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Cleanup Action Report

Gasoline Tanker Spill Site
Mile Marker 80, Interstate 90
Cle Elum, Washington

Prepared For:

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October 23, 2019

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ABBREVIATIONS AND ACRONYMS

Abbreviation / Acronym	Definition
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
COC	Contaminant of concern
CUL	Cleanup level
DPT	Direct-push technology
DTD	Direct Technologies Drilling, Inc.
Ecology	Washington State Department of Ecology
EPI	Environmental Partners, Inc.
GRO	Gasoline-range organics
I-90	Interstate 90
IO	IO Environmental and Infrastructure, Inc.
IRA	Interim Remedial Action
Kenan	Kenan Advantage Group, Inc.
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
NRC	NRC Environmental Services, Inc.
O&M	Operations and maintenance
P&ID	Process and Instrumentation Diagram
PID	Photoionization detector
ppmv	Parts per million by volume
PSE	Puget Sound Energy
PVC	Polyvinyl chloride
scfm	Standard cubic feet per minute
SHJ	SHJ Electric Co., Inc.
SRIRA	Spill Response and Interim Remedial Action
SVE	Soil vapor extraction
TVH	Total volatile hydrocarbons
w.c.	Water column
WAC	Washington Administrative Code

1.0 INTRODUCTION

Environmental Partners, Inc. (EPI) is pleased to submit this *Cleanup Action Report* for a gasoline release near Mile Marker 80, on Interstate 90 (I-90), Cle Elum, Washington ("Site"). The location of the Site is shown on Figure 1. A layout of the Site with associated surface water features, monitoring wells, and soil vapor extraction (SVE) wells is depicted on Figure 2. The work presented herein was performed on behalf of the Kenan Advantage Group, Inc. (Kenan) in an o-going effort to comply with the Model Toxics Control Act (RCW 70.105D) and its implementing regulations (Washington Administrative Code [WAC] 173-340; collectively "MTCA") for Site remediation. The Site is enrolled in the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP), VCP project number CE0500, in order to achieve regulatory closure.

1.1 Site History

Soil at the Site was impacted with petroleum hydrocarbons as a result of a raw gasoline spill from a tanker truck accident on December 4, 2015. A double fuel tanker truck carrying regular unleaded gasoline product (gasoline) operated by Kenan collided with a bridge support structure prior to crossing the Cle Elum River. An estimated 3,000 gallons of gasoline spilled onto the roadway from the truck and trailer as a result of the collision. The gasoline migrated primarily into the median and beneath the eastbound lanes of I-90.

1.2 Prior Work

During the previously implemented interim remedial action (IRA), approximately 6,866 tons of petroleum-contaminated soil (PCS) were successfully removed from the impacted areas in the median of the highway and transported off-Site for disposal. Confirmation soil samples collected from the excavation limits from all accessible areas within the median indicated that concentrations of contaminants of concern (COCs), specifically gasoline-range organics (GRO) and benzene, toluene, ethylbenzene, and total xylenes (BTEX), were at concentrations less than applicable MTCA Method A soil cleanup levels (CULs). Due to reaching the limits of practicability within the excavation beneath the highway and against the bridge deck, no additional excavation was performed. Therefore, the only impacts remaining to soil were limited to beneath the eastbound lanes of I-90.

Performance soil samples were collected to determine the extent of soil impacts beneath the eastbound lanes of I-90. Analytical results from the southern wall of the excavation (i.e., beneath the eastbound lanes of I-90) and from direct-push technology (DPT) sampling performed on the eastbound lanes of I-90 exceeded the applicable CULs. Approximately 1,960 cubic yards of PCS remained beneath the eastbound lanes of I-90. The work conducted for the spill response and the resulting environmental conditions at the Site are detailed in the *Spill Response and Interim Remedial Action Report* dated September 12, 2016 (SRIRA Report).

In 2017, EPI installed an SVE system to remove the remaining impacts beneath the roadway. The SVE remediation system design is detailed in the *Cleanup Action Plan* (CAP) dated September 12, 2016. The SVE system operated continuously, excluding shut downs for maintenance, for approximately 2 years. In March 2019 EPI performed DPT soil sampling in the roadway to evaluate the residual impacts of petroleum contamination under the eastbound lanes of I-90. The sample locations outlined in the CAP were agreed upon by Ecology in an opinion letter dated March 4, 2019 (Attachment A). The DPT soil samples collected were all in compliance with the applicable MTCA Method A soil CULs, a summary of analytical results is presented in Table 1.

2.0 SVE SYSTEM CONSTRUCTION

2.1 Permitting

The following section describes the permits necessary for installation and operation of the SVE system.

2.1.1 Construction and Building Permits

Because all SVE surface equipment is stored in a trailer, it was not classified as an “accessory” structure and was not subject to building permit requirements.

2.1.2 Air Discharge Permit

An Ecology air operating permit and notice of construction (NOC) were not required for the SVE system operation, based on pilot test results and phone communications with the Ecology Air Quality Division. Benzene was not detected at concentrations greater than the laboratory reporting limit in the effluent air samples. Therefore, the SVE system could not remove more than Ecology’s allowable discharge limit rate of 0.331 pounds of benzene per year, referenced in Table 2.

2.2 SVE System Installation

Remediation system installation activities were conducted between September 15, 2016 and July 11, 2017. Drilling and construction activities were overseen by an EPI representative and were completed in accordance with design specifications in the CAP. Directed Technologies Drilling Inc. (DTD) of Bremerton, Washington, provided drilling and well installation services, and NRC Environmental Services, Inc. (NRC) of Seattle, Washington, provided system trenching and piping installation services. Enviro-Equipment, Inc. of Pineville, North Carolina, provided and constructed the remediation system. Freedom Trailers, LLC of Lincolnton, North Carolina, provided the system trailer and enclosure. The following sections describe procedures and considerations associated with construction and installation of the SVE remediation system.

2.3 System Well Construction

The SVE system comprises a total of six horizontal SVE wells. The SVE wells (SVE-1 through SVE-6) were installed at the Site between September 15 and September 21, 2016. The SVE wells were installed horizontally and a well construction summary is provided in Table 3. The as-built locations of the SVE wells are shown on Figure 2 and well construction details are illustrated on Figure 3.

2.3.1 Horizontal SVE Well Installation

A track-mounted Vermeer D24x40a horizontal directional drill was used to install each of the horizontal SVE wells. Well installation was performed by DTD under the direct supervision of EPI field personnel between September 15 and September 21, 2016.

All horizontal wells were installed at a depth of approximately 5 to 6 feet below ground surface (bgs). As illustrated on Figure 3, the as-built horizontal wells included the following:

- Two wells (SVE-1 and SVE-2) were installed with approximately 9.8 feet of 0.02-inch slotted well screen; and
- Four wells (SVE-3, SVE-4, SVE-5, and SVE-6) were installed with approximately 29.4 feet of 0.020-inch slotted well screen.

At each horizontal well location, the grass or soil surface material was removed using a skid-steer "bobcat" loader. DTD personnel then excavated an 18-inch-wide and 2-foot-deep vault at each well location to drill and install the horizontal wells. Upon completion of drilling, 3-inch Schedule 40 polyvinyl chloride (PVC) 0.020-inch (20-slot) well screen was installed followed by blank 3-inch Schedule 40 PVC riser pipe to the surface. The filter pack at each well location consisted of ¾-inch clean gravel completed to approximately 2 feet above the screened section. Following installation of the well screen, riser pipe, and filter pack, each well annulus was sealed with concrete grout to approximately 1 foot bgs.

2.4 Trenching and Piping

Shallow trenches were excavated for the installation of buried conveyance piping for the SVE system. This excavation work was performed by NRC under the direct supervision of EPI personnel. IO Environmental and Infrastructure Inc. (IO) constructed the system manifold and sumps prior to making final connections to the SVE system enclosure. The system trenching is shown on Figures 2 and 3.

2.4.1 Trenching Construction

Prior to trenching, the existing native vegetation and soil was removed. A main trench, approximately 2.5 feet wide and 2.5 feet deep was excavated from the eastern extent of the Site extending southwest towards the treatment system enclosure (Figure 2). Side trenches, approximately 2 feet wide, were

excavated off the main trench to connect piping to SVE wellheads. The SVE piping trenches generally extended no deeper than 2 feet bgs.

Most areas of trenching were excavated using a mini excavator. In areas where monitoring wells were present, trenches were excavated by hand. Clean sand was placed in the bottom of the trenches to provide uniform bedding and support for the system conveyance piping. Following piping installation, the trenches were backfilled with clean gravel to 1-foot bgs. Filter fabric was installed over the gravel, and the remainder of the trenches were backfilled with sifted native soil material to eliminate large cobbles within the trench.

2.4.2 System Piping Installation

Underground piping and connections were installed from the six SVE system wells to the aboveground treatment system equipment. Each wellhead was completed with a 3-inch to 2-inch Schedule 40 PVC reducer, 2-inch ball valve and 2-inch “Y” fitting, displayed on Figure 3. A 2-foot-by-2-foot irrigation grade well box was installed at each location around the wellhead, secured with backfilled sand and native material.

Connections at the horizontal SVE wells were made using 45-degree “Y” fittings to allow for well access upon conveyance line completion.

Piping connections from the side trenches to the main trench were made using long-radius sweep elbows as shown on Figure 3. All SVE conveyance lines transitioned to aboveground manifold piping within the remediation system enclosure using long-radius sweep elbows. Individual 2-inch diameter Schedule 40 PVC lines were connected to the daylighted SVE piping.

On September 23, 2016, prior to backfilling, all SVE conveyance pipes were pressure-tested by the system installation contractor under supervision of the EPI field geologist. . All SVE piping was tested with compressed air at 10 pounds per square inch (psi) and held for 30 minutes. Upon completion of pressure testing, data indicated no leaks in the piping connecting the six SVE wells.

2.5 Remediation System Equipment Installation

Installation of the SVE system equipment and enclosure was performed on May 11, 2017 following the trenching and piping installation activities described in the preceding sections. All remediation system equipment was supplied by Enviro-Equipment, Inc. of Pineville, North Carolina, and the system enclosure was supplied by Freedom Trailers, LLC of Lincolnton, North Carolina. IO personnel prepared the area for installation of the enclosure trailer, constructed sumps (Figure 3), and mobilized the trailer into place. Electrical work was completed by Puget Sound Energy (PSE) of Thorp, Washington, and SHJ Electric Co., Inc. (SHJ) of SeaTac, Washington.

2.5.1 System Enclosure

The system enclosure consists of a 7-foot by 14-foot, double-axle enclosed, cargo trailer. The location of the trailer is located at the south side of I-90, approximately 285 feet south of the bridge, depicted on Figure 2 (SVE Trailer). Lockable double doors are located at the back end of the trailer (facing east) and another lockable single door is located on one side of the trailer (facing south) for additional access. After the trailer was mobilized into its designated space, the trailer was leveled and secured.

2.5.2 System Components

Prior to delivery to the Site, the SVE system equipment was mounted within the trailer according to the layout shown in Figures 4 and 5. The system components include the following:

- Regenerative vacuum extraction blower (3-horsepower, single-phase, 230-volt explosion-proof);
- Moisture separator tank (60-gallon) with sight glass and level switches;
- Auto-drain and liquid transfer pump (for discharging water from moisture separator tank);
- Six-leg SVE piping manifold (mounted and plumbed through trailer wall) with SVE header and individual well controls and vapor monitoring ports; and
- Associated filters, valves, sampling ports, gauges, and electrical controls.

Equipment specifications and connection details are identified in the Process and Instrumentation Diagram (P&ID) illustrated on Figure 5. A complete list of system components is provided in Attachment B. Technical specification sheets are included in the vendor-supplied Operation and Maintenance Manual presented in Attachment C.

2.5.3 System Connections and Discharge Piping

After the SVE system trailer was mobilized to its current locations (Figure 2), IO completed final piping connections between the individual SVE lines and the system equipment. The individual SVE conveyance lines were connected to the SVE manifold pipes that were also plumbed through the wall of the trailer. The SVE connections were made using 2-inch schedule 40 and schedule 80 PVC, connections are outlined on Figures 3 and 4.

For routing system vapors through the catalytic oxidizer, a 3-inch diameter galvanized steel pipe was connected from the blower discharge stack, plumbed through the roof of the trailer and completed with a weather-proof cap.

2.5.4 Electrical Components and Installation

A Class 1, Division 2, 300-amp, 208-volt, three-phase electrical service, provided by PSE was installed at the Site for operation of the SVE system. To meet the power requirements for the system, PSE

installed a single-phase transformer connection to a three-phase transformer on a utility pole located at the south side of I-90 west of the system enclosure (Figure 2). SHJ brought the service from the new transformer to the system trailer.

SHJ installed conduit and wiring from the distribution panel at the pole to the system control panel located at the front of the SVE trailer above the tow bar. The distribution panel and the system control panel are rated National Electrical Manufacturers Association (NEMA) Type 4 and are Underwriter Laboratories (UL) listed. All electrical wiring conforms to applicable laws, ordinances, building and construction codes, rules, and regulations. All electrical connections and conduit runs were inspected by PSE following installation. SHJ was responsible for all electrical permits and inspections.

Enviro-Equipment installed all wiring within the SVE system trailer prior to shipping the trailer to the Site. This included wiring installed from the control panel to the SVE blower, the liquid transfer pump, the ventilation fan, interior lights, and all associated sensors, switches, and alarms. A telemetry module and auto-dialer were also installed near the control panel for remote monitoring of the system. Electrical wiring and control diagrams for the system are provided in the vendor-supplied Operation and Maintenance Manual presented in Attachment C.

2.5.5 System Controls and Alarms

Manual system control valves and instrumentation were installed on the SVE piping manifolds and equipment within the enclosure to control and monitor SVE flow rates and vacuum. Other switches and controls were installed on system components for monitoring and controlling system vacuum and temperatures, liquid levels in the moisture separator, and water discharges. Controls and instrumentation are included on the P&ID on Figure 5.

Condensate accumulation within the moisture separator is monitored with sight glass and level indicators, high- and low-level switches activate and deactivate the liquid transfer pump to discharge water to a 55-gallon containment drum on the exterior of the system enclosure. A high-level shutoff switch will shut down the SVE system if the accumulated condensate rises above the maximum allowable level in the moisture separator.

A vapor control valve installed on the SVE header provides manual dilution of extracted vapors that are routed to the vent stack.

The system electrical control panel includes hour meters and “HAND/OFF/AUTO” switches for operating the SVE blower and liquid transfer pump. The panel also includes indicator lights for showing the following various alarm conditions when the system shuts down automatically:

- High water level in the moisture separator; and
- Low vacuum at the SVE blower.

The telemetry module (Sensaphone® Sentinel) installed at the control panel monitors operational status of the SVE system as well as alarm status for the conditions indicated above. The module utilizes a local

cellular service for remotely accessing this information via the internet. When an alarm condition occurs and the SVE system shuts down, the telemetry module is programmed to alert designated operation and maintenance personnel via a cellular auto-dialer. Additional information about the system control panel and telemetry module is provided in Attachment C.

2.6 Waste Management

The liquid generated from the SVE well sumps and moisture separator was collected and contained in 55-gallon drums on-Site pending proper disposal. Wastewater disposal documentation is provided in Attachment D.

2.7 Site Restoration

As noted in Section 2.4.1, the system trenches were backfilled with sifted native material. Due to the proximity and density of native grasses and small shrubs no sod or re-seeding was performed at the Site. The entire Site was left in a neat and clean condition: no debris, soil stockpiles, or excess construction materials remained on the Site after completion of the project.

2.8 System Startup Testing

On July 13, 2017, EPI personnel at the Site performed a system check, the power to the system was turned on and all electrical components, including sensors, alarms, and system wiring, were checked to ensure proper operation. Various adjustments were made and then the system was started to perform a full-scale pilot test of the SVE components. All the system gauges were monitored to confirm that they were correctly displaying system operational parameters.

During system startup, EPI personnel monitored the SVE system operational parameters and collected system vapor samples for laboratory analysis. System vacuums, pressures, and flow rates were observed to be within the design limits. Vapor concentrations were also measured at the SVE wells with a photoionization detector (PID). The PID readings at the individual wells ranged from 4 parts per million by volume (ppmv) to 83 ppmv, with the greatest concentration detected at SVE-4, which is screened within source area soil.

Influent and effluent vapors were sampled for laboratory analysis during the startup period to monitor discharge concentrations and to estimate the rate and total contaminant mass removed from the Site. System influent and effluent vapor samples were collected during system operation and maintenance (O&M) events performed on July 13, 2017 and August 10, 2017, and were submitted to Fremont Analytical in Seattle, Washington, for analysis of gasoline-range organics (GRO) and benzene, toluene, ethylbenzene, and total xylenes (BTEX). In addition to the influent and effluent vapor samples, extracted vapors from all the SVE lines (SVE-1 through SVE-6) were also sampled during the startup period to further quantify PID field measurements at the SVE manifold.

The influent vapor samples from July 13, 2017 contained GRO at concentrations of 36.5 µg/L, as noted in Table 2. Analysis of vapor samples from the individual SVE well lines (SVE-1 through SVE-6) during the startup period contained GRO at concentrations of 52.6 µg/L, <5.0 µg/L, 14.6 µg/L, 542 µg/L, 7.59 µg/L and 5.34 µg/L, respectively, as summarized in Table 4. SVE-4 was resampled on September 14, 2017 at 17.4 µg/L to re-evaluate the high concentration detected in the July 13, 2017 sample. The final influent vapor sample from SVE-4 was collected on April 19, 2018 and GRO was not detected at the analytical laboratory reporting limit.

Benzene was not detected at concentrations greater than the analytical detection limit in any of the collected effluent samples during system operation (see Table 4). Based on the system monitoring data collected during the approximately month-long startup period, the system extracted approximately 5.1 pounds of total volatile hydrocarbons (TVH) from the Site between July 13 and August 10, 2017, as noted in Table 2. A summary of vapor sample analytical results is presented in Table 4. The laboratory analytical reports are included in Attachment E.

2.9 Initial System Operation and Performance

After the system was started up on July 13, 2017, it operated continuously without incident during the 4-week startup period (July 13, 2017 to August 10, 2017). Minor adjustments were made during this time to optimize operational performance and mass removal. The system was turned off on October 3, 2017, and January 21, 2019 for 24 hours prior to performing depth-to-water measurements and collecting groundwater samples from the 14 on-Site monitoring wells. The system was restarted immediately following the groundwater monitoring events.

2.10 Initial System Monitoring

During the startup period, the system was generally monitored twice per week for the first 2 weeks, then weekly for the remainder of the startup period. Each Site visit during this period included monitoring and recording system operational parameters, (e.g., vacuums, pressures, temperatures, flow rates, and vapor concentrations). The system moisture separator was also checked for accumulated condensate.

The system monitoring data collected during the startup period indicate that the SVE components operated within expected ranges for vacuum, pressure, and flow rates. Operational data for the SVE components are summarized as follows:

- The applied system vacuum (measured at the blower) generally ranged between 38 and 42 inches of water column (inches w.c.). The applied system vacuum measured at individual SVE wellheads generally ranged between 20 and 42 inches w.c., and the total system vapor flow rate ranged from approximately 494 standard cubic feet per minute (scfm) to 560 scfm with 500 scfm being the predominant measured flow rate.

- System influent vapor concentrations measured with a PID at the SVE blower discharge prior to entering the catalytic oxidizer ranged from 4 ppmv to 83 ppmv. System effluent vapor concentrations measured with a PID at the catalytic oxidizer discharge stack ranged from 0 ppmv to 7 ppmv.

2.11 System Operation and Maintenance

After the initial startup period, O&M site visits were performed on a monthly basis. During each O&M event, all SVE system operational parameters and individual system well parameters were monitored and recorded on a Site-specific O&M field form. System adjustments were made as necessary to optimize performance of the system, and routine maintenance of system components were performed in accordance with the vendor-supplied system O&M manual (Attachment C).

In February 2018, EPI personnel visited the Site and determined that the SVE system was off and the blower motor was unable to restart. Inspection and troubleshooting of the equipment revealed that the SVE blower had malfunctioned, which ultimately caused the shutdown. On April 18, 2018 EPI determined that the blower motor was seized due to excessive hard water mineral deposits within the flow passages and impeller housing. The SVE blower was cleaned, serviced, and returned to normal operation on April 19, 2018.

2.12 Vapor Discharge Monitoring

Extracted vapors were monitored with a PID and system influent and effluent vapor samples were collected on a monthly basis for laboratory analysis. Each vapor sample was collected into a new, single-use Tedlar® bag and submitted to Fremont Analytical in Seattle, Washington, for GRO and BTEX analysis by NWTPH-Gx and EPA Method 8021. System vapors were monitored and sampled on a monthly basis, the data were used to evaluate mass removal and remedial progress.

2.13 Water Discharge Monitoring

The moisture separator (knockout tank or KO tank) on the SVE system was monitored for accumulated water during each O&M event. The system was configured with the water transfer pump turned off and the valve on the discharge line closed to prevent non-regulated system water discharges. When a sufficient amount of water accumulated in the separator tank, the water was manually drained and placed in on-Site 55-gallon drums. The drums were sampled on July 20, 2017 and August 2, 2017 and water samples were collected into new, laboratory-supplied sample containers and submitted to the laboratory for the following analyses:

- GRO by NWTPH-Gx
- BTEX by EPA Method 8021

The SVE moisture separator sample results for GRO and BTEX were less than laboratory reporting limits (Attachment E).

3.0 DIRECT-PUSH TECHNOLOGY INVESTIGATION

3.1 Ecology-Approved Sample Locations

On March 11 and 12, 2019 EPI sampled five direct-push technology (DPT) soil borings to confirm that soils beneath the eastbound lanes of I-90 were effectively cleaned up to applicable MTCA soil CULs. Soil borings were advanced to 15-feet below the grade of the highway. The boring locations were identified based on the September 12, 2016 CAP report EPI submitted to Ecology. Boring locations, presented on Figure 6, were approved based on a written Ecology approval opinion letter dated March 4, 2019 (Attachment A).

3.2 Summary of Investigation

As stated in Section 3.1, five soil borings were advanced to 15 feet below the surface of the highway to assess the soils beneath the eastbound lanes of I-90. The five boring locations, CDP-1 through CDP-5 are depicted on Figure 6. Boring logs are presented in Attachment F. Drilling locations CDP-1 through CDP-3 and CDP-5 investigated the eastern area impacts. Drilling locations CDP-1 through CDP-3 were placed approximately 30 feet apart to assess areas with the greatest contaminant concentrations as identified during the initial DPT investigation. Boring location CDP-5 was advanced to assess the southern extent of the remedial area.

Boring location CDP-4 investigated the western portion of impacts near the northern shoulder, examining the performance in that area.

Soil samples were obtained from the five borings through the use of decontaminated stainless-steel DPT samplers equipped with new, single-use polyethylene sample liners. The stainless-steel sampler was decontaminated to the satisfaction of the on-Site EPI geologist prior to each sample using a solution of Alconox and potable water. A portion of the soil was retrieved in a laboratory-supplied sampling jar by EPA Method 5035 using a laboratory-supplied single-use sample plunger. The remaining portion of the sample was used for visual observations and headspace field screening with a PID.

Soil samples were placed in a cooler with enough double-bagged ice to maintain an internal temperature of 4 degrees Celsius during transport to the analytical laboratory. Standard chain-of-custody procedures were followed in transporting the soil samples to the laboratory.

Samples were analyzed for GRO by NWTPH-Gx and BTEX using EPA Method 8021B by to Libby Environmental, Inc. in Olympia, Washington.

3.3 Analytical Results

A total of 12 samples were collected from the 5 borings. Each sample was analyzed for GRO and BTEX using the methods described in Section 3.2. Analytical results indicate that all 12 soil samples collected from beneath the eastbound lanes of I-90 did not exceed the MTCA Method A Soil CULs for GRO or BTEX. Analytical results are summarized in Table 1. Laboratory analytical reports are included in Attachment E. The DPT investigation data indicate that petroleum contamination has been reclaimed by a combination of excavation of contaminated soil and implementation of the on-Site SVE system. The data suggest that soil beneath the eastbound lanes of I-90 at the Site is no longer impacted.

4.0 GROUNDWATER

During late 2015 and early 2016 EPI installed 14 groundwater monitoring wells: four wells north of I-90 and 10 wells south of I-90 at the locations shown on Figure 7 and sampled groundwater periodically to evaluate and monitor potential petroleum impacts to groundwater. Details of monitoring well installation, boring logs and as-built diagrams are presented in the SRIRA Report. Monitoring well installation, water level measurements, groundwater sampling, and decommissioning tasks are presented in the following sections.

4.1 Groundwater Sampling Methods

EPI has performed multiple groundwater sampling events for the 14 well monitoring network at the Site. The methods and procedures used for these groundwater sampling events are described in the following sections.

4.1.1 Piezometric Conditions

Prior to sampling groundwater, the static depth-to-water of each well was measured to the nearest 0.01 foot relative to the surveyed point at the top of the well casing using an electronic water level meter. To ensure reproducibility of the data, all measurements were taken on the north side of the top surface of the PVC well casing. Depth-to-water measurements ranged from 4.14 to 16.24 feet below the top of the casing. The depths correspond to groundwater elevations ranging between 1970.72 to 1960.38 feet above mean sea level (MSL). Figure 7 depicts groundwater elevations and inferred groundwater flow directions at the Site as measured during the January 2019 sampling event.

EPI previously surveyed measuring point elevations for all on-Site monitoring wells and used those data, along with measured depth-to-water data, to determine groundwater flow directions at the Site. A summary of the depths to water and monitoring well and groundwater elevations are provided in Table 5. These data indicate that groundwater flow at the Site is generally in a southerly direction.

4.1.2 Well Purging

Following static depth-to-water measurements , each well was purged using a peristaltic pump and low-flow purging methods. Each well contained dedicated polyethylene tubing that was used for purging and sampling. Flex tubing and the polyethylene tubing connecting the flex tubing to the multiparameter instrument flow cell were new and were changed between each well. During purging, groundwater was field analyzed for the following parameters using a multiparameter instrument (e.g., YSI Model 556 or equivalent) equipped with a flow cell:

- pH
- Temperature
- Turbidity
- Oxidation-reduction potential (ORP)
- Specific conductivity
- Dissolved oxygen (DO)

Low-flow purging was continued until these field parameters met stabilization criteria for three successive readings.

4.1.3 Sample Collection

Following purging and field parameter stabilization, groundwater samples were collected into new, laboratory-supplied containers using a peristaltic pump with new surface tubing for each well. During sample collection the flow rate of the pump was reduced to 100 milliliters per minute to limit the potential loss of volatile constituents. Samples were placed in a cooler with enough double bagged ice to maintain an internal temperature of 4 degrees Celsius or lower and submitted under standard chain-of-custody protocol to Friedman & Bruya, Inc. (FBI) in Seattle, Washington. EPI submitted 14 groundwater samples for GRO by NWTPH-Gx and BTEX by EPA Method 8021.

4.2 Analytical Results

Analytical results for historical groundwater sampling events are summarized in Table 6. These data indicate that groundwater impacts were limited to four well locations, MW-1, MW-2, MW-3, and MW-5. Groundwater sampling events were performed periodically at the on-Site wells from 2015 through 2019 with no contaminant concentrations exceeding applicable MTCA Method A CULs after the February 23, 2016 sampling event. Since that time, five consecutive groundwater sampling events that included wells MW-1, MW-2, MW-3, MW-5, and other wells have been performed with no MTCA Method A CUL exceedances in samples from any well during those events.

The most recent groundwater sampling event was performed on January 9 and 10, 2019. During that event, EPI sampled all 14 groundwater monitoring wells (MW-1 through MW-14). The locations of the monitoring wells are identified on Figure 7.

Table 6 summarizes the analytical results for groundwater quality monitoring at the Site since December 2015. GRO and BTEX concentrations in groundwater have been less than CULs since February 2016. The laboratory analytical reports for the 2016, 2017 and 2019 groundwater monitoring events are included in Attachment E.

4.3 Well Decommissioning

On April 19, 2019, after receiving an agreement letter from Ecology (Attachment A), EPI decommissioned five monitoring wells that were located in the direct path of the upcoming bridge replacement project to be performed by the Washington State Department of Transportation (WSDOT). The locations of the decommissioned wells (MW-6, MW-13, MW-14, MW-4, and MW-3) are depicted on Figure 2. These wells were decommissioned in accordance with all applicable Ecology regulations.

5.0 CONCLUSIONS

The following conclusions are supported by the findings of the previous Site investigation and remediation work, detailed in the *Spill Response and Interim Remedial Action Report* (SRIRA Report) and *Cleanup Action Plan* (CAP) dated September 12, 2016 as well as the findings of the scope of work described in this *Cleanup Action Report*.

- Detectable concentrations of GRO and BTEX did not exceed MTCA Method A CULs within the median excavation area, as documented in the SRIRA Report.

- The SVE system and horizontal SVE wells installed under the eastbound lanes of I-90 remediated the residual source soil contamination, as documented in the CAP.

- The DPT investigation data document that petroleum contamination in soil has been removed or remediated by a combination of the excavation of contaminated soil and implementation of the on-Site SVE system. The data indicate that soil beneath the eastbound lanes of I-90 at the Site is no longer impacted.

- Groundwater data indicate that petroleum contamination in groundwater has been remediated by a combination of Site excavation of contaminated soil (source removal) and implementation of the on-Site SVE system. The data indicate that groundwater at the Site is no longer impacted.

- It is EPI's opinion that the cleanup actions performed at the Site, as documented in the SRIRA Report, CAP, and this *Cleanup Action Report*, complies with the substantive requirements of the MTCA regulation.

- With submittal of this report, EPI requests that Ecology provide an unrestricted No Further Action (NFA) Determination for the Site.

Tables

Table 1
Analytical Results for Direct-Push Investigation
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Sample Location	Sample Date	Sample Depth (feet)	GRO[a]	Benzene[b]	Toluene[b]	Ethyl-benzene[b]	Total Xylenes[b]
CDP-1	3/11/2019	6	22	<0.02	<0.10	<0.05	**0.99**
	3/11/2019	6 Duplicate	24	<0.02	<0.10	<0.05	**1.1**
CDP-2	3/11/2019	4	<10	<0.02	<0.10	**0.12**	**0.62**
	3/11/2019	8	<10	<0.02	<0.10	<0.05	<0.15
CDP-3	3/11/2019	4	<10	<0.02	<0.10	<0.05	<0.15
	3/11/2019	8	<10	<0.02	<0.10	<0.05	<0.15
CDP-4	3/11/2019	4	<10	<0.02	<0.10	<0.05	<0.15
	3/11/2019	4 Duplicate	<10	<0.02	<0.10	<0.05	<0.15
	3/11/2019	8	<10	<0.02	<0.10	<0.05	<0.15
CDP-5	3/12/2019	1.5	<10	<0.02	<0.10	<0.05	<0.15
	3/12/2019	4	<10	<0.02	<0.10	<0.05	<0.15
	3/12/2019	8	<10	<0.02	<0.10	<0.05	<0.15
Selected Soil Cleanup Level[c]			**30[d]**	**0.03**	**7**	**5.1[e]**	**9**

Notes:

All results presented in milligrams per kilogram (mg/kg).

Bold Bold results exceed the laboratory detection limit.

a Analyzed by NWTPH-Gx.

b Analyzed by EPA Method 8260C.

c Unless otherwise indicated, cleanup level is based on the Model Toxics Control Act (MTCA) Method A Soil Cleanup Level for Unrestricted Land Uses, Table 740-1 of Washington Administrative Code 173-340-900.

d Cleanup level is 30 when benzene is present and the total of toluene, ethylbeznene, and total xylenes are greater than 1% of the total gasoline mixture.

e Cleanup level based on terrestrial ecological evaluation (TEE).

< Indicates the concentration is less than the laboratory reporting limit.

Compound:

GRO Gasoline-range organics

Table 2
SVE System Mass Removal Summary
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Date	System Parameters		Laboratory Results				Mass Removal						
	Time Since Last Event (days)	Effluent System Flow Rate (scfm)	Influent GRO (µg/L)	Influent BTEX (µg/L)	Effluent GRO (µg/L)	Effluent BTEX (µg/L)	GRO Removal Rate (lbs/day)	GRO Removed During Period (lbs)	Cumulative GRO Removed (lbs)	BTEX Removal Rate (lbs/day)	BTEX Removed During Period (lbs)	Cumulative BTEX Removed (lbs)	Cumulative TVH Removed (lbs)
07/13/17	1	560	36.5	0.384	33.3	0.1	1.7	1.7	1.7	0.005	0.0	0.0	1.7
08/10/17	29	500	--	0.268	2.5	0.1	0.1	3.3	4.9	0.004	0.1	0.1	5.1
09/14/17	36	494	--	--	2.5	0.1	0.1	4.0	8.9	0.004	0.2	0.3	9.2
10/12/17	48	500	--	--	2.5	0.1	0.1	5.4	14.3	0.004	0.2	0.5	14.8
11/18/17	37	500	--	--	2.5	0.1	0.1	4.2	18.5	0.004	0.2	0.7	19.1
12/12/17	24	500	--	--	2.5	0.1	0.1	2.7	21.1	0.004	0.1	0.8	21.9
01/09/18	28	500	--	--	2.5	0.1	0.1	3.1	24.3	0.004	0.1	0.9	25.2
4/19/18*	1	500	--	--	2.5	0.1	0.1	0.1	24.4	0.004	0.0	0.9	25.3
05/16/18	27	500	--	--	2.5	0.1	0.1	3.0	27.4	0.004	0.1	1.0	28.5
06/27/18	42	500	--	--	2.5	0.1	0.1	4.7	32.1	0.004	0.2	1.2	33.4
07/25/18	28	500	--	--	8.3	0.113	0.4	10.5	42.6	0.005	0.1	1.4	44.0
09/05/18	42	500	--	--	10.0	0.291	0.4	18.9	61.4	0.013	0.5	1.9	63.4
10/11/18	36	500	--	--	2.5	0.286	0.1	4.0	65.5	0.013	0.5	2.4	67.9
11/15/18	35	500	--	--	15.1	0.455	0.7	23.7	89.2	0.020	0.7	3.1	92.3

Notes:

*	System was shutdown between Febuary and April 18, 2018; system runtime has been adjusted for this downtime.
SVE	Soil vapor extraction.
scfm	Standard cubic feet per minute.
µg/L	Micrograms per liter.
lbs	Pounds.
--	Sample not submitted to laboratory for analysis.

Compounds:

GRO	Gasoline-range organics
BTEX	Benzene, toluene, ethylbenzene, and total xylenes
TVH	Total volatile hydrocarbons

Table 3
SVE System Well Construction Summary
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Well ID	Installation Date	Orientation	Well Diameter (inches)	Well Length (feet)	Screen Length (feet)	Screen Slot Size (inches)
SVE-1	9/21/16	Horizontal	3	64	9.8	0.02
SVE-2	9/20/16	Horizontal	3	64	9.8	0.02
SVE-3	9/20/16	Horizontal	3	65	29.4	0.02
SVE-4	9/15/16	Horizontal	3	65	29.4	0.02
SVE-5	9/16/16	Horizontal	3	69	29.4	0.02
SVE-6	9/19/16	Horizontal	3	68	29.4	0.02

Table 4
Air Analytical Results
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Sample Identification	Date Collected	GRO[a]	Benzene[b]	Toluene[b]	Ethyl-benzene[b]	Total Xylenes[b]
SVE-1	8/2/2017	**52.6**	<0.100	<0.100	<0.100	<0.100
SVE -2	7/20/2017	<5.0	<0.100	<0.100	<0.100	<0.100
SVE-3	7/13/2017	**14.6**	<0.100	<0.100	<0.100	<0.100
	4/19/2018	<5.0	<0.100	<0.100	<0.100	<0.100
SVE-4	7/13/2017	**542**	<0.100	**3.25**	**0.485**	**4.84**
	9/14/2017	**17.4**	<0.100	<0.100	<0.100	**0.379**
	4/19/2018	<5.0	<0.100	<0.100	<0.100	<0.100
SVE-5	7/20/2017	**7.59**	<0.100	<0.100	<0.100	<0.100
	4/19/2018	<5.0	<0.100	<0.100	<0.100	<0.100
SVE-6	8/2/2017	**5.34**	<0.100	<0.100	<0.100	<0.100
TOT-INF	7/13/2017	**36.5**	<0.100	**0.174**	<0.100	**0.210**
TOT-EFF		**33.3**	<0.100	**0.159**	<0.100	**0.189**
TOT-INF-081017	8/10/2017	<5.0	<0.100	**0.140**	<0.100	**0.128**
TOT-EFF-081017		<5.0	<0.100	<0.100	<0.100	<0.100
TOT-EFF-091417	9/14/2017	<5.0	<0.100	<0.100	<0.100	<0.100
TOT-EFF-101217	10/12/2017	<5.0	<0.100	<0.100	<0.100	<0.100
TOT-EFF-110817	11/8/2017	<5.0	<0.100	<0.100	<0.100	<0.100
Tot-Eff-121217	12/12/2017	<5.0	<0.100	<0.100	<0.100	<0.100
Tot-Eff-010918	1/9/2018	<5.0	<0.100	<0.100	<0.100	<0.100
Tot-Eff-041918	4/19/2018	<5.0	<0.100	<0.100	<0.100	<0.100
TOT-EFF-051618	5/16/2018	<5.0	<0.100	<0.100	<0.100	<0.100
SP-2	6/27/2018	<5.0	<0.100	<0.100	<0.100	<0.100
TOT-EFF-062718		<5.0	<0.100	<0.100	<0.100	<0.100
SP-5	7/25/2018	**9.17**	<0.100	<0.100	<0.100	<0.100
TOT-EFF-072518		**8.32**	<0.100	<0.100	<0.100	**0.113**
TOT-EFF-091618	9/5/2018	**10.0**	<0.100	<0.100	<0.100	**0.291**
TOT-EFF-101118	10/11/2018	<5.0	<0.100	<0.100	<0.100	**0.286**
TOT-EFF-111518	11/15/2018	**15.1**	<0.100	<0.100	**0.114**	**0.341**

Notes:

All results presented in micrograms per liter (µg/L).

Bold Bold results exceed the laboratory reporting limit.

a Analysis in accordance with EPA Method NWTPH-GRO

b Analysis in accordance with EPA Method 8260C

< Indicates the concentration exceeds the laboratory reporting limit.

Table 5
Well Survey Data and Groundwater Elevations
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Well ID	Top of Casing Elevation[a]	X	Y	Date	Depth to Groundwater (feet)	Groundwater Elevation[a]
MW-1	1980.6	3038.549	-245.51	12/14/2015	9.01	1971.59
				12/15/2015	9.06	1971.54
				12/16/2015	9.08	1971.52
				12/17/2015	9.06	1971.54
				12/18/2015	9.09	1971.51
				12/21/2015	9.19	1971.41
				12/22/2015	9.20	1971.40
				12/29/2016	9.30	1971.30
				1/5/2016	9.32	1971.28
				1/11/2016	9.32	1971.28
				2/4/2016	9.15	1971.45
				2/22/2016	8.92	1971.68
				3/9/2016	8.84	1971.76
				9/19/2016	9.16	1971.44
				10/3/2017	9.20	1971.40
				1/21/2019	9.20	1971.40
MW-2	1978.54	2903.371	-243.374	12/14/2016	6.94	1971.60
				12/15/2015	6.98	1971.56
				12/16/2015	7.01	1971.53
				12/17/2015	6.99	1971.55
				12/18/2015	7.03	1971.51
				12/21/2015	7.14	1971.40
				12/22/2015	7.15	1971.39
				12/29/2016	7.27	1971.27
				1/5/2016	7.38	1971.16
				1/11/2016	7.35	1971.19
				1/25/2016	7.16	1971.38
				2/4/2016	7.15	1971.39
				2/16/2016	6.66	1971.88
				2/22/2016	6.91	1971.63
				3/9/2016	6.94	1971.60
				9/19/2016	7.16	1971.38
				10/3/2017	7.23	1971.31
				1/21/2019	7.19	1971.35
MW-3	1977.58	3204.793	-210.185	12/14/2016	6.17	1971.41
				12/15/2015	6.12	1971.46
				12/16/2015	6.13	1971.45
				12/17/2015	6.11	1971.47
				12/18/2015	6.15	1971.43
				12/21/2015	6.21	1971.37
				12/22/2015	6.21	1971.37
				12/29/2016	6.30	1971.28
				1/5/2016	6.40	1971.18
				1/11/2016	6.31	1971.27
				2/4/2016	6.19	1971.39
				2/22/2016	5.99	1971.59
				3/9/2016	6.01	1971.57
				9/19/2016	6.11	1971.47
				10/3/2017	6.14	1971.44
				1/21/2019	6.18	1971.40
MW-4	1979.16	3196.019	-134.589	12/14/2016	7.46	1971.70
				12/15/2015	7.50	1971.66
				12/16/2015	7.51	1971.65
				12/17/2015	7.50	1971.66
				12/18/2015	7.55	1971.61
				12/21/2015	7.60	1971.56
				12/22/2015	7.60	1971.56
				12/29/2016	7.68	1971.48
				1/5/2016	7.80	1971.36
				1/11/2016	7.84	1971.32
				1/15/2016	7.55	1971.61
				2/4/2016	7.63	1971.53
				2/16/2016	7.12	1972.04
				2/22/2016	7.48	1971.68
				3/9/2016	7.40	1971.76
				9/19/2016	7.57	1971.59
				10/3/2017	7.60	1971.56
				1/21/2019	7.63	1971.53
MW-5	1978.48	2972.422	-246.270	12/14/2016	6.92	1971.56
				12/15/2015	6.94	1971.54
				12/16/2015	6.96	1971.52
				12/17/2015	6.93	1971.55
				12/18/2015	6.97	1971.51
				12/21/2015	7.08	1971.40
				12/22/2015	7.09	1971.39

Table 5
Well Survey Data and Groundwater Elevations
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Well ID	Top of Casing Elevation[a]	X	Y	Date	Depth to Groundwater (feet)	Groundwater Elevation[a]
MW-5	1978.48	2972.422	-246.270	12/29/2016	7.21	1971.27
				1/5/2016	7.27	1971.21
				1/11/2016	7.29	1971.19
				1/25/2016	7.09	1971.39
				2/4/2016	7.09	1971.39
				2/16/2016	6.59	1971.89
				2/22/2016	6.83	1971.65
				3/9/2016	6.85	1971.63
				9/19/2016	7.11	1971.37
				10/3/2017	7.15	1971.33
				1/21/2019	7.15	1971.33
MW-6	1984.85	2792.409	-147.031	12/14/2016	12.62	1972.23
				12/15/2015	12.69	1972.16
				12/16/2015	12.72	1972.13
				12/17/2015	12.70	1972.15
				12/18/2015	12.74	1972.11
				12/21/2015	12.82	1972.03
				12/22/2015	12.83	1972.02
				12/29/2016	13.03	1971.82
				1/5/2016	13.14	1971.71
				1/11/2016	13.17	1971.68
				2/4/2016	12.02	1972.83
				2/22/2016	12.67	1972.18
				3/9/2016	12.68	1972.17
				9/19/2016	12.92	1971.93
				10/3/2017	13.01	1971.84
				1/21/2019	12.96	1971.89
MW-7	1977.68	2835.793	-243.886	1/5/2016	6.32	1971.36
				1/11/2016	6.32	1971.36
				2/4/2016	6.08	1971.60
				2/16/2016	5.59	1972.09
				2/22/2016	5.83	1971.85
				3/9/2016	5.86	1971.82
				9/19/2016	6.03	1971.65
				10/3/2017	6.18	1971.50
				1/21/2019	6.12	1971.56
MW-8	1974.86	3041.453	-369.868	1/5/2016	4.32	1970.54
				1/11/2016	4.31	1970.55
				1/25/2016	4.17	1970.69
				2/4/2016	4.16	1970.70
				2/16/2016	3.70	1971.16
				2/22/2016	3.92	1970.94
				3/9/2016	3.97	1970.89
				9/19/2016	4.13	1970.73
				10/3/2017	4.19	1970.67
				1/21/2019	4.14	1970.72
MW-9	1976.74	2973.435	-374.564	1/5/2016	6.25	1970.49
				1/11/2016	6.26	1970.48
				1/25/2016	6.09	1970.65
				2/4/2016	6.09	1970.65
				2/16/2016	5.64	1971.10
				2/22/2016	5.85	1970.89
				3/9/2016	5.89	1970.85
				9/19/2016	6.13	1970.61
				10/3/2017	6.18	1970.56
				1/21/2019	6.16	1970.58
MW-10	1976.44	2922.928	-383.431	1/5/2016	5.85	1970.59
				1/11/2016	5.86	1970.88
				2/4/2016	5.65	1971.09
				2/22/2016	5.43	1971.31
				3/9/2016	5.48	1970.96
				9/19/2016	5.67	1970.77
				10/3/2017	6.78	1969.66
				1/21/2019	5.67	1970.77
MW-11	1976.62	2934.221	-429.147	1/5/2016	6.33	1970.29
				1/11/2016	6.34	1970.28
				2/4/2016	6.14	1970.48
				2/22/2016	5.93	1970.69
				3/9/2016	5.98	1970.64
				9/19/2016	6.13	1970.49
				10/3/2017	6.21	1970.41
				1/21/2019	6.12	1970.50
MW-12	1980.94	3005.992	-310.037	1/25/2016	10.10	1970.84
				2/4/2016	10.12	1970.82
				2/22/2016	9.84	1971.10

Table 5
Well Survey Data and Groundwater Elevations
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Well ID	Top of Casing Elevation[a]	X	Y	Date	Depth to Groundwater (feet)	Groundwater Elevation[a]
MW-12	1980.94	3005.992	-310.037	3/9/2016	9.89	1971.05
				9/19/2016	10.07	1970.87
				10/3/2017	10.12	1970.82
				1/21/2019	10.13	1970.81
MW-13	1986.89	2891.901	-144.270	3/9/2016	14.80	1972.09
				9/19/2016	15.09	1971.80
				10/3/2017	15.16	1971.73
				1/21/2019	15.15	1971.74
MW-14	1987.68	3011.967	-146.878	3/9/2016	15.13	1972.55
				9/19/2016	16.16	1971.52
				10/3/2017	16.22	1971.46
				1/21/2019	16.24	1971.44

Note:
a Measured in feet above mean sea level.

Table 6
Groundwater Analytical Results
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Sample Location	Sample Date	GRO[a]	Benzene[b]	Toluene[b]	Ethyl-benzene[b]	Total Xylenes[b]
MW-1	12/14/2015	<100	**2.1**	**13**	**1.0**	**5.1**
	12/21/2015	<100	<1	**2.2**	<1	<3
	12/29/2015	<100	<1	**1.5**	<1	<3
	1/6/2016	<100	<1	**1.2**	<1	<3
	1/12/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/23/2016	<100	<1	<1	<1	<3
	3/9/2016	<100	<1	**1.6**	<1	<3
	9/19/2016	<100	<1	<1	<1	<3
	10/4/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MW-2	12/14/2015	**580**	**7.6**	**91**	**13**	**77**
	12/21/2015	<100	<1	<1	<1	<3
	12/29/2015	<100	<1	<1	<1	<3
	1/5/2016	<100	<1	**1.7**	<1	<3
	1/12/2016	<100	<1	**3.1**	<1	<3
	1/25/2016	<100	<1	**3.1**	<1	<3
	2/4/2016	**200**	**4.7**	**36**	**2.6**	**13**
	2/16/2016	<100	<1	**1.7**	<1	<3
	2/23/2016	<100	<1	**1.5**	<1	<3
	3/9/2016	<100	<1	<1	<1	<3
	9/19/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3
MW-3	12/14/2015	<100	<1	<1	<1	<3
	12/21/2015	<100	<1	**1.4**	<1	<3
	12/29/2015	<100	<1	**1.3**	<1	<3
	1/6/2016	<100	<1	**1.1**	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	2/5/2016	<100	<1	<1	<1	<3
	2/23/2016	<100	<1	<1	<1	<3
	3/9/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/4/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MW-4	12/14/2015	<100	<1	<1	<1	<3
	12/21/2015	<100	<1	<1	<1	<3
	12/29/2015	<100	<1	<1	<1	<3
	1/6/2016	<100	<1	<1	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	1/25/2016	<100	<1	<1	<1	<3
	2/5/2016	<100	<1	<1	<1	<3
	2/16/2016	<100	<1	<1	<1	<3
	2/23/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/4/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MW-5	12/14/2015	**3,700**	**150**	**890**	**35**	**190**
	12/21/2015	**190**	<1	**5.5**	**2.5**	**13**
	12/29/2015	**340**	<1	**8.7**	**7.8**	**60**
	1/5/2016	**190**	<1	<1	**2.3**	**31**
	1/14/2016	**280**	<1	**1.2**	<1	**39**
	1/25/2016	**1,700**	**69**	**330**	**11**	**140**
	2/4/2016	**160**	<1	**6.7**	<1	**12**
	2/16/2016	**5,700**	**120**	**1,300**	**11**	**450**
	2/23/2016	<100	<1	<1	<1	<3
	3/9/2016	<100	<1	**3.5**	<1	**3.1**
	9/19/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MW-6	12/14/2015	<100	<1	<1	<1	<3
	12/21/2015	<100	<1	<1	<1	<3
	12/29/2015	<100	<1	<1	<1	<3
	1/6/2016	<100	<1	<1	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	2/5/2016	<100	<1	<1	<1	<3
	2/23/2016	<100	<1	<1	<1	<3
	3/9/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/4/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MW-7	12/31/2015	<100	<1	<1	<1	<3
	1/5/2016	<100	<1	<1	<1	<3
	1/12/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/16/2016	<100	<1	<1	<1	<3
	2/23/2016	<100	<1	<1	<1	<3
	9/19/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3

Table 6
Groundwater Analytical Results
Cleanup Action Report
Gasoline Tanker Spill Site
Mile Marker 80, I-90, Cle Elum, Washington

Sample Location	Sample Date	GRO[a]	Benzene[b]	Toluene[b]	Ethyl-benzene[b]	Total Xylenes[b]
MW-8	12/31/2015	<100	<1	<1	<1	<3
	1/6/2016	<100	<1	<1	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	1/25/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/16/2016	<100	<1	<1	<1	<3
	2/23/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3
MW-9	12/31/2015	<100	<1	<1	<1	<3
	1/6/2016	<100	<1	<1	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	1/25/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/16/2016	<100	<1	<1	<1	<3
	2/22/2016	<100	<1	<1	<1	<3
	9/19/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3
MW-10	12/31/2015	<100	<1	<1	<1	<3
	1/6/2016	<100	<1	<1	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/22/2016	<100	<1	<1	<1	<3
	9/19/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3
MW-11	12/31/2015	<100	<1	<1	<1	<3
	1/6/2016	<100	<1	<1	<1	<3
	1/14/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/22/2016	<100	<1	<1	<1	<3
	9/19/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3
MW-12	1/25/2016	<100	<1	<1	<1	<3
	2/4/2016	<100	<1	<1	<1	<3
	2/22/2016	<100	<1	<1	<1	<3
	3/9/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/3/2017	<100	<1	<1	<1	<3
	1/9/2019	<100	<1	<1	<1	<3
MW-13	3/9/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/4/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MW-14	3/9/2016	<100	<1	<1	<1	<3
	9/18/2016	<100	<1	<1	<1	<3
	10/4/2017	<100	<1	<1	<1	<3
	1/10/2019	<100	<1	<1	<1	<3
MTCA Method A Groundwater Cleanup Levels[c]		**800[c]**	**5**	**1,000**	**700**	**1,000**

Notes:

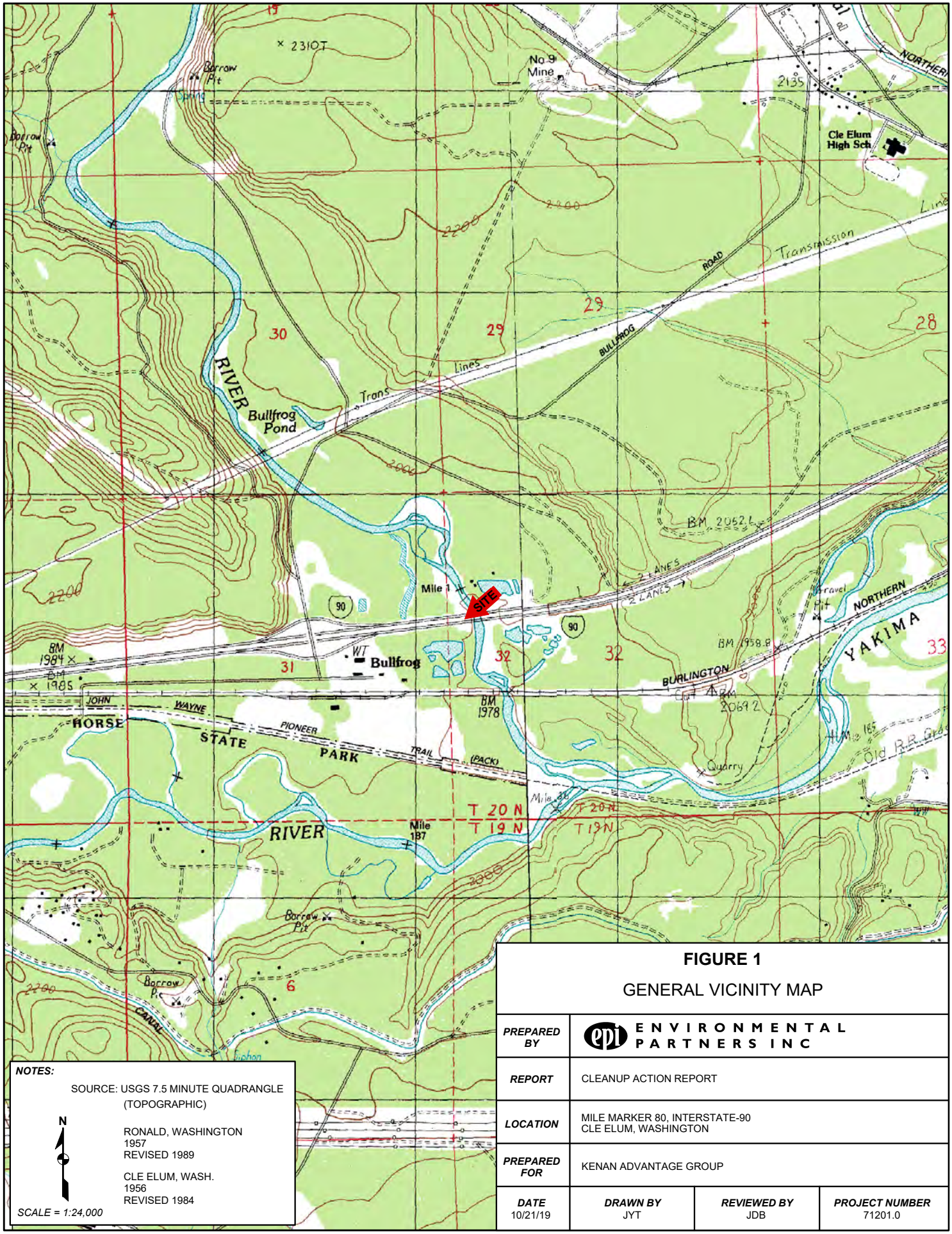
All results presented in micrograms per liter (µg/L).

Bold	Bold results exceed the laboratory detection limit.
	Shaded results exceed the cleanup level.
a	Analyzed by NWTPH-Gx.
b	Analyzed by EPA Method 8021B.
c	Model Toxics Control Act (MTCA) Groundwater Cleanup Level from Table 720-1 of Washington Administrative Code Chapter 173-340-900.
d	Cleanup level is 800 when benzene is present.
<	Indicates the concentration is less than the laboratory reporting limit.

Compounds:

GRO	Gasoline-range organics

Figures



NOTES:

SOURCE: USGS 7.5 MINUTE QUADRANGLE (TOPOGRAPHIC)

RONALD, WASHINGTON
1957
REVISED 1989

CLE ELUM, WASH.
1956
REVISED 1984

N

SCALE = 1:24,000

FIGURE 1

GENERAL VICINITY MAP

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	***DRAWN BY*** JYT	***REVIEWED BY*** JDB	***PROJECT NUMBER*** 71201.0

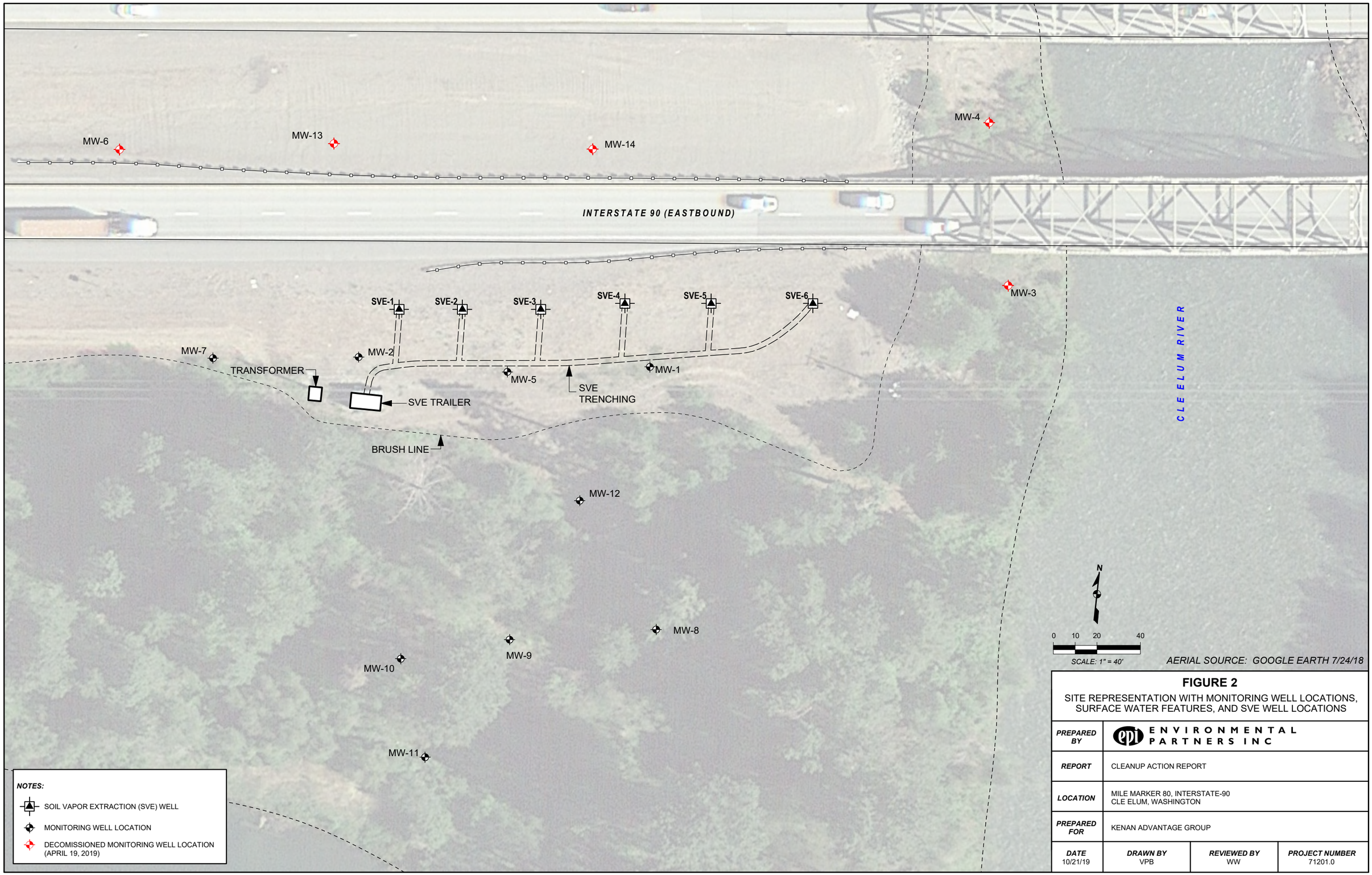
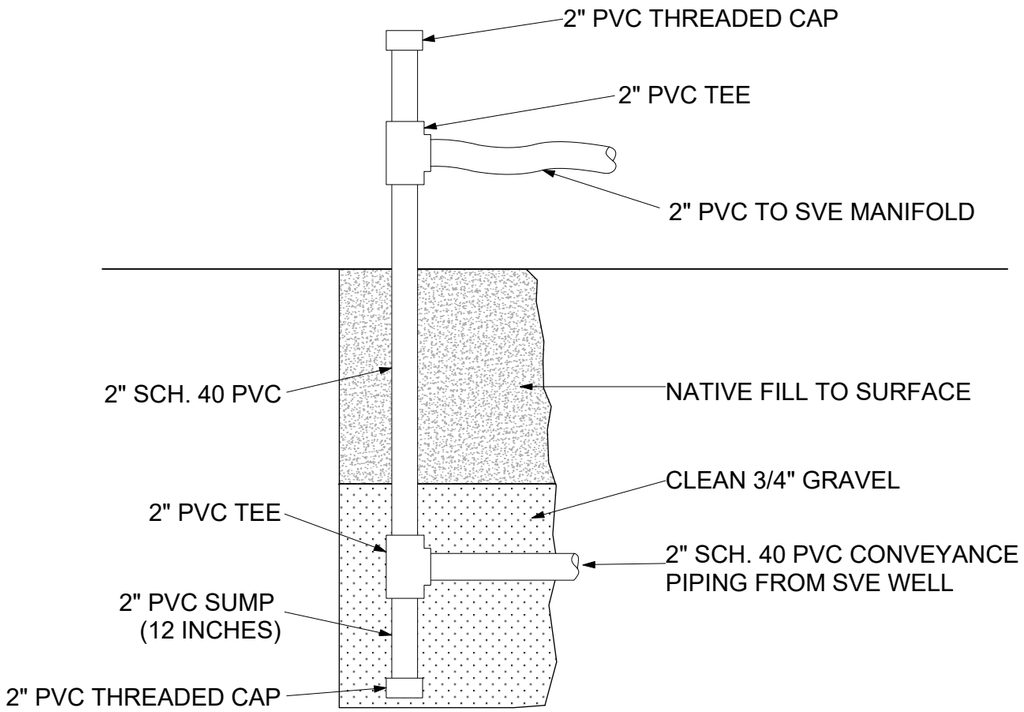


FIGURE 2

SITE REPRESENTATION WITH MONITORING WELL LOCATIONS, SURFACE WATER FEATURES, AND SVE WELL LOCATIONS

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	**DRAWN BY** VPB	**REVIEWED BY** WW	**PROJECT NUMBER** 71201.0

TYPICAL ABOVEGROUND PIPING CONNECTIONS - ELEVATION VIEW
(NOT TO SCALE)



SVE-1 - SVE-6

HORIZONTAL WELL HEAD CONNECTION
(NOT TO SCALE)

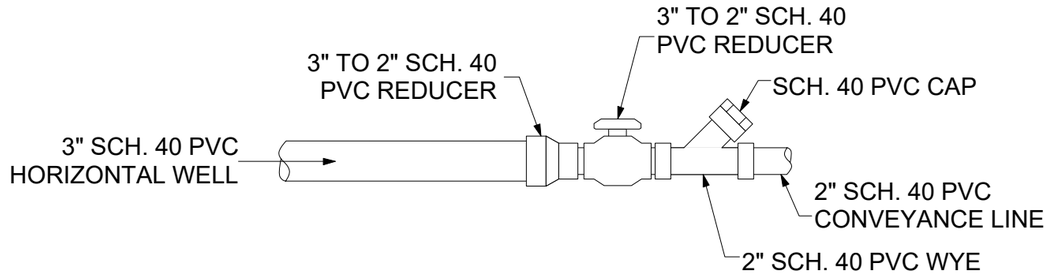


FIGURE 3
AS-BUILT SVE WELL CONSTRUCTION AND PIPING/TRENCHING DETAILS

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	***DRAWN BY*** VPB	***REVIEWED BY*** JS	***PROJECT NUMBER*** 71201.0

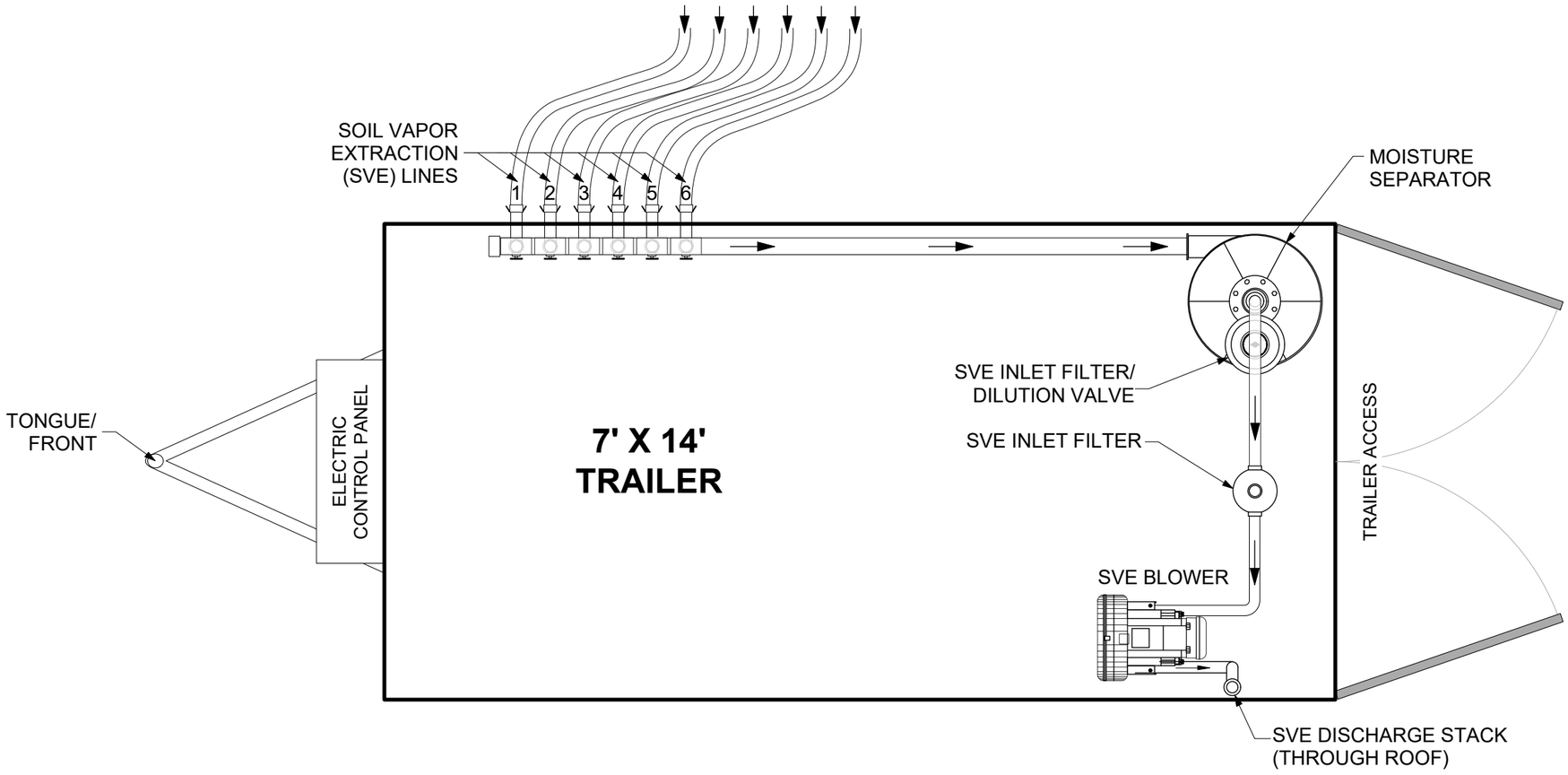
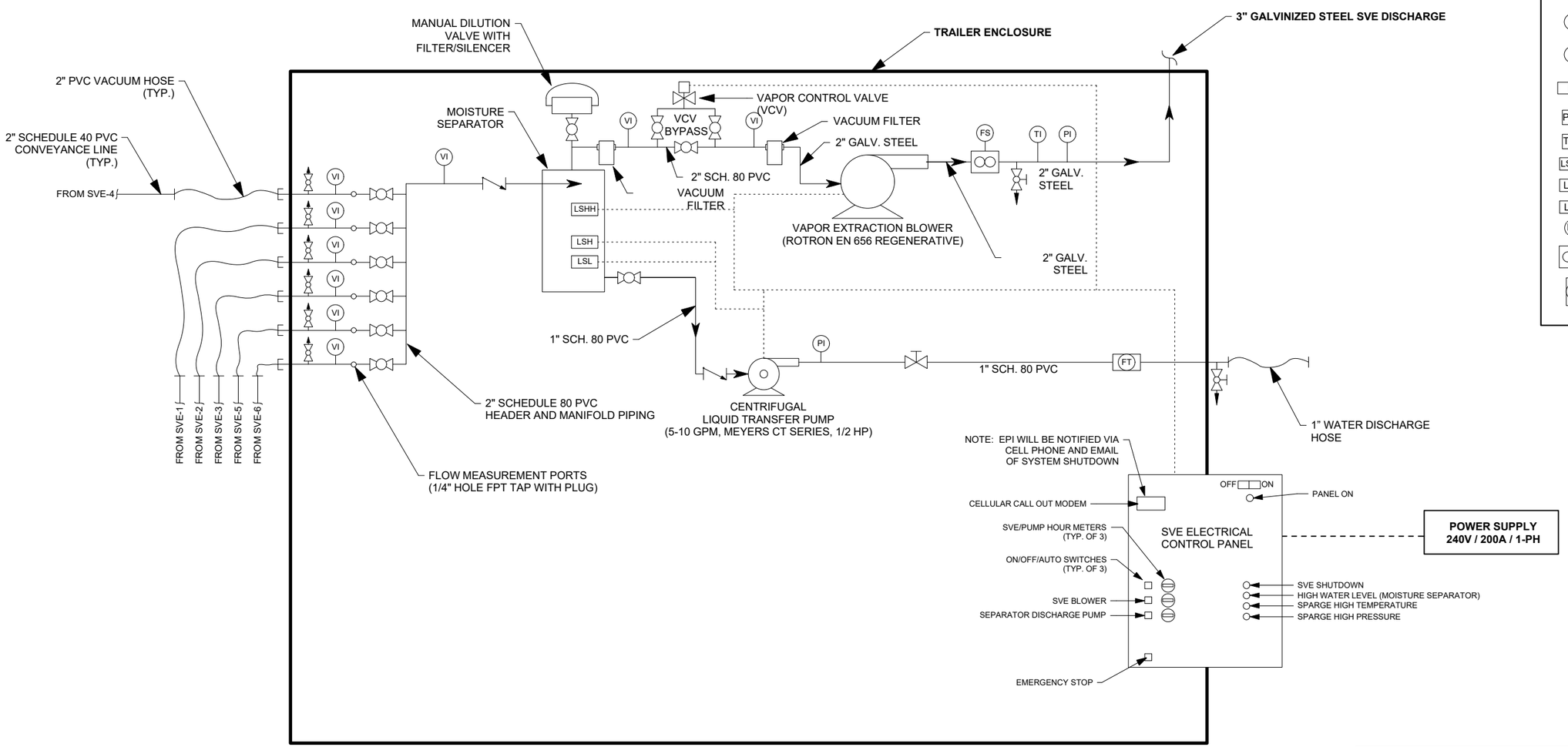


FIGURE 4

AS-BUILT SVE EQUIPMENT LAYOUT

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	***DRAWN BY*** VPB	***REVIEWED BY*** JS	***PROJECT NUMBER*** 71201.0



NOTES:

- BALL VALVE
- GATE VALVE
- CHECK VALVE
- SAMPLE PORT
- VI — VACUUM INDICATOR, 0 - 30 IN. W.C., TYP.
- PI — PRESSURE INDICATOR, 0 - 30 PSI, TYP.
- TI — TEMPERATURE INDICATOR, 0 - 300°F, TYP.
- FI — AIR FLOW INDICATOR, 0 TO 10 SCFM
- PSH — HIGH PRESSURE SWITCH
- TSH — HIGH TEMPERATURE SWITCH
- LSHH — LEVEL SWITCH, HIGH ALARM
- LSH — LEVEL SWITCH, HIGH
- LSL — LEVEL SWITCH, LOW
- FS — FLOW SENSOR, 0 - 100 SCFM
- FT — TOTALIZING FLOW METER, GALLONS

FIGURE 5

PROCESS AND INSTRUMENTATION DIAGRAM

PREPARED BY	EPI ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	***DRAWN BY*** VPB	***REVIEWED BY*** JS	***PROJECT NUMBER*** 71201.0

NOTES:

- DIRECT-PUSH TECHNOLOGY BORING LOCATION
- DEEP EXCAVATION LIMITS

(INTERIOR SAMPLES NOT DISPLAYED)

CDP-4

CDP-3

CDP-2

CDP-1

CDP-5

N

0 5 10 20

SCALE: 1" = 20'

SOURCE: GOOGLE EARTH 7/15/14

FIGURE 6
SAMPLE LOCATIONS FOR DIRECT-PUSH TECHNOLOGY INVESTIGATION

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	***DRAWN BY*** JYT	***REVIEWED BY*** JDB	***PROJECT NUMBER*** 71201.0

RIVER LEVEL SURVEY POINT
(UNDER THE BRIDGE)

MW-6
(1971.89)

MW-13
(1971.74)

MW-14
(1971.44)

MW-4
(1971.53)

INTERSTATE 90 (EASTBOUND)

1971.8
1971.7
1971.7
1971.6
1971.6
1971.5
1971.5
1971.4
1971.4
1971.3
1971.3
1971.2
1971.2
1971.1
1971.1
1971.0
1971.0
1970.9
1970.9
1970.8
1970.8
1970.7
1970.7
1970.6
1970.6

MW-7
(1971.56)

MW-2
(1971.35)

MW-5
(1971.33)

MW-1
(1971.40)

MW-3
(1971.40)

BRUSH LINE

MW-12
(1970.81)

MW-8
(1970.72)

MW-10
(1970.77)

MW-9
(1970.58)

MW-11
(1970.50)

PW-2

PW-1

CLE ELUM RIVER

N

0 10 20 40

SCALE: 1" = 40'

SOURCE: GOOGLE EARTH 7/15/14

NOTES:

DECOMISSIONED MONITORING WELL LOCATION

MW-1 (1971.40) — MONITORING WELL LOCATION WITH GROUNDWATER ELEVATION IN FEET ABOVE MEAN SEA LEVEL

1970.6 — GROUNDWATER ELEVATION CONTOUR IN FEET ABOVE MEAN SEA LEVEL

GROUNDWATER FLOW DIRECTION

FIGURE 7
MONITORING WELL LOCATIONS AND
GROUNDWATER ELEVATION CONTOURS - JANUARY 2019

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	CLEANUP ACTION REPORT		
LOCATION	MILE MARKER 80, INTERSTATE-90 CLE ELUM, WASHINGTON		
PREPARED FOR	KENAN ADVANTAGE GROUP		
DATE 10/21/19	DRAWN BY JYT/VPB	REVIEWED BY WW	PROJECT NUMBER 71201.0

Attachment A
KAG Truck Spill Ecology Opinion

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1250 W Alder St • Union Gap, WA 98903-0009 • (509) 575-2490

March 4, 2019

Josh Bernthal
Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

Re: KAG Truck Spill opinion

- **Site Name:** KAG Truck Spill
- **Site Address:** I90 MP 81 Cle Elum
- **Facility/Site ID No.:** 16970
- **Cleanup Site ID No.:** 12993
- **VCP Project No.:** CE0500

Dear Josh Bernthal:

The Washington State Department of Ecology (Ecology) received your request for an opinion on your proposed independent cleanup of the KAG Truck Spill facility (Site). This letter provides our opinion.

You requested an answer to the following two questions:

- Can Washington State Department of Transportation (WSDOT) abandon necessary wells for a bridge replacement project?
    - **Yes.** Per a January 14, 2019 phone conversation, Ecology understands the wells in question are MW-6, MW-13, MW-14, MW-4, and MW-3. Ecology believes that proper decommissioning of these wells is appropriate to protect human health and the environment.
- Does DOE agree with the investigation plan in the roadway?
    - **Yes.** The Direct Push Technology (DPT) approach outlined in the Cleanup Action Plan is adequate to characterize remaining contamination.

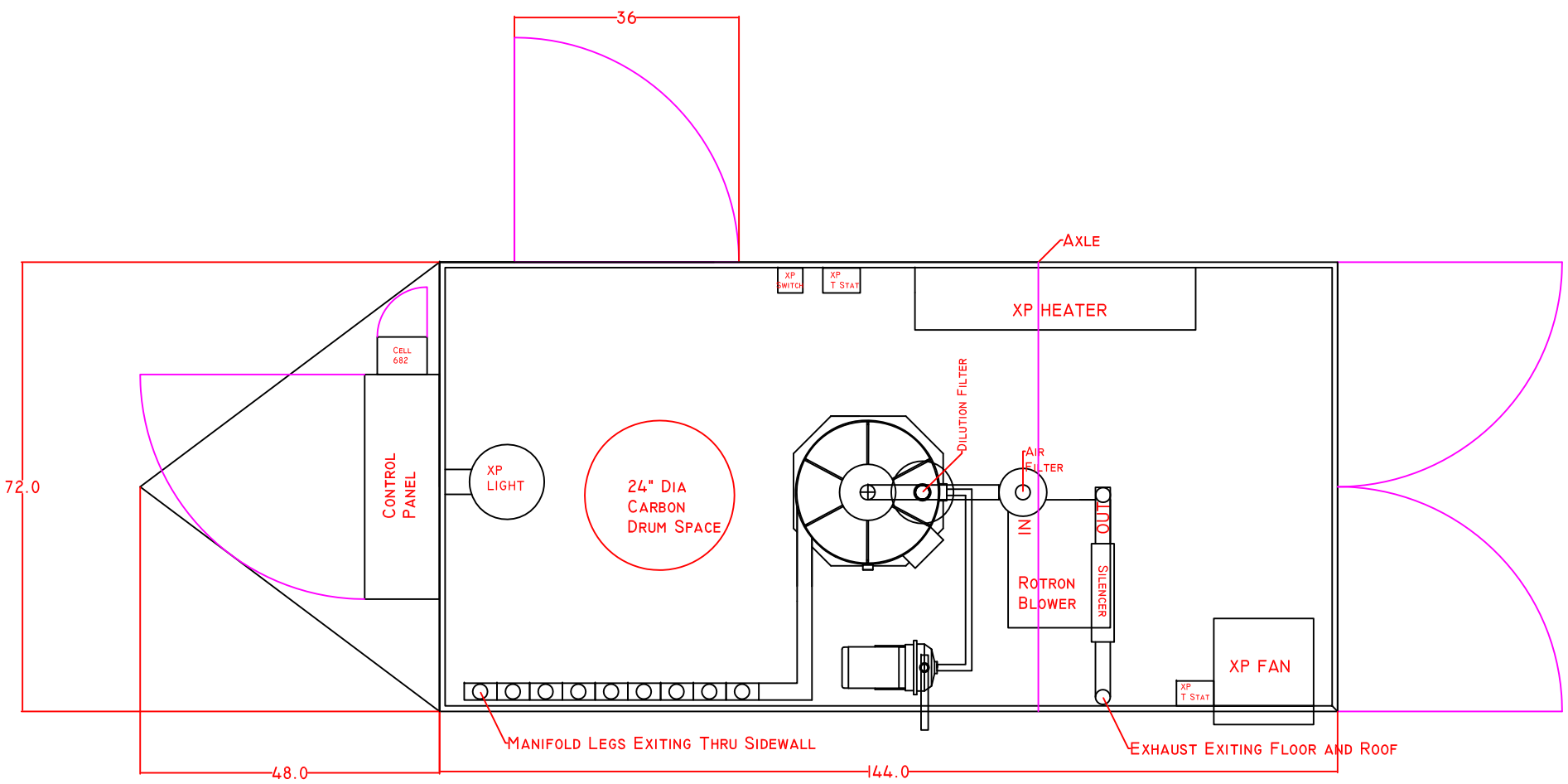
Under Washington Administrative Code (WAC) 173-340-840 "all engineering work submitted under this chapter shall be under the seal of a professional engineer registered with the state of Washington." Please submit the appropriate certifications for the provided reports.

Sincerely,

Kyle Parker
Site Manager
Toxics Cleanup Program
Central Regional Office

cc: Brian Wymer, Kenan Advantage Group

Attachment B
System Components List



DATE	REVISION	BY	CH'D

ENVIRO-EQUIPMENT, INC.
10120 Industrial Drive
Pineville, N.C. 28134
PHONE 704-556-7723
FAX 704-556-7728

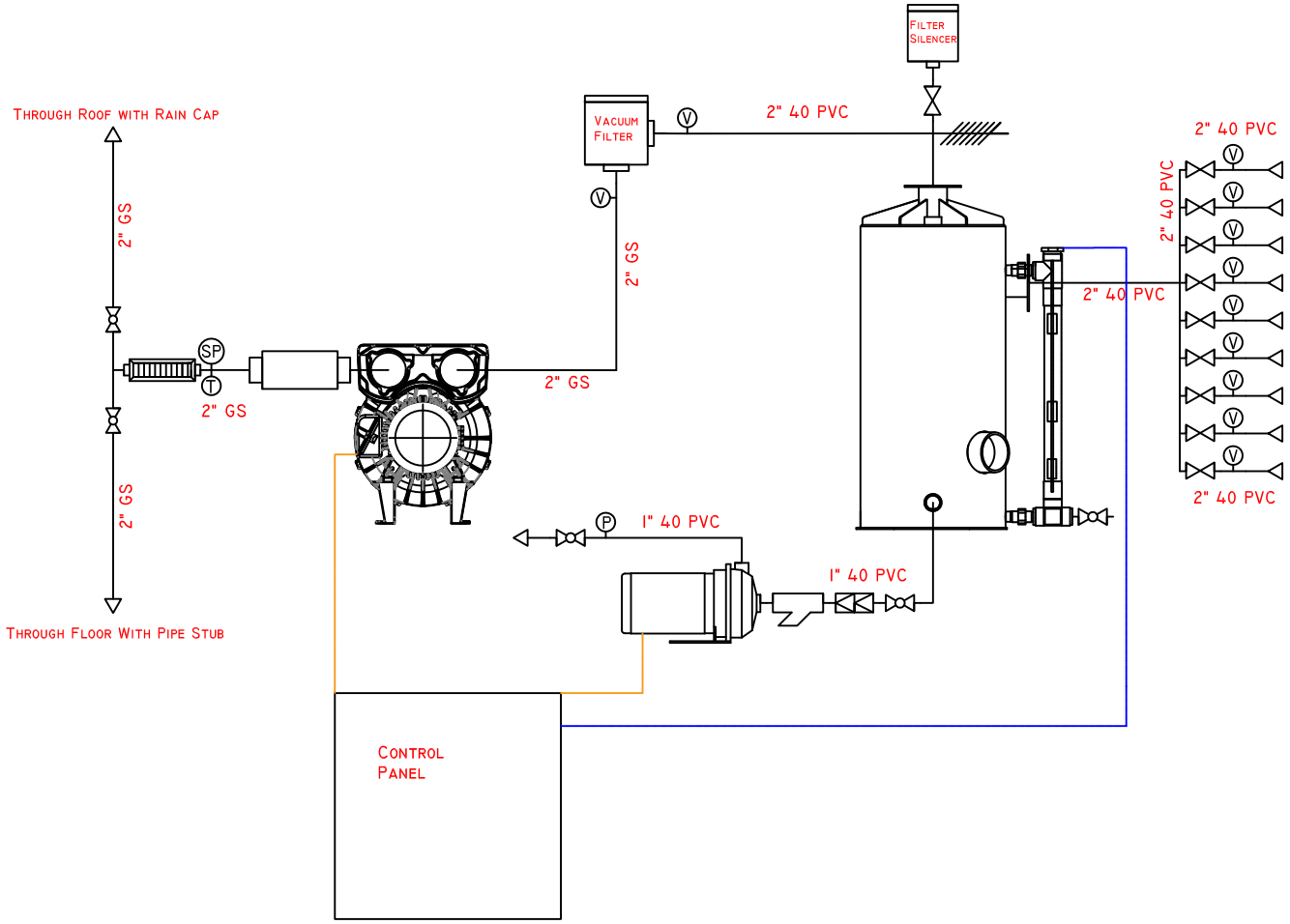
TOLERANCES (UNLESS OTHERWISE SPECIFIED)

CUSTOMER: REI

TITLE: LAYOUT
SVE SYSTEM

SCALE:	DRAWN BY:	CHECKED BY:	APP'D BY:
1"	EVAN CHEW	EC	EC

DATE:	SHEET	OF SHEETS	DRAWING NO.
5/15/2015	1	1	3057



SYMBOL	DESCRIPTION
SP	SAMPLE PORT
VS	VACUUM SWITCH
V	VACUUM GAUGE
TS	TEMPERATURE SWITCH
PS	PRESSURE SWITCH
P	PRESSURE GAUGE
T	TEMPERATURE GAUGE
	RELIEF VALVE
SV	SOLENOID VALVE
	WYE STRAINER
	CHECK VALVE
	GATE VALVE
	BALL VALVE
VACUUM FILTER	VACUUM FILTER
FILTER SILENCER	FILTER SILENCER
	EXHAUST MUFFLER
	FLOW METER
	TRANSFER PUMP
	VACUUM BLOWER
	AIR COMPRESSOR
	MOISTURE SEPARATOR
	HEAT EXCHANGER
	INTRINSICALY SAFE WIRING
	POWER WIRING

DATE	REVISION	BY	CH'D

ENVIRO-EQUIPMENT, INC.
10120 Industrial Drive
Pineville, N.C. 28134
PHONE 704-556-7723
FAX 704-556-7728

TOLERANCES (UNLESS OTHERWISE SPECIFIED)

CUSTOMER: REI

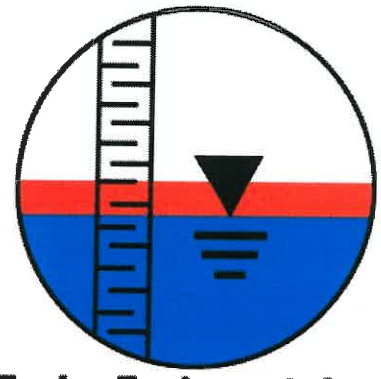
TITLE: P&ID
SVE TRAILER

SCALE:	DRAWN BY:	CHECKED BY:	APP'D BY:
NTS	Evan Chew	EC	EC

DATE:	SHEET	OF SHEETS	DRAWING NO.
8-10-15	1	1	3057

Attachment C
Operation and Maintenance Manual

Table of Contents



Enviro-Equipment, Inc.

SVE System
3980


1
2
3
4
5
6
7
8

www.cell682.com

EEI JOB 3980 - Operation and Maintenance Manual

General

- FIRST - Review all manufacturer documentation.
- Perform and document routine maintenance at manufacturer recommended intervals. Documentation of routine maintenance performed at manufacturer recommended intervals must be provided when making a warranty claim. Failure to perform and document routine maintenance at manufacturer recommended intervals will void any warranty claims.
- Only qualified individuals should connect, start up, operate, maintain and decommission this system.

System Control Panel

- FIRST – Review all control panel documentation.
- A licensed electrician should bring power from the electrical service into the main system control panel.
- Check all wiring connections for proper tightness and torque before powering the system. Verify proper grounding at the control panel. Verify all selector switches are in the OFF position. Verify all valve settings on each system component are set properly for startup.
- Verify proper voltage at the top of disconnect or main terminal block in the main system control panel enclosure.
- If the system has a phase monitor, adjust the phase monitor for proper input voltage, then turn the power on. Check for steady green light on phase monitor, if incorrect, turn off all power then switch L1 and L3.
- Close and secure the enclosure then turn power on to the system and the telemetry unit.
  - Cell 682 PIN# 3832, Default Password cell682, website www.cell682.com
- Turn all HOA switches to the auto position. Operating in hand mode is for testing purposes only. Damage to the system may result from continuously operating in hand mode which will void the warranty.

Alarm Descriptions

Control Device	Result Condition	Control Panel Indication
Moisture Separator High Level Alarm	Shuts down SVE Blower	Moisture Separator High Level Alarm Light Illuminates

Alarm Troubleshooting

Component	Problem	Possible Cause	Solution
Any Pump or Blower Motor	Will not run in hand	Tripped overload or Faulty Component	Check to see if overload if tripped, if not tripped, contact EEI about faulty component
SVE Blower	Blower will run in hand but not in auto	Moisture Separator High Level Alarm	Drain below High Level Alarm then Reset Alarm

Soil Vapor Extraction Blower

- FIRST - Review all Soil Vapor Extraction blower documentation.
- Ensure valves are open in vacuum lines. If the system has a dilution air valve open it completely. Start the blower up under as little vacuum as possible and increase the vacuum gradually as needed once started up.

- Ensure rotation is correct by "bumping" the blower on in hand mode and then off. Check rotation against rotation arrows or see if there is suction at the vacuum connections and pressure at the exhaust outlet. If rotation is backwards, have an electrician exchange two of the power leads. Be sure to lock out and tag the main incoming power. Verify that there is not power with a multimeter. If the system has a phase monitor the rotation should already be correct and this process may not be necessary.
- Do not operate beyond maximum vacuum capacity of the blower. Vacuum relief valve should be set at maximum vacuum threshold to protect blower.
- Check air filters per manufacturer's recommendation or at least once a month. Clean and replace as necessary.

Moisture Separator

- FIRST - Review all moisture separator documentation.
- If the moisture separator has a clear PVC sight glass, it should be removed and cleaned at least once a month or as necessary so the liquid level can be clearly read.
- If the moisture separator has a clean out port, the inside of the moisture separator should be flushed with clean water at least once a month or as necessary to remove any dirt or debris.
- The moisture separator high level alarm float (if any) is installed so the moisture separator does not flood and allow liquid to be sucked into the vacuum blower. Dirt and debris can cause this float to not operate properly so it should be gently flushed with clean water at least once a month or as necessary.
- The moisture separator low level and high level floats (if any) operate the moisture separator transfer pump (if any) while in auto mode. The low level float turns the pump off to prevent it from running dry and the high level float turns the pump on once sufficient liquid has filled the tank. Dirt and debris can cause these floats to not operate properly so they should be gently flushed with clean water at least once a month or as necessary.
- Upon shut down, ensure all sources of water are disabled. Drain completely.

Transfer Pumps

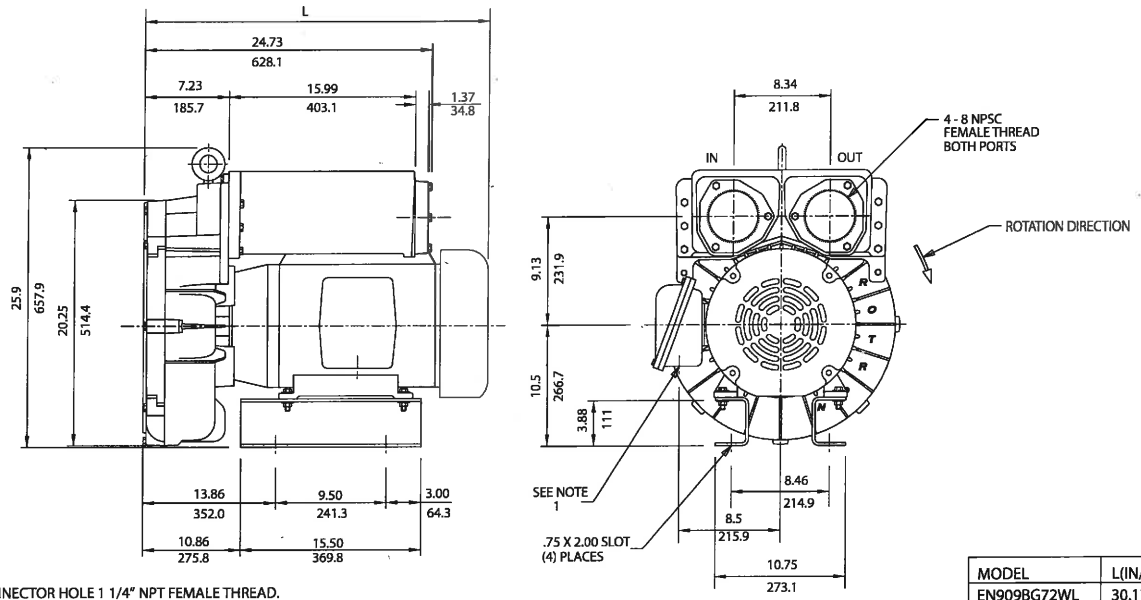
- FIRST – Review all Transfer Pump documentation.
- Ensure that all valves up stream on the pump are open. Valves up stream should never be used to throttle the pump. All valves located up stream of a pump are strictly isolation valves for servicing the pump.
- Unless collecting samples, keep all sample ports closed while operating the transfer pump.
- Bump the pump to verify rotation by holding the PUMP HOA in the "HAND" position for no more than a few seconds. Rotation arrows are located on the pump to signify proper rotation. If rotation is backwards, have an electrician exchange two of the power leads. Be sure to lock out and tag the main incoming power. Verify that there is not power with a multimeter. If the system has a phase monitor the rotation should already be correct and this process may not be necessary.
- Prime the pump.
    - If there is a suction head requirement on the pump inlet due to elevation, the pump may be primed by opening the top plug and adding water until full.
    - If there is a suction head requirement due to a mechanical vacuum, the pump may be primed by turning off the source of the vacuum. Water should gravity feed into the pump.
    - If there is a positive suction head, the pump should self-prime.
- Throttle the pump to the desired flow. Do not exceed the maximum pressure the pump is rated for.
- Upon shut down drain pump head and all inlet and outlet lines.

Environmental / Chemical Processing Blowers

EN 909 & CP 909

ROTRON®

10.0 / 15.0 HP Sealed Regenerative w/Explosion-Proof Motor



IN
MM

NOTES
1 TERMINAL BOX CONNECTOR HOLE 1 1/4" NPT FEMALE THREAD.
2 DRAWING NOT TO SCALE, CONTACT FACTORY FOR SCALE CAD DRAWING.
3 CONTACT FACTORY FOR BLOWER MODEL LENGTHS NOT SHOWN.

MODEL	L(IN/MM)
EN909BG72WL	30.17/766.3
EN909DB72WL	23.66/601.0

		Part/Model Number			
		EN909BG72WL	EN909BG86WL	EN909BD72WL	CP909GA72WLR
Specification	Units	081741	081736	081743	038982
Motor Enclosure - Shaft Mtl.	-	15	15	10	15
Horsepower	-	Explosion-proof-CS	Explosion-proof-CS	Explosion-proof-CS	Chem XP-SS
Phase - Frequency	-	Three-60 hz	Three-60 hz	Three-60 hz	Three-60 hz
Voltage	AC	230/460	575	230/460	230/460
Motor Nameplate Amps	Amps (A)	36/18	14.4	24/12	36/18
Max. Blower Amps	Amps (A)	48/24	18	32/16	48/24
Inrush Amps	Amps (A)	240/120	100	234/117	240/120
Service Factor	-	2/2	2	2/1	2/2
Starter Size	-	1.0	1.0	1.0	1.0
Thermal Protection	-	Class B - Pilot Duty	Class B - Pilot Duty	Class B - Pilot Duty	Class B - Pilot Duty
XP Motor Class - Group	-	I-D, II-F&G	I-D, II-F&G	I-D, II-F&G	I-D, II-F&G
Shipping Weight	Lbs	524	524	504	524
	Kg	237.7	237.7	228.6	237.7

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.

