ISW60) and CM: Line operation starts according to the switching sequence built in the inverter. (For 60Hz commercial line)		J22
	(FR2/FR1)	Operation command 2/1	ON across (FR2/FR1) and CM: The operation command switches to (FWD2) (REV2) side.		F02
	(FWD2)	Forward rotation/stop command 2	Forward operation upon ON across (FWD) and CM. Deceleration and stop upon OFF. (Second operation command)		
	(REV2)	Reverse operation/stop command 2	Reverse operation upon ON across (REV) and CM. Deceleration and stop upon OFF. (Second operation command)		
	PLC	PLC terminal	Connect to PLC output signal power supply. Common for 24V power.	+24V 50mA max.	
	CM	Common	Common terminal for digital input signal	Isolated from terminals 11 and CMY .Two terminals are provided.	

Terminal Functions

Division	Symbol	Terminal name	Functions	Remarks	Related function code
Analog output	FMA	Analog monitor	The output style can be selected between DC voltage (0 to 10V) and DC current (4 to 20mA). One of the following items can be output in the selected output style. • Output frequency. • Output current. • Output voltage. • Output torque. • Load factor. • Input power. • PID feedback value. • DC link circuit voltage. • Universal AO. • Motor output. • Analog output test. • PID command. • PID output	In the case of voltage output, up to two analog voltmeters (0 to 10Vdc, input impedance: 10kΩ) can be connected. In the case of current output, analog ammeters (up to 500Ω) can be connected. Gain adjustment range: 0 to 200%	F29 to F31
Pulse output	FMP	Pulse monitor	One of the following items can be output in a pulse frequency. • Output frequency. • Output current. • Output voltage. • Output torque. • Load factor. • Power consumption. • PID feedback value. • DC link circuit voltage. • Universal AO. • Motor output. • Analog output test. • PID command. • PID output	Up to two analog voltmeters (0 to 10Vdc, input impedance: 10kΩ) can be connected. (Driven at average voltage) Gain adjustment range: 0 to 200%	F33 to F35
Transistor output	(PLC)	Transistor output power	• Power supply for a transistor output load.(24Vdc 50mAdc Max.)(Note: Same terminal as digital input PLC terminal)	Short circuit across terminals CM and CMY to use.	
	Y1	Transistor output 1	The following functions can be set at terminals Y1 to Y3 for signal output. • The setting of "short circuit upon active signal output" or "open upon active signal output" is possible. • Sink/source support (switching unnecessary)	Max. voltage: 27Vdc, max. current: 50mA, leak current: 0.1mA max., ON voltage: within 2V (at 50mA)	E20
	Y2	Transistor output 2			E21
	Y3	Transistor output 3			E22
	(RUN)	Inverter running (speed exists)	An active signal is issued when the inverter runs at higher than the starting frequency.		
	(RUN2)	Inverter output on	A signal is issued when the inverter runs at smaller than the starting frequency or when DC braking is in action.		
	(FAR)	Speed/freq. arrival	An active signal is issued when the output frequency reaches the set frequency.	Detection width (fixed): 2.5 (Hz)	
	(FDT)	Speed/freq. detection	An active signal is issued at output frequencies above a preset detection level. The signal is deactivated if the output frequency falls below the detection level.	Hysteresis width (fixed): 1.0 (Hz)	E31
	(LV)	Undervoltage detection	The signal is output when the inverter stops because of undervoltage.		
	(IOL)	Inverter output limit (limit on current)	The signal is output when the inverter is limiting the current.		F43, F44
	(IPF)	Auto-restarting	The signal is output during auto restart operation (after momentary power failure and until completion of restart).		F14
	(OL)	Overload early warning (motor)	The signal is output when the electronic thermal relay value is higher than the preset alarm level.		F10 to F12
	(RDY)	Operation ready output	A signal is issued if preparation for inverter operation is completed.		
	(SW88)	Line-to-inverter switching	The magnetic contactor on the line side of line-to-inverter switching is controlled.		
	(SW52-2)	Line-to-inverter switching	The magnetic contactor on the inverter output side (secondary side) of line-to-inverter switching is controlled.		
	(SW52-1)	Line-to-inverter switching	The magnetic contactor on the inverter input side (primary side) of line-to-inverter switching is controlled.		
	(AX)	AX terminal function	The electromagnetic contactor on the inverter input side (primary side) is controlled.		
	(FAN)	Cooling fan ON/OFF control	The ON/OFF signal of the cooling fan is issued.		H06
	(TRY)	Retry in action	The signal is output during an active retry.		H04, H05
	(U-DO)	Universal DO	The signal transmitted from the host controller is issued.		
	(OH)	Heat sink overheat early warning	An early warning signal is issued before the heat sink trips due to an overheat.		
	(LIFE)	Lifetime alarm	Outputs alarm signal according to the preset lifetime level.		H42, H43, H98
	(REF OFF)	Command loss detection	A loss of the frequency command is detected.		E65
	(OLP)	Overload preventive control	The signal is output when the overload control is activated.		H70
	(ID)	Current detection	The signal is output when a current larger than the set value has been detected for the timer-set time.		E34, E35
	(PID-ALM)	PID alarm output	An absolute value alarm or deviation alarm under PID control is issued as a signal.		J11 to J13
	(PID-CTL)	Under PID control	The valid state of PID control is issued as a signal.		
	(PID-STP)	PID stop upon small water flow	A signal is issued if operation is stopped due to a small water flow under PID control. (The inverter is stopped even if the operation command is issued.)		J15 to J17
	(U-TL)	Low torque detection	A signal is issued if the torque falls below the preset low torque detection level for a set time.		E80, E81
	(RMT)	In remote mode	A signal is issued in the remote mode.		
	(AX2)	Operation command input	A signal is issued if there is an operation command input and operation ready is completed.		
	(ALM)	Alarm relay output (for any fault)	An alarm relay output (for any fault) signal is issued as a transistor output signal.		
	CMY	Transistor output common	Common terminal for transistor output	The terminal is isolated from terminals 11 and CM.	
Contact output	Y5A,Y5C	General-purpose relay output	• Multi-purpose relay output; signals similar to above-mentioned signals Y1 to Y3 can be selected. • An alarm output is issued upon either excitation or no excitation according to selection.	Contact capacity: 250 V AC, 0.3A, cos ϕ=0.3 +48 V DC, 0.5A	E24
	30A,30B,30C	Alarm relay output (for any fault)	• A no-voltage contact signal (1c) is issued when the inverter is stopped due to an alarm. • Multi-purpose relay output; signals similar to above-mentioned signals Y1 to Y3 can be selected. • An alarm output is issued upon either excitation or no excitation according to selection.		E27
Communication	—	RJ45 connector for connection with the keypad	One of the following protocols can be selected. • Modbus RTU • Protocol exclusively for keypad (default selection) • Fuji's special inverter protocol • SX protocol for PC loader	Power (+5V) is supplied to the keypad.	H30 y01 to y20 y98, y99

Terminal Arrangement

● Main circuit terminals

Power supply voltage	Applicable motor rating (HP)	Inverter type	Reference
Three-phase 208V	1	FRN001F1S-2U	Fig. A
	2	FRN002F1S-2U	
	3	FRN003F1S-2U	
	5	FRN005F1S-2U	
	7	FRN007F1S-2U	Fig. B
	10	FRN010F1S-2U	
	15	FRN015F1S-2U	
	20	FRN020F1S-2U	Fig. C
	25	FRN025F1S-2U	
	30	FRN030F1S-2U	Fig. D
	40	FRN040F1S-2U	Fig. E
	50	FRN050F1S-2U	Fig. G
	60	FRN060F1S-2U	
	75	FRN075F1S-2U	
	100	FRN100F1S-2U	
	125	FRN125F1S-2U	Fig. J
Three-phase 460V	1	FRN001F1S-4U	Fig. A
	2	FRN002F1S-4U	
	3	FRN003F1S-4U	
	5	FRN005F1S-4U	
	7	FRN007F1S-4U	
	10	FRN010F1S-4U	Fig. B
	15	FRN015F1S-4U	
	20	FRN020F1S-4U	
	25	FRN025F1S-4U	Fig. C
	30	FRN030F1S-4U	
	40	FRN040F1S-4U	Fig. D
	50	FRN050F1S-4U	Fig. E
	60	FRN060F1S-4U	
	75	FRN075F1S-4U	Fig. F
	100	FRN100F1S-4U	
	125	FRN125F1S-4U	Fig. G
	150	FRN150F1S-4U	
	200	FRN200F1S-4U	Fig. H
	250	FRN250F1S-4U	Fig. I
	300	FRN300F1S-4U	
	350	FRN350F1S-4U	
	400	FRN400F1S-4U	Fig. K
	450	FRN450F1S-4U	
	500	FRN500F1S-4U	Fig. L
	600	FRN600F1S-4U	
	700	FRN700F1S-4U	Fig. M
	800	FRN800F1S-4U	
	900	FRN900F1S-4U	

Fig. A

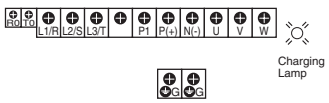


Fig. B

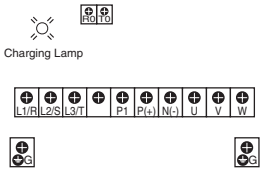


Fig. C

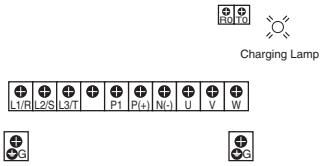


Fig. D

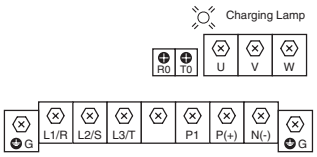


Fig. E

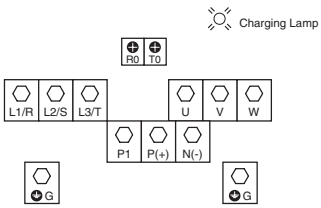


Fig. F

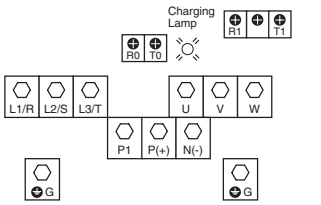


Fig. G

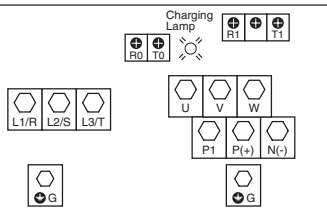


Fig. H

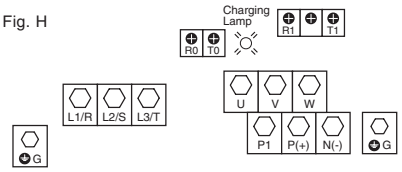


Fig. I

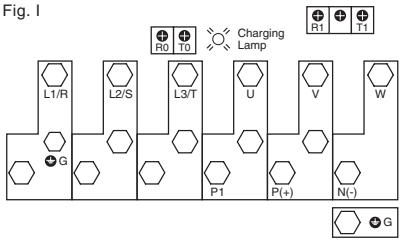


Fig. J

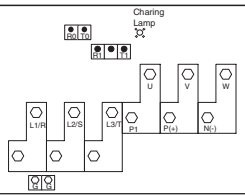


Fig. K

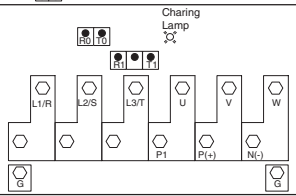


Fig. L

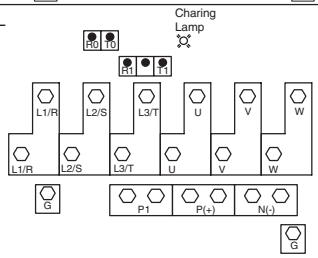
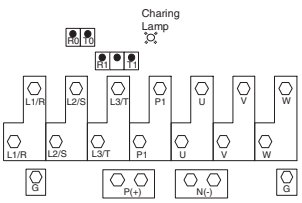
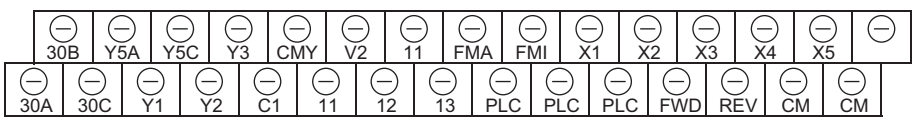


Fig. M



● Control circuit terminals (common to all models)

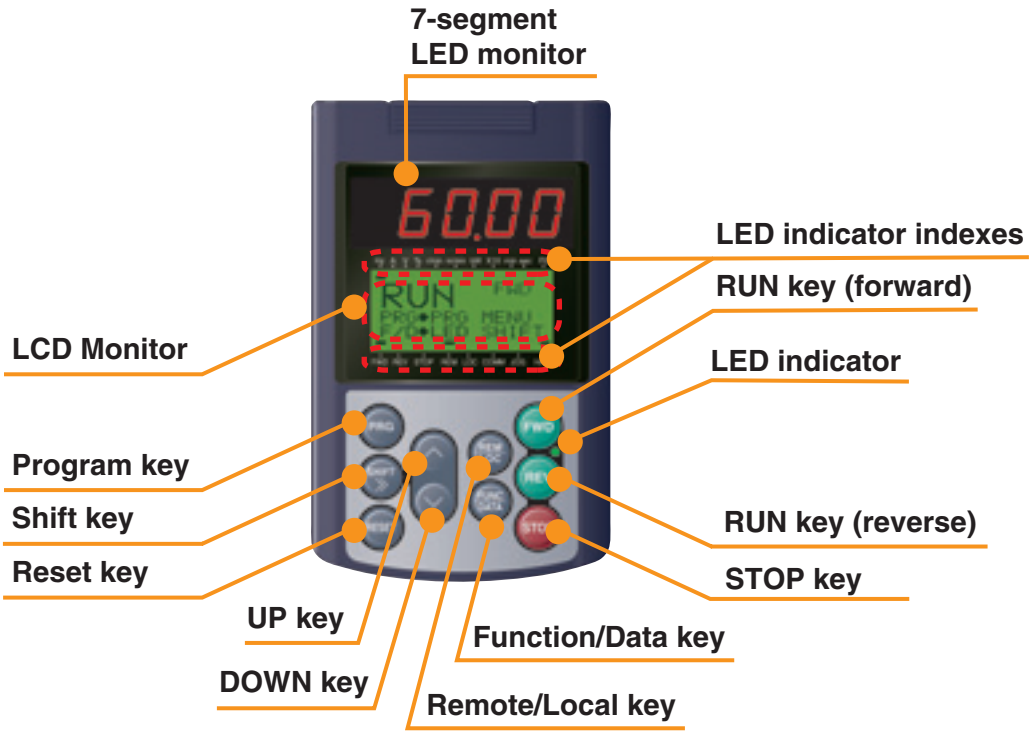


Screw size: M3 Tightening torque: 4.4 to 5.3lb-in(0.5 to 0.6 (N·m))

Control Circuit Terminals

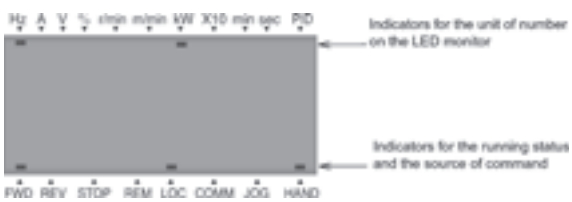
Screwdriver to be used (Head style)	Allowable wire size	Bared wire length	Dimension of openings in the control circuit terminals
Flat head (0.6 x 3.5mm)	AWG26 to AWG16 (0.14 to 1.5 mm²)	0.28 inch (7 mm)	0.10 (W) x 0.11 (H) inch (2.75 (W) x 2.86 (H) mm)

Multi-function keypad



Item	Monitor, LED indicator or Key	Functions
LED/LCD Monitor	60.00	Five-digit, 7-segment LED monitor which displays the following according to the operation mode: ■ In Running Mode: Running status information (e.g., output frequency, current, and voltage) ■ In Programming Mode: same as above ■ In Alarm Mode: Alarm code, which identifies the cause of alarm if the protective function is activated.
	RUN	LCD monitor which displays the following according to the operation modes: ■ In Running Mode: Running status information ■ In Programming Mode: Menus, function codes and their data ■ In Alarm Mode: Alarm code, which identifies the cause of alarm if the protective function is activated.
	LED indicator indexes	In running mode, display the unit of the number displayed on the LED monitor and the running status information shown on the LCD monitor. For details,see next page.
Keypad Operation Key	PRG	Switches the operation modes of the inverter.
	SHIFT	Shifts the cursor to the right when entering a number.
	RESET	Pressing this key after removing the cause of an alarm will switch the inverter to Running Mode. Used to reset a setting or screen transition.
	and	UP and DOWN keys. Used to select the setting items or change the function code data displayed on the LED monitor.
	FUNC DATA	Function/Data key. Switches the operation as follows: ■ In Running Mode: Pressing this key switches the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A), output voltage (V), etc.). ■ In Programming Mode: Pressing this key displays the function code and confirms the data you have entered. ■ In Alarm Mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor.
Run Operation Key	FWD	Starts running the motor (forward rotation).
	REV	Starts running the motor (reverse rotation).
	STOP	Stops the motor.
	REM LOC	Pressing this toggle key for more than 1 second switches between Local and Remote modes.
LED Indicator	FWD / REV LED	Lights while a run command is supplied to the inverter.

Type	Item	Description (information, condition, status)
Unit of Number Displayed on LED Monitor	Hz	Output frequency, frequency command
	A	Output current
	V	Output voltage
	%	Calculated torque, load factor, speed
	r/min	Motor speed, set motor speed, load shaft speed, set load shaft speed
	m/min	Line speed, set line speed (Not applicable to FRENIC-Eco)
	kW	Input power, motor output
	X10	Data greater than 99,999
	min	Constant feeding rate time, constant feeding rate time setting (Not applicable to FRENIC-Eco)
	sec	Timer
	PID	PID process value
Operating Status	FWD	Running (forward rotation)
	REV	Running (reverse rotation)
	STOP	No output frequency
Source of Operation	REM	Remote mode
	LOC	Local mode
	COMM	Communication enabled (RS-485 (standard, optional), field bus option)
	JOG	Jogging mode (Not applicable to FRENIC-Eco)
	HAND	Keypad effective (lights also in local mode)



Function Settings

●F codes: Fundamental Functions

Code	Name	Data setting range	Increment	Unit	Data copying *2	Default setting
F00	Data Protection	0 : Disable data protection (Function code data can be edited.) 1 : Enable data protection	—	—	Y	0
F01	Frequency Command 1	0 : Enable ▲/▼ keys on keypad 1 : Enable voltage input to terminal [12] (0 to 10 VDC) 2 : Enable current input to terminal [C1] (4 to 20 mA DC) 3 : Enable sum of voltage and current inputs to terminals [12] and [C1] 5 : Enable voltage input to terminal [V2] (0 to 10 VDC) 7 : Enable terminal command (UP) / (DOWN) control	—	—	Y	0
F02	Run Command	0 : Enable FWD / REV / STOP keys on keypad (Motor rotational direction from digital terminals [FWD] / [REV]) 1 : Enable terminal command (FWD) or (REV) 2 : Enable FWD / STOP keys on keypad (forward) 3 : Enable REV / STOP keys on keypad (reverse)	—	—	Y	0
F03	Maximum Frequency	25.0 to 120.0	0.1	Hz	Y	60.0
F04	Base Frequency	25.0 to 120.0	0.1	Hz	Y	60.0
F05	Rated Voltage at Base Frequency	0 : Output a voltage in proportion to input voltage 80 to 240V: Output a voltage AVR-controlled (for 3-phase 208 V series) 160 to 500V: Output a voltage AVR-controlled (for 3-phase 460 V series)	1	V	Y2	Refer to table below
F07	Acceleration Time 1	0.00 to 3600 Note: Entering 0.00 cancels the acceleration time, requiring external soft-start.	0.01	s	Y	20.0
F08	Deceleration Time 1	0.00 to 3600 Note: Entering 0.00 cancels the deceleration time, requiring external soft-start.	0.01	s	Y	20.0
F09	Torque Boost	0.0 to 20.0 (Percentage of the rated voltage at base frequency (F05)) Note: This setting is effective when F37 = 0, 1, 3, or 4.	0.1	%	Y	0.0
F10	Electronic Thermal Overload Protection for Motor (Select motorcharacteristics)	1 : For general-purpose motors with built-in self-cooling fan 2 : For inverter-driven motors or high-speed motors with forced-ventilation fan	—	—	Y	1
F11	(Overload detection level)	0.00: Disable 1 to 135% of the rated current (allowable continuous drive current) of the motor	0.01	A	Y1 Y2	Refer to table below
F12	(Thermal time constant)	0.5 to 75.0	0.1	min	Y	Refer to table below
F14	Restart Mode after Momentary Power Failure (Mode selection)	0 : Disable restart (Trip immediately) 1 : Disable restart (Trip after a recovery from power failure) 3 : Enable restart (Continue to run, for heavy inertia or general loads) 4 : Enable restart (Restart at the frequency at which the power failure occurred, for general loads) 5 : Enable restart (Restart at the starting frequency, for low-inertia load)	—	—	Y	0
F15	Frequency Limiter (High)	0.0 to 120.0	0.1	Hz	Y	70.0
F16	(Low)	0.0 to 120.0	0.1	Hz	Y	0.0
F18	Bias (Frequency command 1)	-100.00 to 100.00 *1	0.01	%	Y	0.00
F20	DC Braking (Braking start frequency)	0.0 to 60.0	0.1	Hz	Y	0.0
F21	(Braking level)	0 to 60 (Rated output current of the inverter interpreted as 100%)	1	%	Y	0
F22	(Braking time)	0.00 : Disable 0.01 to 30.00	0.01	s	Y	0.00
F23	Starting Frequency	0.1 to 60.0	0.1	Hz	Y	0.5
F25	Stop Frequency	0.1 to 60.0	0.1	Hz	Y	0.2
F26	Motor Sound (Carrier frequency)	0.75 to 15 (208 V : 25 HP or below, 460 V : 30 HP or below) *3 0.75 to 10 (208 V : 30 HP or above, 460 V : 40 HP to 100 HP) 0.75 to 6 (125 HP or above)	1	kHz	Y	2
F27	(Tone)	0 : Level 0 (Inactive) 1 : Level 1 2 : Level 2 3 : Level 3	—	—	Y	0
F29	Analog Output [FMA] (Mode selection)	0 : Output in voltage (0 to 10 VDC) 1 : Output in current (4 to 20 mA DC)	—	—	Y	0
F30	(Output adjustment)	0 to 200	1	%	Y	100
F31	Analog Output [FMA] (Function)	Select a function to be monitored from the followings. 0 : Output frequency 2 : Output current 3 : Output voltage 4 : Output torque 5 : Load factor 6 : Input power 7 : PID feedback value (PV) 9 : DC link bus voltage 10 : Universal AO 13 : Motor output 14 : Test analog output 15 : PID process command (SV) 16 : PID process output (MV)	—	—	Y	0
F33	Reserved *4	(Pulse rate at 100% output)	—	—	Y	1440

*1 When you make settings from the keypad, the incremental unit is restricted by the number of digits that the LED monitor can display.
(Example) If the setting range is from -200.00 to 200.00, the incremental unit is as follows:
"1" for -200 to -100, "0.1" for -99.9 to -10.0, "0.01" for -9.99 to -0.01, "0.01" for 0.00 to 99.99, and "0.1" for 100.0 to 200.0

*2 Symbols used in the data copy column:
Y: Copied Y1: Not copied if the inverter capacity differs. Y2: Not copied if the voltage series differs. N: Not copied

*3 When setting the carrier frequency at 1kHz or below, lower the maximum motor load to 80% of the rated load.

*4 F33 is displayed, but it is reserved for particular manufacturers. Unless otherwise specified, do not access this function code.

<Changing, setting, and saving data during operation>
: No data change allowed : Change with ▲▼ key, and set and save with PROG/DATA key. : Change and set with ▲▼ key, and save with PROG/DATA key.

■ Function Settings

●F codes: Fundamental Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
F34	Terminal [FMI] (Output adjustment)	0 to 200: Voltage output adjustment	1	%	Y	100
F35	(Function)	Select a function to be monitored from the followings. 0 : Output frequency 2 : Output current 3 : Output voltage 4 : Output torque 5 : Load factor 6 : Input power 7 : PID feedback value (PV) 9 : DC link bus voltage 10 : Universal AO 13 : Motor output 14 : Test analog output 15 : PID process command (SV) 16 : PID process output (MV)	—	—	Y	0
F37	Load Selection/ Auto Torque Boost/ Auto Energy Saving Operation	0 : Variable torque load increasing in proportion to square of speed 1 : Variable torque load increasing in proportion to square of speed (Higher startup torque required) 2 : Auto-torque boost 3 : Auto-energy saving operation(Variable torque load increasing in proportion to square of speed) 4 : Auto-energy saving operation(Variable torque load increasing in proportion to square of speed (Higher startup torque required)) Note:Apply this setting to a load with short acceleration time. 5 : Auto-energy saving operation(Auto torque boost) Note: Apply this setting to a load with long acceleration time.	—	—	Y	1
F43	Current Limiter (Mode selection)	0 : Disable (No current limiter works.) 1 : Enable at constant speed (Disabled during acceleration and deceleration) 2 : Enable during acceleration and at constant speed	—	—	Y	0
F44	(Level)	20 to 120 (The data is interpreted as the rated output current of the inverter for 100%.)	1	%	Y	110

●E codes: Extension Terminal Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
E01	Command Assignment to: [X1]	Selecting function code data assigns the corresponding function to terminals [X1] to [X5] as listed below. Setting the value of 1000s in parentheses ( ) shown below assigns a negative logic input to a terminal. 0 (1000) : Select multistep frequency (SS1) 1 (1001) : Select multistep frequency (SS2) 2 (1002) : Select multistep frequency (SS4) 6 (1006) : Enable 3-wire operation (HLD) 7 (1007) : Coast to a stop (BX) 8 (1008) : Reset alarm (RST) 9 (1009) : Enable external alarm trip (THR) 11 (1011) : Switch frequency command 2/1 (Hz2/Hz1) 13 : Enable DC brake (DCBRK) 15 : Switch to commercial power (50 Hz) (SW50) 16 : Switch to commercial power (60 Hz) (SW60) 17 (1017) : UP (Increase output frequency) (UP) 18 (1018) : DOWN (Decrease output frequency) (DOWN) 19 (1019) : Enable write from keypad (Data changeable) (WE-KP) 20 (1020) : Cancel PID control (Hz/PID) 21 (1021) : Switch normal/inverse operation (IVS) 22 (1022) : Interlock (IL) 24 (1024) : Enable communications link via RS-485 or field bus (option) (LE) 25 (1025) : Universal DI (U-DI) 26 (1026) : Select starting characteristics (STM) 30 (1030) : Force to stop (STOP) 33 (1033) : Reset PID integral and differential components (PID-RST) 34 (1034) : Hold PID integral component (PID-HLD) 35 (1035) : Select local (keypad) operation (LOC) 38 (1038) : Enable to run (RE) 39 : Protect motor from dew condensation (DWP) 40 : Enable integrated sequence to switch to commercial power (50 Hz) (ISW50) 41 : Enable integrated sequence to switch to commercial power (60 Hz) (ISW60) 50 (1050) : Clear periodic switching time (MCLR) 51 (1051) : Enable pump drive (motor 1) (MEN1) 52 (1052) : Enable pump drive (motor 2) (MEN2) 53 (1053) : Enable pump drive (motor 3) (MEN3) 54 (1054) : Enable pump drive (motor 4) (MEN4) 87 (1087) : Switch run command 2/1 (FR2/FR1) 88 : Run forward 2 (FWD2) 89 : Run reverse 2 (REV2) Note: In the case of (THR) and (STOP), data (1009) and (1030) are for normal logic, and "9" and "30" are for negative logic, respectively.	—	—	Y	6
E02	[X2]		—	—	Y	7
E03	[X3]		—	—	Y	8
E04	[X4]		—	—	Y	11
E05	[X5]		—	—	Y	35

*1 When you make settings from the keypad, the incremental unit is restricted by the number of digits that the LED monitor can display.
(Example) If the setting range is from -200.00 to 200.00, the incremental unit is as follows:
"1" for -200 to -100, "0.1" for -99.9 to -10.0, "0.01" for -9.99 to -0.01, "0.01" for 0.00 to 99.99, and "0.1" for 100.0 to 200.0

*2 Symbols used in the data copy column:
Y: Copied
Y1: Not copied if the inverter capacity differs.
Y2: Not copied if the voltage series differs.
N: Not copied

<Changing, setting, and saving data during operation>
: No data change allowed : Change with ▲▼ key, and set and save with STR key. : Change and set with ▲▼ key, and save with STR key.

