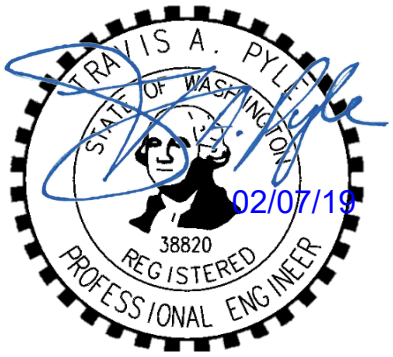
Asotin County Regional Landfill Plan of Operations Update

February 2019

Prepared for

Asotin County Solid Waste Division

Prepared by



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1.0 Introduction

This Plan of Operations Update is a revision of Chapter 3 – *Operations Plan Update of the Asotin County Regional Landfill 2007 Solid Waste Permit Reissuance Application* (CH2M HILL, 2007). Periodic updates are necessary to capture changes in facility operational practices, and as new areas of the facility and infrastructure are brought online. This plan covers operational practices for Cells A-D (and Future Cell E) at the Asotin County Regional Landfill (ACRL).

1.1 Purpose of This Document

This plan addresses the requirements of WAC 173-351-210, *Plan of Operation*, for the Active Landfill Unit (Cells A-D and Future Cell E) at the ACRL (also known as the Active Landfill Unit).

In accordance with WAC 173-350-210:

Each owner or operator of a landfill must develop, keep, and abide by a plan of operation approved as part of the permitting process under WAC 173-351-700 or through the permit modification process of WAC 173-351-720(6). The Plan of Operation must describe the facilities' operation and must convey to site operating personnel the concept intended by the designer. The plan of operation must be available for inspection at the request of the jurisdictional health department [Asotin County Health Department (ACHD)] and the department [of Ecology]. The facility must be operated in accordance with the plan of operation or the plan must be so modified with the approval of the jurisdictional health department [ACHD].

Each plan of operation must include:

Table 1 – Regulatory Requirements for Landfill Operation Plans (WAC 173-351)

Requirement	Located in Section(s)
(1) How solid wastes are to be handled on-site during its active life, including transportation, routine filling, grading, cover and housekeeping;	2.4, 2.4 and 4.1
(2) How inspections are conducted and frequency;	3.1 - 3.3 and 6.3
(3) Actions to take if there is a fire or explosion;	7.17 and 7.18
(4) Actions to take for sudden releases (e.g., failure of run-off containment system);	3.5 and 1.5
(5) How equipment such as leachate collection and gas collection equipment are to be operated and maintained;	5 and 7.7 - 7.8
(6) A safety plan or procedure;	7.0

Requirement	Located in Section(s)
(7) How operators will meet each requirement of WAC 173-351-200 [Operating Criteria] and 173-351-220 [Additional Operating Criteria]; and	This Plan serves as a training document and provides information to operators on how to meet the requirements of WAC 173-351-200
(8) Other such details as required by the jurisdictional health department.	No other details are known to be required by ACHD

1.2 Our Mission and Vision

The mission of Asotin County's Solid Waste Division is to protect public health and the environment through efficient, effective and fiscally-responsible practices, while also providing stable and affordable waste management services for the community and its solid waste partners.

The County's vision is to provide waste disposal services in a manner that will preserve the environment for future generations. This mission considers the three E's of sustainability, which reconcile **e**nvironmental, social **e**quity, and **e**conomic demands within Asotin County.

1.3 Background

1.3.1 Location and History

The ACRL facility is located approximately 3 miles southwest of the City of Clarkston, Washington in the Clarkston Heights (**Exhibit 1**). The landfill facility occupies approximately 76.5 acres within the southern portion of Section 36, Township 11, Range 45 East, Willamette Meridian. The County owns all of Section 36, except for a small portion of property that was annexed to the Port of Clarkston for an Industrial Park in 2013.

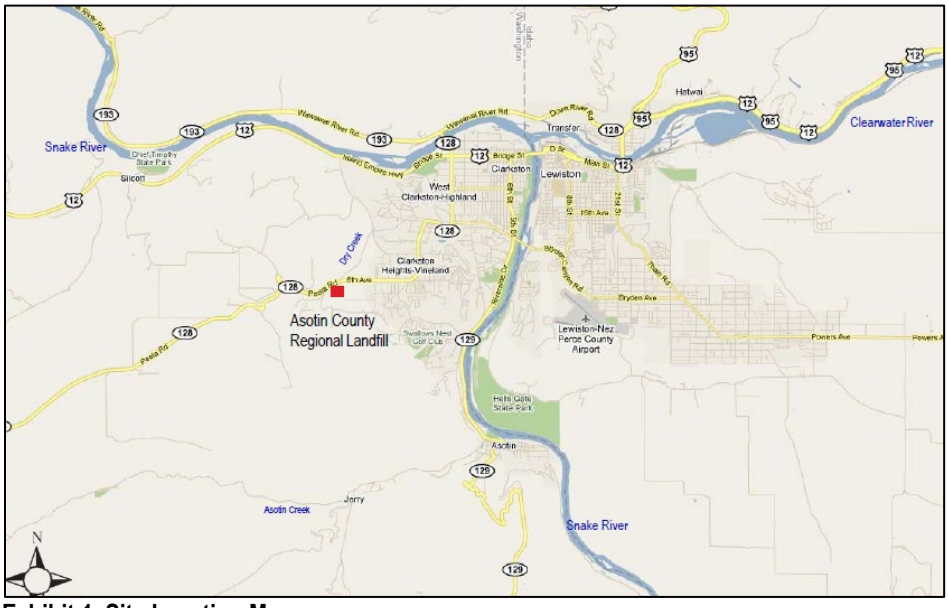


Exhibit 1. Site Location Map

The ACRL began accepting waste in 1975. Waste was placed in unlined trenches oriented in a north-south direction in the western portion of the site. This area is nearly 46 acres in size and was closed in 1993 ("Closed Landfill Unit"). East of this area is the Active Landfill Unit that is comprised of Cells A-D. Cell A began filling in 1991, and Cell B and C opened together in 1997. In 2013, Cell D opened. All four cells are currently part of the active landfilling footprint. Refer to **Exhibit 2** for an overview of the landfill facility.

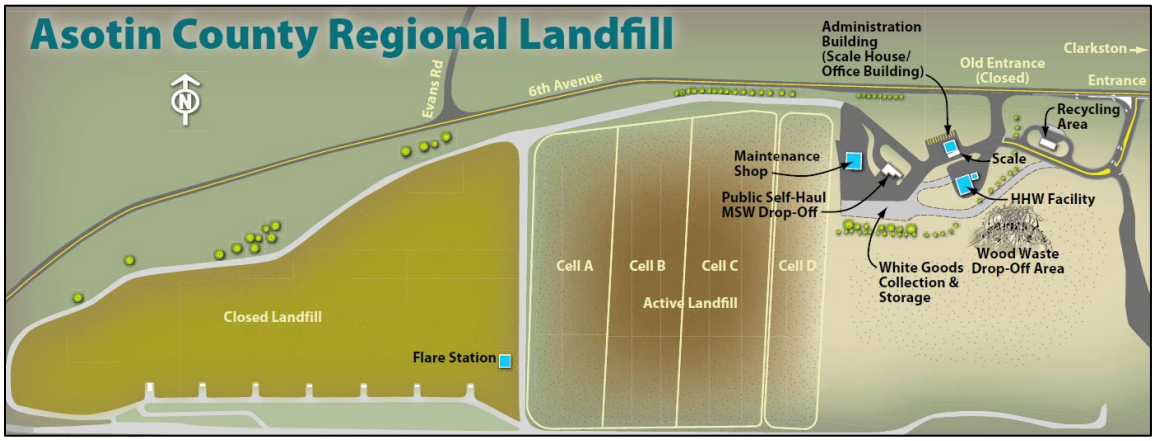


Exhibit 2. Overview of ACRL Facility

The ACRL currently disposes of approximately 55,000 tons per year of municipal solid waste (MSW). The ACRL serves the communities of Asotin County (City of Asotin, City of Clarkston, and unincorporated Asotin County) and its solid waste partners (City of Pomeroy and Garfield County in Washington, and the City of Lewiston and Nez Perce County in Idaho). Asotin County is responsible for providing solid waste disposal for both the Washington and Idaho partners and presently operates the ACRL. Asotin County has an intergovernmental agreement (IGA) with the City of Lewiston for disposal of MSW generated by the City of Lewiston. The IGA was renewed on October 1, 2016, and will automatically renew annually on October 1, unless terminated early, for nine additional one-year terms. There are no waste disposal contracts or IGAs currently in place with the other small service areas (Garfield County, City of Lapwai, and City of Pomeroy) outside of Asotin County.

1.3.2 Future Expansion and Development Plans

Asotin County plans to continue providing waste management services for its community and waste disposal partners for many years to come. Through a series of strategic evaluations and capital facilities planning initiatives, the Asotin County Solid Waste Division plans to expand the ACRL into a new lateral (contiguous) cell (Cell E) and vertically expand Cells A-D in order to regain airspace that was lost when the landfill capacity was reduced in 2017 to stay below the air quality design capacity thresholds. **Exhibit 3** presents a general layout of the future Cell E and relocated facilities with realignment of 6th Avenue. Based on current incoming waste tonnage and waste densities projections, the ACRL will provide waste disposal services for approximately 40 more years. At which time, the facility is planned to be converted to a transfer station to collect and consolidate MSW for transport to a regional landfill.

Once Cells A-D reach an interim closure elevation, Cell E is planned to be developed sequentially in two phases – first the southern half (Phase E1) and then the northern half

(Phase E2). The northern half development will necessitate relocation of the entrance and support facilities and realignment of 6th Avenue. The County also has plans to locate a shared maintenance shop building, on the north side of 6th Avenue, with the County's Road Department and build a new Public Works Administration Building. For more information about future expansion of the landfill, refer to the ACRL Master Development Plan.

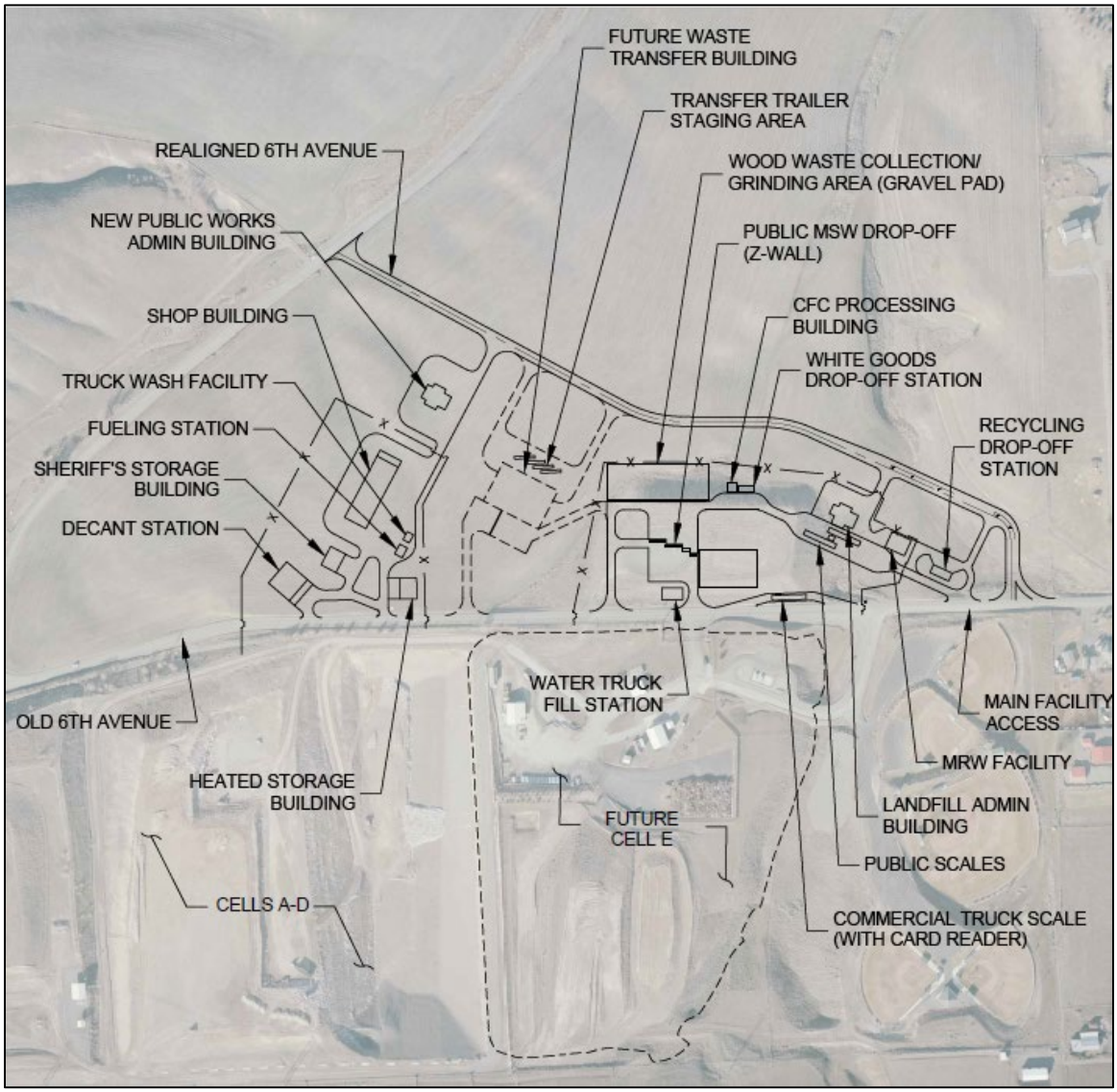


Exhibit 3. Future Cell E and Relocated Entrance Facilities with Realignment of 6th Avenue

2.0 Overview of Facility Operations

2.1 Hours of Operation

The ACRL is open a minimum of 8 hours per day, Monday-Saturday, except holidays. These hours may be increased on weekends, during the summer or under special circumstances. A permanent chain link fence encloses the site. The entrance gate is shut and locked while the facility is closed to prevent unauthorized vehicular traffic and illegal dumping of waste. A sign is posted at the landfill entrance, displaying the following information: name of site, hours of operation and unacceptable materials. A recycling drop-off area is located in front of the main entrance gate to allow customers to drop-off acceptable recyclable materials at any time. **Exhibit 4** shows a picture of the main landfill entrance area and recycling drop-off area.

2.2 Landfill Personnel

There must a minimum of two personnel on-site at all times during normal operating hours. One person must be in the scalehouse and the other at the working face of the landfill.

The following positions are required to operate the ACRL:

- County Engineer/Public Works Director
- Solid Waste Supervisor
- Landfill Foreman
- Engineering/Landfill Technician
- Equipment Operator
- Scale Attendant

Other personnel may be needed on a periodic basis to assist with special operational activities, such as surveying, recycling coordination, and litter cleanup. The specific responsibilities of each key position are described as follows.

2.2.1 County Engineer/Public Works Director

The County Engineer/Public Works Director oversees the Solid Waste Division of the Public Works Department and reports directly to the Board of County Commissioners. This person works collaboratively with the Solid Waste Supervisor to ensure that the facility is operating in accordance with the regulations and is properly permitted. This person is also responsible for ensuring contracts are in-place with the regional solid waste partners and tip fees are set for operating the facility in a fiscally and environmentally responsible manner.

2.2.2 Solid Waste Supervisor

The Solid Waste Supervisor performs skilled equipment operation work directing landfill disposal operations, offsite recycling system and other related work. More specifically, this person:

- Works collaboratively with the County Engineer/Public Works Director
- Assigns site maintenance work as required;
- Supervises site personnel;
- Manages landfill finances, designs and construction activities for ongoing infrastructure development;
- Secures needed permits and assures that the landfill is operating under authorized permits for all aspects of landfill activities;
- Plans and directs filling activities;
- Prepares grant applications and works with the waste partners for collaboration and solid waste management planning;
- Functions as liaison for the County with federal and state agencies, to assure compliance with regulations;
- Ensures that scale is operating and functioning properly and maintains scale certifications;
- Develops, implements, and manages community education and assistance programs;
- Maintains Management of Landfill Operations (MOLO) certification and continuing education credits; and
- Authorizes repairs and equipment purchases.

2.2.3 Engineering/Landfill Technician

The Engineering Technician performs routine subprofessional-level engineering and landfill technician work, including participating in the Moderate Risk Waste (MRW) Facility ([also known as the Household Hazardous Waste (HHW) Facility] operations and environmental site monitoring. More specifically, this person:

- Performs routine monitoring of landfill gas wells and flare station (including buildings and gas probes), quarterly sampling of groundwater monitoring wells and leachate water quality (including laboratory coordination, field quality control, and reporting);
- Reviews laboratory analytical data results for reasonableness and accuracy;
- Prepares quarterly and annual reports for groundwater, landfill gas, and leachate and/or other monitoring data and works with the County's engineering consultant for reviews and reporting;
- Supervises the operation of the MRW Facility during designated operating days and reports activities to the Solid Waste Supervisor;
- Coordinates the recovery of chlorofluorocarbons (CFCs) from refrigerators, freezers, and air conditioners at the white goods collection and storage area with contractor
- Sorts, bulk packs or lab packs, and arranges for proper disposal of moderate risk waste delivered to the landfill recovery station
- Periodically checks that only recyclable materials are deposited in the recycling area, monitors the amount of materials in the containers, arranges for the emptying of full containers, and maintains and cleans the area.

2.2.4 Landfill Foreman

The Landfill Foreman performs routine and manual landfill maintenance work using hand tools and equipment. The Landfill Foreman also assists in scalehouse operations with

computer data entry and assists the Engineering/Landfill Technician with operation of MRW Facility.

2.2.5 Equipment Operator

The Equipment Operator(s) operates equipment including a compactor, scraper, loader, water wagon, and/or dozer. This person also is authorized to use other equipment to move both waste materials and soils at the landfill. More specifically, this person:

- Directs traffic on the active disposal area;
- Spreads and compacts refuse according to the fill plan and this Plan of Operations;
- Performs daily, intermediate, and final cover operations;
- Plows snow and sands access roads;
- Assists in site maintenance work as required (e.g., maintains roads, constructs refuse lifts, maintains liner-leachate collection system, maintains gas control system, maintains groundwater monitoring wells, and cleans out culverts and drainage ditches);
- Multi-lift equipment operation for collecting recyclables at the County's recycling sites;
- Assists in making inspections or with maintenance on surface water, leachate, and gas control systems, and groundwater monitoring systems;
- Lubricates equipment and performs minor maintenance adjustments;
- Randomly inspects commercial loads;
- Knows emergency procedures;
- Reports landfill fires to the Solid Waste Supervisor and assists in extinguishing minor landfill fires (hot loads);
- Constructs litter fences and assists with litter collection; and
- Assists with post-closure inspections and repairs.

2.2.6 Scale Attendant

The Scale Attendant has primary responsibility of scale operations and greeting the customers. A favorable first impression will be achieved by dressing appropriately, being kind and courteous, and maintaining a clean orderly work space.

- Greets incoming and outgoing customers, and operates scale system;
- Reminds customers about the opportunity to recycle various commodities (e.g. front entrance recycling drop-off, large appliances also known as "whitegoods" and yard waste/clean woody debris);
- Communicates with customers on types of wastes and directs them to appropriate receiving area; radios for support as-needed for receiving area, and screens incoming waste for HHW, ashes from burn barrels or wood stoves, and recyclable white goods;
- Assesses, collects payment, and issues a receipt for landfill tipping fees based on established charges per ton; has commercial account drivers sign for charges, and records all cash received;
- Assists in preparing accounting reports and manages the accounts receivable system;
- Prepares and sometimes makes daily bank deposits;

- Assists with preparation and mailing of accounts receivable statements, including copies of invoices to commercial charge account customers;
- Furnishes information to the public concerning the disposal site, HHW and recycling;
- Provides general directions to site users; controls incoming and departing vehicles to/from the unloading areas at the public tipping or landfill sites;
- Keeps and files records; and
- Answers the telephone.

2.3 Landfill Facilities

The landfill facilities include support facilities and drop-off/receiving areas. An aerial view of the entrance into the ACRL is provided in **Exhibit 4**.

Exhibit 4. Aerial View of the ACRL Entrance

Directional and traffic control signs are provided throughout the facility to control traffic and alert drivers. Typical examples of signs, both permanent and movable, include:

- Speed Limit Signs
- Stop Signs
- Yield or Merging Traffic Signs
- Caution Signs
- No Dumping Signs
- Directional Signs
- Warning Signs

Exhibit 5. Example Signs Used at the ACRL

Inoperative vehicles must be promptly removed from access roads in order to minimize disruptions to traffic patterns and operations. Care must be exercised when assisting inoperative vehicles to prevent private vehicle damage. Vehicles with inoperative unloading devices shall be unloaded by hand.

2.3.1 Support Facilities

The following are the various support facilities located at the ACRL.

Administration Building (Office/Scalehouse)

The Administration Building includes the office and scalehouse and is located just inside (west) the main entrance. The scalehouse controls vehicles entering and leaving the facility. The Scale Attendant is stationed inside the scalehouse during the facility's operating hours. Traffic lights are used by the scale attendant to manually control traffic passing over the scale in both directions (inbound and outbound vehicles). Scalehouse operations include determination of waste type and quantity (weight), designation of point of delivery (to drop-off facilities, direct to landfill, or other), payment (or charge-out) of appropriate fees and recording of all pertinent data. The scalehouse is equipped with a computer to record scale and customer data.

Customers are charged a fee depending on the type of waste. Customers with HHW materials are directed to the MRW Facility. If the MRW Facility is closed, the scale attendant provides the customer with a brochure for the MRW Facility operating hours and requests

that they return when it is open. Automotive and recreational vehicle batteries (lead-acid batteries), however, are collected from the customer for recycling during normal landfill operating hours. **Exhibit 6** shows an aerial view of the scale/scalehouse side of the Administration Building

Exhibit 6. Aerial View of the Administration Building (showing the scale and scalehouse portions)

Maintenance Shop

The Maintenance Shop is located west of the scalehouse/office building. Machinery is serviced and maintained in this shop. Waste oil is collected and recycled through the MRW Facility. Immediately next to the Maintenance Shop is the water truck filling station that consists of a large concrete pad and overhead fill nozzle. A photo of the Maintenance Shop is shown in **Exhibit 7**.

Exhibit 7. Maintenance Shop with Truck Fill Station in the Background

Flare Station

The flare station is located west of the Active Landfill Unit (Cells A-D) on the eastern portion of the Closed Landfill Unit. The flare station was replaced this year (2018) and includes a new gas handling skid with two blowers, a condensate knockout tank, pipes and valves, and a programmable logic control (PLC) unit that controls and monitors the system (refer to **Exhibit 8**). The flare station collects and thermally oxidizes (burns) landfill gas collected from

both the Closed Landfill as part of a vapor extraction (VE) system and the Active Landfill Unit as part of the active landfill gas collection system. The flare station is operated in accordance with the manufacturer's written instructions and the operating plan that is incorporated by reference.

Exhibit 8. Flare Station Air Handling Skid and Stack

Other Support Facilities

Other support facilities include annex buildings next to the MRW Building that provides additional storage and a conference/meeting room, a decant facility for the Stormwater Division, and a heated storage building also for the Stormwater Division.

2.4 Drop-Off Facilities/Receiving Areas

The ACRL offers a variety of drop-off facilities and receiving areas for different types of waste materials and customers. Being a regional landfill facility, transfer trailer trucks and commercial garbage (packer) trucks alike utilize the facility in addition to the general public (self-haulers). All vehicles enter and exit the facility through the main entrance.

2.4.1 Landfill

Commercial garbage trucks, transfer trailer trucks, and some public customers with large loads of MSW (such as contractors) are directed to the landfill for dumping. Designated areas are provided to separate the public from commercial customers. Exhibit 9 shows a photograph of a transfer trailer truck (walking-floor trailer) unloading at the landfill working face.

Exhibit 9. Transfer Trailer Truck Unloading at the ACRL

2.4.2 Public Self-Haul MSW Drop-Off

A drop-off area is provided just west of the scale for the general public to conveniently drop-off MSW instead of going to the landfill working face. The area features concrete retaining walls and roll-off containers. When the containers are full or at the end of each day, the waste is hauled to the landfill and dumped. Exhibit 10 shows an aerial view of the public-self haul drop-off site (z-wall).

Exhibit 10. Aerial View of the Public Self-Haul MSW Drop-off (Z-Wall) Area

2.4.3 Recyclables Drop-off Area

Conventional-type recyclables generated from households and certain businesses are accepted at the ACRL. The recyclables drop-off area is located in front (east) of the main gate and is open 24/7. Materials are accepted, provided that they are clean/empty, sorted, and placed in the appropriate bins. Signs in the area direct the users to place materials by material type in the appropriate bin. Recyclables can be removed, prior to entering the scale or after weighing out. Exhibit 11 shows a picture of a recycling material container.

Exhibit 11. Recyclables Drop-Off Area

2.4.4 White Goods Collection & Storage Area

A drop-off area for white goods (large appliances) is provided to minimize disposal of these types of materials in the landfill and to recycle. White goods are charged to the customer by the unit at two rates. A higher rate is paid for appliances with refrigerants, such as refrigerators and freezers. After entering the site, the public can by-pass the scales with acknowledgement from the Scale Attendant and drop off their white goods at the White Goods Collection & Storage Area. The Scale Attendant will make note of the appliances that are dropped off and charge the customer accordingly. The customer will then have to pull through the scales for weigh-in, if they have other materials to drop-off such as MSW or woody debris. Alternately, the customer can pass through the scale first, drop off their waste, pass back over the scale, and then proceed to the White Goods Collection & Storage Area to drop off appliances.

2.4.5 Wood Waste

The ACRL offers wood waste recycling to support alternatives to open burning and divert these types of wastes from the landfill. Under this program, Asotin County residents and its solid waste partners may drop-off acceptable woody waste at no charge. The materials are then chipped and used for "hog fuel" or other purposes. Acceptable materials include tree limbs and branches up to 24 inches and 8-feet long, and clean wood pallets. Materials such as treated lumber, construction and demolition (C&D) debris, MSW, leaves, and yard clippings are not permitted and must be disposed in the landfill. Exhibit 12 shows a photograph of the wood waste pile and grinding operation.

Exhibit 12. Wood Waste Drop-off Area (and Grinding Operation)

2.4.6 Moderate Risk Waste Facility

The primary purpose of the Moderate Risk Waste (MRW) Facility [also known as Household Hazardous Waste (HHW) Facility] is to collect and properly handle hazardous wastes generated from households and businesses that are classified as conditionally-exempt small quantity generators (CESQGs). The MRW Facility is open every Wednesday, and the first and third Saturdays of the month, from 8 AM to 4 PM. The facility is operated in accordance with WAC 173-350 and the most current *MRW Facility Operations Plan*. Exhibit 13 shows a photograph of the facility.

Exhibit 13. Moderate Risk Waste (Household Hazardous Waste) Facility

2.5 Roads and Working Decks

There are essentially two types of landfill roads at the ACRL. These include permanent all-weather access roads used by the public and waste hauling vehicles, and temporary access roads for use by heavy equipment and waste hauling vehicles.

2.5.1 Permanent All-Weather Access Roads

The onsite access road from 6th Avenue into the facility is an all-weather permanent road. Main accesses into the entrance/receiving facilities and the perimeter road around the landfill cells are also all-weather roads. These roads are paved with asphalt up through the scale area to the maintenance shop. The all-weather roads outside of the scale are gravel surfaced. All-weather access roads are maintained, as needed, to facilitate year-round access.

2.5.2 Temporary Access Roads/Working Decks

Tracked machines and heavy, earthmoving equipment use haul roads separate from delivery access roads. Roads that are used for landfill equipment and waste hauling vehicles gaining access to the tipping face are subjected to excessive loads that are relatively short-term but frequent and must be continuously extended and/or relocated. These roads and working decks require constant reconstructing and repair and are typically constructed using onsite compacted sand and gravel, inert wastes, C&D debris, and other suitable materials. The wearing surface also can be built using recycled pavement, pit-run stone or suitable, onsite sand and gravels.

2.6 Landfill Equipment

Equipment utilized at the ACRL includes the following:

- 826H Caterpillar Waste Compactor
- Al-Jon Compactor (back-up)
- 623G Caterpillar Scraper
- D6 Caterpillar Crawler
- Massey Ferguson Utility Tractor
- Caterpillar Water Wagon
- Two Multi-Lift Recycling Truck

Other mobile or backup equipment that might be temporarily needed is available through the County's equipment inventory or rented. A picture of the Waste Compactor operating in the ACRL is shown in **Exhibit 14**.

Exhibit 14. Waste Compactor at the ACRL

3.0 Waste Stream Control

3.1 Waste Stream Control Program Overview

The control and management of the waste stream entering the facility is carried out in several different ways. A sign at the entrance of the facility lists prohibited wastes. Personnel are also trained to recognize unacceptable wastes and conduct load inspections. Inquiries about the source, composition and the amount of waste are made to determine if it is acceptable and where the waste needs to be unloaded. This dialogue between the Scale Attendant and the customer also provides an opportunity to inform and educate the public about what types of wastes are accepted at the ACRL. The Scale Attendant also distributes household hazardous waste flyers for public information at the scalehouse. The Scale Attendant can also provide the customer with information on other facilities in the area that may accept their waste if it is not accepted at the ACRL.

The Scale Attendant and Equipment Operator(s) are also trained to spot suspicious wastes, such as those brought to the facility in containers used for hazardous materials, in containers not ordinarily used for the disposal of household wastes, or in unmarked containers. Loads may also warrant inspection if brought to the facility in vehicles not typically used to haul these types of wastes, of if the vehicle is marked with a hazardous or flammable waste insignia.

No liquid or soluble industrial wastes or hazardous wastes are accepted at the site, except for those that are accepted and properly managed at the MRW Facility. “Hot” loads or loads which may catch fire, due to the presence of items such as hot ashes, motor oil, cooking oil, and other flammable chemicals, are also not accepted at the landfill, nor are polychlorinated biphenyl (PCB) wastes or septic sewage sludges.

If there is uncertainty regarding questionable wastes delivered to the site, the Landfill Supervisor, the Engineering Technician, or their designee will inspect the load. Load inspections also occur at the landfill working face by the Equipment Operator(s).

At the working face, the Equipment Operator(s) will observe waste as they are dumped for unusual odor, color or texture and assure compliance with any pre-delivery specifications. For example, waste drums must have the top removed or holes punched in the top, bottom, and center of the drum. The equipment operator also performs random inspections of commercial loads.

The employee training program covers all areas of hazardous communications, including identifying hazardous wastes and prohibited materials and where they are stored in the work area, processing protocol, waste properties and compatibility, and evaluating conditions and situations that could result in spills and/or exposures to employees. The employee training program also covers respiratory equipment training, emergency response, and first-aid training.

3.2 Discovery of Unacceptable Materials

If a customer is observed dumping or attempting to dump suspicious or unacceptable materials, the individual will be instructed to immediately remove the material from the site, or in some instances, the waste may be removed to the MRW Facility. The hauler will be asked about the source of the suspect load or material. A record of pertinent facts will be made, including but not limited to the following:

- Name of hauler
- License plate number
- Origin of the load
- Any visible evidence of the identity of waste substance
- Quantity and state of the substance (solid, liquid, contained or loose)

If hazardous material escapes detection at the scalehouse and is observed in the public tipping area, it will be moved and secured in the MRW Facility until it can be removed from the site for proper and legal disposal. This will be done only if there is no risk of exposure (i.e., the material is in sealed containers). If there is some risk of exposure, personnel will call 911 and request assistance. Unauthorized hazardous waste, including PCBs, will be reported to the Landfill Supervisor who will in turn report it to Ecology and ACHD.

Sampling of the suspected hazardous material must be performed by qualified personnel only.

3.3 Random Load Inspections

Landfill employees perform random inspections of incoming loads to ensure that they do not contain regulated dangerous or PCB wastes (refer to **Appendix A** for the Random Load Inspection Form). Load inspections involve dumping the waste in a designated area and viewing the contents prior to disposal. Load inspections allow the ACRL to reject waste deemed inappropriate. Inspections are performed near or adjacent to the working face of the landfill or in an empty 22 cubic yard container at the landfill. Although random inspections are performed by landfill operations personnel, the Equipment Operator(s) at the working face continuously look for prohibited waste and other material-related dangers as they are unloaded and pushed/compacted.

The frequency of inspections depends partly on familiarity with customers. For example, waste received from a waste generator that ACRL has little prior knowledge of will require more frequent inspections. Additionally, waste from commercial or industrial sources may require more frequent inspection than waste predominantly from households. Records of inspections are kept on-site in the landfill Operating Record. Inspection records include the date and time wastes were received during inspection, names of the hauling firm and driver, source of the wastes, vehicle identification numbers, and all observations made by the inspector.

In the event that hazardous wastes or other prohibited wastes are received at the landfill, staff will take appropriate action. Landfill personnel who encounter such wastes will notify the Solid Waste Supervisor immediately. The staff will then assess the situation and determine if their staff are properly trained and equipped to address the situation. If this determination is made appropriate, handling and disposal of the waste will be initiated. If the situation exceeds the landfill staff's capabilities to handle the situation properly, the Solid Waste Supervisor will notify ACHD and/or Ecology and request immediate assistance. Inspection records will be kept in the landfill office building. Ongoing training for Equipment Operators, as well as scale attendants and any other staff performing load inspections, regarding unacceptable quantities, types and descriptions of hazardous wastes, and PCBs, will be provided as needed to keep staff prepared and informed.

3.4 Special Waste Handling

Special wastes that are accepted at the ACRL include:

- Asbestos (only non-friable is acceptable with special handling provisions)
- Animal Carcasses (dead animals are accepted by appointment only)
- Bulky Wastes (large appliances, furniture, car bodies, etc.)
- C&D Debris (concrete, asphalt, building materials, etc.)
- Dusty Wastes (saw dust, ash, etc.)
- Green Wastes (lawn clippings, leaves, etc.)
- Infectious/Medical Wastes (hospital waste, sharps containers, etc.) in sealed containers
- Tires (truck and car tires)
- Other special wastes such as lead acid (car) batteries, waste oil and antifreeze, e-wastes, pesticides/herbicides, etc. are handled through the MRW Facility.

3.4.1 Asbestos

Friable asbestos is not accepted at the ACRL. Any vehicles containing friable asbestos will not be allowed to dump and will be directed to the nearest waste facility that has a designated asbestos disposal area. Proof of non-friable asbestos is required before it will be accepted. State law requires that all asbestos must be placed in double bags specially made and marked for asbestos disposal. Non-friable asbestos is accepted at the ACRL by appointment only, to provide time for ACRL staff to prepare for special landfill handling procedures and precautions. It is placed at the toe of the fill and covered with other garbage so that it cannot become airborne.

3.4.2 Animal Carcasses

Animal carcasses from the public or businesses are accepted on an appointment-only basis at the landfill. Arrangements must be made 24 hours in advance, so that an equipment operator is available. Disposal of these special wastes must occur at the active working face of the landfill. A tipping fee will be charged at the current rate for the type of carcass (e.g., large animals such as horses and cows or smaller animals such cats and dogs).

3.4.3 Bulky Wastes

Bulky wastes that are crushable (e.g., mattresses, furniture, etc.) may be disposed of in the landfill. Appliances and other pieces of metal are collected at the white goods collection & storage area. Landfill operators are trained and certified to remove refrigerant liquids. Once the refrigerant is claimed, appliances are taken to a recycler.

3.4.4 Demolition Debris

Inert materials such as soil, asphalt, and broken concrete suitable for road surfacing or fill will be directed to other areas within the landfill for reuse. Materials that are not inert or otherwise not suitable for road surfacing or fill, including lumber or sheet rock, are accepted at the landfill for disposal. Commercial loads of these materials will be taken directly to the landfill active disposal area, to be dumped at the toe of the working face and worked into the toe of the fill, or spread out evenly along the working face, depending on the type of wastes. A pit also can be excavated in the working face for disposal of large bulky items.

3.4.5 Dusty Wastes

Commercial quantities of wastes such as sawdust and other dusty material are accepted. Special handling is required since these wastes tend to become airborne due to equipment operation and wind. Once airborne, the dust may be a hazard to personnel through inhalation or skin contact. Personnel working in areas with dusty wastes are encouraged to wear protective clothing, eye protection, and dust masks. Some dusty wastes may be wetted down with water and then covered immediately with soil or refuse. If water is not available, the wastes may be disposed of in a hole excavated in the working face.

Ashes from private citizen's burn barrels are accepted at the public tipping area in a special container marked "ash." Commercial quantities of ashes may be accepted at the active disposal area if they have been wetted to control dust.

3.4.6 Green Wastes

Green wastes such as yard clippings are currently co-mingled with the general MSW in the landfill. The ACRL will be evaluating the need for a separate tipping area in the future, with bins to accept green waste for processing and beneficial uses. Most green waste, however, in the County and in Lewiston/Nez Perce County, is currently collected and managed at the Clearwater Compost Facility in Lewiston. The County will continue to evaluate the need for onsite green waste collection, processing, composting, and recycling opportunities.

3.4.7 Infectious/Medical Wastes

Infectious wastes from hospitals, clinics, dentists, and veterinarians are classified as "red bag" wastes. These wastes include sharps, infectious materials, tissue, and other regulated medical wastes in medical wastes. These wastes are accepted at the ACRL with pre-approval and only by appointment, to provide time for ACRL staff to prepare for special landfill disposal procedures and precautions. These wastes may be subject to other constraints such as maintenance of special records. The infectious waste must be sterilized by autoclaving or incineration before it is accepted at the ACRL. All sharps must be in special containers to prevent contact. State law requires that all regulated hospital waste be placed

in red colored bags specially made and marked for disposal as infectious waste. The infectious waste is then disposed similarly to other wastes received at the landfill.

3.4.8 Tires

Tires are landfilled at the ACRL. Tires from businesses are not accepted. The public may dispose of up to four tires per visit, charged at the standard tipping fee. Any additional tires are charged at a significantly higher rate (about three times more than MSW) to discourage them from being brought to the ACRL. Tires are blended in with normal refuse to make sure that compaction is being achieved.

3.4.9 Other Special Wastes

Wastes such as lead-acid (automotive and recreational vehicle) batteries, rechargeable batteries, paints and aerosols, e-wastes, used oil and antifreeze, pesticides/herbicides, and other such wastes are accepted and managed through the MRW facility.

3.5 Spill Response

The ACRL will take immediate and necessary actions to contain and clean-up spills. Spills may occur from landfill equipment or vehicles (hydraulic fluid, motor oil, and fuel) or from materials intermixed in the waste. When a spill occurs, personnel working in the landfill area will immediately notify the main facility administration building of the spill characteristics and their material (absorbents, containers, etc.) and PPE needs and required assistance to quickly manage the spill.

Inside the landfill, the landfill liner system acts as a spill containment feature offering secondary containment and absorption capacity. Small releases will quickly absorb into the cover soil and superficial refuse layer, allowing the material to be excavated and placed into containers for proper disposal and management. In the case of larger spills (which are uncommon), the waste body again will act as a sponge and soak up the spill. Liquids will be contained as quickly as possible with containment diking (earthen berms) and at the surface to keep the material from infiltrating into the underlying leachate collection system. Surface materials will be cleaned up with extra sorbent material, as needed, and containerized. Any material that infiltrates into the leachate system will eventually discharge into the leachate pump station before being pumped to the City sewer. Depending on the quantity of the release and the characteristics of the material (that is, level of hazard), the leachate pump station can be used as a secondary line of defence. The pumps can be manually turned off to allow monitoring of leachate characteristics before leachate is released into the sanitary sewer system.

If handling the spill is beyond the landfill's capacity, the ACHD or Ecology must be notified. If the spill is discovered while the hauler is still onsite, the hauler will be questioned as to the source of the load. The hauler's name and license plate number will also be recorded. Ecology must also be notified if it is discovered that the spill is hazardous to ensure that treatment, storage, and disposal is performed in accordance with all applicable state and federal requirements. The Solid Waste Supervisor or the County Engineer/Director of Public Works will contact the ACHD or Ecology as required.

4.0 Waste Handling and Landfilling Procedures

At the landfill, waste is unloaded as directed by the Equipment Operator(s), and then it is pushed to the working face, spread out, and compacted. Typically, commercial garbage trucks and long-haul transfer trailers are kept separate from the public. Public customers such as contractors with pickup trucks and trailers are directed to the landfill to dump instead of dumping at the public unloading area. The Equipment Operator(s) may ask additional questions to the customer and perform inspections as necessary to ensure that the waste is acceptable prior to, and in conjunction with, waste unloading. Load inspections oftentimes also occur in a designated area at the landfill.

The active working face is built large enough to accommodate the expected user volume but is also kept small enough to reduce blowing litter and minimize daily cover needs. It can vary in size depending on the time of year, weather conditions, and geometry of the fill area. Typically, the working face is kept as narrow as possible, no more than 50 feet wide. This is wide enough for vehicle unloading and safe operation of landfill equipment.

Surface monitoring for closed and interimly closed areas of the landfill shall be conducted monthly the identification of the following conditions: settling of the cap, dead vegetation, erosion, ponding of water, surface cracking, acceptable vegetation, and exposed waste in the LFG extraction areas. Refer to Appendix A for the landfill surface inspection form.

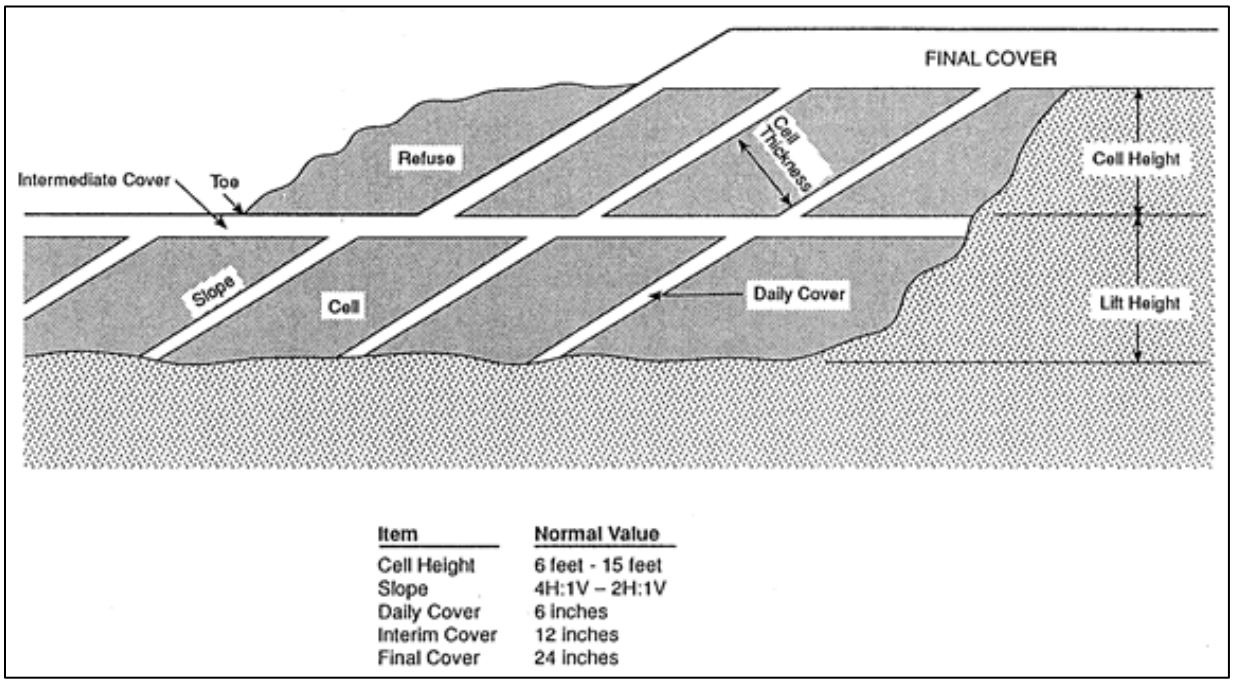
4.1 Landfill Waste Filling

Proper waste filling involves pushing, spreading, and compacting operations. These functions are accomplished by using properly sized equipment for the amount of waste the landfill handles. Primarily, this is done by the waste compactor. Pushing is the action of moving the trash from the dumping location to the working face. The dozer can best accomplish this task. Unloading trucks close to the working face will minimize the distance the waste must be pushed. The purpose of the spreading action is to distribute the waste over the working face in thin layers of two feet or less. Spreading is accomplished by the compactor. The dozer is only used in emergency conditions when the compactors are not operational. Thin layers improve the crushing action (force) imposed by the compactor and permit increased equipment travel speeds as a result of reduced rolling resistance. Thin layers also result in less wear and tear on the machine, which translates to less maintenance cost and downtime. Waste compactors are specially designed to impose a large amount of force on the trash to densify it and to tear and shred the waste under its wheels. The waste becomes compacted when the force (the weight of and motion of the compactor) moves over it, crushes the material, and reduces the voids by shredding it and binding it with the other wastes.

The waste compactor traverses the working face by making several passes. The amount of passes depends on the type of waste after the machine walks out of the garbage. Typically, three to five passes are made until the waste is relatively unyielding and firm. Six inches of daily cover is placed at the end of each working day. The total thickness of each lift, including the daily cover soil, is approximately 8 feet. Interim soil layers are added when

areas are not going to be filled for several days or weeks. Cover soil is hauled to the landfill and is spread over the waste using a scraper. A dozer is used to finish and spread, to get a more uniform thickness of soil cover. The water wagon is used on occasion to moisten the trash and cover material, to control dust at the working face. The water wagon is also used to control dust on the unpaved access roads and working deck.

The ACRL is filled in full, approximate 8-ft lifts from south to north. An illustration of a typical waste placement is presented in **Exhibit 15**. An aerial photograph of the ACRL showing the lift filling moving from south to north is shown in **Exhibit 16**. The filling requires careful coordination with other site operations and infrastructure, including access roads, landfill gas collection trenches, and the commercial and public tipping areas. Additionally, the waste placement and lift slopes need to be coordinated with stormwater and erosion control measures. To keep the lift thickness uniform and to help reduce the quantity of refuse excavated for placement of horizontal gas collection lines, the lifts are sloped at about 2 percent from south to north following the bottom slope of the landfill cells. Access roads immediately above the lifts with buried gas trenches require extra cover at the crossings to protect the gas pipes.



Item	Normal Value
Cell Height	6 feet - 15 feet
Slope	4H:1V – 2H:1V
Daily Cover	6 inches
Interim Cover	12 inches
Final Cover	24 inches

Exhibit 15. Typical Landfill Waste Placement and Fill Sequencing Illustration

Exhibit 16. Aerial View of the ACRL (Cell D) Showing Lift Construction from South to North

4.1.1 Survey Control

Survey-datum elevations and a coordinate system have been permanently established at the ACRL. Construction limits and facilities are field-located using on-site monuments. Grade stakes control perimeter grading work, final subgrade surfaces, and cell construction limits. Filling operations are continuously monitored by landfill staff to ensure that appropriate grades are maintained.

4.2 Protection of the Bottom Liner

Certain precautions are taken in order to protect the bottom liner system. When initial operations begin in a cell, a minimum 4-ft thick, "fluff" layer of select waste is placed over the bottom liner system (leachate collection layer) to build the lift. The select material, general household waste free of C&D debris and special (bulky) waste items, is compacted by only a dozer and covered with soil to provide an additional protective layer before the normal landfill operating equipment and general waste is placed. The select waste oftentimes is also used to build the ramp and operations decks. Heavy vehicles, or those with a high contact pressure, are never allowed to operate directly on the leachate collection layer. Also caution must be used when working near the interior side slopes of the landfill or the perimeter edges, to avoid liner damage.

4.3 Nuisance Control

Asotin County utilizes several procedures to abate nuisances at the ACRL. These nuisances include blowing litter, dust, vectors, odors, and noise. Procedures to minimize these nuisance conditions at the landfill are listed below.

4.3.1 Litter

Litter generated at the ACRL is controlled through the compaction of waste, placement of daily cover, and regular collection of wind-blown litter on and around the landfill site (typically blown into the perimeter landfill fence). Litter is currently collected as necessary to

prevent health hazards and to maintain the aesthetics of the landfill facility and surrounding area.

4.3.2 Dust

Dust is controlled by minimizing earthwork during windy conditions, promptly covering excessively dry or powdery wastes with other waste or daily cover, applying water to moisten dusty waste or cover material, and reducing vehicle speeds on access. In addition, Asotin County currently uses an annual application of a synthetic dust control agent to control dust on unpaved, permanent access roads.

4.3.3 Vectors

Vectors which can create health hazards and nuisances include flies, mosquitoes, rodents and birds. There has been no documented vector problem at the ACRL. Through preventative measures such as proper spreading and compaction of the refuse and prompt application of daily cover material, it is expected that vectors will continue to not be an issue at the ACRL.

4.3.4 Odors

Odors are controlled in active areas by applying a daily and intermediate soil cover, and by the active landfill gas control system.

4.3.5 Noise

Noise levels of on-site equipment are controlled using proper mufflers. The impact of traffic noise on nearby residences is minimized by limiting operating hours of landfill equipment to the established hours of operation.

4.3.6 Smoke and Open Burning

As specified in the regulations, open burning of municipal solid waste is prohibited, abating any potential smoke nuisance. Smoking is only allowed in designated smoking areas near the landfill entrance.

5.0 Environmental Systems and Controls

Environmental systems and controls at the ACRL start with the proper design and construction of the landfill with quality bottom liner and leachate control and collection systems. These controls are supplemented with landfill gas collection and proper stormwater and erosion control measures during the filling operations. Groundwater is also routinely monitored at the ACRL.

The landfill facility is open to the ACHD and Ecology for inspection. A record for each inspection showing the date and time of inspection, the inspector's printed name and signature, the observations made, and the date and nature of any repairs or corrective actions will be maintained at the site for at least three years following the inspection. The objective of these regular inspections is to identify and correct irregular conditions before they impede operations or become a danger to human health or the environment.

5.1 Bottom Liner System

The bottom liner systems for the Active Landfill Unit (Cells A-D) meet the requirements of WAC 173-351. There is no bottom liner system in the Closed Landfill Unit, as the old landfill pre-dates these requirements.

The bottom liner system in the first modern cell, Cell A, consists of 24 inches of soil-bentonite (amendment), with a maximum permeability of 1 x 10-7 cm/sec, covered by a 60-mil high-density polyethylene (HDPE) geomembrane. The geomembrane is covered by 18 inches of drainage/operations layer material to protect the liner and to provide for leachate collection and drainage. Instead of the 24-inch-thick bentonite-soil layer, a geosynthetic clay liner (GCL) is used in Cells B-D. This was the first GCL to be used in the State of Washington and saved the County hundreds of thousands of dollars.

A reinforcing geotextile is also included in the bottom liner systems, for Cells B and C, along with mid-slope benches on the south interior slopes of the cells, to add strength to the geosynthetic layers. As a result of advances in liner material strength properties and additional testing, the design of Cell D eliminated the mid-slope bench and the need for the reinforcing geotextile. Similar to Cell A, 18 inches of drain sand overlay the bottom liner system for leachate collection and liner protection in Cells B-D.

Future Cell E is planned to use the same bottom liner system as Cell D. Leachate collection will also be similar but may use a composite drainage net instead of strip drains. The final design of the bottom liner system will dictate the types of geosynthetics and soil materials to be used for building Cell E. To optimize cell capacity and because of geometry and slopes, the leachate collection system in Cell E will be lower in elevation than Cells B-C, and thus, will require an in-cell leachate pumping station. A separate leachate pressure line will be connected to the main lift station or directly to the sewer system.

5.2 Leachate Control and Management System

Leachate, according to WAC 173-351, is "a liquid that has passed through or emerged from solid waste and contains soluble, suspended or miscible materials removed from such waste."

Operationally, any water that percolates through the waste in the landfill or has come in contact with uncovered waste is considered leachate and needs to be managed as such.

5.2.1 Regulations/Requirements

Each of the cells making up the Active Landfill Unit (Cells A-D and Future Cell E), also known as the modern landfill area, have engineered bottom liner systems with leachate collection. The leachate collection and control system (LCCS) is designed to keep leachate to 12 inches or less on the bottom liner, in accordance with WAC 173-351, *Criteria for Municipal Solid Waste Landfills*. The purpose of this requirement is to reduce the amount of leakage through the bottom liner system in case there is a hole or some sort of defect. The Closed Landfill Unit, however, was not constructed with leachate collection or a bottom liner system. That area was a trench-fill system where large trenches were dug, and the waste was dumped into the trenches. Leachate control is being achieved by an impervious closure cap, closed under WAC 173-304, *Minimum Functional Standards for Solid Waste Handling*.

5.2.2 Description of the Leachate System

The following are the key components and features of the leachate control and management system in Cells A-D. **Figure 1** (in **Appendix B**) presents a flow diagram of the leachate system for Cells A-D. **Exhibit 17** presents a construction photograph of Cell D, showing the leachate collection pipes, drainage sand layer

- **Leachate collection layer** – Each landfill cell contains a drainage layer of sand (and strip drains in Cells B-D) over the bottom liner system that collects and conveys leachate to the collection trenches on the floor and to the central sump. To enhance leachate drainage, strip drains were added on top of the geomembrane in Cells B-D. Each cell floor is sloped at about 2 percent from south to north, toward the leachate sump. The leachate collection trenches are installed with cleanouts at the top of the cell side on both the north and south ends. Refer to **Exhibit 17** showing construction of Cell D and the sand drainage layer.
- **Leachate collection trenches/sumps** – Each landfill cell has leachate collection trenches (perforated pipes encased in gravel and geotextile), which are installed along the centreline of the landfill floor. The trenches collect leachate from the leachate collection layer (drain sand/strip drains) within each cell and transmits it by gravity to the sump where it is conveyed to the leachate discharge pipe. Cell D also has a toe collector pipe that collects leachate that drains off the interior side slopes of the cell. Each of the leachate collection lines has cleanouts that surface at the shoulder of the landfill. **Exhibit 17** also shows the leachate collection pipes.

Exhibit 17. Cell D Construction Showing Sand Drainage Layer and Leachate Collection Pipes

- **Dual containment/leachate discharge pipe(s)** – Leachate collected in Cells B-D drain by gravity from the cells to the pump station through a dual containment line. Cell A discharges leachate separately through a gravity drain line directly to the leachate pump station.
- **Leachate pump station** – The leachate pump station is the point of discharge for all the landfill cells, and consists of a wet well, duplex system of submersible pumps, and float switches that operate the pumps. **Exhibit 18** shows the ground-level of the leachate pump station wet well and the control panel.

Exhibit 18. Leachate Pump Station

- Valve vault – The valve vault houses plug and check valves for the two discharge lines from the pump station. It also is the location where the two lines manifold together into the pressurized leachate force main.
- Pressurized leachate force main – Leachate is pumped from the leachate pump station to a sanitary sewer manhole (MH 11), where it drains by gravity to the City of Clarkston's Wastewater Treatment Plant. Domestic sewage from the landfill's administration building connects to the force main before it discharges to MH 11. Discharges to the WWTP are permitted through a State Wastewater Discharge Permit, which is renewed every 5 years.
- Magnetic flow meter – A flow meter is located immediately downstream of the force main connection with the domestic sewage line from the Administration Building (and the Decant Station), and therefore, records the wastewater flows from the combined facility.

5.2.3 Leachate System Maintenance

The following sections describe the maintenance required for optimal performance of the leachate system.

Leachate Collection Pipes and Discharge Lines

Leachate cleanouts have been provided around the perimeter of the landfill for the collection trench pipes and the leachate discharge lines, to allow routine cleaning/flushing. The central collection trench in Cell A is designed with one cleanout on the south end, and Cells B-D are equipped with cleanouts on both the north and south ends. There is also a toe collector cleanout on the north and south ends of Cell D. The south end cleanouts for all the cells are connected to the active landfill gas extraction system. The gas extraction system needs to be isolated from these cleanout lines during flushing. All cleanouts are or will be retrofitted with a camlock assembly, to allow quick-connection with a water truck hose line for flushing.

Cleanouts are also provided on the north end of the landfill for the dual containment pipe. These lines are not connected to the landfill gas extraction system but are retrofitted with a camlock assembly for flushing.

As best management practice, the collector pipes will be flushed annually with clean water and monitored at the leachate pump station for sediment levels (collect samples of the liquid with a designated bailer and visually observe the level of sediment and/or test with a turbidity monitor). Flushing operations will start with the north central collection trench cleanouts for Cells B-D, then to the south cleanouts to allow sediment and any debris in the line to be washed back down to the dual containment discharge pipe and eventually into the leachate pump station. Cell A should be flushed from the south access in conjunction with the other south cleanouts. Flushing should then progress from east to west along the dual containment pipe toward the pump station. The schedule for cleaning the leachate collection lines may be intensified or reduced, based upon the sediment level detected in the samples.

The leak detection system (vertical 18-inch riser pipe) on the dual containment line will be inspected semi-annually. Inspection are done by removing the manhole cover and blind flange assembly on the vertical riser pipe. Shine a flashlight down into the bottom of the riser and inspect for moisture. Also drop the water level meter probe down into the riser pipe to determine if there is any liquid pooling in the sump portion of the riser. If liquid is detected, collect a sample with a new disposal bailer unit and send the sample into the laboratory for analytical testing, following the leachate sampling procedures. Compare the laboratory test results with those from the leachate pump station. If the chemistry is similar, it is indicative that the liquid has originated from a leak in the dual containment line. Otherwise, if the analytical results indicate that the sample is "clean," it is more than likely a result of inflow/infiltration of precipitation into the sleeve pipe at the access. In either case, the landfill staff should contact the site engineer to evaluate the issue and contact Ecology and ACHD if it is found to be leachate. Note that this does not suggest that leachate has leaked from the sleeve pipe into the environment.

Leachate Pump Station

The leachate pump station is inspected annually, during periods of low leachate flow (summer). The inspection is done from the top of the concrete pad by opening the hatch and includes examining the station wet well for sludge buildup, structural integrity and the metal components for corrosion, to determine if structural repairs are necessary. The datasheets for the pumps are provided in **Appendix C**.

No employees are permitted to enter the enclosed area of the pump station. If maintenance needs to be done by entering the enclosed space, a professional will be contracted to perform the required work. Twice a year, during the biannual leachate sampling event, the pumps will be manually started for a short period to ensure that they are functioning properly and that there is not an appreciable level of sludge buildup on the bottom of the wet well. Manual operation of the pumps is done by switching the pump controls at the control panel from AUTOMATIC to HAND mode operation. Every 3 to 5 years, the pumps will be pulled, and performance tested and greased to ensure that they are running efficiently. Past inspections have shown that the pumps are in good condition and not enduring excessive wear and tear. The pumps are extracted by pulling them up by chains and

inspecting them for signs of corrosion and impeller wear. Regular inspection of the condition of the lifting handle and chain is important to ensure safe extraction of the pumps. Worn or corroded parts will be replaced on the pumps and general maintenance will be performed in accordance with the manufacturer's recommendations. Pump maintenance requires special tools, and thus, should be done by a professional. The ACRL uses a variety of service providers for pump maintenance depending on the need.