XP Motor Class - Group - See Explosive Atmosphere Classification Chart in Section I

AMETEK TECHNICAL & INDUSTRIAL PRODUCTS
75 North Street, Saugerties, NY 12477
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Customer Service Fax: +1 215.256.1338
www.ametektip.com

AMETEK®
TECHNICAL & INDUSTRIAL PRODUCTS

Environmental / Chemical Processing Blowers

ROTRON®

EN 909 & CP 909

10.0 / 15.0 HP Sealed Regenerative w/Explosion-Proof Motor

FEATURES

- Manufactured in the USA - ISO 9001 and NAFTA compliant
- Maximum flow: 615 SCFM
- Maximum pressure: 140 IWG
- Maximum vacuum: 112 IWG
- Standard motor: 15 HP, explosion-proof
- Cast aluminum blower housing, impeller , cover & manifold; cast iron flanges (threaded); teflon® lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

MOTOR OPTIONS

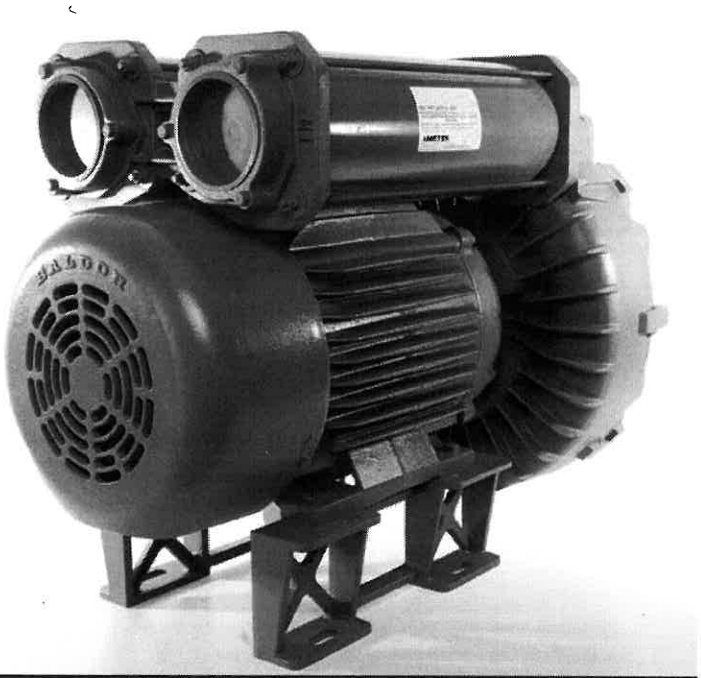
- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS

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

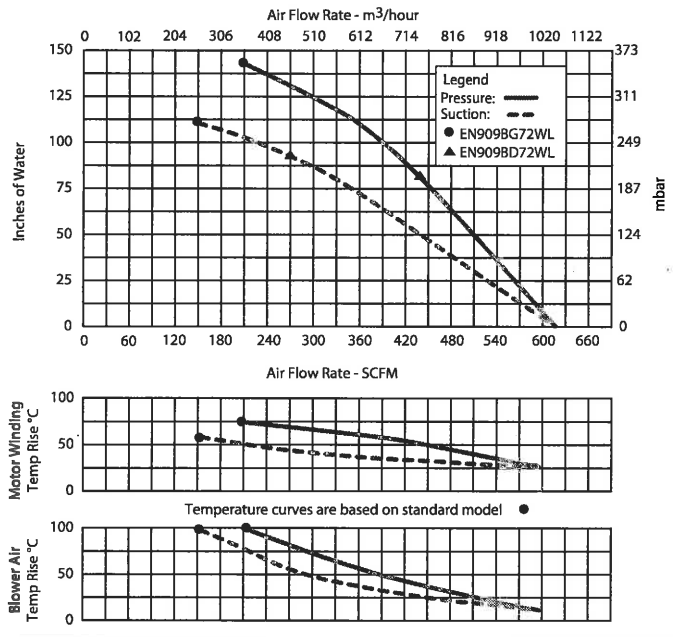
ACCESSORIES

- 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

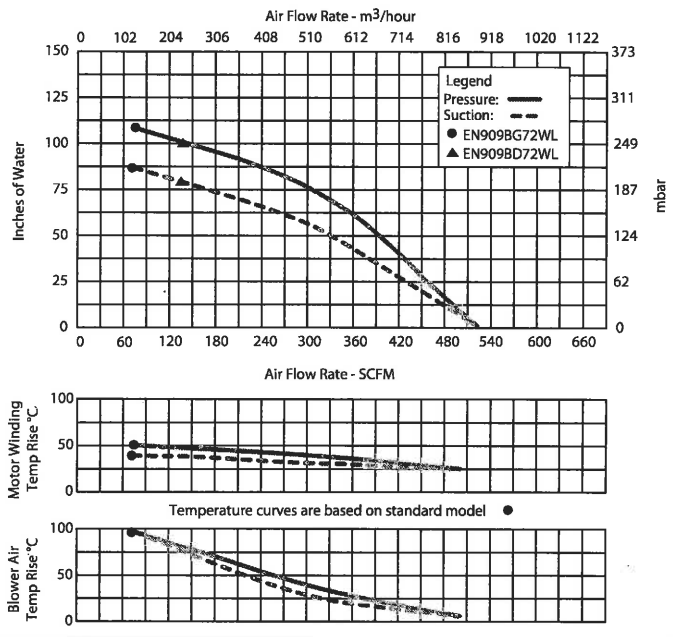


Blower Performance at Standard Conditions

60 Hz



50 Hz



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AMETEK®
TECHNICAL & INDUSTRIAL PRODUCTS

SERVICE AND PARTS MANUAL
FOR
BLOWER MODEL

EN6, EN858, EN909, EN979, EN14

DIRECT DRIVE REGENERATIVE BLOWER

Technical & Industrial Products
627 Lake Street, Kent, Ohio 44240 U.S.A.
Telephone: 330-673-3452 Fax: 330-677-3306
e-mail: rotronindustrial@ametek.com
internet: www.ametektip.com

Your Choice. Our Commitment.™

WARRANTY, INSTALLATION, MAINTENANCE AND TROUBLESHOOTING INSTRUCTIONS

TECHNICAL AND INDUSTRIAL PRODUCTS
627 Lake Street, Kent, Ohio 44240 USA
Telephone: 330-673-3452 Fax: 330-677-3306
e-mail: rotronindustrial@ametek.com web site: www.ametektip.com

1. AMETEK Rotron DR, EN and HiE regenerative direct drive blowers are guaranteed for one full year from the date of installation (limited to 18 months from the date of shipment) to the original purchaser only. Should the blower fail we will evaluate the failure If failure is determined to be workmanship or material defect related, we will at our option repair or replace the blower.

2. AMETEK Rotron Minispiral, Revaflow, Multiflow, Nautilair, remote drive blowers, moisture separators, packaged units, CP blowers, Nasty Gas™ models and special built (EO) products are guaranteed for one full year from date of shipment for workmanship and material defect to the original purchaser only. Should the blower fail, If failure is determined to be workmanship or material defect related, we will at our option repair or replace the blower.

3. **Parts Policy** - AMETEK Rotron spare parts and accessories are guaranteed for three months from date of shipment for workmanship and material defect to the original purchaser only. If failure is determined to be workmanship or material defect related we will at our option repair or replace the part.

Corrective Action - A written report will be provided indicating reason(s) for failure, with suggestions for corrective action. Subsequent customer failures due to abuse, misuse, misapplication or repeat offense will not be covered. AMETEK Rotron will then notify you of your options. Any failed unit that is tampered with by attempting repair or diagnosis will void the warranty, unless authorized by the factory.

Terms and Conditions - Our warranty covers repairs or replacement of regenerative blowers only, and will not cover labor for installation, outbound and inbound shipping costs, accessories or other items not considered integral blower parts. Charges may be incurred on products returned for reasons other than failures covered by their appropriate warranty. Out-of-warranty product and in warranty product returned for failures determined to be caused by abuse, misuse, or repeat offense will be subject to an evaluation charge. Maximum liability will in no case exceed the value of the product purchased. Damage resulting from mishandling during shipment is not covered by this warranty. It is the responsibility of the purchaser to file claims with the carrier. Other terms and conditions of sale are stated on the back of the order acknowledgement.

Installation Instructions for SL, DR, EN, CP, and HiE Series Blowers

1. **Bolt It Down** - Any blower must be secured against movement prior to starting or testing to prevent injury or damage. The blower does not vibrate much more than a standard electric motor.

2. **Filtration** - All blowers should be filtered prior to starting. Care must be taken so that no foreign material enters the blower. If foreign material does enter the blower, it could cause internal damage or may exit at extremely high velocity.

   Should excessive amounts of material pass through the blower, it is suggested that the cover(s) and impeller(s) be removed periodically and cleaned to avoid impeller imbalance. Impeller

imbalance greatly speeds bearing wear, thus reducing blower life. Disassembling the blower will void warranty, so contact the factory for cleaning authorization.

3. **Support the Piping** - The blower flanges and nozzles are designed as connection points only and are not designed to be support members.

   Caution: Plastic piping should not be used on blowers larger than 1 HP that are operating near their maximum pressure or suction point. Blower housing and nearby piping temperatures can exceed 200°F. Access by personnel to the blower or nearby piping should be limited, guarded, or marked, to prevent danger of burns.

4. **Wiring** - Blowers must be wired and protected/fused in accordance with local and national electrical codes. All blowers must be grounded to prevent electrical shock. Slo-Blo or time delay fuses should be used to bypass the first second of start-up amperage.

5. **Pressure/Suction Maximums** - The maximum pressure and/or suction listed on the model label should not be exceeded. This can be monitored by means of a pressure or suction gage (available from Rotron), installed in the piping at the blower outlet or inlet. Also, if problems do arise, the Rotron Field representative will need to know the operating pressure/suction to properly diagnose the problem.

6. **Excess Air** - Bleed excess air off. DO NOT throttle to reduce flow. When bleeding off excess air, the blower draws less power and runs cooler.

   Note: Remote Drive (Motorless) Blowers - Properly designed and installed guards should be used on all belts, pulleys, couplings, etc. Observe maximum remote drive speed allowable. Due to the range of uses, drive guards are the responsibility of the customer or user. Belts should be tensioned using belt gauge.

Maintenance Procedure

When properly piped, filtered, and applied, little or no routine maintenance is required. Keep the filter clean. Also, all standard models in the DR, EN, CP, and HiE series have sealed bearings that require no maintenance. Bearing should be changed after 15,000 to 20,000 hours, on average. Replacement bearing information is specified on the chart below.

Bearing Part Number	Size	Seal Material	Grease	Heat Stabilized
510217 510218 510219	205 206 207	Polyacrylic	Nye Rheotemp 500 30% +/- 5% Fill	Yes – 325 F
510449 516440 516648	203 202 307	Buna N	Exxon Polyrex Grease	NO
516840 516841 516842 516843 516844 516845 516846 516847	206 207 208 210 309 310 311 313	Buna N	Exxon Polyrex Grease	NO

Troubleshooting

		POSSIBLE CAUSE	OUT OF WARRANTY REMEDY ***
IMPELLER DOES NOT TURN	Humming Sound	1. * One phase of power line not connected 2. * One phase of stator winding open 3. Bearings defective 4. Impeller jammed by foreign material 5. Impeller jammed against housing or cover 6. ** Capacitor open	1. Connect 2. Rewind or buy new motor 3. Change bearings 4. Clean and add filter 5. Adjust 6. Change capacitor
	No Sound	1. * Two phases of power line not connected 2. * Two phases of stator winding open	1. Connect 2. Rewind or buy new motor
IMPELLER TURNS	Blown Fuse	1. Insufficient fuse capacity 2. Short circuit	1. Use time delay fuse of proper rating 2. Repair
	Motor Overheated Or Protector Trips	1. High or low voltage 2. * Operating in single phase condition 3. Bearings defective 4. Impeller rubbing against housing or cover 5. Impeller or air passage clogged by foreign material 6. Unit operating beyond performance range 7. Capacitor shorted 8. * One phase of stator winding short circuited	1. Check input voltage 2. Check connections 3. Check bearings 4. Adjust 5. Clean and add filter 6. Reduce system pressure/vacuum 7. Change capacitor 8. Rewind or buy new motor
	Abnormal Sound	1. Impeller rubbing against housing or cover 2. Impeller or air passages clogged by foreign material 3. Bearings defective	1. Adjust 2. Clean and add filter 3. Change bearings
	Performance Below Standard	1. Leak in piping 2. Piping and air passages clogged 3. Impeller rotation reversed 4. Leak in blower 5. Low voltage	1. Tighten 2. Clean 3. Check wiring 4. Tighten cover, flange 5. Check input voltage

* 3 phase units

** 1 phase units

*** Disassembly and repair of new blowers or motors will void the Rotron warranty. Factory should be contacted prior to any attempt to field repair an in-warranty unit.

Blower Disassembly:

WARNING: Attempting to repair or diagnose a blower may void Rotron's warranty. It may also be difficult to successfully disassemble and reassemble the unit.

1) Disconnect the power leads. **CAUTION:** Be sure the power is disconnected before doing any work whatsoever on the unit.

2) Remove or separate piping and/or mufflers and filters from the unit.

3) Remove the cover bolts and then the cover. **NOTE:** Some units are equipped with seals. It is mandatory that these seals be replaced once the unit has been opened.

4) Remove the impeller bolt and washers and then remove the impeller. **NOTE:** Never pry on the edges of the impeller. Use a puller as necessary.

5) Carefully note the number and location of the shims. Remove and set them aside. NOTE: If the disassembly was for inspection and cleaning the unit may now be reassembled by reversing the above steps. If motor servicing or replacement and/or impeller replacement is required the same shims may not be used. It will be necessary to re-shim the impeller according to the procedure explained under assembly.

6) Remove the housing bolts and remove the motor assembly (arbor/.housing on remote drive models).

7) Arbor disassembly (Applicable on remote drive models only):
   a) Slide the bearing retraining sleeve off the shaft at the blower end.
   b) Remove the four (4) screws and the bearing retaining plate from the blower end.
   c) Lift the shaft assembly far enough out of the arbor to allow removal of the blower end snap ring.
   d) Remove the shaft assembly from the arbor.
   e) If necessary, remove the shaft dust seal from the pulley end of the arbor.

Muffler Material Replacement:

1) Remove the manifold cover bolts and them manifold cover.

2) The muffler material can now be removed and replaced if necessary. On blowers with fiberglass acoustical wrap the tubular retaining screens with the fiberglass matting before sliding the muffler pads over the screens.

3) Reassemble by reversing the procedure.

NOTE: On DR068 models with tubular mufflers it is necessary to remove the cover and impeller accessing the muffler material from the housing cavity.

Blower Reassembly:

1) Place the assembled motor (assembled arbor assembly for remote drive models) against the rear of the housing and fasten with the bolts and washer.

2) To ensure the impeller is centered within the housing cavity re-shim the impeller according to the procedure outlined below.

3) If blower had a seal replace the seal with a new one.

4) Place the impeller onto the shaft making sure the shaft key is in place and fasten with the bolt, washer and spacer as applicable. Torque the impeller bolt per the table below. Once fastened carefully rotate the impeller to be sure it turns freely.

5) Replace the cover and fasten with bolts.

6) Reconnect the power leads to the motor per the motor nameplate.

Bolt Size	Torque Pound-Force-Foot
1/4-20	6.25 +/- 0.25
5/16-18	11.5 +/- 0.25
3/8-16	20.0 +/- 0.5
½-13	49.0 +/- 1
5/8 –11	90.0 +/- 2

Impeller Shimming Procedure:

WARNING: This unit may be difficult to shim. Extreme care may be exercised.

Tools Needed: Machinist's Parallel Bar
Vernier Caliper with depth measuring capability
Feeler gauges or depth gauge

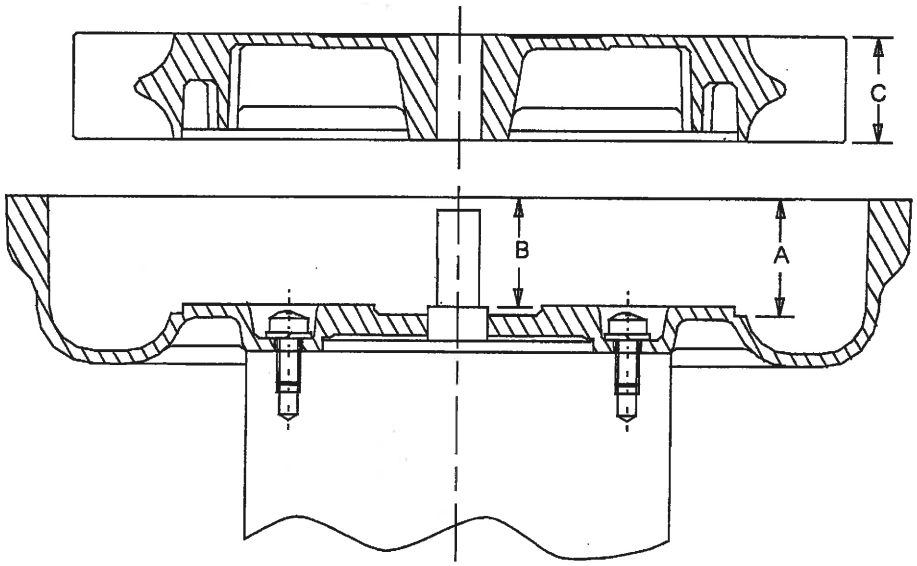
Measure the Following:

Distance from the flange face to the housing (A)
Distance from the flange face to the motor shaft shoulder (B)
Impeller Thickness (C)

Measurements (A) and (B) are made by laying the parallel bar across the housing flange face and measuring to the proper points. Each measurement should be made at three points, and the average of the readings should be used.

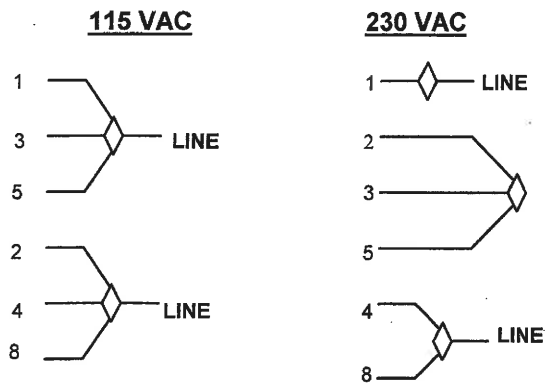
Shim Thickness = B – (A+C)/2

After the impeller installation (step #4 above) the impeller/cover clearance can be checked with feeler gauges, laying the parallel bar across the housing flange face. This clearance should nominally be (A-C)/2.



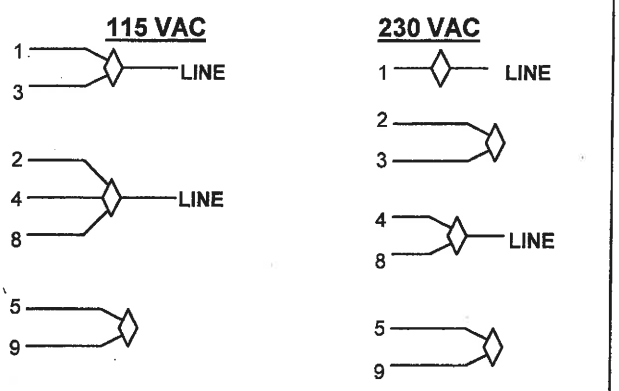
WIRING DIAGRAMS, XP MOTORS

H. 1Ø, 6 WIRE



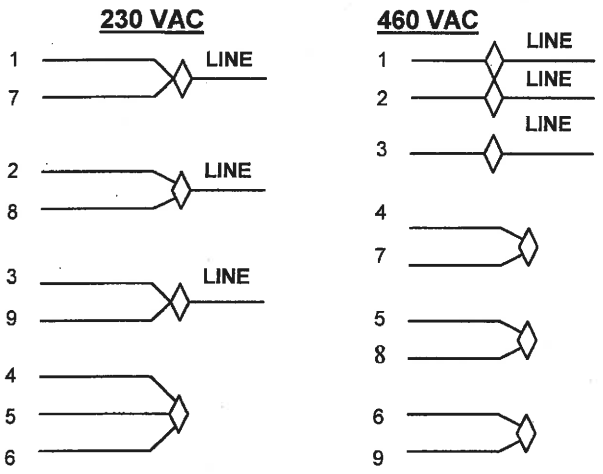
INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION

I. 1Ø, 7 WIRE



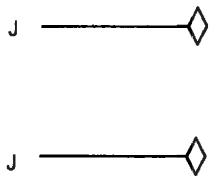
INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION

K. 3Ø, 9 WIRE



INTERCHANGE ANY TWO LEAD LINES TO REVERSE ROTATION

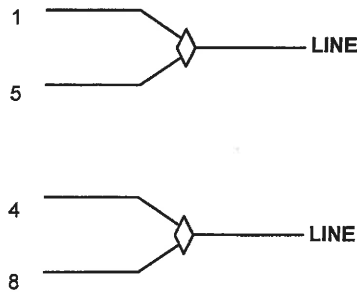
L. PILOT DUTY THERMAL OVERLOADS



HOOK J LEADS TO CONTROL CIRCUITRY

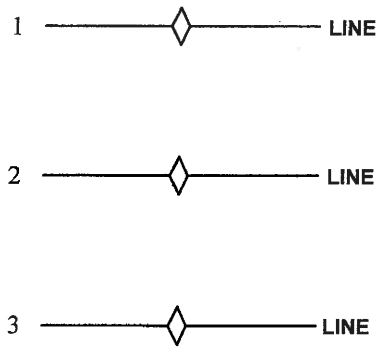
M. 1Ø 230 VAC

SINGLE VOLTAGE



INTERCHANGE LEADWIRES 5 & 8 TO REVERSE ROTATION

N. 3Ø 575 VAC



INTERCHAGE ANY TWO LEAD LINES TO REVERSE ROTATION

AMETEK®
ROTRON TECHNICAL MOTOR DIVISION
REGENERATIVE BLOWER GROUP

75 North Street
Saugerties, New York 12477
Phone: (845) 246-3401
Fax: (845) 246-3802

EXPLOSION-PROOF BLOWERS

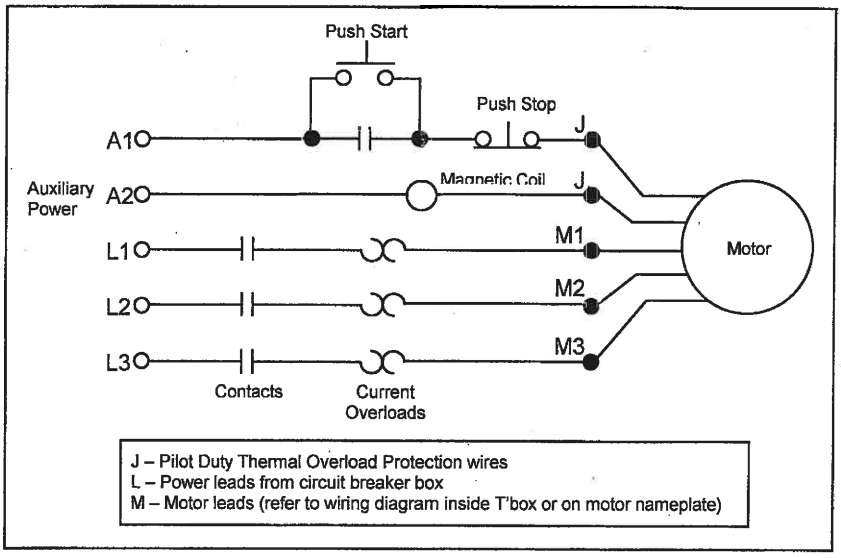
IMPORTANT: Read before wiring this Explosion-proof Blower

This AMETEK Rotron Explosion-proof Regenerative Blower may be equipped with Pilot Duty Thermal Overload (PDTO) or Automatic Thermal Overload (ATO) protection. When properly wired to a motor starter, this protection limits the motor winding temperature rise per the National Electric Code (NEC) article 500. Failure to properly wire this blower is an NEC violation and could cause an explosion. AMETEK Rotron assumes no responsibilities for damages incurred by negligent use of this product, and will not warranty a blower on which the PDTO is not properly connected. Some blowers 1 HP and under do not require PDTO and have built in ATO. Consult the factory if verification of wiring connections is required.

In all cases, follow the motor controller manufacturer's instructions. The following schematic is for conceptual understanding only, and may not apply to all motor/controller combinations.

The manufacturer's wiring diagram found on the motor takes precedent over reference diagrams supplied by AMETEK Rotron Technical Motor Division.

Schematic



The schematic is shown for a three phase motor. For a single phase motor disregard L3 and M3. Pushing the START button completes the auxiliary control circuit, allowing current to flow through the magnetic coil. The contacts are magnetically closed, starting the motor and latching the auxiliary circuit. The motor will continue to run until the STOP push button is depressed, the motor reaches the overload temperature, or the current sensing overloads trip out.

If you have any questions, contact AMETEK Rotron at 914-246-3401 for the location of your area representative.

POLICY REGARDING INSTALLATION OF AMETEK ROTRON REGENERATIVE BLOWERS IN HAZARDOUS LOCATIONS

AMETEK Rotron will not knowingly specify, design or build any regenerative blower for installation in a hazardous, explosive location without the proper NEMA motor enclosure. AMETEK Rotron does not recognize sealed blowers as a substitute for explosion-proof motors. Sealed units with standard TEFC motors should never be utilized where local, state, and/or federal codes specify the use of explosion-proof equipment.

AMETEK Rotron has a complete line of regenerative blowers with explosion-proof motors. Division 1 & 2, Class I, Group D; Class II, Groups F & G requirements are met with these standard explosion-proof blowers.

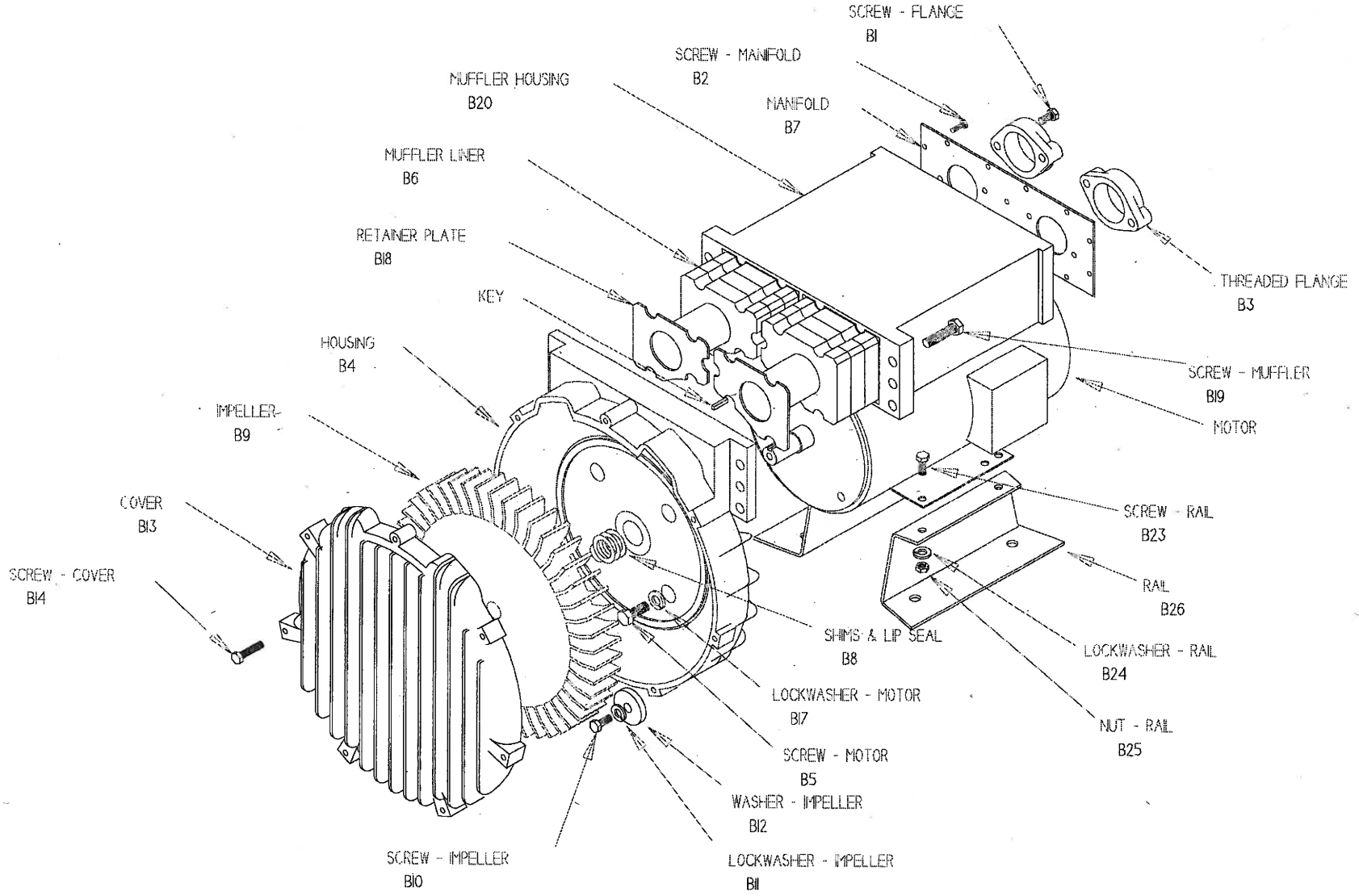
AMETEK Rotron will not knowingly specify, design or build any regenerative blower for installation in a hazardous, corrosive environment without the proper surface treatment and sealing options.

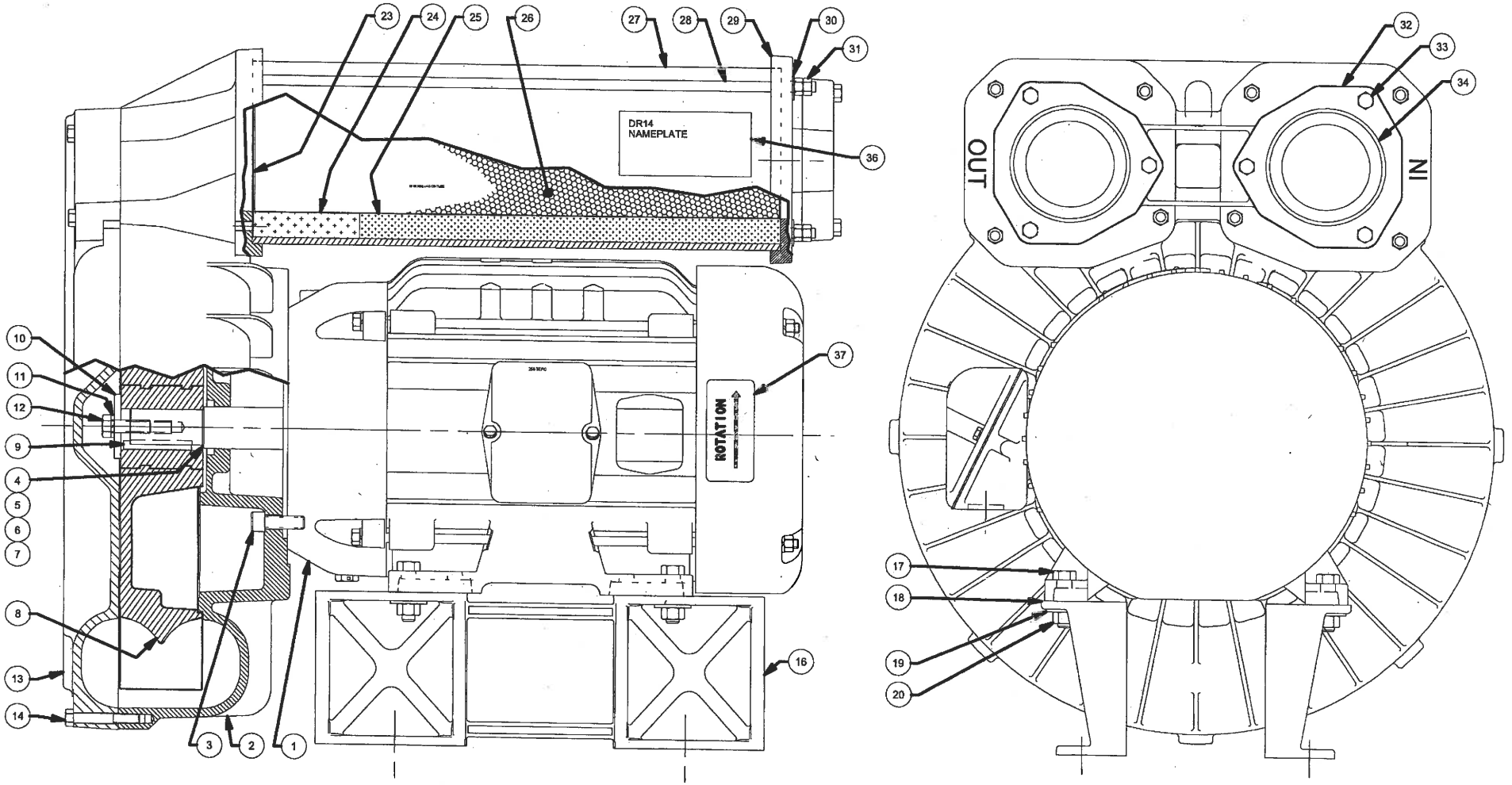
AMETEK Rotron has a complete line of Chemical Processing and Nasty Gas™ regenerative blowers with Chem-Tough™, stainless steel parts, and seals.

AMETEK Rotron offers general application guidance; however, suitability of the particular blower selection is ultimately the responsibility of the purchaser, not the manufacturer of the blower.

FS2 Rev B 3/10/98

ASSEMBLY DIAGRAM
EN6 EN808 EN909 EN14





ASSEMBLY DWG "B"

EN 6/858/909/14
Service and Parts Manual

Parts Breakdown

Item No.	Qty. Req'd	Description	EN6 038361 038180 038438	EN858 038744 038745 080070	EN909 038629 038634 080071	EN14 038762 038761	EN14 038760	EN979 80724
M3	1	Key Motor Shaft	510212	511532	511532	155066	511532	551570
B1	6	Screw, Flange	(4 pcs) 120255	(4 pcs) 155067	140016	140016	140016	140016
B2		Screw, Manifold	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B3	2	Flange	See Next Page	511614	529912	529912	529912	529912
	2	O-ring	Not Used	Not Used	155377	155377	155377	155377
		Elbow 90°	See Next Page	Not Used	Not Used	Not Used	Not Used	Not Used
B4	1	Housing	516747	516764	515356	516799	516797	551560
B5	4	Screw, Hsg /Motor	251792	155034	140014	120205	120205	120205
B6	7	Muffler Material (Gray)	Not Used	551736	(10 pcs) 551738	(12)551740	(12)551740	(8) 551571
	2	Muffler Material (White)	Not Used	551737	551739	551741	551741	Not Used
	2	Finger Guard	Not Used	Not Used	551730	551744	551744	Not Used
B8	*	Shim .002"	272703	511547	511547	515991	511547	511547
	*	Shim .005"	272704	511548	511548	515992	511548	511548
	*	Shim .010"	272705	511549	511549	515993	511549	511549
	*	Shim .020"	272706	511550	511550	515994	511550	511550
	*	Shim .030"	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B9	1	Impeller	515484	515249	515270	515509	515683	551566
B10	1	Bolt, Impeller	251791	120210	140015	155068	120251	140015
B11	1	Lockwasher, Impeller	251787	251788	251788	251788	251788	251788
B12	1	Washer, Impeller	Not Used	511529	Not Used	Not Used	Not Used	Not Used
B13	1	Cover	515488	515247	515359	515910	515910	551409
B14	8	Screw, Cover	155170	140016	140016	155069	155069	155512
B15	1	Eye Bolt	Not Used	140019	140019	140019	140019	Not Used
B16	1	Spacer, Impeller Bolt	478336	515555	511529	515990	515990	511529
		Shaft Sleeve	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B17		Lockwasher, Housing	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B18	2	Screen, Muffler Retaining,	Not Used	551723	551725	551727	551727	551611
B19	6	Bolt, Muffler Hsg/Hsg	Not Used	155025	155025	155067	155067	155512
B19A	4	Bolt, Muffler/Housing	Not Used	120214	120214	120214	120214	Not Used
B20	1	Muffler Housing	Not Used	550019	529932	550039	550039	551422
	1	Muffler Discrete	522948	Not Used	Not Used	Not Used	Not Used	Not Used
		Bolt, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B21		Heat Slinger	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B22		Guard Heat slinger	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
B23	4	Bolt, Rail	251791	120007	140016	120256	155025	120256
B24	4	Lockwasher Rail	251787	251787	251787	251788	251788	Not Used

*As needed **Viewed looking at inlet/outlet ports

B24A	8	Washer, Rail/Motor	Not Used	Not Used	155091	Not Used	Not Used	Not Used
B25	6	Nut, Rail	251789	251789	251789	(4 pcs)155070	(4 pcs)155070	155070
B26	2	Rail Mounting	478338	595301	551584	551658	551658	551658
	1	Lip Seal	516691	516693	516693	516694	516693	516693

Model	Part No.	Motor	Wiring Diagram	Specific Parts	Bearing, Rear (M1)	Impeller End (M2)
EN6F5L	038361	529475	M + L	B3 Flange 511480 (2 pcs) Elbow 120153 (2 pcs)	510217	510218
EN6F72L	038180	500297	K + L	B3 Flange 478341 (2 pcs) Elbow Not Used, Screen Guard, Flange 511479 (2 pcs)		
EN6F86L	038438	529634	N + L	B3 Flange 478341 (2 pcs) , Elbow Not Used Screen Guard, Flange 511479 (2 pcs)		
EN858BD72WL	038744	515556	K + L		516840	516844
EN858BD86WL	038745	529627	N + L			
EN858BA72W	080070	515558	K + L			
EN909BG72WL	038629	511512	K + L		516842	516844
EN909BG86WL	038634	529631	N + L			
EN909BD72WL	080071	515556	K + L			
EN14DX86MWL	038762	529632	N + L		516844	516846
EN14DX72MWL	038761	516095	K + L			
EN14BK72MWL	038760	511513	K + L		516842	516844
EN979BK72WL	080724	551637	K + L		Call Factory	

*As needed **Viewed looking at inlet/outlet ports

Use Assembly Diagram "B"

EN/CP 14
Service and Parts Manual

Parts Breakdown

Model:	**EN14**	**EN14**
Part No.:	**081486**	**081485**
	081487	

REF #	QTY	Description		
1	1	Motor	See below	See below
2	1	Housing	552373	552375
3	4	Housing to mtr bolts	120256	155025
4	*	Shim	515991	511547
5	*	Shim	515992	511548
6	*	Shim	515993	511549
7	*	Shim	515994	511550
8	1	Impeller	515509	515683
9	1	Mtr shaft Key	155066	511532
10	1	Impeller washer	515990	515990
11	1	Impeller lockwasher	251788	251788
12	1	Impeller bolt	155068	120251
13	1	Cover	515910	515910
14	8	Cover screws	155069	155069
15		Not used	Not used	Not used
16	2	Mounting Rails	551658	551658
17	4	Rail Bolts	155025	155025
18	4	Rail spacers	Not used	Not used
19	4	Rail lockwashers	251788	251788
20	4	Rail -Nuts	155070	155070
21	4	Rail washers	155091	155091
22		Not used	Not used	Not used
23	2	Finger guard screen	552322	552322
24	2	Muffler foam (hi temp)	552328	552328
25	2	Muffler foam (regular)	552327	552327
26	2	Retainer	552332	552332
27	2	Muffler tube	552324	552324
28	8	Muffler Tie Rod	552325	552325
29	1	Connector plate	552298	552298
30	8	Muffler washer	155091	155091

*As needed **Viewed looking at inlet/outlet ports

31	16	Muffler tie rod nuts	251789	251789
32	2	Flange	529912	529912
	2	Flange - O-Ring	155377	155377
33	6	Flange bolts	140016	140016
34		Flange Cap.	Not used	Not used
35		Not used	Not used	Not used
36		Nameplate- Blower	Not used	Not used
37		Rotation Sticker	Not used	Not used
38		Not used	Not used	Not used
39				
40		Lip Seal	516694	516693
41				
42				

Model	Part #	Motor	Wiring Diagram	Specific Parts	Bearing, Rear (M1)	Bearing, Impeller End (M2)
EN14DX86MWL	081487	529632	N + L			
EN14DX72MWL	081486	516095	K + L		516844	516846
EN14BK72MWL	081485	511513	K + L			
					516842	516844

*As needed **Viewed looking at inlet/outlet ports

Enviro-Equipment Inc.
Remediation Division
10120 Industrial Drive
Pineville NC 28134
704 556 7723

EEI ALUMINUM AIR WATER SEPARATORS

STANDARD AWS SPECIFCATION

TYPE	WORKING VOLUME @(LSH)	AVAILABLE CONNECTION TYPE																CLEAN OUT PIPE	A	B	C (DIA.)	D	E	F	G	H	J
		FLANGE						MNPT					FNPT														
		2"	3"	4"	6"	8"	10"	2"	3"	4"	6"	8"	2"	3"	4"	6"	8"										
AWS30	12 GAL	X	X	X	-	-	-	X	X	X	-	-	X	X	X	-	-	6"	-	-	16 1/4"	25"	2"	19"	30"	33 1/2"	6"
AWS60	24 GAL	X	X	X	X	-	-	X	X	X	X	-	X	X	X	-	-	6"	24"	24"	23"	25"	2"	23"	30"	36 1/2"	6"
AWS80	47 GAL	X	X	X	X	-	-	X	X	X	X	-	X	X	X	-	-	8"	24"	24"	23"	39"	2"	39"	48"	54 3/4"	12"
AWS120	50 GAL	X	X	X	X	X	-	X	X	X	X	-	X	X	X	-	-	8"	24"	24"	23"	49"	2"	49"	60"	66 3/4"	12"
AWS220	107 GAL	-	X	X	X	X	X	X	X	X	X	-	X	X	X	-	-	8"	34"	34"	33 1/2"	49"	2"	49"	60"	66 3/4"	12"

RECOMMENED AIR FLOW (ACFM)						
	2"	3"	4"	6"	8"	10" +
ACFM	120	280	320	500	750	1000

NOTES:
1.MATERIAL : 1/8" & 3/16" ALUMINUM SHT 5052
2. PROBE (SIGHT TUBE) : 2" CLEAR PVC
3. CUSTOM SIZES AVAILABLE

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10120 Industrial Drive
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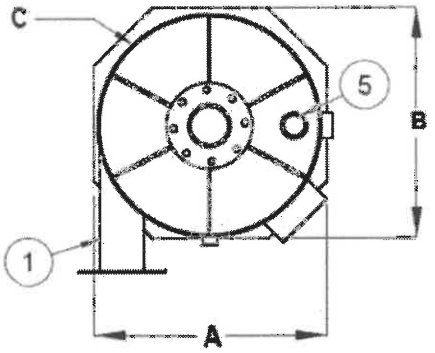
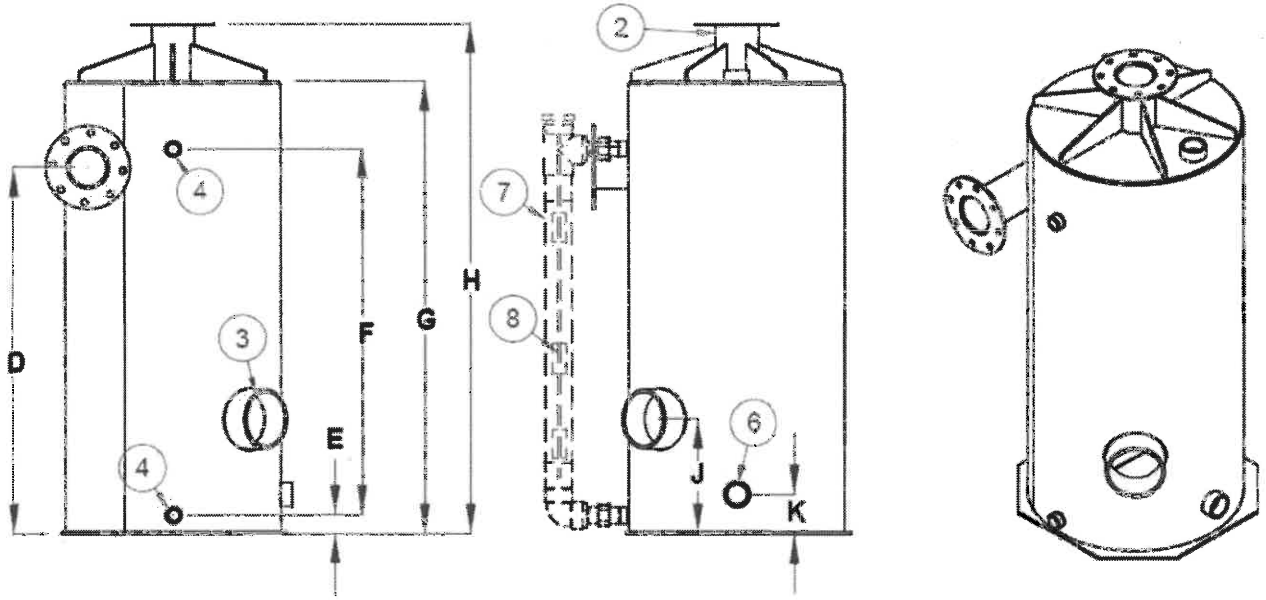
ITEM #	DESCRIPTION
1	INLET PIPE (SEE TABLE FOR AVAILABLE SIZE AND CONNECTION TYPE)
2	OUTLET PIPE (SEE TABLE FOR AVAILABLE SIZE AND CONNECTION TYPE)
3	CLEAN OUT
4	1" FNPT (MULTI LEVEL PROBE)
5	2" FNPT
6	2" FNPT
7	SIGHT TUBE 2" CLEAR PVC
8	MULTI LEVEL PROBE





Enviro-Equipment Inc.
10120 Industrial Drive
Pineville NC 28134

FPI FLOAT SWTICH FOR AWS220-4 TANK:

50 OAL, SS, 2" POLY DUST CAP, THREE LEVEL, 1010.60 FLOAT, SET COLLARS, CENTER DISK, 30 FT CABLE
L1-48 NO, L2-22 NO, L3-18 NC

Fitting: 2" QD Poly Dust Cap, with ½" conduit connection
Stem: 5/16" SS, 50" OAL
Float: 1" x 1", SS, .60 SG
Float Stops: SS set collars
L3: 18.0" NC blue & brown
L2: 22.0" NO green & white
L1: 48.0" NO red & black
Switch: 50 watt, SPST
Wiring: 30', 6 cond cable
Centering Disk- 1.5" PVC

COMPACT "T" STYLE VACUUM FILTERS
"CT Series" 2" - 6" FPT

SOLBERG®

- **Compact Design**
- **Multi-Stage Filtration**
- **Quick Change Out**
- **Vacuum Tested**

BENEFITS

- **Compact** design for space restrictions; **Minimal** service area needed
- **Integrated Inlet Baffle**
- Inlet is above the element to **Extend** element life and maintenance intervals
- "T" style design **Minimizes** piping requirements
- "Drop-Down" housing for easy servicing and containment of particles
- Cast aluminum head **Resists** corrosion
- Pressure differential ports standard for monitoring
- Casting has 4 unthreaded tap holes for mounting bracket
- **Vacuum level**: Typically $1x10^{-3}$ mmHg ($1.3x10^{-3}$ mbar)
- Swing Bolts on 5" & 6" sizes for additional strength

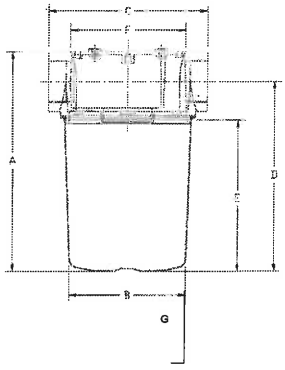
OPTIONS (Inquires Encouraged)

- Various media alternatives
- **See Through Bottom for Visual Inspection Now available for 3" and 4" housings!**
- Swing Bolts for 2" - 4" Sizes

CT-851/850
2" & 2 1/2" FPT

CT-235P/234P
3" & 4" FPT

CT-275P/274P
5" & 6" FPT



Dimension tolerance ± 1/4"

I = Industrial Duty S = Severe Duty E = Extreme Duty

	with Polyester Element	with Paper Element	FPT Inlet & Outlet	DIMENSIONS - inches A	B	C	D	E	Rated Flow SCFM Nominal Rating	Element Rating	Approx. Wt. lbs
I	CT-851-200C	CT-850-200C	2"	13	10 7/8	9	9	18	175	290	16
I	CT-851-250C	CT-850-250C	2-1/2"	13	10 7/8	9	9	18	210	290	15
I	CT-235P-300C	CT-234P-300C	3"	18 7/8	16 1/8	13 1/2	13	25	300	570	30
I	CT-235P-400C	CT-234P-400C	4"	18 7/8	16 1/8	13 1/2	13	25	520	570	26
S	CT-275P-500C	CT-274P-500C	5"	18 1/4	14 3/8	19	9 7/8	20	800	1100	50
I	CT-275P-600C	CT-274P-600C	6"	18 1/4	14 3/8	19	9 7/8	20	1100	1100	45

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Solberg – Discover the Possibilities

Small Compact Filter Silencers
w/ Standard Filter Design
"FS" Series 1/2" - 3" MPT

APPLICATIONS & EQUIPMENT

- Industrial & Severe Duty
- Piston Compressors
- Screw Compressors
- Blowers - Side Channel & P.D.
- Hydraulic Breathers – fine filtration
- Engines
- Construction\Contractor Industry
- Workshop
- Medical\Dental Industry
- Pneumatic Conveying
- Waste Water Aeration
- Nailers and Staplers
- Vacuum Vent Breathers

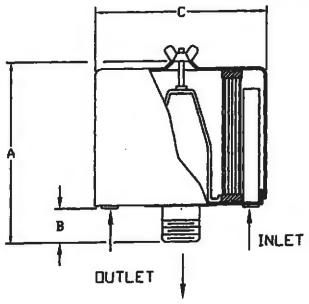
FEATURES & SPECIFICATIONS

- Polyester: 99%+ removal efficiency standard to 5 micron
- Paper: 99%+ removal efficiency standard to 2 micron
- Fully drawn weatherhood - no welds to rust or vibrate apart
- Tubular silencing design - tube is positioned to maximize attenuation and air flow while minimizing pressure drop
- Durable carbon steel construction with baked enamel finish and powder coated weatherhood
- Interchangeable media: Polyester, Paper, HEPA
- Several element sizes available per given connection (safety factor)
- Temp (continuous): min -15°F (-26°C) max 220°F (104°C)
- Filter change out differential: 10"-15" H_2O over initial delta P
- Pressure drop graphs available upon request

OPTIONS (Inquiries Encouraged)

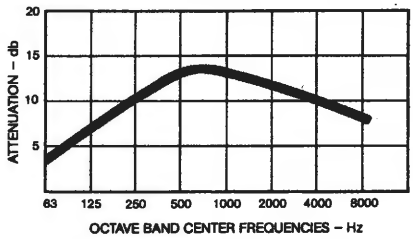
- 1/8" tap holes
- Pressure Drop Indicator
- Available in ***Stainless Steel***
- Epoxy coated housings
- Various media available
- Special connections, BSPT

CONFIGURATION DRAWING



Dimension tolerance ± 1/4"

TYPICAL NOISE ATTENUATION – FS SERIES



- Noise attenuation may vary due to the wide range of applications and machines

I = Industrial Duty S = Severe Duty

	with Polyester Element	with Paper Element	MPT Outlet	DIMENSIONS - inches A	B	C	Rated Flow SCFM Piston	Screw, Blower, Fan	Element Rating	No. of Silencing Tubes	Approx. Wt. lbs
I	FS-15-050	FS-14-050	1/2"	4	1 1/2	6	10	10	35	1	2
I	FS-15-075	FS-14-075	3/4"	4	1 1/2	6	20	25	35	2	2
I	FS-15-100	FS-14-100	1"	4	1 1/2	6	25	35	35	3	2
S	FS-19P-100	FS-18P-100	1"	6 5/8	1 5/8	6	35	55	100	3	3
I	FS-19P-125	FS-18P-125	1 1/4"	6 5/8	1 5/8	6	55	70	100	5	3
I	FS-19P-150	FS-18P-150	1 1/2"	6 5/8	1 5/8	6	70	85	100	5	4
I	FS-31P-200	FS-30P-200	2"	7 1/4	2 1/4	10	85	135	195	5	8
S	FS-231P-200	FS-230P-200	2"	12 1/4	2 1/4	10	135	135	300	5	14
S	FS-231P-250	FS-230P-250	2 1/2"	12 1/2	2 1/2	10	195	195	300	9	15
I	FS-231P-300	FS-230P-300	3"	13	3	10	200	300	300	9	15

Note: Model offerings and design parameters may change without notice.

1151 Ardmore Ave. • Itasca, IL 60143 USA
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Absorptive Silencers

Air Intake and Discharge

"SLCR" Series 1/2" - 4" MPT, FPT

APPLICATIONS & EQUIPMENT

- Small Air Compressors
- Centrifugal Blowers
- Regenerative Blowers
- Vacuum Pumps & Systems
- Vacuum Packaging Equipment
- Vacuum Lifters
- Small Low Pressure Vents
- Blowers - Side Channel

FEATURES & SPECIFICATIONS

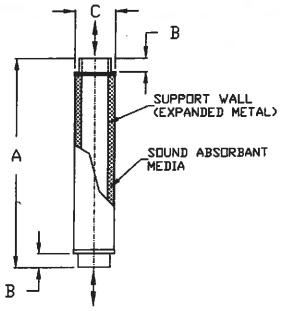
- Layered sound absorbent media
- **Minimal** pressure drop because it does not rely on internal baffles, tubes or other restrictive devices
- Reduces high frequency noise up to 30 decibels (Due to the wide range of applications and machines these units are used on, please inquire for your specific application.)
- **Inlet or Discharge** silencing applications with maximum temperature of 212°F (100°C)
- Durable inline carbon steel construction with baked enamel finish
- For inline air service

OPTIONS (Inquiries Encouraged)

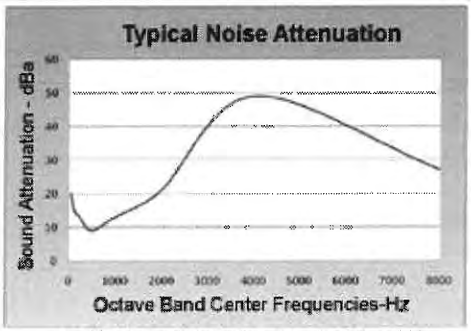
- Flange Adapters
- Larger sizes available

CONFIGURATION

DRAWING



Dimension tolerance ± 1/4"



Note: Noise attenuation may vary due to the wide range of applications and equipment.

Model No.	Inlet & Outlet	Connection Style	DIMENSIONS - inches A	B	C	Rated Flow SCFM	Approx. Wt. Lbs
SLCR100	1"	FPT	12	11/16	2 1/2	42	2
SLCR125	1 1/4"	FPT	12	11/16	2 1/2	55	2
SLCR150	1 1/2"	FPT	12	11/16	3 1/8	155	3
SLCR200	2"	FPT	16 3/4	11/16	3 5/8	270	4
SLCR250	2 1/2"	FPT	21	1 1/2	4 5/8	385	8
SLCR300	3"	FPT	26	1 9/16	5 1/8	575	10
SLCR400	4"	FPT	23 7/8	1 11/16	10	575	26
SLCRT050	1/2"	MPT	14 1/2	2	2 1/2	25	2
SLCRT075	3/4"	MPT	14 1/2	2	2 1/2	35	2
SLCRT100	1"	MPT	14 1/2	2	2 1/2	42	2
SLCRT125	1 1/4"	MPT	14 1/2	2	2 1/2	55	2
SLCRT150	1 1/2"	MPT	14	1 3/4	3 1/8	155	3
SLCRT200	2"	MPT	16 1/2	2 1/8	3 5/8	270	4
SLCRT250	2 1/2"	MPT	23 11/16	2 5/8	4 5/8	385	8
SLCRT300	3"	MPT	28	2 5/8	5 1/8	575	10
SLCRT400	4"	MPT	29 5/16	4	10	575	26

Note: Model offerings and design parameters may change without notice.

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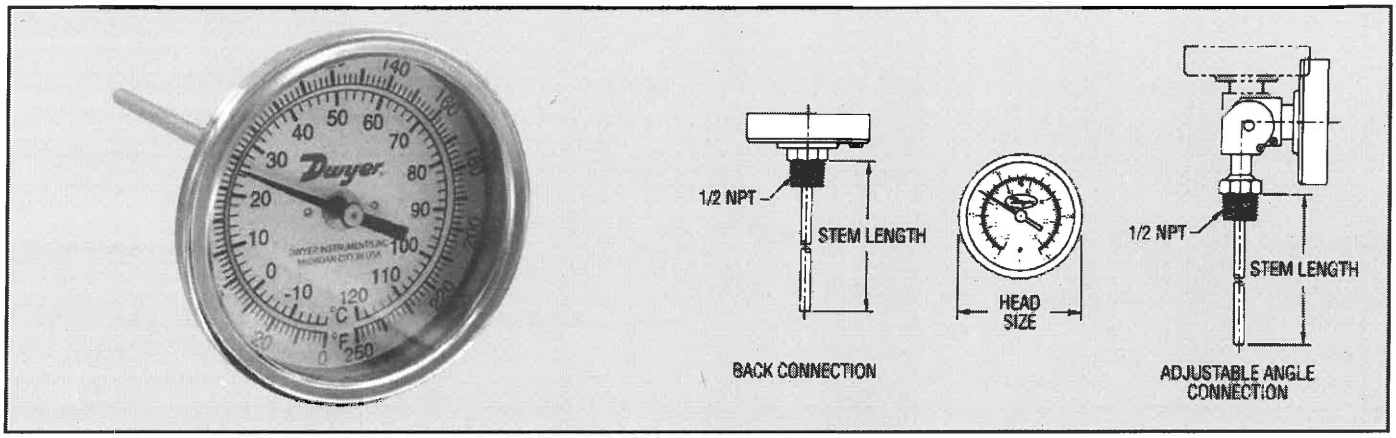
Series BT

Bimetal Thermometers

2″, 3″ or 5″ Dial, Dual Scale, ±1% FS Accuracy, External Reset



Series BT Bimetal Thermometers offer accurate, reliable service even in the toughest environments. These corrosion resistant units are constructed from stainless steel and are hermetically sealed to prevent crystal fogging. The bimetal element directly drives pointer, eliminating gears and linkage. An external reset screw allows field calibration and easy-to-read aluminum dial minimizes parallax error. Choose back connection, lower connection or adjustable angle for easy viewing and installation. Adjustable models can be rotated a full 360° and tilted over a 180° arc. NOTE: When using in pressurized applications, use a suitable thermowell. Bimetal thermometers are commonly used to measure water temperature on chillers and boilers.

SPECIFICATIONS

Wetted Materials: 304 SS.
Housing Material: Series 300SS.
Lens: Glass.
Accuracy: ±1% full scale.
Response Time: ≤ 40 seconds.
Temperature Limits: Head: 200°F (93°C); Stem: Not to exceed 50% over-range or 1000°F (538°C) or 800°F (427°C) continuously.
Process Connection: 1/4″ NPT on 2″ dial size; 1/2″ NPT on 3″ or 5″ dial size.
Stem Diameter: 1/4″ O.D.
Immersion Depth: Minimum 2″ in liquids, 4″ in gas.

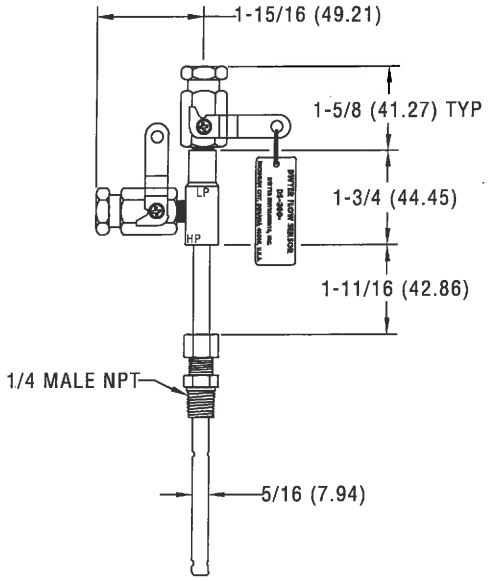
Model	Dial Size, Stem Length	Temperature Range, °F(°C)	Degree Div., °F(°C)
Back Connection			
BTB22551*	2″, 2-1/2″	0/250	2
BTB2405D	2″, 4″	0/250 (-20/120)	2 (2)
BTB2409D	2″, 4″	200/1000 (100/550)	10 (5)
BTB32510D	3″, 2-1/2″	0/200 (-20/100)	2 (2)
BTB3255D	3″, 2-1/2″	0/250 (-20/120)	2 (2)
BTB3257D	3″, 2-1/2″	50/550 (10/290)	5 (5)
BTB34010D	3″, 4″	0/200 (-20/100)	2 (2)
BTB3405D	3″, 4″	0/250 (-20/120)	2 (2)
BTB3407D	3″, 4″	50/550 (10/290)	5 (5)
BTB3605D	3″, 6″	0/250 (-20/120)	2 (2)

Model	Dial Size, Stem Length	Temperature Range, °F(°C)	Degree Div., °F(°C)
Adjustable Angle Connection			
BTA54010D	5″, 4″	0/200 (-20/100)	2 (2)
BTA5405D	5″, 4″	0/250 (-20/120)	2 (2)
BTA5407D	5″, 4″	50/550 (10/290)	5 (5)
BTA56010D	5″, 6″	0/200 (-20/100)	2 (2)
BTA5605D	5″, 6″	0/250 (-20/120)	2 (2)
BTA5607D	5″, 6″	50/550 (10/290)	5 (5)
Lower Connection			
BTC3255D	3″, 2.5″	0/250(-20/120)	2 (2)

*Model offered in Fahrenheit scale only.

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

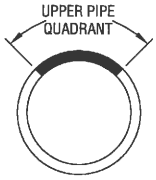
POSITION

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

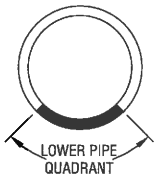
Install in upper quadrant of pipe



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

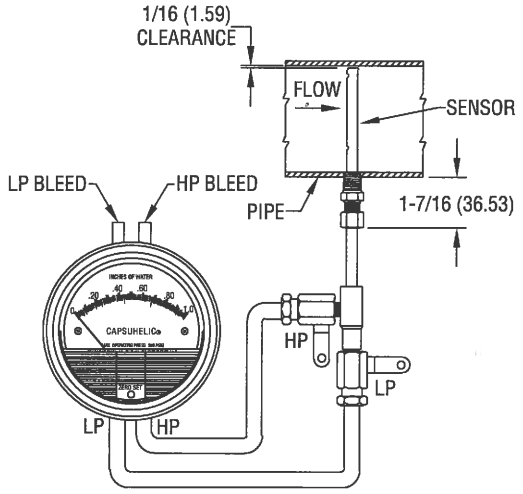
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

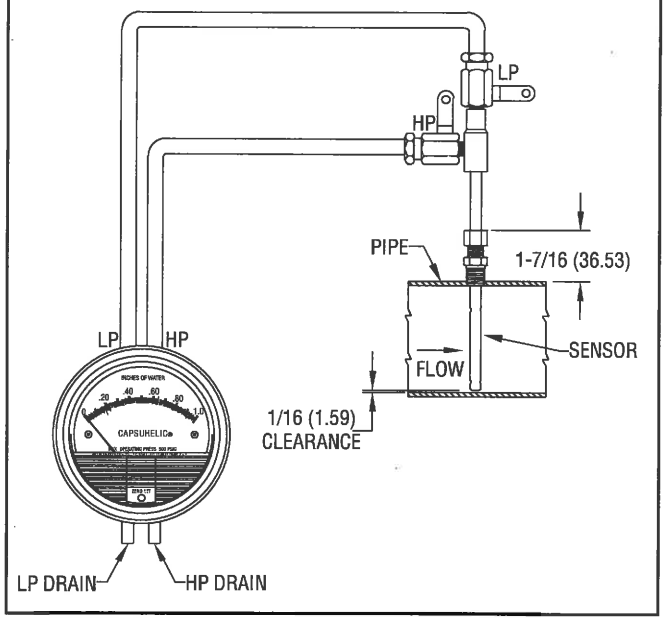
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

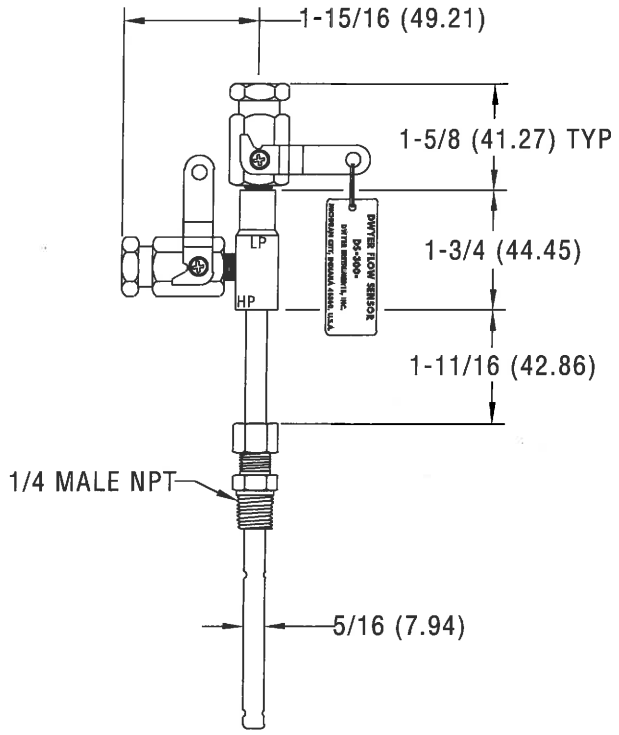
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

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

Printed in U.S.A. 7/04 FR# 72-440451-01 Rev. 2

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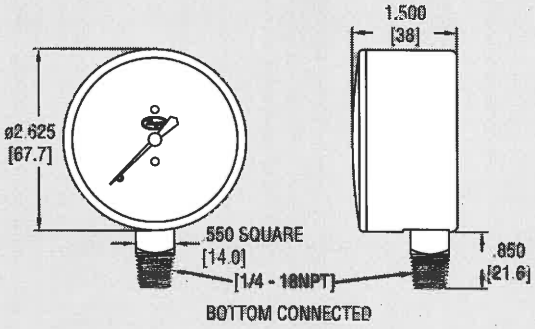
Series LPG4

2.5" Low Pressure Gage

1.5% Full Scale Accuracy in a 2-1/2" Gage



Our **Series LPG4** gages offer top of the line performance and accuracy for pressure and vacuum applications up to and including 160 in w.c. The LPG4 is constructed from a single beryllium-copper diaphragm affixed to a precision-machined brass plate. This innovative design, together with a high-precision, milled-teeth brass movement and nickel-silver pinion and bearing surface, provide the user with a top of the line low pressure instrument.

SPECIFICATIONS

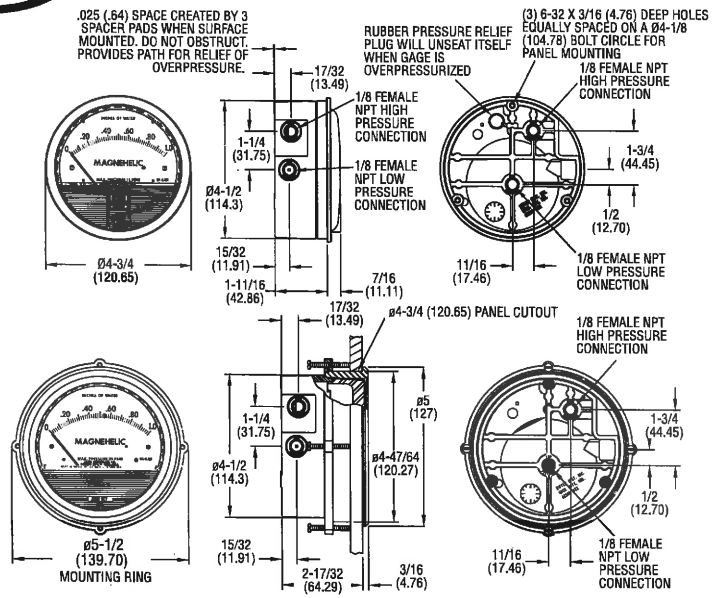
Service: Compatible gases & liquids.
Wetted Materials: Brass and beryllium copper.
Housing: Drawn steel, black finish.
Lens: Polycarbonate (removable).
Accuracy: ±1.5% full scale.
Pressure Limit: 100% of range scale.

Temperature Limits:
Process: -40 to 160°F (-40 to 70°C);
Ambient: -40 to 140°F (-40 to 60°C).
Size: 2.5" (63 mm).
Process Connections: 1/4" male NPT.
Enclosure Rating: NEMA 3 (IP55).
Weight: 7.3 oz (0.21 kg).

Model	Range	Model	Range
LPG4-D7122N	-10-0 in. w.c. (-2.5-0 kPa)	LPG4-D8322N	0-40 in. w.c. (0-10 kPa)
LPG4-D7222N	-16-0 in. w.c. (-4-0 kPa)	LPG4-D8422N	0-60 in. w.c. (0-15 kPa)
LPG4-D7322N	-25-0 in. w.c. (-6-0 kPa)	LPG4-D8522N	0-80 in. w.c. (0-20 kPa)
LPG4-D7422N	-40-0 in. w.c. (-10-0 kPa)	LPG4-D8622N	0-100 in. w.c. (0-25 kPa)
LPG4-D7522N	-60-0 in. w.c. (-15-0 kPa)	LPG4-D8722N	0-160 in. w.c. (0-40 kPa)
LPG4-D7622N	-80-0 in. w.c. (-20-0 kPa)	LPG4-D8922N	-4-0-6 in. w.c. (-1-0-1.5 kPa)
LPG4-D7722N	-100-0 in. w.c. (-25-0 kPa)	LPG4-D9022N	-6-0-10 in. w.c. (-1.5-0-2.5 kPa)
LPG4-D7822N	-160-0 in. w.c. (-40-0 kPa)	LPG4-D9122N	-8-0-16 in. w.c. (-2-0-4 kPa)
LPG4-D7922N	-235-0 in. w.c. (-60-0 kPa)	LPG4-D9222N	-16-0-24 in. w.c. (-4-0-6 kPa)
LPG4-D8022N	0-10 in. w.c. (0-2.5 kPa)	LPG4-D9322N	-24-0-40 in. w.c. (-6-0-10 kPa)
LPG4-D8122N	0-15 in. w.c. (0-3.75 kPa)	LPG4-D9422N	-30-0-50 in. w.c. (-7.5-0-14.5 kPa)
LPG4-D8222N	0-25 in. w.c. (0-6 kPa)	LPG4-D9522N	-40-0-60 in. w.c. (-10-0-0.15 kPa)

Bulletin A-27

Magnehelic® Differential Pressure Gage



**The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.*

STANDARD GAGE ACCESSORIES: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapters and three flush mounting adapters with screws.

MP AND HP GAGE ACCESSORIES: Mounting ring and snap ring retainer substituted for 3 adaptors, 1/4" compression fittings replace 1/8" pipe thread to rubber tubing adaptors.

OVERPRESSURE PROTECTION: Standard Magnehelic® Differential Pressure Gages are rated for a maximum pressure of 15 psig and should not be used where that limit could be exceeded. Models employ 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 (excludes MP and HP models). To provide a free path for pressure relief, there are four spacer pads which maintain .023" clearance when gage is surface mounted. Do not obstruct the gap created by these pads.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. (MP model has polycarbonate cover).
Accuracy: ±2% of full scale (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on -00, - 00N, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20" Hg to 15 psig.† (-0.677 bar 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. The blowout plug is not used on models above 180 inches of water pressure, medium or high pressure models, or on gages which require an elastomer other than silicone for the diaphragm.
Temperature Limits: 20 to 140°F (-6.67 to 60°C). *Low temperature models available as special 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).
Agency Approvals: RoHS.

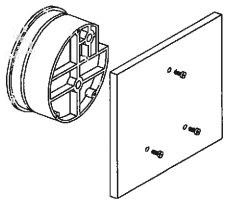
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options.

Note: May be used with hydrogen when ordering Buna-N diaphragm. Pressure must be less than 35 psi.

INSTALLATION

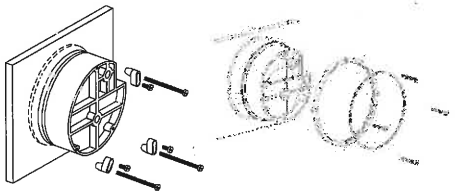
Select a location free from excessive vibration and where the ambient temperature will not exceed 140°F (60°C). Also, avoid direct sunlight which accelerates discoloration of the clear plastic cover. Sensing lines may be run any necessary distance. Long tubing lengths will not affect accuracy but will increase response time slightly. Do not restrict lines. If pulsating pressures or vibration cause excessive pointer oscillation, consult the factory for ways to provide additional damping.
All standard Magnehelic® Differential Pressure Gages are calibrated with the diaphragm vertical and should be used in that position for maximum accuracy. If gages are to be used in other than vertical position, this should be specified on the order. Many higher range gages will perform within tolerance in other positions with only rezeroing. Low range models of 0.5" w.c. plus 0.25" w.c. and metric equivalents must be used in the vertical position only.

SURFACE MOUNTING



Locate mounting holes, 120° apart on a 4-1/8" dia. circle. Use No. 6-32 machine screws of appropriate length.

FLUSH MOUNTING



Provide a 4-9/16" dia. (116 mm) opening in panel. Provide a 4-3/4" dia. (120 mm) opening for MP and HP models. Insert gage and secure in place with No. 6-32 machine screws of appropriate length, with adapters, firmly secured in place.

PIPE MOUNTING

To mount gage on 1-1/4" - 2" pipe, order optional A-610 pipe mounting kit.

TO ZERO GAGE AFTER INSTALLATION

Set the indicating pointer exactly on the zero mark, using the external zero adjust screw on the cover at the bottom. Note that the zero check or adjustment can only be made with the high and low pressure taps both open to atmosphere.

OPERATION

Positive Pressure: Connect tubing from source of pressure to either of the two high pressure ports. Plug the port not used. Vent one or both low pressure ports to atmosphere.
Negative Pressure: Connect tubing from source of vacuum or negative pressure to either of the two low pressure ports. Plug the port not used. Vent one or both high pressure ports to atmosphere.
Differential Pressure: Connect tubing from the greater of two pressure sources to either high pressure port and the lower to either low pressure port. Plug both unused ports.
When one side of the gage is vented in dirty, dusty atmosphere, we suggest an A-331 Filter Vent Plug be installed in the open port to keep inside of gage clean.

A. For portable use of temporary installation use 1/8" pipe thread to rubber tubing adapter and connect to source of pressure with flexible rubber or vinyl tubing.
B. For permanent installation, 1/4" O.D., or larger, copper or aluminum tubing is recommended.

MAINTENANCE

No lubrication or periodic servicing is required. Keep case exterior and cover clean. Occasionally disconnect pressure lines to vent both sides of gage to atmosphere and re-zero. Optional vent valves should be used in permanent installations. The Series 2000 is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

WARNING

Attempted field repair may void your warranty. Recalibration or repair by the user is not recommended.

TROUBLE SHOOTING TIPS

Gage won't indicate or is sluggish.

1. Duplicate pressure port not plugged.
2. Diaphragm ruptured due to overpressure.
3. Fittings or sensing lines blocked, pinched, or leaking.
4. Cover loose or "O"ring damaged, missing.
5. Pressure sensor, (static tips, Pitot tube, etc.) improperly located.
6. Ambient temperature too low. For operation below 20°F (-7°C), order gage with low temperature, (LT) option.

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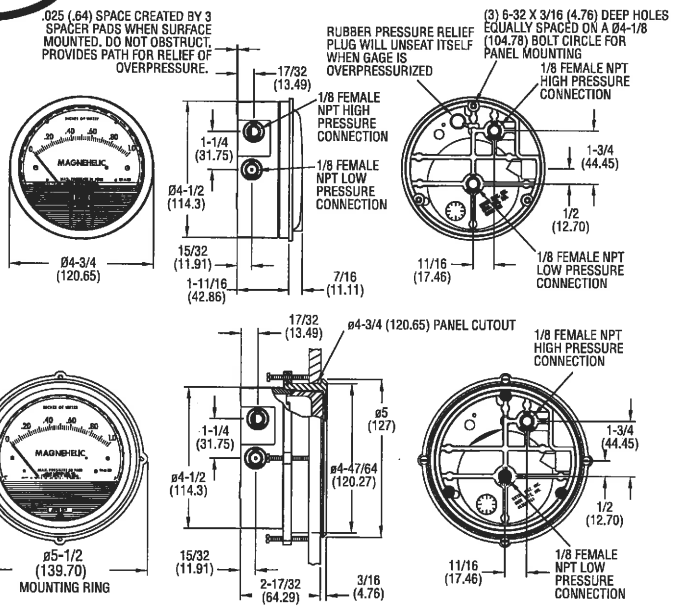
Bulletin A-27

Magnehelic® Differential Pressure Gage

INSTRUCCIONES Y LISTA DE PARTES



(El tapón de goma no es usado en los modelos sobre 180 pulgadas de presión de agua, modelos de presión media o alta, o en instrumentos que requieren un elastizado en cualquier otro material que no sea silicona para el diafragma.)

Accesorios: Tapones 1/8" NPT para las conexiones duplicadas, dos adaptadores de rosca 1/8" NPT a tubo de goma; y tres adaptadores para montaje al ras y tornillos.

Accesorios para Los Modelos MP y HP: El anillo de montaje y el retensor del anillo de presión son substituidos por 3 adaptadores, accesorios de compresión de 1/4" remplazan a los adaptadores de rosca 1/8" a tubo de goma.

Protección Para Sobrepresión: Los Manómetros Diferenciales Magnehelic Estándar están clasificados para una presión máxima de 15 psi y no se deberían de usar donde el límite puede excederse. Los modelos emplean un tapón de goma en el trasero que funciona como una válvula de alivio desmontándose y ventilando el interior del instrumento cuando la sobrepresión alcanza aproximadamente 25 psig. (Los modelos MP y HP son excluidos) Para proveer un camino libre para el alivio de presión, el instrumento viene con rodilleras que mantienen un espacio de .023" cuando el instrumento es montado en superficie. No bloque el espacio creado por estas rodilleras.

† Para aplicaciones con alto ciclo de velocidad dentro de la clasificación de presión total del instrumento, la próxima clasificación mas alta es recomendada. Vea las opciones de media y alta presión.

El instrumento puede ser usado con hidrogeno cuando se ordena con diafragma de Buna-N. La presion tiene que ser menos de 35 psi.

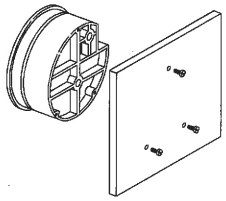
ESPECIFICACIONES

Servicio: aire y gases no combustibles, gases compatibles. (ópcion disponible para uso con gas natural).
Materiales Mojados: Consulte con la fábrica.
Carcasa: Caja y anillo de retención de aluminio fundido a presión con tapadera de acrílico. (El modelo MP tiene la tapadera de policarbonato.)
Exactitud: ±2% de fondo de escala a 21 °C
Mod. 2000-0 ±3%; Mod. 2000-00 ±4%
Límite de Presión: -20 Hg. a 15 psig. † (-0.677 bar a 1,034 bar); opción MP: 35 psig (2.41 bar), opción HP: 80 psig (5.52 bar).
Sobrepresión: El tapón de alivio se abre aproximadamente a los 25 psig, modelos estandard únicamente. El tapón de goma no es usado en los modelos sobre 180 pulgadas de presión de agua, modelos de presión media o alta, o en instrumentos que requieren un elastizado en cualquier otro material que no sea silicio para el diafragma.
Límite de Temperatura: -6.67 a 60°C. * Modelos de baja temperatura disponibles como opción especial.
Dimensiones: diám. 120,65 mm x 55,6 prof.
Orientación de Montaje: El diafragma debe ser usado solo en posición vertical. Consulte con la fábrica para otras orientaciones de posición.
Conexiones: 1/8" NPT para alta y baja presión, duplicadas (atrás, a los lados).
Peso: 510 g, MP y HP 963 g.
Aprobación de la agencia: RoHS.

Instalacion

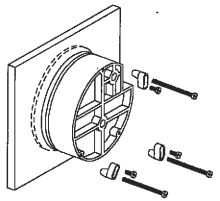
Seleccione un lugar libe de exceso de vibraciones, y donde la temperatura ambiente no supere los 60°C. Evite luz solar directa, para evitar decoloración de la cubierta plástica. Las conexiones de proceso pueden tener cualquier longitud sin afectar la exactitud, pero pueden extender el tiempo de respuesta del instrumento. Si hay pulsación de presión o vibración, consulte a fábrica sobre medios de amortiguación.
Los MAGNEHELIC han sido calibrados con el diafragma vertical, y deben ser usados en esas condiciones. Para otras posiciones, se debe especificar en la orden de provisión. Los de rango elevado pueden ser usados en diversas posiciones, pero se debe reajustar el cero. Los modelos de la serie 2000-00 y equivalentes métricos deben ser usados solo verticalmente.

Montaje en Superficie



Perfore tres orificios separados 120° sobre una circunferencia de 105 mm de diám. y sostenga el instrumento con tres tornillos 6-32 de long. apropiada.

Montaje alineado



Perfore un circulo de 115 mm de diám. en el panel, y sostenga el instrumento mediante los.

Montaje Sobre Pipa

Para montar el instrumento sobre pipas de 32 a 50 mm de diám., ordene el adaptador opcional A-610.

Puesta a Cero Después de Instalar

Deje las conexiones de presión abiertas a atmósfera y ajuste a cero desde tornillo del panel frontal.

Operacion

Presión Positiva: Conecte la tubería desde la fuente de presión a cualquiera de las dos conexiones de alta presión (HIGH), bloqueando la no usada; Las conexiones de baja (LOW) presión pueden dejarse uno o los dos abiertos a la atmósfera.
Presión Negativa: Repita el procedimiento anterior, conectado en este caso las conexiones de baja presión (LOW). Deje las otras conexiones abiertas.
Presión diferencial: Conecte el tubo correspondiente a la presión más positiva al cualquiera de los conectores de alta presión (HIGH) bloqueando el no usado, y la más baja presión o presión negativa (vacío) al conector de baja presión (LOW). Puede usarse cualquier conector de cada par, dejando siempre uno bloqueado. Si se deja una conexión abierta a la atmósfera, se recomienda el uso de un filtro tipo A-331 en el lugar correspondiente para mantener limpio el interior del instrumento. Para uso portable, o instalación temporaria, uso adapta dores para rosca de tubo de 1/89 a tubo flexible, y conecte a proceso mediante una tubería de goma, o equivalente. Para instalación permanente, se recomienda el uso de tubo de cobre o aluminio de por lo menos 1/4" de diám. exterior.

No se requiere mantenimiento específico alguno, ni lubricación. Periódicamente, desconecte el instrumento, ventee la presión acumulada, y reajuste el cero. Para instalaciones permanentes, se debe usar un juego de válvulas de montaje permanente para el venteo.
El instrumento de Serie 2000 no puede ser re parado en el campo y debería de ser regresado si reparos son necesarios (Reparos en el campo no deben de ser intentados y pueden cancelar la garantía.). Asegurarse de incluir una descripción breve del problema más cualquier notas pertinentes a la aplicación para devolución de productos antes de enviar el instrumento.

Cuidado! : La recalibración en campo puede invalidar la garantía. No se recomienda la recalibracion por parte del usuario. En caso necesario envie el instrumento con transporte pago a:

Localización De Fallas

• *El instrumento no indica, o es lento en reacción.*
1. Conexión duplicada abierta.
2. Diafragma roto por sobrepresión.
3. Tubería de conexión perforada, con pérdidas o pinchazos.
4. Anillo de retención flojo, u "O " ring dañado.
5. Conexión a proceso indebida o inadecuada.
6. Temperatura muy baja. Para este caso ordene tipos LT (baja temperatura).

Printed in U.S.A. 12/11 FR# 12-440212-10 Rev. 4

DWYER INSTRUCTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360 U.S.A.
Phone: 219/879-8000
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e-mail: info@dwyer-inst.com
DWYER INSTRUMENTS, INC.
P.O. BOX 373 • MICHIGAN CITY, INDIANA 46360 U.S.A.
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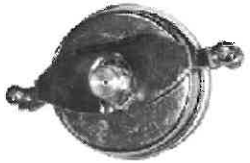
VACUUM AND PRESSURE LIQUID FILLED GAUGES
Back Mount



U Clamp

Standard

Flange Mount

- Suitable for Air, Water, Oil & Gas
- Dual Scale PSI/Kpa
- Stainless Steel Case & Bezel
- Brass Internals & NPT Connection
- Phosphor Bronze Bourdon Tube
- Accuracy 1-1/2" - 2-1/2": 3-2/3% 4":1%
- Ambient Temperature -30 F to 160˚F
- Liquid Filled Helps Dampen Effects of Pulsation and Vibration
- Liquid Filled Lubricates the Gauge Movement Keeping the Contaminates (Dirt) Away, Extending the Life of the Gauge
- ANSE 40.1 Compliant
- Connection: 1/8" NPT 1-1/2" Dial 1/4" NPT 2" & Above

Part No.	Dial Size (In)	Pressure Range Code
Back Mount Pressure Gauges		
LFSB15-PSI	1-1/2	2
LFSB20-PSI	2	3
LFSB25-PSI	2-1/2	4
LFSB25-PSI	2-1/2	6
LFSB40-PSI	4	5
LFSB40-PSI	4	6
Back Mount U-Clamp Pressure Gauges		
LFSB25-PSI-U	2-1/2	4
LFSB25-PSI-U	2-1/2	6
LFSB40-PSI-U	4	5
LFSB40-PSI-U	4	6
Back Mount Flange Pressure Gauges		
LFSB25-PSI-F	2-1/2	4
LFSB25-PSI-F	2-1/2	6
LFSB40-PSI-F	4	5

LFSB40-PSI-F	4	6
Back Mounted Vacuum Gauges		
VFSB15-030	1-1/2	7
VFSB20-030	2	7
VFSB25-030	2-1/2	7
VFSB40-030	4	7
Back Mount U- Clamp Vacuum Gauges		
VFSB25-030U	2-1/2	7
VFSB40-030U	4	7

Pressure Code Range	**PSI/Hg**
1	15, 30, 60, 100, 160, 200, 300 PSI
2	Same As Range 1 Plus 600, 1000, 2000, 3000, 5000 PSI
3	Same As Range 1 Plus 600, 1000, 2000, 3000, 5000, 6000 PSI
4	Same As Range 1 Plus 400, 600, 1000, 1500, 2000, 3000, 4000, 5000, 6000 PSI
5	Same As Range 1 Plus 400, 600, 1000, 1500, 2000, 3000, 5000, 6000 psI
6	10,000, 15000 PSI
7	-30" to 0" Hg

KUNKLE

Model 215V is Non-code Vacuum Relief. Model 337 is ASME Section VIII Air/Gas "UV" National Board Certified Safety Valve. Both are PED Certified for Non-Hazardous Gas.

Features

- Large nozzle design provides high capacity.
- Flat bronze valve seats are lapped for optimum performance.
- Warn ring offers easy adjustability for precise opening with minimum pre-open or simmer.
- Pivot between disc and spring corrects misalignment and compensates for spring side thrust.
- Each Kunkle valve is tested and inspected for pressure setting and leakage.

Model Descriptions

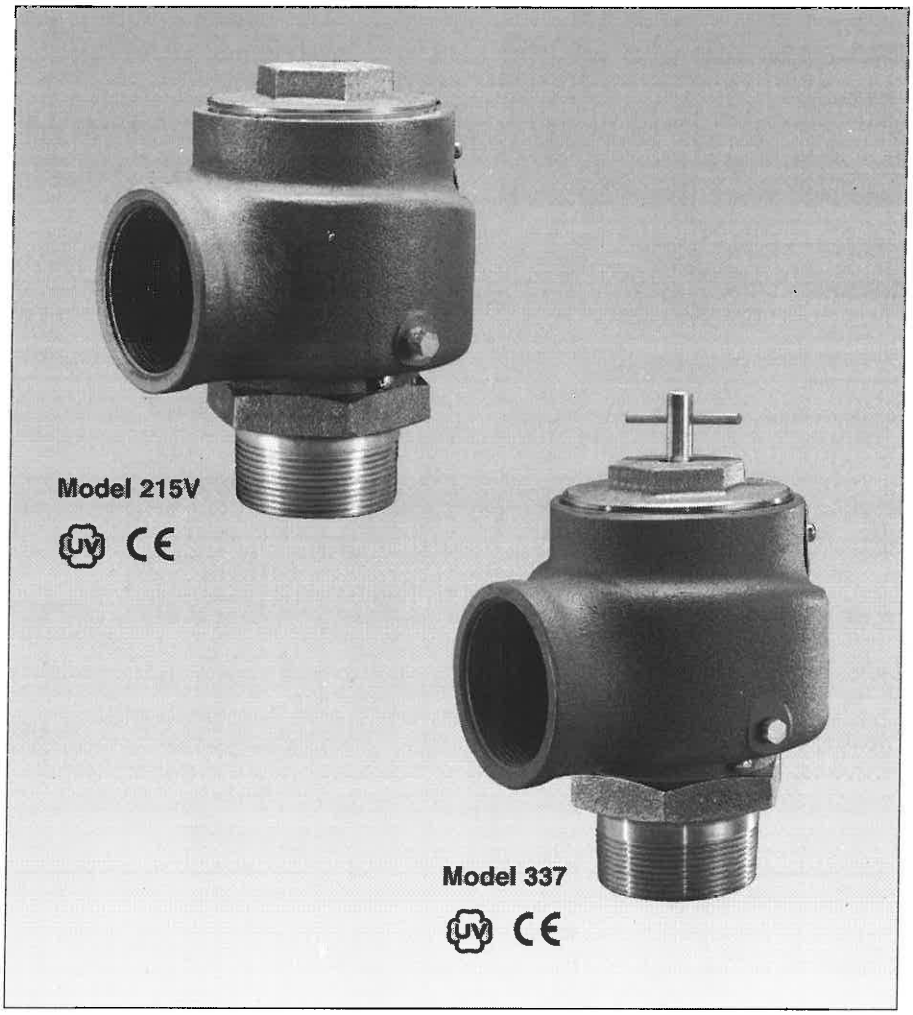
- **Model 337:** has "lift-pin" lift device for easy manual testing.
- All adjustments are factory sealed to help prevent tampering or disassembly.

Option

- Stainless Steel (SS) trim. (nozzle and disc) (variation 03)

Applications

- Protection of low to medium pressure high volume blowers, compressors and pneumatic conveying systems.
- Bulk hauling trailers/equipment.
- Light gauge tanks.
- Protection of high volume vacuum pumps and conveying systems.



Vacuum Limits

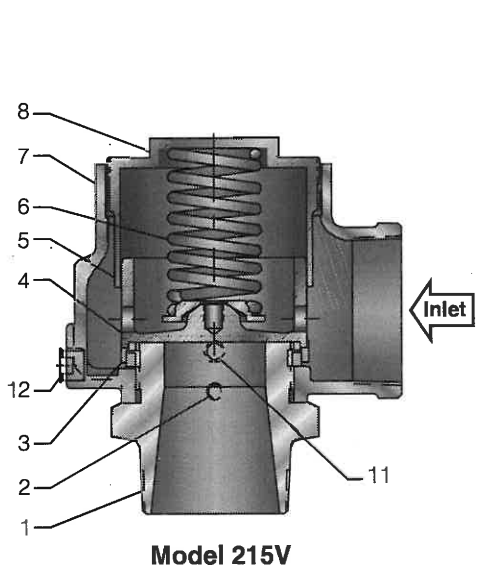
Model 215V:
2" Hg to 29" Hg [67.7 to 982 mbarg]
-20° to 406°F [-29° to 208°C]

Pressure and Temperature Limits

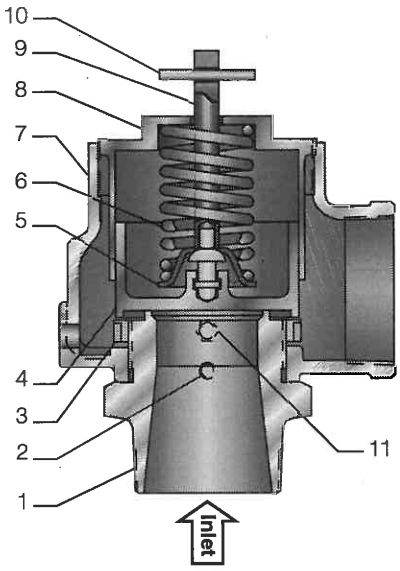
Model 337:
1 to 60 psig [0.07 to 4.1 barg]
-20° to 406°F [-29° to 208°C]

tyco Flow Control

Parts and Materials



Model 215V



Model 337

Models 215V and 337

No.	Part Name	215V	337
1	Nozzle[1]	Bronze, SB62 or Brass B283-C48500	Bronze, SB62 or Brass B283-C48500
2	Set Screw	Steel A108-1018 Brass Plated	Steel A108-1018 Brass Plated
3	Regulator Ring	Bronze B584 Alloy 84400	Bronze B584-C84400
4	Disc[1]	Bronze B584 Alloy 84400	Bronze B584-C84400
5	Spring Step	Steel A-109 Coated[3]	Steel A109 Coated[3]
6	Spring	SS, A313 TY 302	SS A313-302
7	Body	Cast Iron A-126, CL A or B	Iron A-126, CL A or B
8	Compression Screw	Bronze, B-584 Alloy 84400	Bronze, B584-C84400
9	Stem[2]	N/A	Brass B16
10	Lift Pin[2]	N/A	Steel, Zinc Plated
11	Regulator Ring Set Screw	N/A	Brass B16
12	NPT Drainplug	Steel A108-1018	N/A

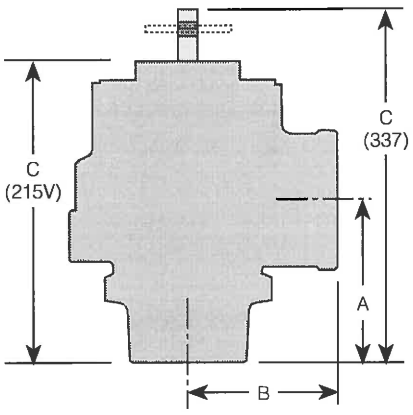
Notes

1. Disc and nozzle available in SSA-479 TY 316.
2. Stem and lift pin available on Model 337 only.
3. Corrosion preventative coating.

Specifications

Size Inlet and Outlet	Dimensions, in [mm] A	B	C 215V	C 337	Weight lb [kg]
2" [50.8 mm]	3¼ [82.5]	3 [76.2]	6½ [165.1]	7 [177.8]	8 [3.6]
2½" [63.5 mm]	3¾ [95.2]	3½ [88.9]	7⅝ [194.6]	8 [203.2]	12 [5.4]
3" [76.2 mm]	4¼ [107.9]	4 [101.6]	8½ [215.9]	9 [228.6]	20 [9.07]

Dimensions are for reference only.



Model 337

Capacities

Model 337, Non-code[1] and ASME Section VIII Air (SCFM)

Set Pressure (psig)	Valve Inlet and Outlet Size 2" Orifice Area, in² 1.84	2 1/2" Orifice Area, in² 2.79	3" Orifice Area, in² 4.04
1	240	364	527
5	531	805	1166
10	741	1124	1628
15	948	1436	2081
20	1092	1656	2399
25	1237	1875	2718
30	1382	2095	3036
35	1542	2337	3386
40	1701	2578	3736
45	1860	2820	4086
50	2020	3061	4436
55	2179	3303	4786
60	2338	3544	5136

Note

1. No code stamp or "NB" on nameplate below 15 psig set.

Model 337, Non-code[1] and ASME Section VIII Air [Metric, Nm³/h]

Set Pressure [barg]	Valve Inlet and Outlet Size 50 mm	63 mm	80 mm
0.5	1049	1589	2303
1.0	1457	2208	3200
1.5	1888	2861	4147
2.0	2235	3387	4910
2.5	2613	3959	5739
3.0	2995	4538	6579
3.5	3377	5117	7418
4.0	3760	5696	8258

Note

1. No code stamp or "NB" on nameplate below 1.1 barg set.

Model 215V, Non-code Vacuum Air (SCFM)

Relief Set (in, HG)	Valve Inlet and Outlet Size 2" Orifice Area, in² 1.84	2 1/2" Orifice Area, in² 2.79	3" Orifice Area, in² 4.04
2	229	347	503
5	338	512	742
10	415	630	912
15	426	646	936
20	426	646	936
29	426	646	936

Note

1. Based on 10% accumulation.

Model 215V, Non-code Vacuum Air [Metric, Nm³/h]

Relief Set [mbarg]	Valve Inlet and Outlet Size 5.08 cm Orifice Area [11.86 cm²]	6.35 cm Orifice Area [17.97 cm²]	7.62 cm Orifice Area [26.05 cm²]
50	328	498	722
100	450	682	988
150	533	807	1170
200	593	899	1303
250	638	966	1400
300	669	1014	1470
350	690	1046	1516
400	701	1062	1540
450	704	1067	1546
500	704	1067	1546
550	704	1067	1546
600	704	1067	1546
650	704	1067	1546
700	704	1067	1546
750	704	1067	1546

Note

1. Based on 10% accumulation.

Model Number/Order Guide

Model Number Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	2	1	5	V	—	H	0	1	A	Q	E	0	0	5	0

Model
215V
0337

Inlet Size
H - 2" [50.8 mm]
J - 2½" [63.5 mm]
K - 3" [76.2 mm]

Variation (01 to 99)
01 - Bronze Disc and Nozzle
03 - SS Disc and Nozzle
60 - BSP Connections

Design Revision
Indicates non-interchangeable revision.
Current Design is at Revision "A."

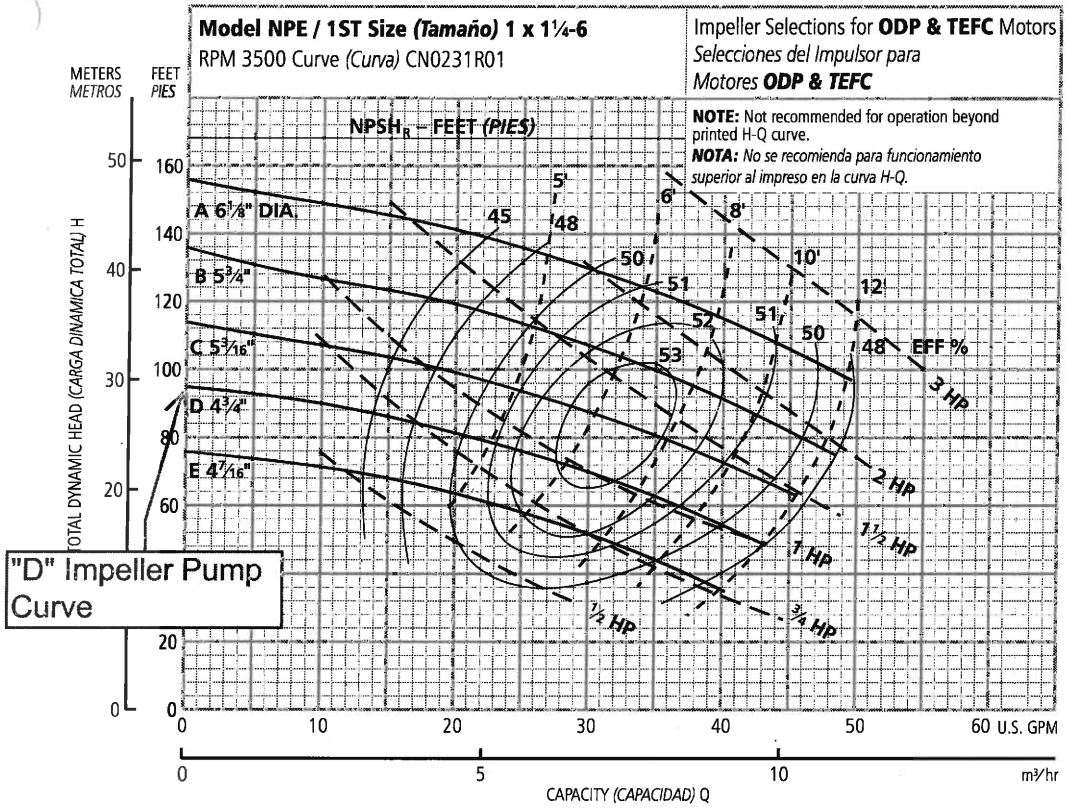
Valve Service
K - Air ASME Section VIII (Model 337 only)
Q - Vacuum (Model 215V only)
N - Non-code Air/Gas (Model 337 only)

Spring Material
E - SST Type 302
(H-Orifice up to 8 psi; J-Orifice up to 20 psi; K-Orifice up to 25 psi)
M - SST Type 17-7
(H-Orifice above 8 psi; J-Orifice above 20 psi; K-Orifice above 25 psi)

Set Pressure
Model 337, 1 psig [0.7 barg] (0001) to 60 psig [4.1 barg] (0060)
Model 215V, 2" Hg [68 mbarg] (0002) to 29" Hg [982 mbarg] (0029) vacuum

KUNKLE
953 Old U.S. Highway 70
Black Mountain, North Carolina 28711-2549
Customer Service Phone: 1-828-669-3700
www.kunklevalve.com

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

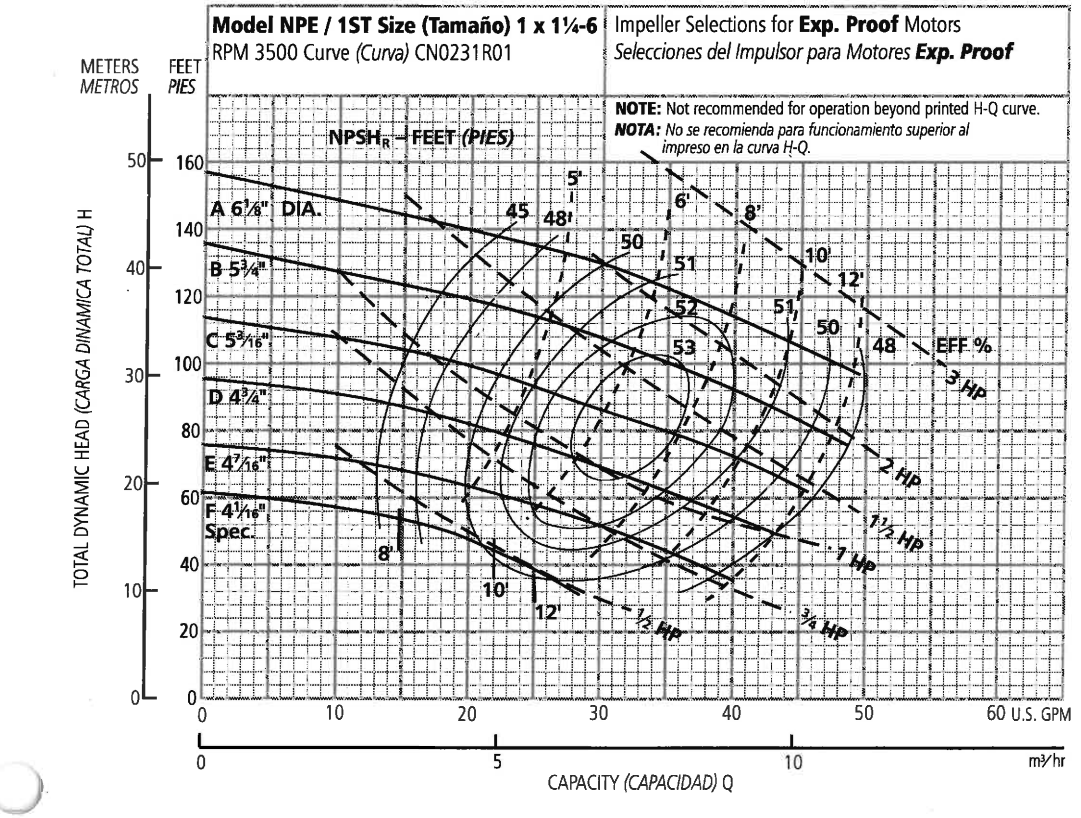


Ordering Code, Código de Pedido	Standard HP Rating, Estándar HP Potencia	Imp. Dia.
E	½	4⁷⁄₁₆"
D	¾	4¾
C	1	5³⁄₁₆
B	1½	5¾
A	2	6⅛

NOTE: Although not recommended, the pump may pass a ¹⁄₁₆" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ¹⁄₁₆".*

MODEL 1ST1D5D4



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 ¹⁄₁₆" sphere.