●E codes: Extension Terminal Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
E20	Signal Assignment to: (Transistor signal) [Y1]	Selecting function code data assigns the corresponding function to terminals [Y1] to [Y3], [Y5A/C], and [30A/B/C] as listed below. Setting the value of 1000s in parentheses ( ) shown below assigns a negative logic input to a terminal. 0 (1000) : Inverter running (RUN) 1 (1001) : Frequency arrival signal (FAR) 2 (1002) : Frequency detected (FDT) 3 (1003) : Undervoltage detected (Inverter stopped) (LU) 5 (1005) : Inverter output limiting (IOL) 6 (1006) : Auto-restarting after momentary power failure (IPF) 7 (1007) : Motor overload early warning (OL) 10 (1010) : Inverter ready to run (RDY) 11 : Switch motor drive source between commercial power and inverter output (For MC on commercial line) (SW88) 12 : Switch motor drive source between commercial power and inverter output (For primary side) (SW52-2) 13 : Switch motor drive source between commercial power and inverter output (For secondary side) (SW52-1) 15 (1015) : Select AX terminal function (For MC on primary side) (AX) 25 (1025) : Cooling fan in operation (FAN) 26 (1026) : Auto-resetting (TRY) 27 (1027) : Universal DO (U-DO) 28 (1028) : Heat sink overheat early warning (OH) 30 (1030) : Service life alarm (LIFE) 33 (1033) : Command loss detected (REF OFF) 35 (1035) : Inverter output on (RUN2) 36 (1036) : Overload prevention control (OLP) 37 (1037) : Current detected (ID) 42 (1042) : PID alarm (PID-ALM) 43 (1043) : Under PID control (PID-CTL) 44 (1044) : Motor stopping due to slow flowrate under PID control (PID-STP) 45 (1045) : Low output torque detected (U-TL) 54 (1054) : Inverter in remote operation (RMT) 55 (1055) : Run command activated (AX2) 56 (1056) : Motor overheat detected (PTC) (THM) 59 (1059) : Terminal C1 off signal (C1OFF) 60 (1060) : Mount motor 1, inverter-driven (M1_I) 61 (1061) : Mount motor 1, commercial-power-driven (M1_L) 62 (1062) : Mount motor 2, inverter-driven (M2_I) 63 (1063) : Mount motor 2, commercial-power-driven (M2_L) 64 (1064) : Mount motor 3, inverter-driven (M3_I) 65 (1065) : Mount motor 3, commercial-power-driven (M3_L) 67 (1067) : Mount motor 4, commercial-power-driven (M4_L) 68 (1068) : Periodic switching early warning (MCHG) 69 (1069) : Pump control limit signal (MLIM) 99 (1099) : Alarm output (for any alarm) (ALM)	—	—	Y	0
E21	[Y2]		—	—	Y	1
E22	[Y3]		—	—	Y	2
E24	(Relay contact signal) [Y5A/C]		—	—	Y	15
E27	[30A/B/C]		—	—	Y	99
E31	Frequency Detection (FDT) (Detection level)	0.0 to 120.0	0.1	Hz	Y	60.0
E32	(Hysteresis width)	0.0 to 120.0	0.1	Hz	Y	1.0
E34	Overload Early Warning (Level) /Current Detection	0: (Disable) Current value of 1 to 150% of the inverter rated current	0.01	A	Y1 Y2	Refer to table below
E35	(Timer)	0.01 to 600.00 *1	0.01	s	Y	10.00
E40	PID Display Coefficient A	-999 to 0.00 to 999	0.01	—	Y	100
E41	PID Display Coefficient B	-999 to 0.00 to 999	0.01	—	Y	0.00
E43	LED Monitor (Item selection)	0: Speed monitor (Select by E48.) 3: Output current 4: Output voltage 8: Calculated torque 9: Input power 10: PID process command (Final) 12: PID feedback value 14: PID output 15: Load factor 16: Motor output 17: Analog input	—	—	Y	0
E45	LCD Monitor (Item selection)	0: Running status, rotational direction and operation guide 1: Bar charts for output frequency, current and calculated torque	—	—	Y	0
E46	(Language selection)	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian	—	—	Y	1
E47	(Contrast control)	0 (Low) to 10 (High)	1	—	Y	5
E48	LED Monitor (Speed monitor item)	0: Output frequency 3: Motor speed in r/min 4: Load shaft speed in r/min 7: Display speed in %	—	—	Y	0
E50	Coefficient for Speed Indication	0.01 to 200.00 *1	0.01	—	Y	30.00
E51	Display Coefficient for Input Watt-hour Data	0.000: (Cancel/reset) 0.001 to 9999	0.001	—	Y	0.010
E52	Keypad (Menu display mode)	0: Function code data editing mode (Menus #0, #1 and #7) 1: Function code data check mode (Menus #2 and #7) 2: Full-menu mode (Menus #0 through #7)	—	—	Y	0

■Function Settings

●E codes: Extension Terminal Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
E61	Analog Input for (Extension function selection) [12]	Selecting function code data assigns the corresponding function to terminals [12], [C1] and [V2] as listed below. 0 : None 1 : Auxiliary frequency command 1 2 : Auxiliary frequency command 2 3 : PID process command 1 5 : PID feedback value 20 : Analog input monitor	—	—	Y	0
E62	[C1]		—	—	Y	0
E63	[V2]		—	—	Y	0
E64	Saving Digital Reference Frequency	0 : Auto saving (at the time of main power turned off) 1 : Saving by pressing FUNC/DATA key	—	—	Y	0
E65	Command Loss Detection (Level)	0 : Decelerate to stop 20 to 120 999: Disable	1	%	Y	999
E80	Detect Low Torque (Detection level)	0 to 150	1	%	Y	20
E81	(Timer)	0.01 to 600.00 *1	0.01	s	Y	20.00
E98	Command Assignment to: [FWD]	Selecting function code data assigns the corresponding function to terminals [FWD] and [REV] as listed below. Setting the value of 1000s in parentheses ( ) shown below assigns a negative logic input to a terminal. 0 (1000) : } Select multistep frequency (SS1) 1 (1001) : } (SS2) 2 (1002) : } (SS4) 6 (1006) : Enable 3-wire operation (HLD) 7 (1007) : Coast to a stop (BX) 8 (1008) : Reset alarm (RST) 9 (1009) : Enable external alarm trip (THR) 11 (1011) : Switch frequency command 2/1 (Hz2/Hz1) 13 : Enable DC brake (DCBRK) 15 : Switch to commercial power (50 Hz) (SW50) 16 : Switch to commercial power (60 Hz) (SW60) 17 (1017) : UP (Increase output frequency) (UP) 18 (1018) : DOWN (Decrease output frequency) (DOWN) 19 (1019) : Enable write from keypad (Data changeable) (WE-KP) 20 (1020) : Cancel PID control (Hz/PID) 21 (1021) : Switch normal/inverse operation (IVS) 22 (1022) : Interlock (IL) 24 (1024) : Enable communications link via RS-485 or field bus (option) (LE) 25 (1025) : Universal DI (U-DI) 26 (1026) : Select starting characteristics (STM) 30 (1030) : Force to stop (STOP) 33 (1033) : Reset PID integral and differential components (PID-RST) 34 (1034) : Hold PID integral component (PID-HLD) 35 (1035) : Select local (keypad) operation (LOC) 38 (1038) : Enable to run (RE) 39 : Protect motor from dew condensation (DWP) 40 : Enable integrated sequence to switch to commercial power (50 Hz) (ISW50) 41 : Enable integrated sequence to switch to commercial power (60 Hz) (ISW60) 50 (1050) : Clear periodic switching time (MCLR) 51 (1051) : Enable pump drive (motor 1) (MEN1) 52 (1052) : Enable pump drive (motor 2) (MEN2) 53 (1053) : Enable pump drive (motor 3) (MEN3) 54 (1054) : Enable pump drive (motor 4) (MEN4) 87 (1087) : Switch run command 2/1 (FR2/FR1) 88 : Run forward 2 (FWD2) 89 : Run reverse 2 (REV2) 98 : Run forward (FWD) 99 : Run reverse (REV) Note: In the case of (THR) and (STOP), data (1009) and (1030) are for normal logic, and "9" and "30" are for negative logic, respectively.	—	—	Y	98
E99	[REV]		—	—	Y	99

*1 When you make settings from the keypad, the incremental unit is restricted by the number of digits that the LED monitor can display.
(Example) If the setting range is from -200.00 to 200.00, the incremental unit is as follows:
"1" for -200 to -100, "0.1" for -99.9 to -10.0, "0.01" for -9.99 to -0.01, "0.01" for 0.00 to 99.99, and "0.1" for 100.0 to 200.0

*2 Symbols used in the data copy column:
Y: Copied
Y1: Not copied if the inverter capacity differs.
Y2: Not copied if the voltage series differs.
N: Not copied

<Changing, setting, and saving data during operation>
: No data change allowed : Change with ▲▼ key, and set and save with FUNC/DATA key. : Change and set with ▲▼ key, and save with FUNC/DATA key.

●C codes: Control Functions of Frequency

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
C01	Jump Frequency 1	0.0 to 120.0	0.1	Hz	Y	0.0
C02	2				Y	0.0
C03	3				Y	0.0
C04	(Band)	0.0 to 30.0	0.1	Hz	Y	3.0
C05	Multistep Frequency 1	0.00 to 120.00*1	0.01	Hz	Y	0.00
C06	2				Y	0.00
C07	3				Y	0.00
C08	4				Y	0.00
C09	5				Y	0.00
C10	6				Y	0.00
C11	7				Y	0.00
C30	Frequency Command 2	0 : Enable ▲ / ▼ keys on keypad 1 : Enable voltage input to terminal [12] (0 to 10 VDC) 2 : Enable current input to terminal [C1] (4 to 20 mA DC) 3 : Enable sum of voltage and current inputs to terminals [12] and [C1] 5 : Enable voltage input to terminal [V2] (0 to 10 VDC) 7 : Enable terminal command (UP) / (DOWN) control	—	—	Y	2
C32	Analog Input Adjustment for [12] (Gain)	0.00 to 200.00 *1	0.01	%	Y	100.0
C33	(Filter time constant)	0.00 to 5.00	0.01	s	Y	0.05
C34	(Gain reference point)	0.00 to 100.00 *1	0.01	%	Y	100.0
C37	Analog Input Adjustment for [C1] (Gain)	0.00 to 200.00 *1	0.01	%	Y	100.0
C38	(Filter time constant)	0.00 to 5.00	0.01	s	Y	0.05
C39	(Gain reference point)	0.00 to 100.00 *1	0.01	%	Y	100.0
C42	Analog Input Adjustment for [V2] (Gain)	0.00 to 200.00 *1	0.01	%	Y	100.0
C43	(Filter time constant)	0.00 to 5.00	0.01	s	Y	0.05
C44	(Gain reference point)	0.00 to 100.00 *1	0.01	%	Y	100.0
C50	Bias Reference Point (Frequency command 1)	0.00 to 100.0 *1	0.01	%	Y	0.00
C51	Bias for PID command 1 (Bias value)	-100.0 to 100.00 *1	0.01	%	Y	0.00
C52	(Bias reference point)	0.00 to 100.00 *1	0.01	%	Y	0.00
C53	Selection of Normal/ Inverse Operation (Frequency command 1)	0 : Normal operation 1 : Inverse operation	—	—	Y	0

●P codes: Motor Parameters

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
P01	Motor (No. of poles)	2 to 22	2	Pole	Y1 Y2	4
P02	(Rated capacity)	0.01 to 1000 (where, the data of function code P99 is 0, 3, or 4.) 0.01 to 1000 (where, the data of function code P99 is 1.)	0.01 0.01	kW HP	Y1 Y2	Refer to table below
P03	(Rated current)	0.00 to 2000	0.01	A	Y1Y2	Refer to table below
P04	(Auto-tuning)	0 : Disable 1 : Enable (Tune %R1 and %X while the motor is stopped.) 2 : Enable (Tune %R1 and %X while the motor is stopped, and no-load current while running.)	—	—	N	0
P06	(No-load current)	0.00 to 2000	0.01	A	Y1Y2	Refer to table below
P07	(%R1)	0.00 to 50.00	0.01	%	Y1Y2	Refer to table below
P08	(%X)	0.00 to 50.00	0.01	%	Y1Y2	Refer to table below
P99	Motor Selection	0 : Characteristics of motor 0 (Fuji standard motors, 8-series) 1 : Characteristics of motor 1 (HP-rated motors) 3 : Characteristics of motor 3 (Fuji standard motors, 6-series) 4 : Other motors	—	—	Y1Y2	1

●H codes: High Performance Functions

Code	Name	Data setting range	Increment	Unit	Data copying	Default setting
H03	Data Initialization	0 : Disable initialization 1 : Initialize all function code data to the factory defaults 2 : Initialize motor parameters	—	—	N	0
H04	Auto-resetting (Times)	0 : Disable 1 to 10	1	Times	Y	0
H05	(Reset interval)	0.5 to 20.0	0.1	s	Y	5.0
H06	Cooling Fan ON/OFF Control	0 : Disable (Always in operation) 1 : Enable (ON/OFF controllable)	—	—	Y	0
H07	Acceleration/Deceleration Pattern	0 : Linear 1 : S-curve (Weak) 2 : S-curve (Strong) 3 : Curvilinear	—	—	Y	0
H09	Select Starting Characteristics (Auto search for idling motor speed)	0 : Disable 3 : Enable (Follow Run command, either forward or reverse.) 4 : Enable (Follow Run command, both forward and reverse.) 5 : Enable (Follow Run command, inversely both forward and reverse.)	—	—	Y	0
H11	Deceleration Mode	0 : Normal deceleration 1 : Coast-to-stop	—	—	Y	0
H12	Instantaneous Overcurrent Limiting	0 : Disable 1 : Enable	—	—	Y	1

■ Function Settings

●H codes: High Performance Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
H13	Restart Mode after Momentary Power Failure (Restart time)	0.1 to 10.0	0.1	s	Y1 Y2	Refer to table below
H14	(Frequency fall rate)	0.00 : Set deceleration time 0.01 to 100.00 999 : Follow the current limit command	0.01	Hz/s	Y	999
H15	(Continuous running level)	208V series: 200 to 300 460V series: 400 to 600	1	V	Y2	235 470
H16	(Allowable momentary power failure time)	0.0 to 30.0 999: The longest time automatically determined by the inverter	0.1	s	Y	999
H17	Select Starting Characteristics (Frequency for idling motor speed)	0.0 to 120.0 999: Harmonize at the maximum frequency	0.1	Hz	Y	999
H26	PTC Thermistor (Mode selection)	0 : Disable 1 : Enable (Upon detection of (PTC), the inverter immediately trips and stops with 0H4 displayed.) 2 : Enable (Upon detection of (PTC), the inverter continues running while outputting alarm signal (THM).)	—	—	Y	0
H27	(Level)	0.00 to 5.00	0.01	V	Y	1.60
H30	Communications Link Function (Mode selection)	Frequency command / Run command 0 : F01/C30 / F02 1 : RS-485 link / F02 2 : F01/C30 / RS-485 link 3 : RS-485 link / RS-485 link 4 : RS-485 link (Option) / F02 5 : RS-485 link (Option) / RS-485 link 6 : F01/C30 / RS-485 link (Option) 7 : RS-485 link / RS-485 link (Option) 8 : RS-485 link (Option) / RS-485 link (Option)	—	—	Y	0
H42	Capacitance of DC Link Bus Capacitor	Indication for replacing DC link bus capacitor (0000 to FFFF: Hexadecimal)	1	—	N	—
H43	Cumulative Run Time of Cooling Fan	Indication of cumulative run time of cooling fan for replacement	—	—	N	—
H47	Initial Capacitance of DC Link Bus Capacitor	Indication for replacing DC link bus capacitor (0000 to FFFF: Hexadecimal)	—	—	N	Set at factory shipping
H48	Cumulative Run Time of Capacitors on the Printed Circuit Board	Indication for replacing capacitors on printed circuit board (0000 to FFFF: Hexadecimal). Resettable.	—	—	N	—
H49	Select Starting Characteristics (Auto search time for idling motor speed)	0.0 to 10.0	0.1	s	Y	0.0
H50	Non-linear V/f Pattern (Frequency)	0.0 : Cancel 0.1 to 120.0	0.1	Hz	Y	0.0
H51	(Voltage)	0 to 240: Output a voltage AVR-controlled (for 208 V series) 0 to 500: Output a voltage AVR-controlled (for 460 V series)	1	V	Y2	0
H56	Deceleration Time for Forced Stop	0.00 to 3600	0.01	s	Y	20.0
H63	Low Limiter (Mode selection)	0 : Limit by F16 (Frequency Limiter: Low) and continue to run 1 : If the output frequency lowers less than the one limited by F16 (Frequency Limiter: Low), decelerates to stop the motor.	—	—	Y	0
H64	(Lower limiting frequency)	0.0 (Depends on F16 (Frequency Limiter: Low)) 0.1 to 60.0	0.1	Hz	Y	2.0
H69	Automatic Deceleration	0 : Disable 3 : Enable (Control DC link bus voltage at a constant.)	—	—	Y	0
H70	Overload Prevention Control (Frequency drop rate)	0.00: Follow deceleration time specified by F08 0.01 to 100.00 999: Disable	0.01	Hz/s	Y	999
H71	Deceleration Characteristics	0 : Disable 1 : Enable	—	—	Y	0
H80	Gain for Suppression of Output Current Fluctuation for Motor	0.00 to 0.40	0.01	—	Y	Refer to table below
H86	Reserved. *5	0 to 2	1	—	Y1 Y2	Refer to table below
H87	Reserved. *5	25.0 to 120.0	0.1	Hz	Y	25.0
H88	Reserved. *5	0 to 3,999	1	—	N	0
H89	Motor overload memory retention	0 : Inactive 1 : Active	—	—	Y	1
H90	Reserved. *5	0,1	—	—	Y	0
H91	C1 disconnection detection time (PID control feedback line)	0.0 : Disable 0.1 to 60.0 : Detection time	0.1	s	Y	0.0
H92	Continue to Run (P-component: gain)	0.000 to 10.000,999 *1	0.001	Times	Y1 Y2	999
H93	(I-component: time)	0.010 to 10.000,999 *1	0.001	s	Y1 Y2	999
H94	Cumulative Run Time of Motor	Change or reset the cumulative data	—	—	N	—
H95	DC Braking (Braking response mode)	0 : Slow 1 : Quick	—	—	Y	1
H96	STOP Key Priority/ Start Check Function	Data / STOP key priority / Start check function 0 / Disable / Disable 1 / Enable / Disable 2 / Disable / Enable 3 / Enable / Enable	—	—	Y	3
H97	Clear Alarm Data	Setting H97 data to "1" clears alarm data and then returns to zero.	—	—	N	0
H98	Protection/ Maintenance Function	0 to 63: Display data on the keypad's LED monitor in decimal format (In each bit, "0" for disabled, "1" for enabled.) Bit 0 : Lower the carrier frequency automatically Bit 1 : Detect input phase loss Bit 2 : Detect output phase loss Bit 3 : Select life judgment criteria of DC link bus capacitor Bit 4 : Judge the life of DC link bus capacitor Bit 5 : Detect DC fan lock	—	—	Y	19 (Bits 4, 1, 0 = 1 Bits 5, 3, 2 = 0)

●J codes: Application Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
J01	PID Control (Mode selection)	0 : Disable 1 : Enable (normal operation) 2 : Enable (inverse operation)	—	—	Y	0
J02	(Remote process command)	0 : Enable ▲ / ▼ keys on keypad 1 : PID process command 1 3 : Enable terminal command (UP) / (DOWN) control 4 : Command via communications link	—	—	Y	0
J03	P (Gain)	0.000 to 30.000 *1	0.001	Times	Y	0.100
J04	I (Integral time)	0.0 to 3600.0 *1	0.1	s	Y	0.0
J05	D (Differential time)	0.00 to 600.00 *1	0.01	s	Y	0.00
J06	(Feedback filter)	0.0 to 900.0	0.1	s	Y	0.5
J10	(Anti reset windup)	0 to 200	1	%	Y	200
J11	(Select alarm output)	0 : Absolute-value alarm 1 : Absolute-value alarm (with Hold) 2 : Absolute-value alarm (with Latch) 3 : Absolute-value alarm (with Hold and Latch) 4 : Deviation alarm 5 : Deviation alarm (with Hold) 6 : Deviation alarm (with Latch) 7 : Deviation alarm (with Hold and Latch)	—	—	Y	0
J12	(Upper limit alarm (AH))	0 to 100	1	%	Y	100
J13	(Lower limit alarm (AL))	0 to 100	1	%	Y	0
J15	(Stop frequency for slow flowrate)	0: Disable 1 to 120	1	Hz	Y	0
J16	(Slow flowrate level stop latency)	1 to 60	1	s	Y	30
J17	(Starting frequency)	0 : Disable 1 to 120	1	Hz	Y	0
J18	(Upper limit of PID process output)	1 to 120 999: Depends on setting of F15	1	Hz	Y	999
J19	(Lower limit of PID process output)	1 to 120 999: Depends on setting of F16	1	Hz	Y	999
J21	Dew Condensation Prevention (Duty)	1 to 50	1	%	Y	1
J22	Commercial Power Switching Sequence	0 : Keep inverter operation (Stop due to alarm) 1 : Automatically switch to commercial-power operation	—	—	Y	0
J25	Pump Control (Mode selection)	0 : Disable 1 : Enable (Fixed, inverter-driven) 2 : Enable (Floating, inverter-driven)	—	—	Y	0
J26	Motor 1 Mode	0 : Disable (Always OFF) 1 : Enable 2 : Force to run by commercial power	—	—	Y	0
J27	Motor 2 Mode		—	—	Y	0
J28	Motor 3 Mode		—	—	Y	0
J29	Motor 4 Mode		—	—	Y	0
J30	Motor Switching Order	0 : Fixed 1 : Automatically (Constant run time)	—	—	Y	0
J31	Motor Stop Mode	0 : Stop all motors (inverter- and commercial power-driven) 1 : Stop inverter-driven motor only (excl. alarm state) 2 : Stop inverter-driven motor only (incl. alarm state)	—	—	Y	0
J32	Periodic Switching Time for Motor Drive	0.0 : Disable switching 0.1 to 720.0: Switching time range 999 : Fix to 3 minutes	0.1	h	Y	0.0
J33	Periodic Switching Signaling Period	0.00 to 600.00	0.01	s	Y	0.10
J34	Mount of Commercial Power-driven Motor (Frequency)	0 to 120 999: Depends on setting of J18 (This code is used to judge whether or not to mount a commercial power-driven motor by checking the output frequency of the inverter-driven motor.)	1	Hz	Y	999
J35	(Duration)	0.00 to 3600	Variable	s	Y	0.00
J36	Unmount of Commercial Power-driven Motor (Frequency)	0 to 120 999 : Depends on setting of J19 (This code is used to judge whether or not to unmount a commercial power-driven motor by checking the output frequency of the inverter-driven motor.)	1	Hz	Y	999
J37	(Duration)	0.00 to 3600	Variable	s	Y	0.00
J38	Contactor Delay Time	0.01 to 2.00	0.01	s	Y	0.10
J39	Switching Time for Motor Mount (Decl. time)	0.00 : Depends on the setting of F08, 0.01 to 3600	Variable	s	Y	0.00
J40	Switching Time for Motor Unmount (Accl. time)	0.00 : Depends on the setting of F07, 0.01 to 3600	Variable	s	Y	0.00
J41	Motor Mount/Unmount Switching Level	0 to 100	1	%	Y	0
J42	Switching Motor Mount/ Unmount (Dead band)	0.0 : Disable 0.1 to 50.0	0.1	%	Y	0.0

*1 When you make settings from the keypad, the incremental unit is restricted by the number of digits that the LED monitor can display.
(Example) If the setting range is from -200.00 to 200.00, the incremental unit is as follows:
"1" for -200 to -100, "0.1" for -99.9 to -10.0, "0.01" for -9.99 to -0.01, "0.01" for 0.00 to 99.99, and "0.1" for 100.0 to 200.0

*2 Symbols used in the data copy column:
Y: Copied
Y1: Not copied if the inverter capacity differs.
Y2: Not copied if the voltage series differs.
N: Not copied

*5 H86, H87, H88 and H90 are displayed, but they are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

<Changing, setting, and saving data during operation>
: No data change allowed : Change with ▲▼ key, and set and save with FUNC/DATA key. : Change and set with ▲▼ key, and save with FUNC/DATA key.

●J codes: Application Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
J43	PID Control Startup Frequency	0: Disable 1 to 120 999: Depends on the setting of J36	1	Hz	Y	999
J45	Signal Assignment to: (For relay output card) [Y1A/B/C]	Selecting function code data assigns the corresponding function to terminals [Y1A/B/C], [Y2A/B/C], and [Y3A/B/C].	—	—	Y	100
J46	[Y2A/B/C]	100: Depends on the setting of E20 to E22	—	—	Y	100
J47	[Y3A/B/C]	60 (1060) : Mount motor 1, inverter-driven (M1_I) 61 (1061) : Mount motor 1, commercial-power-driven (M1_L) 62 (1062) : Mount motor 2, inverter-driven (M2_I) 63 (1063) : Mount motor 2, commercial-power-driven (M2_L) 64 (1064) : Mount motor 3, inverter-driven (M3_I) 65 (1065) : Mount motor 3, commercial-power-driven (M3_L) 67 (1067) : Mount motor 4, commercial-power-driven (M4_L) 68 (1068) : Periodic switching early warning (MCHG) 69 (1069) : Pump control limit signal (MLIM)	—	—	Y	100
J48	Cumulative Run Time of Motor (Motor 0)	Indication of cumulative run time of motor for replacement	1	h	Y	—
J49	(Motor 1)		1	h	Y	—
J50	(Motor 2)		1	h	Y	—
J51	(Motor 3)		1	h	Y	—
J52	(Motor 4)		1	h	Y	—
J53	Maximum Cumulative Number of Relay ON Times [Y1A/B/C] to [Y3A/B/C]	Indication of the maximum number of ON times of relay contacts on the relay output card or those built in inverter Display of 1.000 means 1000 times.	1	Times	Y	—
J54	[Y1], [Y2], [Y3]	For relay output card	1	Times	Y	—
J55	[Y5A], [30A/B/C]	For built-in mechanical contacts	1	Times	Y	—

●y codes: Link Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
y01	RS-485 Communication(Standard) (Station address)	1 to 255	1	—	Y	1
y02	(Communications error processing)	0 : Immediately trip and alarm Er8 1 : Trip and alarm Er8 after running for the period specified by timer y03 2 : Retry during the period specified by timer y03. If retry fails, trip and alarm Er8. If it succeeds, continue to run. 3 : Continue to run	—	—	Y	0
y03	(Error processing timer)	0.0 to 60.0	0.1	s	Y	2.0
y04	(Transmission speed)	0 : 2400 bps 1 : 4800 bps 2 : 9600 bps 3 : 19200 bps 4 : 38400 bps	—	—	Y	3
y05	(Data length)	0 : 8 bits 1 : 7 bits	—	—	Y	0
y06	(Parity check)	0 : None 1 : Even parity 2 : Odd parity	—	—	Y	0
y07	(Stop bits)	0 : 2 bits 1 : 1 bit	—	—	Y	0
y08	(No-response error detection time)	0 (No detection), 1 to 60	1	s	Y	0
y09	(Response latency time)	0.00 to 1.00	0.01	s	Y	0.01
y10	(Protocol selection)	0 : Modbus RTU protocol 1 : FRENIC Loader protocol (SX protocol) 3 : Metasys-N2 4 : FLN P1	—	—	Y	1

*2 Symbols used in the data copy column:
Y: Copied
Y1: Not copied if the inverter capacity differs.
Y2: Not copied if the voltage series differs.
N: Not copied

<Changing, setting, and saving data during operation>
: No data change allowed : Change with ▲▼ key, and set and save with FUNC/DATA key. : Change and set with ▲▼ key, and save with FUNC/DATA key.

●y codes: Link Functions

Code	Name	Data setting range	Increment	Unit	Data copying*2	Default setting
y11	RS-485 Communication (Optioon) (Station address)	1 to 255	1	—	Y	1
y12	(Communications error processing)	0 : Immediately trip and alarm ErP 1 : Trip and alarm ErP after running for the period specified by timer y13. 2 : Retry during the period specified by timer y13. If retry fails, trip and alarm ErP. If it succeeds, continue to run. 3 : Continue to run.	—	—	Y	0
y13	(Error processing timer)	0.0 to 60.0	0.1	s	Y	2.0
y14	(Transmission speed)	0 : 2400 bps 1 : 4800 bps 2 : 9600 bps 3 : 19200 bps 4 : 38400 bps	—	—	Y	3
y15	(Data length)	0 : 8 bits 1 : 7 bits	—	—	Y	0
y16	(Parity check)	0 : None 1 : Even parity 2 : Odd parity	—	—	Y	0
y17	(Stop bits)	0 : 2 bits 1 : 1 bit	—	—	Y	0
y18	(No-response error detection time)	0 : (No detection), 1 to 60	1	s	Y	0
y19	(Response latency time)	0.00 to 1.00	0.01	s	Y	0.01
y20	(Protocol selection)	0 : Modbus RTU protocol 3 : Metasys-N2 4 : FLN P1	—	—	Y	0
y98	Bus Link Function (Mode selection)	0: Frequency command: Follow H30 data / Run command: Follow H30 data 1: Via field bus option / Follow H30 data 2: Follow H30 data / Via field bus option 3: Via field bus option / Via field bus option	—	—	Y	0
y99	Loader Link Function (Mode selection)	0: Frequency command: Follow H30 and y98 data / Run command: Follow H30 and y98 data 1: Via RS-485 link (Loader) / Follow H30 and y98 data 2: Follow H30 and y98 data / Via RS-485 link (Loader) 3: Via RS-485 link (Loader) / Via RS-485 link (Loader)	—	—	N	0

■208V Default setting

Inverter type	F05	F11	F12	E34	P02	P03	P06	P07	P08	H13	H80	H86
FRN001F1S-2U	208	3.16	5.0	3.16	1.00	3.16	1.39	4.61	10.32	0.5	0.20	0
FRN002F1S-2U	208	6.16	5.0	6.16	2.00	6.16	2.53	5.04	9.09	0.5	0.20	0
FRN003F1S-2U	208	8.44	5.0	8.44	3.00	8.44	3.23	3.72	24.58	0.5	0.20	0
FRN005F1S-2U	208	13.60	5.0	13.60	5.00	13.60	4.32	3.99	28.13	0.5	0.20	0
FRN007F1S-2U	208	20.19	5.0	20.19	7.50	20.19	5.63	3.18	34.70	0.5	0.20	0
FRN010F1S-2U	208	27.42	5.0	27.42	10.00	27.42	7.91	2.91	36.89	0.5	0.20	0
FRN015F1S-2U	208	40.44	5.0	40.44	15.00	40.44	11.49	2.48	34.92	1.0	0.20	0
FRN020F1S-2U	208	53.98	5.0	53.98	20.00	53.98	8.32	2.54	35.90	1.0	0.20	0
FRN025F1S-2U	208	65.49	5.0	65.49	25.00	65.49	15.10	2.11	38.01	1.0	0.20	0
FRN030F1S-2U	208	79.06	5.0	79.06	30.00	79.06	17.91	2.29	39.31	1.0	0.20	0
FRN040F1S-2U	208	100.20	10.00	100.20	40.00	100.20	12.30	2.22	30.83	1.0	0.20	0
FRN050F1S-2U	208	126.60	10.00	126.60	50.00	126.60	16.91	2.34	30.27	1.0	0.10	2
FRN060F1S-2U	208	150.80	10.00	150.80	60.00	150.80	18.81	1.57	32.85	1.5	0.10	2
FRN075F1S-2U	208	191.50	10.00	191.50	75.00	191.50	25.86	1.67	32.97	1.5	0.10	2
FRN100F1S-2U	208	248.80	10.00	248.80	100.00	248.80	33.82	1.31	28.97	1.5	0.10	2
FRN125F1S-2U	208	295.60	10.00	295.60	125.00	295.60	26.95	1.28	27.93	1.5	0.10	2

■460V Default setting

Inverter type	F05	F11	F12	E34	P02	P03	P06	P07	P08	H13	H80	H86
FRN001F1S-4U	460	1.50	5.0	1.50	1.00	1.50	0.77	3.96	8.86	0.5	0.20	0
FRN002F1S-4U	460	2.90	5.0	2.90	2.00	2.90	1.40	4.29	7.74	0.5	0.20	0
FRN003F1S-4U	460	4.00	5.0	4.00	3.00	4.00	1.79	3.15	20.81	0.5	0.20	0
FRN005F1S-4U	460	6.30	5.0	6.30	5.00	6.30	2.39	3.34	23.57	0.5	0.20	0
FRN007F1S-4U	460	9.30	5.0	9.30	7.50	9.30	3.12	2.65	28.91	0.5	0.20	0
FRN010F1S-4U	460	12.70	5.0	12.70	10.00	12.70	4.37	2.43	30.78	0.5	0.20	0
FRN015F1S-4U	460	18.70	5.0	18.70	15.00	18.70	6.36	2.07	29.13	1.0	0.20	0
FRN020F1S-4U	460	24.60	5.0	24.60	20.00	24.60	4.60	2.09	29.53	1.0	0.20	0
FRN025F1S-4U	460	30.00	5.0	30.00	25.00	30.00	8.33	1.75	31.49	1.0	0.20	0
FRN030F1S-4U	460	36.20	5.0	36.20	30.00	36.20	9.88	1.90	32.55	1.0	0.20	0
FRN040F1S-4U	460	45.50	5.0	45.50	40.00	45.50	6.80	1.82	25.32	1.0	0.20	0
FRN050F1S-4U	460	57.50	10.00	57.50	50.00	57.50	9.33	1.92	24.87	1.0	0.20	0
FRN060F1S-4U	460	68.70	10.00	68.70	60.00	68.70	10.40	1.29	26.99	1.5	0.20	0
FRN075F1S-4U	460	86.90	10.00	86.90	75.00	86.90	14.30	1.37	27.09	1.5	0.10	2
FRN100F1S-4U	460	113.00	10.00	113.00	100.00	113.00	18.70	1.08	23.80	1.5	0.10	2
FRN125F1S-4U	460	134.00	10.00	134.00	125.00	134.00	14.90	1.05	22.90	1.5	0.10	2
FRN150F1S-4U	460	169.00	10.00	169.00	150.00	169.00	45.20	0.96	21.61	1.5	0.10	2
FRN200F1S-4U	460	231.00	10.00	231.00	200.00	231.00	81.80	0.72	20.84	2.0	0.10	2
FRN250F1S-4U	460	272.00	10.00	272.00	250.00	272.00	41.10	0.71	18.72	2.5	0.10	2
FRN300F1S-4U	460	323.00	10.00	323.00	300.00	323.00	45.10	0.53	18.44	2.5	0.10	2
FRN350F1S-4U	460	375.00	10.00	375.00	350.00	375.00	68.30	0.99	19.24	2.5	0.10	2
FRN400F1S-4U	460	429.00	10.00	429.00	400.00	429.00	80.70	1.11	18.92	4.0	0.10	2
FRN450F1S-4U	460	481.00	10.00	481.00	450.00	481.00	85.50	0.95	19.01	4.0	0.10	2
FRN500F1S-4U	460	534.00	10.00	534.00	500.00	534.00	99.20	1.05	18.39	5.0	0.10	2
FRN600F1S-4U	460	638.00	10.00	638.00	600.00	638.00	140.00	0.85	18.38	5.0	0.10	2
FRN700F1S-4U	460	638.00	10.00	638.00	700.00	638.00	140.00	0.85	18.38	5.0	0.10	2
FRN800F1S-4U	460	638.00	10.00	638.00	800.00	638.00	140.00	0.85	18.38	5.0	0.10	2
FRN900F1S-4U	460	638.00	10.00	638.00	900.00	638.00	140.00	0.85	18.38	5.0	0.10	2

Remote keypad (Standard equipment)
Use an extension cable to perform remote operation.
Multi-function keypad
TP-G1
This multi-function keypad has a large 5-digit 7-segment LED with backlit LCD.