To date, buildup of sludge in the pump station wet well has not been an issue. However, in the event that sludge is found during routine inspections of the wet well, a professional will be contracted to evacuate the waste using a vacuum suction truck. The material can then be dumped at the decant facility to dry and then disposed in the landfill.

Every 5 years, the wet well should be leak tested (also during the summer period when there is not recordable inflow into the wet well) using a two-step process. Because there are no shutoff valves for the leachate drain lines going into the wet well, a more rudimentary approach of testing is required. The theory behind this approach is to fill the wet well with water over the normal operating liquid level and create as much head as possible to drive water out of any potential cracks in the concrete wet well structure. The first step in this process is to track the baseline inflow of leachate by first switching the pumps to the OFF position and measuring the depth to the liquid surface in the wet well using a water level sensor over a 4-hour period (1-hour reading intervals). There should be no net change in the surface. (Note that if there is leachate coming into the wet well, it will back up volume into the Cell A drain pipe during Step 2 and will cause an error in the net surface change reading.) For Step 2, fill the wet well with clean water from a water truck up to the invert level of the Cell A influent pipe (Elevation 1156 feet). (This may trigger a high-level alarm. If so, acknowledge the alarm.) Testing is then conducted over a second 4-hour period by tracking liquid surface elevations again in 1-hour intervals and noting the overall change in the depth to liquid surface (measuring from the same point of reference for Step 1). A leak is indicated by a drop in the depth-to-water surface reading during Step 2. If a net drop of more than a 0.1 foot (normal accuracy in reading the level sensor tape) is determined over the 4-hour period, redo Step 2. If two consecutive tests indicate a drop of more than 0.1 foot, then the wet well is considered to be possibly leaking and will require a more thorough inspection of the concrete structure by an outside professional contractor and possibly servicing the structure (such as a spray-on liner application). After testing, switch one of the pumps to the HAND mode until the liquid surface is back to the normal level. Then switch both pumps to AUTOMATIC.

Leachate Pump Station Alarm Response

A high-level float switch (set at elevation 1156 feet) causes the standby (backup) pump to turn ON when the lead pump cannot keep up with the inflow rate and triggers a high-level alarm at the nearby control panel. An alarm condition is also triggered during pump failure. The alarm is a two-phase process. First a high-pitched audio alarm will sound for a period of 20 to 30 minutes followed by illumination of a red light on the exterior of the control panel. It can be difficult for landfill staff to see the visual alarm if the audio phase has passed. As a result, the landfill has wired in a light beacon system to run up the south slope (south) and attach to the fence line at the slope shoulder.

To respond to an alarm, carefully approach the leachate pump station area and assess what may have caused the alarm to sound. If the area is safe to enter, and if the audio alarm is triggered, open the control panel and push the SILENCE button to acknowledge the alarm. Take note, if the operating lights for both pumps are illuminated. If they are both lit, this is an indication that the backup pump is operating and that there was a high-level alarm condition. Carefully open the wet well hatch and observe the liquid level to verify that it is elevated and is the cause of the backup pump to be triggered (the liquid will be level or higher than the Cell A discharge pipe). Allow the pumps to operate and routinely check on the system over the next several hours until the liquid level in the wet well drops down to normal operating levels. The RESET button may need to be pushed once the liquid level drops below the high-level alarm elevation to reset the system. If the liquid does not drop, this could indicate a pump failure condition or possibly extremely high flows entering the pump station. For pump failure conditions, pull the pumps and coordinate as needed with the pump service technician. For high leachate flows, follow the procedures under the Slug Discharge Plan section of the Leachate Discharge Plan.

Under pump failure conditions, again silence the audio alarm to acknowledge the alarm condition. Red lights in the control panel will illuminate below the pump number identification showing which pump has failed. Push the “RESET” button to determine whether the pump will restart. This may require that the pump be switched to “HAND” mode to manually override the float switches and start the pump. If the pump does not start after several iterations, contact the pump service company.

Valve Vault and Process System Piping

The valve vault should be inspected annually at the same time as the leachate pump station. The pumps in the pump station should be switched to the “OFF” position following standard lock-out/tag-out procedures while performing any maintenance on the discharge piping, fittings, and valves. Enter the valve vault under the confinement space entry procedures established for spaces at the landfill facility. Check the piping and valves for corrosion and the pipe connections for leaks. The shutoff (plug) valves should be inspected by manually operating them between the fully open and closed positions. Be sure to leave the valves in the open position.

To check the operation of the check valves, manually turn “ON” and “OFF” the pumps and check the exterior operation of the spring for movement from the open to close position. The valves should close completely so that water liquid does not drain back and through the pumps, which can be monitored by the liquid level in the wet well.

Flow Meter/Transmitter

No specific guidance from the manufacturer of the flow meter (FoxBoro) and transmitter for maintenance requirements is available; typically, these systems are maintenance free. Foxboro flowtubes are supplied by Sea-Port Controls of Vancouver, Washington. **Appendix C** provides the datasheets for the flow meter.

5.3 Groundwater Monitoring

Groundwater monitoring systems consist of a series of wells placed upgradient and downgradient of the landfill. The wells are installed in the uppermost aquifer (defined as the geological formation nearest the natural ground surface that is capable of yielding water). Samples collected from upgradient wells show the background (non-landfill impact) concentrations of constituents in the groundwater, while the downgradient wells show the extent of groundwater contamination caused by the landfill.

5.3.1 Regulations and Monitoring Network Overview

The groundwater monitoring network at the ACRL currently consist of a total of 14 wells (9 at the Closed Landfill Unit and 5 at the Active Landfill Unit). Leachate is also sampled from the pump station that services the Active Landfill Unit. Groundwater is monitored in accordance with WAC 173-351, and the most current version of the Groundwater Monitoring Plan [also commonly referred to as the Sampling and Analysis Plan (SAP)], which is incorporated by reference into this Plan of Operations. The SAP describes the objectives and procedures for the groundwater monitoring program at the ACRL. The program has undergone various stages and evolutions since 1997 to arrive at the monitoring program that is currently governing the monitoring activities at the ACRL. This includes a combination of detection and assessment monitoring programs that have been developed over the years as approved by the regulatory agencies.

Sampling includes a series of measurements and tests to check the static water level in each well and then purging the wells to produce representative water in the aquifer and testing field parameters. After collecting samples, a chain-of custody form is filled out and the samples are packed and shipped to a qualified laboratory for analyses.

5.3.2 Groundwater Well Maintenance

During each sampling event, each well is visually inspected for any signs of damage or tampering of the outer protective monuments, well casing, and the well cap and seal. The inspection notes are logged on the sampling forms. In case of damage, the sampling team will alert the Solid Waste Supervisor of the observed issues for repair. If there is a decline in the amount of water a well is producing, there may be a need to redevelop the well by mechanical and/or chemical means. Wells screens may clog up due to sedimentation or biological growth. When this occurs, the County will work with their site engineer to make a recommendation on how best to redevelop the well.

On occasion, well pumps will also need to be repaired or replaced. Most all of the wells have dedicated pumps. Those that do not use a baler to collect samples. Pumps will be replaced with the same type of pump or equivalent when the time comes.

5.3.3 Closed Landfill – MTCA Cleanup Action

The Closed Landfill Unit has been shown to have residual, low-level, groundwater contamination that is being mitigated as part of a cleanup program under Ecology's Model Toxics Control Act (MTCA). The Active Landfill Unit, which is not shown to be a source of observed contamination, is monitored to support the detection monitoring program under WAC 173-351.

5.3.4 Analysis/Reporting

Groundwater monitoring results are reported quarterly to Ecology and the ACHD along with groundwater levels, groundwater flow direction, groundwater flow rates, groundwater data quality, and statistical trend analyses.

5.4 Landfill Gas Control and Management System

The decomposition of waste in landfills produces landfill gas, mainly consisting of methane (CH4) and carbon dioxide (CO2), with trace amounts (typically less than one percent of the total landfill gas content) of other gases. These other gases include a variety of different non-methane organic compounds (NMOCs) such as volatile organic compounds (VOCs) that are often regulated as air pollutants. The ACRL actively collects landfill gas from above the geomembrane component of the bottom lining system in Cells A-D (and Future Cell E) and below the final cover system upon closure of the landfill. A gas control system is also being used at the Closed Landfill Unit of the ACRL, to extract volatile organic compounds (VOCs), as part of a voluntary clean-up action. All extracted gases are sent to the flare station for thermal combustion (burning).

5.4.1 Regulations/Requirements

General Landfill Air Quality Requirements

The Active Landfill Unit of the ACRL (Cells A-D and Future Cell E) is required to comply with WAC 173-351-200(4) and 173-351-200(5), that address explosive gas control and air criteria. The ACRL is also required to comply with the regulations for air pollution sources in accordance with WAC 173-400 and controls for toxic air pollutants per WAC 173-460.

The Federal landfill gas regulations, namely 40 CFR Part 60, Standards of Performance for New Stationary Sources, subpart WWW – Standards of Performance for Municipal Solid Waste Landfills (known as NSPS) and subpart Cf – Emission Guidelines and Compliance Times for Municipal Solid Waste Landfills (known as EGs) were published in the federal register on August 29, 2016 and became effective 60 days later on October 28, 2016 The NSPS rules are in effect for landfills that commenced construction, reconstruction, or modification after July 17, 2014. Under the NSPS rules, a modification is defined as “an increase in the permitted volume design capacity of the landfill by either horizontal or vertical expansion based on its permitted design capacity as of May 30, 1991.” Modification does not occur until construction begins on the horizontal or vertical expansion.

The provisions of this regulation apply to each MSW landfill that commenced construction, reconstruction, or modification on or after May 30, 1991. The active landfill unit (Cells A-D) of the ACRL was permitted and constructed after May 1991, and therefore, the ACRL must comply with subpart WWW (NSPS).

To be considered a regulated facility under the NSPS rules, a MSW landfill must have a design capacity equal to or greater than 2,500,000 cubic meters (m3) and 2,500,000 megagrams (Mg) (equal to metric tons). These same design capacity thresholds apply to Title V regulations. The combined capacity of the ACRL facility for Cells A-D (closure at elevation 1,320 ft – see below) is below the mass design capacity threshold and is unregulated under these rules.

Originally, the final closure elevation of Cells A-D was set at 1,350 feet. In January of 2018, an update to the Closure and Post-Closure Plan (Chapter 6 of the original permitting documents) lowered the closure elevation to 1,320 feet in order for Cells A-D to remain below the NSPS design capacity (mass) threshold. In the future, when the landfill expands laterally into Cell E, the plan is to also expand vertically back to 1,350 feet to regain the airspace design capacity of Cells A-D.

Since this modification (expansion laterally into Cell E and vertically back to 1,350 feet) will occur after July 17, 2014, the ACRL will eventually have to meet the requirements of 40 CFR Part 60, subpart XXX (or another subpart that is adopted in the future). The modification, as per the definition, however, will not take place until construction commences. In the meantime, the County plans to expand operations into future Cell E, excavating soil and using the material for cover, as the filling progresses and interim closure occurs in Cells A-D. Eventually, Cell E will be constructed, and the waste filling will transition into the cell. At that point, the ACRL will not have to comply with NSPS until the construction occurs (i.e., when the final grading and liner is installed in preparation for waste filling in Cell E).

New Contaminant Source Regulations

In pursuant to RCW 70.94.152, the County has secured a New Contaminant Source permit for the new flare station at the ACRL (Approval Order No. 18AQ-E039), as issued on October 8, 2018. The current version of the Approval Order is incorporated into this Plan of Operations by reference. The general provisions of the permit include (paraphrased – refer to the permit for actual language and the source-specific O&M Manual):

- **Equipment Requirements** – Shutoff valve at the flare station to isolate the flare from the wellfield; Gas flow meter must be installed on the main-line piping; and a automatic shutoff valve for the blower in the event of an extinguished flame at the flare.
- **Production** – Maximum flow of 600 standard cubic feet per minute (scfm); and no odor is allowed at the property boundary with corrective action requirements.
- **Emission Limits** – No visible emissions (zero opacity) is allowed at the property boundary; visible emissions onsite are not allowed to exceed 10% opacity; and visible emissions from the flare stack is not allowed to exceed 10% opacity.
- **Landfill Gas Control System** – the new system is required to be operational within 180 days of the of the Approval Order; all actively collected gas must be conveyed to the flare station; the flare needs to be operated at all times when the gas is collected and routed to the system; the enclosed flare must exhaust vertically without obstruction at a height no less than 25 feet; the Destruction Removal Efficiency (DRE) of the flare must be a minimum of 90% with a minim temperature setpoint of no less than 1400 degrees Fahrenheit (°F); and the wellhead temperatures must be operated at a temperature less than 131°F.
- **Testing** – Visible emissions from the flare need to be measured by EPA Method 22; Visible emissions from the landfill operations must be measured by EPA Method 9; and periodic texting of air emissions from the flare is not required but Ecology may require air emission testing; the stack needs to be installed with ports for monitoring the flare performance in accordance with 40 CFR and Method 2.

- **Monitoring and Recordkeeping –** Device must be provided to shutoff gas at the flare in case of an extinguished flame; a device must be installed on each wellhead to measure oxygen, temperature and landfill gas (methane) on a monthly basis; surface monitoring must be done on a monthly to identify physical changes or issues (settling cap, dead vegetation, surface cracking, ponding of water, and exposed waste) with records to be kept onsite; equipment must be properly operated and maintained at all times by properly trained personnel; complaints shall be logged and investigated within 24 hours; records need to be kept onsite for the 5 years; flare temperature needs to be continuously monitored with a minimum temperature of 1400 °F to achieve the minimum 98% DRE.
- **Operation and Maintenance Manual –** A source-specific O&M Manual is required; this manual will be prepared separately to meet the requirements of the Approval Order and is incorporated into this Plan of Operations by reference.
- **Reporting –** All notifications and reports need to be sent to the Air Quality Program of Ecology's Eastern Regional Office (Spokane); reports must include an annual summary of the fugitive dust from the roads, flare emissions, total landfill gas flared, landfill gas fugitives, and the annual total tonnage of waste received at the landfill.

5.4.2 Description of the Landfill Gas Control Systems

The original landfill gas control system at the ACRL was installed in the mid-1990s to collect gas from the old landfill (known now as the "Closed Landfill Unit") and portions of Cell A. Nine vertical gas wells (LGWs) were installed at that time, on the south perimeter of the old landfill, to cut off gas migration from the south landfill property line. Two monitoring stations (MS-1 and MS-2) were also constructed and connected to the Cell A leachate cleanout line (labeled LGT-1), followed by LGT-2, installed in about the fourth 8-10-ft lift of waste. The wells were connected to a flare station, generally consisting of two blowers, with one flare (open candlestick) stack. Several expansions and modifications to the system have taken place since it was installed in the mid-1990's, including extending the gas header line to Cell D, adding gas monitoring stations, retrofitting wellheads, adding horizontal collectors and wellheads, and this year (2018), the entire flare station (gas handling skid and flare) will be replaced. The new flare station will include a more modern gas handling skid with programmable logic control (PLC) and an enclosed flare.

In recent years, the collection system in the Closed Landfill Unit was converted to a vapor extraction (VE) system as a voluntary cleanup of the old landfill. The piping was decoupled from the flare station and sent to a separate blower system with direct vent to the atmosphere because of the poor-quality gas. With the replacement of the flare station with a more modern unit, the VE system will be reconnected to the flare station to burn the gases. The reconnection of the VE system will include a new monitoring station that allows for gas content and flow rate monitoring, separate of the gases that are extracted from Cells A-D and Future Cell E.

5.4.3 Landfill Gas Monitoring Systems

The following sections discuss landfill gas monitoring systems at the ACRL.

<u>Explosive Gas Monitoring</u>

The County uses a routine methane monitoring program for explosive gases at the ACRL. The concentration of methane gas may not exceed the lower explosive limit (LEL) at the facility property boundaries, in accordance with WAC 173-351. There are ten gas probes (GPs), located around the perimeter of the ACRL (refer to **Exhibit 19**). Four probes are located south of the Closed Landfill Unit (denoted as existing with stars in **Exhibit 19,** as they were preexisting before the newer probes were installed in 2009). Six probes are located on the remaining boundary of the landfill (both the Closed and Active Landfill Units).

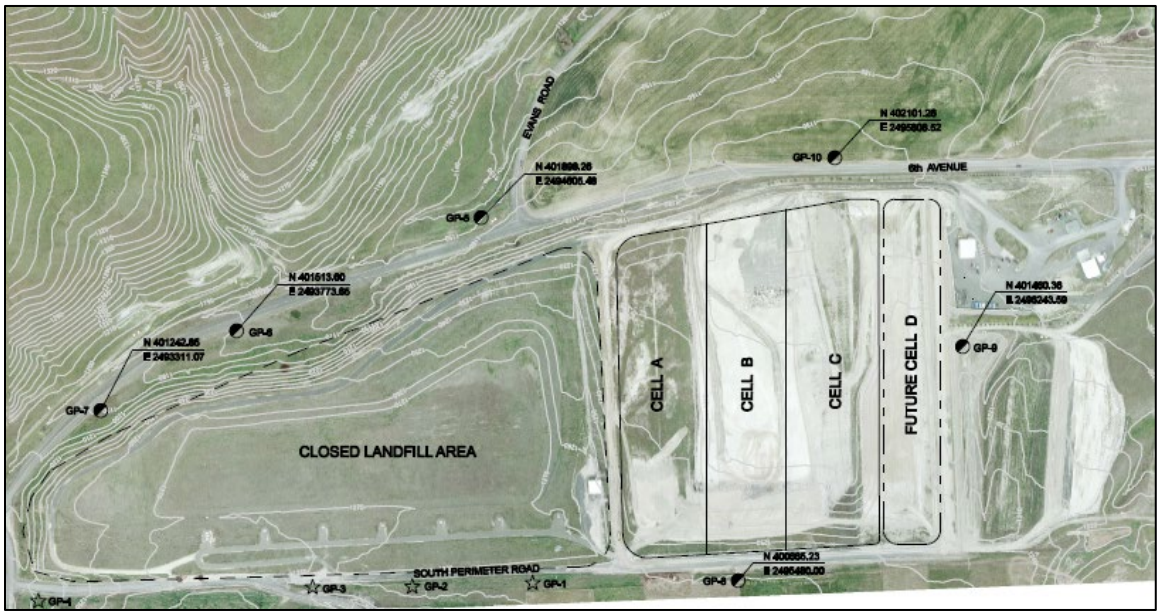


Exhibit 19. Gas Probe Locations

The original, four GPs are comprised of a shallow and a deep probe. The remaining six, installed in 2009, are comprised of only one probe. The gas probes are monitored quarterly and logged on a results summary worksheet (refer to **Appendix D**). The summary sheets are included as part of the annual gas monitoring report issued to Ecology and ACHD. **The gas monitor for the GP gas readings must be "bump tested" or calibrated each quarter with the results logged.**

When sampling GPs, it is important to purge at least 3 air volumes before taking a reading. This is to ensure that the ambient air, trapped within the probe, has been extracted and an accurate reading can be taken. **Table 2** below provides the details of each GP, as well as the time needed to pump out at least 3 air volumes, using a pump that operates at roughly 30 liters per minute (L/min).

Table 2 – Gas Probe Information and Purge Time

Gas Probe	Diameter (Inches)	Depth (Feet)	Volume (Liters)	Purge Time at 30 L/min
1-D	1	30	5	30 Seconds
1-S	1	15	2	30 Seconds
2-D	1	28	4	30 Seconds
2-S	1	15	2	30 Seconds

Gas Probe	Diameter (Inches)	Depth (Feet)	Volume (Liters)	Purge Time at 30 L/min
3-D	1	20	3	30 Seconds
3-S	1	10	2	30 Seconds
4-D	1	21	3	30 Seconds
4-S	1	10	2	30 Seconds
5	2	20	12	2 Minutes
6	2	30.5	19	2 Minutes
7	2	30.5	19	2 Minutes
8	2	79.5	49	5 Minutes
9	2	39.5	24	3 Minutes
10	2	40	25	3 Minutes

The concentration of methane gas may not exceed 25% of the LEL in nearby facility structures. As part of the methane monitoring program, methane concentrations are tested quarterly at the Administration Building, Maintenance Shop, and in the central sump of the MRW Facility. Particular attention is paid to lower than floor grade areas (such as floor drains) where gases might accumulate. Monitoring is performed in all confined spaces such as closed cabinets, along walls, and in corners of buildings. If gas concentrations exceed 25% of the LEL, they are immediately reported to the Solid Waste Supervisor, who will take the necessary corrective actions. The Solid Waste Supervisor will also report the situation to the County Engineer and ACHD.

WAC 173-351 also requires that no more than 100 parts per million (ppm) by volume of methane is permitted in offsite structures. However, there are no offsite structures that are influenced by the landfill and, therefore, none are currently monitored.

Gas monitoring instrument(s) will be routinely serviced and checked, if damaged. Instruments will be calibrated, according to manufacturer's recommendations. The Engineering Technician is trained in the use, function, and operation of the gas measuring instrument. All personnel are also safety trained for work around landfill gases and the landfill environment.

Flare Station

Monitoring systems associated with the flare station (air handling skid and flare stack) are included in the Flare Station O&M Manual. The most current version of the Flare Station O&M Manual is incorporated into this Plan by reference.

Active Gas Collection System (Cells A-D and Future Cell E)

The landfill gas system is routinely monitored for gas quantity and quality. Each of the monitoring stations is equipped with wellheads connected to LGTs, consisting of an orifice plate to monitor gas flow rate, valve to regulate vacuum and flow, and monitoring ports to sample and monitor the gas content. Monitoring of the landfill gas control system is accomplished by trained landfill personnel using a handheld gas meter. Monitoring activities

are reported to Ecology on a quarterly basis. The following sections describe the general gas system monitoring procedures that are implemented at the ACRL.

Vapor Extraction (VE) System (Closed Landfill Unit)

The VE system is routinely checked for gas quantity and quality. Similarly to the horizontal gas wells in the Active Landfill Unit, the vertical wells for the VE system are equipped with wellheads that have orifice plates, valves, and ports to check flow, gas content, and to regulate flow and vacuum. The procedures listed below for the Active Landfill Unit generally apply to the VE system, however, there are also specific procedures for the VE system provided in the in the *Operations, Maintenance, and Monitoring Plan for the Vapor Extraction System*. The most current procedures should be followed for the VE system and are incorporated into this plan by reference.

The VE system monitoring station (refer to **Exhibit 20**) is located south of the flare station, between the main manifold gas cross and the tee. The VE monitoring station includes a flowmeter and gas and temperature ports, accessed via a spring-loaded vault. The flowmeter has a remote readout display, located on the electrical rack, north of the vault (refer to **Attachment C** for the flowmeter datasheet). Readings should be taken at the VE system monitoring station, monthly. Flow, as well as gas concentrations and temperature should be recorded.

Condensate build up in the main manifold is drained into a condensate sump, west of the vault via a p-trap that isolates the condensate from the gas line. Between the manhole vault and the gas monitoring vault is a riser that allows access to the p-trap. This line should always be charged with liquid to make sure the line is isolated. A submersible pump sits within the sump manhole, and a high-level sensor triggers an beacon alarm if the condensate builds up to a preset high level (refer to **Attachment C** for the pump datasheet). Condensate is pumped out of the sump via a 2-inch line connected to a camlock fitting. Electrical panels sit north of the station. Within them are housed the flowmeter readout, pump controller, and power supplies. A convenience outlet is located below the panels.

Exhibit 20. VE System Monitoring Station

5.4.4 Active Gas Extraction System Wellheads

General Wellhead Monitoring

Each wellhead must be checked for gas flow, pressure, methane content, carbon dioxide content, and oxygen content on a routine basis. The following steps describe the monitoring procedures that shall be employed:

1. Before leaving the office, ensure that the GEM instrument has been recently factory-calibrated (within the recommended time period per the manufacturer's recommendations). **At least once per month, perform a "bump test" on the instrument, to check that the meter is reading the calibration gas concentrations accurately and log the test results.**
2. Connect the GEM instrument to the static test port (upstream from the orifice plate), making an airtight fit. Record the static pressure (vacuum) reading.
3. Take gas content readings for methane, carbon dioxide, and oxygen at the static test port. For readings outside the normal operating range (refer Acceptable Ranges below), repeat the readings to eliminate the possibility of an error.
4. Collect the flow rate reading by attaching the "dynamic pressure" hose of the GEM instrument to the system pressure port, while the static line is still connected. The GEM instrument automatically computes volumetric flow rates, based on the velocity for the calibrated orifice plate. Make sure that the correct orifice plate size is entered into the GEM instrument for proper flow rate calculations.
5. Store each reading in the instrument and download when returning to the office. If taking manual readings, log the readings in the field and enter them into the spreadsheet in the office.

Orifice Plate Sizing/Change-out

The QED precision wellheads uses a Quick-Change™ orifice plate assembly to allow changing to the correct plate size based on the flowrate. Achieving a pressure drop between 0.5 inch and 6 inches of water column across the plate is essential to generate stable and accurate flow readings. **Exhibit 21** shows the flow rate curves for the different size plates with an ideal range of 1.0 – 5.0 inches of water column.

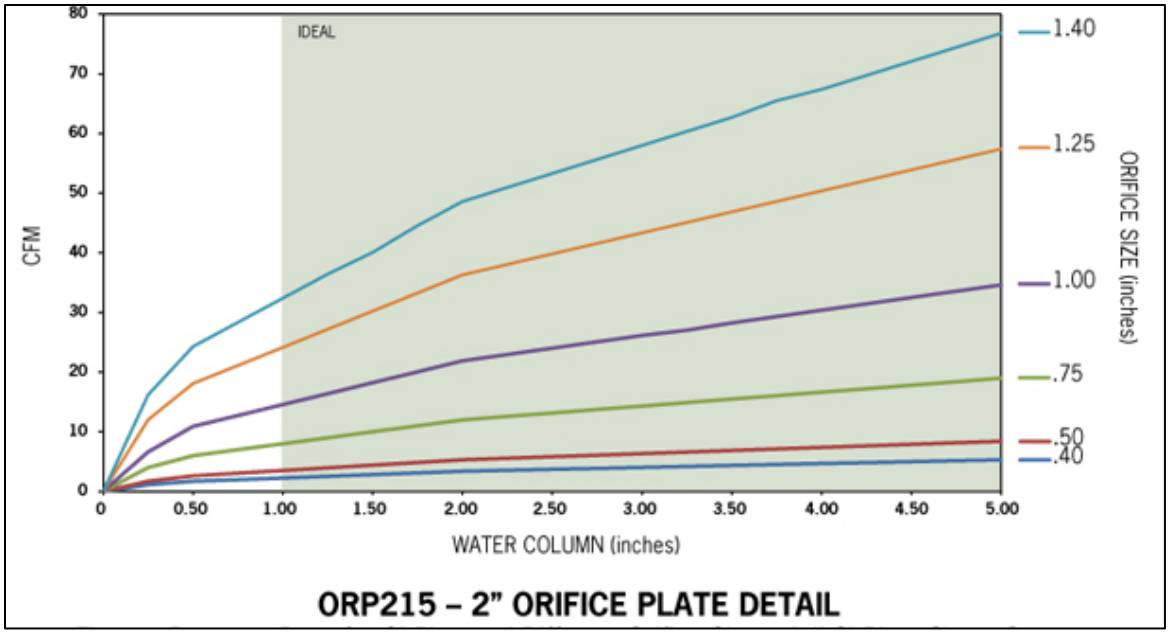


Exhibit 21. Orifice Plate Flow Curve

Monitoring Frequency

Bring wellheads online once the waste begins to generate sufficient landfill gas. This timeframe is typically on the order of 1 to 2 years after the waste has been placed in the influence zone of the well.

The gas monitoring stations should be checked on a weekly or biweekly basis, depending on the stability of the wellfield. When new wellheads are first brought online, monitoring will need to be more frequent (daily or every other day) until some experience is gained with the flow rate, gas constituent concentrations and temperatures. Oftentimes, the new wells will generate good quality gas at first and then will dissipate once the accumulate gas has been drawn off. Adjustments should continue until relatively steady state conditions are achieved.

Monitoring should continue as long as the gas control system is operational. Monitoring may be terminated after the LFG control system is no longer needed to maintain low gas pressures in the landfill. This will occur long after landfill closure, when it is impossible for the gas extraction system to maintain a sustainable gas flow rate because of low gas production, and no significant fugitive air emissions or gas migration are occurring. When this occurs, the plan is to convert the active system to passive wellheads and vent the gases to the atmosphere. Air quality testing will need to be conducted in advance of the conversion to ensure that the emissions do not exceed permissible levels.

In accordance with WAC 173-400, a Notice of Construction (NOC) Permit is required to install a new source of air pollution or modify an existing source of air pollution. The new flare station falls under the classification of a modification to an existing source, and as such, NOC reporting requirements apply. Approval Order No. 18AQ-E039 was issued to the ACRL on October 8, 2018. In accordance with Condition 9, the ACRL must report annually to Ecology. Refer to the Approval Order for the specific reporting requirements.

Table 3 presents a summary of the landfill gas monitoring activities and frequencies. Those that are required per Condition 7 – *Monitoring and Recordkeeping* of the Approval Order are noted in the table as such.

Table 3 – Summary of the Landfill Gas Monitoring and Frequency at the ACRL

Measurement	Frequency
Landfill Gas Collection System Flow Rates	Log weekly at the Flare Station using station's flow meter readout and weekly or biweekly for the rest of the collection system using the GEM meter when doing wellfield collections/ adjustments.
Landfill Gas Collection System Temperatures	Log weekly at the Flare Station using the stations temperature readout and weekly or biweekly for the rest of the collection system using the GEM meter when doing wellfield collections/ adjustments. The flare temperature is required to be continuously monitored and ne a minimum of 1400 °F to maintain the minimum Destruction and Removal Efficiency (DRE) of 98%.*
Atmospheric Pressure	Log weekly, or more frequently if taking/adjusting wellfield using the GEM meter barometric pressure readout.
Methane Concentrations	Collect Weekly at the Flare Station and once a week for the rest of the collection system using the GEM meter.
Landfill Operation Emissions – General *	On occasion, but at least monthly, and especially during windy/dusty days, perform visual determination of landfill operation fugitive emissions noting "Dust" or "No Dust" or other emissions leaving the site at the property boundary (no visible emissions are allowed at property boundary and only 10% opacity onsite in the in the vicinity of landfill operations); Quarterly perform visual fugitive emissions monitoring at the site boundary using EPA Method 22. Ecology has the right to perform more sophisticated visual testing of the landfill operation emissions using Method 9. Refer to Air Quality Permit for additional information.
Flare Stack Emissions*	Once a week perform visual determination of fugitive emissions from the flare stack noting ("Smoke" or "No Smoke") observations using Method 22); Ecology has the right to perform more sophisticated opacity tests using Method 9 to determine if opacity is greater than 10%
Vapor Extraction System – Wellfield and VE Monitoring Station	Refer to the VE System Workplan for the operation, flow rate readings and testing requirements.
Landfill Surface Monitoring*	Monthly basis, and shall include, but not be limited to, identification of the following conditions: settling of cap, dead vegetation, erosion, ponding of water, surface cracking, acceptable vegetation, and exposed waste in the gas extraction areas.
Record of Complaints*	Keep a record of complaints (related to air quality and the emissions equipment) as received by the public, Ecology, or other entity. Complaints shall be investigated promptly (within 24 hours). A record shall be maintained of the investigation and what, if any, corrective action taken in response to the complaint. Ecology shall be notified within 3 days of receipt of complaint.

Notes: *Required per Condition 7 – *Monitoring and Recordkeeping* of the Air Quality Permit Approval Order.

Measurements are obtained at the flare station using gauges included with the Perennial Energy Inc. (PEI) Flare Station and taking methane readings using a GEM meter. All

measurements obtained from gas extraction wells and the VE system wells and monitoring station are also collected using a GEM meter. The GPs and other LEL level type readings are collected using a 4-gas handheld meter.

Acceptable Ranges

The three primary operating parameters that are monitored in a landfill gas collection system are: 1) methane content; 2) oxygen content; and 3) flow rate. Carbon dioxide concentration and temperature are also important and should be measured as a check on the primary operating parameters. Each of these are explained in more detail below.

- **Methane Content —** Methane content is measured at each wellhead and at the flare station. Operators may either store the readings in the GEM instrument and download into an electronic database or record them on field logs. If a low methane content is encountered, the well may be overdrawing or pulling air from the surface (also considering oxygen levels). Adjust the well vacuum as instructed below to maintain a methane level of 40 percent or greater while maximizing gas flow.
- **Oxygen —** Oxygen concentration in LFG should be maintained below 2 percent. Oxygen above this level could indicate air intrusion into the well and should be monitored closely. The LFG flow rate from a well with oxygen concentrations in this range should be decreased.
- **Flow Rate —** Flow rates are measured primarily to provide a guide for adjusting the wellhead to achieve the desired well pressure and methane concentration. Normal operating ranges for individual well flow rates will vary because of heterogeneities in the waste fill materials, age, moisture content, etc.
- **Pressure —** The normal operating range for vacuum (negative pressure) for the gas extraction wells should be based on experience with the system. Too much vacuum will increase flows beyond the generation rate of LFG in the refuse, and oxygen intrusion may occur. Alternately, too little vacuum pressure will not provide sufficient influence around the well piping and gas will not be collected efficiently.
- **Temperature —** Never allow the temperature of gas from extraction wells and trenches to exceed 131 degrees Fahrenheit (°F). If this occurs, close the gate valve and monitor the other neighboring wells. In general, the temperatures at the ACRL are less than 100°F and this should be the upper limit before having to adjust. Readjust, as necessary, to bring the extraction line back online during the normal monitoring schedule. Typically, high temperature is coincident with high oxygen and carbon dioxide content. These parameters should be looked at in combination with any elevated temperature readings. Some landfills are known to have elevated temperatures but the ACRL is not one of these landfills.
- **Carbon Dioxide to Methane Ratio —** The ratio of carbon dioxide to methane content should not be allowed to exceed 1.2:1. An excessive ratio typically indicates air infiltration and aerobic conditions in the landfill, which can lead to overheating and potentially to a landfill fire. Adjusting the flow rate downward will increase the methane concentration and consequently reduce the carbon dioxide-to-methane ratio. The adjustment should also be watched with the oxygen content and methane levels.

Wellfield Adjustments/Balancing

The wellfield is balanced by adjusting the wellheads and at the air handling skid.

It is important to not make too many adjustments at any one time. Each wellhead is influenced by another. Adjust only one or two wellheads at a time to fine-tune the wellfield.

Each wellhead has a valve to adjust the flowrate and vacuum pressure induced on the well. An addition, each well has an orifice plate to measure flow rate, and a monitoring port to check gas content.

The process of adjusting a wellfield is iterative and includes the following four general steps:

1. During or immediately after a monitoring round, determine which wells are outside their normal operating range, or any that can be adjusted for better optimization.
2. Estimate the amount of valve adjustment that should be necessary to achieve the normal operating range. The precision wellhead valves have a relatively linear adjustment and have markings to indicate the percentage that they are open. Opening valves will tend to decrease the methane content and increase the vacuum and flow rate.
3. Once the adjustments are made and after the system has stabilized (usually wait a minimum of 1 hour after adjustments are made), take another round of sampling and note how much the adjustment changed the operating parameters.
4. Adjustments can also be made at the air handling skid by changing the blower draw, by either valve adjustments and/or adjusting the variable speed drives (VFDs) on the blowers. The entire wellfield will be impacted by making adjustments to the vacuum pressure/flow rate at the air handling skid. Take extra precaution in doing this and make only small adjustments.

5.4.5 Landfill Gas System Maintenance

During routine monitoring of the LFG system, as discussed above, system components are visually inspected. Wells with excessive moisture in them, as observed in the monitoring port tubes or any well pipes that are surging, should be drained and inspected. Wells that have a sudden increase in oxygen content should be inspected immediately for pipe breakage at or near the station or a bad gasket or O-ring seal.

Maintenance of the flare station will follow the manufacturer's recommendations as included in the O&M manual. Refer to that manual for further information and instruction, which is incorporated into this plan by reference.

5.5 Stormwater and Erosion Control

The primary purpose of the stormwater control facilities is to collect, convey, and discharge runoff from closed and intermediately closed areas, in order to minimize infiltration through the cover system, and minimize the amount of water that comes into contact with refuse (i.e., becomes contaminated) and needs to be managed as leachate. Erosion is controlled by use of various measures to minimize soil transport by wind and water.

The Closed Landfill Unit is covered with an impermeable cover to mitigate infiltration of stormwater into the underlying waste. Active landfilling areas within the Active Landfill Unit are graded to shed water to the inside fill zones and/or surrounded by a perimeter berm to catch stormwater to infiltrate into the waste mass before running off. Intermediately closed areas are covered with an interim cap of no less than 12 inches of soil. Where the landfill grades are above the perimeter roadway in these areas, stormwater is allowed to shed into interior roadside ditches and managed through the stormwater system. In areas below the roadside grades, the water is managed as leachate.

Erosion control features on the intermediate closed areas of the landfill include hydroseeding and straw bales/waddles. Water in areas that are below the roadway infiltrates into the waste profile and eventually ends up and is managed in the leachate collection system. Interim runoff control berms will also be constructed at the same locations, established for the final runoff control berms, as shown in the current version of the ACRL's Master Development Plan.

Best practices for erosion control will be employed as necessary during normal landfill operations and earthmoving activities. Temporary berms, straw bales, plastic sheeting, and ditches may be used to control surface water runoff and erosion of bare earth. Other best management practices (BMPs) for stormwater and erosion control that may be used includes the following:

- Check dams (rock, sandbag, and/or geotextile encased)
- Silt fences
- Temporary cover measures (such as straw mulch and tackifier)
- Erosion control matting

5.5.1 Stormwater Control System Maintenance

Areas with intermediate soil cover will be inspected for poor vegetative growth (which maybe a sign of fugitive landfill gas emissions) and erosion. Areas where there are signs of concentrated flow (channeling), will be filled in and intercept berms, or other measures to reduce the energy of the stormwater flow into these areas, will be built if the problem persists.

Ditches and culverts are regularly inspected and cleaned, if necessary, and repairs made if erosion is noted. Drainage structures and ditches will be cleaned of debris as soon as such problems are identified, to prevent damming and ponding. When unlined channels silt-up or become overgrown with vegetation, routine cleaning will be required to restore the original capacity of the channels.

Major damage of stormwater and erosion control features will be repaired promptly. Structures with minor damage that still allow the features to perform as intended will be repaired during dry weather seasons. A backlog of repair work may be accumulated so that a full day's work can be scheduled for a repair crew. During the wet season, repairs will be made as soon as possible to prevent further damage to the structure or erosion of soil.

6.0 Records and Reporting Duties

Record keeping is performed daily, and summary reports are prepared on a monthly basis. All vehicles entering the landfill site are recorded into the computer system by customer category, commodity, and type of account. Inspections and reports to the ACHD and Ecology are performed by various personnel on monthly, quarterly, and/or an annual basis. Record keeping responsibilities for the MRW Facility are presented in the *MRW Facility Operations Plan*.

6.1 Scale Attendant

1. Daily:
    1. Enters data on all vehicles that use the landfill to include date; time; gross, tare, and net weight; waste type; customer category; and type of account; the types of accounts include cash, charge, and no charge
    2. Runs daily landfill report, and backs up database files at the end of each day
2. Weekly:
    1. Collects accounts receivable receipts received during the week and figures breakout of refuse collection tax, separating funds where appropriate; enters appropriate information in payments file in landfill program and database program
    2. Fills out treasurer fund breakdown and sends one copy with a set of deposit slips to the County Treasurer's office while also filing one copy and one set of deposit slips for reconciliation
3. Monthly:
    1. Runs monthly and year-to-date reports including activity summary, tax summary, summary by group, and list of accounts showing current balance
    2. Reconciles bank statement with computer generated report, using "Checkbook" spreadsheet and deposit slips
    3. Reconciles Treasurer's revenue ledger with computer-generated reports and copy of Treasurer's fund breakdown
4. Annually:
    1. Performs data purge to clear all data files and resets prior year balances; deletes unnecessary accounts and modifies coding for commodity, category, price, etc., as needed; completes spreadsheets for tonnage, revenue expenses, and graph updates

6.2 Engineering/Landfill Technician

1. Weekly:
    1. Records landfill gas flare readings at the flare station (flow rate, temperature, atmospheric pressure, and methane concentrations)
    2. Records landfill gas wellhead readings weekly or biweekly (percent of valve open, temperature, and methane concentrations)
2. Monthly:
    1. Prepares monthly recycling report

2. Prepares monthly MRW report
3. Keeps track of environmental control system repair status
4. Performs stack air emissions observations and logs results.
5. Surface monitoring of the closure cap and gas extraction/collection network inspection at the closed landfill unit and intermediately closed areas of the active landfill unit.

3. Quarterly:
    1. Supports the preparation of quarterly groundwater monitoring reports by the County's engineering consultant, including groundwater sampling data (both analytical data and field parameters), statistical analysis, notification of any statistical increases or concentrations above MCLs, static water level readings, groundwater hydrograph plots, and cation-anion balances
    2. Prepares inspection reports on the facility including:
        a. Overall operation (litter, proper cover, fences, etc.)
        b. Groundwater monitoring system
        c. Leachate Pump Station
        d. Landfill Gas Systems,
    3. Maintains and analyzes groundwater, leachate, and landfill gas sampling data records; enters test results into statistical spreadsheets; prepares graphs as necessary, and reviews data for problem areas
    4. Submits grant funding payment requests to Ecology
4. Annually:
    1. Supports the preparation of annual groundwater monitoring reports prepared by the County's engineering consultant, including statistical analysis
    2. Prepares inspection reports on the facility including: gas control system, leachate system, and stormwater control system.

6.3 Equipment Operator

Monthly:

1. Conducts random inspections of commercial loads
2. Maintains records on equipment repairs and maintenance

6.4 Solid Waste Supervisor

Annually:

1. Completes the annual reports, including information on facility activities during the previous year (i.e., facility location, facility contact, operational and/or post closure information, permit status, compliance information, facility capacity information, and information on violation of ambient standards for surface water and explosive gases, whose monitoring is required by WAC 173-351 or performed as part of the permit issued under WAC 173-351-700)
2. In accordance with WAC 173-351-200 (10), keeps the following records in the landfill receiving office: operating permits, inspection records, training records and procedures, safety meeting minutes, notification procedures, procedures for excluding the receipt of hazardous waste, inspection documents

associated with the plan of operation, gas and water monitoring results and related records, records of any major deviation from the plan of operation, and daily records of weights and types of waste (These records are available to ACHD and Ecology, and they are notified, as required by WAC 173-351-200 (10)(b))

6.5 County Engineer/Public Works Director

Annually:

1. Reviews reports as necessary and sign-off with input and coordination with the Solid Waste Supervisor.

7.0 Site Safety and Health Plan

This Site Safety and Health Plan (SSHP) is intended to serve multiple purposes. It ensures that health and safety concerns are addressed, as required by applicable regulations. In addition, it provides the landfill management personnel sufficiently detailed information to implement the plan, including reference material and guidance for the landfill personnel. Also, the SSHP is used as the basis for training landfill employees about the hazards related to working at the landfill and establishes measures for worker protection and site control. The SSHP will be updated or amended if the design, operation, construction, or maintenance of the landfill materially changes.

7.1 Field Activities

Standard field activities include waste screening, waste spreading and compaction, application of daily cover material, minor earthmoving and road-building, leachate and landfill gas collection system operation and maintenance, equipment maintenance, and monitoring landfill gas and groundwater conditions.

7.2 Key Personnel and Responsibilities

The County Engineer/Public Works Director has overall management responsibilities of the Asotin County Solid Waste Division. The Solid Waste Supervisor manages the landfill operations and reports to the County Engineer. The Solid Waste Supervisor is responsible for generating, organizing, and compiling the SSHP and maintaining records of occupational injuries and illnesses. This person is responsible for ensuring that training is provided to all employees and that each employee is provided a copy of the SSHP.

The Solid Waste Supervisor also ensures that all employees comply with the SSHP and informs employees of new hazards, as they become evident. This person has the authority to monitor and correct health and safety problems. Additional responsibilities include providing site safety briefings for employees, documenting compliance with the SSHP, updating safety equipment or procedures to be used on site, and posting location and telephone numbers of emergency services on a dedicated “safety” bulletin board.

Other landfill employees and operators are responsible for ensuring that field work is performed in accordance with the SSHP, and that deviations from this plan are based upon field conditions encountered and are well documented in field notes. Additional employee/operator responsibilities include reporting to the supervisor any unsafe condition or practices, reporting to the supervisor all facts pertaining to incidents which result in injury, and reporting to the supervisor any equipment malfunctions or deficiencies.

7.3 Training

The safety training program is directed towards employee work functions that could potentially lead to injury and/or property damage. This program addresses standard operating procedures such as accident prevention, lifting injuries, operating landfilling and environmental monitoring equipment, and decontamination. Emergency procedure training

includes CPR/first aid, fire protection, and hazardous waste identification and handling. Specialized household hazardous waste training is provided for personnel working in the MRW Facility.

This training program is conducted semi-annually, with comprehensive classes, during the first year for each field employee, and refresher courses thereafter. The Washington State Department of Labor can assist in health and safety consultation, safety program development, and safety training.

7.4 Accidents

In the case of an accident, there are a series of forms that need to be completed. These forms are included in **Appendix E.**

7.5 Standard Procedures

A number of employee safety requirements are mandated by the State of Washington. The most relevant to standard operating activities at the landfill include the following:

- WAC 296-24 General Safety Standards
- WAC 296-27 Record Keeping and Reporting
- WAC 296-62 General Occupational Health Standards
- WAC 296-65 Safety Standards for Construction Work

All operating activities will be performed in accordance with these regulations. The following are brief descriptions of the most prevalent landfill safety concerns and associated operating procedures.

7.6 Puncture Precautions

Personnel working around solid waste must be continually aware of sharp and jagged items, moving machinery, and falling objects. Protective clothing can be effective in reducing and eliminating injury, including safety shoes, gloves, hard hats, safety glasses or goggles, respirators, and brightly colored reflective vests and clothing.

7.7 Dangerous Wastes

As previously discussed, dangerous wastes not considered household hazardous wastes are prohibited from being disposed at the ACRL. It is possible that such wastes may inadvertently or illegally be delivered to the landfill with other wastes, or in carelessly discarded containers. Landfill employees should be suspicious of drums, bags, or boxes containing any solid sludge or liquid materials. Labels may be an indication of such materials but should not be totally relied upon. All wastes should be visually screened for identification upon entering the site, in accordance with the hazardous waste detection and prevention program.

7.8 Leachate Safety

Landfill employees should be aware of the dangers associated with leachate. Leachate can have high levels organic content and elevated chemical levels that can cause rashes or burns upon contact with skin. Physical contact with leachate should be avoided. Leachate can also harbor dissolved landfill gas containing high levels of methane and other landfill gas constituents (such as hydrogen sulfide and volatile organic compounds). When performing leachate sampling, proper PPE should be donned; the following additional safety issues should be considered:

- Preservatives used in sample containers (such as nitric acid) are corrosive in nature. Handling and storage of corrosive materials should follow Material Safety Data Sheet (MSDS) information and recommendations, which are provided in the ACRL MSDS binder located in the MRW Facility.
- Sample collection at the leachate pump station should be undertaken in a manner that minimizes potential safety hazards associated with physical access and sample retrieval. The lid to the pump station manhole requires removal for sample collection, and, therefore, caution should be taken when standing over the opening. Also, landfill gas accumulates in these areas and should be evaluated during the walk-up to the area and during sample collection. Sampling of leachate from the leachate pump station should only be performed by an experienced and trained landfill employee who is familiar with the leachate system and the overall safety concerns of leachate and landfill gas.

7.9 Landfill Gas Safety

Landfill employees should be aware of the dangers associated landfill gases. Landfill gas could present toxic or explosive atmospheres in unventilated spaces. Testing of potentially dangerous areas such as excavations in refuse and utility spaces must be conducted prior to working in or entry into such a space. If such a situation arises, a confined space entry program must be developed, and employees must be trained before any confined space entry is permitted.

7.10 Chemical Hazards

Chemical hazards are present when performing groundwater sampling. Groundwater monitoring personnel should wear protective gloves, eye wear, and aprons when using chemicals for calibration or for preservation of samples. Groundwater monitoring personnel must wear gloves to prevent exposure to groundwater or contamination of samples.

Other chemical hazardous exist at the MRW Facility. Consult the *MRW Facility Operations Plan* for more information.

7.11 First Aid

In case of an emergency, first-aid kits and dry chemical fire extinguishers are provided in the office building, all landfill vehicles, and all major operating equipment. Personnel are expected to be familiar with their location, use, and operation. All landfill personnel have current CPR/first aid certification.

7.12 Emergency Procedures

Landfill employees are trained to respond to emergencies in an efficient and timely manner. Employee training stresses protection of public health, maintaining environmental quality, and resuming normal operation of the facility as quickly as possible. Planning for an emergency saves valuable time in the event of a hazard. A posted emergency response directory is located inside the Administration Building and includes the telephone numbers and locations of local police, state police, fire department, ambulance and rescue services, poison control center, hospitals, supervisor of operations, power authority, ACHD, and Ecology.

Possible specific events that may require corrective actions and immediate follow-up response procedures are listed below.

7.13 Emergency Situation Response

When an emergency situation is apparent, the response should be as follows:

1. Assess the condition and its impact upon human lives, public health, the environment, and the operation of the facility.
2. Provide for the safety/first aid of all persons onsite at the time of event.
3. Dial 911 for police, fire department, or medics, if necessary.
4. Contain and prevent the spreading of the hazard by constructing physical barriers, if appropriate.
5. Notify the County Engineer and Solid Waste Supervisor and other appropriate County personnel, utilities, and regulatory agencies to receive direction as soon as possible.
6. Restore the facility to normal operation.

Remedial efforts will continue until the facility is restored to its normal operating condition.

7.14 Earthquakes

If an earthquake occurs at the landfill, the first priority is to respond to any life-threatening situations and provide first aid for any injured persons. Once this immediate action is taken, all operating landfill equipment should be shut down and inspected. Damages resulting from the earthquake must be assessed to determine any necessary further action. If the earthquake damages the facility so that structures or equipment are out of service, waste may need to be rerouted to another facility. Take special precautions of operating around waste slopes during or after an earthquake. These areas can become instable and are known to fail.

7.15 High Winds

High winds could potentially topple power poles and blow debris. Should a power pole be damaged, immediately notify the local power authority and the Solid Waste Supervisor.

7.16 Explosive Gases Exceedances

Refer to **Section 5** for explosive gas monitoring. If excessive landfill gas odor is uncovered, it needs to be immediately reported to the Solid Waste Supervisor.

7.17 Volcanic Eruptions

As demonstrated by the 1980 eruption of Mount St. Helens, the possibility of a volcanic eruption exists. Personnel should take direction from area-wide emergency response staff for their personal health and safety. If the landfill experiences an ash fall, the site's operating equipment could be severely affected if ash is drawn into air induction systems. Ash fallout can be very abrasive and can seriously damage engines and other moving parts.

7.18 Explosions

If an explosion occurs, injured persons should be removed from the immediate area and given first aid. The Asotin County Fire District No. 1, the County Engineer, and the Solid Waste Supervisor should be contacted. The gates to the landfill should be closed to all but emergency vehicles. Further explosions may be prevented by isolating the source of explosion and possible ignition sources.

7.19 Fire

Landfill facilities are subject to a variety of different scenarios that may cause fires. Fires may occur in buildings started by faulty electrical wiring or equipment, chemical fires in the MRW Facility, or other such causes. Landfill equipment and vehicles may also cause fires. Equipment fires are generally started by an electrical failure and subsequent spreading to oil and grease on machinery and then to waste areas.

Two types of fires are generally common in landfills – surface and underground fires. Surface fires involve recently received or buried waste situated on or close to the landfill surface, generally no more than 4 feet deep. These fires may be intensified by fugitive landfill gas (methane) emissions, which may cause the fire to spread. Surface fires are commonly caused by dumping smoldering materials into the landfill that are still burning (known as "hot loads"). Hot ashes and cinders are the typical culprits. Other sources are cigarettes or hazardous substances that ignite when they are mixed with other chemicals (also known as spontaneous combustion). Rechargeable batteries are also known to cause fires and should be handled through the MRW Facility.

Underground fires in landfills occur deeper below the surface and involve waste materials that are months to years old. These fires can be much more difficult to extinguish than surface fires and can also cause large voids in the landfill causing cave-ins. The most common cause of underground fires is an increase in oxygen content from active gas systems pulling too much vacuum and drawing in ambient air. High temperatures can result and when these areas come into contact with pockets of methane it can cause a fire.

In case of a minor fire, personnel may use a fire extinguisher while exercising care in not putting themselves at risk. Fire extinguishers are located at the Administration Building,

MRW Facility, Maintenance Shop and on landfill equipment. In case of a major fire, or if at all questioning the magnitude or severity of the fire, personnel should leave the area of the fire, notify the Asotin County Fire District No. 1 by calling 911, and notify the Solid Waste Supervisor. The gates should be closed to all but emergency vehicles.

In the landfill area, if a fire is on or near the surface, a fire extinguisher may also be used again if personnel are not put into harms-way. Dirt can also be placed on the fire to smolder it and/or water applied to the fire using the water wagon (if not a chemical fire).

In case of an underground fire at the landfill, the burning area may need to be excavated evidenced by unusual or rapid settlement, smoke emissions, combustion residues in landfill gas control system, or elevated landfill gas temperatures.

Always exercise caution in working around these areas as they are known to cave-in. Direction and approval by the Solid Waste Supervisor is mandatory before trying to extinguish these fires.

A backhoe or excavator may be used to excavate burning garbage in layers to be assured that all burning and smoldering materials are excavated and cooled. Once exposed, the fire can be extinguished oftentimes by adding soil and/or water into the excavation pit as wells as applying to material that has been excavated. In the event of an uncontrolled fire that spreads below fill surface or one that cannot be extinguished from the surface, notify the Asotin County Fire District No. 1 by calling 911.

After extinguishing the fire, an engineering evaluation will need to be conducted to determine if any landfill components or systems have been damaged.

7.20 Hazardous Waste

If unacceptable wastes are discovered at the landfill, the Solid Waste Supervisor and the ACHD must be notified. All flames or other sources of ignition (e.g., operations equipment) should be turned off if the material is discovered on the working face. No site users or personnel should enter or work in areas near the substance until the substance and its characteristics have been identified and its safety managed.

If a regulated dangerous waste or PCB waste is discovered at the facility, Asotin County will follow all notification procedures required by the regulations including 40 CFR Part 258.20, *Procedures for Excluding the Receipt of Hazardous Waste*. The Solid Waste Supervisor or designee will immediately notify Ecology that a hazardous waste has been discovered at the landfill. If the waste is unable to be returned to the transporter, the Solid Waste Supervisor or designee will ensure that the waste is treated, stored, or disposed of in accordance with all applicable state and federal requirements.

Appendix A

Inspection Forms

RANDOM LOAD INSPECTION

Facility:
Asotin County Regional Landfill
2901 6th Avenue
Clarkston, WA 99403

DATE _____ TIME _____

INSPECTOR/OPERATOR _____

VEHICLE/LOAD INSPECTED _____

DID LOAD PASS YES _____ NO _____

IF NO, WHAT ITEMS WERE IN THE LOAD _____

_____

_____

_____

OTHER COMMENTS _____

_____

_____

Landfill Surface Inspection Form

Facility:

Asotin County Regional Landfill
2901 6th Avenue
Clarkston, WA 99403

DATE_____ INSPECTOR_____

HAS THE CAP ON ANY OF THE CLOSED/INTERIMELY CLOSED AREAS SETTLED, SINCE THE PREVIOUS INSPECTION? CIRCLE ANSWER. YES NO

IF YES, NOTE THE LOCATION(S) AND THE EXTENT OF THE SETTLEMENT, AND CORRECTIVE ACTIONS TAKEN.

_____

_____

_____

_____

CIRCLE THE FOLLOWING CONDITIONS IN ANY OF THE CLOSED/INTERIMELY CLOSED AREAS AND NOTE THE LOCATION(S) BELOW.

DEAD VEGITATION EROSION PONDING OF WATER SURFACE CRACKING

_____

_____

_____

_____

IS ANY WASTE EXPOSED IN THE LFG EXTRACTION AREAS? CIRCLE ANSWER. YES NO

IF YES, NOTE THE LOCATION(S) AND THE EXTENT OF THE EXPOSURE, AND ANY CORRECTIVE ACTIONS TAKEN.