NOTA: *Si bien no se recomienda, la bomba puede pasar una esfera de ¹⁄₁₆".*

ITT

Commercial Water

Goulds Pumps

G&L SERIES

MODEL NPE/NPE-F

Installation, Operation and
Maintenance Instructions

GOULDS PUMPS

Goulds Pumps is a brand of ITT Corporation.

www.goulds.com

Engineered for life

Table of Contents

Owner's Information

Pump Model Number: _____

Pump Serial Number: _____

Dealer: _____

Dealer Phone No.: _____

Date of Purchase: _____

Date of Installation: _____

Current Readings at Startup:

1 Ø	3 Ø	L1-2	L2-3	L3-1
Amps: _____	Amps: _____	_____	_____	_____
Volts: _____	Volts: _____	_____	_____	_____

SAFETY INSTRUCTIONS

TO AVOID SERIOUS OR FATAL PERSONAL INJURY OR MAJOR PROPERTY DAMAGE, READ AND FOLLOW ALL SAFETY INSTRUCTIONS IN MANUAL AND ON PUMP.

THIS MANUAL IS INTENDED TO ASSIST IN THE INSTALLATION AND OPERATION OF THIS UNIT AND MUST BE KEPT WITH THE PUMP.

This is a **SAFETY ALERT SYMBOL.** When you see this symbol on the pump or in the manual, look for one of the following signal words and be alert to the potential for personal injury or property damage.

⚠ DANGER Warns of hazards that **WILL** cause serious personal injury, death or major property damage.

⚠ WARNING Warns of hazards that **CAN** cause serious personal injury, death or major property damage.

⚠ CAUTION Warns of hazards that **CAN** cause personal injury or property damage.

NOTICE: INDICATES SPECIAL INSTRUCTIONS WHICH ARE VERY IMPORTANT AND MUST BE FOLLOWED.

THOROUGHLY REVIEW ALL INSTRUCTIONS AND WARNINGS PRIOR TO PERFORMING ANY WORK ON THIS PUMP.

MAINTAIN ALL SAFETY DECALS.

⚠WARNING

Hazardous fluids can cause fire, burns or death.

UNIT NOT DESIGNED FOR USE WITH HAZARDOUS LIQUIDS OR FLAMMABLE GASES. THESE FLUIDS MAY BE PRESENT IN CONTAINMENT AREAS.

DESCRIPTION & SPECIFICATIONS:

The Models NPE (close-coupled) and NPE-F (frame-mounted) are end suction, single stage centrifugal pumps for general liquid transfer service, booster applications, etc. Liquid-end construction is all AISI Type 316 stainless steel, stamped and welded. Impellers are fully enclosed, non-trimable to intermediate diameters. Casings are fitted with a diffuser for efficiency and for negligible radial shaft loading.

Close-coupled units have NEMA 48J or 56J motors with C-face mounting and threaded shaft extension. Frame-mounted units can be coupled to motors through a spacer coupling, or belt driven.

1. IMPORTANT:

1.1. Inspect unit for damage. Report any damage to carrier/dealer immediately.

1.2. Electrical supply must be a separate branch circuit with fuses or circuit breakers, wire sizes, etc., per national and local electrical codes. Install an all-leg disconnect switch near pump.

⚠ CAUTION **Always disconnect electrical power when handling pump or controls.**

1.3. Motors must be wired for proper voltage. Motor wiring diagram is on motor nameplate. Wire size must limit maximum voltage drop to 10% of nameplate voltage at motor terminals, or motor life and pump performance will be lowered.

1.4. Always use horsepower-rated switches, contactor and starters.

1.5. Motor Protection

1.5.1. Single-phase: Thermal protection for single-phase units is sometimes built in (check nameplate). If no built-in protection is provided, use a contactor with a proper overload. Fusing is permissible.

1.5.2. Three-phase: Provide three-leg protection with properly sized magnetic starter and thermal overloads.

1.6. Maximum Operating Limits:

Liquid Temperature:	250° F (120° C)
Pressure:	125 PSI
Starts Per Hour:	20, evenly distributed

1.7. Regular inspection and maintenance will increase service life. Base schedule on operating time. Refer to Section 8.

2. INSTALLATION:

2.1. General

2.1.1. Locate pump as near liquid source as possible (below level of liquid for automatic operation).

2.1.2. Protect from freezing or flooding.

2.1.3. Allow adequate space for servicing and ventilation.

2.1.4. All piping must be supported independently of the pump, and must "line-up" naturally.

⚠ CAUTION **Never draw piping into place by forcing the pump suction and discharge connections.**

2.1.5. Avoid unnecessary fittings. Select sizes to keep friction losses to a minimum.

2.2. Close-Coupled Units

2.2.1. Units may be installed horizontally, inclined or vertically.

⚠ CAUTION **Do not install with motor below pump. Any leakage or condensation will affect the motor.**

2.2.2. Foundation must be flat and substantial to eliminate strain when tightening bolts. Use rubber mounts to minimize noise and vibration.

2.2.3. Tighten motor hold-down bolts before connecting piping to pump.

2.3. Frame-Mounted Units

2.3.1. It is recommended that the bedplate be grouted to a foundation with solid footing. Refer to Figure 1.

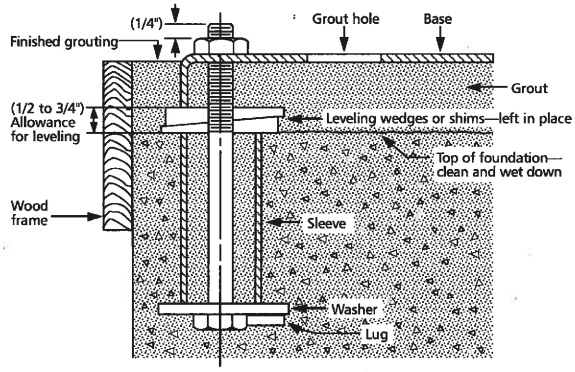


Figure 1

2.3.2. Place unit in position on wedges located at four points (two below approximate center of driver and two below approximate center of pump). Adjust wedges to level unit. Level or plumb suction and discharge flanges.

2.3.3. Make sure bedplate is not distorted and final coupling alignment can be made within the limits of movement of motor and by shimming, if necessary.

2.3.4. Tighten foundation bolts finger tight and build dam around foundation. Pour grout under bedplate making sure the areas under pump and motor feet are filled solid. Allow grout to harden 48 hours before fully tightening foundation bolts.

2.3.5. Tighten pump and motor hold-down bolts before connecting the piping to pump.

3. SUCTION PIPING:

3.1. Low static suction lift and short, direct, suction piping is desired. For suction lift over 10 feet and liquid temperatures over 120 F, consult pump performance curve for Net Positive Suction Head Required.

3.2. Suction pipe must be at least as large as the suction connection of the pump. Smaller size will degrade performance.

3.3. If larger pipe is required, an eccentric pipe reducer (with straight side up) must be installed at the pump.

3.4. Installation with pump below source of supply

3.4.1. Install full flow isolation valve in piping for inspection and maintenance.

⚠ CAUTION **Do not use suction isolation valve to throttle pump.**

3.5. Installation with pump above source of supply

3.5.1. Avoid air pockets. No part of piping should be higher than pump suction connection. Slope piping upward from liquid source.

3.5.2. All joints must be airtight.

3.5.3. Foot valve to be used only if necessary for priming, or to hold prime on intermittent service.

3.5.4. Suction strainer open area must be at least triple the pipe area.

3.6. Size of inlet from liquid source, and minimum submergence over inlet, must be sufficient to prevent air entering pump through vortexing. See Figures 2-5.

3.7. Use 3-4 wraps of Teflon tape to seal threaded connections.

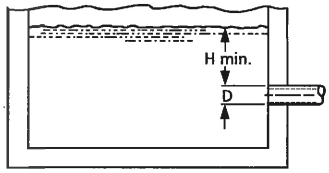


Figure 2

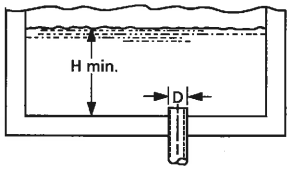


Figure 3

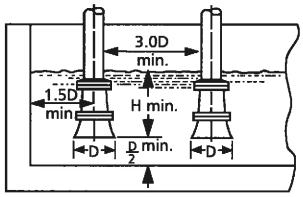


Figure 4

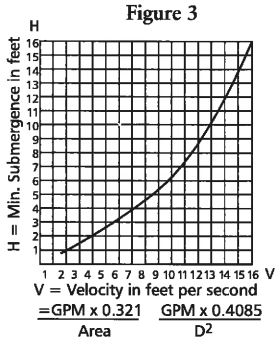


Figure 5

4. DISCHARGE PIPING:

4.1. Arrangement must include a check valve located between a gate valve and the pump. The gate valve is for regulation of capacity, or for inspection of the pump or check valve.

4.2. If an increaser is required, place between check valve and pump.

4.3. Use 3-4 wraps of Teflon tape to seal threaded connections.

5. MOTOR-TO-PUMP SHAFT ALIGNMENT:

5.1. Close-Coupled Units

5.1.1. No field alignment necessary.

5.2. Frame-Mounted Units

5.2.1. Even though the pump-motor unit may have a factory alignment, this could be disturbed in transit and must be checked prior to running. See Figure 6.

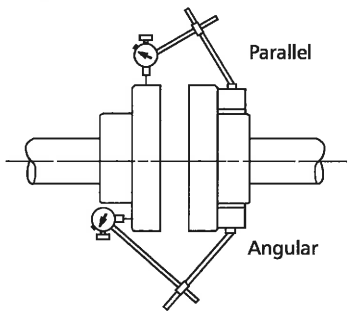


Figure 6

5.2.2. Tighten all hold-down bolts before checking the alignment.

5.2.3. If re-alignment is necessary, always move the motor. Shim as required.

5.2.4. Parallel misalignment - shafts with axis parallel but not concentric. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the outside diameter of the other hub. Parallel alignment occurs when Total Indicator Reading is .005", or less.

5.2.5. Angular misalignment - shafts with axis concentric but not parallel. Place dial indicator on one hub and rotate this hub 360 degrees while taking readings on the face of the other hub. Angular alignment is achieved when Total Indicator Reading is .005", or less.

5.2.6. Final alignment is achieved when parallel and angular requirements are satisfied with motor hold-down bolts tight.

⚠ CAUTION **Always recheck both alignments after making any adjustment.**

6. ROTATION:

6.1. Correct rotation is right-hand (clockwise when viewed from the motor end). Switch power on and off quickly. Observe shaft rotation. To change rotation:

6.1.1. Single-phase motor: Non-reversible.

6.1.2. Three-phase motor: Interchange any two power supply leads.

7. OPERATION:

7.1. Before starting, pump must be primed (free of air and suction pipe full of liquid) and discharge valve partially open.

⚠ CAUTION **Pumped liquid provides lubrication. If pump is run dry, rotating parts will seize and mechanical seal will be damaged. Do not operate at or near zero flow. Energy imparted to the liquid is converted into heat. Liquid may flash to vapor. Rotating parts require liquid to prevent scoring or seizing.**

7.2. Make complete check after unit is run under operating conditions and temperature has stabilized. Check for expansion of piping. On frame-mounted units coupling alignment may have changed due to the temperature differential between pump and motor. Recheck alignment.

8. MAINTENANCE:

8.1. Close-Coupled Unit. Ball bearings are located in and are part of the motor. They are permanently lubricated. No greasing required.

8.2. Frame-Mounted Units

8.2.1. Bearing frame should be regreased every 2,000 hours or 3 month interval, whichever occurs first. Use a #2 sodium or lithium based grease. Fill until grease comes out of relief fittings, or lip seals, then wipe off excess.

8.2.2. Follow motor and coupling manufacturers' lubrication instructions.

8.2.3. Alignment must be rechecked after any maintenance work involving any disturbance of the unit.

9. DISASSEMBLY:

Complete disassembly of the unit will be described. Proceed only as far as required to perform the maintenance work needed.

9.1. Turn off power.

9.2. Drain system. Flush if necessary.

9.3. Close-Coupled Units: Remove motor hold-down bolts.

Frame-Mounted Units: Remove coupling, spacer, coupling guard and frame hold-down bolts.

9.4. Disassembly of Liquid End

9.4.1. Remove casing bolts (370).

9.4.2. Remove back pull-out assembly from casing (100).

9.4.3. Remove impeller locknut (304).

⚠ CAUTION **Do not insert screwdriver between impeller vanes to prevent rotation of close-coupled units. Remove cap at opposite end of motor. A screwdriver slot or a pair of flats will be exposed. Using them will prevent impeller damage.**

9.4.4. Remove impeller (101) by turning counter-clockwise when looking at the front of the pump. Protect hand with rag or glove.

⚠ CAUTION **Failure to remove the impeller in a counter-clockwise direction may damage threading on the impeller, shaft or both.**

9.4.5. With two pry bars 180 degrees apart and inserted between the seal housing (184) and the motor adapter (108), carefully separate the two parts. The mechanical seal rotary unit (383) should come off the shaft with the seal housing.

9.4.6. Push out the mechanical seal stationary seat from the motor side of the seal housing.

9.5. Disassembly of Bearing Frame

9.5.1. Remove bearing cover (109).

9.5.2. Remove shaft assembly from frame (228).

9.5.3. Remove lip seals (138 and 139) from bearing frame and bearing cover if worn and are being replaced.

9.5.5. Use bearing puller or arbor press to remove ball bearings (112 and 168).

10. REASSEMBLY:

10.1. All parts should be cleaned before assembly.

10.2. Refer to parts list to identify required replacement items. Specify pump index or catalog number when ordering parts.

10.3. Reassembly is the reverse of disassembly.

10.3.1. Impeller and impeller locknut assembled onto motor shaft with 10 ft-lbs of torque.

10.4. Observe the following when reassembling the bearing frame.

10.4.1. Replace lip seals if worn or damaged.

10.4.2. Replace ball bearings if loose, rough or noisy when rotated.

10.4.3. Check shaft for runout. Maximum permissible is .002" T.I.R.

10.5. Observe the following when reassembling the liquid-end.

10.5.1. All mechanical seal components must be in good condition or leakage may result. Replacement of complete seal assembly, whenever seal has been removed, is good standard practice.

It is permissible to use a light lubricant, such as glycerin, to facilitate assembly. Do not contaminate the mechanical seal faces with lubricant.

10.5.2. Inspect casing O-ring (513) and replace if damaged. This O-ring may be lubricated with petroleum jelly to ease assembly.

10.5.3. Inspect guidevane O-ring (349) and replace if worn.

⚠ CAUTION **Do not lubricate guidevane O-ring (349). Insure it is not pinched by the impeller on reassembly.**

10.6. Check reassembled unit for binding. Correct as required.

10.7. Tighten casing bolts in a star pattern to prevent O-ring binding.

11. TROUBLE SHOOTING CHART:

MOTOR NOT RUNNING:
(See causes 1 thru 6)

LITTLE OR NO LIQUID DELIVERED:
(See causes 7 thru 17)

POWER CONSUMPTION TOO HIGH:
(See causes 4, 17, 18, 19, 22)

EXCESSIVE NOISE AND VIBRATION:
(See causes 4, 6, 9, 13, 15, 16, 18, 20, 21, 22)

PROBABLE CAUSE:

1. Tripped thermal protector
2. Open circuit breaker
3. Blown fuse
4. Rotating parts binding
5. Motor wired improperly
6. Defective motor
7. Not primed
8. Discharge plugged or valve closed
9. Incorrect rotation
10. Foot valve too small, suction not submerged, inlet screen plugged
11. Low voltage
12. Phase loss (3-phase only)
13. Air or gasses in liquid
14. System head too high
15. NPSHA too low:
    Suction lift too high or suction losses excessive. Check with vacuum gauge.
16. Impeller worn or plugged
17. Incorrect impeller diameter
18. Head too low causing excessive flow rate
19. Viscosity or specific gravity too high
20. Worn bearings
21. Pump or piping loose
22. Pump and motor misaligned

NPE STANDARD REPAIR PARTS LIST

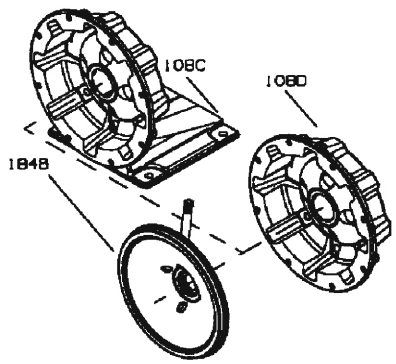
Item No.	Description	Materials of Construction
100	Casing	AISI 316L Stainless Steel
101	Impeller	
108A	Motor adapter with foot	
108B	Motor adapter less foot	
108C	Motor adapter with foot and flush	
108D	Motor adapter less foot with flush	
123	Deflector	BUNA-N
184A	Seal housing std.	AISI 316L S.S.
184B	Seal housing with seal flush	
240	Motor support	300 S.S.
	Rubber channel	Rubber
304	Impeller locknut	AISI 316 S.S.
347	Guidevane	AISI 316L S.S.
349	Seal-Ring, guidevane	Viton (standard)
		EPR
		BUNA
370	Socket head screw, casing	AISI 410 S.S.
371	Bolts, motor	Steel/plated
383	Mechanical seal	
408	Drain and vent plug, casing	AISI 316 S.S.
412B	O-Ring, drain plugs	Viton (standard)
		EPR
		BUNA
513	O-Ring, casing	Viton (standard)
		EPR
		BUNA

MECHANICAL SEAL APPLICATION CHART

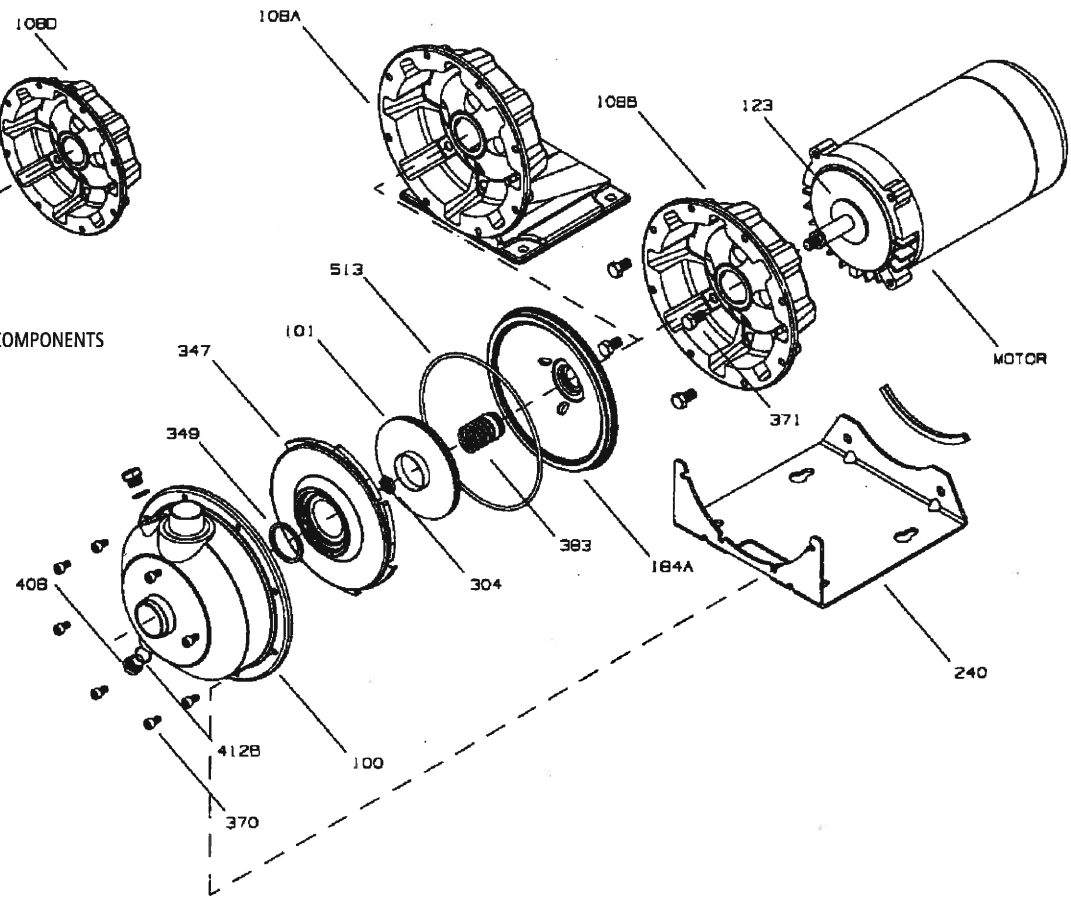
Item 383 Mechanical Seal (⅝" seal)				
Rotary	Stationary	Elastomers	Metal Parts	Part No.
Carbon	Sil-Carbide	EPR	316SS	10K18
		Viton		10K55
Sil-Carbide		EPR		10K81
		Viton		10K62

NOTE: Close coupled units supplied with ½ HP 1750 RPM, ½ - 3 HP Explosion Proof or 5 HP motors, utilize motor adapter less foot and a footed motor.

NOTE: Frame mounted units (NPE-F) utilize the XS Power frame and motor adapter less foot. For repair parts for the power frame refer to the XS-Power frame repair parts page in the parts section of your catalog. To order the power frame complete order item 14L61.



NOTE: OPTIONAL SEAL FLUSH COMPONENTS



GOULDS PUMPS LIMITED WARRANTY

This warranty applies to all water systems pumps manufactured by Goulds Pumps.

Any part or parts found to be defective within the warranty period shall be replaced at no charge to the dealer during the warranty period. The warranty period shall exist for a period of twelve (12) months from date of installation or eighteen (18) months from date of manufacture, whichever period is shorter.

A dealer who believes that a warranty claim exists must contact the authorized Goulds Pumps distributor from whom the pump was purchased and furnish complete details regarding the claim. The distributor is authorized to adjust any warranty claims utilizing the Goulds Pumps Customer Service Department.

The warranty excludes:

(a) Labor, transportation and related costs incurred by the dealer;
(b) Reinstallation costs of repaired equipment;
(c) Reinstallation costs of replacement equipment;
(d) Consequential damages of any kind; and,
(e) Reimbursement for loss caused by interruption of service.

For purposes of this warranty, the following terms have these definitions:

(1) "Distributor" means any individual, partnership, corporation, association, or other legal relationship that stands between Goulds Pumps and the dealer in purchases, consignments or contracts for sale of the subject pumps.
(2) "Dealer" means any individual, partnership, corporation, association, or other legal relationship which engages in the business of selling or leasing pumps to customers.
(3) "Customer" means any entity who buys or leases the subject pumps from a dealer. The "customer" may mean an individual, partnership, corporation, limited liability company, association or other legal entity which may engage in any type of business.

THIS WARRANTY EXTENDS TO THE DEALER ONLY.

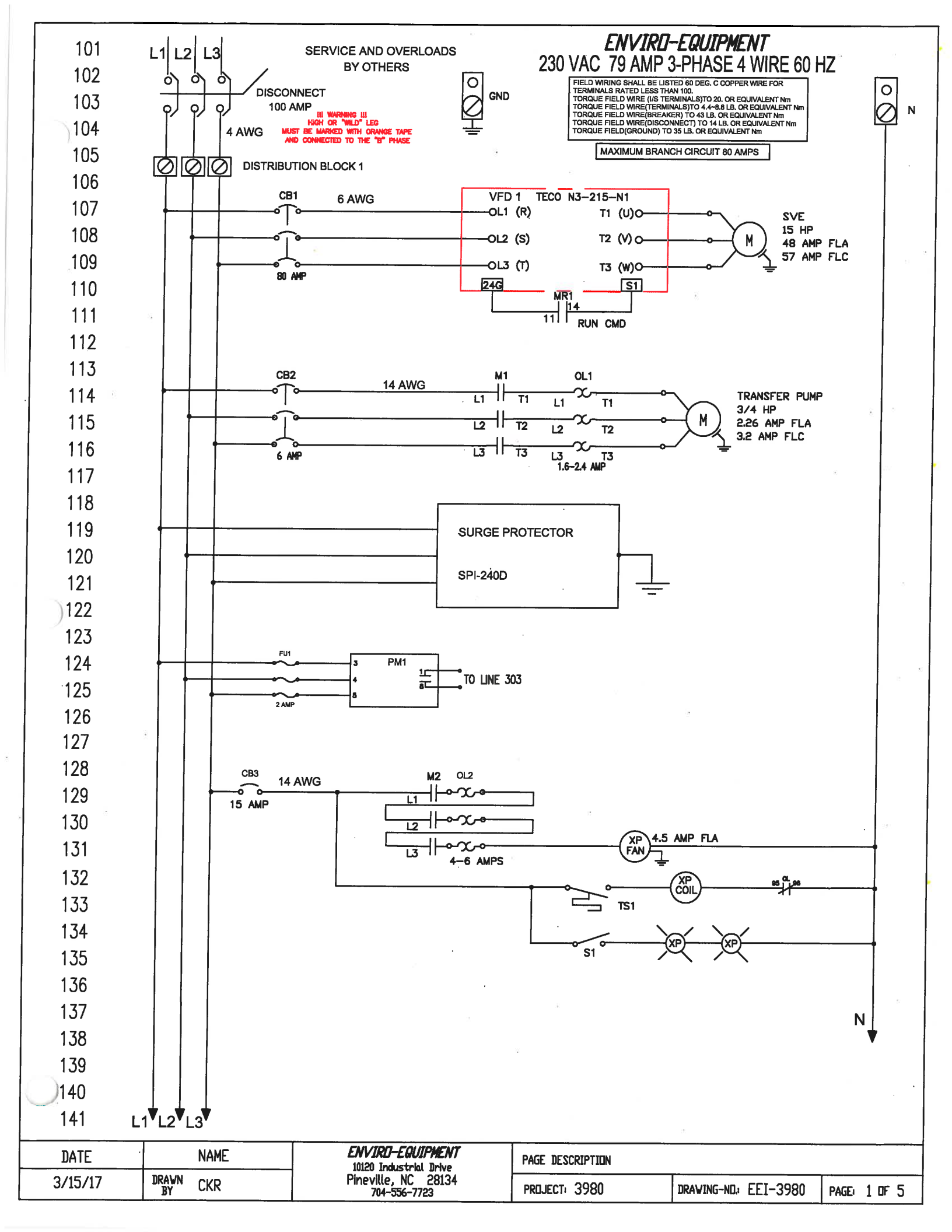
GOULDS PUMPS

IM013 Revision Number 8 April, 2008

Engineered for life

ENVIRO-EQUIPMENT

230 VAC 79 AMP 3-PHASE 4 WIRE 60 HZ



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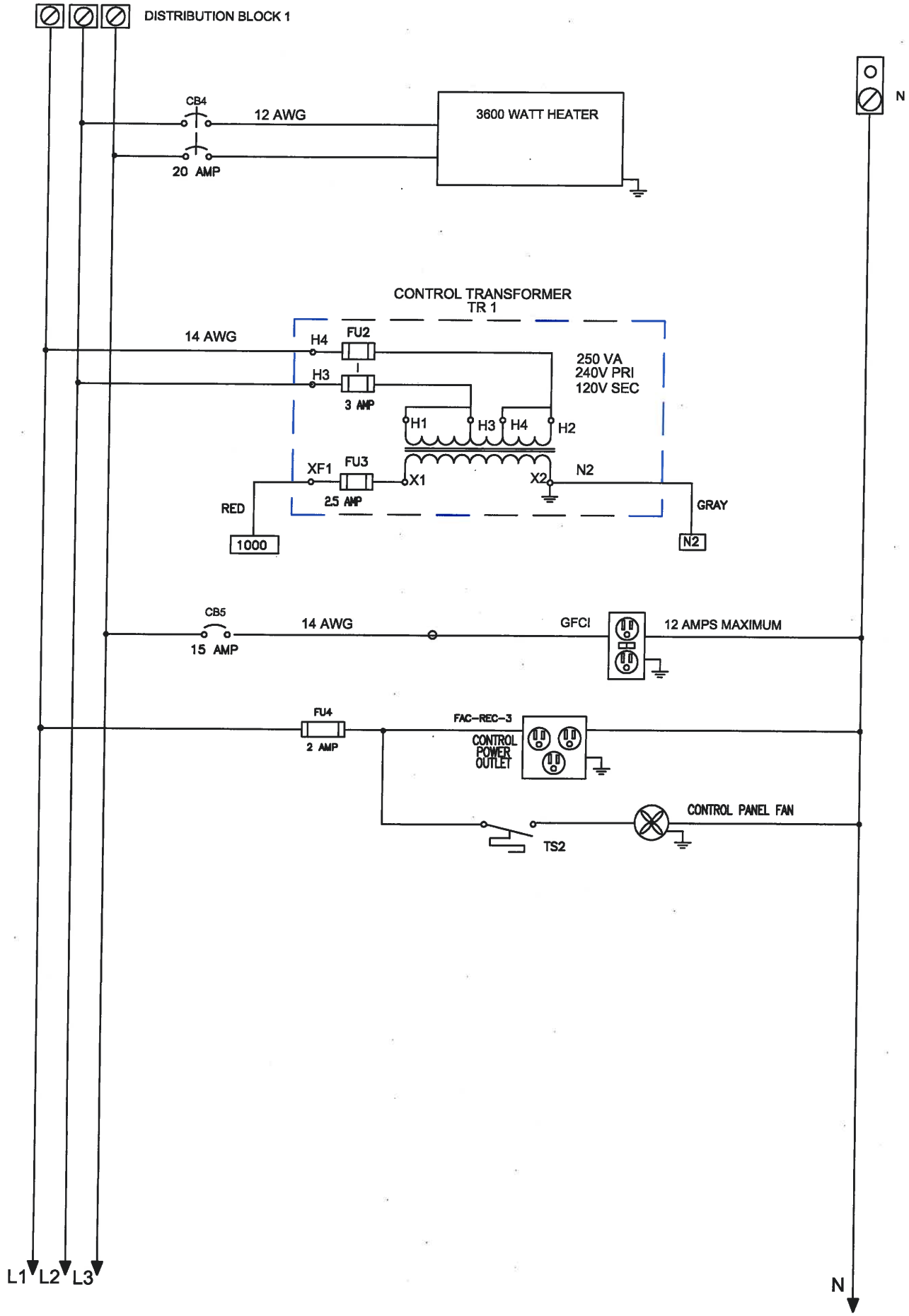

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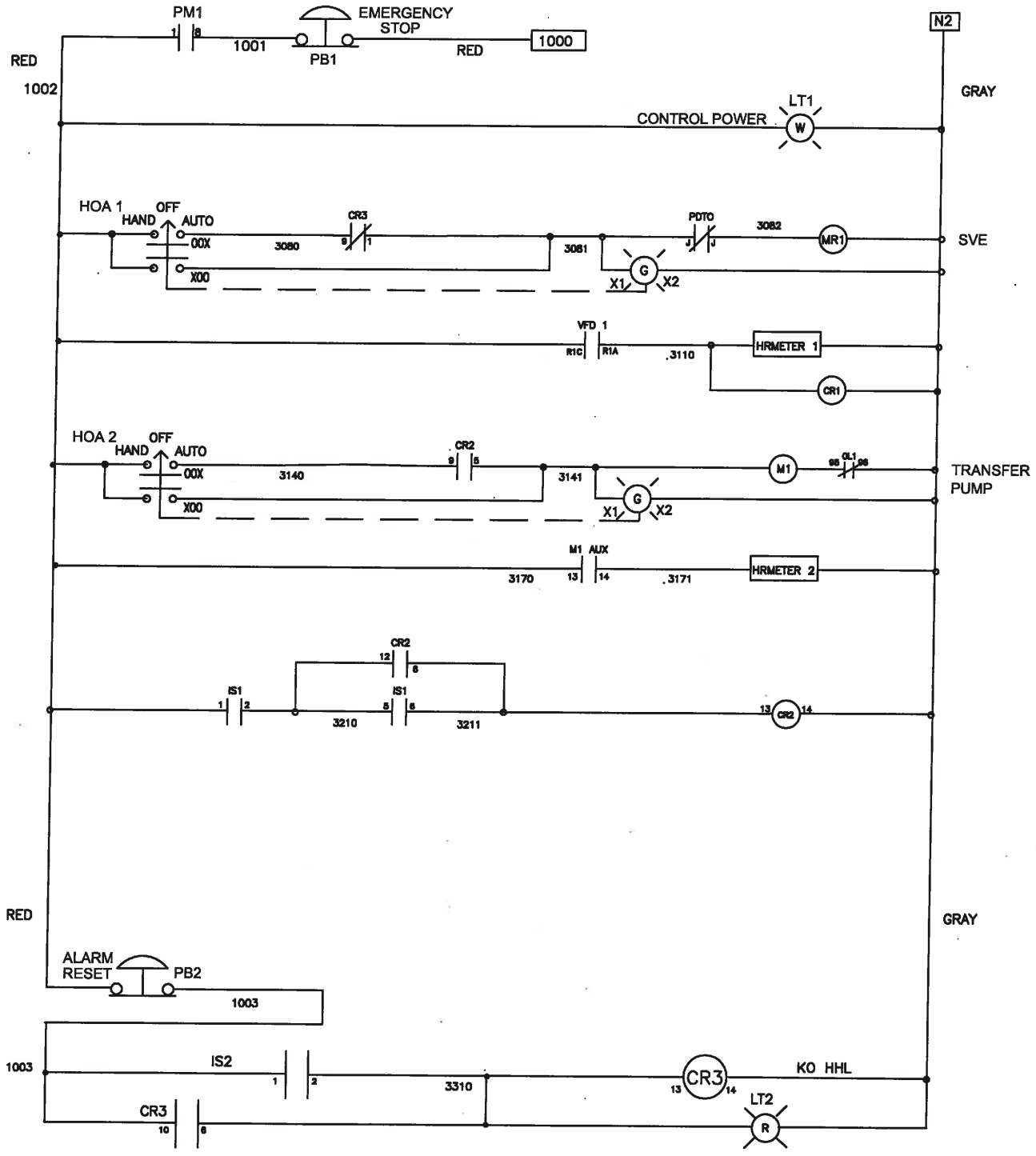

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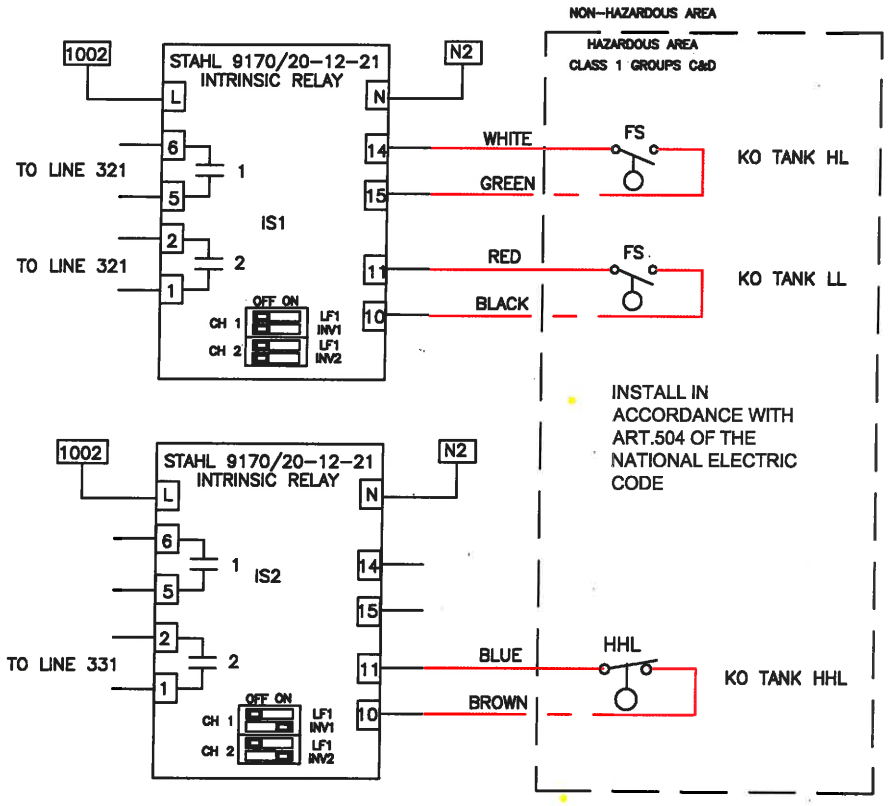

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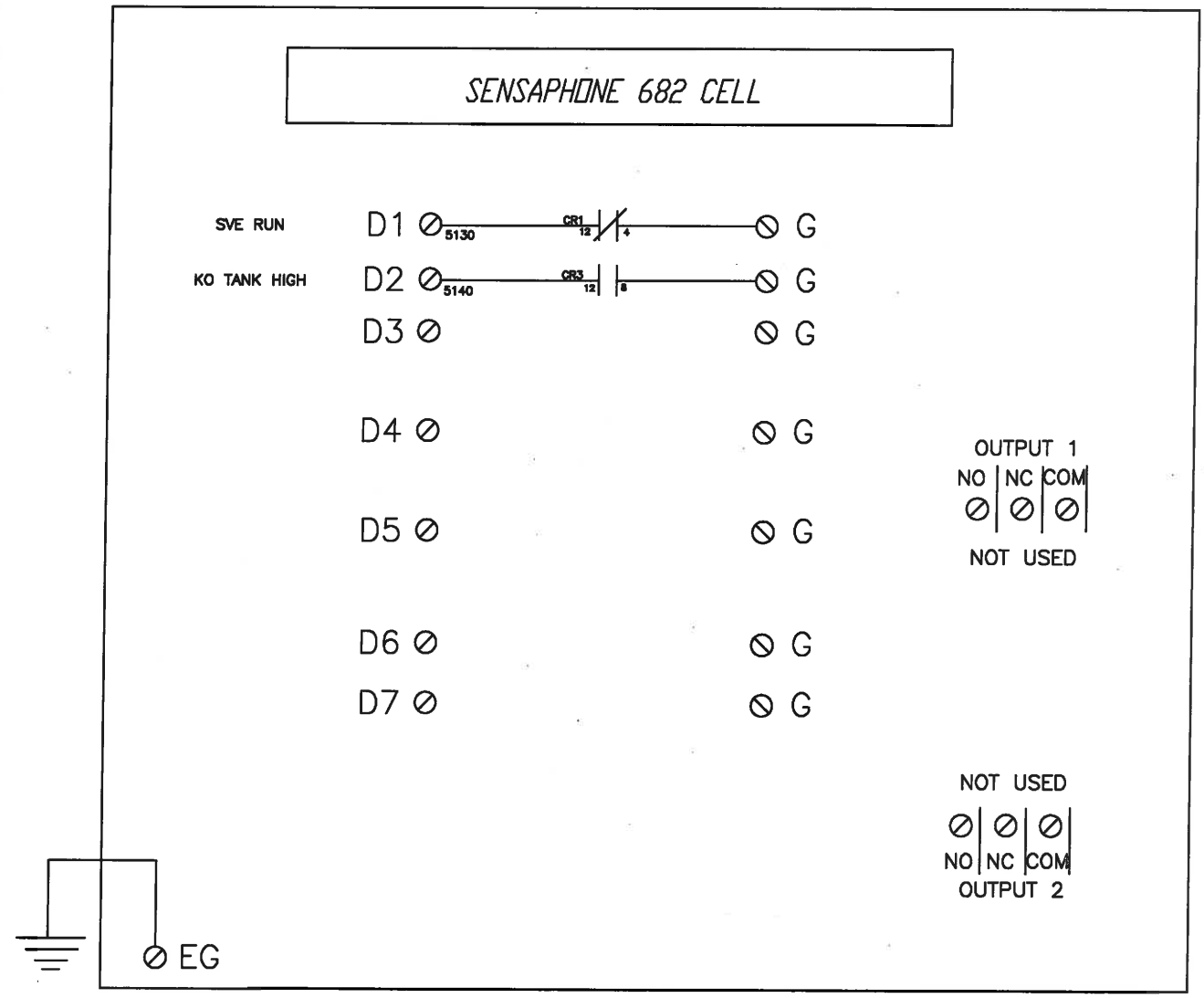

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ENVIRO EQUIPMENT COMPONENT TRACABILITY

PROJECT # 3980
LABEL SN 0081

COMPONENT	MANUFACTURER	PART NUMBER	LISTING
6MM TERMINAL BLOCK, 1 LEVEL	EATON	XBUT4	UR
GROUNDING BAR 10 POSITION	EATON	GBK10	UL
250VA TRANSFORMER	EATON	C0250E5E	UL
E/M HR METER, 115VAC, 2.8-IN RND, 3-HOLE FLANGE	EATON	6-T-3H-508RPM-406	UR
MCB, 3POLE, 6A, D CURVE	EATON	FAZD6/3-NA	UL
3POS GREEN ILL. , RET FROM LEFT, 2NO	EATON	M22-WRLK3-2-G-K20-G	UL
BLACK PUSHBUTTON, 1NC	EATON	M22-D-S-K01	UL
LITTELFUSE 3P, CC CLASS FUSE HOLDER	LITTLEFUSE	L60030C-1CDIN	UL
CONTACTOR 7A, 120V COIL	EATON	XTCE007B10A	UL
OVERLOAD 6A	EATON	XTOB006BC1	UL
100A NON-FUSIBLE DISCONNECT	EATON	R9D3100U	UL
OVERLOAD 1.6-2.4A	EATON	XTOB2P4BC1	UL
EMERGENCY STOP, 1NC	EATON	M22-PVT-K01	UL
3POLE RELAY 120V	IDEC	RH3B-UAC120	CSA
3POLE SOCKET	IDEC	SH3B-05	CSA
2POLE RELAY 120V	IDEC	RH2B-UAC120	CSA
2POLE SOCKET	IDEC	SH2B-05	CSA
6MM SLIM RELAY, 120VAC	IDEC	RV8H-L-A110	CSA
DUAL CHANNEL ISOLATOR	STAHL	9170/20-12-21	UL
208-480V PLUG-IN UNIVERSAL VOLTAGE MONITOR	EATON	D65VMLP480	UL
SOCKET FOR VOLTAGE MONITOR	IDEC	D3PA2	UL
SERIES G MCB	EATON	EGB3080FFG	UL
BREAKER, 1POLE, 15A	EATON	QCR1015	UL
BREAKER, 2POLE, 20A	EATON	QCR2020	UL
RED PILOT LIGHT, 85-264VAC	EATON	M22-L-R-230R	UL
WHITE PILOT LIGHT, 85-264VAC	EATON	M22-L-W-230W	UL

I CERTIFY THAT THE COMPONENTS AS LISTED, OR THE ATTACHED LIST OF COMPONENTS HAVE BEEN REVIEWED FOR ACCEPTANCE UNDER THE PANEL LISTING PROGRAM. THESE COMPONENTS ARE EITHER CERTIFIED, LISTED, OR RECOGNIZED BY A COMPONENT APPROVING AGENCY. UNEVALUATED CONTROL COMPONENTS PROTECTED BY A LISTED GFCI MAY BE USED IN ACCORDANCE WITH UL5O8A FOR U.S. PANELS, HOWEVER NO UNEVALUATED COMPONENTS ARE AUTHORIZED FOR PANELS APPROVED FOR CANADA.

SIGNATURE: __CRAIG RICHARDSON_____ DATE: ____ 4/25/2017

INSTRUCTION MANUAL

TECO

230V Class 1Ø 0.5~3HP
0.4~2.2KW

230V Class 3Ø 0.5~40HP
0.4~30 KW

460V Class 3Ø 1~75HP
0.75~55 KW

TECO INVERTER 7300N3

Quick Start Guide

This guide is to assist in installing and running the inverter to verify that the drive and motor are working properly. Starting, stopping and speed control will be from the keypad. If your application requires external control or special system programming, consult the N3 Instruction Manual supplied with your inverter.

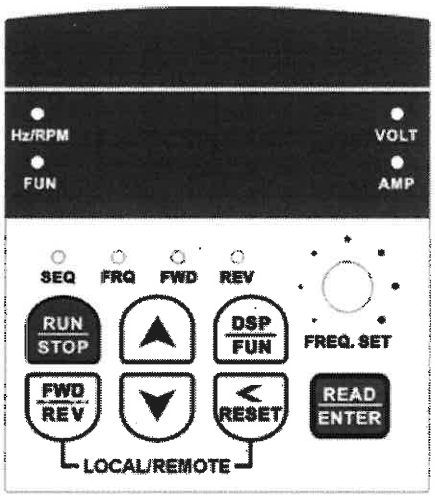
Step 1 Before Starting the Inverter

Please review Preface and Safety Precautions (page 0-1 through 1-4) of the N3 Instruction Manual. Verify that the drive was installed in accordance with the procedures as described in N3 Ambient Environment and Installation on pages 3-1 through 3-8. If you feel this was improper in any way, do not start the drive until qualified personnel have verified proper installation. (Failure to do so could result in serious injury.)

- **Check inverter and motor nameplates to determine that they have matched HP and voltage ratings. (Ensure that full load motor amps do not exceed that of the inverter.)**

- **Remove the terminal cover to expose the motor and power terminals.**

  a. Verify that AC power is wired to L1, L2, and L3 (pages 3-12).
  b. Verify that Motor leads are connected to T1, T2, and T3 (pages 3-12).
  (The two leads may need to be reversed if motor rotation is not correct.



1. **SEQ LED :** 1_00 =1, LED Lit.
2. **FRQ LED :** 1_01 = 1/2/3/4, LED Lit
3. **FWD LED:** Forward Direction, LED action(Flash in stop, solid in Run).
4. **REV LED :** Reverse Direction, LED action(Flash in stop, solid in Run).
5. **Four actions of FUN、Hz/RPM、VOLT、AMP** LED and display of four 7-segment display. (Refer to operation description of the keypad.)
6. **LCD keypad without** FUN, Hz/RPM, VOLT, AMP LED.

Step 2 Apply Power to the Drive

- **Apply AC power to the Drive and observe keypad. Four 7-segments Display should read Power Voltage for 3~5 seconds and then read Frequency/Speed, 05.00. Four 7-segment Display and FWD LED should be flashing all the time.**

Step 3 Check Motor Rotation Without Load

- **Press RUN key (FWD LED should light); Four 7-segment Display should run from 00.00 to 05.00.**
- **Check motor rotation.**
  If it is not correct:
  Press STOP key. Remove AC power. Wait for LED "charge" lamp to extinguish.
  Reverse motor leads T1 and T2.Restart the drive and check new rotation.
- **Press STOP key to stop rotation.**

Step 4 Check Full Speed at 50Hz/60Hz

- **Frequency/Speed can be changed by pressing the up or down Arrow keys. To move right or left for next digit, press SHIFT / RESET key. Press the READ / ENTER key to set the speed.**
- **Set frequency up to 50Hz/60Hz in accordance with the default base frequency.**
- **Press RUN key. Check drive acceleration up to full speed.**
- **Press STOP key to stop drive and check deceleration.**

Step 5 Other Operations

For information, see N3 Instruction Manual.
Please refer to the following pages:

Table of Contents

Index of Figures

Preface

Preface

To extend the performance of the product and ensure personnel safety, please read this manual thoroughly before using the inverter. Should there be any problem in using the product that cannot be solved with the information provided in the manual, contact your nearest Teco's distributor or sales representative who will be willing to help you.

※Precautions

The inverter is an electrical product. For your safety, there are symbols such as "Danger", "Caution" in this manual as a reminder to pay attention to safety instructions on handling, installing, operating, and checking the inverter. Be sure to follow the instructions for highest safety.

! Danger	Indicates a potential hazard could cause death or serious personal injury if misused.
⚠ Caution	Indicates that the inverter or the mechanical system might be damaged if misused.

! Danger

- Do not touch any circuit boards or components while the charging indicator is still lit after turned the power off. (The light will fade)
- Do not wire when the inverter is electrified. Do not check parts and signals on circuit boards during the inverter operation.
- Do not disassemble the inverter not and modify any internal wires, circuits, or parts.

Ground the ground terminal of the inverter properly. For 200V class ground to 100 Ω or below. For 400v class ground to 10Ω or below.

⚠ Caution

- Do not perform a voltage test on parts inside the inverter. High voltage can destroy these semiconductor parts.
- Do not connect T1 (U), T2 (V), and T3 (W) terminals of the inverter to any AC input power supply.
- CMOS ICs on the inverter's main board are susceptible to static electricity. Do not touch the main circuit board

Product Inspection

TWMC's inverters have all passed the function test before delivery. Please check the following when you receive and unpack the inverter:

- The model and capacity of the inverter are the same as those specified in your purchase order.
- Check for any damages caused by transportation. Please do not apply power, and contact a TWMC sales representative if any of the above problems occurred.

Chapter 1 Safety Precautions

1.1 Operation Precautions

1.1.1 Before Power Up

⚠ Caution

The line voltage applied must comply with the inverter's specified input voltage.(See product nameplate)

Danger

Make sure the main circuit connections are correct. L1 (L), L2 and L3 (N) are power-input terminals and must not be mistaken for T1, T2 and T3. Otherwise, inverter damage can result.

⚠ Caution

- To avoid the front cover from disengaging or other damage, do not carry the inverter by its cover. Support the drive by its heat sink when transporting. Improper handling can damage the inverter or injure personnel, and should be avoided.
- To avoid the risk of fire, do not install the inverter on flammable objects. Install on nonflammable objects such as metal surfaces.
- If several inverters are placed in the same control panel, provide heat removal means to keep the temperature below 40°C to avoid overheat or fire.
- When removing or installing the operator, turn OFF the power first, and manipulate the operator following the instruction of the diagram to avoid operator error or no display caused by bad contact.

Warning

This product is sold subject to IEC 61800-3. In a domestic environment this product may cause radio interference in which case the user may be required to apply corrective measures.

1.1.2 During Power Up

Danger

- Do not insert or remove input line connectors on the inverter when powered up to avoid the control panel damage resulting from possible voltage surge from contact bounce.
- When momentary power loss is longer than 2 seconds (the larger of horse power, the longer of time), the inverter does not have enough storage power to control the circuit; Therefore, when power is regenerated, the operation of the inverter is based on the setup of B000 / A015 and the condition of external switch, this is considered to be 「restart」 in the following paragraphs.
- When the momentary power loss is short, the inverter still has enough storage power to control the circuit. Therefore, when power is regenerated, the inverter will automatically restart depending on the setup of A013/A014.
- When restarting the inverter, the operation of the inverter is based on the setup of B000 and A015 and the condition of external switch (FWD/REV button). Attention: the start operation is irrelevant with A013/A014/A018/A019.

  1. When B000=0000, the inverter will not automatically run after restart.

  2. When B000=0001 and the external switch (FWD/REV button) is OFF, the inverter will not run after restart.

  3. When B000=0001, the external switch (FWD/REV button) is ON, and A015=0000, the inverter will run automatically after restart. Attention: In the sake of safety, please turn off the external switch (FWD/REV button) after power loss to avoid damage to the machine and injury to personnel after sudden regeneration of power.
- To ensure the safety of people and machine, please refer to the description and warnings for A015.

1.1.3 Before Operation

Danger

Make sure the model and inverter capacity match the A175 setting.

⚠ Caution

The inverter will flash display the power voltage set by A007 for 5 seconds when applying power.

1.1.4 During Operation

⚠ Danger
Do not connect or disconnect the motor during operation. Otherwise, the over-current will cause the inverter to trip or damage the unit.

⚠ Danger
• To avoid electric shock, do not take the front cover off when power is on. • The motor will restart automatically after stop when auto-restart function is on. In this case, use caution while working near the drive, motor, or driven equipment. • Note: The stop switch function is different from the emergency stop switch, which must be set first to be effective.

⚠ Caution
• Do not touch heat-generating components such as heat sinks and braking resistors. • The inverter can drive the motor from low speed to high speed. Verify the allowable capacities range of the motor and the associated machinery. • Note the settings related to the braking reactor. • Do not check signals on circuit boards while the inverter is running.

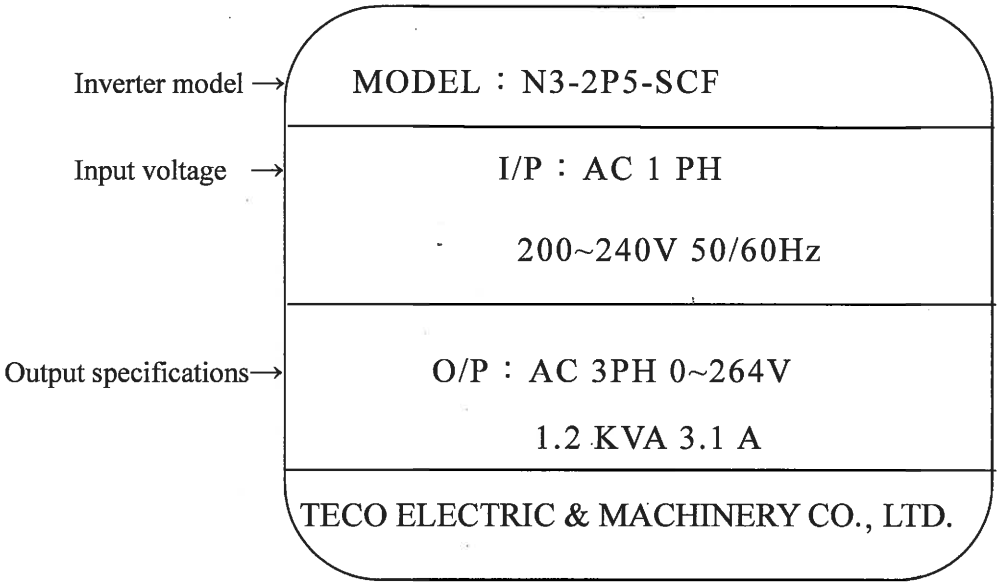
⚠ Caution
Allow 5 minutes after disconnecting power before disassembling or checking the components. The power led should not be illuminated.

1.1.5 During Maintenance

⚠ Caution
The inverter should be used in a non-condensing environment with temperature range of 14-104°F (-10-40°C) and a relative humidity of 95% non-condensing.

⚠ Caution
When the inverter top cover has removed, it can be used in a non-condensing environment with temperature from 14-122°F (–10°C to +50°C) and relative humidity of 95%, but the environment should be free from water and metal dust.

Chapter 2 Definition of model



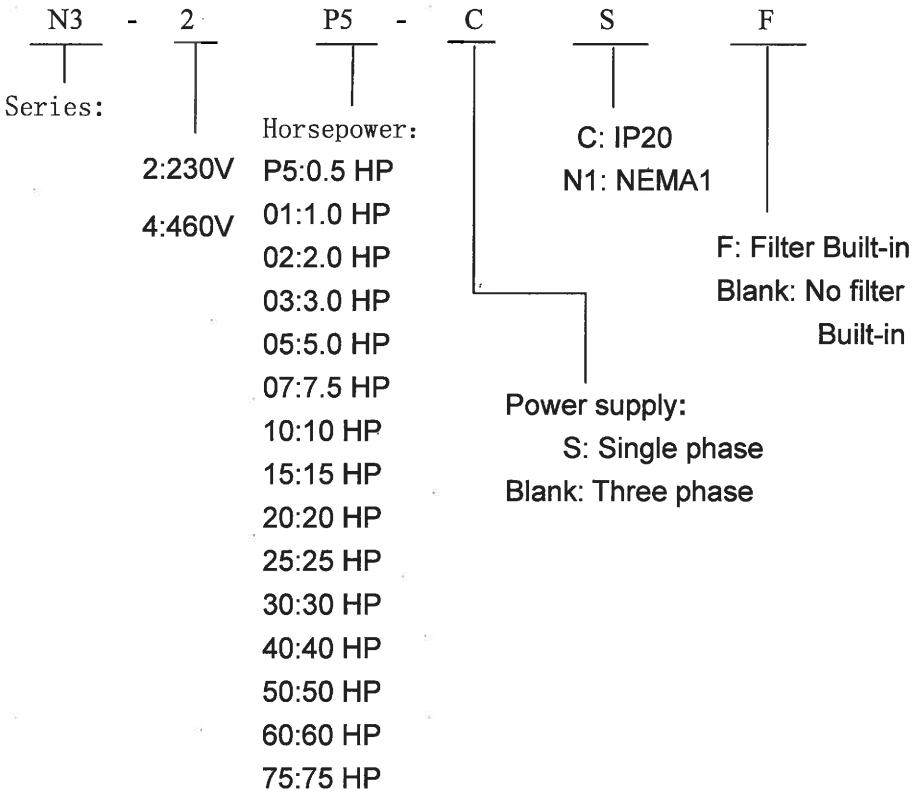


Figure 2-1 Inverter Nameplate

Chapter 3 Ambient Environment and Installation

3.1 Environment

The environment will directly affect the proper operation and the life span of the inverter, so install the inverter in an environment complying with the following conditions:

- Ambient temperature: 14-104℉(-10°C - +40°C); without cover:14-122℉(-10°C - +50°C)
- Avoid exposure to rain or moisture.
- Avoid direct sunlight.
- Avoid oil mist and salinity.
- Avoid corrosive liquid and gas.
- Avoid dust, lint fibers, and small metal filings.
- Keep away from radioactive and flammable materials.
- Avoid electromagnetic interference (soldering machine, power machine).
- Avoid vibration (stamping, punching machine). Add a vibration-proof pad if the situation cannot be avoided.
- If several inverters are placed in the same control panel, provide heat removal means to maintain temperatures below 40°C.

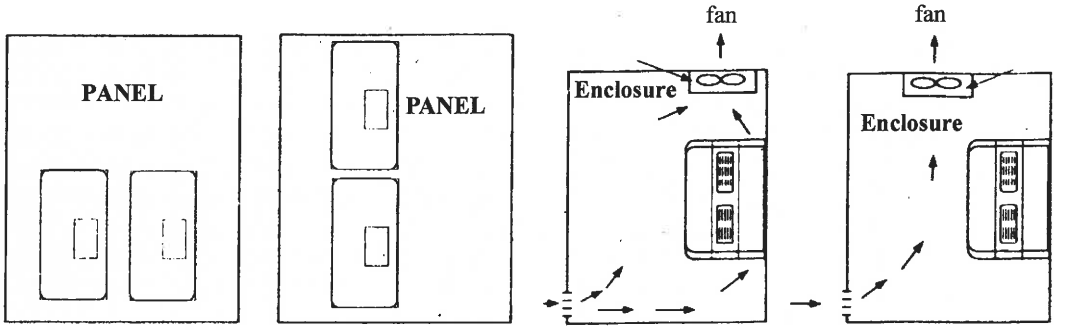


Figure 3-1 Panel and enclosure arrangement for N3 inverters

- Place the front side of the inverter onward and top upward to in favor of heat sink.
  - Install the inverter according to the following figures: (take the dustproof cover off in favor of heat sinking if it is installed in a box or the environment allows to do so)

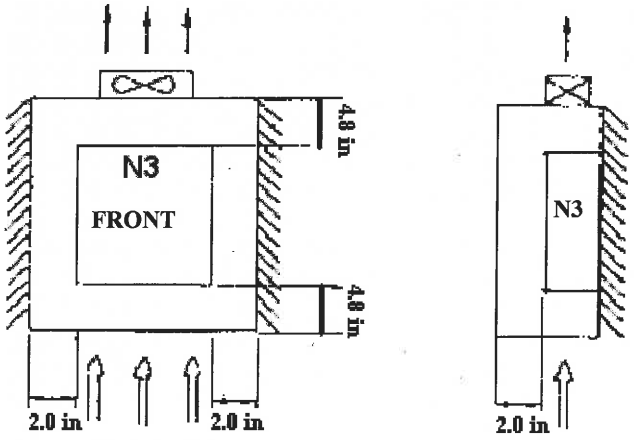
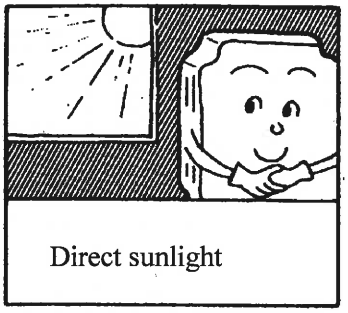


Figure 3-2 DIN RAIL MOUNTING OF THE N3 INVERTER

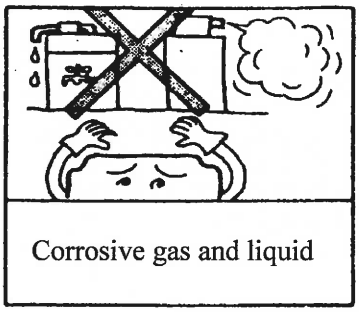
Air convection
14℉-104℉ (-10°C - +40°C)
(a) Front view
(b) Side view

3.2 Environmental precautions

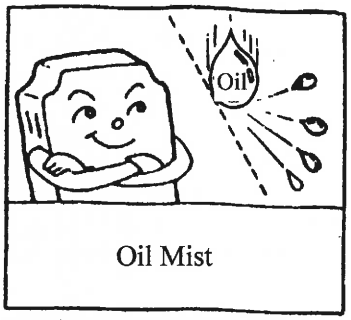
Do not use the inverter in an environment with the following conditions:



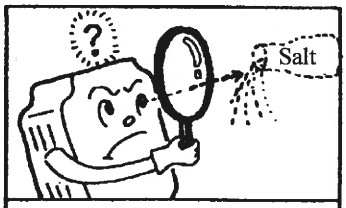
Direct sunlight



Corrosive gas and liquid

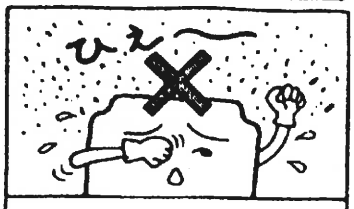


Oil Mist

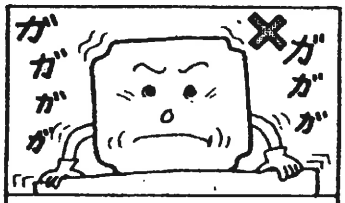


Salt

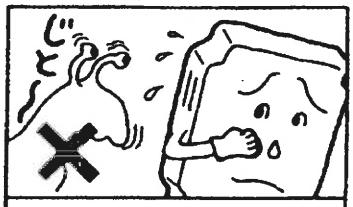
Wind, rain, and water drops may get into



Iron filings, dust

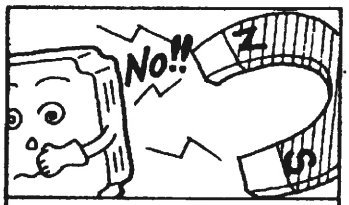


Strong vibration

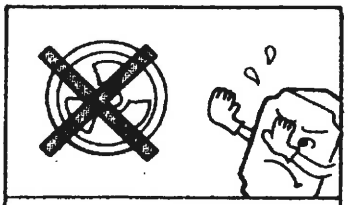


Extreme low temperature

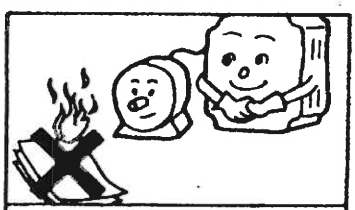
Excessive high temperature



Electromagnetic wave and ultra high wave
(Near an electric welding machine)



Radioactive materials



Inflammable materials

3.3 Inflammable materials

3.3.1 Notice for wiring

A. Tightening torque:

Wine with a screwdriver or other tools per the tightening the torques listed below:

Tightening torque			
Horsepower	Power source	Nominal torque for TM1 terminal	
0.5/1/2(3φ)	200-240V	0.59/0.08 (LBS-FT / KG-M)	7.10/8.20 (LBS-IN/KG-CM)
1/ 2	380-480V		
2(1φ)/3/5/7.5/10	200-240V	1.5/0.21 (LBS-FT/KG-M)	18.00/20.28 (LBS-IN/KG-CM)
3/ 5/ 7.5/ 10/15	380-480V		
15/20/25	200-240V	1.84/0.3 (LBS-FT / KG-M)	22.1/30 (LBS-IN/KG-CM)
20/25/30	380-480V		
30/40	200-240V	4.42/0.66 (LBS-FT/KG-M)	53.1/66 (LBS-IN/KG-CM)
40/50/60/75	380-480V		

B. Power wires:

Power wires are connecting to L1, L2, L3, T1, T2, T3, P, BR and P1. Select power wire in accordance with the following criteria:

(1) Use copper wires only. Proper diameters of wires should be based on ratings at 105°C.
(2) For rating voltage of wires, the minimum voltage of 230VAC type is 300V, and 460VAC type is 600V.
(3) For safety reasons, the power wires should be fixed by terminal type.

C. Control wires:

Control wires are wires connecting to TM2 control terminal. Choose the wire in accordance with the following criteria:

(1) Use copper wires only. Proper diameters of wires should be based on ratings at 105°C.
(2) To avoid noise interference, do not route control wiring in the same conduit with power wires and motor wiring.

D. Nominal electrical specifications of the terminals Block:

The following list is nominal values of TM1:

Horsepower	Power source	Volts	Amps
0.5/1/ 2(3φ)	200-240V	600	15A
1/ 2	380-480V		
5/ 7.5/ 10	200-240V		40A
2(1φ)/3/ 5/ 7.5/ 10/15	380-480V		
15/20/25	200-240V		80A
20/25/30	380-480V		60A
30	200-240V		100A
40/50	380-480V		
40	200-240V		150A
60/75	380-480V		

※Note: Nominal values of input and output signals (TM2) – follow the specifications of class 2 wiring.

E. Fuse types

Drive input fuses are provided to disconnect the drive from power in the event that a component fails in the drive's power circuitry. The drive's electronic protection circuitry is designed to clear drive output short circuits and ground faults without blowing the drive input fuses. Below table shows the N3 input fuse ratings.

To protect the inverter most effectively, use fuses with current-limit function.

RK5, CC/T TYPE FUSE FOR N3

220V class (1φ)

N3-2	HP	KW	KVA	100% CONT Output AMPS (A)	Max.RK5 FUSE Rating(A)	Max.CC or T FUSE Rating(A)
P5-S	0.5	0.4	1.2	3.1	10	20
01-S	1	0.75	1.7	4.5	15	30
02-S	2	1.5	2.9	7.5	20	40
03-S	3	2.2	4.0	10.5	25	50

220V class (3φ)

N3-2	HP	KW	KVA	100% CONT Output AMPS (A)	Max.RK5 FUSE Rating(A)	Max.CC or T FUSE Rating(A)
P5	0.5	0.4	1.2	3.1	8	10
01	1	0.75	1.7	4.5	12	15
02	2	1.5	2.9	7.5	15	20
03	3	2.2	4.0	10.5	20	30
05	5	3.7	6.7	17.5	30	50
07	7.5	5.5	9.9	26	50	60
10	10	7.5	13.3	35	60	70
15	15	11.0	20.6	48	80	100
20	20	15.0	27.4	64	100	125
25	25	18.5	34.0	80	125	150
30	30	22.0	41.0	96	160	200
40	40	30.0	54.0	130	200	250

440V class (3φ)

N3-4	HP	KW	KVA	100% CONT Output AMPS (A)	Max.RK5 FUSE Rating(A)	Max.CC or T FUSE Rating(A)
01	1	0.75	1.7	2.3	6	10
02	2	1.5	2.9	3.8	10	15
03	3	2.2	4.0	5.2	10	20
05	5	3.7	6.7	8.8	20	30
07	7.5	5.5	9.9	13	25	35
10	10	7.5	13.3	17.5	30	50
15	15	11.0	20.6	25	50	60
20	20	15.0	27.4	32	60	70
25	25	18.5	34.0	40	70	80
30	30	22.0	41.0	48	80	100
40	40	30.0	54.0	64	100	125
50	50	37.0	68.0	80	125	150
60	60	45.0	82.0	96	150	200
75	75	55.0	110.0	128	200	250

*Fuse ratings are based upon 250V fuses for 230V inverter, and 600V for 460V inverters

※Notice

- To avoid shock hazards, do not touch any electrical component when the power is applied or with in five minutes after the power is disconnected. The other action should be performed after the charge indicator goes off.
- Do not perform wiring on the inverter while it is still connected. Disregarding this notice of this notice could cause serious insure or death to personnel.

※This product is designed to use in Pollution Degree 2 environment or equivalent environments.

3.3.2 Applicable specification of magnetic contactor and wires

Molded-case circuit breaker/magnetic contactor

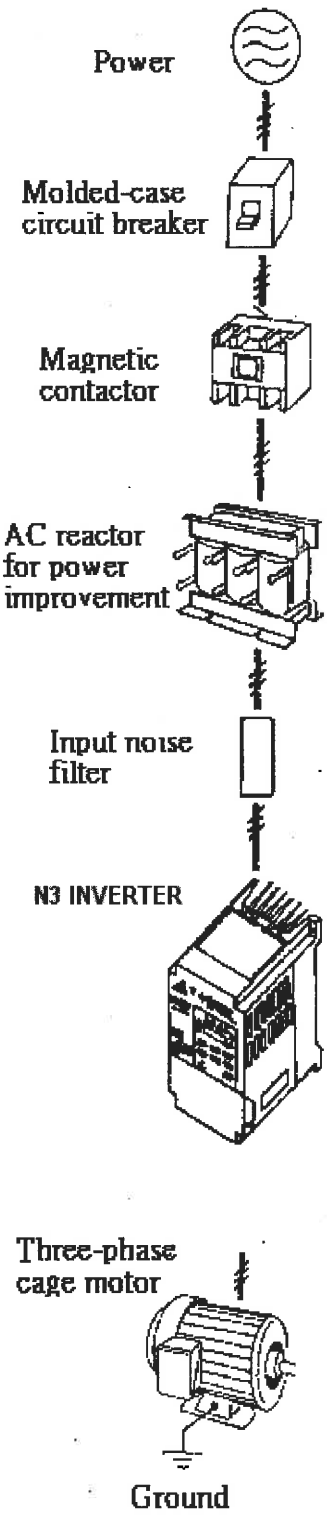
- Teco bears no responsibility to service for failures caused by the following conditions:
  (1) A molded-case circuit breaker is not installed, or an improper or overrated breaker is used, between the power source and the inverter.
  (2) A magnetic contactor, a phase capacitor, or a burst absorber is connected between the inverter and the motor.

N3 model	N3-2□□											
	P5	01	02	03	05	07	10	15	20	25	30	40
Molded-case circuit breaker made by Teco	TO-50E 10A	TO-50E 20A	TO-50E 30A	TO-50E 30A	TO-50E 30A	TO-50E 50A	TO-100S 60A	TO-100S 100A	TO-100S 100A	TO-225S 150A	TO-225S 175A	TO-225S 175A
Magnetic contactor (MC) made by Teco	CN-11				CN-16	CN-18	CN-25	CN-50	CN-65	CN-80	CN-100	CN-125
Main circuit terminals (TM1)	Wire gauge 2.0 mm^2			Wire gauge 3.5 mm^2		Wire gauge 5.5 mm^2		Wire gauge 22 mm^2			Wire gauge 30mm^2	Wire gauge 50mm^2
Signal terminals (TM2)	Wire gauge 0.75mm^2 (# 18 AWG)											

N3 model	N3-4□□										
	01/ 02/ 03/ 05	07	10	15	20	25	30	40	50	60	75
Molded-case circuit breaker made by Teco	TO-50E 15A	TO-50E 20A	TO-50E 30A	TO-50E 50A	TO-100S 50A	TO-100S 75A	TO-100S 100A	TO-100S 100A	TO-125S 125A	TO-225S 175A	TO-225S 175A
Magnetic contactor (MC) made by Teco	CN-11	CN-16	CN-18	CN-25	CN-35	CN-50	CN-50	CN-65	CN-80	CN-100	CN-125
Main circuit terminals (TM1)	Wire gauge 2.0mm^2	Wire gauge 3.5mm^2		Wire gauge 5.5mm^2	Wire gauge 14mm^2			Wire gauge 30mm^2		Wire gauge 50mm^2	Wire gauge 50mm^2
Signal terminals (TM2)	Wire gauge 0.75mm^2 (# 18 AWG), terminal screw M3										

- Use three-phase squirrel cage induction motor with capacity suitable for the inverter.
- If one inverter is driving several motors, the total current of all motors running simultaneously must be less than the rated current of the inverter, and each motor has to be equipped with a proper thermal overload relay.
- Do not add capacitive components, such as a phase capacitors, LC or RC, between the inverter and the motor.

3.3.3 Precautions for peripheral applications:



Power supply:

- Make sure the correct voltage is applied to avoid damaging the inverter.
- A molded-case circuit breaker or fused disconnect must be installed between the AC source and the inverter

Molded-case circuit breaker:

- Use a molded-case circuit breaker that conforms to the rated voltage and current of the inverter to control the power and protect the inverter.
- Do not use the circuit breaker as the run/stop switch for the inverter.

Leakage breaker:

- Install a leakage breaker to prevent problems caused by electric leakage and to protect personnel.
- Setting current should be 200mA or above and the operating time at 0.1 second or longer to prevent malfunctions.

Magnetic contactor:

- Normal operations do not need a magnetic contactor. However a contactor has to be installed in primary side when performing functions such as external control and auto restart after power failure, or when using a brake controller.
- Do not use the magnetic contactor as the run/stop switch of the inverter.

AC Line reactor for power quality improvement:

- When inverters below 200V/400V 15KW are supplied with high capacity (above 600KVA) power source or an AC reactor can be connected to improve the power performance.

Input noise filter:

- A filter must be installed when there are inductive loads affecting the inverter

Inverter:

- Input power terminals L1, L2, and L3 can be used in any sequence regardless of phase.
- Output terminals T1, T2, and T3 are connected to U, V, and W terminals of the motor. If the motor is reversed while the inverter is set to run forward, just swap any two terminals of T1, T2, and T3.
- To avoid damaging the inverter, do not connect the input terminals T1, T2, and T3 to AC input power.
- Connect the ground terminal properly. 230 V series: class 3 grounding, <100Ω; 460 V series : <10Ω.

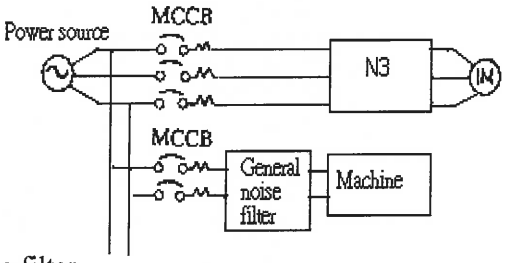
Figure 3-3 Typical Installation Schematic

Make external connections according to the following instruction. Check connections after wiring to make sure all connections are correct. (Do not use the control circuit buzzer to check connections)

Figure 3-4a Installation Examples

- The inverter uses dedicated power line A general noise filter may not provide correct results

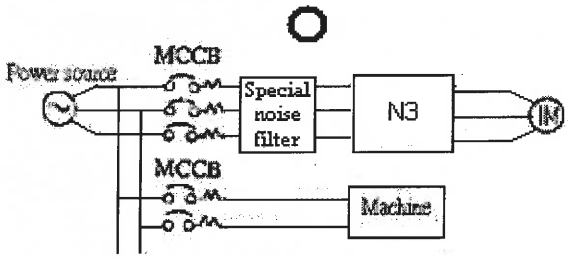
CORRECT

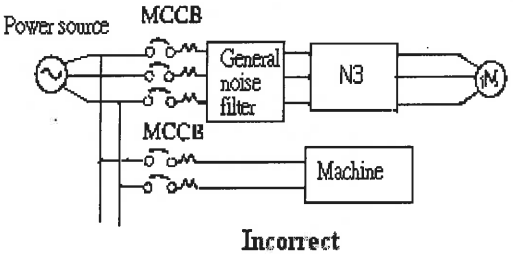


Incorrect

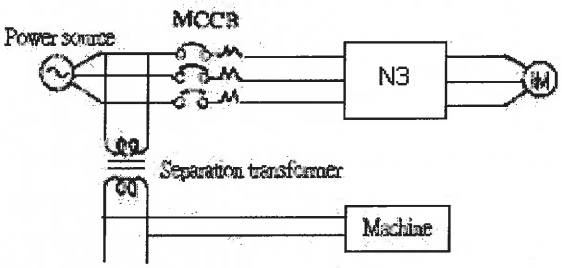
- Add a noise filter or separation transformer when shaning the power line with other machines.
- the inverter shares the power line with other machines.

Figure 3-4b Installation Examples using a filter





Incorrect



Correct

(A) Main circuit's wiring must separate from other high voltage or high current power line to avoid noise interference. Refer to the figures below:

- A noise filter in the output of the main circuit can suppress conductive noise. To prevent radiative noise, the wires should be put in a ferromagnetic metal pipe and sepoorated from all other signal lines by at least 1ft..

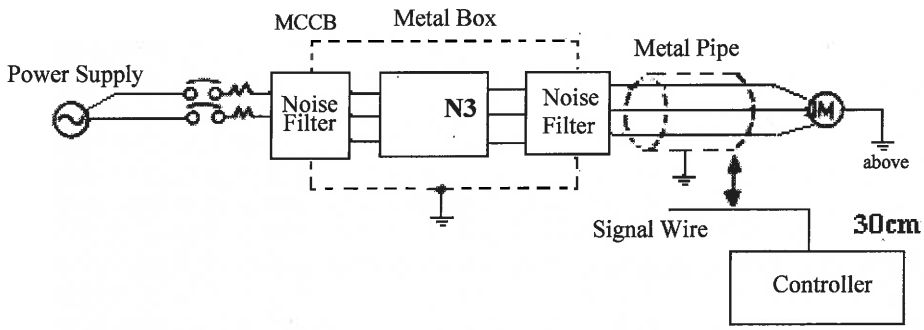


Figure 3-4c Installation Examples with Adjacent Signal Conductors

- When the connection between the inverter and the motor appears long, factor in the voltage drop of the cables. Phase-to-phase voltage drop (V) = $\sqrt{3}$ × resistance of wire (Ω/km) × length of line (m) × current × 10^{-3}. The number of carriers must be adjusted based on the line length.

Cable length between the inverter and the motor	Below 75ft	Below 150ft	Below 300ft	Above 300ft
Recommended carrier frequency allowed	Below 16KHz	Below 12KHz	Below 8KHz	Below 5KHz
Setting of parameter 3-22	16	12	8	5

(B) The control circuit wiring must be separated and routed away from the main circuit control line or other high voltage or current power lines to avoid noise interference

- To avoid erroneous operation caused by noise interference, shield the control circuit wiring with twisted-wires, and connect the shielded wire to a ground terminal. Refer to the figure below.
  The wiring distance should not exceed 150ft.

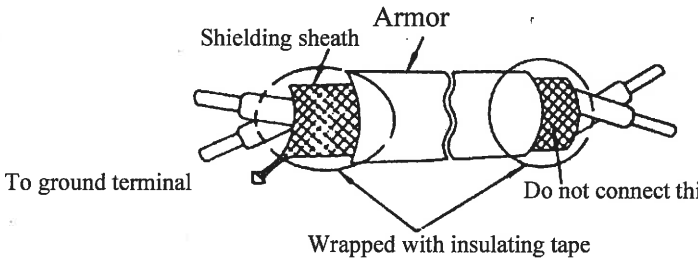


Figure 3-5 Processing he ends of twisted pair cables

(C) Ground the ground terminal of the inverter properly. For 230V class ground 100Ω or less; for 460V class ground 10Ω or less.

- Ground wiring AWG is sized per the electrical equipment specifications. Minimize wire length is recommended.
- Do not share the ground of the inverter with other high current loads (welding machine, high power motor). Connect the terminals to their own ground.
- Do not make a loop when several inverters share a common ground point.

Figure 3-6 Grounding Examples

(a) **Good** (b) **Good** (c) **Bad**

(D) To ensure maximum safety, use proper wire gauges (AWG) for the main power circuit and control circuit. (See table in section 3.2.2)

(E) Verify that all wiring is correct, wires are intact, and terminal screws are secured.

3.4 Specifications

3.4.1 Product Specifications

Single phase, 200-240V model

N3-2□□-SC/SCF	P5	01	02	03
Horsepower(HP)	0.5	1	2	3
Max Applicable Motor Output (KW)	0.4	0.75	1.5	2.2
Rated Output Current(A)	3.1	4.5	7.5	10.5
Rated Capacity(KVA)	1.2	1.7	2.9	4.0
Max. Input Voltage	Single Phase: 200~240V +10% -15% , 50/60Hz ± 5%			
Max. Output Voltage	Three Phase: 200~240V			
Input Current(A)	8.5	12	16	23.9
Net Weight Lb(KG)	2.87(1.3)	2.87(1.3)	3.31(1.8)	5.07(2.3)
Allowable momentary power loss time (second)	1.0	1.0	2.0	2.0

Three phase, 200 – 240V model

N3-2□□-C/N1	P5	01	02	03	05	07	10	15	20	25	30	40
Horsepower(HP)	0.5	1	2	3	5	7.5	10	15	20	25	30	40
Max Applicable Motor Output (KW)	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30
Rated Output Current(A)	3.1	4.5	7.5	10.5	17.5	26	35	48	64	80	96	130
Rated Capacity(KVA)	1.2	1.7	2.9	4.0	6.7	9.9	13.3	20.6	27.4	34	41	54
Max. Input Voltage	Three Voltage: 200~240V +10% -15% , 50/60Hz ± 5%											
Max. Output Voltage	Three Voltage: 200~240V											
Input Current(A)	4.5	6.5	11	12.5	20.5	33	42	57	70	85	108	138
Net Weight Lb(KG)	2.65 (1.2)	2.65 (1.2)	2.65 (1.2)	3.85 (1.75)	4.19 (1.9)	12.3 (5.6)	12.3 (5.6)	33. 1(15)	33.1 (15)	33.1 (15)	72.8 (33)	75.0 (34)
Allowable momentary power loss time (second)	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Three phase, 380 – 480V model

N3-4□□-C/CF/N1	01	02	03	05	07	10	15	20	25	30	40	50	60	75
Horsepower(HP)	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75
Max Applicable Motor Output (KW)	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Rated Output Current(A)	2.3	3.8	5.2	8.8	13.0	17.5	25	32	40	48	64	80	96	128
Rated Capacity(KVA)	1.7	2.9	4.0	6.7	9.9	13.3	19.1	27.4	34	41	54	68	82	110
Max. Input Voltage	Three Voltage:380~480V +10% -15% , 50/60Hz ± 5%													
Max. Output Voltage	Three Voltage: 380~480V													
Input Current(A)	4.2	5.6	7.3	11.6	17	23	31	38	48	56	75	92	112	142
Net Weight Lb(KG)	2.87 (1.3)	2.87 (1.3)	3.31 (2.2)	3.31 (2.2)	12.3 (6.6)	12.3 (6.6)	12.3 (6.6)	33.1 (15)	33.1 (15)	33.1 (15)	72.8 (33)	72.8 (33)	110 (50)	110 (50)
Allowable momentary power loss time (second)	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

3.4.2 General Specifications

Item		N3 TYPE
Control Mode		V/F or Current Vector Control
Frequency Control	Range	0.1~650.0 Hz
	Start control torque	150%/1Hz (Current Vector)
	Speed control range	50:1 (Current Vector)
	Speed Control Precision	±0.5% (Current Vector)
	Setting resolution	Digital：0.01Hz(Note *1)；Analog: 0.06Hz/ 60Hz(10bits)
	Keypad setting	Set directly with▲▼ keys or the VR on the keypad
	Display Function	Four digital LED (or 2×16 LCD) and status indicator; display frequency/ speed/ line speed/ DC voltage/ Output voltage/ Current/ Rotation direction/ Inverter parameter/ Trouble Log/ Program Version
	External signal setting	1. External potentiometer/ 0-10V/ 0-20mA/ 10-0V/ 20-0mA 2. Performs up/down controls, speed control or automatic procedure control with multifunctional contacts on the terminal block (TM2)
	Frequency Limit Function	Upper/lower frequency limits and three skip frequencies
	Carrier frequency	2 ~ 16 kHz
	V/F pattern	18 pre-configured patterns, 1programable curve
	Acc/Dec control	Two-stage Acc/Dec time (0.1 – 3,600 seconds) and two-stage S curves (refer to descriptions on 3-05)
	Multifunction analog output	6 functions (refer to description on A103/A104)
	Multifunction input	30 functions (refer to description on A050~A056)
	Multifunction output	16 functions (refer to description on A105~A106)
	Digital Input Signal	NPN (SINK) / PNP (SOURCE) toggle
	Other Functions	Momentary Power Loss Restart, Speed Search, Overload Detection, 8 preset speeds. Acc/Dec Switch (2 Stages), S Curves, 3-wire Control, PID control, torque boost, Slip Compensation, Frequency Upper/ Lower Limit, Auto energy saving, Modbus slave and PC/PDA Link, Auto Restart.

Item		N3 TYPE
Communication Control		1. Control by RS232 or RS485 2. One to one or one to more (RS485 ONLY) control. 3. BAUD RATE/STOP BIT/PARITY/bit can be set
Braking Torque		About 20% , the model built-in braking transistor and connected braking resistor is 100%
Operation temperature		14-120°F(-10 ~ 50°C)(note 2)
Storage temperature		4-140°F(-20 ~ 60°C)
Humidity		0 – 95% Relative Humidity(Non-condense)
Vibration		1G (9.8m/s^2)
EMC		Complies with requirement EN 61800-3 (with optional Filter).
LVD		Complies with requirement EN 50178
Enclosure		IP20 (NEMA 1 by external box attached)
Safety Level		UL 508C
Protective Functions	Overload protection	The relays to protect the motor (the curve can be set) and the inverter (150 % / 1min)
	Over Voltage	230V class : DC Voltage＞410V 460V class : DC Voltage＞820V
	Under Voltage	230V class : DC Voltage＜190V 460V class : DC Voltage＜380V
	Momentary Power Loss Restart	Stop for more than 15ms-power-loss can be restarted with spin start after momentary power loss in Max 2 sec.15ms
	Stall Prevention	Stall prevention for Acceleration/ Deceleration/ Operation.
	Short-circuit output terminal	Electronic Circuit Protection
	Grounding Fault	Electronic Circuit Protection
	Other Function	Protection for overheating of heat sink, over torque detection, error contact control, reverse prohibit, prohibit for direct start after power up and error recovery, parameter lock out.

(• 220V, 15HP and above capacity are not CE complied)

※Note 1 : The setting resolution of above 100Hz is 0.1Hz when controlled by the keypad, and 0.01 Hz when controlled using computer (PC) or programmable controller (PLC).

※Note 2 : 14-120°F(–10 ~ 50°C) in distributor (without dustproof cover),

14-104°F (–10 ~ 40°C) outside distributor (with dustproof cover).

3.5 Wiring diagram N3 series inverter

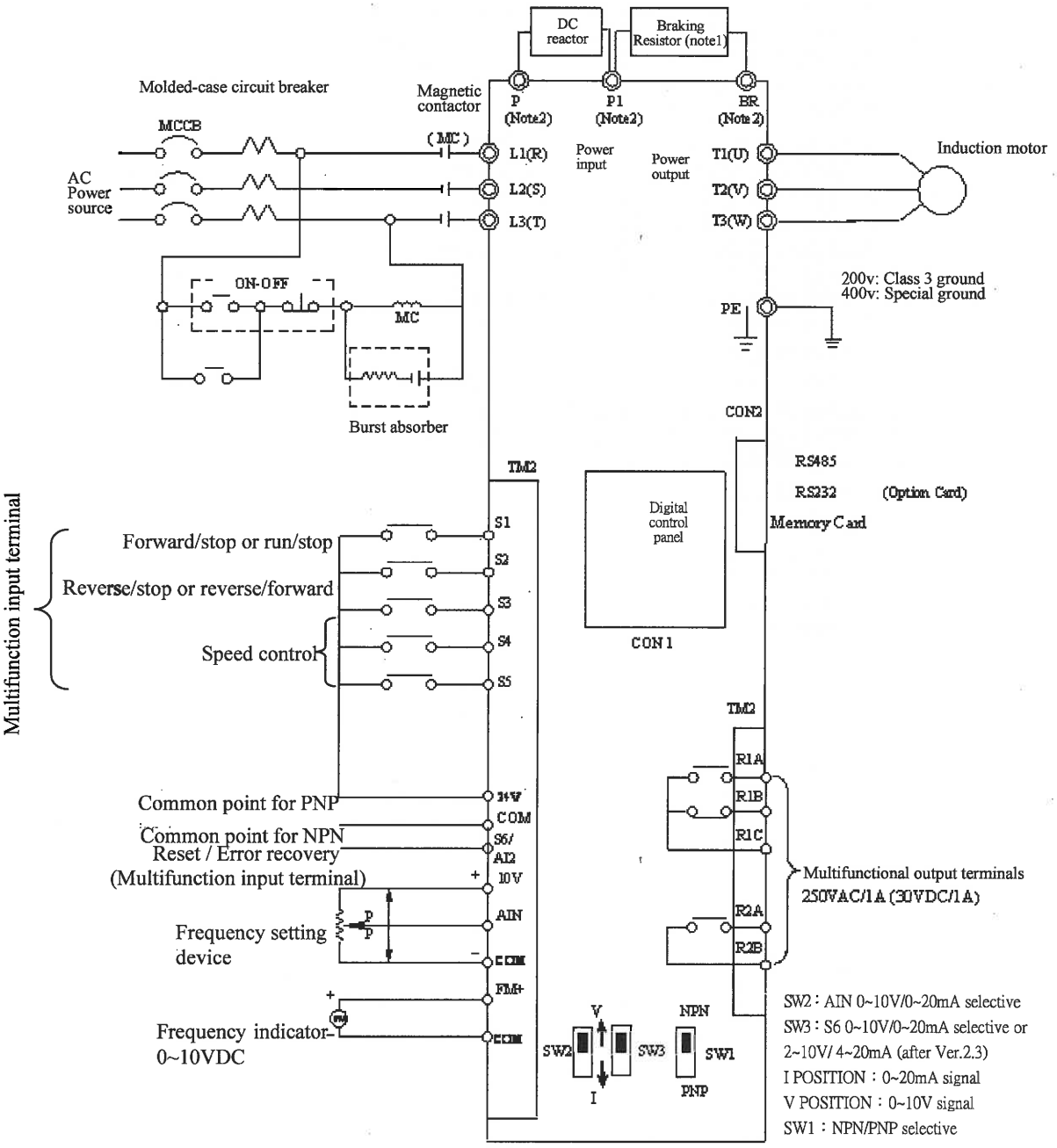
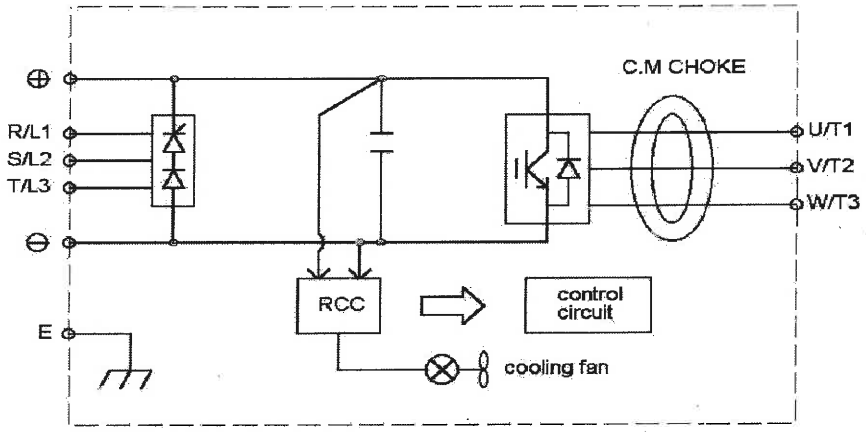


Figure 3-7 Wiring Diagram

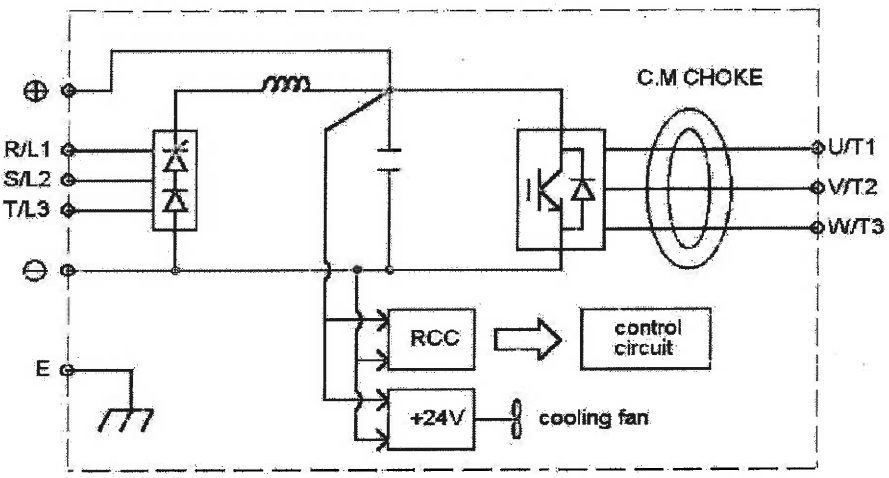
※Note 1 : Please refer to description of main circuit terminals (P1, BR) and specification of braking resistor for value selection.

※Note 2 : Above scheme applies for models 230V:0.5~10HP and 460V:1~15HP only.

- 230V: 25HP 440V: 25~30HP



- 230V: 30~40HP 440: 40~75HP



3.6 Description of terminals of troubleshooting inverter

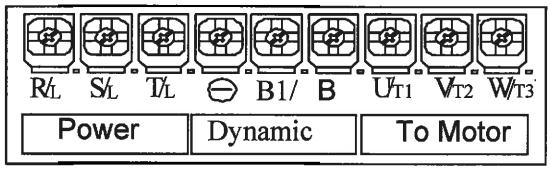
Descriptions of main circuit terminals

Symbol	Description	
R / L1 (L)	Main power input Single-phase: L/N	
S / L2	Three-phase: L1/L2/L3	
T / L3 (N)		
P1	Braking resistor connection terminal: Used in cases where the inverter regenerates due to large load inertias or short deceleration time (refer to specifications of the braking resistor)	For 230V:0.5~10HP, 460V:1~15HP
BR		
P1 、 P	DC reactor connecting terminals	
B1/P	● B1/P-⊖ : DC power supply input B1/P-B2 : External braking resistor (For 230V : 15~20HP and 460V : 20HP)	-
B2		
⊖		● ⊕-⊖ : DC power supply input or External braking unit. See Chapter 6.3 For 230V : 25~40HP and 460V : 25~75HP
⊕	-	
U / T1	Inverter outputs	
V / T2		
W / T3		

Descriptions of N3 control circuit terminals

Symbol	Description		
R2A	Multifunctional terminal – Normal open		Contact rated capacity: (250VAC/1A or 30VDC/1A) Contact using description:(refer to parameters 8-02, 8-03)
R2B			
R1C	Common contact	Multifunctional output terminals	
R1B	Normal close contact		
R1A	Normal open contact		
10V	Frequency knob (VR) power source terminal (pin 3)		
AIN	Analog frequency signal input terminal or multifunction input terminals S7 (H level:>8V, L level:<2V, PNP only) (refer to parameter A056 description)		
24V	Common for S1~S5 (S6, S7) in PNP (Source) input. Connect pin 2 and pin 3 (refer to N3 wiring diagram) of SW1 when using PNP input		
COM	Common for analog input /output signal for S1~S5in NPN (Sink) input. Connect pin 2 and pin 3 (refer to N3 wiring diagram) of SW1 when used NPN input		
FM+	The positive multifunction analog output signal for multifunction (refer to parameter A103 description), the signal for output terminal is 0-10VDC (below 2mA).		