Extension cable for remote operation
This cable is used if remote operation is to be performed.
* Connector type: RJ-45

Model	Length [ft (m)]
CB-5S	16 (5)
CB-3S	9.8 (3)
CB-1S	3.3 (1)

Inverter loader software for Windows
This software is used to set function codes in the inverter from a personal computer, to manage data, etc.
USB-RS-485 converter, USB cable
[Handled by System Sacom Sales Corp.].

Power supply 3~

MCCB or GFCI

Arrestor
CN232□□□□
Used to absorb lightning surges that come in from the power supply to protect all the equipment that is connected to the power supply.
[Handled by Fuji Electric Technica Co., Ltd.]

Radio noise reducing zero phase reactor
ACL-40B, ACL-74B, F200160
This is used to reduce noise. For the most part, control effects can be obtained in frequency band of 1MHz or higher. Since the frequency band where effects can be obtained is broad, it is effective as a simple countermeasure against noise. If the wiring distance between a motor and the inverter is short (66ft (20m) is a good guideline), it is recommended that it be connected to the power supply side, and if the distance exceeds 66ft (20m), connect it to the output side.

EMC compliant filter
EFL-□□□
This is an exclusive filter used to comply with European regulations in the EMC Directives (emissions). For details, make connections in accordance with the "Installation Manual."

Power filter
RNF□□□□-□□
This filter can be used for the same purpose as the "EMC compliant filter" described above, but it does not comply with the EMC Directives.

Magnetic contactor

Output circuit filter
OFL-□□□-□
This filter is connected to the output circuits of low noise type inverters (carrier frequency 8kHz to 15kHz, 6kHz or greater in 40HP or higher inverter) and is used for the following purposes.
- Suppresses fluctuation of motor terminal voltages.
  Prevents damage to motor insulation due to surge voltage in 460V series inverters.
- Suppresses leak current in output side wiring.
  Reduces leak current when multiple motors are run side by side or when there is long distance wiring.
- Suppresses radiation noise and induction noise from output side wiring.
  If the wiring length in a plant, etc. is long, it is effective as a countermeasure for noise reduction.

* When this filter is connected, be sure to set the carrier frequency (F26) at 8kHz or higher (6kHz or higher for 40HP or larger model).

OFL-□□□-4A
This filter is connected to the inverter output circuit for the following purposes.
- Suppresses fluctuation of motor terminal voltages.
  Prevents damage to motor insulation due to surge voltage in 460V series inverters.
- Suppresses radiation noise and induction noise from output side wiring.
  If the wiring length in a plant, etc. is long, it is effective as a noise reduction countermeasure.

*This filter is not limited by carrier frequency. Also, motor tuning can be carried out with this option in the installed state.

Surge suppression unit
SSU-□□□-□TA-NS
Prevents the motor insulation from being damaged by the surge current of the inverter.

Motor

Surge absorber
S2-A-O: For magnetic contactors
S1-B-O: For mini control relays, timers
Absorbs external surges and noise and prevents malfunction of magnetic contactors, mini control relays and timers, etc.
[Handled by Fuji Electric Technica Co., Ltd.]

Surge killer
FLS-323
Absorbs external surges and noise, preventing malfunction of electronic devices used in control panels, etc.

Keypad connector

Option board

Control circuit terminal base

L1/R L2/S L3/T P1 P(+) N(-) U V W G

■Interface card

DeviceNet card
OPC-F1-DEV

PROFIBUS card
OPC-F1-PDP

LONWORKS card
OPC-F1-LNW

BACnet card
OPC-F1-BAC(available soon)

Relay output card
OPC-F1-RY
This option card is used to convert the transistor outputs from the FRENIC Eco's terminals Y1 to Y3 into the relay outputs.
Caution: FRENIC Eco's terminals Y1 to Y3 cannot be used while this card is installed.
- Relay output: Built-in three circuits
- Signal type: SPDT contact
- Contact capacity: 250V AC, 0.3A cosϕ=0.3
  48V DC, 0.5A (resistance load)

DC Reactor
DCR□-□□□
(For power supply coordination)
1) Used when the power supply's transformer capacity is 500kVA or higher and is 10 or more times the rated capacity of the inverter.
2) Used in cases where a thyristor converter is connected as a load on the same transformer.
* If a commutating reactor is not used in the thyristor converter, it is necessary to connect an AC reactor on the inverter's input side, and so be sure to verify that this is done.
3) Used to prevent tripping in cases where an inverter overvoltage trip is caused by opening and closing of the phase advancing capacitor in the power supply system
4) Used when there is a phase unbalance of 2% or greater in the power supply voltage.
(For improving input power factor, reducing harmonics)
- Used to reduce the input harmonics current (or improve power factor).

* Concerning reduction effects, please refer to the accompanying guidelines.

Other inverters

Filter capacitor for radio noise reduction
NFM□□M315KPD□
Used to reduce noise.
It is effective in the AM radio frequency band.
* Do not use this in the inverter output side.
[Made by NIPPON CHEMI-CON, handled by Fuji Denki Technica Co., Ltd.]

NEMA1 kit (NEMA1-□□□F1-□□)
NEMA1 kit, when fitted to the FRENIC-Eco series, protects the inverter body with the structure the conforms to the NEMA1 standard (approved as UL TYPE1).

Panel-mount adapter
This adapter makes the latest inverters interchangeable with older inverter models manufactured by Fuji Electric.

MA-F1-5.5	FRN007P11S-2/4U → FRN007F1S-2/4U
MA-F1-15	FRN020P11S-2/4U → FRN020F1S-2/4U
MA-F1-30	FRN040P11S-2/4U → FRN040F1S-2/4U

Analog frequency meter
(1.77, 2.36inch square (45, 60mm square)) TRM-45, FM-60
[Handled by Fuji Denki Technica Co., Ltd.]

Frequency setting VR
RJ-13, WAR3W-1kΩ
[Handled by Fuji Denki Technica Co., Ltd.]

Mounting adapter for external cooling
This is an adapter for relocating the inverter's cooling fan to the outside of the control panel.

PB-F1-5.5	FRN001F1S-2/4U~FRN007F1S-2/4U
PB-F1-15	FRN010F1S-2/4U~FRN020F1S-2/4U
PB-F1-30	FRN025F1S-2/4U~FRN040F1S-2/4U

DC REACTOR

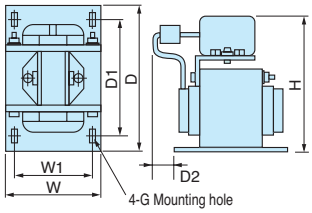


Fig. A

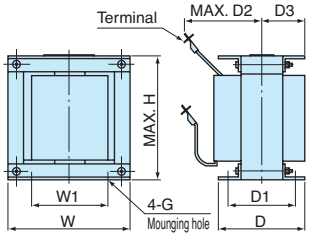


Fig. B

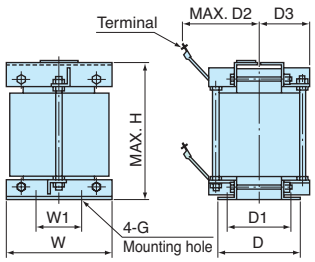


Fig. C

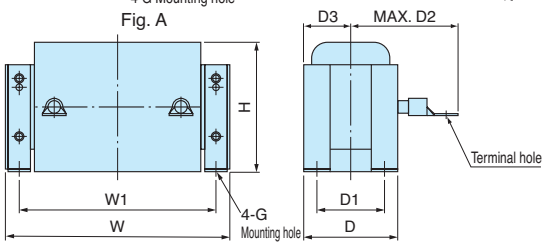


Fig. D

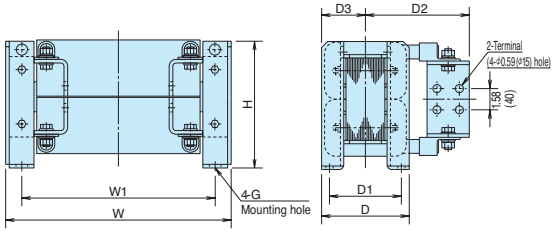


Fig. E

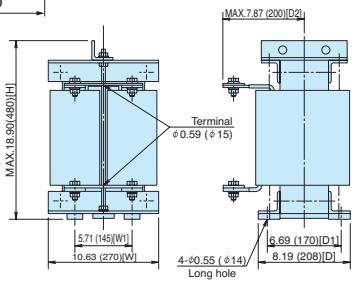


Fig. F

Unit:inch (mm)

Power supply voltage	Applicable motor rating (HP)	Inverter type	REACTOR type	Fig.	Dimensions [inch (mm)]									Mass [lbs(kg)]
					W	W1	D	D1	D2	D3	H	Mounting hole	Terminal hole	
3-phase 208V	1	FRN001F1S-2U	DCR2-1.5	A	2.6(66)	2.20(56)	3.54(90)	2.83(72)	0.79(20)	—	3.70(94)	0.2x0.31(5.2x8)	M4	3.5(1.6)
	2	FRN002F1S-2U	DCR2-2.2	A	3.39(86)	2.80(71)	3.94(100)	3.15(80)	0.39(10)	—	4.33(110)	0.24x0.43(6x11)	M4	4.0(1.8)
	3	FRN003F1S-2U												
	5	FRN005F1S-2U	DCR2-3.7	A	3.39(86)	2.80(71)	3.94(100)	3.15(80)	0.79(20)	—	4.33(110)	0.24x0.43(6x11)	M4	5.7(2.6)
	7	FRN007F1S-2U	DCR2-7.5	A	4.37(111)	3.74(95)	3.94(100)	3.15(80)	0.91(23)	—	5.12(130)	0.28x0.43(7x11)	M5	8.4(3.8)
	10	FRN010F1S-2U	DCR2-11	A	4.37(111)	3.74(95)	3.94(100)	3.15(80)	0.94(24)	—	5.39(137)	0.28x0.43(7x11)	M6	9.5(4.3)
	15	FRN015F1S-2U	DCR2-15	A	5.75(146)	4.88(124)	4.72(120)	3.78(96)	0.59(15)	—	7.09(180)	0.28x0.43(7x11)	M6	13(5.9)
	20	FRN020F1S-2U	DCR2-18.5	A	5.75(146)	4.88(124)	4.72(120)	3.78(96)	0.98(25)	—	7.09(180)	0.28x0.43(7x11)	M8	16(7.4)
	25	FRN025F1S-2U	DCR2-24U	A	5.75(146)	4.88(124)	4.72(120)	3.78(96)	0.98(25)	—	7.09(180)	0.28x0.43(7x11)	M8	17(7.5)
	30	FRN030F1S-2U	DCR2-30B	B	5.98(152)	3.54(90)	6.14(156)	4.57(116)	4.53(115)	3.07(78)	5.12(130)	0.31(8)	M8	26(12)
	40	FRN040F1S-2U	DCR2-37B	B	6.73(171)	4.33(110)	5.94(151)	4.33(110)	4.53(115)	2.95(75)	5.91(150)	0.31(8)	M8	31(14)
	50	FRN050F1S-2U	DCR2-45B	B	6.73(171)	4.33(110)	6.54(166)	4.92(125)	4.72(120)	3.39(86)	5.91(150)	0.31(8)	M10	35(16)
	60	FRN060F1S-2U	DCR2-55B	C	7.48(190)	6.30(160)	5.16(131)	3.54(90)	3.94(100)	2.56(65)	8.27(210)	0.31(8)	M12	35(16)
	75	FRN075F1S-2U	DCR2-75C	D	10.04(255)	8.86(225)	4.17(106)	3.39(86)	5.71(145)	2.09(53)	5.71(145)	0.24(6)	M12	25(11.4)
	100	FRN100F1S-2U												
	125	FRN125F1S-2U	DCR2-110C	D	11.81(300)	10.43(265)	4.57(116)	3.54(90)	7.28(185)	2.28(58)	6.30(160)	M8	M12	37(17)
3-phase 460V	1	FRN001F1S-4U	DCR4-0.75	A	2.6(66)	2.20(56)	3.54(90)	2.83(72)	0.79(20)	—	3.70(94)	0.20x0.31(5.2x8)	M4	3.1(1.4)
	2	FRN002F1S-4U	DCR4-1.5	A	2.6(66)	2.20(56)	3.54(90)	2.83(72)	0.79(20)	—	3.70(94)	0.20x0.31(5.2x8)	M4	3.5(1.6)
	3	FRN003F1S-4U	DCR4-2.2	A	3.39(86)	2.80(71)	3.94(100)	3.15(80)	0.59(15)	—	4.33(110)	0.24x0.35(6x9)	M4	4.4(2.0)
	5	FRN005F1S-4U	DCR4-3.7	A	3.39(86)	2.80(71)	3.94(100)	3.15(80)	0.79(20)	—	4.33(110)	0.24x0.35(6x9)	M4	5.7(2.6)
	7	FRN007F1S-4U	DCR4-5.5	A	3.39(86)	2.80(71)	3.94(100)	3.15(80)	0.79(20)	—	4.33(110)	0.24x0.35(6x9)	M4	5.7(2.6)
	10	FRN010F1S-4U	DCR4-7.5	A	4.37(111)	3.74(95)	3.94(100)	3.15(80)	0.94(24)	—	5.12(130)	0.28x0.43(7x11)	M5	9.3(4.2)
	15	FRN015F1S-4U	DCR4-11	A	4.37(111)	3.74(95)	3.94(100)	3.15(80)	0.94(24)	—	5.12(130)	0.28x0.43(7x11)	M5	9.5(4.3)
	20	FRN020F1S-4U	DCR4-15	A	5.75(146)	4.88(124)	4.72(120)	3.78(96)	0.59(15)	—	6.73(171)	0.28x0.43(7x11)	M5	13(5.9)
	25	FRN025F1S-4U	DCR4-18.5	A	5.75(146)	4.88(124)	4.72(120)	3.78(96)	0.98(25)	—	6.73(171)	0.28x0.43(7x11)	M6	16(7.2)
	30	FRN030F1S-4U	DCR4-22A	A	5.75(146)	4.88(124)	4.72(120)	3.78(96)	0.98(25)	—	6.73(171)	0.28x0.43(7x11)	M6	16(7.2)
	40	FRN040F1S-4U	DCR4-30B	B	5.98(152)	3.54(90)	6.18(157)	4.53(115)	3.94(100)	3.07(78)	5.12(130)	0.31(8)	M8	29(13)
	50	FRN050F1S-4U	DCR4-37B	B	6.73(171)	4.33(110)	5.91(150)	4.33(110)	3.94(100)	2.95(75)	5.91(150)	0.31(8)	M8	33(15)
	60	FRN060F1S-4U	DCR4-45B	B	6.73(171)	4.33(110)	6.50(165)	4.92(125)	4.33(110)	3.23(82)	5.91(150)	0.31(8)	M8	40(18)
	75	FRN075F1S-4U	DCR4-55B	B	6.73(171)	4.33(110)	6.69(170)	5.12(130)	4.33(110)	3.35(85)	5.91(150)	0.31(8)	M8	44(20)
	100	FRN100F1S-4U	DCR4-75C	D	10.04(255)	8.86(225)	4.17(106)	3.39(86)	4.92(125)	2.09(53)	5.71(145)	0.24(6)	M10	27(12.4)
	125	FRN125F1S-4U	DCR4-90C	D	10.08(256)	8.86(225)	4.57(116)	3.78(96)	5.12(130)	2.28(58)	5.71(145)	0.24(6)	M12	32(14.7)
	150	FRN150F1S-4U	DCR4-110C	D	12.05(306)	10.43(265)	4.57(116)	3.54(90)	5.51(140)	2.28(58)	6.10(155)	0.31(8)	M12	41(18.4)
	200	FRN200F1S-4U	DCR4-132C	D	12.05(306)	10.43(265)	4.96(126)	3.94(100)	5.91(150)	2.48(63)	6.30(160)	0.31(8)	M12	49(22)
	250	FRN250F1S-4U	DCR4-200C	D	14.06(357)	12.20(310)	5.55(141)	4.45(113)	6.50(165)	2.78(70.5)	7.48(190)	0.39(10)	M12	65(29.5)
	300	FRN300F1S-4U												
	350	FRN350F1S-4U	DCR4-220C	D	14.06(357)	12.20(310)	5.75(146)	4.65(118)	7.28(185)	2.87(73)	7.48(190)	0.39(10)	M12	72(32.5)
	400	FRN400F1S-4U	DCR4-280C	D	13.78(350)	12.20(310)	6.34(161)	5.24(133)	8.27(210)	3.17(80.5)	7.48(190)	M10	M16	79(36)
	450	FRN450F1S-4U												
	500	FRN500F1S-4U	DCR4-355C	E	15.75(400)	13.58(345)	6.14(156)	5.04(128)	7.87(200)	3.07(78)	8.86(225)	M10	—	104(47)
	600	FRN600F1S-4U	DCR4-400C	E	17.52(445)	15.16(385)	5.71(145)	4.61(117)	8.39(213)	2.85(72.5)	9.65(245)	M10	—	115(52)
	700	FRN700F1S-4U	DCR4-450C	E	17.32(440)	15.16(385)	5.91(150)	4.80(122)	8.46(215)	2.95(75)	9.65(245)	M10	—	132(60)
	800	FRN800F1S-4U	DCR4-500C	E	17.52(445)	15.35(390)	6.50(165)	5.39(137)	8.66(220)	3.25(82.5)	9.65(245)	M10	—	154(70)
	900	FRN900F1S-4U	DCR4-560C	F	10.63(270)	5.71(145)	8.19(208)	6.69(170)	7.87(200)	—	18.90(480)	ϕ0.55(ϕ14) long hole	ϕ0.59(ϕ15)	154(70)

●Interface card

DeviceNet card (OPC-F1-DEV)

Use this interface card to enter or monitor operation commands or frequency or to change or check the settings of function codes necessary for operation at the master station of DeviceNet.

- ●Number of connectable nodes: Max. 64 (including the master)
- ●MAC ID: 0 to 63
- ●Insulation: 500V DC (by photocoupler)
- ●Transmission speed: 500kbps/250kbps/125kbps
- ●Network power consumption: Max. 50mA at 24V DC

BACnet card (OPC-F1-BAC)

Available soon

Relay output card (OPC-F1-RY)

Use this option card to convert the transistor outputs issued from the terminals Y1 to Y3 of the main body of FRENIC-Eco into relay outputs.

Note: FRENIC-Eco's terminals Y1 to Y3 cannot be used while this card is installed.

- ●Relay outputs: Built-in three circuits
- ●Contact: SPDT contact
- ●Contact capacity: 250V AC, 0.3A cosφ=0.3
  48V DC, 0.5A (resistance load)

PROFIBUS card (OPC-F1-PDP)

With this interface card, you can do the following operations from the PROFIBUS-DP master: issuing the inverter operation command, issuing the frequency command, monitoring the operating status, and changing the settings in all the function codes of FRENIC-Eco.

- ●Transmission speed: 9.6kbps to 12Mbps
- ●Transmission distance: Max. 3900ft (1200m)
- ●Connector: 6-pole terminal base

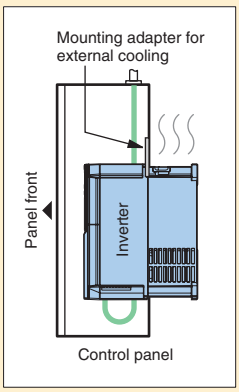
LonWorks interface card (OPC-F1-LNW)

With use of this interface card, the peripheral devices (including a master) linked through LonWorks can be connected to FRENIC-Eco. This allows you to issue an operation command or a frequency setting command from the master.

- ●No. of network variables: 62
- ●No. of connectable devices: 24
- ●Transmission speed: 78kbps

●Mounting adapter for external cooling (PB-F1-□□□)

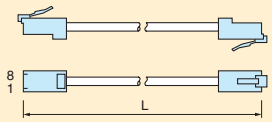
Use this adapter to shift the heat sink to the outside of the control panel. For 50HP or larger inverters, the head sink can be extended, without using this adapter, by simply relocating the mounting base.



Optional type	Applicable inverter type
PB-F1-5.5	FRN001F1 *-2U
	FRN002F1 *-2U
	FRN003F1 *-2U
	FRN005F1 *-2U
	FRN001F1 *-4U
	FRN002F1 *-4U
	FRN003F1 *-4U
	FRN005F1 *-4U
	FRN007F1 *-4U
PB-F1-15	FRN007F1 *-2U
	FRN010F1 *-2U
	FRN015F1 *-2U
	FRN010F1 *-4U
	FRN015F1 *-4U
	FRN020F1 *-4U
PB-F1-30	FRN020F1 *-2U
	FRN025F1 *-2U
	FRN030F1 *-2U
	FRN025F1 *-4U
	FRN030F1 *-4U
	FRN040F1 *-4U

●Extension cable for remote operation (CB-□S)

This straight cable is used to connect the inverter and the remote keypad.



Connector type: RJ-45

Optional type	Length (ft (m))
CB-5S	16 (5)
CB-3S	9.8 (3)
CB-1S	3.3 (1)

■NEMA1 kit (NEMA1-□□□F1-□□)

NEMA1 kit, when fitted to the FRENIC-Eco series, protects the inverter body with the structure the conforms to the NEMA1 standard (approved as UL TYPE1).

●Combination between F1S Series Inverter and NEMA1 Cover

Optional type	Inverter type	Dimensions [inch(mm)]								Outside figure
	FECOA	W	H	D	A	B	C	E	Conduit dia × pcs	
NEMA1-5.5F1-24	FRN001 to 005F1S-2U FRN002 to 007F1S-4U	5.91 (150)	10.24 (260)	6.42 (163)	—	—	—	—	ϕ1.06(27)×3	A
NEMA1-11F1-24	FRN007 to 010F1S-2U FRN010 to 015F1S-4U	8.66 (220)	10.24 (260)	8.47 (215)	—	—	—	—	ϕ1.06(27)×1 ϕ1.34(34)×2	A
NEMA1-15F1-24	FRN015F1S-2U FRN020F1S-4U	8.66 (220)	10.24 (260)	8.47 (215)	1.18 (30)	3.57 (90.7)	6.55 (166.4)	—	ϕ1.34(34)×1 ϕ1.65(42)×2	B
NEMA1-22F1-24	FRN020 to 025F1S-2U FRN025 to 030F1S-4U	9.84 (250)	15.75 (400)	8.47 (215)	—	—	—	—	ϕ1.34(34)×1 ϕ1.65(42)×2	A
NEMA1-30F1-24	FRN030F1S-2U FRN040F1S-4U	9.84 (250)	15.75 (400)	8.47 (215)	3.94 (100)	7.21 (183.2)	8.07 (205)	—	ϕ1.34(34)×1 ϕ1.89(48)×2	C
NEMA1-45F1-24	FRN040F1S-2U FRN050 to 060F1S-4U	12.60 (320)	21.65 (550)	10.04 (255)	4.92 (125)	4.35 (110.5)	12.73 (323.4)	5.90 (150)	ϕ1.89(48)×1 ϕ2.52(64)×3	D
NEMA1-75F1-2	FRN050 to 60F1S-2U	13.98 (355)	24.21 (615)	10.63 (270)	7.48 (190)	4.35 (110.5)	14.11 (358.4)	8.47 (215)	ϕ1.89(48)×1 ϕ3.03(77)×3	D
	FRN075 to 100F1S-2U	13.98 (355)	29.13 (740)	10.63 (270)						
NEMA1-75F1-4	FRN075F1S-4U	13.98 (355)	21.65 (550)	10.63 (270)	3.54 (90)	4.35 (110.5)	14.11 (358.4)	4.53 (115)	ϕ1.89(48)×1 ϕ2.52(64)×3	D
	FRN100F1S-4U	13.98 (355)	24.21 (615)	10.63 (270)						
NEMA1-110F1-4	FRN125 to 150F1S-4U	13.98 (355)	29.13 (740)	11.81 (300)	3.74 (95)	5.53 (140.5)	14.11 (358.4)	4.72 (120)	ϕ1.89(48)×1 ϕ2.52(64)×3	D
NEMA1-132F1-4	FRN200F1S-4U	20.87 (530)	29.13 (740)	12.40 (315)	3.74 (95)	5.24 (133)	21.00 (533.4)	5.12 (130)	ϕ1.89(48)×1 ϕ2.52(64)×3	D
NEMA1-110F1-2	FRN125F1S-2U	26.77 (680)	34.65 (880)	15.55 (395)	14.02 (356)	10.04 (255)	26.90 (683.2)	15.16 (385)	ϕ1.89(48)×1 ϕ3.54(90)×3	D
NEMA1-220F1-4	FRN250 to 300F1S-4U FRN350F1S-4U	20.87 (530)	39.37 (1000)	14.17 (360)	5.12 (130)	7.01 (178)	21.00 (533.4)	6.50 (165)	ϕ1.89(48)×1 ϕ4.33(110)×3	D
NEMA1-280F1-4	FRN400 to 450F1S-4U	26.77 (680)	39.37 (1000)	14.96 (380)	9.65 (245)	5.58 (141.6)	26.94 (684.2)	11.02 (280)	ϕ1.89(48)×1 ϕ4.33(110)×3	D
NEMA1-400F1-4	FRN500F1S-4U FRN600F1S-4U	26.77 (680)	55.12 (1400)	17.32 (440)	9.95 (240)	7.94 (201.6)	26.94 (684.2)	10.83 (275)	ϕ1.89(48)×1 ϕ5.63(14)×3	D
NEMA1-560F1-4	FRN700F1S-4U FRN800F1S-4U FRN900F1S-4U	34.65 (880)	55.12 (1400)	17.32 (440)	9.95 (240)	7.94 (201.6)	34.81 (884.2)	10.83 (275)	ϕ1.89(48)×1 ϕ5.63(14)×3	D

Fig. A

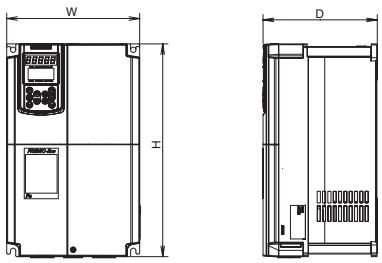


Fig. B

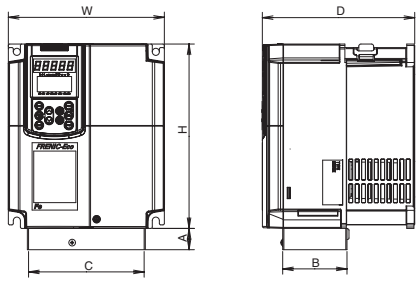


Fig. C

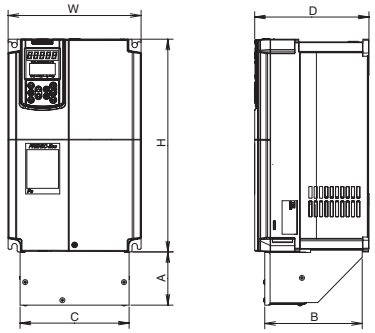
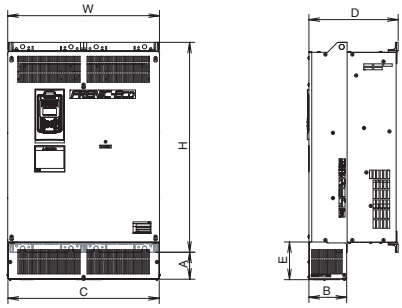


Fig. D



Required torque and wire size

Power supply voltage	Inverter type	Required torque lb-in (N·m)			Wire size AWG				Class J fuse size (A)	Circuit breaker trip size (A)
		Main terminal	Aux. Control Power Supply R0, T0	Control circuit Europe type terminal block	Main terminal	Aux. Control Power Supply R0, T0	Aux. Fan Power Supply R1, T1	Control circuit Europe type terminal block		
Three-phase 208 V	FRN001F1S-2U	15.9 (1.8)	10.6 (1.2)	4.4 (0.5)	14	14	—	20	10	15
	FRN002F1S-2U								15	
	FRN003F1S-2U								20	20
	FRN005F1S-2U				12				35	30
	FRN007F1S-2U	33.6 (3.8)			8				60	50
	FRN010F1S-2U				4				70	70
	FRN015F1S-2U	51.3 (5.8)							100	100
	FRN020F1S-2U				3				125	125
	FRN025F1S-2U				2				150	150
	FRN030F1S-2U	119.4 (13.5)			1/0				175	175
	FRN040F1S-2U								200	200
	FRN050F1S-2U	238.9 (27)			3/0		14		225	225
	FRN060F1S-2U				4/0				300	300
	FRN075F1S-2U				300					
	FRN100F1S-2U				2/0x2				350	350
	FRN125F1S-2U	424.7 (48)			4/0x2				400	400
Three-phase 460 V	FRN001F1S-4U	15.9 (1.8)	10.6 (1.2)	4.4 (0.5)	14	14	—	20	6	15
	FRN002F1S-4U								10	
	FRN003F1S-4U								15	
	FRN005F1S-4U								20	20
	FRN007F1S-4U								30	30
	FRN010F1S-4U	33.6 (3.8)			12				40	
	FRN015F1S-4U				10				50	40
	FRN020F1S-4U	51.3 (5.8)			8				70	50
	FRN025F1S-4U								80	70
	FRN030F1S-4U				6				100	80
	FRN040F1S-4U	119.4 (13.5)			4					100
	FRN050F1S-4U				2				125	125
	FRN060F1S-4U				1				150	150
	FRN075F1S-4U				1/0		14		175	175
	FRN100F1S-4U				3x2					
	FRN125F1S-4U	238.9 (27)			4/0				200	200
	FRN150F1S-4U				250				225	225
	FRN200F1S-4U				2/0x2				300	300
	FRN250F1S-4U	424.7 (48)			500				400	400
	FRN300F1S-4U				4/0x2				450	450
	FRN350F1S-4U				300x2				500	500
	FRN400F1S-4U				350x2				600	600
	FRN450F1S-4U				400x2				700	700
	FRN500F1S-4U				300x3					
	FRN600F1S-4U				350x3				1000	1000
	FRN700F1S-4U				300x4					
	FRN800F1S-4U				350x4				1200	1200
	FRN900F1S-4U				400x4				1600	1600

*1: Select the rated current of a fuse or a circuit breaker which is suitable to the connecting wire size.