_____

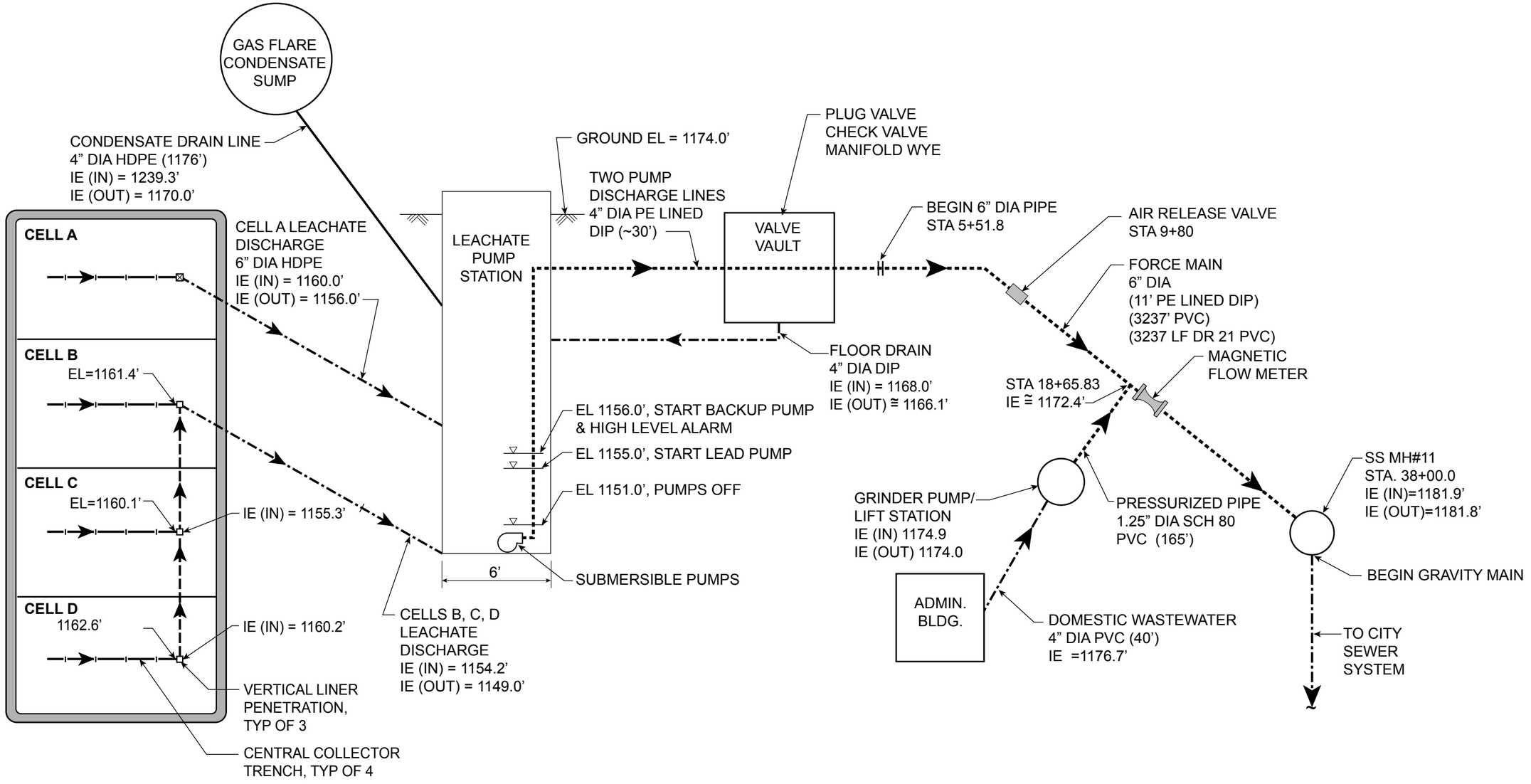
_____

_____

_____

Appendix B

Figures



LEGEND:

- ⊠ HORIZONTAL LINER PENETRATION
- □ VERTICAL LINER PENETRATION
- DUAL CONTAINMENT GRAVITY MAIN
- CENTRAL LEACHATE COLLECTOR SYSTEM
- FORCE MAIN (PRESSURIZED)
- GRAVITY DRAIN LINE

ABBREVIATIONS:

DIA	DIAMETER
DIP	DUCTILE IRON PIPE
HDPE	HIGH DENSITY POLYETHYLENE
PE	POLYETHYLENE
PVC	POLYVINYL CHLORIDE
SS	SANITARY SEWER
STA	STATION

FIGURE 1
LEACHATE MANAGEMENT SYSTEM FLOW DIAGRAM
ASOTIN COUNTY REGIONAL LANDFILL

Appendix C

Equipment Datasheets

FLYGT

Installation, care and maintenance

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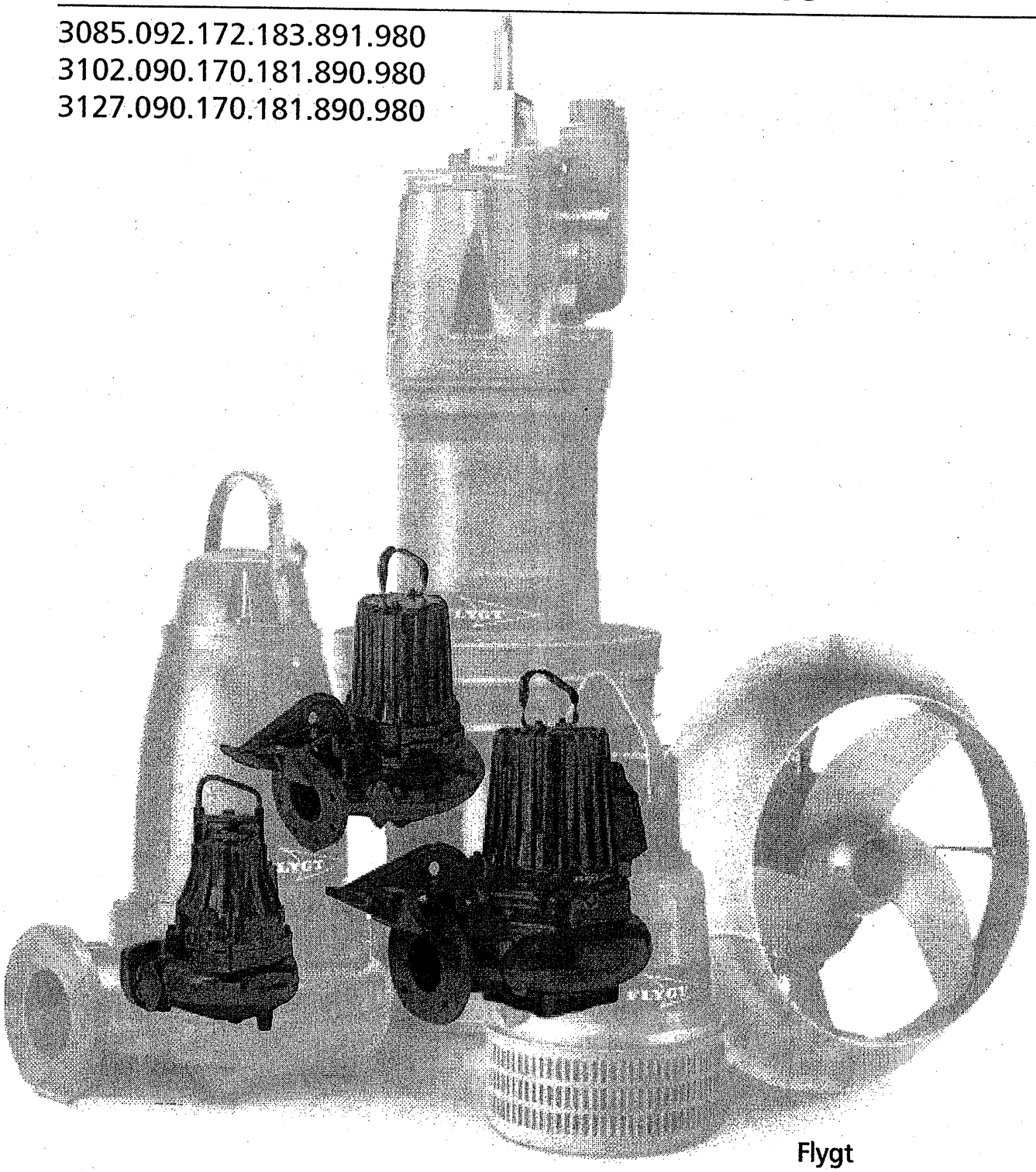
3102.090.170.181.890.980
3127.090.170.181.890.980



Flygt

ITT Industries

895663/03

CONTENTS

SAFETY

This manual contains basic information on the installation, operating and maintenance and should be followed carefully. It is essential that these instructions are carefully read before installation or commissioning by both the installation crew as well as those responsible for operation or maintenance. The operating instructions should always be readily available at the location of the unit.

Identification of safety and warning symbols

General Danger:

Safety instructions in this manual, which could cause danger to life if not observed, have been specifically highlighted with this general danger symbol.

High Voltage:

The presence of a dangerous voltage is identified with this safety symbol.

WARNING! Non-observance to this warning could damage the unit or affect its function

Qualifications of personnel

An authorized (certified) electrician and mechanic shall carry out all work.

Safety regulations for the owner/operator

All government regulations, local health and safety codes shall be complied with.

All dangers due to electricity must be avoided (for details consult the regulations of your local electricity supply company).

Unilateral modification and spare parts manufacturing

Modifications or changes to the unit/installation should only be carried out after consulting with Flygt.

Original spare parts and accessories authorized by the manufacturer are essential for compliance. The use of other parts can invalidate any claims for warranty or compensation.

Dismantling and re-assembly

If the pump has been used to pump hazardous media, care must be taken that, when draining the leakage, personnel and environment are not endangered.

All waste and emissions such as used coolant must be appropriately disposed of. Coolant spills must be cleaned up and emissions to the environment must be reported.

The pumping station must be kept tidy and in good order at all times.

All government regulations shall be observed.

The pictures in this manual may differ somewhat from the delivered pump depending on the hydraulic end configuration.

SAFETY

NOTES FOR EX-PRODUCTS

- **Only Ex-approved pumps may be used in an explosive or flammable environment.**
- **Do not open the pump when an explosive gas atmosphere may be present.**
- **Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and can not be energized. This applies to the control circuit as well.**
- **All mechanical work on the explosion-proof motor section must be performed by personnel authorized by Flygt.**
- **Electrical connection on the explosion-proof motor must be made by authorized personnel.**
- **Thermal contacts must be connected to a protection circuit intended for that purpose according to the approval of the product.**
- **The pump may be used only in accordance with the approved motor data stated on the data plates.**
- **Intrinsically safe circuits are normally required (Ex i) for the automatic level control system by level regulator if mounted in zone 0.**
- **This equipment must be installed in conformity to international or national standards (IEC/EN 60079-14).**
- **The maintenance operation must be made in conformity to the international or national standards (IEC/EN 60079-17).**
- **The yield stress of fastener elements in the product must be in conformity with the value specified in the table for "Material of fastener" on the approval drawing or the parts specified in the part list for the product.**
- **According to the ATEX directive the Ex-pump must never run dry or snore. For permitted minimum water level, see dimensional drawing for the pump.**
  Dry running at service and inspection is only permitted outside the Ex area.
- **The user must know about the risks due to the electrical current and the chemical and physical characteristics of the gas and/or vapours present in hazardous areas.**
- **Flygt disclaims all responsibility for work done by untrained, unauthorized personnel.**

GUARANTEE

ITT Flygt undertakes to remedy faults in products sold by Flygt provided:

- that the fault is due to defects in design, materials or workmanship;
- that the faults are reported to Flygt or Flygt's representative during the guarantee period;
- that the product is used only under condition described in the Installation, Care and Maintenance manual and in applications for which it is intended;
- that the monitoring equipment incorporated in the product is correctly **connected** and **in use**;
- that all service and repair work is done by a work shop authorized by Flygt;
- that genuine Flygt parts are used.

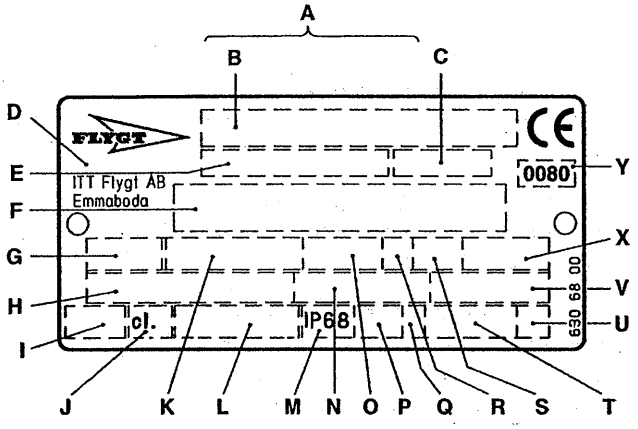
Hence, the guarantee does not cover faults caused by deficient maintenance, improper installation, incorrectly executed repair work or nomal wear and tear.

Flygt assumes no liability for either bodily injuries, material damages or economic losses beyond what is stated above.

Flygt guarantees that spare parts will be kept for 15 years after that the manufacture of this product has been discontinued.

DATA PLATE INTERPRETATION

General data plate

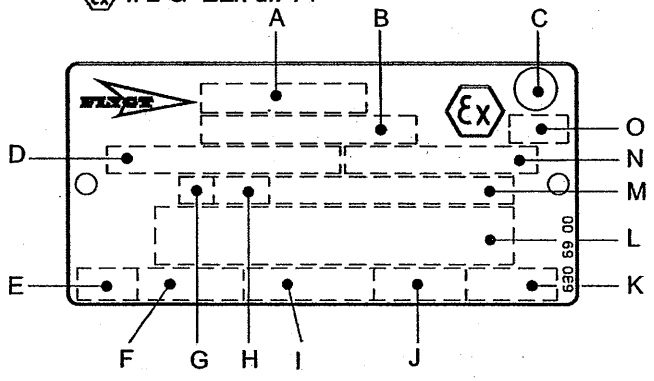


A	Serial number
B	Product code + Number
C	Curve code / Propeller code
D	Country of origin
E	Product number
F	Additional information
G	Phase; Type of current; Frequency
H	Rated voltage
I	Thermal protection
J	Thermal class
K	Rated shaft power
L	International standard
M	Degree of protection
N	Rated current
O	Rated speed
P	Max. submergence
Q	Direction of rotation: L=left, R=right
R	Duty class
S	Duty factor
T	Product weight
U	Locked rotor code letter
V	Power factor
X	Max. ambient temperature
Y	Notified body/Only for EN-approved Ex-products

Approval plates

These approval plates apply to an explosion-proof submersible Flygt pump.
The plates are used together with the general data plate on the pump.

EN: European Norm
ATEX Directive
EN 50014, EN 50018, EN 1127-1
⟨Ex⟩ II 2 G EEx dII T4

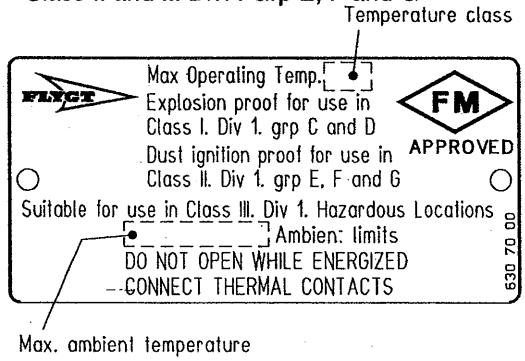


A	Approval
B	Approval authority + Approval Number
C	Approval for Class I
D	Approved drive unit
E	Stall time
F	Starting current / Rated current
G	Duty class
H	Duty factor
I	Input power
J	Rated speed
K	Controller
L	Additional information
M	Max. ambient temperature
N	Serial number
O	ATEX marking

EN approval for the Cable entry

Certificate number: INERIS 03ATEX9008 U
⟨Ex⟩ II 2 G or IM2 EEx d IIC or EEx d I

FM: Factory Mutual
Class I Div. I Grp C and D
Class II and III Div. I Grp E, F and G



PRODUCT DESCRIPTION

Introduction

Thank you for buying a submersible ITT Flygt pump. In this Installation, Care and Maintenance manual you will find general information on how to install and service the 3085, 3102 or 3127 pump to give it a long and reliable life. In the Parts List you will find all the specific technical data for your pump.

Application

This Installation, Care and Maintenance manual applies to a submersible Flygt pump. If you have bought an Ex-approved pump (please see approval plate on your pump or Parts List) special handling instructions apply as described in this document.

Depending on the hydraulic end, the pump is intended to be used for:

— pumping of waste water

— pumping of light liquid manure and urine

— pumping of sludge

— pumping of ground water

— pumping of sewage if the solids need to be cut into small pieces.

The pumps must not be used in highly corrosive liquids. See pH limits below.

The pump is available for permanent installation in a sump or portable installation with hose connection and stand.

In some applications, the pump is also available for a dry stationary installation on a base stand directly connected to the inlet and outlet lines.

For further information on applications, contact your nearest Flygt representative.

Specific technical data

For specific technical data regarding your pump, please see Parts List.

General technical data

Liquid temperature: max. 40°C (104°F). The pump can be operated at full load only if at least half the stator housing is submerged.

The pump can be equipped for operation at temperatures up to 70°C (160°F). (90°C (195°F) for 980-version). At increased temperatures, the pump must be completely submerged when operated at full load.

Higher temperatures than 40°C (104°F) are not permitted for Ex-approved pumps.

Liquid density: max. 1100 kg/m³ (9.2 lb per US gal.)

The pH of the pumped liquid: 5.5 - 14 (cast iron pumps).

The pH of the pumped liquid: 3—14 (stainless steel pumps).

Depth of immersion: max. 20 m (65 ft).

— **In some installations and at certain operating points on the performance curve, the noise level of 70 dB or the noise level specified for the actual pump may be exceeded.**

— **NOTE for Ex-version page 3.**

Warranty claim

Flygt pumps are high quality products with expected reliable operation and long life. However, should the need arise for a warranty claim, please contact your Flygt representative.

Recycling

Local and/or private laws and regulations regarding recycling must be followed. If there are no laws or regulations, or the product is not accepted by an authorized recycling company, the product or it's parts can be returned to the nearest Flygt sales company or service workshop.

GENERAL DESIGN OF A FLYGT PUMP

Design

The pump is a submersible, electric motor-driven product.

1. Impeller

The pump is available with a wide range of impellers for different applications and capacities.

2. Shaft seals

The pump has two mechanical face seals – one inner and one outer, with an intermediate oil housing.

3. Shaft

The shaft is delivered with the rotor as an integral part.

Shaft material: stainless steel.

4. Bearings

The support bearing of the rotor consists of a single-row ball bearing.

The main bearing of the rotor consists of a two-row angular contact ball bearing.

5. Oil housing

The oil lubricates and cools the seals and acts as a buffer between the pump housing and the electric motor.

6. Motor

Squirrel-cage 1-phase or 3-phase induction motor for 50 Hz or 60 Hz.

The motor can be started by direct on-line or star-delta starting.

The motor can be run continuously or intermittently with a maximum of 30 evenly spaced starts per hour.

Flygt motors are tested in accordance with IEC 34-1.

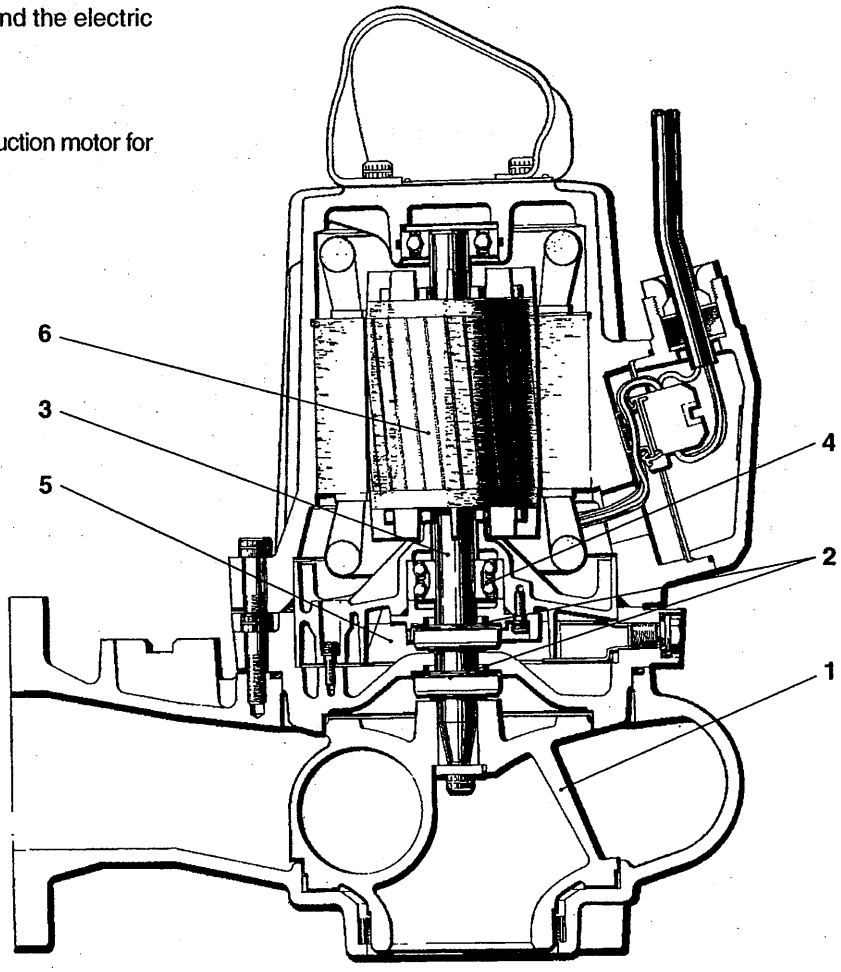
The stator is insulated in accordance with class H (180°C, 360°F). The motor is designed to deliver its rated output at ± 5% variation from the rated voltage. Without overheating the motor, ± 10% variation from the rated voltage can be accepted provided that the motor does not run continuously at full load. The motor is designed to operate at a voltage imbalance of up to 2% between the phases.

Monitoring equipment

The stator incorporates thermal contacts connected in series.

The pump can be equipped with sensors for sensing water in the oil* and/or stator housing.

*Not applicable to Ex-approved pumps.



INSTALLATION

Handling equipment

Lifting equipment is required for handling the pump.

— **Stay clear of suspended loads.**

— **Always lift the pump by its lifting handle - never by the motor cable or the hose.**

The minimum height between the lifting hook and the floor shall be sufficient to lift the pump out of the sump.

The lifting equipment shall be able to hoist the pump straight up and down in the sump, preferably without the need for resetting the lifting hook.

Oversize lifting equipment could cause damage if the pump should stick when being lifted.

Make sure that the lifting equipment is securely anchored.

General recommendations

To ensure proper installation, please see the dimensions on the dimensional drawing in the Parts List.

NOTE! The end of the cable must not be submerged. It must be above flood level, as water may penetrate through the cable into the junction box or the motor.

Check that the lifting handle and chain are in good condition.

For automatic operation of the pump (level control), it is recommended that the level regulators be used at low voltage. The data sheet delivered with the regulators gives the permissible voltage. Local rules may specify otherwise.

Clean out all debris from the sump before the pump is lowered down and the station is started.

NOTE for Ex version page 3.

— **Minimum stop level should be according to the dimensional drawing.**

— **The pump must never run dry.**

Safety precautions

In order to minimize the risk of accidents in connection with the service and installation work, the following rules should be followed:

1. Never work alone. Use a lifting harness, safety line and a respirator as required. Do not ignore the risk of drowning.
2. Make sure there are no poisonous gases within the work area.
3. Check the explosion risk before welding or using electric hand tools.
4. Do not ignore health hazards. Observe strict cleanliness.
5. Bear in mind the risk of electrical accidents.
6. Make sure that the lifting equipment is in good condition.
7. Provide a suitable barrier around the work area, e.g a guard rail.
8. Make sure you have a clear path of retreat!
9. Use safety helmet, safety goggles and protective shoes.
10. All personnel who work with sewage systems must be vaccinated against diseases to which they may be exposed.
11. A first-aid kit must be close at hand.
12. Note that special rules apply to installation in explosive athmosphere.

Follow all other health and safety rules and local codes and ordinances.

ELECTRICAL CONNECTIONS

— **Before starting work on the pump, make sure that the pump and the control panel are isolated from the power supply and cannot be energized.**

— **If the pump is equipped with automatic level control, there is a risk of sudden restart.**

— **All electrical equipment must be earthed. This applies to both pump equipment and any monitoring equipment. Failure to heed this warning may cause a lethal accident. Make sure that the earth lead is correctly connected by testing it.**

— **If persons are likely to come into physical contact with the pump or pumped media (liquid), e.g on construction sites and farms, the earthed (grounded) socket must have an additional earth-(ground-) fault protection device (GFI) connected.**
When pumping near a lake (jetties, beaches, ponds, fountains etc) a safety-distance of at least 20 m (65 ft) between the person and the pump is applicable.
The pump must never be placed directly into a swimming pool. If used in connection with swimming pools, special safety regulations apply.

NOTE for Ex version page 3.

- All electrical work shall be carried out under the supervision of an authorized electrician.
- Local codes and regulations shall be complied with.
- Check on the data plate which voltage supply is valid for your pump.
- Check that the main voltage and frequency agree with the specifications on the pump data plate.
- If the pump can be connected to different voltages, the connected voltage is specified by a yellow sticker.
- Connect the motor cable to the starter equipment as illustrated in the wiring diagrams.
- When the pump is connected to the public mains it may cause flicker of incandescent lamps when starting. In this case the supply authority should be notified before installing the pump.

Conductors that are not in use must be isolated.

The cable should be replaced if the outer sheath is damaged. Contact a Flygt service shop.

Make sure that the cable does not have any sharp bends and is not pinched.

Under no circumstances may the starter equipment be installed in the sump.

NOTE! For safety reasons, the earth conductor should be approx. 50 mm (2.0") longer than the phase conductors. If the motor cable is jerked loose by mistake, the earth conductor should be the last conductor to come loose from its terminal. This applies to both ends of the cable.

Thermal contacts are incorporated in the stator. The thermal contacts can be connected to max 250 V, breaking current max 4 A. Flygt recommends that they be connected to 24 V over separate fuses to protect the other automatic equipment.

Make sure that the pump is correctly earthed (grounded).

When using a variable-frequency-drive (VFD) the shielded cable (type NSSHÖU.../3E+St) should be used in order to fulfil European CE requirements. Contact your Flygt representative and ask your VFD-supplier for electrical limitations.

ELECTRICAL CONNECTIONS

Remember that the starting current in direct on-line starting can be up to six times higher than the rated current. Make sure that the fuses or circuit breakers are of the proper rating.

The Parts List gives rated current. Fuse rating and cable shall be selected in accordance with local rules and regulations. Note that with long cables, the voltage drop in the cable must be taken into consideration, since the motor's rated voltage is the voltage that is measured at the terminal board in the pump.

The overload protection (motor protection breaker) for direct on-line starting shall be set to the motor rated current as given on the data plate.

Check the phase sequence in the mains with the phase sequence indicator.

If intermittent operation is prescribed (see Data Plate), the pump shall be provided with control equipment that provides such operation.

Single phase operation

The Flygt single phase pumps must be equipped with a starter which has start and run capacitors.

A special Flygt designed starter is required for the operation of single phase pumps. The connection of the motor cable to the starter is shown in the wiring diagram.

NOTE! It is not possible to change the direction of rotation of a single phase pump by changing the cable conductors on the starter. Please contact your nearest Flygt representative.

Monitoring equipment

A plate in the junction box shows if the pump is equipped with sensors.

CLS-30 is a leakage sensor for sensing water in the oil housing and initiates an alarm when the oil contains 30% water. Oil change is recommended after the alarm. If the sensor initiates an alarm shortly after the oil is changed, contact your nearest Flygt representative. The CLS sensor is installed in the bearing housing and goes down into the oil housing. The sensor is not applicable to Ex-approved pumps.

CLS sensor body made of glass. Handle with care.

The **FLS** sensor consists of a small float switch for sensing water in the stator housing. Its design makes it suitable for pumps in vertical installations. The FLS sensor is installed in the bottom of the stator housing.

The two sensors, CLS and FLS, can be used in the same pump. They are connected in parallel. Follow the instructions for monitoring equipment.

The **MiniCas II** is a monitoring relay to which CLS and/or FLS are connected.

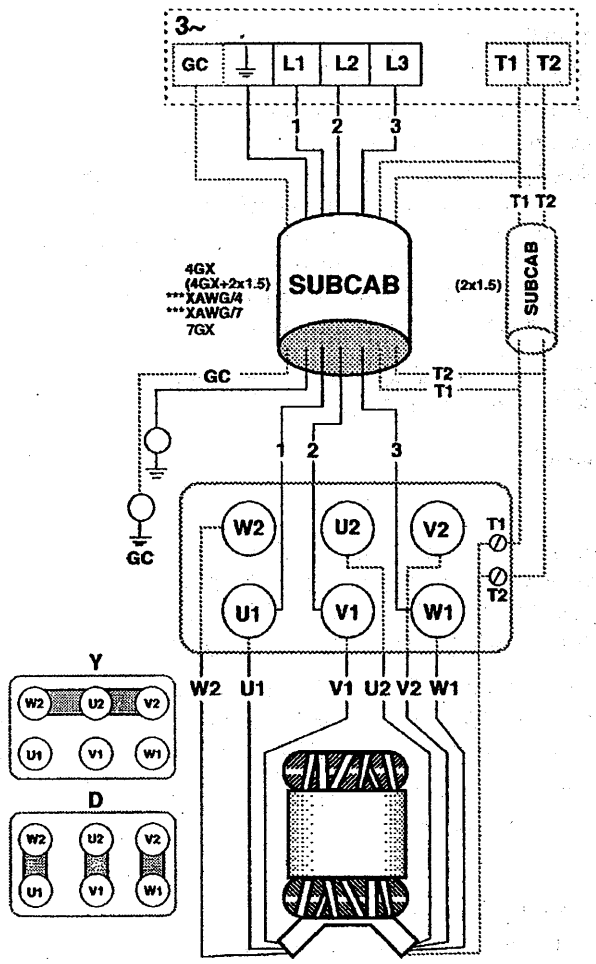
Check:

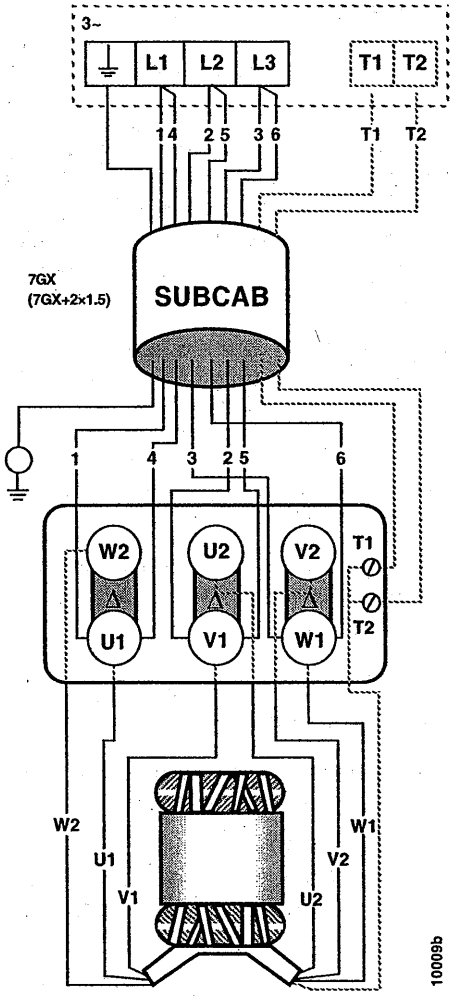
— signals and tripping function.

— that relays, lamps, fuses and connections are intact.

Replace defective equipment.

CABLE CHART





3-phase, direct-on-line starting

	Conductors	Connection starter
SUBCAB4Gx	1 brown ***red	L1
*****SUBCABxAWG/4**	2 blue/alt. grey ***white	L2
HØ7RN-F4Gx	3 black ***black	L3
BIHF4Gx silicon	yellow/green	earth
SUBCAB4Gx+2x1,5	1 brown	L1
	2 blue/alt. grey	L2
	3 black	L3
	yellow/green	earth
	T1 black	T1*
	T2 black	T2*
SUBCAB7Gx	1 black	L1
HØ7RN-F7Gx	2 black	L2
SO7E6E5-F7x2.5	3 black	L3
	4 black	T1*
	5 black	T2*
	6 black	cut off
	yellow/green	earth
For Canada/USA	red	L1
*****SUBCABxAWG/7**	white	L2
	black	L3
	yellow	GC**
	yellow/green	earth
	orange	T1*
	blue	T2*

Stator leads

U1	=	red	V2	=	blue
V1	=	brown	W2	=	black
W1	=	yellow	U2	=	green

3-phase, direct-on-line Δ, 2 // connected cores

	Conductors	Connection starter
SUBCAB7Gx	1 black	L1
SO7E6E5-F7x2.5	2 black	L2
	3 black	L3
	4 black	L1
	5 black	L2
	6 black	L3
	yellow/green	earth
SUBCAB7Gx+2x1,5	1 black	L1
	2 black	L2
	3 black	L3
	4 black	L1
	5 black	L2
	6 black	L3
	T1 black	T1*
	T2 black	T2*
	yellow/green	earth

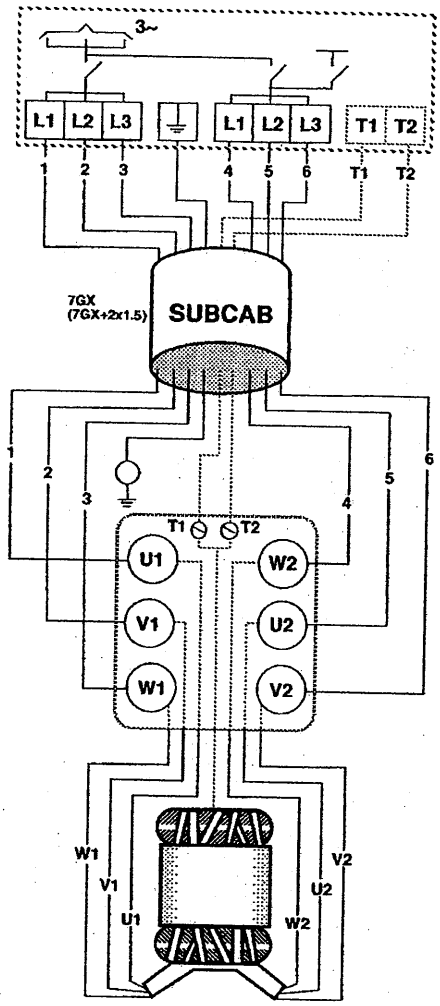
Stator leads

U1	=	red	V2	=	blue
V1	=	brown	W2	=	black
W1	=	yellow	U2	=	green

* Terminal for connection of thermal contacts in the motor and monitoring equipment.
** GC = Ground Check
*** SUBCAB/AWG

SUBCAB is a registered trademark of ITT Flygt AB for electrical cables.

CABLE CHART



3-phase, star-delta starting

	Conductors	Connection starter
SUBCAB 7Gx	1 black	L1
HCR SO7E6E5-F 7x2.5	2 black	L2
	3 black	L3
	4 black	L1
	5 black	L2
	6 black	L3
	yellow/green	earth
SUBCAB 7Gx+2x1,5	1 black	L1
	2 black	L2
	3 black	L3
	4 black	L1
	5 black	L2
	6 black	L3
	T1 black	T1*
	T2 black	T2*
	yellow/green	earth

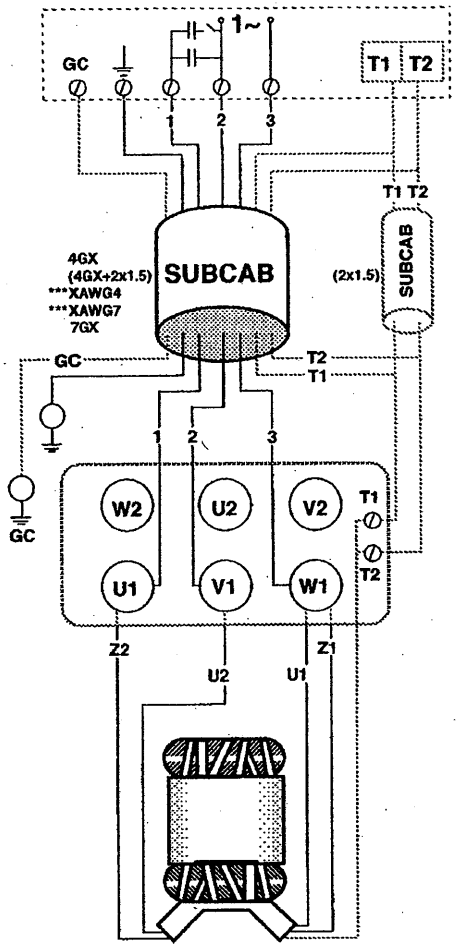
Stator leads

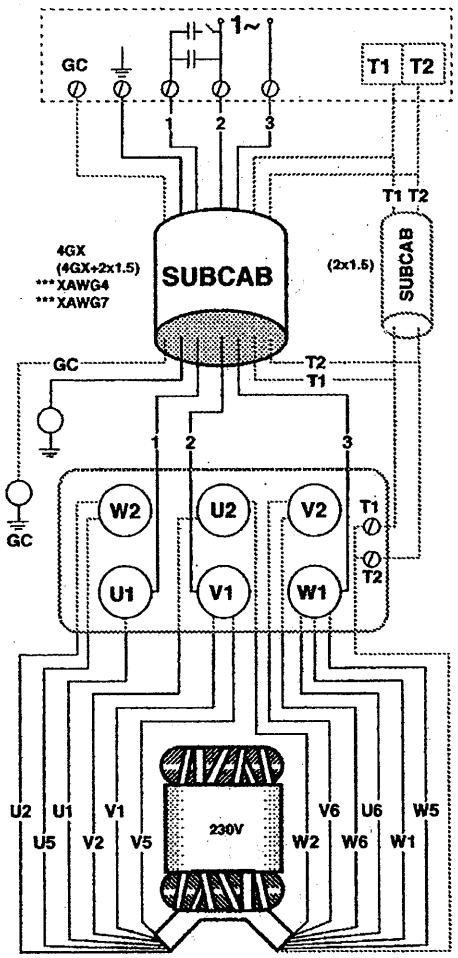
U1	=	red	V2	=	blue
V1	=	brown	W2	=	black
W1	=	yellow	U2	=	green

* Terminal for connection of thermal contacts in the motor and monitoring equipment.

SUBCAB is a registered trademark of ITT Flygt AB for electrical cables.

CABLE CHART





Single phase

	Conductors	Connection starter
SUBCAB 4Gx	1 brown ***red	1
*****SUBCAB xAWG/4**	2 black ***black	2
HØ7RN-F 4Gx	3 blue/alt. grey ***white	3
BIHF 4Gx silicon	yellow/green	earth
SUBCAB 4Gx+2x1,5	1 brown	1
	2 black	2
	3 blue/alt. grey	3
	yellow/green	earth
	T1 black	T1*
	T2 black	T2*
SUBCAB 7Gx	1 black	1
	2 black	2
	3 black	3
	4 black	T1*
	5 black	T2*
	6 black	cut off
	yellow/green	earth
For Canada/USA	red	1
*****SUBCAB xAWG/7**	black	2
	white	3
	yellow	GC**
	yellow/green	earth
	orange	T1*
	blue	T2*

Stator leads

U1	=	red	U2	=	brown
Z1	=	yellow	Z2	=	black

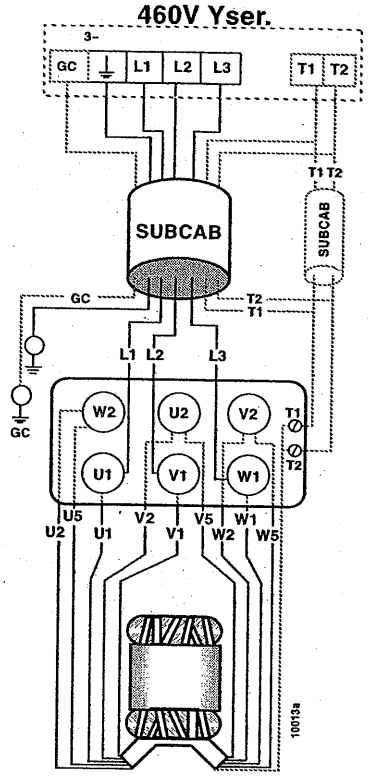
* Terminal for connection of thermal contacts in the motor and monitoring equipment.
** GC = Ground Check
*** SUBCAB/AWG

Stator leads

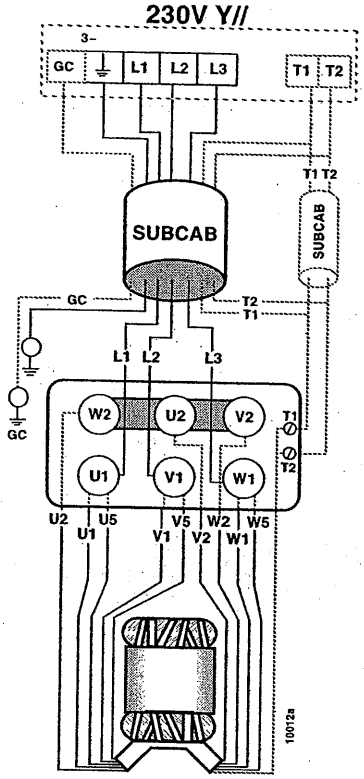
U1	=	red	U5	=	red
V1	=	brown	V5	=	brown
W1	=	yellow	W5	=	yellow
U2	=	green	U6	=	green
V2	=	blue	V6	=	blue
W2	=	black	W6	=	black

CABLE CHART

460V Yser.



230V Y//



Mains	Lead	Pump terminal board
L1	brown/(red*)	U1
L2	blue/alt. grey (white*)	W1
L3	black (black*)	V1
Earth (ground)	yellow/green	⏚
Groundcheck (GC)	yellow*)	

Stator leads **460V-Y SER** connection:	
Stator lead	Pump terminal board
U1, red	U1
W2, black	V2
V1, brown	V1
U2, green	W2
W1, yellow	W1
V2, blue	U2
V5, brown	U2
W5, yellow	V2
U5, red	W2

Control	Cable lead
T1	T1 black /orange*
T2	T2 black/blue*

Mains	Lead	Pump terminal board
L1	brown/(red*)	U1
L2	blue/alt. grey (white*)	W1
L3	black (black*)	V1
Earth (ground)	yellow/green	⏚
Groundcheck (GC)	yellow*)	

Stator leads **230V-Y//** connection:	
Stator lead	Pump terminal board
U1, red	U1
U5, red	U1
V1, brown	V1
V5, brown	V1
W1, yellow	W1
W5, yellow	W1
U2, green	W2
V2, blue	U2
W2, black	V2

* SUBCAB AWG

TRANSPORTATION AND STORAGE

The pump can be transported and stored in a vertical or horizontal position.

— **Always lift the pump by its lifting handle – never by the motor cable or the hose.**

— **Make sure that the pump cannot roll or fall over and injure people or damage property.**

The pump is frostproof as long as it is operating or is immersed in the liquid. If the pump is raised when the temperature is below freezing, the impeller may freeze.

The pump shall be run for a short period after being raised in order to discharge all remaining water.

A frozen impeller can be thawed by allowing the pump to stand immersed in the liquid for a short period before it is started. Never use a naked flame to thaw the pump.

For longer periods of storage, the pump must be protected against moisture and heat. The impeller should be rotated occasionally (for example every other month) to prevent the seals from sticking together.

After a long period of storage, the pump should be inspected before it is taken into operation. Pay special attention to the seals and the cable entry.

Follow the instructions under the heading "Before starting".

OPERATION

Before starting

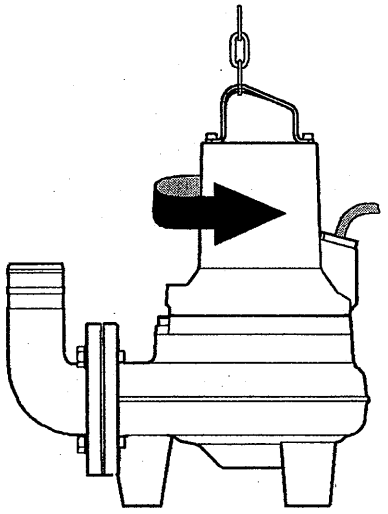
— **Before starting work on the pump, make sure that the pump is isolated from the power supply and cannot be energized.**

— **Make sure that the pump cannot roll or fall over and injure people or damage property.**

- Check that the visible parts on the pump and installation are undamaged and in good condition.
- Check the oil level in the oil housing.
- Remove the fuses or open the circuit breaker and check that the impeller can be rotated freely.
- Check that the monitoring equipment (if any) works.
- Check the direction of rotation. The impeller shall rotate clockwise, as viewed from above. When started, the pump will jerk in the opposite direction to the direction in which the impeller rotates. See the figure.
- In the case of dry installation, check the direction of rotation through the inlet elbow access cover.
- Transpose two phase leads if the impeller rotates in the wrong direction (3 ~).

In some installations the pump surface and the surrounding liquid may be hot. Bear in mind the risk of burn injuries.

Starting jerk



Watch out for the starting jerk, which can be powerful.

CARE AND MAINTENANCE

Before starting work on the pump, make sure that the pump is isolated from the power supply and cannot be energized.

This applies to the control circuit as well.

NOTE for Ex version page 3.

Make sure that the pump cannot roll or fall over and injure people or damage property.

The following points are important in connection with work on the pump:

— Make sure that the pump has been thoroughly cleaned.

— Beware of the risk of infection.

— Follow local safety regulations.

The pump is designed for use in liquids which can be hazardous to health. In order to prevent injury to the eyes and skin, observe the following points when working on the pump:

— Always wear goggles and rubber gloves.

— Rinse the pump thoroughly with clean water before starting work.

— Rinse the components in water after dismantling.

— The oil housing may be under pressure. Hold a rag over the oil screw (oil plug) to prevent splatter.

Proceed as follows if hazardous chemicals have splashed into your eyes:

— Rinse your eyes immediately in running water for 15 minutes. Hold your eyelids apart with your fingers.

— Contact an eye specialist.

On your skin:

— Remove contaminated clothes.

— Wash your skin with soap and water.

— Seek medical attention, if required.

Inspection

Regular inspection and preventive maintenance ensure more reliable operation.

The pump should be inspected at least once a year, but more frequently under severe operating conditions.

Under normal operating conditions, the pump should have a major overhaul in a service shop at least every third year for permanent installation and every year for portable pumps. This requires special tools and should be done by an authorized service shop.

If the seals have been replaced an inspection of the oil is recommended after one week of operation.

NOTE! Regular check of the condition of the lifting handle and chain is important.

Inspection of hot water applications

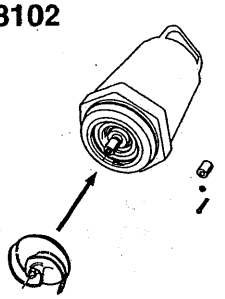
Pumps in hot water applications shall undergo inspection or overhaul at a service shop as follows, depending on the time they have been submerged in the hot water:

Temp.	Mode of operation	Inspection	Shop overhaul
≤70°C (160°F)	Continuous	1000 hours	4000 hours
≤70°C (160°F)	Intermittent	twice a year	once a year

N-type impeller - replacing and setting clearance

Warning! The impellers may have very sharp edges.
Use protective gloves.

N3085/3102



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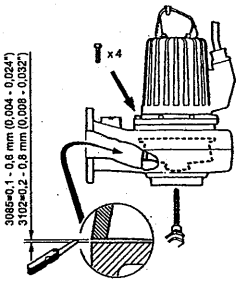
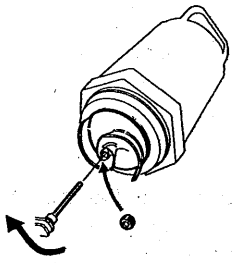


2.

Not valid for 3102 SH-version



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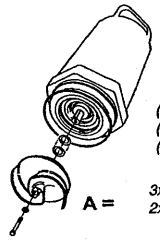
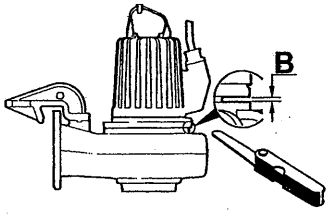
NP/NS/NL3127



(3x) 0,3 mm (0,012") 298 62 00
(1x) 1,5 mm (0,060") 298 62 01
(2x) 0,5 mm (0,020") 298 62 02

3x 0,3 + 1x 1,5 + 2x 0,5 = 2,9 mm

1.



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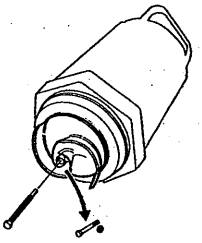

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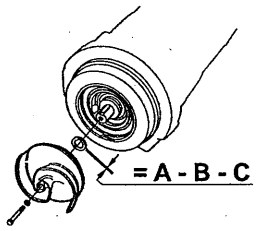

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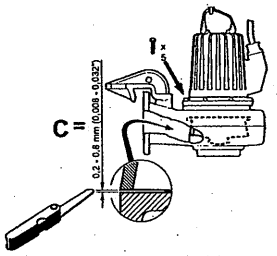

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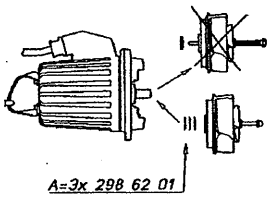
NT/NZ 3127



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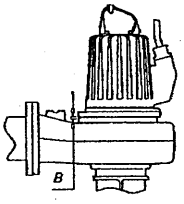

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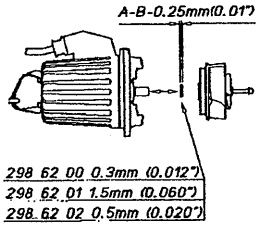

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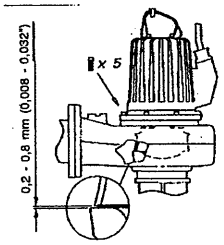


4.

OIL CHANGE

The oil housing may be under pressure. Hold a rag over the oil plug to prevent splatter.

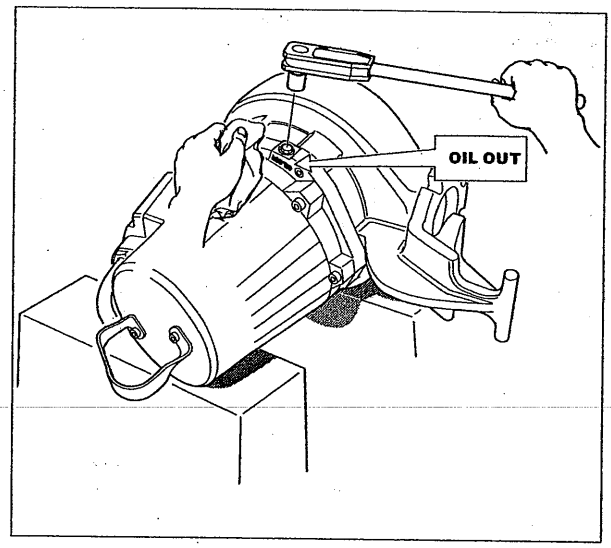
1. Lay the pump on its side on a bench or over two supports. Unscrew the oil housing screw (oil plug) marked "oil out". Emptying the oil must be done through the "oil out" hole.

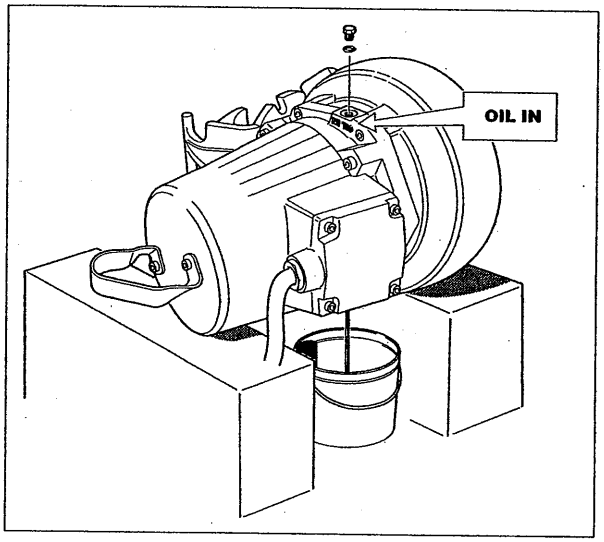
2. Turn the pump. Unscrew the "oil in" oil hole screw/ plug. In order to drain out all oil, the pump must be raised upright for a short while during drainage.

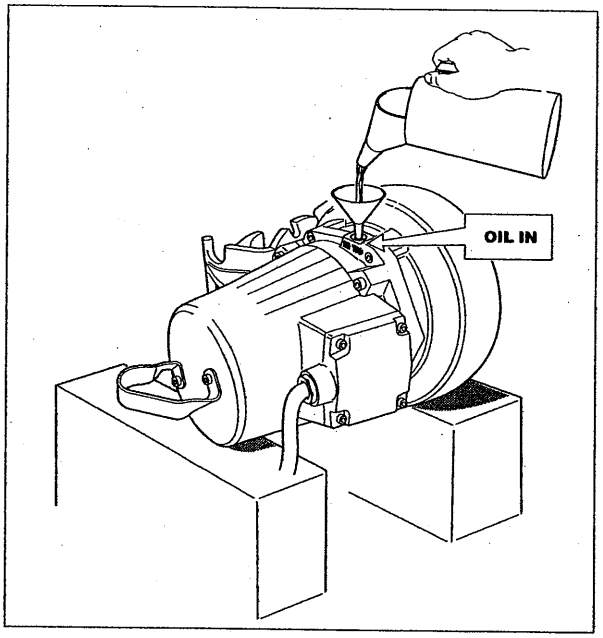
3. Replace the O-rings under the oil housing screws (plugs) with new ones.

4. Install the "oil out" screw/plug and fill with oil through the other hole. It is important that the oil be added through the hole marked "oil in" since the oil housing must contain some air for pressure equalization. The pump should be tilted slightly and put down again horizontally in order to get the full amount of oil in.

   A paraffin oil with viscosity close to ISO VG32 is recommended (e.g. Mobil Whiterex 309). The pump is delivered from factory with this type of oil.







Approx. oil quantity		
	l	US quarts
3085	1.0	1.1
3085.280/290	0.8	0.8
3102	1.0	1.1
3127	2.0	2.1

SERVICE LOG

Most recent service date	Pump No.	Hours of operation	Remarks	Sign.

Instruction

MI
021-363
September 1990

8000 SERIES PULSED dc MAGNETIC FLOWMETERS STYLES A, B, C, AND D

Configuration and Operation

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TABLES

FIGURES

INTRODUCTION

Description

The 8000 Series Pulsed dc Magnetic Flowmeter System is comprised of a magnetic flowtube and a magnetic flow transmitter. The system is available in a variety of configurations that includes either an integrally mounted transmitter, or a remote transmitter mounted on a pipe or a flat surface.

The compact transmitter features microprocessor-based electronics that provide automatic rezeroing, built-in calibration (no mechanical adjustments nor calibration equipment are required), and diagnostics software for external indication of a fault and its source.

The 4-digit liquid crystal display (LCD) on the front of the transmitter performs several functions.

- During normal operation it indicates Flow Rate in a choice of percentage of upper range value to one decimal place or engineering units up to 999.
- It indicates Error Codes and Alarm Messages.
- It is utilized as the Readout during the Configuration Procedure.
- It provides a mode indication when empty tube zero is activated and indicates value of current output.

Reference Material

This instruction addresses only the configuration (parameter value entries via the SELECT and SET pushbuttons in the transmitter) and the operation (interpretation of error and alarm indications) of the 8000 Series Magnetic Flowmeter System. Installation and maintenance are covered in separate instructions. See Table 1 for titles and document numbers.

Table 1. 8000 Series Instructions

DOCUMENT NUMBER AND STYLE(*)			8000 SERIES FLOWMETER DOCUMENT DESCRIPTION
*A	*B	*C,*D	
MI 021-361	MI 021-361	MI 021-369	with Remote Transmitter-Installation
MI 021-362	MI 021-362	MI 021-370	with Integral Transmitter-Installation
MI 021-364	MI 021-364	MI 021-371	Flowmeter Maintenance
MI 021-365	MI 021-365	MI 021-365	Flowtube with Type Y Purge

PARAMETER DEFINITIONS

To prepare a properly installed 8000 Series Magnetic Flowmeter System for operation, you need only to calculate and enter (configure) the values of all the parameters using the two pushbuttons in the transmitter. These parameters establish the upper range value (URV) of the flow rate in the desired engineering units (parameters 1 and 2), pulse rate output (parameter 3), input signal damping (parameter 4), and display range select (parameter 5).

The entry of these parameters is detailed in the "Configuration Procedure" section. But before beginning the configuration procedure, the "Parameter Definitions" section must be read. For a reconfiguration, proceed directly to the "Configuration Procedure" section if you are already familiar with the definitions of the parameters. The table below lists the parameters available with the different product styles.

Table of Parameter Availability in Flowmeter Product Styles

Parameters P1 through P4	Available in Product Style A
Parameters P1 through P5	Available in Product Styles B, C, and D

Scaling Number (Parameters P1 and P2)

The first two parameters (P1 and P2) are derived from a calculation that yields a Scaling Number. P1 will be a four digit number between 140 and 6000, and P2 will have a value of either 0 or 1. Entering P1 and P2 into the transmitter scales the maximum value of the output signal to the flow rate URV in the selected engineering units.

Pulse Rate Output (Parameter P3)

Parameter P3 determines pulse rate output frequency.

If a high pulse rate output (0 to 2000 Hz) is required or pulse output is not used, the P3 value is set to 000.0.

If a variable low pulse rate output is desired, the pulse rate must be within the range limits of 0.100 and 9.999 pulses per second. The desired pulse rate output frequency (x 100) will be the value used for P3.

Input Signal Damping (Parameter P4)

The fourth parameter is the input signal damping factor. This factor acts on the input signal to provide a noise-free output signal during normal operation.

While its range limits are 00.0 and 49.9 (approximate) seconds, a standard minimum value of 01.0 seconds is typical and is set in by the factory.

Display Range Select (Parameter P5)

Parameter P5 determines the output meter reading in percent of URV or in engineering units. The 4-digit percent display (0 to 100%) is set (00.0) by the factory. Other settings of P5 result in a 3-digit display of URV in any number desired in its range (10 to 999).

NOTE

When entering P5, ignore the decimal sign. Assume that all of the numbers are integers.

CONFIGURATION PROCEDURE

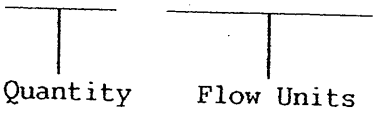
The user should first determine the values of the parameters and record them. The "Configuration Plan and Worksheet" section that follows provides a convenient means for doing this. A table (Table 7) is also provided in the "Appendix" section to record application data and parameter values.

Configuration Plan and Worksheet

Fill in the blank spaces in the parameter sections that follow to establish the parameter values for your application.

Determining Parameters P1 and P2 - Scaling Number

1. Record the URV of flow rate and applicable flow rate units.



Example 1. 75 U.S. Gallons per minute

Quantity — Flow Units

Example 2. 10 Cubic Metres per Hour

Quantity — Flow Units

2. Find the calibration factor which is stamped on a data plate attached to the flowtube, and note its value.

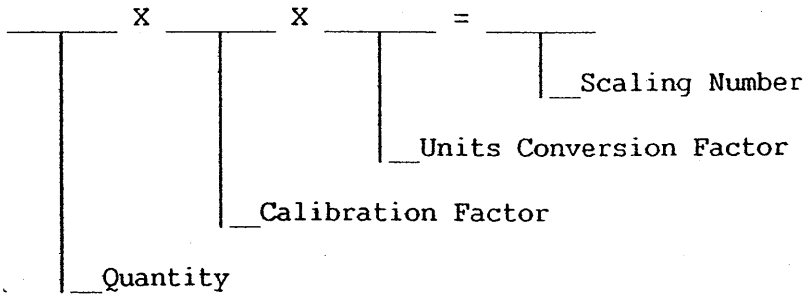
Example: 18.22 [18.22 is a typical calibration factor value for a 40 mm (1.5 in) flowtube]

Calibration Factor

3. Select and record the appropriate Units Conversion Factor from Table 6 in the "Appendix" section. _____

   e.g., 1.000 is the Units Conversion Factor for Example 1 above, and
   4.4029 is the Units Conversion Factor for Example 2 above.

4. Multiply the appropriate values from Steps 1, 2, and 3 together to obtain the Scaling Number.



   for Example 1: 75 X 18.22 X 1.000 = 1366.5
   for Example 2: 10 X 18.22 X 4.4029 = 802.208

NOTE

If the Scaling Number is not between 140 and 6000, then either the flowtube is the wrong size, or incorrect volumetric flow rate units have been selected.