· 230V : 15 ~ 20 HP 460V : 20HP



· 230V 25 ~ 40HP 460V 25~75HP

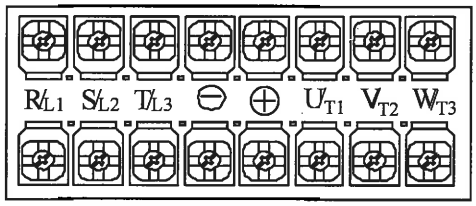
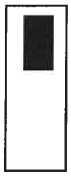


Figure 3-8 Power input locations

Symbol	Function Description
S1	Multifunction input terminals(refer to parameters A050 ~ A054 description) (S5 = Encoder input terminal. Encoder voltage range: 19.2V~24.7V)
S2	
S3	
S4	
S5	
S6	Multifunction input terminals (Digital terminal high level:>8V, Low level:<2V, PNP only) or analog input terminal AI2(0~10Vdc/4~20mA)(refer to A055 description)

Descriptions of SW function

SW2/SW3	Type of external signal	Remarks
	0~10VDC analog signal	Effective when External control is used as (B004=0002)
	0~20mA analog signal	

SW1	Type of external signal	Remarks
	NPN (SINK) input	
	PNP (SOURCE) input	Factory default

3.7 Outline Dimensions

(1) Frame1 : Single phase N3-2__-S: P5, 01

Three phase N3-2/4__: P5, 01, 02

(2) Frame2 : Single phase N3-2__-S: 02, 03

Three phase N3-2/4__: 03, 05

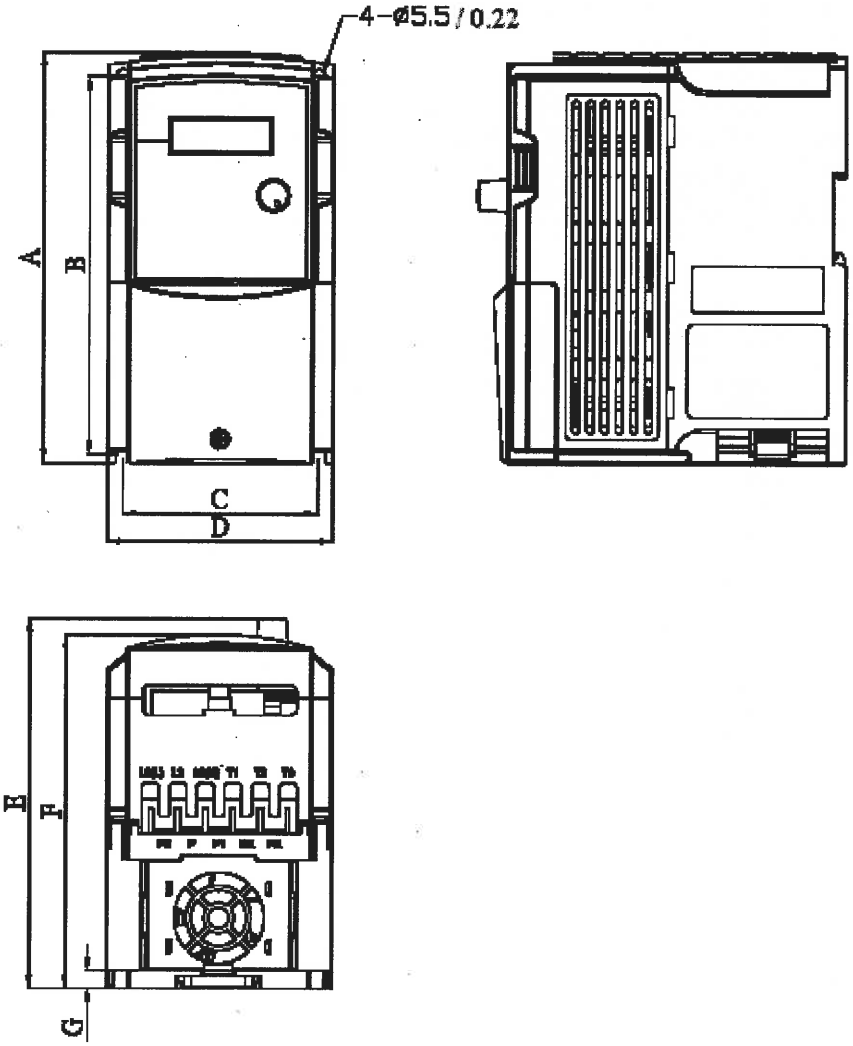


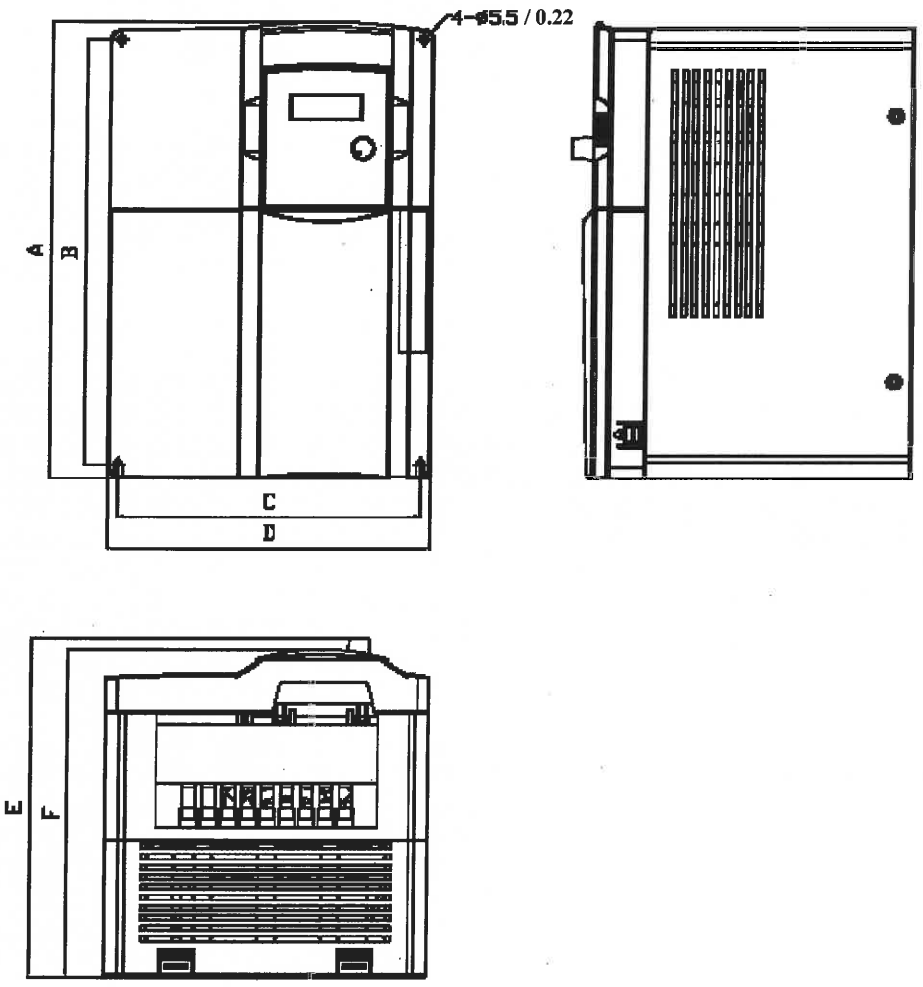
Figure 3-9 Frames1, 2 Dimensions

Unit : mm/inch

LENGTH / MODEL	A	B	C	D
Frame 1	163/6.42	150/5.9	78/3.07	90/3.54
Frame 2	187.1/7.36	170.5/6.71	114.6/4.51	128/5.04
LENGTH / MODEL	**E**	**F**	**G**	
Frame 1	147/5.79	141/5.55	7/0.28	
Frame 2	148/5.83	142.1/5.59	7/0.28	

(3) Frame3 : Three phase N3-2__: 07, 10

N3-4__: 07, 10, 15



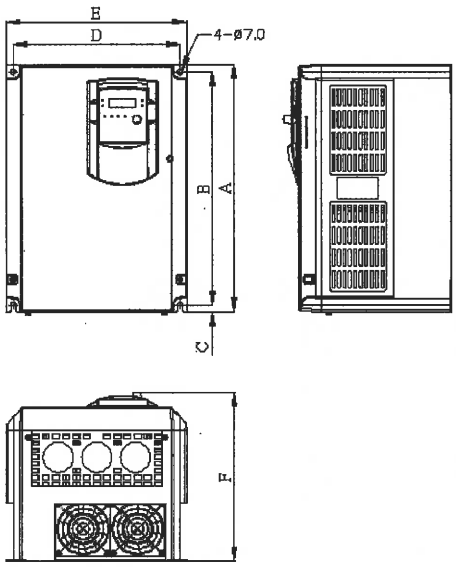
Unit : mm/inch

LENGTH / MODEL	A	B	C	D	E	F
Frame 3	260/10.24	244/9.61	173/6.81	186/7.32	195/7.68	188/7.4

Figure 3-10 Frames 3 Dimensions

(4) Frame4 : Three phase N3-2__ : 15, 20, 25

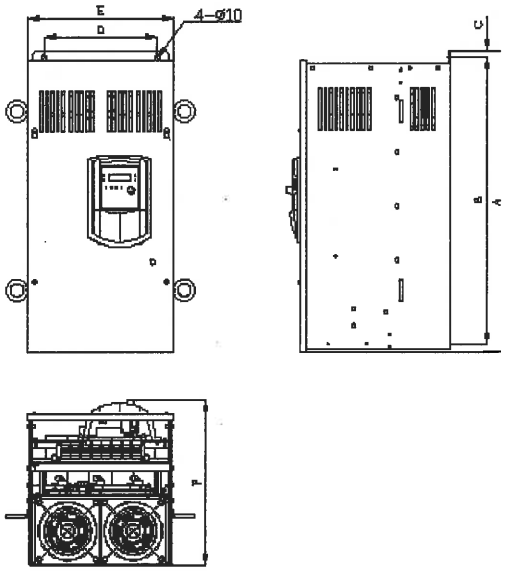
N3-4__ : 20, 25, 30



(5) Frame5 : Three phase N3-2__ : 30, 40

N3-4__ : 40, 50

(6) Frame6 : Three phase N3-4 __ : 60, 75



(Open Chassis Type－IP00)

Unit : mm/inch

LENGTH / MODEL	A	B	C	D	E	F
Frame4	360/14.2	340/13.4	10/0.4	245/9.6	265/10.4	247.5/9.7
Frame5	553/21.8	530/20.9	10/0.4	210/8.3	269/10.6	303.6/12
Frame6	653/25.7	630/24.8	10/0.4	250/9.8	308/12.1	308.6/15.2

Figure 3-11 FRAMES SIZE 4, 5, 6 DIMENSIONS

Chapter 4 Software Index

4.1 Keypad Description

4.1.1Keypad Display and Operation Instruction

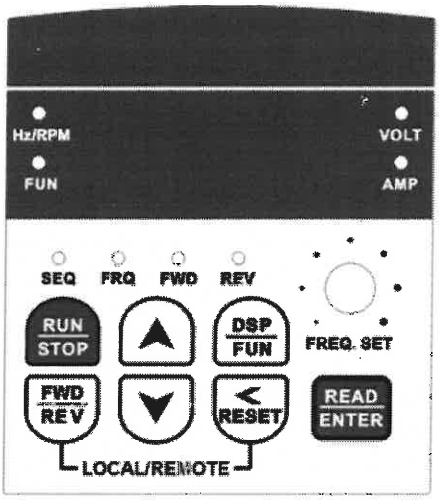


Figure 4-1 Keypad Layout

1. SEQ LED: Parameter B000 =1/2/3, LED Lit.
2. FRQ LED: Parameter B004 = 1/2/3/4, LED Lit
3. FWD LED: Forward Direction, LED action (Flash while stopped, solid during Lit operation).
4. REV LED: Reverse Direction, LED action (Flash while stopped, solid during Lit operation).
5. Four actions of FUN mode: Hz/RPM, VOLT, AMP LED, and display of four 7-segment display. (Refer to operation description of the keypad).
6. LCD keypad in display mode: Hz/RPM, VOLT, AMP, LED and FREQ.SET pot.

⚠ Caution
To avoid keypad damage, do not operate it with a screwdriver or any sharp and hard tool.

Remote/Local Mode

- Local mode – Operation Command via RUN/STOP key on keypad
  – Frequency Command by ▲▼ key on keypad
- Remote mode – Operating Command via B000
  – Frequency Command via B004

To Change the Remote/Local mode, you must push FWD/REV and 《/RESET key at the same time.

The Remote /Local mode of change can be used in STOP mode, but is not allowed in Run mode.

4.1.2 Operation Instruction of the keypad

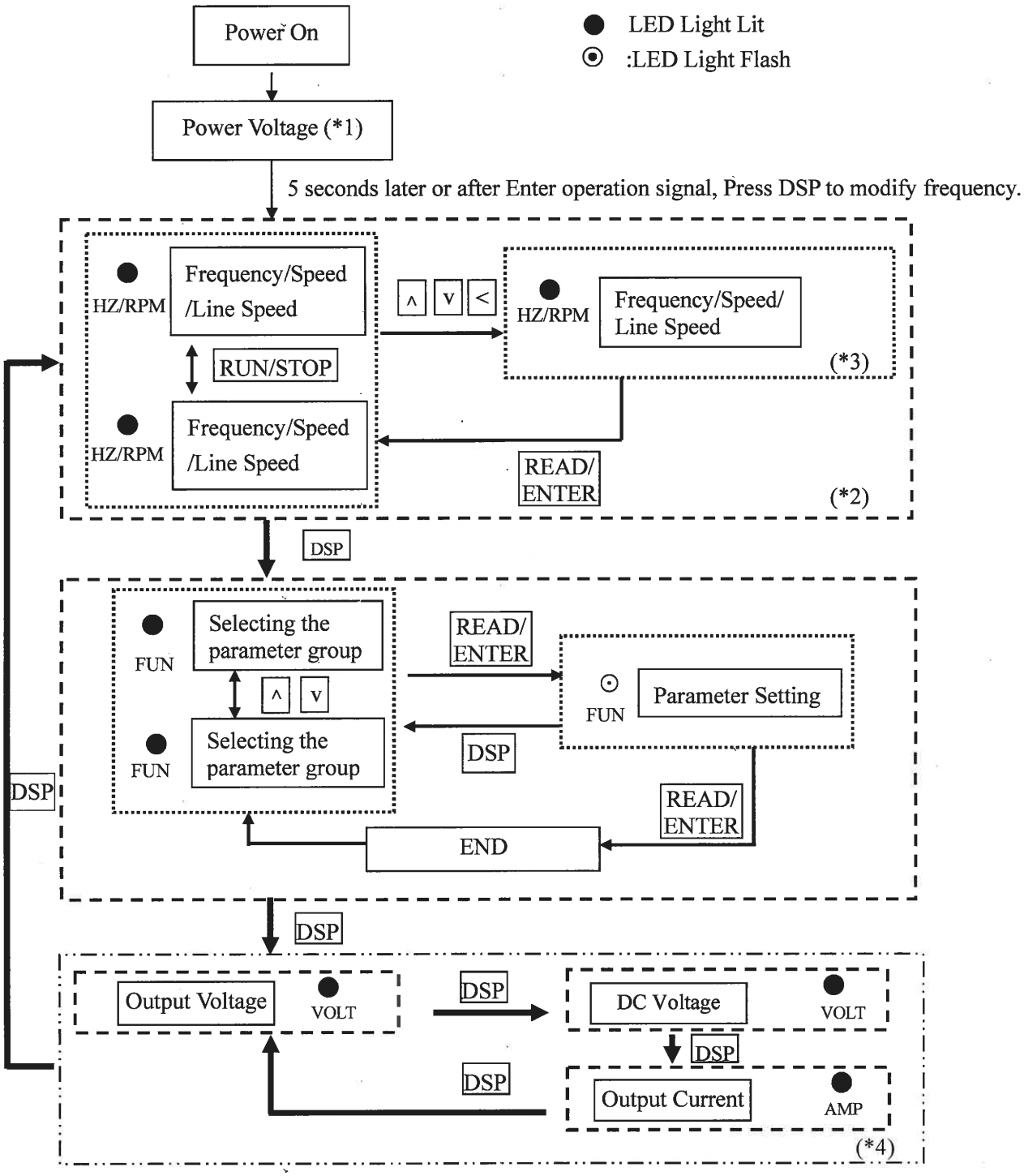


Figure 4-2 Keypad Operations Sequence

*1: The inverter will flash the current setting of A007 (power supply voltage) after power up.

*2: A045, A046 determines the displaying of frequency, speed or line speed.

*3: It is not necessary to press ENTER key when stopped for modification. Refer to example 1, 2.

*4: Whether output current, output voltage, DC voltage is displayed or not is determined by B013 ~ B015 respectively.

4.1.3 Operation Instruction of the LED keypad

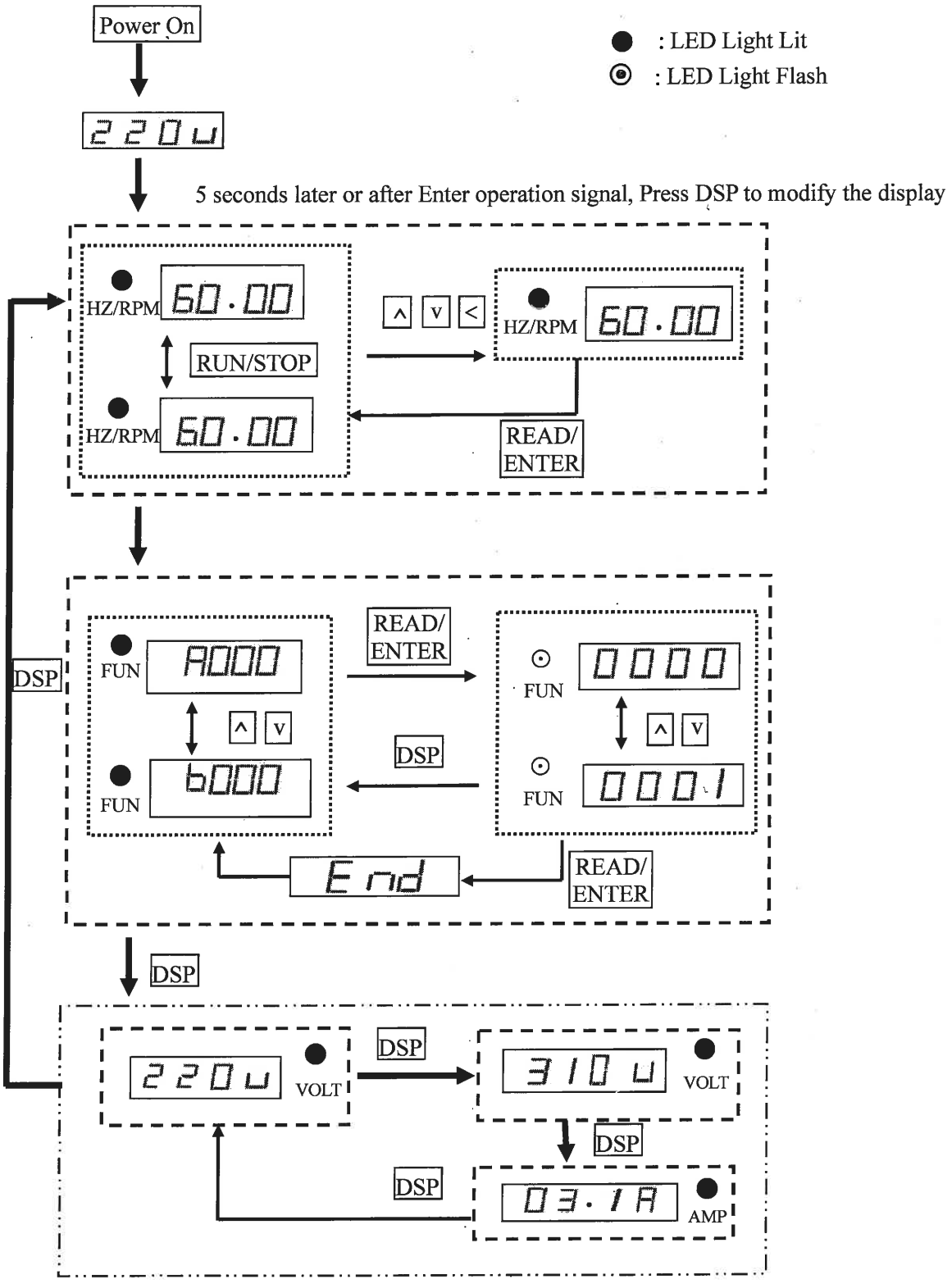


Figure 4-3 LED Operations Instruction Keypad

4.1.4 Operation Instruction of the LCD keypad

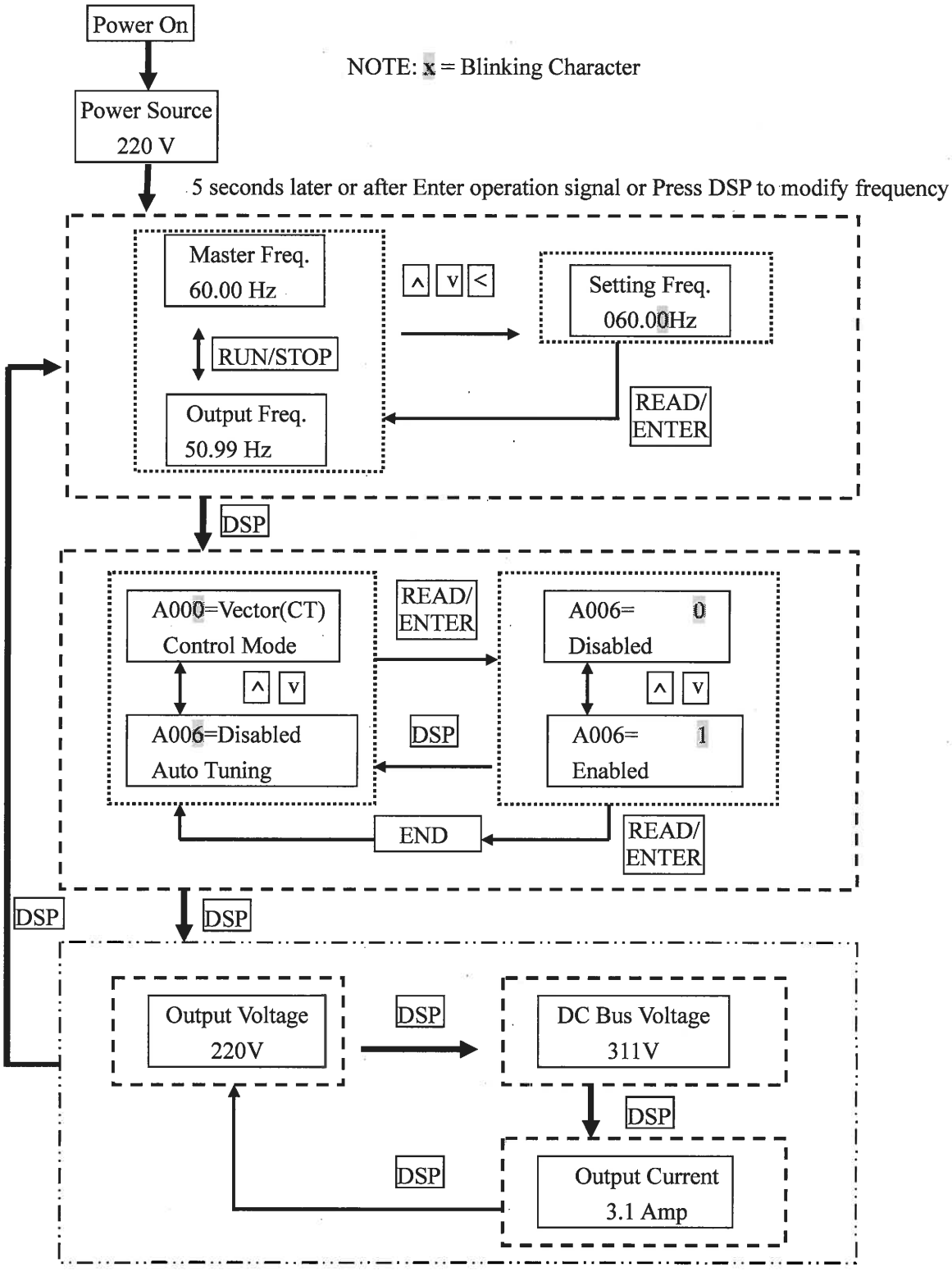
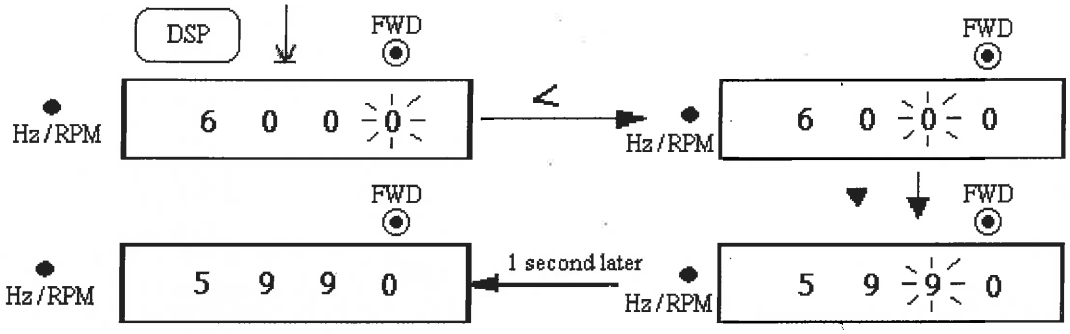


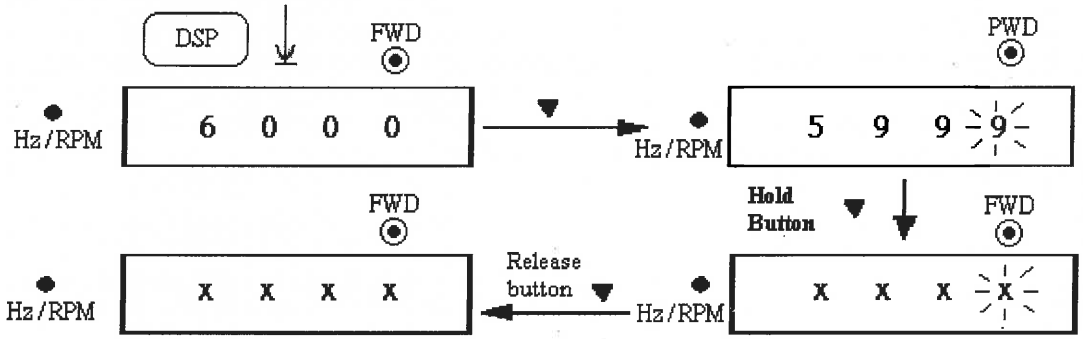
Figure 4-4 LCD Operations Instruction Keypad

4.1.5 Keypad Operating Example

Example 1. Modify frequency while stopped

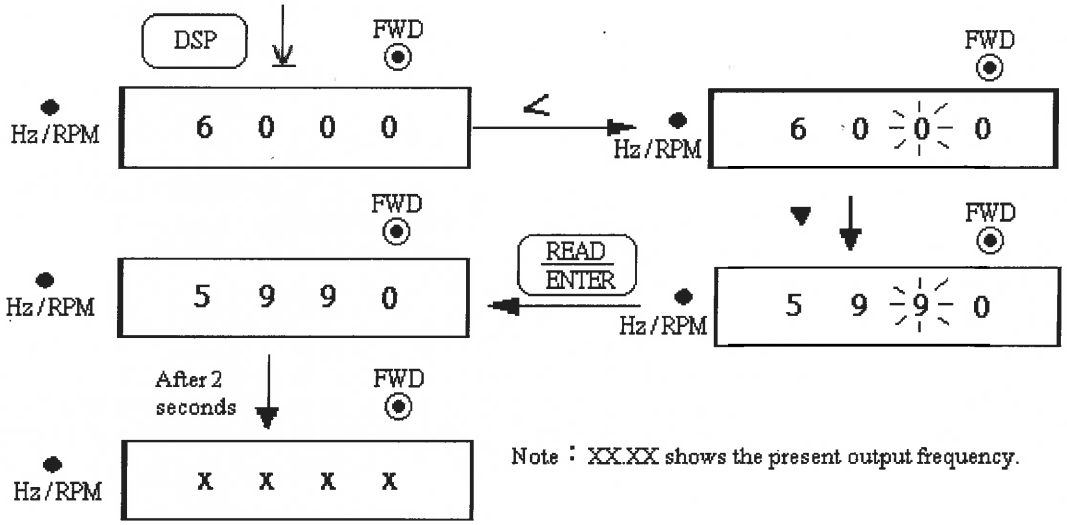


Example 2. Modify frequency during Run



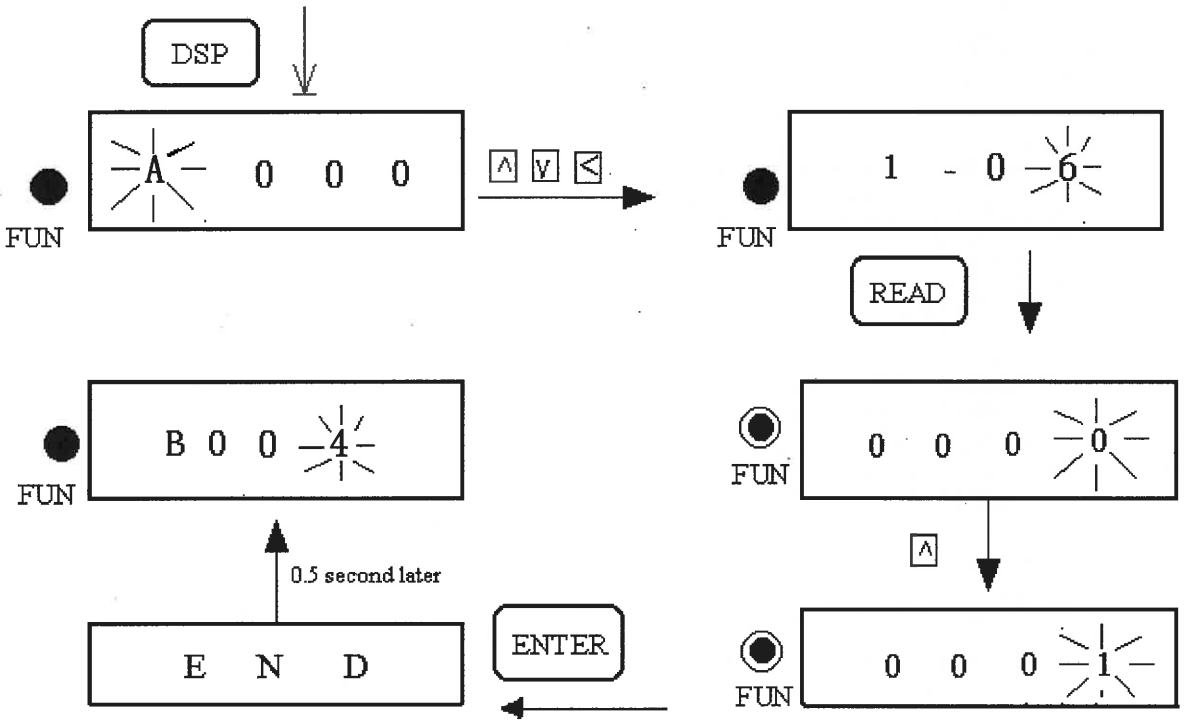
Note : XX.XX shows the present output frequency. The value ranges from 59.98 to 0 Hz, depending on the length of time the key ▼ pressed.

Example 3. Modify frequency in running



Note : XX.XX shows the present output frequency.

Example4. Modify the Value of Parameter



Example 5. Operation Control

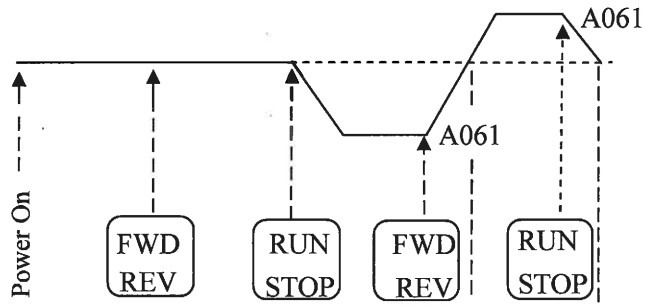


Figure 4-5 Keypad RUN Sequence

FWD LED	⊙	○	○	●	⊙
REV LED	○	⊙	●	○	○

●: LED Lit ⊙: LED Flashing ○: LED Off

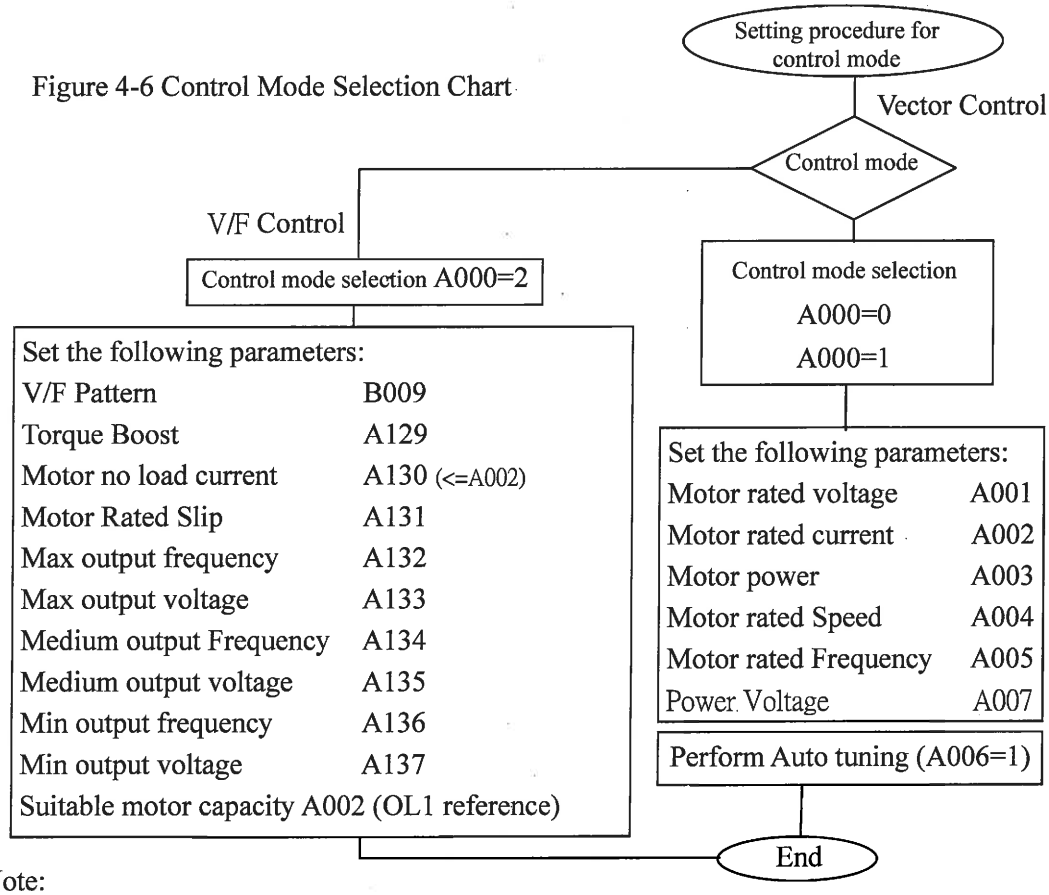
4.2 Control Mode Selection

The N3 Series inverter has three control modes:

1. General Vector Control Mode
2. VT Vector Control Mode (Special for Fans, Blowers, Pumps).
3. V/F Control Mode。

The user can choose these modes with the digital keypad according to the application characteristics. The factory setting is general vector control mode. Before operation, please set the control mode and the relative parameters of the motor in accordance with the following flow chart. (The Vector control mode only applies when the inverter is power matched to the motor, or varies by 1HP rating).

Figure 4-6 Control Mode Selection Chart



※Note:

1. Use V/F Control Mode:
   (1) Use one inverter to drive several motors simultaneously
   (2) Motor's nameplate is unknown or motor's specifications are too special, it will cause Auto-tuning fault.
   (3) Specification of inverter and motor differ more than 1 class.
2. One inverter drives several motors (Only in V/F mode); set the motor parameters according to the following rules:
   (1). Sum the rated current of all motors for total inverter current.
   (2). Input correct VF Pattern parameter (A132~A137).
3. When the nameplate of the motor is unknown, the inverter will set the internal parameters according to the standard TWMC motor.
4. When parameter A000 is set to 2, the keypad will display 'Err2' when performing Auto tuning.
5. In VF control, A001~A005 max. & min. values are determined by the TWMC standard motor specification limit.

The N3 inverter has a wide variety of programmable functions. They are organized into two categories: 1) Advanced or "A" parameters and 2) Basic or "B" parameters.

Basic parameters are intended for applications that are straightforward. They include the set of parameters that almost all users need to consider. Examples of basic settings are acceleration and deceleration rates (B007 and B008), Run command and frequency sources (B000 and B004), and optional current and voltage displays (B013 - B015). The user can also select whether to allow access to the advanced parameters. (B011). In order to see and change "A" parameters, B011 must be set to enable.

Advanced parameters are intended for specific and more focused applications. They provide the means to set up the N3 inverter to operate in specialized ways, such as applying a PID control mode, Auto-run mode, RS485 communication set-up, Vector control mode plus more. In addition, all analog and digital input and output configurations plus motor parameters are entered in the Advanced Parameters.

The table below summarizes all parameters. They are individually discussed in detail below the table.

4.3 N3 Programmable Functions List

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A000	(Control Mode)	Control Mode	0000: Vector (General Purpose) 0001: Vector (Variable Torque) 0002: Volts/Hz	0002	*3
A001	(Motor Rated Volt)	Motor Rated Voltage (Vac)	-----		*3*5
A002	(Motor Rated Amps)	Motor Rated Current (Amp)	-----		*3*5
A003	(Motor Rated HP)	Motor Rated Power (HP)	-----		*3*5
A004	(Motor Rated RPM)	Motor Rated Speed (RPM)X100	-----		*3*5
A005	(Motor Rated Hz)	Motor Rated Frequency (Hz)	-----		*3*5
A006	(Auto Tuning)	Motor Parameter Auto Tuning	0000: Disabled 0001: Enabled	0000	
A007	(AC Input Volt)	AC Line Input Voltage (Vac)	230V SERIES:170.0~264.0 460V SERIES:323.0~528.0		*3
A008 A009	(Reserved)	Reserved			
A010	(Keypad Stop)	Keypad Stop Button (In External Run/Stop Mode)	0000: Stop Button Enabled 0001: Stop Button Disabled	0000	
A011	(Keypad Up/Down)	Keypad Frequency Setting with Up/Down Keys in Run Mode	0000: 'Enter' must be pressed after frequency change with Up/Down Keys on keypad. 0001: Frequency will be changed directly when Up/Down Keys are Pressed	0000	
A012	(Starting Method)	Starting Method Selection	0000: Normal Start 0001: Enable Speed Search	0000	
A013	(PwrL Selection)	Momentary Power Loss and Restart	0000: Momentary power loss and restart disable 0001: Momentary power loss and restart enable 0002: Momentary power loss and restart enable while CPU is still powered up.	0000	
A014	(PwrL Ridethru T)	Momentary Power Loss Ride-Thru Time (Seconds)	0.0 - 2.0	0.5	
A015	(Dir Start Sel)	Direct Run After Power-Up	0000: Enable Direct run after power-up 0001: Disable Direct run after power-up	0001	
A016	(Dir Start Delay)	Delay-ON Timer (Seconds)	0.0-300.0	0.0	
A017	(Auto Restart)	Auto Restart Method	0000: Enable Speed Search 0001: Normal Start	0000	
A018	(Auto Restart Sel)	Number of Auto Restart Attempts	0 - 10	0	

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A019	(Auto Restart Delay)	Auto Restart Delay Time (Seconds)	0.0 - 800.0	0.0	
A020	(Reset Mode Sel)	Reset Mode Setting	0000: Enable Reset Only when Run Command is Off 0001: Enable Reset when Run Command is On or Off	0000	
A021 A022	(Reserved)	Reserved			
A023	(S-Curve 1)	S-Curve Acc/Dec # 1 (Seconds)	0.0 - 4.0	0.2	
A024	(S-Curve 2)	S-Curve Acc/Dec # 2(Seconds)	0.0 - 4.0	0.2	
A025	(Accel Time 2)	Acceleration Time # 2 (MFIT)≠ (Seconds)	0.1 – 3600.0	10.0	*1
A026	(Decel Time 2)	Deceleration Time # 2 (MFIT)≠ (Seconds)	0.1 – 3600.0	10.0	*1
A027	(Jog Acc Time)	Jog Acceleration Time (MFIT)≠ (Seconds)	0.1 - 25.5	0.5	*1
A028	(Jog Dec Time)	Jog Deceleration Time (MFIT)≠ (Seconds)	0.1 - 25.5	0.5	*1
A029	(DC Inj Freq)	DC Injection Braking Start Frequency (Hz)	0.1 - 10.0	1.5	
A030	(DC Inj Level)	DC Injection Braking Level (%)	0.0 20% (Level 100% by based on Motor Rate Voltage A001)	5.0	
A031	(DC Inj Time)	DC Injection Braking Time (Seconds)	0.0 - 25.5	0.5	
A032	(Skip Freq 1)	Skip Frequency # 1 (Hz)	0.00 - 400.00	0.0	*1
A033	(Skip Freq 2)	Skip Frequency # 2 (Hz)	0.00 - 400.00	0.0	*1
A034	(Skip Freq 3)	Skip Frequency # 3 (Hz)	0.00 - 400.00	0.0	*1
A035	(Skip Bandwidth)	Skip Frequency Bandwidth(± Hz)	0.00 - 30.00	0.0	*1
A036 A037 A038	(Reserved)	Reserved			
A039	(Parameter Lock)	Parameter Lock	0000: Enable all Functions 0001: A059 – A068 cannot be changed 0002: All Functions Except A059 – A068 cannot be changed 0003: Disable All Functions	0000	
A040	(Parameter Copy)	Copy Unit	0000: Disable 0001: Inverter to Copy Unit 0002: Copy Unit to Inverter 0003: Verify Copy Operation	0000	
A041	(Fan Control)	Fan Control	0000: Auto (Depend on temp.) 0001: Operate while in RUN mode 0002: Always Running 0003: Always Stopped	0000	
A042	(Energy Save Mode)	Energy Saving Mode *1	0000: Disabled 0001: Controlled by MFIT≠ at Set Frequency	0000	*6

≠: MFIT =Multi-function input terminal.

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A043	(Energy Save Gain)	Energy Saving Gain (%)	0 - 100	80	*6
A044	(Carrier Freq)	Carrier Frequency (kHz)	4 - 16	10	
A045	(Display Units)	Custom Units (Line Speed) Display Mode	0000: Drive Output Frequency is Displayed 0001: Line Speed is Displayed as an Integer (xxxx) 0002: Line Speed is Displayed with One Decimal Place (xxx.x) 0003: Line Speed is Displayed with Two Decimal Places (xx.xx) 0004: Line Speed is Displayed with Three Decimal Places (x.xxx)	0000	*1
A046	(Display Scaling)	Custom Units (Line Speed) Value	0 - 9999	1800	*1
A047 A048 A049	(Reserved)	Reserved			

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A050	(S1 Terminal Sel)	Multifunction Input Term. S1	0000: Forward/Stop Command 0001: Reverse/Stop Command 0002: Frequency Command 2 (A062) 0003: Frequency Command 3 (A063) 0004: Frequency Command 4 (A065) 0005: Jog 0006: Acc/Dec # 2 0007: Emergency Stop A Contact 0008: Base Block 0009: Speed Search 0010: Energy Saving 0011: Control Signal Selection 0012: Communication Selection 0013: Acc/Dec Disabled 0014: Up Command 0015: Down Command 0016: Master/Auxiliary Speed 0017: PID Function Disabled 0018: Reset 0019: Pulse Input terminal (terminal S5) 0020: PID feedback signal AI2 (terminal S6) 0021: AI2 Bias signal 1 input (terminal S6) 0022: AI2 Bias signal 2 input (terminal S6) 0023: Analog input (terminal AIN) 0024: Multi-Sequence Control	0000	
A051	(S2 Terminal Sel)	Multifunction Input Term. S2		0001	
A052	(S3 Terminal Sel)	Multifunction Input Term. S3		0002	
A053	(S4 Terminal Sel)	Multifunction Input Term. S4		0003	
A054	(S5 Terminal Sel)	Multifunction Input Term. S5		0004	
A055	(S6 Terminal Sel)	Multifunction Input Term. S6		0018	
A056	(AIN Term Sel)	Multifunction Input Term. AIN		0023	
A057	(Term Scan Time)	Multifunction Input Term. S1 - S6 Signal Verification Scan Time (mSec X 4)	1 – 100 (4-400msec)	5(20ms)	

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A058	(Up/Dn Stop Mod)	Stop Mode Using Up/Down	0000: When the terminals are Programmed for Up/Down Frequency Control, the Set Frequency will remain when the Drive stops. When the Drive stops, Up/Down Function Disabled. 0001: Up/Down is used. The preset frequency is reset to 0 Hz as the inverter stops. 0002: When the terminals are Programmed for Up/Down Frequency Control, the Set Frequency will remain when the Drive stops. When the Drive stops, Up/Down Function is Enabled.	0000	
A059	(Jog Freq)	Jog Frequency (Hz)	0.00 - 400.00	2.00	*1
A060	(Up/Down Step Fnct)	Up/Down Step Function (Hz)	0.00 – 5.00	0.00	
A061	(Freq command 1)	Frequency Command 1 (Hz)	0.00 - 400.00	5.00	*1
A062	(Freq command 2)	Frequency Command 2 (Hz)	0.00 - 400.00	5.00	*1
A063	(Freq command 3)	Frequency Command 3 (Hz)	0.00 - 400.00	10.00	*1
A064	(Freq command 4)	Frequency Command 4 (Hz)	0.00 - 400.00	20.00	*1
A065	(Freq command 5)	Frequency Command 5 (Hz)	0.00 - 400.00	30.00	*1
A066	(Freq command 6)	Frequency Command 6 (Hz)	0.00 - 400.00	40.00	*1
A067	(Freq command 7)	Frequency Command 7 (Hz)	0.00 - 400.00	50.00	*1
A068	(Freq command 8)	Frequency Command 8 (Hz)	0.00 - 400.00	60.00	
A069 A070	(Reserved)	Reserved			
A071	(Auto_ Run Sel 1)	Auto_ Run Mode Operation Selection 1	(0-3600 sec)	0000	
A072	(Auto_ Run Sel 2)	Auto_Run Mode Operation Selection 2			
A073	(Auto_ Run Sel 3)	Auto_Run Mode Operation Selection 3			

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A074	(Auto_ Run Sel 4)	Auto_Run Mode Operation Selection 4	(0-3600 sec)	0000	
A075	(Auto_ Run Sel 5)	Auto_Run Mode Operation Selection 5			
A076	(Auto_ Run Sel 6)	Auto_Run Mode Operation Selection 6			
A077	(Auto_ Run Sel 7)	Auto_Run Mode Operation Selection 7			
A078	(Auto_ Run Sel 8)	Auto_Run Mode Operation Selection 8			
A079 A080	(Reserved)	Reserved			
A081	(Auto _ Run Stop 1)	Auto_ Run Stop 1	0000: STOP 0001: Forward 0002: Reverse	0000	
A082	(Auto _ Run Stop 2)	Auto_ Run Stop 2		0000	
A083	(Auto _ Run Stop 3)	Auto_ Run Stop 3		0000	
A084	(Auto _ Run Stop 4)	Auto_ Run Stop 4		0000	
A085	(Auto _ Run Stop 5)	Auto_ Run Stop 5		0000	
A086	(Auto _ Run Stop 6)	Auto_ Run Stop 6		0000	
A087	(Auto _ Run Stop 7)	Auto_ Run Stop 7		0000	
A088	(Auto _ Run Stop 8)	Auto_ Run Stop 8		0000	
A089 A090	(Reserved)	Reserved			

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A091	(Auto Run Invalid)	Operation Mode Selection During Auto Run	0000: Auto Run mode not effective 0001: Auto Run mode for cycle. (continue running from the unfinished step if restarting) 0002: Auto Run mode performed periodically (continue running from the unfinished step if restarting) 0003: Auto Run mode for cycle, then hold the speed of final step to run. (continue running from the unfinished step if restarting) 0004: Auto Run mode for cycle. (starting a new cycle if restarting) 0005: Auto Run mode be performed periodically (starting a new cycle if restarting) 0006: Auto Run mode for one single cycle, then hold the speed of final step to run. (starting a new cycle if restarting)	0000	
A092	(AIN Gain)	AIN Gain (%)	0 - 200	100	*1
A093	(AIN Offset)	AIN Bias (%)	0 - 100	0	*1
A094	(AIN Bias)	AIN Bias Selection	0000: Positive 0001: Negative	0000	*1
A095	(AIN Slope)	AIN Slope	0000: Positive 0001: Negative	0000	*1
A096	(AIN Scan Time)	AIN Signal Verification Scan Time (AIN, AI2) (mSec x 2)	1 - 100	50	
A097	(AI2 Gain)	AI2 Gain (%)(S6)	0 - 200	100	*1
A098	Pulse Inp. Mult.	Encoder Impulse Ratio	0.001 - 9.999	1.000	
A099	Ref. Source2	Select the source of auxiliary frequency command	0 - 4	0	
A100 | A102	(Reserved)	Reserved			

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A103	(AO Mode Sel)	Analog Output Voltage Mode (0 - 10 VDC, Term. FM+)	0000: Output Run Frequency 0001: Input Frequency Setting 0002: Output Voltage 0003: DC Voltage 0004: Output Current 0005: PID Feedback	0000	*1
A104	(AO Gain)	Analog Output Gain (%)	0 - 200	100	*1
A105	(Relay R1 Sel)	Output Relay R1 Operation Mode	0000: Run 0001: Frequency Reached (Frequency Command) (Set Frequency ± 8-05) 0002: Set Frequency (8-04 ± 8-05) 0003: Frequency Threshold Level (> 8-04) - Frequency Reached 0004: Frequency Threshold Level (< 8-04) - Frequency Reached 0005: Over torque Threshold Level	0006	
A106	(Relay R2 Sel)	Output Relay R2 Operation Mode	0006: Fault 0007: Auto Restart 0008: Momentary AC Power Loss 0009: Rapid Stop Mode 0010: Coast-to-Stop Mode 0011: Motor Overload Protection 0012: Drive Overload Protection 0013: PID Feedback Signal Loss 0014: PLC Operation 0015: Under torque Threshold Level	0	
A107	(Freq Agree)	Frequency Reached (Hz) (Refer to A105: 0001)	0.00 - 400.00	0.00	*1
A108	(Freq Agree width)	Frequency Reached Bandwidth (± Hz)	0.00 - 30.00	2.00	*1
A109 A110	(Reserved)	Reserved			
A111	(Trip Prevent –ACC)	Trip Prevention Selection During Acceleration	0000: Enable Trip Prevention During Acceleration 0001: Disable Trip Prevention During Acceleration	0000	
A112	(Trip ACC Level)	Trip Prevention Level During Acceleration (%)	50 - 300(Level 100% based on Motor HP setting A003)	150	
A113	(Trip Prevent -DEC)	Trip Prevention Selection During Deceleration	0000: Enable Trip Prevention During Deceleration 0001: Disable Trip Prevention During Deceleration	0000	
A114	(Trip DEC Level)	Trip Prevention Level During Deceleration (%)	50 - 300(Level 100% based on Motor HP setting A003)	150	

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A115	(Trip Prevent -RUN)	Trip Prevention Selection in Run Mode	0000: Enable Trip Prevention in Run Mode 0001: Disable Trip Prevention in Run Mode	0000	
A116	(Trip Run Level)	Trip Prevention Level In Run Mode (%)	50 - 300 (Level 100% based on Motor HP setting A003)	150	
A117	(Dec Trip Time)	Trip Prevention Deceleration Time Selection in Run Mode	0000: Trip Prevention Deceleration Time Set by B008 0001: Trip Prevention Deceleration Time Set by A118	0000	
A118	(Dec Trip Time)	Deceleration Time In Trip Prevention Mode (Seconds)	0.1 – 3600.0	3.0	
A119	(Motor OL1 Sel)	Electronic Motor Overload Protection Operation Mode	0000: Enable Electronic Motor Overload Protection 0001: Disable Electronic Motor Overload Protection	0000	
A120	(Motor Type)	Motor type Selection	0000: Electronic Motor Overload Protection Set for Non-Inverter Duty Motors 0001: Electronic Motor Overload Protection Set for Inverter Duty Motors	0000	
A121	(Motor OL1 Curve)	Motor Overload Protection Curve Selection	0000: Curve 1 (OL =103 %) (150 % for 1 Minute) 0001: Curve 1 (OL = 113 %) (123 % for 1 Minute)	0000	
A122	(Motor OL1 Operat)	Operation After Overload Protection is Activated	0000: Coast-to-Stop After Overload Protection is Activated 0001: Drive Will Not Trip when Overload Protection is Activated (OL1)	0000	
A123	(Torq Det Sel)	Over/Under torque Detection Selection	0000: Disable Over/Under torque Operation 0001: Enable Over/Under torque Operation Only if at Set Frequency 0002: Enable Over/Under torque Operation while the Drive is in Run Mode	0000	
A124	(Torq Det Res)	Operation After Over/Under torque Detection is Activated	0000: Drive will Continue to Operate After Over-torque is Activated 0001: Coast-to-Stop After Over-torque is Activated	0000	
A125	(Torq Hi Level)	Over-torque Threshold Level (%)	30 – 200 (Level 100% based by Motor HP A003)	150	
A126	(Torq Hi Delay)	Over-torque Activation Delay Time (Seconds)	0.0 - 25.0	0.1	

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A127	(Torq Low Level)	Under-torque Threshold Level (%)	30-200 (Level 100% based by Motor HP A003)	0	
A128	(Torque Reserved Time)	Under-torque Activation Delay Time (Seconds)	0.0 – 25.0	0.1	
A129	(Torque Boost)	Volts/Hz Curve Modification (Torque Boost) (%)	0 – 30.0	0.0	*1*6
A130	(Motor noLoad Amp)	Motor No Load Current (Amps AC)	-----		*5*6
A131	(Motor rated Slip)	Motor Slip Compensation (%)	0.0 – 100.0	0.0	*1*6
A132	(Max frequency)	Maximum Frequency (Hz)	0.20 - 400.00	50.00/ 60.00	*4*6
A133	(Max Voltage)	Maximum Frequency Voltage Ratio (%)	0.0 - 100.0 (1 100% based on AC Input Volt A007)	100.0	*6
A134	(Mid frequency)	Mid Frequency (Hz)	0.10 - 400.00	25.00/ 30.00	*4*6
A135	(Mid Voltage)	Mid Frequency Voltage Ratio (%)	0.0 - 100.0 (100% based on AC Input Volt A007)	50.0	*6
A136	(Min frequency)	Minimum Frequency (Hz)	0.10 - 400.00	0.50/ 0.60	*6
A137	(Min Voltage)	Minimum Frequency Voltage Ratio (%)	0.0 - 100.0 (100% based on AC Input Volt A007)	1.0	*6
A138 A139	Reserved	Reserved			
A140	(PID Mode Sel)	Mode Selection	0000: Disabled 0001: Bias D Control 0002: Feedback D Control 0003: Bias D Reversed Characteristics Control 0004: Feedback D Reversed Characteristics Control 0005: Frequency Command + Bias D Control 0006: Frequency Command + Feedback D Control 0007: Frequency Command + Bias D Reversed Characteristics Control 0008: Frequency Command + Feedback D Reversed Characteristics Control	0000	
A141	(Feedback Gain)	Feedback Gain (%)	0.00 - 10.00	1.00	*1
A142	(PID Gain)	Proportional Gain (%)	0.0 - 10.0	1.0	*1
A143	(PID I Time)	Integration Time (Seconds)	0.0 - 100.0	10.0	*1
A144	(PID D Time)	Differentiation Time (Seconds)	0.00 - 10.00	0.00	*1
A145	(PID Offset)	PID Offset	0000: Positive 0001: Negative	0000	*1
A146	(PID Offset Adj)	PID Offset Adjust (%)	0 - 109	0	*1
A147	(Output Filter T)	Output Lag Filter Time (Seconds)	0.0 - 2.5	0.0	*1

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A148	(Fdbk Sel)	Feedback Loss Detection Mode	0000: Disabled 0001: Enabled - Drive Continues to Operate After Feedback Loss 0002: Enabled - Drive "STOPS" After Feedback Loss	0000	
A149	(Fdbk Lvl)	Feedback Loss Detection Level (%)	0 - 100	0	
A150	(Fdbk Los Time)	Feedback Loss Detection Delay Time (Seconds)	0.0 -25.5	1.0	
A151	(PID I Limit)	Integration Limit Value (%)	0 - 109	100	*1
A152	(I Time value Sel)	Integration Value Resets to Zero when Feedback Signal Equals the set point	0000: Disabled 0001: 1 Second 0030: 30 Seconds	0000	
A153	(I Error Margin)	Allowable Integration Error Margin (Units) (1 Unit = 1/8192)	0 - 100	0	
A154	(PID Comm. Source)	PID Feedback signal	0000: 0~10V or 0~20mA 0001: 2~10V or 4~20mA	0000	
A155	(Sleep Level)	Sleep Function Operation Level	0.00-400.00	0.0	
A156	(Sleep Delay Time)	Sleep Function Delay Time	0.0-25.5	0.0	
A157	(Unit : NONE)	Engineering Unit (only for PID feedback used for LCD type)	0000 : NONE 0001 : FPM (feet per minute) 0002 : CFM (cubic feet per minute) 0003 : PSI (pounds per square inch) 0004 : GPH (gallons per hour) 0005 : GPM (gallons per minute) 0006 : in 0007 : ft 0008 : /s (units per second) 0009 : /m (units per minute) 0010 : /h (units per hour) 0011 :Deg F 0012 : inW (inches in water column) 0013 : HP 0014 : m/s (meters per second) 0015 : MPM (meters per minute) 0016 : CMM (cubic meters per minute) 0017 : W 0018 : kW 0019 : m 0020 : Deg C 0021 : % 0022 : rpm	0000	

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
A158	(PID Fdbk Dsp Max)	PID Feedback Display Unit Max	0-9999	1000	Only for LCD keypad
A159	(PID Fdbk Dsp Min)	PID Feedback Display Unit Min	0-9999	0	Only for LCD keypad
A160 | A162	(Reserved)	Reserved			
A163	(Se Comm Adr)	Assigned Communication Station Number	1 - 254	1	*2*3
A164	(Se Baud Rate)	Baud Rate Setting (bps)	0000: 4800 0001: 9600 0002: 19200 0003: 38400	0003	*2*3
A165	(Comm Stop Bit)	Stop Bit Selection	0000: 1 Stop Bit 0001: 2 Stop Bits	0000	*2*3
A166	(Comm Parity Sel)	Parity Selection	0000: Without Parity 0001: With Even Parity 0002: With Odd Parity	0000	*2*3
A167	(Comm Data Format)	Data Format Selection	0000: 8-Bits Data 0001: 7-Bits Data	0000	*2*3
A168	(Stator Resistor)	Stator Resistance (Ohms)	-----		*3*5
A169	(Rotor Resistor)	Rotor Resistance (Ohms)	-----		*3*5
A170	(Equi Inductance)	Equivalent Inductance (mH)	-----		*3*5
A171	(Magnet Current)	Magnetizing Current (Amps AC)	-----		*3*5
A172	(Ferrite Loss)	Ferrite Loss Conductance (gm)	-----		*3*5
A173 A174	Reserved	Reserved			
A175	(Drive Model)	Drive Horsepower Code	-----		*3
A176	(Software Version)	Software Version	-----	-----	*3
A177	(Fault Log)	Fault Jog (Last 3 Faults)	-----	-----	*3
A178	(Elapsed Hours)	Accumulated Operation Time (Hours)	0 - 9999	-----	*3
A179	(Elapsed Hr*10000)	Accumulated Operation Time (Hours X 10000)	0 - 27	-----	*3
A180	(Elapsed Time Sel)	Accumulated Operation Time Mode	0000: Time Under Power 0001: Run Time	0000	*3
A181	(Reset Parameter)	Reset Drive to Factory Settings	1110: Reset for 50 Hz Motor Operation 1111: Reset for 60 Hz Motor Operation	0000	*4

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
B000	(Run Source)	Run Command Source Selection	0000: Keypad 0001: External Run/Stop Control 0002: Communication	0000	
B001	(MFIT Run Mode)	Run/Stop-Forward/Reverse Operation Mode with External Terminals	0000: Forward/Stop-Reverse/Stop 0001: Run/Stop-Forward/Reverse 0002: 3-Wire Control Mode-Run/Stop	0000	
B002	(Reverse Oper)	Reverse Prohibit operation	0000: Enable Reverse Command 0001: Disable Reverse Command	0000	
B003	(Stopping Method)	Stopping Method Selection	0000: Deceleration-to- Stop with DC Injection Braking (Rapid Stop) 0001: Coast to a Stop		
B004	(Frequency Source)	Frequency Command Source Selection	0000: Keypad 0001: Potentiometer on Keypad 0002: External Analog Signal Input or Remote Potentiometer 0003: Up/Down Frequency Control Using MFIT (S1 - S6) 0004: Communication setting frequency 0005: Pulse Follower	0000	
B005	(Freq Upper Limit)	Frequency Upper Limit (Hz)	0.01 - 400.00	50.00／60.00	*4
B006	(Freq Lower Limit)	Frequency Lower Limit (Hz)	0.00 - 400.00	0.00	
B007	(Accel Time 1)	Acceleration Time # 1 (Seconds)	0.1 – 3600.0	10.0	*1
B008	(Decel Time 1)	Deceleration Time # 1 (Seconds)	0.1 – 3600.0	10.0	*1

Function Code No.	LCD Display	Description	Range/Code	Factory Setting	Remarks
B009	(V/F Selection)	Volts/Hz Patterns(Password protected	0 - 18	9	*4*6
B010	(Password)	Parameter Lock(except B010)	0000: Disable 0001: Enable	0000	
B011	(Advanced Display)	Advanced Display	0000: Disable 0001: Enable	0000	
B012	(Select Language)	Language Selection	0000: English 0001: German 0002: French 0003: Italian 0004: Spanish	0000	Only for LCD keypad
B013	(Mtr Current)	Motor Current Display Selection	0000: Disable Motor Current Display 0001: Enable Motor Current Display	0000	*1
B014	(Mtr Voltage)	Motor Voltage Display Selection	0000: Disable Motor Voltage Display 0001: Enable Motor Voltage Display	0000	*1
B015	(Bus Voltage)	DC Bus Voltage Display Selection	0000: Disable Bus Voltage Display 0001: Enable Bus Voltage Display	0000	*1
B016	(PID Fdbk(S6)Disp)	PID Feedback Display Selection	0000: Disable PID Feedback Display 0001: Enable PID Feedback Display	0000	*1

※Notes: *1 can be modified during run

*2 cannot be modified while communication is active

*3 do not change while performing auto tuning or serial settings

*4 related to factory setting in North America or overseas

*5 the parameter will be changed by replacing motor (see descriptions of the POSTSCRIPT 1)

*6 only available in V/F mode

4.4 Parameter Function Description

A000:Control Mode
0000:Vector mode (General Mode)
0001:Vector mode (VT Mode)
0002:V/F mode

Select the appropriate vector control mode or V/F mode according to the load characteristics.

1. Vector (general mode) is best suited to control the general load or rapidly-changed torque load.
2. Vector (VT mode) is suitable for Blower/ Pump and HVAC loads. The magnetic current of motor will vary with the torque, which will reduce the current and save energy.
3. If V/F mode is selected, please set parameters, B000 & A129~A137 to comply with the load features.

A001:Motor Rated Voltage(Vac)
A002:Motor Rated Current (A)
A003:Motor Rated Power (kW)
A004:Motor Rated Speed (RPM)
A005:Motor Rated Frequency (Hz)
A006:Motor Parameter Auto Tuning
0000: Disabled 0001: Enabled

It is necessary to input data on the motor nameplate and auto tune whenever vector mode is selected.
Auto tuning: Input the data to A001~A005 according to the nameplate after power off, then set A006=0001and perform auto tuning; the detected internal data will automatically be written to parameter group 14 when display shows "End".
Ex. If the motor rated speed is 1700 rpm, set A004 to 17.0

⚠ Precaution

1. The motor parameter auto tuning is stationary auto tuning. During motor auto tuning, the motor does not rotate, and the keypad displays "-AT-".
2. During motor parameter auto tuning, the input signal in the control circuit is invalid.
3. Before motor parameter auto tuning, please confirm the motor is stopped.
4. The motor parameter auto tuning is only available for vector control modes (A000=0000or A000=0001).

A007 AC Line Input Voltage (Volts AC)
230V series:170.0~264.0
460V series:323.0~528.0

To accurately represent the voltage level of inverter, please input the actual on-site line voltage.

A010 : Keypad Stop Button 0000: Stop Button Enable
0001: Stop Button Disable

A010=0000, The STOP key is available for commanding the inverter to stop.

A011:Keypad Operation with Up/Down Keys in Run Mode
0000: 'Enter' must be pressed after frequency changes with the Up/Down Keys on keypad.
0001: Frequency will be changed directly when Up/Down Keys are Pressed

A012 : Starting Method Selection **0000: Normal Start**
0001: Enable Speed Search

1.) A012=0000: At start, the inverter accelerates from 0 to target frequency in the set time.

2.) A012=0001: At start, the inverter accelerates to target frequency from the detected speed of motor.

A013: Momentary Power Loss and Restart
0000: Momentary Power Loss and Restart Disable
0001: Momentary Power Loss and Restart is Enable
0002: Momentary Power Loss and Restart Enable while CPU is Operating.
A014 : Momentary Power Loss Ride-Thru Time(sec): 0.0 - 2.0 second

1.) Changing power supply often results in lowering the voltage below the under voltage threshold level and the inverter will stop at once. If the power supply recovers within the A014 preset time, it will spin start from the trip frequency, or the inverter will trip with 'LV-C' displayed.
2.) The allowable power loss time differs with the models ratings. The range is from 1 to 2 seconds.
3.) A013=0000: if power is lost, the inverter will not start.
4.) A013=0001: if the loss time is less than the value of A014, the inverter will Spin Start in 0.5 second as the power is re-supplied, and restart times are unlimited.
5.) A013=0002: the power is lost for on extended time, before the inverter loses control power for the CPU, the inverter will restart according to the B000 and A017 settings and status of external switch as the power re-applied.

※Note: B000=0001, A017=0000, A013=0001 or 0002 after power is lost for an extended time, please disconnect the power and power switches to avoid injury to personnel and equipment by the re-applied power.

A015 :Direct run after power up:
0000: Enable Direct Run After Power Up
0001: Disable Direct Run After Power Up

Danger:

1.) A015=0000 and the inverter is set external terminal control (B000=0001). If the run switch is ON as power is supplied, the inverter will auto-start. It is recommend to disconnect the power switch and run switch to avoid injury to personnel or equipment as power is re-applied.
2.) A015=0001and the inverter is set external terminal control (B000=0001). If the run switch is ON as power is supplied, the inverter will not auto start and flash STP1. It is necessary to disconnect the run switch and then restart.

A016 : Delay-ON Timer (seconds): 0 ~ 300.0 second

On power up with A015=0000, the inverter will perform auto restart after the time for the selected delay.

A017 : Auto restart method:

0000: Enable Speed Search

0001: Normal Start

1.) A017=0000: the inverter will detect motor speed and accelerate to the set frequency.

2.) A017=0001: the inverter will be accelerated from stop (zero speed) to set frequency.

A018: Number of Auto restart Attempts :0 ~ 10 times

A019: Auto restart Delay Time :0 ~ 800.0 second

1.) A018=0: the inverter will not auto restart after fault trip.

2.) A018>0, A019= 0:

The inverter will conduct SPIN START 0.5 seconds after fault trip. The motor will inertia run to frequency at the trip stop, then according to acceleration or deceleration time to set frequency.

3.) A018>0, A019>0:

The output will be stopped for a period which is determined by parameters A019 after fault trip. Then, the inverter spin starts to present set frequency.

4.) If the inverter is set in braking deceleration or DC braking, it will not perform restart after fault trip.

A020: Error reset mode setting 0000: Enable Reset Only when Run Command is Off

0001: Enable Reset when Run Command is On or Off

A020=0000 if the inverter trips on fault, remove the Run switch to perform reset, or restarting is not possible unless power is cycled.

B007 : Acceleration Time #1 (second): 0.1 – 3600.0
B008 : Deceleration Time #1 (second): 0.1 – 3600.0
A023 : S Curve of First Acceleration Stage (second): 0.0 – 4.0
A024 : S Curve of Second Acceleration Stage (second): 0.0 – 4.0
A025 : Acceleration Time #2 (second): 0.1 – 3600.0
A026 : Deceleration Time #2 (second): 0.1 – 3600.0
A027 : Jog Acceleration Time (second): 0.1 –25.5
A028 : Jog Deceleration Time (second): 0.1 – 25.5

1.) Formula for calculating acceleration and deceleration time: The denominator is based on the rated frequency of the motor.

$$\text{Acceleration time} = \text{B007 (or A025)} \times \frac{\text{Preset frequency}}{\text{A005}}, \quad \text{Deceleration time} = \text{B008 (or A026)} \times \frac{\text{Preset frequency}}{\text{A005}}$$

2.)When A050 – A056 is set as 06 (the second acceleration and deceleration time), the first acceleration/ deceleration/ S curve or the second acceleration/ deceleration/ S curve will be set by the external input terminal.

3.) When A050 – A056 is set as 05 (Jog), Jog run is controlled by external terminals. The acceleration and deceleration action will be at Jog acceleration and deceleration times.

4.) When A050 – A056 is set as 05(Jog) and 06(acceleration and deceleration time 1/2 toggle), to change the acceleration and deceleration times by the external terminals, and the settings as shown:

Function / preset value	Acc/ Dec time 1(B007/B008)	Acc/ Dec time 2 (A025/A026)	JOG Acc/Dec time (A027/A028)
	B004 determines the output frequency	B004 determines the output frequency	Run at A059Jog frequency
A050~A056=05 Jog command	Off	Off	On
A050~A056=04 Toggle Acc/Dec time.	Off	On	Off

5.) When S curve time (A023/A024) is set as 0, the S curve is ignored. Acceleration and deceleration ramps are linear.

6.) When S curve time (A023/A024) is greater than 0, the acceleration and deceleration action is as shown in figure 4-7.

7.) Regardless of the stall prevention period, actual acceleration and deceleration time =preset acceleration / deceleration time + S curve time. For example: acceleration time = B008+ A023.

8.) During acceleration and deceleration process, there might be residual error in acceleration and deceleration toggling. Please set the S curve time as 0 (A023/A024), if you need to toggle acceleration and deceleration time in acceleration / deceleration process.

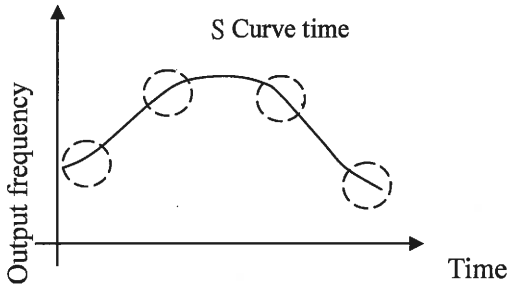


Figure 4-7 S-Curve characteristics

A029 : DC Injection Brake Start Frequency (Hz) : 0.1 – 10.0
A030 : DC Injection Brake Level (%) : 0.0 – 20.0
A031 : DC Injection Brake Time(second) : 0.0 – 25.5

A031 / A029 is the active time and start frequency of DC braking, as shown below:

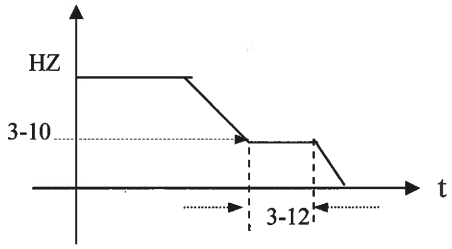
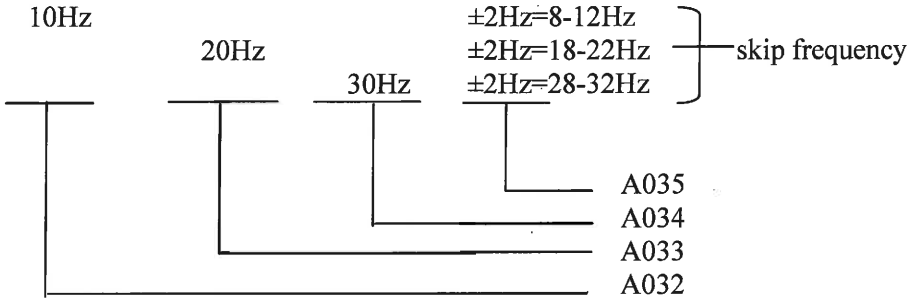


Figure 4-8 DC Injection Braking Example

A032 : Skip Frequency #1 (Hz) : 0.00 –400.00
A033 : Skip Frequency #2 (Hz) : 0.00 –400.00
A034 : Skip Frequency #3 (Hz) : 0.00 –400.00
A035 : Skip Frequency Bandwidth (± Hz) : 0.00 –30.00

Example: A032is set to 10.0Hz / A033 to 20.0 Hz / A034 to 30.0 Hz / A035 to 2.0Hz



A039: Parameter lock function

0000: Enable all Functions
0001: A059 - A068 cannot be changed
0002: All Functions Except A059 - A068 cannot be changed
0003: Disable All Functions

A040: Parameter Copy

0000: Disable
0001: Inverter to Copy Unit
0002: Copy Unit to Inverter
0003: Verify

1.) A040=0000: Inverter copy operation not in copy mode.
2.) A040=0001: Copy the inverter parameters to keypad module.
3.) A040=0002: Copy the keypad module parameters to inverter.
4.) A040=0003: Copy the parameters to inverter or keypad module to mutually verify the parameters.
※Note: The copy function is only available for the models with same ratings.

A041: Fan Run Control

0000: Auto (Depend on temp.)
0001: Operate while in RUN Mode
0002: Always Running
0003: Always Stopped

1.) A041=0000: The fan runs as the inverter senses temperature, extending the service period.
2.) A041=0001: The fan runs while the inverter is running.
3.) A041=0002: The fan is continuously running regardless of the action of the inverter.
4.) A041=0003: The fan is always stopped regardless of the action of the inverter.
※Note: Depending on the hardware; the function is disabled at and above 15HP for 230V class and above 20HP for 460V class. The fan is running after the inverter power on.

A042: Energy Saving Mode Operation 0000: Disabled
0001: Controlled by MFIT at Set Frequency
A043: Energy saving operation gain (%): 0-100 (see Note 1)

1.) With FANS, PUMPS or other heavy inertia loads, starting torques are typically high, while at speed torque demand is less. Consequently, the output voltage can be lowered to save energy by setting A042.

2.) A050 ~A056 (Multifunction input terminal) set to 10 to enable energy saving.

3.) A042=0001, If the multifunction terminal is set as 10(energy saving control terminal), the output voltage will gradually decline to 'original voltage'×'A043' preset value as the terminal' is ON. The output voltage will rise to original voltage if the input is low.

※Note:1. The declining and rising speeds of voltage for energy saving are the same as those for SPEED SEARCH.

2. Energy saving mode is only available in V/F mode. (A000 = 0002).

A044: Carrier Frequency (KHz) : 2-16

A044	Carrier Frequency	A044	Carrier Frequency	A044	Carrier Frequency	A044	Carrier Frequency
2	2KHz	6	6KHz	10	10KHz	14	14KHz
3	3KHz	7	7KHz	11	11KHz	15	15KHz
4	4KHz	8	8KHz	12	12KHz	16	16KHz
5	5KHz	9	9KHz	13	13KHz		

※ Note: Increasing the carrier frequency will generally result in quieter operation of the motor. However, increased carrier frequencies can potentially cause electrical interference on other equipment operating in proximity to the N3 inverter.

A045 : Custom Units (Line Speed) Display Mode
0000:Drive Output Frequency is Displayed
0001:Line Speed is Displayed as an Integer (xxxx)
0002:Line Speed is Displayed with One Decimal Place (xxx.x)
0003:Line Speed is Displayed with Two Decimal Places (xx.xx)
0004:Line Speed is Displayed with Three Decimal Places (x.xxx)

The preset frequency is displayed when the inverter is stopped while the operation line speed is displayed while the inverter is running.

A046:Custom Units (Line Speed) Value : 0-9999

The max preset line value of A046 is equal to the rated frequency (A005) of the motor. For instance, line speed at 1800 RPM is equal to 900 RPM when output is 30Hz while the base frequency is 60Hz.

Multifunction input terminals (TM2 S1-S6/AIN) controlling:

A050~A056

0000: Forward/Stop Command
0001: Reverse/Stop Command
0002: Frequency Command 2 (A062)
0003: Frequency Command 3 (A063)
0004: Frequency Command 4 (A065)
0005: Jog
0006: Acc/Dec time # 2
0007: Emergency Stop Contact A
0008: Base Block
0009: Speed Search Stop
0010: Energy Saving
0011: Control Signal Selection
0012: Communication Control Signal Selection
0013: Acc/Dec Disabled
0014: Up Command
0015: Down Command
0016: Master/Auxiliary Speed
0017: PID Function Disabled
0018: Reset
0019: Pulse Input Terminal（Terminal S5）
0020: PID Feedback Signal AI2 （Terminal S6）
0021: AI2 Bias Signal 1 Input（Terminal S6）
0022: AI2 Bias Signal 2 Input（Terminal S6）
0023: Analog Input（Terminal AIN）
0024: Multi-Sequence Control

A. The terminals S1-AIN on terminal block (TM2) are multifunction input terminals. The 30 functions shown above can be set in these terminals.

B. Function Description for A050~A056:

1. A050~A056=0/1(Forward/Reverse/Stop)

If forward command is ON, the inverter runs and stops when the command is OFF. The A050 factory setting is forward.

As reverse command is ON, the inverter runs stops when the command is OFF. The A051 factory setting is reverse.

2. A050~A056=2-4 (Frequency Command 2/3/4 at A062/A063/A065)

When External multifunction input terminals are ON, the inverter operates at the preset speed, and the duration is determined by the time the input is ON. The corresponding frequency parameter match to the terminal input states is shown in the table on the next page.

3. A050~A056=5(Jog)

When Jog operation, is selected, the inverter operates at the Jog acceleration and deceleration times. The corresponding jog frequency parameter is shown below:

The priority order of frequency: Jog Speed→Preset Speed→Keypad frequency or external frequency signal

Multifunction terminal3 Preset value=04	Multifunction terminal 2 Preset value =03	Multifunction terminal 1 Preset value =02	Jog Command terminal Preset value =05	Output frequency preset value
0	0	0	0	6-00
X	X	X	1	A059
0	0	1	0	A061
0	1	0	0	A062
0	1	1	0	A063
1	0	0	0	A064
1	0	1	0	A065
1	1	0	0	A066
1	1	1	0	A067

4. A050~A056=6 (toggle acceleration and deceleration time)

This input selects the acceleration 1/ deceleration 1/ S curve 1 or acceleration 2/ deceleration 2/ S curve 2.

5. A050~A056=7: External Emergency Stop Contact A.

The inverter will decelerate to stop and Flash E.S as the emergency stop signal is received regardless of B003 setting. After the signal is released, toggle the run input or press the run key in keypad mode and the inverter will restart from the start frequency. If the emergency signal is released before the inverter stops completely, the inverter still carries out the emergency stop. The A105/A106 determines the action of the error terminal. If A105/A106=0: the fault is not enabled when the external emergency signal is input. If A105/A106=9, the fault is actuated when the emergency signal is input.

6. A050~A056=8: Base Block

The inverter immediately stops sending output voltage, and the motor does a Coast stop.

7. A050~A056=9: Speed Search Stop

When starting, the inverter detects the present speed of the motor, then accelerates from that present speed to preset speed.

8. A050~A056=10: Energy-saving operation

With FANS, PUMPS, or other heavy inertia loads, starting torques are typically higher while at speed, torque demand is less. Consequently the output voltage is reduced to save energy.

The output voltage gradually declines as the input is ON. It will gradually increase (to the original voltage) as the input is OFF.

※Note: The acceleration and deceleration speed of energy saving operation is the same as the speed of SPEED SEARCH.

9. A050~A056=11: Switch of the control signal

OFF: B000/B001 determines the operation signal and frequency signal.
ON: Keypad controls the operation signal and frequency signal.

※ NOTE: Switch of control signal via A050~A056=11 is allowed while the drive is running (on the fly). Please exercise caution around operating equipment when operating in this mode.

10. A050~A056=12: Switch of the inverter control (RS485) communication

OFF: in communication, the master (PC or PLC) can control the inverter operation and frequency signal and allow modification or the parameters. The operation signals from Keypad and TM2 are idle. Furthermore, the keypad can only display the voltage, current and frequency; the parameters are read-only, while Emergency Stop is valid.

ON: in communication, the inverter is controlled by the keypad regardless of the settings of B000/B004 and master. Under such circumstance, the RS485 master still can read and write the inverter parameters.

11. A050~A056=13: Disable acceleration and deceleration

The acceleration and deceleration action is unavailable until the disable signals are released.

The action is illustrated in the graph below:

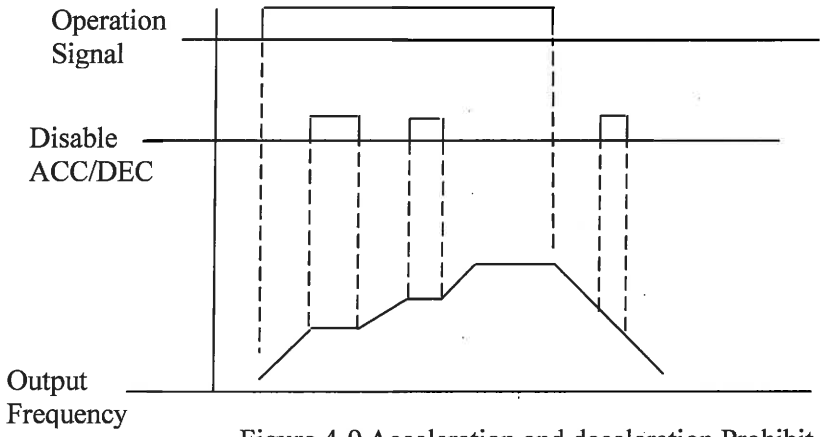


Figure 4-9 Acceleration and deceleration Prohibit

12. A050~A056=14,15: UP / DOWN Function (Actual ACC/DEC time is based on the setting):

(1) B004 = 3 to use the UP/DOWN Function. The other frequency signals are useless.

(2)Set A058 = 0 and A060 = 0. The inverter accelerates to the preset value of A061 when in RUN, then it maintains a constant speed. As the inverter receives either the UP/DOWN command, it will accelerate / decelerate until the command is released. The inverter runs at the speed setting at the time of release. The inverter will ramp stop or Free-Fun stop which is determined by the B003 as long as the inverter receives the STOP command. The frequency at Stop time will be stored in A061. The UP/DOWN KEY is invalid when the inverter is stopped. It is necessary to use the Keypad to modify the preset parameters.

(3)Set A058 = 1, the inverter will operate from 0Hz when the operation terminal is ON. The action of UP/DOWN is the same as above. The inverter will ramp stop or free-run stop as determined by B003 setting when it receives the Stop Command. The next operation will start at 0 Hz.

(4) UP/Down Signals simultaneously pressed are invalid

(5) A060≠ 0, the inverter accelerates to the setting of A061 and maintains speed. When the UP/Down terminal is ON, setting frequency is the value A061±A060, and the inverter will accelerate/ decelerate to frequency A061. The upper frequency limit and lower frequency limit also restrict the operation. If the signal of UP/ DOWN is maintained over 2 seconds, the inverter will begin to accelerate/ decelerate. If A060=0, the operation is the same, until the UP/ DOWN signal is released. Please refer to the time diagram of A060.

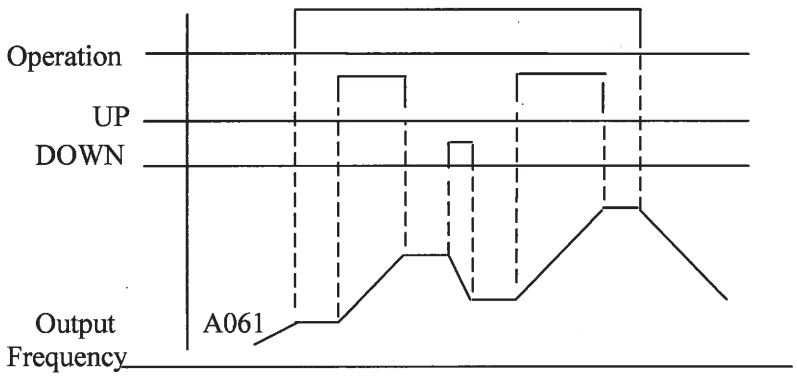


Figure 4-10 UP/DOWN key sequencing

13. A050~A056=16 Principal/Auxiliary speed toggle

OFF: the frequency is set by the potentiometer (Master Speed) on the Keypad. ON: the frequency is set by the analog signal terminal (Auxiliary Speed) on TM2.

14. A050~A056=17(PID Function Disable)

When the PID Function Disable is ON, PID is not controlled by A140.

15. A050~A056=18(Reset Command)

The Reset command is same as the Reset Key on the panel. When the command is OFF, the inverter does not respond. The factory default of A055 is Reset command.

16. A054=19 (Pulse Input Terminal)

The multifunction terminal S5 is set at 19 and becomes the input terminal for encoder signals.

17. A055=20 (PID feedback input terminal)

The multifunction terminal S6=20 becomes the PID feedback input terminal and 0~10V (0~ 20 mA) or 2~10V (4~20mA) is available by the setting of A140.

18. A055=21 /22(Bias signal 1/2 input)

To regulate the Offset of the Keypad Potentiometer or AIN analog input (only 0~10V (0~ 20 mA) or 2~10V (4~20mA) is available).

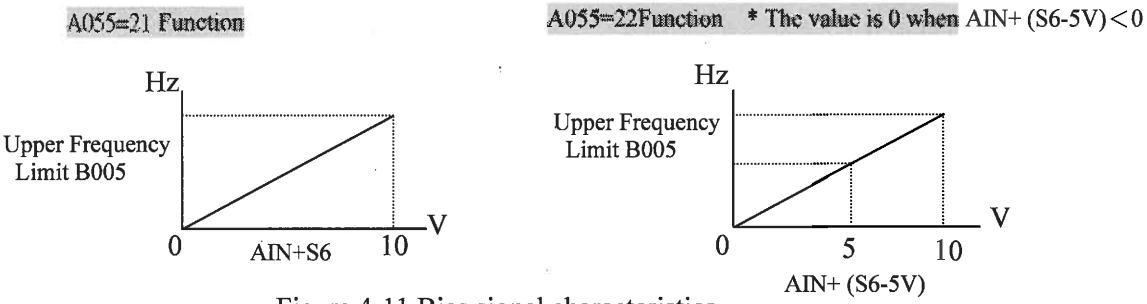


Figure 4-11 Bias signal characteristics

19. A056=23 (Analog input AIN)

The multifunction terminal AIN = 23. This is provided for setting the frequency.

20. A050~A056=24 (Multi-Sequence Control)

The Multi-Sequence control is set at 24 to become the input terminal for the Auto_Run Mode.

Digital /Analog input signal scan times:

A057: Multifunction terminal S1 ~ S6 and AIN signal confirm the scan times (mSec X 4),1~100 times

1.TM2 terminal is used for scanning. If there are the same signals continuously input for N times, the inverter will treat the signal as normal. During the signal evaluation, if the scan times are less than N, the signal will be treated as noise.

2. Each scan period is 4ms.
3. The user can specify the scan times interval duration according to the noise environment. If the noise is serious, increase the value of A057, however the response will be slower.
4. Note: If the S6 and AIN is digital, the voltage level for digital signal above 8V is treated as ON, below 2V is OFF.

Stop Mode Using Up/Down:

A058:

0000: When Up/Down is used, the preset frequency is held as the inverter stops, and the UP/Down is idle.

0001: When Up/Down is used, the preset frequency is reset to 0 Hz as the inverter stops.

0002: When Up/Down is used, the preset frequency is held as the inverter stops, and the UP/Down is available.

(1) 0: the inverter will accelerate to the speed set in parameter 6-00 upon receiving the Run command and run at commanded speed. The inverter begins to accelerate (decelerate) as the UP (Down) terminal is energized. The inverter will hold the speed as the UP/DOWN command released. When the Run Signal releases, the inverter will ramp stop or stop as determined by the B003. It will store the frequency when the run signal is removed. UP/DOWN keys are idle when the inverter is stopped. The keypad is available to modify the preset frequency (6-00). If A058=0002, the UP/Down is available as the inverter stops.

(2) 1: as the Run terminal is energized, the inverter operates from 0 Hz, the Function of UP/DOWN is same as the above description. When the Run signal is released, the inverter will ramp stop or stop output (determined by B003) to 0 Hz. The next run command will always begin from 0 Hz.

Jog and Preset (MFIT) Speed Setting on Keypad:

A059 & A061~A068: Set Jog and preset speed by Keypad

A. A050~056=2-4(preset speed 1~3)

ON: the inverter operates at preset speed. The operation time of the 8 stages is based on the bit pattern of the three available inputs. Please refer to the corresponding parameters list:

B. A050~056=5(Jog terminal)

ON: the inverter operates in Jog acceleration time/ Jog decelerate time/ON

Function Code No.	LCD Display	Description	Range/Code
A059	(Jog Freq)	Jog Frequency (Hz)	0.00 - 400.00
A061	(Freq Command 1)	Frequency Command 1 (Hz)	0.00 - 400.00
A062	(Freq Command 2)	Frequency Command 2 (Hz)	0.00 - 400.00
A063	(Freq Command 3)	Frequency Command 3 (Hz)	0.00 - 400.00
A064	(Freq Command 4)	Frequency Command 4 (Hz)	0.00 - 400.00
A065	(Freq Command 5)	Frequency Command 5 (Hz)	0.00 - 400.00
A066	(Freq Command 6)	Frequency Command 6 (Hz)	0.00 - 400.00
A067	(Freq Command 7)	Frequency Command 7 (Hz)	0.00 - 400.00
A068	(Freq Command 8)	Frequency Command 8 (Hz)	0.00 - 400.00

Priority in reading the frequency: Jog > Preset speed > Keypad frequency or external frequency signal

Multifunction terminal3 Preset value=04	Multifunction terminal 2 Preset value =03	Multifunction terminal 1 Preset value =02	Jog Command terminal Preset value =05	Output frequency preset value
0	0	0	0	A061
X	X	X	1	A059
0	0	1	0	A062
0	1	0	0	A063
0	1	1	0	A064
1	0	0	0	A065
1	0	1	0	A066
1	1	0	0	A067
1	1	1	0	A068

Step of Up/Down Function (Hz):
A060: Up/Down (Hz) 0.00 – 5.00

There are two modes covered below:

(1) A060 = 0.00, The operation is just as the original one. When the UP terminal is ON, the frequency increases; while the DOWN terminal is ON, the frequency decreases. (Refer to the following graph).

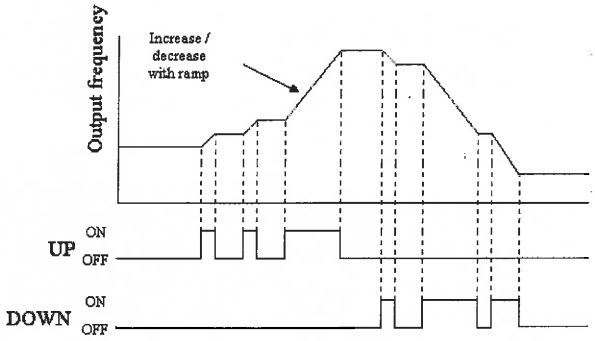


Figure 4-12 UP/DOWN profile example

(2) A060 = 0.01 to 5.00, and UP/ DOWN terminal ON, is equivalent to a step increase/ decrease at the increment frequency in A060. If UP/DOWN is pressed over 2 seconds, the original UP/DOWN mode is restored (Please refer to the following diagram)

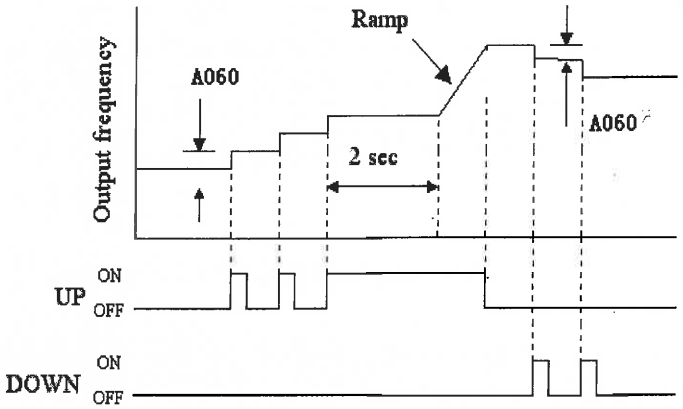


Figure 4-13 UP/DOWN with incremental steps

A061 : Auto _ Run Mode Frequency Command 1 (0-400Hz)
A062 : Auto _ Run Mode Frequency Command 2 (0-400Hz)
A063 : Auto _ Run Mode Frequency Command 3 (0-400Hz)
A064 : Auto _ Run Mode Frequency Command 4 (0-400Hz)
A065 : Auto _ Run Mode Frequency Command 5 (0-400Hz)
A066 : Auto _ Run Mode Frequency Command 6 (0-400Hz)
A067 : Auto _ Run Mode Frequency Command 7 (0-400Hz)
A068 : Auto _ Run Mode Frequency Command 8 (0-400Hz)

A071 : Auto _ Run Mode Operation Selection 1 (0-3600sec)
A072 : Auto _ Run Mode Operation Selection 2 (0-3600sec)
A073 : Auto _ Run Mode Operation Selection 3 (0-3600sec)
A074 : Auto _ Run Mode Operation Selection 4 (0-3600sec)
A075 : Auto _ Run Mode Operation Selection 5 (0-3600sec)
A076 : Auto _ Run Mode Operation Selection 6 (0-3600sec)
A077 : Auto _ Run Mode Operation Selection 7 (0-3600sec)
A078 : Auto _ Run Mode Operation Selection 8 (0-3600sec)

A081: Auto _ Run Stop 1 (0000 : STOP、0001:forward、0002:reverse)
A082: Auto _ Run Stop 2 (0000 : STOP、0001:forward、0002:reverse)
A083: Auto _ Run Stop 3 (0000 : STOP、0001:forward、0002:reverse)
A084: Auto _ Run Stop 4 (0000 : STOP、0001:forward、0002:reverse)
A085: Auto _ Run Stop 5 (0000 : STOP、0001:forward、0002:reverse)
A086: Auto _ Run Stop 6 (0000 : STOP、0001:forward、0002:reverse)
A087: Auto _ Run Stop 7 (0000 : STOP、0001:forward、0002:reverse)
A088: Auto _ Run Stop 8 (0000 : STOP、0001:forward、0002:reverse)

Operation Mode Selection During Auto Run

A091: 0000: Auto Run mode not effective.

0001: Auto Run mode for one cycle. (continuing running from the unfinished step if restarting)

0002: Auto Run mode be performed periodically (continuing running from the unfinished step if restarting)

0003: Auto Run mode for one cycle, then hold the speed of final step to run. (continuing running from the unfinished step if restarting)

0004: Auto Run mode for one cycle. (starting a new cycle if restarting)

0005: Auto Run mode be performed periodically (starting a new cycle if restarting)

0006: Auto Run mode for one single cycle, then hold the speed of final step to run. (starting a new cycle if restarting)

(1) Auto_Run Mode Selection (A091)

(2) Auto_Run Mode Setting Selection (A061~A068、A071~A078、A081~A088)

- A PLC operation mode is ready to use with the following settings of the multi-step frequency command 1~8 (A061~A068), Auto_Run mode time setting (A071~A078) under the Auto_Run mode selection (A091). The FWD/REV direction can be set with the setting of (A081~A088).
- In the Auto_Run mode, the multi-step frequency commands 2~4 are ineffective.
- Some examples in auto_run mode follow：

(A) Single Cycle Running (A091= 1, 4)

The inverter will run for a single full cycle based upon the specified setting mode. Then, it will stop.

For example:

A091＝1	A081~83=1(FWD)	A084=2(REV)	A085~88＝0
A061＝15Hz	A062＝30Hz	A063＝50Hz	A064＝20Hz
A071＝20s	A072＝25s	A073＝30s	A074＝40s
A065~68＝0Hz	A075~78＝0s		

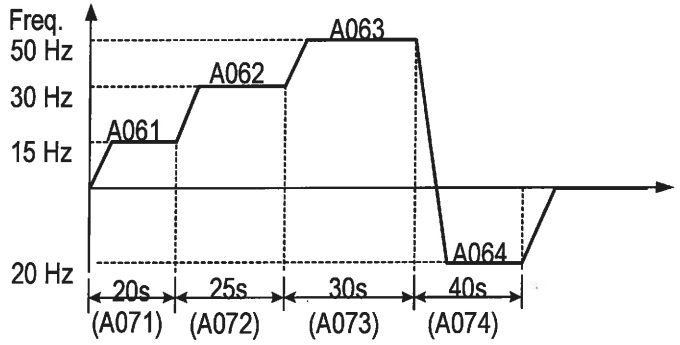


Figure 4-14 Single cycle auto run

(B) Periodic Running (A091＝2, 5)

The inverter will repeat the same cycle periodically.