To all our customers who purchase Fuji Electric FA Components & Systems' products:

Please take the following items into consideration when placing your order.

When requesting an estimate and placing your orders for the products included in these materials, please be aware that any items such as specifications which are not specifically mentioned in the contract, catalog, specifications or other materials will be as mentioned below.
In addition, the products included in these materials are limited in the use they are put to and the place where they can be used, etc., and may require periodic inspection. Please confirm these points with your sales representative or directly with this company.
Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

1. Free of Charge Warranty Period and Warranty Range

1-1 Free of charge warranty period

(1) The product warranty period is "1 year from the date of purchase" or 24 months from the manufacturing date imprinted on the name place, whichever date is earlier.
(2) However, in cases where the installation environment, conditions of use, use frequency and times used, etc., have an effect on product life, this warranty period may not apply.
(3) Furthermore, the warranty period for parts restored by Fuji Electric's Service Department is "6 months from the date that repairs are completed."

1-2 Warranty range

(1) In the event that breakdown occurs during the product's warranty period which is the responsibility of Fuji Electric, Fuji Electric will replace or repair the part of the product that has broken down free of charge at the place where the product was purchased or where it was delivered. However, if the following cases are applicable, the terms of this warranty may not apply.
1) The breakdown was caused by inappropriate conditions, environment, handling or use methods, etc. which are not specified in the catalog, operation manual, specifications or other relevant documents.
2) The breakdown was caused by product other than the purchased or delivered Fuji product.
3) The breakdown was caused by product other than Fuji product, such as the customer's equipment or software design, etc.
4) Concerning the Fuji's programmable products, the breakdown was caused by a program other than a program supplied by this company, or the results from using such a program.
5) The breakdown was caused by modifications or repairs affected by a party other than Fuji Electric.
6) The breakdown was caused by improper maintenance or replacement using consumables, etc. specified in the operation manual or catalog, etc.
7) The breakdown was caused by a chemical or technical problem that was not foreseen when making practical application of the product at the time it was purchased or delivered.
8) The product was not used in the manner the product was originally intended to be used.
9) The breakdown was caused by a reason which is not this company's responsibility, such as lightning or other disaster.

(2) Furthermore, the warranty specified herein shall be limited to the purchased or delivered product alone.
(3) The upper limit for the warranty range shall be as specified in item (1) above and any damages (damage to or loss of machinery or equipment, or lost profits from the same, etc.) consequent to or resulting from breakdown of the purchased or delivered product shall be excluded from coverage by this warranty.

1-3. Trouble diagnosis

As a rule, the customer is requested to carry out a preliminary trouble diagnosis. However, at the customer's request, this company or its service network can perform the trouble diagnosis on a chargeable basis. In this case, the customer is asked to assume the burden for charges levied in accordance with this company's fee schedule.

2. Exclusion of Liability for Loss of Opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, this company shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than this company's products, whether foreseen or not by this company, which this company is not be responsible for causing.

3. Repair Period after Production Stop, Spare Parts Supply Period (Holding Period)

Concerning models (products) which have gone out of production, this company will perform repairs for a period of 7 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 7 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 7-year period. For details, please confirm at our company's business office or our service office.

4. Transfer Rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

5. Service Contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or service costs. Depending on the request, these can be discussed separately.

6. Applicable Scope of Service

Above contents shall be assumed to apply to transactions and use of the country where you purchased the products.
Consult the local supplier or Fuji for the detail separetaly.

NOTES

When running general-purpose motors

• Driving a 460V general-purpose motor
When driving a 460V general-purpose motor with an inverter using extremely long cables, damage to the insulation of the motor may occur. Use an output circuit filter (OFL) if necessary after checking with the motor manufacturer. Fuji's motors do not require the use of output circuit filters because of their reinforced insulation.

• Torque characteristics and temperature rise
When the inverter is used to run a general-purpose motor, the temperature of the motor becomes higher than when it is operated using a commercial power supply. In the low-speed range, the cooling effect will be weakened, so decrease the output torque of the motor. If constant torque is required in the low-speed range, use a Fuji inverter motor or a motor equipped with an externally powered ventilating fan.

• Vibration
When the motor is mounted to a machine, resonance may be caused by the natural frequencies, including that of the machine. Operation of a 2-pole motor at 60Hz or more may cause abnormal vibration.
* Study use of tier coupling or dampening rubber.
* It is also recommended to use the inverter jump frequency control to avoid resonance points.

• Noise
When an inverter is used with a general-purpose motor, the motor noise level is higher than that with a commercial power supply. To reduce noise, raise carrier frequency of the inverter. High-speed operation at 60Hz or more can also result in more noise.

When running special motors

• High-speed motors
When driving a high-speed motor while setting the frequency higher than 120Hz, test the combination with another motor to confirm the safety of high-speed motors.

• Explosion-proof motors
When driving an explosion-proof motor with an inverter, use a combination of a motor and an inverter that has been approved in advance.

• Submersible motors and pumps
These motors have a larger rated current than general-purpose motors. Select an inverter whose rated output current is greater than that of the motor.
These motors differ from general-purpose motors in thermal characteristics. Set a low value in the thermal time constant of the motor when setting the electronic thermal facility.

• Brake motors
For motors equipped with parallel-connected brakes, their braking power must be supplied from the primary circuit (commercial power supply). If the brake power is connected to the inverter power output circuit (secondary circuit) by mistake, problems may occur.
Do not use inverters for driving motors equipped with series-connected brakes.

• Geared motors
If the power transmission mechanism uses an oil-lubricated gearbox or speed changer/reducer, then continuous motor operation at low speed may cause poor lubrication. Avoid such operation.

• Synchronous motors
It is necessary to use software suitable for this motor type. Contact Fuji for details.

• Single-phase motors
Single-phase motors are not suitable for inverter-driven variable speed operation. Use three-phase motors.
* Even if a single-phase power supply is available, use a three-phase motor as the inverter provides three-phase output.

Environmental conditions

• Installation location
Use the inverter in a location with an ambient temperature range of -10 to 50˚C (14 to 122˚F).
The inverter and braking resistor surfaces become hot under certain operating conditions. Install the inverter on nonflammable material such as metal.
Ensure that the installation location meets the environmental conditions specified in "Environment" in inverter specifications.

Combination with peripheral devices

• Installing a molded case circuit breaker (MCCB)
Install a recommended molded case circuit breaker (MCCB) or a ground-fault circuit interrupter (GFCI) in the primary circuit of each inverter to protect the wiring. Ensure that the circuit breaker capacity is equivalent to or lower than the recommended capacity.

• Installing a magnetic contactor (MC) in the output (secondary) circuit
If a magnetic contactor (MC) is mounted in the inverter's secondary circuit for switching the motor to commercial power or for any other purpose, ensure that both the inverter and the motor are fully stopped before you turn the MC on or off. Remove the surge killer integrated with the MC.

• Installing a magnetic contactor (MC) in the input (primary) circuit
Do not turn the magnetic contactor (MC) in the primary circuit on or off more than once an hour as an inverter fault may result. If frequent starts or stops are required during motor operation, use FWD/REV signals.

• Protecting the motor
The electronic thermal facility of the inverter can protect the motor. The operation level and the motor type (general-purpose motor, inverter motor) should be set. For high-speed motors or water-cooled motors, set a small value for the thermal time constant to protect the motor.
If you connect the motor thermal relay to the motor with a long cable, a high-frequency current may flow into the wiring stray capacitance. This may cause the relay to trip at a current lower than the set value for the thermal relay. If this happens, lower the carrier frequency or use the output circuit filter (OFL).

• Discontinuance of power-factor correcting capacitor
Do not mount power factor correcting capacitors in the inverter (primary) circuit. (Use the DC REACTOR to improve the inverter power factor.) Do not use power factor correcting capacitors in the inverter output circuit (secondary). An overcurrent trip will occur, disabling motor operation.

• Discontinuance of surge killer
Do not mount surge killers in the inverter output (secondary) circuit.

• Reducing noise
Use of a filter and shielded wires are typical measures against noise to ensure that EMC Directives are met.

• Measures against surge currents
If an overvoltage trip occurs while the inverter is stopped or operated under a light load, it is assumed that the surge current is generated by open/close of the phase-advancing capacitor in the power system.
We recommend connecting a DC REACTOR to the inverter.

• Megger test
When checking the insulation resistance of the inverter, use a 500V megger and follow the instructions contained in the Instruction Manual.

Wiring

• Wiring distance of control circuit
When performing remote operation, use the twisted shield wire and limit the distance between the inverter and the control box to 65.6ft (20m).

• Wiring length between inverter and motor
If long wiring is used between the inverter and the motor, the inverter will overheat or trip as a result of overcurrent (high-frequency current flowing into the stray capacitance) in the wires connected to the phases. Ensure that the wiring is shorter than 164ft (50m). If this length must be exceeded, lower the carrier frequency or mount an output circuit filter (OFL).

• Wiring size
Select cables with a sufficient capacity by referring to the current value or recommended wire size.

• Wiring type
Do not use multicore cables that are normally used for connecting several inverters and motors.

• Grounding
Securely ground the inverter using the grounding terminal.

Selecting inverter capacity

• Driving general-purpose motor
Select an inverter according to the applicable motor ratings listed in the standard specifications table for the inverter. When high starting torque is required or quick acceleration or deceleration is required, select an inverter with a capacity one size greater than the standard.

• Driving special motors
Select an inverter that meets the following condition: Inverter rated current > Motor rated current.

Transportation and storage

When transporting or storing inverters, follow the procedures and select locations that meet the environmental conditions that agree with the inverter specifications.

Fuji Electric FA Components & Systems Co., Ltd.
http://www.fujielectric.com
Fuji Electric Corp. of America
47520 Westinghouse Drive Fremont, CA 94539, U.S.A.
Tel.+1-510-440-1060 Fax.+1-510-440-1063

Printed on recycled paper

Printed in Japan 2008-6 (F08a/E08) CM 30 FIS

QUOTATION

PO Box 937 Royersford PA 19468
(610) 495-9700 Ext. 104
(610) 495-9710 FAX
E-Mail: JohnP@ramequipment.com
Web site: www.ramequipment.com

Environmental Assessment & Remediations
225 Atlantic Ave.
Putehogue NY 11772

Attention: **Ian Hoffman** | **Quote # :** **15082702**
Reference: **Blower Package** | **Date:** **07/12/07**

QTY					
1	Blower:	**Roots Blower 33URAI**			
		Airflow: 130 ICFM		Discharge Pressure:	10.0 psig
		Gas: Air		Specific Gravity:	1.0
		Inlet Pres: 14.7 PSIA		Inlet Temperature:	95° F
		Speed: 3168		Brake Horsepower:	9.4
	Blower Connections	Inlet: 2" thd		Discharge:	2" thd
1	Base:	Elevated Steel Baseplate			
1	Drive:	V-Belt Drive			
1	Drive Guard:	Enclosed Style			
1	Relief Valve:	Kunkle 337-2" set @ 11.0 psig.			
1	Inlet Filter:	2.5" w/paper filter			
1	Inlet Silencer:	2.5" with supports			
1	Discharge Silencer:	2.5" with supports			
1	Motor:	15HP 1800RPM TEFC 230/460/3/60			
1	Slide Base:	Double Adjusting			
1	Layout & Mount:	Yes			
2	Flexible Connectors:	Flex Series 300 Spool Type R&M Standard			
1	Crating:	Domestic			
	Accessories:				
1	Vacuum Gage:	2-1/2" 0-15 psig. liquid filled mounted on discharge spool			
1	Paint & Assembly:	Fully Assembled & Finish Painted R&M Standard			
2	Engineering:	Sets of Submittals, O&M Manuals R&M Standard			

Estimated dBa w/out a sound enclosure 94 @ 3 feet free field
Delivery is 6-8 weeks After Approval if required
Optional 85dBA sound enclosure mounted off the base $ 2,200.00 each

THANK YOU FOR THE OPPORTUNITY
TO SUBMIT OUR PROPOSAL

John P. Pumo, Jr.

Company: ROOTS Division
Address: 16240 Port Northwest Drive, Houston, Texas 77041
Ph: 832-590-2305/1-877-393-7668 Fax: 832-590-2326

ROOTS BLOWER PERFORMANCE REPORT : Program Version 6.30 Release Date 4/26/2012
Program Mode: SELECTION Run Date: 10/06/2015

AMBIENT CONDITIONS:

Gas	AIR	
Relative Humidity	36%	
Molecular Weight	28.75	
k-Value	1.394	
Specific Gravity	.992	
Ambient Temperature	95	deg F
Ambient Pressure	14.7	PSIA

STANDARD CONDITIONS:

Pressure	14.7	PSIA
Temperature	68	deg F
Relative Humidity	36	%

SELECTED UNIT DETAIL: Model 33 URAI

	Design	Des/Max
Speed, RPM	3168	88.0%
System Inlet Volume, ICFM	138	
Actual Blower Inlet Volume, ICFM	140	+/-5 %
Standard Volume, SCFM	130	
Mass/Weight Flow, #/min	9.8	+/-5 %
System Inlet Temperature, deg F	95.0	
System Inlet Pressure, PSIA	14.700	
Inlet Pressure Loss, PSI	0.200	
Blower Inlet Pressure, PSIA	14.500	
Blower Discharge Pressure, PSIA	24.900	
Discharge Press. Loss, PSI	0.200	
System Discharge Pressure, PSIG	10.000	
Blower Diff. Press., PSI	10.400	86.7%
Power, BHP	9.39	+/-4%
Temperature Rise, deg F	141.3	62.8%
Discharge Temperature, deg F	236.3	
System Discharge Volume, ACFM	102	
Relief Valve Setting, PSIG	11.0	91.1%
Power @ RV Setting, BHP	10.24	
Temp. Rise @ Relief Setting, deg F	157.0	69.8%
Disch. Temp @ Relief Setting, deg F	252.0	
V-Belt: Est. B10 Brg Life, hours	484971	
Coupling: Est. B10 Brg Life, hours	484971	
Est. Free Field Noise, dBa	92.5	

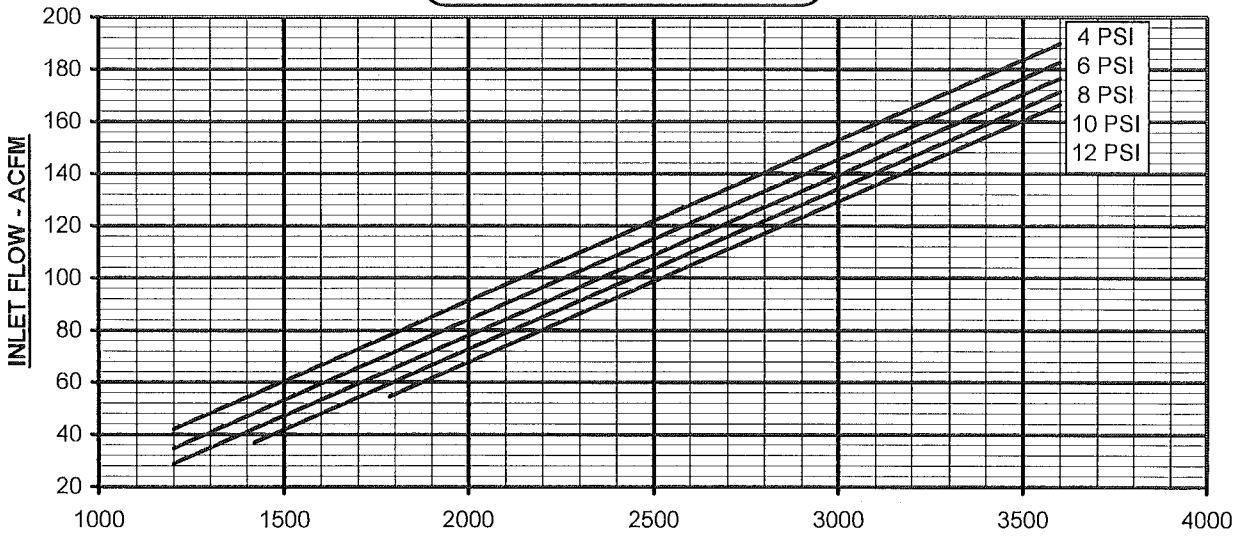
Measured as sound press. level per ISO 2151:2004E with +/-3 dBA tol.

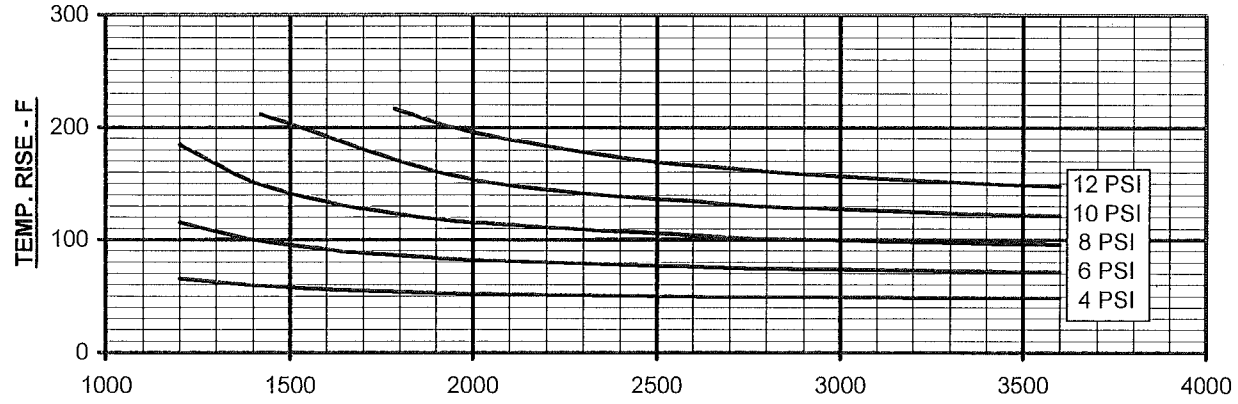
DRESSER Roots

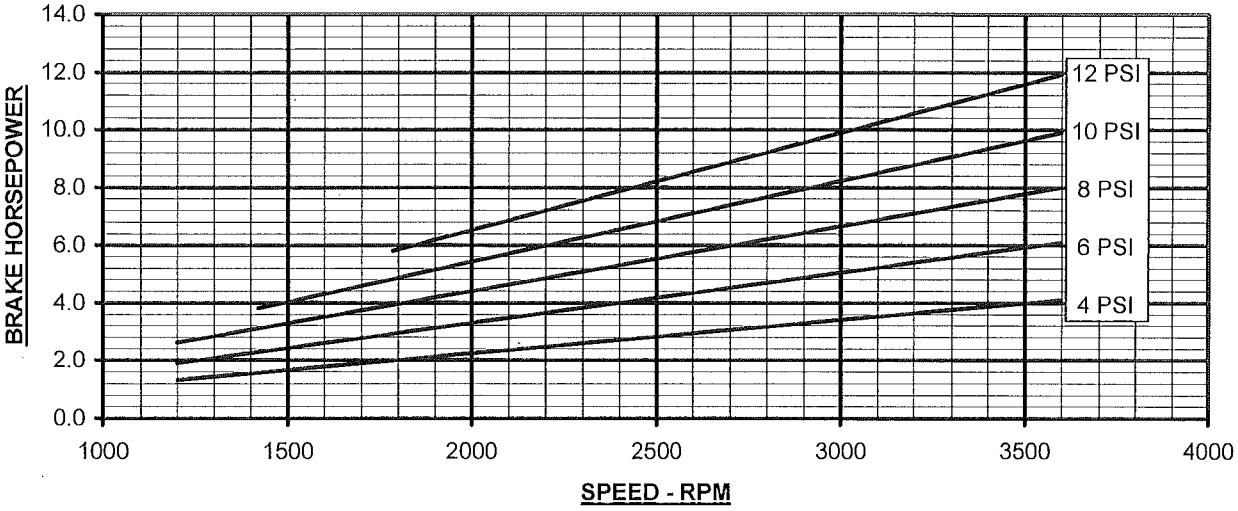
DRESSER INC.
WWW.ROOTSBLOWER.COM

PERFORMANCE BASED ON AIR,
INLET AT 14.7 PSIA & 68°F
DECEMBER 2004

PRESSURE PERFORMANCE
FRAME 33 U-RAI
MAX. PRESSURE RISE = 12 PSI
MAX. SPEED = 3600 RPM



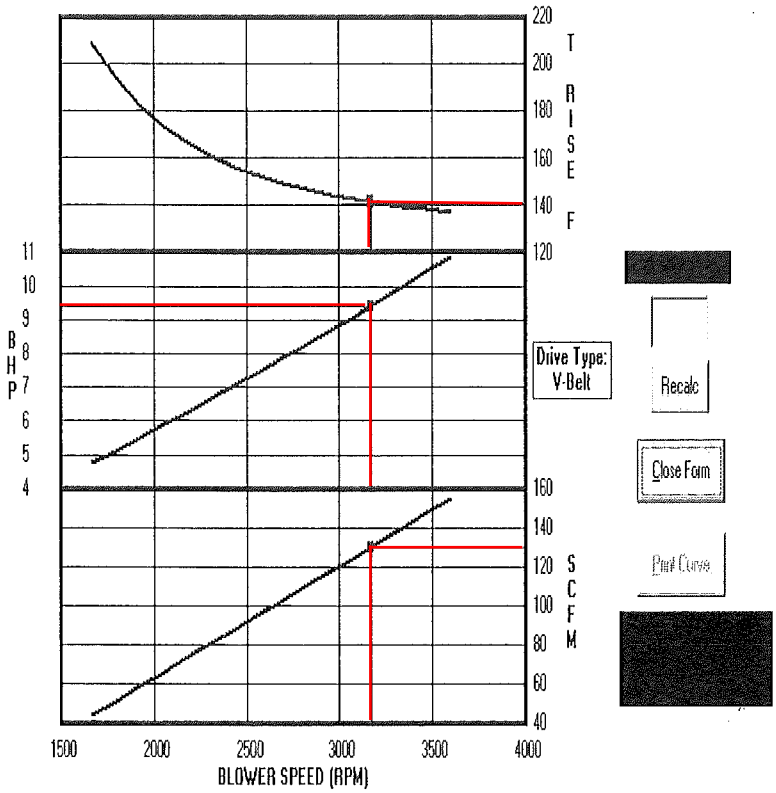




PC-12-33

33 URAI: Variable Speed Performance

Dresser ROOTS



Drive Type: V-Belt

Recalc

Close Form

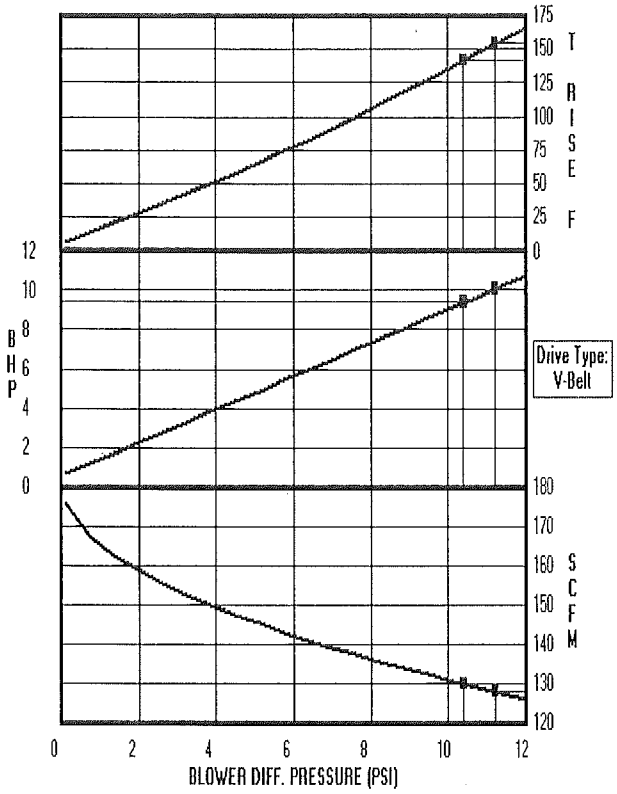
Perf Curve

Design Data

INLET CONDITIONS: AIR
RH = 36.00%, MW = 28.75, k = 1.394, Tin = 95 deg F
DESIGN: Speed = 3168 RPM
System Inlet P = 14.7 PSIA, Inlet P Loss = 0.2 PSI
System Disch P = 10 PSIG, Disch P Loss = 0.2 PSI
STD: RH = 36%, T = 68 deg F, P = 14.7 PSIA

33 URAI: Variable Pressure Performance

Dresser ROOTS



Close Form

Print Curve

[redacted]

INLET CONDITIONS: AIR
RH = 36.00%, MW = 28.75, k = 1.394, Tin = 95 deg F
DESIGN: Speed = 3168 RPM
System Inlet P = 14.7 PSIA, Inlet P Loss = 0.2 PSI
System Disch P = 10 PSIG, Disch P Loss = 0.2 PSI
STD: RH = 36%, T = 68 deg F, P = 14.7 PSIA Relief Valve P = 11 PSIG

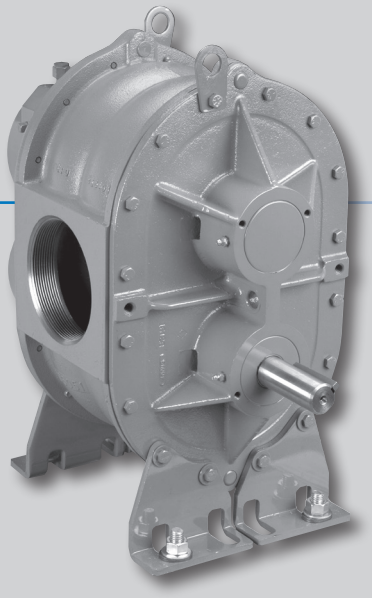
Design Data
Relief Valve Data

[redacted]

DRESSER Roots

The original ROOTS blower still leads the way™

ROOTS™ UNIVERSAL RAI® Rotary Positive Displacement Blowers



Specifications Frames 22 thru 718

DESIGN AND CONSTRUCTION FEATURES

- Steel detachable mounting feet
- Rigid one-piece cast iron casing
- Anti-friction bearings
- Thrust control
- Splash oil lubricated spur timing gears
- Connections in standard pipe sizes
- Balanced, precision machined bi-lobe impellers
- Ground steel shafts

Basic Blower Description

Universal RAI blowers are heavy duty blowers designed with detachable rugged steel mounting feet that permit easy in-field adaptability to either vertical or horizontal installation requirements.

Because of the detachable mounting feet, these units can be easily adapted to any of four drive shaft positions - right hand, left hand, bottom or top. The compact, sturdy design is engineered for continuous service when operated in accordance with speed and pressure ratings.

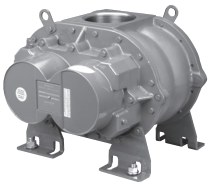
The basic model consists of a cast iron casing and cast iron involute impellers. Carburized and ground alloy steel spur timing gears are secured to the steel shafts with a taper mounting and locknut. Oversized antifriction bearings are used, with a cylindrical roller bearing at the drive shaft to withstand V-belt pull. The Universal RAI features thrust control, with splash oil lube on the gear end and grease lube on the drive end.

Available accessories include driver, relief valve, inlet and discharge silencers, inlet filter, check valve, extended base, v-belt or flexible coupling and drive guards.

Strongest Warranty in the Industry

ROOTS™ Universal RAI® blowers are warranted for two years plus an additional 6 months for shipping and construction where required. ROOTS synthetic oil is recommended for longer lubricant life.