5. Round off the Scaling Number to four significant digits. Disregard the decimal point and record the four significant digits for the P1 value.

NOTE

The transmitter display has a fixed decimal point. The Scaling Numbers from Step 4 are shown in Examples 1 and 2 below.

For Example 1: P1 = 1 3 6 . 7 (Fixed Decimal)

For Example 2: P1 = 8 0 2 . 2 (Fixed Decimal)

6. Determine the P2 value by comparing the scaling number calculated in Step 4 to the following:

   a. If Scaling Number is less than 1000, then P2 value is 0.
   b. If Scaling Number is 1000 or greater, then P2 value is 1.

   P2 = ___.

   For Example 1: P2 = 1. and
   For Example 2: P2 = 0.

Determining Parameter 3 - Pulse Rate Output

IF PULSE OUTPUT IS NOT USED--P3 may be ignored. Leave the default value 000.0 in place and proceed to determining Parameter 4.

HIGH PULSE OUTPUT--To provide a 0 to 2000 pps output for a 0 to 100% URV flow, set P3 to 000.0.

LOW FREQUENCY PULSE OUTPUT--Set P3 as follows:

1. Convert the URV into units/second.
   For example; 900 U.S. gal/min converts to 15 U.S. gal/s

2. Multiply the units/second URV by 10 to derive HIGH LIMIT.
   For example; HIGH LIMIT = (15)(10) = 150

3. Divide the units/second URV by 10 to derive LOW LIMIT.
   For example; LOW LIMIT = (15)/(10) = 1.5

4. Choose the amount of product (in volume units) that each pulse is required to represent. This number must be within the HIGH and LOW limits derived in Steps 2 and 3. For example, assume that each pulse is to represent 10 U.S. gallons.

5. Now divide the Step 1 result by the Step 4 volume per pulse value;
   (15)/(10) = 1.5

6. Then multiply the Step 5 result by 100;
   (1.5)(100) = 150

   Now enter the 150 in P3. Each pulse will now represent a volume of 10 U.S. gallons (see Step 4).

NOTE

Calculations that result in a P3 value having more than one decimal place may be rounded up or down to the next nearest number. For example in Step 4, suppose we choose 4.5 gallons to represent each pulse. This would result in a Step 6 value for P3 of 333.33333...; we can round this to P3 = 333.3 and use this value. In doing so, the user must be aware that the accuracy of resultant totalization will be impaired by the amount of "rounding" applied to the result. Specification accuracy can only apply when the user chooses "quantities" and "URV" which result in a P3 value having an exact 4 digit answer similar to example given. Leading and/or trailing zeroes are acceptable values.

Example — Determine P3 when the URV = 1800 L/min and the required volume per pulse equals 16 litres.

Solution — Proceed with Steps 1 through 6 above, as follows:

1. 1800 L/min = 30 L/s
2. HIGH LIMIT = (Step 1)(10) = (30)(10) = 300
3. LOW LIMIT = (Step 1)/(10) = (30)/(10) = 3
4. Desired volume/pulse = 16 litres/pulse (given)
5. Step 1/Step 4 – (30)/(16) = 1.875
6. Now, (Step 5)(100) = (1.875)(100) = 187.5

   Enter the result, 187.5, into P3.

Determining Parameter 4 - Input Signal Damping

As stated previously, the fourth parameter controls the output signal damping to provide a noise-reduced output signal during normal operation. Two modes of damping are provided, "Auto" and "Manual". These two modes are described in the paragraphs that follow.

AUTO DAMPING--In "Auto", the damping is in continual self-adjustment and assumes a value that provides a short term stability of ±1% of span. "Auto" damping is recommended for processes in which the process input signal-to-noise ratio varies frequently, unpredictably, and significantly due to process inconsistencies and variables (e.g., additives). An example of this characteristic behavior is evidenced by a recorded output signal which paints a varying pattern on the recorder.

If "Auto" damping is preferred, the P4 value shall be set at 00.0.

MANUAL DAMPING--In "Manual", the damping is in accordance with the value of the P4 setting. "Manual" damping is particularly advantageous for applications requiring a set speed of response, or to dampen the occasional "noise spike" resulting from an electrical charge/discharge within the process, or the passage of an abnormal or foreign object (e.g., large suspended solid or gas bubble) within the pipeline (magnetic flowtube).

If "Manual" damping is desired, then the P4 value is set to any value between 00.1 and 49.9 seconds. Minimum damping occurs when P4 is set at 00.1 seconds. While its range limits are 00.1 and 49.9 (approximate) seconds, a standard value of 01.0 seconds is considered typical and is factory set at this value.

NOTES

1. When the Model 8000 Magnetic Flowmeter is used as the measurement in a controlled loop, it is recommended that the Model 8000 be placed in "Manual" when tuning the controller. If the controller is an adaptive type (such as Foxboro's EXACT Controller), then the Model 8000 should continue to be operated in the "Manual" damping mode. If the controller is a fixed parameter controller, then the Model 8000 (if desired by user) may be switched to the "Auto" mode of damping.

2. In "Auto", the dynamic characteristics of the controlled loop will vary as the damping factor varies. It may therefore by necessary to occasionally tighten or relax the controller tuning to achieve optimum response for the prevailing signal conditions.

Determining Parameter 5 - Display Range Select

This parameter provides a choice of what the display will present during normal operation. The parameter has no effect upon the current or pulse output. When shipped, all units are set to 00.0 (Providing Readout in Percent). For the display to operate in engineering units, set the P5 value to match the upper range value of engineering units used. This will cause the display to read from 0 to URV.

NOTE

The URV value should be within the range of 10 to 999. Disregard fixed decimal when entering URV.

Example: For 0 to 75 gpm, set P5 to 075, display will read 0 to 75.
For 0 to 10 m^3/h, set P5 to 010, display will read 0 to 10.

NOTES

1. Whole numbers assumed, decimals ignored.

2. If display is set for URV of 999, and flow is greater, display will overrange, indicated by - - - - - .

User may desire to affix label indicating type of readout and/or reading times factor if used, i.e., gpm - reading times 1, 10, 100, 0.1

NOTE

To display, for example, a URV of 1200, the user can accomplish this by setting P5 to 120, and multiplying the resultant display by 10.

Entering the Parameters

The Parameter Set mode enables the user to display or configure the parameter values for the application.

****
* CAUTION *
****

Entering the Parameter Set mode during normal operation freezes the transmitter output at its last value.

In the following procedure, it is assumed that a new configuration is required or that the system is being configured for the first time.

NOTE

To configure the transmitter, it is not necessary that the transmitter be connected to the flowtube, or if connected to the flowtube that the process liquid be present or flowing in the flowtube. However, after configuration is completed, to achieve correct operational system functionality, it is necessary:

1. For the transmitter and flowtube to be properly installed and power to be applied.

2. For the flowtube to have process liquid present in the flowtube at all times.

   If either or both of the above conditions are not observed, the transmitter display will be indeterminate ranging from no display to false readings alternating with error codes (L3,L4,L6).

   Before beginning the parameter entry procedure, verify that installation and electrical connections are compliant to the Installation Procedures listed in Table 1.

The parameter entry procedure is as follows:

1. Apply power to the system. The display will indicate a series of diagnostic tests being performed by the transmitter upon the system.

   NOTE

   If the system was previously configured and is currently operational, then the display will indicate normal operational values.

If the system has not been previously configured, the initial intermediate display may be ignored EXCEPT as follows:

Error Codes 0A, 1A, 2A, 4A, or 5A appear. (System requires servicing prior to configuration data entry. See "Error Codes.)

If optional factory configuration code was not specified, the default values listed below are entered by Foxboro.

PARAMETER	DISPLAYED VALUE
P1	316.2
P2	1.0
P3	000.0 or 999.9
P4	1.0
P5	00.0

2. Loosen the four captive screws that retain the Terminations Cover and lift off cover.

****
* CAUTION *
****

DO NOT DISCONNECT SECURING CABLE FROM COVER. Certifying agencies require that the cover be permanently attached to the transmitter. The cable meets this requirement.

NOTE

A plate secured to the inside of the cover provides abbreviated information regarding the parameters, operation, and error codes. This plate is provided for reference only and is not intended as a substitute for this instruction.

3. Press and hold the SELECT DIGIT pushbutton (SELECT).

4. Press the SET DIGIT pushbutton while still holding SELECT.

5. Now release both the SET DIGIT and SELECT pushbuttons.

The display changes to:

P 1 .

NOTE

If 888.8 appears on display, wait a few seconds and try again.

This prompt message indicates that the Parameter Set mode has been successfully entered.

6. Press SELECT and release, the last entered value for P1 will now be displayed. The most significant digit will be flashing, indicating that the value of this digit may be changed by pressing SET.

NOTE

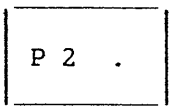
The value of the flashing digit can be changed one unit at a time by repeated pressings of SET, or it can be changed rapidly by holding the SET pushbutton down.

7. To move to the next significant digit, press SELECT and release and use SET to change its value.

   This sequence of pressing SELECT to move to the next digit and changing its value with SET is repeated until the fourth (and least significant) digit has been displayed and modified.

8. When the desired value is displayed, press and hold SELECT and press SET. Now release both pushbuttons.

   The display changes to:



9. Press SELECT and the last entered value for P2 will be displayed and flashing. This will be a single digit (0 or 1) to the left of the decimal point and it can be changed with the SET pushbutton.

Continue this pattern of pressing and holding SELECT and then pressing SET to access the next parameter, pressing SELECT to display its value, and entering the appropriate value utilizing the pushbuttons until all parameter entries have been made for the application.

After the least significant digit for P5[1] has been entered, press and hold SELECT and press SET to store the value and terminate parameter entry for all parameters. The display will flicker, go blank for about two seconds, and then return to normal operation.

****
* CAUTION *
****

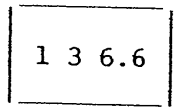
To lock in parameter values, the sequence of P1 through P5[1] must be completed. A final review of P1 through P5[1] values should be made to verify proper settings.

NOTES

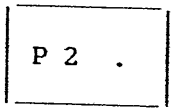
a. At any point in the parameter entry procedure, the prompt for the next parameter can be brought up on the display by pressing and holding SELECT and then pressing SET.

[1] P4 for product Style A.

For example, if the display for P1 is



and the digit 1, 3, 6, or .6 is flashing, press and hold SELECT and press SET to change the display to



b. While in normal operation, pressing of the SELECT pushbutton is ignored. The transmitter will respond only to the sequence, press and hold SELECT and press SET to prompt parameter mode.

c. While in normal operation, pressing of the SET pushbutton will reverse the input polarity. This mode is used as a convenience check in confirming reverse flow or wiring.

d. When a parameter prompt message is displayed (e.g., P1, P2, P3, P4, or P5), pressing of SET is ignored.

e. When a parameter prompt message is displayed, the value of the parameter will automatically be displayed after approximately 25 seconds if SELECT is not pressed.

   Then, if SET is not pressed within another 25 seconds, the system will automatically return to normal operation or the mode that was active before the Parameter Set mode was entered.

OPERATION

Operating a properly installed and configured 8000 Series Magnetic Flowmeter System mainly involves taking appropriate action in response to various Error Codes or Alarm Messages if they appear on the LCD.

Most of the actions to be taken in response to Error Codes are system-related, while responses to Alarm Messages are process-related. Refer to the "Error Codes" and "Alarm Messages" sections that follow.

Controls and Indicators

The only controls are two pushbuttons in the transmitter, identified "SELECT DIGIT" and "SET DIGIT". The 4-digit LCD on the transmitter is the system indicator. The various functions of the pushbuttons and the LCD are described in Table 3.

Table 3. Controls and Indicators

CONTROLS/ INDICATORS	ACCESS	FUNCTIONS
SELECT DIGIT Pushbutton	Remove Terminations Cover	1. Used in conjunction with the SET DIGIT pushbutton to enter the Parameter Set mode. 2. Used to display the value of a particular parameter. 3. Used to move from one significant digit to the next to facilitate changing the value with the SET DIGIT pushbutton. 4. Used in conjunction with the SET DIGIT pushbutton to store a parameter value, move to the next parameter, and terminate the Parameter Set mode. 5. Used to step outputs by 25% increments, up to 100% of flow rate when external contact (signal lock, empty tube zero) is closed.
SET DIGIT Pushbutton	Remove Terminations Cover	1. Used in conjunction with the SELECT DIGIT pushbutton to enter the Parameter Set mode. 2. Used to change the value of a parameter. 3. Used in conjunction with the SELECT DIGIT pushbutton to store a parameter value, move to the next parameter, and terminate the Parameter Set mode. 4. Used as a transient means to test the wiring for correct terminations. Pressing and holding down the "SET" button electronically reverses the polarity of the input signals. This feature is intended as an aid during initial installation or maintenance to verify correct wiring of the magnetic flow tube.
4-Digit LCD	Visible on transmitter	1. Indicates flow rate in percent of URV or engineering units. 2. Displays parameter values. 3. Displays Error Codes and Alarm Messages. 4. Displays empty tube mode

Turning System On

The 8000 Series Magnetic Flowmeter System is turned on by simply applying power to the transmitter. On power up, the display will first indicate a series of diagnostic tests being performed by the transmitter on the system. Within a few seconds, the display will indicate flow rate in percent of URV (normal operation), an Error Code, an Alarm Message or Mode Status.

Error Codes

In the event of a system failure, the display will indicate an Error Code. Table 4 provides a list of the Error Codes and their interpretation. Refer to the Maintenance Instruction MI 021-364 (Styles A and B) and MI 021-371 (Styles C and D) for probable cause of the failure and corrective action.

Table 4. Error Codes and Interpretation

ERROR CODE	INTERPRETATION
0A	Malfunction in power supply, microprocessor, or electronics module.
1A	Shorted wire, switch failure.
2A	Factory calibration data lost.
3A	Invalid user data stored in memory.
4A	Malfunction in electronics module.
5A	Malfunction in electronics module.
L3	Malfunction in coil circuit, electronics module, or electrode fouled.
L4	Electrodes fouled, electrode wiring.
L6	Interruptions in coil circuit, open coil, oepn wire, or low drive.

Empty Tube Zero Contact

Closure of an external isolated contact connected across TB6 (Ext Contact) will cause the 8000 Flowmeter to output a preset value of 4 mA and zero pulse rate. The display will alternate between "SL" (SIGNAL LOCK) and the number "4" (denoting 4 mA output). Pressing the "SELECT" button will cause the output (and display) to increment 4 mA with each "press" of the button until 20 mA is reached. Similarly, the pulse output rate increases in 25% steps. Further pressing of the "SELECT" button will reset the output to 4 mA and zero pulse output rate. The cycle may then be repeated. All values remain in a steady state until the contact made is an open circuit, at which time the system returns to normal processing.

NOTE

These signals are of system output accuracy and may be used as a calibration source for calibrating external equipment interfaced to the 8000 Flowmeter.

Alarm Messages

During normal operation, the display indicates flow rate in percent of URV or in engineering units for flow between 0 and +106% of URV. For any flow rate outside of this range, an Alarm Message will appear on the LCD. Alarm Messages and their interpretations are listed in Table 5.

Table 5. Alarm Messages and Interpretation

DISPLAY[1,2]	FLOW RATE (PERCENT OF URV)
-A/ 0.0	-6.0 or greater
HA/n n n.n[4]	106.0 to 327.7
HA/3 2 7.7[4]	Greater than 327.7
SL/4[3]	Signal Lock external contact closed
- - - -	Exceeded engineering units display_limit (999)

[1] The negative sign indicates reverse flow, or that the flowtube coil leads or electrode leads are reversed, or that the flowtube is installed with the flow direction arrow in the opposite direction to the flow. Refer to Maintenance Instruction MI 021-364 or MI 021-371 (see Table 1). (If the flow direction arrow is opposite to the direction of the flow, you may not have to change flowtube orientation. Refer to Installation Instruction MI 021-361, 021-362, 021-369, or 021-370.)

[2] The solidus (/) is used in this table to indicate that the display alternates between an alarm identifier and a value.

[3] Or 8, 12, 16, or 20 dependent on number of times "SELECT" pushbutton is depressed. Similarly, pulse rate output is in 25% increments up to 100%.

[4] When display is in engineering units, the highest nnn factor displayed is 106% of URV or 999, whichever is the smaller. Above 999 the display is - - -. - .

Totalizer Option

A built-in Totalizer (Model Code Optional Selection -"T") consists of an 8-digit LCD Counter mounted on a totalizer printed wiring assembly (PWA). This PWA is fastened to the totalizer assembly cover as shown in Figure 1. The Totalizer itself is battery operated, and the battery life is approximately seven years under normal use.

If this option was specified on the Sales Order when ordering the transmitter, then the factory will have installed and prewired the Totalizer to the Transmitter's externally powered low rate pulse output (Code 6) circuitry. The pulse rate is determined by Parameter 3, as discussed earlier in this document. The Totalizer will count up to a maximum of 99,999,999, at which time the count rolls over to all zeroes. The Totalizer may be configured as nonresettable or resettable by means of an internal pushbutton and/or an external magnetic switch. Unless otherwise specified, the factory will have set "RESET" for both internal and external operation. If desired, the "RESET" mode may be changed using link (jumper) positions on the totalizer PWA. Refer to Totalizer Assembly section of Instruction MI 021-371 for link positions.

To reset the Totalizer using the internal reset pushbutton, remove the Totalizer assembly from the Transmitter by loosening the four corner screws on the assembly cover. The pushbutton is now accessible (see Figure 1).

To reset the Totalizer externally, use the magnet provided, or another equally strong magnet, and brush it across the face of the Totalizer Assembly cover at the area marked RESET (lower left corner of cover).

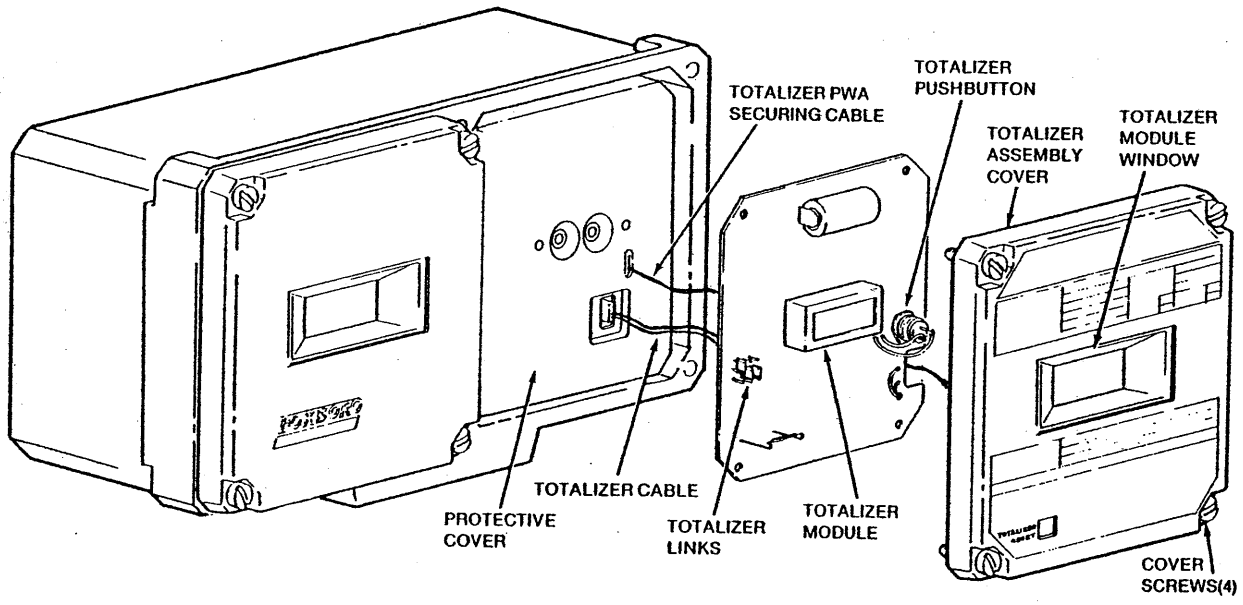


Figure 1. Totalizer Assembly

Turning System Off

To turn off the system, simply remove power from the transmitter.

APPENDIX

Table 6. Units Conversion Factors

VOLUMETRIC FLOW UNITS[1]	UNITS CONVERSION FACTOR
Cubic Metres per minute	264.159
Cubic Metres per hour	4.4029
Cubic Metres per day	0.18345
Cubic Feet per second	448.83
Cubic Feet per minute	7.480
Cubic Feet per hour	0.1247
Imp Gallons per second	72.056
Imp Gallons per minute	1.2010
Imp Gallons per hour	0.02002
U.S. Gallons per second	60.000
U.S. Gallons per minute	1.000
U.S. Gallons per hour	0.01667
U.S. Gallons per day	0.0006944
Litres per second	15.850
Litres per minute	0.26417
Litres per hour	0.004403

[1] For unit conversion factor of other volumetric flow rate units, simply convert the other flow rate units to those listed in the table, and then use the appropriate unit conversion factor.

Table 7. Application Data and Parameter Settings

USER TAG OR LOOP NUMBER _____

FLOWTUBE MODEL NUMBER _____ SERIAL NUMBER _____

TRANSMITTER MODEL NUMBER _____ SERIAL NUMBER _____

PROCESS DATA _____

FLOW RANGE (URV) _____

FLOWTUBE CALIBRATION FACTOR _____

PARAMETER P1 VALUE _____

PARAMETER P2 VALUE _____

PARAMETER P3 VALUE _____

PARAMETER P4 VALUE _____

PARAMETER P5 VALUE _____

PULSE OUTPUT = _____ PER COUNT. TAG VALUE: MULTIPLY BY _____

USER INFORMATION _____

Instruction

MI
021-369
June 1992

8000 Series Pulsed dc Magnetic Flowmeter With Remote-Mounted Transmitter

Styles C and D

Installation

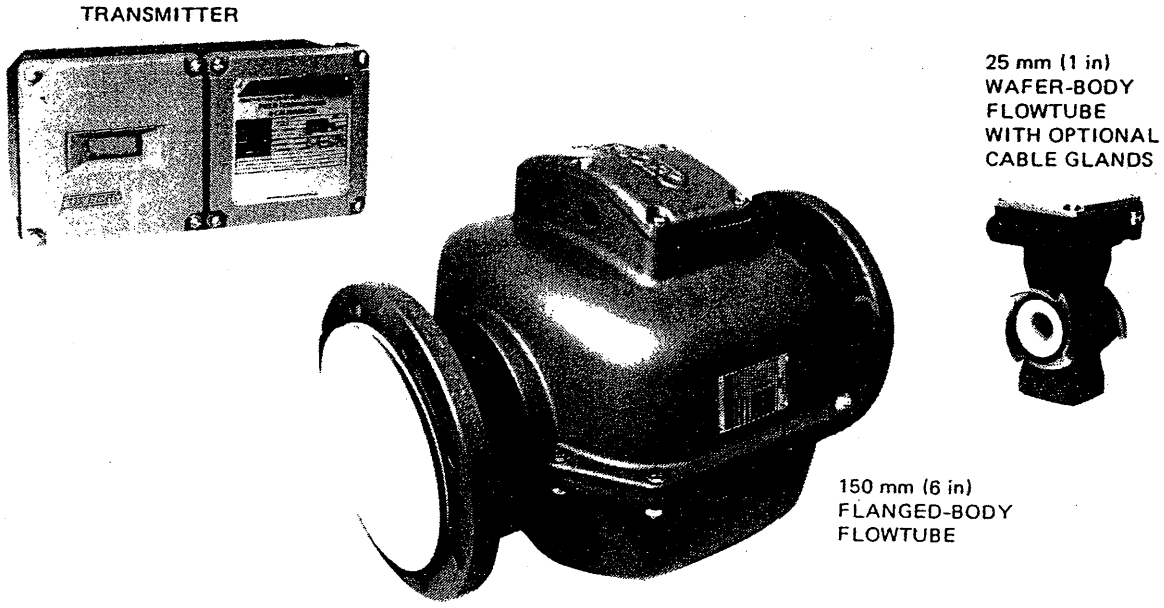


Figure 1.
8000 Series Pulsed dc Magnetic Flowmeter With Remote-Mounted Transmitter

FOXBORO®
A SIEBE COMPANY

FIGURES

TABLES

INTRODUCTION

General Description

This section gives a brief description of the flowmeter. For unpacking details, refer to "Unpacking and Handling Procedures" section.

The flowmeter consists of an 8000 Series Flowtube and an 8000-S (surface-mounted) or 8000-P (pipe-mounted) Transmitter. The flowtube is either wafer-body (without flanges) or flanged-body type as specified in the sales order. Wafer-body flowtubes have a ceramic lining and are available in 15 through 150 mm (1/2 through 6 in) line sizes. Flanged-body flowtubes have either a polyurethane or ptfe lining, as specified. They are available in 150 through 300 mm (6 through 12 in) line sizes. The flowtube is energized by the transmitter as described in the following paragraph.

The transmitter uses a pulsed-dc technique to energize the flux-producing coils of the flowtube. As the process fluid passes through the magnetic field in the flowtube, low-level voltage pulses are developed across a pair of electrodes. The voltage level of these pulses is directly proportional to the average velocity of the fluid. The transmitter converts the voltage pulses to both a standard 4 to 20 mA output signal that is used to indicate, record, and/or control a variable and a pulse output signal that can be used for totalization. The pulse output signal can be configured by the user for either a high-rate or a low-rate pulse. Details of the output signals are given in the "Standard Specifications" section.

An additional feature of the 8000 Flowmeter is its provision of an input terminal for application of an external contact. When the external contact is closed, the transmitter outputs are forced to zero (4 mA, zero pulse rate). This may be used in conjunction with system maintenance to prevent false measurement when flowtube is empty or when cleaning in place. In the empty-tube mode, the 8000 Flowmeter outputs may be incremented in preset steps to provide a signal source for the calibration/verification of downstream equipment (e.g., recorders, totalizers, etc.) connected to the 8000 Flowmeter. An installation press button feature is also included which allows a temporary electronic reversal of the input wiring. This is used to verify correct installation.

This instruction contains installation details of the flowmeter. For a list of instructions containing operation and other details, refer to the "Reference Documents" section that follows.

Reference Documents

Additional information relating to the Flowmeter is contained in the following documents:

Operating Instructions:	MI 021-363
Maintenance Instructions:	MI 021-371
Type Y Purging of Flowtubes in Division 1 Locations:	MI 021-365
Accidental Submergence Construction (-H Option)	MI 021-368
Parts Lists	
Transmitter:	PL 008-602
Wafer-Body Flowtube:	PL 008-597
Flanged-Body Flowtube:	PL 008-541
Dimensions	
Transmitter:	DP 021-353
Wafer-Body Flowtube:	DP 021-142
Flanged-Body Flowtube:	DP 021-143
Product Specifications:	PSS 1-6F2 A

Standard Specifications

Flow Rate Limits See Table 1.
Ambient Temperature Limits
(Transmitter and Flowtube)
Normal Limits −20 and +55 °C (−4 and +131 °F)
Operative Limits −20 and +70 °C (−4 and +158 °F). Transmitter may be operated down to −30 °C (−22 °F) without degradation of analog or pulse outputs. However, the "LCD" rate indicator/display will become increasingly slow or sluggish to respond.
Process Pressure and Temperature Limits
Ceramic-Lined Flowtubes and Polyurethane-Lined Flowtubes See Table 2.
ptfe-Lined Flowtubes See Figure 2.
Environmental Protection The transmitter and flowtube housing is weatherproof as defined by IEC IP65 and provides the watertight protection of NEMA Type 4X.
Electrical Classification See Table 3.
Approximate Mass
Transmitter 5 kg (11 lb)
Flowtube See Table 4.
Enclosure Finish High-build epoxy paint
Output Isolation Both the current and the pulse output circuits are galvanically isolated from the input circuits. If external power is used for at least one of the output circuits, the circuits are also isolated from each other.
Current Output Signal
Output Range 4 to 20 mA dc proportional to flow rate
Power Source The current output circuit can be powered either by an external 14 to 50 V dc power source or by the internal unregulated 24 V dc supply. Source type is specified on transmitter data plate.
Maximum Load Resistance
With Internally-Powered Output 300 Ω
With Externally-Powered Output
Maximum load resistance (R_L) is determined by the following formula:

$$\text{Max. } R_L = (50)(\text{Supply Voltage} - 14)\ \Omega$$

Pulse Output Signal Configured for low-rate pulse output or high-rate pulse output, as specified.
Power Source The pulse output circuit can be powered either by an external power source up to 40 V dc or by the internal unregulated 24 V dc supply. Source type is specified on transmitter data plate.
Low-Rate Pulse Output
Pulse Rate Configurable from 0.1 to 10 Hz at maximum flow rate
Pulse Amplitude
Internally-Powered 24 V, unregulated
Externally-Powered Equal to external dc voltage level
Pulse Duration 50 ms
Maximum Load Resistance 5 kΩ
Maximum Output Current Fused at 250 mA
Maximum Output Voltage Drop 2.4 V at 200 mA
Output Power Capable of driving a 9 W counter at 24 V
Low Signal Cut-off 2% of Span
High-Rate Pulse Output
Pulse Rate 2000 Hz at flow-rate upper range value. Pulse rate is proportional to flow rate.
Pulse Amplitude
Internally-Powered 24 V, unregulated
Externally-Powered Equal to external dc voltage level
Pulse Duration 200 ms
Maximum Line Capacitance 0.1 μF
Maximum Load Resistance 5 KΩ
Maximum Output Current Fused at 250 mA
Maximum Output Voltage Drop 2.4 V at 200 mA
Low Signal Cut-off 2% of Span
Input (External Contact) for Empty Tube Requirement Specification Isolated normally open contact
Open Resistance 500 kΩ minimum
Closed Resistance 10 Ω maximum
Power Requirements
Voltage and Frequency Requirements See data plate on transmitter.
System Power Consumption Less than 15 W with any size flowtube at nominal mains voltage and frequency

Table 1. Flow Rate Limits

Flowtube Type				Minimum and Maximum Upper Range Flow Rates	
Lining	Size mm	Size in	Model Code* Series	L/m	U.S. gpm
Ceramic	15	1/2	800H-WCR	4.0 and 80	1.0 and 20
	25	1	8001-WCR	14 and 280	3.5 and 73
	40	1 1/2	801H-WCR	34 and 680	9 and 170
	50	2	8002-WCR	51 and 1000	13 and 250
	80	3	8003-WCR	125 and 2500	31 and 625
	100	4	8004-WCR	220 and 4400	55 and 1100
	150	6	8006-WCR	490 and 9750	122 and 2440
ptfe	150	6	8006-□TR	600 and 12000	150 and 3000
	200	8	8008-□TR	1030 and 20600	260 and 5150
	250	10	8010-□TR	1645 and 32800	410 and 8200
	300	12	8012-□TR	2350 and 46900	590 and 11700
Polyurethane	150	6	8006-□AR	465 and 9250	115 and 2300
	200	8	8008-□AR	870 and 17300	220 and 4300
	250	10	8010-□AR	1430 and 28600	360 and 7150
	300	12	8012-□AR	2100 and 41800	525 and 10450

* Model Code is located on flowtube data plate as shown in Figure 3.
The symbol □ represents "B" or "Z" in the model code.

Table 2. Process Pressure and Temperature Limits for Ceramic-Lined and Polyurethane-Lined Flowtubes

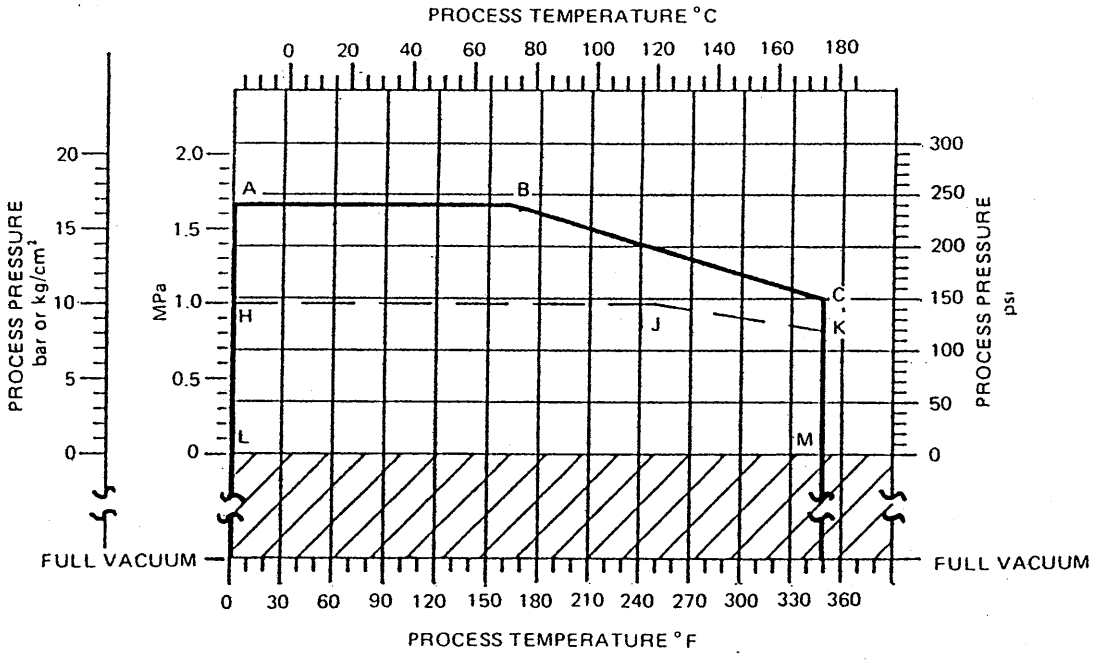
Flowtube Type			Process Pressure Limits		Process Temperature Limits**	
Lining	Body Construction	Model Code*	MPa	psi	°C	°F
Ceramic	Wafer	800H-WCR through 8002-WCR	Full Vacuum to 5.1 MPa at 38 °C and 4.4 MPa at 204 °C	Full Vacuum to 740 psi at 100 °F and 635 psi at 400 °F	−40 and +204	−40 and +400
		8003-WCR through 8006-WCR	Full Vacuum to 4.6 MPa at 38 °C and 4.0 MPa at 204 °C	Full Vacuum to 675 psi at 100 °F and 580 psi at 400 °F	−40 and +204	−40 and +400
Polyurethane	ANSI Class 150 R.F. Flange	8006-BAR through 8012-BAR	Full Vacuum and 1.7 MPa	Full Vacuum and 240 psi	−18 and +70	0 and +160
	PN 10 R.F. Flange	8006-ZAR through 8012-ZAR	Full Vacuum and 1.0 MPa	Full Vacuum and 150 psi	−18 and +70	0 and +160

* Model Code is located on flowtube data plate as shown in Figure 3.
** For ceramic-lined flowtubes, maximum allowable step change in process temperature with respect to flowtube lining is +125 °C (+225 °F) and −75 °C (−135 °F).

Table 3. Electrical Classification

Testing Laboratory, Types of Protection and Area Classification	Conditions of Certification	Electrical Certification Specification
CSA certified for use in ordinary locations, and Class I, Groups A, B, C, and D, Division 2, hazardous locations.	800H through 8006-WCR Flowtubes, and 8000-P and 8000-S Transmitters. Temperature Class T3.	CS-E/CN-A
CSA certified for Type Y purging for Class I, Groups A, B, C, and D, Division 1, hazardous locations.	800H through 8006-WCR Flowtubes. Temperature Class T3.	CS-E/CP-A
Foxboro certified for use in ordinary locations.	An FG-F* transmitter must connect to an FG-F* flowtube.	CS-E/FG-F
Foxboro certified for use in Class I, Groups A, B, C, and D, Division 2 hazardous locations.	Transmitter: Temperature Class T6. Must connect to an FN-F* or FP-F* flowtube. Flowtube: Temperature Class T3. Must connect to an FN-F* transmitter.	CS-E/FN-F
Foxboro certified for Type Y purging for Class I, Groups A, B, C, and D, Division 1 hazardous locations.	Flowtubes only. Temperature Class T3. Must connect to an FN-F* transmitter.	CS-E/FP-F
PTB certified for use in ordinary locations, and intrinsically safe (Ex) ib, Zone 1.	8000-P and 8000-S Transmitters.	CS-E/PGB-E
PTB certified intrinsically safe signal circuit and increased safety mains connection for IEC Groups IIIA, IIIB, and IIIC, Zone 1.	800H through 8006-WCR Flowtubes.	CS-E/PS-E

* CG-A, FG-F, FN-F, and FP-F refer to the suffix of the electrical certification specification. For flowtube and transmitter electrical certification specification, see their respective data plates. Location of "cert spec" on data plates is shown in Figure 3.



Process temperature and pressure must be within the boundaries:
LABCM for flowtubes with ANSI Class 150 flanges
LHJKM for flowtubes with PN (ND) 10 flanges
Refer to Foxboro for applications involving elevated pressure.

Figure 2. Process Pressure and Temperature Limits for ptfe-Lined Flowtubes

Table 4. Approximate Flowtube Mass

Flowtube Size		Model Code* Series	Approximate Mass	
mm	in		kg	lb
15	1/2	800H-WCR	2.3	5.0
25	1	8001-WCR	3.0	6.6
40	1 1/2	801H-WCR	3.5	7.7
50	2	8002-WCR	4.5	9.9
80	3	8003-WCR	7.0	15.4
100	4	8004-WCR	10.0	22.0
150	6	8006-WCR	17.7	39.0
150	6	8006-□□R	55	122
200	8	8008-□□R	85	188
250	10	8010-□□R	91	200
300	12	8012-□□R	125	275

* The Model Code is located on the flowtube data plate as shown in Figure 3. The symbol □ represents letters in flanged-body model code.

Flowmeter Identification

The flowmeter can be identified by data plates located on the transmitter terminations cover and on the flowtube. Typical data plates are shown in Figure 3. Wafer-body flowtubes have two data plates as shown. Flanged-body flowtubes have similar data on a single data plate.

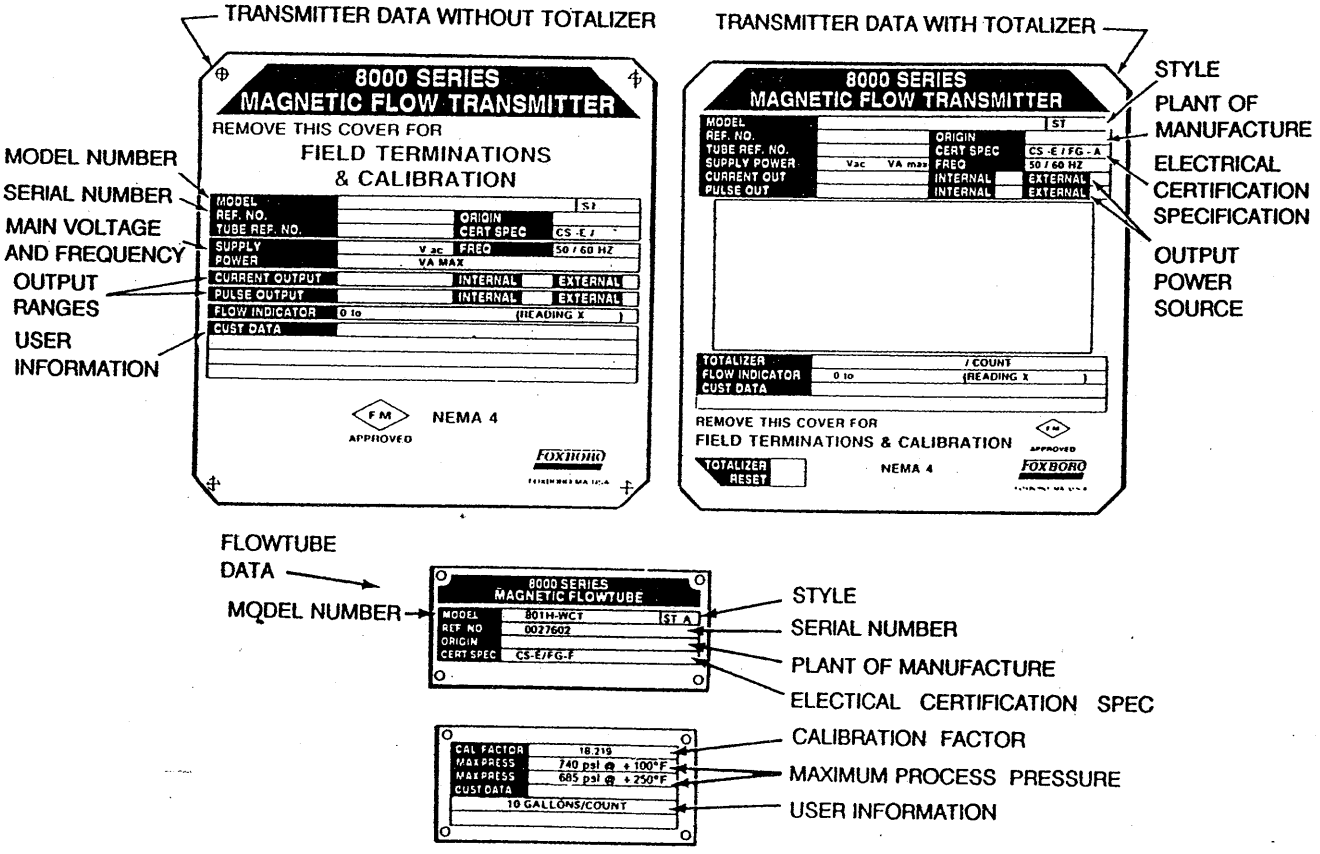


Figure 3. Typical Data Plates

UNPACKING AND HANDLING PROCEDURE

Before removing the flowtube from its shipping carton, move it as close as possible to its installation point. Flanged-body flowtubes are shipped with end covers to protect the flowtube lining. If the covers must be removed for receiving inspection, REINSTALL THE END COVERS AFTER INSPECTION.

In ptfe-lined flowtubes, the white material extending over the flanges is the ptfe lining; not packaging material. DO NOT ATTEMPT TO REMOVE OR CUT THE FLOWTUBE LINING.

To lift a flanged-body flowtube out of its carton, use a rope fall, chain hoist, etc. as shown in Figure 4. In some instances it may be more convenient to insert bolts into the flange bolt holes and use hooks around the bolts for lifting (rather than tying slings around the flowtube). NEVER PUT ANYTHING THROUGH THE FLOWTUBE TO LIFT IT.

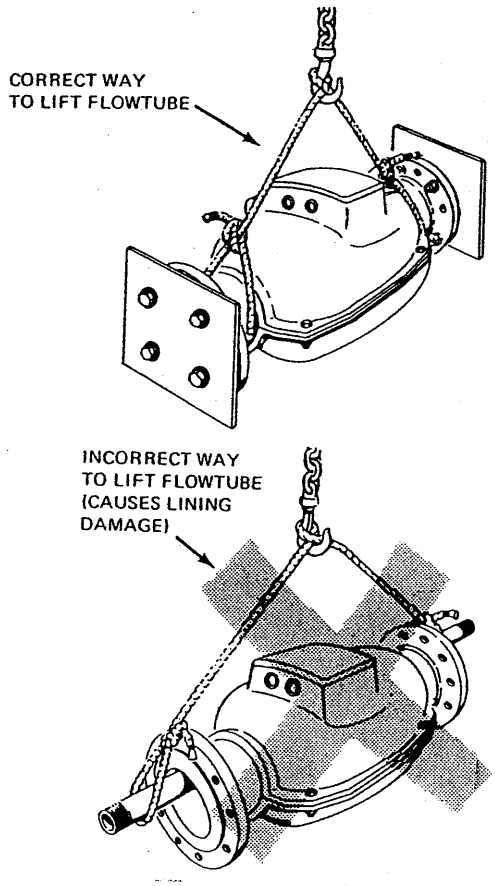


Figure 4. Handling Flanged-Body Flowtube

After removing flowmeter (flowtube and transmitter) from its shipping cartons, inspect it for visible damage. If any damage is observed, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier.

AVOID TOUCHING ELECTRODES WITH FINGERS OR MATERIALS THAT CAN CONTAMINATE ELECTRODES. Deposit on electrodes will result in high-impedance boundary between electrodes and conductive fluid. If electrodes have been touched, clean them with isopropyl alcohol.

INSTALLING WAFER-BODY FLOWTUBE

The following procedures are used for installing wafer-body flowtubes shown in Figure 1. For details of installing flanged-body flowtube, see "Installing Flanged-Body Flowtube" procedure.

NOTE

Before installing the flowtube and the transmitter, ensure that cable length between them will not be greater than 300 m (1000 ft).

Flowtube Dimensions

For dimensions of wafer-body flowtube, refer to Dimensional Print DP 021-142.

Flowtube Earthing (Grounding)

Continuity between flowing liquid and metal metering tube is required to provide a reference for the measurement signal. Earthing (grounding) wires are provided on the junction box for this purpose. The grounding wires are shown in Figure 5. Additional grounding details are given in "System Wiring" section.

When the flowtube is mounted between unlined metal pipe, continuity is provided by connecting the grounding wires from the flowtube junction box to the pipe flanges as described in "Mounting Procedure" on Page 6.

When the flowtube is mounted between non-metal or lined metal pipe, installation of earthing rings (grounding rings) on each pipe flange is required as shown in Figure 5. Continuity is provided by connecting the grounding wires from the flowtube junction box to the grounding rings.

Grounding rings can be made from orifice plates. Inside diameters of grounding rings are specified in Table 5. These diameters will permit grounding rings to be in contact with process fluid.

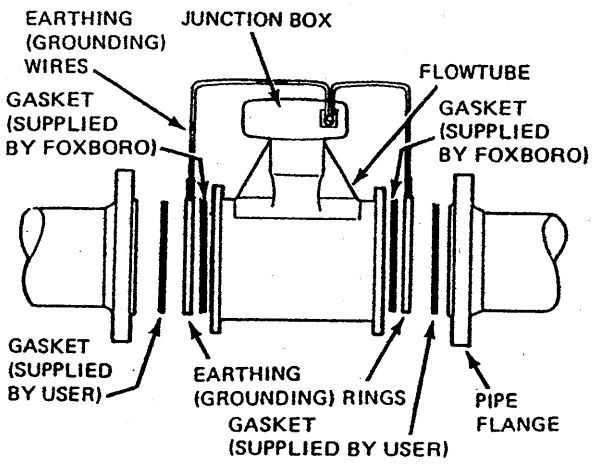


Figure 5.
Use of Grounding Rings with Wafer-Body Flowtube

Table 5. Inside Diameters of Grounding Rings for Wafer-Body Flowtubes

Flowtube Size		Grounding-Ring Inside Diameter	
mm	in	mm	in
15	1/2	15.7	0.62
25	1	26.9	1.06
40	1 1/2	41.1	1.62
50	2	50.8	2.00
80	3	75.4	2.97
100	4	100.8	3.97
150	6	152.0	5.98

Mounting Positions

The flowtube can be mounted in any position: vertical, horizontal, or at an angle. However, for accurate measurement, the flowtube must be completely full. Vertical installation with flow in an upward direction, as shown in Figure 6, is generally recommended. If mounting flowtube in other than a vertical position, it is recommended that it be turned about the flow axis shown in Figure 7 so that electrodes are horizontal. Electrodes should be horizontal to avoid contacting bubbles (at top) or sediment (at bottom) inside flowtube.

Flow through the flowtube can be in either direction. However, if it is installed with the "direction-of-flow" arrow (shown in Figure 6) pointing upstream, it will be necessary to reverse the flowtube coil-drive wires. An indication that the coil-drive wires should be reversed is given by a negative flow reading or "-A" reading during process flow. Wiring details are given in the "System Wiring" section.

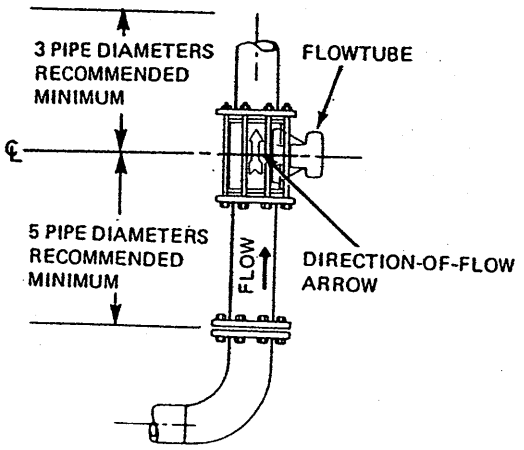


Figure 6. Wafer-Body Flowtube Mounted Vertically

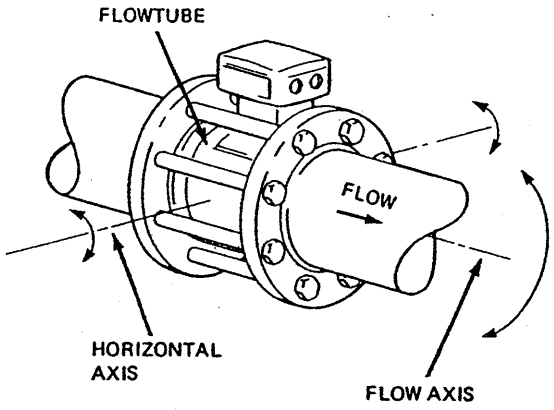


Figure 7. Wafer-Body Flowtube Mounted Horizontally

Mounting Procedure

When installing flowtube, use correct size mounting studs. Size is determined by size of flowtube and type and size of pipe flanges. If specified in sales order, mounting studs were supplied with flowtube. They can also be purchased separately from Foxboro. For a list of part numbers, refer to Parts List PL 008-597.

1. Before installing the flowtube, install and adequately support piping. When installing the piping, it is recommended that straight lengths of pipe be used for at least five pipe diameters upstream and three pipe diameters downstream of flowtube center line (see Figure 6) to retain system accuracy.

   Leave correct space for later installation of flowtube. For flowtube dimensions, see Dimensional Print DP 021-142. Adjust piping and flanges so that flanges will be aligned and parallel with ends of flowtube when flowtube is installed. Piping flanges must not be forced into alignment during installation of flowtube. Correct alignment of piping is shown in Figure 8.

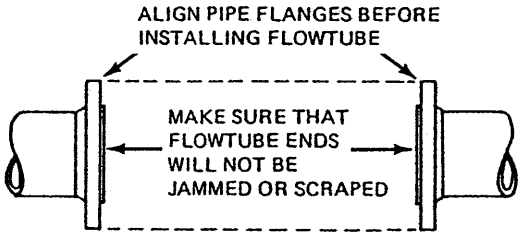


Figure 8.
Piping Alignment for Wafer-Body Flowtube

2. Locate and remove all foreign objects from the piping. If possible, make up and install a section of pipe (spool piece) in the space provided for the flowtube. Start up the process to help locate any foreign objects.

3. If grounding rings are not being used (see "Flowtube Earthing"), drill and tap a hole in each pipe flange to accept grounding wires. If grounding rings are being used, connect grounding wires to the grounding rings. Grounding wires are located on flowtube junction box as shown in Figure 5. Lugs on end of grounding wires will accept an M6 or 1/4-20 screw.

4. Check that flowtube gaskets shown in Figures 9 and 10 did not come free during shipping; if they did, put them back into position on flowtube.

CAUTION

Although Gylon Style 3510 (ptfe and barium sulfate) gaskets provided with flowtube are suitable for use in most magnetic-flow applications, some hot acids may attack gasket material. Examples are hydrochloric acid and sulfuric acid at temperatures above 65 °C (150 °F). SUBSTITUTE GASKETS PROVIDED WITH SUITABLE GASKET MATERIAL FOR THESE APPLICATIONS.

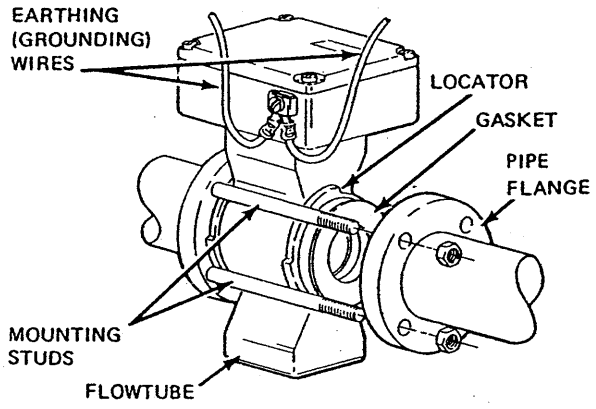


Figure 9.
Installation of 15 or 25 mm
(1/2 or 1 in) Size Wafer-Body Flowtubes

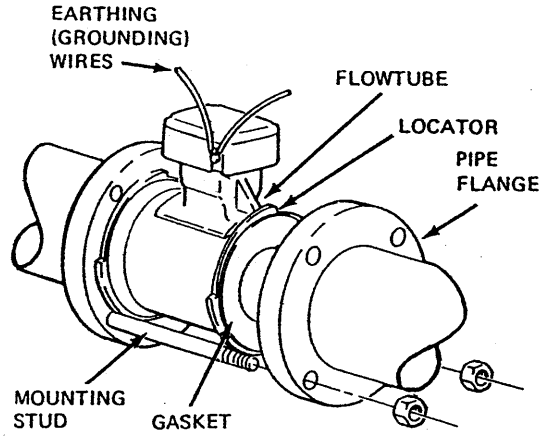


Figure 10.
Installation of 50 through 150 mm
(2 through 6 in) Size Wafer-Body Flowtubes

5. Check that locators shown in Figures 9 and 10 are on flowtube. If not, install them so that lobes on both locators are facing in same direction as shown.

6. For 15 or 25 mm (1/2 and 1 in) flowtubes, loosely install two studs in one side of pipeline as shown in Figure 9. Studs will be a guide to permit approximate alignment of flowtube with pipe. If grounding rings are being used, position them between flowtube ends and pipe flanges. Use additional suitable gasket material between grounding rings and flanges. Position flowtube between pipe flanges or, if grounding rings are used, between gaskets.

   For 50 through 150 mm (2 through 6 in) flowtubes, loosely install two or three mounting studs to form a cradle for the flowtube as shown in Figure 10. Rest flowtube on mounting studs. If grounding rings are being used, position them between flowtube ends and pipe flanges. Use additional suitable gasket material between grounding rings and flanges.

7. Install remaining mounting studs through pipe flange holes. If flowtube locators (shown in Figures 9 and 10) interfere with installation of mounting studs, turn locators about flowtube axis so that mounting studs will clear them. Tighten stud nuts alternately and uniformly until pipe flanges are snug enough to hold flowtube in place but loose enough to allow movement of flowtube for alignment.

8. Refer to Figure 11. With a blunt rod and small hammer, gently tap one of the locator lobes so that locator turns about flowtube axis and comes in contact with a mounting stud. Repeat for other locator.

CAUTION

Tapping plastic locators firmly may cause them to break. WHEN TAPPING LOCATORS, REMOVE WEIGHT OF FLOWTUBE FROM THEM.

9. Continue to tap locators. This will cause flowtube to shift position until each locator lobe is touching a mounting stud. Flowtube will then be correctly aligned with piping.

10. Slightly tighten one nut on mounting stud. Then proceed to slightly tighten diametrically-opposite nuts sequentially. The torque on each nut should be less than one-half the value given in Table 6. Continue to tighten nuts gradually, uniformly, and alternately, as required to prevent leakage when system is put into operation. Final torque values must be less than or equal values given in Table 6.

11. Connect grounding wires from flowtube junction box to tapped holes in flanges or to grounding rings, as applicable.

Table 6. Maximum Mounting-Nut Torques for Wafer-Body Flowtubes

Flowtube Size		Number of Bolts in Flange	Maximum Mounting-Nut Torque	
mm	in		N•m	lb•ft
15	1/2	4	7	5
25	1	4	15	10
40	1 1/2	4	40	30
50	2	4	75	55
		8	40	30
80	3	4	120	90
		8	70	50
100	4	4	175	130
		8	95	70
150	6	8	170	125
		12	110	80

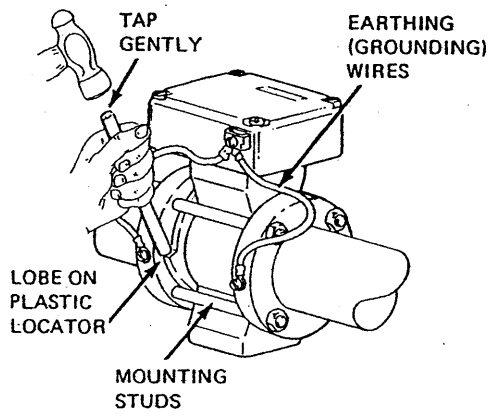


Figure 11. Aligning Wafer-Body Flowtube

INSTALLING FLANGED-BODY FLOWTUBE

The following procedures are used for installing flanged-body flowtube shown in Figure 1. For details of installing wafer-body flowtube, see "Installing Wafer-Body Flowtube" procedure.

NOTE

Before installing the flowtube and the transmitter, ensure that cable length between them will not be greater than 300 m (1000 ft).

General Precautions

1. Leave end covers installed over flanges any time flowtube is put in storage. Do not cut or remove flowtube lining.

2. Good piping practice should be used for the installation of all magnetic flowtubes. Gaskets are recommended. Select a gasket material that is compatible with the process liquid.

3. The flowtube lining extends outward and over the raised face of the flange.

CAUTION

To avoid damage to the lining extension, do not exceed torque values specified when tightening flange bolts.

4. The flowtube lining is susceptible to damage from excessive heat. Avoid such heat sources (such as welding adjacent piping).

5. To avoid possible loss of accuracy, it is recommended that the flowtube be connected in a straight section of pipe at least five pipe diameters upstream from the center line of the flowtube and three pipe diameters downstream as shown in Figure 13. The center line of the flowtube is the same location as the electrode location. Note that for some small line sizes, the recommended straight runs of pipe are included in the overall length of the flowtube.

To avoid excessive lining wear (especially with ptfe), it is recommended that five pipe diameters of straight section of pipe be connected from the flowtube flange end. If this recommendation cannot be met, it is suggested that a protective device (i.e., grounding ring) be installed on the upstream end of the flowtube.

Flowtube Dimensions

For dimensions of flanged-body flowtube, refer to Dimensional Print DP 021-143.

Flowtube Earthing (Grounding)

Continuity between flowing liquid and metal metering tube is required to provide a reference for the measurement signal. With unlined metal pipe connected to the flowtube flange, continuity is provided by the pipe and the flange bolts. Additional grounding details are given in "System Wiring" section.

Installations in which non-metal or lined metal pipe is used require installation of earthing rings (grounding rings) on each flowtube flange as shown in Figure 12. To provide continuity, connect one end of a wire (6 mm^2 {10 AWG} recommended size) to the grounding ring; connect the other end to a flange bolt or to a hole drilled and tapped in the flange.