For example:

A091 ＝ 2

A061～68, A071～78, A081-88 ： same setting as the example (A)

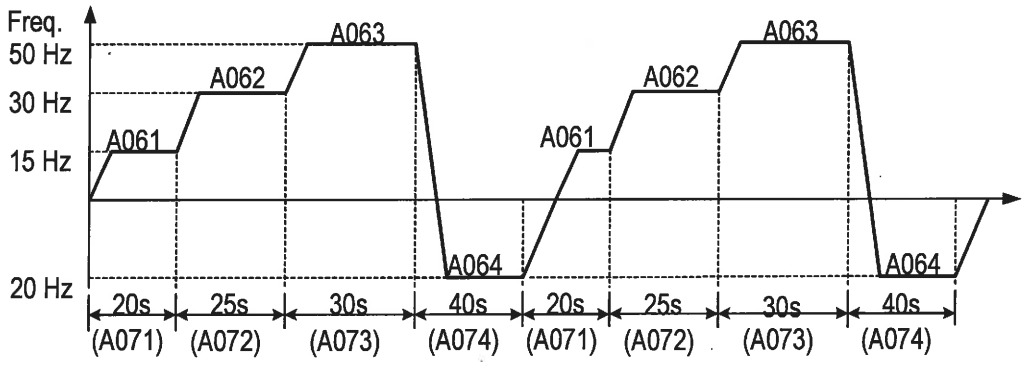


Figure 4-15 Periodic cycle auto run

(C) Auto_Run Mode for Single Cycle (A091 = 3, 6)

The speed of final step will be held to run.

For example:

A091 = 3

A081~84 = 1 (FWD) A085~88 = 0

A061～68, A071～78 : same setting as the example (A)

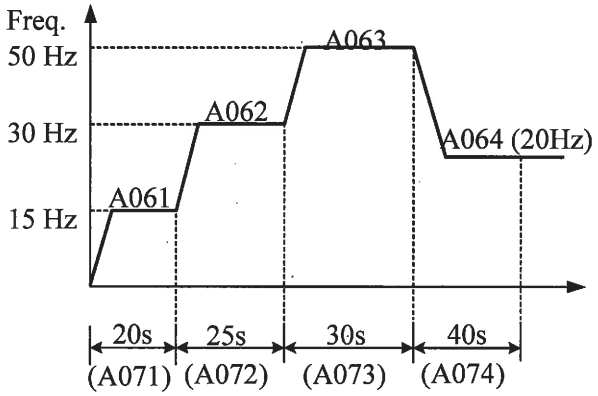


Figure 4-16 Single cycle auto run: final step hold

- A091 = 1~3 : If the inverter stops and re-starts, it will continue running from the unfinished step, according to the setting of A091.
  = 4~6 : If the inverter stops and re-starts, it will begin a new cycle and continue running according to the setting of A091.

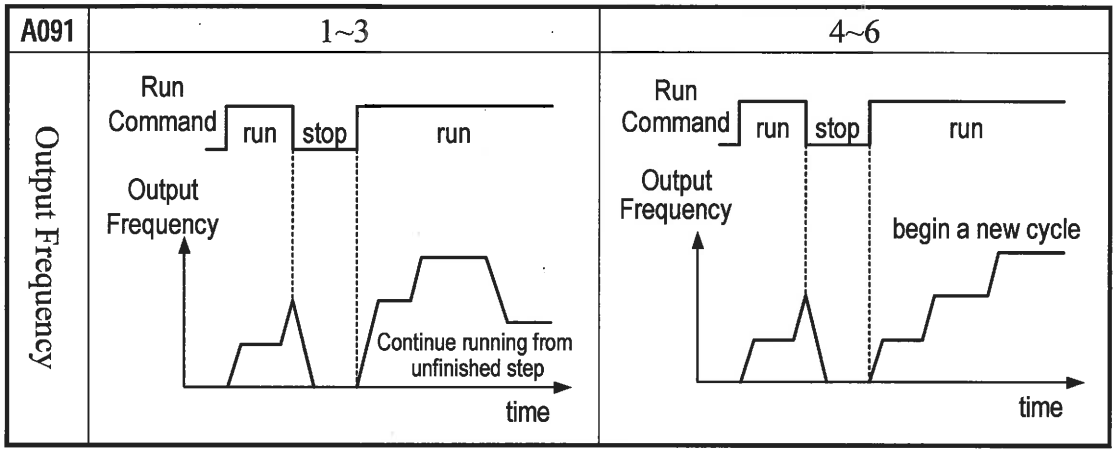


Figure 4-17 AUTO_RUN cycle with interrupt

- ACC/DEC time follow the setting of B007, B008 in Auto_Run Mode.

Analog Input Signal Operation Mode:
A092:AIN Gain(%) 0 - 200
A093:AIN Bias(%) 0 - 100
A094:AIN Bias Selection: 0000:positive 0001:Negative
A095:AIN Slope: 0000:positive 0001:Negative
A096: AIN signal verification Scan Time (AIN, AI2) 1–100 (× 4mSec)
A097: AI2 Gain (%)(S6) 0 - 200

1. A094 = 0: 0V (0mA) corresponding to Lower Frequency Limit., 10V (20mA) corresponding to Upper Frequency Limit.
2. A094 = 1: 10V (20mA) corresponding to Lower Frequency Limit, 0V (0mA) corresponding to Upper Frequency Limit.
3. A154 = 0: 0~10V (0~20mA)
   F= I*(B005)/20 I>=0 ; SW2= I or F=V*(B005)/10 V>=0 ; SW2=V
   = 1: 2~10V (4~20mA) (PID FEEDBACK)
   F= (I-4)*(B005)/16 I>=4 ; SW2= I
   F=0 I<4
   F= (V-2)*(B005)/8 V>=2 ; SW2=V or
   F=0 V<2

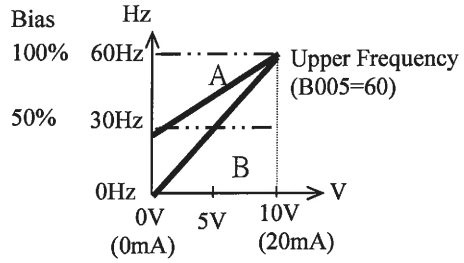
Figure 4-18 Analog scaling examples

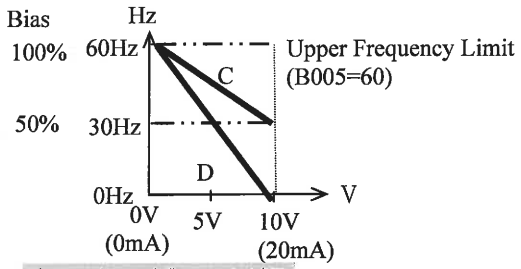
The setting of figure 4-18A:

	A092	A093	A094	A095	A097
A	100%	50%	0	0	100%
B	100%	0%	0	0	100%

The setting of figure 4-18B:

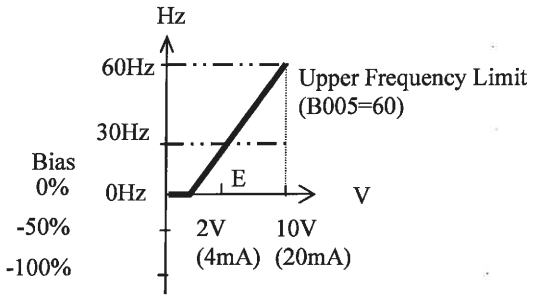
	A092	A093	A094	A095	A097
C	100%	50%	0	1	100%
D	100%	0%	0	1	100%





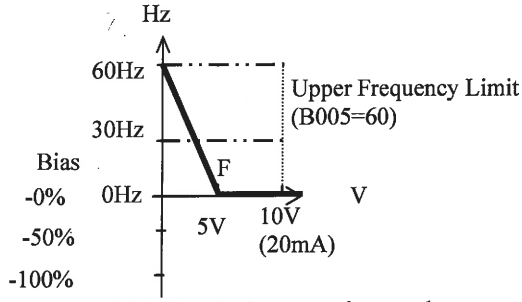
The setting of figure 4-18C:

	A092	A093	A094	A095	A097
E	100%	20%	1	0	100%



The setting of figure 4-18D:

	A092	A093	A094	A095	A097
F	100%	50%	1	1	100%



3. The inverter reads the average value of A/D signals once per (A096×4ms). Set scan intervals according to noise in the environment. Increase A096 in a noisy environment, but the response time will increase accordingly.

Multifunction analog output control:

A103: Analog Output Voltage Mode:

0000: Output frequency

0001: Frequency Setting

0002: Output voltage

0003: DC Voltage

0004: Output current

0005: PID Feedback

A104: Analog Output Gain = 0 ~ 200%

The multifunction analog output terminal of the terminal block (TM2), is 0~10Vdc analog output volts. The output type is determined by A104. A104 is to calibrate the external voltage meter and peripheral equipment, according to A103.

The FEEDBACK value of PID (the input voltage and current of S6) outputs analog value from FM+ terminal. (Set by parameter B016) The value corresponds to the input signal 0~10V (0 ~ 20 mA) or 2~10V (4~20mA).

※Note: The max output voltage is 10V

Multifunction output terminals control:

A105: RELAY1(R1C,R1B,R1A terminal on TM2)

A106: RELAY2(R2C,R2A terminal on TM2)

0000: Run

0001: Frequency Reached (Target Frequency) (Set Frequency ± A108)

0002: Set Frequency (A107 ± A108)

0003: Frequency Threshold Level (> A107) - Frequency Reached

0004: Frequency Threshold Level (< A107) - Frequency Reached

0005: Over-torque Threshold Level

0006: Fault

0007: Auto-restart

0008: Momentary AC Power Loss

0009: Rapid Stop Mode

0010: Coast-to-Stop Mode

0011: Motor Overload Protection

0012: Drive Overload Protection

0013: PID Feedback Signal Break

0014: Power On :

0015: Under-torque Threshold Level

A107: Frequency Reached Output Setting =0 ~ 400Hz

A108: Frequency Reached Bandwidth =0 ~ 30Hz

A105/A106= 01:

The preset frequency is reached (± A108)

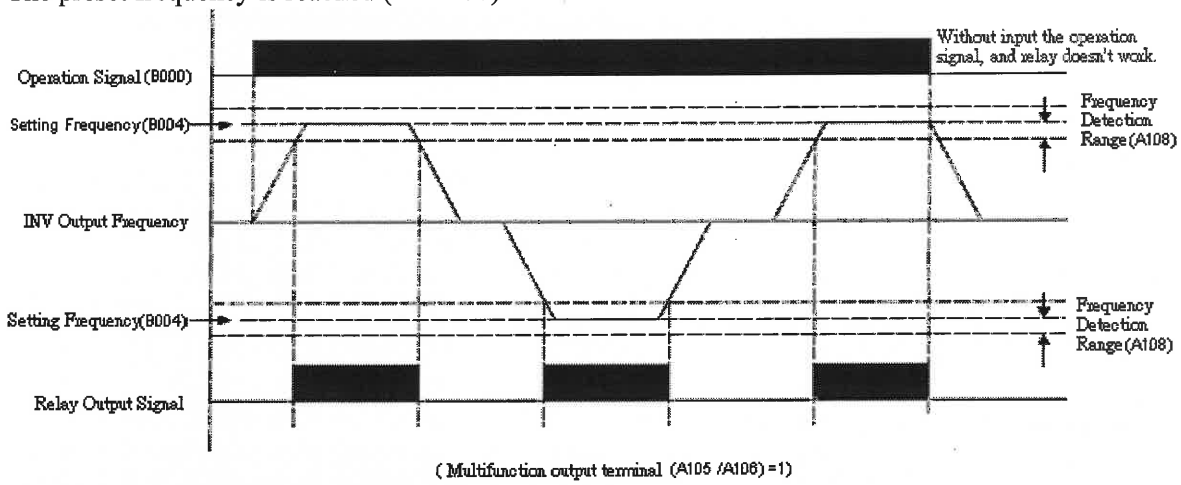


Figure 4-19 Frequency reached example

A105/A106= 02:

Arbitrary frequency consistency Fout = A107 ± A108

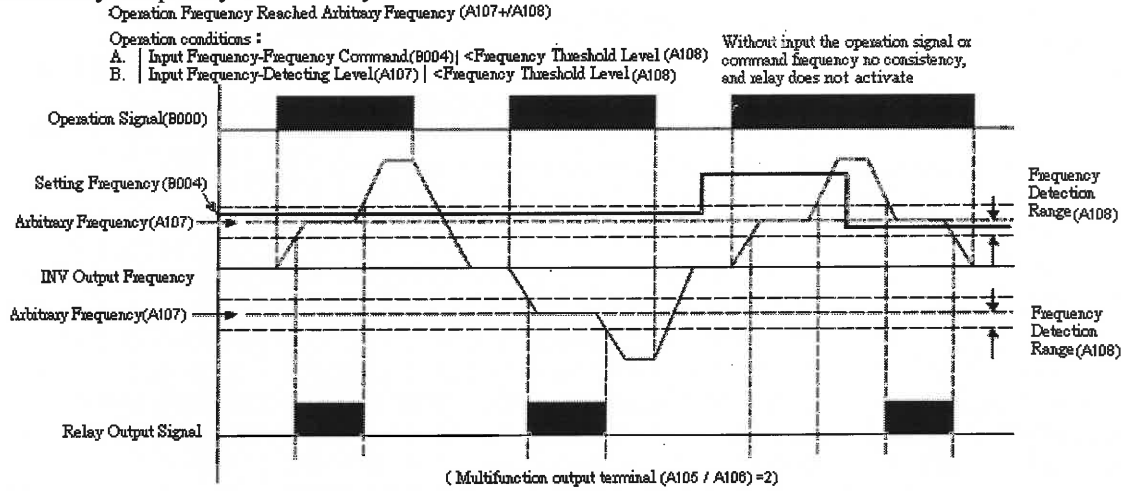


Figure 4-20 Frequency within specified range example

A105/A106 = 03: frequent detection Fout > A107

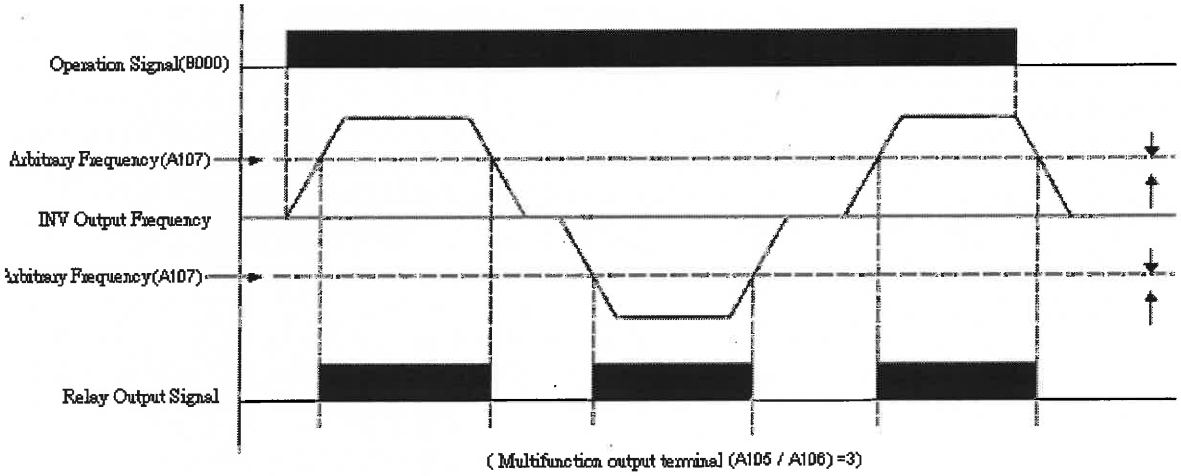


Figure 4-21 Frequency outside of range example

A105/A106 = 04: frequent detection Fout < A107

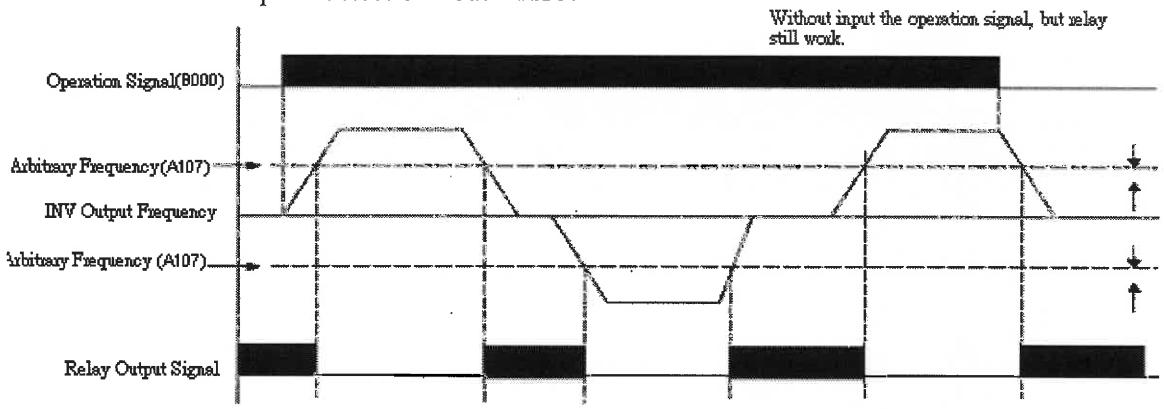


Figure 4-22 Frequency at or below specified range example

A105/A106= 05: over torque detection

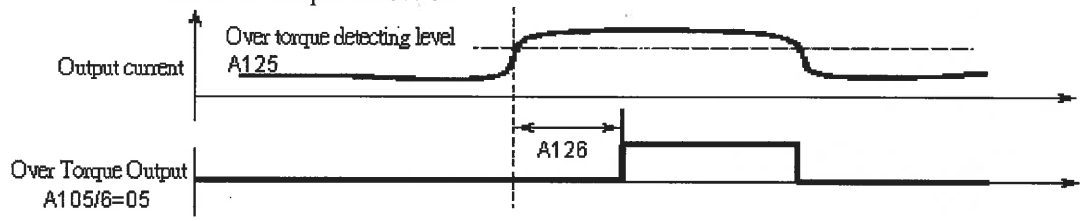


Figure 4-23 Over torque detection example

A111: Trip Prevention Selection During Acceleration:
0000: Enable Trip Prevention During Acceleration
0001: Disable Trip Prevention During Acceleration
A112: Trip Prevention Level During Acceleration: 50% ~ 300%(based by Motor HP A003)
A113: Trip Prevention Selection During Deceleration:
0000: Enable Trip Prevention During Deceleration
0001: Disable Trip Prevention During Deceleration
A114: Trip Prevention Level During Deceleration: 50% ~ 300%(based by Motor HP A003)
A115: Trip Prevention Selection in Run Mode:
0000: Enable Trip Prevention in Run Mode
0001: Disable Trip Prevention in Run Mode
A116: Trip Prevention Level in Run Mode: 50% ~ 300%(based by Motor HP A003)
A117: Trip Prevention Deceleration Time Selection in Run Mode:
0000: Trip Prevention Deceleration Time Set by B008
0001: Trip Prevention Deceleration Time Set by A118
A118: Deceleration Time in Trip Prevention Mode (sec): 0.1 ~ 3600.0

1. During acceleration, the inverter will delay the acceleration time if the acceleration time is too short, and otherwise resulting in the over current trip.
2. During deceleration, the inverter will delay the deceleration time if the deceleration time is too short, otherwise resulting in the over voltage of DC BUS trips with 'OV' displayed.
3. Some mechanical equipment (such as a press) or unusual breakdown (seizing due to insufficient lubrication, uneven operation, impurities of processed materials, etc.) will cause the inverter to trip. When the operating torque of the inverter exceeds the setting of A116, the inverter will lower the output frequency following the deceleration time set by A117, and return to the normal operation frequency after the torque level stabilizes.

A119: Electronic Motor Overload Protection Operation Mode:
0000: Enable Electronic Motor Overload Protection
0001: Disable Electronic Motor Overload Protection
A120: Motor Type Selection:
0000: Electronic Motor Overload Protection Set for Non-Inverter Duty Motor
0001: Electronic Motor Overload Protection Set for Inverter Duty Motor
A121: Motor Overload Protection Curve Selection:
0000: Constant Torque (OL=103%)(150%,1 minute)
0001: Variable Torque (OL=113%)(123%,1 minute)
A122: Operation After Overload Protection is Activated:
0000: Coast-to-Stop After Overload Protection is Activated
0001: Drive Will not Trip when Overload Protection is Activated (OL1)

Description of the thermal relay function:

1. A121 = 0000: protect the general mechanical load. If the load is less than 103% rated current, the motor continues to run. If the load is larger than 150% rated current, the motor will run for 1 minute. (Refer to curve (1).
   = 0001: protect HVAC load (FAN、PUMP…so on): If the load is less than 113% rated current, the motor continues to run. If the load is larger than 123% rated current, the motor will run for 1 minute.
2. The heat sink function will diminish when the motor runs at low speed. The thermal relay action level will diminish at the same time. (The curve 1 will change to curve 2).
3. A120 = 0000: set A005 as the rated frequency of the motor.
   A122 = 0000: the inverter coasts to stop as the thermal relay acts and flash OL1. Press the 'reset' or the external reset terminal to continue to run
   = 0001: the inverter continues to run as the thermal relay acts and the display flashes OL1. Until the current declines to 103% or 113 %(determined by A121), then OL1 disappears.

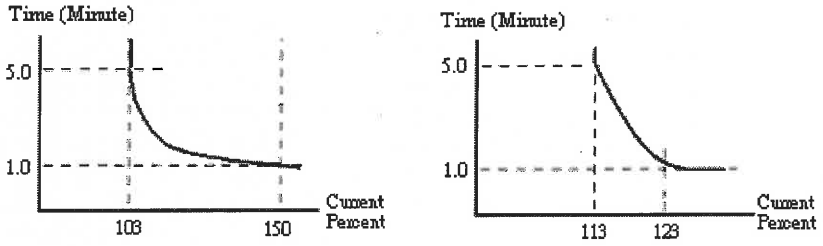
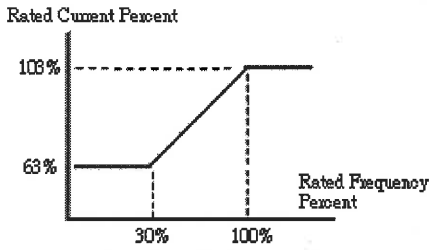
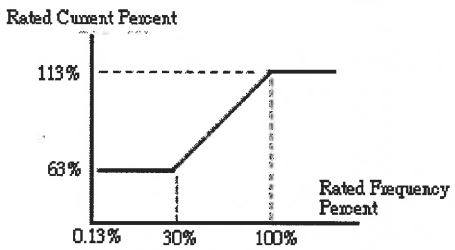


Figure 4-24 Thermal Overload Curves

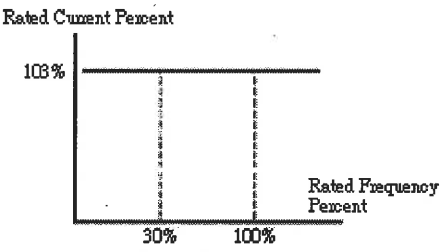
Electronic Motor Overload OL1 protection current and frequency



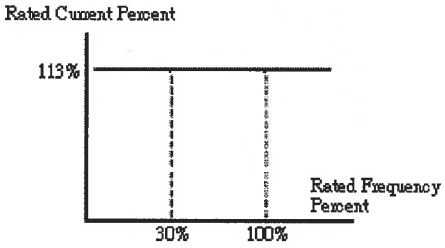
Inverter Duty Motor OL1 Protection Curve
OL=103% Start, 150%/1 Min.



Non-Inverter Duty Motor OL1 Protection Curve
OL=113% Start, 123%/1 Min.



Inverter Duty Motor OL1 Protection Curve
OL=103% Start, 150%/1 Min.



Inverter Duty Motor OL1 Protection Curve
OL=113% Start, 123%/1 Min.

A123: Over/Under Torque Detection Selection:00
= 0000: Disable Over/Under Torque Operation
= 0001: Enable Over/Under Torque Operation Only if at Set Frequency
= 0002: Enable Over/Under Torque Operation while the Drive is in Run Mode
A124: Operation After Over/Under Torque Detection is Activated:
= 0000: Drive will Continue to Operate After Over/Under Torque is Activated
= 0001: Coast-to-Stop After Over/Under Torque is Activated
A125: Over Torque Threshold Level (%): 100-200%
A126: Over Torque Activation Delay Time (s): 0.0-25.0
A127: Under torque Threshold Level (%): 0-100%
A128: Under torque activation Delay Time (Seconds): 0.0-25.0

The over torque is defined as the output torque is active for longer than parameter A126 and, the voltage level (the inverter rated torque is 100%) exceeds over A125 parameter.

Over Torque:

A124 = 0000: If there is over torque, the inverter can continue to run and flashes OL3 until the output torque is less than the A125 setting value.

= 0001: If there is over torque, the inverter coasts to stop and flashes OL3. It is required to press 'RESET' or external terminal to continue running.

Parameter A105, A106 (Multifunction output terminal) = 05, the output terminal is output over torque signal.

The Under torque is defined as the output torque is active for longer than parameter A126 and the voltage level (the inverter rated torque is 100%) is less than A125 parameter.

Under Torque:

A124 = 0000: If there is under torque, the inverter can continue to run and flashes OL4 until the output torque is over than the A125 setting value.

= 0001: If there is under torque, the inverter coasts to stop and flashes OL4. It is required to press 'RESET' or external terminal to continue running.

Parameter A105, A106 (Multifunction output terminal) = 15, the output terminal is output under torque signal.

※ Note: Over torque output signal will be output as the parameter A123=0001or 0002 when the set level and time are over the range.

V/F PATTERN Selection

B009: V/F PATTERN Selection = 0 – 18

A129: Torque boost gain(V/F pattern modulation)% = 0.0 – 30.0%

A130: Motor no load current(Amps AC) ----------

A131: Motor rated slip compensation(%) = 0.0 – 100.0%

A132: Max output frequency(HZ) = 0.20 – 400.0Hz

A133: Max output frequency voltage ratio(%) = 0.0 – 100.0%

A134: Medium frequency(HZ) = 0.10 –400.0Hz

A135: Medium output frequency voltage ratio (%) = 0.0 – 100.0%

A136: Min output frequency(HZ) = 0.10 –400.0Hz

A137: Min output frequency voltage ratio (%) = 0.0 – 100.0%

1. B009=18, set the V/F pattern freely complying with A132~A137 (Refer to following diagram)

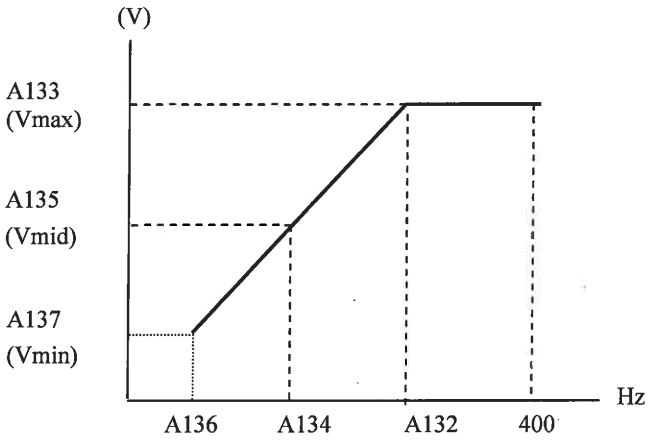


Figure 4-25 Custom V/F Settings

2. B009 = 0 – 17 V / F Pattern (Refer to following list) 。

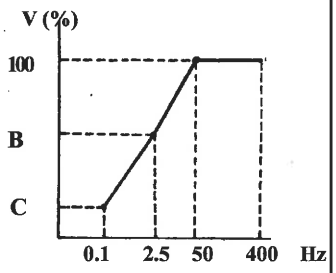
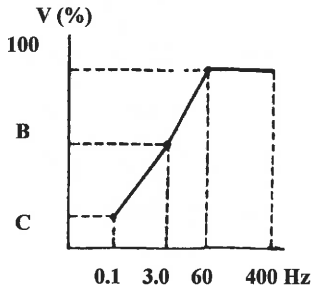
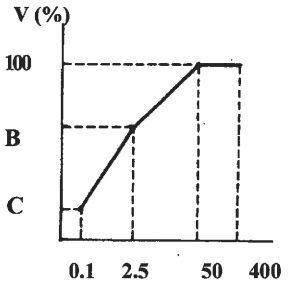
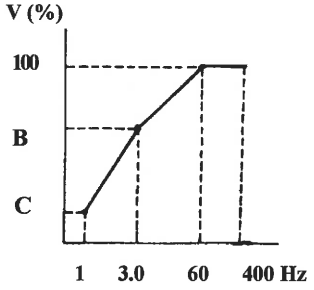
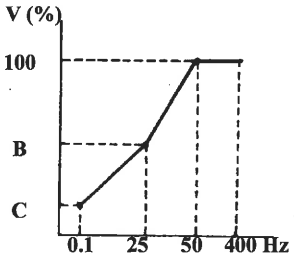
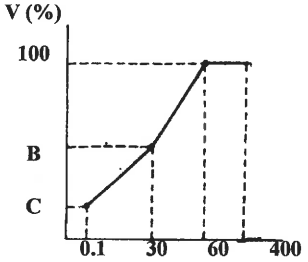
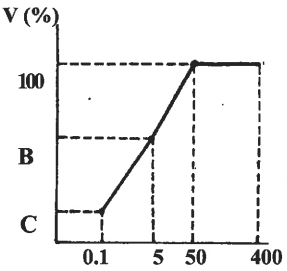
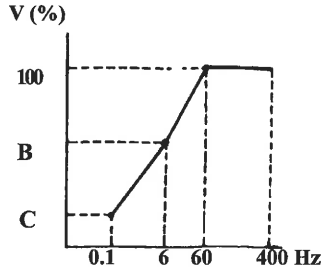
type	Function	B009	V/F pattern	type	Function	B009	V/F pattern
50 Hz	General Use	0		60 Hz	General Use	9	
	High start torque	1			High start torque	10	
		2				11	
		3				12	
	Decreasing torque	4			Decreasing torque	13	
		5				14	
	Constant torque	6			Constant torque	15	
		7				16	
		8				17	

Figure 4-26 Custom V/F Patterns

B009	B	C
0 / 9	50.0%	1.0%
1 / 10	60.0%	1.0%
2 / 11	65.0%	1.0%
3 / 12	70.0%	1.0%
4 / 13	40.0%	1.0%
5 / 14	35.0%	1.0%
6 / 15	45.0%	1.0%
7 / 16	55.0%	1.0%
8 / 17	65.0%	1.0%

3. The inverter will output the value of B, C voltage (refer to B009) points according the A129 V/F pattern setting. The starting torque will be raised as shown.

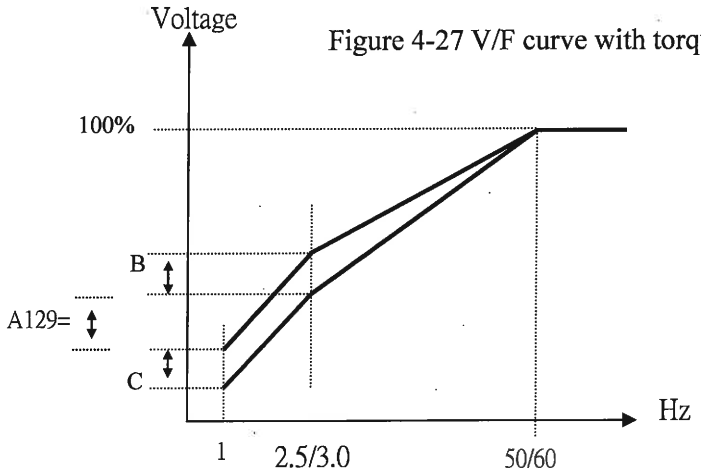


Figure 4-27 V/F curve with torque boost

※Note: A129=0, Torque boost function is invalid

4. When the induction motor is in running, there must be slip due to the load. It is necessary to boost voltage to improve the precision of the speed.

$$\text{Slip frequency boost} = \frac{\text{Output Current-(A130)}}{\text{(A002)-(A130)}} \times (\text{A131})$$

Note : A002=motor rated current
A130=motor no load current

A131 approximate value= (Motor synchronization speed– Rated speed) / Motor synchronization speed

↑ Marked on the motor nameplate

$$\text{Motor synchronization speed (RPM)} = \frac{120}{\text{Motor Poles}} \times \text{Motor rated frequency (50Hz or 60Hz)}$$

$$\text{Example: 4 Poles,60Hzinduction motor synchronization speed} = \frac{120}{4} \times 60 = 1800 \text{ RPM}$$

※Note: Motor no load current (A130) differs with the inverter capacities (A175) (Refer to A002 note). It should be regulated according to actual conditions.

A140: PID Operation Selection

0000: PID disable

0001: PID enable (Deviation is D-controlled)

0002: PID Feedback D-controlled

0003: PID D Reverse characteristic controlled

0004: PID Feedback D characteristic controlled

0005: PID, Frequency command + D controlled

0006: PID, Frequency command + Feedback D controlled

0007: PID, Frequency Command + D reverse Characteristic controlled.

0008: PID, Frequency Command + Feedback D reverse Characteristic controlled.

See figure 4-28 for

A140 =1, D is the deviation of the process error signal in unit time (A144).

=2, D is the deviation of the feedback in unit time (A144).

=3, D is the deviation of the process error signal in the unit time (A144). If the deviation is positive, the output frequency decreases and vice versa.

=4, D is the deviation of feedback in unit time (A144). When the deviation is positive, the frequency decreases, and vice versa.

=5, D is equal to the deviation of the process error signal in unit time (A144) +Frequency command.

=6, D is equal to the deviation of feedback in unit time + Frequency command.

=7, D is equal to the deviation of the process error signal in unit time +Frequency command. If the deviation is positive, the output frequency decreases, and vice versa.

=8, D is equal to the deviation of feedback in unit time + Frequency command. When the deviation is positive, the frequency decreases, vice versa.

A141: Feedback Calibration Gain(%) : 0.00 - 10.00

A141 is the calibration gain. Deviation = (set point –feedback signal) × A141

A142: Proportion Gain(%) : 0.00 - 10.00

A142: Proportion gain for P control.

A143: Integrate Time (s) : 0.0 - 100.0

A143: Integrate time for I control

A144: Differential Time (s) : 0.00 - 10.00

A144: Differential time for D control

A145: PID Offset : 0000 : Positive Direction

0001 :Negative Direction

A146: PID Offset Adjust (%) : -109% ~ +109%

A145/A146: PID the calculated result pluses A146 (the sign of A146 is determined by A145).

A147: Output Lag Filter Time (s) : 0.0 - 2.5

A147: Update time for output frequency.

※Note: PID Function is available for controlling the output flow, external fan flow and temperature.

The PID block diagram is as follows:

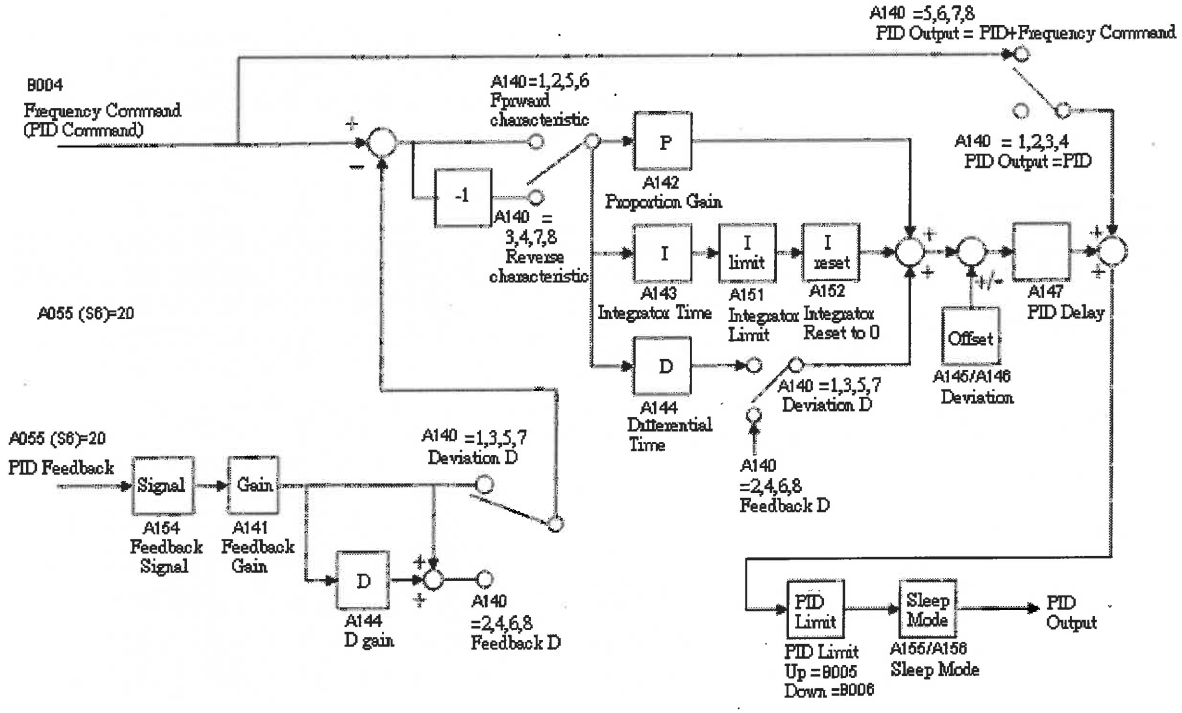


Figure 4-28 PID BLOCK DIAGRAM

1. To enable PID control, set A055=20, AI2 (S6) on TM2 is defined as the PID feedback signal.
2. The set point in the above diagram is the B004 input frequency.
3. There are two ways to view the PID feedback signal: one is using the Keypad switch display (B016 must be set to 1), the other is using analog output FM+ (A103 must be set to 5).

A148: Feedback Loss Detection Mode: 0000:Disable
0001:Enable – Drive Continues to Operate After Feedback Loss
0002:Enable – Drive "STOPS" After Feedback Loss

A148= 0: Disable; A148= 1: detect, continue running, and display 'PDER' ; A148= 2: detect, stop, and display 'PDER' 。

A149: Feedback Loss Detection Mode (%): 0 - 100

A149 is the level for signal loss. Error = (Set point – Feedback value). When the error is larger than the loss level setting, the feedback signal is considered lost.

A150: Feedback Loss Detection Delay Time (s): 0.0 -25.5

A150: the minimum time window to consider the feedback signal lost.

A151: Integrate Limit Value (%): 0 - 109

A151: the Limiter to prevent the PID from saturating.

A152: Integrator Reset to 0 when Feedback Signal Equals the set point:
0000:Disable
0001:1 second
0030: 30 seconds

A152=0: As PID feedback value reaches the set point, the integrator will not be reset to 0.
A152=1~30: As PID feedback value reaches the set point, reset to 0 in 1~30 seconds and inverter stops. The inverter will run again when the feedback value differs from the set point value.

A153: Allowable Integration Error Margin (Unit Value) (1 Unit = 1/8192): 0 - 100

A153=0 ~ 100% unit value: Restart the tolerance after the integrator reset to 0.

A154: PID Feedback Signal: 0000: 0~10V or 0~20mA
0001: 2~10V or 4~20mA

A154: Feedback signal selection, A154=0: 0~10V or 0~20mA (signal V or I set by SW3)
A154=1: 2~10V or 4~20mA (signal V or I set by SW3)

A155, A156: PID Sleep Mode

PID SLEEP MODE:
A140=1(PID Enable)
A055=20(PID FEEDBACK Enable)
B004=PID setting frequency source (Target Value)
A155: set the sleep threshold frequency, Unit: HZ
A156: set the time for sleep delay, Unit: sec
When PID output frequency is less than the sleep threshold frequency and exceeds the time of sleep delay, the inverter will decelerate to 0 and enter PID sleep mode.

When PID output frequency is larger than the sleep threshold frequency for sleep start the inverter will reactivate and enter PID wake mode. The time diagram is as follow:

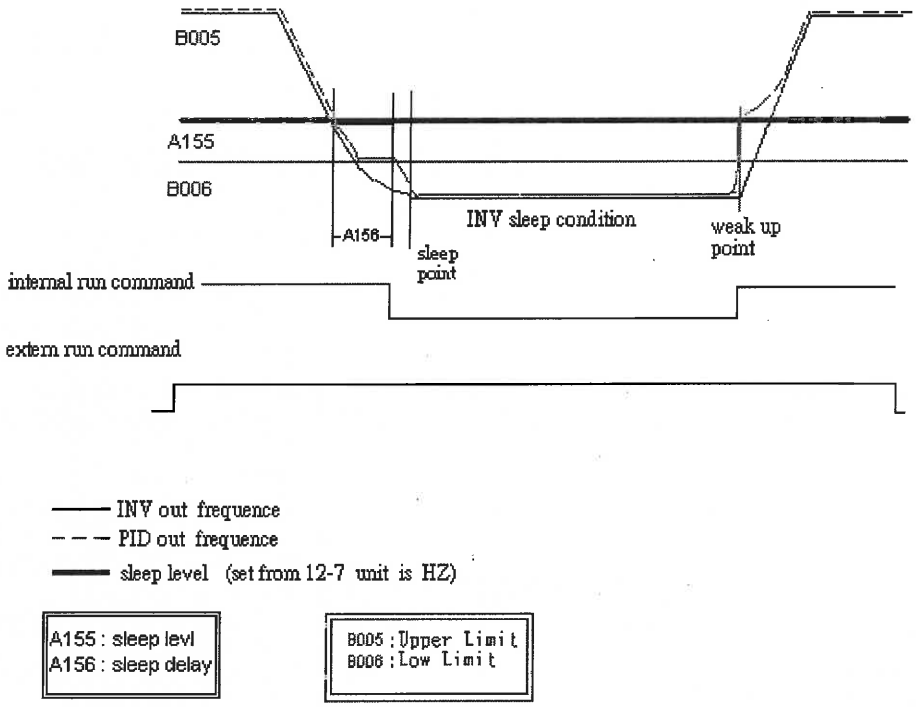


Figure 4-29 PID sleep wake mode diagram

A157: Engineering Units(only for PID feedback used on LCD display)

0000 : NONE	**0012 : inW (inches in water column)**
0001 : FPM (feet per minute)	**0013 : HP**
0002 : CFM (cubic feet per minute)	**0014 : m/s (meters per second)**
0003 : PSI (pounds per square inch)	**0015 : MPM (meters per minute)**
0004 : GPH (gallons per hour)	**0016 : CMM (cubic meters per minute)**
0005 : GPM (gallons per minute)	**0017 : W**
0006 : in	**0018 : kW**
0007 : ft	**0019 : m**
0008 : /s (units per second)	**0020 : ° C**
0009 : /m (units per minute)	**0021 : %**
0010 : /h (units per hour)	**0022 : rpm**
0011 : ° F	

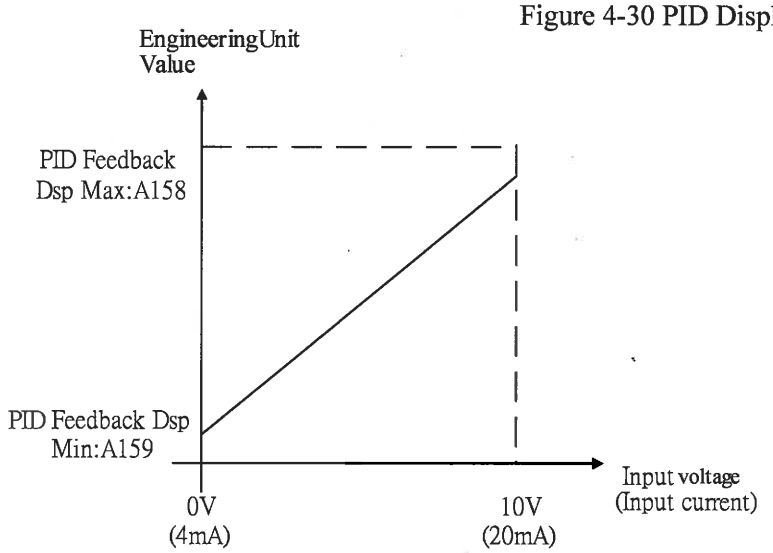
A158: PID Feedback Display Unit Max : 0-9999**(only for PID feedback used on LCD type display)**

A159: PID Feedback Display Unit Min : 0-9999**(only for PID feedback used on LCD type display)**

A157: PID Feedback Engineering Unit.

A158:PID Feedback Display Maximum
A159:PID Feedback Display Minimum

Figure 4-30 PID Display Scaling



A163: RS485 Communication Station Drop Number: 1 - 254

A163: to set the RS485 communication station codes which are suitable for driving multi drop situations on inverter networks.

A164: Baud Rate setting (bps): 0000: 4800
0001: 9600
0002: 19200
0003: 38400

A165: Stop Bit Selection: 0000: 1 stop bit
0001: 2 stop bit

A166: Parity Selection : 0000 : no parity
0001 : even parity
0002 : odd parity

A167: Data Format Selection: 0000 : 8 bit data
0001 : 7 bit data

1. RS-485 Communication:
   (1)1 vs. 1 Control: to control one inverter by a PC or PLC or controller. (set A163 = 1~254)
   (2)1 vs. Multiple Drop Control: to control more than one inverter by PC, PLC, or Host Controller (The max number of inverter drops is 254. Set A163 = 1~254). When the inverter receives the host communication (station code = 0), the communication command is followed regardless the setting value of A163.
2. RS-232communication: (RS232 interface is required)
   1vs1 control only: to control one inverter by a PC, PLC, or controller. (Set A163 = 1~254)

※Note:

a. The BAUD RATE (A164) of PC (or PLC or Controller) has to match the inverter baud rate setting. Communication format (A165/A166/A167) should also be set as the same.
b. The inverter will confirm and acknowledge commands as PC modifies the parameters of the inverter.
c. Please refer to the N3 Communication PROTOCOL.

A168: Stator Resistance(Ohms) Gain
A169: Rotator Resistance(Ohms) Gain
A170: Equivalent Inductance(mH) Gain
A171: Magnetized Current(Amps AC) Gain
A172: Ferrite Loss Conduction (gm) Gain

1. If A000=0 or 1(vector control mode), when powered up, set A006=1. The motor will run while the inverter performs auto tuning. Once the motor stops, auto tuning is finished. The inverter will write the internal parameters of the motor to A168~ A172, and auto reset the A006 to 0.
2. Auto tuning must be carried out whenever the motor is changed. If the internal parameters are known already, they can be input to A168~A172 directly.
3. Set A006=1 to perform auto tuning. When finished, A006 auto resets to 0. The Keypad displays END.
4. The parameter group is only effective in current vector mode.
5. Never perform the auto tune when the inverter and motor are not connected.

A175: Drive Horsepower Code

A175	Inverter Model	
2P5	N3-	2P5-SC/SCF/C
201		201-SC/SCF/C
202		202-SC/SCF/C
203		203-SC/SCF/C
205		205-C
207		207-C
210		210-C
215		215-N1,
220		220-N1
225		225-N1
230		230-N1
240		240-N1

A175	Inverter Model	
401	N3-	401-C/CF
402		402-C/CF
403		403-C/CF
405		405-C/CF
407		407-C/CF
410		410-C/CF
415		415-C/CF
420		420-N1
425		425-N1
430		430-N1
440		440-N1
450		450-N1
460		460-N1
475		475-N1

A176: Software Version

A177: Fault Jog（Latest 3 times）

1. When the inverter trips on a fault, the former fault log stored in2.xxxx will be transferred to 3.xxxx, the one in 1.xxxx to 2.xxxx. The present fault will be stored in the blank 1.xxxx. The fault stored in 3.xxxx is the earliest one of the most recent three, while the one 1.xxxx is the latest.
2. When pressing 'ENTER' at A177, the fault 1.xxxx will be displayed first. Press▲, to read 2.xxx→3.xxx→1.xxx press▼, and the order is 3.xxx→2.xxx→1.xxx→3.xxx.
3. When pressing 'ENTER' at A177, the three fault log will be cleared when the reset key is pressed. The log content will change to 1.---,2.---,3.---.
4. E.g. the fault log content is '1.OCC', this indicates the latest fault is OC-C, etc.

A178: Accumulated Operation Time 1 (Hours): 0 – 9999
A179: Accumulated Operation Time 2 (Hours X 10000): 0 - 27
A180: Accumulated Operation Time Mode: 0000: Power on time
0001: Operation time

1. When the operation time is to 9999 as the elapsed time 1 is set. The next hour will be carried to operation A179. Meanwhile, the recorded value will be cleared to 0000, and the record value of operation duration 2 will be 01.
2. Description of operation time selection:

Preset value	Description
0	Power on, count the accumulated time.
1	Inverter operation, count the accumulated operation time

A181: Reset to the factory setting: 1110: Reset to the 50Hz factory setting
1111: Reset to the 60Hz factory setting

When A181 is set to 1111, the parameter will be reset to the factory setting. The max output voltage will comply with the voltage and frequency (A001/A005) on the nameplate of the motor. The output frequency is 60Hz if the upper frequency limit is not set.

※Note:
Motor parameters (A168~A172) will be modified under V/F control mode when reset factory setting is performed.
Motor parameters (A168~A172) will not be modified under vector control mode when reset factory setting is performed.

B000 : Run Command Source Selection
0000:Keypad
0001:External terminal control
0002:Communication control

1.) B000=0000 the inverter is controlled by the keypad.
2.) B000=0001 the inverter is controlled by the external terminals. The Stop key for emergency will function. (Refer to A010 description).
Note: B000=0001, please refer to parameter group A013, A014, A019 and A018 for detail description for safety of persons and machines.
3.) B000=0002 the inverter is Rs485 communication controlled.

B001 : Operation modes for external terminals

0000:Forward/stop-reverse/stop

0001:Run/stop-forward/reverse

0002:3-wire control mode -run/stop

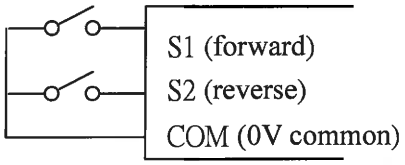
1.) When operation command B000 = 0001 (external terminal), B001 is valid.

2.) When operation command B000 = 0001 (external terminal control), the stop button for emergency is available. (Refer to A010 for detail description).

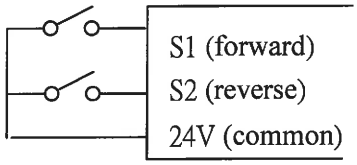
3.) When both forward and reverse commands are ON will be treated as STOP.

B001 = 0000, Control mode is as below:

(1).Input signal is NPN:

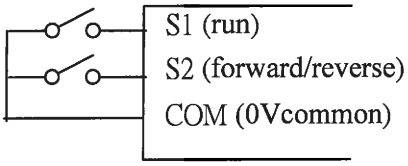


(2). Input signal is PNP:



B001 = 0001, Control mode is as below:

(1). Input signal is NPN:



(2). Input signal is PNP:

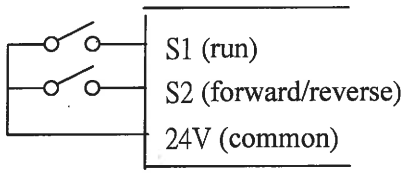
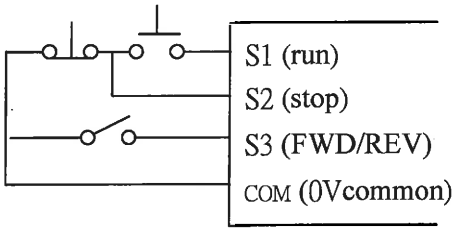


Figure 4-31 Terminal Board Drive Operation Modes

B001 = 0002, Control mode is as below:

(1). Input signal is NPN:



(2). Input signal is PNP:

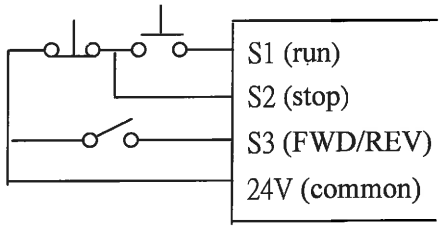


Figure 4-32 3-Wire start/stop wiring

□Note: As 3 wire control mode is selected, the terminal S3 is not controlled by A052.

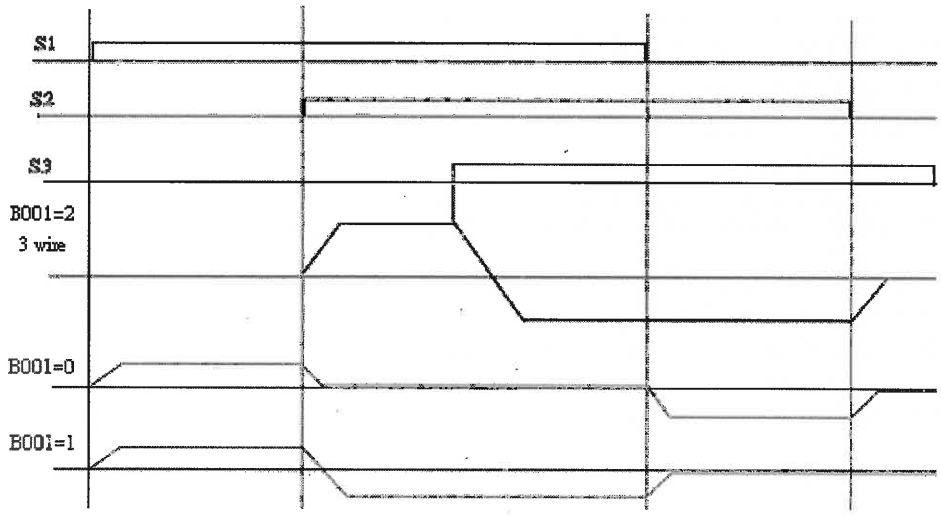


Figure 4-33 Drive start/stop operation sequences

□Note: B002=0001, the reverse command is unavailable.

B002 : Prohibition of Reverse Operation	**0000: Enable Reverse Command** **0001: Disable Reverse Command**

B002=0001, the reverse command is invalid.

B003 : Stopping Method	**0000: Controlled Deceleration-to- Stop with DC Injection Braking (Rapid Stop)** **0001: Free run stop (Coast stop)**

1.) B003=0000: the inverter will decelerate to 0Hz within configured deceleration time after receiving the stop command.

2.) B003=0001: the inverter will stop after receiving the stop command. The motor will coast to stop.

B004 : Frequency Command Source Selection

0000: Set the Frequency with Keypad

0001: Potentiometer on Keypad

0002: External Analog Signal Input or Remote Potentiometer

0003: Up/Down Frequency Control Using MFIT (S1 - S6)

0004: Communication Setting Frequency

0005: Impulse frequency (S5) setting frequency (ver2.3)

1.) B004=0001: if one of the parameters in group A050~ A056is set to 16 and the multifunction terminal is OFF, the frequency is set by the potentiometer (VR for principal speed) on keypad. While the multifunction is ON, the frequency is set by analog signal (auxiliary speed) on terminal block (TM2).

2.) B004=0002: if one of the parameters in group A050~ A056 is set to 16 and the multifunction terminal is OFF, the frequency is set by the analog signal (principal speed) on terminal block (TM2), While the input is ON, the frequency is set by the potentiometer (VR for auxiliary speed) on the keypad.

3.) Please refer to the description of parameter group A050~ A056 (multifunction input terminals) for the function Up/Down terminal.

4.) The priority in reading frequency is Jog> preset speed>▲▼ on keypad or Up / Down or communication control.

B005: Frequency Upper limit(Hz) : 0.01 - 400.00

B006: Frequency Lower limit(Hz) : 0.01 - 400.00

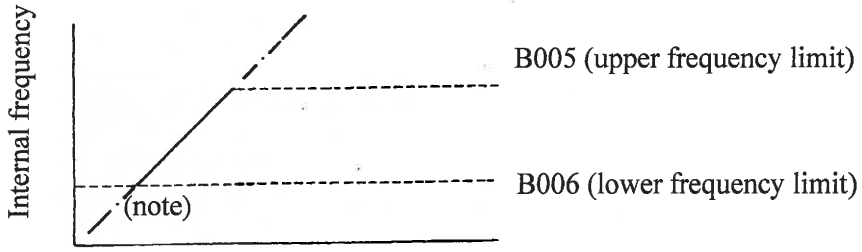


Figure 4-34 Frequency reference limits

※Note: When B006 = 0 Hz and frequency command is 0 Hz, the inverter will stop at 0 speed. When B006 > 0 Hz and frequency command ≦B006, the inverter will output the B006 preset value.

B010 : Parameter Lock(except B010) : 0000: Disable
0001: Enable

0000: Disable parameter lock.
0001: Enable parameter lock.

B011 : Advanced Display : 0000: Disable
0001: Enable

0000: Disable advanced display.
0001: Enable access to advanced functions (A000~A181).

B012 Language Selection

0000: English
0001: German
0002: French
0003: Italian
0004: Spanish

The function is only available for the products with LCD operation keypad. The operation is not valid with the LED keypad.

B013:Motor Current Display Selection: 0000: Disable Motor Current Display
0001: Enable Motor Current Display

B014:Motor Voltage Display Selection: 0000: Disable Motor Voltage Display
0001: Enable Motor Voltage Display

B015:DC Bus Voltage Display Selection: 0000: Disable Bus Voltage Display
0001: Enable Bus Voltage Display

B016:PID Feedback Display 0000:Disabled
0001:Enable

Keypad displays PID feedback value:
Parameter A055=20 (When S6 is set as the PID feedback analog terminal, refer to PID), A140=1(PID is enabled), and B016=1 (Displays S6 as PID analog feedback value 0~100, the formula is as follows:
If feedback signal is 0~10V, (A154=0000), the keypad display value = (S6/10V)*100
If feedback Signal is 4~20mA, (A154=0001), the keypad display value = (S6/20mA)*100
※Note: Please press DSP Key to switch between the output frequency and PID feedback value.
※Note: The inverter displays XXXF when in Run mode, while XXXr when stopped.

Chapter 5 Troubleshooting and maintenance

5.1. Error display and corrective action

5.1.1. Faults which can not be recovered manually

	Display	Fault	Cause	Corrective action
	CPF	Program problem	External noise interference	Connect a parallel RC suppressor across the magnetizing coil of the magnetic contactor that causes the interference
	EPR	EEPROM problem	Faulty EEPROM	Replace EEPROM
@	-OV-	Voltage too high when stopped	Detection circuit malfunction	Return the inverter
@	-LV-	Voltage too low when stopped	1. Power voltage too low 2. Pre-charge resistor or fuse burnt out. 3. Detection circuit malfunction	1. Check if the power voltage is correct 2. Replace the pre-charge resistor or the fuse 3. Return the inverter
@	-OH-	The inverter is overheated when stopped	1. Detection circuit malfunction 2. Ambient temperature too high or bad ventilation	1. Return the inverter 2. Improve ventilation conditions
	CTER	Current Sensor detection error	Current sensor error or circuit malfunction	Return the inverter

※ Note： "@" the Failure contact does not function.

5.1.2. Faults which can be recovered manually and automatically

Display	Fault	Cause	Corrective Action
OC-S	Over current at start	1. the motor winding short circuit 2. motor contacts and ground short circuit 3. the IGBT module damaged	1.inspect the motor 2.inspect the wiring 3.replace the transistor module
OC-D	Over-current at deceleration	The preset deceleration time is too short.	Set a longer deceleration time
OC-A	Over-current at acceleration	1. Acceleration time too short 2. The capacity of the motor exceeds the capacity of the inverter 3. Short circuit between the motor coil and the case 4. Short circuit between motor wiring and ground 5. IGBT module damaged	1. Set a longer acceleration time 2. Replace inverter with one that has the same rating as that of the motor 3. Check the motor 4. Check the wiring 5. Replace the IGBT module
OC-C	Over-current at fixed speed	1. Transient load change 2. Transient power change	1.Increase the capacity of the inverter 2.Repeat parameter auto tuning (A006 = 1) 3.Reduce stator resistance (A168) if the above actions are ineffective
OV-C	Excessive Voltage during operation/ deceleration	1. Deceleration time setting too short or excessive load inertia 2. Power voltage varies widely (fluctuates)	1. Set a longer deceleration time 2. Add a brake resistor or brake module 3. Add a reactor at the power input side 4. Increase inverter capacity
Err4	Illegal interrupt of CPU	Outside noise interference	Return unit if this happens regularly
OVSP	Over speed during operating	1. Motor load too big or Inverter capacity too small 2. Motor parameter error (vector mode) 3. The gain is excessive in vector mode 4. Current detection circuit fault	1. Increase acceleration / deceleration time (B007/B008) 2. Input correct motor Parameter 3.Change stator Resistance gain and Rotor resistance gain (A168/A169), (suggest incremental Decrease of 50~100) 4. (Return unit)

5.1.3 Faults which can be recovered manually but not automatically

Display	Fault	Cause	Corrective Action
OC	Over-current during stop	1. Detection circuit malfunction 2. Bad connection for CT signal cable	1.Check the noise between Power line and motor line 2.Return the inverter for repair
OL1	Motor overload	1. Excessive load 2. Inappropriate settings on A002, A119~A122	1. Increase the motor capacity 2. set A002, A119~A122 properly
OL2	Inverter overload	Excessive Load	Increase the inverter capacity
OL3	Over torque	1. Excessive Load 2. Improper settings on A125, A126	1. Increase the inverter capacity 2. set A125, A126 properly
LV-C	Voltage too low during operation	1. Power voltage too low 2. Power voltage varies widely (fluctuates)	1. Improve power quality or increase the value of A014 2. Set a longer acceleration time 3. Add a reactor at the power input side
OH-C	Heat-sink temperature too High during operation	1. Excessive load 2. Ambient temperature too high or bad ventilation	1. Check if there are any problems with the load 2. Increase inverter capacity 3. Improve ventilation conditions

5.1.4 Special conditions

Display	Fault	Description
STP0	Zero speed stop	Occurs when preset frequency <0.1Hz
STP1	Fail to start directly	1. If the inverter is set for external terminal control mode (B000=1) and direct start is disabled (A017=0001) The inverter cannot be started and will flash STP1. The run input is active at power-up (refer to descriptions of A017). 2. Direct start is possible when A017=0001.
STP2	Keypad emergency stop	1. If the inverter is set in external control mode (B000=0001) and the Stop key is enabled (A010=0000), the inverter will stop according to the setting on B003. When the Stop key is pressed, 'STP2' flashes after stop. Release and re-assert the run contact to restart the inverter. 2. If the inverter is in communication mode and the Stop key is enabled (A010=0000), the inverter will stop in the way set by B003 when Stop key is pressed during operation and then flashes STP2. The Host controller has to send a Stop command then a Run command to the inverter for it to be restarted. 3. Stop key cannot perform an emergency stop when A010=0001
E.S.	External emergency stop	The inverter will ramp stop and then flash E.S., when input external emergency stop signal via the multifunctional input terminal activates (refer to descriptions of A050~A056).
b.b.	External base block	The inverter stops immediately and then flashes b.b., when external base block is input through the multifunctional input terminal activates (refer to descriptions of A050~A056).
ATER	Auto-tuning faults	1. Motor data error resulting in for auto-tuning failure 2. Stopping the inverter during Auto-tuning before completion
PDER	PID feedback loss	PID feedback loss detect

5.1.5 Operation errors

Display	Error	Cause	Corrective Action
LOC	Parameter and frequency reverse already locked	1.Attempt to modify frequency parameter while A039>0000 2.Attempt to reverse while B002=0001	1.Set A039=0000 2. Set B002=0000
Err1	Keypad operation error	1. Press ▲ or ▼while B004>0 or running at preset speed. 2. Attempt to modify the parameter can not be modified during operation (refer to the parameter list).	1.The ▲ or▼ is available for modifying the parameter only when B004=0 2.Modify the parameter while STOP
Err2	Parameter setting error	1. B006 is within the range of A032 ± A035 or A033 ± A035or A034 ± A035 2. B005≤B006 3. Setting error while performing Auto tuning(e.g. B000 ≠ 0, B004 ≠ 0)	1.Modify A032~A034 or A035 2. B005>B006 Set B000=0, B004=0 during Auto tuning
Err5	Modification of parameter is not available in RS485 communication	1.Issue a control command during RS485 communication disallowed 2.Modify the function A164 ~ A167 during RS485 communication	1.Issue enable command before communication 2.Set parameters 164-167 function before RS485 communication
Err6	Communication failed	1.Wiring error 2.Communication parameter setting error. 3.Sum-check error 4.Incorrect communication protocol	1.Check hardware and wiring 2.Check Functions A161 ~ A164
Err7	Parameter conflict	1.Attempt to modify the function A175. 2.Voltage and current detection circuit is abnormal	If Reset is not available, please contact TWMC
EPr1	Parameter setting error copy unit failed	1. Set A040=1/2 to without connecting copy unit. 2. Copy unit failed.	1.Modify A040 2.Replace copy unit
EPr2	Parameter mis-match	Problem during copying of the parameter to inverter to	1.Retry copy command 2.Replace copy unit

5.2 General troubleshooting

Status	Checking point	Remedy
Motor can not run	Is power applied to L1 (L), L2, and L3 (N) terminals (is the charging indicator lit)?	• Is the power applied? • Turn the power OFF and then ON again. • Make sure the power voltage is correct. • Make sure screws are secured firmly.
	Is there voltage across the output terminals T1, T2, and T3?	• Turn the power OFF and then ON again.
	Is overload causing the motor to stall?	• Reduce the load so the motor will run.
	Are there any abnormalities in the inverter?	• See error descriptions to check wiring and correct if necessary.
	Is forward or reverse run command issued?	
	Has the analog frequency signal been input?	• Is analog frequency input signal wiring correct? • Is voltage of frequency input correct?
	Is the operation mode setting correct?	• Operate through the digital keypad .
Motor runs in wrong direction	Is the wiring for output terminals T1, T2, and T3 correct?	• Wiring must match U, V, and W terminals of the motor.
	Is the wiring for forward and reverse signals correct?	• Check wiring are correct if necessary.
The motor speed can not be regulated.	Is the wiring for the analog frequency inputs correct?	• Check wiring are correct if necessary.
	Is the setting of operation mode correct?	• Check the operation mode of the operator.
	Is the load too excessive?	• Reduce the load.
Motor running speed too high or too low	Are specifications for the motor (poles, voltage…) correct?	• Confirm the motor specifications.
	Is the gear ratio correct?	• Confirm the gear ratio.
	Is the setting of the highest output frequency correct?	• Confirm the highest output frequency.
Motor speed varies unusually	Is the load too excessive?	• Reduce the load.
	Does the load vary excessively?	• Minimize the variation of the load. • Increase capacities of the inverter and the motor.
	Is the input power erratic or is a phase loss occurring?	• Add an AC reactor at the power input side if using single-phase power. • Check wiring if using three-phase power.

5.3 Quick troubleshooting of N3

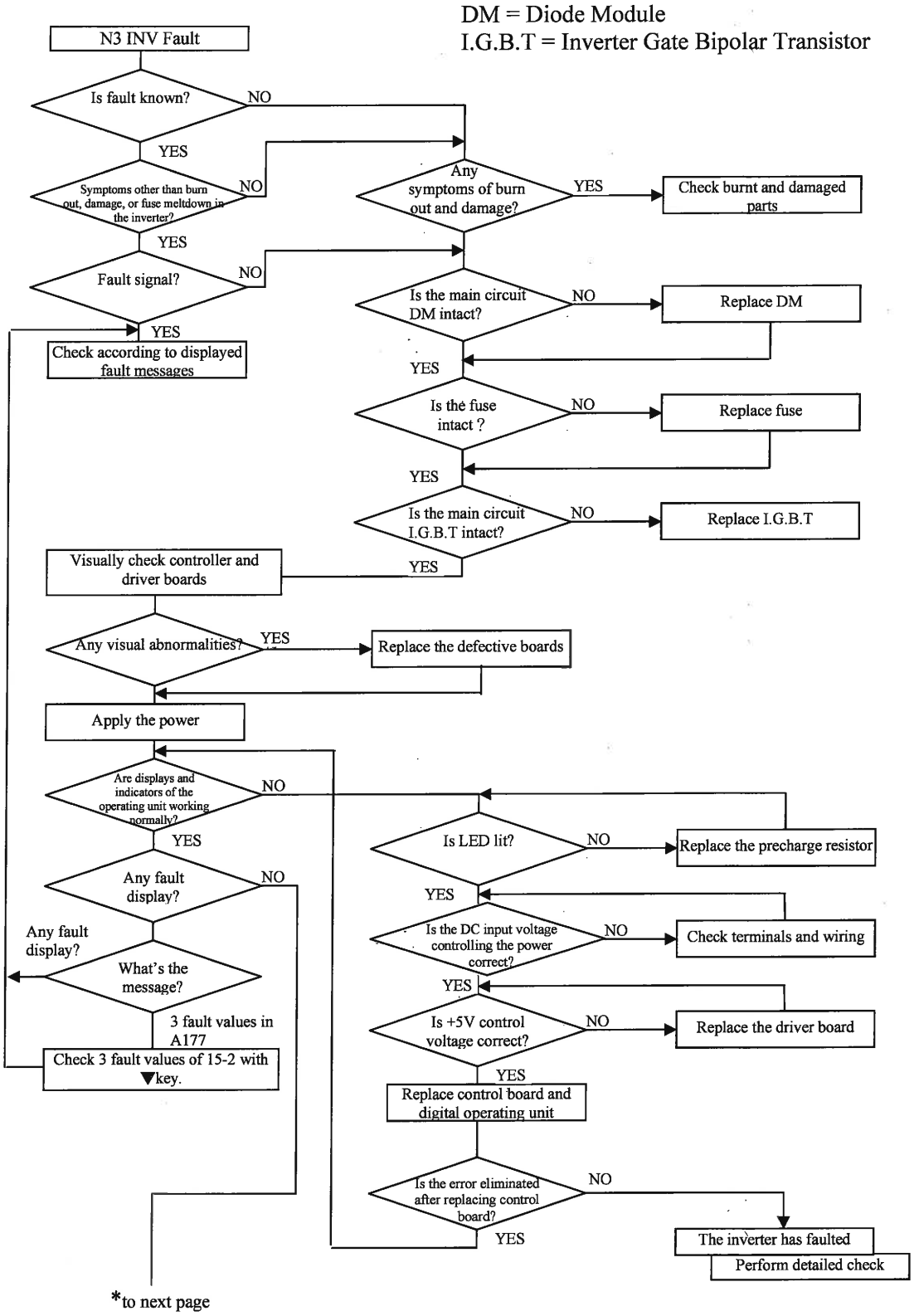


Figure 5-1 N3 fault display troubleshooting flow chart

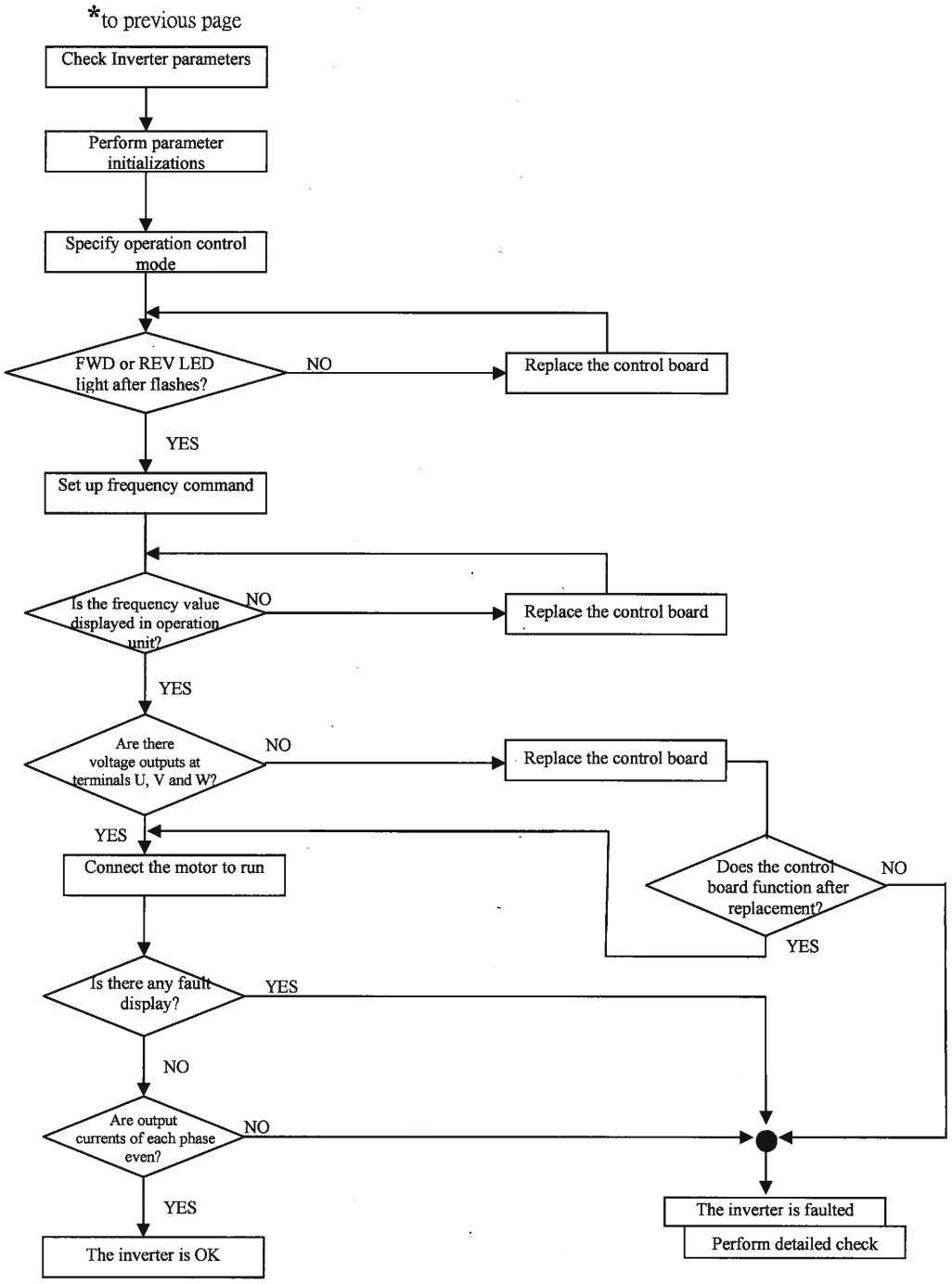


Figure 5-1 N3 fault display troubleshooting flow chart

Troubleshooting for OC, OL error displays

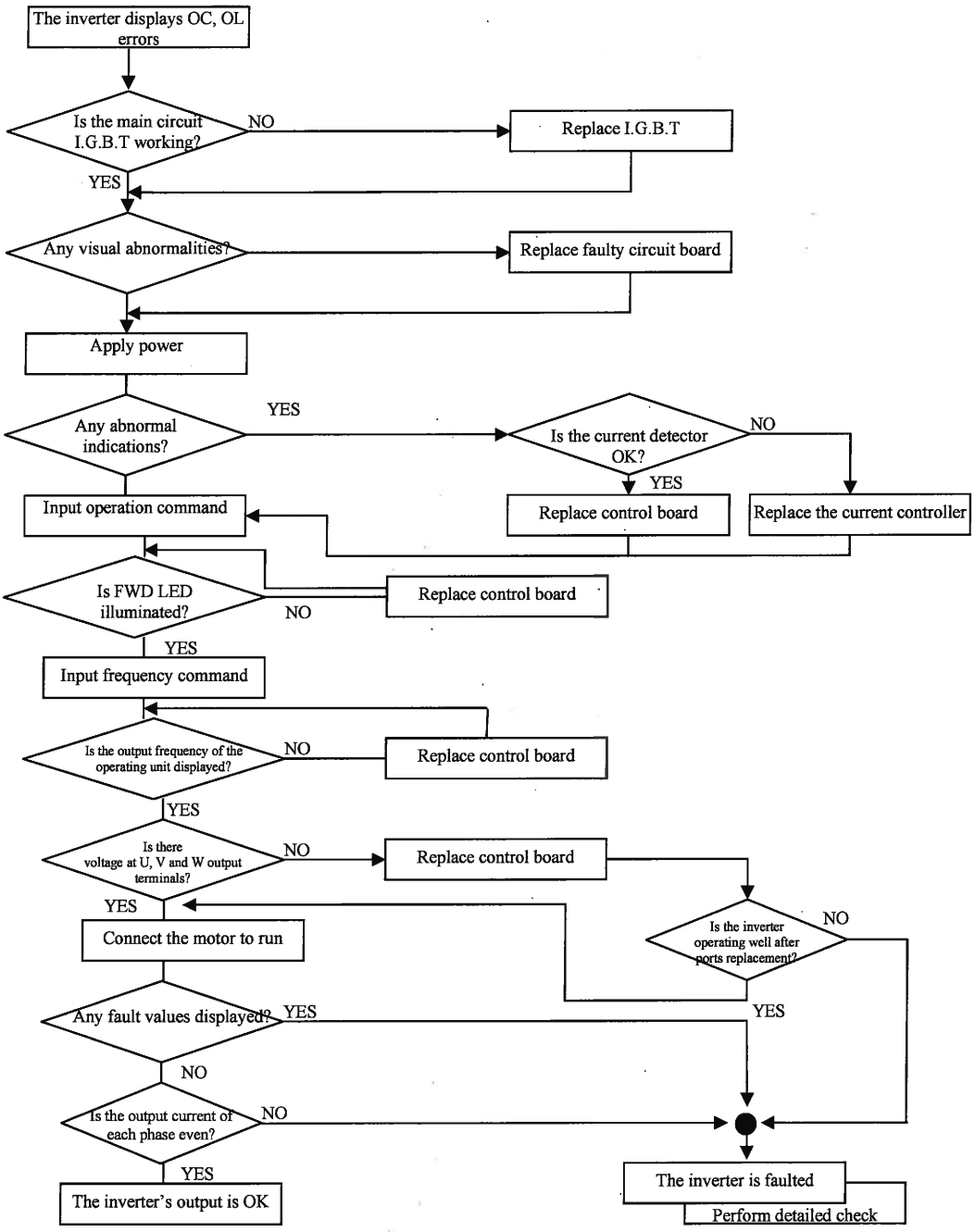


Figure 5-2 OC, OL Fault Flow Chart

Troubleshooting for OV, LV error

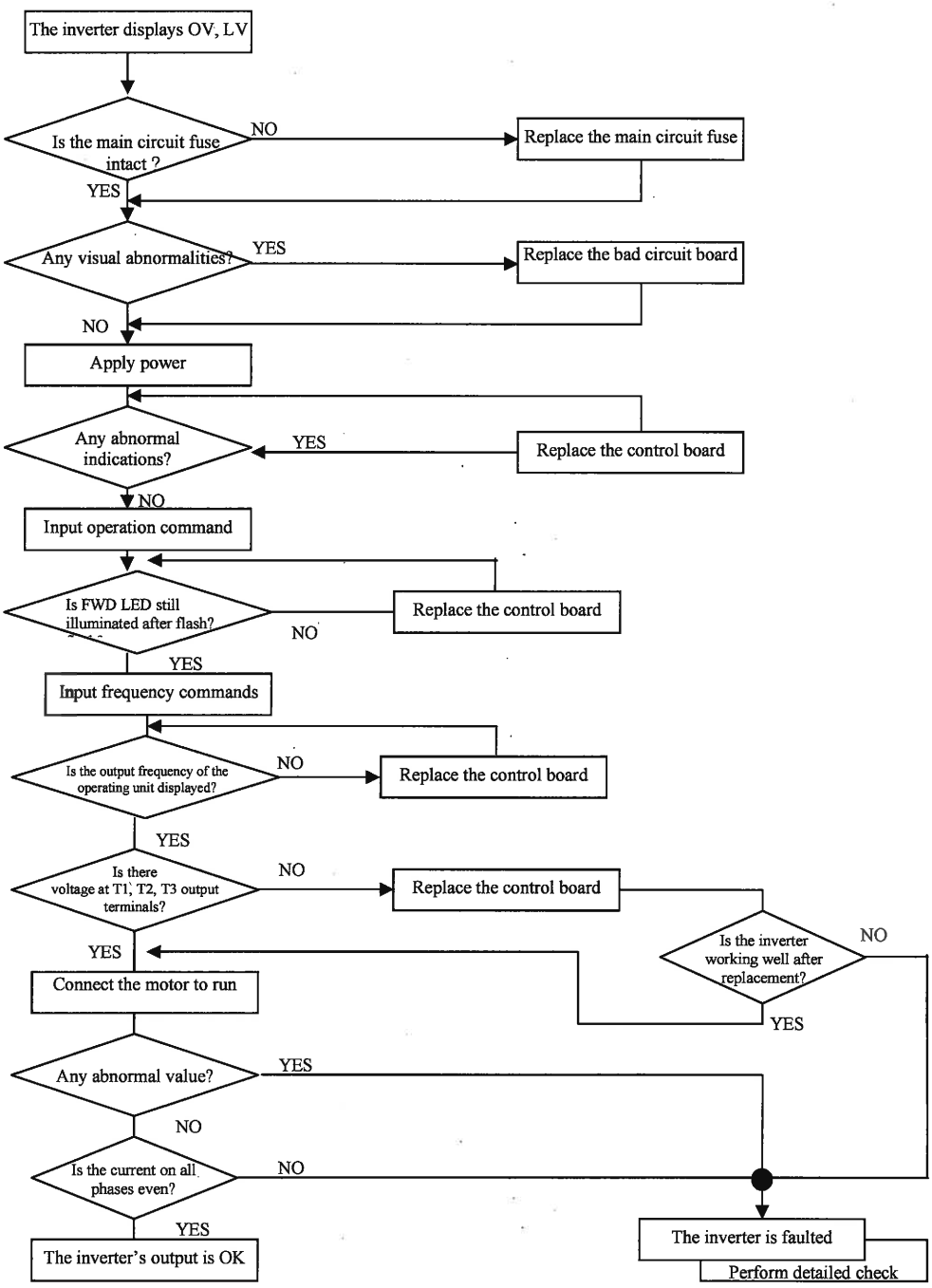


Figure 5-3 OC, LV Fault Flow Chart

The motor can not run

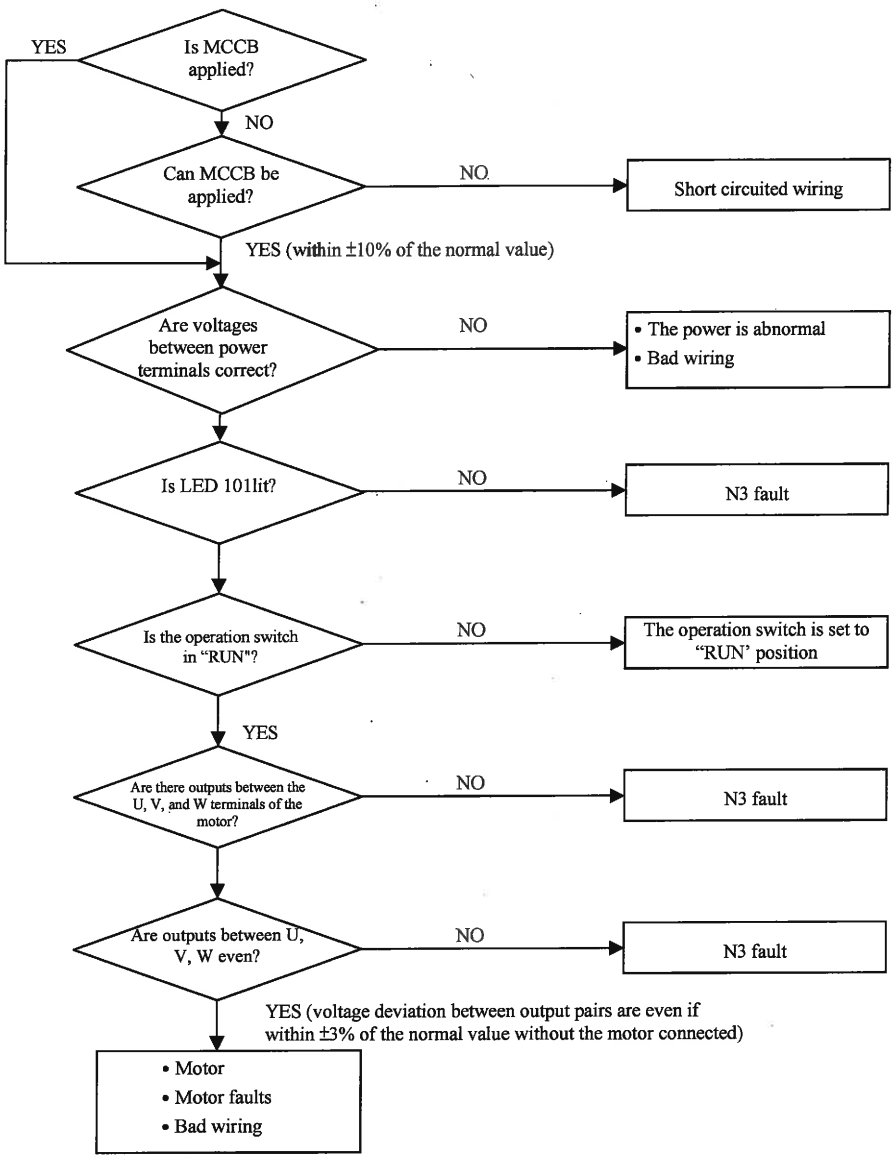


Figure 5-4 RUN MODE TROUBLESHOOTING Flow Chart

The motor is overheated

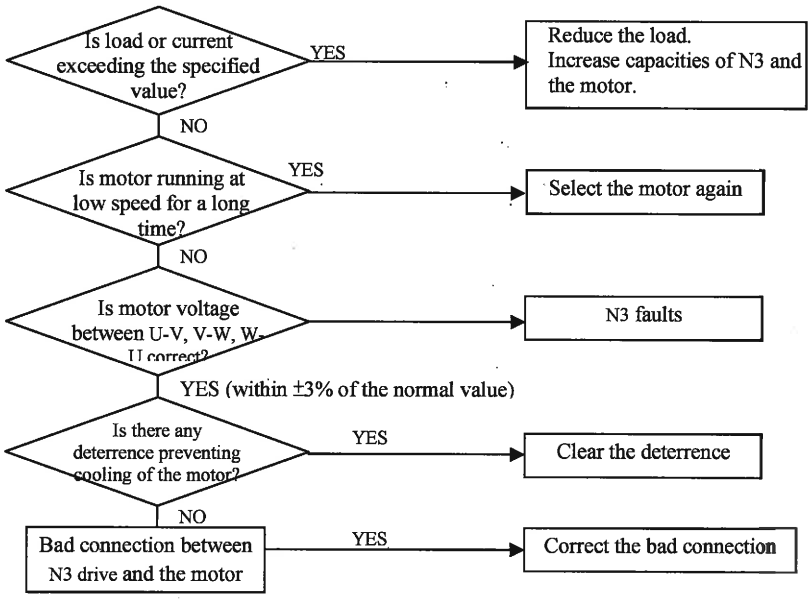


Figure 5-5 Motor Overheat Troubleshooting Flow Chart

Motor runs unevenly

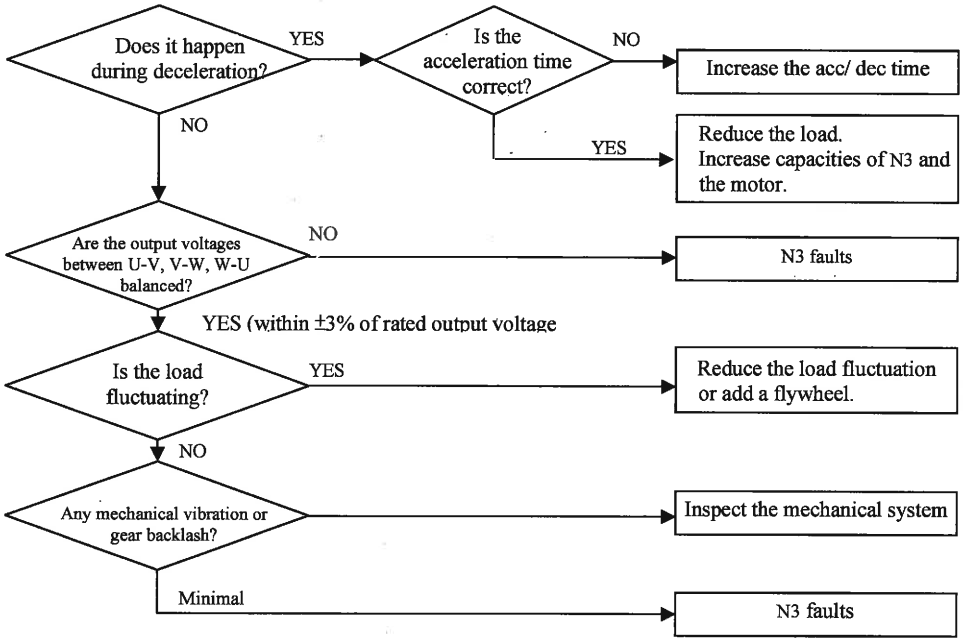


Figure 5-6 Motor Instability Troubleshooting Flow Chart

5.4 Routine inspection and period inspection

To ensure stable and safe operations, check and maintain the inverter at regular intervals.

The table below lists the items to be checked to ensure stable and safe operations.

Check these items 5 minutes after the "Charge" indicator goes out to prevent injury to personnel by residual electric power.

Items	Details	Checking period		Methods	Criteria	Remedies
		Daily	1Year			
Ambient conditions around the machine	Confirm the temperature and humidity at the machine	○		Measure with thermometer and hygrometer according to installation notices.	Temperature: -10 – 40°C (14-120°F) Humidity: Below 95% RH	Improve the ambient or relocate the drive to a better area.
	Are there inflammable materials in the vicinity?	○		Visual check	Keep area clear	
Installation and grounding of the inverter	Any unusual vibration from the machine	○		Visual, hearing check	No vibration	Secure screws
	Is the grounding resistance correct?		○	Measure the resistance with a multi-tester	200V series: below 100Ω 400V series: below 10Ω	Improve the grounding
Input power voltage	Is the voltage of the main circuit correct?	○		Measure the voltage with a multi-tester	Voltage must conform with the specifications	Improve input voltage
External terminals and internal mounting screws of the inverter	Are secure parts loose?		○	Visual check Check with a screwdriver	Secure terminals and no rust	Secure or send back for repair
	Is the terminal base damaged?		○			
	Visual rust stains present?		○			
Internal wiring of the inverter	Any unusual bends or breaks?		○	Visual check	No abnormalities	Replace or send back for repair
	Any damage of the wire insulation?		○			
Heat sink	Excessive dust or debris	○		Visual check	No abnormalities	Clean up debris or dust
Printed circuit board	Excessive conductive metal shavings or oil sludge		○	Visual check	No abnormalities	Clean or replace the circuit board
	Discolored, overheated, or burned parts		○			
Cooling fan	Unusual vibration and noise		○	Visual or hearing check	No abnormalities	Replace the cooling fan
	Excessive dust or debris	○		Visual check		Clean fan
Power component	Excessive dust or debris		○	Visual check	No abnormalities	Clean component
	Check resistance between each terminals		○	Measure with a multi-tester	No short circuit or broken circuit in three-phase output	Replace power component or inverter
Capacitor	Any unusual odor or leakage	○		Visual check	No abnormalities	Replace capacitor or inverter
	Any deformity or protrusion	○				

Chapter 6 Peripherals Components

6.1 Reactor specification at Input side

Model		AC inductance at input side	
		Current (A)	Inductance (mH)
N3-	2P5	5.0	2.1
	201	5.0	2.1
	202	10.0	1.1
	203	15.0	0.71
	205	20.0	0.53
	207	30.0	0.35
	210	40.0	0.265
	215	60.0	0.18
	220	80.0	0.13
	225	90.0	0.12
	230	120.0	0.09
	240	160.0	0.07

Model		AC inductance at input side	
		Current (A)	Inductance (mH)
N3-	401	2.5	8.4
	402	5.0	4.2
	403	7.5	3.6
	405	10.0	2.2
	407	15.0	1.42
	410	20.0	1.06
	415	30.0	0.7
	420	40.0	0.53
	425	50.0	0.42
	430	60.0	0.36
	440	80.0	0.26
	450	90.0	0.24
	460	120.0	0.18
	475	150.0	0.15

6.2 Reactor specification at DC side

Model		DC inductance at input side	
		Current (A)	Inductance (mH)
N3	2P5	3.1	5.65
	201	4.5	3.89
	202	7.5	2.33
	203	10.5	1.67
	205	17.5	1.00
	207	26	0.67
	210	35	0.50
	401	2.3	15.22
	402	3.8	9.21
	403	5.2	6.73
	405	8.8	3.98
	407	13	2.69
	410	17.5	2.00
	415	25	1.40

6.3 Braking unit and braking resistor

N3 series braking specifications

Inverter Model	Braking Unit		Braking Resistor per braking unit	Suitable Motor Capacity (HP)	Suitable Motor Capacity (KW)	Braking resistor Specification		Braking resistor Duty Cycle (%)	Braking torque (%)	Resistor dimension (L*W*H) mm (inches)
	Model	Number used	Type			(W)	(Ω)			
2P5	-	-	JNBR-150W200	0.5	0.4	150	200	10	238	251*28*60 (9.88*1.10*2.36)
201	-	-	JNBR-150W200	1	0.75	150	200	10	119	251*28*60 (9.88*1.10*2.36)
202	-	-	JNBR-150W100	2	1.5	150	100	10	119	251*28*60 (9.88*1.10*2.36)
203	-	-	JNBR-260W70	3	2.2	260	70	10	115	274*34*78 (10.79*1.34*3.07)
205	-	-	JNBR-390W40	5	3.7	390	40	10	119	395*34*78 (10.79*1.34*3.07)
207	-	-	JNBR-520W30	7.5	5.5	520	30	10	108	400*40*100 (15.7*1.57*3.94)
210	-	-	JNBR-780W20	10	7.5	780	20	10	119	400*40*100 (15.7*1.57*3.94)
215	-	-	JNBR-2R4KW13R6	15	11	2400	13.6	10	117	535*50*110 (*2 pcs) (21.1*1.96*4.33)
220	-	-	JNBR-3KW10	20	15	3000	10	10	119	615*50*110 (*2 pcs)
225	JNTBU-230	1	JNBR-4R8KW8	25	18.5	4800	8	10	119	535*50*110 (*4 pcs) (21.1*1.96*4.33)
230	JNTBU-230	1	JNBR-4R8KW6R8	30	22	4800	6.8	10	117	535*50*110 (*4 pcs) (21.1*1.96*4.33)
240	JNTBU-230	2	JNBR-3KW10	40	30	3000	10	10	119	615*50*110 (*2 pcs) (24.21*1.96*4.33)
401	-	-	JNBR-150W750	1	0.75	150	750	10	126	251*28*60 (9.88*1.10*2.36)
402	-	-	JNBR-150W400	2	1.5	150	400	10	119	251*28*60 (9.88*1.10*2.36)
403	-	-	JNBR-260W250-	3	2.2	260	250	10	126	274*34*78 (10.79*1.34*3.07)
405	-	-	JNBR-400W150-	5	3.7	400	150	10	126	395*34*78 (10.79*1.34*3.07)
407	-	-	JNBR-600W130-	7.5	5.5	600	130	10	102	470*50*100 (15.7*1.57*3.94)
410	-	-	JNBR-800W100	10	7.5	800	100	10	99	535*50*110 (24.21*1.96*4.33)
415	-	-	JNBR-1R6KW50	15	11	1600	50	10	126	615*50*110 (24.21*1.96*4.33)
420	-	-	JNBR-1R5KW40	20	15	1500	40	10	119	615*50*110 (24.21*1.96*4.33)
425	JNTBU-430	1	JNBR-4R8KW32	25	18.5	4800	32	10	119	535*50*110 (*4 pcs) (21.1*1.96*4.33)
430	JNTBU-430	1	JNBR-4R8KW27R2	30	22	4800	27.2	10	117	535*50*110 (*4 pcs) (21.1*1.96*4.33)
440	JNTBU-430	1	JNBR-6KW20	40	30	6000	20	10	119	615*50*110 (*4 pcs) (24.21*1.96*4.33)
450	JNVPHV-0060	1*5	JNBR-9R6KW16	50	37	9600	16	10	119	535*50*110 (*4 pcs) (21.1*1.96*4.33)
460	JNVPHV-0060	1*5	JNBR-9R6KW13R6	60	45	9600	13.6	10	117	535*50*110 (*4 pcs) (21.1*1.96*4.33)
475	JNTBU-430	2	JNBR-6KW20	75	55	6000	20	10	126	615*50*110 (*4 pcs) (24.21*1.96*4.33)

□ Formula for brake resistor: **W= (Vpnb * Vpnb) * ED% / R**

1. **W :** braking resistor power (Watts)
2. **Vpnb:** braking voltage (220V=380VDC, 440V=760VDC)
3. **ED%:** braking effective period
4. **R:** braking resistor rated ohms
5. **Alternative selection choice:** 450: (JNTBU-430 + JNBR-4R8KW32) × 2
   460: (JNTBU-430 + JNBR-4R8KW27R2) × 2

□ Above 25HP, please add Braking Transistor Units: 200V JNTBU-230
400V JNTBU-430
400V JUVPHV-0060

For more detailed information, please contact TWMC.

6.4 Digital operator and extension cable

A. Remote Cable Kit

Inverter Model	Extension Cable Kit	Cable Length FT (Meter)
All models	JNSW-30P5	1.6 (0.5)
	JNSW-3001	3.3 (1.0)
	JNSW-3002	6.6 (2.0)
	JNSW-3003	9.8 (3.0)
	JNSW-3005	16.4 (5.0)

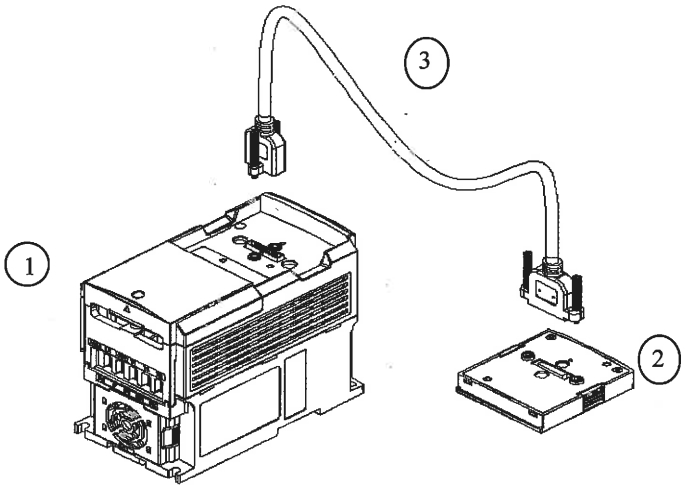


Figure 6-1 Digital Operator Extension Cable

B. Content

① Inverter

② LED (N3-LED) or LCD (N3-LCD) Keypad

③REMOTE Cable for Keypad

C. Operation procedure:

Warning: Disconnect the power supply. The following procedures should be performed after there is no display on the keypad.

1. Remove the keypad from the Inverter.
2. Please refer to Figure 6-1 before mounting the keypad to your machine or Panel.
3. Connect the inverter and the keypad with the remote cable in accordance with the Figure 6-1.