Vertical Gear End



Horizontal Gear End

Horizontal Drive End

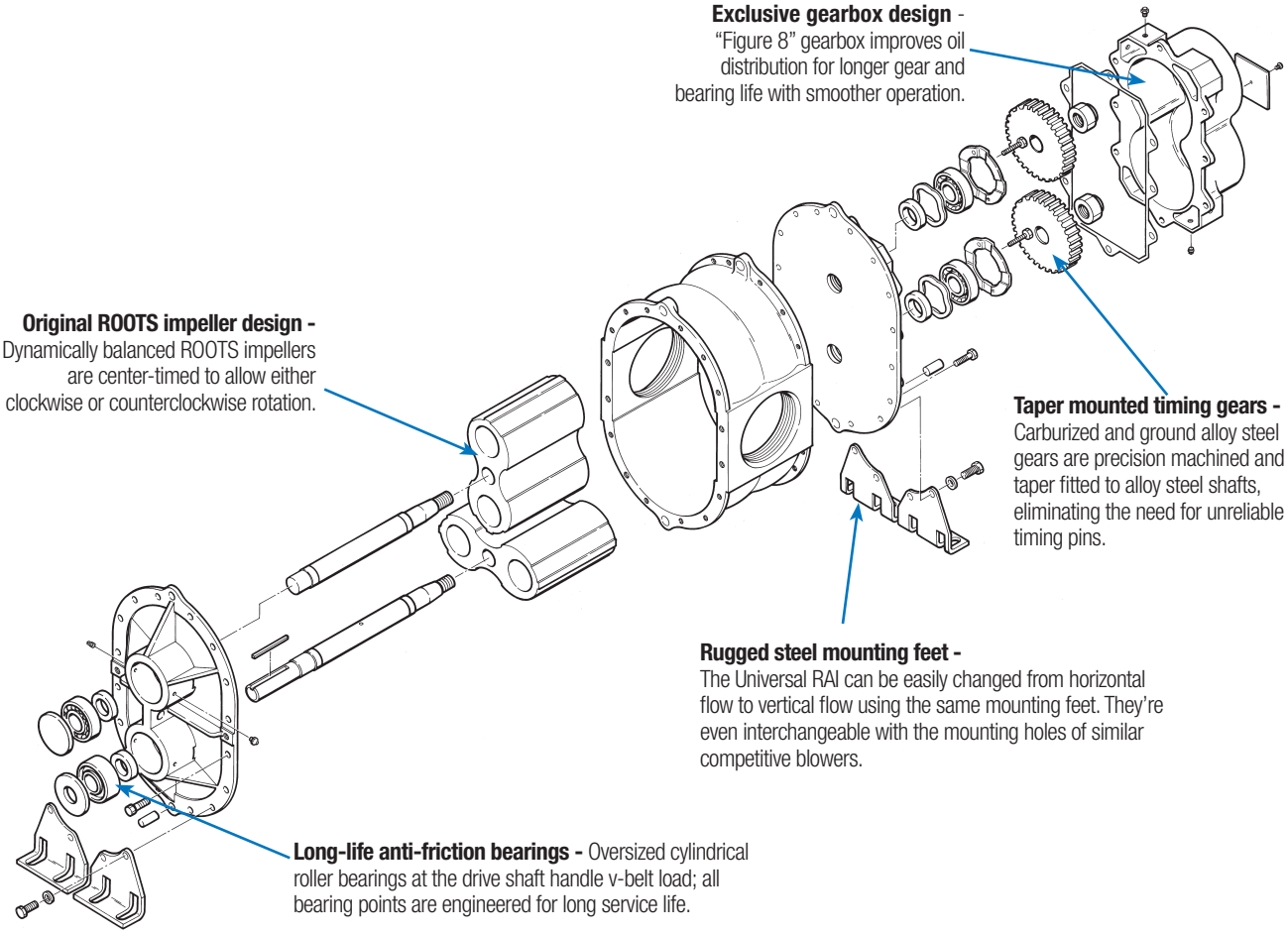
Exclusive gearbox design - "Figure 8" gearbox improves oil distribution for longer gear and bearing life with smoother operation.

Original ROOTS impeller design - Dynamically balanced ROOTS impellers are center-timed to allow either clockwise or counterclockwise rotation.

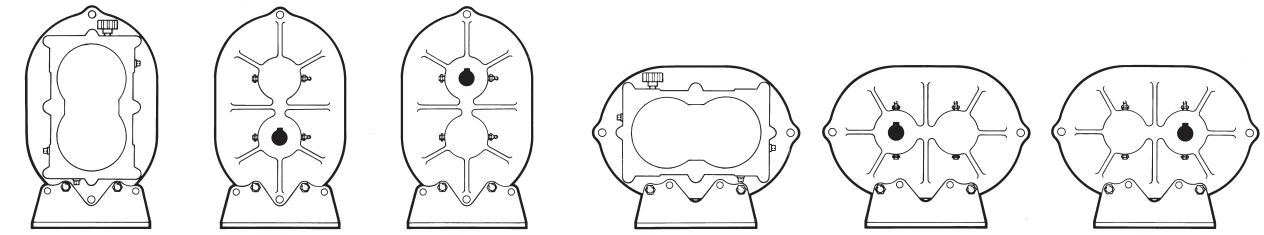
Taper mounted timing gears - Carburized and ground alloy steel gears are precision machined and taper fitted to alloy steel shafts, eliminating the need for unreliable timing pins.

Rugged steel mounting feet - The Universal RAI can be easily changed from horizontal flow to vertical flow using the same mounting feet. They're even interchangeable with the mounting holes of similar competitive blowers.

Long-life anti-friction bearings - Oversized cylindrical roller bearings at the drive shaft handle v-belt load; all bearing points are engineered for long service life.



Versatile mounting - You can mount the Universal RAI in multiple positions to accommodate your specific needs. With your choice of 17 frame sizes, there's a URAI that fits right into your OEM or replacement application.



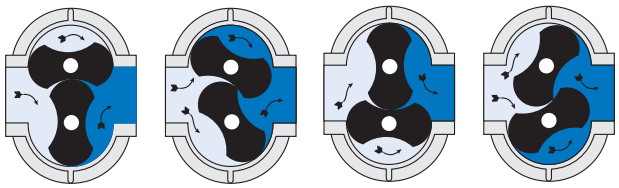
Vertical Mounting (Horizontal Air Flow)

Horizontal Mounting (Vertical Air Flow)

Bi-Lobe Operating Principle

Two figure-eight lobe impellers mounted on parallel shafts rotate in opposite directions. As each impeller passes the blower inlet, it traps a finite volume of air and carries it around the case to the blower outlet, where the air is discharged. With constant speed operation, the displaced volume is essentially the same regardless of pressure,

temperature or barometric pressure. Timing gears control the relative position of the impellers to each other and maintain small but finite clearances. This allows operation without lubrication being required inside the lobe cavity.

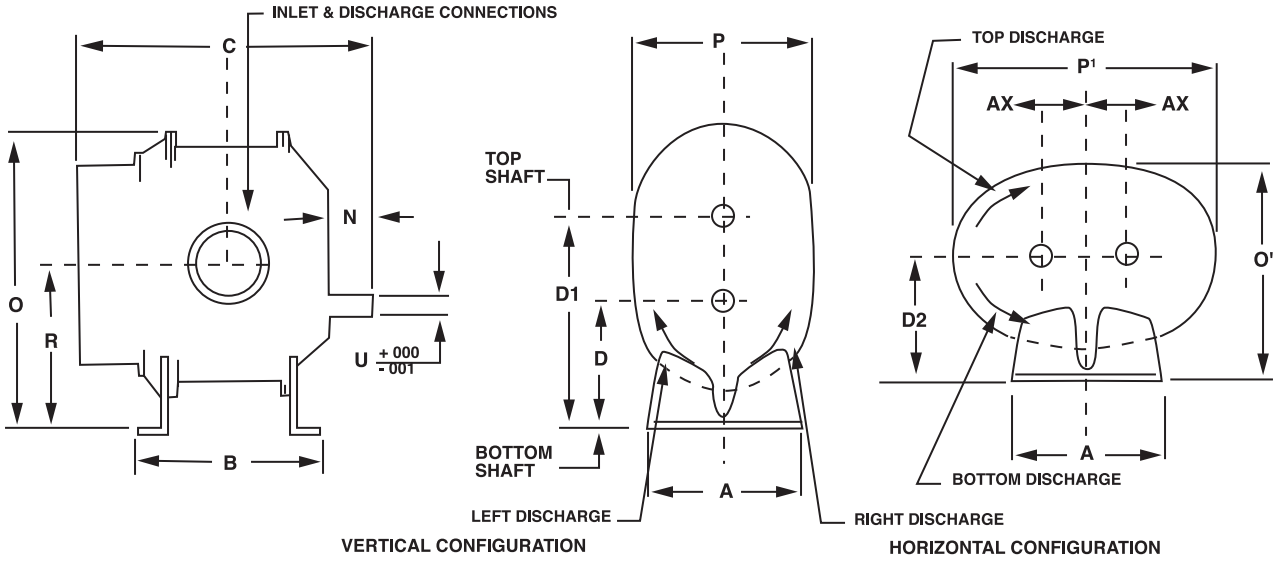


URAI Blower Performance

Frame Size	Speed RPM	1 PSI		6 PSI		7 PSI		10 PSI		12 PSI		13 PSI		14 PSI		15 PSI		Maximum Vacuum		
		CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	CFM	BHP	"HGV	CFM	BHP
	1160	10	0.1															4	6	0.2
22	3600	49	0.3	38	1.6	36	1.8	32	2.6	29	3.1							14	28	1.8
	5275	76	0.5	64	2.4	63	2.7	59	3.8	56	4.6							15	53	2.8
	1160	24	0.2															6	12	0.5
24	3600	102	0.6	83	3.1	81	3.6											14	69	3.5
	5275	156	0.9	137	4.6	135	5.4											15	119	5.5
	1160	40	0.2	21	1.4	19	1.6											10	18	1.1
32	2800	113	0.6	95	3.4	93	3.9	86	5.6	82	6.7	81	7.2	79	7.8	77	8.3	15	78	4.1
	3600	149	0.9	131	4.4	129	5.2	122	7.3	118	8.7	117	9.4	115	10.1	113	10.8	16	110	5.3
	1160	55	0.3	31	1.9	28	2.2											10	27	1.5
33	2800	156	0.9	132	4.6	129	5.4	120	7.7	116	9.2							14	113	5.2
	3600	205	1.2	181	6.1	178	7	170	9.9	165	11.9							15	159	7.3
	1160	95	0.5	61	3.1	57	3.6											10	55	2.5
36	2800	262	1.5	229	7.7	224	8.9											12	213	7.5
	3600	344	2.1	310	10.1	306	11.7											15	278	12.1
	860	38	0.2	18	1.4	15	1.6											8	19	0.9
42	1760	92	0.5	72	2.8	69	3.3	62	4.7	58	5.6							14	56	3.2
	3600	204	1.4	183	6.1	181	7.1	173	9.9	169	11.8	167	12.8	165	13.7	163	14.7	16	160	7.7
	860	79	0.5	42	2.7	37	3.2											8	46	1.8
45	1760	188	1	151	5.7	146	6.6	133	9.4									12	134	5.5
	3600	410	2.7	374	12.2	369	14.1	356	19.8									16	332	15.4
	860	105	0.6	59	3.6	53	4.2											8	63	2.4
47	1760	249	1.3	203	7.5	196	8.7											12	181	7.3
	3600	542	3.5	496	16.1	490	18.6											15	452	19.1
	700	72	0.4	42	2.4	38	2.8											10	36	2
53	1760	211	1.2	181	6.3	177	7.3	167	10.3	160	12.3	157	13.3	155	14.4			14	158	7.1
	2850	355	2.5	325	10.7	321	12.3	310	17.2	304	20.5	301	22.1	298	23.8	295	25.4	16	291	13.4
	700	123	0.7	78	4.1	72	4.7											10	70	3.3
56	1760	358	2	312	10.5	306	12.2	290	17.3	280	20.6	276	22.3					14	276	11.8
	2850	598	4	553	17.7	547	20.5	531	28.7	521	34.2	517	37					16	501	22.4
	700	187	1	130	5.9													8	135	3.9
59	1760	529	2.9	472	15.3	464	17.8											12	445	14.9
	2850	881	5.9	824	26	816	30											15	770	30.8
	700	140	0.8	93	4.5	86	5.3	70	7.5									12	71	4.4
65	1760	400	2.4	353	11.9	347	13.8	330	19.4	320	23.2	316	25.1	311	27	307	28.9	16	300	15.2
	2350	546	3.8	499	16.4	492	19	475	26.5	466	31.6	461	34.1	457	36.6	452	39.1	16	445	25.6
	700	224	1.2	149	7.3	139	8.5											10	135	5.9
68	1760	643	3.7	567	18.9	557	21.9	530	31	515	37	507	40.1	500	43.1			15	495	22.7
	2350	876	5.6	801	25.9	790	29.9	763	42.1	748	50.2	740	54.2	733	58.3			16	715	32.8
	700	420	2.3	279	13.6	260	15.9											8	292	8.9
615	1760	1205	6.6	1063	34.9	1044	40.6											12	997	33.9
	2350	1641	9.7	1500	47.6	1481	55.2											14	1389	53.4
	575	192	1.1	134	6.1	126	7.1	105	10.2									12	117	6
76	1400	527	3	468	15.4	460	17.8	439	25.3	427	30.2	421	32.7	415	35.1	410	37.6	16	413	19.7
	2050	790	5.3	731	23.4	723	27	702	37.9	690	45.1	684	48.7	679	52.4	673	56	16	674	29.5
	575	362	1.9	271	11.1	258	13	226	18.6									12	228	10.9
711	1400	970	5.2	880	27.7	867	32.2	835	45.7									15	793	33.5
	2050	1450	8.8	1359	41.8	1347	48.4	1315	68.2									16	1256	53.1
	575	600	3.1	470	18.1													10	446	14.8
718	1400	1590	8.1	1460	44.8													12	1398	43.6
	2050	2370	13.3	2240	66.9													12	2178	64.7

Notes: 1. Performance based on inlet air at standard pressure of 14.7 psia, standard temperature of 68° F, and specific gravity of 1.0.
2. Vacuum ratings based on inlet air at standard temperature of 68°F, discharge pressure of 30" Hg and specific gravity of 1.0.

Outline Drawing and Dimensions



Universal RAI® Blower Dimensions

Frame Size	A	B	C	Drive Shaft Location			N	O	O1	P	P1	R	U	Keyway	Inlet & Disch. Dia.	AX	Approx Net Wt. (lbs.)
				D	D1	D2											
22	5.13	5.00	9.75	3.75	6.25	3.75	2.50	9.63	6.88	6.25	9.25	5.00	.625	.188 x .094	1.0 NPT	1.25	32
24	5.13	7.00	11.75	3.75	6.25	3.75	2.50	9.63	6.88	6.25	9.25	5.00	.625	.188 x .094	2.0 NPT	1.25	43
32	7.25	6.75	11.25	5.00	8.50	5.00	2.44	12.81	8.88	7.75	12.13	6.75	.750	.188 x .094	1.25 NPT	1.75	69
33	7.25	7.63	12.13	5.00	8.50	5.00	2.44	12.81	8.88	7.75	12.13	6.75	.750	.188 x .094	2.0 NPT	1.75	74
36	7.25	10.00	14.63	5.00	8.50	5.00	2.56	12.81	8.88	7.75	12.13	6.75	.750	.188 x .094	2.5 NPT	1.75	102
42	8.00	7.25	13.00	6.25	10.25	6.25	3.18	15.06	10.63	8.75	13.63	8.25	.875	.188 x .094	1.5 NPT	2.00	88
45	8.00	10.00	15.50	6.25	10.25	6.25	2.94	15.06	10.63	8.75	13.63	8.25	.875	.188 x .094	2.5 NPT	2.00	109
47	8.00	11.75	17.63	6.25	10.25	6.25	3.31	15.06	10.50	8.50	13.63	8.25	.875	.188 x .094	3.0 NPT	2.00	128
53	10.50	8.38	15.38	6.25	11.25	6.75	3.68	17.38	11.88	10.25	17.25	8.75	1.125	.250 x .125	2.5 NPT	2.50	143
56	10.50	11.00	18.00	6.25	11.25	6.75	3.38	17.38	12.25	11.00	17.25	8.75	1.125	.250 x .125	4.0 NPT	2.50	170
59	10.50	14.00	21.18	6.25	11.25	6.75	3.88	17.38	12.25	11.00	17.25	8.75	1.125	.250 x .125	4.0 NPT	2.50	204
65	11.00*	10.00	18.38	8.75	14.75	8.75	3.56	21.63	15.13	12.75	19.75	11.75	1.375	.312 x .156	3.0 NPT	3.00	245
68	11.00*	13.00	21.38	8.75	14.75	8.75	3.69	21.63	15.13	12.75	19.75	11.75	1.375	.312 x .156	5.0 NPT	3.00	285
615	11.00*	20.00	28.38	8.75	14.75	8.75	3.69	21.63	16.25	15.00	19.75	11.75	1.375	.312 x .156	6.0 FLG	3.00	425
76	14.00**	11.75	19.94	11.00	18.00	11	4.06	26.13	20.69	19.38	23.25	14.50	1.562	.375 x .188	4.0 NPT	3.50	400
711	14.00**	16.75	25.19	11.00	18.00	11	4.31	26.13	19.50	17.00	23.25	14.50	1.562	.375 x .188	6.0 FLG	3.50	530
718	14.00**	23.75	32.19	11.00	18.00	11	4.31	26.13	19.50	17.00	23.25	14.50	1.562	.375 x .188	8.0 FLG	3.50	650

*17.00 in horizontal configuration
**21.00 in horizontal configuration

Dresser Roots
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European Operations • Phone: +44 (0) 1695 52600 • Email: roots.europe@dresser.com
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Houston, Texas Factory Service • Phone: +1 713-896-4810
Mexico City Sales and Factory Service • Phone: +52 55 5889 5811
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Malaysia Sales • Phone: +60 3 2267 2600
China Sales • Phone: +86 10 8486 2440
Shanghai Factory Service • Phone: +86 21 5858 7638

S-12K84 rev. 0810

DRESSER Roots

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Product Information Packet

EM2333T

15HP,1765RPM,3PH,60HZ,254T,0944M,TEFC,F1

Part Detail

Revision:	A	**Status:**	PRD/A	**Change #:**		**Proprietary:**	No
Type:	AC	**Prod. Type:**	0944M	**Elec. Spec:**	09WGZ910	**CD Diagram:**	
Enclosure:	TEFC	**Mfg Plant:**		**Mech. Spec:**	09P11	**Layout:**	
Frame:	254T	**Mounting:**	F1	**Poles:**	04	**Created Date:**	11-07-2012
Base:	RG	**Rotation:**	R	**Insulation:**	F	**Eff. Date:**	02-01-2013
Leads:	9#12	**Literature:**		**Elec. Diagram:**		**Replaced By:**	

Nameplate NP1259L

CAT.NO.	EM2333T					
SPEC.	09P011Z910G1					
HP	15					
VOLTS	230/460					
AMP	36.2/18.1					
RPM	1765					
FRAME	254T	**HZ**	60	**PH**	3	
SER.F.	1.15	**CODE**	H	**DES**	A	**CL** F
NEMA-NOM-EFF	92.4	**PF**	83			
RATING	40C AMB-CONT					
CC	010A	**USABLE AT 208V**	38			
DE	6309	**ODE**	6208			
ENCL	TEFC	**SN**				

Parts List

Part Number	Description	Quantity
SA253898	SA 09P011Z910G1	1.000 EA
RA240710	RA 09P011Z910G1	1.000 EA
S/P107-000-005	SUPER-E PROC'S(254/6 FR.) ZK PLANT - POL	1.000 EA
HW1002A63	WASHER, 5/8 HI-COLLAR SPRLCKWASHER	1.000 EA
09CB3002SP	CB W/1.38 LEAD HOLE FOR 37, 39, 307 & 30	1.000 EA
09GS1000SP	GASKET-CONDUIT BOX, 1/16 THICK LEXIDE	1.000 EA
10XN2520K12	1/4-20 X.75 GRD 5	2.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	2.000 EA
WD1000B17	T&B CX35TN TERMINAL	1.000 EA
11XW1032G06	10-32 X .38, TAPTITE II, HEX WSHR SLTD U	1.000 EA
09EP1100A194	ENDPLATE, MACH	1.000 EA
XY3816A12	3/8-16 FINISHED NUT	4.000 EA
HW1001A38	LOCKWASHER 3/8, ZINC PLT .688 OD, .382 I	4.000 EA
HW5100A08	W3118-035 WVY WSHR (WB)	1.000 EA
10XN2520K28	1/4-20 X 1.75" HX HD SCRWGRADE 5, ZINC P	2.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	2.000 EA
09EP1101A136	PU ENDPLATE, MACH	1.000 EA
HW4600B44SP	V-RING SLINGER 1.500 X 2.290 X 0.280	1.000 EA
10XN2520K36	1/4-20 X 2.25" HX HD SCRWGRADE 5, ZINC P	4.000 EA
HW1001A25	LOCKWASHER 1/4, ZINC PLT .493 OD, .255 I	4.000 EA
HA3113A02	THRUBOLT 3/8-16 X 16.750	4.000 EA
HW1001A38	LOCKWASHER 3/8, ZINC PLT .688 OD, .382 I	4.000 EA
09FH4000SP	FAN COVER, STAMPED	1.000 EA
HA2081A05	SPACER TUBE, 309 FAN HSG, 2.00 LONG	4.000 EA

Parts List (continued)

Part Number	Description	Quantity
XY3816A12	3/8-16 FINISHED NUT	4.000 EA
HW1001A38	LOCKWASHER 3/8, ZINC PLT .688 OD, .382 I	4.000 EA
09CB3501SP	CONDUIT BOX LID FOR 09CB3001 & 09CB3002	1.000 EA
09GS1013SP	09 GS FOR 09CB3501 LID - LEXIDE	1.000 EA
51XW2520A12	.25-20 X .75, TAPTITE II, HEX WSHR SLTD	2.000 EA
HW2501G25	KEY, 3/8 SQ X 2.875	1.000 EA
LB1115	LABEL,LIFTING DEVICE	1.000 EA
LB5040	INSTRUCTION TAG, AC & DC	1.000 EA
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
HW4500A05	1669B ALEM/UNIV860 GR FTG X	1.000 EA
HW4500A17	317400 ALEMITE GREASE RELIEF	1.000 EA
HA4066A01	PUSH IN T-DRAIN FITTING (BLACK)	1.000 EA
MJ1000A75	GREASE, POLYREX EM EXXON	0.080 LB
HA4051A00	PLASTIC CAP FOR GREASE FITTING	1.000 EA
HW4500A03	GREASE FITTING, .125 NPT 1610(ALEMITE) 8	1.000 EA
HW4500A17	317400 ALEMITE GREASE RELIEF	1.000 EA
HA4066A01	PUSH IN T-DRAIN FITTING (BLACK)	1.000 EA
09FN3001D01SP	EXTERNAL FAN, PLASTIC	1.000 EA
HW2500A25	WOODRUFF KEY USA #1008 #BLOW CARBON STEE	1.000 EA
51XB1214A20	12-14X1.25 HXWSSLD SERTYB	1.000 EA
MG1000Y03	WILKO 689.710 GOLD PAINT SUPER E	0.050 GA
85XU0407A04	#4-7 X 1/4 DRIVE PIN	2.000 EA
LB1119	WARNING LABEL	1.000 EA
LB1125C02	SUPER-E (STOCK CTN LABEL SUPER-E WITH FL	4.000 EA

Parts List (continued)

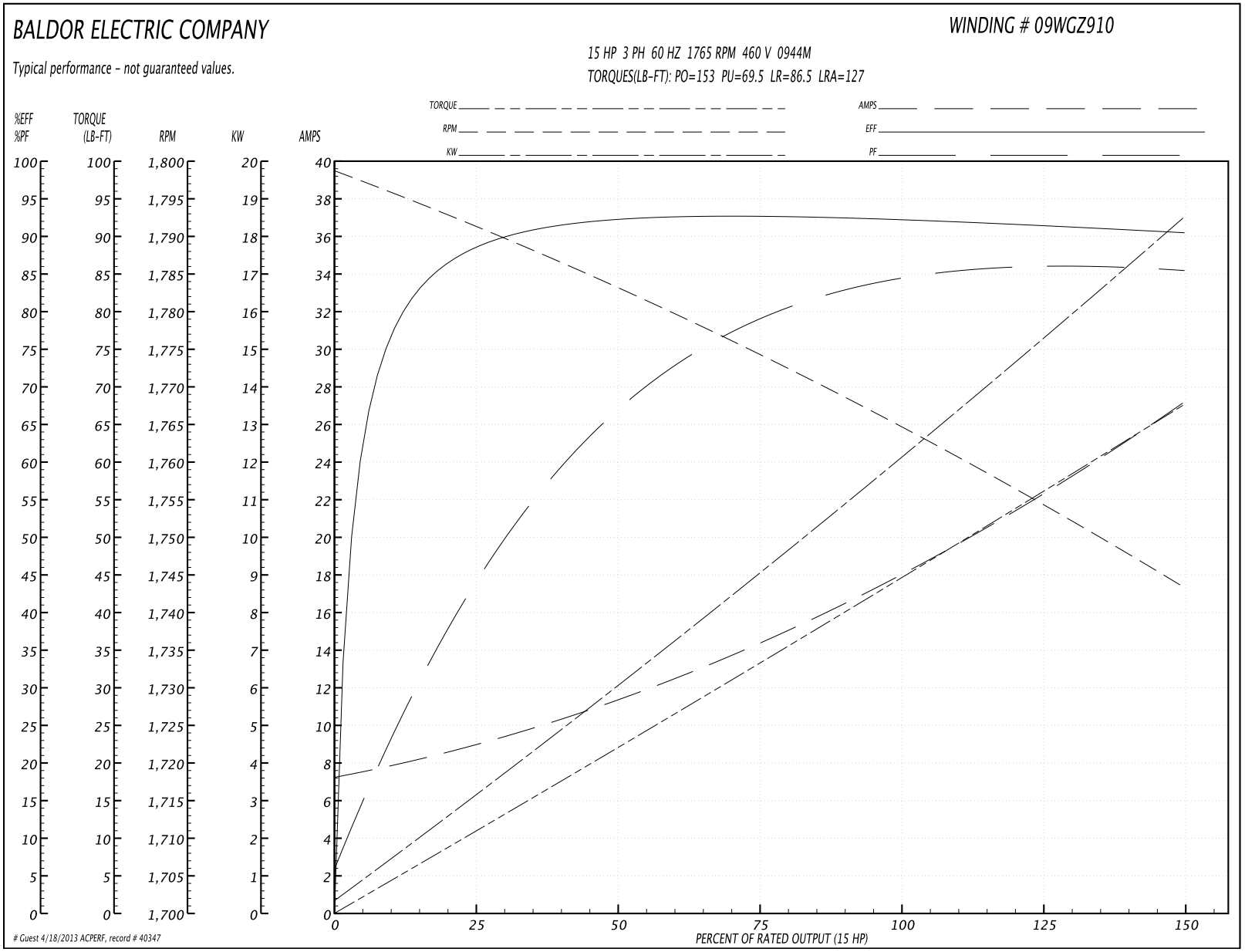
Part Number	Description	Quantity
LC0005	CONN.DIA.,TY M,9-LD,DUAL VOLT,REVERSING	1.000 EA
NP1259L	ALUM SUPER-E UL CSA-EEV CC NEMA PREMIUM	1.000 EA
09PA1000	PACKAGING GROUP COMBINED PRINT	1.000 EA
LB1506	LABEL "AMERICAN MADE" 1.50 X 1.00	1.000 EA

Accessories

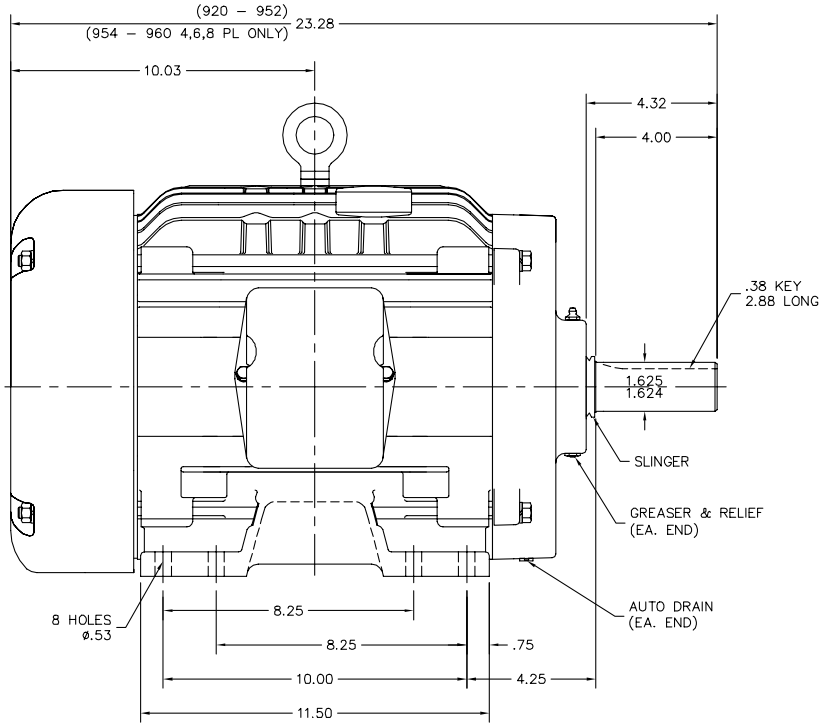
Part Number	Description	Multiplier
09-1309	C FACE KIT (kit may require RB3001A01)	A8

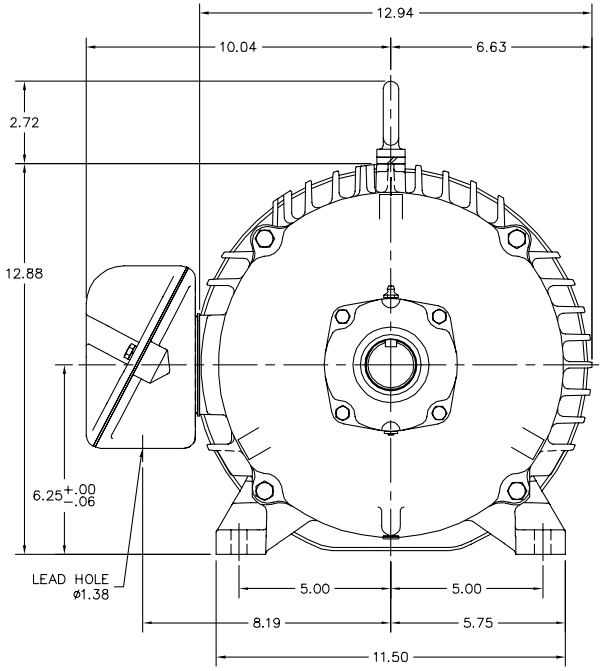
Performance Data at 460V, 60Hz, 15.0HP (Typical performance - Not guaranteed values)							
General Characteristics							
Full Load Torque:	44.5 LB-FT			**Start Configuration:**		DOL	
No-Load Current:	7.56 Amps			**Break-Down Torque:**		153.0 LB-FT	
Line-line Res. @ 25°C.:	0.59555 Ohms A Ph / 0.0 Ohms B Ph			**Pull-Up Torque:**		69.5 LB-FT	
Temp. Rise @ Rated Load:	54 C			**Locked-Rotor Torque:**		86.5 LB-FT	
Temp. Rise @ S.F. Load:	67 C			**Starting Current:**		127.0 Amps	
Load Characteristics							
% of Rated Load	**25**	**50**	**75**	**100**	**125**	**150**	**S.F.**
Power Factor:	45.0	69.0	79.0	83.0	85.0	87.0	84.0
Efficiency:	88.2	92.2	92.7	92.4	91.5	90.4	91.9
Speed:	1791.3	1783.1	1774.0	1765.2	1754.6	1743.1	1759.0
Line Amperes:	8.62	11.0	14.5	18.2	22.6	26.9	20.8

Performance Graph at 460V, 60Hz, 15.0HP Typical performance - Not guaranteed values



09LYP011





09LYP011

CUSTOMER IS RESPONSIBLE FOR DETERMINING THAT BALDOR'S PRODUCT WILL PERFORM SUITABLY IN THE INTENDED APPLICATION.