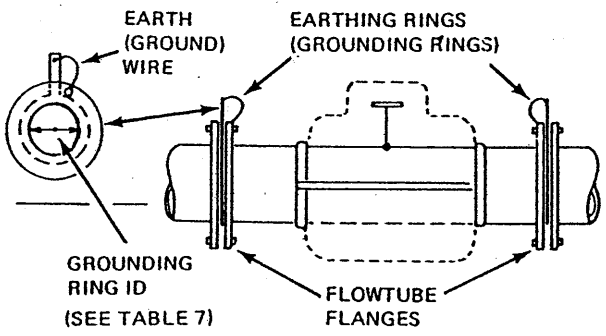


Figure 12.
Use of Grounding Rings with
Flanged-Body Flowtube

Grounding rings can be made from orifice plates. Inside diameters of grounding rings are specified in Table 7. These diameters will provide positive contact with process fluid.

Table 7.
Inside Diameters of
Grounding Rings for Flanged-Body Flowtubes

Flowtube Size		Grounding-Ring Inside Diameter			
		For ptfe-Lined Flowtube		For Polyurethane Lined Flowtube	
mm	in	mm	in	mm	in
150	6	151.9	5.98	145.6	5.73
200	8	199.9	7.88	195.5	7.70
250	10	253.0	9.97	248.7	9.80
300	12	303.0	11.94	298.6	11.76

Protection from Abrasive Flow

In addition to providing metering tube earthing (grounding), grounding rings can also be used to protect the leading edge of flowtube lining from abrasives. For grounding-ring details, see "Flowtube Earthing".

Mounting Positions

The flowtube can be mounted in any position: vertical, horizontal, or at an angle. However for accurate measurement, the flowtube must be completely full. Vertical installation with flow in an upward direction, as shown in Figure 13, is generally recommended. This is particularly so in slurries with abrasive solids. If mounting flowtube in other than a vertical position, it is recommended that flowtube be turned about the flow axis shown in Figure 14 so that electrodes are horizontal. Electrodes should be horizontal to avoid contacting bubbles (at top) or sediment (at bottom) inside metering tube.

Flow through the flowtube can be in either direction. However, if it is installed with the "direction-of-flow" arrow (shown in Figure 13) pointing upstream, it will be necessary to reverse the flowtube coil-drive wires. An indication that the coil-drive wires should be reversed is given by a negative flow reading or "-A" reading during process flow. Wiring details are given in the "System Wiring" section.

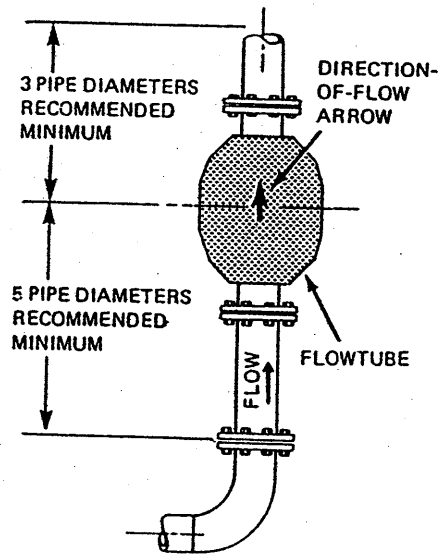


Figure 13.
Flanged-Body Flowtube Mounted Vertically

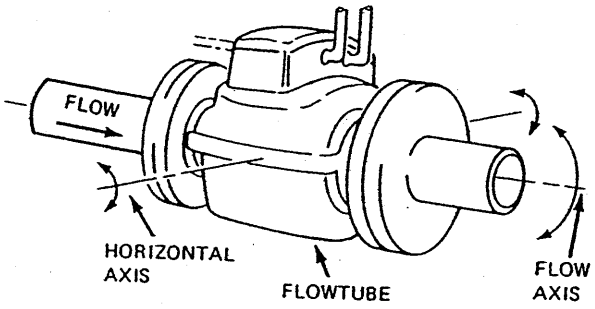


Figure 14.
Flanged-Body Flowtube Mounted Horizontally

Mounting Procedure

CAUTION

Excessive forces during installation and operation of flowtube can crush extended ends of flowtube lining. Some causes of these forces are excessive bolt torque, weight of vertical pipeline, thermal expansion of pipeline, and misalignment of flanges. To minimize these forces, adhere to the following procedure.

1. Before installing flowtube, install and adequately support piping. If flowtube is being mounted vertically, add piping supports above and below flowtube to avoid strain to flanges and damaging lining.

   Leave space for later installation of flowtube and adjoining spool pieces (if applicable, see Step 3). Adjust piping and flanges so that flanges will be aligned and parallel with flowtube flanges when flowtube is installed. Flanges must not be forced into alignment during installation of flowtube. See Figure 15 for correct alignment of piping. Also allow for thermal expansion of piping during operation, as required.

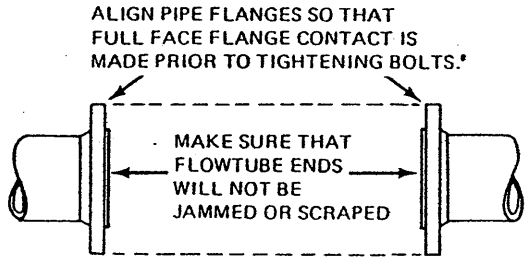


Figure 15.
Piping Alignment for Flanged-Body Flowtube

NOTE

Piping supports must be firm enough so that addition of process fluid will not disrupt alignment of flowtube and adjacent piping.

2. Locate and remove all foreign objects from the piping. If possible, make up and install a section of pipe (spool piece) in the space provided for the flowtube. Start up the process to help locate any foreign objects.

3. It is recommended that adjoining spool pieces (pieces of pipe) be installed on flowtube before installation.

   If adjoining spool pieces are being installed, complete this step. Otherwise proceed to Step 4.

   a. Refer to Figure 16. Position gaskets and grounding rings (as applicable) adjacent to flowtube flanges. (For details of grounding rings, see "Flowtube Earthing" section.)

   b. Connect spool pieces to flowtube on floor. Tighten flange bolts alternately and uniformly to specifications given in Table 8.

   c. Hoist complete assembly into position as shown in Figure 16. Align flanges and bolt into place.

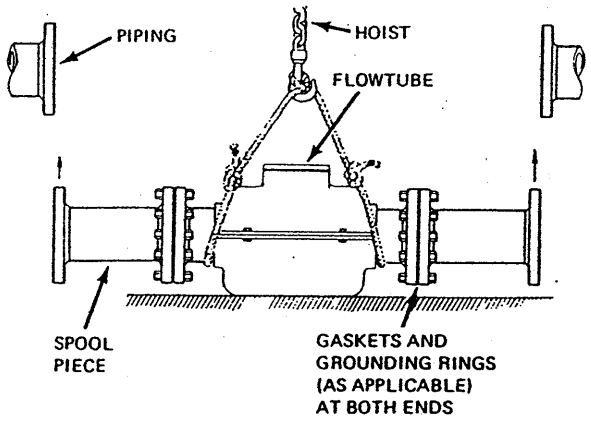


Figure 16.
Installing Flanged-Body Flowtube
with Spool Pieces

4. If adjoining spool pieces are not being installed on flowtube, complete this step.

   a. Refer to Figure 17. Spring back piping to allow clearance as necessary to insert flowtube without causing damage to lining.

   b. Install gaskets and grounding rings (as applicable) adjacent to flowtube flanges. (For details of grounding rings, see "Flowtube Earthing" section.)

   c. Align flanges, install bolts, and position piping into place.

   d. Tighten flange bolts alternately and uniformly to specifications given in Table 8.

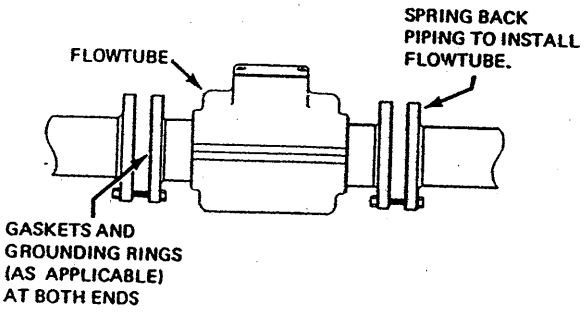


Figure 17.
Installing Flanged-Body Flowtube without Spool Pieces

Table 8.
Flange-Bolt Torque Specifications for Flanged-Body Flowtubes

Flowtube Size		Number of Bolts in Flange	Flange-Bolt Torque			
			ptfe Lining		Polyurethane Lining	
mm	in		N•m	lb•ft	N•m	lb•ft
150	6	8	80	60	120	90
		12	60	45	95	70
200	8	8	100	75	150	120
		12	80	60	120	90
250	10	12	95	70	140	110
		16	80	60	120	90
300	12	12	110	80	160	120
		16	95	70	140	110

INSTALLING TRANSMITTER

The transmitter can be mounted horizontally or vertically, as desired. It is supplied with pipe-mounting or surface-mounting hardware as specified in the sales order.

Transmitter Dimensions

For transmitter dimensions, refer to Dimensional Print DP 021-353.

Mounting Pipe-Mounted Transmitter

NOTE

Symmetrical arrangement of mounting holes in transmitter and mounting hardware allow transmitter to be turned about mounting bracket in 90° increments. This permits a variety of transmitter orientations as shown in Figure 18. Transmitter covers can also be turned in 90° increments by unscrewing four screws. This permits transmitter display and data plate to be turned so they can be easily read. When reinstalling terminations cover, make certain that securing cable (shown in Figure 18) is inserted fully behind cover and not crimped between cover and transmitter housing.

CAUTION

Certifying agencies require terminations cover to be permanently attached to transmitter. This is done by means of the securing cable (see Figure 18). DO NOT DISCONNECT COVER FROM CABLE.

1. Select desired transmitter orientation and position covers on transmitter as described in preceding note.

2. Screw one nut fully onto each of the four mounting studs as shown in Figure 18. Slide one washer onto same end of stud as nut as shown.

3. Position one of the mounting brackets against transmitter as required for desired transmitter orientation (see preceding note). Screw four mounting studs into transmitter mounting holes and secure bracket by tightening four nuts against washers.

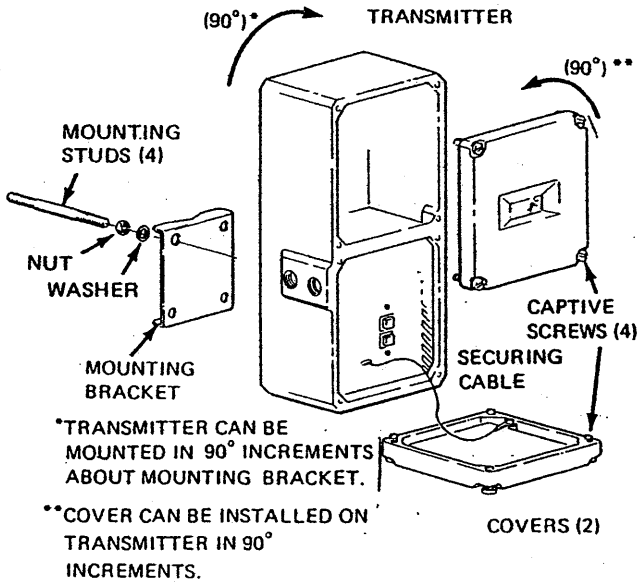


Figure 18.
Orienting Pipe-Mounted Transmitter and Covers

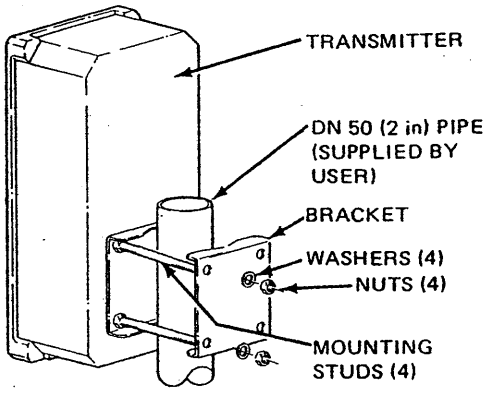


Figure 19.
Mounting Pipe-Mounted Transmitter

4. Mount transmitter onto pipe with other mounting bracket; secure bracket with remaining four nuts and washers as shown in Figure 19.

5. For transmitter wiring details, proceed to "System Wiring" section.

Mounting Surface-Mounted Transmitter

NOTE

Transmitter can be turned in 90° increments for mounting against surface as shown in Figure 20. Note that transmitter covers can also be turned in 90° increments by unscrewing four screws. This permits transmitter display and data plate to be turned so they can be easily read. When reinstalling terminations cover, make certain that securing cable (shown in Figure 18) is inserted fully behind cover and not crimped between cover and transmitter housing.

CAUTION

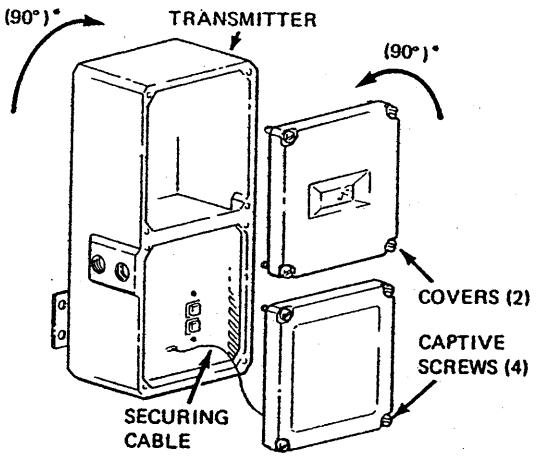
Certifying agencies require terminations cover to be permanently attached to transmitter. This is done by means of the securing cable (see Figure 20). DO NOT DISCONNECT COVER FROM CABLE.

1. Select desired transmitter orientation and position covers on transmitter as described in preceding note.

2. Attach mounting bracket to rear of transmitter with the four screws provided as shown in Figure 21.

3. Turn transmitter to desired orientation against surface; mount to surface using four mounting holes in bracket and required mounting hardware (supplied by user) as shown in Figure 21. Mounting holes in bracket will accept M8 or ASA 5/16 screws.

4. For transmitter wiring details, proceed to "System Wiring" section.



*COVERS CAN BE INSTALLED ON TRANSMITTER IN 90° INCREMENTS PERMITTING DATA TO BE EASILY READ FOR VARIOUS ORIENTATIONS OF TRANSMITTER.

Figure 20.
Orienting Surface-Mounted Transmitter and Covers

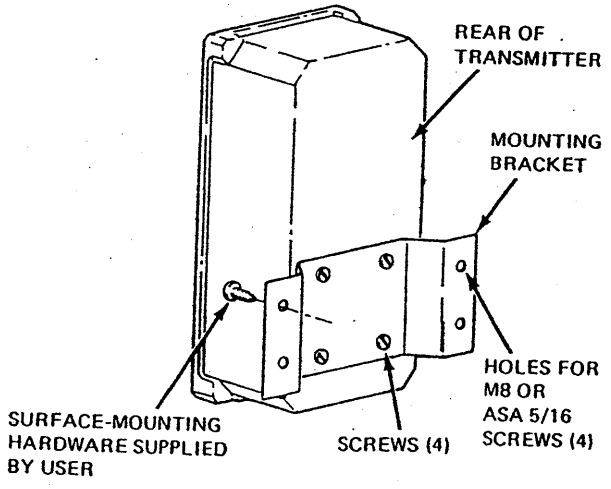


Figure 21.
Mounting Surface-Mounted Transmitter

SYSTEM WIRING

Wire Entrances and Conduit Connections

Wire entrances to the transmitter and the flowtube are either tapped for 1/2 inch conduit or provided with optional cable glands (flanged flowtubes have 3/4 in tapped conduit holes). If using conduit, connect it to transmitter and flowtube as shown in Figure 22. Separate conduit runs are recommended for input signal, output signal, ac supply, and flowtube coil drive wires. Optional cable glands are for use with cables having a thickness between 7 and 12 mm (0.27 and 0.48 in) as shown in Figure 22. Use of cable glands is described when applicable in following sections.

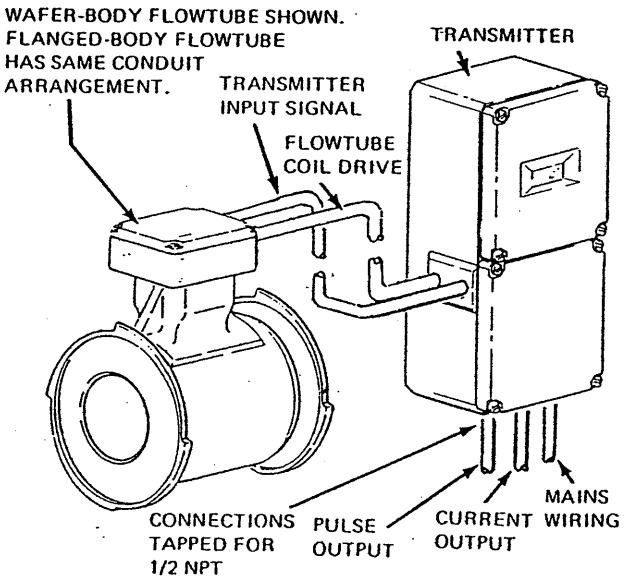


Figure 22. Conduit Connections

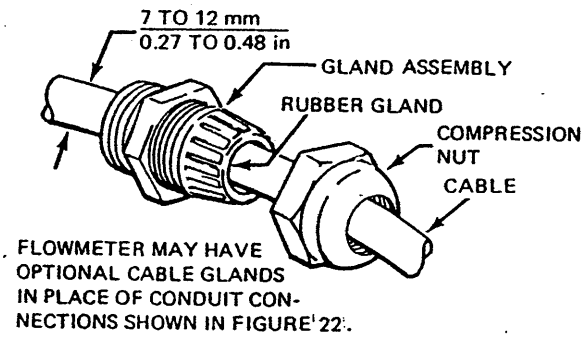


Figure 23. Optional Cable Glands

Wire and Cable Details

The following type and size wires are recommended:

Power Mains Wiring:
3-core (3-conductor) 2.50 mm^2, 14 AWG, or correct size and type wires in conformance with local wiring practice.

Transmitter Input Signal Wiring:
Multicore, multiscreened (multiconductor, multishielded) cable, Foxboro Part Number R0101ZS. Maximum length of cable is 300 m (1000 ft) with a minimum process fluid conductivity of 5 μS/cm.

Flowtube Coil Drive Wire:
2-core (2-conductor) or 3-core (3-conductor) 2.50 mm^2 (14 AWG). 90 °C (194 °F) rated wire is adequate if process temperature is below 150 °C (302 °F).

Analog Output, Pulse Output, and Signal Lock (External Contact) Wiring:
0.50 mm^2 (22 AWG) shielded wire or larger recommended.

Preparing Input-Signal Cable for Wiring

For access to terminals inside transmitter, unscrew the 4 captive screws on terminations cover shown in Figure 24. Remove terminations cover and allow it to hang by the securing cable. Unscrew the two captive screws on protective cover. Remove protective cover and rest it against terminations cover.

CAUTION

Certifying agencies require terminations cover to be permanently attached to transmitter. This is done by means of the securing cable shown in Figure 24. DO NOT DISCONNECT COVER FROM CABLE.

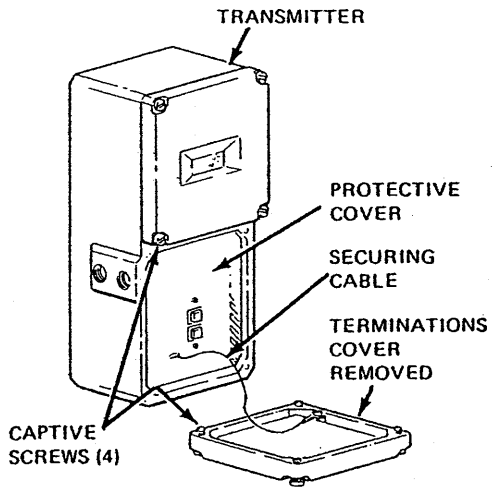


Figure 24.
Accessing Terminals Inside Transmitter

For access to terminals inside flowtube, remove flowtube terminations cover shown in Figure 25.

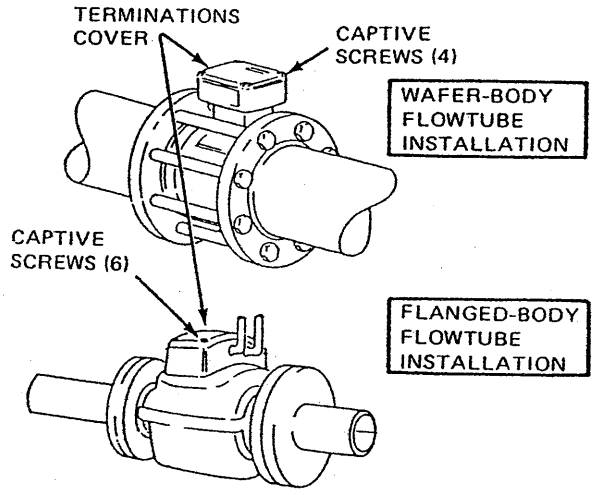


Figure 25.
Accessing Terminals Inside Flowtube

If conduit is being used for input-signal cable, run cable through conduit shown in Figure 22.

If transmitter and flowtube are equipped with optional cable glands, run and dress input-signal cable from flowtube to transmitter. Insert cable through cable gland at flowtube and/or transmitter as applicable. Cable glands are shown in Figure 23. Use same wire entrances to flowtube and transmitter as indicated in Figure 22 for conduit connections.

Prepare ends of cable by using the following procedures as applicable.

NOTE

Do not tin ends of wires. Tinned wires can result in poor connections and cause signal noise.

TERMINATIONS TO WAFER-BODY FLOWTUBE

Use this procedure to prepare the multicore (multiconductor) signal cable provided for connection to the flowtube and the transmitter:

1. Strip back outer jacket and foil screen (shield) as shown in Figure 26. Do not cut screen lead.

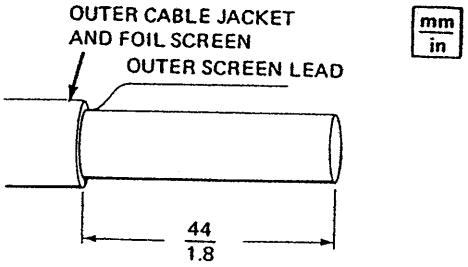


Figure 26.
Outer Jacket of Signal Cable Stripped Back for Connection to Wafer-Body Flowtube Terminals

2. Strip back inner jacket and foil screen as shown in Figure 27. Do not cut inner screen lead.

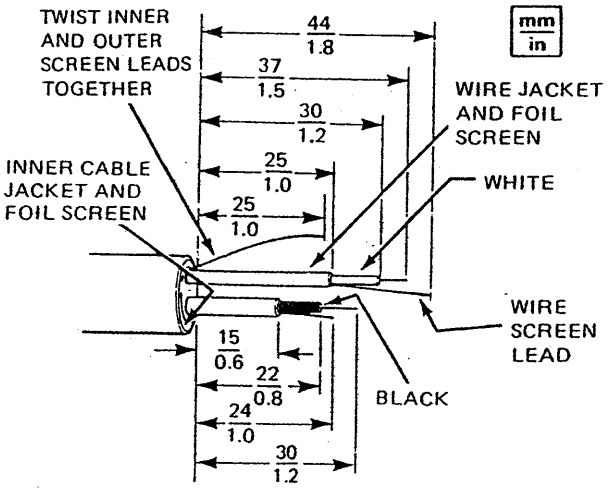


Figure 27.
Inner and Lead Jackets of Signal Cable Stripped Back for Connection to Wafer-Body Flowtube Terminals

3. Strip back lead jackets and foil screens as shown (Figure 27). Do not cut screen leads.

4. Strip insulation from black and white leads as shown (Figure 27).

TERMINATIONS TO FLANGED-BODY FLOWTUBE

1. Strip back outer jacket and foil screen (shield) as shown in Figure 28. Do not cut outer screen lead.

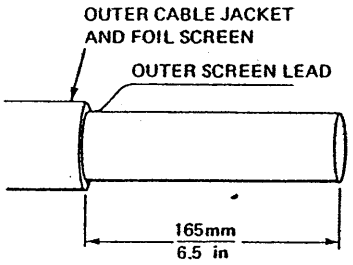


Figure 28.
Outer Jacket of Signal Cable Stripped Back for Connection to Flanged-Body Flowtube Terminals

2. Strip back inner jacket and foil screen as shown in Figure 29. Do not cut inner screen lead.

3. Strip back lead jackets and foil screens as shown (Figure 29). Do not cut screen leads.

4. Strip insulation from black and white leads as shown (Figure 29).

5. If connections to terminal lugs are desired, connect lugs (supplied by user) to leads as shown in Figure 29.

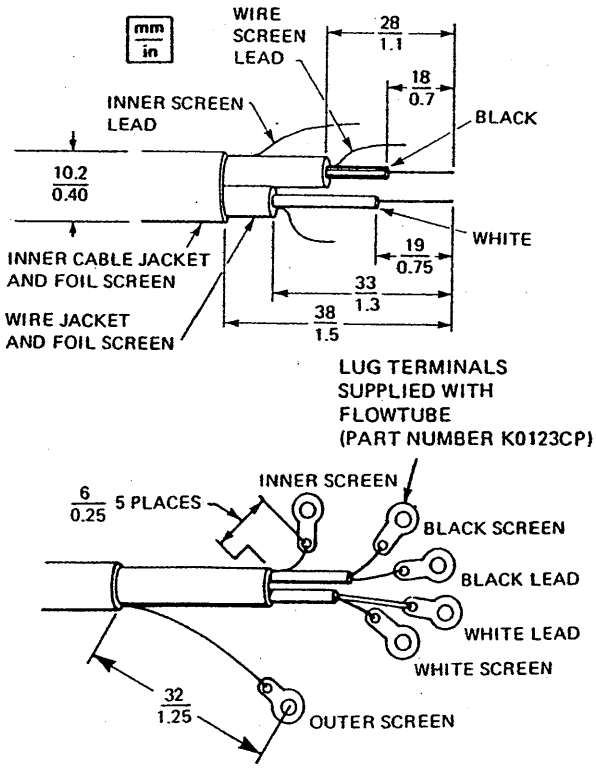


Figure 29.
Inner and Lead Jackets of Signal Cable Stripped Back for Connection to Flanged-Body Flowtube Terminals

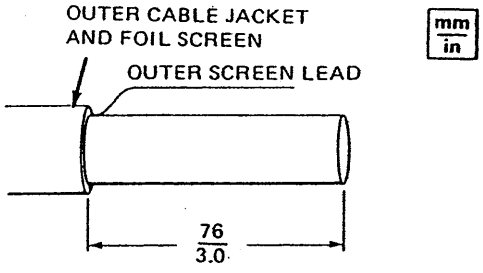


Figure 30.
Outer Jacket of Signal Cable Stripped Back for Connection to Transmitter Terminals

TERMINATIONS TO TRANSMITTER

1. Strip back outer jacket and foil screen as shown in Figure 30. Cut outer screen lead flush with edge of jacket.

2. Strip back inner jacket and foil screen as shown in Figure 31. Do not cut inner screen lead.

3. Strip back lead jackets as shown (Figure 31). Do not cut screen leads.

4. Strip insulation from white and black leads as shown (Figure 31).

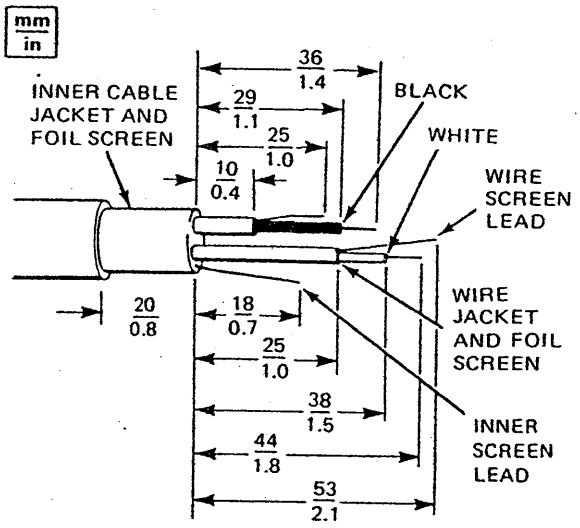


Figure 31. Inner and Lead Jackets of Signal Cable Stripped Back for Connection to Transmitter Terminals

General Procedure for Connecting Wires to Compression Type Terminals

The compression-type terminals used for output-signal, coil-drive, and mains wiring have a lower clamp jaw as shown in Figure 32. To connect wires to these terminals, open clamp by turning terminal screw counterclockwise. Insert wire in terminal slot so that it is on top of clamp jaw as shown in Figure 32. Turn terminal screw to tighten clamp. Check that clamp grips the metal wire only and not the insulation. Also check that wire is secured in place after tightening clamp.

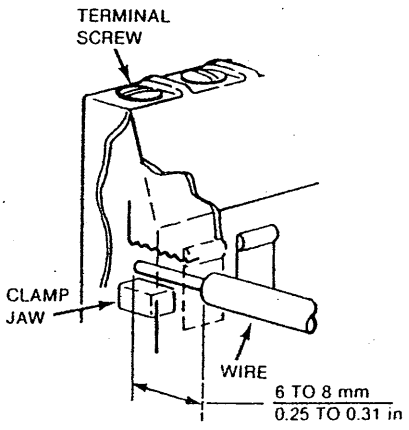


Figure 32.
Connecting Wire to Compression Type Terminal Having a Clamp Jaw

Wiring Systems With Wafer-Body Flowtube

1. Run current-output signal, external contact (if used), pulse-output signal, ac-supply, flowtube coil-drive, and earth (ground) wires through conduit or optional cable glands, as shown in Figure 33. Conduit connections are shown in Figure 22.

2. Connect input-signal wires to flowtube output terminals as shown in Figure 33 or Figure 35, as applicable.

3. If flowtube has optional cable glands, turn compression nut (shown in Figure 23) until rubber gland is snug around input-signal cable.

4. If "direction-of-flow" arrow on flowtube is pointing downstream, connect coil-drive wires to flowtube terminals as shown in Figure 33. If arrow is pointing upstream, reverse white and black coil-drive wires.

5. Connect flowtube earth (ground) terminal to earth or to transmitter earth terminal to comply with local code requirements.

   To connect to transmitter earth terminal, run wire in same conduit as coil wires.

6. Reinstall terminations cover on flowtube.

7. Connect input-signal wires from flowtube to transmitter input terminals as shown in Figure 33 or Figure 35. Clamp cable over its inner jacket as shown.

8. If transmitter has optional cable glands, turn compression nut (shown in Figure 23) until rubber gland is snug around input-signal cable.

9. Connect current-output, external contact (if used), and pulse-output wires to transmitter terminals as shown in Figures 33 or 35. Tighten optional gland compression nuts if applicable. For details of connecting output-signal, coil-drive, and mains wires to transmitter, see "General Procedure for Connecting Wires to Compression Type Terminals" section. For external wiring of pulse-output and current-output wires, see Figure 34.

10. Ensure that link positions of jumpers 2, 3, 4, 5, and 6 conform to the unique application requirements of the installation per Tables 9, 10, and 11 in the "Link Positions" section.

CAUTION

Application of power to a transmitter whose links are incorrectly installed may result in permanent damage to transmitter, flowtube, and other circuits connected to the output.

11. Connect coil-drive, mains and earth (ground) wires to transmitter terminals as shown Figure 33 or Figure 35. Be certain that earth (ground) wires are connected as shown. Tighten optional gland compression nuts if applicable.

NOTE

Local agency requirements take precedence for mains wiring and grounding. If no grounded neutral wire is available, connect protective earth (ground) to plant safety ground.

12. Reinstall terminations cover on transmitter. Check cover alignment for free clearance around pushbuttons. System is now ready for operation.

NOTE

If a negative flow or "-A" is read on display during process flow, direction of flow does not correspond with coil-drive wiring. Disconnect flowmeter power and reverse coil-drive wires inside transmitter. Wires are shown in Figure 33. Reverse flow or wiring may be confirmed by momentarily depressing the "SET" pushbutton while observing the display or output for indication of flow. If normal operation is indicated, release pushbutton, disconnect flowmeter power and reverse coil-drive wires inside transmitter. Wires are shown in Figure 33 or Figure 35.

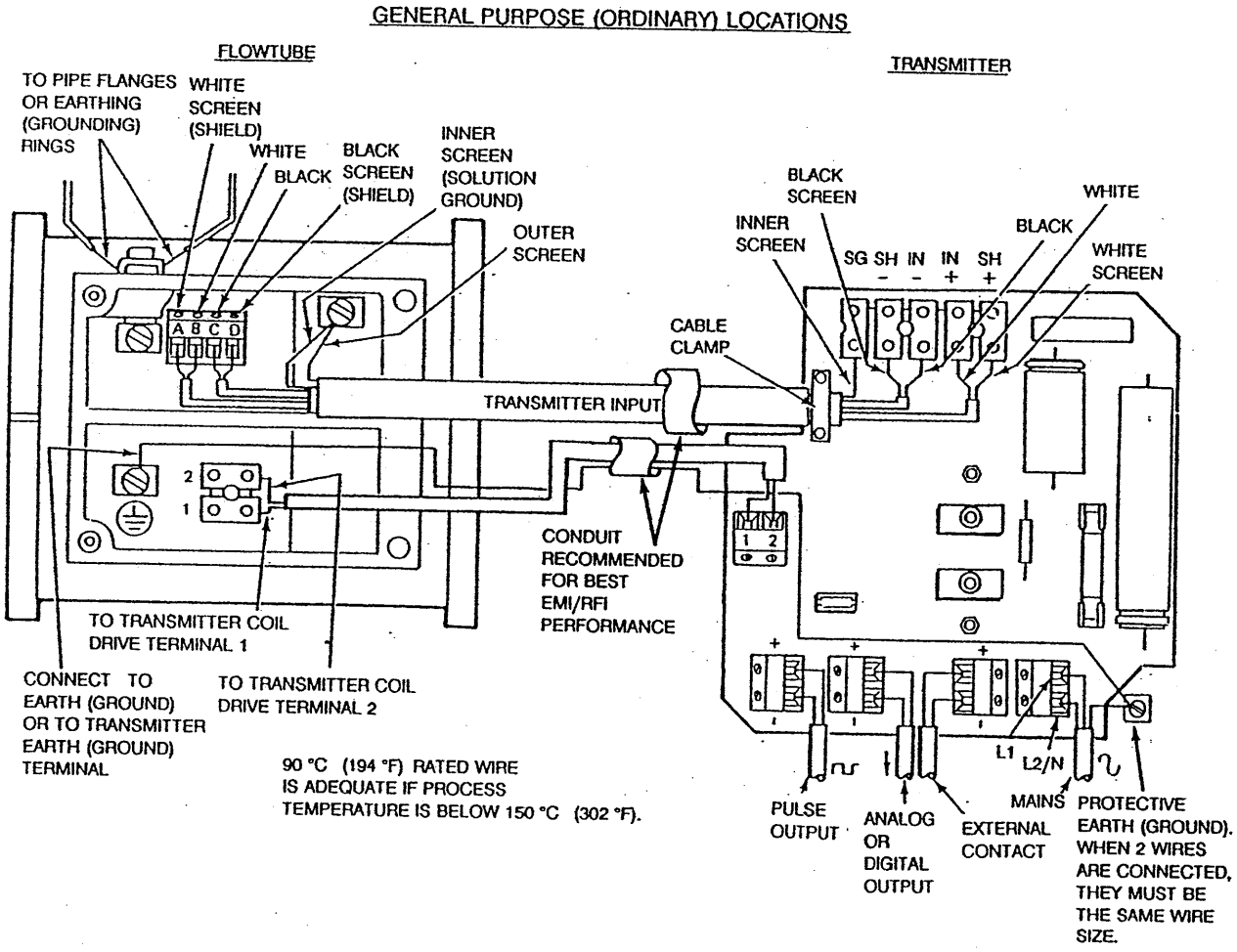
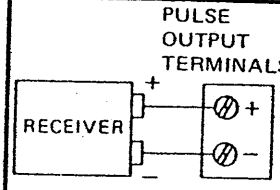
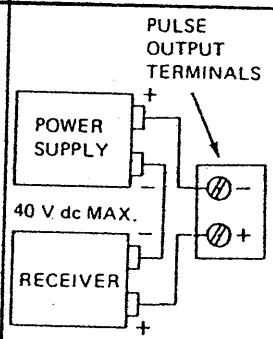
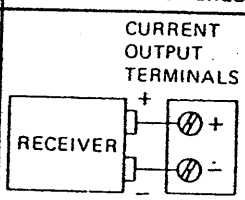
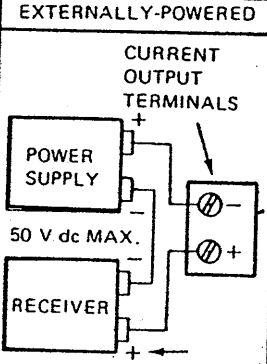
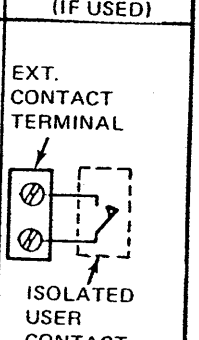


Figure 33. Flowmeter Wiring with Wafer-Body Flowtube for use in General Purpose/Ordinary Locations

PULSE OUTPUT		CURRENT OUTPUT		EXTERNAL CONTACT INPUT (IF USED)
INTERNALLY-POWERED	EXTERNALLY-POWERED	INTERNALLY-POWERED	EXTERNALLY-POWERED	
 MAX. CURRENT: FUSED AT 250 mA *MAX. LOAD RESISTANCE: 5 kΩ MAX. LINE CAPACITANCE FOR HIGH RATE PULSE (2000 PPS) OUTPUT: 0.1 μF INTERNAL SUPPLY: 24 V dc, UNREGULATED	 MAXIMUM CURRENT: FUSED AT 250 mA		 $R_{MAX.} = (50)(V_{SUPP} - 14)$ WHERE: R_{MAX} = MAXIMUM EXTERNAL LOAD V_{SUPP} = SUPPLY VOLTAGE	 NORMAL FLOW-OPEN >500 kΩ NO FLOW (EMPTY TUBE) -CLOSED<10 Ω

*IF HIGH PULSE OUTPUT CONNECTED TO RECEIVER WITH INPUT IMPEDANCE GREATER THAN 5K CONNECT A 1 TO 2K RESISTOR ACROSS RECEIVER INPUT TERMINALS.

Figure 34. External Wiring of Pulse-Output, Current-Output, and External Contact Input Wires Shown in Figure 33

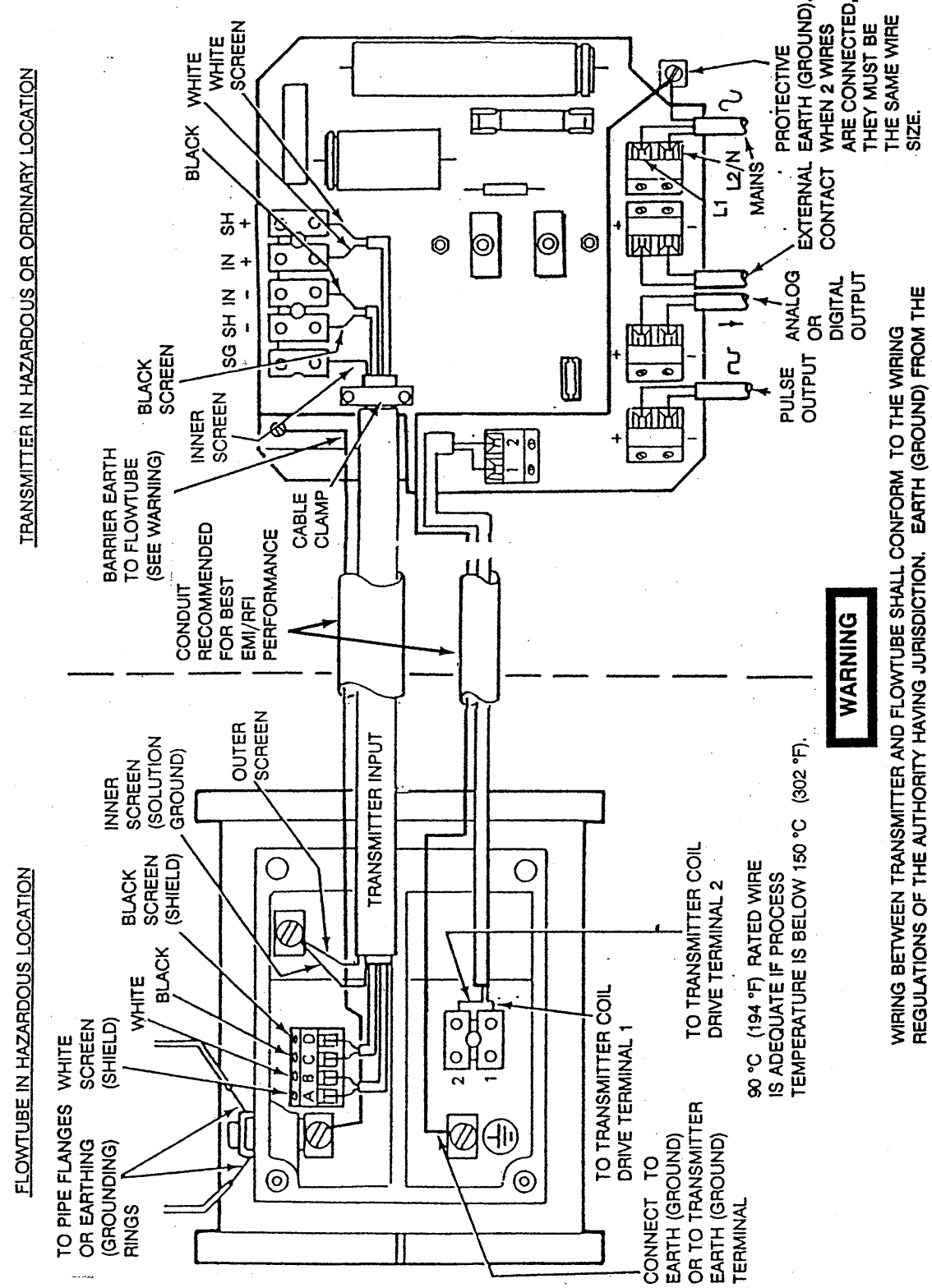


Figure 35. Flowmeter Wiring with Wafer-Body Flowtube for use in Hazardous Locations

Wiring Systems With Flanged-Body Flowtube

1. Run current-output signal, external contact (if used), pulse-output signal, ac-supply, flowtube coil-drive, and earth (ground) wires through conduit or optional cable glands, as shown in Figure 36. If flowmeter is certified for use in hazardous locations, run barrier earth wire through same conduit (or glands) as signal cable wires. Wires are shown in Figure 38. Conduit connections are shown in Figure 22; optional cable gland is shown in Figure 23.

2. See Figure 36 or Figure 38. Connect input-signal wires to flowtube output terminals as shown.

3. In flowtube, clamp transmitter input cable over its inner jacket with cable clamp as shown in Figure 36 or Figure 38.

4. If flowtube has optional cable glands, turn compression nut (Figure 23) until rubber gland is snug around input-signal cable.

5. Remove protective cover (shown in Figure 36 or Figure 38) from coil-drive terminals.

6. If "direction-of-flow" arrow on flowtube is pointing downstream, connect coil-drive wires to flowtube terminals as shown in Figure 36 or Figure 38. If arrow is pointing upstream, reverse white and black coil-drive wires.

7. Connect flowtube earth (ground) terminal to earth or to transmitter earth terminal to comply with local code requirements. To connect to transmitter earth terminal, run wire in same conduit as coil wires.

8. Reinstall protective cover (Figures 36 or 38) over flowtube coil-drive terminals.

9. Reinstall terminations cover on flowtube.

10. Connect input-signal wires from flowtube to transmitter input terminals as shown in Figure 36 or Figure 38. Clamp cable over its inner jacket as shown.

11. If transmitter has optional cable glands, turn compression nut (shown in Figure 23) until rubber gland is snug around input-signal cable.

12. Connect current-output, external contact , and pulse-output wires to transmitter terminals as shown in Figures 36 or 38. Tighten optional gland compression nuts if applicable. For details of connecting output-signal, coil-drive, and mains wires to transmitter, see "General Procedure for Connecting Wires to Compression Type Terminals" section. For external wiring of pulse-output and current-output wires, see Figure 34.

13. Ensure that link positions of jumpers 2, 3, 4, 5, and 6 conform to the unique application requirements of the installation per Tables 9, 10, and 11 in the "Link Positions" section.

CAUTION

Application of power to a transmitter whose links are incorrectly installed may result in permanent damage to transmitter, flowtube, and other circuits connected to the output.

14. Connect coil-drive, mains and earth (ground) wires to transmitter terminals as shown in Figure 36 or Figure 38. Ensure that earth wires are connected as shown. Tighten optional gland compression nuts if applicable.

NOTE

Local agency requirements take precedence for mains wiring and grounding. If no grounded neutral wire is available, connect protective earth (ground) to plant safety ground.

15. Reinstall terminations cover on transmitter. Check cover alignment for free clearance around pushbutton. System is now ready for operation.

NOTE

If a negative flow or "-A" is read on display during process flow, direction of flow does not correspond with coil-drive wiring. Reverse flow or wiring may be confirmed by momentarily depressing the "SET" pushbutton and observing the display or output for indication of flow. Disconnect flowmeter power and reverse coil-drive wires inside transmitter or flowtube. Wires are shown in Figure 36 or Figure 38.

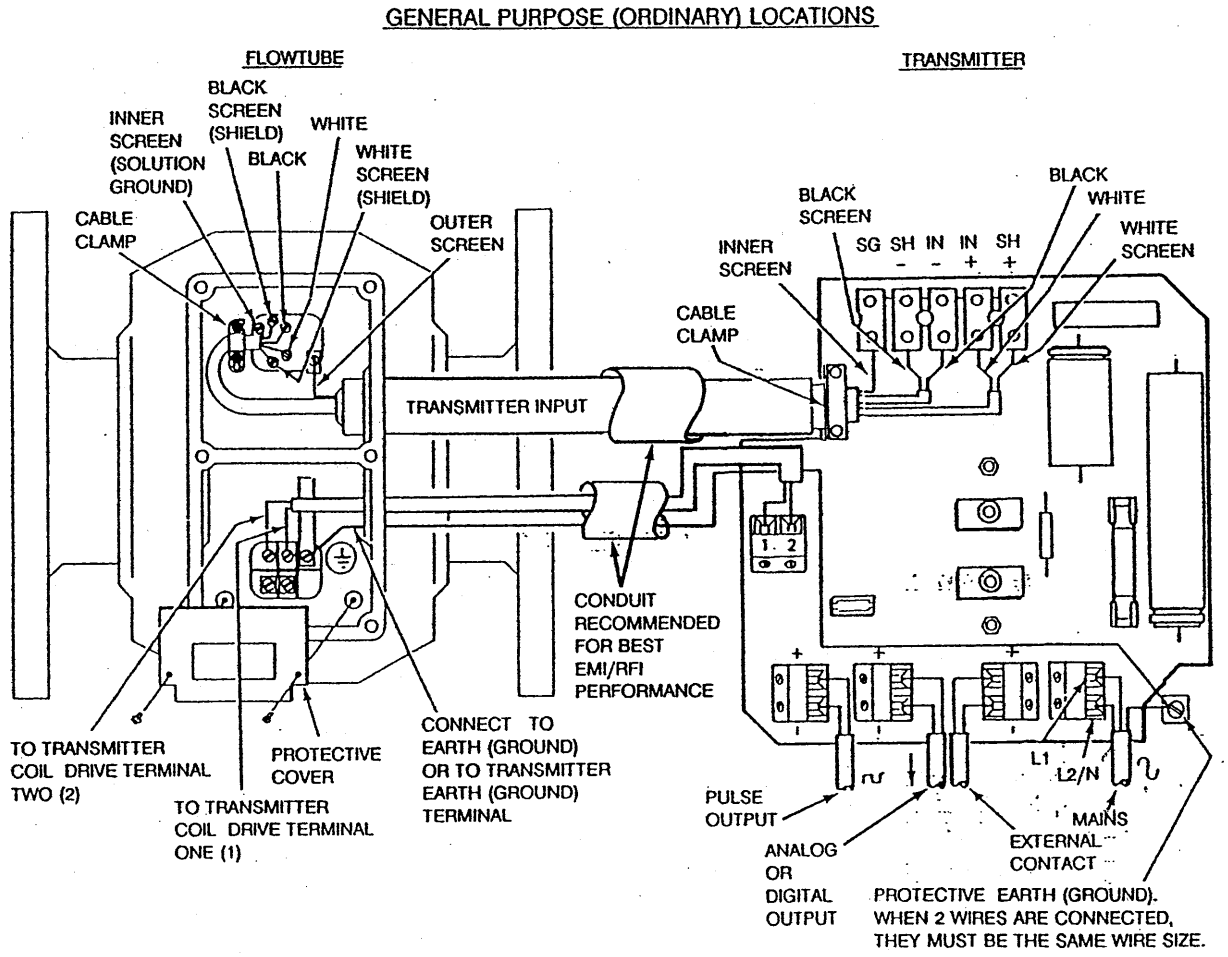


Figure 36. Flowmeter Wiring with Flanged-Body Flowtube for use in General Purpose/Ordinary Locations

PULSE OUTPUT		CURRENT OUTPUT		EXTERNAL CONTACT INPUT (IF USED)
INTERNALLY-POWERED	EXTERNALLY-POWERED	INTERNALLY-POWERED	EXTERNALLY-POWERED	
PULSE OUTPUT TERMINALS RECEIVER MAX. CURRENT: FUSED AT 250 mA MAX. LOAD RESISTANCE: 5 kΩ MAX. LINE CAPACITANCE FOR HIGH RATE PULSE (2000 PPS) OUTPUT: 0.1 μF INTERNAL SUPPLY: 24 V dc, UNREGULATED	PULSE OUTPUT TERMINALS POWER SUPPLY 40 V dc MAX. RECEIVER MAXIMUM CURRENT: FUSED AT 250 mA	CURRENT OUTPUT TERMINALS RECEIVER 300 Ω MAX. 4 TO 20 mA	CURRENT OUTPUT TERMINALS POWER SUPPLY 50 V dc MAX. RECEIVER 4 TO 20 mA $R_{MAX.} = (50)(V_{SUPP} - 14)$ WHERE: R_{MAX} = MAXIMUM EXTERNAL LOAD V_{SUPP} = SUPPLY VOLTAGE	EXT. CONTACT TERMINAL ISOLATED USER CONTACT NORMAL FLOW-OPEN >500 kΩ NO FLOW (EMPTY TUBE) -CLOSED<10 Ω

Figure 37. External Wiring of Pulse-Output, Current-Output, and External Contact Input Wires Shown in Figure 36

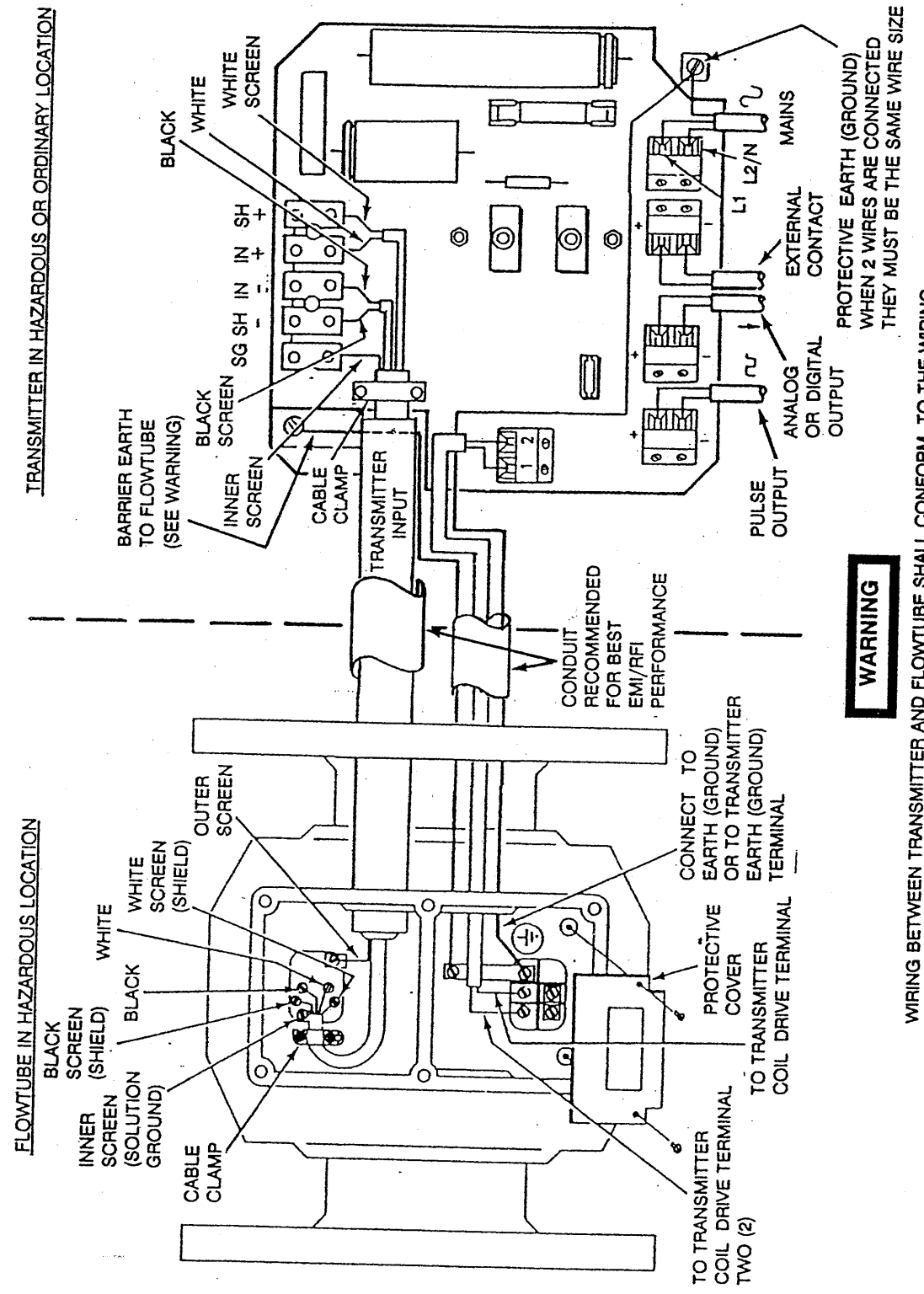


Figure 38. Flowtube Wiring with Flanged-Body Flowtube for use in Hazardous Locations

Minimum Signal Lock (External Contact)

This feature provides a stable zero (see note) percent output (4 mA, zero pulse output) when an isolated switch closure (supplied by user) is made across external contact terminal on transmitter (see Figure 39). Signal lock may be used to prevent false output measurement if flowtube drains of process fluid, or to prevent measurement of clean-in-place (CIP) solutions, if so desired.

NOTE

With external contact closed, outputs may be increased in 25% increments up to 100% by each depression of "SELECT" pushbutton.

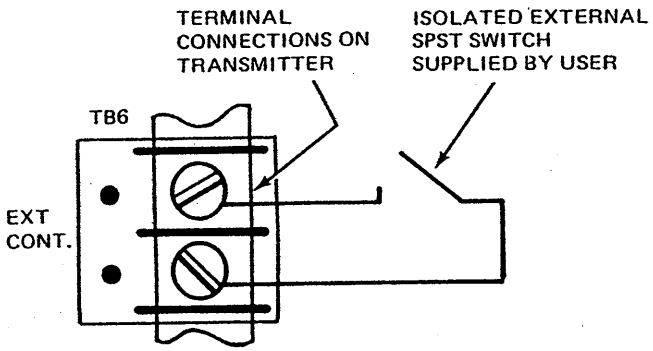


Figure 39.
Switch Connections with Minimum Signal Lock

External Equipment Calibration Signal

The 8000 Flowmeter has the capability to provide output "test" signals to enable calibration of external equipment interfaced with it. To obtain test signals, connect a "temporary" jumper across the "external contact" input terminal. The display will now alternate between the letters "SL" and "4". Current output is now 4 mA. Pulse output is zero pulses. To increase the output (depress and release), the blue "SELECT" button. Repeat for each increment. Outputs will increment as shown in the adjacent table.

Display	Current Output	Pulse Output(1)
SL/ 4	4 mA	0 pps
SL/ 8	8 mA	500 pps
SL/12	12 mA	1000 pps
SL/16	16 mA	1500 pps
SL/20	20 mA	2000 pps

(1) Parameter P3 assumed as shipped = 000.0

NOTE

At the completion of calibration, ensure that the temporary jumper is removed.

LINK POSITIONS

Before installing a new power-supply assembly, position links on terminations PWA for correct transmitter supply voltage and output-circuit power sources as shown in Tables 9, 10, and 11. Locations of links on the terminations PWA are shown in Figure 40.

CAUTION

POWER SUPPLY VOLTAGE LINK MUST BE POSITIONED AS SHOWN IN TABLE 9 BEFORE APPLYING TRANSMITTER POWER. Applying power with link incorrectly positioned can result in damage to transmitter.