Supply power ONLY after all components are secured.

LED Keypad (N3-LED) Mounting Dimensions Unit: in (mm)

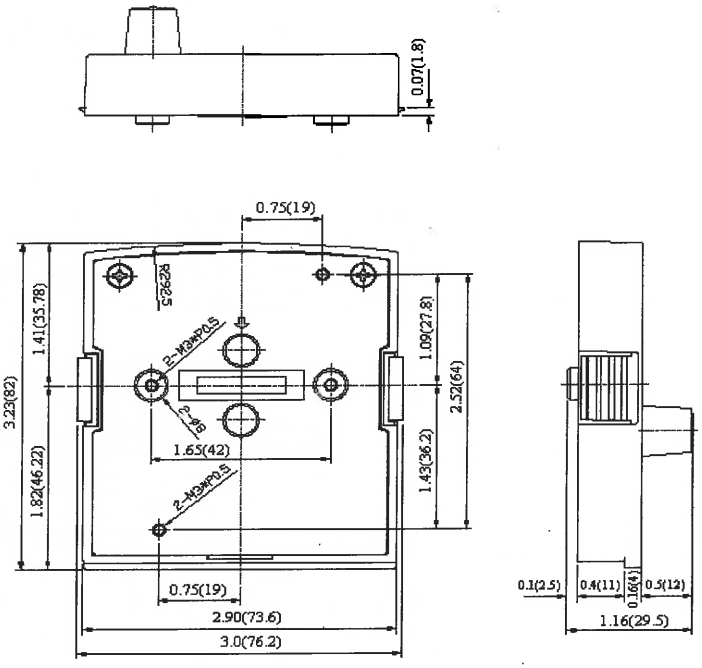


Figure 6-2 LED Keypad (N3-LED) Mounting Dimensions

LCD Keypad (N3-LCD) Mounting Dimensions Unit: in (mm)

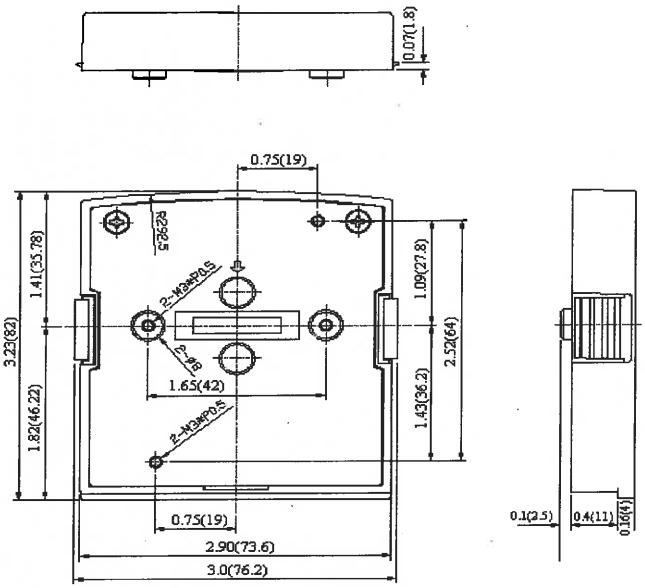


Figure 6-3 LCD Keypad (N3-LCD) Mounting Dimensions

6. 5 EMC Filter

The inverter adopts rapid switching components to improve the efficiency of the motor and to reduce the motor noise. Using the EMC Filter allows the EMI (Electromagnetic Interference) and RFI (Radio Frequency interference) to be controlled within ranges compliant with the directives as shown.

EMC Directives

The inverter with optional filter complies with the EMC directives 89/336/EEC, limiting the environmental EMI and RFI. Independent tests have demonstrated compliance to the following standards when the optional filters are used.

EMI radio standard、EMS immunity standard

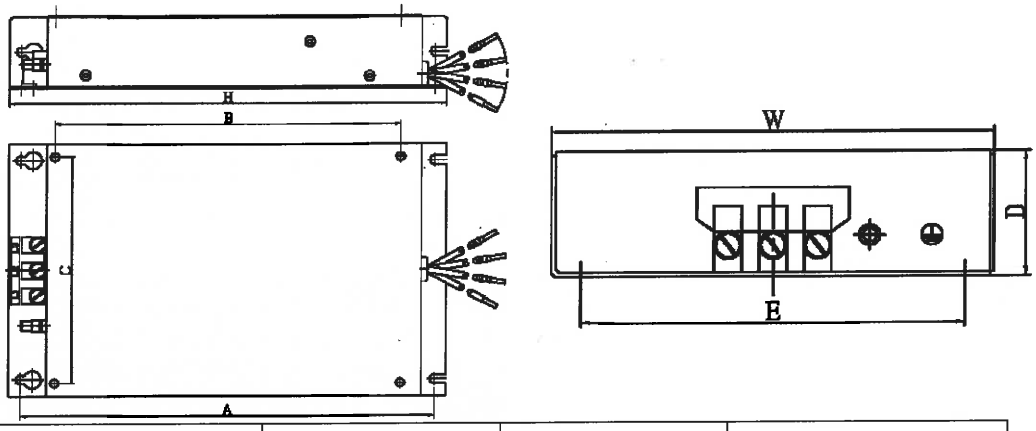
EN 61800-3 1996/A11: 2000: First Environment Unrestricted Distribution (Class B).

EN 61800-3 1996/A11: 2000: First Environment Restricted Distribution

Filter Selection

Inverter Model		Rating (INPUT)	Filter Model	
			First Environment Restricted Distribution	First Environment Unrestricted Distribution
N3	2P5-SCF	1 ϕ 170 ~264V	Built in	FS 6146-11-07
	201-SCF	1 ϕ 170~264V	Built in	FS 6146-11-07
	202-SCF	1 ϕ 170~264V	Built in	FS 6146-27-07
	203-SCF	1 ϕ 170 ~264V	Built in	FS 6146-27-07
	2P5-SC	1 ϕ 170 ~264V	FS 6146-11-07	--
	201-SC	1 ϕ 170~264V	FS 6146-11-07	--
	202-SC	1 ϕ 170~264V	FS 6146-27-07	--
	203-SC	1 ϕ 170 ~264V	FS 6146-27-07	--
	2P5-C	3 ϕ 170 ~264V	FS 6147-8.9-07	--
	201-C	3 ϕ 170 ~264V	FS 6147-8.9-07	--
	202-C	3 ϕ 170 ~264V	FS 6147-8.9-07	--
	203-C	3 ϕ 170 ~264V	FS 6147-19-07	--
	205-C	3 ϕ 170 ~264V	FS 6147-19-07	--
	207-C	3 ϕ 170 ~264V	FS 6147-39-07	--
	210-C	3 ϕ 170 ~264V	FS 6147-39-07	--
	401-CF	3 ϕ 323~528 V	Built in	FS 6149-4.6-07
	402-CF	3 ϕ 323~528 V	Built in	FS 6149-4.6-07
	403-CF	3 ϕ 323~528 V	Built in	FS 6149-10-07
	405-CF	3 ϕ 323~528 V	Built in	FS 6149-10-07
	407-CF	3 ϕ 323~528 V	Built in	FS 6149-28-07
	410-CF	3 ϕ 323~528 V	Built in	FS 6149-28-07
	415-CF	3 ϕ 323~528 V	Built in	FS 6149-28-07
	401-C	3 ϕ 323~528 V	FS 6149-4.6-07	--
	402-C	3 ϕ 323~528 V	FS 6149-4.6-07	--
	403-C	3 ϕ 323~528 V	FS 6149-10-07	--
	405-C	3 ϕ 323~528 V	FS 6149-10-07	--
	407-C	3 ϕ 323~528 V	FS 6149-28-07	--
	410-C	3 ϕ 323~528 V	FS 6149-28-07	--
	415-C	3 ϕ 323~528 V	FS 6149-28-07	--
	420-N1	3 ϕ 323~528 V	JUNF34048S-MA	--
	425-N1	3 ϕ 323~528 V	KMF370A	--
	430-N1	3 ϕ 323~528 V	KMF370A	--
	440-N1	3 ϕ 323~528 V	KMF3100A	--
	450-N1	3 ϕ 323~528 V	KMF3100A	--
	460-N1	3 ϕ 323~528 V	KMF3150A	--
	475-N1	3 ϕ 323~528 V	KMF3180A	--

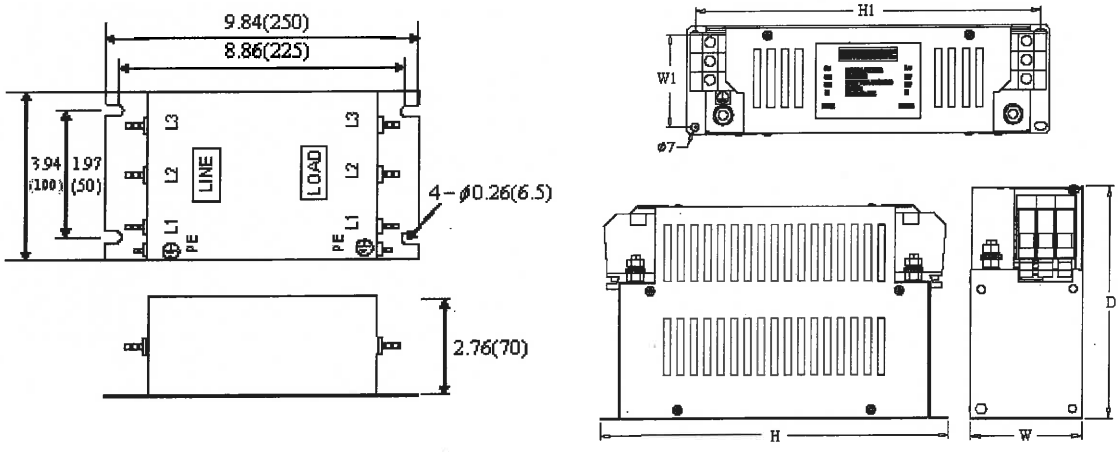
Figure 6-4 N3 External Filter Dimensions



MODEL \ SIZE	In (mm) Inverter Mounting Dimensions (C*B)	In (mm) External Filter Size (W*H*D)	In (mm) External Filter Mounting Dimensions(E*A)
FS 6146 - 11 - 07 FS 6147 - 8.9 - 07 FS 6149- 4.6 - 07	**3.07*5.91 (78 * 150)**	**3.58*7.56*1.10 (91 * 192 * 28)**	**2.91*7.13 (74 * 181)**
FS 6146 - 27 – 07 FS 6147 - 19 –07 FS 6149 - 10 - 07	**4.51*6.71 (114.6 * 170.5)**	**5.04*8.46*1.46 (128 * 215 * 37)**	**4.37*8.03 (111 * 204)**
FS 6147 - 39 – 07 FS 6149 - 28 - 07	**6.81*9.61 (173 * 244)**	**7.40*11.34*1.65 (188 * 289 * 42)**	**6.50*10.94 (165 * 278)**

Figure 6-5 JUNF34048S-MA:

Model	Dimensions in(mm)						
	W	W1	H	H1	D	d	M
KMF370A	3.66(93)	3.11(79)	12.3(312)	11.7(298)	7.48(190)	0.28(7)	M6
KMF3100A	3.66(93)	3.11(79)	12.3(312)	11.7(298)	7.48(190)	0.28(7)	M6
KMF3150A	4.96(126)	4.41(112)	12.3(312)	11.7(298)	8.82(224)	0.28(7)	M6
KMF3180A	4.96(126)	4.41(112)	12.3(312)	11.7(298)	8.82(224)	0.28(7)	M6



6.6 Interface Card

6.6.1 RS-485 Interface Card (Model: JNSIF-485)

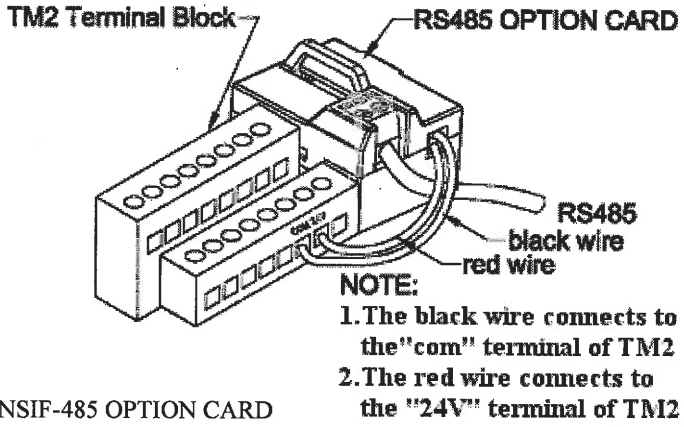
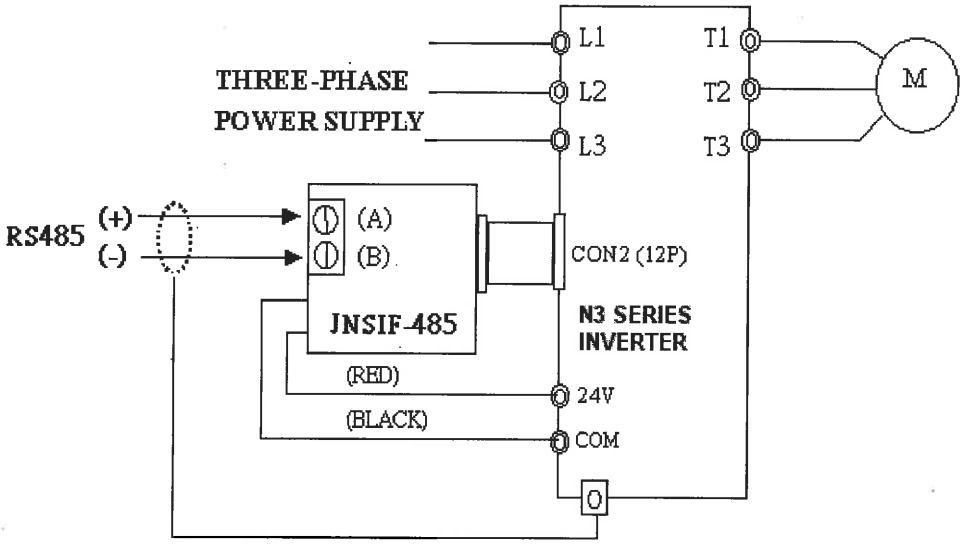


Figure 6-6 JNSIF-485 OPTION CARD

Figure 6-7 JNSIF-485 Wiring Diagram:



□**Note:**

Please reinstall the cover of inverter to avoid electrical noise disturbances on the Interface Card.

Please use isolated RS232 / RS485 converter to link the PC and interface card to avoid equipment damage.

6.6.2 RS-232 Interface Card (Model: JNSIF-232)

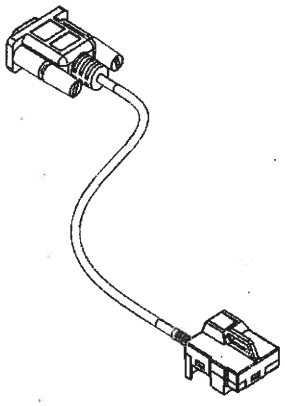
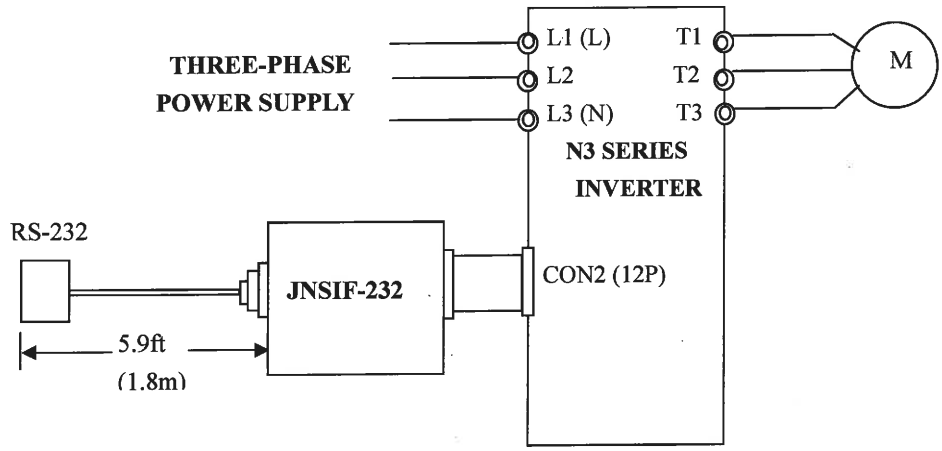


Figure 6-8 JNSIF-232 OPTION CARD

Figure 6-9 JNSIF-232Wiring Diagram:



6.6.3 Program Copy Unit (Model: JNSIF-MP)

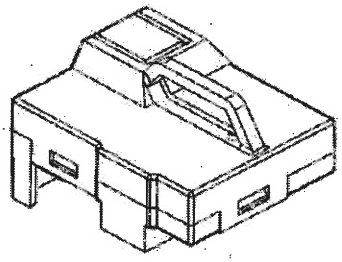
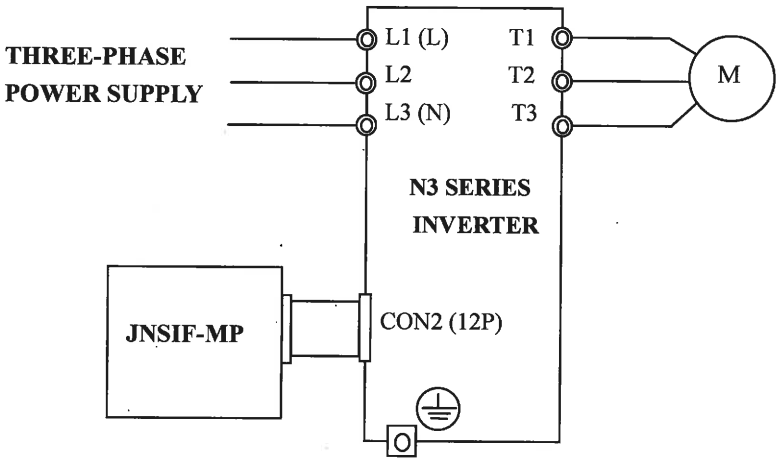


Figure 6-10 Program Copy Unit

Figure 6-11 JNSIF-MP Wiring Diagram



6.6.4 PDA Link

. HP iPAQ Pocket PC h2210. (PDA) / PC hx2190
. PDA wire (JNSWPDA).
. RS-232 Interface Card (JNSIF-232).
. Inverter

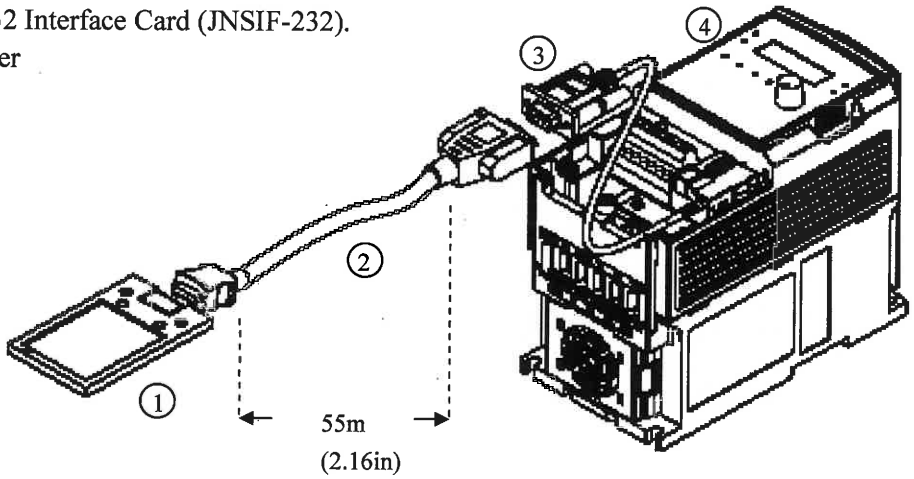


Figure 6-12 PDA Link Board Installation

Appendix 1: N3 Motor Internal Parameter List

Factory Setting of the Motor Internal Parameters：

Model \ Parameter		A168 (Stator Resistance)	A169 (Rotor Resistance)	A170 (Equivalent Inductance)	A171 (Magnetization Current)	A172 (Iron Loss Conductance)
N3	2P5	200	200	800	7200	0
	201 401	380	300			
	202 402	300	280			
	203 403	280	240			
	205 405	260	200			
	207 407	240	160			
	210 410	220	150			
	215 415	200	140			
	220 420	180	130		4100	205
	225 425					
	230 430					
	240 440					
	450					
	460					
	475					

※Note：

1. The above motor internal parameters are not used in V/F Control Mode. These parameters are used for vector control mode only.
2. The motor parameters (A168~A172) are not be modified when factory setting under vector mode. The internal parameters will be maintained after auto tuning (refer to Auto Tuning and Description on motor Internal Parameter).
3. The motor parameters (A168~A172) will be modified to factory setting completely under any operation mode. When conducting factory setting, change the Drive Horsepower code (A175).

Appendix 2: N3 parameter setting list

Customer						Inverter Model			
Using Site						Contact Phone			
Address									
Parameter Code	Setting Content	Parameter Code	Setting Content	Parameter Code	Setting Content	Parameter Code	Setting Content	Parameter Code	Setting Content
A000		A040		A080		A120		A160	
A001		A041		A081		A121		A161	
A002		A042		A082		A122		A162	
A003		A043		A083		A123		A163	
A004		A044		A084		A124		A164	
A005		A045		A085		A125		A165	
A006		A046		A086		A126		A166	
A007		A047		A087		A127		A167	
A008		A048		A088		A128		A168	
A009		A049		A089		A129		A169	
A010		A050		A090		A130		A170	
A011		A051		A091		A131		A171	
A012		A052		A092		A132		A172	
A013		A053		A093		A133		A173	
A014		A054		A094		A134		A174	
A015		A055		A095		A135		A175	
A016		A056		A096		A136		A176	
A017		A057		A097		A137		A177	
A018		A058		A098		A138		A178	
A019		A059		A099		A139		A179	
A020		A060		A100		A140		A179	
A021		A061		A101		A141		A180	
A022		A062		A102		A142		A181	
A023		A063		A103		A143		B000	
A024		A064		A104		A144		B001	
A025		A065		A105		A145		B02	
A026		A066		A106		A146		B003	
A027		A067		A107		A147		B004	
A028		A068		A108		A148		B005	
A029		A069		A109		A149		B006	
A030		A070		A110		A150		B007	
A031		A071		A111		A151		B008	
A032		A072		A112		A152		B009	
A033		A073		A113		A153		B010	
A034		A074		A114		A154		B011	
A035		A075		A115		A155		B012	
A036		A076		A116		A156		B013	
A037		A077		A117		A157		B014	
A038		A078		A118		A158		B015	
A039		A079		A119		A159		B016	

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4KA72X034T01 Ver:01 2006.02

CELL682 Wireless Alarms

SENSAPHONE®
REMOTE MONITORING SOLUTIONS

Sensaphone CELL682 Users Manual

Version 1.5

LIT-0171

USER'S MANUAL

VERSION 1.5

SENSAPHONE®
REMOTE MONITORING SOLUTIONS

First Edition, version 1.5, November 2014

Written and produced by Sensaphone

Please address comments on this publication to:

Sensaphone

901 Tryens Road

Aston, PA 19014

IMPORTANT SAFETY INSTRUCTIONS

Your Cell682 has been carefully designed to give you years of safe, reliable performance. As with all electrical equipment, however, there are a few basic precautions you should take to avoid hurting yourself or damaging the unit:

• Read the installation and operating instructions in this manual carefully. Be sure to save it for future reference.

• Read and follow all warning and instruction labels on the product itself.

• To protect the Cell682 from overheating, make sure all openings on the unit are not blocked. Do not place on or near a heat source, such as a radiator or heat register.

• Do not use your Cell682 near water, or spill liquid of any kind into it.

• Be certain that your power source matches the rating listed on the AC power transformer. If you're not sure of the type of power supply to your facility, consult your dealer or local power company.

• Do not allow anything to rest on the power cord. Do not locate this product where the cord will be abused by persons walking on it.

• Do not overload wall outlets and extension cords, as this can result in the risk of fire or electric shock.

• Never push objects of any kind into this product through ventilation holes as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electric shock.

• To reduce the risk of electric shock, do not disassemble this product, but return it to Sensaphone Customer Service or another approved repair facility when any service or repair work is required. Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electric shock when the unit is subsequently used.

• If anything happens that indicates that your Cell682 is not working properly or has been damaged, unplug it immediately and follow the procedures in the manual for having it serviced. Return the unit for servicing under the following conditions:

1. The power cord or plug is frayed or damaged.
2. Liquid has been spilled into the product or it has been exposed to water.
3. The unit has been dropped, or the enclosure is damaged.
4. The unit doesn't function normally when you're following the operating instructions.

CAUTION: To reduce the risk of fire or injury to persons, read and follow these instructions:

1. Replace the battery only with the same or equivalent type recommended by the manufacturer.
2. Do not dispose of the battery in a fire. The cell may explode. Check with local codes for possible special disposal instructions.
3. Do not open or mutilate the battery. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.
4. Exercise care in handling battery in order not to short the battery with conducting materials such as rings, bracelets, and keys. The battery or conductor may overheat and cause burns.

FCC REQUIREMENTS

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician help.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: 1) this device may not cause harmful interference, and 2) this device must accept any interference received, including interference that may cause undesired operation.

If you experience trouble with the Cell682, or you need information on obtaining service or repairs, please contact:

Sensaphone
901 Tryens Road
Aston, PA 19014
Phone: 610.558.2700
FAX: 610.558.0222

2 YEAR LIMITED WARRANTY

PLEASE READ THIS WARRANTY CAREFULLY BEFORE USING THE PRODUCT.

THIS LIMITED WARRANTY CONTAINS SENSAPHONE'S STANDARD TERMS AND CONDITIONS. WHERE PERMITTED BY THE APPLICABLE LAW, BY KEEPING YOUR SENSAPHONE PRODUCT BEYOND THIRTY (30) DAYS AFTER THE DATE OF DELIVERY, YOU FULLY ACCEPT THE TERMS AND CONDITIONS SET FORTH IN THIS LIMITED WARRANTY.

IN ADDITION, WHERE PERMITTED BY THE APPLICABLE LAW, YOUR INSTALLATION AND/OR USE OF THE PRODUCT CONSTITUTES FULL ACCEPTANCE OF THE TERMS AND CONDITIONS OF THIS LIMITED WARRANTY (HEREINAFTER REFERRED TO AS "LIMITED WARRANTY OR WARRANTY"). IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS THIS WARRANTY, INCLUDING ANY LIMITATIONS OF WARRANTY, INDEMNIFICATION TERMS OR LIMITATION OF LIABILITY, THEN YOU SHOULD NOT USE THE PRODUCT AND SHOULD RETURN IT TO THE SELLER FOR A REFUND OF THE PURCHASE PRICE. THE LAW MAY VARY BY JURISDICTION AS TO THE APPLICABILITY OF YOUR INSTALLATION OR USE ACTUALLY CONSTITUTING ACCEPTANCE OF THE TERMS AND CONDITIONS HEREIN AND AS TO THE APPLICABILITY OF ANY LIMITATION OF WARRANTY, INDEMNIFICATION TERMS OR LIMITATIONS OF LIABILITY.

1. **WARRANTOR**: IN THIS WARRANTY, WARRANTOR SHALL MEAN "DEALER, DISTRIBUTOR, AND/OR MANUFACTURER."

2. **ELEMENTS OF WARRANTY**: THIS PRODUCT IS WARRANTED TO BE FREE FROM DEFECTS IN MATERIALS AND CRAFTSMANSHIP WITH ONLY THE LIMITATIONS AND EXCLUSIONS SET OUT BELOW.

3. **WARRANTY AND REMEDY**: TWO-YEAR WARRANTY — IN THE EVENT THAT THE PRODUCT DOES NOT CONFORM TO THIS WARRANTY AT ANY TIME DURING THE TIME OF TWO YEARS FROM ORIGINAL PURCHASE, WARRANTOR WILL REPAIR THE DEFECT AND RETURN IT TO YOU AT NO CHARGE.

THIS WARRANTY SHALL TERMINATE AND BE OF NO FURTHER EFFECT AT THE TIME THE PRODUCT IS: (1) DAMAGED BY EXTRANEOUS CAUSE SUCH AS FIRE, WATER, LIGHTNING, ETC. OR NOT MAINTAINED AS REASONABLE AND NECESSARY; OR (2) MODIFIED; OR (3) IMPROPERLY INSTALLED; OR (4) MISUSED; OR (5) REPAIRED OR SERVICED BY SOMEONE OTHER THAN WARRANTORS' AUTHORIZED PERSONNEL OR SOMEONE EXPRESSLY AUTHORIZED BY WARRANTOR'S TO MAKE SUCH SERVICE OR REPAIRS; (6) USED IN A MANNER OR PURPOSE FOR WHICH THE PRODUCT WAS NOT INTENDED; OR (7) SOLD BY ORIGINAL PURCHASER.

LIMITED WARRANTY, LIMITATION OF DAMAGES AND DISCLAIMER OF LIABILITY FOR DAMAGES: THE WARRANTOR'S OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AT THE WARRANTOR'S OPTION AS TO REPAIR OR REPLACEMENT. IN NO EVENT SHALL WARRANTORS BE LIABLE OR RESPONSIBLE FOR PAYMENT OF ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL AND/OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO ANY LABOR COSTS, PRODUCT COSTS, LOST REVENUE, BUSINESS INTERRUPTION LOSSES, LOST PROFITS, LOSS OF BUSINESS, LOSS OF DATA OR INFORMATION, OR FINANCIAL LOSS, FOR CLAIMS OF ANY NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS IN CONTRACT, BREACH OF WARRANTY OR TORT, AND WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE. IN THE EVENT THAT IT IS DETERMINED IN ANY ADJUDICATION THAT THE LIMITED WARRANTIES OF REPAIR OR REPLACEMENT ARE INAPPLICABLE, THEN THE PURCHASER'S SOLE REMEDY SHALL BE PAYMENT

TO THE PURCHASER OF THE ORIGINAL COST OF THE PRODUCT, AND IN NO EVENT SHALL WARRANTORS BE LIABLE OR RESPONSIBLE FOR PAYMENT OF ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL AND/OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO ANY LOST REVENUE, BUSINESS INTERRUPTION LOSSES, LOST PROFITS, LOSS OF BUSINESS, LOSS OF DATA OR INFORMATION, OR FINANCIAL LOSS, FOR CLAIMS OF ANY NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS IN CONTRACT, BREACH OF WARRANTY OR TORT, AND WHETHER OR NOT

CAUSED BY WARRANTORS' NEGLIGENCE.

WITHOUT WAIVING ANY PROVISION IN THIS LIMITED WARRANTY, IF A CIRCUMSTANCE ARISES WHERE WARRANTORS ARE FOUND TO BE LIABLE FOR ANY LOSS OR DAMAGE ARISING OUT OF MISTAKES, NEGLIGENCE, OMISSIONS, INTERRUPTIONS, DELAYS, ERRORS OR DEFECTS IN WARRANTORS' PRODUCTS OR SERVICES, SUCH LIABILITY SHALL NOT EXCEED THE TOTAL AMOUNT PAID BY THE CUSTOMER FOR WARRANTORS' PRODUCT AND SERVICES OR $250.00, WHICHEVER IS GREATER. YOU HEREBY RELEASE WARRANTORS FROM ANY AND ALL OBLIGATIONS, LIABILITIES AND CLAIMS IN EXCESS OF THIS LIMITATION.

INDEMNIFICATION AND COVENANT NOT TO SUE: YOU WILL INDEMNIFY, DEFEND AND HOLD HARMLESS WARRANTORS, THEIR OWNERS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, SUPPLIERS OR AFFILIATED COMPANIES, AGAINST ANY AND ALL CLAIMS, DEMANDS OR ACTIONS BASED UPON ANY LOSSES, LIABILITIES, DAMAGES OR COSTS, INCLUDING BUT NOT LIMITED TO DAMAGES THAT ARE DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, AND INCLUDING ATTORNEYS FEES AND LEGAL COSTS, THAT MAY RESULT FROM THE INSTALLATION, OPERATION, USE OF, OR INABILITY TO USE WARRANTORS' PRODUCTS AND SERVICES, OR FROM THE FAILURE OF THE WARRANTORS' SYSTEM TO REPORT A GIVEN EVENT OR CONDITION, WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE.

YOU AGREE TO RELEASE, WAIVE, DISCHARGE AND COVENANT NOT TO SUE WARRANTORS, THEIR OWNERS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, SUPPLIERS OR AFFILIATED COMPANIES, FOR ANY AND ALL LIABILITIES POTENTIALLY ARISING FROM ANY CLAIM, DEMAND OR ACTION BASED UPON ANY LOSSES, LIABILITIES, DAMAGES OR COSTS, INCLUDING BUT NOT LIMITED TO DAMAGES THAT ARE DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, AND INCLUDING ATTORNEYS FEES AND LEGAL COSTS, THAT MAY RESULT FROM THE INSTALLATION, OPERATION, USE OF, OR INABILITY TO USE WARRANTORS' PRODUCTS AND SERVICES, OR FROM THE FAILURE OF THE WARRANTORS' SYSTEM TO REPORT A GIVEN EVENT OR CONDITION, WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE, EXCEPT AS NECESSARY TO ENFORCE THE EXPRESS TERMS OF THIS LIMITED WARRANTY.

EXCLUSIVE WARRANTY: THE LIMITED WARRANTY OR WARRANTIES DESCRIBED HEREIN CONSTITUTE THE SOLE WARRANTY OR WARRANTIES TO THE PURCHASER. ALL IMPLIED WARRANTIES ARE EXPRESSLY DISCLAIMED, INCLUDING: THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR USE AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND THE WARRANTY OF NON-INFRINGEMENT AND/OR ANY WARRANTY ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IT MUST BE CLEAR THAT THE WARRANTORS ARE NOT INSURING YOUR PREMISES OR BUSINESS OR GUARANTEEING THAT THERE WILL NOT BE DAMAGE TO YOUR PERSON OR PROPERTY OR BUSINESS IF YOU USE THIS PRODUCT. YOU SHOULD MAINTAIN INSURANCE COVERAGE SUFFICIENT TO PROVIDE COMPENSATION FOR ANY LOSS, DAMAGE, OR EXPENSE THAT MAY ARISE IN CONNECTION WITH THE USE OF PRODUCTS OR SERVICES, EVEN IF CAUSED BY WARRANTORS' NEGLIGENCE. THE WARRANTORS ASSUME NO LIABILITY FOR INSTALLATION OF THE PRODUCT AND/

OR INTERRUPTIONS OF THE SERVICE DUE TO STRIKES, RIOTS, FLOODS, FIRE, AND/OR ANY CAUSE BEYOND SELLER'S CONTROL, FURTHER SUBJECT TO THE LIMITATIONS EXPRESSED IN ANY LICENSE AGREEMENT OR OTHER AGREEMENT PROVIDED BY WARRANTORS TO PURCHASER.

THE AGREEMENT BETWEEN THE WARRANTORS AND THE PURCHASER, INCLUDING BUT NOT LIMITED TO THE TERMS AND CONDITIONS HEREIN SHALL NOT BE GOVERNED BY THE CONVENTION FOR THE INTERNATIONAL SALE OF GOODS. WHERE APPLICABLE, THE UNIFORM COMMERCIAL CODE AS ADOPTED BY THE STATE OF DELAWARE SHALL APPLY.

4. **PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY**: IN THE EVENT THAT THE PRODUCT DOES NOT CONFORM TO THIS WARRANTY, THE PRODUCT SHOULD BE SHIPPED OR DELIVERED FREIGHT PREPAID TO A WARRANTOR WITH EVIDENCE OF ORIGINAL PURCHASE.

5. **LEGAL REMEDIES AND DISCLAIMER**: SOME JURISDICTIONS MAY NOT ALLOW, OR MAY PLACE LIMITS UPON, THE EXCLUSION AND/OR LIMITATION OF IMPLIED WARRANTIES, INCIDENTAL DAMAGES AND/OR CONSEQUENTIAL DAMAGES FOR SOME TYPES OF GOODS OR PRODUCTS SOLD TO CONSUMERS AND/OR THE USE OF INDEMNIFICATION TERMS. THUS, THE EXCLUSIONS, INDEMNIFICATION TERMS AND LIMITATIONS SET OUT ABOVE MAY NOT APPLY, OR MAY BE LIMITED IN THEIR APPLICATION, TO YOU. IF THE IMPLIED WARRANTIES CAN NOT BE EXCLUDED, AND THE APPLICABLE LAW PERMITS LIMITING THE DURATION OF IMPLIED WARRANTIES, THEN THE IMPLIED WARRANTIES HEREIN ARE TO BE LIMITED TO THE SAME DURATION AS THE APPLICABLE WRITTEN WARRANTY OR WARRANTIES HEREIN. THE WARRANTY OR WARRANTIES HEREIN MAY GIVE YOU SPECIFIC LEGAL RIGHTS THAT WILL DEPEND UPON THE APPLICABLE LAW. YOU MAY ALSO HAVE OTHER LEGAL RIGHTS DEPENDING UPON THE LAW IN YOUR JURISDICTION.

6. **CHOICE OF FORUM AND CHOICE OF LAW**: IN THE EVENT THAT A DISPUTE ARISES OUT OF OR IN CONNECTION WITH THIS LIMITED WARRANTY, THEN ANY CLAIMS OR SUITS OF ANY KIND CONCERNING SUCH DISPUTES SHALL ONLY AND EXCLUSIVELY BE BROUGHT IN EITHER THE COURT OF COMMON PLEAS OF DELAWARE COUNTY, PENNSYLVANIA OR THE UNITED STATES DISTRICT COURT FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

REGARDLESS OF THE PLACE OF CONTRACTING OR PERFORMANCE, THIS LIMITED WARRANTY AND ALL QUESTIONS RELATING TO ITS VALIDITY, INTERPRETATION, PERFORMANCE AND ENFORCEMENT SHALL BE GOVERNED BY AND CONSTRUED IN ACCORDANCE WITH THE LAWS OF THE STATE OF DELAWARE, WITHOUT REGARD TO THE PRINCIPLES OF CONFLICTS OF LAW.

Effective date 05/01/2004

PHONETICS, INC. d.b.a. SENSAPHONE

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www.sensaphone.com

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION

Congratulations on your purchase of the Cell682 by Sensaphone.

The Cell682 is a powerful monitoring, alarm, and control system. Its built-in wireless technology means you won't need a telephone line to communicate with the unit. It can monitor and control your environment and equipment using eight dry contact inputs, six analog inputs, built-in power failure detection, and two relay outputs. It can perform simplex or duplex alternating pump control using a level transducer or float switches. The unit can also perform machine-to-machine control among multiple Cell682 devices. Up to 8 machine-to-machine control algorithms can be configured per device so that input conditions on one Cell682 can logically control outputs on another using simple, fill-in-the-blank, comparison programming. The unit features several communication options including: voice telephone call, e-mail, and text messaging. You can also request a status report from any e–mail compatible device. The Cell682 is fully programmable via the included Cell682 Software package for Windows or through the unit's web page at www.Cell682.com. Activation of a wireless messaging plan required.

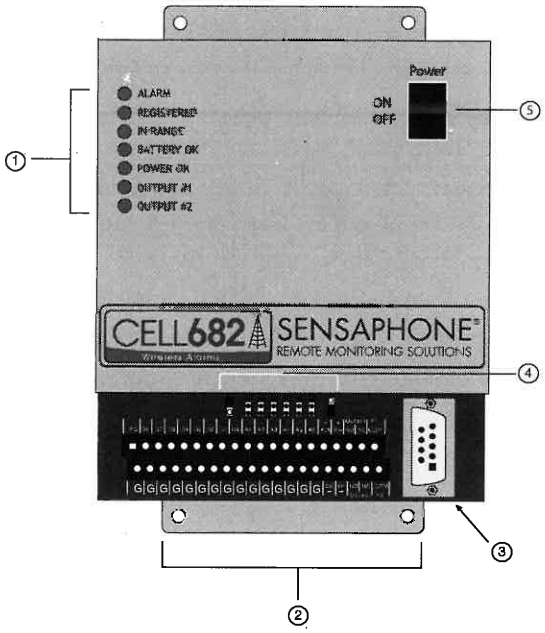
The Cell682 will produce a web page of input and output status and alarm acknowledgement history that can be viewed at **www.cell682.com**. You can also program the unit or control outputs from the web page. The Cell682 is the ultimate choice for remote monitoring and control where telephone lines are nonexistent or too expensive. Applications include pump houses, cable TV huts, remote equipment rooms, and tower light monitoring.

On the front of the unit are LED indicators to show the operating status (Power, Battery OK, In-Range, Registered, Alarm, and Outputs). All programming is stored in nonvolatile memory so that all programming is retained even without power. A complete status report of all monitored conditions can be retrieved via e-mail for viewing on a computer or text messaging device. The Cell682.com web page can be updated on demand to allow viewing of the current conditions at the site from any internet-connected computer. The unit comes in a plastic NEMA-4X enclosure with internal rechargeable battery backup, power supply and antenna.

FEATURES

- 8 Dry Contact Inputs: NO, NC, Pulse Count, Equipment Run-Time
- 6 Analog Inputs: 2.8K and 10K Thermistor (temperature), or 4–20mA
- 2 Relay Outputs: 20 different automatic and manual modes
- Local Logic Control
- Machine-to-Machine Control among Cell682 units
- Duplex and Simplex Pump Control
- Wireless Alarm Message Delivery via Voice, E-mail, or text message.
- Status & Programming via web page
- NEMA 4X enclosure and Battery Backup

CELL682 DIAGRAM



1. LEDs
2. Terminal blocks
3. RS-232 DCE
4. Jumpers for Temperature or 4–20mA settings
5. Power On, Off switch

QUICK START

When installing and programming a Cell682 there are several steps required for all installations. Listed below are those required for a typical installation and start-up of the Cell682.

1) Confirm wireless coverage for the installation site. The CELL682 uses GSM cellular providers T-Mobile and AT&T. You can check "data" coverage using their respective websites or contact Sensaphone technical support and we'll check it for you. The CELL682 is available in a T-Mobile version or an AT&T version which is specified at time of ordering
2) Activate a wireless service plan for the unit. Contact Sensaphone and have your serial number available. This is required for the unit to operate. Activation enables access to your unit via the CELL682 website, as well as provides for notification of alarms via e-mail and voice phone call.
3) Install the unit in an area that provides good cellular reception. An optional external antenna with 16' cable is available, if necessary.
4) Attach the antenna to the top of the enclosure and plug-in the power supply. Connect the black battery wire (taped to the inside of the enclosure) to the (BAT -) terminal.
5) Once the unit powers-up, make sure the In Range and Registered LED's are lit.
6) Configure the input jumpers, if necessary, and connect the sensors to the terminal strip.
7) Verify status on the web site. (the PIN number is the last four digits of the serial number and the default password is "cell682").

CELL682 WEB PAGE

Your CELL682 is accessible via the Internet at www.CELL682.com. Simply enter your PIN and password (default is cell682) and you will be logged in to the web page for your device. Your PIN is the last 4 digits of your serial number. Be sure to change your password for security purposes. To see the current values click the Status Refresh link and in about 2 minutes you will see the current input and output values displayed on the page. You can make programming changes and even control the relay outputs from the web page. If any programming was performed using a direct connection to the serial port of the CELL682, then be sure to click the Programming Refresh link on the web page, so that you will be viewing the latest programming in the device..

TECHNICAL SUPPORT

This instruction manual will help you install and program the Cell682 properly. Be sure to read it completely before beginning the installation process. If there are any questions or problems that arise upon installation or operation, please contact our Technical Support team:

SENSAPHONE®
901 Tryens Road
Aston, PA 19014
Phone: 610.558.2700
FAX: 610.558.0222
support@sensaphone.com

CHAPTER 2: INSTALLATION

OPERATING ENVIRONMENT

The Cell682 should be mounted and operated in a clean, dry environment. The unit must communicate to the wireless network, so care must be taken not to install the unit inside a metal cabinet or other location that will prevent the unit from receiving a radio signal unless the antenna can be relocated to a location free of obstruction. The unit is microprocessor-controlled and, as a result, should not be installed near devices that generate strong electromagnetic fields. Such interference is typically generated by power switching equipment such as motors, contactors, or variable frequency drives. Where this is unavoidable, mount the unit in a separate, grounded steel enclosure with an external antenna (see Appendix F: Accessories). A poor operating environment may result in unwanted system resets and/or system lockup. The temperature range the unit can operate in is -22°F to 140°F (-30°C to 60°C).

WARNING: Attach the antenna before applying power to the Cell682. Never remove the antenna while the unit is powered on.

ACTIVATING YOUR CELL682

Your Cell682 device *must* be activated on the wireless network before you can send or receive messages *and* before any local programming is performed for the first time.

To activate your Cell682 device, fill out the registration form included with the package and follow the instructions, or contact your sales representative with the device serial number.

Your Cell682 is activated when the "In Range" and "Registered" LEDs are lit.

MOUNTING THE CELL682 (NEMA-4X HOUSING)

Locate a suitable mounting location for the Cell682 enclosure that provides good radio reception and convenient wiring to your equipment and power. On the top and bottom of the housing are mounting tabs to attach the unit to a wall. The mounting surface should be sturdy enough to support 10 lbs. The unit should be mounted using four #10-32 bolts where appropriate, or four #10 tapping screws. (The screw kit for the Cell682 includes (4) #10-32 screws, (4) #10-32 nuts, and (4) #10 lockwashers). When mounting the unit to a wall, make sure the mounting screws fully engage a solid member (for example, a stud) of the support structure. Mount the Cell682 in an upright position so that you can easily connect wires to the terminal strips. The dimensions of the NEMA-4x enclosure are: 12.1" x 8.0" x 5.5" / 30.7 x 20.3 x 13.9cm. See Figure 1.

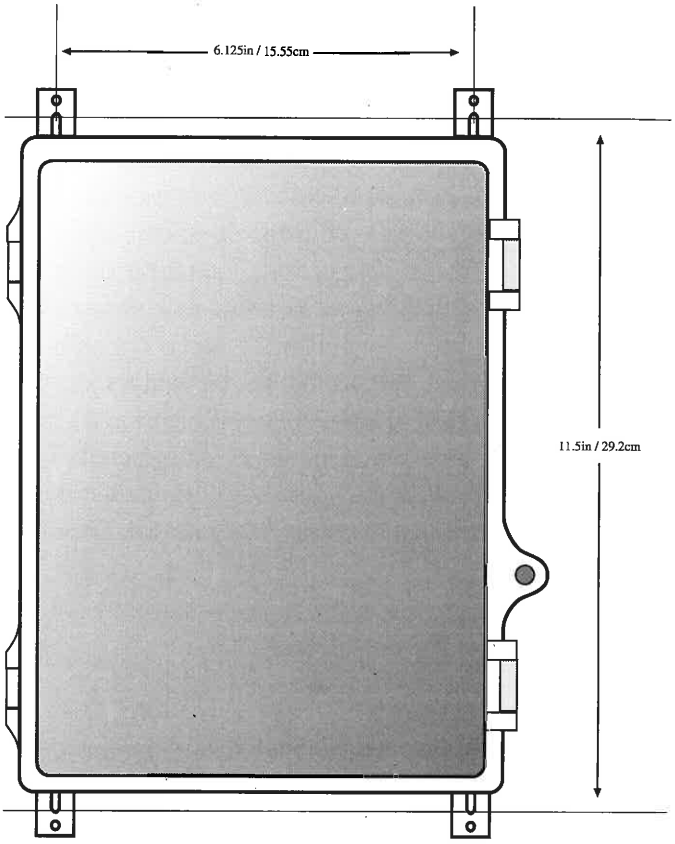


Figure 1: NEMA-4 Mounting diagram

LOCKING THE NEMA 4X ENCLOSURE

The Cell682 enclosure can be locked by installing a small padlock through the loop on the front door of the enclosure. See Figure 2.

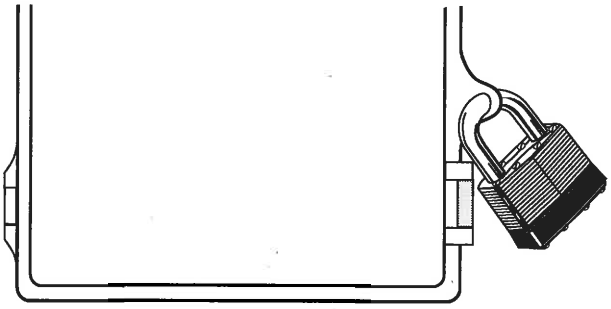


Figure 2: Locking the NEMA-4x enclosure

ANTENNA INFORMATION

The Cell682 comes with a unity-gain antenna designed specifically for the frequency range required. In order to comply with FCC RF exposure, the external antenna must be mounted in a location where people will never come within 20cm of the antenna. The gain of the antenna may not exceed 0dBi. For optimum antenna performance, there should be no metal objects within close proximity of the antenna.

> **WARNING:** Do not over-tighten the antenna on the Cell682; this may cause permanent damage to the device.

The antenna must be connected before the device is powered up.

CONNECTING THE POWER SUPPLY

The Cell682 requires a 18VDC power supply to operate. This power supply will charge the internal 12V battery and provide the necessary power to transmit messages over the wireless network.

WARNING: Do not substitute supplies with lower capacity.

Connect the positive terminal of the Power Supply to the **+Vin** terminal on the Cell682.

Connect the negative terminal of the Power Supply to the **-Vin** terminal on the Cell682.

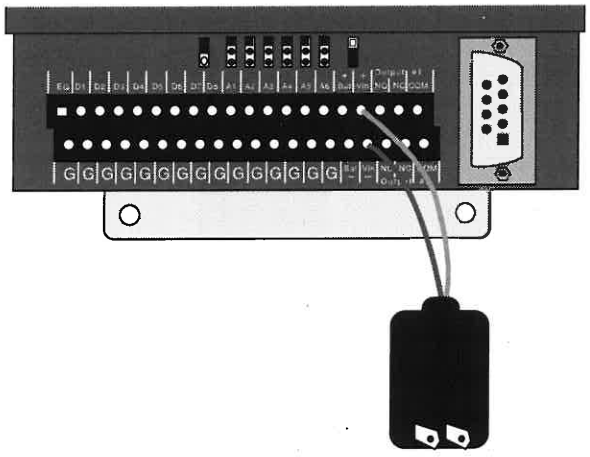


Figure 3: Power Supply Wiring

CONNECTING THE BATTERY

The CELL682 contains an internal 12V rechargeable battery that must be wired to the terminal strip at the time of installation (see procedure below). The battery will power the system for several hours in the event of a power failure. The unit incorporates circuitry to maintain the proper charge for a 12V gel-cell battery whenever the power supply is plugged-in. The unit also includes special circuitry to prevent the battery from being damaged in the event of an extended power outage. The battery should provide approximately 3-5 years of service life before needing replacement depending on temperature and the number of charge/discharge cycles.

WIRING PROCEDURE

Connect the positive terminal of the battery (red wire) to the **+ Bat** terminal on the Cell682.

Connect the negative terminal of the battery (black wire) to the **– Bat** terminal on the Cell682.

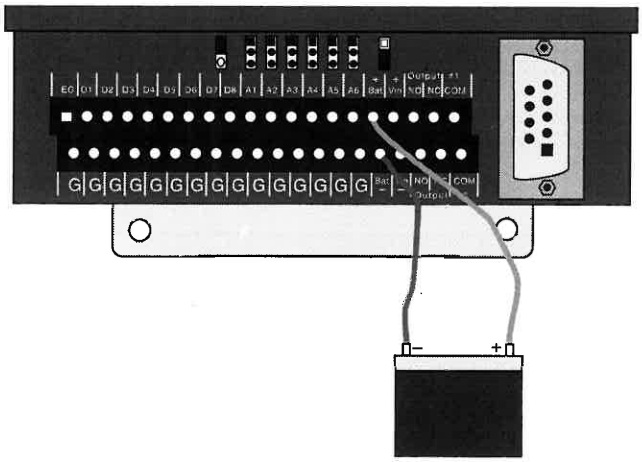


Figure 4: Battery connection

The battery is considered low at 12.0V and the Battery LED will blink at this voltage level. If main power is less than 7.0V and the battery voltage reaches 11V, the battery LED will go out and the unit will go into hibernation mode (a low-power mode in which the unit shuts down). The unit will return to its regular operating mode when either the main power is restored or the battery voltage rises above 11.5V. If the battery voltage continues to fall below 10.5V, the unit will disconnect the battery to prevent deep discharge damage to the battery. The unit will not reconnect the battery until the battery voltage rises above 12.5V.

GROUNDING

Connect a #14AWG copper wire to the earth ground terminal (marked "EG") on the left end of the terminal strip and connect the other end to a ground rod or metal cold water pipe *(See Figure 6)*. It is extremely important that the earth ground connection be as short as possible. The ground rod should have sufficient depth to provide a low impedance connection to earth. This connection is required for the surge/lightning protection circuits to function properly.

NOTE: Proper earth grounding of the Cell682 is required for warranty coverage.

Ground rods can typically be found at local electrical supply houses and/or hardware stores. You MUST contact your state "Call before you dig" hotline at least *two* days before you install your ground rod, to insure that it is safe to install the ground rod in a chosen area.

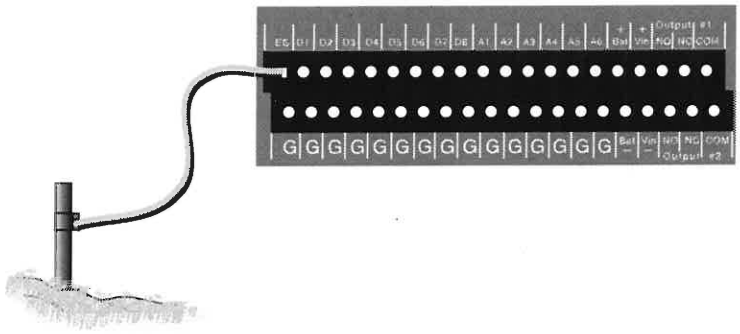


Figure 5: Grounding the Cell682

WIRING SENSORS TO DRY CONTACT INPUTS

The Cell682 has 8 Dry Contact inputs that can be used to monitor Normally Open (N.O.) or Normally Closed (N.C.) sensors. In addition, they can also be used for pulse counting and equipment run-time accumulation. When used for pulse count or run time functions, the unit will count the pulse (or accumulate time) when the input changes to the opposite of its normal state.

Dry contact sensors are wired to the terminals labeled D1 through D8. The corresponding Ground terminals are located on the lower level terminal strip. The input type is programmed within the Cell682 Software or website.

WARNING: Do not use sensors, switches, or relays that supply any voltage or current to the Cell682.

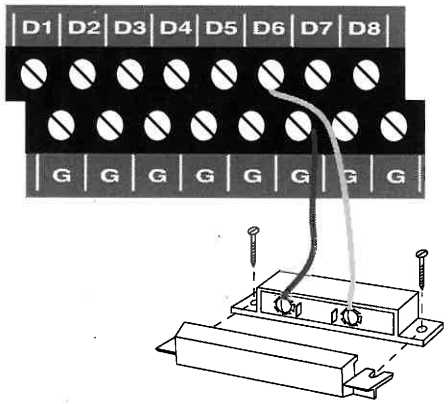


Figure 6: Sensor connected to a dry contact input]

Any N.O. or N.C. sensor can be attached to the Cell682 using 18–24 gauge wire. For distances of 1000' or more, use heavier gauge wire. When running wire outdoors it is recommended that shielded cable be used. Connect the shield to a good earth ground or metallic cold water pipe. The total resistance of the circuit cannot be greater than 100 ohms. Use wire appropriate for the application. See the wire length recommendations, later in this chapter.

The Cell682 may have more than one sensor connected to the same terminal, however, the normal condition for each sensor on the same terminal must be identical (either all N.O. or all N.C.).

NORMALLY CLOSED SENSORS

To wire more than one normally closed sensor on one input, they must be connected in series. Connect a lead from the first sensor to one of the Dry Contact Inputs on the terminal strip. Next, take the other lead from the first sensor and connect it to one lead from the next sensor. Continue connecting sensors end-to-end until you have connected all of your sensors. Take the second lead from your last sensor and connect it to the ground screw on the Cell682 terminal strip. See Figure 7.

Multiple N.C. inputs are typically magnetic reed switches to monitor the security of windows and doors.

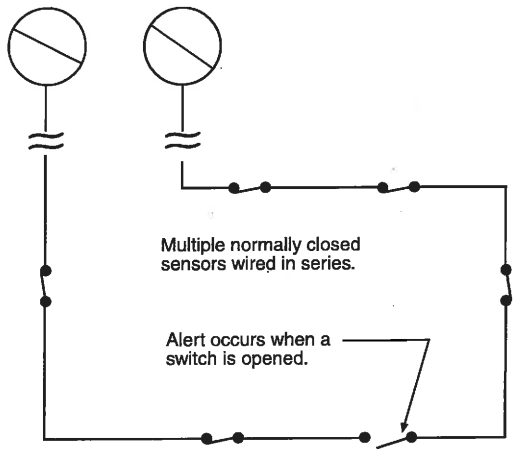


Figure 7: Connecting multiple N.C. sensors to one input terminal

NORMALLY OPEN SENSORS

To wire several normally open sensors to one Dry Contact input, connect them in parallel. To do this, take one lead from each sensor and attach it one of the Dry Contact Input terminals. Then take the second lead from each sensor and attach it to the corresponding ground terminal. See Figure 8.

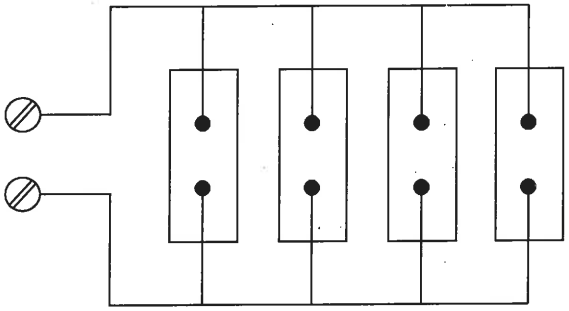


Figure 8: Connecting multiple N.O. sensors to one input terminal

WIRING SENSORS TO ANALOG INPUTS

The Cell682 has 6 Analog inputs that can be used to monitor 2.8K or 10K Thermistors (temperature) or 4–20mA transducers. Analog transducers are wired to the terminals labeled A1 through A6. The corresponding Ground terminals are located on the lower level terminal strip. The input must be configured by setting the corresponding jumper in either the Temperature or 4–20mA position. See figure below:

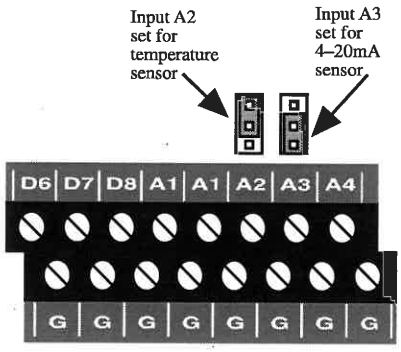


Figure 9: Input A2 configured for temp, A3 configured for 4-20mA

Temperature: The unit will accept 2.8K or 10K thermistors. These should be wired to an Analog Input terminal and the adjacent ground terminal. For compatible thermistors check the accessory list or thermistor data in the appendices. 10K Thermistor temperature range: -60°F to 175°F (-51°C to 79°C).

4–20mA: A 4–20mA transducer requires you to have an external DC power supply for the transducer. Connect the positive wire of your transducer to the positive terminal of your DC power supply. Connect the negative terminal of the transducer to an Analog Input terminal on the Cell682. Connect the negative terminal from your power supply to the adjacent ground terminal on the Cell682.

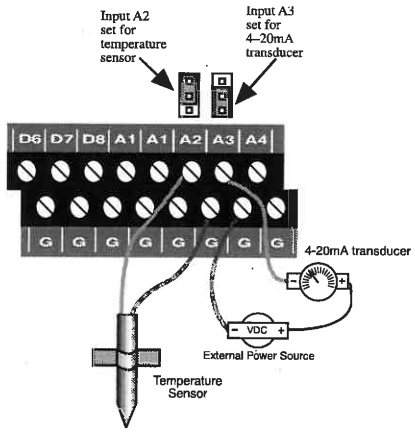


Figure 10: A thermistor and a 4–20mA transducer connected to the unit

WIRING RECOMMENDATIONS

The Cell682 will work fine in indoor environments using unshielded cable. When wiring will be subject to long lengths (>100') or if run outdoors, it is highly recommended that shielded cable be used and that the shield be connected to an earth

ground. This is particularly important for sensor wires that are run in conduit with other noise-generating conductors, such as 60Hz AC. It is strongly recommended that input wiring be run in a conduit separated from AC power or output wiring. When wire runs are long or are in close proximity to large power consuming, power generating, or power switching equipment, it is highly recommended that shielded wire be used.

Also, be sure to use the appropriate gauge wire based on the distance and sensor type. See chart below:

Wire Gauge	Thermistor	NO/NC Contact & 4–20mA
#24	250'	1000'
#22	500'	2000'
#20	1000'	4000'

When preparing wire for connection to the terminal blocks, strip 1/4" of insulation from the conductor (see figure below).

Figure 11: Wire stripped for connection

NOTE: All wiring should comply with Section 17 of the UL requirements.

LED INDICATORS

The LEDs provide on-site alarm and status information. Listed below are descriptions of how the LEDs work.

ALARM:

LED Off: No alarms

LED Blinking: Unacknowledged alarm exists

LED On: Acknowledged alarm exists

REGISTERED:

LED Off: Not registered (unit not activated)

LED Blinking: Cell682 is sending or receiving messages

LED On: Registered

IN RANGE:

LED Off: Not in range of wireless network

LED On: In range of wireless network

BATTERY OK:

LED Off: No Battery

LED Blinking: Battery condition low

LED On: Battery OK

POWER OK:

LED Off: Power is Off

LED Blinking slow: Power very low (unit hibernating)

LED Blinking fast: Power is low

LED On: Power is OK

OUTPUT #1:

LED Off: Output Relay #1 is off.

LED On: Output Relay #1 is on.

OUTPUT #2:

LED Off: Output Relay #2 is off.

LED On: Output Relay #2 is on.

CHAPTER 3: SOFTWARE INSTALLATION

This section describes how to install and configure the Cell682 Programming Software for your computer.

INSTALLING AND STARTING THE SOFTWARE

Minimum requirements:

- Microsoft Windows™ 2000, XP, Vista, or 7
- CD-ROM drive
- Serial Port (or USB-to-serial adapter)Installation

The Cell682 Programming Software is easy to install. Make sure that all Windows applications are closed before attempting to run Setup. If you encounter problems during installation, please call Sensaphone Technical Support at 610-558-2700. The Cell682 Software will install to a directory named *C:\Program Files\Cell682*, unless you choose to change the directory name.

1. Start Windows.
2. Insert the Cell682 CD-ROM. The installation program should run automatically. Follow the prompts as directed.

If the software does not install automatically, then click the *Windows Start* button, and select *Run*, then type in d:\setup.exe. Click *OK*. Follow the prompts as directed.

3. Reboot your computer when the installation is complete.

ACTIVATING YOUR CELL682

Your Cell682 device *must* be registered on the wireless network before you can send or receive messages *and* before any local programming is performed for the first time.

To activate your Cell682 device, fill out the registration form included with the package and follow the instructions, or contact your sales representative with the device serial number.

Your Cell682 is activated when the "In Range" and "Registered" LEDs are lit.

Note: The *Registered* LED will blink when the Cell682 is sending or receiving messages.

CONNECTING LOCALLY

The Cell682 Software will allow you to connect with the unit to view status and program it. First, connect a serial cable to a serial port on your computer. Connect the other end to the 9-pin RS-232 connector on the Cell682. Run the Cell682 Software. The following screen will appear.

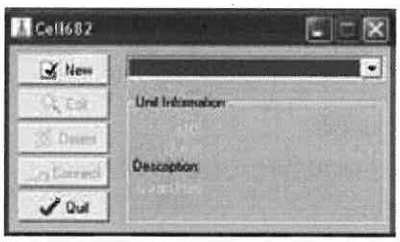


Figure 1: First-Run Unit Information form

Click the *New* button to set-up a new Cell682 unit. The *Edit Cell682 Unit* screen will appear (see right).

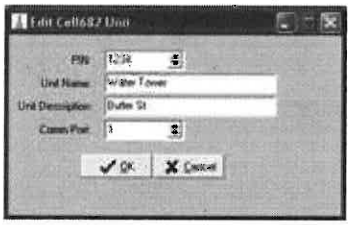


Figure 2: Edit Cell682 Unit

Enter the PIN, Name, Description, and Comm Port settings for this unit. The PIN is the last four digits of the serial number. The unit Name can be up to 20 characters, the Description can be up to 30 characters. Click *OK*. Now click the *Connect* button and the software should connect and start downloading the programming from the unit.

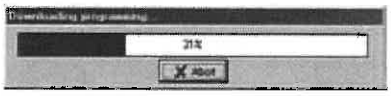


Figure 3: Programming Download in progress

If this was a new unit (factory default settings) the Name you entered on the edit screen will automatically be copied into the unit. After downloading the programming, the main Cell682 window will appear (see next page).

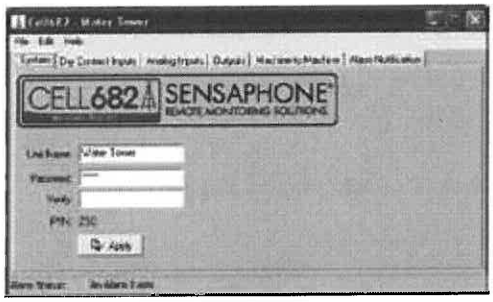


Figure 4: Main Cell682 Window: System Tab

This is a good time to enter a new Password. The Password, while not required for local access, is required for all remote communication. The password can be up to 8 characters. Click *Apply* when finished.

CHECKING WIRELESS SIGNAL STRENGTH

The Cell682 performs all of its communication over the wireless network, so it is very important that there be sufficient signal strength at the installation site. You can check the received signal strength from within the Cell682 software while connected through the serial port. Login to your Cell682 and then click on Help then About from the main menu. A list of items will appear about the Software Version, Firmware Version, etc... the last item is called Signal Quality. In order for the Cell682 to operate properly this number must be greater than 10. A higher number is better. Values typically range from 0 to 50. See the sample screen below:

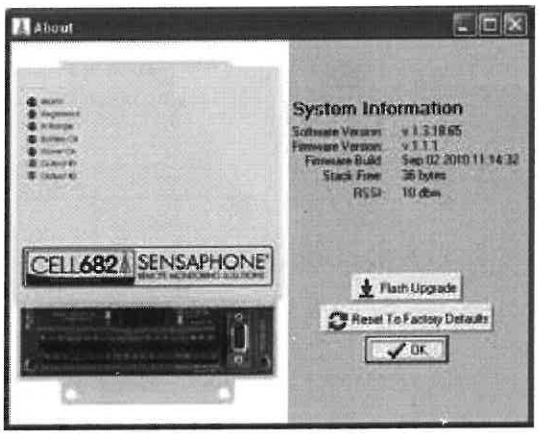


Figure 5: System Information Window

If your Signal Quality value is less than 10 you must either relocate/reposition the unit to improve its ability to communicate with the wireless network or add an

external antenna that can be installed in a better location. Contact Sensaphone technical support for assistance.

CELL682 WEB PAGE

You can view status and change settings in your Cell682 via the internet. This makes it possible to manage your unit from anywhere in the world. See Chapter 10 for detailed information on using the web page.

HOW IT WORKS

You can perform CELL682 programming using either the CELL682 Software or the webpage. Generally, if you are at the unit's location it's faster to perform the programming using the software while directly connected to the device. Alternatively you can program the unit remotely using the CELL 682 web page. The PIN number of your unit is the last 4 digits of the unit's serial number. The default password for the web page is "cell682". You should change this password for security purposes.

If you performed programming using the CELL 682 software then you must click the Programming Refresh link on the web page to have those programming changes updated on the website. To get just the current status of the Inputs and Outputs, you should click the Status Refresh Link. This will retrieve the latest input status from your unit. It may take a few minutes for this process to complete.

CHAPTER 4: INPUT PROGRAMMING

The Cell682 features 8 dry contact inputs and 6 analog inputs. The analog inputs are configurable as temperature or 4–20mA. The contact inputs can be used with Normally Open (NO) or Normally Closed (NC) sensors. The analog inputs can be used with 2.8K or 10K thermistors for temperature monitoring (available from Sensaphone) or any 4–20mA transducer. The monitored temperature range is -60° to 175° F (-51° to 79° C). See page 20 for 2.8K range. Programmable table values can be entered when using 4–20mA transducers to scale the reading to the appropriate units of measure.

Note: It is highly recommended that if you make any programming changes locally (at the unit via the serial port) after your web page has been initialized, that you click the *Programming Refresh* Link on the web page soon thereafter. This is to ensure that the information you are viewing on the web page is up to date. This will also ensure that the alarm log information displayed on the web page is accurate.

ALARM STATES

Each Dry Contact or Analog input is monitored based on the programming parameters that define the input type and the alarm limits for each input. Based on this programming all inputs will always be in one of four *Alarm States*: Normal, Alarm, Unacknowledged Alarm, or Normal-Unacknowledged. Each of these alarm states is defined below:

A "**Normal**" alarm state means that an input is either:

a) Within the programmed alarm limits.

b) A Normally Open input is open, or a Normally Closed input is closed.

c) An input is beyond its limits or is opposite of its programmed normality, but has not yet met its programmed alarm *Recognition Time*.

An input that is in an "**Alarm**" state means that:

a) The selected input is currently beyond its programmed alarm limits or is opposite of its programmed normality.

b) The selected input has exceeded the programmed recognition time.

c) The alarm has been acknowledged.

An input that is in an "**Unacknowledged Alarm**" state means that:

a) The selected input is currently beyond its programmed alarm limits or is opposite of its programmed normality.

b) The selected input has exceeded the programmed recognition time.

c) The alarm has not been acknowledged.

An input that is in a "**Normal** but **Unacknowledged**" state means that:

a) The selected input is within its programmed alarm limits.

b) A Normally Open input is open, or a Normally Closed input is closed.

c) A prior alarm on the selected input has not yet been acknowledged.

DRY CONTACT INPUTS

The 8 dry contact inputs can be programmed for normally open (NO) or normally closed (NC) operation. In addition, you can have the Cell682 count the number of times the input changes state (pulse count) and maintain the amount of time that the input is in the opposite state (Run Time). Click on the *Dry Contact* Tab to display the main status screen.

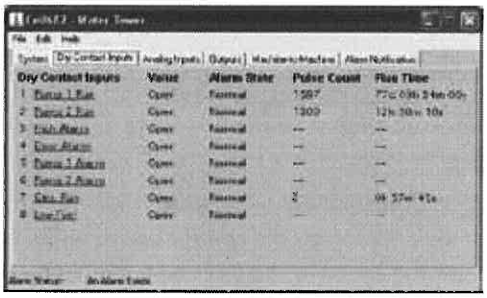


Figure 1: Dry Contact tab

This screen displays the current status of all 8 dry contact inputs. If any of the inputs were in alarm the *Alarm State* column would display the word "Alarm." If the alarm was unacknowledged, the Alarm State would say "Alarm;Unack" and a button would appear at the bottom of the screen to acknowledge the alarm.

DRY CONTACT PROGRAMMING

Click the input name to bring up the properties screen for the selected input. The following screen will appear:

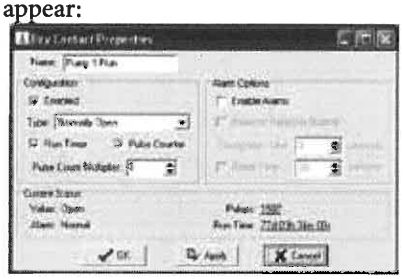


Figure 2: Dry Contact properties

If a dry contact changes from its Normal state to the opposite state for the duration of the programmed recognition time, the input will go into alarm. Note that it must be a continuous change to be recognized as an alarm. Once an alarm trips, the unit will begin its notification sequence (unless you are online through the serial port, in which case you can acknowledge the alarm directly and cancel the notification process). Listed below are definitions for each of the parameters for programming the dry contact inputs.

CONFIGURING THE INPUT NAME

The input *Name* is used to describe the condition being monitored. It can be up to 20 characters.

INPUT ENABLE/DISABLE

A channel must be *Enabled* for the input to be read by the Cell682. When a channel is enabled its status will appear on the status screen and on the web page.

CONFIGURING THE INPUT TYPE

The input *Type* can be either Normally Open or Normally Closed. When an input changes from its normal condition to the opposite condition, the Pulse Count (if enabled) will increment, the Run Timer (if enabled) will start running, and the Alarm Recognition timer will start running (if alarms are enabled).

CONFIGURING THE RUN TIMER

The *Run Timer* can be used to track how long an input condition has existed. This can be useful for monitoring pump or generator run times. The value can be preset by clicking on the run time value on the lower right part of the screen.

CONFIGURING THE PULSE COUNTER

The *Pulse Counter* can be used to track how many times a contact closure has changed state. Other possibilities include: measuring rainfall from a tipping bucket rain gauge or measuring liquid flow from a pulsed output flow gauge. The maximum value of the Pulse Counter (after the multiplier is applied) is 2 billion. Minimum Pulse Width for Pulse Count: 50ms.

The *Pulse Count Multiplier* allows you to make each pulse equate to a greater value. For example, suppose a flow gauge outputs a single pulse for every 100 gallons. By setting the *Pulse Count Multiplier* to 100 the Pulse Count value now becomes the actual total number of gallons measured by the gauge. The range of values for the Pulse Count Multiplier is 1 to 65,535.

ALARM ENABLE/DISABLE

The *Enable Alarms* checkbox activates the alarm processing functions for the selected channel. When the input exceeds the the programmed alarm limits and exceeds the programmed recognition time the notification process begins.

ALARM ON RETURN-TO-NORMAL

The Cell682 has the capability to notify you when an input (that had previously gone into alarm) returns to normal. When checked, *Alarm on Return-to-Normal* initiates this notification.

ALARM RECOGNITION TIME

The *Recognition Time* is the time required for a fault condition to qualify as an alarm event. The sensor/channel must remain beyond the limits or in a fault condition continuously for this entire period of time in order to become an alarm. The range of values is 0–32,767 seconds.

ALARM RESET TIME

The *Reset Time* is the time allowed for an acknowledged alarm's fault condition to be corrected before the Cell682 resets (reactivates) the alarm and begins the message delivery process all over again. The minimum reset time is 30 minutes, the maximum is 32,767 minutes.

ANALOG INPUTS

The 6 analog inputs can be programmed for 2.8K or 10K thermistor (temperature in degrees Fahrenheit or Celsius) or 4–20mA transducer. The Cell682 will maintain the minimum and maximum values reached for each channel. When 4–20mA is selected you can enter table low and high values to correlate the 4mA and 20mA signals to actual values for your application. Click on the Analog Inputs Tab to display the main status screen.

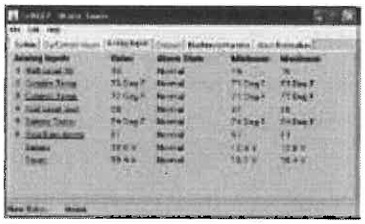


Figure 3: Analog Inputs tab

This screen displays the current status of all 6 analog inputs. If any of the inputs were in alarm the *Alarm State* column would display the word "Alarm." If the alarm was unacknowledged the Alarm State would say "Alarm Unack" and a button would appear at the bottom of the screen to acknowledge the alarm.

ANALOG INPUTS PROGRAMMING

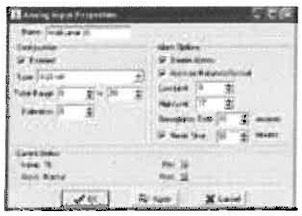


Figure 4: Analog Inputs Properties

CONFIGURING THE INPUT NAME

The input Name is used to describe the condition being monitored. It can be up to 20 characters.

CONFIGURING THE INPUT TYPE

The input Type can be temperature 2.8K (°F/°C), 10K (°F/°C), or 4–20mA. Select the type to match your sensor.

Note: Be sure to put the input jumper in the correct position.

INPUT ENABLE/DISABLE

A channel must be Enabled for the input to be read by the Cell682. When a channel is enabled its status will appear on the status screen and on the web page. Select the type of analog input from the pulldown menu.

SETTING TABLE LIMITS

When 4–20mA is selected, you can enter table low and high values to correlate the 4mA and 20mA signals to actual values for your application. For example, suppose you're using a 4–20mA transducer to measure the depth of water in a 15 foot well. Simply enter a Table Low value of 0 and a Table High value of 15 and the Cell682 will scale the input to read between 0 and 15 feet.

Programmable range

Table Low/High: -16,300 to 16,300

Default settings

Table Low value: 0

Table High value: 100

CALIBRATION

To compensate for minor variances in sensor accuracy, an offset may be programmed for each analog input. For example, if the above input were sensing temperature and was reading 3 degrees too low, then the calibration would be set at 3 as shown above, to obtain an accurate reading. Only Analog-type inputs can be calibrated.

ALARM ENABLE/DISABLE

The Enable Alarms checkbox activates the alarm processing functions for the selected channel. When the input exceeds the the programmed low or high alarm limits and exceeds the programmed recognition time the notification process begins.

ALARM ON RETURN-TO-NORMAL

The Cell682 has the capability to notify you when an input (that had previously gone into alarm) has returned to normal, that is, returns to within the programmed alarm limits. When checked, Alarm on Return-to-Normal initiates this notification.

SETTING THE ALARM LIMITS

Each analog input has a programmable Low and High Alarm limit. When the input value goes beyond the programmed alarm limits for the duration of the recognition time, the Cell682 will go into alarm and initiate the alarm notification process.

Programmable range

Alarm Low/High: -16,300 to 16,300

Default settings

Alarm Low value: 0

Alarm High value: 100

ALARM RECOGNITION TIME

The Recognition Time is the time required for a fault condition to qualify as an alarm event. The sensor/channel must remain beyond the programmed limits continuously for this entire period of time in order to become an alarm. The range of values is 0–32,767 seconds.

ALARM RESET TIME

The Reset Time is the time allowed for an acknowledged alarm's fault condition to be corrected before the Cell682 resets (reactivates) the alarm and begins the message delivery process all over again. The minimum reset time is 30 minutes, the maximum is 32,767 minutes.

POWER INPUT

Power monitoring is a built-in function. The unit will go into alarm when the power level drops below 11.75V for the programmed recognition time. In this state the Power LED will blink.

BATTERY INPUT

Battery monitoring is a built-in function. The unit will go into alarm when the battery level drops below 12.0V for the programmed recognition time. In this state the Battery LED will blink.

SPECIAL FUNCTION INPUTS

When the Cell682 is used for Pump Control, several of the inputs are dedicated to a specific task depending on whether *Dry Contact* or *Analog Level* is selected as the Pump Control method. The tables below identify which inputs are used and what function they serve. Refer to the Pump Control chapter for more information.

Dry Contact Fill/Drain Pump Control

Dry Contact Input #6 – Lead pump float switch

Dry Contact Input #7 – Lag pump float switch

Dry Contact Input #8 – All pumps off float switch

Analog Level Fill/Drain Pump Control

Analog Input #6 – connect to analog (4–20mA) level sensor

CHAPTER 5: OUTPUT PROGRAMMING

The Cell682 has two relay outputs capable of switching up to 0.3A at 120VAC, or 1.0A at 24VDC. The outputs can be controlled in a number of ways both automatically and manually. Some examples are listed below:

- Each relay can be manually turned on or off through the PC software or via the Cell682 web page.
- Either relay can be set to turn on when a particular alarm occurs.
- Either relay can be set to turn on when any alarm occurs.
- Either relay can be set to turn on when any digital or any analog alarm occurs.
- One or both relays can be programmed to operate in pump control mode (simplex/duplex) for fill or drain applications.
- A relay can be controlled automatically based on Dry Contact or Analog input values using greater-than, less-than, or equal-to statements *(See Chapter 7: Machine-to-Machine Control)*.
- A relay may also be controlled by another Cell682 unit using machine-to-machine control. This allows the Cell682 to be used for distant pump/well control applications.

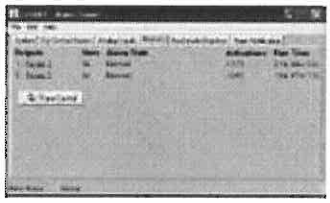


Figure 1: Outputs tab

SETTING THE OUTPUT NAME

To set up the relay outputs, click on the *Outputs* tab. Next, click on the Name for Output 1 (blue) to bring up the *Output 1 Properties* screen. Enter a name for the output which describes the device that the output will be controlling.

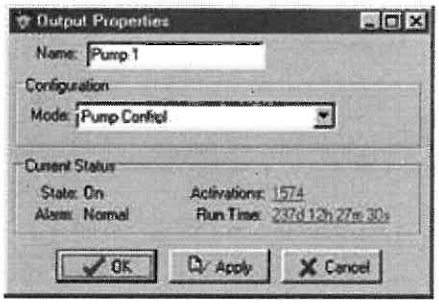


Figure 2: Output Properties screen

CONFIGURING THE OUTPUT OPERATING MODE

Click the drop-down arrow and select the operating *mode* for the output. You can have the relay automatically turn on for a variety of alarm conditions, either individual alarms or if any alarm occurs. When set to turn ON automatically on an Alarm condition, it will remain ON until the alarm is acknowledged. If you will be controlling the output manually or via a machine-to-machine command, select *Manual* mode. If you will be using the output for fill or drain pump control, select *Pump Control*. For simplex pump control set only one output to Pump Control mode; for duplex pump control set both outputs to Pump Control mode. See Chapter 6 for more information on pump control programming.

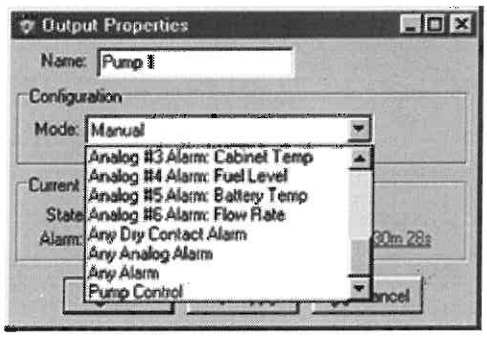


Figure 3: Output Operating mode

SWITCHING THE OUTPUT

To manually turn an output on, click on the current state (On or Off) and select the new state, then click *OK*. See the following screen.

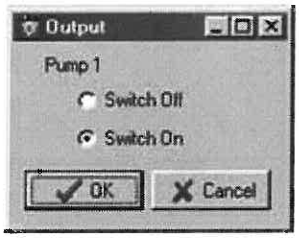


Figure 4: Output manual select

OUTPUT STATUS & STATISTICS

The Cell682 software will display the current state of the output as well as the number of times the relay has turned on, the total time the relay has been on (cumulative), and the alarm status of the output (valid in pump control mode only). This information can be useful for monitoring how often a device (pump,

machine, generator, ...) has been activated and for how long. These values can be reset and/or preset by clicking on the displayed value and entering a new one.

CHAPTER 6: PUMP CONTROL

The Cell682 can be used in Fill or Drain pump control applications using either float switches or an analog level transducer. When used with Float Switches, dry contact inputs #6-8 have a dedicated special function (see below):

Pump Control using Float Switches

Dry Contact Input #6 – Lead pump float switch

Dry Contact Input #7 – Lag pump float switch

Dry Contact Input #8 – Pumps-off float switch

When performing pump control using an analog level transducer (4–20mA), analog input #6 is designated as the well level input.

Note: Only normally-open float switches can be used for pump control (e.g. the switch is open when no water is present).

HOW IT WORKS—FLOAT SWITCHES

When performing drain pump control using float switches, three floats are required: Lead, Lag, and Pumps-Off (see Fig 1). The Lead float determines when to turn on the first pump. If the first pump is unable to bring the level below the Pumps-Off float, then the Lag float will close, turning on the second pump. When the level drops below the Pumps-Off float, both pumps are turned off. If any of the floats get stuck (i.e. the lead and pumps-off floats closed, or the lag and pumps-off floats closed) then both pumps will be turned on and an alarm will be tripped on the output or outputs in question. In duplex mode, the Cell682 will automatically alternate between the two pumps to facilitate uniform run time between the two.

If only one relay output is set to pump-control mode, then simplex control is performed. In Simplex mode only the Lead float (Dry Contact #6) and Pumps-Off float (Dry Contact #8) are required. Either output relay can be used in simplex mode.

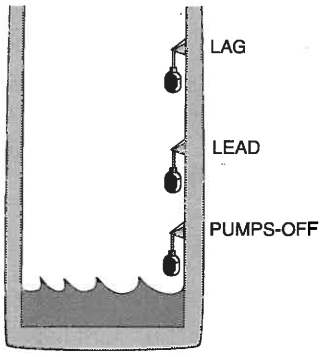


Figure 1: Float positions for a drain application

In a Fill application, the Lag and Pumps-Off floats would change position as shown below:

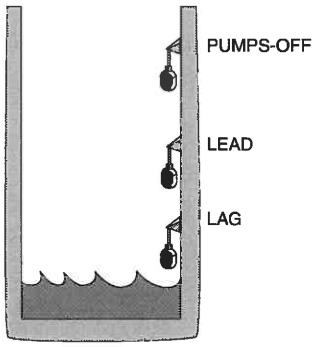


Fig 2. Float positions for a Fill application

In this case, the pumps are attempting to keep the well full. When the well is full all three floats are closed. If the level drops below the Lead float, then the first pump will turn on. If the level rises above the Pumps-Off float then the pump will turn off. If the level continues to fall below the Lag float, then the 2nd pump will turn on. Both pumps will remain on until the Pumps-Off float closes. If only one relay output is set to pump-control mode, then simplex control is performed. In Simplex mode only the Lead float (Dry Contact #6) and Pumps-Off float (Dry Contact #8) are required. Either output relay can be used in simplex mode.

HOW IT WORKS—ANALOG LEVEL SENSOR

When performing pump control with an analog level sensor, the Lead, Lag, and Pumps-Off levels are programmed into the Cell682 software. The unit then measures the actual level on Analog Input #6 and turns on the appropriate relay outputs. If both outputs are set to Pump Control mode, then alternating duplex control will be performed. If only one output is set, then Simplex control will be performed. The analog level sensor must be a 4–20mA transducer that is selected and calibrated based on the depth of the well. The specified output of the transducer must be entered into the Table Range settings for Analog Input #6.

INSTALLATION RECOMMENDATIONS

Be sure to install and wire the Cell682 and associated equipment in accordance with all local codes and regulations. Adhere to Standard Practice/Best Practice policies when installing and wiring any control system. Be sure to include hand-operated switches to disconnect power on all pumps/equipment to insure worker safety when installing and servicing equipment.

PROGRAMMING FOR PUMP CONTROL

To program the unit for Pump Control, click on the Outputs tab.

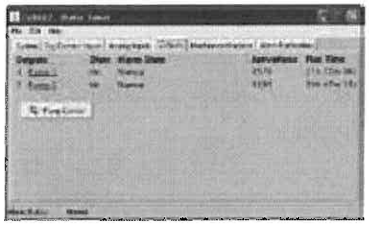


Figure 2: Output properties showing pump control

Next, click on the Pump Control link. This will bring up the pump mode setup screen. Next, select the type of pump control you want to do:

- Drain Analog Level
- Drain Dry Contact Floats
- Fill Analog Level
- Fill Dry Contact Floats

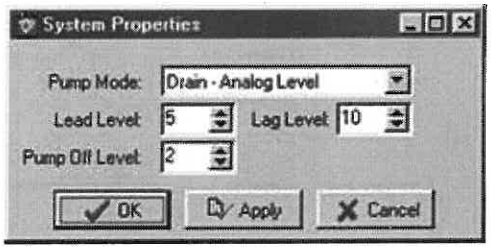


Figure 3: Pump Mode—Analog programming

If you select one of the Analog modes, you will have to fill in the Lead, Lag, and Pumps-Off fields. In Dry Contact Float mode these fields are disabled. Enter the appropriate values and click OK or Apply.

Next, click on the output to use for Pump Control. Click the drop-down box and scroll to the bottom to select Pump Control. Click OK or Apply. This will activate the Pump Control logic. Make sure all input devices and equipment are operational and ready for use. For test purposes you may wish to use hand operated switches to manually control the pumps and simply watch the system LEDs to see if the Cell682 is functioning properly. If you are using "duplex" pump control, select the other output and set it for Pump Control mode also. After verifying that the unit is functioning properly, move your hand-operated pump switches to "Auto" and verify that the Cell682 is properly controlling the system.

OUTPUT WIRING

The output relays on the Cell682 are for low current control signals (0.3A 120VAC/1.0A 24VDC maximum).

DO NOT directly connect the power for the pumps to these relays—THIS WILL PERMANENTLY DAMAGE THE Cell682.

Use the Cell682 outputs to control intermediate motor contactors/relays that will switch actual power to the pumps.

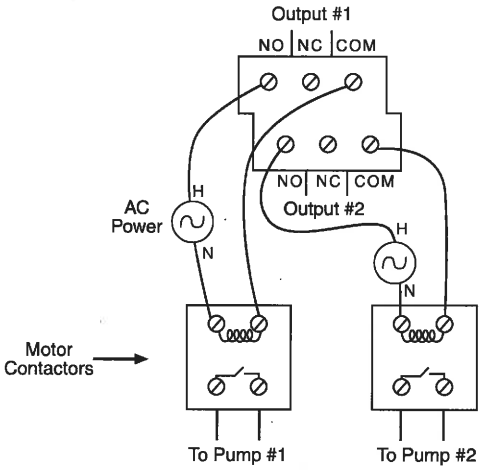


Figure 4: Output wiring to two pumps

CHAPTER 7: MACHINE-TO-MACHINE CONTROL

The Machine-to-Machine Control feature allows you to control outputs of other Cell682 units (or outputs within the same unit) based on input conditions. For example, you can switch an output on a Cell682 unit several miles away if an input on a different unit is greater than a specified value. The output being controlled must be set to manual mode. Up to 8 machine-to-machine control events can be configured per Cell682 unit. Note that when an input condition causes an output to change state, a separate event must be programmed to make the output change back. For example, if you program output #1 to turn on when input #5 is greater than 60, the output will **not** turn off when the input drops below 60. A separate event must be programmed to make the output turn off when the input is less than 60.

To program Machine-to-Machine Control click on the Machine-to-Machine Tab. The following screen will appear:

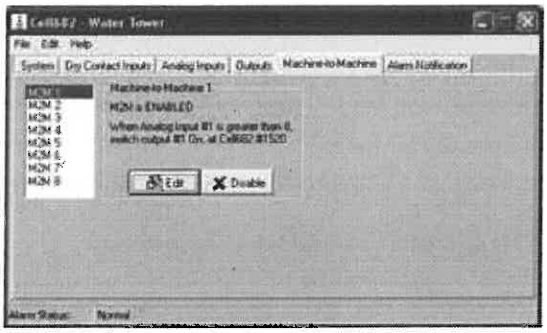


Figure 1: Machine-to-Machine tab

The 8 peer-to-peer events are listed in the window to the left. Clicking on each one will display a description of the control event programmed for each. To program a new peer-to-peer event click on the first unused (Disabled) peer event and click the *Edit* button. The following screen will appear:

Figure 2: Peer-to-peer Edit screen

Click the down arrow in the *Input Trigger* field to select the input that will initiate the event. If you select a Dry Contact input, you can have the event occur when the selected input goes from *Open-to-Closed* or *Closed-to-Open*. If you select an Analog input you can have the event occur if the input is *equal-to*, *greater-than*, or *less-than* a specified value.

Enter a value for the comparison (range: -16,300 to 16,300).

Note: Peer-to-peer events are triggered as soon as the input meets the trigger conditions. There is no recognition time applied in this case. Also, peer-to-peer events will not be executed while you are on line locally.

Next, enter the *PIN* and *Password* of the Cell682 unit whose output you want to switch. Select the output number and action (either ON or OFF). Click *Apply* or *OK* when finished. Remember, the target output must be set to manual mode, otherwise the command will be ignored. If the password is wrong the command will be ignored as well.

LOCAL OUTPUT CONTROL

You can perform control logic using the same inputs and outputs on a single Cell682 unit. If you want to switch an output on the same Cell682 as the input, then simply enter the unit's own PIN (a password is not required in this case). The output must be set to *manual* mode. Local output control does not use any airtime and also executes instantly (as long as there are no preceding peer-to-peer events that must communicate with a different Cell682 device).

IMPORTANT INFORMATION AND WARNINGS

- It may take several minutes for the peer-to-peer command to reach the destination Cell682.
- Peer-to-peer commands are processed in a sequential, non-predetermined order. This means that if more than one command is triggered, the subsequent commands must wait until the currently processed command is finished. If two peer-to-peer commands are triggered simultaneously that affect the same output, the order of the processing cannot be guaranteed.
- Both the source and destination Cell682 devices must be powered on and operational for peer-to-peer commands to operate correctly.
- If the unit is in the middle of alarm processing, peer-to-peer commands may be delayed while alarms are being sent.
- Peer-to-peer commands are not processed while logged in with the PC software. The user should log off and the serial cable should be unplugged during normal operation to ensure that peer-to-peer commands are properly processed.

- Setting peer-to-peer trigger values too close can cause output oscillations. Peer-to-peer commands are an advanced feature and should be well thought out. Do not use them for critical applications where the risk is unacceptable.
- All peer-to-peer control actions will use a wireless message packet.

SAMPLE APPLICATION

Suppose you had a well and a pump which were several miles apart. When the pump runs, it fills the well. Your goal is to maintain a certain level in the well. If you place one Cell682 unit at each location you can have two peer-to-peer events accomplish your goal. In addition, you can use the Cell682 inputs to monitor other key items such as:

- Well level too low
- Well level too high
- Pump failure
- Power failure
- Generator on
- Temperature

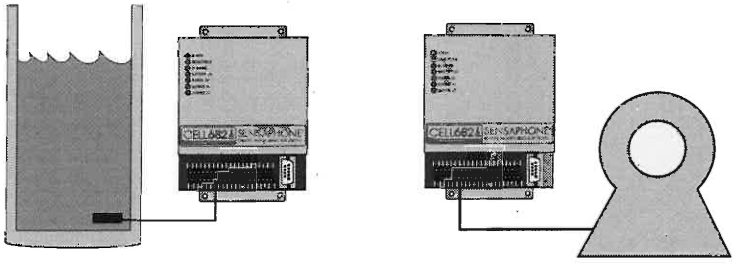


Figure 3: Well and Pump Control via Machine-to-Machine Commands

Let's suppose the well level is 25' and you need to maintain the level between 5' and 20'. The first thing you would need is a level transducer in the well. Next, program your two machine-to-machine events into the Cell682 located at the well. The first would be to turn ON the pump if the level is *Less-Than* 5'. The second event would be to turn the pump OFF if the level is *Greater-Than* 20'. Consider the rate at which the well fills when the pump is running, in order to account for the machine-to-machine command delay time between the Cell682 units. Also note that machine-to-machine control is completely independent of alarm processing, so you can also trip high or low-level alarms based on the well level.

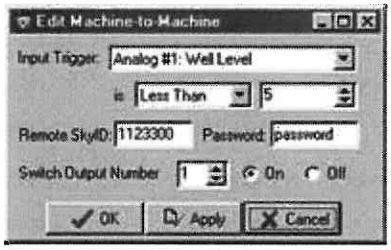


Figure 4: Turn Pump On if Level is Less than 5 feet

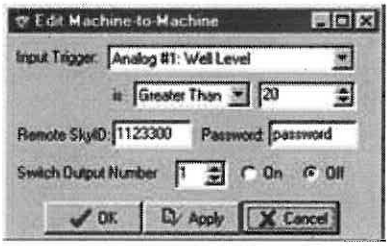


Figure 5: Turn Pump Off is Level is Greater than 20 feet

CHAPTER 8: ALARM NOTIFICATION

The Cell682 can deliver alarm message notifications by voice phone call, internet e-mail, and text messaging to various messaging devices and cell phones. A total of 24 notification destinations can be programmed to be contacted in the event of an alarm. The unit also lets you to set an escalation level for each destination, allowing you to have a group of people contacted first (tier 1) and, if the alarm is not acknowledged, a second group of people (tier 2) contacted. You can program up to 24 tier levels of destinations and include a programmable delay time between each tier.

HOW DOES NOTIFICATION WORK

Once an alarm occurs, the Cell682 will begin sending its alarm message to the programmed destinations. The unit will start with destinations at tier 1. Once the *Tier Delay* expires, the unit will start sending alarm messages to destinations in the next tier. The *Tier Delay* time begins as soon as the alarm occurs, so if it were programmed to 60 minutes, the next tier would start receiving alarm messages one hour after the alarm occurred. The Cell682 will send its alarm message to each destination until it receives acknowledgment, or it will automatically acknowledge the alarm after all destinations have been sent the message or when the last tier delay time has expired.

Note: If you are logged in through the serial port, no alarms will be sent until you log off and disconnect the serial cable. If you acknowledge the alarm through the software before logging off, no alarm messages will be sent. This can be useful for performing on-site maintenance or testing the system. If you are not logged on through the serial port the alarm messages will be sent immediately, one at a time.

VOICE PHONE CALL

The Cell682 can send alarm messages via a voice telephone call. It does this without having a telephone line connected to the unit. When an alarm message is sent as a voice call the number is dialed from the Cell682 Messaging Service Center. The message is spoken from a computer that will customize the message based on the programming in your Cell682 including the programmed *Unit Name*, *PIN*, and *Input Name*. To program a Voice destination, click on the *Alarm Notification* tab.

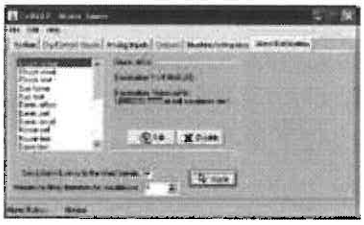


Figure 1: Alarm Notification

This screen provides a list of the programmed alarm destinations. To program or change a destination's information, click on the name of the person to edit (or select *unused* for a new entry) and then click the *Edit* button. The *Edit Destination* screen will appear:

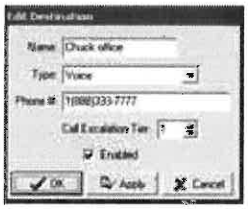


Figure 2: Contact Edit for Voice Call

Enter the name for this destination (up to 14 characters) and in the *Type* field select *Voice*. In the *Phone #* field enter the area code and telephone number. A sample alarm telephone call is shown below:

"CELL682 Alarm Message"

"Low/High temperature alarm at "*Unit Name*",

"Pin number xxxx",

"*input name*", is "xx" degrees "Fahrenheit/Celsius",

"Level crossed limit of "xx" degrees"

"To acknowledge press 1"

Example:

CELL682 Alarm Message

High temperature alarm at "Jim's Ice Cream"

Pin Number "1234"

"Freezer #5" is 38 degrees Fahrenheit

Level crossed limit of 36 degrees

To acknowledge press 1

To acknowledge the alarm your must press 1 on a touch-tone telephone when prompted. The system will reply with "alarm acknowledged" when it receives your acknowledgment. The message will be repeated 3 times so you have 3 chances to acknowledge the alarm during the call. If the the alarm is not acknowledged the system will hang up, wait a few minutes, and then call again. The system will call up to 3 times per telephone number.