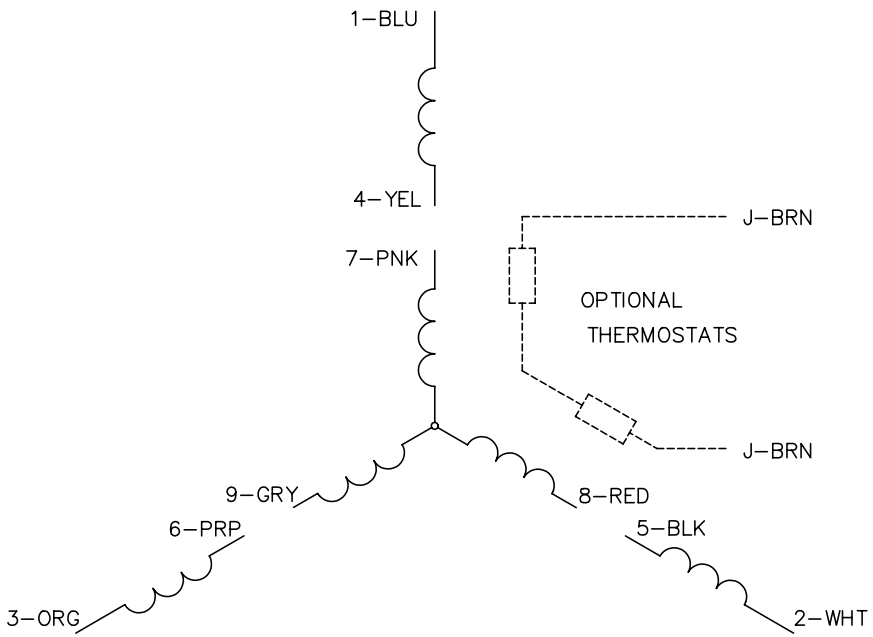
REV. DESC: CHG FH SPACER TO MATCH BOM AND ADJUST OAL		
REV. LTR: K	VERSION: 05	TDR: 000000793196
FILE: \AAA\00026\716	REVISED: 02:17:51 04/03/2013	BY: ENODIDO
MTL: –		

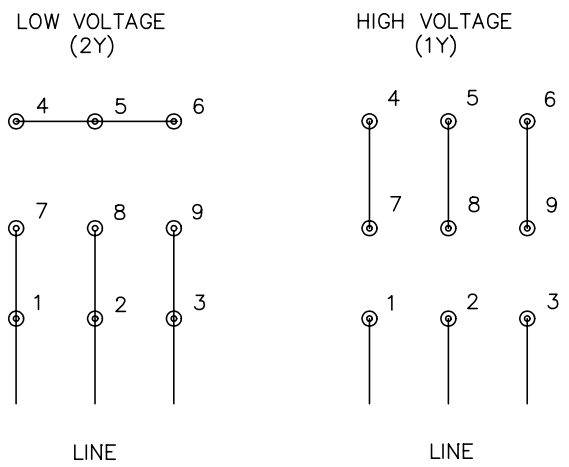
BALDOR

HORZ TEFC 254–6T SUPER–E

SH 1 of 1

CD0005





NOTES:

1. INTERCHANGE ANY TWO LINE LEADS TO REVERSE ROTATION.
2. OPTIONAL THERMOSTATS ARE PROVIDED WHEN SPECIFIED.
3. ACTUAL NUMBER OF INTERNAL PARALLEL CIRCUITS MAY BE A MULTIPLE OF THOSE SHOWN ABOVE.
4. LEAD COLORS ARE OPTIONAL. LEADS MUST ALWAYS BE NUMBERED AS SHOWN.

CD0005

REV. DESC: REVISE TO SHOW OPTIONAL COLORS			BALDOR ELECTRIC Co.
REV. LTR: E	BY: JLP	REVISED: 01/19/99 10:15	TDR: 0171435
CD0005		FILE: AAA00005140	MDL: –
		MTL: –	3PH, DV, 9 LEADS

SENSAPHONE®
REMOTE MONITORING SOLUTIONS

Sensaphone CELL682

Remote Monitoring via Cellular

ASSURANCE

COUNTLESS INDUSTRIES DEPEND ON SENSAPHONE FOR THE MOST COMPREHENSIVE REMOTE MONITORING SOLUTIONS AVAILABLE. WHEN YOU NEED TO BE ABSOLUTELY SURE A REMOTE SITE IS STABLE, SECURE AND MONITORED AROUND THE CLOCK, THERE'S NO SUBSTITUTE FOR CERTAINTY.

Easy to use – everyday

The Sensaphone CELL682 is easy to use – everyday. And we offer free tech support to walk you setup or any problems you may encounter.

We've got a sensor for that

Sensaphone has a sensor for monitoring everything from environmental conditions to security and more.

Your business is our business

With over 400,000 systems installed worldwide, we've put Sensaphone to the test in just about every application imaginable.

Suggested Applications

Agriculture
Know that the temperature, humidity, or other critical conditions where plants or animals live are in check while you're away.

Water & Wastewater
Use your Sensaphone CELL682 to monitor pumps, power failure and other conditions in water and wastewater applications.

Oil & Gas
Don't find out about equipment failure until the morning. The Sensaphone CELL682 will call or e-mail as soon as an alarm condition exists.

Sensaphone CELL682

Features and Specifications

Cellular

Use the CELL682 in locations where a traditional land line is not available. Receive alarms via a phone call, text, or e-mail.

LEDs

LED lights give a quick visual status. Know everything is okay by simply looking at the CELL682.

Power

Comes with a plug in power supply that also monitors for power failures.

Battery Backup

Rest easy knowing that even if the power goes out, the CELL682 will keep monitoring.

Output

Connect to an output such as a light or horn to alert anyone nearby there's a problem.

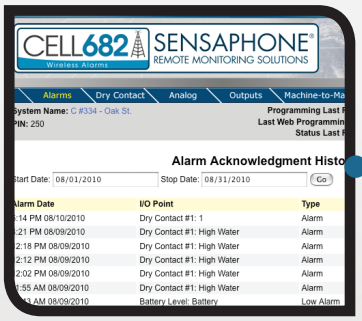
Inputs

Accept fourteen different inputs – a wide range of sensors are available.

Contact Series | 2.8K Series | 10K Series | 4-20mA Series

Enclosure

The CELL682 comes sealed in a NEXA 4X enclosure which allows it to be placed in less than ideal environments.



Web Services

Program, adjust and monitor the status of the sensors on a webpage the CELL682 creates.

Popular Compatible Sensors & Accessories

2.8K Room Temperature Sensor	FGD-0100
2.8K Weatherproof Temperature Sensor	FGD-0101
2.8K Temperature Sensor in Glass Bead Vial	FGD-0107
Temp Alert Temperature Switch	FGD-0022
Humidistat Humidity Switch	FGD-0027
PowerOut Alert Power Failure Switch	FGD-0054
Magnetic Reed Door and Window Switch	FGD-0006
Zone Water Detection Sensor	FGD-0056
Additional 10' of Water Rope	FGD-0063
Infrared Motion Detection Sensor	FGD-0007
Float Switch	FGD-0222

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ASTON, PA 19014

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F: 610-558-0222

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Distributed By:

Sensaphone CELL682 Monitoring System

Call to order: 877 - 373 - 2700

Product Number: FGD-CELL682

Product Name	Sensaphone CELL682 Monitoring System
Product Number	FGD-C682-3GATCD Cell682 w/3G Modem on AT&T with Clear Door FGD-C682-3GATSD Cell682 w/3G Modem on AT&T with Solid Door FGD-C682-3GRWCD Cell682 w/3G Modem on Rogers with Clear Door FGD-C682-3GRWSD Cell682 w/3G Modem on Rogers with Solid Door
Communication Method	Cellular
Number of Inputs	14 Total 6 Analog (Temperature & 4-20mA) 8 Dry Contact Run time accumulation
Input Types	Contact, 2.8K, 10K, 4-20mA
Remote Access	Website to access status and programming
Local Access	LEDs to show alarm status, registration, wireless signal, battery backup status, power status, and output states
Alarm Notification	24 alarm destinations - any combination of e-mail, text message, or custom

	voice phone calls
Power Supply	Plug in power supply also monitors for power failures Built in battery backup
Battery Backup Time	12 hours
Physical	12 x 8 x 6” | 305 x 203 x 152mm 8lbs | 2.7kg
Operating Conditions	-22° to 140°F | -30° to 60°C -40° to 185°F | -40° to 85°C with battery life impact
Other	Communication service required for operation
Warranty	2 Years
Standards	FCC Part 15 Class A, USA Emission Standards
Temperature Sensing Range	2.8K: -100°F to 124°F | -80°C to 55°C 10K: -60°F to 175°F | -51°C to 79°C

Family owned and made in the USA since 1985

901 Tryens Road

Aston, PA 19014

Phone: 888-369-4781

Email: contact@sensaphone.com (mailto:contact@sensaphone.com)

(https://www.facebook.com/sensaphone)

(https://twitter.com/sensaphone)

(https://www.youtube.com/user/sensaphone)

(https://www.linkedin.com/company/9372170?trk=tyah&trkInfo=clickedVertical%3Acompany%2Cidx%3A1-1-1%2CtarId%3A1427808956791%2Ctas%3Asensaphon)

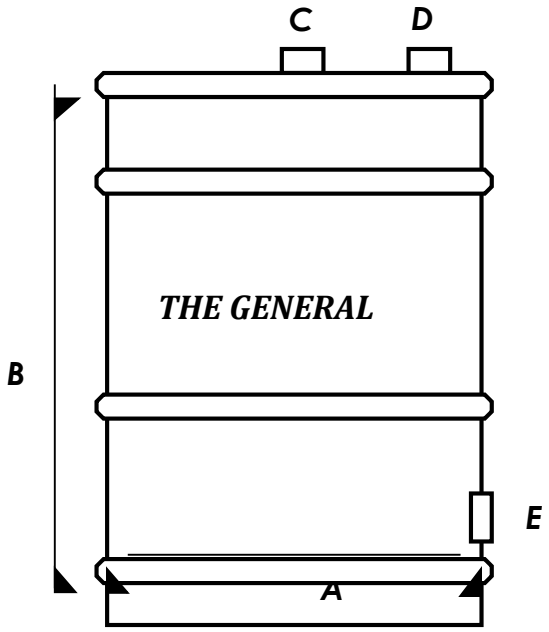
"CLEANING THE WORLD WITH ACTIVATED CARBON"

GENERAL CARBON CORP.

THE GENERAL

air pollution control barrels

THE GENERAL AIR POLLUTION CONTROL BARRELS are ready to use, low cost, self-contained air purification adsorbers designed to treat airflows streams of up to 250 CFM. The units are available in four different sizes to better serve your treatment applications.



SPECIFICATIONS	30 GALLON	55 GALLON	85 GALLON	110 GALLON
A - Diameter, Outside	19 -1/2"	24"	28"	32"
B – Height, Outside	29"	35"	39"	43"
Inlet Fitting	E - 2" MPT	E - 2" MPT	C - 4" FPT	C - 4" FPT
Outlet Fitting	C - 2" MPT	C - 2" MPT	D - 4" FPT	D - 4" FPT
Drain Fitting	E - 2" FPT	E - 2" FPT	E - 1" FPT	E - 1" FPT
Carbon Weight, lbs.	90	150	300	400
Max. Recommended Flow Rate, CFM	100	100	180	250
Maximum Pressure, psig	7	10	7	7
Maximum Design Temp., Deg F	140	140	140	140
Flow Direction	Upflow	Upflow	Upflow	Upflow

Activated Carbon - The General vapor adsorbers are filled with virgin, high activity, activated carbon. Any of virgin coal, coconut shell, reactivated or impregnated carbons are available as well.

Removable Lid - 16 gauge lid with ring & bolt closure, poly-clad cellulose gasket.

Connections - Metal connections with standard pipe threads insure easy, durable and leak proof hookup to your system. Unions or quick connect fittings are advised to make drum exchange easy. Drains let you remove any accumulated condensate.

Flow Distributors - The 55 gallon barrel uses an air chamber to insure even distribution of the airflow through the carbon. Low-pressure drop slotted Schedule 40 PVC collectors are used in the 85 gallon and 110 gallon drums for proper flow distribution. Stainless Steel internals and drums are available for special applications.

Coatings - The General pollution control barrels are coated on the inside with heat cured phenolic epoxy. The outside coating is industrial enamel. A polyethylene liner is available for extra corrosion resistance for the 55 gallon and 85 gallon units.

Installation & Start Up - The General air pollution control barrel requires no special procedure for startup. Just connect the inlet and outlet to the treatment system and start it up. Multiple units are usually connected in series with testing advised between the units to determine when the first unit needs to be changed out.

Maintenance - Once connected, The General requires no maintenance other than the monitoring of the influent and effluent air streams and the operating pressure of the system. Monitoring the air stream into the last Air Pollution Control Barrel in series mode is a recommended safeguard against breakthrough in the final discharge. When the concentration of contaminants in the outflow equals the concentration in the inflow, The General has reached its removal capacity and should be removed from service. The working life of each adsorber is dependent upon the type of contaminant in the air as well as its concentration and the airflow rate. A pressure relief device is advised to prevent damage to the canister in the event of excessive pressure buildup.

Recharging The General - Once the carbon has reached its pollutant removal capacity, the unit should be removed and replaced with a fresh one. To purchase replacement carbon or to arrange for a carbon change out, please contact our office.

Disposal - Dispose of the spent carbon in accordance with Federal, State and Local regulations.

Caution!

Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels. Confined space / low oxygen procedures should be put in place before any entry is made. Such procedures should comply with all applicable local, state and federal guidelines.

33 Paterson Street, Paterson, New Jersey 07501 Tel: 973 523 2223 Fax: 973 523 1494
www.generalcarbon.com sales@generalcarbon.com

GENERAL CARBON CORP.

GC 4 x 8S

coconut shell granular activated carbon

GC 4x8S granular activated carbon is ideal for most air purification purposes. Made from selected grades of coconut shell, its superior level of hardness makes it cleaner than most other carbons and gives it longer life expectancy. This, combined with its high activity level, makes it well suited for use in any kind of carbon filter or system.

Specifications

Mesh Size - 4x8, %:	90 (min)
Less than No. 4, %:	5 (max)
Greater than No. 8, %:	5 (max)
CCl4 Activity, %:	60 (min)
Iodine No., mg/g:	1100 (min)
Hardness No., %:	98 (min)
Ash Content, %:	5 (max)
Moisture, % (as packaged):	5 (avg)
Typical Density, lbs./cu.ft.:	29-32
g/cc:	0.47-0.50

*****Standard packaging is in 55 lb. vinyl bags. Other packaging is available upon request.

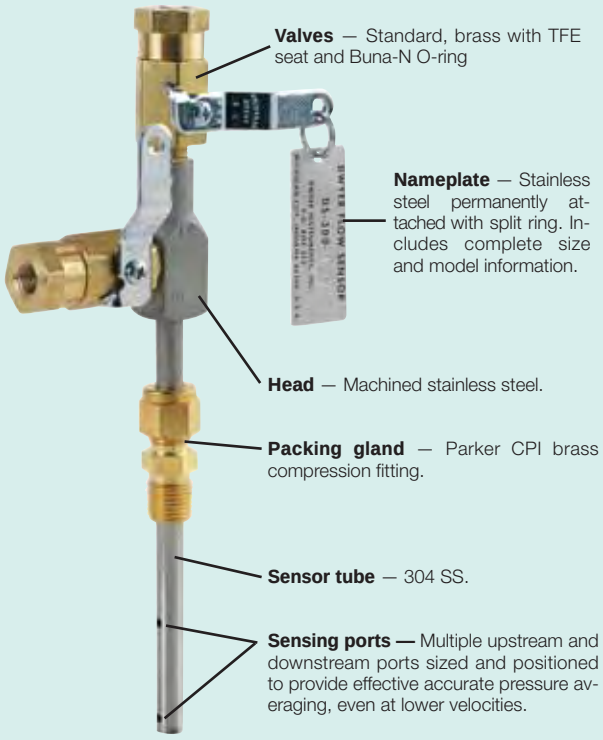
Caution!

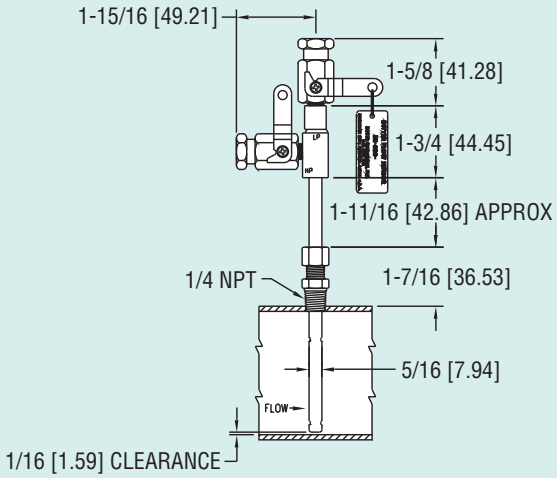
Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels. Confined space/low oxygen procedures should be put in place before any entry is made. Such procedures should comply with all applicable Local, State and Federal guidelines.

33 Paterson Street, Paterson, New Jersey 07501 Tel: 973 523 2223 Fax: 973 523 1494
www.generalcarbon.com sales@generalcarbon.com

Series DS In-Line Flow Sensors

Use with the Dwyer® Differential Pressure Gages or Transmitters





In-Line Flow Sensors are averaging Pitot tubes that provide accurate and convenient flow rate sensing for schedule 40 pipe. When purchased with a Dwyer® Capsuhelic® differential pressure gage of appropriate range, the result is a flow indicating system delivered off the shelf at an economical price.

Pitot tubes have been used in flow measurement for years. Conventional pitot tubes sense velocity pressure at only one point in the flowing stream. Therefore, a series of measurements must be taken across the stream to obtain a meaningful average flow rate. The Dwyer® flow sensor eliminates the need for "traversing" the flowing stream because of its multiple sensing points and built-in averaging capability.

The Series DS-300 flow sensors are designed to be inserted in the pipeline through a compression fitting. They are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® gage kit. Standard valves are rated at 200 psig (13.7 bar) and 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 flow sensors are available for pipe sizes from 1″ to 10″.

DS-400 Averaging Flow Sensors are quality constructed from extra strong 3/4″ dia. stainless steel to resist increased forces encountered at higher flow rates with both air and water. This extra strength also allows them to be made in longer insertion lengths up to 24 inches (61 cm). All models include convenient and quick-acting quarter-turn ball valves to isolate the sensor for zeroing. Process connections to the valve assembly are 1/8″ female NPT. A pair of 1/8″ NPT X 1/4″ SAE 45° flared adapters are included, compatible with hoses used in the Model A-471 Portable Capsuhelic® Gage Kit. Supplied solid brass mounting adapter has a 3/4″ dia. compression fitting to lock in required insertion length and a 3/4″ male NPT thread for mounting in a Threaded Branch Connection.

Select model with suffix which matches pipe size

DS-300-1″
DS-300-1-1/4″
DS-300-1-1/2″
DS-300-2″
DS-300-2-1/2″
DS-300-3″
DS-300-4″
DS-300-6″
DS-300-8″
DS-300-10″

DS-400-6″
DS-400-8″
DS-400-10″
DS-400-12″
DS-400-14″
DS-400-16″
DS-400-18″
DS-400-20″
DS-400-24″

Options and Accessories

A-160 Threaded Branch Connection, 3/8″ NPT, forged steel, 3000 psi

A-161 Brass Bushing, 1/4″ x 3/8″

DS-300 Less Valves. To order, add suffix **-LV**

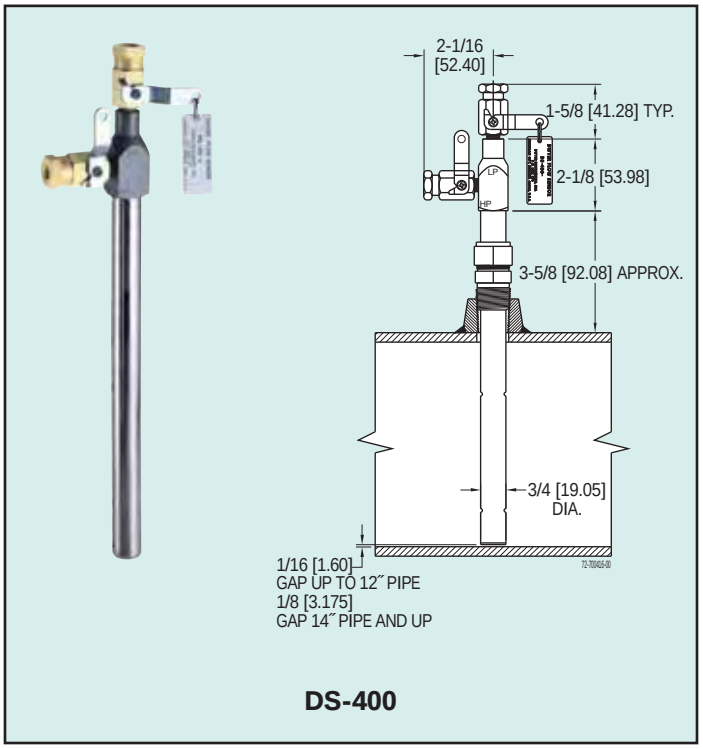
How To Order

Merely determine the pipe size into which the flow sensor will be mounted and designate the size as a suffix to Model DS-300. For example, a flow sensor to be mounted in a 2˝ pipe would be a Model No. DS-300-2˝.

For non-critical water and air flow monitoring applications, the chart below can be utilized for ordering a stock Capsuhelic® differential pressure gage for use with the DS-300 flow sensor. Simply locate the maximum flow rate for the media being measured under the appropriate pipe size and read the Capsuhelic® gage range in inches of water column to the left. The DS-300 sensor is supplied with installation and operating instructions, Bulletin F-50. It also includes complete flow conversion information for the three media conditions shown in the chart below. This information enables the user to create a complete differential pressure to flow rate conversion table for the sensor and differential pressure gage employed. Both the Dwyer® Capsuhelic® gage and flow sensor feature excellent repeatability so, once the desired flow rate is determined, deviation from that flow in quantitative measure can be easily determined. You may wish to order the adjustable signal flag option for the Capsuhelic® gage to provide an easily identified reference point for the proper flow.

Capsuhelic® gages with special ranges and/or direct reading scales in appropriate flow units are available on special order for more critical applications. Customer supplied data for the full scale flow (quantity and units) is required along with the differential pressure reading at that full flow figure. Prior to ordering a special Capsuhelic® differential pressure gage for flow read-out, we recommend you request Bulletin F-50 to obtain complete data on converting flow rates of various media to the sensor differential pressure output. With this bulletin and after making a few simple calculations, the exact range gage required can easily be determined.

Large 3/4 Inch Diameter for Extra Strength in Lengths to 24 Inches



DS-400

GAGE RANGE (IN. W.C.)	MEDIA @ 70°F	FULL RANGE FLOWS BY PIPE SIZE (APPROXIMATE)									
		1˝	1-1/4˝	1-1/2˝	2˝	2-1/2˝	3˝	4˝	6˝	8˝	10˝
2	Water (GPM) Air @ 14.7 PSIA (SCFM) Air @ 100 PSIG (SCFM)	4.8 19.0 50.0	8.3 33.0 90.5	11.5 42.0 120.0	20.5 65.0 210.0	30 113 325	49 183 510	86 330 920	205 760 2050	350 1340 3600	560 2130 6000
5	Water (GPM) Air @ 14.7 PSIA (SCFM) Air @ 100 PSIG (SCFM)	7.7 30.0 83.0	14.0 51.0 142.0	18.0 66.0 190.0	34.0 118.0 340.0	47 178 610	78 289 820	138 510 1600	320 1200 3300	560 2150 5700	890 3400 10000
10	Water (GPM) Air @ 14.7 PSIA (SCFM) Air @ 100 PSIG (SCFM)	11.0 41.0 120.0	19.0 72.0 205.0	25.5 93.0 275.0	45.5 163.0 470.0	67 250 740	110 410 1100	195 725 2000	450 1690 4600	800 3040 8100	1260 4860 15000
25	Water (GPM) Air @ 14.7 PSIA (SCFM) Air @ 100 PSIG (SCFM)	18.0 63.0 185.0	32.0 112.0 325.0	40.5 155.0 430.0	72.0 255.0 760.0	108 390 1200	173 640 1800	310 1130 3300	720 2630 7200	1250 4860 13000	2000 7700 22000
50	Water (GPM) Air @ 14.7 PSIA (SCFM) Air @ 100 PSIG (SCFM)	25.0 90.0 260.0	44.0 161.0 460.0	57.5 205.0 620.0	100.0 360.0 1050.0	152 560 1700	247 900 2600	435 1600 4600	1000 3700 0000	1800 6400 18500	
100	Water (GPM) Air @ 14.7 PSIA (SCFM) Air @ 100 PSIG (SCFM)	36.5 135.0 370.0	62.0 230.0 660.0	82.0 300.0 870.0	142.0 505.0 1500.0	220 800 2300	350 1290 3600	620 2290 6500	1500 5000 5000		

Model A-471 Portable Kit

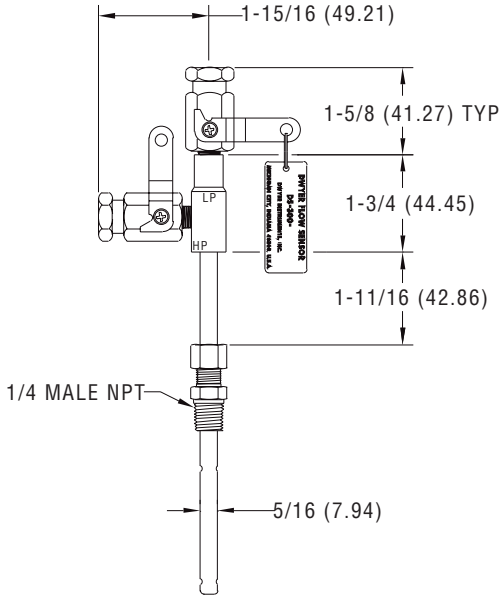
The Dwyer® Series 4000 Capsuhelic® differential pressure gage is ideally suited for use as a read-out device with the DS-300 Flow Sensors. The gage may be used on system pressures of up to 500 psig even when the flow sensor differential pressure to be read is less than 0.5˝ w.c. With accuracy of ±3% of full scale, the Capsuhelic® gage can be used in ambient temperatures from 32 to 200°F (0 to 93.3°C). Zero and range adjustments are made from outside the gage. The standard gage with a die cast aluminum housing can be used with the flow sensor for air or oil applications. For water flow measurements, the optional forged brass housing should be specified. The Capsuhelic® gage may be panel or surface mounted and permanently plumbed to the flow sensor if desired. The optional A-610 pipe mounting bracket allows the gage to be easily attached to any 1-1/4˝ - 2˝ horizontal or vertical pipe.

For portable operation, the A-471 Capsuhelic® Portable Gage Kit is available complete with tough polypropylene carrying case, mounting bracket, 3-way manifold valve, two 10' high pressure hoses, and all necessary fittings. See pages 8 and 9 for complete information on the Capsuhelic® gage.