Table 9.
Supply Voltage Link Position

Model Code	Power Supply Part Number	Supply Voltage (V ac)	Link Position (J2)
A	Q0110BF	120	P1 to P2
B	Q0110BK	220	P2 to P3
C	Q0110BK	240	P1 to P2

Table 10.
Link Positions to Select Internal or External Power Source for Current Output Circuit

Model Code	Power Source	Link Positions	
		J3	J4
1	Internal	P29 to P31	P28 to P30
0 or 2	External	P27 to P29	P26 to P28

Table 11.
Link Positions to Select Internal or External Power Source for Pulse Output Circuit

Model Code	Power Source	Link Positions	
		J3	J4
3 or 5	Internal	P23 to P25	P22 to P24
0, 4, or 6	External	P21 to P23	P20 to P22

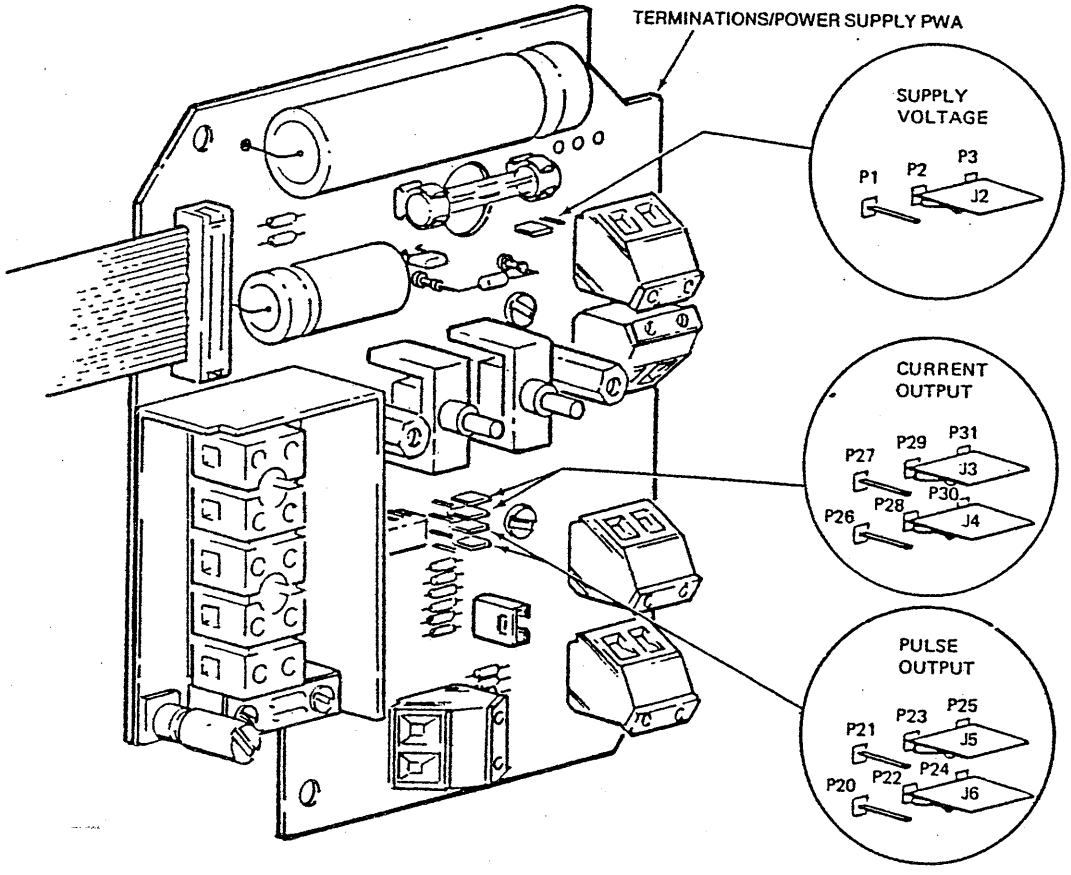


Figure 40. Link Locations

ISSUE DATES
FEB 1989
SEP 1990
JUN 1992

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Instruction

MI
021-371
August 1990

8000 SERIES PULSED dc MAGNETIC FLOWMETER STYLES C AND D

Maintenance

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FIGURES

TABLES

INTRODUCTION

General Description

This instruction contains fault location and module replacement procedures for 8000 Series Pulsed dc Magnetic Flowmeters. The flowmeters are shown in Figure 1.

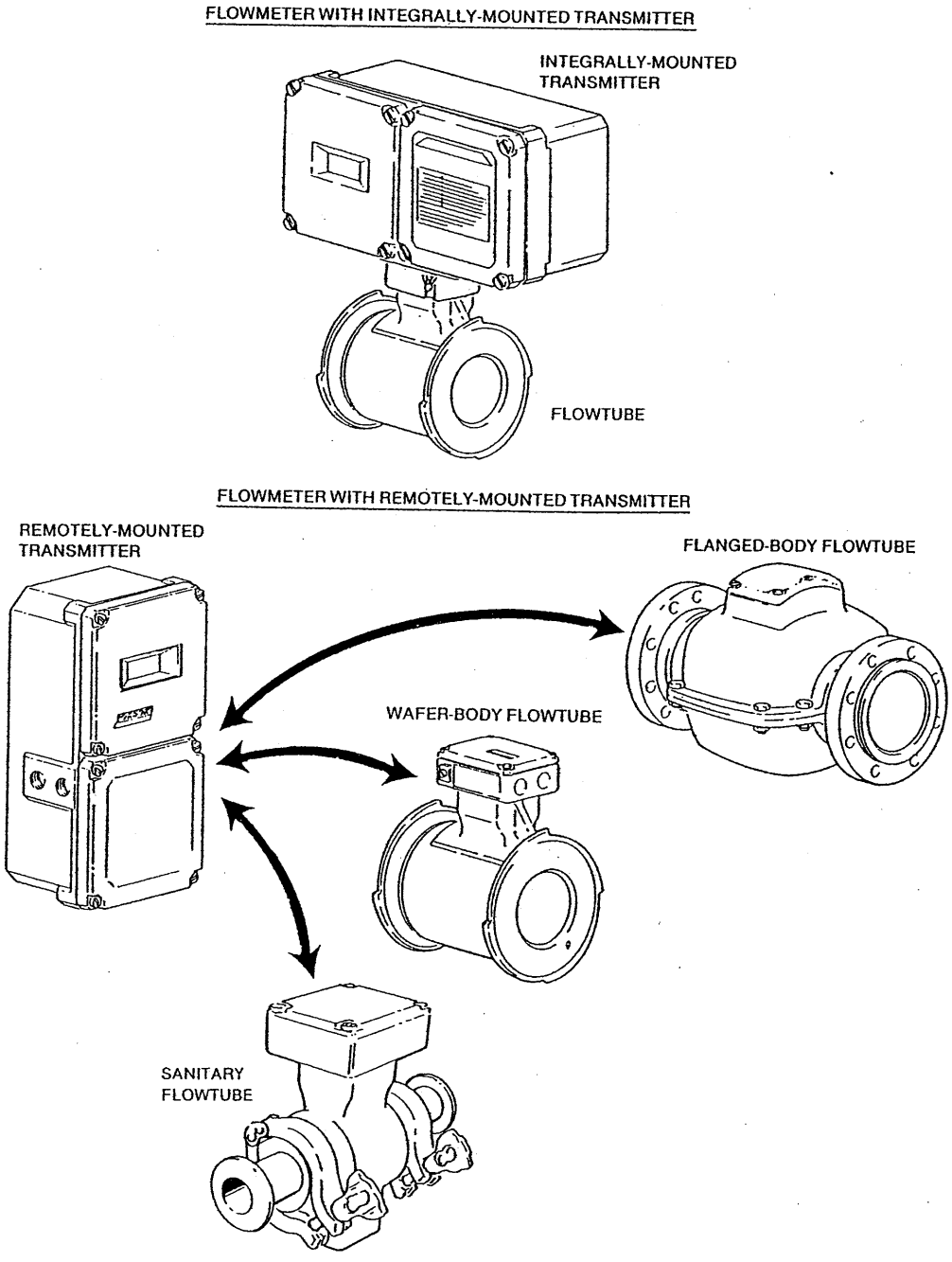


Figure 1.
8000 Series Pulsed dc Magnetic Flowmeters

Reference Documents

The following instructions contain additional information relating to the flowmeter as indicated:

Installation	
Flowmeter With Integrally-Mounted Transmitter:	MI 021-370
Flowmeter With Remotely-Mounted Transmitter and Non-Sanitary Flowtube:	MI 021-369
Flowmeter with Remotely-Mounted Transmitter and Sanitary Flowtube:	MI 021-378
Configuration and Operation:	MI 021-363
Type Y Purging for Flowtubes in Division I Locations:	MI 021-365
Accidental Submergence Construction (-H Option)	MI 021-368
Parts Lists	
Transmitter:	PL 008-602
Wafer-Body Flowtube:	PL 008-597
Flanged-Body Flowtube:	PL 008-541
Sanitary Flowtube:	PL 008-609

Component Location Diagram

Defective flanged-body flowtubes can either be replaced by the user or returned to Foxboro for repair. For repair, the user may call Foxboro Repair Services, (800) 441-6014, for return authorization. The locations of replaceable modules inside the transmitter are shown in Figure 2.

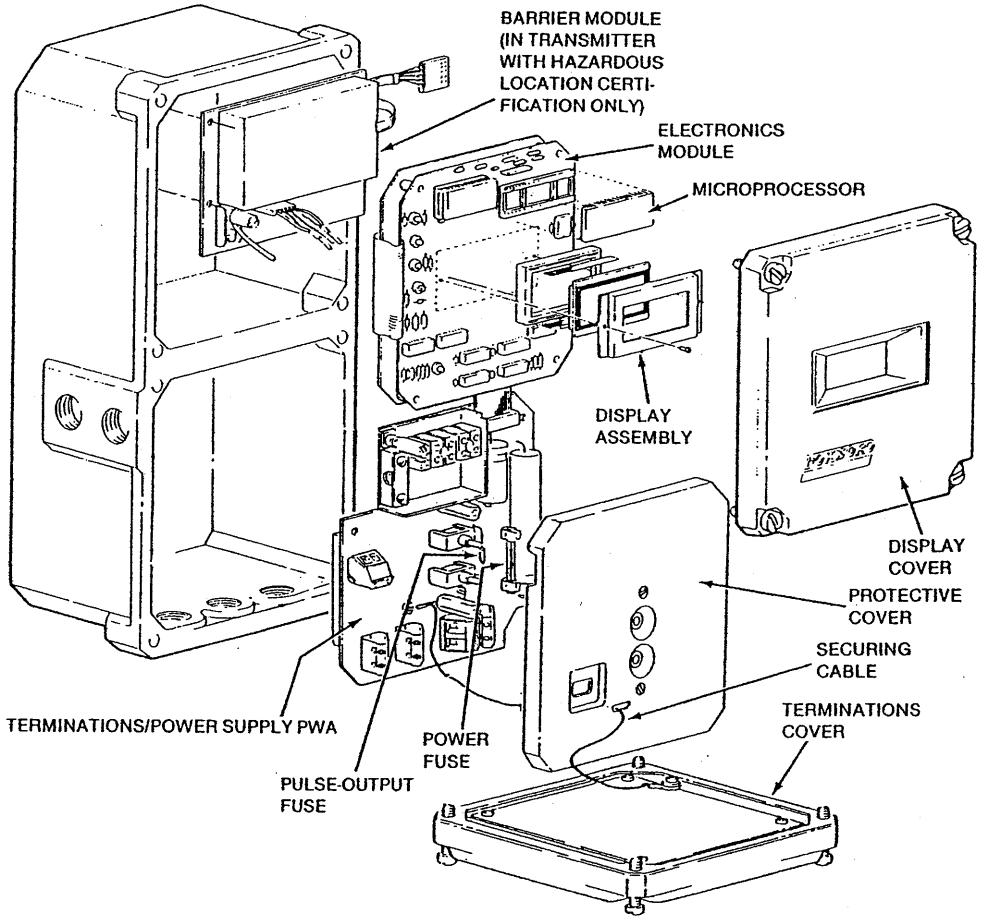


Figure 2.
Locations of Replaceable Transmitter Components

FAULT LOCATION

Error Messages

A list of error messages, possible causes, and corrective action are given in Table 1.

Table 1. Error Messages

DISPLAY CONDITION	POSSIBLE CAUSES	CORRECTIVE ACTION
No Display	Mains (Line Power) not Connected	Connect mains (line power).
	Power-Supply Fuse Blown	Install new fuse using "Fuse Replacement" procedure.
	Defective Power Supply	Check dc voltages as indicated in "Power-Supply Tests" procedure. If fault is found, install power-supply assembly using "Terminations/Power Supply PWA Replacement" procedure. If fault is not found, microprocessor or display may be defective.
	Defective Microprocessor	Install new microprocessor using "Microprocessor Replacement" procedure.
	Defective Display	Install new display using "Display Replacement" procedure.
Random or Obscure Display	Defective Power Supply	Perform "Power Supply Tests" procedure. If fault is found, install new power-supply assembly using "Terminations/Power Supply PWA Replacement" procedure. If fault is not found, microprocessor or display may be defective.
	Defective Microprocessor	Install new microprocessor using "Microprocessor Replacement" procedure.
	Defective Display	Install new display using "Display Replacement" procedure.
0A Displayed	Defective Power Supply	Check line frequency reference voltage per "Power Supply Tests" procedure. If voltage is incorrect, install new power supply assembly using "Terminations/Power Supply PWA Replacement" procedure. If voltage is correct, microprocessor or electronics module may be defective.
	Defective Microprocessor	Install new microprocessor using "Microprocessor Replacement" procedure.
	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.
1A Displayed	Defective Microprocessor	Install new microprocessor using "Microprocessor Replacement" procedure.
	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.
2A Displayed	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.
3A Displayed	Invalid User Data Stored in Memory	Check configuration. For configuration procedure, refer to Instruction MI 021-363.
	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.
4A Displayed	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.

Table 1. Error Messages (Cont.)

DISPLAY CONDITION	POSSIBLE CAUSES	CORRECTIVE ACTION
5A Displayed	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.
-A* Displayed	Flowtube Installed with Direction-of-Flow Arrow Pointing Upstream	Either reposition flowtube so that direction-of-flow arrow points in direction of process flow or reverse coil-drive wires. For details of reversing coil-drive wires, refer to Instruction MI 021-369 if transmitter is remote from flowtube, or MI 021-370 if transmitter is integral to flowtube.
	Transmitter Input Wires or Flowtube Coil-Drive Wires Incorrectly Installed During Installation or Maintenance of Flowmeter	Reverse coil-drive wires. If transmitter is remote from flowtube, refer to Instruction MI 021-369 for details. If Transmitter is integral to flowtube, refer to Instruction MI 021-370 for details.
HA* Displayed or L3 Displayed or L4 Displayed	Flow Rate Upper Range Value Incorrectly Configured by User	Check values of P1 and P2. If incorrect, enter correct values. For configuration details, refer to Instruction MI 021-363.
	Flowtube Size Too Small or Process Flow Rate Greater than Expected	Check if correct flowtube size is being used for the process flow range.
	Buildup of Material is Coating Inside of Flowtube	Clean inside of flowtube.
	Open Circuit in Transmitter Input Cable (from Flowtube Electrodes)	To check input wiring, short transmitter input between "IN +" and "IN -" terminals in transmitter. Terminals are shown in Figures 5 (integrally-mounted transmitter) and 6 (remotely-mounted transmitter). If display still reads "HA", electronics module may be defective or, if transmitter is certified for use in hazardous locations, its barrier module may be defective. If display now reads zero, check that transmitter input wires are securely connected to terminals and remove short between input terminals. If "HA" is again read on display and transmitter is mounted on flowtube, electrodes are probably defective. If transmitter is remotely mounted, check if transmitter input wires are secured to flowtube terminals shown in Figures 7 (wafer-body flowtube) and 8 (flanged-body flowtube). If they are not, secure them. If they are, repeat short test at flowtube end of wires. If display again reads zero, electrodes are probably defective. If display still reads "HA", install new transmitter input cable. For cable installation details, see Instruction MI 021-369.
	Defective Barrier Module (in Transmitter Certified for use in Hazardous Locations Only)	Perform "Barrier Module Test" procedure. If barrier module is defective, install new module using "Barrier Module Replacement" procedure. If module is not defective and short tests (above) indicate other fault, electronics module is probably defective.
	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.
	Defective Electrodes	If flowtube is wafer-body type, install new flowtube. If flowtube is flanged-body type, either install new flowtube or return old flowtube to factory for repair. For flowtube installation details, refer to "Transmitter or Flowtube Replacement" procedure.

*This reading will alternate with one of following values: actual flow rate or 327.7, whichever is smaller.

Table 1. Error Messages (Cont.)

DISPLAY CONDITION	POSSIBLE CAUSES	CORRECTIVE ACTION
L6 Displayed	Open Circuit in Coil-Drive Wires (between Flowtube and Transmitter) High Coil Resistance Low Coil Drive	Check that coil-drive wires are making contact with transmitter terminals shown in Figures 5 (integrally-mounted transmitter) and 6 (remotely mounted transmitter). If they are not, secure them to terminals. If they are, disconnect them and measure resistance between them. Resistance should be about 70 Ω; if it is, power-supply assembly or electronics module may be defective. If it is not and transmitter is flowtube-mounted, flowtube coils are probably defective. If transmitter is remotely-mounted, reconnect coil-drive wires to transmitter terminals and check that other end of wires are making contact with flowtube terminals. If they are not, secure them to terminals. If they are, disconnect them and check for 70 Ω resistance between flowtube terminals. If resistance is incorrect, flowtube coil is probably defective. If resistance is correct, install new coil-drive wires between flowtube and transmitter. For installation details, refer to Instruction MI 021-369.
	Defective Flowtube Coil	If flowtube is wafer-body type, install new flowtube. If flowtube is flanged-body type, either install new flowtube or return old flowtube to factory for repair. For flowtube installation details, refer to "Transmitter or Flowtube Replacement" procedure.
	Defective Power Supply	Check dc voltages as indicated in "Power-Supply Tests" procedure. If fault is found, install power supply assembly using "Terminations/Power Supply PWA" procedure. If fault is not found, electronics module is probably defective.
	Defective Electronics Module	Install new electronics module using "Electronics Module Replacement" procedure.

Pulse-Output Tests

If output is not present at pulse output terminals and none of the display conditions given in Table 1 are present, disconnect mains and the pulse output external wiring and perform tests listed in Table 2.

Table 2. Pulse-Output Tests

TEST TYPE	TEST PROCEDURE
Fuse	Measure resistance across pulse-output fuse shown in Figure 3. If fuse is open, replace it.
External Wiring Check	If pulse output is internally powered, measure resistance of external circuit (must be in the range of 500 to 10 000 Ω). If pulse output is externally powered, place a current meter across external circuit (must be in the range of 40 to 250 mA). If either limits are exceeded, external wiring and/or receiver loading is in error and must be corrected prior to reconnecting to the Model 8000. Refer to Instruction MI 021-370 (transmitter mounted on flowtube), MI 021-369 (transmitter remote from flowtube, non-sanitary), or MI 021-378 (transmitter remote from flowtube, sanitary) for external wiring details.
Voltage	If pulse output is internally powered, perform "Power Supply Tests" to verify correct voltage levels. If pulse output is externally-powered, check that correct power is connected to transmitter as shown in Instruction MI 021-370 (transmitter mounted on flowtube), MI 021-369 (transmitter remote from flowtube, non-sanitary), or MI 021-378 (transmitter remote from flowtube, sanitary). If not, apply correct power. Make sure all jumpers (J3, J4, J5, and J6) are in correct position.
System	Reconnect external wiring to pulse output terminals. Apply power to Model 8000. If output pulse is not present, pulse output circuitry in "Electronics Module" has probably failed. Replace Electronics Module.

Current-Output Tests

If current output is externally-powered, check that correct power is connected to transmitter as shown in Instruction MI 021-370 (transmitter mounted on flowtube), MI 021-369 (transmitter remote from flowtube, non-sanitary), or MI 231-378 (transmitter remote from flowtube, sanitary). If not, connect correct power. If correct power is connected to transmitter, electronics module is probably defective. To install new module, use "Electronics Module Replacement" procedure.

If current output is internally-powered, perform power-supply tests. If all voltage values are correct, electronics module is probably defective. To install new module, use "Electronics Module Replacement" procedure. If any voltage value is incorrect, power supply is probably defective. To install new power supply, use "Terminations/Power Supply PWA Replacement" procedure.

External Contact Tests

If the Model 8000 Transmitter is functional except for operation of external contact (empty tube), turn power off and disconnect external wiring to external contact terminals.

Connect dc current meter across external contact terminals and reconnect power to Model 8000. Current flow should be approximately 15 mA. If reading is incorrect, a faulty power supply is indicated. Install a replacement power supply module.

If current flow is correct, relay RL1 in power supply module is probably malfunctioning. Be sure relay is properly seated in its socket. If problem persists, install replacement terminations/power supply PWA. For details of this PWA, see Figure 18. A remote possibility is failure of Electronics Module and internal wiring.

Power-Supply Tests

All power supply voltages are measured with the power-supply cable (shown in Figure 3) unlatched and disconnected from the electronics module. For access to the electronics module remove the display cover from transmitter.

Voltage test points are located on the terminations/power supply PWA shown in Figure 3. For access to the PWA, remove both the terminations cover and the protective cover (shown in Figure 3) from the transmitter.

Line Frequency Reference Voltage

Measure the line frequency reference voltage between Test Points TP1 and TP2 shown in Figure 3. The voltage should be approximately 8 V rms.

dc Voltages

Approximate dc voltages are shown in Table 3. Corresponding test points are shown in Figure 3.

Table 3. Power-Supply dc Voltages

TEST POINTS	APPROXIMATE dc VOLTS
TP1 (-), TP3 (+)	+12
TP1 (-), TP4 (+)	-12
TP6 (-), TP5 (+)	-35
TP7 (-), TP8 (+)	-30
TP9 (-), TP10 (+)	-30

Set and Select Pushbutton Tests

An "-A" or "1A" display on the transmitter can indicate that either the SET DIGIT or the SELECT DIGIT pushbutton is shorted. The pushbuttons and test points are shown in Figure 3. For their access, remove the terminations cover and the protective cover (shown in Figure 3) from the transmitter. Then, apply power to the transmitter.

If "-A" is displayed, check the SET DIGIT pushbutton only by performing the following voltage test between test points TP1 (-) and TP11 (+).

If "1A" is displayed, also check the SELECT DIGIT pushbutton by performing the voltage test between test points TP1 (-) and TP12 (+).

Measure the voltage between the indicated test points. The voltage should be as follows:

Pushbutton Depressed: 0 V dc.
Pushbutton Released: 5 V dc.

If the voltage remains at 0 v dc when the pushbutton is released, the switch is probably shorted. A remote possibility is a defective electronics module or defective internal wiring.

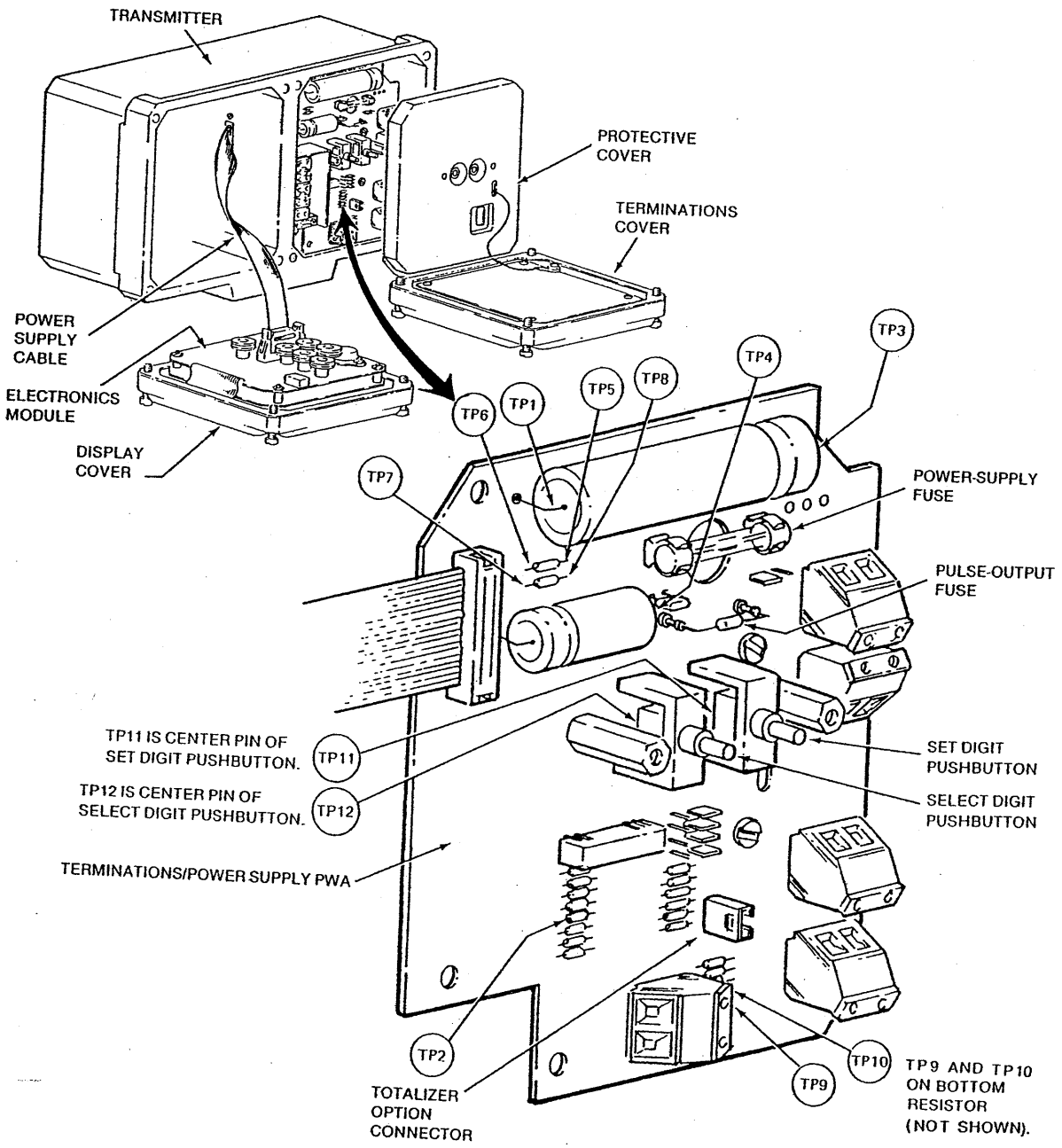


Figure 3. Test Points on Terminations/Power Supply PWA

Barrier-Module Test

The optional barrier module is located inside the transmitter as shown in Figure 2. This test checks for open circuits inside the module. Measure resistance between pins on printed wiring assembly (PWA) and connector on cable as shown in Figure 4 and Table 4. If any measurement indicates an open circuit or if other barrier fault is suspected, install a new barrier module.

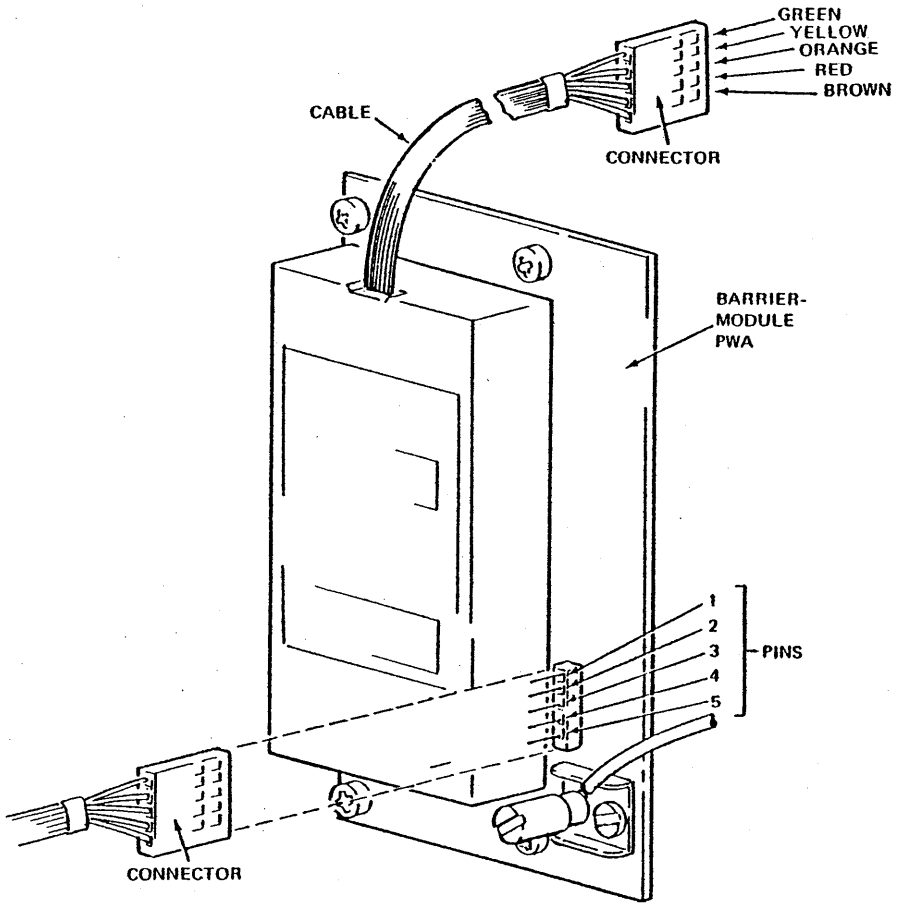


Figure 4.
Test Points on Optional Barrier Module

Table 4.
Continuity Checks of Optional Barrier Module

PWA PIN NUMBER	CABLE WIRE COLOR	APPROXIMATE RESISTANCE (Ω)
1	Brown	1000
2	Red	1000
3	Orange	0
4	Yellow	1000
5	Green	1000

COMPONENT REPLACEMENT

****
* WARNING *
****

Replacing components with power connected can present a shock hazard or cause damage to the flowmeter. ALWAYS DISCONNECT POWER BEFORE REPLACING ANY COMPONENTS.

****
* CAUTION *
****

The transmitter printed wiring assemblies (PWA's) contain complementary metal oxide semiconductor (CMOS) devices that are susceptible to damage from static electricity. REFER HANDLING OF THESE ASSEMBLIES TO QUALIFIED PERSONNEL.

Transmitter or Flowtube Replacement in System with Integrally-Mounted Transmitter

This procedure can be used to replace either the transmitter or the flowtube in systems where the transmitter is flowtube-mounted. For flowmeter (flowtube and transmitter) installation details, refer to Instruction MI 021-370.

1. Turn off system power.

2. Remove terminations cover and protective cover (shown in Figure 2) from transmitter.

****
* CAUTION *
****

Certifying agencies require terminations cover to be permanently attached to transmitter. This is done by means of a securing cable connected to the cover (securing cable is shown in Figure 2). DO NOT DISCONNECT COVER FROM CABLE.

3. Disconnect power, output, external contact, and flowtube wires from transmitter. Wires are shown in Figure 5. Note arrangement of wires for later reconnection.

NOTE

Coil-drive wires were connected at factory as shown in Figure 5. Wires may have been reversed by user during installation to compensate for reverse direction of process flow. For additional details, see Instruction MI 021-370.

4. Disconnect conduit from transmitter or unclamp power and output cables by loosening nut on optional cable glands, if applicable.

5. If transmitter is being replaced, proceed directly to Step 6.

   If flowtube is being replaced, note direction that direction-of-flow arrow (on flowtube) is pointing so that new flowtube can be oriented the same way. Drain flowtube of process fluid; disconnect flowtube earth (ground) wires from pipe flanges or grounding rings, as applicable (see flowtube mounting details in Instruction MI 021-370); remove flowtube from piping and set it down.

6. On under side of transmitter mounting plate (shown in Figure 5), unscrew the four transmitter mounting screws from transmitter. Save screws and washers for use in installing new transmitter or flowtube. Separate transmitter from flowtube.

7. Install new transmitter or flowtube using screws and washers removed in Step 6.

8. Connect flowtube wires to transmitter as shown in Figure 5.

9. If flowtube was removed from pipeline, install new flowtube with direction-of-flow arrow pointing in same direction that old arrow was pointing (see Step 5). For flange-bolt torque and other installation details refer to Instruction MI 021-370.

10. Reconnect power, output, external contact, and flowtube wires to transmitter as shown in Figure 5 (see Note in Step 3); connect conduit or tighten cable glands, if applicable. Reinstall covers on transmitter.

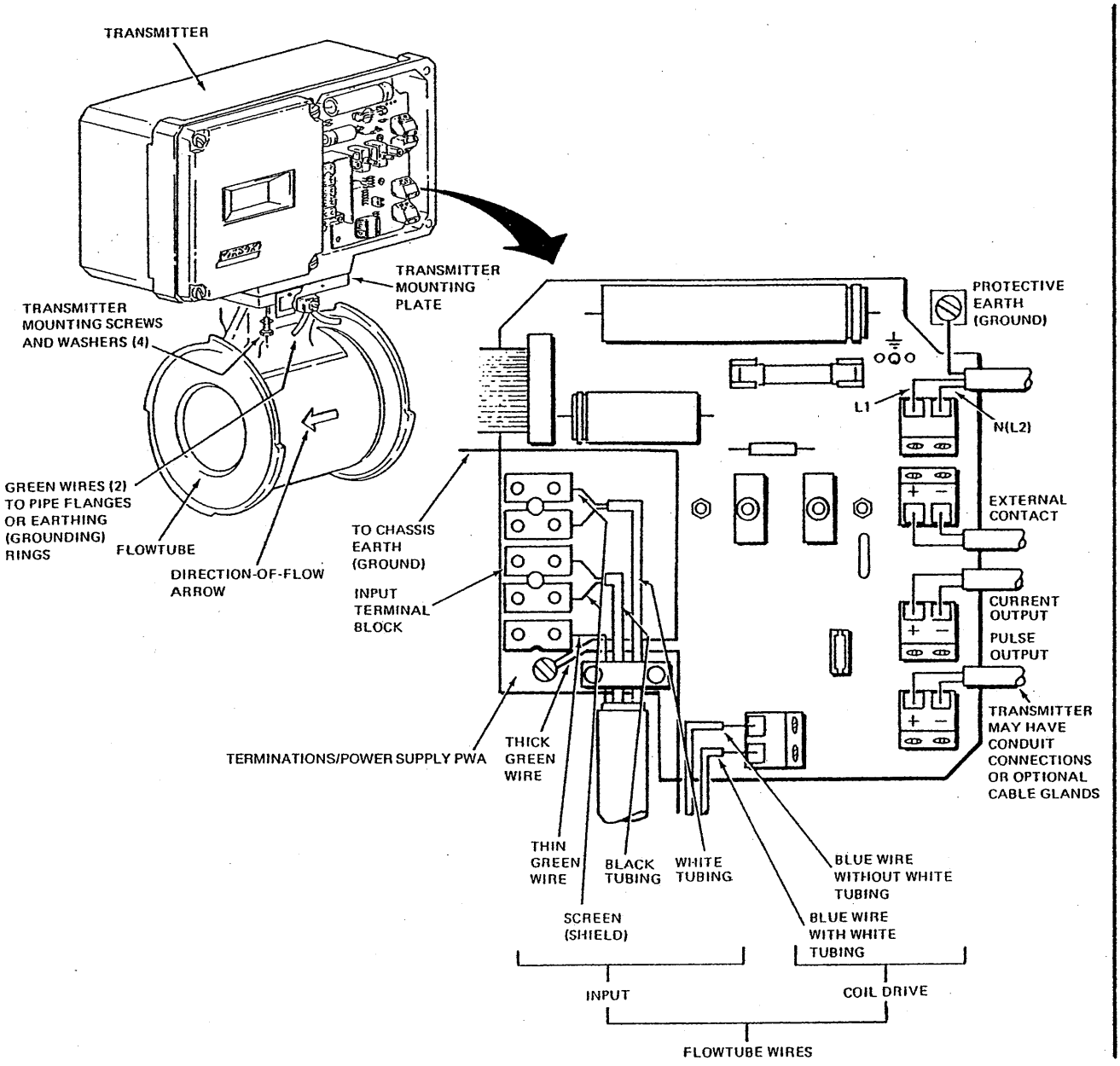


Figure 5.
Wiring and Mounting Details of Integrally-Mounted Transmitter

Flowtube Replacement

1. Turn off system power.

2. Remove terminations cover from flowtube. On flanged-body flowtube, also remove protective cover shown in Figure 8.

3. Refer to Figure 7 (wafer-body flowtube) or Figure 8 (flanged-body flowtube) and disconnect all wires from flowtube terminals. Also disconnect flowtube earthing (grounding) wires from pipe flanges or grounding rings, if applicable.

   NOTE

   Coil-drive may be reversed from that shown in Figures 7 and 8. Wire arrangement depends on direction of process flow through flowtube. For additional details, see Instruction MI 021-369 (non-sanitary flowtube) or MI 021-378 (sanitary flowtube).

4. Disconnect conduit from flowtube or unclamp power and output cables by loosening nut on optional cable glands, if applicable.

5. Note direction that direction-of-flow arrow is pointing so that new flowtube can be oriented the same way. Drain flowtube of process fluid and remove flowtube from piping. Rest flowtube on a flat surface.

6. Install flowtube in pipeline with direction-of-flow flow arrow pointing in same direction that old arrow was pointing (see Step 5). Reconnect wires to flowtube as shown in Figure 7 or 8, as applicable; also see Note in Step 3. Connect conduit or tighten cable glands, if applicable and reinstall cover(s) on flowtube. For additional installation details, see Instruction MI 021-369 (non-sanitary flowtube) or MI 021-378 (sanitary flowtube).

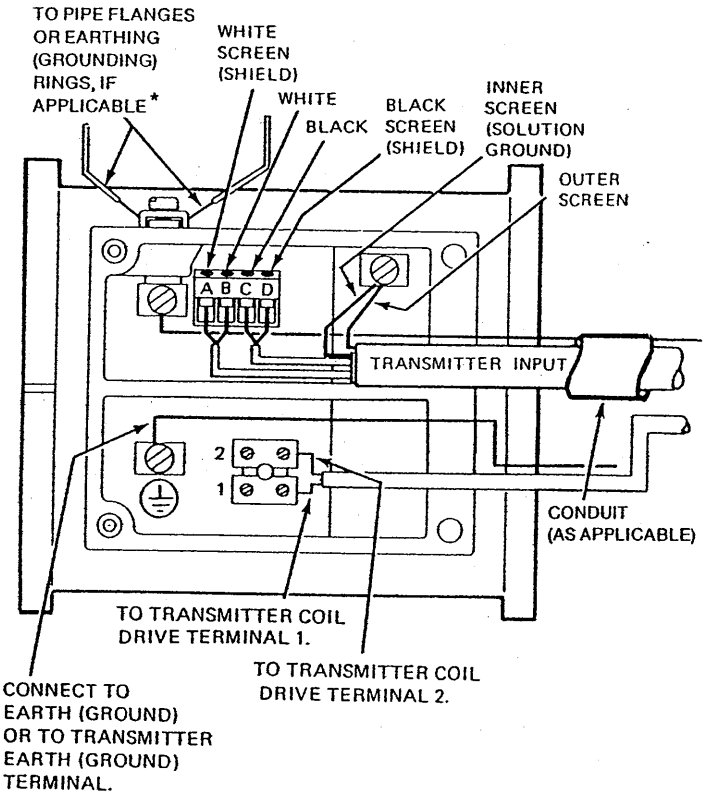


Figure 7.
Wiring Details of Wafer-Body Flowtube Having Remotely-Mounted Transmitter

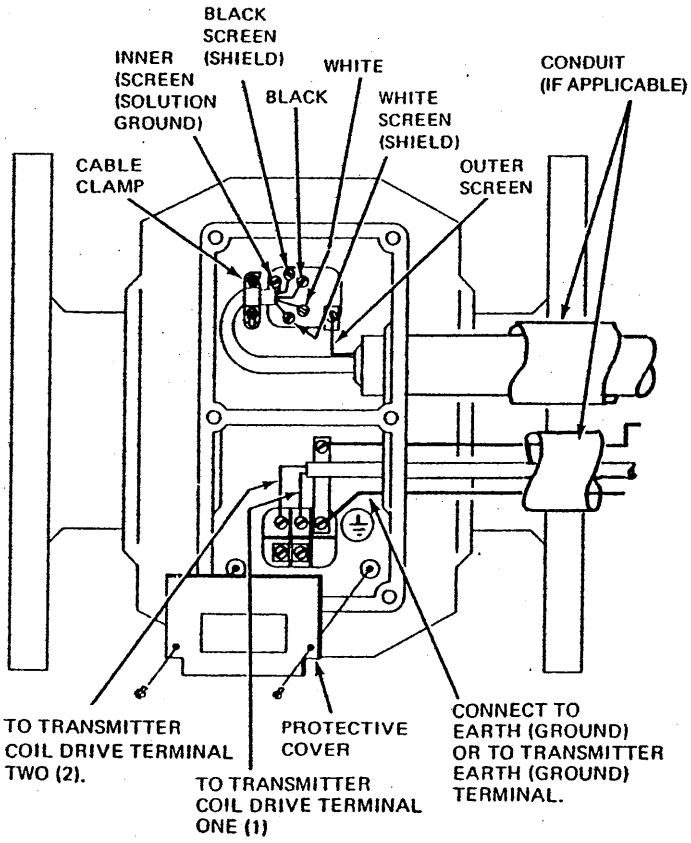


Figure 8.
Wiring Details of Flanged-Body Flowtube

Fuse Replacement

Before replacing fuses, disconnect power source.

Power-supply and pulse-output fuses are located on the terminations/power supply PWA as shown in Figure 3. The power supply fuse is mounted in a fuse clip. The pulse-output fuse is soldered onto standoffs and should be replaced only by qualified personnel. For access to the terminations/power supply PWA, remove the terminations cover and the protective cover (shown in Figure 3) from the transmitter.

****
* CAUTION *
****

Certifying agencies require ter minations cover to be permanently attached to transmitter. This is done by means of a securing cable connected to the cover (securing cable is shown in Figure 3). DO NOT DISCONNECT COVER FROM CABLE.

Electronics Module Replacement

The electronics module is located on the inside of the display cover as shown in Figure 9. To install a new module, complete the following steps.

1. Turn off system power.

2. Refer to Figure 9 and remove display cover from transmitter.

3. Unlatch power-supply cable (shown in Figure 9) from connector on electronics module. Disconnect power-supply and signal cables from module.

4. Unscrew the four mounting nuts (shown in Figure 9) from electronics module. Save nuts and washers for use in installing new module.

5. Lift electronics module off display cover.

6. Unscrew holding screw (shown in Figure 9) from electronics module. Save screw for use in installing new module.

7. On new electronics module, fold flex cable to bring PWA's in contact with standoffs as shown in Figure 9.

8. Install holding screw (removed in Step 6) to hold PWA's together. Do not tighten screw. This is to allow PWA's to be aligned during installation.

9. Install new electronics module onto the four mounting studs on display cover as shown in Figure 9. Green earth (ground) wire on cover should pass through slot in inner PWA as shown. Secure module in place with four mounting nuts and washers removed from old module (in Step 4).

10. Tighten holding screw so that it is snug against PWA.

11. Connect and latch power-supply cable to connector on electronics module (see Figure 9) and secure it with end clamps on connector.

12. Connect signal cable to electronics module as shown in Figure 9 (pins and slots in alignment). Connectors are keyed to fit one way only. Do not force incorrectly-mated connectors together.

13. Reinstall display cover on transmitter.

****
* CAUTION *
****

Attempts to repair electronics module assembly could result in damage and voiding of the warranty. Recommended procedure is replacement of the assembly or returning the PWA to Foxboro for repair.

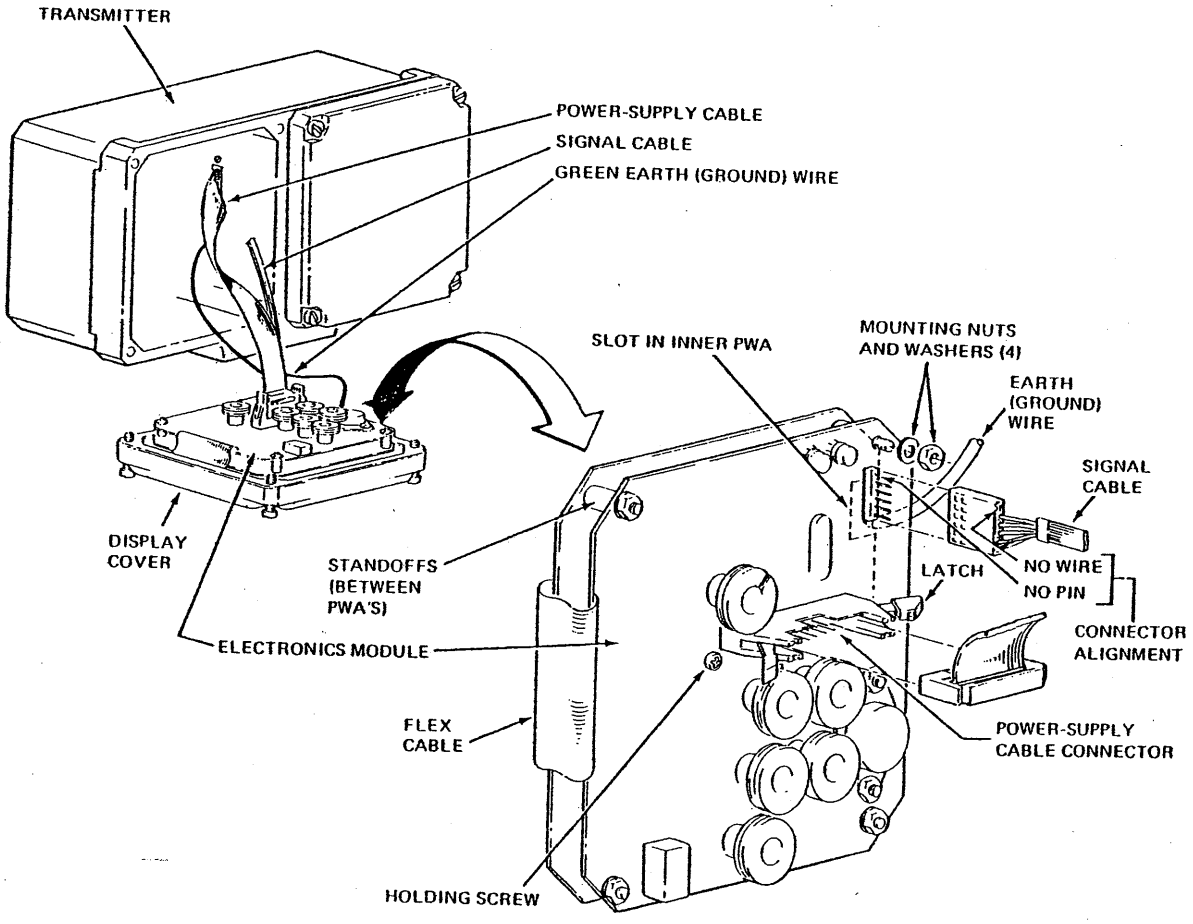


Figure 9. Electronics Module Replacement

Microprocessor Replacement

The microprocessor is located on the electronics module as shown in Figure 10. To install a new microprocessor, complete the following steps.

1. Turn off system power.
2. Refer to Figure 10 and remove display cover from transmitter.
3. Unscrew four mounting nuts from electronics module (shown in Figure 10); remove nuts and washers and lift module off display cover.
4. To remove old microprocessor, lift it out of its socket. Install new microprocessor so that its keying notch is aligned with keying notch on socket as shown in Figure 10.
5. Reinstall electronics module on display cover with four nuts and washers removed in Step 3.
6. Reinstall display cover on transmitter.

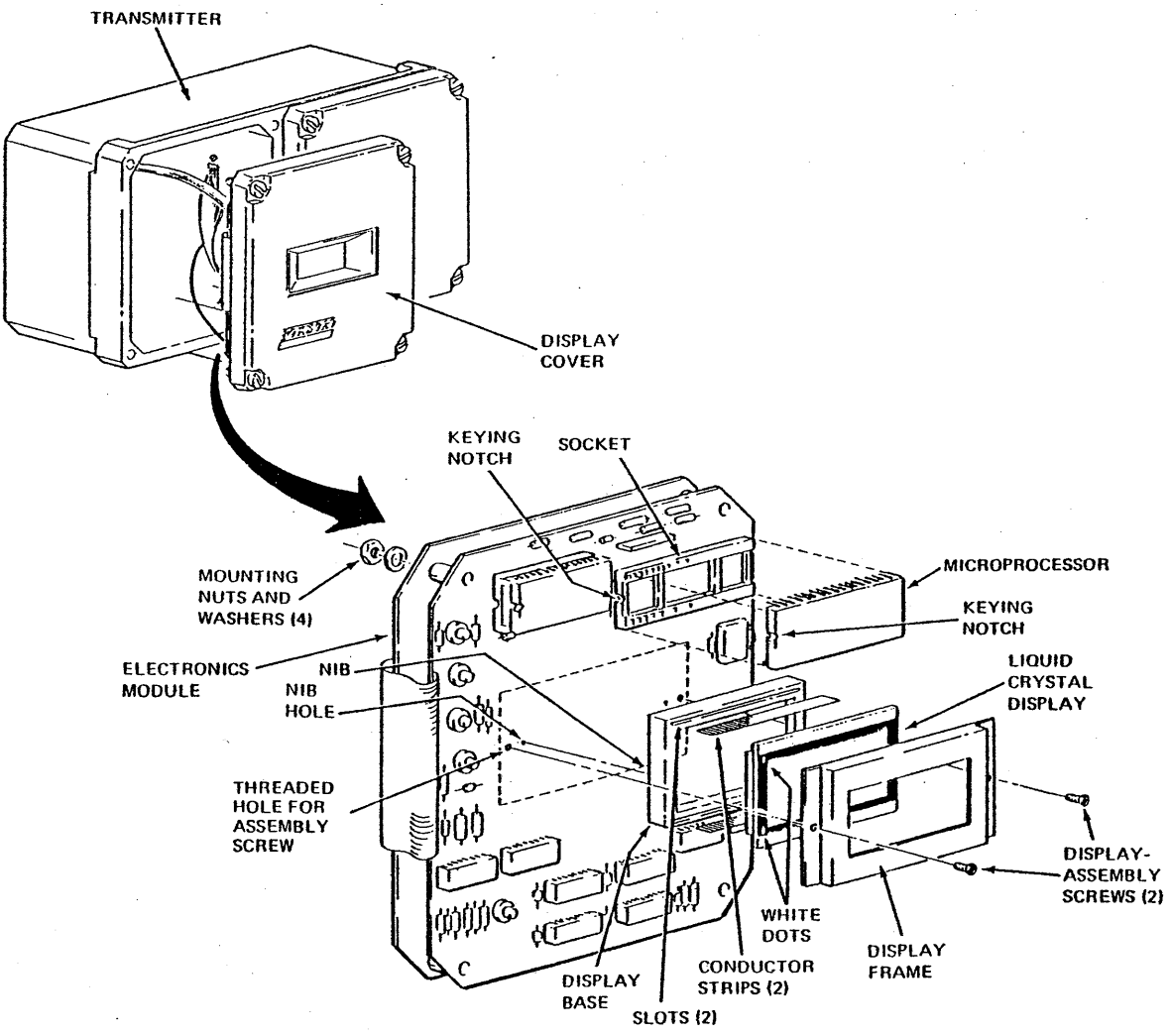


Figure 10. Microprocessor and Display Replacement

Display Replacement

The liquid crystal display (LCD) is located on the electronics module as shown in Figure 10. To install a new display, complete the following steps.

1. Turn off system power.
2. Refer to Figure 10 and remove display cover from transmitter.
3. Unscrew four mounting nuts from electronics module (shown in Figure 10); remove nuts and washers and lift module off display cover.
4. Remove display-assembly screws from PWA; lift display frame off display base.
5. Before installing new LCD, check that two conductor strips are inserted in their slots in display base (see Figure 10). Also check that nibs on the display base are inserted into nib holes in electronics module.
6. Rest LCD in base with white dot on LCD positioned as shown in Figure 10.
7. Install display frame over LCD and secure in place with display-assembly screws and nuts removed in Step 4.
8. Reinstall electronics module on display cover with four nuts and washers removed in Step 3.
9. Reinstall display cover on transmitter.

Terminations/Power Supply PWA Replacement

****
* CAUTION *
****

BEFORE INSTALLING NEW TERMINATIONS/ POWER SUPPLY PWA, CHECK THAT IT IS CORRECT PART FOR SPECIFIED VOLTAGE. THEN POSITION POWER-SUPPLY LINKS ON ASSEMBLY AS SHOWN IN "LINK POSITIONS" SECTION. Using wrong power supply or applying power with link incorrectly positioned can result in damage to the transmitter.

1. Turn off system power.
2. After positioning links on new power supply (see CAUTION above), remove display cover from transmitter as shown in Figure 11.
3. Unlatch and unplug power supply cable from connector on electronics module (see Figure 11.
4. Remove two screws and lockwashers from feedthrough terminal on power-supply cable (see Figure 11). Save screws for installation of new cable.
5. Remove terminations cover (shown in Figure 11) from transmitter.
6. Disconnect securing cable from terminations cover. Save screw, spacer, and washer for use in connecting new cable to cover.

****
* CAUTION *
****

Securing cable is used to keep cover connected to transmitter housing as required by certifying agencies. To retain flowmeter certification, CABLE MUST BE RECONNECTED TO COVER BEFORE INSTALLING COVER ONTO TRANSMITTER.

7. Unscrew two mounting screws in protective cover. Slip securing cable through slot in protective cover and remove cover.
8. Loosen all ten terminal screws on input terminal block shown in Figure 11.
9. If transmitter is integrally mounted (on flowtube), refer to Figure 5; if transmitter is remotely-mounted (away from flowtube), refer to Figure 6. Note color coding of flowtube wires (input wires and coil-drive wires); disconnect them from input terminals and coil-drive terminals in transmitter. If input cable is secured by cable clamp shown in Figure 6, loosen the two clamp screws and swing slotted end of clamp away from clamp screw.
10. Disconnect all output, earth, and mains wires from transmitter. (Wires are shown in Figures 5 and 6.)
11. Refer to Figure 11 and remove two mounting screws from terminations/power supply PWA. Also, loosen two transformer screws that secure transformer to the transmitter housing.
12. Lift terminations/power supply PWA (shown in Figure 11) out of transmitter housing just far enough so that electronics-module wires can be disconnected from input terminals of transmitter. Wires have color coded tubing. Note color code and disconnect wires from terminals.
13. Having disconnected the wires, now carefully lift PWA (and attached transformer) out of transmitter housing and remove old terminations/power supply PWA.

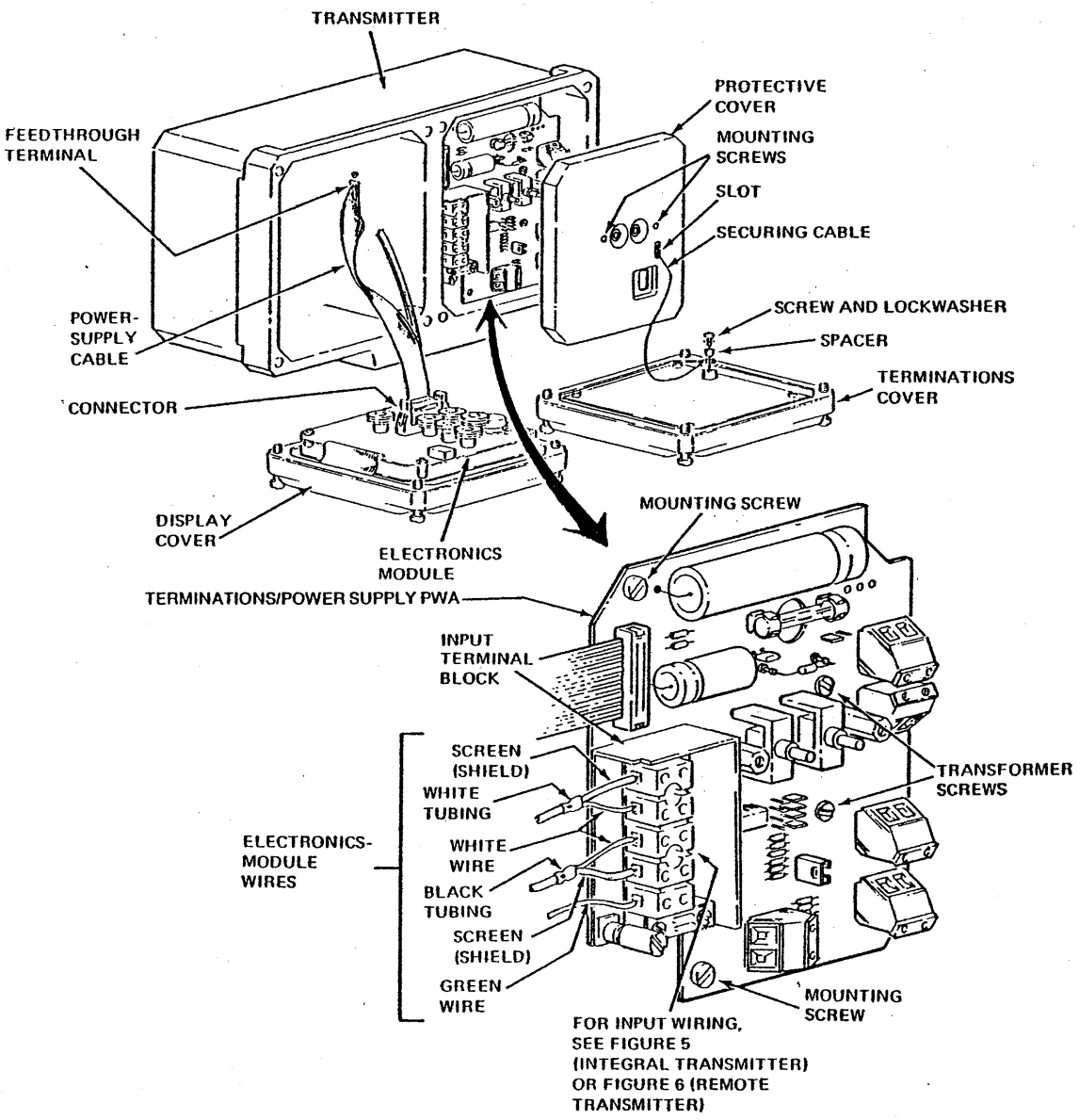


Figure 11. Removing Terminations/Power Supply PWA from Transmitter

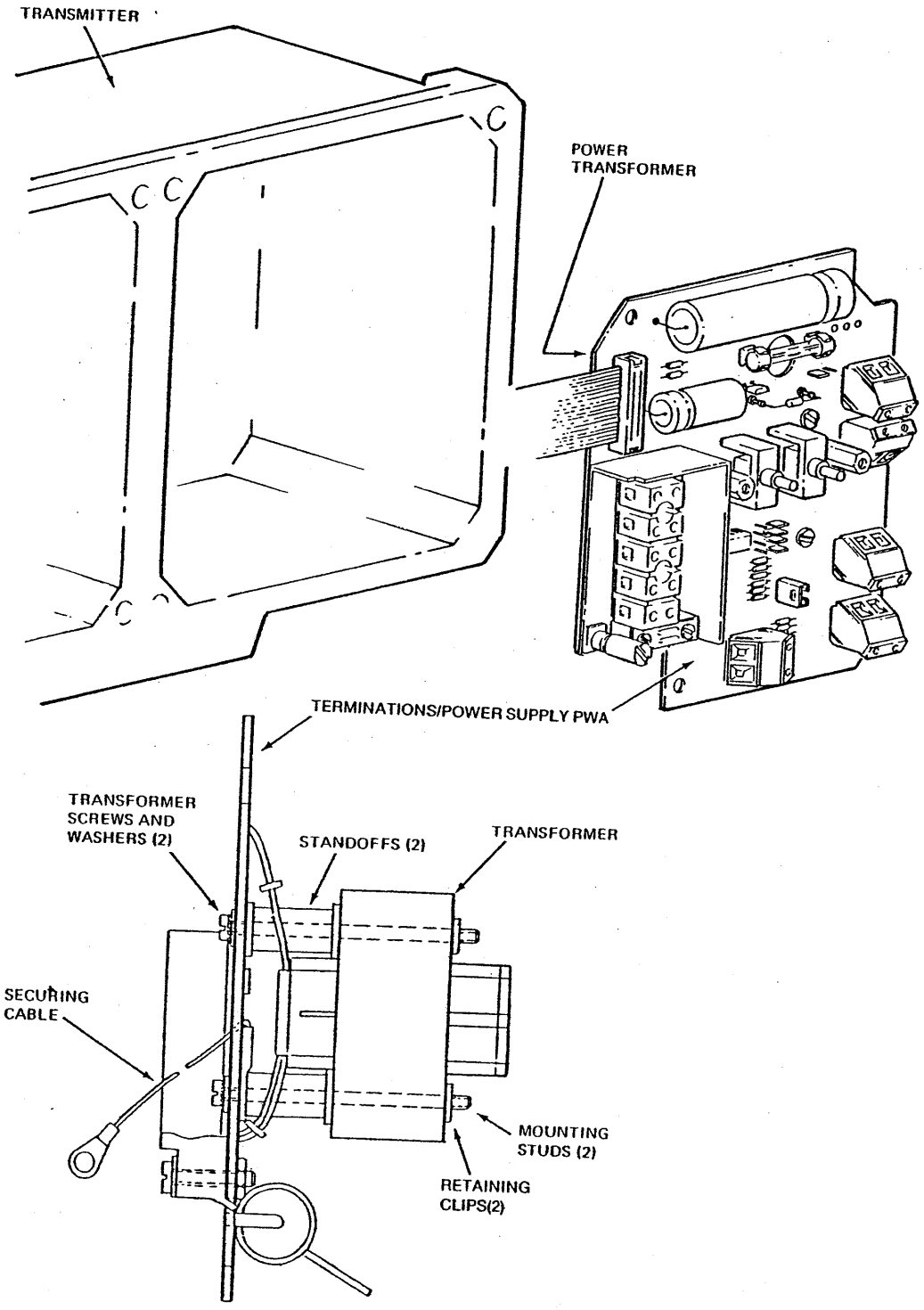


Figure 12. New Terminations/Power Supply PWA

14. Retrieve the new terminations/power supply PWA (Figure 12).

15. To install this PWA, insert power supply cable through feedthrough terminal in transmitter housing. Secure feedthrough terminal with hardware saved in Step 4. Ensure that the cable has not been twisted during installation.