INTERNET E-MAIL

The Cell682 can send alarm messages to internet e-mail addresses. The alarm message will comprise information from within your Cell682 including the programmed *Unit Name*, and *Input Name*. To program an e-mail destination, click on the *Alarm Notification* tab.

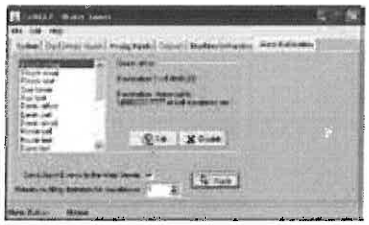


Figure 3: Alarm Notification

This screen provides a list of the programmed alarm destinations. To program or change a destination's information, click on the name of the person to edit (or select *unused* for a new entry) and then click the *Edit* button. The *Edit Destination* screen will appear:

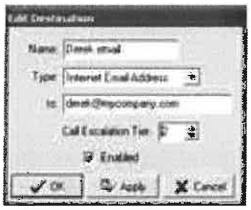


Figure 4: Destination Edit for E-mail

Enter the name for this destination (up to 14 characters) and in the *Type* field select *Internet E-mail.* In the *To:* field enter the e-mail address (up to 34 characters).

Warning: Before entering an e-mail address into the Cell682, be sure to test the address first, using your computer and standard email software. Verify that the address is working and that the message is delivered.

A sample e-mail alarm message is shown below:

```
To: derek@mycompany.com
From: 1234@cell682.com
High Temperature ALARM at "Jim's Ice Cream"
Cell682 #1234
"Freezer #5" is now 38 Deg F
Level crossed limit of 36 Deg F
To acknowledge send 1202
```

ALPHANUMERIC PAGER

The Cell682 can send alarm messages to your alphanumeric pager or mobile text messaging device. The message will be sent to an e-mail address for your pager based on your paging provider and your pin number. The provider-format list below will instruct you on how to enter the e-mail address for your particular service provider. The alarm message will comprise information from within your Cell682 including the programmed *Unit Name* and *Input Name*. To program an e-mail destination click on the *Alarm Notification* tab.

Figure 5: Alarm Notification

This screen provides a list of the programmed alarm destinations. To program or change a destination's information, click on the name of the person to edit (or select *unused* for a new entry) and then click the *Edit* button. The *Destination Edit* screen will appear:

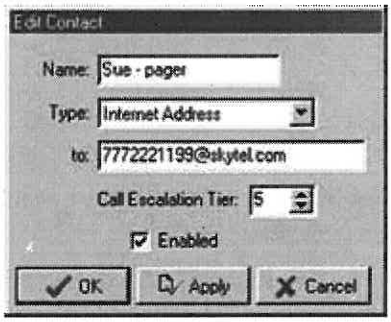


Figure 6: Destination Edit for Alphapager

Enter the name for this destination (up to 14 characters) and in the *Type* field select *Internet E-mail.* In the *To:* field enter the e-mail address as described in the list below (up to 34 characters).

Warning: Before entering an e-mail address into the Cell682, be sure to test the address first, using your computer and standard email software. Verify that the address is working and that the message is delivered.

TEXT MESSAGING TO CELL PHONES

The Cell682 can send alarm messages to your wireless cellular telephone. The message will be sent to an e-mail address for your cell phone based on your cellular provider and your telephone number. The cell-provider/format list below will instruct you on how to enter the e-mail address for your particular service provider. The alarm message will be composed of information from within your Cell682 including the programmed *Unit Name* and *Input Name.* To program an e-mail destination, click on the *Alarm Notification* tab.

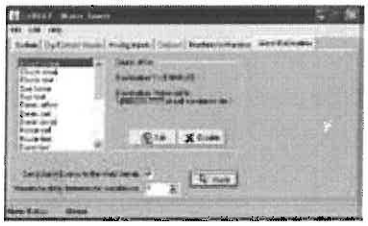


Figure 7: Alarm Notification

This screen provides a list of the programmed alarm destinations. To program or change a destination's information, click on the name of the person to edit (or select *unused* for a new entry) and then click the *Edit* button. The *Edit Destination* screen will appear:

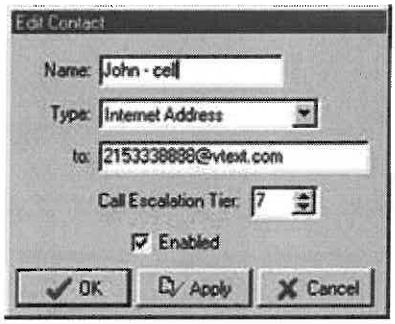


Figure 8: Destination Edit for Cell Phone

Enter the name for this destination (up to 14 characters) and in the *Type* field select *Internet E-mail.* In the *To:* field enter the e-mail address as described in the list below (up to 34 characters).

Warning: Before entering an e-mail address into the Cell682, be sure to test the address first, using your computer and standard email software. Verify that the address is working and that the message is delivered.

Cellular Provider	E-mail Address Format
3 River Wireless	xxxxxxxxx@sms.3rivers.net
Advantage Communications	xxxxxxxxx@advantagepaging.com
AirVoice	xxxxxxxxx@mmode.com
Airtouch Pagers	xxxxxxxxx@airtouch.net
Airtouch Pagers	xxxxxxxxx@airtouchpaging.com
Airtouch Pagers	xxxxxxxxx@alphapage.airtouch.com
Airtouch Pagers	xxxxxxxxx@myairmail.com
AllTel	xxxxxxxxx@message.alltel.com
Alltel PCS	xxxxxxxxx@message.alltel.com
Alltel	xxxxxxxxx@alltelmessage.com
Ameritech Paging	xxxxxxxxx@pageapi.com
Arch Pagers (PageNet)	xxxxxxxxx@archwireless.net
Arch Pagers (PageNet)	xxxxxxxxx@epage.arch.com
AT&T	xxxxxxxxx@txt.att.net
Bell South (Blackberry)	xxxxxxxxx@bellsouthtips.com
Bell South Mobility	xxxxxxxxx@blsdcs.net
Bell South	xxxxxxxxx@blsdcs.net
Bell South	xxxxxxxxx@sms.bellsouth.com
Bell South	xxxxxxxxx@wireless.bellsouth.com
Bluegrass Cellular	xxxxxxxxx@sms.bluecell.com
Boost Mobile	xxxxxxxxx@myboostmobile.com
Boost	xxxxxxxxx@myboostmobile.com
CallPlus	xxxxxxxxx@mmode.com
Carolina Mobile Communications	xxxxxxxxx@cmcpaging.com
Cellular One East Coast	xxxxxxxxx@phone.cellone.net
Cellular One PCS	xxxxxxxxx@paging.cellone-sf.com
Cellular One South West	xxxxxxxxx@swmsg.com
Cellular One West	xxxxxxxxx@mycellone.com
Cellular One	xxxxxxxxx@message.cellone-sf.com

Cellular One . . . . . xxxxxxxxx@mobile.celloneusa.com
Cellular One . . . . . xxxxxxxxx@sbcemail.com
Cellular South . . . . . xxxxxxxxx@csouth1.com
Central Vermont Communications . . . . . xxxxxxxxx@cvcpaging.com
CenturyTel . . . . . xxxxxxxxx@messaging.centurytel.net
Cingular (GSM) . . . . . xxxxxxxxx@cingularme.com
Cingular (TDMA) . . . . . xxxxxxxxx@mmode.com
Cingular Wireless . . . . . xxxxxxxxx@mobile.mycingular.net
Cingular . . . . . xxxxxxxxx@cingularme.com
Communication Specialists. . . . . xxxxxxx@pageme.comspeco.net
Cook Paging . . . . . xxxxxxxxx@cookmail.com
Corr Wireless Communications . . . . . xxxxxxxxx@corrwireless.net
Dobson Communications Corporation . . . . . xxxxxxxxx@mobile.dobson.net
Dobson-Alex Wireless /
Dobson-Cellular One . . . . . xxxxxxxxx@mobile.cellularone.com
Edge Wireless . . . . . xxxxxxxxx@sms.edgewireless.com
GCS Paging. . . . . xxxxxxxxx@webpager.us
GTE . . . . . xxxxxxxxx@gte.pagegate.net
GTE . . . . . xxxxxxxxx@messagealert.com
Galaxy Corporation . . . . . xxxxxxxxx@sendabeep.net
GrayLink / Porta-Phone. . . . . xxxxxxxxx@epage.porta-phone.com
Houston Cellular. . . . . xxxxxxxxx@text.houstoncellular.net
Inland Cellular Telephone . . . . . xxxxxxxxx@inlandlink.com
JSM Tele-Page . . . . . xxxxxxxxx@jsmtel.com
Lauttamus Communication. . . . . xxxxxxxxx@e-page.net
MCI Phone . . . . . xxxxxxxxx@mci.com
MCI . . . . . xxxxxxxxx@pagemci.com
Metro PCS . . . . . xxxxxxxxx@metropcs.sms.us
Metro PCS . . . . . xxxxxxxxx@mymetropcs.com
MetroPCS. . . . . xxxxxxxxx@mymetropcs.com
Metrocall 2-way . . . . . xxxxxxxxx@my2way.com
Metrocall . . . . . xxxxxxxxx@page.metrocall.com
Midwest Wireless . . . . . xxxxxxxxx@clearlydigital.com
Mobilecom PA . . . . . xxxxxxxxx@page.mobilcom.net
Mobilfone. . . . . xxxxxxxxx@page.mobilfone.com
Morris Wireless . . . . . xxxxxxxxx@beepone.net

NPI Wireless . . . . . xxxxxxxxx@npiwireless.com
Nextel . . . . . xxxxxxxxx@messaging.nextel.com
Nextel . . . . . xxxxxxxxx@page.nextel.com
Ntelos . . . . . xxxxxxxxx@pcs.ntelos.com
Omnipoint . . . . . xxxxxxxxx@omnipoint.com
Omnipoint . . . . . xxxxxxxxx@omnipointpcs.com
OnlineBeep . . . . . xxxxxxxxx@onlinebeep.net
PCS One . . . . . xxxxxxxxx@pcsone.net
Pacific Bell . . . . . xxxxxxxxx@pacbellpcs.net
PageMart . . . . . xxxxxxxxx@pagemart.net
PageOne NorthWest . . . . . xxxxxxxxx@page1nw.com
Pioneer / Enid Cellular . . . . . xxxxxxxxx@msg.pioneerenidcellular.com
Price Communications . . . . . xxxxxxxxx@mobilecell1se.com
ProPage . . . . . xxxxxxxxx@page.propage.net
Public Service Cellular . . . . . xxxxxxxxx@sms.pscel.com
Qualcomm . . . . . name@pager.qualcomm.com
Qwest . . . . . xxxxxxxxx@qwestmp.com
RAM Page. . . . . xxxxxxxxx@ram-page.com
ST Paging . . . . . pin@page.stpaging.com
Safaricom . . . . . xxxxxxxxx@safaricomsms.com
Satelindo GSM . . . . . xxxxxxxxx@satelindogsm.com
Satellink . . . . . xxxxxxxxx.pageme@satellink.net
Simple Freedom . . . . . xxxxxxxxx@text.simplefreedom.net
Skytel Pagers . . . . . xxxxxxxxx@ email.skytel.com
Skytel Pagers . . . . . xxxxxxxxx@skytel.com
Smart Telecom . . . . . xxxxxxxxx@mysmart.mymobile.ph
Southern LINC. . . . . xxxxxxxxx@page.southernlinc.com
Southwestern Bell . . . . . xxxxxxxxx@email.swbw.com
Sprint PCS . . . . . xxxxxxxxx@messaging.sprintpcs.com
Sprint . . . . . xxxxxxxxx@sprintpaging.com
SunCom . . . . . xxxxxxxxx@tms.suncom.com
Surewest Communications . . . . . xxxxxxxxx@mobile.surewest.com
T-Mobile . . . . . xxxxxxxxx@tmomail.net
TIM . . . . . xxxxxxxxx@timnet.com
TSR Wireless . . . . . xxxxxxxxx@alphame.com
TSR Wireless . . . . . xxxxxxxxx@beep.com

Teletouch . . . . . xxxxxxxxx@pageme.teletouch.com
Telus . . . . . xxxxxxxxx@msg.telus.com
The Indiana Paging Co . . . . . xxxx@pager.tdspager.com
Triton . . . . . xxxxxxxxx@tms.suncom.com
US Cellular . . . . . xxxxxxxxx@email.uscc.net
USA Mobility. . . . . xxxxxxxxx@mobilecomm.net
Unicel . . . . . xxxxxxxxx@utext.com
Verizon PCS . . . . . xxxxxxxxx@myvzw.com
Verizon Pagers . . . . . xxxxxxxxx@myairmail.com
Verizon . . . . . xxxxxxxxx@vtext.com
Virgin Mobile. . . . . xxxxxxxxx@vmobl.com
Virgin Mobile. . . . . xxxxxxxxx@vxtras.com
WebLink Wireless . . . . . xxxxxxxxx@pagemart.net
West Central Wireless . . . . . xxxxxxxxx@sms.wcc.net
Western Wireless. . . . . xxxxxxxxx@cellularonewest.com
Wyndtell . . . . . xxxxxxxxx@wyndtell.com

ALARM ACKNOWLEDGMENT VIA E-MAIL

An alarm message received via e-mail can be acknowledged by simply selecting "reply" to the original message, as long as the original message is contained in the reply. If not, simply reply with the 4-digit acknowledgment code provided at the end of the message. Once received, this will cancel alarm message delivery to all destinations configured with higher tier levels, and the web page History will show that you have acknowledged the alarm.

ADDITIONAL INFORMATION

You can use tier escalation to organize the destination delivery. Set each destination to its own tier level and set the delay to **two** minutes. In this case a new message will be sent every two minutes to the next tier level.

Rearranging the destination order can be done simply by changing the Tier Levels.

CHAPTER 9: OPERATION

After installation and programming have been completed, the Cell682 is fully operational. This chapter explains how the Cell682 operates.

PART ONE: ALARM NOTIFICATION AND ACKNOWLEDGMENT

There are 3 stages to a complete alarm event: 1) Alarm Recognition, 2) Alarm Notification, and 3) Acknowledgment.

Note that not all fault conditions will go through each stage. For example, some may not meet the recognition time.

ALARM RECOGNITION

1) The Cell682 monitors 8 dry contact inputs, 6 analog inputs, main power, and battery backup. When the status of an input changes or exceeds user-programmed limits, it causes a fault condition.
2) If the fault condition lasts long enough to meet its programmed recognition time, the fault condition becomes an alarm and the Cell682 begins the alarm notification sequence.

ALARM NOTIFICATION

The Cell682 can send alarms via Voice phone call, E-mail, Alphanumeric pager, or Text message to wireless (cell) phone.

DIALOUT NOTE: CALL PROGRESS

The Cell682 monitors call progress when dialing out in voice mode. If it dials out and encounters a busy signal or no answer it will wait about a minute and try again up to 3 times. If the call is answered by an answering machine or voice mail system the alarm message will likely be recorded , however, since the alarm was not acknowledged the system will make additional calls.

ALARM NOTIFICATION—VOICE

When dialing out to a destination programmed as "voice," the Cell682 waits for the phone to be answered, then recites its identification message, then the message identifying the input that has gone into alarm.

Below is an example of what the Cell682 would say during a typical 'voice' notification:

```
CELL682 Alarm Message
High temperature alarm at "Jim's Ice Cream"
Pin Number "1234"
"Freezer #5" is 38 degrees Fahrenheit
Level crossed limit of 36 degrees
To acknowledge press 1 Alarm Notification—E-mail
```

When sending an alarm message via e-mail the Cell682 will compose a text message based on the Unit's name, PIN, Input name, Input type, current value, and alarm limit (where applicable). A sample alarm message is shown below:

```
To: derek@mycompany.com
From: 1520@cell682.com

Contact ALARM at Oak Station CELL682#1520
Contact 1 Security is in alarm
To acknowledge send 1202
```

ALARM NOTIFICATION–ALPHANUMERIC PAGER

When sending an alarm message to an Alphanumeric pager, the Cell682 leaves a text message on the display of the pager. A sample is shown below:

```
Low 4-20ma ALARM at Sensaphone Cell682 #250
2 Water Level is now 21
Level crossed limit of 20
To acknowledge send 2002
```

ALARM NOTIFICATION—TEXT MESSAGE TO CELL PHONE

When sending an alarm text message to a cell phone the Cell682 leaves a message on the display of the phone. A sample is shown below

```
Low 4-20mA ALARM at Sensaphone Cell682 #250
2 Water Level is now 21
Level crossed limit of 20
To acknowledge send 2002
```

TIER DELAY

You can group destinations into tiers and then program a delay time until the next tier gets called. This allows you to contact your primary personnel first and, if necessary, escalate the calling to the next level. Up to 24 tiers can be configured. The Cell682 will start sending alarm messages to all destinations programmed in Tier 1. If the alarm is acknowledged, it will halt the notification process for that alarm and no additional alarm messages will be delivered. If all of the Tier 1 destinations have been sent the alarm message and no acknowledgement was received, the unit will wait the programmed *Tier Delay Time* and then start sending the alarm to the destinations in the next Tier. An example is described below:

Tier 1 destinations:	Tier 2 destinations:	Tier 3 destinations:
Chuck	Janet	Morton
Mary	George	Zach
Sue	Ron	Tony
Derek	Jason	
Dave	Carmen	

Tier Delay Time: 60 minutes

An alarm occurs at 8:00pm

The Cell682 starts sending alarm messages to members of Tier 1.

No one acknowledges the alarm.

At 9:00pm the Tier delay has expired and the unit begins to send alarm messages to members of Tier 2.

At 9:30pm the Cell682 receives an acknowledgement message and the unit stops the notification process.

The people in Tier 3 do not get contacted.

ALARM ACKNOWLEDGMENT

Acknowledging an alarm will halt the alarm notification process to the destination being called and also to destinations set to higher tier levels. Voice notification alarms must be acknowledged during the original phone call. E-mail, Alphanumeric pager, and Cell phone alarms can be acknowledged by replying back to the original alarm message or by sending the unit a message with the alarm acknowledgment code. The sections below detail the procedure to acknowledge an alarm.

ALARM ACKNOWLEDGMENT—VOICE NOTIFICATION

CELL682 Alarm Message

High temperature alarm at "Jim's Ice Cream" <unit name>

Pin Number "1234"

"Freezer #5" <input name> is 38 degrees Fahrenheit

Level crossed limit of 36 degrees

To acknowledge press 1

To acknowledge the alarm you must press "1" when prompted. The Cell682 will respond by saying: "Alarm acknowledged". If the Touch-Tone acknowledgment code is not received the Cell682 will say "error, not acknowledged" and repeat the message 2 more times. If no acknowledgment is received the system will wait a few minutes and then call again. The system will call up to 3 times per telephone number.

Note: An alarm cannot be acknowledged using a pulse (rotary) telephone.

ALARM ACKNOWLEDGMENT—ALPHANUMERIC PAGER

When sending an alarm message to an Alphanumeric pager, the Cell682 leaves a text message on the display of the pager. If you have a two-way alphanumeric pager you can acknowledge the alarm by replying to the original message with the alarm acknowledgement code. For example, if the acknowledgement code was 1503, you would simply reply back with "1503." If you do not have a two-way pager then you can send the Cell682 an e-mail using either a computer or a cell phone. The e-mail address of your Cell682 is PIN@cell682.com, where you would substitute the word PIN with your PIN number. In the message area simply send the unit the alarm acknowledgement code.

ALARM ACKNOWLEDGMENT—TEXT MESSAGE TO CELL PHONE

When sending an alarm message to a cell phone the Cell682 leaves a text message on the display of the phone. You can acknowledge the alarm by sending an email reply back to the Cell682 with the alarm acknowledgement code. For example, if your alarm acknowledgement code was 1107, you would simply reply back with "1107." Alternatively you can send the Cell682 an e-mail using a computer. The e-mail address of your Cell682 is PIN@cell682.com, where you would substitute the word PIN with your PIN number. In the message area simply send the alarm acknowledgement code.

ALARM ACKNOWLEDGMENT—AUTOMATIC

The Cell682 will acknowledge an alarm itself (automatically) if all of the destinations have been contacted and no acknowledgement was received.

PART TWO: STATUS REQUEST

You can request a status report from your Cell682 by sending it a command via e-mail. When the unit receives the command it will assemble a status report and send it back to the originating e-mail address. Only inputs that are *enabled* will be included in the report. If alarm monitoring is not enabled for a particular input, its status will be displayed as *disabled.* To request the status report you need the unit's password and PIN. The e-mail format to request a status report is shown below:

To: *PIN*@cell682.com {replace *PIN* with your unit's PIN number}
Subject:
Message:
p *password* {replace *password* with your unit's password}
gst

A sample e-mail Status Report is shown below:

D1: Pump 1 Run 243:33:12 1591 OK
D2: Pump 2 Run 012:30:00 1295 OK
D3: High Water 000:00:00 0 OK
D4: Door sensor 000:00:00 0 Alarm
D5: Pump 1 fault 000:00:00 0 OK
D6: Pump 2 fault 000:00:00 0 OK
D7: Gen. Run 000:57:49 2 Disabled
D8: Low Fuel 000:00:00 0 OK
A1: Well Level 16 OK
A2: Outside Temp 78 F Disabled
A3: Cabinet Temp 86 F OK
A4: Fuel Level 38 OK
A5: Battery Temp 81 F OK
A6: Flow Rate 33 OK
B: Battery 13.50v OK
P: Power 16.82v OK
O1: Pump 1 On 015:54:44 1573 OK
O2: Pump 2 Off 012:30:00 1295 OK

CHAPTER 10: CELL682 WEB PAGE

The Cell682 Web Page is where you can check status, make programming changes, and even control outputs from any internet connected computer.

Once the Cell682 is installed and turned on you can go to *www.Cell682.com*, enter your *PIN* and *Password (default password is cell682)*, and click *Login*. The web page for your Cell682 will be displayed. The web page presents a view of the system which is very similar to the Cell682 PC Software, except for the fact that it is a snapshot of information from a specific point in time—it is not updating in real-time. To retrieve the latest values you must click either the *Status Refresh or Programming Refresh* links. For security purposes be sure to change your password.

> **Note:** It is highly recommended that if at any time you make any programming changes locally (at the unit via the serial port) that you click the *Programming Refresh* link on the web page soon thereafter, to ensure that the information you are viewing is up to date. This will also ensure that the alarm history information will also be accurate.

STATUS REFRESH

You can retrieve the latest input and output values by clicking the *Status Refresh* link. This will send a message to the Cell682 requesting the latest input and output status information. When the unit receives the request it will immediately send back a reply. During this waiting period the web page will display the input and output values in green italics until the updated information returns. At the top of the screen is a time-stamp which indicates the date and time of the last update.

PROGRAMMING REFRESH

The *Programming Refresh* command will refresh all Cell682 programming as well as input/output status. You only need to click this button if you believe that programming changes may have occurred locally, at the unit, and you want to refresh the information on the web server.

PROGRAMMING VIA THE WEB PAGE

You can change any parameter in your Cell682 from the web page, just as you would using the Cell682 PC Software. All programmable items will appear as Blue links. For the inputs you can click on any item for that channel and the respective programming screen will appear. If you change an item and click *OK*, the change will be sent to your unit. This will take a few minutes to process.

Similarly you can change Output programming, Notification programming, and Machine-to-machine programming.

SWITCHING OUTPUTS VIA THE WEB PAGE

To switch an output, Login to the web page and click *Outputs*. Next, click on the Output number you want to switch. On the programming screen, locate the *State* field and select On or Off, then click OK. The command to switch the output will be sent to your unit. Note that this may take 1–2 minutes.

ALARM ACKNOWLEDGEMENT HISTORY

An alarm history log is available on the web page to provide details on alarms that have occurred and whom acknowledged them. The log can be queried by entering a start and end date range, or by selecting one of the *QuickDates* options. Note that the time stamps appearing on the web page do not indicate when the alarm occurred, but rather the time that they were received by the web server.

CHAPTER 11: TESTING THE CELL682

It is extremely important that you test the system after installation to make sure that it is working properly and that all programming is correct. In addition, it is highly recommended that you test and/or verify proper operation on a weekly basis to ensure that the system continues to function as required. *(See Appendix A.)* The following items should be tested:

- Notification to all destinations to make sure that each one is programmed correctly and that the messages are actually delivered.
- Input testing to make sure that the system is reading them correctly and that when a fault occurs the system responds appropriately.
- Output testing to make sure they are wired correctly and that they switch on and off when instructed.
- Control programming—Local control, Machine-to-machine, or Pump control—to make sure that the system is functioning properly, as required for your application.

NOTIFICATION TESTING

Create an alarm and confirm that all destinations receive the alarm message. This can be done by forcing an input into alarm, by temporarily adjusting an alarm limit, or by changing the normality of a Dry Contact input. The Alarm LED on the front of the unit will begin blinking when an alarm has occurred. Be sure to disconnect from the serial port after creating the alarm, otherwise the notifications will not be sent. After confirming that all notification messages were delivered, correct the alarm condition and/or adjust your programming as required.

INPUT TESTING

Check the current value of all of the programmed Dry Contact and Analog Inputs. Make sure that the values being displayed are correct.

For Dry Contact inputs, momentarily reverse the input condition to verify that the unit recognizes the change of state. For example, if you have a normally open sensor connected to Dry Contact #1, force that sensor closed and verify that the unit displays the value as closed.

For analog inputs, verify that the input reading matches the entity being measured. For example, for temperature inputs confirm that the unit is reporting the correct temperature.

For 4–20mA inputs, confirm that the level or value being displayed in the Cell682 matches the actual conditions being measured.

OUTPUT TESTING

Confirm that the power limitations of the outputs will not be exceeded. The Cell682 outputs are rated for a maximum of 0.3A at 120VAC or 1.0A at 24VDC. Test the outputs by switching them on and off manually and confirming that the device being controlled turns on and off. The Output LEDs on the front of the unit should also turn on and off.

CONTROL PROGRAMMING

For applications that utilize control programming it is important to test all scenarios that may affect system operation. This means you should test your system under normal operating conditions as well as abnormal (or failure) conditions to make sure that you have designed your system to operate under the worst-case scenario.

Note that Local and Machine-to-Machine control will not execute while you are connected locally.

To test Local control operation, force input conditions as necessary to activate the output(s). Confirm that the input-to-output control logic is executing properly. Test each programmed control algorithm separately to make sure that each one is functioning as desired.

To test Machine-to-Machine control, force input conditions as necessary to activate the output(s) on your remote Cell682 device(s). Confirm that the outputs on the remote unit(s) have turned on or off as instructed. Test each programmed control algorithm separately to make sure they are all functioning. Have the system go through a complete automated control cycle of your system to confirm that the unit and its programming are operating as intended.

PUMP CONTROL

To test Pump Control using float switches, force the float switch inputs open or closed as necessary, to make the output(s) turn on or off. In a Drain application the first pump would turn on if the Pumps-Off and Lead float switches were closed. The second pump would turn on if the Lag float switch also closed. Both pumps would then turn off when all three float switches opened. In a fill application, the first pump would turn on when the Pumps-Off and Lead floats opened. The second pump would turn on when the Lag float also opens. Both Pumps would turn off when all three floats closed.

To test Pump Control using a level transducer you can temporarily force the input level to a certain value by adjusting the calibration for the Analog Input.

In a drain application, force the input to be above the Lead level and the first pump should turn on. If you then set the input above the Lag level, the second pump should also turn on. Setting the input below the Pumps-Off setting will turn both pumps off. In a fill application, setting the input below the lead level will turn the first pump on. Setting the input below the Lag level will turn on the second pump. Setting the input above the pumps-Off level will turn off both pumps.

Once you have confirmed that the Cell682 is controlling the system properly, allow the system to operate automatically. Observe a complete Drain or Fill cycle and verify that the system is operating as required.

APPENDIX A: CHECKING YOUR CELL682 FOR PROPER OPERATION

We recommend that you test your Cell682 weekly to be sure it is functioning properly. This will ensure that when a problem arises the Cell682 will be ready to alert the appropriate personnel. A blank Test Log is included at the back of this manual.

There are several tests to be performed:

1. Request a Status Report from the unit by sending it an e-mail message and verifying the reply. This will test the unit's ability to receive and send a message. It will also verify that all of the inputs are reading properly, the alarm conditions are OK, the electricity is on, and the battery is OK.
2. Create an alarm on each input by tripping all connected sensors. This will verify that each input is being recognized by the unit and that it is programmed properly.

Temperature sensors: Heat or cool the sensor.

Motion sensors: Have someone walk in front of the sensor.

Door and window sensors: Open the door or window.

Water sensors: Apply a small amount of water beneath the sensor or use a wet towel and touch it to the sensor probes.

Humidity sensors: Raise the humidity around the sensor by holding a cup of very hot water beneath it.

4–20mA Transducers: Verify that the Cell682 is reading the proper level by measuring the monitored quantity using alternative methods.

Allow the unit to send its alarm message to all programmed contacts. This will make sure that the Cell682 is programmed properly. It will also prepare personnel to respond appropriately when they receive a call from the Cell682.

3. Test the battery by unplugging the AC adapter and making sure that the Cell682 continues to function. Check the LEDs to make sure that the Power LED starts to blink and the Battery LED glows steadily. Keep the AC adapter unplugged so that a Power Failure alarm occurs. Allow the unit to send its alarm message to all programmed contacts while running on battery backup. Plug in the AC adapter after the unit has finished sending all of its messages.
4. If you require assistance, contact Sensaphone Technical Support at (610) 558-2700.

APPENDIX B: TROUBLESHOOTING

I CAN'T COMMUNICATE WITH MY UNIT LOCALLY.

- Make sure you have entered the proper PIN.
- Make sure the cable is connected from your computer to the Cell682.
- Make sure you have the right Com port selected (*typically 1 or 2*).
- Make sure the unit is receiving power.

I CAN'T ACCESS MY UNIT ON THE WEB PAGE.

- Have you entered the proper *PIN* and *Password*? The default password is "cell682"

WHY IS THE 'IN RANGE' LED OFF?

- If the unit is not within range of the wireless network the LED will not turn on.
- It typically takes 1-2 minutes from power-up for the Cell682 to recognize the wireless network and turn on the LED.
- Make sure the unit is receiving power.

WHY IS THE 'REGISTERED' LED OFF?

- If the IN RANGE LED is lit but the REGISTERED LED is not, then the unit is not activated yet.
- Make sure the unit is receiving power.

WHY IS THE 'BATTERY OK' LED OFF?

- There is no battery connected.
- The battery voltage is low.

WHY IS THE 'POWER OK' LED OFF?

- The main power has failed and the unit is running batteries.
- The voltage at the Vin terminals is low.

WHY IS THE 'ALARM' LED BLINKING?

- There is an unacknowledged alarm.

WHY IS THE 'ALARM' LED ON?

- There is an alarm but it has been acknowledged.

WHY WON'T THE UNIT SEND ME ALARM MESSAGES?

- The Cell682 will not send any alarm messages if you are connected locally.
- There are no destinations programmed.
- None of the destinations are enabled.
- The unit is not activated on the wireless network
- The destinations are not programmed correctly.
- There are no unacknowledged alarms.

MY UNIT WON'T MAKE A VOICE CALL.

- The telephone number is programmed incorrectly.
- The Cell682 will not send any alarm messages if you are connected locally.
- There are no destinations programmed.
- None of the destinations are enabled.
- The unit is not activated on the wireless network
- There are no unacknowledged alarms.

MY UNIT WON'T SEND A TEXT MESSAGE TO MY CELL PHONE OR ALPHANUMERIC PAGER.

- The Destination is programmed incorrectly. You must use the e-mail address format for your cellular or paging provider as specified in chapter 8.
- The Destination type is set incorrectly. It should be set to Internet E-mail Address.
- The Cell682 will not send any alarm messages if you are connected locally.
- There are no destinations programmed.
- None of the destinations is enabled.
- The unit is not activated on the wireless network
- There are no unacknowledged alarms.

WHY DOES THE UNIT CALL PEOPLE EVEN AFTER I ACKNOWLEDGED THE ALARM?

- When an alarm occurs the unit will begin to sequentially broadcast all alarm messages for the first Tier. Depending on how quickly they get dispatched from the messaging center its possible for additional calls to be made even after the alarm has been acknowledged. Once the message is received at the messaging center it will be called regardless of acknowledgement.

MY UNIT WON'T EXECUTE A LOCAL MACHINE-TO-MACHINE COMMAND.

- Machine-to-machine commands will not execute while you are connected locally.
- The output you are trying to switch is not set to manual mode.
- The input condition for the machine-to-machine command is not being met.

MY UNIT WON'T EXECUTE A REMOTE MACHINE-TO-MACHINE COMMAND.

- Machine-to-machine commands will not execute while you are connected locally.
- The output on the remote unit you are trying to switch is not set to manual mode.
- The input condition for the machine-to-machine command is not being met.
- The PIN and Password for the remote unit is programmed incorrectly.

MY CELL682 ISN'T DISPLAYING THE CORRECT VALUE FROM MY 4–20MA TRANSDUCER.

- The analog input jumper isn't set to the 4–20mA position.
- The analog input "type" isn't set to 4–20mA in the software.
- The transducer is not wired correctly.
- The transducer is not calibrated for the desired measurement range.
- The analog input table values aren't programmed to the calibrated range of the transducer.
- The transducer is not compatible with single-ended inputs therefore an isolation device is required.

MY TEMPERATURE SENSOR ISN'T DISPLAYING THE CORRECT VALUE.

- The analog input jumper isn't set to the Temperature position.
- The analog input "type" isn't set to Temperature in the software
- The temperature sensor isn't a compatible 2.8K or 10K thermistor.
- The temperature sensor isn't wired correctly.

WHY DON'T THE VALUES DISPLAYED ON THE WEB PAGE MATCH THE VALUES DISPLAYED IN THE CELL682 SOFTWARE?

- The web page displays a snapshot of the values at a particular moment in time. It does not display real-time values, as is the case when connected locally through the Cell682 software.
- Click the Status Update button on the web page to retrieve a current snapshot.

WHY CAN'T I GET PUMP CONTROL TO WORK?

- The Output(s) are not set to Pump Control mode.
- The Pump Control parameters are programmed incorrectly.
- The level transducer is not wired to analog input #6.
- The level transducer is not reading the proper values.

- The float switches are not wired to Dry Contact inputs #6, #7, and #8.
- The float switches are not Normally Open.
- The Lead, Lag, and Pumps-Off float switches are not wired to the proper inputs.

APPENDIX C: THERMISTOR TABLE

10K THERMISTOR DATA

Degrees Celsius	Resistance (Ohms)
-30	135.2K
-20	78.91K
-10	47.54
0	29.49K
10	18.79K
20	12.25K
30	8,194
40	5,592
50	3,893
60	2,760
70	1,990

2.8K THERMISTOR DATA

Degrees Celsius	Resistance (Ohms)
-50	187,625
-40	94,206
-30	49,549
-20	27,180
-10	15,491
0	9,142
10	5,572
20	3,498
30	2,256
40	1,491
50	1,009
60	697
70	490
80	351

APPENDIX D: CELL682 SPECIFICATIONS

ENVIRONMENTAL INPUTS

Number of Dry Contact Inputs: 8

Dry Contact Input Types: N.O./N.C. contact, pulse count, equipment run time

Dry Contact Input Electrical Characteristics: 47KΩ to 5V

Number of Analog Inputs: 6

Analog Input Types: 2.8K thermistor (-100°F to 124°F / -80°C to 55°C), 10K thermistor (-60°F to 175°F / -51°C to 79°C) and 4–20mA (-16,300 to 16,300)

Analog Input Electrical Characteristics: 22KΩ to 2.5V (temperature) and 250 Ohms to ground (4–20mA)

Input Connector: terminal block

A/D Converter Resolution: 10 bits ±2 LSB

Input Protection: Metal Oxide Varistors and fast acting diode clamps

RELAY OUTPUTS

Number of Relay Outputs: 2

Rating: 0.3A 120VAC / 1.0A 24VDC Maximum

Type: SPDT Form-C Latching

Relay Output Connector: terminal block

LED INDICATORS

Function: Alarm, Radio Registered, Radio In Range, Battery OK, Power OK, Output#1, Output #2

POWER SUPPLY

Power Supply: 18VDC 800mA power transformer

Power Consumption: 50mA typical, 700mA burst (radio transmit)

Power Protection: Metal Oxide Varistor

Battery Backup/Charger: Compatible with 12V sealed gel-cell, 2.2AH

ENVIRONMENTAL

Operating Temperature: -22° to 140°F (-30° to 60°C)

Operating Humidity: 0 to 90% RH non-condensing

Storage Temperature: -22° to 158°F (-30° to 70°C)

PHYSICAL: CELL682 UNIT IN NEMA-4 ENCLOSURE

Dimensions: 12"h x 8"w x 6"d (30.5 x 20.3 x 15.2 cm)

Weight: 8 lbs. (2.7kg)

Specifications subject to change without notice.

APPENDIX E: REPLACING THE BACKUP BATTERY

The back-up battery will provide about 3–5 years of service life depending on usage and temperature. After 5 years (or when backup time is insufficient) the battery should be replaced. Replacement batteries can be ordered from Sensaphone. To replace the battery, follow the instructions below:

1. Disconnect the red battery wire and cover the bare wire with insulating electrical tape.
2. Disconnect the black battery wire and cover the bare wire with insulating electrical tape.
3. Unplug the power transformer.
4. Loosen the compression wiring connectors and allow 6-10" of cable slack to come into the enclosure. This will make it easier to turn the panel over.
5. Remove the four screws securing the Cell682 housing to the back panel and carefully remove the Cell682.
6. Remove the connectors from the battery by carefully pulling and wiggling the connectors from the battery tabs.
7. Remove the screws holding the battery bracket and remove the bracket.
8. Dispose of/recycle the old battery following local recycling regulations for lead batteries.
9. Insert the new replacement battery into the slot and replace the bracket. Secure the bracket with the two screws.
10. Attach the battery connector at the end of the BLACK wire to the -(negative) terminal of the new battery.
11. Attach the battery connector at the end of the RED wire to the +(positive) terminal of the new battery.
12. Place the Cell682 over the four metal stand-offs and re-attach the four screws.
13. Readjust the cables through the compression connectors and secure the fittings.
14. Plug the power transformer into the outlet.
15. Connect the Black battery wire to the "BAT -" terminal.

16. Connect the Red battery wire to the "BAT +" terminal.

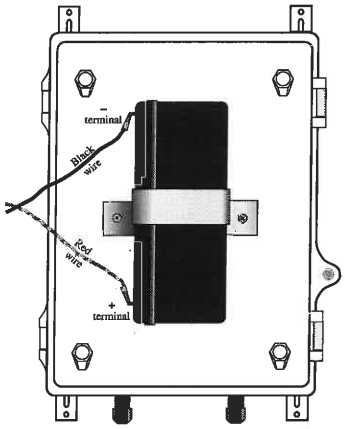


Figure 1: Battery placement

APPENDIX F: OPTIONAL ACCESSORIES

The sensors and accessories listed below are available from Sensaphone and represent the most commonly used devices. Other dry contact sensors or 4–20mA transducers, designed for more specialized applications, may also be used. Commercial or industrial electrical supply houses can provide devices to monitor virtually any condition. For further information, contact a Sensaphone Sales Associate toll-free at 1-877-373-2700.

PART .....PART/NUMBER DESCRIPTION

FGD-0006 ..... Magnetic Reed Switch
FGD-0007 ..... Passive Infra-Red Detector
FGD-0010 ..... 50' 2-conductor #22AWG shielded accessory Cable
FGD-0013 ..... Spot Water Detector
FGD-0022 ..... Temp° Alert
FGD-0027 ..... Humidistat
FGD-0049 ..... Smoke Detector with Built-in Relay
FGD-0052 ..... Humidity Transmitter
FGD-0054 ..... Power-Out Alert™
FGD-0056 ..... Zone Water Detector w/Water Rope
FGD-0063 ..... 10' additional Water Rope for FGD-0056
FGD-0067 ..... Surge Suppressor
FGD-0101 ..... 2.8K Weatherproof Temperature Probe
FGD-0102 ..... 10K Weatherproof Temperature Probe
FGD-0104 ..... 10K Outdoor Air Weatherproof Temperature Sensor
FGD-0205 ..... Multipoint Wireless I/O System
FGD-CELL-ANT . Outdoor GSM Antenna with 16' Cable

APPENDIX G: RETURNING YOUR CELL682 FOR REPAIR

In the event that the Cell682 does not function properly, we suggest that you do the following:

1. Record your observations regarding the Cell682's malfunction.
2. Call Sensaphone Technical Support toll-free at 1-877-373-2700 or e-mail support@sensaphone.com prior to sending the unit to Sensaphone for repair. Our product support specialists are able to diagnose and correct many unit setup and programming problems over the phone.

If the unit must be sent to Sensaphone for servicing, please do the following:

1. Unplug the power supply, disconnect the battery, and disconnect all wiring.
2. Carefully pack the unit to avoid damage in transit. Use the original container (if available) or a sturdy shipping box.
3. To avoid shipping delays, you must include the following information:
   a) Your name, address and telephone number.
   b) A note explaining the problem.
4. Ship your package to the address below:
   SERVICE DEPARTMENT
   Sensaphone.
   901 Tryens Road
   Aston, PA 19014
5. Ship prepaid and insured via UPS or US Mail to ensure a traceable shipment with recourse for damage or replacement.

Test Log

Date	Inputs	Dialout	Call-In	Battery		Tested By
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	
	Pass ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	*Pass* ☐ *Fail* ☐	

Date	Inputs		Dialout		Call-In		Battery				Tested By
	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	
	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	
	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	
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Date	Inputs		Dialout		Call-In		Battery				Tested By
	Pass ☐	Fail ☐	Pass ☐	Fail ☐	Pass ☐	Fail ☐	Pass ☐	Fail ☐	Pass ☐	Fail ☐	
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Date	Inputs		Dialout		Call-In		Battery				Tested By
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Date	Inputs		Dialout		Call-In		Battery				Tested By
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Attachment D
Waste Disposal

INVOICE

DATE: May 28, 2019
INVOICE: 7324

Supplier # 113620
Fed. ID # 57-1160277
WA UBI# 602 284 251
WA CLB# DHENVEI871NB

BILL TO:
Mariem Esparra
Project Engineer
Enivronmental Partners, Inc
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

REMIT TO:
DH Environmental, Inc.
C/O Sterling National Bank
P.O. Box 75359
Chicago, IL 60675-5359

Contact: Scott St. John at (206) 327-0026 or scottstjohn@dhenviro.com

Project Reference: Transportation & Disposal of Non-Regulated Soil - Keenan Advantage Group

DESCRIPTION	Qty	Unit	Rate	Amount
Project Location: Interstate 90, Milepost 80 Cle Elum, WA 98922 **Dates of Service: May 23, 2019** **Waste profiling, preparations of shipping documents, transportation and disposal of tetrachlorethene liquids.**				
Project Management - Profile and Logistics	1.5	Hour	$ 90.00	**$ 135.00**
Transportation	1	Lump Sum	$ 300.00	**$ 300.00**
Disposal: Non-Regulated Soil - Direct Landfill (no free liquids)	1	15 gal DM	$ 80.00	**$ 80.00**
			INVOICE SUBTOTAL	**$ 515.00**
Thank you for your business			**Sales Tax**	**$ -**
			TOTAL INVOICE	**$ 515.00**

Please pay this amount

Payment Terms: Net 30 Days.
Electronic Funds Transfer
Account Type: Checking
Financial Institute: Sterling National Bank
For Further Credit To: DH Environmental, Inc.
ABA Routing Number: 221-970-443
Account Number: 0316066702

Please update your records with our new banking and remit to information*

Please print or type.

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number	2. Page 1 of	3. Emergency Response Phone	4. Manifest Tracking Number
None Required	1	800-337-7455	020121198 JJK

GENERATOR

5. Generator's Name and Mailing Address
Kenan Advantage Group
505 Eagleview Blvd Suite 100
Exton PA 19341
Alt Manem Esparra
Generator's Phone: 475 - 305 - 8014

Generator's Site Address (if different than mailing address)
Kenan Advantage Group
Interstate 90, Milepost 80
Cle Elum WA 98922

6. Transporter 1 Company Name
DH Environmental Inc
U.S. EPA ID Number
WAH000041717

7. Transporter 2 Company Name
Chemical Waste Management
U.S. EPA ID Number
ORD009452352

8. Designated Facility Name and Site Address
CHEMICAL WASTE MANAGEMENT, INC
17629 CEDAR SPRINGS LANE
ARLINGTON OR 97812
Facility's Phone: 541 454-7843
U.S. EPA ID Number
ORD009452353

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes		
	1. Non-RCRA, non-DOT (IDW Soil OR341871)	01	DM	100	P	NONE		
	2.							
	3.							
	4.							

14. Special Handling Instructions and Additional Information
#1 OR341871

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: Jacob Burke on behalf of Kenan Advantage Group
Signature
Month: 5 Day: 23 Year: 19

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials

Transporter 1 Printed/Typed Name: Jacob Burke
Signature
Month: 5 Day: 23 Year: 19

Transporter 2 Printed/Typed Name: [illegible]
Signature
Month: 5 Day: [illegible] Year: 19

DESIGNATED FACILITY

18. Discrepancy

18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection

Manifest Reference Number:

18b. Alternate Facility (or Generator)
U.S. EPA ID Number
Facility's Phone:

18c. Signature of Alternate Facility (or Generator)
Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)

1.	2.	3.	4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a

Printed/Typed Name
Signature
Month Day Year

EPA Form 8700-22 (Rev. 12-17) Previous editions are obsolete.

GENERATOR'S INITIAL COPY

Attachment E
Laboratory Analytical Reports

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: 71201
Work Order Number: 1707120

July 18, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 4 sample(s) on 7/14/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

CC:
Joe Sherrod

Date: *07/18/2017*

CLIENT: Environmental Partners, Inc.
Project: 71201
Work Order: 1707120

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1707120-001	SVE-3	07/13/2017 1:12 PM	07/14/2017 8:00 AM
1707120-002	SVE-4	07/13/2017 1:17 PM	07/14/2017 8:00 AM
1707120-003	TOT-INF	07/13/2017 1:24 PM	07/14/2017 8:00 AM
1707120-004	TOT-EFF	07/13/2017 1:30 PM	07/14/2017 8:00 AM

Case Narrative

WO#: **1707120**
Date: **7/18/2017**

CLIENT: Environmental Partners, Inc.
Project: 71201

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1707120**
Date Reported: **7/18/2017**

Client: Environmental Partners, Inc.
Collection Date: 7/13/2017 1:12:00 PM
Project: 71201
Lab ID: 1707120-001
Matrix: Air
Client Sample ID: **SVE-3**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37422		Analyst: NG
Benzene	ND	0.100		µg/L	1	7/14/2017 4:26:58 PM
Toluene	ND	0.100		µg/L	1	7/14/2017 4:26:58 PM
Ethylbenzene	ND	0.100		µg/L	1	7/14/2017 4:26:58 PM
m,p-Xylene	ND	0.100		µg/L	1	7/14/2017 4:26:58 PM
o-Xylene	ND	0.100		µg/L	1	7/14/2017 4:26:58 PM
Surr: Dibromofluoromethane	95.8	61.1 - 128		%Rec	1	7/14/2017 4:26:58 PM
Surr: Toluene-d8	100	66 - 138		%Rec	1	7/14/2017 4:26:58 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	101	64.7 - 128		%Rec	1	7/14/2017 4:26:58 PM
Gasoline by NWTPH-Gx				Batch ID: R37423		Analyst: NG
Gasoline	14.6	5.00		µg/L	1	7/14/2017 4:26:58 PM
Surr: 4-Bromofluorobenzene	104	65 - 135		%Rec	1	7/14/2017 4:26:58 PM
Surr: Toluene-d8	97.3	65 - 135		%Rec	1	7/14/2017 4:26:58 PM

Analytical Report

Work Order: **1707120**
Date Reported: **7/18/2017**

Client: Environmental Partners, Inc.
Collection Date: 7/13/2017 1:17:00 PM
Project: 71201
Lab ID: 1707120-002
Matrix: Air
Client Sample ID: **SVE-4**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37422		Analyst: NG
Benzene	ND	0.100		µg/L	1	7/14/2017 5:24:53 PM
Toluene	3.25	0.100		µg/L	1	7/14/2017 5:24:53 PM
Ethylbenzene	0.485	0.100		µg/L	1	7/14/2017 5:24:53 PM
m,p-Xylene	3.72	0.100		µg/L	1	7/14/2017 5:24:53 PM
o-Xylene	1.12	0.100		µg/L	1	7/14/2017 5:24:53 PM
Surr: Dibromofluoromethane	95.6	61.1 - 128		%Rec	1	7/14/2017 5:24:53 PM
Surr: Toluene-d8	104	66 - 138		%Rec	1	7/14/2017 5:24:53 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	7/14/2017 5:24:53 PM
Gasoline by NWTPH-Gx				Batch ID: R37428		Analyst: EM
Gasoline	542	50.0	D	µg/L	10	7/14/2017 6:06:09 PM
Surr: 4-Bromofluorobenzene	104	65 - 135		%Rec	1	7/14/2017 5:24:53 PM
Surr: Toluene-d8	103	65 - 135		%Rec	1	7/14/2017 5:24:53 PM

Analytical Report

Work Order: **1707120**
Date Reported: **7/18/2017**

Client: Environmental Partners, Inc.
Collection Date: 7/13/2017 1:24:00 PM
Project: 71201
Lab ID: 1707120-003
Matrix: Air
Client Sample ID: **TOT-INF**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37422		Analyst: NG
Benzene	ND	0.100		µg/L	1	7/14/2017 4:55:55 PM
Toluene	0.174	0.100		µg/L	1	7/14/2017 4:55:55 PM
Ethylbenzene	ND	0.100		µg/L	1	7/14/2017 4:55:55 PM
m,p-Xylene	0.210	0.100		µg/L	1	7/14/2017 4:55:55 PM
o-Xylene	ND	0.100		µg/L	1	7/14/2017 4:55:55 PM
Surr: Dibromofluoromethane	95.6	61.1 - 128		%Rec	1	7/14/2017 4:55:55 PM
Surr: Toluene-d8	100	66 - 138		%Rec	1	7/14/2017 4:55:55 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	101	64.7 - 128		%Rec	1	7/14/2017 4:55:55 PM
Gasoline by NWTPH-Gx				Batch ID: R37423		Analyst: NG
Gasoline	36.5	5.00		µg/L	1	7/14/2017 4:55:55 PM
Surr: 4-Bromofluorobenzene	105	65 - 135		%Rec	1	7/14/2017 4:55:55 PM
Surr: Toluene-d8	98.7	65 - 135		%Rec	1	7/14/2017 4:55:55 PM

Analytical Report

Work Order: **1707120**
Date Reported: **7/18/2017**

Client: Environmental Partners, Inc.
Collection Date: 7/13/2017 1:30:00 PM
Project: 71201
Lab ID: 1707120-004
Matrix: Air
Client Sample ID: **TOT-EFF**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37422		Analyst: NG
Benzene	ND	0.100		µg/L	1	7/14/2017 3:58:02 PM
Toluene	0.159	0.100		µg/L	1	7/14/2017 3:58:02 PM
Ethylbenzene	ND	0.100		µg/L	1	7/14/2017 3:58:02 PM
m,p-Xylene	0.189	0.100		µg/L	1	7/14/2017 3:58:02 PM
o-Xylene	ND	0.100		µg/L	1	7/14/2017 3:58:02 PM
Surr: Dibromofluoromethane	95.1	61.1 - 128		%Rec	1	7/14/2017 3:58:02 PM
Surr: Toluene-d8	101	66 - 138		%Rec	1	7/14/2017 3:58:02 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	99.8	64.7 - 128		%Rec	1	7/14/2017 3:58:02 PM
Gasoline by NWTPH-Gx				Batch ID: R37423		Analyst: NG
Gasoline	33.3	5.00		µg/L	1	7/14/2017 3:58:02 PM
Surr: 4-Bromofluorobenzene	103	65 - 135		%Rec	1	7/14/2017 3:58:02 PM
Surr: Toluene-d8	98.0	65 - 135		%Rec	1	7/14/2017 3:58:02 PM

Work Order: 1707120
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **MB-R37422** SampType: **MBLK** Units: **µg/L** Prep Date: **7/14/2017** RunNo: **37422**
Client ID: **MBLKW** Batch ID: **R37422** Analysis Date: **7/14/2017** SeqNo: **719230**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.33		2.500		93.3	61.1	128				
Surr: Toluene-d8	2.49		2.500		99.7	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.36		2.500		94.6	64.7	128				

Sample ID **1707104-003AREP** SampType: **REP** Units: **µg/L** Prep Date: **7/14/2017** RunNo: **37422**
Client ID: **BATCH** Batch ID: **R37422** Analysis Date: **7/14/2017** SeqNo: **719219**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.36		2.500		94.3	61.1	128		0		
Surr: Toluene-d8	2.47		2.500		98.8	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.40		2.500		96.2	64.7	128		0		

Sample ID **LCS-R37422** SampType: **LCS** Units: **µg/L** Prep Date: **7/14/2017** RunNo: **37422**
Client ID: **LCSW** Batch ID: **R37422** Analysis Date: **7/14/2017** SeqNo: **719229**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.06	0.100	2.000	0	103	67.1	132				
Toluene	2.16	0.100	2.000	0	108	73.6	127				
Ethylbenzene	2.16	0.100	2.000	0	108	78	127				
m,p-Xylene	4.37	0.100	4.000	0	109	77.5	130				

Work Order: 1707120
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-R37422** SampType: **LCS** Units: **µg/L** Prep Date: **7/14/2017** RunNo: **37422**
Client ID: **LCSW** Batch ID: **R37422** Analysis Date: **7/14/2017** SeqNo: **719229**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	2.18	0.100	2.000	0	109	77.6	126				
Surr: Dibromofluoromethane	2.46		2.500		98.2	61.1	128				
Surr: Toluene-d8	2.44		2.500		97.8	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.66		2.500		107	64.7	128				

Work Order: 1707120
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID	**MB-R37423**	SampType: **MBLK**		Units: **µg/L**		Prep Date: **7/14/2017**		RunNo: **37423**		
Client ID:	**MBLKW**	Batch ID: **R37423**				Analysis Date: **7/14/2017**		SeqNo: **719263**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.44		2.500		97.7	65	135				
Surr: Toluene-d8	2.57		2.500		103	65	135				

Sample ID	**CCV-R37428A**	SampType: **CCV**		Units: **µg/L**		Prep Date: **7/14/2017**		RunNo: **37428**		
Client ID:	**CCV**	Batch ID: **R37428**				Analysis Date: **7/14/2017**		SeqNo: **719363**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	515	5.00	500.0	0	103	80	120				
Surr: 4-Bromofluorobenzene	24.8		25.00		99.0	65	135				
Surr: Toluene-d8	24.5		25.00		98.0	65	135				

Sample ID	**1707104-003AREP**	SampType: **REP**		Units: **µg/L**		Prep Date: **7/14/2017**		RunNo: **37423**		
Client ID:	**BATCH**	Batch ID: **R37423**				Analysis Date: **7/14/2017**		SeqNo: **719253**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.48		2.500		99.2	65	135		0		
Surr: Toluene-d8	2.51		2.500		101	65	135		0		

Sample ID	**MB-R37428**	SampType: **MBLK**		Units: **µg/L**		Prep Date: **7/14/2017**		RunNo: **37428**		
Client ID:	**MBLKW**	Batch ID: **R37428**				Analysis Date: **7/14/2017**		SeqNo: **719365**		
Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.48		2.500		99.4	65	135				
Surr: Toluene-d8	2.44		2.500		97.4	65	135				

Work Order: 1707120
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID	LCS-R37423	SampType:	LCS	Units:	µg/L	Prep Date:	7/14/2017	RunNo:	37423
Client ID:	LCSW	Batch ID:	R37423			Analysis Date:	7/14/2017	SeqNo:	719262

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	48.6	5.00	50.00	0	97.1	65	135				
Surr: 4-Bromofluorobenzene	2.65		2.500		106	65	135				
Surr: Toluene-d8	2.41		2.500		96.3	65	135				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1707120**
Logged by:	**Erica Silva**	Date Received:	**7/14/2017 8:00:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☑	No ☐	NA ☐

Person Notified:	Josh Bernthal	Date	7/14/2017
By Whom:	Erica Silva	Via:	☐ eMail ☑ Phone ☐ Fax ☐ In Person
Regarding:	Method request		
Client Instructions:	EPA 8260		

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Air Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 7/13/17 Page: 1 of: 1

Project Name: 71201

Project No: 71201

Location: I-90, MP-80

Collected by: J. Sherrod

Reports to (PM): Josh Bernthal, Joe Sherrod

Email (PM): joshb@epi-wa.com, joes@epi-wa.com

Laboratory Project No (Internal): 1707120

Special Remarks:

Client: EPI

Address: 1180 NW Maple St.

City, State, Zip: Issaquah, WA 98027

Telephone: 425-395-0010

Fax:

Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1 SVE-3	Canister / Flow Reg	7/13/17 Date / 1312 Time	S	TB	1L	~5 min		Pressure / Date	Pressure / Time	Pressure / Time	Gx + BTEX		
2 SVE-4	Canister / Flow Reg	7/13/17 Date / 1317 Time	↓	↓	↓	↓		Pressure / Date	Pressure / Time	Pressure / Time	Gx + BTEX		
3 TOT-INF	Canister / Flow Reg	7/13/17 Date / 1324 Time	↓	↓	↓	↓		Pressure / Date	Pressure / Time	Pressure / Time	Gx + BTEX		
4 TOT-EFF	Canister / Flow Reg	7/13/17 Date / 1330 Time	↓	↓	↓	↓		Pressure / Date	Pressure / Time	Pressure / Time	Gx + BTEX		
5	Canister / Flow Reg	Date / Time						Pressure / Date	Pressure / Time	Pressure / Time			

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x	7/14/17 / 0800	x	7/14/2017 0800
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day _____ (specify)

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

July 27, 2017

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: 71201, F&BI 707267

Dear Mr Bernthal:

Included is the amended report from the testing of material submitted on July 20, 2017 from the 71201, F&BI 707267 project. Per your request, the sample ID has been amended.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0725R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
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fbi@isomedia.com
www.friedmanandbruya.com

July 25, 2017

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: 71201, F&BI 707267

Dear Mr Bernthal:

Included are the results from the testing of material submitted on July 20, 2017 from the 71201, F&BI 707267 project. There are 4 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0725R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on July 20, 2017 by Friedman & Bruya, Inc. from the Environmental Partners 71201, F&BI 707267 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Environmental Partners
707267-01	KO Tank Water

All quality control requirements were acceptable.

Date of Report: 07/25/17
Date Received: 07/20/17
Project: 71201, F&BI 707267
Date Extracted: 07/21/17
Date Analyzed: 07/21/17

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
KO Tank Water 707267-01	<1	<1	<1	<3	<100	73
Method Blank 07-1511 MB	<1	<1	<1	<3	<100	73

Date of Report: 07/25/17
Date Received: 07/20/17
Project: 71201, F&BI 707267

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 707245-03 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	1.0	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	3.1	3.9	23 a
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	101	65-118
Toluene	ug/L (ppb)	50	99	72-122
Ethylbenzene	ug/L (ppb)	50	99	73-126
Xylenes	ug/L (ppb)	150	96	74-118
Gasoline	ug/L (ppb)	1,000	97	69-134

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

707267. [redacted]

SAMPLE CHAIN OF CUSTODY

ME 7/20/17 [redacted] VWI

Page # 1 of 1

Report To Josh Bernthal

Company EPI

Address 1180 NW Maple St

City, State, ZIP Issaquah, WA 98027

Phone ______ Email joshb@epi-wa.com

SAMPLERS (signature) [signature]	
PROJECT NAME 71201	PO #
REMARKS	INVOICE TO

TURNAROUND TIME
- ☐ Standard Turnaround
- ☒ RUSH ~~[illegible]~~ Draft by Tues 7/25 Pr
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Archive Samples
- ☐ Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
~~SVE Water~~ KO Tank Water per CM MG 7/20/17	01AB	7/20/17	1002	Water	2			X	X								

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: [signature]	Elizabeth Webber-Bruya	EPI	7/20/17	1620
Received by: [signature]	Dd Lo	FeBz	7-20-17	16:20
Relinquished by:				
Received by:		Samples received at 4 °C		

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Tena Seeds
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: 71201
Work Order Number: 1708032

August 07, 2017

Attention Tena Seeds:

Fremont Analytical, Inc. received 2 sample(s) on 8/2/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *08/07/2017*

CLIENT: Environmental Partners, Inc.
Project: 71201
Work Order: 1708032

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1708032-001	SVE-6	08/02/2017 11:46 AM	08/02/2017 2:15 PM
1708032-002	SVE-1	08/02/2017 11:49 AM	08/02/2017 2:15 PM

Case Narrative

WO#: **1708032**
Date: **8/7/2017**

CLIENT: Environmental Partners, Inc.
Project: 71201

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1708032**
Date Reported: **8/7/2017**

Client: Environmental Partners, Inc.
Collection Date: 8/2/2017 11:46:00 AM
Project: 71201
Lab ID: 1708032-001
Matrix: Air
Client Sample ID: **SVE-6**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37823		Analyst: NG
Benzene	ND	0.100		µg/L	1	8/3/2017 3:52:02 PM
Toluene	ND	0.100		µg/L	1	8/3/2017 3:52:02 PM
Ethylbenzene	ND	0.100		µg/L	1	8/3/2017 3:52:02 PM
m,p-Xylene	ND	0.100		µg/L	1	8/3/2017 3:52:02 PM
o-Xylene	ND	0.100		µg/L	1	8/3/2017 3:52:02 PM
Surr: Dibromofluoromethane	97.6	61.1 - 128		%Rec	1	8/3/2017 3:52:02 PM
Surr: Toluene-d8	108	66 - 138		%Rec	1	8/3/2017 3:52:02 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	98.6	64.7 - 128		%Rec	1	8/3/2017 3:52:02 PM
Gasoline by NWTPH-Gx				Batch ID: R37824		Analyst: NG
Gasoline	5.34	5.00		µg/L	1	8/3/2017 3:52:02 PM
Surr: 4-Bromofluorobenzene	101	65 - 135		%Rec	1	8/3/2017 3:52:02 PM
Surr: Toluene-d8	97.7	65 - 135		%Rec	1	8/3/2017 3:52:02 PM

Analytical Report

Work Order: **1708032**
Date Reported: **8/7/2017**

Client: Environmental Partners, Inc.
Collection Date: 8/2/2017 11:49:00 AM
Project: 71201
Lab ID: 1708032-002
Matrix: Air
Client Sample ID: **SVE-1**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37823		Analyst: NG
Benzene	ND	0.100		µg/L	1	8/3/2017 3:21:49 PM
Toluene	ND	0.100		µg/L	1	8/3/2017 3:21:49 PM
Ethylbenzene	ND	0.100		µg/L	1	8/3/2017 3:21:49 PM
m,p-Xylene	ND	0.100		µg/L	1	8/3/2017 3:21:49 PM
o-Xylene	ND	0.100		µg/L	1	8/3/2017 3:21:49 PM
Surr: Dibromofluoromethane	87.4	61.1 - 128		%Rec	1	8/3/2017 3:21:49 PM
Surr: Toluene-d8	98.2	66 - 138		%Rec	1	8/3/2017 3:21:49 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	98.0	64.7 - 128		%Rec	1	8/3/2017 3:21:49 PM
Gasoline by NWTPH-Gx				Batch ID: R37824		Analyst: NG
Gasoline	52.6	5.00		µg/L	1	8/3/2017 3:21:49 PM
Surr: 4-Bromofluorobenzene	100	65 - 135		%Rec	1	8/3/2017 3:21:49 PM
Surr: Toluene-d8	99.6	65 - 135		%Rec	1	8/3/2017 3:21:49 PM

Work Order: 1708032
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-R37824** SampType: **LCS** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37824**
Client ID: **LCSW** Batch ID: **R37824** Analysis Date: **8/3/2017** SeqNo: **727019**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	53.5	5.00	50.00	0	107	65	135				
Surr: 4-Bromofluorobenzene	2.61		2.500		104	65	135				
Surr: Toluene-d8	2.52		2.500		101	65	135				

Sample ID **MB-R37824** SampType: **MBLK** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37824**
Client ID: **MBLKW** Batch ID: **R37824** Analysis Date: **8/3/2017** SeqNo: **727020**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.49		2.500		99.7	65	135				
Surr: Toluene-d8	2.46		2.500		98.2	65	135				

Sample ID **1708038-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37824**
Client ID: **BATCH** Batch ID: **R37824** Analysis Date: **8/3/2017** SeqNo: **727016**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	10.3	5.00						10.41	0.763	30	
Surr: 4-Bromofluorobenzene	2.50		2.500		99.8	65	135		0		
Surr: Toluene-d8	2.43		2.500		97.4	65	135		0		

Work Order: 1708032
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-R37823** SampType: **LCS** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37823**
Client ID: **LCSW** Batch ID: **R37823** Analysis Date: **8/3/2017** SeqNo: **726945**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.00	0.100	2.000	0	100	67.1	132				
Toluene	2.11	0.100	2.000	0	106	73.6	127				
Ethylbenzene	2.14	0.100	2.000	0	107	78	127				
m,p-Xylene	4.14	0.100	4.000	0	104	77.5	130				
o-Xylene	2.02	0.100	2.000	0	101	77.6	126				
Surr: Dibromofluoromethane	2.57		2.500		103	61.1	128				
Surr: Toluene-d8	2.62		2.500		105	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.59		2.500		103	64.7	128				

Sample ID **MB-R37823** SampType: **MBLK** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37823**
Client ID: **MBLKW** Batch ID: **R37823** Analysis Date: **8/3/2017** SeqNo: **726946**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.51		2.500		101	61.1	128				
Surr: Toluene-d8	2.62		2.500		105	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.45		2.500		97.8	64.7	128				

Sample ID **1708038-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37823**
Client ID: **BATCH** Batch ID: **R37823** Analysis Date: **8/3/2017** SeqNo: **726942**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0.1015	7.41	30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	0.161	0.100						0.1608	0.407	30	

Work Order: 1708032
CLIENT: Environmental Partners, Inc.
Project: 71201

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1708038-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **8/3/2017** RunNo: **37823**
Client ID: **BATCH** Batch ID: **R37823** Analysis Date: **8/3/2017** SeqNo: **726942**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	0.110	0.100						0.1049	4.84	30	
Surr: Dibromofluoromethane	2.40		2.500		96.0	61.1	128		0		
Surr: Toluene-d8	2.41		2.500		96.3	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.44		2.500		97.8	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1708032**
Logged by:	**Clare Griggs**	Date Received:	**8/2/2017 2:15:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 8/2/17 Page: 1 of: 1

Laboratory Project No (internal): 1708032

Project Name: 71201

Special Remarks:

Client: EPI

Project No:

Address: 1180 NW Maple St

Collected by: E. Webber-Bruya

City, State, Zip: Issaquah, WA 98027

Location: 71201

Telephone:

Report To (PM): Tena Seeds

Sample Disposal: ☐ Return to client ☒ Disposal by lab (after 30 days)

Fax:

PM Email: Tenas@epi-wa.com

Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX 8260	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8) Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1 SVE-6	8/2/17	1146	Air		X											
2 SVE-1	8/2/17	1149	Air		X											
3																
4																
5																
6																
7																
8																
9																
10																

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	8/2/17 1415	x [signature]	8/2/2017 1415
Relinquished x	Date/Time	Received x	Date/Time

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: 71201.0
Work Order Number: 1707195

July 25, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 2 sample(s) on 7/20/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *07/25/2017*

CLIENT: Environmental Partners, Inc.
Project: 71201.0
Work Order: 1707195

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1707195-001	SVE-5	07/20/2017 10:23 AM	07/20/2017 4:35 PM
1707195-002	SVE-2	07/20/2017 10:25 AM	07/20/2017 4:35 PM

Case Narrative

WO#: **1707195**
Date: **7/25/2017**

CLIENT: Environmental Partners, Inc.
Project: 71201.0

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1707195**
Date Reported: **7/25/2017**

Client: Environmental Partners, Inc.
Collection Date: 7/20/2017 10:23:00 AM
Project: 71201.0
Lab ID: 1707195-001
Matrix: Air
Client Sample ID: **SVE-5**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37555		Analyst: MW
Benzene	ND	0.100		µg/L	1	7/21/2017 1:20:41 PM
Toluene	ND	0.100		µg/L	1	7/21/2017 1:20:41 PM
Ethylbenzene	ND	0.100		µg/L	1	7/21/2017 1:20:41 PM
m,p-Xylene	ND	0.100		µg/L	1	7/21/2017 1:20:41 PM
o-Xylene	ND	0.100		µg/L	1	7/21/2017 1:20:41 PM
Surr: Dibromofluoromethane	96.2	61.1 - 128		%Rec	1	7/21/2017 1:20:41 PM
Surr: Toluene-d8	98.6	66 - 138		%Rec	1	7/21/2017 1:20:41 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	94.9	64.7 - 128		%Rec	1	7/21/2017 1:20:41 PM
Gasoline by NWTPH-Gx				Batch ID: R37556		Analyst: MW
Gasoline	7.59	5.00		µg/L	1	7/21/2017 1:20:41 PM
Surr: 4-Bromofluorobenzene	98.8	65 - 135		%Rec	1	7/21/2017 1:20:41 PM
Surr: Toluene-d8	103	65 - 135		%Rec	1	7/21/2017 1:20:41 PM

Analytical Report

Work Order: **1707195**
Date Reported: **7/25/2017**

Client: Environmental Partners, Inc.
Collection Date: 7/20/2017 10:25:00 AM
Project: 71201.0
Lab ID: 1707195-002
Matrix: Air
Client Sample ID: **SVE-2**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: R37555		Analyst: MW
Benzene	ND	0.100		µg/L	1	7/21/2017 2:20:30 PM
Toluene	ND	0.100		µg/L	1	7/21/2017 2:20:30 PM
Ethylbenzene	ND	0.100		µg/L	1	7/21/2017 2:20:30 PM
m,p-Xylene	ND	0.100		µg/L	1	7/21/2017 2:20:30 PM
o-Xylene	ND	0.100		µg/L	1	7/21/2017 2:20:30 PM
Surr: Dibromofluoromethane	95.4	61.1 - 128		%Rec	1	7/21/2017 2:20:30 PM
Surr: Toluene-d8	100	66 - 138		%Rec	1	7/21/2017 2:20:30 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	94.1	64.7 - 128		%Rec	1	7/21/2017 2:20:30 PM
Gasoline by NWTPH-Gx				Batch ID: R37556		Analyst: MW
Gasoline	ND	5.00		µg/L	1	7/21/2017 2:20:30 PM
Surr: 4-Bromofluorobenzene	97.7	65 - 135		%Rec	1	7/21/2017 2:20:30 PM
Surr: Toluene-d8	99.8	65 - 135		%Rec	1	7/21/2017 2:20:30 PM

Work Order: 1707195
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-R37556**	SampType: **LCS**	Units: **µg/L**	Prep Date: **7/21/2017**	RunNo: **37556**
Client ID: **LCSW**	Batch ID: **R37556**		Analysis Date: **7/21/2017**	SeqNo: **721702**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	57.9	5.00	50.00	0	116	65	135				
Surr: 4-Bromofluorobenzene	2.46		2.500		98.4	65	135				
Surr: Toluene-d8	2.53		2.500		101	65	135				

Sample ID **MB-R37556**	SampType: **MBLK**	Units: **µg/L**	Prep Date: **7/21/2017**	RunNo: **37556**
Client ID: **MBLKW**	Batch ID: **R37556**		Analysis Date: **7/21/2017**	SeqNo: **721703**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.46		2.500		98.2	65	135				
Surr: Toluene-d8	2.45		2.500		98.0	65	135				

Sample ID **1707195-001AREP**	SampType: **REP**	Units: **µg/L**	Prep Date: **7/21/2017**	RunNo: **37556**
Client ID: **SVE-5**	Batch ID: **R37556**		Analysis Date: **7/21/2017**	SeqNo: **721698**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	7.34	5.00						7.585	3.29	30	
Surr: 4-Bromofluorobenzene	2.49		2.500		99.4	65	135		0		
Surr: Toluene-d8	2.57		2.500		103	65	135		0		

Work Order: 1707195
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-R37555** SampType: **LCS** Units: **µg/L** Prep Date: **7/21/2017** RunNo: **37555**
Client ID: **LCSW** Batch ID: **R37555** Analysis Date: **7/21/2017** SeqNo: **721688**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.99	0.100	2.000	0	99.5	67.1	132				
Toluene	2.09	0.100	2.000	0	104	73.6	127				
Ethylbenzene	2.15	0.100	2.000	0	107	78	127				
m,p-Xylene	4.25	0.100	4.000	0	106	77.5	130				
o-Xylene	2.15	0.100	2.000	0	108	77.6	126				
Surr: Dibromofluoromethane	2.50		2.500		100	61.1	128				
Surr: Toluene-d8	2.54		2.500		102	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.51		2.500		100	64.7	128				

Sample ID **MB-R37555** SampType: **MBLK** Units: **µg/L** Prep Date: **7/21/2017** RunNo: **37555**
Client ID: **MBLKW** Batch ID: **R37555** Analysis Date: **7/21/2017** SeqNo: **721689**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.49		2.500		99.4	61.1	128				
Surr: Toluene-d8	2.41		2.500		96.4	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.36		2.500		94.5	64.7	128				

Sample ID **1707195-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **7/21/2017** RunNo: **37555**
Client ID: **SVE-5** Batch ID: **R37555** Analysis Date: **7/21/2017** SeqNo: **721684**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	

Work Order: 1707195
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1707195-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **7/21/2017** RunNo: **37555**
Client ID: **SVE-5** Batch ID: **R37555** Analysis Date: **7/21/2017** SeqNo: **721684**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.41		2.500		96.5	61.1	128		0		
Surr: Toluene-d8	2.45		2.500		98.1	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.38		2.500		95.3	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1707195**
Logged by:	**Erica Silva**	Date Received:	**7/20/2017 4:35:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 7/20/17 Page: 1 of: 1

Project Name: 71201.0

Project No:

Collected by: E. Webber - Bruya

Location:

Report To (PM): Josh Bernthal

PM Email: Josh@epi-wa.com

Laboratory Project No (internal): 1707195

Special Remarks:

Sample Disposal: ☐ Return to client ☒ Disposal by lab (after 30 days)

Client: EPI

Address: 1180 NW Maple St

City, State, Zip: Issaquah, WA 98027

Telephone:

Fax:

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX 8260	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8) Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	SVE-5	7/20/17	1023	Air		X											
2	SVE-2	7/20/17	1025	Air		X											
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	7/20/17 1635	x [signature]	7/20/17 1635
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: Cle Elum
Work Order Number: 1708116

August 17, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 2 sample(s) on 8/10/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *08/17/2017*

CLIENT: Environmental Partners, Inc.
Project: Cle Elum
Work Order: 1708116

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1708116-001	TOT-INF-081017	08/10/2017 9:00 AM	08/10/2017 4:37 PM
1708116-002	TOT-EFF-081017	08/10/2017 9:10 AM	08/10/2017 4:37 PM

Case Narrative

WO#: **1708116**
Date: **8/17/2017**

CLIENT: Environmental Partners, Inc.
Project: Cle Elum

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1708116**
Date Reported: **8/17/2017**

Client: Environmental Partners, Inc.
Collection Date: 8/10/2017 9:00:00 AM
Project: Cle Elum
Lab ID: 1708116-001
Matrix: Air
Client Sample ID: **TOT-INF-081017**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 17877		Analyst: MW
Benzene	ND	0.100		µg/L	1	8/11/2017 2:36:00 PM
Toluene	0.140	0.100	Q	µg/L	1	8/11/2017 2:36:00 PM
Ethylbenzene	ND	0.100		µg/L	1	8/11/2017 2:36:00 PM
m,p-Xylene	0.128	0.100		µg/L	1	8/11/2017 2:36:00 PM
o-Xylene	ND	0.100		µg/L	1	8/11/2017 2:36:00 PM
Surr: Dibromofluoromethane	135	56.4 - 141		%Rec	1	8/11/2017 2:36:00 PM
Surr: Toluene-d8	122	66 - 138		%Rec	1	8/11/2017 2:36:00 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	98.6	64.7 - 128		%Rec	1	8/11/2017 2:36:00 PM

NOTES:
Q - Indicates an analyte with a continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF) - high bias

Gasoline by NWTPH-Gx				Batch ID: 17877		Analyst: MW
Gasoline	ND	5.00		µg/L	1	8/11/2017 2:36:00 PM
Surr: 4-Bromofluorobenzene	108	65 - 135		%Rec	1	8/11/2017 2:36:00 PM
Surr: Toluene-d8	86.7	65 - 135		%Rec	1	8/11/2017 2:36:00 PM

Analytical Report

Work Order: **1708116**
Date Reported: **8/17/2017**

Client: Environmental Partners, Inc.
Collection Date: 8/10/2017 9:10:00 AM
Project: Cle Elum
Lab ID: 1708116-002
Matrix: Air
Client Sample ID: **TOT-EFF-081017**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 17877		Analyst: MW
Benzene	ND	0.100		µg/L	1	8/11/2017 1:31:00 PM
Toluene	ND	0.100		µg/L	1	8/11/2017 1:31:00 PM
Ethylbenzene	ND	0.100		µg/L	1	8/11/2017 1:31:00 PM
m,p-Xylene	ND	0.100		µg/L	1	8/11/2017 1:31:00 PM
o-Xylene	ND	0.100		µg/L	1	8/11/2017 1:31:00 PM
Surr: Dibromofluoromethane	115	56.4 - 141		%Rec	1	8/11/2017 1:31:00 PM
Surr: Toluene-d8	115	66 - 138		%Rec	1	8/11/2017 1:31:00 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	96.2	64.7 - 128		%Rec	1	8/11/2017 1:31:00 PM
Gasoline by NWTPH-Gx				Batch ID: 17877		Analyst: MW
Gasoline	ND	5.00		µg/L	1	8/11/2017 1:31:00 PM
Surr: 4-Bromofluorobenzene	104	65 - 135		%Rec	1	8/11/2017 1:31:00 PM
Surr: Toluene-d8	96.7	65 - 135		%Rec	1	8/11/2017 1:31:00 PM

Work Order: 1708116
CLIENT: Environmental Partners, Inc.
Project: Cle Elum

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-17877**	SampType: **LCS**	Units: **µg/L**	Prep Date: **8/11/2017**	RunNo: **38042**
Client ID: **LCSW**	Batch ID: **17877**		Analysis Date: **8/11/2017**	SeqNo: **731163**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	50.7	5.00	50.00	0	101	65	135				
Surr: 4-Bromofluorobenzene	2.46		2.500		98.5	65	135				
Surr: Toluene-d8	2.43		2.500		97.0	65	135				

Sample ID **MB-17877**	SampType: **MBLK**	Units: **µg/L**	Prep Date: **8/11/2017**	RunNo: **38042**
Client ID: **MBLKW**	Batch ID: **17877**		Analysis Date: **8/11/2017**	SeqNo: **731179**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.39		2.500		95.5	65	135				
Surr: Toluene-d8	2.38		2.500		95.2	65	135				

Sample ID **1708116-002AREP**	SampType: **REP**	Units: **µg/L**	Prep Date: **8/11/2017**	RunNo: **38042**
Client ID: **TOT-EFF-081017**	Batch ID: **17877**		Analysis Date: **8/11/2017**	SeqNo: **731177**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.37		2.500		94.9	65	135		0		
Surr: Toluene-d8	2.58		2.500		103	65	135		0		

Work Order: 1708116
CLIENT: Environmental Partners, Inc.
Project: Cle Elum

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-17877** SampType: **LCS** Units: **µg/L** Prep Date: **8/11/2017** RunNo: **38044**
Client ID: **LCSW** Batch ID: **17877** Analysis Date: **8/11/2017** SeqNo: **731185**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.12	0.100	2.000	0	106	67.1	132				
Toluene	2.35	0.100	2.000	0	117	73.6	127				
Ethylbenzene	2.22	0.100	2.000	0	111	78	127				
m,p-Xylene	4.44	0.100	4.000	0	111	77.5	130				
o-Xylene	2.20	0.100	2.000	0	110	77.6	126				
Surr: Dibromofluoromethane	2.05		2.500		82.0	56.4	141				
Surr: Toluene-d8	2.20		2.500		88.2	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.58		2.500		103	64.7	128				

Sample ID **MB-17877** SampType: **MBLK** Units: **µg/L** Prep Date: **8/11/2017** RunNo: **38044**
Client ID: **MBLKW** Batch ID: **17877** Analysis Date: **8/11/2017** SeqNo: **731186**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.05		2.500		81.8	56.4	141				
Surr: Toluene-d8	2.15		2.500		86.0	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.22		2.500		88.7	64.7	128				

Sample ID **1708116-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **8/11/2017** RunNo: **38044**
Client ID: **TOT-EFF-081017** Batch ID: **17877** Analysis Date: **8/11/2017** SeqNo: **731182**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	0.120	0.100						0.09324	24.7	30	

Work Order: 1708116
CLIENT: Environmental Partners, Inc.
Project: Cle Elum

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1708116-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **8/11/2017** RunNo: **38044**
Client ID: **TOT-EFF-081017** Batch ID: **17877** Analysis Date: **8/11/2017** SeqNo: **731182**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.42		2.500		97.0	56.4	141		0		
Surr: Toluene-d8	2.62		2.500		105	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.18		2.500		87.2	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1708116**
Logged by:	**Erica Silva**	Date Received:	**8/10/2017 4:37:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☐	No ☑	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☑	No ☐	NA ☐

Person Notified:	Josh Bernthal	Date	8/10/2017
By Whom:	Erica Silva	Via:	☑ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:	Both samples labeled "INF"		
Client Instructions:	Only bag with additional blank label is "INF"		

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Air Chain of Custody Record & Laboratory Services Agreement

Laboratory Project No (Internal): 1708116

Special Remarks:

Client: EPI	Date: 8/10/17 Page: 1 of: 1
Address: ~~295 NE Gilman~~ 1180 NW Maple	Project Name: Cle Elum
City, State, Zip: Issaquah, WA 98027	Project No: 71201.0
Telephone: 425-241-5400	Location: Cle Elum
Fax:	Collected by: JB
	Reports to (PM): Josh Bernthal
	Email (PM): joshb@epi-wa.com

	Sample Name	Canister / Flow Reg Serial #	Sample Date & Time	Sample Type (Matrix) *	Container Type **	Sample Volume	Fill Time	Flow Rate	Internal: Initial Evacuation Pressure (mtorr)	Field Initial Sample Pressure (" Hg)	Field Final Sample Pressure (" Hg)	Analysis Requested	Internal: Receipt Date	Internal: Final Pressure ("Hg)
1	TOT-INF-081017		8/10/17 0900	S	TB	1L	15s	/				Gx + BTEX		
2	TOT-EFF 081017		8/10/17 0910	S	TB	1L	15s	/				Gx + BTEX		
3														
4														
5														

* Matrix Codes: AA = Ambient Air IA = Indoor Air L = Landfill S = Subslab / Soil Gas

** Container Codes: BV = 1 Liter Bottle Vac CAN = Canister CYL = High Pressure Cylinder F = Filter S = Sorbent Tube TB = Tedlar Bag

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	8/10/17	x [signature]	8/10/17 16:37
x Betsy Wing	8/10/17 16:38	x	

Turn-Around Time:

- [x] Standard
- [ ] 3 Day
- [ ] 2 Day
- [ ] Next Day
- Same Day ______ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: KAG
Work Order Number: 1709130

September 19, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 2 sample(s) on 9/14/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *09/19/2017*

CLIENT: Environmental Partners, Inc.
Project: KAG
Work Order: 1709130

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1709130-001	TOT-Eff-091417	09/14/2017 9:00 AM	09/14/2017 12:54 PM
1709130-002	SVE-4	09/14/2017 9:10 AM	09/14/2017 12:54 PM

Case Narrative

WO#: **1709130**
Date: **9/19/2017**

CLIENT: Environmental Partners, Inc.
Project: KAG

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1709130**
Date Reported: **9/19/2017**

Client: Environmental Partners, Inc.
Collection Date: 9/14/2017 9:00:00 AM
Project: KAG
Lab ID: 1709130-001
Matrix: Air
Client Sample ID: **TOT-Eff-091417**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 18209		Analyst: MW
Benzene	ND	0.100		µg/L	1	9/15/2017 11:17:56 AM
Toluene	ND	0.100		µg/L	1	9/15/2017 11:17:56 AM
Ethylbenzene	ND	0.100		µg/L	1	9/15/2017 11:17:56 AM
m,p-Xylene	ND	0.100		µg/L	1	9/15/2017 11:17:56 AM
o-Xylene	ND	0.100		µg/L	1	9/15/2017 11:17:56 AM
Surr: Dibromofluoromethane	89.2	56.4 - 141		%Rec	1	9/15/2017 11:17:56 AM
Surr: Toluene-d8	91.5	66 - 138		%Rec	1	9/15/2017 11:17:56 AM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	9/15/2017 11:17:56 AM
Gasoline by NWTPH-Gx				Batch ID: 18209		Analyst: MW
Gasoline	ND	5.00		µg/L	1	9/15/2017 11:17:56 AM
Surr: 4-Bromofluorobenzene	99.7	65 - 135		%Rec	1	9/15/2017 11:17:56 AM
Surr: Toluene-d8	104	65 - 135		%Rec	1	9/15/2017 11:17:56 AM

Analytical Report

Work Order: **1709130**
Date Reported: **9/19/2017**

Client: Environmental Partners, Inc.
Collection Date: 9/14/2017 9:10:00 AM
Project: KAG
Lab ID: 1709130-002
Matrix: Air
Client Sample ID: **SVE-4**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 18209		Analyst: MW
Benzene	ND	0.100		µg/L	1	9/15/2017 1:40:44 PM
Toluene	ND	0.100		µg/L	1	9/15/2017 1:40:44 PM
Ethylbenzene	ND	0.100		µg/L	1	9/15/2017 1:40:44 PM
m,p-Xylene	0.265	0.100		µg/L	1	9/15/2017 1:40:44 PM
o-Xylene	0.114	0.100		µg/L	1	9/15/2017 1:40:44 PM
Surr: Dibromofluoromethane	89.4	56.4 - 141		%Rec	1	9/15/2017 1:40:44 PM
Surr: Toluene-d8	91.6	66 - 138		%Rec	1	9/15/2017 1:40:44 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	9/15/2017 1:40:44 PM
Gasoline by NWTPH-Gx				Batch ID: 18209		Analyst: MW
Gasoline	17.4	5.00		µg/L	1	9/15/2017 1:40:44 PM
Surr: 4-Bromofluorobenzene	100	65 - 135		%Rec	1	9/15/2017 1:40:44 PM
Surr: Toluene-d8	103	65 - 135		%Rec	1	9/15/2017 1:40:44 PM

Work Order: 1709130
CLIENT: Environmental Partners, Inc.
Project: KAG

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **MB-18209** SampType: **MBLK** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38666**
Client ID: **MBLKW** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742926**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.46		2.500		98.6	65	135				
Surr: Toluene-d8	2.56		2.500		102	65	135				

Sample ID **1709130-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38666**
Client ID: **TOT-Eff-091417** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742921**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.47		2.500		98.7	65	135		0		
Surr: Toluene-d8	2.57		2.500		103	65	135		0		

Sample ID **LCS-18209** SampType: **LCS** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38666**
Client ID: **LCSW** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742925**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	49.3	5.00	50.00	0	98.6	65	135				
Surr: 4-Bromofluorobenzene	2.54		2.500		101	65	135				
Surr: Toluene-d8	2.61		2.500		104	65	135				

Work Order: 1709130
CLIENT: Environmental Partners, Inc.
Project: KAG

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **MB-18209** SampType: **MBLK** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38664**
Client ID: **MBLKW** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742871**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.21		2.500		88.4	56.4	141				
Surr: Toluene-d8	2.30		2.500		91.9	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.49		2.500		99.7	64.7	128				

Sample ID **1709130-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38664**
Client ID: **TOT-Eff-091417** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742866**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.23		2.500		89.2	61.1	128		0		
Surr: Toluene-d8	2.31		2.500		92.3	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.48		2.500		99.0	64.7	128		0		

Sample ID **LCS-18209** SampType: **LCS** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38664**
Client ID: **LCSW** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742870**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.88	0.100	2.000	0	94.0	67.1	132				
Toluene	1.90	0.100	2.000	0	95.2	73.6	127				
Ethylbenzene	2.01	0.100	2.000	0	101	78	127				
m,p-Xylene	4.10	0.100	4.000	0	102	77.5	130				

Work Order: 1709130
CLIENT: Environmental Partners, Inc.
Project: KAG

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-18209** SampType: **LCS** Units: **µg/L** Prep Date: **9/15/2017** RunNo: **38664**
Client ID: **LCSW** Batch ID: **18209** Analysis Date: **9/15/2017** SeqNo: **742870**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	2.05	0.100	2.000	0	103	77.6	126				
Surr: Dibromofluoromethane	2.35		2.500		93.9	56.4	141				
Surr: Toluene-d8	2.33		2.500		93.1	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.58		2.500		103	64.7	128				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1709130**
Logged by:	**Brianna Barnes**	Date Received:	**9/14/2017 12:54:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 9/14/17 Page: 1 of: 1

Laboratory Project No (internal): 1709130

Project Name: KAG

Special Remarks:

Client: Environmental Partners, Inc

Project No: ~~7120~~ 7120.0

Address: 1180 NW Maple St.

Collected by: JB

City, State, Zip: Issaquah WA 98027

Location: Cle Elum, WA

Telephone: 425-241-5400

Report To (PM): Josh Berthel

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epi.wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8) Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	TOT-Eff-091417	9/14/17	0900	Air		X											
2	SVE-4	9/14/17	0910	Air		X											
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	9/14/17 1300	x [signature]	9/14/17 12:54
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

August 8, 2017

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: 71201, F&BI 708048

Dear Mr Bernthal:

Included are the amended results from the testing of material submitted on August 2, 2017 from the 71201, F&BI 708048 project. The sample ID has been updated.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0808R.DOC

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

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August 8, 2017

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: 71201, F&BI 708048

Dear Mr Bernthal:

Included are the results from the testing of material submitted on August 2, 2017 from the 71201, F&BI 708048 project. There are 4 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0808R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on August 2, 2017 by Friedman & Bruya, Inc. from the Environmental Partners 71201, F&BI 708048 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Environmental Partners
708048 -01	KO Tank Water

All quality control requirements were acceptable.

Date of Report: 08/08/17
Date Received: 08/02/17
Project: 71201, F&BI 708048
Date Extracted: 08/06/17
Date Analyzed: 08/06/17

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 50-150)
KO Tank Water 708048-01	<1	<1	<1	<3	<100	69
Method Blank 07-1616 MB	<1	<1	<1	<3	<100	58

Date of Report: 08/08/17
Date Received: 08/02/17
Project: 71201, F&BI 708048

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 707458-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	80	72-119
Toluene	ug/L (ppb)	50	79	71-113
Ethylbenzene	ug/L (ppb)	50	80	72-114
Xylenes	ug/L (ppb)	150	82	72-113
Gasoline	ug/L (ppb)	1,000	81	70-119

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

7080048

ME 0802-17 MW 1

SAMPLE CHAIN OF CUSTODY

Page # 1 of 1

Report To Josh Bernthal

Company EPI

Address 1180 NW Maple St

City, State, ZIP Issaquah, WA

Phone _____ Email _____

SAMPLERS (*signature*) E.D.M.B.

PROJECT NAME 71201

PO #

REMARKS

INVOICE TO

TURNAROUND TIME
- [x] Standard Turnaround
- [ ] RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- [ ] Dispose after 30 days
- [ ] Archive Samples
- [ ] Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	ANALYSES REQUESTED: TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
KD Tank water	01 AB	8/2/17	941	Water	2			X	X								

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: E.D.M.B.	Elizabeth Webber-Bruya	EPI	8/1/17	1600
Received by:	TOM LADD	FBI	8-2-17	1600
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

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Eric Young, B.S.

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fbi@isomedia.com
www.friedmanandbruya.com

October 9, 2017

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: 71201, F&BI 710067

Dear Mr Bernthal:

Included are the results from the testing of material submitted on October 5, 2017 from the 71201, F&BI 710067 project. There are 5 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI1009R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on October 5, 2017 by Friedman & Bruya, Inc. from the Environmental Partners 71201, F&BI 710067 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Environmental Partners
710067 -01	MW-11
710067 -02	MW-10
710067 -03	MW-9
710067 -04	MW-8
710067 -05	MW-12
710067 -06	MW-5
710067 -07	MW-2
710067 -08	MW-7
710067 -09	MW-6
710067 -10	MW-13
710067 -11	MW-14
710067 -12	MW-4
710067 -13	MW-3
710067 -14	MW-1
710067 -15	Dup-1

All quality control requirements were acceptable.

Date of Report: 10/09/17
Date Received: 10/05/17
Project: 71201, F&BI 710067
Date Extracted: 10/05/17
Date Analyzed: 10/05/17

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-11 710067-01	<1	<1	<1	<3	<100	93
MW-10 710067-02	<1	<1	<1	<3	<100	91
MW-9 710067-03	<1	<1	<1	<3	<100	93
MW-8 710067-04	<1	<1	<1	<3	<100	90
MW-12 710067-05	<1	<1	<1	<3	<100	92
MW-5 710067-06	<1	<1	<1	<3	<100	97
MW-2 710067-07	<1	<1	<1	<3	<100	93
MW-7 710067-08	<1	<1	<1	<3	<100	95
MW-6 710067-09	<1	<1	<1	<3	<100	96
MW-13 710067-10	<1	<1	<1	<3	<100	95

Date of Report: 10/09/17
Date Received: 10/05/17
Project: 71201, F&BI 710067
Date Extracted: 10/05/17
Date Analyzed: 10/05/17

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-14 710067-11	<1	<1	<1	<3	<100	90
MW-4 710067-12	<1	<1	<1	<3	<100	90
MW-3 710067-13	<1	<1	<1	<3	<100	87
MW-1 710067-14	<1	<1	<1	<3	<100	90
Dup-1 710067-15	<1	<1	<1	<3	<100	88
Method Blank 07-2218 MB	<1	<1	<1	<3	<100	90

Date of Report: 10/09/17
Date Received: 10/05/17
Project: 71201, F&BI 710067

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 710057-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	103	65-118
Toluene	ug/L (ppb)	50	103	72-122
Ethylbenzene	ug/L (ppb)	50	111	73-126
Xylenes	ug/L (ppb)	150	105	74-118
Gasoline	ug/L (ppb)	1,000	95	69-134

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

710067

SAMPLE CHAIN OF CUSTODY

ME 10/5/17 VWS

Page # 1 of 2

Report To Josh Bernthal

Company EPI

Address 1180 NW Maple St

City, State, ZIP Issaquah, WA

Phone _____ Email _____

SAMPLERS (*signature*)

PROJECT NAME: 71201

PO #

REMARKS

INVOICE TO

TURNAROUND TIME
- [x] Standard Turnaround
- [ ] RUSH
- Rush charges authorized by: _____

SAMPLE DISPOSAL
- [x] Dispose after 30 days
- [ ] Archive Samples
- [ ] Other _____

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
						ANALYSES REQUESTED											
MW-11	01A-C	10/3/17	1039	Water	3			X	X								
MW-10	02		1109		3			X	X								
MW-9	03		1136		3			X	X								
MW-8	04		1158		3			X	X								
MW-12	05		1222		3			X	X								
MW-5	06		1245		3			X	X								
MW-2	07		1353		3			X	X								
MW-7	08	↓	1418	↓	3			X	X								
MW-6	09	10/4/17	905	Water	3			X	X								
MW-13	10	~~10/4~~ ↓	932	↓	3			X	X								

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Elizabeth Wehker-Bruya	EPI	10/5/17	825
Received by:	Nhan Phan	FEBI	10/5/17	825
Relinquished by:				
Received by:		Samples received at 4 °C		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

710067

SAMPLE CHAIN OF CUSTODY

ME 10/5/17 VW5

Page # 2 of 2

Report To Josh Bernthal

Company EPI

Address 1180 NW Maple St

City, State, ZIP Issaquah, WA

Phone _____ Email _____

SAMPLERS (*signature*): E.D. Webber Bruya

PROJECT NAME: 71201

PO #:

REMARKS:

INVOICE TO:

TURNAROUND TIME
- [x] Standard Turnaround
- [ ] RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- [x] Dispose after 30 days
- [ ] Archive Samples
- [ ] Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
						ANALYSES REQUESTED											
MW-14	11	10/4/17	758	water	3			X	X								
MW-4	12		1027		3			X	X								
MW-3	13		1050		3			X	X								
MW-1	14		1132		3			X	X								
Dup-1	15	10/3/17		water	3			X	X								

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: E.D. Webber Bruya	Elizabeth Webber Bruya	EPI	10/5/17	825
Received by: Dhan Phan	Dhan Phan	FEBT	10/5/17	825
Relinquished by:				
Received by:		Samples received at 4 °C		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: 71201.0
Work Order Number: 1710156

October 17, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 10/12/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *10/17/2017*

CLIENT: Environmental Partners, Inc.
Project: 71201.0
Work Order: 1710156

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1710156-001	Tot-Eff-101217	10/12/2017 8:00 AM	10/12/2017 10:10 AM

Case Narrative

WO#: **1710156**
Date: **10/17/2017**

CLIENT: Environmental Partners, Inc.
Project: 71201.0

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1710156**
Date Reported: **10/17/2017**

Client: Environmental Partners, Inc.
Collection Date: 10/12/2017 8:00:00 AM
Project: 71201.0
Lab ID: 1710156-001
Matrix: Air
Client Sample ID: **Tot-Eff-101217**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 18519		Analyst: MW
Benzene	ND	0.100		µg/L	1	10/13/2017 1:42:50 PM
Toluene	ND	0.100		µg/L	1	10/13/2017 1:42:50 PM
Ethylbenzene	ND	0.100		µg/L	1	10/13/2017 1:42:50 PM
m,p-Xylene	ND	0.100		µg/L	1	10/13/2017 1:42:50 PM
o-Xylene	ND	0.100		µg/L	1	10/13/2017 1:42:50 PM
Surr: Dibromofluoromethane	101	56.4 - 141		%Rec	1	10/13/2017 1:42:50 PM
Surr: Toluene-d8	104	66 - 138		%Rec	1	10/13/2017 1:42:50 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	95.3	64.7 - 128		%Rec	1	10/13/2017 1:42:50 PM
Gasoline by NWTPH-Gx				Batch ID: 18519		Analyst: MW
Gasoline	ND	5.00		µg/L	1	10/13/2017 1:42:50 PM
Surr: 4-Bromofluorobenzene	98.3	65 - 135		%Rec	1	10/13/2017 1:42:50 PM
Surr: Toluene-d8	101	65 - 135		%Rec	1	10/13/2017 1:42:50 PM

Work Order: 1710156
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-18519**	SampType: **LCS**	Units: **µg/L**	Prep Date: **10/13/2017**	RunNo: **39273**
Client ID: **LCSW**	Batch ID: **18519**		Analysis Date: **10/13/2017**	SeqNo: **755724**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	46.6	5.00	50.00	0	93.2	65	135				
Surr: 4-Bromofluorobenzene	2.52		2.500		101	65	135				
Surr: Toluene-d8	2.51		2.500		100	65	135				

Sample ID **MB-18519**	SampType: **MBLK**	Units: **µg/L**	Prep Date: **10/13/2017**	RunNo: **39273**
Client ID: **MBLKW**	Batch ID: **18519**		Analysis Date: **10/13/2017**	SeqNo: **755725**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.39		2.500		95.7	65	135				
Surr: Toluene-d8	2.33		2.500		93.3	65	135				

Sample ID **1710156-001AREP**	SampType: **REP**	Units: **µg/L**	Prep Date: **10/13/2017**	RunNo: **39273**
Client ID: **Tot-Eff-101217**	Batch ID: **18519**		Analysis Date: **10/13/2017**	SeqNo: **755721**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.45		2.500		98.0	65	135		0		
Surr: Toluene-d8	2.34		2.500		93.6	65	135		0		

Work Order: 1710156
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-18519** SampType: **LCS** Units: **µg/L** Prep Date: **10/13/2017** RunNo: **39274**
Client ID: **LCSW** Batch ID: **18519** Analysis Date: **10/13/2017** SeqNo: **755734**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.98	0.100	2.000	0	99.2	67.1	132				
Toluene	1.89	0.100	2.000	0	94.5	73.6	127				
Ethylbenzene	2.04	0.100	2.000	0	102	78	127				
m,p-Xylene	4.00	0.100	4.000	0	99.9	77.5	130				
o-Xylene	2.00	0.100	2.000	0	99.9	77.6	126				
Surr: Dibromofluoromethane	2.36		2.500		94.6	56.4	141				
Surr: Toluene-d8	2.19		2.500		87.5	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.63		2.500		105	64.7	128				

Sample ID **MB-18519** SampType: **MBLK** Units: **µg/L** Prep Date: **10/13/2017** RunNo: **39274**
Client ID: **MBLKW** Batch ID: **18519** Analysis Date: **10/13/2017** SeqNo: **755735**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.16		2.500		86.3	56.4	141				
Surr: Toluene-d8	2.06		2.500		82.6	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.33		2.500		93.2	64.7	128				

Sample ID **1710156-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **10/13/2017** RunNo: **39274**
Client ID: **Tot-Eff-101217** Batch ID: **18519** Analysis Date: **10/13/2017** SeqNo: **755731**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	

Work Order: 1710156
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1710156-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **10/13/2017** RunNo: **39274**
Client ID: **Tot-Eff-101217** Batch ID: **18519** Analysis Date: **10/13/2017** SeqNo: **755731**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.56		2.500		102	61.1	128		0		
Surr: Toluene-d8	2.44		2.500		97.6	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.39		2.500		95.7	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1710156**
Logged by:	**Clare Griggs**	Date Received:	**10/12/2017 10:10:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Sample		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 10/12/17 Page: 1 of 1

Project Name:

Laboratory Project No (internal): 171015e

Special Remarks:

Client: ENVIRONMENTAL PARTNERS, INC.