CAPSUHELIC® GAGE SHOWN INSTALLED IN A-471 PORTABLE KIT

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations



Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46361, U.S.A.
Phone: 219/879-8000 **www.dwyer-inst.com**
Fax: 219/872-9057 **e-mail: info@dwyer-inst.com**

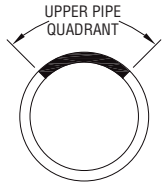
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

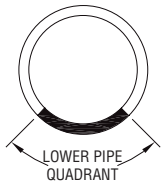
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. Tighten packing gland nut finger tight. Then tighten nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

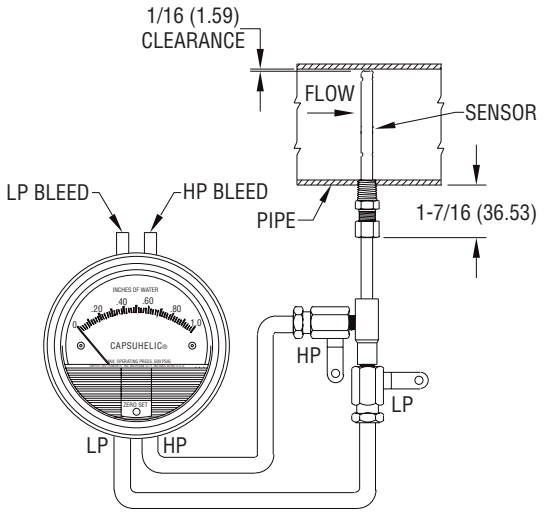
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

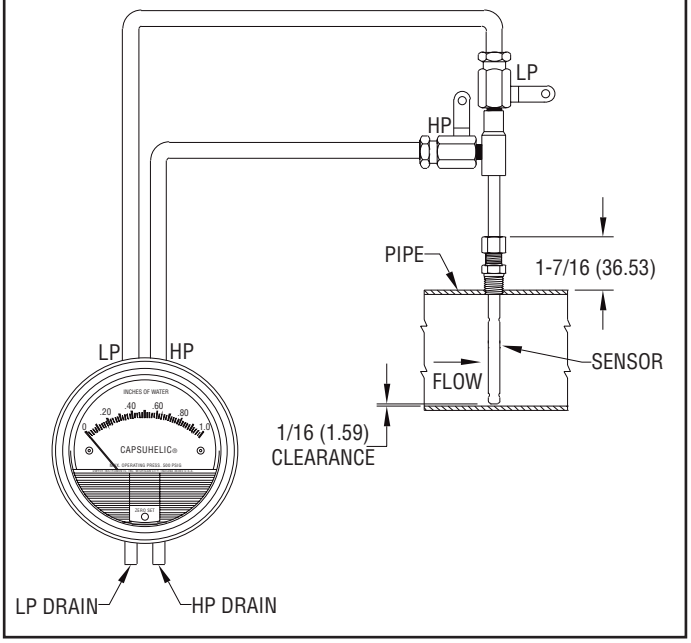
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

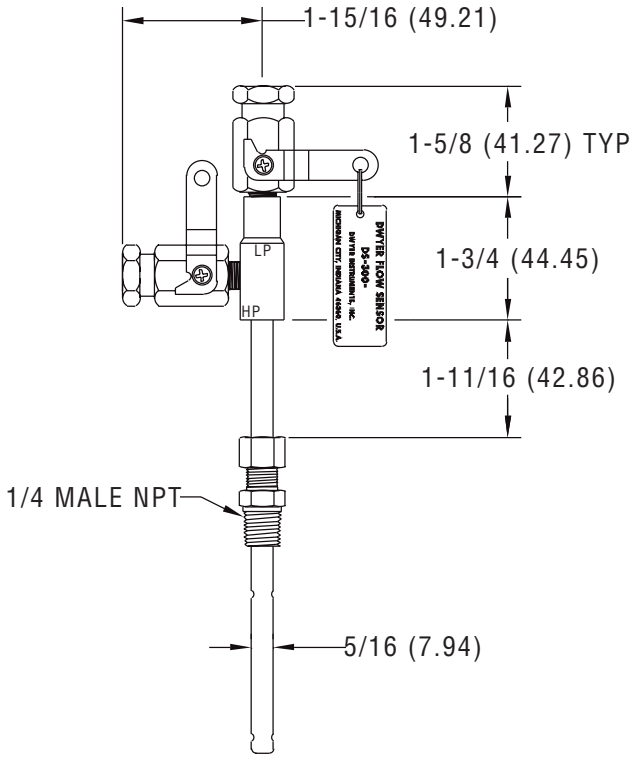
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 “Flow of Fluids Through Valves, Fittings and Pipe.” It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient “K”	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Water @ 70°F (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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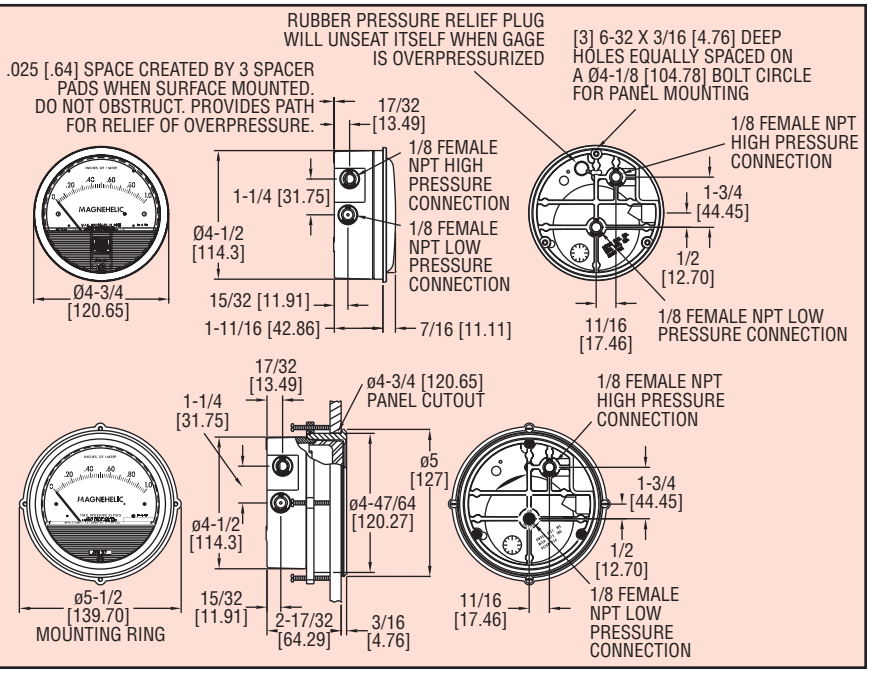
Series 2000

Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%



Scan here to watch product video

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.❶

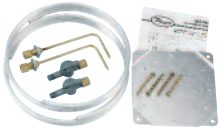
SPECIFICATIONS

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.❷
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.

ACCESSORIES

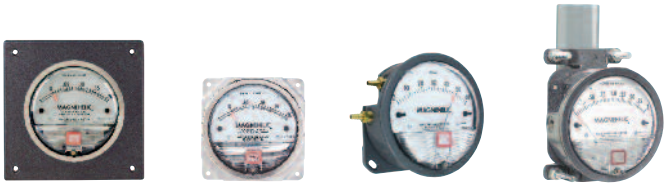
Model A-432 Portable Kit
Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft (2.7 m) of 3/16″ ID rubber tubing, standhang bracket and terminal tube with holder.



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



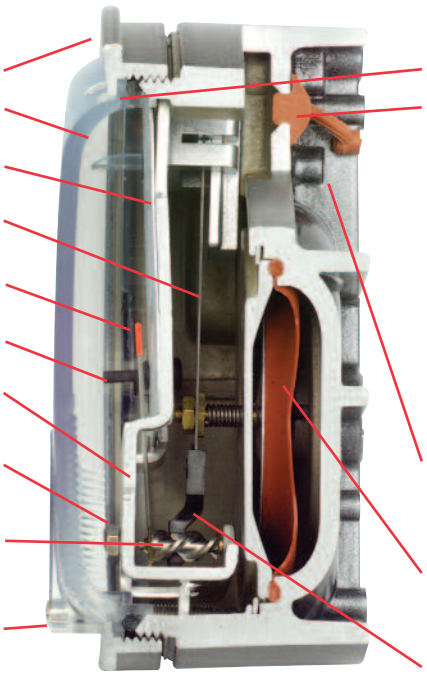
Flush, Surface, Integrated Plate or Pipe Mounted

Enclosure Mounted

❶See page 7 (Magnehelic® Gage Mounting Accessories)
❷Over Protection Note: See page 5 (Series 2000)

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.

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.

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.

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.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

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-401, Plastic Carry Case

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.

Type 1490 Low Pressure Diaphragm Gauge

- *Glass-filled polysulfone case material, won't rust or dent*
- *Beryllium copper diaphragm*
- *Brass socket*
- *Wetted materials of beryllium copper, brass, polysulfone and RTV silicone*

The Ashcroft® Type 1490 low pressure diaphragm gauge is designed to measure pressure from 10 in. H_2O to 15 psi, both positive and negative pressures. This gauge uses a very sensitive diaphragm capsule to measure low pressure and vacuum. The gauge is specifically designed for use whenever the pressure medium is a gas that is not corrosive to beryllium copper, brass, polysulfone and RTV silicone. The polysulfone case is suitable for intermittent or continuous service on natural gas provided a .013 throttle plug is installed in the socket. Typical applications are, but not limited to, vacuum pumps, gas leak detectors, air compressors, air filters, gas burners, gas measurement, vacuum ovens, suction regulators and respirators.

PRODUCT SPECIFICATIONS

Model Number:	1490
Accuracy:	±2-1-2% full scale (Grade A, ASME B40.100)
Ranges:	10 in. H_2O through 15 psi including vac. and compound
Dial Size:	2½″ and 3½″ diameter
Case Material:	Black, glass filled polysulfone
Socket Material:	Brass
Movement:	Brass
Sensing Element:	Beryllium copper diaphragm
Wetted Material:	Beryllium copper, brass, polysulfone and RTV silicone
Window:	Polycarbonate, quarter turn bayonet style mounting
Dial:	Aluminum, white background, black figures and intervals.
Pointer:	Black, aluminum, fixed
Connection Size:	⅛ NPT (01) ¼ NPT (02) ⅛″ tubing hose barb (HD) 3⁄16″ tubing hose barb (HE) ¼″ tubing hose barb (HF) ¼″ O.D. polytube hose barb (HG) 10-32 2B female thread (HH)
Connection Location:	Lower (L) Center Back (B) Top (T) 3 o'clock (D) 9 o'clock (E)
Operating Temperature:	–20 to 180°F
Proof Pressure:	150% of range
Burst Pressure:	Up to 5 psi = 50 psi Greater than 5 psi = 100 psi

OPTIONAL FEATURES

1% Accuracy:	XAN
Dial Marking:	XDA
Stainless Steel Tag:	XNH
Paper Tag:	XNN
Throttle Plug:(1)(3)	XTU
Throttle Screw:(4)	XTS
U-clamp:(2)	XUC
FlutterGuard™:	XZY

(1) A throttle plug must be installed in the socket whenever the gauge is used for intermittent or continuous service on natural gas.
(2) U-clamp furnished when hose barb or female thread is specified.
(3) Throttle plug not available with hose barb or female thread connections.
(4) .020 throttle screw available with HH connection only.

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

Type 1490 Low Pressure Diaphragm Gauge

lower range for wellheads and manifold, higher ranges for post manifold

STANDARD RANGES		
Pressure	**Figure Intervals**	**Minor Graduation**
0/10 in.H_2O	1	0.1
0/15 in.H_2O	5	0.2
0/30 in.H_2O	5	0.5
0/60 in.H_2O	10	1
0/100 in.H_2O	10	1
0/160 in.H_2O	20	2
0/200 in.H_2O	20	2
0/300 in.H_2O	50	5
0/10 oz./in.^{2}	1	0.1
0/15 oz./in.^{2}	5	0.2
0/30 oz./in.^{2}	5	0.5
0/60 oz./in.^{2}	10	1
0/100 oz./in.^{2}	10	1
0/160 oz./in.^{2}	20	2
0/250 oz./in.^{2}	50	5
0/3 psi	0.5	0.05
0/5 psi	1	0.1
0/10 psi	1	0.1
0/15 psi	5	0.2

STANDARD RANGES (Cont.)		
Vacuum	**Figure Intervals**	**Minor Graduation**
15/0 in.H_2O	5	0.2
30/0 in.H_2O	5	0.5
60/0 in.H_2O	10	1
100/0 in.H_2O	10	1
200/0 in.H_2O	20	2
15/0 oz./in.^{2}	5	0.2
30/0 oz./in.^{2}	5	0.5
60/0 oz./in.^{2}	10	1
100/0 oz./in.^{2}	10	1
Compound		
–30/30 in.H_2O	10	1
–30/30 in.oz./in.^{2}	10	1
–10/10 in.H_2O	2	0.2

Dual Scale

Range		Graduations			
		Inner Scale		Outer Scale	
Inner Scale	**Outer Scale**	**Figure Intervals**	**Minor Grad.**	**Figure Intervals**	**Minor Grad.**
0/9 oz./in.^{2}	0/15 in.H_2O	1	0.2	5	0.2
0/20 oz./in.^{2}	0/35 in.H_2O	5	0.5	5	0.5
0/35 oz./in.^{2}	0/60 in.H_2O	5	0.5	10	1
0/60oz./in.^{2}	0/100 in.H_2O	10	1	10	1

Other ranges available on request. Consult factory.

STANDARD METRIC RANGES		
Pressure	**Figure Intervals**	**Minor Graduation**
0/60 cm. H_2O	10	1
0/2.5 kPa	0.5	0.05
0/4 kPa	1	0.1
0/10 kPa	1	0.1
0/16 kPa	2	0.2
0/25 kPa	5	0.5
0/40 kPa	10	1
0/100 kPa	10	1
Vacuum		
2.5/0 kPa	0.5	0.05
4/0 kPa	1	0.1
10/0 kPa	1	0.1
16/0 kPa	2	0.2
25/0 kPa	5	0.5
40/0 kPa	10	1
100/0 kPa	10	1
Compound		
–10/60 cm H_2O	10	1
–10/80 cm H_2O	10	1
–20/40 cm H_2O	10	1
–10/100 cm H_2O	10	1
–10/120 cm H_2O	20	2

SELECTION TABLE

Dial Size		Type		Wetted Material		Conn. Size & Type		Connection Location		Ranges		Optional Features	
Code	**Desc.**	**Code**	**Description**	**Code**	**Description**	**Code**	**Description**	**Code**	**Description**	**Code**	**Description**	**Code**	**Description**
25	2½″	1490	Low Pressure Diaphragm Gauge	A	Beryllium Copper Brass Polysulfone RTV Silicone	01	⅛ NPT	L	Lower	10 IW	0 to 10 in.H_2O	XAN	1% Opt. Accuracy
35	3½″					02	¼ NPT	B	Center Back			XDA	Dial Marking
						HD	⅛″ I.D.Tubing Hose Barb[2,3]	T	Top		See Chart for Entire List of Ranges	XNH	Stain. Steel Tag
						HE	3/16″ I.D.Tubing Hose Barb[2,3]	D	3 O'Clock			XNN	Paper Tag
						HF	¼″ I.D.Tubing Hose Barb[2,3]	E	9 O'Clock			XTU[1,3]	Throttle Plug
						HG	¼″ O.D. Polytube Hose Barb[2,3]					XTS[4]	Throttle Screw
						HH	10-32-2B Female Thread[2,3,5]					XUC[2]	U-clamp
												XZY	FlutterGuard™

(1) A throttle plug must be installed in the socket whenever the gauge is used for intermittent or continuous service on natural gas.
(2) U-clamp furnished when hose barb or female thread is specified.
(3) Throttle plug not available with hose barb or female thread connections.
(4) .020 throttle screw available with HH connection only.

HOW TO ORDER: 25 1490 A 02L XXX 10 IW

1. Dial size – 2½ (25), 3½ (35)
2. Case type
3. Wetted material
4. Connection size – ¼ (02), ⅛ (01)
5. Connection location – Lower (L), Back (B)
6. Optional features
7. Standard pressure range – 10 in.H_2O

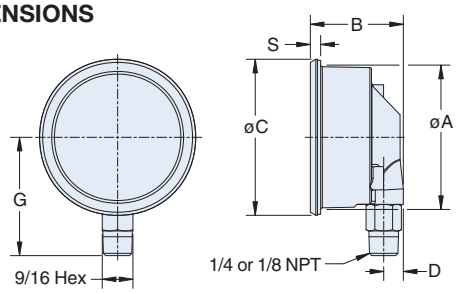
ISO 9001
REGISTERED FIRM

BULLETIN DG-1490

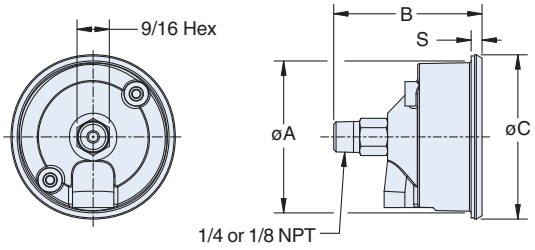
Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
Tel: 203-378-8281 • Fax: 203-385-0408
email: info@ashcroft.com • www.ashcroft.com

Type 1490 Low Pressure Diaphragm Gauge

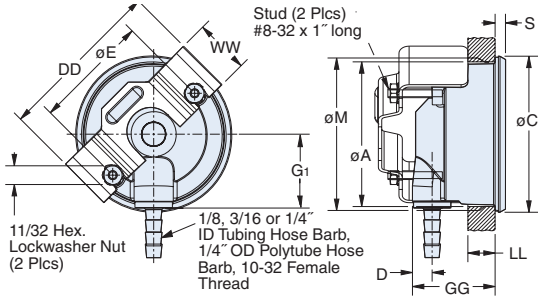
DIMENSIONS



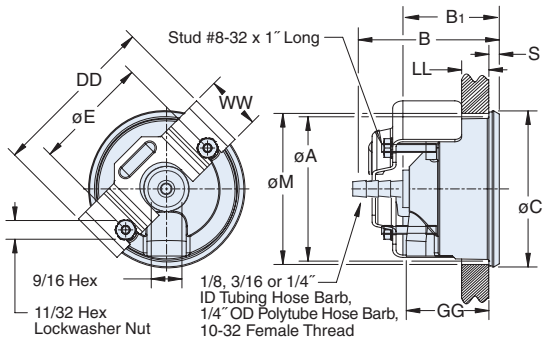
Size	øA	B	øC	D	G	S
25	2 19/32 (66)	1 23/32 (44)	2 7/8 (73)	3/8 (10)	2 3/16 (55)	13/64 (5)
35	3 21/32 (93)	1 11/16 (43)	3 31/32 (101)	3/8 (10)	2 23/32 (69)	13/64 (5)



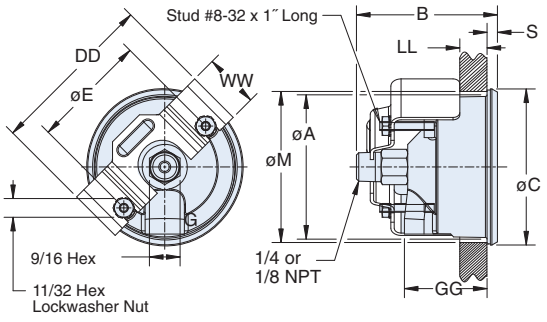
Size	øA	B	øC	S
25	2 19/32 (66)	2 19/32 (66)	2 7/8 (73)	13/64 (5)
35	3 21/32 (93)	2 9/16 (65)	3 31/32 (101)	13/64 (5)



Size	øA	øC	D	øE	G				G1	øM	S	DD	GG	LL Max.	WW
					1/8 ID Tubing	3/16 ID Tubing	1/4 ID Tubing	1/4 OD Tubing	10-32 Female						
25	2 19/32 (66)	2 7/8 (73)	3/8 (10)	2 1/8 (54)	1 3/4 (44)	2 1/8 (54)	2 9/32 (54)	1 3/4 (44)	1 11/32 (34)	2 21/32 (67)	13/64 (5)	3 1/16 (78)	1 19/32 (40)	1/2 (13)	1 (25)
35	3 21/32 (93)	3 31/32 (101)	3/8 (10)	3 3/16 (67)	2 5/16 (59)	2 21/32 (81)	2 13/16 (54)	2 5/16 (59)	1 31/32 (50)	3 3/4 (95)	13/64 (5)	4 1/8 (105)	1 17/32 (39)	1/2 (13)	1 (25)



Size	øA	B				B1	øC	øE	øM	S	DD	GG	LL Max.	WW
		1/8 ID Tubing	3/16 ID Tubing	1/4 ID Tubing	1/4 OD Tubing	10-32 Female								
25	2 19/32 (66)	2 3/16 (55)	2 17/32 (64)	2 11/16 (68)	2 3/16 (55)	1 25/32 (45)	2 7/8 (73)	2 1/8 (54)	2 21/32 (67)	13/64 (5)	3 1/16 (78)	1 19/32 (40)	1/2 (13)	1 (25)
35	3 21/32 (93)	2 1/8 (54)	2 1/2 (63)	2 21/32 (67)	2 1/8 (54)	1 23/32 (44)	3 31/32 (101)	3 3/16 (81)	3 3/4 (95)	13/64 (5)	4 1/8 (105)	1 17/32 (39)	1/2 (13)	1 (25)



U-clamp Option

Size	øA	B	øC	øE	øM	S	DD	GG	LL MAX	WW
25	2 19/32 (66)	2 19/32 (66)	2 7/8 (73)	2 1/8 (54)	2 21/32 (67)	13/64 (5)	3 1/16 (78)	1 19/32 (40)	1/2 (13)	1 (25)
35	3 21/32 (93)	2 9/16 (65)	3 31/32 (101)	3 3/16 (81)	3 3/4 (95)	13/64 (5)	4 1/8 (105)	1 17/32 (39)	1/2 (13)	1 (25)

Ashcroft Inc., 250 East Main Street, Stratford, CT 06614 USA
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email: info@ashcroft.com • www.ashcroft.com

VIBRATION-RESISTANT LIQUID-FILLED GAUGES

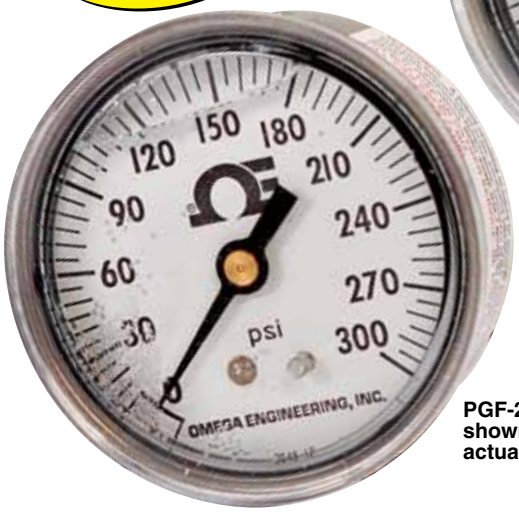
30 inHg to 10,000 psi

Liquid-Filled for Vibration Resistance

PGF Series

1 YEAR WARRANTY

PGF-25L-400 lower fitting shown smaller than actual size.



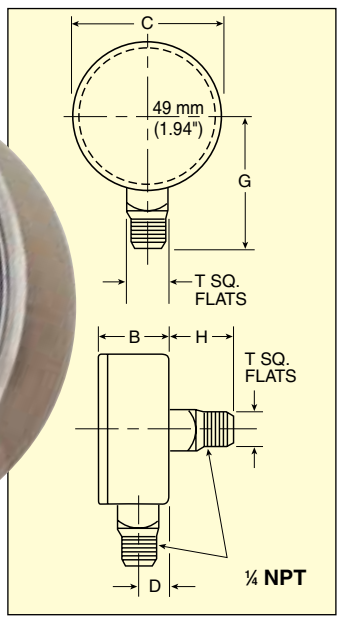
PGF-25B-300 back fitting shown smaller than actual size.

- **Easy-to-Read 64 mm (2½") Dial**
- **Superior Performance in Vibration, Pulsation, Shock Environments**
- **Leakproof O-Ring Seal**
- **Lower and Back Mounts**

SPECIFICATIONS

Case: Stainless steel
Wetted Parts: Brass/bronze
Window: Polycarbonate with O-ring seal
Fill Fluid: Glycerine
Temperature: 66°C (150°F) maximum
Fitting: ¼ NPT brass
Accuracy: ±3-2-3%

PGF-25B-1000 back fitting shown smaller than actual size.



RangeTable

CODE psi	FIGURE INTERVAL	MINOR TICKS
15	1	0.5
30	5	0.5
60	5	1
100	10	1
200	20	5
300	30	5
400	50	10
600	50	10
1000	200	20
3000	500	100
5000	1000	100
10,000	1000	200
VACUUM		
30V inHg	5 inHg inches	0.5 inHg inches

Dimensions: mm (inch)

GAUGE	B	C	D	G	H	T	WEIGHT
Back	31 (1.21)	69 (2.71)	N/A	N/A	22 (0.88)	14 (0.56)	21 kg (0.47 lb)
Lower	31 (1.21)	69 (2.71)	12 (0.46)	56 (2.20)	N/A	14 (0.56	21 kg (0.47 lb)

To Order ***Visit omega.com/pgf for Pricing and Details***

DIAL DIAMETER.	MODEL NO.	CONNECTION
64 mm (2½")	**PGF-25B-[*]**	Back
64 mm (2½")	**PGF-25L-[*]**	Lower

***[*]** Insert range from Range Table at left.*
***Ordering Examples: PGF-25B-100,** back-mount gauge with a pressure range to 100 psi.*
***PGF-25L-3000,** lower-mount gauge with pressure range of 0 to 3000 psi.*

Series VFC & VFCII

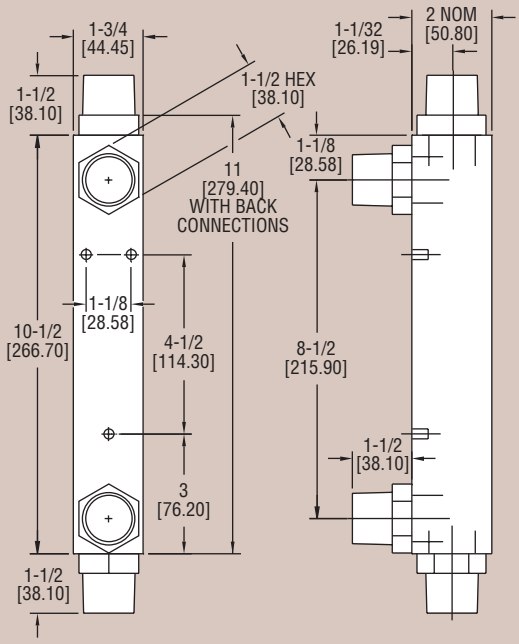
Visi-Float® Flowmeters

Used to Indicate Air or Water Flow

VFCII with 1″ MNPT End Connections

VFC with 1″ FNPT End Connections

VFC with 1″ FNPT Back Connections



Scan here to watch product video

The accurate and durable VFC Visi-Float® flowmeter contains a stainless steel guide rod and large diameter float for excellent stability and visibility in high flow rates. The large 5″ scale provides a ±2% full-scale accuracy for precision measurement required in medical or laboratory applications. The VFC models have PVC 1″ female NPT connections. VFC II units are equipped with acetal thermoplastic 1″ male NPT fittings. VFC II fittings also include hex wrench flats to prevent stripped threads. All models have metal mounting inserts on the back for panel mounting. Units may also be supported directly by system piping.

How To Order
Series—Range No.—Option
Example: VFC-123-EC
Series VFC with 10-100 SCFM Air Range and 1″ female NPT End Connections

VFC

Model	Thread Type	Process Connection
VFC-X	1″ FNPT	Back
VFCII-X	1″ MNPT	Back
VFC-X-EC	1″ FNPT	In-Line End
VFCII-X-EC	1″ MNPT	In-Line End

Popular Ranges

Model VFC — 5″ Scale			
Range No.	**Range SCFM Air**	**Range No.**	**Range GPM Water**
121	4-25	141	.5-5
122	5-50	142	1-10
123	10-100	143	2-20
	LPM Air		**LPM Water**
131	100-700	151	2-20
132	200-1400	152	4-40
133	300-2800	153	10-75

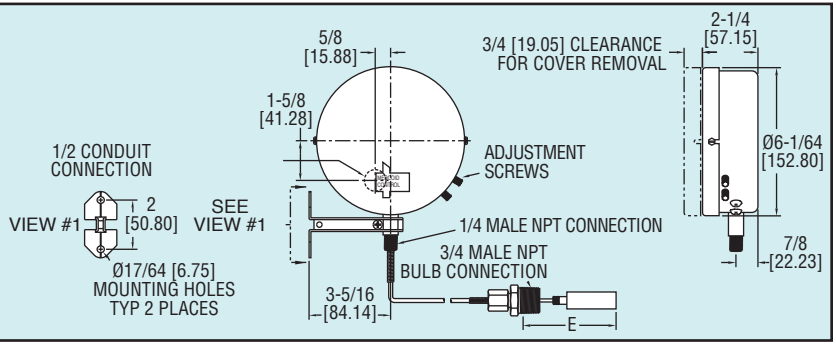
SPECIFICATIONS
Service: Compatible gases & liquids.
Wetted Materials:
Body: Acrylic plastic;
O-ring: Buna-N (fluoroelastomer available);
Metal parts: SS;
Float: SS.
Fittings: VFC: PVC; VFCII: Acetal thermoplastic.
Temperature & Pressure Limits: 100 psig (6.9 bar) @ 120°F (48°C).
Accuracy: 2% of full scale.
Process Connection: VFC: 1″ female NPT back connections. End connections optional; VFCII: 1″ male NPT back connections. End connections optional.
Scale Length: 5″ typical length.
Mounting Orientation: Mount in vertical position.
Weight: 24 to 25 oz (.68 to .71 kg).

OPTIONS
-VIT, Fluoroelastomer O-Rings
-FDA, 316 SS Float & Guide Rod (only available on VFCII with fluoroelastomer O-Rings)
-NIST, NIST traceable calibration certificate

Series DA-7035N

Temperature Switches

Bulb and Capillary, Inert Gas Fill



Series DA-7035N temperature switches include the same time-proven switching mechanism used in our Series DA pressure switches. Bourdon tube assures high sensitivity and long life. Fully adjustable deadband makes units suitable for a wide range of control applications. Visible, calibrated dial and external adjustments make changing setpoints simple and fast.

Model	Range °F (°C)	Max. Temp. °F (°C)	Min. Deadband °F (°C)	Min. Insertion Depth "E" in. (mm)
DA-7035-153-1N	-60 to +30 (-50 to 0)	150 (65)	23 (13)	2-7/8 (73)
DA-7035-153-3N	0 to 100 (-18 to 40)	240 (115)	25 (14)	2-7/8 (73)
DA-7035-153-4N	50 to 150 (10 to 65)	250 (120)	25 (14)	2-7/8 (73)
DA-7035-153-5N	100 to 200 (40 to 95)	300 (150)	25 (14)	2-7/8 (73)
DA-7035-153-7N	140 to 300 (60 to 150)	500 (260)	41 (23)	2-7/8 (73)
DA-7035-153-8N	250 to 415 (120 to 215)	550 (290)	42 (23)	2-7/8 (73)
DA-7035-153-9N	350 to 550 (175 to 290)	600 (315)	50 (28)	4-7/8 (124)
DA-7035-153-10N	100 to 300 (40 to 150)	500 (260)	50 (28)	2-7/8 (73)
DA-7035-153-11N	100 to 500 (40 to 260)	600 (315)	100 (56)	2-7/8 (73)

Insertion depth can be increased through use of bulb supports or wells. Consult factory.

SPECIFICATIONS

Service: Compatible liquids or gases.
Wetted Materials: Bulb and connection: 304 SS.
Temperature Limit: Process: See model chart; Ambient: 180°F (82°C).
Pressure Limit: 300 psi (20.6 bar).
Enclosure Rating: General purpose. Optional weatherproof and explosion-proof.
Repeatability: ±1% of full-scale.
Switch Type: SPDT snap switch. Optional DPDT snap and a variety of mercury switches.
Electrical Rating: 10A @ 120/240/480 VAC.
Electrical Connections: Screw terminal.
Conduit Connection: 7/8″ (22.23 mm) hole for 1/2″ (12.7 mm) conduit hub.

FEATURES

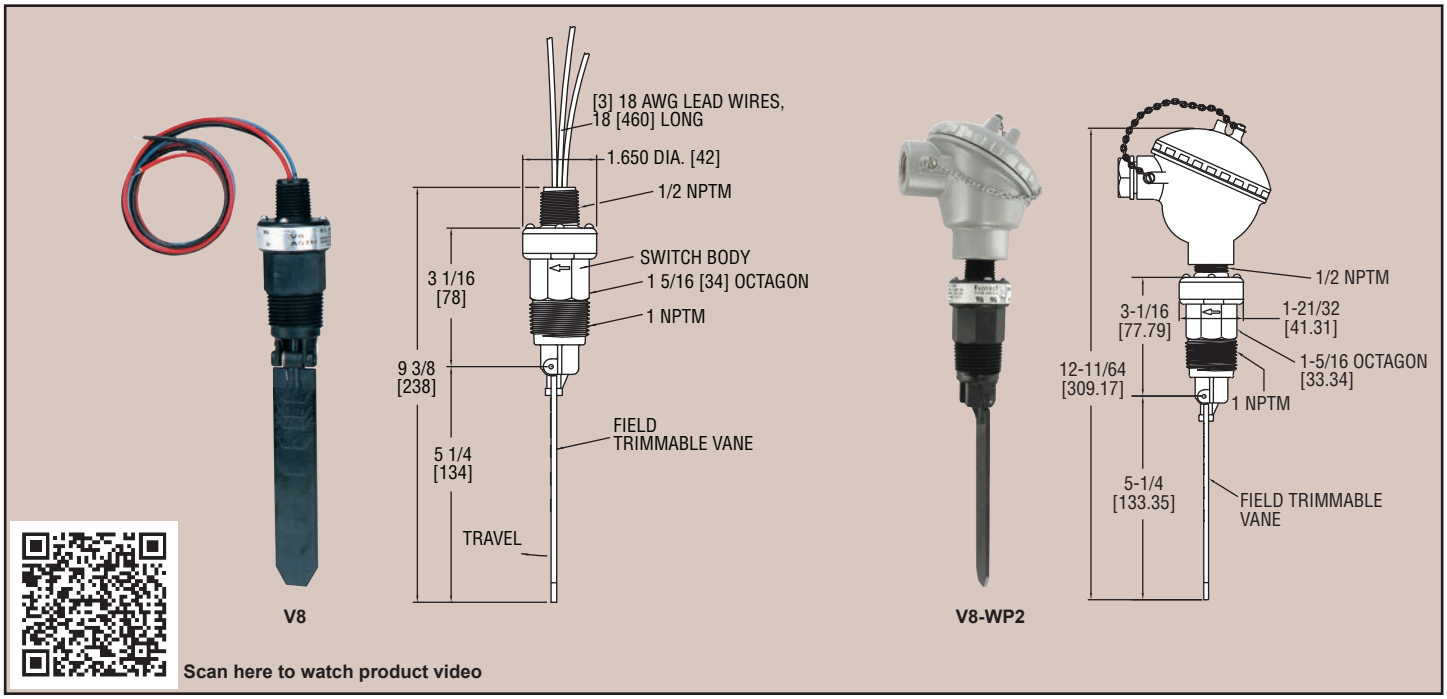
- Adjustable deadband
- Snap action switch standard
- Inert gas activated Bourdon tube
- No cross ambient temperature effects
- No bulb elevation correction required
- Visible dial calibrated in both °F and °C
- Visible on/off indication

Process Connection: 3/4″ male NPT. Other sizes available.
Mounting Orientation: Vertical and level.
Set Point Adjustment: External knobs for set point and reset point.
Weight: 5 lb (2.3 kg).
Deadband: Adjustable from minimum in model chart to full range. Optional low fixed deadband.
Capillary: 6 ft (1.8 m) standard. Ranges 1N to 7N, and 10N: copper. Ranges 8N, 9N, 11N: 304 SS.
Set Point Scale: Indication in °F and °C.
Options: See switch type, see enclosures, fixed deadband, longer or shorter capillary, armored capillary, wells, two stage, 1/2″ or 1″ connection sizes, manual reset, and other bulb styles.

Series V8

FLOTECT® Vane Operated Flow Switch

Field Adjustable — 1 to 6 Inch Pipe, Leak Proof Body



V8 Flotect® Flow Switch Protects Equipment: Operation is simple and dependable. In most applications, the switch is normally off while there is sufficient flow of liquid or air. When flow stops, the vane spring moves the vane, actuating a single pole double throw switch rated 5A @ 120/250 VAC to start or stop motor, pump, engine, etc. Operate a damper or valve; shut down a burner or actuate an alarm or signal, protecting unattended equipment from damage or loss of production.

The V8 Flotect® Flow Switch has a leak proof body and vane constructed of tough durable polyphenylene sulfide which has excellent chemical resistance. The full size trimmable vane is provided with molded-in graduations allowing for installation in a 1″ to 6″ pipe. Operating pressures are up to 150 psig (10 bar) and temperatures to 212°F (100°C). The V8 flow switch can be used in various chemical processes, industrial systems and similar applications where process conditions are compatible with polyphenylene sulfide, ceramic 8 and 316SS. The V8 Flotect® flow switch is UL recognized as an industrial motor controller per UL standard 508, suitable for mounting in a protected environment.

Cold Water Flow Rates Approximate actuation/ deactuation **GPM** upper, **LPM** lower		**Air Flow Rates** Approximate actuation/ deactuation **SCFM** upper, **LPM** lower	
Pipe Size		**Pipe Size**	
1″	10.8/9.1 40.9/34.6	1″	39/32.6 1105/923
1-1/4″	9.8/8.3 37.2/31.4	1-1/4″	37.5/32.2 1062/912
1-1/2″	8.6/6.8 32.4/25.7	1-1/2″	33.4/26.7 945/757
2″	10.9/8.8 41.2/33.4	2″	43/36.8 1218/1042
3″	12.9/8.9 48.8/33.5	3″	52.7/38.9 1493/1100
4″	21.1/13.8 79.7/52.2	4″	87.6/63.6 2482/1802
6″	45/33 170.2/124.7	6″	168.6/137.4 4775/3890

approx. set-point range

APPLICATIONS

Applications are chemical processing, air conditioning, refrigeration, heating systems, cooling lines, machinery, liquid transfer systems, water treatment, food processing, and machine tools. Also, other applications compatible with the materials of construction.

SPECIFICATIONS

Service: Compatible gases or liquids.
Wetted Materials:
Vane and body: Polyphenylene Sulfide (PPS);
Pin and spring: 316 SS or Inconel®;
Magnet: Ceramic 8.
Temperature Limit: 212°F (100°C).
Pressure Limit: 150 psig (10.34 bar).
Enclosure Rating: General purpose, WP/WP2 option is weatherproof.
Switch Type: SPDT snap switch, MV option: SPDT gold contact snap switch.
Electrical Rating: 5A @ 125/250 VAC, 5A resistive, 3A inductive @ 30 VDC; MV option: 1A @ 125 VAC, 1A resistive, 0.5A inductive @ 30 VDC.
Electrical Connections: 18 AWG, 18″ (460 mm) long.
Conduit Connection: 1/2″ male NPT, 1/2″ female NPT on WP and WP2.
Process Connection: 1″ male NPT.
Mounting Orientation: Actuation/deactuation flow rates are based on horizontal pipe runs and are nominal values. Unit cannot be used with vertical down flow.
Set Point Adjustment: Vane is trimmable.
Weight: 4.5 oz (0.13 kg).
Agency Approvals: CE, cUR, UR.

Series V8, Flow Switch

OPTIONS

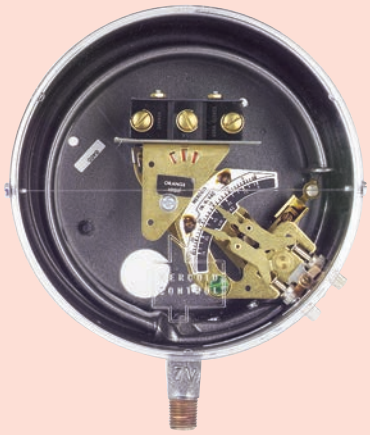
Gold Plated Contacts, for dry circuits. Rated 1A @ 125 VAC; 1A resistive, 0.5A inductive @ 30 VDC. To order add suffix -MV.
Example: **V8-MV**
Inconel® Alloy Option. Inconel® Alloy replaces standard 316 SS wetted parts. Wetted parts are Inconel® Alloy, ceramic 8, and Polyphenylene Sulfide. To order add suffix -INC.
Example: **V8-INC**
Weatherproof Enclosure. Optional housing is phenylpolioxide and provides weatherproof protection for electrical wiring.
To order add suffix -WP. (Not UL approved)
Example: **V8-WP**
Weatherproof Enclosure. Optional housing is aluminum and provides weatherproof protection for electrical wiring.
To order add suffix -WP2. (Not UL approved)
Example: **V8-WP2**

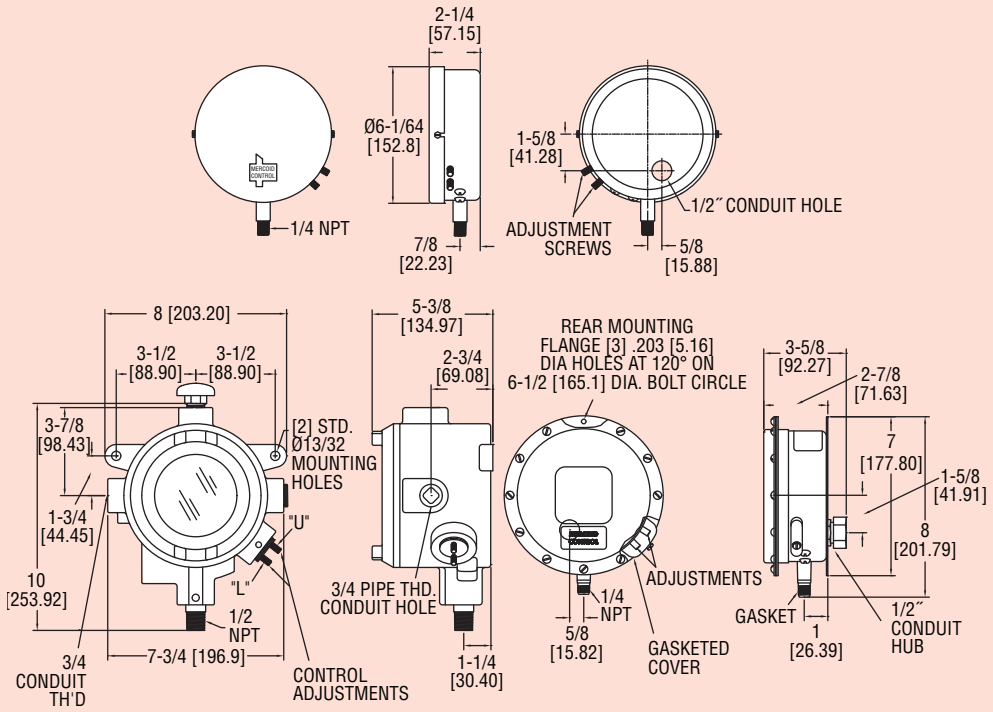
Mercoid®

Series DA/DS

Bourdon Tube Pressure Switches

Pressure Ranges to 8000 psi (551.6 bar)





Scan here to watch product video

Customers tell us that this is the best pressure switch made. The Mercoid D Series is one of the world's broadest lines of pressure switches.

The D Series has extremely high sensitivity and great repeatability. The DA Models are equipped with two external adjustments, one for setting high pressure operating point, the other for setting low pressure operating point. Deadband, the difference between high and low setpoints, is adjustable over the full-scale. The DS Models are equipped with a single external adjustment for setting operating point only. For mercury-free switches, choose between the snap action switch or hermetically sealed snap action switch. Hermetically sealed mercury switch also available.

FEATURES

- Visible calibrated dial
- On/off indication (except hermetically sealed snap switch models)
- Adjustable or fixed deadband
- SPDT snap-action, hermetically sealed snap action or hermetically sealed mercury switch
- External switch setpoint adjustments
- Minimum deadband is obtainable at any point in the range
- Pressure ranges of full vacuum to 8000 psig
- UL listed, CSA approved, many models FM approved
- General purpose, weatherproof or explosion-proof enclosures

OPTIONS

Weatherproof Enclosure, Series DAW – Add "W" to model number after DA or DS and change 1 to 3.
Example: DAW-33-153-7

Explosion-Proof Enclosure, Series DAH – Suitable for Class I, Groups C and D; NEMA 7; Class II, Groups E, F, G; Class III NEMA 9 and 9A, Division 1. Add "H" to model number after DA or DS.
Example: DAH-31-153-7

FM Approved: For general purpose and explosion-proof models see agency approvals. Add "F" to model number after DA, DS, DAH or DSH.
Examples: DAF-31-153-7 or DAHF-31-153-7

Other Options (Consult Factory): DPDT switches or other switch types, fixed deadband mercury switch units for low deadband applications, manual reset operation, two-stage operation, acetal bushed movement for applications with high amounts of vibration and/or pulsation, fungus proofing, siphon, diaphragm seals, mounting flange and remote connection.

SPECIFICATIONS

Wetted Materials: Brass, 403 SS, or 316 SS.
Temperature Limit: 180°F (82°C).
Pressure Limit: Maximum pressure of the operating range.
Enclosure Rating: General purpose, weatherproof or explosion-proof.
Repeatability: ±1% of full operating range, ±1.5% on DS-7300 models.
Switch Type: SPST mercury switch, SPDT mercury switch, SPDT snap switch, or SPDT hermetically sealed snap switch. Other circuit types available.
Electrical Rating: See model charts.
Electrical Connections: Screw terminal.
Conduit Connection: General purpose: 1/2″ hole for conduit hub; Weatherproof: 1/2″ conduit hub; Explosion-proof: 3/4″ female NPT.
Process Connection: General purpose and weatherproof: 1/4″ male NPT, 1/2″ male NPT on ranges 15S and 16S; Explosion-proof: 1/2″ male NPT and 1/4″ female NPT.
Mounting Orientation: Vertical.
Set Point Adjustment: Thumbscrew.
Weight: General purpose: 4 lb (1.8 kg); Weatherproof: 6 lb (2.7 kg); Explosion-proof: 8 lb (3.5 kg).
Deadband: See model chart.
Agency Approvals: CE, CSA, FM, UL (mercury switch units are not CE approved) (Consult factory for FM approved models).

D Series Pressure Switch with Snap Action Switch and General Purpose Enclosure							
		Adjustable Deadband SPDT: 10A @ 120/240 VAC		Fixed Deadband SPDT: 15A @ 120/240 AC		Hermetically Sealed, Fixed Deadband SPDT: 5A @ 120/240 VAC, 5A res. @ 30 VDC	
Bourdon Tube Material	Adjustable Operating Range (psig)	Minimum Deadband (psig)	Model	Fixed	Model	Fixed	Model
Brass	0-30″ Hg VAC	13.5″ Hg	DA-7031-153-2	3″ Hg	DS-7231-153-2	5″ Hg	DS-7331-153-2
	10″ Hg VAC - 12	6	DA-7031-153-3	1.5	DS-7231-153-3	3	DS-7331-153-3
	25″ Hg VAC - 50	12	DA-7031-153-27	2.5	DS-7231-153-27	3.75	DS-7331-153-27
	1/8 – 15	6	DA-7031-153-1	1.5	DS-7231-153-1	3	DS-7331-153-1
	1/8 – 20	6	DA-7031-153-3A	1.5	DS-7231-153-3A	3	DS-7331-153-3A
	1 – 35	7.5	DA-7031-153-4	1.5	DS-7231-153-4	3	DS-7331-153-4
	2 – 60	9	DA-7031-153-5	2	DS-7231-153-5	3	DS-7331-153-5
	5 – 100	13.5	DA-7031-153-6	2.5	DS-7231-153-6	3.75	DS-7331-153-6
	5 – 150	24	DA-7031-153-7	3	DS-7231-153-7	5.25	DS-7331-153-7
	10 – 200	24	DA-7031-153-8	4	DS-7231-153-8	6.75	DS-7331-153-8
	10 – 300	37.5	DA-7031-153-9	5	DS-7231-153-9	9	DS-7331-153-9
Stainless Steel	30″ Hg VAC – 60	18	DA-7021-153-25S	3.5	DS-7221-153-25S	5.25	DS-7321-153-25S
	30″ Hg VAC – 75	22.5	DA-7021-153-26S	3.5	DS-7221-153-26S	5.25	DS-7321-153-26S
	2 – 60 13.5	13.5	DA-7021-153-5S	3	DS-7221-153-5S	4.5	DS-7321-153-5S
	5 – 100 19.5	19.5	DA-7021-153-6S	3.5	DS-7221-153-6S	5.25	DS-7321-153-6S
	10 – 200 22.5	22.5	DA-7021-153-8S	4	DS-7221-153-8S	7.125	DS-7321-153-8S
	10 – 300 28.5	28.5	DA-7021-153-9S	6	DS-7221-153-9S	10.5	DS-7321-153-9S
	40 – 350 30	30	DA-7021-153-9AS	6	DS-7221-153-9AS	10.5	DS-7321-153-9AS
	25 – 600 67.5	67.5	DA-7021-153-10S	10	DS-7221-153-10S	18	DS-7321-153-10S
	50 – 1000 142.5	142.5	DA-7021-153-11S	20	DS-7221-153-11S	33	DS-7321-153-11S
	100 – 1500 195	195	DA-7021-153-12S	30	DS-7221-153-12S	52.5	DS-7321-153-12S
	300 – 2500 390	390	DA-7021-153-13S	60	DS-7221-153-13S	90	DS-7321-153-13S
	500 – 5000 1350	1350	DA-7021-153-15S	200	DS-7221-153-15S	300	DS-7321-153-15S
	800 – 8000 2250	2250	DA-7021-153-16S	500	DS-7221-153-16S		
316 Stainless Steel	30″ Hg VAC – 75	15	DA-7041-153-26E	3.5	DS-7241-153-26E	5.25	DS-7341-153-26E
	5 – 75	12	DA-7041-153-23E	4	DS-7241-153-23E	6	DS-7341-153-23E
	10 –100	15	DA-7041-153-6E	3.5	DS-7241-153-6E	5.25	DS-7341-153-6E
	10 – 150	16.5	DA-7041-153-24E	4	DS-7241-153-24E	6.75	DS-7341-153-24E
	10 – 300	42	DA-7041-153-9E	8	DS-7241-153-9E	12	DS-7341-153-9E
	30 – 400	78	DA-7041-153-21E	10	DS-7241-153-21E	18	DS-7341-153-21E
	75 – 800	180	DA-7041-153-22E	25	DS-7241-153-22E	37.5	DS-7341-153-22E
	100 – 1000	285	DA-7041-153-11E	35	DS-7241-153-11E	52.5	DS-7341-153-11E
	200 - 2500	600	DA-7041-153-13E	75	DS-7241-153-13E	112.5	DS-7341-153-13E

D Series Pressure Switch with Mercury Switch and General Purpose Enclosure					
		Adjustable Deadband			
Bourdon Tube Material	Adjustable Operating Range (psig)	Minimum Deadband (psig)	SPDT 4A @ 120 V 2A @ 240 V AC/DC	SPST Open on Increase 10A @ 120 V 5A @ 240 V AC/DC	SPST Close on Increase 10A @ 120 V 5A @ 240 V AC/DC
Brass	30″– 0 Hg VAC	2″ Hg	DA-31-153-2	DA-31-2-2	DA-31-3-2
	10″ Hg VAC - 12	1	DA-31-153-3	DA-31-2-3	DA-31-3-3
	25″ Hg VAC - 50	3.5	DA-31-153-27	DA-31-2-27	DA-31-3-27
	1/8 – 15	1	DA-31-153-1	DA-31-2-1	DA-31-3-1
	1/8 – 20	1	DA-31-153-3A	DA-31-2-3A	DA-31-3-3A
	1 – 35	1.75	DA-31-153-4	DA-31-2-4	DA-31-3-4
	2 – 60	3	DA-31-153-5	DA-31-2-5	DA-31-3-5
	5 – 100	3.75	DA-31-153-6	DA-31-2-6	DA-31-3-6
	5 – 150	6	DA-31-153-7	DA-31-2-7	DA-31-3-7
	10 – 200	8	DA-31-153-8	DA-31-2-8	DA-31-3-8
	10 – 300	12	DA-31-153-9	DA-31-2-9	DA-31-3-9
403 Stainless Steel	30″ Hg VAC – 60	6	DA-21-153-25S	DA-21-2-25S	DA-21-3-25S
	30″ Hg VAC – 75	8	DA-21-153-26S	DA-21-2-26S	DA-21-3-26S
	2 – 60	4	DA-21-153-5S	DA-21-2-5S	DA-21-3-5S
	5 – 100	6	DA-21-153-6S	DA-21-2-6S	DA-21-3-6S
	10 – 200	8	DA-21-153-8S	DA-21-2-8S	DA-21-3-8S
	10 – 300	14	DA-21-153-9S	DA-21-2-9S	DA-21-3-9S
	40 – 350	14	DA-21-153-9AS	DA-21-2-9AS	DA-21-3-9AS
	25 – 600	25	DA-21-153-10S	DA-21-2-10S	DA-21-3-10S
	50 – 1000	60	DA-21-153-11S	DA-21-2-11S	DA-21-3-11S
	100 – 1500	90	DA-21-153-12S	DA-21-2-12S	DA-21-3-12S
	300 – 2500	150	DA-21-153-13S	DA-21-2-13S	DA-21-3-13S
	500 – 5000	450	DA-21-153-15S	DA-21-2-15S	DA-21-3-15S
	800 – 8000	750	DA-21-153-16S	DA-21-2-16S	DA-21-3-16S
316 Stainless Steel	30″ Hg VAC – 75	7	DA-41-153-26E	DA-41-2-26E	DA-41-3-26E
	5 – 75	3	DA-41-153-23E	DA-41-2-23E	DA-41-3-23E
	10 –100	7	DA-41-153-6E	DA-41-2-6E	DA-41-3-6E
	10 – 150	6	DA-41-153-24E	DA-41-2-24E	DA-41-3-24E
	10 – 300	18	DA-41-153-9E	DA-41-2-9E	DA-41-3-9E
	30 – 400	30	DA-41-153-21E	DA-41-2-21E	DA-41-3-21E
	75 – 800	75	DA-41-153-22E	DA-41-2-22E	DA-41-3-22E
	100 – 1000	100	DA-41-153-11E	DA-41-2-11E	DA-41-3-11E
	200 - 2500	210	DA-41-153-13E	DA-41-2-13E	DA-41-3-13E

APPENDIX E: WASTE TRANSPORTER PERMIT (ISLAND PUMP & TANK)

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF MATERIALS MANAGEMENT

PART 364
WASTE TRANSPORTER PERMIT NO. 1A-1036

Pursuant to Article 27 ,Titles 3 and 15 of the Environmental Conservation Law and 6 NYCRR 364

PERMIT ISSUED TO:

ISLAND PUMP & TANK CORP
40 DOYLE COURT
EAST NORTHPORT, NY 11731

CONTACT NAME: FRANK DIANDREA
COUNTY: SUFFOLK
TELEPHONE NO: (631)462-2226

PERMIT TYPE:

☐ NEW
☐ RENEWAL
■ MODIFICATION

EFFECTIVE DATE: 02/27/2015
EXPIRATION DATE: **02/07/2016**
US EPA ID NUMBER: NYR000191726

AUTHORIZED WASTE TYPES BY DESTINATION FACILITY:

The Permittee is Authorized to Transport the Following Waste Type(s) to the Destination Facility listed :

Destination Facility	Location	Waste Type(s)	Note
110 Sand Company Clean Fill Disposal Site	Melville , NY	Non-Hazardous Industrial/Commercial	
AB Oil Service Ltd.	Bohemia , NY	Non-Hazardous Industrial/Commercial	PETR CONT WATER
ADVANCED WASTEWATER TECHNOLOGIES, INC.	FARMINGDALE , NY	Non-Hazardous Industrial/Commercial	PETR CONT WATER
BERGEN POINT STP	WEST BABYLON , NY	Non-Hazardous Industrial/Commercial	
BROOKHAVEN TOWN LANDFILL	BROOKHAVEN , NY	Non-Hazardous Industrial/Commercial	
CLEAN WATER OF NEW YORK, INC.	STATEN ISLAND , NY	Non-Hazardous Industrial/Commercial	PETR CONT WATER
CLEAR BROOK	DEER PARK , NY	Non-Hazardous Industrial/Commercial Petroleum Contaminated Soil Grease Trap Waste Non-Residential Raw Sewage or Sewage-Contaminated Wastes	
CLEAR FLO TECHNOLOGIES	NORTH LINDENHURST , NY	Non-Hazardous Industrial/Commercial	
CONKLIN SERVICES & CONSTRUCTION, INC.	NEWBURGH , NY	Non-Hazardous Industrial/Commercial Petroleum Contaminated Soil Waste Oil	
DEEP GREEN OF NEW YORK	NEW WINDSOR , NY	Petroleum Contaminated Soil	
FENLEY & NICOL ENVIRONMENTAL - 52002	DEER PARK , NY	Non-Hazardous Industrial/Commercial	PETR CONT WATER
NORTHLAND ENVIRONMENTAL, LLC	PROVIDENCE , RI	Non-Hazardous Industrial/Commercial Petroleum Contaminated Soil Hazardous Industrial/Commercial	
POSILLICO MATERIALS LLC - 394-1-30	FARMINGDALE , NY	Petroleum Contaminated Soil	

*** AUTHORIZED WASTE TYPES BY DESTINATION FACILITY LISTING (continued on next page) ***

NOTE: By acceptance of this permit, the permittee agrees that the permit is contingent upon strict compliance with the Environmental Conservation Law, all applicable regulations, and the General Conditions printed on the back of this page.

ADDRESS: New York State Department of Environmental Conservation
Division of Materials Management - Waste Transporter Program
625 Broadway, 9th Floor
Albany, NY 12233-7251

AUTHORIZED SIGNATURE: M McTague Date: 2/27/15

WASTE TRANSPORTER PERMIT

GENERAL CONDITIONS

The permittee must:

1. Carry a copy of this waste transporter permit in each vehicle to transport waste. Failure to produce a copy of the permit upon request is a violation of the permit.

2. Display the full name of the transporter on both sides of each vehicle and display the waste transporter permit number on both sides and rear of each vehicle containing waste. The displayed name and permit number must be in characters at least three inches high and of a color that contrasts sharply with the background.

3. Transport waste only in authorized vehicles. An authorized vehicle is one that is listed on this permit.

4. Submit to the Department a modification application for additions/deletions to the authorized fleet of vehicles. The permittee must wait for a modified permit to be issued before operating the vehicles identified in the modification application.

5. Submit to the Department a modification application to add a new waste category or a new destination facility, or to change the current waste or destination facility category. The permittee must wait for a modified permit before transporting new waste types or transporting to new destination facilities.

6. Submit to the Department a modification application for change of address or company name.

7. Comply with requirements for placarding and packaging as set forth in New York State Transportation Law as well as any applicable federal rules and regulations.

8. Contain all wastes in the vehicle so there is no leaking, blowing, or other discharge of waste.

9. Use vehicles to transport only materials not intended for human or animal consumption unless the vehicle is properly cleaned.

10. Comply with requirements for manifesting hazardous waste, regulated medical waste, or low-level radioactive waste as set forth in the New York State Environmental Conservation Law and the implementing regulations.

11. Deliver waste only to transfer, storage, treatment and disposal facilities authorized to accept such waste. Permittee must demonstrate that facilities are so authorized if requested to do so.

12. Maintain liability insurance as required by New York State Environmental Conservation Law.

13. Maintain records of the amount of each waste type transported to each destination facility on a calendar-year basis. The transporter is obligated to provide a report of this information to the Department at the time of permit renewal, or to any law enforcement officer, if requested to do so.

14. Pay regulatory fees on an annual basis. Non-payment may be cause for revocation or suspension of permit.

15. This permit is not transferrable. A change of ownership will invalidate this permit.

16. This permit does not relieve the permittee from the obligation to obtain any other approvals or permits, or from complying with any other applicable federal, state, or local requirement.

17. **Renewal applications must be submitted no less than 30 days prior to the expiration date of the permit to:**

New York State Department of Environmental Conservation
Division of Materials Management, Waste Transporter Program
625 Broadway, 9th Floor
Albany, NY 12233-7251

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF MATERIALS MANAGEMENT

PART 364

WASTE TRANSPORTER PERMIT NO. 1A-1036

Pursuant to Article 27 ,Titles 3 and 15 of the Environmental Conservation Law and 6 NYCRR 364

PERMIT ISSUED TO:

ISLAND PUMP & TANK CORP
40 DOYLE COURT
EAST NORTHPORT, NY 11731

CONTACT NAME: FRANK DIANDREA
COUNTY: SUFFOLK
TELEPHONE NO: (631)462-2226

PERMIT TYPE:

☐ NEW
☐ RENEWAL
■ MODIFICATION

EFFECTIVE DATE: 02/27/2015
EXPIRATION DATE: **02/07/2016**
US EPA ID NUMBER: NYR000191726

AUTHORIZED WASTE TYPES BY DESTINATION FACILITY: (Continued)
The Permittee is Authorized to Transport the Following Waste Type(s) to the Destination Facility listed :

Destination Facility	Location	Waste Type(s)	Note
REPUBLIC ENVIRONMENTAL SYSTEMS (TRANSPORTATION GROUP) LLC	HATFIELD , PA	Non-Hazardous Industrial/Commercial Petroleum Contaminated Soil Hazardous Industrial/Commercial	
VEOLIA ES TECHNICAL SOLUTIONS	FLANDERS , NJ	Non-Hazardous Industrial/Commercial Hazardous Industrial/Commercial	

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF MATERIALS MANAGEMENT

PART 364
WASTE TRANSPORTER PERMIT NO. 1A-1036

Pursuant to Article 27 ,Titles 3 and 15 of the Environmental Conservation Law and 6 NYCRR 364

PERMIT ISSUED TO:

ISLAND PUMP & TANK CORP
40 DOYLE COURT
EAST NORTHPORT, NY 11731

PERMIT TYPE:

☐ NEW
☐ RENEWAL
■ MODIFICATION

CONTACT NAME:	FRANK DIANDREA	EFFECTIVE DATE:	02/27/2015
COUNTY:	SUFFOLK	EXPIRATION DATE:	**02/07/2016**
TELEPHONE NO:	(631)462-2226	US EPA ID NUMBER:	NYR000191726

AUTHORIZED VEHICLES:

The Permittee is Authorized to Operate the Following Vehicles to Transport Waste:

(Vehicles enclosed in <>'s are authorized to haul Residential Raw Sewage and/or Septage only)

15 (Fifteen) Permitted Vehicle(s)

NY 18104MG
NY 18111MG
NY 18115MG
NY 20338MG
NY 38993PC
NY 38994PC
NY 38995PC
NY 38996PC
NY 38997PC
NY 60461JV
NY 81385JW
NY 85821MD
NY 85822MD
NY 92793MD
NY BF54332
End of List