16. Arrange and connect the color-coded electronics module wires to input terminal block (Figure 11).

17. Ease the PWA (and attached transformer) into the transmitter housing.

18. Now tighten the two transformer screws that secure the transformer (and PWA) to the housing. Ensure that all wires are clear of mounting hardware, and that they are not pinched or otherwise damaged during this PWA installation.

19. Install two PWA mounting screws as shown in Figure 11.

20. Arrange and connect color-coded flowtube wires (transmitter input and flowtube coil-drive wires) to transmitter terminals as noted in Step 9. If transmitter is remotely-mounted (from flowtube), secure input cable with cable clamp shown in Figure 6. Connection of flowtube wires is also shown in Figure 5 (integrally-mounted transmitter) and Figure 6 (remotely-mounted transmitter).

21. Connect output, earth, and mains wires to transmitter as shown in Figure 5 or 6, as applicable.

22. Check that link position of jumpers 2, 3, 4, 5, and 6 conform to the application requirements of the installation per Tables 5, 6, and 7 in the "Link Positions" section.

23. Insert securing cable through slot in protective cover (see Figure 11); reinstall protective cover over transmitter terminals. Connect securing cable to terminations cover with screw, spacer and washer removed in Step 6.

****
* CAUTION *
****

Securing cable is used to keep cover connected to transmitter housing as required by certifying agencies. To retain flowmeter certification, RECONNECT CABLE TO COVER BEFORE REINSTALLING COVER ON TRANSMITTER.

24. Reinstall terminations cover on transmitter.

25. Plug power-supply cable into its connector on electronics module so that connector latches snap into place. Cable and connector are shown in Figure 11.

26. Reinstall display cover on transmitter.

****
* CAUTION *
****

Attempts by the user to repair the power-supply assembly or electronics module assembly could result in damage and voiding of the warranty. The recommended repair procedure is replacement of the assembly or returning the PWA to Foxboro for repair. For repair, the user may call Foxboro Repair Service at (800) 441-6014, for return authorization.

Figures 18 through 20 are for information and reference only. Foxboro reserves the right to make design improvements and design changes without notice.

Barrier Module Replacement

Location of the optional barrier module inside the transmitter is shown in Figure 13. To install a new module, complete the following steps.

1. Disconnect mains power.

2. Refer to Figure 13. Remove display cover from transmitter.

3. Unplug barrier-module input cable (shown in Figure 13) from barrier module.

4. Unplug barrier-module output cable from electronics module.

5. Disconnect earth (ground) wire from grounding post on barrier module.

6. With a cross-head screwdriver, remove the four (three short; one long) mounting screws from barrier module; remove barrier module from transmitter.

7. To install new barrier module, reverse Steps 2 through 6. When plugging in barrier-module cables, align connectors as shown in Figure 13. Connectors are keyed to fit one way only. Do not force incorrectly-mated connectors together.

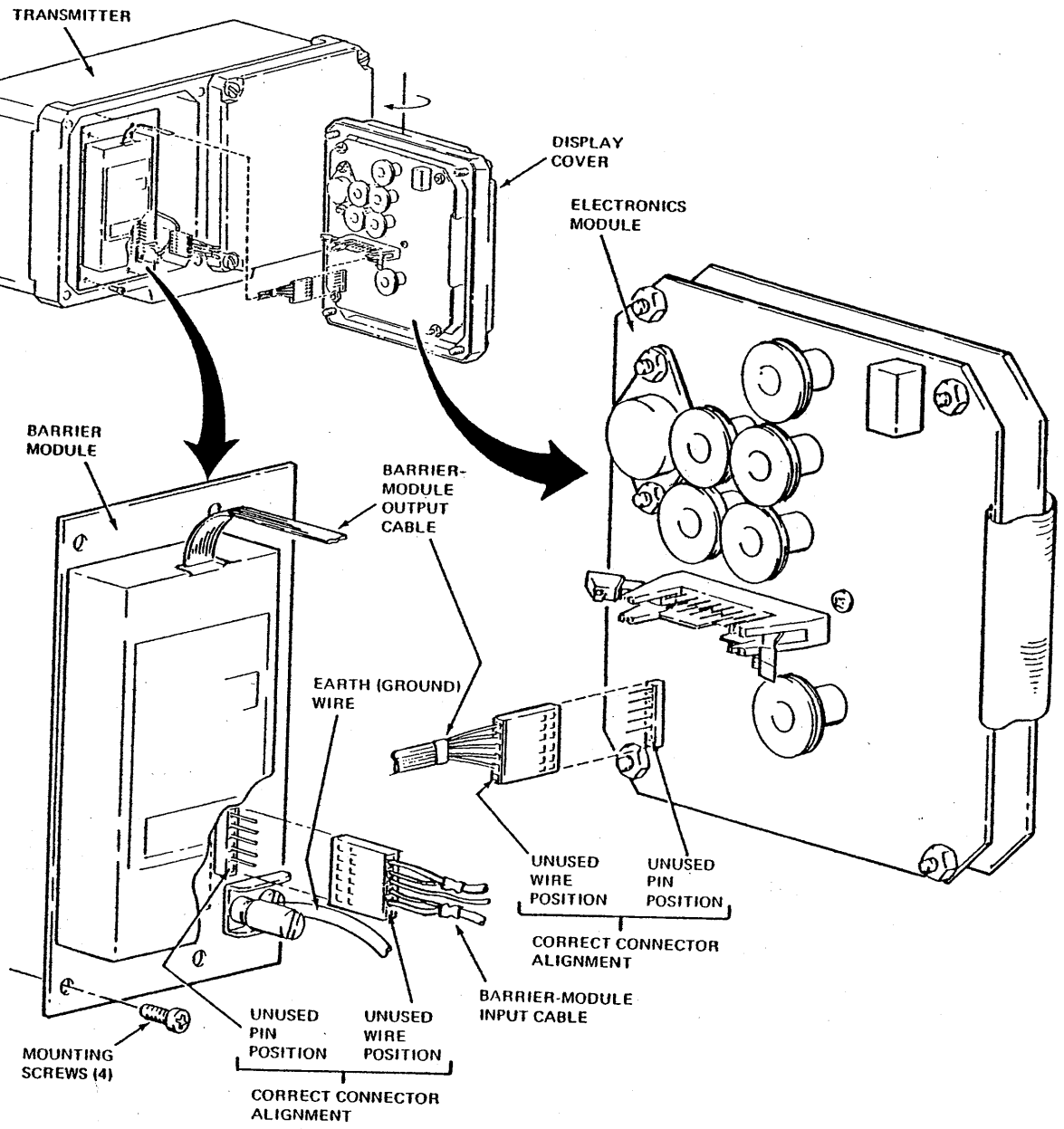


Figure 13. Barrier Module Replacement

Replacing Locator on Wafer-Body Flowtube

If plastic locators become damaged, they can be replaced by pulling off old locators and pushing new locators into place on flowtube as shown in Figure 14. Locators should be installed so that all lobes face in the same (clockwise or counterclockwise) direction.

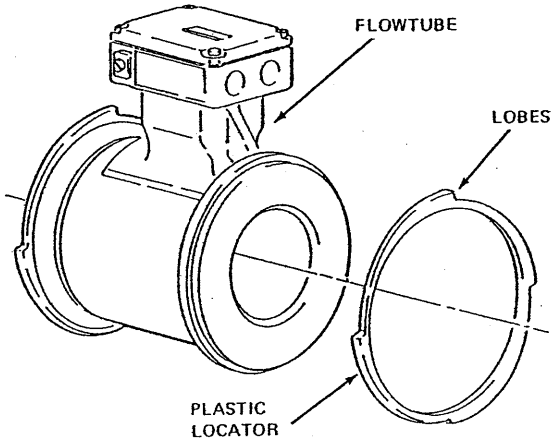


Figure 14.
Replacing Locator on Wafer-Body Flowtube

Replacing Gasket in Sanitary Flowtube

To replace the gasket, remove the sanitary extension from the flowtube as shown in Figure 15. Note that the 20 mm (0.8 in) insert on the sanitary extension fits into the well of the flowtube. If the pipeline is flexible enough, the extension can be removed from the flowtube without disconnecting it from the pipeline. Simply remove the extension clamp (shown in Figure 15) and spring back the pipe to remove the sanitary extension from the flowtube.

If the pipeline is rigid, remove the entire flowtube assembly from the pipeline by disconnecting the user-supplied pipe clamps (shown in Figure 16) from the pipeline. Then, remove the sanitary extension from the flowtube by disconnecting the extension clamp (shown in Figure 16) and sliding the extension out of the flowtube.

After installing the new gasket and inserting the sanitary extension into the flowtube, tighten the extension clamp only enough to prevent leakage. Tightening the clamp more than necessary will reduce the life of the gasket.

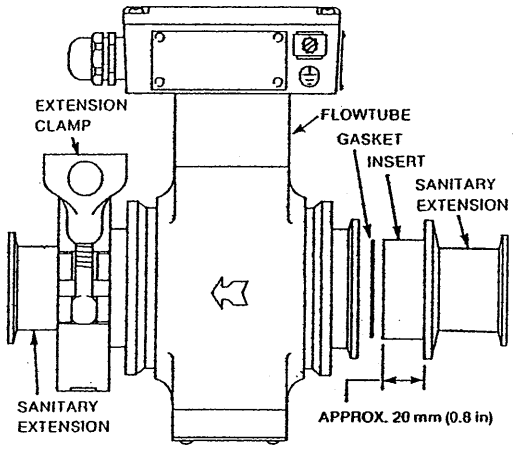


Figure 15.
Replacing Gasket in Sanitary Flowtube

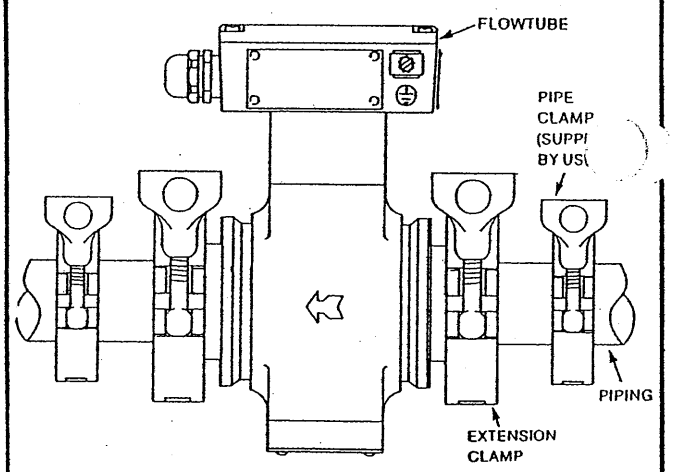


Figure 16.
Sanitary Flowtube Installed in Pipeline

LINK POSITIONS

Before installing a new power-supply assembly position links on terminations PWA for correct transmitter supply voltage and output-circuit power sources as shown in Tables 5 through 7. Locations of links on the terminations PWA are shown in Figure 17.

****
* CAUTION *
****

POWER SUPPLY VOLTAGE LINK MUST BE POSITIONED AS SHOWN IN TABLE 5 BEFORE APPLYING TRANSMITTER POWER. Applying power with link incorrectly positioned can result in damage to transmitter.

Table 5.
Supply Voltage Link Position

MODEL CODE	POWER SUPPLY PART NUMBER	SUPPLY VOLTAGE (V ac)	LINK POSITION (J2)
A	Q0110BF	120	P1 to P2
B	Q0110BK	220	P2 to P3
C	L0118RT	240	P1 to P2

Table 6.
Link Positions to Select Internal or External Power Source for Current-Output Circuit

MODEL CODE	POWER SOURCE	LINK POSITIONS	
		J3	J4
1	Internal	P29 to P31	P28 to P30
0 or 2	External	P27 to P29	P26 to P28

Table 7.
Link Positions to Select Internal or External Power Source for Pulse-Output Circuit

MODEL CODE	POWER SOURCE	LINK POSITIONS	
		J5	J6
3 or 5	Internal	P23 to P25	P22 to P24
0, 4, or 6	External	P21 to P23	P20 to P22

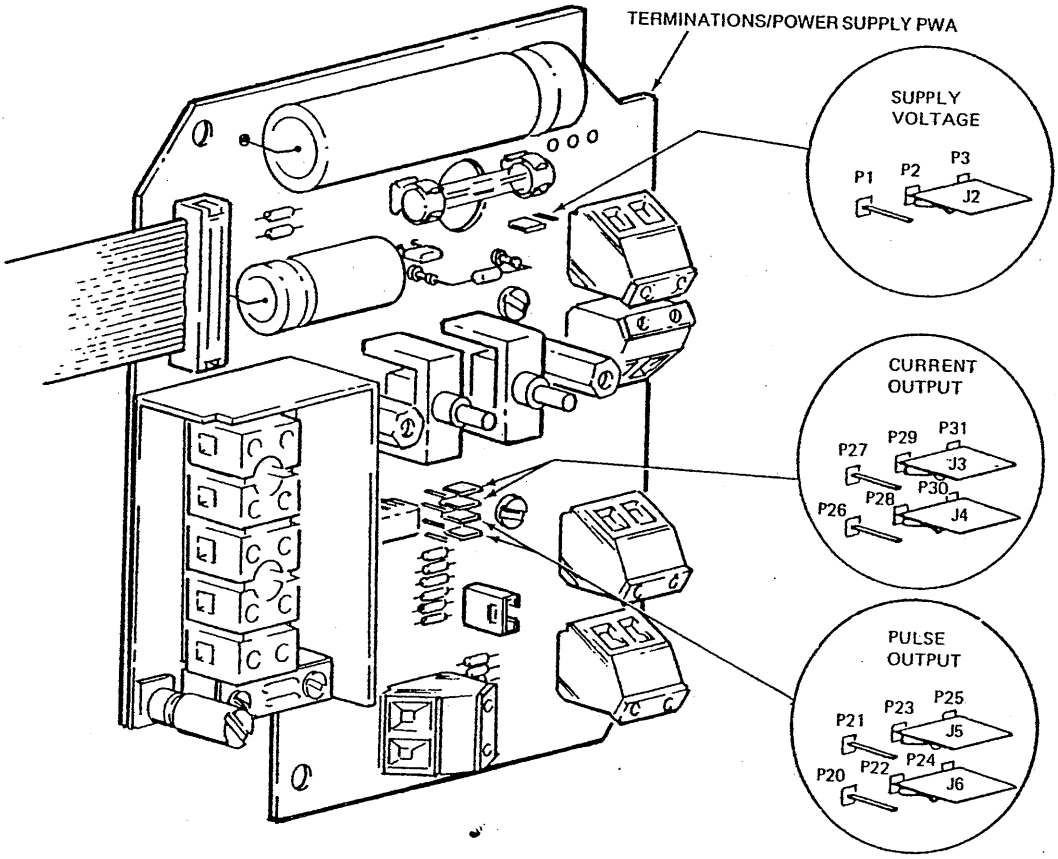
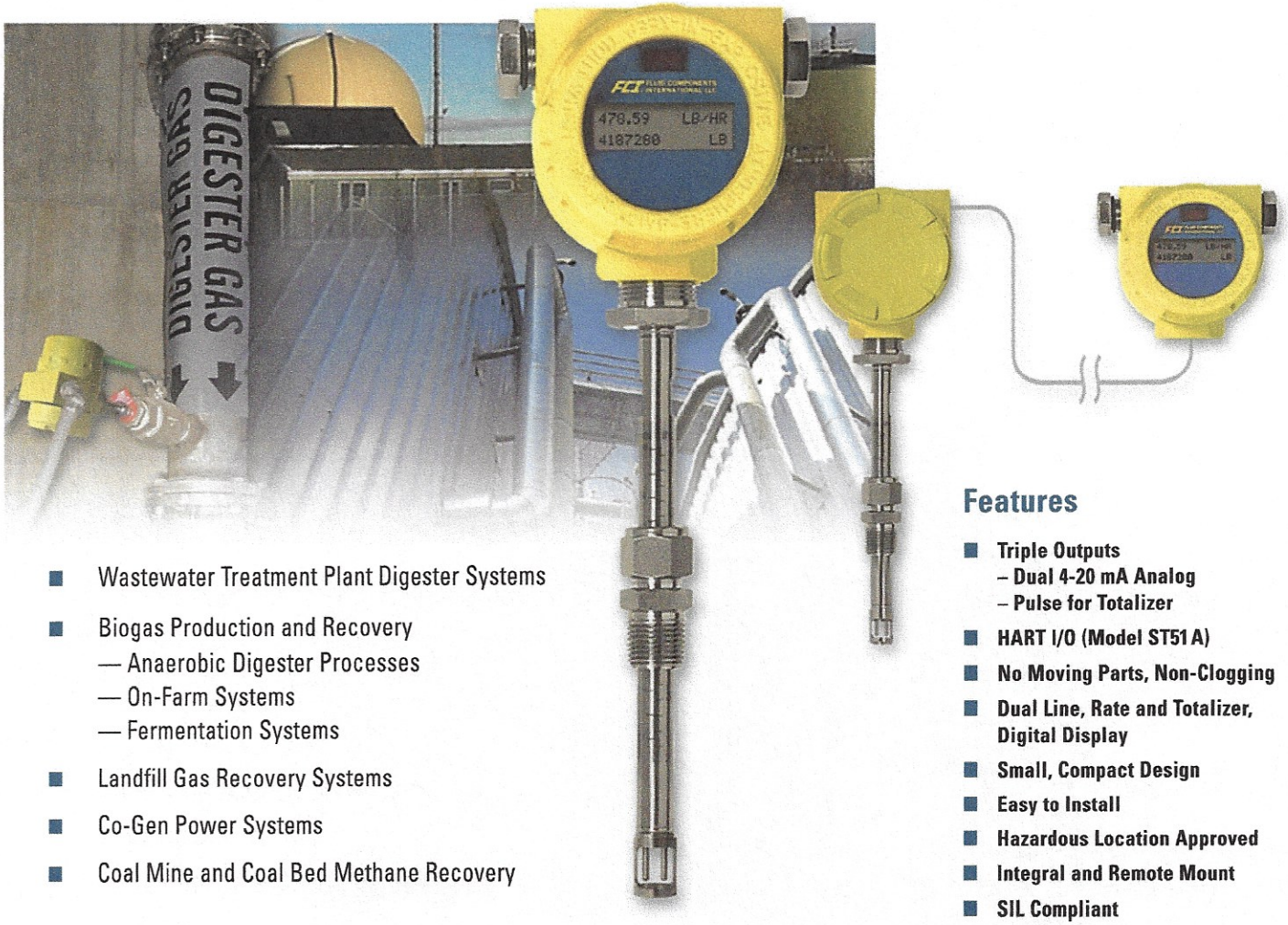


Figure 17. Link Locations

ST51 / ST51 A Mass Flow Meters

FLUID COMPONENTS INTERNATIONAL LLC

For Biogas, Digester Gas, Methane and Natural Gas



- Wastewater Treatment Plant Digester Systems
- Biogas Production and Recovery
  - — Anaerobic Digester Processes
  - — On-Farm Systems
  - — Fermentation Systems
- Landfill Gas Recovery Systems
- Co-Gen Power Systems
- Coal Mine and Coal Bed Methane Recovery

Features

- **Triple Outputs**
  - **– Dual 4-20 mA Analog**
  - **– Pulse for Totalizer**
- **HART I/O (Model ST51 A)**
- **No Moving Parts, Non-Clogging**
- **Dual Line, Rate and Totalizer, Digital Display**
- **Small, Compact Design**
- **Easy to Install**
- **Hazardous Location Approved**
- **Integral and Remote Mount**
- **SIL Compliant**

The ST51 Series Flow Meter is an accurate, easy to install, no moving parts solution for measuring and controlling biogases, digester gases, methane and natural gas flow. ST51 utilizes FCI proven thermal dispersion technology to provide direct mass flow measurement resulting in higher performance at a lower cost than orifice plates, DP, Vortex shedding and other thermal devices.

Biogas and digester gas applications are challenged by wide flow variations and dirty, wet gas. Flow variation is experienced as these processes move from low production start-up phases to a consistent, sustainable process and by seasonal temperature change, where cold temperatures slow gas production and higher temperature accelerate gas production. While the primary composition of these gases is methane and CO_2, residual H_2S and wet vapor leave deposits and corrode surfaces. ST51 provides the solution to these challenges. It features a wide-turndown ratio, up to 100:1 and is highly sensitive to low flow measurement. To measure correctly in fluctuating temperatures, flow meters must include temperature compensation circuitry and it is standard in ST51. ST51 has no moving parts to foul or clog and is easily pulled from the pipe for occasional cleaning.

ST51 installs in line sizes ranging from 2 inch to 24 inch [51 mm to 610 mm] with 1/2 inch or 3/4 inch NPT.

The ST51 uses precision, lithography structured platinum RTD sensors embedded in FCI's equal mass small diameter thermowells. Combined with microprocessor electronics and precision calibration, the ST51 achieves excellent accuracy, fast response and virtually maintenance free operation.

Biogas, digester gas and landfill gas compositions are dominated by methane (CH_4) and present a potentially hazardous installation environment. Sound engineering practice and often regulations mandate that instrumentation meet guidelines and have agency approvals for installation zone safety. Depending on actual installation location, at a minimum the environment will require Class I, Division II and often a more rigorous Class I, Division I [Zone 1 II2GD Ex d IIC] approvals. FCI ST51 meets all of these and has obtained the global agency approvals that ensure your installation is always safe and complies with regulations. And, unlike manufacturers who merely provide their transmitter electronics in an approved OEM enclosure, FCI submits its entire instrument to agency testing. FCI product approvals are different because they are comprehensive system approvals that also take into account the sensor and seal requirements as well the "T" (temperature) ratings. FCI agency approvals are on the total instrument. With ST51 you are assured of the integrity of total instrument approvals that meet or exceed safe engineering practice for your applications.

ST51 Specifications

Instrument

Media Compatibility: Biogas, digester gas, methane, natural gas, air, compressed air, nitrogen

Pipe/Line Size Compatibility: 2" to 24" [51 mm to 610 mm] [1]

Flow Range: 0.3 SFPS to 400 SFPS [0,08 MPS to 122 MPS]

Accuracy: (at ≥ 0.75 SFPS [≥ 0,21 NMPS] [2])

Standard: ±2% reading ±0.5% full scale

Optional: ±1% reading ±0.5% full scale

Repeatability: ±0.5% reading

Temperature Compensation

Standard: 40 °F to 100 °F [4 °C to 38 °C];

Optional: 0 °F to 350 °F [-18 °C to 177 °C]

Temperature Coefficient

With temperature compensation; valid from 10% to 100% of full scale calibration

Flow: Maximum ±0.015% of reading / °F up to 350 °F [±0.03% of reading / °C up to 177 °C]

Turndown Ratio: 3:1 to 100:1

Agency Approvals

FM, FMc: Class I, Division 1, Groups B, C, D; T4 Ta = 60°C
Class II/III, Division 1, Groups E, F, G; T4 Ta = 60°C; Type 4X/IP66
Class I, Division 2, Groups A, B, C, D; T4 Ta = 60°C

ATEX, IECEx: Zone 1, Zone 21
II 2 G Ex db IIC T6...T1 Gb
II 2 D Ex tb IIIC T85°C... T300°C Db; IP66/IP67
Ta = -40°C to +65°C

Other: EAC (TRCU) Russia, CE Marking, CRN

SIL (ST51A): SIL 1 compliant; Safe Failure Fraction (SFF) 78.5% to 81.1%

Warranty: ST51 – 1 year; ST51 A – 2 years

[1] *For line sizes 2" [51 mm] or smaller, see FCI ST75 Series*

[2] *Contact FCI for accuracy below 0.75 SFPS [0,21 NMPS]*

Flow Element

Installation: Insertion, variable length with 1/2" or 3/4" MNPT compression fitting

Type: Thermal dispersion

Material of Construction: 316L stainless steel body with Hastelloy-C22 thermowell sensors, 316 stainless steel compression fitting with Teflon or stainless steel ferrule

Pressure (Maximum Operating without Damage)

Stainless steel ferrule: 500 psig [34 bar(g)]

Teflon ferrule: 150 psig [10 bar(g)]

Operating Temperature

Stainless steel ferrule

ST51: -0 °F to 250 °F [-18 °C to 121 °C]

ST51 A: -0 °F to 350 °F [-18 °C to 177 °C]

Teflon ferrule: -0 °F to 200 °F [-18 °C to 93 °C]

Process Connection: 1/2" MNPT or 3/4" MNPT with stainless steel or Teflon ferrule

Insertion Length (Field Adjustable)

1" to 6" [25 mm to 152 mm]

1" to 12" [25 mm to 305 mm]

1" to 18" [25 mm to 457 mm]

Flow Transmitter

Enclosure

Rating: NEMA 4X, IP67

Material: *Standard* – aluminum, polyester powdered coated
Optional – 316 stainless steel

Conduit/Cable Port: Dual 1/2" NPT or M20x1.5

Operating Temperature: 0 °F to 140 °F [-18 °C to 60 °C]

Input Power

DC: 18 Vdc to 36 Vdc (6 watts max.)

AC: 85 Vac to 265 Vac (12 watts max.; CE Marking approval from 100 Vac to 240 Vac)

Analog Output Signals: Dual 4-20 mA, user assignable to flow rate and/or temperature and a 0-500 Hz pulse output for total flow; ST51A output #1 has fault indication per NAMUR NE43 guidelines, user selectable for high (>21.0 mA) or low (<3.6 mA)

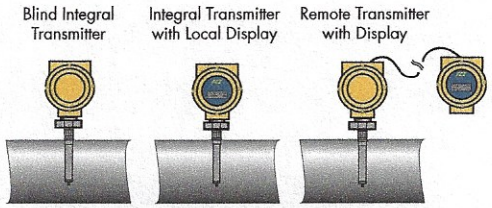
Bus Communications (ST51 A): HART (version 7); FieldComm Group certified; available over output #1; DD file included

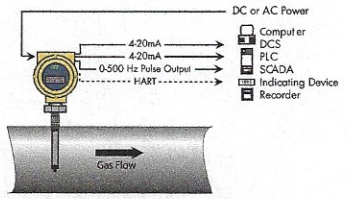
Communication Port: RS-232C

Digital Display (Optional): Two-line x 16 character LCD; displays measured value and engineering units; top line assigned to flow rate, second line user assignable to temperature reading, as flow totalizer or alternating; display can be rotated in 90° increments for optimum viewing orientation

Installation and Mounting: Integral with sensor element or remote mountable up to 50' [15 m] with Model ST51, and up to 100' [30 m] with Model ST51A

	ST51	ST51 A
Dual 4-20 mA outputs	■	■
4-20 mA per NAMUR NE43		■
HART I/O		■
500 Hz pulse output	■	■
Process operating temperature	To 250 °F [to 121 °C]	To 350 °F [to 177 °C]
Maximum remote distance	50' [15 m]	100' [30 m]
SIL compliance rating		■
Warranty *Standard*	1 year	2 years





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Liberty Pumps®

X-Series™

XFL50-Series

1/2 hp

XFL70-Series

3/4 hp

Explosion-proof Submersible Effluent Pumps for Hazardous Locations

POWDER COATED TOUGH™

3 Year Warranty

Patent: See www.libertypumps.com/patents

Dual Sized Discharge
1-1/2" or 2"

Class 1, Division 1 Groups C & D

Class 1, Zone 1 and Group IIA and IIB

Features:

- Dual 1-1/2" or 2" discharge
- 3/4" solids-handling
- Heavy cast iron construction
- Dual shaft seals
- Seal fail sensor
- Semi-open cast iron impeller (bronze optional)
- 416 stainless steel rotor shaft
- 1-1/2" threads provided at power cords for optional conduit connection

For use with ISS-Series and ISD-Series intrinsically safe panels.

Consult factory for proper panel sizing.

innovate. evolve.

XFL50-SERIES 1/2 hp

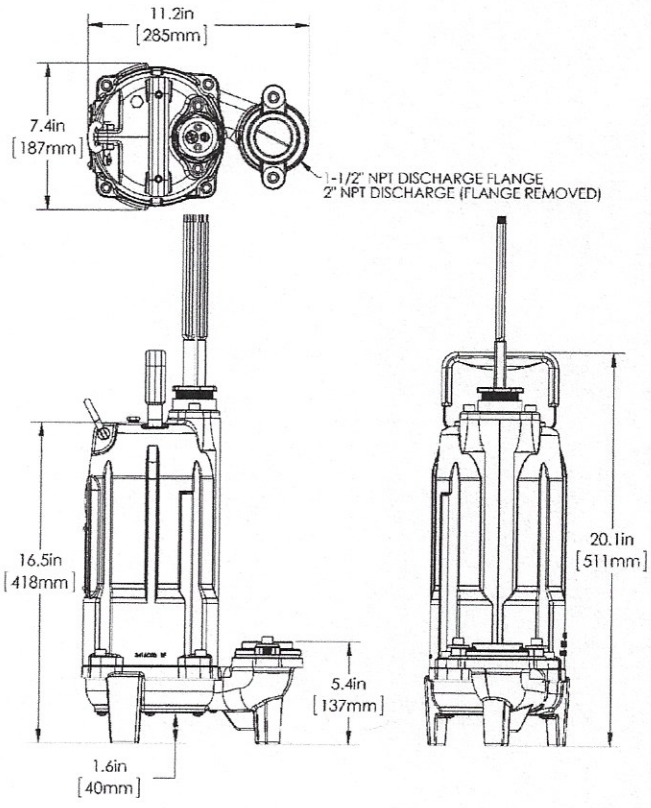
XFL70-SERIES 3/4 hp

TECHNICAL SPECIFICATIONS

MODELS	HP	VOLTS	HZ	PHASE	FULL LOAD AMPS	CAPACITOR KIT	DISCHARGE SIZE	CORD LENGTH	WEIGHT (Lbs.)
XFL51M-2	1/2	115	60	1	14	K001515	1-1/2" & 2"	25'	89
XFL52M-2	1/2	208/230	60	1	7	K001514	1-1/2" & 2"	25'	89
XFL53M-2	1/2	208/230	60	3	4.5	N/A	1-1/2" & 2"	25'	89
XFL54M-2	1/2	440-480	60	3	2.6	N/A	1-1/2" & 2"	25'	89
XFL55M-2	1/2	575	60	3	2.2	N/A	1-1/2" & 2"	25'	89
XFL71M-2	3/4	115	60	1	15	K001515	1-1/2" & 2"	25'	89
XFL72M-2	3/4	208/230	60	1	9	K001514	1-1/2" & 2"	25'	89
XFL73M-2	3/4	208/230	60	3	6	N/A	1-1/2" & 2"	25'	89
XFL74M-2	3/4	440-480	60	3	3	N/A	1-1/2" & 2"	25'	89
XFL75M-2	3/4	575	60	3	2.5	N/A	1-1/2" & 2"	25'	89

25' cords are standard. For 35' or 50' cords, add "-3" or "-5" suffix respectively. Example: XFL52M-5
Cast iron impeller standard. For bronze impeller add "B" to model number. Example: XFL51BM-2
NOTE: 3-phase models require a control panel with overloads properly sized for the pump. See intrinsically safe panels ISS-Series (simplex) or ISD-Series (duplex) literature for complete panel information. Consult factory for proper panel sizing.

DIMENSIONAL DATA:



CONSTRUCTION:

Pump and Motor Housing: Heavy cast iron - Class 30

Impeller: Cast Iron (standard), Bronze option available (order "B" models)

Motor: Submersible type, oil-filled, hermetically sealed

Bearings: Ball bearings upper and lower

Thermal Protection: Single-phase models - built into motor windings with automatic reset. Three-phase models require overloads in the control panel

Capacitor: External run capacitor required in panel (single phase models)

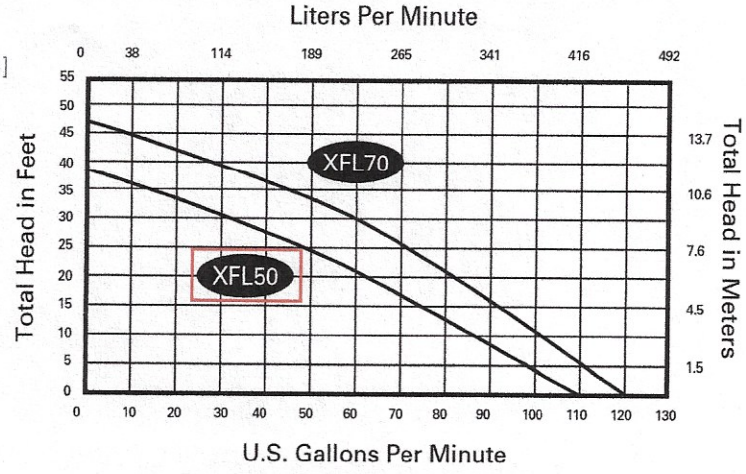
Shaft Seal: Dual seals, silicon carbide with BUNA N elastomers and stainless steel housing

Seal Fail Sensor: Integral moisture sensing probe (functionality requires indicator in panel – see ISS or ISD-Series panels)

Maximum Fluid Temperature: 104° F (40° C)

PERFORMANCE CURVE

60Hz. 3450 RPM



SSPMA CERTIFIED

C SP US

Meets FM Standards

Specifications are subject to change without notice.

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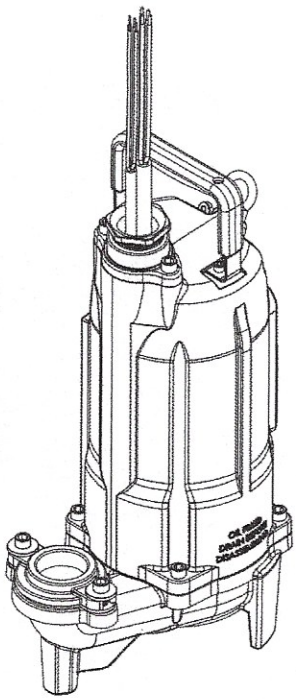
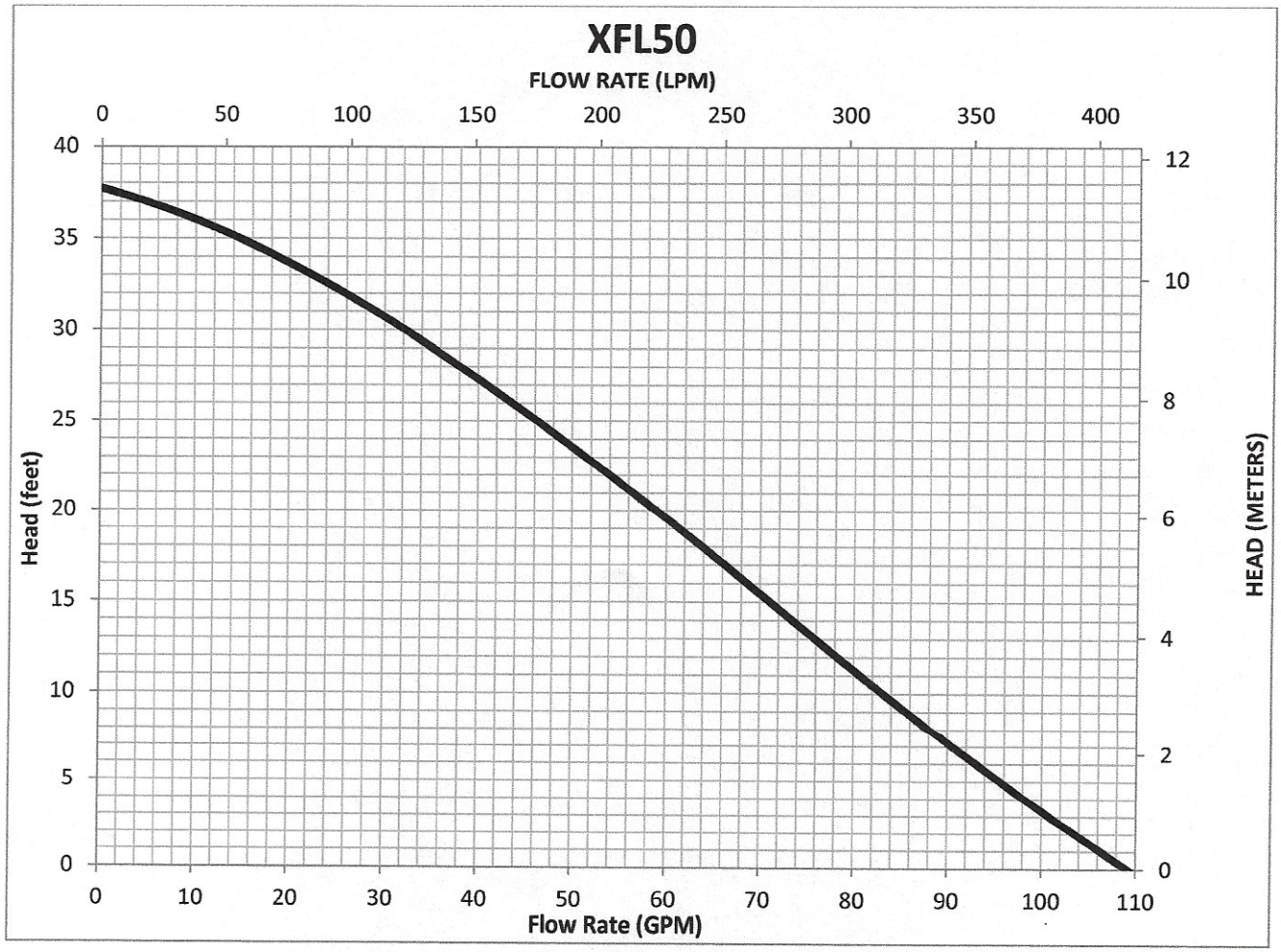
Liberty Pumps®

Pump Specifications

XFL50 Series
½ HP Submersible Effluent Pump
For Hazardous Locations
Class 1, Division 1 Groups C & D
Class 1, Zone 1 and Groups IIA & IIB





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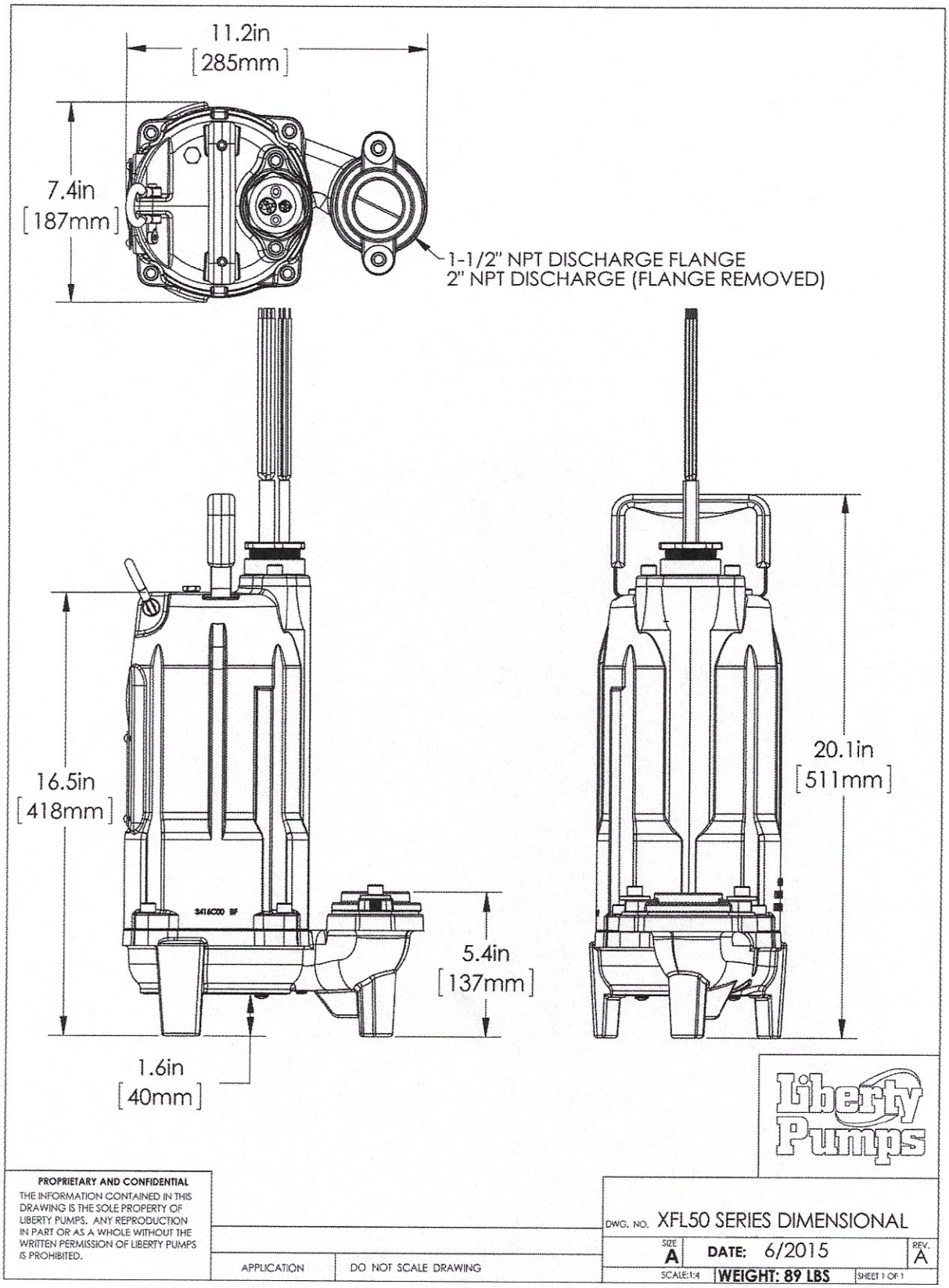
Liberty Pumps®

XFL50-Series Dimensional Data



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XFL50 -Series Electrical Data

MODEL	HP	IMPELLER	VOLTAGE	PHASE	FULL LOAD AMPS	LOCKED ROTOR AMPS	THERMAL OVERLOAD TEMP	STATOR WINDING CLASS	CORD LENGTH (FT)	DISCHARGE NPT
XFL51M-2	1/2	CAST IRON	115	1	14	66	120°C/248°F	F	25	1-1/2" & 2"
XFL51M-3	1/2	CAST IRON	115	1	14	66	120°C/248°F	F	35	1-1/2" & 2"
XFL51M-5	1/2	CAST IRON	115	1	14	66	120°C/248°F	F	50	1-1/2" & 2"
XFL52M-2	1/2	CAST IRON	208/230	1	7	33.6	105°C/221°F	F	25	1-1/2" & 2"
XFL52M-3	1/2	CAST IRON	208/230	1	7	33.6	105°C/221°F	F	35	1-1/2" & 2"
XFL52M-5	1/2	CAST IRON	208/230	1	7	33.6	105°C/221°F	F	50	1-1/2" & 2"
XFL53M-2	1/2	CAST IRON	208/230	3	4.5	33.5	105°C/221°F	F	25	1-1/2" & 2"
XFL53M-3	1/2	CAST IRON	208/230	3	4.5	33.5	105°C/221°F	F	35	1-1/2" & 2"
XFL53M-5	1/2	CAST IRON	208/230	3	4.5	33.5	105°C/221°F	F	50	1-1/2" & 2"
XFL54M-2	1/2	CAST IRON	440-480	3	2.6	33.5	105°C/221°F	F	25	1-1/2" & 2"
XFL54M-3	1/2	CAST IRON	440-480	3	2.6	33.5	105°C/221°F	F	35	1-1/2" & 2"
XFL54M-5	1/2	CAST IRON	440-480	3	2.6	33.5	105°C/221°F	F	50	1-1/2" & 2"
XFL55M-2	1/2	CAST IRON	575	3	2.2	12.8	105°C/221°F	F	25	1-1/2" & 2"
XFL55M-3	1/2	CAST IRON	575	3	2.2	12.8	105°C/221°F	F	35	1-1/2" & 2"
XFL55M-5	1/2	CAST IRON	575	3	2.2	12.8	105°C/221°F	F	50	1-1/2" & 2"
XFL51BM-2	1/2	BRONZE	115	1	14	66	120°C/248°F	F	25	1-1/2" & 2"
XFL51BM-3	1/2	BRONZE	115	1	14	66	120°C/248°F	F	35	1-1/2" & 2"
XFL51BM-5	1/2	BRONZE	115	1	14	66	120°C/248°F	F	50	1-1/2" & 2"
XFL52BM-2	1/2	BRONZE	208/230	1	7	33.6	105°C/221°F	F	25	1-1/2" & 2"
XFL52BM-3	1/2	BRONZE	208/230	1	7	33.6	105°C/221°F	F	35	1-1/2" & 2"
XFL52BM-5	1/2	BRONZE	208/230	1	7	33.6	105°C/221°F	F	50	1-1/2" & 2"
XFL53BM-2	1/2	BRONZE	208/230	3	4.5	33.5	105°C/221°F	F	25	1-1/2" & 2"
XFL53BM-3	1/2	BRONZE	208/230	3	4.5	33.5	105°C/221°F	F	35	1-1/2" & 2"
XFL53BM-5	1/2	BRONZE	208/230	3	4.5	33.5	105°C/221°F	F	50	1-1/2" & 2"
XFL54BM-2	1/2	BRONZE	440-480	3	2.6	33.5	105°C/221°F	F	25	1-1/2" & 2"
XFL54BM-3	1/2	BRONZE	440-480	3	2.6	33.5	105°C/221°F	F	35	1-1/2" & 2"
XFL54BM-5	1/2	BRONZE	440-480	3	2.6	33.5	105°C/221°F	F	50	1-1/2" & 2"
XFL55BM-2	1/2	BRONZE	575	3	2.2	12.8	105°C/221°F	F	25	1-1/2" & 2"
XFL55BM-3	1/2	BRONZE	575	3	2.2	12.8	105°C/221°F	F	35	1-1/2" & 2"
XFL55BM-5	1/2	BRONZE	575	3	2.2	12.8	105°C/221°F	F	50	1-1/2" & 2"

LIBERTY PUMPS CONTROL INFORMATION				
PUMP MODELs	CAPACITOR	SIMPLEX PANEL	DUPLEX PANEL	CAP KIT
XFL51	50uf	ISS24LC1=3-5	ISD24LC2=3-5	K001515
XFL52	45uf	ISS24LC1=3-5	ISD24LC2=3-5	K001514
XFL53	N/A	ISS34=3-171-5	ISD34=3-171-5	N/A
XFL54	N/A	ISS34=3-141-5	ISD34=3-141-5	N/A
XFL55	N/A	ISS54=3-121-5	ISD54=3-121-5	N/A

Note: Liberty Pumps ISS and ISD Series control panels include intrinsically safe float circuits for use with pumps in hazardous locations

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XFL50 - Series Technical Data

IMPELLER	7 VANE CLASS 25 CAST IRON OR BRONZE
SOLIDS HANDLING SIZE	3/4"
PAINT	POWDER COAT
MAX LIQUID TEMP	40˚C 104˚F
MAX STATOR TEMP	130˚C 266˚F
THERMAL OVERLOAD	105˚C 221˚F
POWER CORD TYPE	SOOW
MOTOR HOUSING	CLASS 30 CAST IRON
VOLUTE	CLASS 30 CAST IRON
SHAFT	STAINLESS
HARDWARE	STAINLESS
O RINGS	BUNA - N
MECHANICAL SEAL UPPER	UNITIZED - SILICON CARBIDE / SILICON CARBIDE
MECHANICAL SEAL LOWER	2 PIECE – SILICON CARBIDE / SILICON CARBIDE
MIN BEARING LIFE	50,000 HRS
WEIGHT	89 LBS

XFL50 - Series Specifications

1.01 GENERAL:

The contractor shall provide labor, material, equipment, and incidentals required to provide_____(QTY) centrifugal pumps as specified herein. The pump models covered in this specification are Series XFL50 single phase or three phase pumps. The pump furnished for this application shall be model _____as manufactured by Liberty pumps.

2.01 OPERATING CONDITIONS:

Each submersible pump shall be rated at ____ hp_____volts _____ phase 60 Hz. 3450 RPM. The unit shall produce_____G.P.M. at _____ feet of total dynamic head.

The submersible pump shall be capable of handling residential effluent with 3/4" solid handling capability. The submersible pump shall have The following hydraulic performance:

XFL50: a shut-off head of 38 feet and a maximum flow of 96 GPM @ 5 feet of total dynamic head.

The pump shall be controlled with:

_____A NEMA 4X outdoor simplex control panel with three float switches and a high water alarm.
_____A NEMA 1 indoor simplex control panel with three float switches and a high water alarm.
_____A NEMA 4X outdoor duplex control panel with three float switches and a high water alarm.
_____A NEMA 1 indoor duplex control panel with three float switches and a high water alarm.
_____A NEMA 4X outdoor duplex control panel with four float switches and a high water alarm.
_____A NEMA 1 indoor duplex control panel with four float switches and a high water alarm.

*Note: Control panels must include intrinsically safe float circuits when pumps are installed in hazardous locations.

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3.01 CONSTRUCTION:

Each centrifugal effluent pump shall be equal to the C US certified XFL50 Series pumps manufactured by Liberty Pumps, Bergen NY. The castings shall be constructed of class 30 cast iron. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat from the motor. All mating parts shall be machined and sealed with Buna-N O-rings. All fasteners exposed to the liquid shall be stainless steel. The upper and lower bearing of the motor shall be capable of handling all radial and thrust loads. The pump is protected with a duel seal configuration with an oil cavity between the two seals. A leak sensor is housed in this chamber to detect the presence of water and will activate an alarm at the control panel indicating service is required. Both seals are silicon carbide / silicon carbide with stainless steel housings and spring, however the lower seal is of a two piece design to facilitate service.

4.01 ELECTRICAL POWER CORD

The submersible pump shall be supplied with 25, 35, or 50 feet of a multi-conductor cord of type SOOW The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. A separate control cord SOOW of equal length will also exit the pump. Both cords are located within a casting configured for 1-1/2" conduit if the application requires. The cords are secured with a rubber seal ring and potted – the individual strands are exposed to the epoxy to prevent any wicking through the conductors.

5.01 MOTORS

Single phase motors shall be oil filled, permanent split capacitor, class F insulated, NEMA B design, rated for continuous duty. Three phase motors shall be oil filled, class F insulated NEMA B design, rated for continuous duty. At maximum load the winding temperature shall not exceed 130 degrees C unsubmerged. Since air filled motors are not capable of dissipating heat they shall not be considered equal. Single phase pump motors shall have an integral thermal / current overload switch in the windings for protecting the motor. A capacitor is required and shall be mounted in the control panel. Three phase motors shall have a thermal overload device mounted on the windings which is connected to a motor control relay located in the control panel.

6.01 BEARINGS AND SHAFT

Upper and lower ball bearings shall be required. The bearings shall be a single ball / race type bearing. Both bearings shall be permanently lubricated by the oil which fills the motor housing. The motor shaft shall be made of 300 series stainless steel and have a minimum diameter of .625".

7.01 SEALS

The pump shall have two shaft seals with an oil chamber between them. A leak detection probe is positioned in the oil chamber and continuously monitors for water that would indicate the lower seal has failed. The lower seal is a two piece design and can be serviced in the field. The upper is a unitized design, both seals are silicon carbide / silicon carbide seal faces with stainless steel housings and spring. All other seals are of an O-ring design of Buna –N material.

8.01 IMPELLER

The impeller shall be a class 25 cast iron or bronze, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be threaded onto the motor shaft.

9.01 CONTROLS

All the XFL50 series pumps require a control panel. Single phase units utilize a Permanent Split Capacitor, PSC, type motor and require a specific run capacitor. Three phase motor are equipped with a thermal overload that must be connected in the control panel to protect against overheating. Control panels must include intrinsically safe float circuits when pumps are installed in hazardous locations.

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10.01 PAINT

The exterior of the casting shall be protected with Powder Coat paint.

11.01 SUPPORT

The pump shall have cast iron support legs, enabling it to be a free standing unit. The legs will be high enough to allow 3/4" solids to enter the volute.

12.01 SERVICEABILITY

Components required for the repair of the pump shall be shipped within a period of 24 hours.

13.01 FACTORY ASSEMBLED TANK SYSTEMS WITH GUIDE RAIL AND QUICK DISCONNECT DISCHARGE

_____Guide factory mounted rail system with pump suspended by means of bolt on quick disconnect which is sealed by means of nitrile grommets or o-rings. The Discharge piping shall be schedule 80 PVC and furnished with a check valve and PVC shut-off ball valve. The Tank shall be wound fiberglass or roto-molded plastic. An inlet hub shall be provided with the fiberglass systems.

_____Stainless steel Guide Rail

_____Zinc plated steel Guide Rail

_____"diameter of basin size

_____"height of basin size

_____"distance from top of tank to discharge pipe outlet

_____Fiberglass cover

_____Structural foam polymer cover

_____Steel cover

_____Simplex System with Outdoor panel and alarm

_____Duplex System with Outdoor panel and alarm

_____Simplex System with Indoor panel and alarm

_____Duplex System with Indoor panel and alarm

_____Separate Outdoor Alarm

_____Remote Outdoor Alarm

14.01 TESTING

The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure integrity of the motor enclosure. The pump shall be run, voltage and current monitored, and evaluated for noise or other malfunction.

15.01 QUALITY CONTROL

The pump shall be manufactured in an ISO 9001 certified Facility.

16.01 WARRANTY

Standard limited warranty shall be 3 years.

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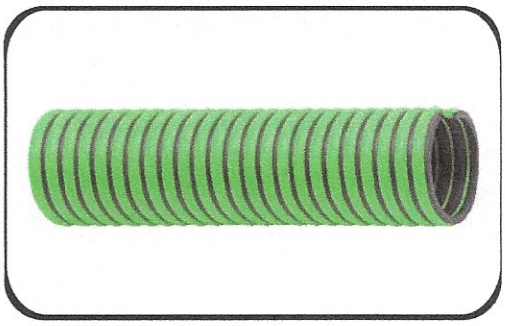
UNISOURCE MFG.
your single source supplier

PRODUCT BULLETIN

Series 1400
EPDM/PVC Suction Hose



Heavy-duty liquid suction hose ideal for construction, dewatering, liquid waste, cesspool cleaning, septic handling, agricultural applications, and marine use. Hose is designed to remain flexible in winter conditions, lightweight, and external helix provides for easy drag. The smooth interior provides for optimum product flow. Flexible for easy handling and storage.

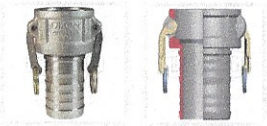
Tube:	Black EPDM w/ Green Polyethylene Helix
Cover:	Black w/ green helix
Length:	100' coils
Temperature:	-40°F to +140°F (-40°C to +60°C)
Note:	Other colors available
Origin:	USA

Part #	I.D. (In)	O.D. (In)	W.P. @ 70°F (PSI)	Vacuum Rating (In Hg)	Bend Radius @ 70°F (In)	Weight (Lbs / Ft)	Std. Length	Stock (Yes) or Min. Order
1400-100	1	1.35	50	29.8	1.9	.23	100'	Yes
1400-125	1-1/4	1.66	50	29.8	3.2	.35	100'	Yes
1400-150	1-1/2	1.85	50	29.8	3.2	.41	100'	Yes
1400-200	2	2.43	50	29.8	5.2	.67	100'	Yes
1400-250	2-1/2	3.00	45	29.8	7.1	1.12	100'	Yes
1400-300	3	3.53	40	29.8	11.0	1.84	100'	Yes

1-800-234-2566
8040 NE 33rd Drive
Portland, Oregon 97211

12/1/2014

Dixon® Cam & Groove Type C Coupler x Hose Shank



View all 2 Photos

Like 0

CAD Data

Part Number	150-C-SS
Material	316 Stainless Steel
Seal	Buna-N
Size	1-1/2"
Maximum Operating Pressure	250 PSI
Optional Pkg/Box Qty	10
Weight Lb	1.6300

Not a Distributor?

Name a local distributor who should carry this product.

or

Add to Wishlist

or

Request a Quote

Live Chat

[-] Product Details

Applications

- Designed for use with liquids, consult Dixon for specific recommendations

Use

- Suitable for use with King Crimp sleeves and ferrules

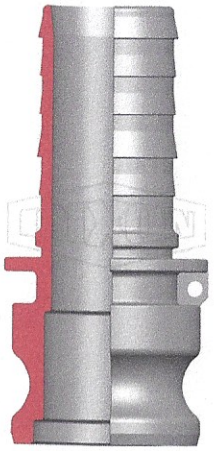
Construction

- Buna-N gasket
- Durable stainless steel cam arm pins
- Supplied with safety clips

Available Options

- Other gasket types are available, contact Dixon.

Dixon® Cam & Groove Type E Adapter x Hose Shank



Part Number	150-E-SS
Material	316 Stainless Steel
Size	1-1/2"
Maximum Operating Pressure	250 PSI
Optional Pkg/Box Qty	10
Weight Lb	1.1900

Not a Distributor?

Name a local distributor who should carry this product.

or

Add to Wishlist

or

Request a Quote

Like 0

CAD Data

Live Chat

[-] Product Details

Applications

- Designed for use with liquids, consult Dixon for specific recommendations

Use

- Suitable for use with King Crimp sleeves and ferrules

Specifications

- Produced to interchange with all product produced to Commercial Item Description A-A-59326D

Features

- Precision machined to rigid tolerances

How It Works

- To make a connection, simply slide the adapter into the coupler and with normal hand pressure, press the cam levers down.
- Uncoupling is as quick and simple as coupling. Just lift the cam arms and remove the adapter.

Safety Notes

- Under no circumstances should cam and groove couplings be used for compressed air or steam service!

Universal Preformed Band Clamp K Series

Like 0

Part Number	K6
Material	Galvanized Steel
Clamp ID	1-1/2" (38.1mm)
Width	5/8"
Thickness	.031"
Optional Pkg/Box Qty	100
Weight Lb	0.1098

Not a Distributor?

Name a local distributor who should carry this product.

or

Add to Wishlist

or

Request a Quote

[-] Product Details

Use

- For use with Fast-Lok™ tools: F1, F40, F100
- For use with Super Strap Tools: 51960 screw action with 51970 adapter
- For use with Bandit®: S100 air tool with S180 Jr. head, C-001 hand tool with J001 Jr. adapter, S350 air tool with S260 Jr. head, T-240 for 3/8" only or T-250 for 3/8" and 5/8", S-38 for 3/8" and 5/8", J-102 Pok-it™ for 3/8" only.
- For use with Punch-Lok® tools: P-1000 for 3/8" and 5/8", P-3000 for 3/8" only, P-38 for 3/8" and 5/8"

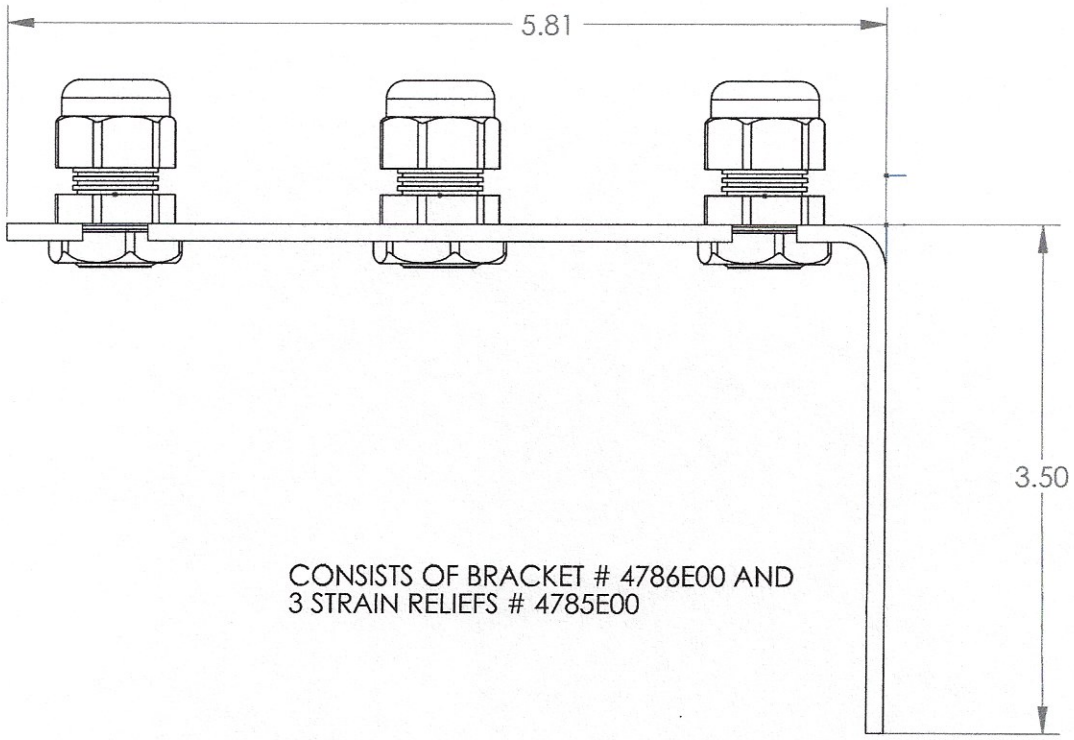
Features

Installation

- Can be center punched or rolled over

Safety Notes

- WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm. Do not use in connection with drinking water. Wash hands after handling.
- **WARNING:** Cancer and Reproductive Harm- www.P65Warnings.ca.gov



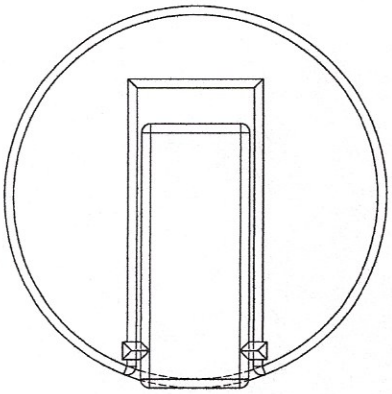
CONSISTS OF BRACKET # 4786E00 AND
3 STRAIN RELIEFS # 4785E00

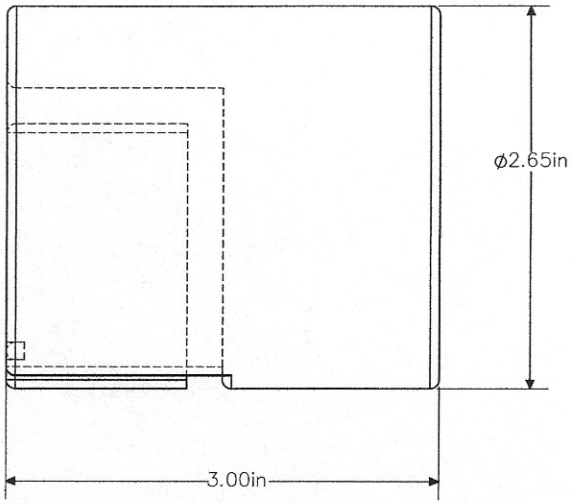
rev	project	date	
B	20670	6/26/00	CHANGED COMPONANT REFERANCES TO XXXXE00
A	20670	3/7/00	NEW PART

Liberty Pumps™

7000 APPLE TREE AVENUE
BERGEN, N.Y. 14416
(585) 494-1817

dm by RWS	tol: xx+/- .02"
	xxx+/- .005"
date 3/7/00	angles +/- 2°
scale 1:1	unless otherwise noted
title 3 FLOAT BRACKET ASSY	
part no. 4787000	
Drawing no. 4787000B sht 1 of 1	A





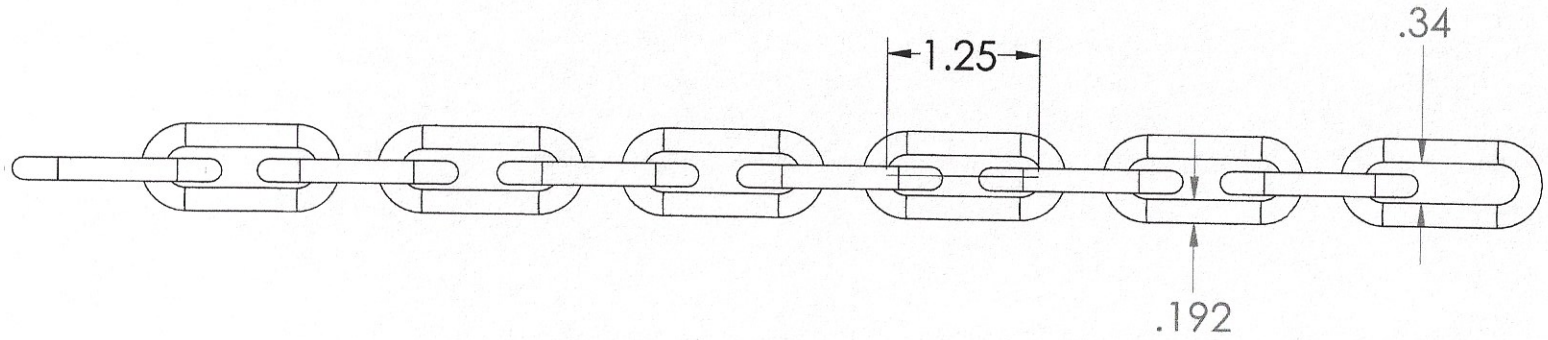
NOTES:
1. HOUSING WEIGHS 1.32 POUNDS
2. SJ# 1002230 OR EQUIVALENT

description of change	rev	project	date	initials
CHANGED WEIGHT FROM 1.93 lbs. to 1.32 lbs.	B	NA	04/03/15	JCC
NEW PART	A	29218	06/01/01	SUE

Liberty Pumps®
7000 APPLE TREE AVENUE
BERGEN, N.Y. 14416
(585) 494-1817

drn by J.CONE	
date 4/3/2015	
color GRAY	angles +/- 2°
material	unless otherwise noted
title CABLE WEIGHT	
part no. 6048000	
drawing no. 6048000	sheet number 1 of 1 / sheet size A

NOTES:
1/8" 304 S/S WELDED CHAIN
ACTUAL MATERIAL DIAMETER: 0.192"
NOMINAL INSIDE LINK SIZE:
WIDTH - 0.34"
LENGTH - 1.25"
520 LB SAFE WORKING LOAD
FASTENAL P/N



description of change	rev	project	date	initials
LARGER CHAIN	C	NA	6/17/14	JCC
REVISED LINK SPECIFICATIONS	B	40370	5/26/09	SUE
NEW PART	A	ECR 24657	4/09/01	MSH

Liberty Pumps™
7000 APPLE TREE AVENUE
BERGEN, N.Y. 14416
(585) 494-1817

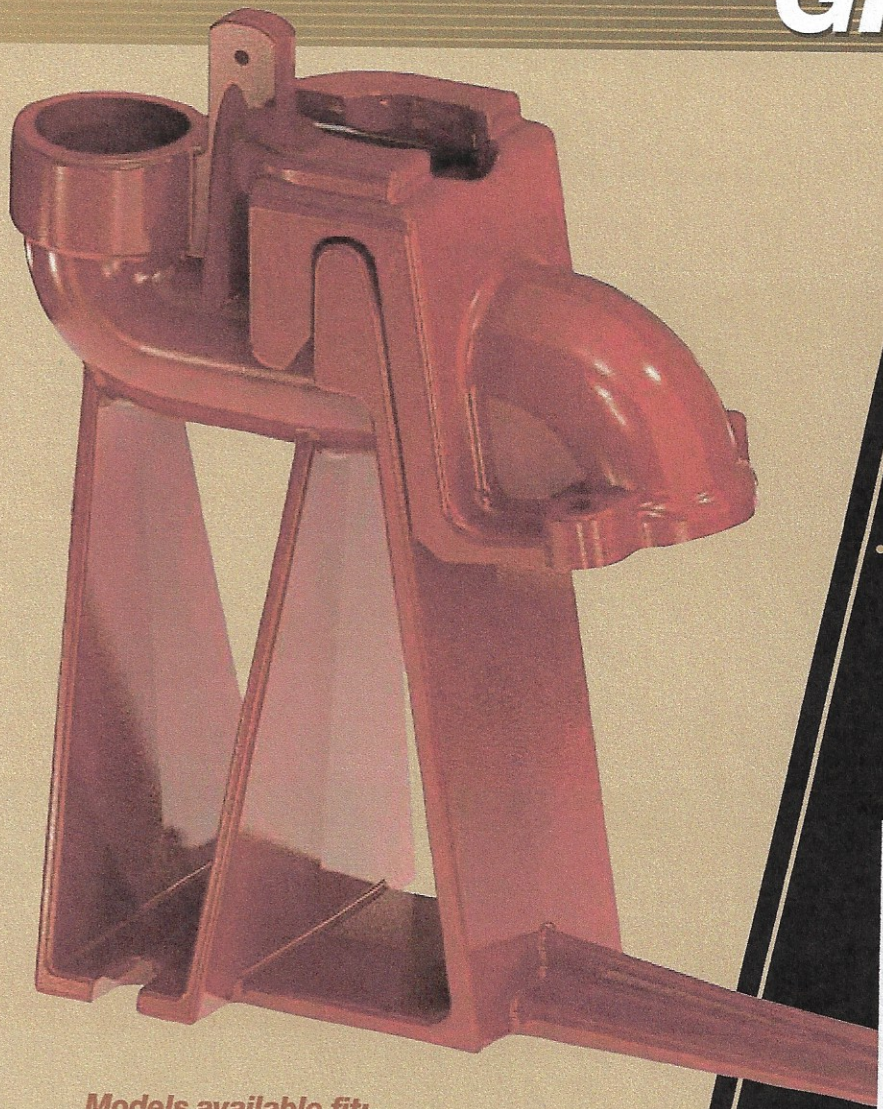
drn by MSH	tol: xx+/- .02"
	xxx+/- .005"
date 4/09/01	angles +/- 2°
scale 1:1	unless otherwise noted
title 1/8" 304 S/S CHAIN	
part no. 4754R00	
Drawing no. 4754000C	sht 1 of 1

B

Liberty Pumps®

GR-Series

Guide Rail System



Features:

- 2" or 3" discharge FNPT
- Heavy cast iron construction
- Rugged one rail design with auto-guide feature
- 1-1/4" guide pipe FNPT (guide rail pipe not included)
- Heavy duty nitrile sealing grommet
- Upper cast iron rail support bracket provided
- Powder coated for corrosion resistance

"NS" non-sparking models feature a bronze claw for installation in hazardous locations and fitment with X-Series pumps.

Models available fit:

FL, LE, LEH and X-Series Pumps

innovate. evolve.

GR-Series Guide Rails

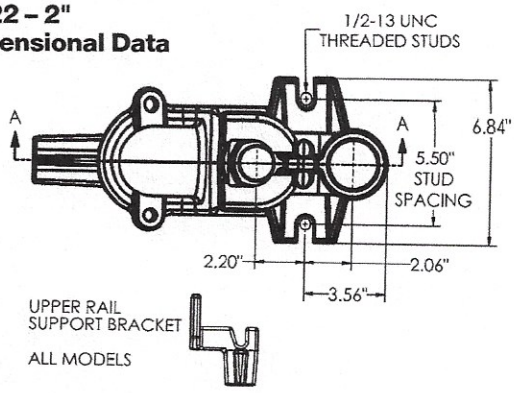
Specifications and Dimensional Data

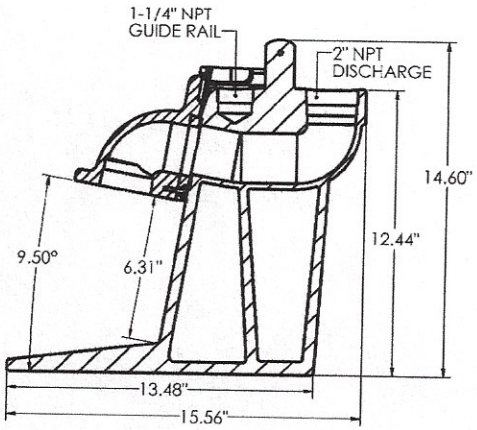
Material: Class 25 Gray Cast Iron (Bronze claw on "NS" models)
Weight: GR22 – 38 lbs. GR30 – 46 lbs.
Seal: Heavy Duty Nitrile
Rail Size: 1¼" (Not Included)
Discharge: GR22 – 2" Female NPT, GR30 – 3" Female NPT
Maximum Pump Weight: 250 lbs.
Upper Rail Support: Class 25 Gray Cast Iron
Rail Support Bolts: Stainless Steel

MODELS:	DISCHARGE	SERIES
*GR22-FL	2"	FL50, FL60, FL70, FL100, FL150, FL200
*GR22NS-FL	2"	XFL50,XFL70
*GR22-LE	2"	LE70, LE100, LEH100, LEH150, LEH200
*GR22NS-LE	2"	XLE50, XLE70
GR22-S	2"	LE40, LE50
GR30	3"	LE70, LE100, LEH100, LEH150, LEH200
GR30NS	3"	XLE50, XLE70

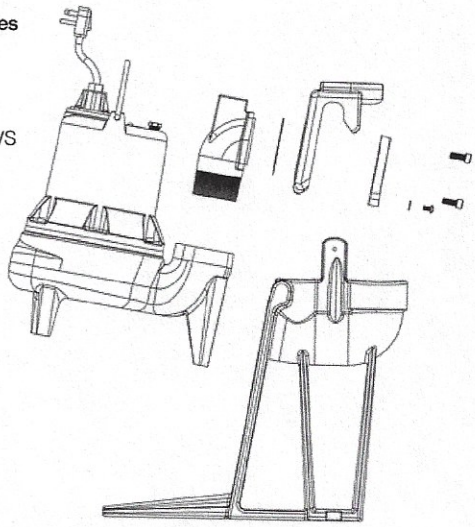
*2" internal female thread on pump mating claw allows for mounting to other pump makes

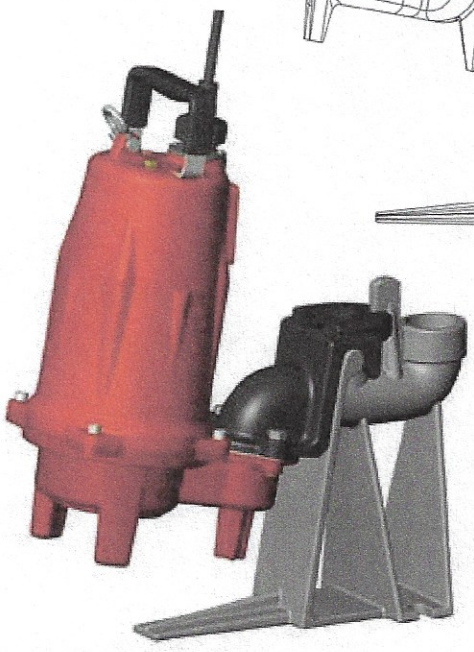
GR22 – 2" Dimensional Data



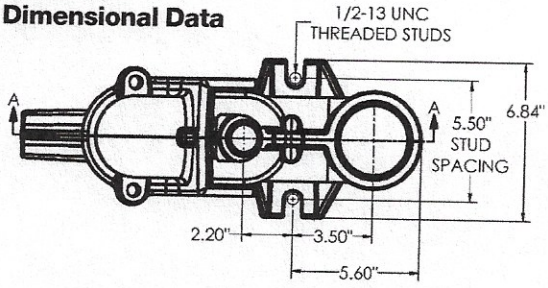


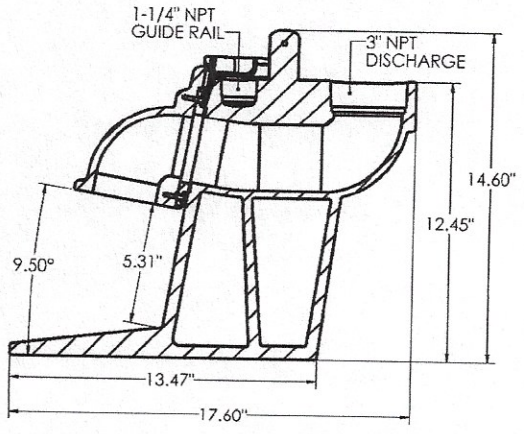
GR22-S
Split pump claw allows fitment to LE40 and LE50 – Series





GR30 – 3" Dimensional Data





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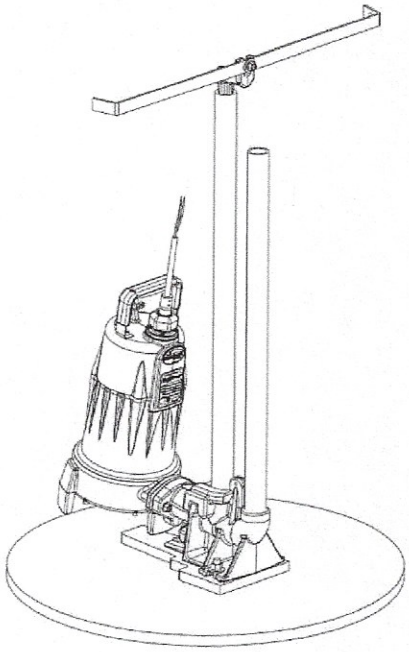
Liberty Pumps®

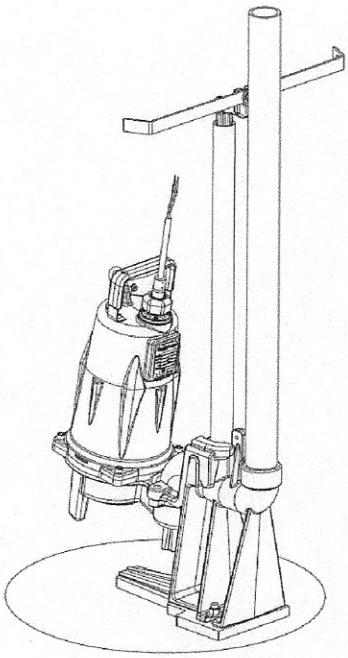
A Family and Employee Owned Company

Specifications

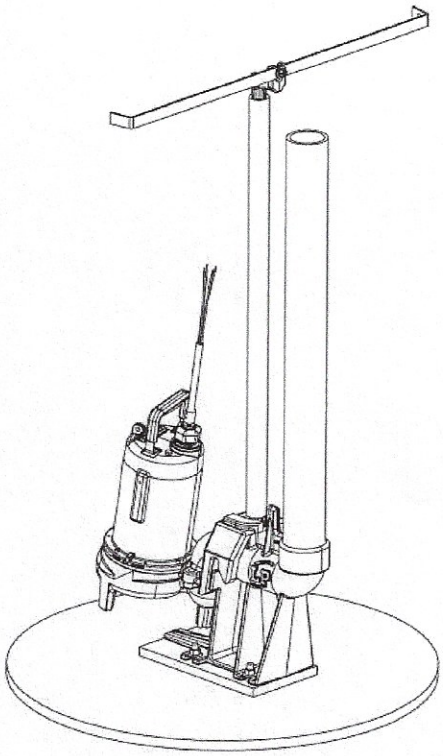
GUIDE RAIL SYSTEMS



GR20-Series
1-1/4" Discharge



GR22-Series
2" Discharge



GR30-Series
3" Discharge

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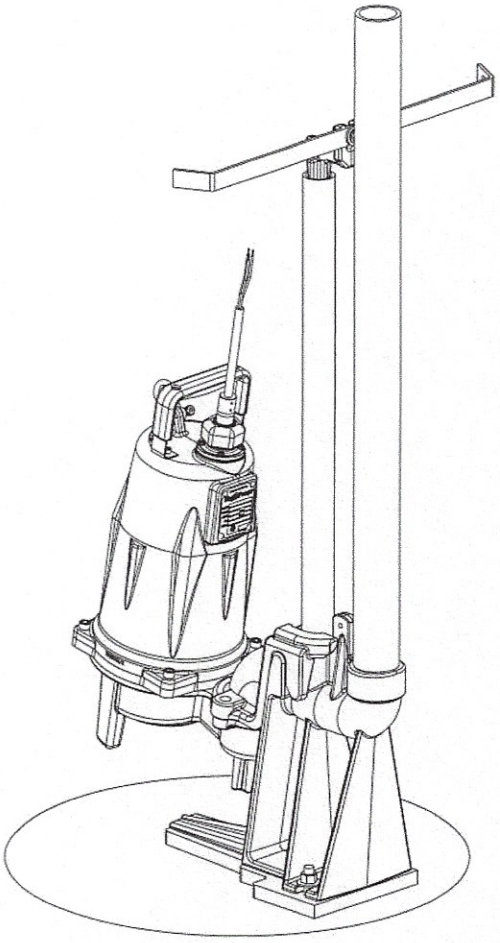
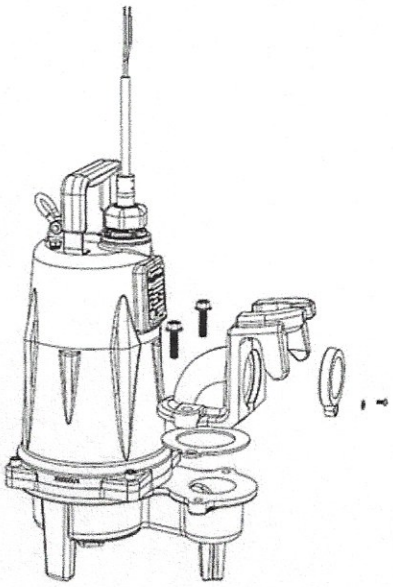
Liberty Pumps

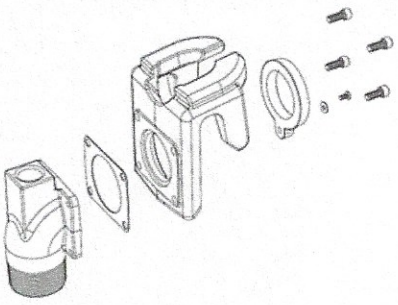
GR22-SERIES

2" Discharge Guide Rail System





The GR22-LE and GR22-FL have a flanged claw that mounts directly to pump. They also have a 2" NPT threaded port for optional nipple connection.



The GR22-S has a 2" NPT detachable threaded nipple.

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GR22-Series Technical Data

MODEL	GR22-SERIES *for standard applications*	GR22NS-SERIES *for hazardous locations*
GUIDE RAIL BASE	CLASS 25 GRAY CAST IRON	CLASS 25 GRAY CAST IRON
DISCONNECT	CLASS 25 GRAY CAST IRON	BRONZE
GUIDE RAIL	ACCEPTS STANDARD 1¼" NPT PIPE (pipe not included)	ACCEPTS STANDARD 1¼" NPT PIPE (pipe not included)
DISCHARGE PIPE	ACCEPTS STANDARD 2" NPT PIPE (pipe not included)	ACCEPTS STANDARD 2" NPT PIPE (pipe not included)
PAINT	POWDERCOATING	POWDERCOATING (except disconnect)
HARDWARE	STAINLESS STEEL	STAINLESS STEEL
SEALING GROMMET	BUNA N	BUNA N
PUMP INTERFACE	**GR22-FL:** FITS FL50, FL60, FLH60, FL70, FL100, FL150, AND FL200 SERIES PUMPS, PLUS 2" FEMALE THREADS ALLOW USE WITH OTHER PUMPS.	**GR22NS-FL:** FITS XFL50, XFL70, XFL100, AND XFL150 SERIES PUMPS, PLUS 2" FEMALE THREADS ALLOW USE WITH OTHER PUMPS.
	GR22-LE: FITS LE70, LE100, LEH100, LEH150 AND LEH200 SERIES PUMPS, PLUS 2" FEMALE THREADS ALLOW USE WITH OTHER PUMPS.	**GR22NS-LE:** FITS XLE50, XLE70, XLE100, AND XLE150 SERIES PUMPS, PLUS 2" FEMALE THREADS ALLOW USE WITH OTHER PUMPS.
	GR22-S: FITS LE40 AND LE50 SERIES, AND PRG SERIES; THE DETACHABLE THREADED NIPPLE ALLOWS THIS RAIL TO BE USED WITH ALMOST ANY PUMP WITH A 2" NPT THREADED DISCHARGE.	N/A
MAXIMUM PUMP WEIGHT	250 LBS	250 LBS

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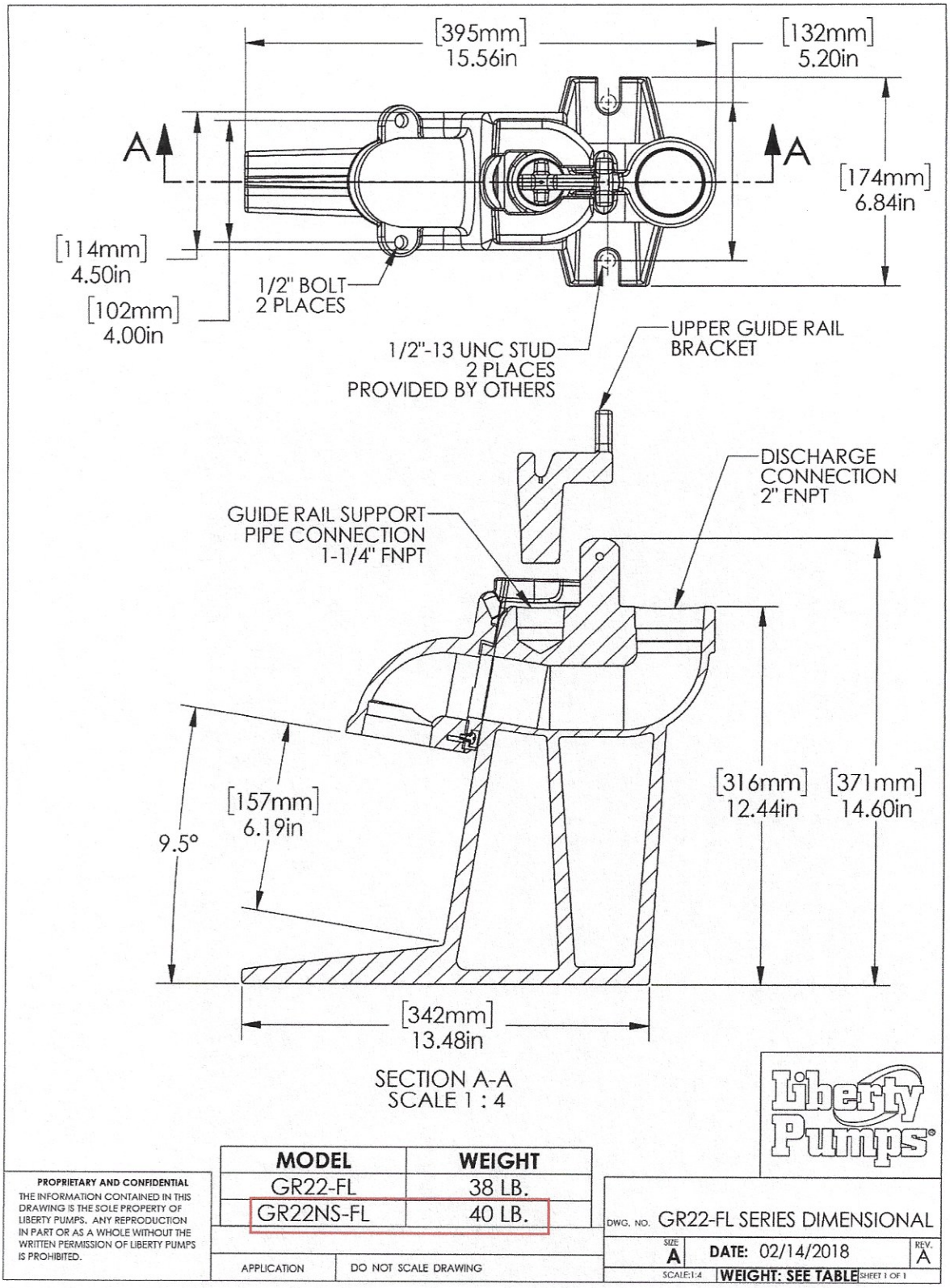
GR22-Series Dimensional Data (*cont.*)



MODEL	WEIGHT
GR22-FL	38 LB.
GR22NS-FL	40 LB.

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APPLICATION | DO NOT SCALE DRAWING

DWG. NO. GR22-FL SERIES DIMENSIONAL

SIZE A | DATE: 02/14/2018 | REV. A

SCALE:1:4 | WEIGHT: SEE TABLE | SHEET 1 OF 1

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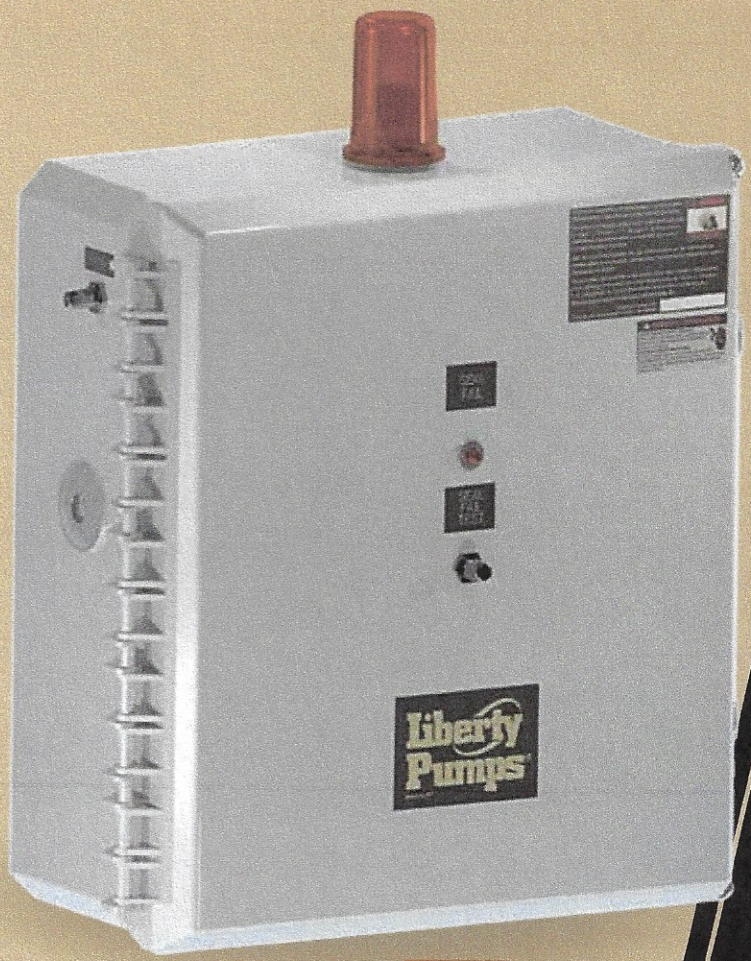
Liberty Pumps®

ISS-Series Simplex
ISD-Series Duplex

Intrinsically Safe Control Panels



3 Year Warranty

Standard Features:

- Intrinsically safe relays and wiring terminals for float controls
- NEMA 4X enclosure
- Magnetic motor contactor(s)
- Hands-Off-Auto switch(s)
- Green pump run indicator(s)
- Terminal block for easy wiring
- Red alarm beacon
- Audible horn (83-85 db)
- Auxiliary dry contacts
- Seal fail indicator light(s) and test switch
- Prewired for capacitors (single phase models)

innovate. evolve.

ISS-Series Simplex
ISD-Series Duplex
Intrinsically Safe Control Panels

ISS-Series and ISD-Series control panels are designed for use with pumps installed in hazardous environments. These panels, when used with explosion-proof rated pumps, provide a safe system that will not allow ignition of explosive gases. All ISS and ISD panels must be installed outside of the hazardous environment and all conduits leading to the panel must be sealed in accordance with section 501-5 of the NEC. Installation by a qualified electrician in accordance with all applicable national and local codes required.

ISS-Series SIMPLEX Models

MODEL	VOLTS	FULL LOAD AMPS	PHASE	ENCLOSURE	WGT. LBS.
ISS24LC1=3-5	120/208/240	0 – 15	1	NEMA 4X	30
ISS24HS1=3-5	120/208/240	20 – 30	1	NEMA 4X	30
ISS34=3-131-5	208/240/480	1.6 – 2.5	3	NEMA 4X	30
ISS34=3-141-5	208/240/480	2.5 – 4.0	3	NEMA 4X	30
ISS34=3-171-5	208/240/480	4.0 – 6.3	3	NEMA 4X	30
ISS34=3-191-5	208/240/480	6.0 – 10.0	3	NEMA 4X	30
ISS34=3-511-5	208/240/480	9.0 – 14.0	3	NEMA 4X	30
ISS54=3-121-5	575	1.6 – 2.5	3	NEMA 4X	30
ISS54=3-151-5	575	2.5 – 4.0	3	NEMA 4X	30
ISS54=3-161-5	575	4.0 – 6.3	3	NEMA 4X	30

ISD-Series DUPLEX Models

MODEL	VOLTS	FULL LOAD AMPS	PHASE	ENCLOSURE	WGT. LBS.
ISD24LC2=3-5	120/208/240	0 – 15	1	NEMA 4X	33
ISD24HS2=3-5	120/208/240	20 – 30	1	NEMA 4X	33
ISD34=3-131-5	208/240/480	1.6 – 2.5	3	NEMA 4X	33
ISD34=3-141-5	208/240/480	2.5 – 4.0	3	NEMA 4X	33
ISD34=3-171-5	208/240/480	4.0 – 6.3	3	NEMA 4X	33
ISD34=3-191-5	208/240/480	6.0 – 10.0	3	NEMA 4X	33
ISD34=3-511-5	208/240/480	9.0 – 14.0	3	NEMA 4X	33
ISD54=3-121-5	575	1.6 – 2.5	3	NEMA 4X	33
ISD54=3-151-5	575	2.5 – 4.0	3	NEMA 4X	33
ISD54=3-161-5	575	4.0 – 6.3	3	NEMA 4X	33

SWITCH SPECIFICATIONS:

All panels include (3) pilot-duty float switches.
50' standard cord length.
5 amp, 120/230V, 50/60 Hz.
140° F. maximum fluid temperature.

ENCLOSURE

NEMA 4X
Ultraviolet stabilized thermoplastic for outdoor or indoor installations.

DIMENSIONS

	Width	Height	Depth
ISS-Series	14"	16"	6"
ISD-Series	16.5"	18.5"	7.5"

NOTES: ISS and ISD panels come with a variable amp range and must be ordered to correctly match the full load amperage of the pump(s) being used. Use the chart above or consult factory for proper panel sizing.

Three-phase panels are equipped with thermal overload protection; failure to utilize this feature with Liberty Pumps X-Series products will de-rate the "T" classification of the pump. See pump installation manuals for details.

All ISS and ISD-Series panels are shipped with 3 control floats.

Standard float cord length is 50'.

Consult factory for 4-float systems and other panel options.

Consult factory for proper panel sizing.

Consult X-Series literature and panel selection guide for appropriate panel and capacitor selection.

Dual safety certification for the United States and Canada

Specifications are subject to change without notice.

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Liberty Pumps®

ISS-Series Simplex

Three Phase Simplex Intrinsically Safe

Installation Instructions and Operation/Troubleshooting Manual

⚠ WARNING!

ELECTRICAL SHOCK HAZARD
Disconnect all power sources before servicing. Failure to do so could result in serious injury or death.

Warranty void if panel is modified.

Call factory with servicing questions:

1-800-543-2550

Liberty Pumps®

7000 Apple Tree Avenue
Bergen, New York 14416
Phone: 1-800-543-2550
Email: liberty@libertypumps.com
www.libertypumps.com

PN1046367A• Rev 01/16

This control panel must be installed and serviced by a licensed electrician in accordance with the National Electric Code NFPA-70, state and local electrical codes.

IMPORTANT: BEFORE PROCEEDING TO INSTALL AND WIRE THE CONTROL PANEL, READ AND THOROUGHLY UNDERSTAND THESE INSTRUCTIONS.

When installed according to these instructions and Article 504 of the National Electric Code (NFPA 70), this control panel provides intrinsically safe sensing circuits for interface with Class 1, Division 1, Groups C and D hazardous locations. Intrinsically safe wiring must be in accordance with the enclosed control drawing of the specific intrinsically safe relay manufacturer. **NEMA 4X enclosures are for indoor or outdoor use,** primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water. **Cable connectors must be liquid-tight in NEMA 4X enclosures.**

Installation

ISS-Series three phase simplex panels are designed to operate with three floats. These floats operate the pump stop, pump start, and high level alarm functions.

NOTE: Options ordered may affect the number of floats and their functions. Please reference the schematic provided with the control panel for proper installation.

Installation of Floats

CAUTION: If control switch cables are not wired and mounted in the correct order, the pump system will not function properly.

1. Use float label kit to identify and label cables on both the float and stripped end (stop, start, alarm, etc.). See schematic for float options.
2. Determine your normal operating level, as illustrated in **Figure 1**.
3. Mount float switches at appropriate levels as illustrated in **Figures 2-4**. Be sure that floats have free range of motion without touching each other or other equipment in the basin.

If using the mounting clamp; follow steps 4-6.

4. Place the cord into the clamp as shown in **Figure 2**.
5. Locate the clamp at the desired activation level and secure the clamp to the discharge pipe as shown in **Figure 2**.

   NOTE: Do not install cord under hose clamp.
6. Tighten the hose clamp using a screwdriver. Over tightening may result in damage to the plastic clamp. Make sure the float cable is not allowed to touch the excess hose clamp band during operation.

   NOTE: All hose clamp components are made of 18-8 stainless steel material. See your Liberty Pumps, Inc. supplier for replacements.

Installation Instructions

Mounting the Control Panel

1. The control panel must be situated in a nonhazardous area in an appropriate NEMA rated enclosure, where an explosive atmosphere will not exist at any time. If distance exceeds the length of either the float switch cables or the pump power cables, splicing will be required. For outdoor or wet installation, we recommend the use of a SJE-Rhombus® liquid-tight junction box with liquid-tight connectors to make required connections. Use separate junction boxes for intrinsically safe wiring.

   WARNING: Intrinsically safe wiring must be kept separate from non-intrinsically safe wiring. Intrinsically safe wiring and non-intrinsically safe wiring may occupy the same raceway if they are at least two inches (50 mm) apart and separately tied down. Inside panels, field wiring terminals for intrinsically safe circuits must be separated from non-intrinsically safe wiring. Do not exceed maximum cable length as stated in intrinsically safe relay control drawing.

2. Mount control panel with mounting devices furnished.

3. Determine conduit entrance locations for intrinsically safe wiring. Entrance location must be within intrinsically safe barrier. A separate rigid metallic conduit must be used to enclose the conductors of the intrinsically safe control circuit.

   NOTE: Be sure that conduit is of adequate size to pull the switch cables through.

4. Determine conduit entrance for "power in" and pump cables. The entrance must be outside of the intrinsically safe barrier area.

   NOTE: Be sure the power supply voltage, and phase are the same as the pump motor being installed. If in doubt, see the pump identification plate for voltage/phase requirements.

5. Drill proper size hole for "power in" and pump cable conduit connections.

6. Attach conduit connectors to control panel.

FOR INSTALLATION REQUIRING A SPLICE, FOLLOW STEPS 7-10; FOR INSTALLATION WITHOUT A SPLICE, GO TO STEP 11.

7. Determine location for mounting junction box according to NEC requirements. Separate junction boxes are required for pump wiring and float wiring. Mount the junction box to proper supports. **Do not** mount the junction box inside the sump or basin.
8. Run conduit to junction box. Drill proper size holes for the type of conduit used. Attach connectors to junction box.

9. Identify and label each wire before pulling through conduit into control panel and junction box. Make wire splice connections at junction box.

10. Firmly tighten and seal all fittings on junction box.

11. If splicing is not required, identify and label pump cable before pulling through conduit into the control panel.

12. Bring intrinsically safe circuits (i.e. float switches) through separate rigid metallic conduit into the control panel area marked for intrinsically safe wiring.

    WARNING: All wiring entering the hazardous location must be sealed by an approval seal in accordance with the National Electric Code Article 504.

13. Wire switch cables according to the schematic provided with control panel.

14. Bring pump cables and "power in" wiring through conduit into the control panel.

15. Wire the pump cables and the "power in" cables according to the schematic provided with control panel.

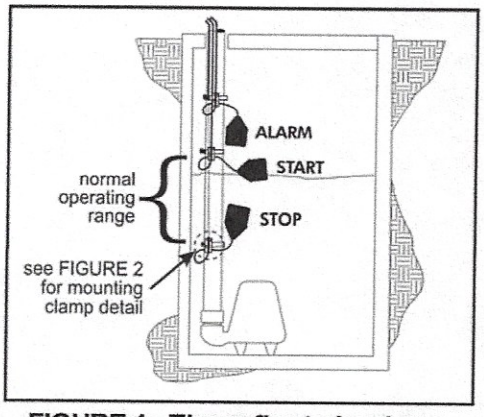


FIGURE 1 - Three float simplex - pump down installation

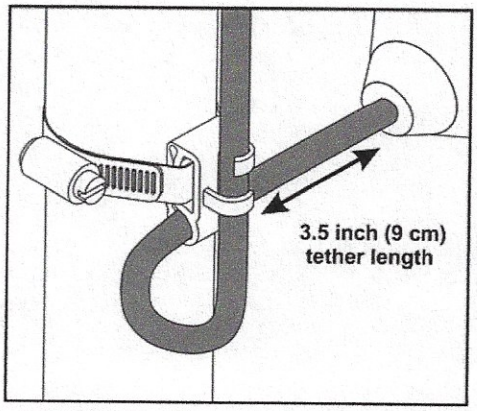


FIGURE 2 - Mounting clamp detail

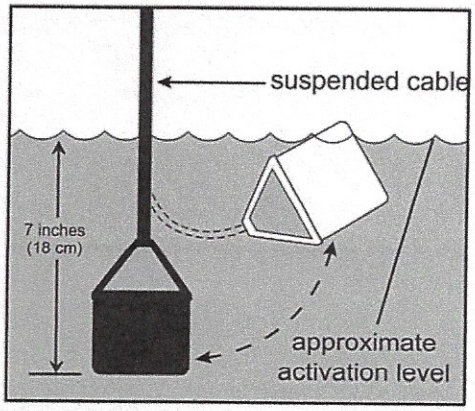


FIGURE 3 - Internally weighted float

Installation Instructions

16. Connect "power-in" conductors to proper locations: 208/240/480 to three position terminal block. **Install tagged factory wire to appropriate transformer primary voltage tap.**

17. The GROUND LUG (GL) is a redundant system ground terminal and MUST BE CONNECTED TO THE EARTH GROUND BUSS OF THE CONTROL'S AC SUPPLY LINE FEEDER. The resistance between the system ground terminals and the earth must be less than 1 ohm. Connect ground wire from conduit system to ground terminal (GL) in the panel.

VERIFY CORRECT OPERATION OF CONTROL PANEL AFTER INSTALLATION IS COMPLETE.

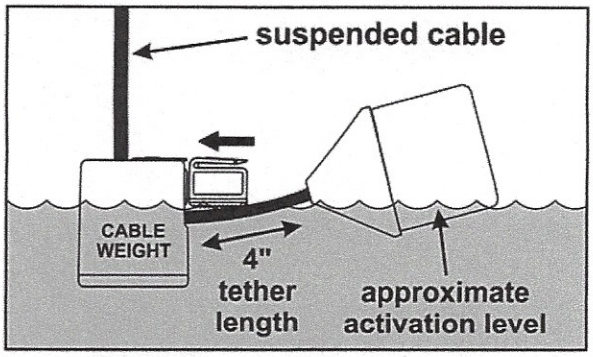


FIGURE 4 - Float with cable weight

Operations

ISS-Series three phase simplex control panels are designed to operate in a three float system as standard. When all floats are in the open or OFF position, the panel is inactive. As the liquid level changes and closes the stop float, the panel remains inactive until the start float also closes. At this point the pump will start, assuming the HOA switch is in the AUTOMATIC mode and the power is ON. If the liquid level travels beyond both the stop and start floats and reaches the alarm float, the audio/visual alarm will be activated. The pump will remain ON until both the stop and start floats open (return to the OFF position).

Alarm System (Horn and Indicator)

When an alarm condition occurs, a red light and a horn will be activated. If the test/normal/silence switch is moved to the silence position, the horn will be silenced. When the alarm condition is cleared, the horn will reset. The alarm system can be tested by moving the test/normal/silence switch to the test position.

Pump Run Light

The run light will be ON in either the hand or the automatic mode when the pump is called to run unless other safety measures are employed.

HOA Switch

A hand-off-automatic switch is provided for the pump. In the hand mode, the pump will turn on unless other safety features are employed. In the automatic mode, the pump will turn on and off from commands by the float switches.

Motor Protective Switch

A motor protective switch is supplied for the pump to provide an adjustable overload, branch circuit protection and pump disconnect. The overload must be set in the field. To set the overload, dial the amp scale to the pump's full load amps (FLA). If the FLA's are unknown use a calibrated amp meter to measure the pump amperage draw under loaded conditions. An auxiliary contact is wired in series with the magnetic contactor coil so that on an overload trip, the magnetic contactor will be disabled. In the event of an overload trip, the motor protective switch must be reset by first, turning the handle counterclockwise to the OFF position, then turning the handle 90° clockwise to the ON position.

Alarm Fuse

Provides alarm circuit protection and provides a means of disconnecting alarm circuit power.

Control Fuse

Provides control circuit protection and provides a means of disconnecting control circuit power.

Seal Failure Circuit and Indicator Light (Optional)

The seal fail circuit has resistance sensitivity and will sense the presence of water in the pump seal chamber. Upon installation, turn the sensitivity dial on the seal fail module to the point where the light turns on, then dial back slowly until the light turns off. If water enters the seal chamber at this point, the seal failure circuit will sense a change in resistance. After a short time delay, the indicator light will turn on. When the condition is cleared, the relay will de-energize and the indicator light will turn off. The seal fail relay has a sensitivity adjustment so that false readings may be tuned out.

Dry Auxiliary Contacts (optional)

Normally open - Contacts are open under normal conditions and closed when alarm condition is present.
Normally closed - Contacts are closed under normal conditions and open when alarm condition is present.

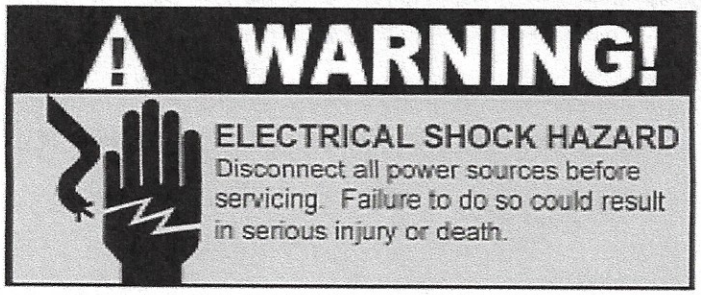
Both types automatically reset once alarm condition is cleared.

Thermal Cutout (Optional)

The thermal cutout circuit is wired in series with the magnetic contactor coil. If the pump's thermal switch opens on high temperature, the magnetic contactor will turn off and stop the pump. When the thermal switch cools and closes, the magnetic contactor will turn on if the pump is called to run.

NOTE: Some options ordered may not be included in this manual.

Troubleshooting



Alarm Horn
Moving the alarm test/normal/silence switch to the test position or activating the alarm float should turn on the alarm horn. If the horn does not sound, replace with horn of same type.

Alarm Light
Moving the alarm test/normal/silence switch to the test position or activating the alarm float should turn on the alarm light. If the light does not activate, replace with same type.

Float Controls
Check the floats during their entire range of operation. Clean, adjust, or replace damaged floats.

Checking the float resistance - The float resistance can be measured to determine if the float is operating correctly or is defective. Use the following procedure to measure the float resistance:

1. Isolate the float by disconnecting one or both of the float leads from the float terminals.
2. Place one ohmmeter lead on one of the float wires, and the other ohmmeter lead on the other float wire.
3. Set the ohmmeter dial to read ohms and place on the R X 1 scale. With the float in the "off" position, the scale should read infinity (high resistance). Replace the float if you do not get this reading. With the float in the ON position, the scale should read nearly zero (very low resistance). Replace the float if you do not get this reading.

NOTE: Readings may vary depending on the length of wire and accuracy of the measuring device.

Fuses
Check the continuity of the fuse. With power OFF, pull the fuse out of the fuse block. With the ohmmeter on the R X 1 scale, measure resistance. A reading of infinity indicates a blown fuse and must be replaced. Replace fuse with same type, voltage and amp rating.

Indicator Lights
If defective, replace all indicator pilot lights with same type.

Magnetic Contactor
Contacts - Check the contacts for severely burnt or welded contacts. The contactor arm should move freely.
Coil - Measure the coil by disconnecting one of the coil leads. Measure the coil resistance by setting the ohmmeter on the R X 1 scale. A defective coil will read zero or infinity, indicating a short or opened coil respectively. Replace defective contactor with same type.

NOTE: Readings may vary depending on accuracy of the measuring device.

Motor Protective Switch
Test by inserting a paper clip or other small device into the test hole and push to the left. The relay should trip.

Liberty Pumps Three-Year Limited Warranty

*NOTE: Liberty Pumps, Inc. assumes no responsibility for damage or injury due to disassembly in the field. Disassembly, other than at Liberty Pumps or its authorized service centers, automatically voids warranty.

Liberty Pumps, Inc. warrants that pumps of its manufacture are free from all factory defects in material and workmanship for a period of 3 years from the date of purchase. The date of purchase shall be determined by a dated sales receipt noting the model and serial number of the pump. The dated sales receipt must accompany the returned pump if the date of return is more than 3 years from the "CODE" (date of manufacture) number noted on the pump nameplate.

The manufacturer's obligation under this Warranty shall be limited to the repair or replacement of any parts found by the manufacturer to be defective, provided the part or assembly is returned freight prepaid to the manufacturer or its authorized service center, and provided that none of the following warranty-voiding characteristics are evident.

The manufacturer shall not be liable under this Warranty if the product has not been properly installed; if it has been disassembled, modified, abused or tampered with; if the electrical cord has been cut, damaged or spliced; if the pump discharge has been reduced in size; if the pump has been used in water temperatures above the advertised rating, or water containing sand, lime, cement, gravel or other abrasives; if the product has been used to pump chemicals or hydrocarbons; if a non-submersible motor has been subjected to excessive moisture; or if the label bearing the serial, model and code number has been removed. Liberty Pumps, Inc. shall not be liable for any loss, damage or expenses resulting from installation or use of its products, or for consequential damages, including costs of removal, reinstallation or transportation.

There is no other express warranty. All implied warranties, including those of merchantability and fitness for a particular purpose, are limited to three years from the date of purchase.

This Warranty contains the exclusive remedy of the purchaser, and, where permitted, liability for consequential or incidental damages under any and all warranties are excluded.

Appendix D

Gas Probe Monitoring Log

Gas Probe Monitoring Results

SCS Engineers

Asotin County Regional Landfill

Date:
Starting Time:
Finishing Time:
Monitored by:
Instruments:
Calibration Date:

Weather Conditions

Weather: (Cloud Cover/Raining/Snowing/Windy):

	Beginning	Ending	Average	
Temperature, T (amb):			0	Deg. F
Wind Speed:			0	mph
Wind Direction:				
Barometric Pressure, P (baro):			0.00	in. Hg

24 hr Baro.Trend (rising/falling/steady/unsteady):

(1) Location Refer. Design.	Time	Temp. T (Deg. F.)	Static Pressure P (sta) (in. W.C.)	Gas Composition: Methane CH_4 (% Vol.)	Carbon Dioxide CO_2 (% Vol.)	Oxygen O_2 (% Vol.)	Water Vapor H_20 (vap) (% Vol.)	Nitrogen N_2 (tot) (% Vol.)
GP-1s							#DIV/0!	#DIV/0!
GP-1d							#DIV/0!	#DIV/0!
GP-2s							#DIV/0!	#DIV/0!
GP-2d							#DIV/0!	#DIV/0!
GP-3s							#DIV/0!	#DIV/0!
GP-3d							#DIV/0!	#DIV/0!
GP-4s							#DIV/0!	#DIV/0!
GP-4d							#DIV/0!	#DIV/0!
LPS-s							#DIV/0!	#DIV/0!
LPS-m							#DIV/0!	#DIV/0!
LPS-d							#DIV/0!	#DIV/0!
LPS-p							#DIV/0!	#DIV/0!

(1) GP Gas Probe
LPS Leachate Pump Station

Notes:

Input values used for calculations

Input data for supplemental information

856.5 Calculated Values

985.6 Values copied from another cell or worksheet

Appendix E

Accident Report Forms

APPENDIX A

ASOTIN COUNTY EMPLOYEE'S REPORT OF ACCIDENT

Complete and Return within 24 hours of Accident to: Risk Management: 243-2078 (Questions)

Send Form Interoffice Mail to County Commissioner Office

Employee Name (Printed): _____

Task being performed when accident occurred: _____

_____

_____

Date and time of accident reported: _____

To whom accident reported: _____

Name(s) of witness(es): _____

_____

Describe how accident occurred: _____

_____

_____

What part of the body was injured: _____

_____

Describe the injuries in detail: _____

_____

_____

Date & time you first sought medical attention: _____

Could anything be done to prevent accidents of this type? If so, what: _____

_____

_____

_____ _____

Department Head Printed Name & Signature Date

_____ _____

Employee Signature Date

_____ _____

Supervisor Printed Name & Signature Date

APPENDIX B

ASOTIN COUNTY SUPERVISOR'S REPORT OF ACCIDENT

Complete and Return within 24 hours of Accident to: Risk Management: 243-2078 (Questions)

Send Form Interoffice Mail to County Commissioner Office

Employee Name (Printed): _____

Job Position/Title: _____

Supervisor's Name: _____

Date and time of accident reported to Supervisor: _____

Name(s) of witness(es): _____

_____

Accident Resulted In: Injury _____ Fatality _____

Property Damage _____

First Aid given: _____ Medical Treatment Required: _____

Was employee able to return to work on next regular shift: _____

If not, estimate how long before return: _____

Describe how accident occurred: _____

_____

_____

What action, events or conditions contributed most directly to this accident: _____

_____

_____

Could anything be done to prevent accidents of this type? If so what: _____

_____

_____

APPENDIX C

ASOTIN COUNTY VEHICLE ACCIDENT REPORT

(TO BE FILLED OUT BY EMPLOYEE)

Complete and Return within 24 hours of Accident to: Risk Management: 243-2078 (Questions)

Send Form Interoffice Mail to County Commissioner Office

Employee Name (Printed): _____

Job Position/Title: _____

Supervisor's Name: _____

Date and time of accident: _____

Location of accident: _____

Name(s) of witness(es): _____

_____

Damage description (including year, make, model of the County vehicle involved): _____

_____

_____

_____

Describe to the best of your knowledge how accident occurred: _____

_____

_____

Name & address of the person(s) driving the other vehicle(s) involved: _____

_____

Phone: _____ Drivers' Lic #: _____

Registered owner's name & address: _____

_____

Vehicle Year: _____ Make: _____ License #: _____

_____ _____

Signature of Employee Date

APPENDIX D

ASOTIN COUNTY VEHICLE ACCIDENT REPORT

(TO BE FILLED OUT BY DEPARTMENT HEAD / SUPERVISOR)

Complete and Return within 24 hours of Accident to: Risk Management: 243-2078 (Questions)

Send Form Interoffice Mail to County Commissioner Office

Employee Name (Printed): _____

Job Position/Title: _____

Supervisor's Name: _____

Date and time of accident: _____

Task being performed when accident occurred: _____

_____

_____

Name(s) of witness(es): _____

_____

Damage description (including year, make, model of the County vehicle involved): _____

_____

_____

_____

Describe to the best of your knowledge how accident occurred: _____

_____

_____

_____ _____

Signature of Supervisor Date