Project No: 71201.0

Address: 1180 NW Maple St. Ste 310

Collected by: JB

City, State, Zip: ISSAQUAH, WA 98027

Location: Cle Elum WA

Telephone: 425-241-5400

Report To (PM): Josh Berthel

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epi-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T)	Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-101217	10/12/17	0800	Air		X													
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:

- ☑ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x	10/12/17 1010	x Casey	10/12/17 1010
Relinquished	Date/Time	Received	Date/Time
x		x	

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80 - I-90
Work Order Number: 1711134

November 14, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 11/8/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *11/14/2017*

CLIENT: Environmental Partners, Inc.
Project: MM80 - I-90
Work Order: 1711134

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1711134-001	Tot-Eff-110817	11/08/2017 8:00 AM	11/08/2017 1:00 PM

Case Narrative

WO#: **1711134**
Date: **11/14/2017**

CLIENT: Environmental Partners, Inc.
Project: MM80 - I-90

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1711134**
Date Reported: **11/14/2017**

Client: Environmental Partners, Inc.
Collection Date: 11/8/2017 8:00:00 AM
Project: MM80 - I-90
Lab ID: 1711134-001
Matrix: Air
Client Sample ID: **Tot-Eff-110817**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 18844		Analyst: NG
Benzene	ND	0.100		µg/L	1	11/10/2017 2:22:03 PM
Toluene	ND	0.100		µg/L	1	11/10/2017 2:22:03 PM
Ethylbenzene	ND	0.100		µg/L	1	11/10/2017 2:22:03 PM
m,p-Xylene	ND	0.100		µg/L	1	11/10/2017 2:22:03 PM
o-Xylene	ND	0.100		µg/L	1	11/10/2017 2:22:03 PM
Surr: Dibromofluoromethane	87.5	56.4 - 141		%Rec	1	11/10/2017 2:22:03 PM
Surr: Toluene-d8	90.8	66 - 138		%Rec	1	11/10/2017 2:22:03 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	93.8	64.7 - 128		%Rec	1	11/10/2017 2:22:03 PM
Gasoline by NWTPH-Gx				Batch ID: 18844		Analyst: NG
Gasoline	ND	5.00		µg/L	1	11/10/2017 2:22:03 PM
Surr: 4-Bromofluorobenzene	98.0	65 - 135		%Rec	1	11/10/2017 2:22:03 PM
Surr: Toluene-d8	98.8	65 - 135		%Rec	1	11/10/2017 2:22:03 PM

Work Order: 1711134
CLIENT: Environmental Partners, Inc.
Project: MM80 - I-90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **MB-18844** SampType: **MBLK** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39901**
Client ID: **MBLKW** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768201**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.44		2.500		97.7	65	135				
Surr: Toluene-d8	2.46		2.500		98.3	65	135				

Sample ID **1711134-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39901**
Client ID: **Tot-Eff-110817** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768197**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.45		2.500		97.8	65	135		0		
Surr: Toluene-d8	2.48		2.500		99.0	65	135		0		

Sample ID **LCS-18844** SampType: **LCS** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39901**
Client ID: **LCSW** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768200**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	52.5	5.00	50.00	0	105	65	135				
Surr: 4-Bromofluorobenzene	2.44		2.500		97.4	65	135				
Surr: Toluene-d8	2.46		2.500		98.5	65	135				

Work Order: 1711134
CLIENT: Environmental Partners, Inc.
Project: MM80 - I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **MB-18844** SampType: **MBLK** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39900**
Client ID: **MBLKW** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768195**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.30		2.500		91.9	56.4	141				
Surr: Toluene-d8	2.28		2.500		91.2	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.33		2.500		93.3	64.7	128				

Sample ID **1711134-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39900**
Client ID: **Tot-Eff-110817** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768191**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.19		2.500		87.6	61.1	128		0		
Surr: Toluene-d8	2.26		2.500		90.4	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.34		2.500		93.5	64.7	128		0		

Sample ID **LCS-18844** SampType: **LCS** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39900**
Client ID: **LCSW** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768194**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.03	0.100	2.000	0	102	67.1	132				
Toluene	2.01	0.100	2.000	0	100	73.6	127				
Ethylbenzene	2.24	0.100	2.000	0	112	78	127				
m,p-Xylene	4.48	0.100	4.000	0	112	77.5	130				

Work Order: 1711134
CLIENT: Environmental Partners, Inc.
Project: MM80 - I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-18844** SampType: **LCS** Units: **µg/L** Prep Date: **11/10/2017** RunNo: **39900**
Client ID: **LCSW** Batch ID: **18844** Analysis Date: **11/10/2017** SeqNo: **768194**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	2.10	0.100	2.000	0	105	77.6	126				
Surr: Dibromofluoromethane	2.37		2.500		94.8	56.4	141				
Surr: Toluene-d8	2.34		2.500		93.6	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.51		2.500		100	64.7	128				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1711134**
Logged by:	**Brianna Barnes**	Date Received:	**11/8/2017 1:00:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 11/8/17 Page: 1 of: 1

Laboratory Project No (internal): 1711134

Project Name: MM 80 - I-90

Special Remarks:

Client: ENVIRONMENTAL PARTNERS, INC

Project No: 71201.0

Address: 1180 NW Maple St Ste 310

Collected by: JB

City, State, Zip: ISSAQUAH, WA 98027

Location: Cle Elum, WA

Telephone: 425-291-5400

Report To (PM): Josh Bernthal

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epi-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX 8260	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T)	Dissolved (D)	Anions (IC)***	EDB (8011)				Comments
1	Tot-Eff-110817	11/8/17	0800	Air		X																
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	11/8/17 1300	x [signature]	11/8/2017 1300
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80-I90
Work Order Number: 1712113

December 14, 2017

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 12/12/2017 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *12/14/2017*

CLIENT: Environmental Partners, Inc.
Project: MM80-I90
Work Order: 1712113

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1712113-001	Tot-Eff-121217	12/12/2017 9:00 AM	12/12/2017 11:50 AM

Case Narrative

WO#: **1712113**
Date: **12/14/2017**

CLIENT: Environmental Partners, Inc.
Project: MM80-I90

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1712113**
Date Reported: **12/14/2017**

Client: Environmental Partners, Inc.
Collection Date: 12/12/2017 9:00:00 AM
Project: MM80-I90
Lab ID: 1712113-001
Matrix: Air
Client Sample ID: **Tot-Eff-121217**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 19173		Analyst: MW
Benzene	ND	0.100		µg/L	1	12/13/2017 4:24:33 PM
Toluene	ND	0.100		µg/L	1	12/13/2017 4:24:33 PM
Ethylbenzene	ND	0.100		µg/L	1	12/13/2017 4:24:33 PM
m,p-Xylene	ND	0.100		µg/L	1	12/13/2017 4:24:33 PM
o-Xylene	ND	0.100		µg/L	1	12/13/2017 4:24:33 PM
Surr: Dibromofluoromethane	102	56.4 - 141		%Rec	1	12/13/2017 4:24:33 PM
Surr: Toluene-d8	88.1	66 - 138		%Rec	1	12/13/2017 4:24:33 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	95.9	64.7 - 128		%Rec	1	12/13/2017 4:24:33 PM
Gasoline by NWTPH-Gx				Batch ID: 19173		Analyst: MW
Gasoline	ND	5.00		µg/L	1	12/13/2017 4:24:33 PM
Surr: 4-Bromofluorobenzene	95.4	65 - 135		%Rec	1	12/13/2017 4:24:33 PM
Surr: Toluene-d8	99.8	65 - 135		%Rec	1	12/13/2017 4:24:33 PM

Work Order: 1712113
CLIENT: Environmental Partners, Inc.
Project: MM80-I90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-19173** SampType: **LCS** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40473**
Client ID: **LCSW** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779517**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	54.4	5.00	50.00	0	109	65	135				
Surr: 4-Bromofluorobenzene	2.45		2.500		98.0	65	135				
Surr: Toluene-d8	2.43		2.500		97.1	65	135				

Sample ID **MB-19173** SampType: **MBLK** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40473**
Client ID: **MBLKW** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779518**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.32		2.500		92.9	65	135				
Surr: Toluene-d8	2.50		2.500		100	65	135				

Sample ID **1712098-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40473**
Client ID: **BATCH** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779513**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.38		2.500		95.1	65	135		0		
Surr: Toluene-d8	2.46		2.500		98.5	65	135		0		

Work Order: 1712113
CLIENT: Environmental Partners, Inc.
Project: MM80-I90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-19173** SampType: **LCS** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40472**
Client ID: **LCSW** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779509**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.17	0.100	2.000	0	108	67.1	132				
Toluene	2.11	0.100	2.000	0	105	73.6	127				
Ethylbenzene	2.29	0.100	2.000	0	115	78	127				
m,p-Xylene	4.58	0.100	4.000	0	114	77.5	130				
o-Xylene	2.31	0.100	2.000	0	115	77.6	126				
Surr: Dibromofluoromethane	2.61		2.500		104	56.4	141				
Surr: Toluene-d8	2.40		2.500		96.1	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.74		2.500		110	64.7	128				

Sample ID **MB-19173** SampType: **MBLK** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40472**
Client ID: **MBLKW** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779510**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.51		2.500		100	56.4	141				
Surr: Toluene-d8	2.19		2.500		87.6	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.34		2.500		93.5	64.7	128				

Sample ID **1712098-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40472**
Client ID: **BATCH** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779505**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	

Work Order: 1712113
CLIENT: Environmental Partners, Inc.
Project: MM80-I90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1712098-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **12/13/2017** RunNo: **40472**
Client ID: **BATCH** Batch ID: **19173** Analysis Date: **12/13/2017** SeqNo: **779505**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.55		2.500		102	61.1	128		0		
Surr: Toluene-d8	2.17		2.500		86.6	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.39		2.500		95.7	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1712113**
Logged by:	**Brianna Barnes**	Date Received:	**12/12/2017 11:50:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 12/12/17 Page: 1 of: 1

Laboratory Project No (internal): 171213

Special Remarks:

Project Name: MM80-290

Project No: 71201.0

Client: Environmental Partners, Inc

Address: 1180 NW Maple St Ste 310

City, State, Zip: Issaquah, WA 98027

Telephone: 425-391-5400

Fax:

Collected by: JB

Location: Cle Elum, WA

Report To (PM): Josh Bernhard

PM Email: joshb@epi.wa.com

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8) Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-12217	12/12/17	0900	AIR	X												
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:

- ☑ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	12/12/17 1150	x Casey Keg	12/12/17 1150
Relinquished	Date/Time	Received	Date/Time
x		x	

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80 - I90
Work Order Number: 1801109

January 12, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 1/9/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *01/12/2018*

CLIENT: Environmental Partners, Inc.
Project: MM80 - I90
Work Order: 1801109

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1801109-001	Tot-Eff-010918	01/09/2018 9:30 AM	01/09/2018 12:40 PM

Case Narrative

WO#: **1801109**
Date: **1/12/2018**

CLIENT: Environmental Partners, Inc.
Project: MM80 - I90

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1801109**
Date Reported: **1/12/2018**

Client: Environmental Partners, Inc.
Collection Date: 1/9/2018 9:30:00 AM
Project: MM80 - I90
Lab ID: 1801109-001
Matrix: Air
Client Sample ID: **Tot-Eff-010918**

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 19473		Analyst: MW
Benzene	ND	0.100		µg/L	1	1/11/2018 1:11:35 PM
Toluene	ND	0.100		µg/L	1	1/11/2018 1:11:35 PM
Ethylbenzene	ND	0.100		µg/L	1	1/11/2018 1:11:35 PM
m,p-Xylene	ND	0.100		µg/L	1	1/11/2018 1:11:35 PM
o-Xylene	ND	0.100		µg/L	1	1/11/2018 1:11:35 PM
Surr: Dibromofluoromethane	99.2	56.4 - 141		%Rec	1	1/11/2018 1:11:35 PM
Surr: Toluene-d8	91.3	66 - 138		%Rec	1	1/11/2018 1:11:35 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	92.5	64.7 - 128		%Rec	1	1/11/2018 1:11:35 PM
Gasoline by NWTPH-Gx				Batch ID: 19473		Analyst: MW
Gasoline	ND	5.00		µg/L	1	1/11/2018 1:11:35 PM
Surr: 4-Bromofluorobenzene	94.9	65 - 135		%Rec	1	1/11/2018 1:11:35 PM
Surr: Toluene-d8	97.2	65 - 135		%Rec	1	1/11/2018 1:11:35 PM

Work Order: 1801109
CLIENT: Environmental Partners, Inc.
Project: MM80 - I90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-19473** SampType: **LCS** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41039**
Client ID: **LCSW** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790732**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	54.3	5.00	50.00	0	109	65	135				
Surr: 4-Bromofluorobenzene	2.47		2.500		98.9	65	135				
Surr: Toluene-d8	2.47		2.500		98.6	65	135				

Sample ID **MB-19473** SampType: **MBLK** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41039**
Client ID: **MBLKW** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790733**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.28		2.500		91.3	65	135				
Surr: Toluene-d8	2.49		2.500		99.8	65	135				

Sample ID **1801109-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41039**
Client ID: **Tot-Eff-010918** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790729**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.38		2.500		95.3	65	135		0		
Surr: Toluene-d8	2.42		2.500		96.7	65	135		0		

Work Order: 1801109
CLIENT: Environmental Partners, Inc.
Project: MM80 - I90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-19473** SampType: **LCS** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41038**
Client ID: **LCSW** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790717**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.92	0.100	2.000	0	96.0	67.1	132				
Toluene	1.92	0.100	2.000	0	96.1	73.6	127				
Ethylbenzene	2.02	0.100	2.000	0	101	78	127				
m,p-Xylene	4.05	0.100	4.000	0	101	77.5	130				
o-Xylene	2.03	0.100	2.000	0	102	77.6	126				
Surr: Dibromofluoromethane	2.33		2.500		93.1	56.4	141				
Surr: Toluene-d8	2.41		2.500		96.5	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.57		2.500		103	64.7	128				

Sample ID **MB-19473** SampType: **MBLK** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41038**
Client ID: **MBLKW** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790718**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.40		2.500		96.1	56.4	141				
Surr: Toluene-d8	2.25		2.500		90.1	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.23		2.500		89.0	64.7	128				

Sample ID **1801109-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41038**
Client ID: **Tot-Eff-010918** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790714**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	

Work Order: 1801109
CLIENT: Environmental Partners, Inc.
Project: MM80 - I90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1801109-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **1/11/2018** RunNo: **41038**
Client ID: **Tot-Eff-010918** Batch ID: **19473** Analysis Date: **1/11/2018** SeqNo: **790714**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.45		2.500		97.8	61.1	128		0		
Surr: Toluene-d8	2.28		2.500		91.1	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.32		2.500		92.9	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1801109**
Logged by:	**Clare Griggs**	Date Received:	**1/9/2018 12:40:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes	☑	No	☐	Not Present ☐
2.	How was the sample delivered?	Client				

Log In

3.	Coolers are present?	Yes	☐	No	☑	NA ☐
		Air Sample				
4.	Shipping container/cooler in good condition?	Yes	☑	No	☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes	☐	No	☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes	☐	No	☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes	☐	No	☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes	☑	No	☐	
9.	Sufficient sample volume for indicated test(s)?	Yes	☑	No	☐	
10.	Are samples properly preserved?	Yes	☑	No	☐	
11.	Was preservative added to bottles?	Yes	☐	No	☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes	☐	No	☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes	☑	No	☐	
14.	Does paperwork match bottle labels?	Yes	☑	No	☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes	☑	No	☐	
16.	Is it clear what analyses were requested?	Yes	☑	No	☐	
17.	Were all holding times able to be met?	Yes	☑	No	☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes	☐	No	☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 1/9/17 Page: 1 of: 1

Laboratory Project No (internal): 1801109

Project Name: MM 80 - I90

Special Remarks:

Client: ENVIRONMENTAL PARTNERS, INC

Project No: 71201.0

Address: 1180 NW Maple St. Ste 310

Collected by: JB

City, State, Zip: ISSAQUAH WA 98027

Location: Cle Elum, WA

Telephone: 425-241-5400

Report To (PM): Josh Berthal

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax: 425-395-0011

PM Email: joshb@epi-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T)	Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-010918	1/9/18	0930	Air		X													
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual*: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Turn-around Time:
- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day ____ (specify)

Relinquished	Date/Time	Received	Date/Time
x	1/9/18 1240	x	1/9/18 1240
Relinquished	Date/Time	Received	Date/Time
x		x	

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: I-90 MM80
Work Order Number: 1804322

April 25, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 4 sample(s) on 4/19/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *04/25/2018*

CLIENT: Environmental Partners, Inc.
Project: I-90 MM80
Work Order: 1804322

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1804322-001	Tot-Eff-041918	04/19/2018 9:00 AM	04/19/2018 12:45 PM
1804322-002	SVE-3-041918	04/19/2018 8:45 AM	04/19/2018 12:45 PM
1804322-003	SVE-4-041918	04/19/2018 8:30 AM	04/19/2018 12:45 PM
1804322-004	SVE-5-041918	04/19/2018 8:20 AM	04/19/2018 12:45 PM

Case Narrative

WO#: **1804322**
Date: **4/25/2018**

CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1804322**
Date Reported: **4/25/2018**

Client: Environmental Partners, Inc.
Collection Date: 4/19/2018 9:00:00 AM
Project: I-90 MM80
Lab ID: 1804322-001
Matrix: Air
Client Sample ID: **Tot-Eff-041918**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 20448		Analyst: MW
Benzene	ND	0.100		µg/L	1	4/19/2018 1:57:56 PM
Toluene	ND	0.100		µg/L	1	4/19/2018 1:57:56 PM
Ethylbenzene	ND	0.100		µg/L	1	4/19/2018 1:57:56 PM
m,p-Xylene	ND	0.100		µg/L	1	4/19/2018 1:57:56 PM
o-Xylene	ND	0.100		µg/L	1	4/19/2018 1:57:56 PM
Surr: Dibromofluoromethane	105	56.4 - 141		%Rec	1	4/19/2018 1:57:56 PM
Surr: Toluene-d8	102	66 - 138		%Rec	1	4/19/2018 1:57:56 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	4/19/2018 1:57:56 PM
Gasoline by NWTPH-Gx				Batch ID: 20448		Analyst: MW
Gasoline	ND	5.00		µg/L	1	4/19/2018 1:57:56 PM
Surr: 4-Bromofluorobenzene	119	65 - 135		%Rec	1	4/19/2018 1:57:56 PM
Surr: Toluene-d8	98.1	65 - 135		%Rec	1	4/19/2018 1:57:56 PM

Analytical Report

Work Order: **1804322**
Date Reported: **4/25/2018**

Client: Environmental Partners, Inc.
Collection Date: 4/19/2018 8:45:00 AM
Project: I-90 MM80
Lab ID: 1804322-002
Matrix: Air
Client Sample ID: **SVE-3-041918**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 20448		Analyst: MW
Benzene	ND	0.100		µg/L	1	4/19/2018 2:28:12 PM
Toluene	ND	0.100		µg/L	1	4/19/2018 2:28:12 PM
Ethylbenzene	ND	0.100		µg/L	1	4/19/2018 2:28:12 PM
m,p-Xylene	ND	0.100		µg/L	1	4/19/2018 2:28:12 PM
o-Xylene	ND	0.100		µg/L	1	4/19/2018 2:28:12 PM
Surr: Dibromofluoromethane	109	56.4 - 141		%Rec	1	4/19/2018 2:28:12 PM
Surr: Toluene-d8	101	66 - 138		%Rec	1	4/19/2018 2:28:12 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	103	64.7 - 128		%Rec	1	4/19/2018 2:28:12 PM
Gasoline by NWTPH-Gx				Batch ID: 20448		Analyst: MW
Gasoline	ND	5.00		µg/L	1	4/19/2018 2:28:12 PM
Surr: 4-Bromofluorobenzene	122	65 - 135		%Rec	1	4/19/2018 2:28:12 PM
Surr: Toluene-d8	97.7	65 - 135		%Rec	1	4/19/2018 2:28:12 PM

Analytical Report

Work Order: **1804322**
Date Reported: **4/25/2018**

Client: Environmental Partners, Inc.
Collection Date: 4/19/2018 8:30:00 AM
Project: I-90 MM80
Lab ID: 1804322-003
Matrix: Air
Client Sample ID: **SVE-4-041918**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 20448		Analyst: MW
Benzene	ND	0.100		µg/L	1	4/19/2018 2:58:38 PM
Toluene	ND	0.100		µg/L	1	4/19/2018 2:58:38 PM
Ethylbenzene	ND	0.100		µg/L	1	4/19/2018 2:58:38 PM
m,p-Xylene	ND	0.100		µg/L	1	4/19/2018 2:58:38 PM
o-Xylene	ND	0.100		µg/L	1	4/19/2018 2:58:38 PM
Surr: Dibromofluoromethane	104	56.4 - 141		%Rec	1	4/19/2018 2:58:38 PM
Surr: Toluene-d8	102	66 - 138		%Rec	1	4/19/2018 2:58:38 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	103	64.7 - 128		%Rec	1	4/19/2018 2:58:38 PM
Gasoline by NWTPH-Gx				Batch ID: 20448		Analyst: MW
Gasoline	ND	5.00		µg/L	1	4/19/2018 2:58:38 PM
Surr: 4-Bromofluorobenzene	121	65 - 135		%Rec	1	4/19/2018 2:58:38 PM
Surr: Toluene-d8	97.2	65 - 135		%Rec	1	4/19/2018 2:58:38 PM

Analytical Report

Work Order: **1804322**
Date Reported: **4/25/2018**

Client: Environmental Partners, Inc.
Collection Date: 4/19/2018 8:20:00 AM
Project: I-90 MM80
Lab ID: 1804322-004
Matrix: Air
Client Sample ID: **SVE-5-041918**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 20448		Analyst: MW
Benzene	ND	0.100		µg/L	1	4/19/2018 3:28:58 PM
Toluene	ND	0.100		µg/L	1	4/19/2018 3:28:58 PM
Ethylbenzene	ND	0.100		µg/L	1	4/19/2018 3:28:58 PM
m,p-Xylene	ND	0.100		µg/L	1	4/19/2018 3:28:58 PM
o-Xylene	ND	0.100		µg/L	1	4/19/2018 3:28:58 PM
Surr: Dibromofluoromethane	108	56.4 - 141		%Rec	1	4/19/2018 3:28:58 PM
Surr: Toluene-d8	101	66 - 138		%Rec	1	4/19/2018 3:28:58 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	4/19/2018 3:28:58 PM
Gasoline by NWTPH-Gx				Batch ID: 20448		Analyst: MW
Gasoline	ND	5.00		µg/L	1	4/19/2018 3:28:58 PM
Surr: 4-Bromofluorobenzene	119	65 - 135		%Rec	1	4/19/2018 3:28:58 PM
Surr: Toluene-d8	97.1	65 - 135		%Rec	1	4/19/2018 3:28:58 PM

Work Order: 1804322
CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **1804312-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43031**
Client ID: **BATCH** Batch ID: **20448** Analysis Date: **4/19/2018** SeqNo: **831658**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	3.01		2.500		120	65	135		0		
Surr: Toluene-d8	2.45		2.500		97.9	65	135		0		

Sample ID **MB-20448** SampType: **MBLK** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43031**
Client ID: **MBLKW** Batch ID: **20448** Analysis Date: **4/19/2018** SeqNo: **831669**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.90		2.500		116	65	135				
Surr: Toluene-d8	2.46		2.500		98.5	65	135				

Sample ID **LCS-20448** SampType: **LCS** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43031**
Client ID: **LCSW** Batch ID: **20448** Analysis Date: **4/20/2018** SeqNo: **831668**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	51.8	5.00	50.00	0	104	65	135				
Surr: 4-Bromofluorobenzene	3.02		2.500		121	65	135				
Surr: Toluene-d8	2.48		2.500		99.1	65	135				

Work Order: 1804322
CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1804312-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43030**
Client ID: **BATCH** Batch ID: **20448** Analysis Date: **4/19/2018** SeqNo: **831641**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.77		2.500		111	61.1	128		0		
Surr: Toluene-d8	2.52		2.500		101	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.52		2.500		101	64.7	128		0		

Sample ID **MB-20448** SampType: **MBLK** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43030**
Client ID: **MBLKW** Batch ID: **20448** Analysis Date: **4/19/2018** SeqNo: **831652**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.61		2.500		105	56.4	141				
Surr: Toluene-d8	2.53		2.500		101	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.43		2.500		97.4	64.7	128				

Sample ID **LCS-20448** SampType: **LCS** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43030**
Client ID: **LCSW** Batch ID: **20448** Analysis Date: **4/19/2018** SeqNo: **831651**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.06	0.100	2.000	0	103	67.1	132				
Toluene	2.06	0.100	2.000	0	103	73.6	127				
Ethylbenzene	2.05	0.100	2.000	0	103	78	127				
m,p-Xylene	4.01	0.100	4.000	0	100	77.5	130				

Work Order: 1804322
CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-20448** SampType: **LCS** Units: **µg/L** Prep Date: **4/19/2018** RunNo: **43030**
Client ID: **LCSW** Batch ID: **20448** Analysis Date: **4/19/2018** SeqNo: **831651**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	2.01	0.100	2.000	0	101	77.6	126				
Surr: Dibromofluoromethane	3.07		2.500		123	56.4	141				
Surr: Toluene-d8	2.56		2.500		102	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.55		2.500		102	64.7	128				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1804322**
Logged by:	**Brianna Barnes**	Date Received:	**4/19/2018 12:45:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 4/19/18 Page: 1 of: 1

Laboratory Project No (internal): 1904322

Project Name: I-90 MMSO

Special Remarks:

Client: ENVIRONMENTAL PARTNERS, INC.

Project No: 71201.0

Address: 1180 NW Maple St, Ste 310

Collected by: JB

City, State, Zip: ISSAQUAH WA 98027

Location: Cle Elum, WA

Telephone: 425-241-5700

Report To (PM): Josh Berthal

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epiwa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	8260	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-041918	4/19/18	0900	AIR		X													
2	SVE-3-041918	4/19/18	0845	AIR		X													
3	SVE-4-041918	4/19/18	0830	AIR		X													
4	SVE-5-041918	4/19/18	0820	AIR		X													
5																			
6																			
7																			
8																			
9																			
10																			

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x	4/19/18 1245	x	4/19/18 1245
Relinquished	Date/Time	Received	Date/Time
x		x	

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: I-90 MM80
Work Order Number: 1805217

May 22, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 5/16/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *05/22/2018*

CLIENT: Environmental Partners, Inc.
Project: I-90 MM80
Work Order: 1805217

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1805217-001	Tot-Eff-051618	05/16/2018 7:30 AM	05/16/2018 10:30 AM

Case Narrative

WO#: **1805217**
Date: **5/22/2018**

CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1805217**
Date Reported: **5/22/2018**

Client: Environmental Partners, Inc.
Collection Date: 5/16/2018 7:30:00 AM
Project: I-90 MM80
Lab ID: 1805217-001
Matrix: Air
Client Sample ID: **Tot-Eff-051618**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 20700		Analyst: TN
Benzene	ND	0.100		µg/L	1	5/16/2018 3:40:11 PM
Toluene	ND	0.100		µg/L	1	5/16/2018 3:40:11 PM
Ethylbenzene	ND	0.100		µg/L	1	5/16/2018 3:40:11 PM
m,p-Xylene	ND	0.100		µg/L	1	5/16/2018 3:40:11 PM
o-Xylene	ND	0.100		µg/L	1	5/16/2018 3:40:11 PM
Surr: Dibromofluoromethane	99.8	56.4 - 141		%Rec	1	5/16/2018 3:40:11 PM
Surr: Toluene-d8	100	66 - 138		%Rec	1	5/16/2018 3:40:11 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	5/16/2018 3:40:11 PM
Gasoline by NWTPH-Gx				Batch ID: 20700		Analyst: TN
Gasoline	ND	5.00		µg/L	1	5/16/2018 3:40:11 PM
Surr: 4-Bromofluorobenzene	99.6	65 - 135		%Rec	1	5/16/2018 3:40:11 PM
Surr: Toluene-d8	96.2	65 - 135		%Rec	1	5/16/2018 3:40:11 PM

Work Order: 1805217
CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **1805217-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43550**
Client ID: **Tot-Eff-051618** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841937**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.50		2.500		99.8	65	135		0		
Surr: Toluene-d8	2.46		2.500		98.3	65	135		0		

Sample ID **LCS-20700** SampType: **LCS** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43550**
Client ID: **LCSW** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841943**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	47.2	5.00	50.00	0	94.3	65	135				
Surr: 4-Bromofluorobenzene	2.54		2.500		101	65	135				
Surr: Toluene-d8	2.53		2.500		101	65	135				

Sample ID **MB-20700** SampType: **MBLK** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43550**
Client ID: **MBLKW** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841944**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.56		2.500		102	65	135				
Surr: Toluene-d8	2.49		2.500		99.5	65	135				

Work Order: 1805217
CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1805217-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43549**
Client ID: **Tot-Eff-051618** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841917**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.48		2.500		99.4	61.1	128		0		
Surr: Toluene-d8	2.54		2.500		102	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.52		2.500		101	64.7	128		0		

Sample ID **LCS-20700** SampType: **LCS** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43549**
Client ID: **LCSW** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841923**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.99	0.100	2.000	0	99.5	67.1	132				
Toluene	2.02	0.100	2.000	0	101	73.6	127				
Ethylbenzene	2.00	0.100	2.000	0	99.8	78	127				
m,p-Xylene	3.89	0.100	4.000	0	97.4	77.5	130				
o-Xylene	1.92	0.100	2.000	0	96.2	77.6	126				
Surr: Dibromofluoromethane	2.60		2.500		104	56.4	141				
Surr: Toluene-d8	2.59		2.500		104	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.64		2.500		105	64.7	128				

Sample ID **MB-20700** SampType: **MBLK** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43549**
Client ID: **MBLKW** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841924**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									

Work Order: 1805217
CLIENT: Environmental Partners, Inc.
Project: I-90 MM80

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **MB-20700** SampType: **MBLK** Units: **µg/L** Prep Date: **5/16/2018** RunNo: **43549**
Client ID: **MBLKW** Batch ID: **20700** Analysis Date: **5/16/2018** SeqNo: **841924**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.39		2.500		95.5	56.4	141				
Surr: Toluene-d8	2.54		2.500		102	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.59		2.500		103	64.7	128				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1805217**
Logged by:	**Clare Griggs**	Date Received:	**5/16/2018 10:30:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 5/16/18 Page: 1 of: 1

Laboratory Project No (internal): 1805217

Special Remarks:

Project Name: I-90 MM 80

Project No: 71201.0

Client: ENVIRONMENTAL PARTNERS, INC.

Address: 1180 NW Maple St. St. 310

City, State, Zip: ISSAQUAH, WA 98027

Telephone: 425-291-5700

Collected by: JB

Location: Cle Elum

Report To (PM): Josh Beinhart

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@ep-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8) Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-051618	5/16/18	0730	AIR		X											
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual*: Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x	5/16/18 1030	x	5/16/18 1030
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:
- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day ____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80 I-90
Work Order Number: 1806332

July 05, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 2 sample(s) on 6/27/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *07/05/2018*

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90
Work Order: 1806332

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1806332-001	SP-2	06/27/2018 6:30 AM	06/27/2018 11:10 AM
1806332-002	Tot-Eff-062718	06/27/2018 6:50 AM	06/27/2018 11:10 AM

Case Narrative

WO#: **1806332**
Date: **7/5/2018**

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1806332**
Date Reported: **7/5/2018**

Client: Environmental Partners, Inc.
Collection Date: 6/27/2018 6:30:00 AM
Project: MM80 I-90
Lab ID: 1806332-001
Matrix: Air
Client Sample ID: **SP-2**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 21115		Analyst: MW
Benzene	ND	0.100		µg/L	1	6/29/2018 5:02:47 PM
Toluene	ND	0.100		µg/L	1	6/29/2018 5:02:47 PM
Ethylbenzene	ND	0.100		µg/L	1	6/29/2018 5:02:47 PM
m,p-Xylene	ND	0.100		µg/L	1	6/29/2018 5:02:47 PM
o-Xylene	ND	0.100		µg/L	1	6/29/2018 5:02:47 PM
Surr: Dibromofluoromethane	109	56.4 - 141		%Rec	1	6/29/2018 5:02:47 PM
Surr: Toluene-d8	100	66 - 138		%Rec	1	6/29/2018 5:02:47 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	6/29/2018 5:02:47 PM
Gasoline by NWTPH-Gx				Batch ID: 21115		Analyst: MW
Gasoline	ND	5.00		µg/L	1	6/29/2018 5:02:47 PM
Surr: 4-Bromofluorobenzene	103	65 - 135		%Rec	1	6/29/2018 5:02:47 PM
Surr: Toluene-d8	99.6	65 - 135		%Rec	1	6/29/2018 5:02:47 PM

Analytical Report

Work Order: **1806332**
Date Reported: **7/5/2018**

Client: Environmental Partners, Inc.
Collection Date: 6/27/2018 6:50:00 AM
Project: MM80 I-90
Lab ID: 1806332-002
Matrix: Air
Client Sample ID: **Tot-Eff-062718**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 21115		Analyst: MW
Benzene	ND	0.100		µg/L	1	6/29/2018 4:31:51 PM
Toluene	ND	0.100		µg/L	1	6/29/2018 4:31:51 PM
Ethylbenzene	ND	0.100		µg/L	1	6/29/2018 4:31:51 PM
m,p-Xylene	ND	0.100		µg/L	1	6/29/2018 4:31:51 PM
o-Xylene	ND	0.100		µg/L	1	6/29/2018 4:31:51 PM
Surr: Dibromofluoromethane	108	56.4 - 141		%Rec	1	6/29/2018 4:31:51 PM
Surr: Toluene-d8	99.7	66 - 138		%Rec	1	6/29/2018 4:31:51 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	100	64.7 - 128		%Rec	1	6/29/2018 4:31:51 PM
Gasoline by NWTPH-Gx				Batch ID: 21115		Analyst: MW
Gasoline	ND	5.00		µg/L	1	6/29/2018 4:31:51 PM
Surr: 4-Bromofluorobenzene	103	65 - 135		%Rec	1	6/29/2018 4:31:51 PM
Surr: Toluene-d8	101	65 - 135		%Rec	1	6/29/2018 4:31:51 PM

Work Order: 1806332
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **1806324-010ADUP** SampType: **DUP** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44417**
Client ID: **BATCH** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859849**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.49		2.500		99.8	65	135		0		
Surr: Toluene-d8	2.52		2.500		101	65	135		0		

Sample ID **MB-21115** SampType: **MBLK** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44417**
Client ID: **MBLKW** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859855**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.48		2.500		99.3	65	135				
Surr: Toluene-d8	2.49		2.500		99.7	65	135				

Sample ID **LCS-21115** SampType: **LCS** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44417**
Client ID: **LCSW** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859854**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	49.8	5.00	50.00	0	99.6	65	135				
Surr: 4-Bromofluorobenzene	2.54		2.500		102	65	135				
Surr: Toluene-d8	2.52		2.500		101	65	135				

Work Order: 1806332
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1806324-010ADUP** SampType: **DUP** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44413**
Client ID: **BATCH** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859830**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0		30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.62		2.500		105	56.4	141		0		
Surr: Toluene-d8	2.43		2.500		97.4	66	138		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.43		2.500		97.2	64.7	128		0		

Sample ID **MB-21115** SampType: **MBLK** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44413**
Client ID: **MBLKW** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859837**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.54		2.500		101	56.4	141				
Surr: Toluene-d8	2.50		2.500		100	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.42		2.500		96.7	64.7	128				

Sample ID **LCS-21115** SampType: **LCS** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44413**
Client ID: **LCSW** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859836**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.10	0.100	2.000	0	105	67.1	132				
Toluene	2.21	0.100	2.000	0	110	73.6	127				
Ethylbenzene	2.12	0.100	2.000	0	106	78	127				
m,p-Xylene	4.23	0.100	4.000	0	106	77.5	130				

Work Order: 1806332
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-21115** SampType: **LCS** Units: **µg/L** Prep Date: **6/29/2018** RunNo: **44413**
Client ID: **LCSW** Batch ID: **21115** Analysis Date: **6/29/2018** SeqNo: **859836**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	2.06	0.100	2.000	0	103	77.6	126				
Surr: Dibromofluoromethane	2.74		2.500		110	56.4	141				
Surr: Toluene-d8	2.69		2.500		107	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.59		2.500		104	64.7	128				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1806332**
Logged by:	**Brianna Barnes**	Date Received:	**6/27/2018 11:10:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples.		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical

3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 6/27/18 Page: 1 of: 1

Laboratory Project No (internal): 1806352

Client: Environmental Partners, Inc
Address: 1180 NW Maple St Ste 310
City, State, Zip: Issaquah, WA 98027
Telephone: 425-241-5470
Fax:

Project Name: MM80 I-90
Project No: 71201.0
Collected by: JB
Location: Cle Elum WA
Report To (PM): Josh Bernthal
PM Email: josh@epi-wa.com

Special Remarks:

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX 8260	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)					Comments
1	SP-2	6/27/18	0630	AIR		✓																
2	Tgt-EFF-062718	6/27/18	0650	AIR		✓																
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:
☑ Standard
☐ 3 Day
☐ 2 Day
☐ Next Day
Same Day ______ *(specify)*

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	6/27/18 1110	x [signature]	6/27/18 1110
x		x	

COC 1.2 - 2.22.17

www.fremontanalytical.com

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80 I-90
Work Order Number: 1807332

August 01, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 2 sample(s) on 7/25/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *08/01/2018*

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90
Work Order: 1807332

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1807332-001	SP-5	07/25/2018 7:50 AM	07/25/2018 2:30 PM
1807332-002	Tot-Eff-072518	07/25/2018 8:10 AM	07/25/2018 2:30 PM

Case Narrative

WO#: **1807332**
Date: **8/1/2018**

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1807332**
Date Reported: **8/1/2018**

Client: Environmental Partners, Inc.
Collection Date: 7/25/2018 7:50:00 AM
Project: MM80 I-90
Lab ID: 1807332-001
Matrix: Air
Client Sample ID: **SP-5**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 21382		Analyst: EM
Benzene	ND	0.100		µg/L	1	7/26/2018 2:29:51 PM
Toluene	ND	0.100		µg/L	1	7/26/2018 2:29:51 PM
Ethylbenzene	ND	0.100		µg/L	1	7/26/2018 2:29:51 PM
m,p-Xylene	ND	0.100		µg/L	1	7/26/2018 2:29:51 PM
o-Xylene	ND	0.100		µg/L	1	7/26/2018 2:29:51 PM
Surr: Dibromofluoromethane	99.7	56.4 - 141		%Rec	1	7/26/2018 2:29:51 PM
Surr: Toluene-d8	101	66 - 138		%Rec	1	7/26/2018 2:29:51 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	106	64.7 - 128		%Rec	1	7/26/2018 2:29:51 PM
Gasoline by NWTPH-Gx				Batch ID: 21382		Analyst: EM
Gasoline	9.17	5.00		µg/L	1	7/26/2018 2:29:51 PM
Surr: 4-Bromofluorobenzene	105	65 - 135		%Rec	1	7/26/2018 2:29:51 PM
Surr: Toluene-d8	97.6	65 - 135		%Rec	1	7/26/2018 2:29:51 PM

Analytical Report

Work Order: **1807332**
Date Reported: **8/1/2018**

Client: Environmental Partners, Inc.
Collection Date: 7/25/2018 8:10:00 AM
Project: MM80 I-90
Lab ID: 1807332-002
Matrix: Air
Client Sample ID: **Tot-Eff-072518**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 21382		Analyst: EM
Benzene	ND	0.100		µg/L	1	7/26/2018 1:59:09 PM
Toluene	ND	0.100		µg/L	1	7/26/2018 1:59:09 PM
Ethylbenzene	ND	0.100		µg/L	1	7/26/2018 1:59:09 PM
m,p-Xylene	0.113	0.100		µg/L	1	7/26/2018 1:59:09 PM
o-Xylene	ND	0.100		µg/L	1	7/26/2018 1:59:09 PM
Surr: Dibromofluoromethane	98.1	56.4 - 141		%Rec	1	7/26/2018 1:59:09 PM
Surr: Toluene-d8	101	66 - 138		%Rec	1	7/26/2018 1:59:09 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	103	64.7 - 128		%Rec	1	7/26/2018 1:59:09 PM
Gasoline by NWTPH-Gx				Batch ID: 21382		Analyst: EM
Gasoline	8.32	5.00		µg/L	1	7/26/2018 1:59:09 PM
Surr: 4-Bromofluorobenzene	103	65 - 135		%Rec	1	7/26/2018 1:59:09 PM
Surr: Toluene-d8	96.5	65 - 135		%Rec	1	7/26/2018 1:59:09 PM

Work Order: 1807332
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **1807296-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45009**
Client ID: **BATCH** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870617**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						5.762	32.9	30	
Surr: 4-Bromofluorobenzene	2.55		2.500		102	65	135		0		
Surr: Toluene-d8	2.46		2.500		98.2	65	135		0		

Sample ID **MB-21382** SampType: **MBLK** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45009**
Client ID: **MBLKW** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870623**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.55		2.500		102	65	135				
Surr: Toluene-d8	2.46		2.500		98.3	65	135				

Sample ID **LCS-21382** SampType: **LCS** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45009**
Client ID: **LCSW** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870622**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	59.7	5.00	50.00	0	119	65	135				
Surr: 4-Bromofluorobenzene	2.54		2.500		102	65	135				
Surr: Toluene-d8	2.44		2.500		97.8	65	135				

Work Order: 1807332
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1807296-002AREP** SampType: **REP** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45008**
Client ID: **BATCH** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870599**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	ND	0.100						0.1028	6.28	30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.49		2.500		99.7	61.1	128		0		
Surr: Toluene-d8	2.51		2.500		100	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.56		2.500		102	64.7	128		0		

Sample ID **MB-21382** SampType: **MBLK** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45008**
Client ID: **MBLKW** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870613**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.44		2.500		97.8	56.4	141				
Surr: Toluene-d8	2.54		2.500		102	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.56		2.500		103	64.7	128				

Sample ID **LCS-21382** SampType: **LCS** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45008**
Client ID: **LCSW** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870612**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.32	0.100	2.000	0	116	67.1	132				
Toluene	2.29	0.100	2.000	0	114	73.6	127				
Ethylbenzene	2.15	0.100	2.000	0	107	78	127				
m,p-Xylene	4.34	0.100	4.000	0	108	77.5	130				

Work Order: 1807332
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-21382** SampType: **LCS** Units: **µg/L** Prep Date: **7/25/2018** RunNo: **45008**
Client ID: **LCSW** Batch ID: **21382** Analysis Date: **7/26/2018** SeqNo: **870612**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	2.14	0.100	2.000	0	107	77.6	126				
Surr: Dibromofluoromethane	2.42		2.500		96.7	56.4	141				
Surr: Toluene-d8	2.59		2.500		104	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.60		2.500		104	64.7	128				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1807332**
Logged by:	**Clare Griggs**	Date Received:	**7/25/2018 2:30:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 7/25/18 | Page: 1 of: 1

Laboratory Project No (internal): 1807332

Project Name: MMA 80 I-90

Special Remarks:

Client: Environmental Partners, Inc

Project No: 71210.0

Address: 1180 NW Maple St. Ste 310

Collected by: JB

City, State, Zip: Issaquah, WA 98027

Location: Cle Elum, WA

Telephone: 425-241-5400

Report To (PM): Josh Bernhard

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epi-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	SP-5	7/25/18	0750	AIR		X												
2	Tot-Eff-072518	7/25/18	0810	AIR		X												
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x	7/25/18 1430	x	7/25/18 1430
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80 I-90
Work Order Number: 1809028

September 12, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 9/5/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *09/12/2018*

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90
Work Order: 1809028

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1809028-001	Tot-Eff-090518	09/05/2018 9:00 AM	09/05/2018 1:50 PM

Case Narrative

WO#: **1809028**
Date: **9/12/2018**

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1809028**
Date Reported: **9/12/2018**

Client: Environmental Partners, Inc.
Collection Date: 9/5/2018 9:00:00 AM
Project: MM80 I-90
Lab ID: 1809028-001
Matrix: Air
Client Sample ID: **Tot-Eff-090518**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 21849		Analyst: KT
Benzene	ND	0.100		µg/L	1	9/6/2018 4:26:53 PM
Toluene	ND	0.100		µg/L	1	9/6/2018 4:26:53 PM
Ethylbenzene	ND	0.100		µg/L	1	9/6/2018 4:26:53 PM
m,p-Xylene	0.219	0.100		µg/L	1	9/6/2018 4:26:53 PM
o-Xylene	ND	0.100		µg/L	1	9/6/2018 4:26:53 PM
Surr: Dibromofluoromethane	116	56.4 - 141		%Rec	1	9/6/2018 4:26:53 PM
Surr: Toluene-d8	79.2	66 - 138		%Rec	1	9/6/2018 4:26:53 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	103	64.7 - 128		%Rec	1	9/6/2018 4:26:53 PM
Gasoline by NWTPH-Gx				Batch ID: 21849		Analyst: KT
Gasoline	10.0	5.00		µg/L	1	9/6/2018 4:26:53 PM
Surr: 4-Bromofluorobenzene	97.2	65 - 135		%Rec	1	9/6/2018 4:26:53 PM
Surr: Toluene-d8	103	65 - 135		%Rec	1	9/6/2018 4:26:53 PM

Work Order: 1809028
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-21849** SampType: **LCS** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **46113**
Client ID: **LCSW** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **893652**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	61.8	5.00	50.00	0	124	65	135				
Surr: 4-Bromofluorobenzene	2.51		2.500		100	65	135				
Surr: Toluene-d8	2.64		2.500		106	65	135				

Sample ID **MB-21849** SampType: **MBLK** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **46113**
Client ID: **MBLKW** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **893653**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.39		2.500		95.4	65	135				
Surr: Toluene-d8	2.63		2.500		105	65	135				

Sample ID **1809028-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **46113**
Client ID: **Tot-Eff-090518** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **893649**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	6.82	5.00						10.00	37.9	30	
Surr: 4-Bromofluorobenzene	2.45		2.500		97.9	65	135		0		
Surr: Toluene-d8	2.55		2.500		102	65	135		0		

Work Order: 1809028
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-21849** SampType: **LCS** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **45980**
Client ID: **LCSW** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **890559**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	1.91	0.100	2.000	0	95.7	67.1	132				
Toluene	1.85	0.100	2.000	0	92.4	73.6	127				
Ethylbenzene	1.99	0.100	2.000	0	99.7	78	127				
m,p-Xylene	4.09	0.100	4.000	0	102	77.5	130				
o-Xylene	2.03	0.100	2.000	0	102	77.6	126				
Surr: Dibromofluoromethane	3.08		2.500		123	56.4	141				
Surr: Toluene-d8	2.39		2.500		95.4	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.69		2.500		108	64.7	128				

Sample ID **MB-21849** SampType: **MBLK** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **45980**
Client ID: **MBLKW** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **890562**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.89		2.500		116	56.4	141				
Surr: Toluene-d8	2.04		2.500		81.5	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.58		2.500		103	64.7	128				

Sample ID **1809028-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **45980**
Client ID: **Tot-Eff-090518** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **890556**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	0.189	0.100						0.2193	14.6	30	

Work Order: 1809028
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1809028-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **9/6/2018** RunNo: **45980**
Client ID: **Tot-Eff-090518** Batch ID: **21849** Analysis Date: **9/6/2018** SeqNo: **890556**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.48		2.500		99.4	61.1	128		0		
Surr: Toluene-d8	2.43		2.500		97.1	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.58		2.500		103	64.7	128		0		

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1809028**
Logged by:	**Brianna Barnes**	Date Received:	**9/5/2018 1:50:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air Samples.		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: _____ Date _____

By Whom: _____ Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding: _____

Client Instructions: _____

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 9/5/18 Page: 1 of: 1

Laboratory Project No (internal): 19090280

Project Name: MM 80 I-90

Special Remarks:

Client: ENVIRONMENTAL PARTNERS, INC

Project No: 71201.0

Address: 1180 NW Maple St Ste 310

Collected by: JB

City, State, Zip: ISSAQUAH, WA 98027

Location: Cle Elum, WA

Telephone: 425-241-5400

Report To (PM): Josh Berthel

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epi-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX $260	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8) Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-090518	9/5/18	0900	AIR		X											
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x	9/5/18 1350	x	9/5/18 1350
Relinquished	Date/Time	Received	Date/Time
x		x	

Turn-around Time:

- ☑ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: MM80 I-90
Work Order Number: 1810247

October 18, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 10/11/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *10/18/2018*

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90
Work Order: 1810247

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1810247-001	Tot-Eff-101118	10/11/2018 8:30 AM	10/11/2018 11:45 AM

Case Narrative

WO#: **1810247**
Date: **10/18/2018**

CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1810247**
Date Reported: **10/18/2018**

Client: Environmental Partners, Inc.
Collection Date: 10/11/2018 8:30:00 AM
Project: MM80 I-90
Lab ID: 1810247-001
Matrix: Air
Client Sample ID: **Tot-Eff-101118**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 22287		Analyst: TN
Benzene	ND	0.100		µg/L	1	10/12/2018 4:52:00 PM
Toluene	ND	0.100		µg/L	1	10/12/2018 4:52:00 PM
Ethylbenzene	ND	0.100		µg/L	1	10/12/2018 4:52:00 PM
m,p-Xylene	0.286	0.100		µg/L	1	10/12/2018 4:52:00 PM
o-Xylene	ND	0.100		µg/L	1	10/12/2018 4:52:00 PM
Surr: Dibromofluoromethane	99.2	56.4 - 141		%Rec	1	10/12/2018 4:52:00 PM
Surr: Toluene-d8	103	66 - 138		%Rec	1	10/12/2018 4:52:00 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	90.8	64.7 - 128		%Rec	1	10/12/2018 4:52:00 PM
Gasoline by NWTPH-Gx				Batch ID: 22287		Analyst: TN
Gasoline	ND	5.00		µg/L	1	10/12/2018 4:52:00 PM
Surr: 4-Bromofluorobenzene	106	65 - 135		%Rec	1	10/12/2018 4:52:00 PM
Surr: Toluene-d8	87.1	65 - 135		%Rec	1	10/12/2018 4:52:00 PM

Work Order: 1810247
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1810247-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46964**
Client ID: **Tot-Eff-101118** Batch ID: **22287** Analysis Date: **10/12/2018** SeqNo: **913393**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	ND	0.100						0		30	
m,p-Xylene	0.225	0.100						0.2860	23.9	30	
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.72		2.500		109	61.1	128		0		
Surr: Toluene-d8	2.48		2.500		99.4	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.28		2.500		91.4	64.7	128		0		

Sample ID **LCS-22287** SampType: **LCS** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46964**
Client ID: **LCSW** Batch ID: **22287** Analysis Date: **10/12/2018** SeqNo: **913397**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.09	0.100	2.000	0	104	67.1	132				
Toluene	2.13	0.100	2.000	0	107	73.6	127				
Ethylbenzene	2.04	0.100	2.000	0	102	78	127				
m,p-Xylene	4.17	0.100	4.000	0	104	77.5	130				
o-Xylene	1.99	0.100	2.000	0	99.4	77.6	126				
Surr: Dibromofluoromethane	2.71		2.500		108	56.4	141				
Surr: Toluene-d8	2.42		2.500		96.9	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.66		2.500		107	64.7	128				

Sample ID **MB-22287** SampType: **MBLK** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46964**
Client ID: **MBLKW** Batch ID: **22287** Analysis Date: **10/13/2018** SeqNo: **913398**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									

Work Order: 1810247
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **MB-22287** SampType: **MBLK** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46964**
Client ID: **MBLKW** Batch ID: **22287** Analysis Date: **10/13/2018** SeqNo: **913398**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.58		2.500		103	56.4	141				
Surr: Toluene-d8	2.44		2.500		97.6	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	1.92		2.500		76.9	64.7	128				

Work Order: 1810247
CLIENT: Environmental Partners, Inc.
Project: MM80 I-90

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **1810247-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46965**
Client ID: **Tot-Eff-101118** Batch ID: **22287** Analysis Date: **10/12/2018** SeqNo: **913402**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00						0		30	
Surr: 4-Bromofluorobenzene	2.46		2.500		98.2	65	135		0		
Surr: Toluene-d8	2.33		2.500		93.3	65	135		0		

Sample ID **LCS-22287** SampType: **LCS** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46965**
Client ID: **LCSW** Batch ID: **22287** Analysis Date: **10/12/2018** SeqNo: **913406**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	44.8	5.00	50.00	0	89.7	65	135				
Surr: 4-Bromofluorobenzene	2.56		2.500		103	65	135				
Surr: Toluene-d8	2.42		2.500		97.0	65	135				

Sample ID **MB-22287** SampType: **MBLK** Units: **µg/L** Prep Date: **10/12/2018** RunNo: **46965**
Client ID: **MBLKW** Batch ID: **22287** Analysis Date: **10/13/2018** SeqNo: **913407**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.41		2.500		96.3	65	135				
Surr: Toluene-d8	2.38		2.500		95.3	65	135				

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1810247**
Logged by:	**Brianna Barnes**	Date Received:	**10/11/2018 11:45:00 AM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air sample.		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Fremont Analytical

3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Chain of Custody Record & Laboratory Services Agreement

Date: 10/11/18 Page: 1 of: 1

Laboratory Project No (internal): 1810247

Special Remarks:

Client: EPI

Address: 1180 NW Maple St Ste 310

City, State, Zip: ISSAQUAH, WA 98027

Telephone: 425-241-5400

Fax:

Project Name: 71201.0

Project No: MM 80 I-90

Collected by: BB

Location: Cle Elum, WA

Report To (PM): Josh Bertholf

PM Email: josh@epi-wa.com

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX 8260	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) / Dissolved (D)	Anions (IC)***	EDB (8011)					Comments
1	Tot-Eff-101118	10/11/18	0830	Air		x																
2	/																					
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Turn-around Time:
☑ Standard
☐ 3 Day
☐ 2 Day
☐ Next Day
Same Day ______ *(specify)*

Relinquished	Date/Time	Received	Date/Time
x [signature]	10/11/18 1145	x [signature]	10/11/18 1145
x		x	

COC 1.2 - 2.22.17

www.fremontanalytical.com

3600 Fremont Ave. N.
Seattle, WA 98103
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Environmental Partners, Inc.
Josh Bernthal
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

RE: 71201.0
Work Order Number: 1811233

November 26, 2018

Attention Josh Bernthal:

Fremont Analytical, Inc. received 1 sample(s) on 11/15/2018 for the analyses presented in the following report.

Gasoline by NWTPH-Gx
Volatile Organic Compounds by EPA Method 8260C

This report consists of the following:

- Case Narrative
- Analytical Results
- Applicable Quality Control Summary Reports
- Chain of Custody

All analyses were performed consistent with the Quality Assurance program of Fremont Analytical, Inc. Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical.

Sincerely,

Mike Ridgeway
Laboratory Director

Date: *11/26/2018*

CLIENT: Environmental Partners, Inc.
Project: 71201.0
Work Order: 1811233

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Date/Time Collected	Date/Time Received
1811233-001	Tot-Eff-111518	11/15/2018 11:00 AM	11/15/2018 1:45 PM

Case Narrative

WO#: **1811233**
Date: **11/26/2018**

CLIENT: Environmental Partners, Inc.
Project: 71201.0

WorkOrder Narrative:
I. SAMPLE RECEIPT:
Samples receipt information is recorded on the attached Sample Receipt Checklist.

II. GENERAL REPORTING COMMENTS:
Results are reported on a wet weight basis unless dry-weight correction is denoted in the units field on the analytical report ("mg/kg-dry" or "ug/kg-dry").

The validity of the analytical procedures for which data is reported in this analytical report is determined by the Laboratory Control Sample (LCS) and the Method Blank (MB). The LCS and the MB are processed with the samples to ensure method criteria are achieved throughout the entire analytical process.

III. ANALYSES AND EXCEPTIONS:
Exceptions associated with this report will be footnoted in the analytical results page(s) or the quality control summary page(s) and/or noted below.

Qualifiers:

* - Flagged value is not within established control limits
B - Analyte detected in the associated Method Blank
D - Dilution was required
E - Value above quantitation range
H - Holding times for preparation or analysis exceeded
I - Analyte with an internal standard that does not meet established acceptance criteria
J - Analyte detected below Reporting Limit
N - Tentatively Identified Compound (TIC)
Q - Analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20% Drift or minimum RRF)
S - Spike recovery outside accepted recovery limits
ND - Not detected at the Reporting Limit
R - High relative percent difference observed

Acronyms:

%Rec - Percent Recovery
CCB - Continued Calibration Blank
CCV - Continued Calibration Verification
DF - Dilution Factor
HEM - Hexane Extractable Material
ICV - Initial Calibration Verification
LCS/LCSD - Laboratory Control Sample / Laboratory Control Sample Duplicate
MB or MBLANK - Method Blank
MDL - Method Detection Limit
MS/MSD - Matrix Spike / Matrix Spike Duplicate
PDS - Post Digestion Spike
Ref Val - Reference Value
RL - Reporting Limit
RPD - Relative Percent Difference
SD - Serial Dilution
SGT - Silica Gel Treatment
SPK - Spike
Surr - Surrogate

Analytical Report

Work Order: **1811233**
Date Reported: **11/26/2018**

Client: Environmental Partners, Inc.
Collection Date: 11/15/2018 11:00:00 AM
Project: 71201.0
Lab ID: 1811233-001
Matrix: Air
Client Sample ID: **Tot-Eff-111518**

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
Volatile Organic Compounds by EPA Method 8260C				Batch ID: 22652		Analyst: CR
Benzene	ND	0.100		µg/L	1	11/16/2018 12:33:45 PM
Toluene	ND	0.100		µg/L	1	11/16/2018 12:33:45 PM
Ethylbenzene	0.114	0.100		µg/L	1	11/16/2018 12:33:45 PM
m,p-Xylene	0.341	0.100		µg/L	1	11/16/2018 12:33:45 PM
o-Xylene	ND	0.100		µg/L	1	11/16/2018 12:33:45 PM
Surr: Dibromofluoromethane	102	56.4 - 141		%Rec	1	11/16/2018 12:33:45 PM
Surr: Toluene-d8	102	66 - 138		%Rec	1	11/16/2018 12:33:45 PM
Surr: 1-Bromo-4-fluorobenzene-BFB	96.2	64.7 - 128		%Rec	1	11/16/2018 12:33:45 PM
Gasoline by NWTPH-Gx				Batch ID: 22652		Analyst: CR
Gasoline	15.1	5.00		µg/L	1	11/16/2018 12:33:45 PM
Surr: 4-Bromofluorobenzene	101	65 - 135		%Rec	1	11/16/2018 12:33:45 PM
Surr: Toluene-d8	104	65 - 135		%Rec	1	11/16/2018 12:33:45 PM

Work Order: 1811233
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **LCS-22652** SampType: **LCS** Units: **µg/L** Prep Date: **11/16/2018** RunNo: **47765**
Client ID: **LCSW** Batch ID: **22652** Analysis Date: **11/15/2018** SeqNo: **931589**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	2.35	0.100	2.000	0	118	67.1	132				
Toluene	2.35	0.100	2.000	0	118	73.6	127				
Ethylbenzene	2.25	0.100	2.000	0	112	78	127				
m,p-Xylene	4.53	0.100	4.000	0	113	77.5	130				
o-Xylene	2.23	0.100	2.000	0	112	77.6	126				
Surr: Dibromofluoromethane	2.56		2.500		102	56.4	141				
Surr: Toluene-d8	2.55		2.500		102	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.52		2.500		101	64.7	128				

Sample ID **MB-22652** SampType: **MBLK** Units: **µg/L** Prep Date: **11/16/2018** RunNo: **47765**
Client ID: **MBLKW** Batch ID: **22652** Analysis Date: **11/16/2018** SeqNo: **931590**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100									
Toluene	ND	0.100									
Ethylbenzene	ND	0.100									
m,p-Xylene	ND	0.100									
o-Xylene	ND	0.100									
Surr: Dibromofluoromethane	2.57		2.500		103	56.4	141				
Surr: Toluene-d8	2.59		2.500		103	66	138				
Surr: 1-Bromo-4-fluorobenzene-BFB	2.41		2.500		96.4	64.7	128				

Sample ID **1811233-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **11/16/2018** RunNo: **47765**
Client ID: **Tot-Eff-111518** Batch ID: **22652** Analysis Date: **11/16/2018** SeqNo: **931585**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.100						0		30	
Toluene	ND	0.100						0		30	
Ethylbenzene	0.101	0.100						0.1142	12.7	30	
m,p-Xylene	0.326	0.100						0.3410	4.43	30	

Work Order: 1811233
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Volatile Organic Compounds by EPA Method 8260C

Sample ID **1811233-001AREP** SampType: **REP** Units: **µg/L** Prep Date: **11/16/2018** RunNo: **47765**
Client ID: **Tot-Eff-111518** Batch ID: **22652** Analysis Date: **11/16/2018** SeqNo: **931585**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
o-Xylene	ND	0.100						0		30	
Surr: Dibromofluoromethane	2.55		2.500		102	61.1	128		0		
Surr: Toluene-d8	2.58		2.500		103	68.2	129		0		
Surr: 1-Bromo-4-fluorobenzene-BFB	2.42		2.500		97.0	64.7	128		0		

Work Order: 1811233
CLIENT: Environmental Partners, Inc.
Project: 71201.0

QC SUMMARY REPORT

Gasoline by NWTPH-Gx

Sample ID **LCS-22652**	SampType: **LCS**	Units: **µg/L**	Prep Date: **11/16/2018**	RunNo: **47769**
Client ID: **LCSW**	Batch ID: **22652**		Analysis Date: **11/15/2018**	SeqNo: **931643**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	48.8	5.00	50.00	0	97.5	65	135				
Surr: 4-Bromofluorobenzene	2.47		2.500		98.8	65	135				
Surr: Toluene-d8	2.64		2.500		106	65	135				

Sample ID **MB-22652**	SampType: **MBLK**	Units: **µg/L**	Prep Date: **11/16/2018**	RunNo: **47769**
Client ID: **MBLKW**	Batch ID: **22652**		Analysis Date: **11/16/2018**	SeqNo: **931640**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	ND	5.00									
Surr: 4-Bromofluorobenzene	2.41		2.500		96.5	65	135				
Surr: Toluene-d8	2.70		2.500		108	65	135				

Sample ID **1811233-001AREP**	SampType: **REP**	Units: **µg/L**	Prep Date: **11/16/2018**	RunNo: **47769**
Client ID: **Tot-Eff-111518**	Batch ID: **22652**		Analysis Date: **11/16/2018**	SeqNo: **931637**

Analyte	Result	RL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Gasoline	9.90	5.00						15.06	41.4	30	R
Surr: 4-Bromofluorobenzene	2.48		2.500		99.0	65	135		0		
Surr: Toluene-d8	2.66		2.500		106	65	135		0		

NOTES:
R - High RPD observed. The method is in control as indicated by the LCS.

Sample Log-In Check List

Client Name:	**EPI**	Work Order Number:	**1811233**
Logged by:	**Brianna Barnes**	Date Received:	**11/15/2018 1:45:00 PM**

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	Client		

Log In

3.	Coolers are present?	Yes ☐	No ☑	NA ☐
		Air sample.		
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
5.	Custody Seals present on shipping container/cooler? (Refer to comments for Custody Seals not intact)	Yes ☐	No ☐	Not Required ☑
6.	Was an attempt made to cool the samples?	Yes ☐	No ☐	NA ☑
7.	Were all items received at a temperature of >0°C to 10.0°C*	Yes ☐	No ☐	NA ☑
8.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
9.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
10.	Are samples properly preserved?	Yes ☑	No ☐	
11.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
12.	Is there headspace in the VOA vials?	Yes ☐	No ☐	NA ☑
13.	Did all samples containers arrive in good condition(unbroken)?	Yes ☑	No ☐	
14.	Does paperwork match bottle labels?	Yes ☑	No ☐	
15.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
16.	Is it clear what analyses were requested?	Yes ☑	No ☐	
17.	Were all holding times able to be met?	Yes ☑	No ☐	

Special Handling (if applicable)

18.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified:		Date	
By Whom:		Via:	☐ eMail ☐ Phone ☐ Fax ☐ In Person
Regarding:			
Client Instructions:			

19. Additional remarks:

Item Information

* Note: DoD/ELAP and TNI require items to be received at 4°C +/- 2°C

Chain of Custody Record & Laboratory Services Agreement

Fremont Analytical
3600 Fremont Ave N.
Seattle, WA 98103
Tel: 206-352-3790
Fax: 206-352-7178

Date: 11/15/18 Page: 1 of: 1

Laboratory Project No (internal): 1811233

Project Name: 7120.0

Special Remarks:

Client: EPI

Project No: MM 80 I-90

Address: 1180 NW Maple St Ste 310

Collected by: JB

City, State, Zip: ISSAQUAH WA 98027

Location: c/e Elum, WA

Telephone: 425-241-5400

Report To (PM): Josh Berryhill

Sample Disposal: ☐ Return to client ☐ Disposal by lab (after 30 days)

Fax:

PM Email: joshb@epi-wa.com

	Sample Name	Sample Date	Sample Time	Sample Type (Matrix)*	VOCs (EPA 8260 / 624)	GX/BTEX	BTEX	Gasoline Range Organics (GX)	Hydrocarbon Identification (HCID)	Diesel/Heavy Oil Range Organics (DX)	SVOCs (EPA 8270 / 625)	PAHs (EPA 8270 - SIM)	PCBs (EPA 8082 / 608)	Metals** (EPA 6020 / 200.8)	Total (T) | Dissolved (D)	Anions (IC)***	EDB (8011)	Comments
1	Tot-Eff-111518	11/15/18	1100	AIR		X												
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

8260

*Matrix: A = Air, AQ = Aqueous, B = Bulk, O = Other, P = Product, S = Soil, SD = Sediment, SL = Solid, W = Water, DW = Drinking Water, GW = Ground Water, SW = Storm Water, WW = Waste Water

**Metals (Circle): MTCA-5 RCRA-8 Priority Pollutants TAL *Individual:* Ag Al As B Ba Be Ca Cd Co Cr Cu Fe Hg K Mg Mn Mo Na Ni Pb Sb Se Sr Sn Ti Tl U V Zn

***Anions (Circle): Nitrate Nitrite Chloride Sulfate Bromide O-Phosphate Fluoride Nitrate+Nitrite

Turn-around Time:

- ☒ Standard
- ☐ 3 Day
- ☐ 2 Day
- ☐ Next Day
- Same Day _____ (specify)

I represent that I am authorized to enter into this Agreement with Fremont Analytical on behalf of the Client named above and that I have verified Client's agreement to each of the terms on the front and backside of this Agreement.

Relinquished	Date/Time	Received	Date/Time
x [signature]	11/15/18 1345	x [signature] Casey O'Keefe	11/15/18 1345
x		x	

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

January 16, 2019

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: Kenan Advantage Group 71201, F&BI 901134

Dear Mr Bernthal:

Included are the results from the testing of material submitted on January 11, 2019 from the Kenan Advantage Group 71201, F&BI 901134 project. There are 5 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days, or as directed by the Chain of Custody document. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0116R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on January 11, 2019 by Friedman & Bruya, Inc. from the Environmental Partners Kenan Advantage Group 71201, F&BI 901134 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Environmental Partners
901134 -01	MW-11
901134 -02	MW-10
901134 -03	MW-9
901134 -04	MW-8
901134 -05	MW-12
901134 -06	MW-7
901134 -07	MW-2
901134 -08	MW-5
901134 -09	MW-1
901134 -10	MW-3
901134 -11	MW-4
901134 -12	MW-6
901134 -13	MW-13
901134 -14	MW-14

All quality control requirements were acceptable.

Date of Report: 01/16/19
Date Received: 01/11/19
Project: Kenan Advantage Group 71201, F&BI 901134
Date Extracted: 01/14/19
Date Analyzed: 01/14/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-11 901134-01	<1	<1	<1	<3	<100	95
MW-10 901134-02	<1	<1	<1	<3	<100	91
MW-9 901134-03	<1	<1	<1	<3	<100	90
MW-8 901134-04	<1	<1	<1	<3	<100	89
MW-12 901134-05	<1	<1	<1	<3	<100	89
MW-7 901134-06	<1	<1	<1	<3	<100	89
MW-2 901134-07	<1	<1	<1	<3	<100	89
MW-5 901134-08	<1	<1	<1	<3	<100	88
MW-1 901134-09	<1	<1	<1	<3	<100	88
MW-3 901134-10	<1	<1	<1	<3	<100	88
MW-4 901134-11	<1	<1	<1	<3	<100	88

Date of Report: 01/16/19
Date Received: 01/11/19
Project: Kenan Advantage Group 71201, F&BI 901134
Date Extracted: 01/14/19
Date Analyzed: 01/14/19

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-6 901134-12	<1	<1	<1	<3	<100	88
MW-13 901134-13	<1	<1	<1	<3	<100	87
MW-14 901134-14	<1	<1	<1	<3	<100	87
Method Blank 09-083 MB	<1	<1	<1	<3	<100	109

Date of Report: 01/16/19
Date Received: 01/11/19
Project: Kenan Advantage Group 71201, F&BI 901134

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 901134-01 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	113	65-118
Toluene	ug/L (ppb)	50	95	72-122
Ethylbenzene	ug/L (ppb)	50	93	73-126
Xylenes	ug/L (ppb)	150	93	74-118
Gasoline	ug/L (ppb)	1,000	96	69-134

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The analyte is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits due to sample matrix effects.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

901134

SAMPLE CHAIN OF CUSTODY ME 01-11-19

VW4

Page # 1 of 2

Report To Josh Bernthal

Company Environmental Partners Inc.

Address 11820 NW Maple St. Suite 310

City, State, ZIP Issaquah, WA 98027

Phone 425-385-0010 Email Josh b@epi-wa.com

SAMPLERS (signature) Romsey Mauldin

PROJECT NAME: Kenan Advantage Group

PO #: 71201

REMARKS

INVOICE TO

TURNAROUND TIME
- ☑ Standard Turnaround
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Archive Samples
- ☐ Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
						ANALYSES REQUESTED											
MW-11	01A-C	1/9/19	0950	WATER	3			X	X								
MW-10	02		1032		3			X	X								
MW-9	03		1125		3			X	X								
MW-8	04		1153		3			X	X								
MW-12	05		1225		3			X	X								
MW-7	06		1458		3			X	X								
MW-2	07		1530		3			X	X								
MW-5	08	1-10-19	09:45	water	3			X	X								
MW-1	09		10:20		3			X	X								
MW-3	10		10:56		3			X	X								

Cooler received at 4 °C

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Romsey Mauldin	Romsey Mauldin	EPI	1-11-19	15:20
Received by: Nhan Phan	Nhan Phan	FEBI	1/11/19	1520
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

901134

SAMPLE CHAIN OF CUSTODY

ME 01-11-19 VWA

Page # 1 of 2

Report To Josh Bernthal

Company Environmental Partners Inc.

Address 1180 NW Maple St. Suite 310

City, State, ZIP Issaquah, WA 98027

Phone 425-395-0010 Email JoshB@epiwa.com

SAMPLERS (signature) Ramsey Mauldin

PROJECT NAME: Kenan Advantage Group

PO # 71201

REMARKS

INVOICE TO

TURNAROUND TIME
- ☑ Standard Turnaround
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Archive Samples
- ☐ Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM					Notes
MW-4	11 A-C	1-10-19	11:30	water	3			X	X								
MW-6	12	"	14:30	"	3			X	X								
MW-13	13	"	14:59	"	3			X	X								
MW-14	14	"	15:25	"	3			X	X								

ANALYSES REQUESTED

Notes: Water received at 4 °C

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: Ramsey Mauldin	Ramsey Mauldin	EPI	1-11-19	15:20
Received by: Nhan Phan	Nhan Phan	FEBT	1-11-19	1520
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

Libby Environmental, Inc.

4139 Libby Road NE • Olympia, WA 98506-2518

March 26, 2019

Josh Bernthal
Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

Dear Mr. Bernthal:

Please find enclosed the analytical data report for the Kenan Advantage Group Project located in Cle Elum, Washington.

The results of the analyses are summarized in the attached tables. Applicable detection limits and QA/QC data are included. The sample(s) will be disposed of in 30 days unless we are contacted to arrange long term storage.

Libby Environmental, Inc. appreciates the opportunity to have provided analytical services for this project. If you have any further questions about the data report, please give me a call. It was a pleasure working with you on this project, and we are looking forward to the next opportunity to work together.

Sincerely,

Sherry L. Chilcutt
Senior Chemist
Libby Environmental, Inc.

Phone (360) 352-2110 • Fax (360) 352-4154 • libbyenv@gmail.com

Libby Environmental, Inc.

Chain of Custody Record

www.LibbyEnvironmental.com

4139 Libby Road NE
Olympia, WA 98506
Ph: 360-352-2110
Fax: 360-352-4154

Date: 3/11/19 Page: 1 of 1

Client: EPI

Project Manager: Josh Bernthal

Address: 1180 NW Maple St Ste 310

Project Name: Kenan Advantage Group

City: Issaquah State: Wa Zip: 98027

Location: Cle Elum, WA I-90 City, State: Cle Elum, Wa

Phone: 425-395-0010 Fax:

Collector: C. McFadden / W. Weisberg Date of Collection: 3/11/19

Client Project # 71201

Email: Joshb@epi-wa.com

	Sample Number	Depth	Time	Sample Type	Container Type	VOC 8260	NWTPH-Gx	BTEX 8021	NWTPH-HCID	NWTPH-Dx	NWTPH-Dx/Dx	c PAH 8270	PAH 8270	Semi Vol 8270	PCB 8082	MTCA 5 Metals	RCRA 8 Metals			Field Notes
1	CDP-1:3	3	1012	Soil	2 VOA 1 4oz															
2	CDP-1:6	6	1030				X	X												
3	CDP-1:4	4	1018																	
4	CDP-1:8	8	1033																	
5	CDP-1:12	12	1045																	
6	CDP-2:4	4	1055				(X)	(X)												"Requested 3/12/19" WRW
7	CDP-2:8	8	1127				X	X												
8	CDP-2:12	12	1135																	
9	CDP-3:4	4	1230				(X)	(X)												" " WRW
10	CDP-3:8	8	1235				X	X												
11	CDP-3:12	12	1245																	
12	CDP-4:4	4	1315				(X)	(X)												" " WRW
13	CDP-4:8	8	1320				X	X												
14	CDP-4:12	12	1355	↓	↓															
15																				
16																				
17																				

Relinquished by:	Date / Time	Received by:	Date / Time
[signature]	3/11/19 1400	[signature]	3/11/19 1400
Relinquished by:	Date / Time	Received by:	Date / Time
Relinquished by:	Date / Time	Received by:	Date / Time

Sample Receipt

Good Condition? (Y) N

Temp. °C

Seals Intact? (Y) N N/A

Total Number of Containers

Remarks:

ML

TAT: 24HR 48HR 5-DAY

Distribution: White - Lab, Yellow - File, Pink - Originator

Libby Environmental, Inc.

4139 Libby Road NE
Olympia, WA 98506
Phone: (360) 352-2110
FAX: (360) 352-4154
Email: libbyenv@gmail.com

KENAN ADVANTAGE GROUP PROJECT
Environmental Partners, Inc.
Cle Elum, Washington
Libby Project # L190311-40
Client Project # 71201

Analyses of Gasoline (NWTPH-Gx) & BTEX (EPA Method 8260C) in Soil

Sample Number	Date Analyzed	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Gasoline (mg/kg)	Surrogate Recovery (%)
Method Blank	3/11/19	nd	nd	nd	nd	nd	101
LCS	3/11/19	124%	110%				119
Method Blank	3/12/19	nd	nd	nd	nd	nd	112
LCS	3/12/19	125%	116%				110
CDP-1:6	3/11/19	nd	nd	nd	0.99	22	108
CDP-1:6 Dup	3/11/19	nd	nd	nd	1.1	24	109
CDP-2:4	3/12/19	nd	nd	0.12	0.62	nd	120
CDP-2:8	3/11/19	nd	nd	nd	nd	nd	94
CDP-3:4	3/12/19	nd	nd	nd	nd	nd	109
CDP-3:8	3/11/19	nd	nd	nd	nd	nd	94
CDP-4:4	3/12/19	nd	nd	nd	nd	nd	132
CDP-4:4 Dup	3/12/19	nd	nd	nd	nd	nd	121
CDP-4:8	3/11/19	nd	nd	nd	nd	nd	96
CDP-4:8 MS	3/11/19	111%	123%				92
CDP-4:8 MSD	3/11/19	116%	127%				90
CDP-4:4 MS	3/12/19	127%	122%				98
CDP-4:4 MSD	3/12/19	127%	123%				109
Practical Quantitation Limit		0.02	0.10	0.05	0.15	10	

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (Toluene-d8): 65% TO 135%

ANALYSES PERFORMED BY: Kodey Eley

Libby Environmental, Inc.

4139 Libby Road NE • Olympia, WA 98506-2518

March 26, 2019

Josh Bernthal
Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, WA 98027

Dear Mr. Bernthal:

Please find enclosed the analytical data report for the Kenan Advantage Group Project located in Cle Elum, Washington.

The results of the analyses are summarized in the attached tables. Applicable detection limits and QA/QC data are included. The sample(s) will be disposed of in 30 days unless we are contacted to arrange long term storage.

Libby Environmental, Inc. appreciates the opportunity to have provided analytical services for this project. If you have any further questions about the data report, please give me a call. It was a pleasure working with you on this project, and we are looking forward to the next opportunity to work together.

Sincerely,

Sherry L. Chilcutt
Senior Chemist
Libby Environmental, Inc.

Phone (360) 352-2110 • Fax (360) 352-4154 • libbyenv@gmail.com

Libby Environmental, Inc.

Chain of Custody Record

www.LibbyEnvironmental.com

4139 Libby Road NE
Olympia, WA 98506
Ph: 360-352-2110
Fax: 360-352-4154

Date: 3/12/19 Page: 1 of 1

Client: EPI

Project Manager: Josh Bernthal

Address: 1180 NW Maple St Ste

Project Name: Kenan Advantage Group

City: Issaquah State: Wa Zip: 98027

Location: City, State: ~~Eth~~ Chehalis, Wa

Phone: 425-395-0010 Fax:

Collector: C. McFadden / W. Weisberg Date of Collection: 3/12/19

Client Project # 71201

Email: Josh@epi-wa.com

	Sample Number	Depth	Time	Sample Type	Container Type	VOC 8260	NWTPH-Gx	BTEX 8021	NWTPH-HCID	NWTPH-Dx	NWTPH-Dx/Dx	c PAH 8270	PAH 8270	Semi Vol 8270	PCB 8082	MTCA 5 Metals	RCRA 8 Metals			Field Notes
1	CDP-5:1.5	1.5	1246	Soil	2 VOA 1 4oz		X	X												
2	CDP-5:4	4	1252	↓	↓		X	X												
3	CDP-5:8	8	1300				X	X												
4	CDP-5:12	12	1308				X													
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				
13																				
14																				
15																				
16																				
17																				

Relinquished by:	Date / Time	Received by:	Date / Time
[signature]	3/12/19 1322	[signature]	3/12/19 1322
Relinquished by:	Date / Time	Received by:	Date / Time
Relinquished by:	Date / Time	Received by:	Date / Time

Sample Receipt

Good Condition?	Y	N	
Temp.		°C	
Seals Intact?	Y	N	N/A
Total Number of Containers			

Remarks:

ML

TAT: 24HR 48HR 5-DAY

Distribution: White - Lab, Yellow - File, Pink - Originator

Libby Environmental, Inc.

4139 Libby Road NE
Olympia, WA 98506
Phone: (360) 352-2110
FAX: (360) 352-4154
Email: libbyenv@gmail.com

KENAN ADVANTAGE GROUP PROJECT
Environmental Partners, Inc.
Cle Elum, Washington
Libby Project # L190312-40
Client Project # 71201

Analyses of Gasoline (NWTPH-Gx) & BTEX (EPA Method 8260C) in Soil

Sample Number	Date Analyzed	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)	Gasoline (mg/kg)	Surrogate Recovery (%)
Method Blank	3/12/19	nd	nd	nd	nd	nd	112
LCS	3/12/19	125%	116%				110
CDP-5:1.5	3/12/19	nd	nd	nd	nd	nd	94
CDP-5:4	3/12/19	nd	nd	nd	nd	nd	96
CDP-5:8	3/12/19	nd	nd	nd	nd	nd	121
L190311-40 MS	3/12/19	127%	122%				98
L190311-40 MSD	3/12/19	127%	123%				109
Practical Quantitation Limit		0.02	0.10	0.05	0.15	10	

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determination.

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE (Toluene-d8): 65% TO 135%

ANALYSES PERFORMED BY: Kodey Eley

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

September 27, 2016

Josh Bernthal, Project Manager
Environmental Partners, Inc.
1180 NW Maple St, Suite 310
Issaquah, WA 98027

RE: 71201, F&BI 609373

Dear Mr Bernthal:

Included are the results from the testing of material submitted on September 20, 2016 from the 71201, F&BI 609373 project. There are 5 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Cynthia Moon
EPI0927R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on September 20, 2016 by Friedman & Bruya, Inc. from the Environmental Partners 71201, F&BI 609373 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Environmental Partners
609373 -01	MW-6
609373 -02	MW-13
609373 -03	MW-14
609373 -04	MW-4
609373 -05	MW-3
609373 -06	MW-12
609373 -07	MW-8
609373 -08	MW-9
609373 -09	MW-10
609373 -10	MW-11
609373 -11	MW-1
609373 -12	MW-5
609373 -13	MW-2
609373 -14	MW-7
609373 -15	Dup-1

All quality control requirements were acceptable.

Date of Report: 09/27/16
Date Received: 09/20/16
Project: 71201, F&BI 609373
Date Extracted: 09/22/16
Date Analyzed: 09/22/16

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-6 609373-01	<1	<1	<1	<3	<100	92
MW-13 609373-02	<1	<1	<1	<3	<100	93
MW-14 609373-03	<1	<1	<1	<3	<100	92
MW-4 609373-04	<1	<1	<1	<3	<100	93
MW-3 609373-05	<1	<1	<1	<3	<100	93
MW-12 609373-06	<1	<1	<1	<3	<100	93
MW-8 609373-07	<1	<1	<1	<3	<100	95
MW-9 609373-08	<1	<1	<1	<3	<100	93
MW-10 609373-09	<1	<1	<1	<3	<100	91
MW-11 609373-10	<1	<1	<1	<3	<100	95

Date of Report: 09/27/16
Date Received: 09/20/16
Project: 71201, F&BI 609373
Date Extracted: 09/22/16
Date Analyzed: 09/22/16

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING METHODS 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 52-124)
MW-1 609373-11	<1	<1	<1	<3	<100	92
MW-5 609373-12	<1	<1	<1	<3	<100	93
MW-2 609373-13	<1	<1	<1	<3	<100	91
MW-7 609373-14	<1	<1	<1	<3	<100	93
Dup-1 609373-15	<1	<1	<1	<3	<100	95
Method Blank 06-1953 MB	<1	<1	<1	<3	<100	92

Date of Report: 09/27/16
Date Received: 09/20/16
Project: 71201, F&BI 609373

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 609372-03 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	RPD (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	98	65-118
Toluene	ug/L (ppb)	50	97	72-122
Ethylbenzene	ug/L (ppb)	50	92	73-126
Xylenes	ug/L (ppb)	150	93	74-118
Gasoline	ug/L (ppb)	1,000	98	69-134

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

609372

SAMPLE CHAIN OF CUSTODY

ME 09/20/16

V4

Report To Josh Bernthal

Company EPI

Address 1180 NW Maple St.

City, State, ZIP Issaquah, WA 98027

Phone 425-395-0010 Email

SAMPLERS (*signature*)

PROJECT NAME: 71201 "Cle Elum"

PO #

REMARKS

INVOICE TO

TURNAROUND TIME
- ☑ Standard Turnaround
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Archive Samples
- ☐ Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM	GX	BTEX			Notes
MW-6	01 A-C	9/18/16	1004	Water	3								✓	✓			
MW-13	02	↓	1054	↓	↓												
MW-14	03		1117														
MW-4	04		1146														
MW-3	05		1212														
MW-12	06		1345														
MW-8	07	↓	1420	↓	↓												
MW-9	08	9/19/16	0838	Water	3												
MW-10	09	↓	0941	↓	↓												Samples received at 3 °C
MW-11	10	↓	1012	↓	↓								↓	↓			

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Joe Sherrod	EPI	9/20/16	1500
Received by:	Michael Erdahl	FedEx	↓	↓
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

609373

SAMPLE CHAIN OF CUSTODY

MF 09/20/16

V4

Page # 2 of 2

Report To Josh Bernthal

Company EPI

Address 1180 NW Maple St.

City, State, ZIP Issaquah, WA 98027

Phone 425-395-0060 Email

SAMPLERS (*signature*)

PROJECT NAME 7120

PO #

REMARKS

INVOICE TO

TURNAROUND TIME
- ☑ Standard Turnaround
- ☐ RUSH
- Rush charges authorized by:

SAMPLE DISPOSAL
- ☐ Dispose after 30 days
- ☐ Archive Samples
- ☐ Other

Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of Jars	TPH-HCID	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by 8260C	SVOCs by 8270D	PAHs 8270D SIM	GX	BTEX			Notes
MW-1	11A-C	9/19/16	1049	Water	3								X	X			
MW-5	12	↓	1116	↓	↓								↓	↓			
MW-2	13		1301														
MW-7	14		1330														
DUP-1	15	↓		↓	↓								↓	↓			

ANALYSES REQUESTED

Samples received at 3 °C

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	Joe Sherrod	EPI	9/20/16	1500
Received by:	Michael Erdahl	FGBr	↓	↓
Relinquished by:				
Received by:				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282

Attachment F
DPT Investigation Boring Logs

ENVIRONMENTAL PARTNERS INC

BORING ID: CDP-1

SITE ADDRESS: **I-90 Near Milemarker 80 Cle Elum, WA**	CLIENT: **Kenan Advantage Group**
DRILLING CONTRACTOR: **Cascade Drilling Inc.**	PROJECT #: **71201**
DRILLING EQUIPMENT: **7822 DT**	DATE: **3/11/2019**
DRILLING METHOD: **Direct Push Technology**	GROUND SURFACE ELEV. FT AMSL: **NM** / DECOMMISSIONING MATERIAL: **Hydrated bentonite chips**
LOGGED BY: **W. Weisberg**	TOTAL DEPTH: **15' bgs** / BOREHOLE SIZE: **2.25"**

Depth (feet)	USCS	Description (USCS name; Color; Moisture; Density; Plasticity; Dilatency; EPI description; Other)	Interval & % Recovery	PID (ppm)	Sample	Sheen	Notes
0		0-1' Concrete					
1	SP	POORLY-GRADED SAND WITH GRAVEL; grayish brown; dry; low density; mostly sand with few gravel; trace silt; slight odor from 1-6'		23.7			
2							
3			50	55.6	CDP-1:3	None	Odor
4		Moist		6.9	CDP-1:4		No Odor
5				8.9			
6		Dry		86.9	CDP-1:6		Odor
7			70	3.2		None	
8		Moist		8.3	CDP-1:8		
9				1			
10		Dry		1.2			
11		Dry		1			
12				1	CDP-1:12		
13			60	1		None	
14		Dry		1			
15		End of Borehole		1			
16							

NOTES:

ENVIRONMENTAL PARTNERS INC

BORING ID: CDP-2

SITE ADDRESS: **I-90 Near Milemarker 80 Cle Elum, WA**	CLIENT: **Kenan Advantage Group**
DRILLING CONTRACTOR: **Cascade Drilling Inc.**	PROJECT #: **71201**
DRILLING EQUIPMENT: **7822 DT**	DATE: **3/11/2019**
DRILLING METHOD: **Direct Push Technology**	GROUND SURFACE ELEV. FT AMSL: **NM**
LOGGED BY: **W. Weisberg**	TOTAL DEPTH: **15' bgs**

DECOMMISSIONING MATERIAL: **Hydrated bentonite chips**

BOREHOLE SIZE: **2.25"**

Depth (feet)	USCS	Description (USCS name; Color; Moisture; Density; Plasticity; Dilatency; EPI description; Other)	Interval & % Recovery	PID (ppm)	Sample	Sheen	Notes
0		0-1' Concrete					
1	SP	POORLY-GRADED SAND WITH GRAVEL; grayish brown; damp; low density; mostly coarse sand; Fe-staining; few gravel; no odor		0.4			
2				0.3			
3			60	0.4		None	
4				0.3	CDP-2:4		No Odor
5				0.3			
6		Refusal at 6' - New Boring		0.1			Refusal - Moved over 2' to west. new boring location
7		Dry		0.2			
8		Dry	80	0.2	CDP-2:8	None	No Odor
9				0.1			
10		Damp		0.1			
11		Dry		0.1			
12		Dry		0.1	CDP-2:12		No Odor
13		Damp	70	0.1		None	
14		Dry		0.1			
15		Dry		0.1			
16		End of Borehole					

NOTES:

ENVIRONMENTAL PARTNERS INC

BORING ID: CDP-3

SITE ADDRESS: **I-90 Near Milemarker 80 Cle Elum, WA**	CLIENT: **Kenan Advantage Group**
DRILLING CONTRACTOR: **Cascade Drilling Inc.**	PROJECT #: **71201**
DRILLING EQUIPMENT: **7822 DT**	DATE: **3/11/2019**
DRILLING METHOD: **Direct Push Technology**	GROUND SURFACE ELEV. FT AMSL: **NM**
LOGGED BY: **W. Weisberg**	TOTAL DEPTH: **13' bgs**
DECOMMISSIONING MATERIAL: **Hydrated bentonite chips**	BOREHOLE SIZE: **2.25"**

Depth (feet)	USCS	Description (USCS name; Color; Moisture; Density; Plasticity; Dilatency; EPI description; Other)	Interval & % Recovery	PID (ppm)	Sample	Sheen	Notes
0		0-1' Concrete					
1	SP	POORLY-GRADED SAND WITH GRAVEL; grayish brown; dry to damp; loose; low density; mostly coarse sand with few gravel; trace silt; no odor		0.2			
2				0.2			
3			45	0.2		None	
4				0.2	CDP-3:4		No Odor
5		Dry		0.2			
6				0.2			
7		Damp		0.2			
8			50	0.2	CDP-3:8	None	No Odor
9		Tan colored sand, brown decomposed organics		0.2			
10				0.2			
11				0.1			
12	SP	POORLY-GRADED SAND; black to reddish brown; damp; loose; no odor; woody debris/organics	50	0.1	CDP-3:12	None	No Odor
13	SP	POORLY-GRADED SAND WITH GRAVEL; grayish brown; dry to damp; loose; low density; mostly coarse sand with few gravel; trace silt; no odor.		0.1			
14		End of Borehole					
15							
16							

NOTES:

ENVIRONMENTAL PARTNERS INC

BORING ID: CDP-4

SITE ADDRESS: **I-90 Near Milemarker 80 Cle Elum, WA**	CLIENT: **Kenan Advantage Group**
DRILLING CONTRACTOR: **Cascade Drilling Inc.**	PROJECT #: **71201**
DRILLING EQUIPMENT: **7822 DT**	DATE: **3/11/2019**
DRILLING METHOD: **Direct Push Technology**	GROUND SURFACE ELEV. FT AMSL: **NM** / DECOMMISSIONING MATERIAL: **Hydrated bentonite chips**
LOGGED BY: **W. Weisberg**	TOTAL DEPTH: **15' bgs** / BOREHOLE SIZE: **2.25"**

Depth (feet)	USCS	Description (USCS name; Color; Moisture; Density; Plasticity; Dilatency; EPI description; Other)	Interval & % Recovery	PID (ppm)	Sample	Sheen	Notes
0		0-1' Concrete					
1	SP	POORLY-GRADED SAND WITH GRAVEL; brown; dry; loose; low density; mostly coarse sand with few gravel; no odor		0.1			
2				0.1			
3			70	0.1		None	
4				0.1	CDP-4:4		No Odor
5				0.1			
6				0.1			
7				0.1			
8		Refusal at 8' bgs - relocating	100	0.1	CDP-4:8	None	Refusal at 8', relocating 2' west. No Odor
9				0.1			
10				0.1			
11				0.1			
12				0.1	CDP-4:12		No Odor
13			50	0.1		None	
14				0.1			
15		End of Borehole		0.1			
16							

NOTES:

ENVIRONMENTAL PARTNERS INC

BORING ID: CDP-5

SITE ADDRESS: **I-90 Near Milemarker 80 Cle Elum, WA**	CLIENT: **Kenan Advantage Group**
DRILLING CONTRACTOR: **Cascade Drilling Inc.**	PROJECT #: **71201**
DRILLING EQUIPMENT: **7822 DT**	DATE: **3/11/2019**
DRILLING METHOD: **Direct Push Technology**	GROUND SURFACE ELEV. FT AMSL: **NM**
LOGGED BY: **W. Weisberg**	TOTAL DEPTH: **15' bgs**
DECOMMISSIONING MATERIAL: **Hydrated bentonite chips**	BOREHOLE SIZE: **2.25"**

Depth (feet)	USCS	Description (USCS name; Color; Moisture; Density; Plasticity; Dilatency; EPI description; Other)	Interval & % Recovery	PID (ppm)	Sample	Sheen	Notes
0		Asphalt					
	SP	POORLY-GRADED SAND WITH GRAVEL; grayish brown; dry to damp; loose; low density; mostly sand with some gravel; no odor; Fe-staining		8.5			
1				1.2			
				0.8	CDP-5:1.5		No Odor
2				0.1			
			65			None	
3				0.1			
4		Damp		0	CDP-5:4		No Odor
5				0			
		No Odor at 5.5'		12.8			Re-analyzed with PID in jar and read 0.1, could have been soil that dropped from <1' level.
6				1.2			
7		Dry		0.8			
			95			None	
8		<Larger gravels, angular, 2-4", 8-10' bgs		0.3	CDP-5:8		No Odor
9				0.2			
10				0.2			
11				1			
12				0.3	CDP-5:12		No Odor
			70			None	
13		<Increase gravel to many		0.1			
14				0.1			
15		End of Borehole		0.1			
16							

NOTES: