STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
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March 25, 2010

Mr. Jim Sumner
Manager, Group Environmental Programs
General Electric Aircraft Engine
One Neumann Way MD T165
Cincinnati, OH 45215

RE: Ecology Approved Revisions to the Agreed Order No. DE 5477, Exhibit G – Recovery Well Operation and Maintenance (O&M) Plan

Dear Mr. Sumner:

The Washington State Department of Ecology (Ecology) has written this letter to approve the revised Recovery Well Operation and Maintenance (O&M) Plan, Revision 3. Based on your environmental consultant's (AECOM) electronic mail response to Ecology, dated March 16, 2010, The General Electric Company (GE) has accepted all of the Ecology redline revisions in full, as provided in the February 24, 2010 Ecology letter to you. Ecology appreciates your review and concurrence with those redline revisions.

The Ecology approved revised O&M Plan is attached to this letter and incorporates all of the previous Ecology redline revisions. This revised O&M Plan is now incorporated into the Agreed Order No. DE 5477, Exhibit G, by reference. Rather than appending Ecology's redline revisions to the previous Ecology approved O & M plan, Ecology thought having an "all revisions accepted" O&M Plan would be less confusing and more convenient for your consultant field staff. Please have your consultant field staff refer to this Ecology approved revised O & M Plan for all future recovery well operation and maintenance procedures.

Please feel free to call me at (425) 649-7264 if you have any questions regarding this letter.

Sincerely,

Dean Yasuda, P.E., Environmental Engineer
Hazardous Waste and Toxics Reduction Program

By certified mail: 7009 1410 0002 4171 1529

cc: Melissa Rourke, Ecology AAG
Jamie Stevens, AECOM
Bill Chapman, K&L Gates
Alex Cordas, Keymac-LCC
Bill Teplicky, McKinstry Co
Bill Joyce, Salter, Joyce, Ziker- PLLC
Marcia Bailey, EPA-X
Julie Sellick & Ed Jones, Ecology HWTR/NWRO
Central Records: WAD009278706 HZW 6.2
Tong Li, Ground Water Solutions
Brien Flanagan, Schwabe, Williamson & Wyatt
Thomas Morin, Environmental Partners
Elizabeth McManus, Ross and Associates
Randy Maciel, Hudson Bay Insulation
Linda Baker, AECOM
James King, Hudson Bay Insulation

Operation and Maintenance Plan - Revision 3

March 2010

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1.0 Introduction

This Operation and Maintenance Plan (O&M Plan) includes an overview of the groundwater recovery system installed at the former General Electric facility located at 220 S. Dawson Street, Seattle WA (Site). The objective of this document is to provide guidance for routine operation and maintenance of the current system and to provide guidance for unexpected events associated with the recovery system.

1.1 Process Description

The groundwater recovery system was installed at the former GE facility in 1996. The original design included two recovery wells (RW-1 and RW-2) located along 2nd Avenue South, pumping at a combined maximum pumping rate of 17 gallons per minute (gpm). In August 2003, the recovery system was modified by adding a new recovery well (RW-3) and discontinuing pumping from RW-1. The modified pumping system continues to operate at a combined flow of 17 gpm. Extracted groundwater is directly discharged to the King County sewer under Discharge Authorization 543-02.

The objective of the groundwater extraction system is to contain and recover groundwater beneath the former GE facility. The current configuration of recovery wells focuses recovery and mass removal on the northern portion of the site.

Table 1-1 Recovery System Details

Recovery Well	Details	Spare Parts
RW-1	Well Diameter: 4 inch Not currently pumping King County Sample port identification number: A4487	
RW-2	Well Diameter: 4 inch Type of Pump: 3 inch stainless steel Redi-Flo3, SQE-NE Grundfos Pump Flow controller: Toshiba Model No: LF424FBB211BBB Flow Totalizer Serial Number: 034241095 Safety features: A safety shut off on the flow controller is triggered when the water level falls below the inlet of the pump.	1 pump body (without controller head)
RW-3	Well Diameter: 4 inch Type of Pump: 3 inch stainless steel Redi-Flo3, SQE-NE Grundfos Pump Flow controller: Toshiba Model No: LF424FBB211BBB Flow Totalizer Serial Number: 034241093 Safety features: A safety shut off on the flow controller is triggered when the water level falls below the inlet of the pump.	1 complete pump (with controller head)

1.2 Contact Information

Table 1-2 Contact Information

Responsibility	Point of Contact
Recovery system owner	James Sumner - GE Aviation (513) 672-3986 Email: jim.sumner@ge.com
General system O&M, monitoring, system performance, project engineer	Jamie Stevens - Project Manager AECOM Phone: (206) 624-9349 Email: jamie.stevens@aecom.com
Site access, facilities concerns	Alex Cordas Keymac/McKinstry Phone: (206) 762-3311 Email:Acordas@McKinstry.com
Ecology contact	Dean Yasuda WA Department of Ecology – NW Regional Office Phone: (425) 649-7264 Email: DYAS461@ECY.WA.GOV
King County Spill/Release Notification	Patricia Magnuson King County Industrial Waste Phone: (206) 263-3000
Discharge Permitting –King County Monthly Flow Reports	Cheryl Jones King County Industrial Waste Phone: (206) 263-3000
Discharge Permitting –King County Annual Reporting and Discharge limits	Patricia Magnuson King County Industrial Waste Phone: (206) 263-3000
Waste disposal	Emerald Services (Envirotech Systems) Phone: (206) 363-9000
Analytical Laboratory	Mark Harris - ARI Phone: (206) 695-6200
Sewer Jetting	Glacier Environmental Phone: (425) 355-2826
Pump manufacturer/parts/repairs	QED Phone: 303-989-7737
Toshiba Flow Controller Parts/Repairs	Axiom-Northwest Inc Phone: (425) 576-9123
55 Gallon Drums	Industrial Container Services Phone: (206) 763-2345
Chemicals	AquaQuip Phone: (206) 624-4394

1.3 Health and Safety

The project Heath and Safety Plan (HASP) contains all site procedures for the site. The HASP includes Job Hazardous Analysis plans for all activities, including contaminant action levels and contingency plans, associated with the routine operation of the recovery system.

It is the responsibility of the office and site health and safety officers to ensure that the all personnel review, understand, and comply with the project HASP. Responsibilities for the office and site health and safety officers are described below.

The Office Health and Safety Officer (HSO) has the following responsibilities:

- Interface with the Project Manager as required in matters of health and safety
- Approve the site-specific Health and Safety Plan (HASP) for the project and require amendment as site conditions warrant
- Appoint or approve a Site Safety Officer (SSO) to assist in implementing the HASP
- Monitor compliance with the HASP
- Assist the Project Manager in ensuring that proper health and safety equipment is available for the project
- Approve personnel to work on the site with regard to medical examinations and health and safety training.

The Site Safety Officer (SSO) is responsible for verifying that project personnel and visitors adhere to the site safety requirements outlined in the HASP. These responsibilities include:

- Conducting the health and safety training for project personnel as appropriate;
- Modifying health and safety equipment or procedure requirements based on data gathered during the site work;
- Determining the posting locations and routes to medical facilities, including poison-control centers, and arranging for emergency transportation to medical facilities;
- Posting the telephone numbers of local public emergency services and facilities; and
- Performing site audits to verify adherence to the requirements of the HASP.

The SSO has authority to stop any operation that threatens the health or safety of the work team, visitors or surrounding populace. The daily health and safety activities may be conducted by the SSO or a designated replacement.

2.0 System Maintenance

2.1 Routine Weekly Procedures

Weekly procedures at the site include checking flow rates at RW-2 and RW-3. Flow readings are recorded on field monitoring forms (Appendix A).

Total flow measurements should not exceed 17.0 gallons per minute (gpm) - this is the maximum discharge limit set by King County. The total flow should be divided between RW-2 and RW-3, with best efforts to maintain the design groundwater extraction of 10 gallons per minute at RW-3 and 6 gallons per minute at RW-2.

The first step will be to visually confirm the pump flow rates from RW-3. If the RW-3 pump flow rate is below the design criteria of 10 gpm, then GE will adjust (further open) the outflow valve to increase the RW-3 pump rate to the design criteria.

If the RW-3 pump flow rate is below its 80% threshold, 8.0 gallons per minute, then GE will use all reasonable efforts to increase the flow rate to its design criteria of 10.0 gallons per minute with methods such as, acid recirculation, and physically cleaning the pump impellers and vault interior piping. If after all of these steps are performed and the design flow rate is not achieved, then replace the pump impeller unit with a new or refurbished/cleaned impeller unit, as this may be the cause of the low pump rates. If GE suspects that the motor unit is not operating properly, the entire motor and impeller unit should be replaced. GE shall keep at least one new or fully refurbished pump motor and impeller unit available at all times in case of any pump partial or full failure. This prevents the down time that would result in ordering the pump and scheduling time to install the pump components after receipt. The spare pump and impeller unit is brought to the site along with other O&M equipment for each weekly O&M check of the recovery well system. In this manner, a poorly functioning pump motor or impeller unit can be immediately replaced.

Next, the same procedures shall be followed for the O&M work at RW-2. However, the design criteria target is 6.0 gallons per minute and the 80% threshold is 4.8 gallons per minute. GE shall include in the RCRA CA progress reports tabulated RW-2 and RW-3 recovery well flow rates both prior to corrective action and after corrective action is implemented.

2.2 Acid Recirculation

An acid recirculation or pump cleaning is performed when system flows are less than 20% of the pumping design capacity at each well (a reduction of 20% pumping capacity results in a flow at RW-2 of 4.8 gpm and at RW-3 of 8 gpm).

The acid recirculation uses muriatic acid to dissolve ferrous iron bioflock accumulation in the pipes in the immediate vicinity of the pumping system. Acid recirculation is performed at both RW-2 and RW-3. The system is generally down for 2 to 4 hours during the acid recirculation and pump cleaning process.

Each time an acid recirculation is performed the pumps are cleaned with muriatic acid to dissolve any ferrous iron bioflock accumulation.

2.2.1.1 Materials Needed

Equipment: pH probe
Supplies: Site keys, safety cones, half face respirator with acid cartage, gloves, and eye protection
Chemicals: Muriatic acid and pH Balancer 200 Paperwork: Field Forms, Health and Safety Plan

2.2.1.2 Detailed Steps

- Secure work area. Set up safety cones around each recovery well; follow HASP steps for securing area and handling chemicals.
- Record initial flow rates at both RW-2 and RW-3.
- Set each recovery well to recirculation mode.
- Wearing respirator, eye protection, gloves, use funnel to pour 1 gallon of muriatic acid into each recovery well.
- Let recovery wells run in recirculation for a minimum of 2 hours. Do not exceed 4 hours.
- Take pH reading of water in recirculation mode; if required, add pH buffer to raise pH to neutral range (6.5-7.5). Follow manufacturer's instructions and site HASP if using pH buffer.
- Return each recovery well to normal flow mode.

If the pumping rate does not increase following acid recirculation, the resistance to flow may be further down the pipe system and sewer jetting may be required, or at the pump itself, in which case perform wirebrush pump cleaning.

2.3 Pump Cleaning Steps

2.3.1 Materials Needed:

Tools: Pipe wrench, screw drivers, pump changing tripod, pump cleaning brushes
Supplies: One 55-gallon/poly/open top drum, 5-gallon buckets, heavy plastic for ground protection, site keys, safety cones, half face respirator with acid cartage, gloves, and eye protection
Chemicals: Alconox and Water
Paperwork: Field forms, Health and Safety Plan

2.3.2 Steps:

- Secure work area. Set up safety cones around each recovery well; follow HASP steps for securing area and handling chemicals. Place plastic on ground, secure edges to minimize slipping.
- Record initial flow rates at both RW-2 and RW-3.
- Turn off both recovery wells, disconnect all power sources (at electrical boxes).
- Using gloves and eye protection remove and dismantle pumps at RW-2 and RW-3. Use guidelines in the HASP for lifting pumps and working with hand tools.
- Dismantle pumps on plastic and clean individual pump parts using wire bush in 5-gallon buckets.
- Attach clean pumps and lower into recovery well vault.

- Turn on each recovery well and check total flows. Adjust flow controls to try to achieve the design flow rates for each extraction well (RW2 = 6.0 gpm; RW-3 = 10.0 gpm). Do not exceed a total flow of 17 gpm.
- Procedures listed above generated a very low volume of water. All rinse water should be returned to the recovery wells for discharge through the piping to the King County treatment facility in accordance with the Discharge Authorization.

If the backup pump is off line during pump cleaning, the recovery system may remain off line for up to 4 hours while the cleaning is preformed. Best efforts will be made to ensure that backup pumps are operational at the time of pump cleanings.

2.4 Routine Quarterly Procedures

Once a quarter, or if recovery system does not respond to monthly acid recirculation and pump cleanings, and pump component replacement, all accessible parts of the recovery piping is cleaned. The pipes are cleaned using a high pressure sewer jetter. Discharged water is collected in 55-gallon drums and disposed of off-site. Contact Emerald Services for drum pick up. This waste has already been characterized by Emerald Services as non-hazardous IDW water. Once pick up date is confirmed, inform building manager (Alex Cordas) of pick up date. The system is generally down for 4-8 hours during routine sewer jetting.

A subcontractor is hired to perform the sewer jetting. The subcontractor is responsible for all equipment and personnel needed. ENSR is responsible for ensuring that subcontractor complies with project HASP, securing site access, providing subcontractor oversight, and disposing of any waste generated.

2.5 Additional Procedures

Additional procedures may include minor pipe repair, electrical repairs, and part replacement. All repairs to the system are done under the supervision of the project engineer. All electrical work is done by a WA licensed electrician. All part replacement is done directly with the manufacturer or through a representative and in accordance with all specified manufactures instructions.

Copies of all available equipment catalogs are included in Appendix B.

2.6 Record Keeping

All field work will be recorded by ENSR staff on daily field logs. Field logs are revised by the project manger and filed at the ENSR office.

2.7 Emergency Contingency Procedures

In the event that the recovery system is malfunctioning the Project Manager will be notified immediately. The project manager will contact Ecology and the City, if necessary, according to the reporting process described in Section 3.0.

Best efforts will be made to correct all system malfunctions immediately. Other than the requirement to have on hand at least one new or fully refurbished pump (motor and impeller

unit), other additional needed spare parts will be "rush" ordered to expedite system operations. Each pump has an independent flow controller, if one pump needs to be off-line to repair the flow controller the pumping at the reaming on line well can be increased only temporarily to compensate until both groundwater extraction wells are operating at their design flow rates.

Guidelines for personnel safety and responding to personnel accidents - including property damage and environmental releases - are called out in the site HASP. All employees must review and comply with the site HASP. In the event of an environmental release Ecology and King County will be immediately notified.

2.8 Well Relocation or Well Decommissioning

Site activities may require that the location of a recovery well, associated piping, or equipment be permanently moved to accommodate site use. If this is required, ENSR will submit to Ecology a memorandum summarizing site conditions, detailing the proposed changes, and summarizing the effects on the performance system. This memo will include a detailed scope of work, include operating procedures for implementing the proposed changes, and list any updates or changes to the recovery system operation and maintenance. Ecology will review and approve this work prior to implementation. Any design changes will be based, at a minimum, on the current recovery system performance and operating objectives. Best efforts will be made to minimize the system down time during relocation. In the event that a recovery well is decommissioned and abandoned, all work will be performed by a Washington licensed driller and will be conducted in accordance with WAC 173-160-381.

3.0 Reporting Requirements

3.1 City of Seattle Permit

Extracted groundwater is directly discharged to the King County sewer under Discharge Authorization #543-03, effective through August 2, 2014.

Biannual discharge samples are collected from the combined discharge point of RW-3 and RW-2, located in the vault for RW-1 twice a year per the King County Discharge Authorization (August 2009). Samples are collected for non-polar oils and grease (NP-FOG) and VOC (EPA Method 8260). Results are submitted to King County annually. A photograph of the RW-1 sample port is included in Appendix C.

Weekly discharge flow readings are collected to ensure that the extraction system is operating within the permitted conditions. Monthly reported flow totals are submitted to King County for billing purposes.

3.2 Ecology Requirements

Ecology notification by email and telephone within 48-hours of system shut down or if the groundwater extraction system operation is operating less than its intended manner. The notification should also include corrective actions taken and a timeline for corrective actions.

Appendix A

Field Forms

Extraction System Monitoring Form

Date: _____

Flow Readings (GPM)	Initial	Corrected
RW-2 Flow Rate	_____	_____
RW-3 Flow Rate	_____	_____

Total Flow Readings (gallons)

Flow Totalizer	_____	_____

Discharge Water Quality Observations

Odor	_____	Solvent	_____	Gasoline	_____	Hydrogen Sulfide	_____
Visual	_____	Oil Sheen	_____	Unusual Color	_____	Turbidity	_____

Additional Observations: _____

_____

_____

_____

Corrective Measures: _____

_____

_____

_____

Were groundwater levels measured? Yes _____ No _____

If yes, attach measurements to this form.

Monitoring Performed by: _____

Signed: _____

ENSR | AECOM

FIELD ACTIVITY LOG

PROJECT _____ **COMPLETED BY** _____
PROJECT NO. _____ **REVIEWED BY** _____
DAY & DATE _____ **SHEET** _____ **OF** _____

TIME	SUMMARY OF DAILY ACTIVITIES AND EVENTS

VISITORS ON SITE: **CHANGES FROM PLANS OR IMPORTANT DECISIONS**

WEATHER CONDITIONS: **IMPORTANT TELEPHONE CALLS:**

CONTRACTOR PERSONNEL & EQUIPMENT ON SITE:

Appendix B

Equipment Catalogs

TOSHIBA

Field Intelligent Device Series

Electromagnetic Flowmeter

LF430 /LF600
LF430 /LF602
15 to 450 mm (1/2" to 18")

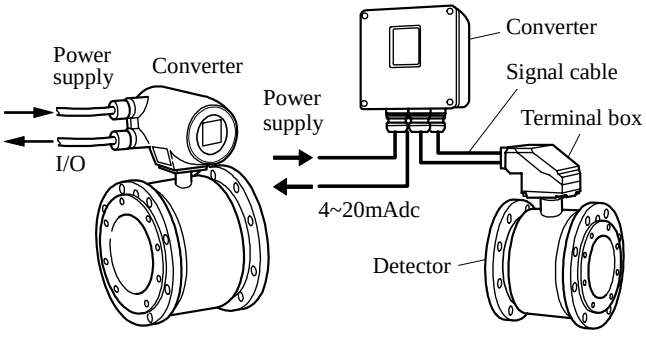
Introduction

The electromagnetic flowmeter uses Faraday's Law of electromagnetic induction to measure the process flow. The device consists of two units: a detector, through which the fluid to be measured flows and in which low-level signals proportional to flow rates are obtained; and a converter, which supplies excitation current to the detector, and amplifies the signals from the detector and then processes and converts the signals into the 4–20mAdc current signal. Thanks to the unique patented magnetic field distribution technology, the meter is highly immune to upstream flow disturbances. Combined with multi-functional converter LF600 (combined type) or LF602 (separate type) equipped with its original noise-suppression circuit and arithmetic operation capability, LF430 has high tolerance to noise, giving stable output even for slurry fluid measurement. IR (Infrared) switch enables parameter setting of the converter without removing the cover. Flow direction can be set in either way, and its 128 x 128 dot matrix LCD display allows the LCD rotated to 90, 180 and 270 degrees with a software.

The AF900 hand-held terminal or Model 375 HART*[1,2] communicator can be used to communicate with the flowmeter from remote places.

*1: HART protocol (Highway Addressable Remote Transducer) is a communication protocol for industrial sensors recommended by the HCF (HART Communication Foundation).

*2: 375 HART is being registered.



Combined type
LF430/LF600
LF434/LF600

Separate type
LF430/LF602
LF434/LF602

Figure1. Configuration

LF430/LF600
LF434/LF600

LF430
LF434

LF602

Figure2. LF430 series Flowmeters

Note : CE is being applied.

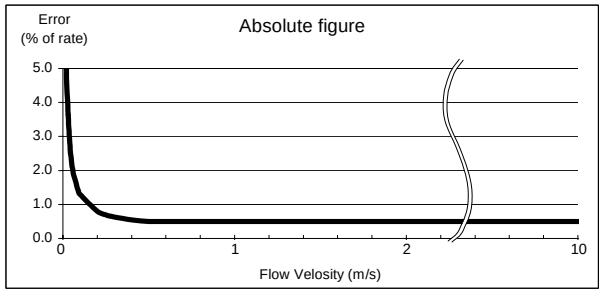
Specifications

■ Overall Specifications

Measurement range in terms of flow velocity:
0 – 0.3 m/s to 0 –10 m/s (0 –1.0 ft/s to 0 – 32.8 ft/s).
0 – 0.1 m/s to 0 – 0.3 m/s (0 – 0.3 ft/s to 0 – 1.0 ft/s) range is available optionally.

Accuracy: See the following graph.
Pulse output:
Vs > 0.5 m/s (1.64 ft/s): +/–0.5 % of rate.
Vs < 0.5 m/s (1.64 ft/s): +/–0.3 % of rate +/–1 mm/s (0.039 inch/s).
Current output: plus +/–8 uA (0.05 % of span)

Note: Span = Range in the magmeters.



Note: The accuracy above is measured under standard operating conditions using the weighing method at Toshiba's flow calibration facility.

Fluid conductivity: 5μS/cm minimum

Fluid temperature:

−10 to +120 °C: Teflon PFA lined flowmeter (14 to 248 °F)

−10 to +80 °C: EPDM rubber lined flowmeter (14 to 176 °F)

Ambient temperature: −20 to +60 °C (−4 to 140 °F)

Structure:

Standard — NEMA 4X (IP 67) Watertight

Option — NEMA 6 (IP 68) Submersible type is available.

Power consumption: approximately 10W(17VA)

Conformance to European Community Directives:

EMC directive 89/336/EEC
The low voltage 93/68/EEC
PED 97/23/EC (Note 1)

Note : See table 2 for detail.

Approved hazardous location certifications:

Model: LF434/LF600 and LF434/LF602

- FM explosion proof:
  FM Class I, Division 2, Groups A,B,C, and D.
  FM Class II, Division 2, Groups F and G.
  FM Class III.
- CSA explosion proof:
  CSA Class I, Division 2, Groups A,B,C, and D.
  CSA Class II, Division 2, Groups E, F, and G.
  CSA Class III.

Detector and converter combination:

LF430/LF600: Combined type for standard specification.
LF430/LF602: Separate type for standard specification.
LF434/LF600: Combined type with Ex approval of Class I, Division 2 (FM & CSA).
LF434/LF602: Separate type with Ex approval of Class I, Division 2 (FM & CSA).

■ Model LF430 Detector

Mounting style: Flange connection type

Fluid pressure: −0.1 to 2.0 MPa (−15 to 300 psi, or −1.0 to 20 bar)

The test pressure is equal to twice the nominal pressure rating of the customer specified flange connection during 15 minutes.

Connection flange standards: ANSI 150, ANSI 300, BS10 and 16, DIN PN10 and PN16, JIS10K, JIS16K and JIS20K

Principal materials:

Case — carbon steel

Flange material — 304 stainless steel: 15mm (1/2") to 200mm (8")
carbon steel: 250mm (10") to 400mm (16")

Linings — 15 to 50mm (1/2" to 2"): Teflon PFA
80 to 400mm (3" to 16"): EPDM rubber (std.) & Teflon PFA (opt.)

Electrodes — 316L stainless steel (std.)

Grounding rings — 316 stainless steel (std.)

Note: See Table 3 for optional materials and other related information.

Measuring tube material — 304 stainless steel

Coating: phthalic acid resin coating (std.), pearl-gray colored

Note: If the optional NEMA 6 (IP 68) structure is specified, the coating is black tar epoxy resin coating 0.5 mm.

Dimensions and weights: See Figure 3 and 4.

Cable connection port: for separate type detectors.
Cable gland —

LF430: Provided as standard, R(PT) 1/2 male screws.
LF434: Not provided, 3/4–14NPT male screws are required.

Applicable diameter — 11 to 13mm (0.433 to 0.512 inch)

■ Model LF600 and LF602 converters

Input signals

Analog signal — the voltage signal from detector, proportional to process flow rate (for LF602 separate type converter).

Digital input DI (opt.)
Signal type: 20 to 30Vdc voltage signal
Input resistance: 2.7kΩ
Number of inputs: one point

DI function — One of the following functions can be assigned to the optional DI signal.

Range switching — Selects either the higher or lower range in the unidirectional or bidirectional 2-range setting.

Totalizer control — Starts and stops the built-in totalizer.

Fixed-value outputs —Outputs fixed-values for current and pulse outputs.

Zero adjustment — Executes zero adjustment (on-stream at zero flow rate).

Output signals

Current output:
4–20mAdc (load resistance 0 to 750Ω)

Digital outputs — One point (std.) and one more point is optionally available as follows.

Digital output DO1 (std.):
Output type: Transistor open collector
Number of outputs: One point
Output capacity: 30Vdc, 200mA maximum

Digital output DO2 (opt.):
Output type: Solidstate relay output (non polarity)
Number of outputs: One point
Output capacity: 150Vdc, 150mA maximum or 150Vac (peak to peak), 100mA maximum

DO1 and DO2 functions — One of the following functions can be assigned to DO1 (std.) and/or DO2 (opt.)

- **Pulse output (available only for DO1)**
  Pulse rate: 3.6 to 3,600,000 pulses/hr
  Pulse width: 0.5 to 500ms (but less than half of the period for 100% flow rate)
- **Multi-range selection outputs (Note 1)**
- **High and/or low limit alarm outputs (Note 2)**
- **Empty pipe alarm output**
- **Digital Output Active Status (DO1 and DO2) (Note 2)**
- **Preset count output**
- **Converter failure alarm output**

Note 1: Two outputs (DO1 and DO2) are needed for 4-range switching and forward/reverse 2-range switching.

Note 2: Normal Open (default set) or Normal Close is selected for alarm outputs when programming.
The status when power failure is kept to Normal Open.

Communications output — Digital signal is superimposed on 4–20mAdc current signal as follows:

- **Conforms to HART protocol**
  Load resistance: 240 to 750Ω
  Load capacitance: 0.25μF maximum
  Load inductance: 4mH maximum
- **ProfibusPA (optional)**

LCD display:
Full dot-matrix 128×128 dot LCD display (back–light provided)
The data on the LCD inside the converter can rotate to 90, 180, and 270 degrees by a software, without rotating the indicator itself. (Combined type only)

Parameter settings — Parameters can be set as follows:

- **IR Switch**: Three key switches are provided to set configuration parameters.
- **Digital communication**: The AF900 hand-held terminal or the Model 375 HART communicator is needed to set parameters.

Zero adjustment:
Zero point adjustment can be started by pressing the switch in the converter.

Damping:
0.5 to 60 seconds (selectable in 1 second increments)

Zero and span calibration:
Built-in calibration signal source allows converter unit check.

Conditions when power fails:
The outputs and display will remain as follows when power fails. Parameter setting values are stored in non–volatile memory and the values will be restored when the power returns to normal condition.

- Current output: 0mAdc
- Digital output: OFF
- LCD display: No display

Power supply:
One of the following can be selected:

- 100 to 240Vac, 50/60Hz (std.)
  (allowable voltage 80 to 264Vac)
- 24Vdc (allowable voltage 18 to 36Vdc)
- 110Vdc (allowable voltage 90 to 130Vdc)

Surge protection:
Arresters are installed in the power supply, and current signal output circuit.

Case: Aluminum alloy (equivalent of IP 67)

Coating: Acrylic resin-baked coating, pearl–gray colored

Cable connection port:
Cable glands —
LF600 and LF602:
Provided as standard
OD of cable ϕ 11~13mm
Material Nylon 66
G (PF) 1/2 male screws.

LF600 and LF602 for FM Approved:
Not provided, 1/2–14NPT male screws are required.

Applicable diameter —
11 to 13mm (0.433 to 0.512 inch)

Vibration resistance:
No resonance to the following levels of vibration:

- 10 to 150Hz with acceleration of 9.8m/s^2
  No defect in putting vibration to each direction of 30Hz with 29.4 m/s^2 in 4h.

Note: Avoid using the flowmeter in an environment with constant vibration.

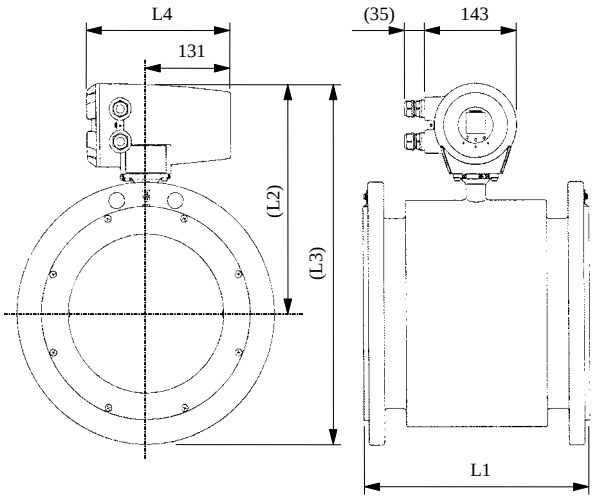
Dimensions and Weights:
See Figure 5. (for separate type)

MTBF: 220,000 hours at 25 deg.C (77 deg.F) based on MIL-HDBK-217F

Installation

■ Dimensions

Unit : mm



Converter type	L4	
	(mm)	(inch)
With display	225	8.85

Note1: Eye bolts are provided at the top for flowmeters sized 200mm (8") or above, and further, a roll-prevention base is provided for flowmeters sized 250mm (10") or larger.

BS16 and DIN PN16 dimensions:

Meter size (mm)	L1 (mm)	L2 (mm)	L3 (mm)	No. of bolts	Weight (kg)
15	140	220	268	4	approx. 6.0
25	160	223	286	4	approx. 8.0
40	170	231	301	4	approx. 10.0
50	180	240	318	4	approx. 12.0
80	230	254	347	8	approx. 18.0
100	240	272	377	8	approx. 22.0
150	260	302	442	8	approx. 37.0
200	300	328	493	12	approx. 50.0
250	350	351	551	12	approx.106.0
300	400	378	601	12	approx.114.0
350	450	395	640	16	approx.131.0
400	500	416	696	16	approx.174.0
450	550	445	755	20	approx.200.0

ANSI class 150 dimensions:

Meter size (inch)	L1 (inch)	L2 (inch)	L3 (inch)	No. of volts	Weight (lbs)
1/2	5.51	8.46	10.24	4	approx. 13.2
1	6.30	8.58	10.71	4	approx. 16.5
1-1/2	6.69	8.90	11.42	4	approx. 22.0
2	7.09	9.25	12.24	4	approx. 27.6
3	9.06	9.80	13.54	4	approx. 44.1
4	9.45	10.51	15.04	8	approx. 56.2
6	10.24	11.69	17.20	8	approx. 84.9
8	11.81	12.72	19.49	8	approx. 125
10	13.78	13.62	21.61	12	approx. 254
12	15.75	14.69	24.21	12	approx. 302
14	17.72	15.35	25.87	12	approx. 359
16	19.69	16.18	27.95	16	approx. 463
18	21.65	17.51	29.72	16	approx. 423

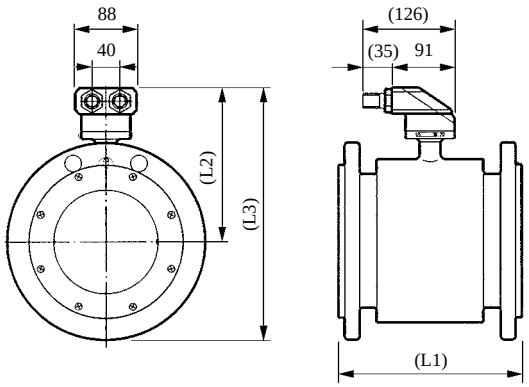
JIS 10K dimensions:

Meter size (mm)	L1 (mm)	L2 (mm)	L3 (mm)	No. of bolts	Weight (kg)
15	140	215	268	4	approx. 6.0
25	160	218	286	4	approx. 8.0
40	170	226	301	4	approx. 10.0
50	180	235	318	4	approx. 12.0
65 (*3)	230 / 200 (*4, *5)	249 / 244 (*4)	336 / 331 (*5)	4	17.0 / 15.0 (*5)
80	230	249	347	8	approx. 18.0
100	240	267	377	8	approx. 22.0
150	260	297	442	8	approx. 37.0
200	300	323	493	12	approx. 50.0
250	350	346	551	12	approx.106.0
300	400	373	601	16	approx.114.0
350	450	390	640	16	approx.131.0
400	500	411	696	16	approx.174.0
450	550	445	755	20	approx.200.0

Note 2: 1 inch = 25.4 mm
Note 3: JIS 10K flange only without any Ex-approvals.
Note 4: EPDM rubber lining / Teflon PFA lining
Note 5: This dimension is changed to “194 mm” when choosing Ta or Pt-Ir grounding ring types in the teflon PFA lining.

Figure 3. LF430/LF600 and LF434/LF600 combined type flowmeters Meter Sizes 15 (1/2") to 450mm (18")

Unit : mm



Note1: Eye bolts are provided at the top for flowmeters sized 200mm (8") or above, and further, a roll-prevention base is provided for flowmeters sized 250mm (10") or larger.

Note2: Cable glands are not provided for LF434 of FM and CSA approved type. Refer to the part Cable connection port at detector.

BS16 and DIN PN16 dimensions:

Meter size (mm)	L1 (mm)	(L2) (mm)	L3 (mm)	No. of bolts	Weight (kg)
15	140	147	194	4	approx. 4.0
25	160	149	207	4	approx. 6.0
40	170	158	233	4	approx. 9.0
50	180	167	250	4	approx. 11.5
80	230	181	281	8	approx. 17.5
100	240	199	309	8	approx. 22.0
150	260	229	372	8	approx. 37.0
200	300	255	425	12	approx. 52.0
250	350	278	481	12	approx. 108
300	400	305	535	12	approx. 121
350	450	322	582	16	approx. 145
400	500	343	633	16	approx. 188
450	550	372	707	20	approx. 208

JIS 10K dimensions:

Meter size (mm)	L1 (mm)	(L2) (mm)	L3 (mm)	No. of bolts	Weight (kg)
15	140	147	194	4	approx. 4.0
25	160	149	212	4	approx. 6.0
40	170	158	228	4	approx. 8.0
50	180	167	244	4	approx. 10.0
65 (*4)	230 / 200 (*5, *6)	181 / 176 (*5)	269 / 263 (*6)	4	15.0 / 14.0 (*6)
80	230	181	274	8	approx. 15.0
100	240	199	304	8	approx. 20.0
150	260	229	369	8	approx. 35.0
200	300	255	420	12	approx. 48.0
250	350	278	478	12	approx. 106
300	400	305	528	16	approx. 116
350	450	322	567	16	approx. 141
400	500	343	623	16	approx. 176
450	550	372	682	20	approx. 200

ANSI class 150 dimensions:

Meter size (inch)	L1 (inch)	L2 (inch)	L3 (inch)	No. of volts	Weight (lbs)
1/2	5.51	5.79	7.56	4	approx. 8.8
1	6.30	5.87	7.99	4	approx. 12.1
1-1/2	6.69	6.22	8.74	4	approx. 17.6
2	7.09	6.57	9.57	4	approx. 23.1
3	9.06	7.13	10.87	4	approx. 39.7
4	9.45	7.83	12.36	8	approx. 51.8
6	10.24	9.02	14.53	8	approx. 80.5
8	11.81	10.04	16.81	8	approx. 120
10	13.78	10.94	18.94	12	approx. 249
12	15.75	12.01	21.54	12	approx. 298
14	17.72	12.68	23.19	12	approx. 355
16	19.69	13.50	25.28	16	approx. 459
18	21.65	14.64	27.7	16	approx. 507

Note 3: 1 inch = 25.4 mm
Note 4: JIS 10K flange only without any Ex-approvals.
Note 5: EPDM rubber lining / teflon PFA lining
Note 6: This dimesion is changed to “194 mm” when choosing Ta or Pt-Ir grounding ring types in the teflon PFA lining.

Figure 4. Separate type detectors LF430 and LF434
Meter sizes 15 (1/2") to 450mm (18")

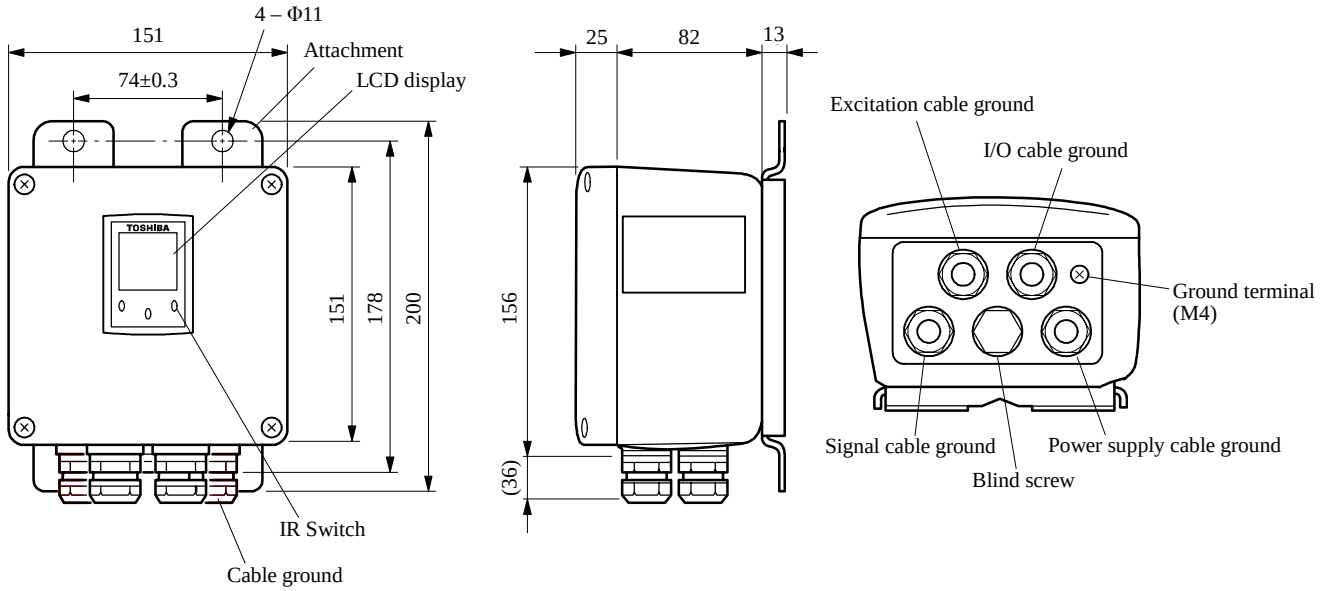
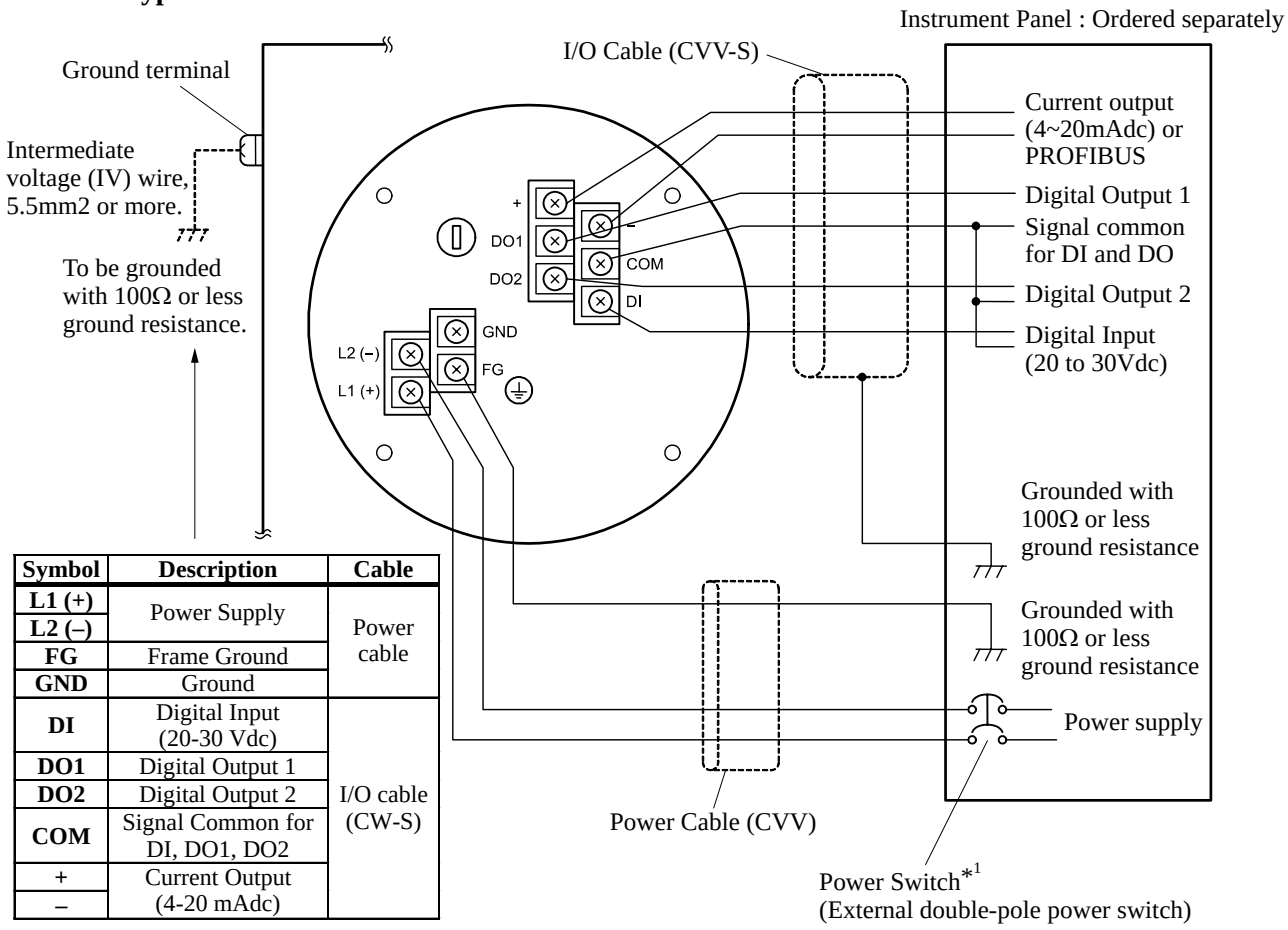


Figure 5. Separate type converter LF602

■ External Connections

- **Combined type LF430/LF600 flowmeter**

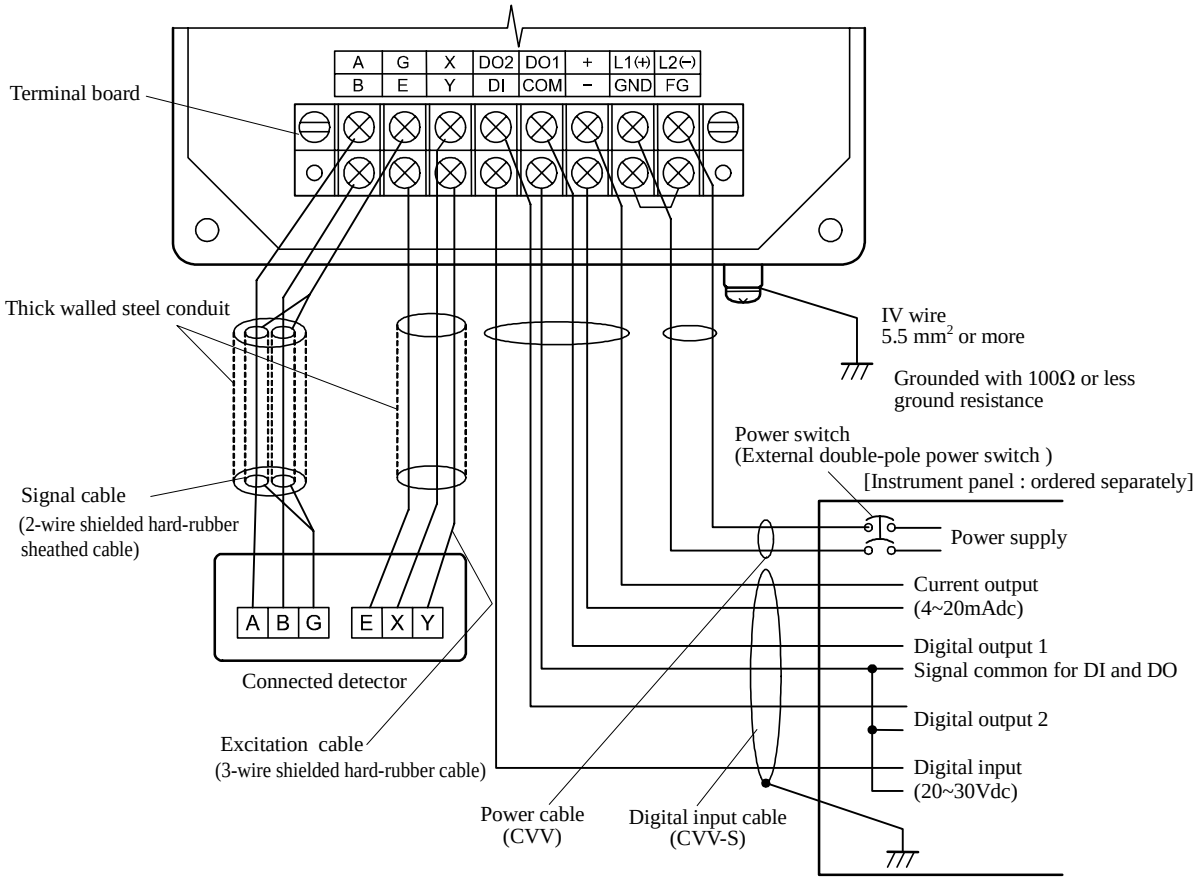


Symbol	Description	Cable
L1 (+)	Power Supply	Power cable
L2 (–)		
FG	Frame Ground	
GND	Ground	
DI	Digital Input (20-30 Vdc)	I/O cable (CW-S)
DO1	Digital Output 1	
DO2	Digital Output 2	
COM	Signal Common for DI, DO1, DO2	
+	Current Output (4-20 mAdc)	
–		

***1** Locate an external double-pole power switch on the power line near the flowmeter within easy reach of operation. Use the appropriate switch rating as shown below:
Switch rating: 250Vac, 6A or more
In rush current: 15A or more

Figure 6. Combined type LF430/LF600 and LF434/LF600 flowmeters Wiring Diagram

<Separate type LF430/LF602 and LF434/LF602 flowmeters>



Symbol	Description	Cable
L1 (+)	Power supply	Power cable (CVV)
L2 (−)		
GND	Ground (for arrester)	
FG	Frame ground	
DI	Digital Input (20～30Vdc)	I/O cable (CVV－S)
DO1	Digital Output 1	
DO2	Digital Output 2	
COM	Signal Common for DI, DO1, DO2	
+	Current Output (4～20mAdc)	
−		
X	Excitation Output	Excitation cable (for only)
Y		
E		
A	Signal Input	Signal cable (for only)
B		
G		

Figure 7. Separate type LF430/LF602 and LF434/LF602 flowmeters wiring Diagram

■ Wiring Precautions

(1) Explosion proof type flowmeters are not provided cable glands.
Refer to the part Cable connection port at detector and converter.

(2) Connect the grounding wire (IV wire 5.5mm² or more) to a good earth ground (100Ω or less ground resistance). Make the wire as short as possible. Do not use a common ground shared with other equipment where earth current may flow. An independent earth ground is recommended.

(3) The allowable cable lengths between the detector and converter for the separate type flowmeter depend on the electrical conductivity of the object fluid. See Figure 8 below.

(4) DO1, DO2 (opt.), and DI (opt.) use the same common terminal (COM). This COM can not connect to other equipments which have their own ground terminal. (Power supply for connecting to DI or DO, etc…) Need to wire separately.

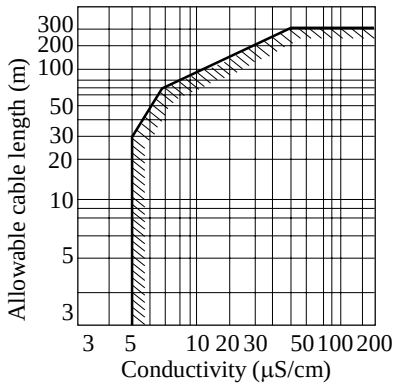
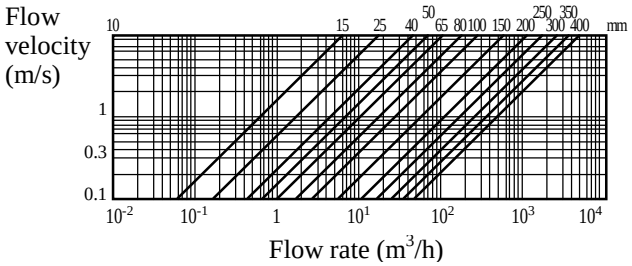


Figure 8. Electrical Conductivity and Cable Length

■ Meter Size

To select the meter size:
See Figure 9 and find meter sizes within the velocity of 0.1 to 10m/s for a specified full-scale (measuring range high limit) flow. Select one that has its full-scale velocity between 1 and 3m/s.

Note: Make sure the full-scale flow rate used for the final planning stage stays within 10m/s in terms of flow velocity.



For SI unit Unit: m^3/h

Meter size (mm)	Flow rate		
	0.3 m/s	1 m/s	10 m/s
15	0.1908	0.6361	6.361
25	0.5301	1.767	17.67
40	1.357	4.523	45.23
50	2.120	7.067	70.67
65 (*1)	3.584	11.95	119.5
80	5.428	18.09	180.9
100	8.482	28.27	282.7
150	19.08	63.61	636.1
200	33.93	113.1	1131
250	53.01	176.7	1767
300	76.34	254.5	2545
350	103.9	346.4	3464
400	135.7	452.3	4523
450	171.7	572.5	5725

Note 1: JIS 10K flange type only.

For English unit Unit: gal/min

Meter size (inch)	Flow rate		
	0.33ft/s	0.98ft/s	32.8ft/s
1/2	0.28148	0.83591	27.977
1	0.78189	2.3220	77.715
1 1/2	2.0016	5.9443	198.95
2	3.1128	9.2879	310.86
3	8.0065	23.777	795.80
4	12.510	37.152	1243.4
6	28.148	83.591	2797.7
8	50.041	148.61	4973.8
10	78.189	232.20	7771.5
12	112.59	334.36	11191
14	153.25	455.11	15232
16	200.16	594.43	19895
18	253.05	752.40	25182

Figure 9. Flow Rate and Flow Velocity

■ Calibration Range

If the calibration range is not specified, the standard range as shown below will be used. If the range is specified, we will use the specified range for calibration.

Table 1. Standard Flow Range

Meter size mm (inch)	Standard flow range		
	Flow rate (m^3/h)	Flow velocity (m/s)	Flow rate (gal/min)
15 (1/2)	2	3.145	25
25 (1)	6	3.395	75
40 (1 1/2)	15	3.315	175
50 (2)	25	3.535	300
65 (2-1/2) (*2)	40	3.348	------
80 (3)	60	3.315	650
100 (4)	100	3.535	1000
150 (6)	200	3.145	2500
200 (8)	300	2.653	4500
250 (10)	600	3.395	7000
300 (12)	900	3.537	10000
350 (14)	1200	3.465	12000
400 (16)	1600	3.537	16000
450 (18)	2500	4.366	25000

Note 1: The unit of "gal/min" is not exchanged (converted) by "m^3/h".

Note 2: JIS 10K flange type only.

■ PED matrix in each flange connection.
The following sizes fall under the category for PED in each flange connection when the meter ships to EU. All of them had complied with it from a notified body.

Table 2 PED matrix in each flange standard

Flange standard	Meter size
DIN PN 16 and BS 16	150 to 400mm (6 to 16 inch)
DIN PN 10 and BS 10	250 to 400mm (10 to 16 inch)
ANSI 150 and JIS 10K	6 to 16 inch (150 to 400mm)

Ordering Information

1. When ordering the LF430 series flowmeters, refer to Tables 3 and 4 (Type Specification Codes). An entry must be made for each of the columns in each of these tables.
2. Fluid characteristics:
   (1) Type of fluid to be measured and its characteristics
   (2) Fluid temperature
   (3) Fluid pressure
   (4) Electrical conductivity of the fluid
3. Measuring range
4. I/O function setting
5. Ordering scope:
   Flow calibration data: (required or not)
6. Other items
   Specifications other than standard items

Consult Toshiba before ordering when choose materials of the wetting parts such as lining, electrodes, and grounding rings.

Table 3. Specification Code (Flange type detector LF430 Series)

Model					Specification Code									Description	Detector category			
															Normal type		Ex. type	
1	2	3	4	5	6	7	8	9	10	11	12	13	14		Gr.-A	Gr.-B	Gr.-C	Gr.-D
L	F	4	3	0										Normal specification type	√	√		
L	F	4	3	4										Hazardous location certification type (Note 1)			√	√
														Meter size				
					D									15mm (½")	√		√	
					E									25mm (1")	√		√	
					S									32mm (1¼")	√		√	
					F									40mm (1½")	√		√	
					G									50mm (2")	√		√	
					W									65mm (2½") (Note 7)		√		
					H									80mm (3")		√		√
					J									100mm (4")		√		√
					K									150mm (6")		√		√
					L									200mm (8")		√		√
					M									250mm (10")		√		√
					N									300mm (12")		√		√
					P									350mm (14")		√		√
					Q									400mm (16")		√		√
					R									450mm (18")		√		√
														Mounting Style				
						L								Detector/Converter combined type (LF430/LF600)	√	√		
						M								Detector/Converter separate type (LF430/LF602)	√	√		
						P								Detector/Converter combined type with PED (LF430/LF600) (Note 6)	√	√		
						Q								Detector/Converter separate type with PED (LF430/LF602) (Note 6)	√	√		
														FM and CSA Class I - Division 2 type (Note 1)				
						A								Detector/Converter combined type (LF434/LF600)			√	√
						B								Detector/Converter separate type (LF434/LF602)			√	√
														Connection flange standard				
							C							ANSI 150	●	●	●	●
							D							ANSI 300	○	○	○	○
							E							BS PN 10	●	●	●	●
							F							BS PN 16	●	●	●	●
							G							DIN PN 10	●	●	●	●
							H							DIN PN 16	●	●	●	●
							J							JIS 10K	●	●	●	●
							K							JIS 16K	○	○	○	○
							L							JIS 20K	○	○	○	○
							Z							Other	○	○	—	—
														Electrode Material (Note 5)				
								B						316L stainless steel	●	●	●	●
								C						Ti (titanium)	○	○	○	○
								D						Pt-Ir (platinum/iridium)	○	○	○	○
								E						Ta (tantalum)	○	○	○	○
								F						Hastelloy C(Equivalent)	○	○	○	○
								Z						Other	○	○	—	—
														Lining Materials (Note 5)				
									C					Teflon FPA	●	○	●	○
									D					EPDM rubber	—	●	—	●
														Grounding Ring Material (Note 5)				
										C				316 stainless steel	●	●	●	●
										D				316L stainless steel	○	○	○	○
										E				Ti (titanium)	○	○	○	○
										F				Ta (tantalum)	○	○	○	○
										G				Pt-Ir (platinum/iridium)	○	○	○	○
										H				Hastelloy C (Equivalent)	○	○	○	○
										Z				Other	○	○	—	—
														Flow and calibration velocity range				
											A			0.3 to 10 m/s (standard range calibration)	●	●	●	●
											B			0.3 to 10 m/s (specified range calibration)	○	○	○	○
											C			0.1 to 10 m/s (specified range calibration)	○	○	○	○
														Excitation and Signal Cables				
												A		not provided	●	●	●	●
												B		30m cable, provided (Note 2)	○	○	○	○
												C		other lengths, provided (Note 3)	○	○	○	○
														Coating				
													B	phthalic acid resin coating pearl-gray colored	●	●	●	●
													C	black tar epoxy resin 0.3mm	○	○	○	○
													D	black tar epoxy resin 0.5mm	○	○	○	○
													E	black tar epoxy resin 0.5mm for submersible type (Note 4)	—	○	—	○

Size code explanation: √: Object ●: Standard ○: Option —: Not available

Note1: Cable glands are not provided. Refer to the part of "Cable connection port" at detector and converter.
Note2: Separate type detector only.
Note3: Separate type detector only. Specifying the code "C", indicate the length of cables from 1 to 300m 1 meter increments.
Note4: EPDM rubber lining is available to choose only in this specification.
Note5: Consult Toshiba before ordering when choose materials at the wetting parts.

Note6: Check the Table 2 whether your chosen meter size meets this directive or not when the meter is shipped to EU. If yes, need to choose this code.
Note7: JIS 10K flange only without any Ex-approvals.

Table 4. Specification Code for converters

Model					Specification Code									Contents	LF600 type	LF602 type
1	2	3	4	5	6	7	8	9	10	11	12	13	14			
L	F	6	0											Electromagnetic flowmeter converter		
				0										Integral type	○	—
				2										Separate type	—	○
					A									Purpose		
														Standard	○	○
					F									FM and CSA class I, Division 2 approved	○	○
						A								Shape		
														Integral type with case	○	—
						B								Separate type with case	—	○
							A							Converter mounting fitting		
														None	○	○
							C							Panel, Accessory for wall mounting (BNP material: SUS304)	—	○
							E							Accessory for pipe installation (BNP material: SUS304)	—	○
								1	1					I/O and Communication function		
														Current output + pulse output points 1 (DO1) + HART communication	○	○
								1	2					Pulse output points 1 (DO1) + PROFIBUS communication	○	○
								2	1					Current output + pulse output points 2 (DO1+DO2) + digital input point 1 (DO1) + HART Communication	○	○
								2	2					Pulse output points 2 (DO1+DO2) + digital input point 1 (DI) + PROFIBUS communication	○	○
										1				Power supply		
														100Vac-240Vac, 50/60Hz	○	○
										2				24Vac	○	○
										3				110Vac	○	○
											A			Instruction manual		
														Japanese	○	○
											E			English	○	○

○: Selectable —: Unselectable

ISO9001 and ISO14001 are certified.

Misuse of this product can result in damages to property or human injury.
Read related manuals carefully before using this product.

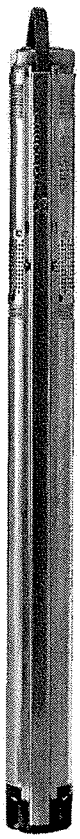
Specifications are subject to change without notice.
Printed in Japan 2006-1 (TDOC)

No. EJL-115A

GRUNDFOS **INSTRUCTIONS**

Redi-Flo3, SQE-NE Environmental pumps

(US) **Installation and operating instructions**



BE›THINK›INNOVATE›

GRUNDFOS

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CONTENTS

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. General description

The Redi-Flo3 is a 3 inch diameter deep well submersible pump mainly designed for the pumping of raw water in domestic water supply.

This manual is designed to assist in the proper set-up, installation and operation of these pumps.

1.1 Applications

Typical applications are

- industrial applications
- irrigation systems.

WARNING: The use of the pump in swimming pool areas has not been investigated.

2. Preinstallation

2.1 Well preparation

If the pump is to be installed in a new well, the well should be fully developed and bailed or blown free of cuttings and sand.

The construction of the Grundfos Redi-Flo3 submersibles makes them resistant to abrasion; however, no pump made of any material can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, the well must be blown or bailed clear of oil.

2.2 Make sure you have the right pump

Determine the maximum depth of the well and the drawdown level at the maximum pump capacity. Pump selection and setting depth should be made based on this data.

2.3 Pumped liquid requirements

Submersible well pumps are designed for pumping clear, cold water; free of air or gases. Decreased pump performance and life expectancy can occur if the water is not clear, cold or contains air or gases.

A check should be made to ensure that the installation depth of the pump will always be at least three feet below the maximum drawdown level of the well. The bottom of the motor should never be installed lower than the top of the well screen or within five feet of the well bottom.

CAUTION: This pump has been approved for pumping water of maximum 86°F only.

2.4 Liquid temperatures/cooling

Figure 1 shows a Redi-Flo3 pump installed in a well.

With the pump operating, figure 1 illustrates the following:

- Well diameter
- Pump diameter
- Temperature of pumped liquid
- Flow past the motor to the pump suction strainer.

Note: The well diameter must be at least 3 inches. If there is a risk that the motor will be covered with sediment, it is recommended the pump be placed in a flow sleeve. The motor should always be installed above the well screen.

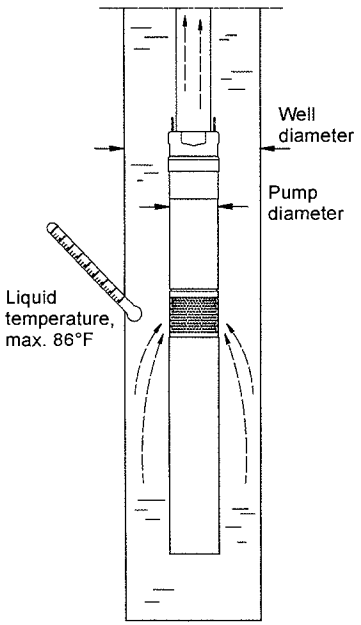

Fig. 1 Pump installed in well

2.5 Motor preparation

Grundfos MSE 3 submersible motors have water-lubricated slide bearings. No additional lubrication is required.

The submersible motors are factory-filled with a special Grundfos motor liquid, type SML 2 or SML 3, which will protect the motor liquid down to 4°F and prevent the growth of bacteria. The level of motor liquid is important for the operating life of the bearings and consequently the life of the motor.

2.6 Refilling of motor liquid

If for any reason the motor liquid has been drained or lost, the motor must be refilled with Grundfos motor liquid SML 2 or SML 3.

To refill the motor, proceed as follows:

1. Remove the cable guard and separate the pump end from the motor.
2. Place the motor in vertical position with an inclination of approximately 10°.
3. Remove the filling plug using a screwdriver or a similar tool.
4. Inject motor liquid into the motor with a filling syringe or similar tool, see fig. 2.
5. To allow possible air to escape, move the motor from side to side and turn the shaft.
6. Replace the filling plug and make sure it is tight.
7. Assemble pump end and motor.
8. Fit the cable guard.

The pump is now ready for installation.

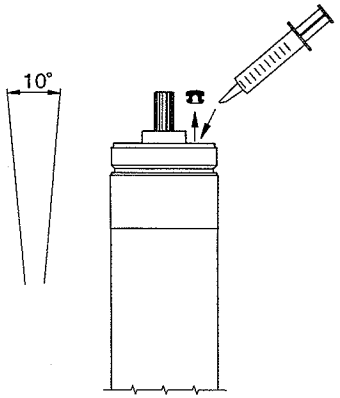

Fig. 2 Injecting motor liquid

3. Installation

3.1 Positional requirements

The pump is suitable for vertical as well as horizontal installation, however, the pump shaft must never fall below the horizontal plane, see fig. 3.

If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

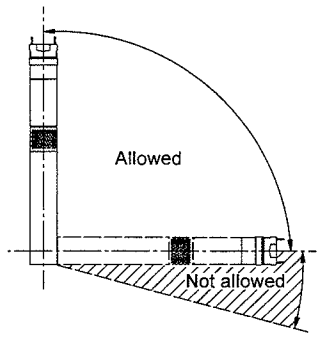

Fig. 3 Pump position

4. Electrical connection

4.1 General

The electrical connection should be carried out by an authorized electrician in accordance with local regulations.

WARNING:

Before starting work on the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

This pump is permanent wiring connection only.

Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding.

The grounding connection must be made by a copper conductor at least at the size of the circuit conductors supplying the pump.

The pump must be connected to an external mains switch.

The pump must never be connected to a capacitor or to another type of control box than Redi-Flo3 Status Box, CU 300 or CU 301.

The pump must never be connected to an external frequency converter.

The supply voltage, rated maximum current and power factor (PF) appear on the motor nameplate.

The required voltage for Grundfos submersible MSE 3 motors, measured at the motor terminals, is –10%/+6% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

If the pump is connected to an installation where a Ground Fault circuit breaker (GFI) is used as additional protection, this circuit breaker must trip out when ground fault currents with DC content (pulsating DC) occur.

Supply voltage

1 x 100-115 V or 1 x 200-240 V, 50/60 Hz.

The current consumption can only be measured accurately by means of a true RMS instrument. If other instruments are used, the value measured will differ from the actual value.

The Redi-Flo3 pumps can be connected to a Redi-Flo3 Status Box, CU 300 or CU 301 control box.

4.2 Motor protection

The motor has built-in automatic thermal overload protection and requires no additional motor protection.

4.3 Connection of motor

The motor can be connected directly to the main circuit breaker.

Start/stop of the pump will typically be done via a pressure switch, see fig. 4.

Note: The pressure switch must be rated for the maximum amps of the specific pump.

WARNING:

Reduced risk of electric shock during operation of this pump requires the provision of acceptable grounding. If the means of connection to the supply connected box is other than grounded metal conduit, ground the pump back to the service by connecting a copper conductor, at least the size of the circuit supplying the pump.

2-wire Grundfos motors 200-240 V

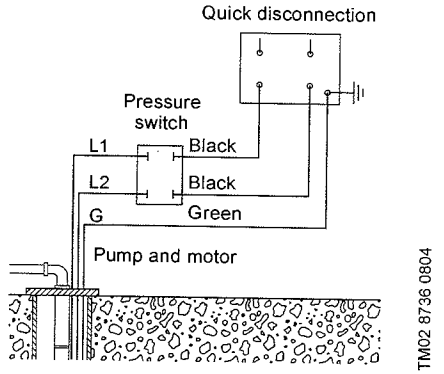

Fig. 4 Wiring diagram, 2-wire (200-240 V)

Single-phase Grundfos motors

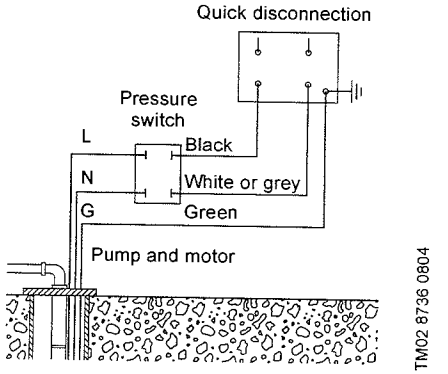

Fig. 5 Wiring diagram, single-phase (100-115 V)

5. Cable sizing

Single-phase 60 Hz maximum cable length (feet) motor service to entrance:

Motor rating			Maximum lengths of copper wire in feet (9% voltage drop)						
Volts	hp	amps	14 AWG	12 AWG	10 AWG	8 AWG	6 AWG	4 AWG	2 AWG
115	0.5	12	140	220	360	550	880	1390	2260
230	0.5	5.2	640	1000	1660	2250	4060		
230	0.75	8.4	400	620	1030	1580	2510	3970	
230	1.0	11.2	300	460	770	1190	1890	2980	4850
230	1.5	12	280	430	720	1110	1760	2780	4530

Note: The values apply to 230 V, 60 Hz, and conform to the requirements stated in the National Electrical Code Book.

Note: Recommended maximum cable length between the Redi-Flo3 Status Box, CU 300 or CU 301 and the SQE = 650 ft.

6. Splicing the cable

The submersible drop cable can be ordered separately in lengths of 25 to 300 ft, see section *17. Accessories*.

The submersible drop cable available for Redi-Flo3 pumps is a 12 AWG ETFE cable with end cover and socket. It is not recommended to splice this type of cable.

7. Fitting the cable guard

To fit the cable guard, proceed as follows:

1. Make sure that the motor lead lies flat in the cable guard.
2. Place the cable guard in the groove in the cable plug. The two flaps must engage with the upper edge of the pump sleeve, see fig. 6.

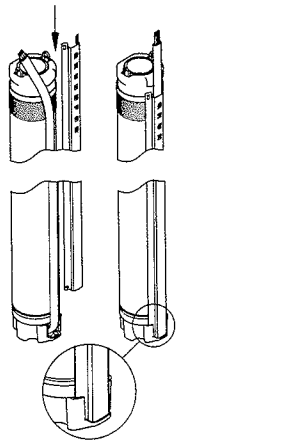

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Fig. 6 Placing the cable guard

3. Fasten the cable guard to the pump suction strainer with the two self-tapping screws supplied, see fig. 7.

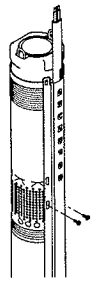

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Fig. 7 Fitting the cable guard to the pump suction strainer

8. Piping

- The pump should only be gripped by the two flats at the top of the pump, see fig. 8.
- The pump can be installed vertically or horizontally. During operation, the pump must always be completely submerged in water.
- When plastic pipe is used, a stainless steel safety wire is recommended for lowering and lifting the pump. Fasten the wire to the eyelet on the pump, see fig. 9.
- The threaded joints must be well cut and fit together tightly to ensure that they do not work loose.

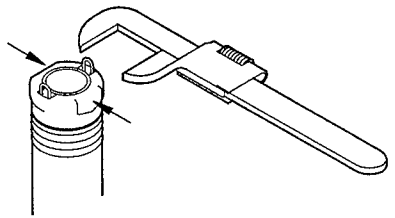

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Fig. 8 Gripping the pump

9. Installing the pump

9.1 Installation depth

The dynamic water level should always be above the pump, see fig. 9.

A = Dynamic water level

B = Static water level

C = Minimum 3 inch well diameter

D = Drawdown

E = Installation depth below static water level. Maximum 500 feet.

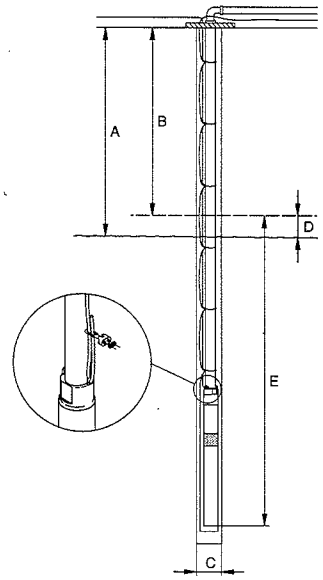

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Fig. 9 Installation depth

Procedure

To install the pump, proceed as follows:

1. Attach the enclosed data plate sticker at the well head.
2. Check the well for proper clearance. The well must be at least 3 inches in diameter. It is a good idea to check the well for clearance using a plumb ring (2.95 ø x 10 in.).
3. Attach the first section of riser pipe to the pump.
4. Lower the pump into the well. Make sure the motor cable is not damaged when the pump is lifted or lowered into the well, especially in 3 inch wells.
   Note: Do not lower or lift the pump using the motor cable.
5. When the pump has been installed to the required depth, the installation should be finished by means of a well seal.
   Note that the dynamic water level should always be above the pump.
6. Loosen the safety wire so that it becomes unloaded and lock it to the well seal using a cable clamp.
7. Complete the electrical connections.

Note: The pump must never be connected to a capacitor or to another type of control box than Redi-Flo3 Status Box, CU 300 or CU 301.

Installation depths

Maximum installation depth:
500 feet below the static water level.

Minimum installation depth:
1.75 feet below the dynamic water level.

Vertical installation

During start-up and operation, the pump must always be completely submerged in water.

Horizontal installation

The pump must be installed at least 1.75 feet below the dynamic water level.

If there is a risk that the pump might be covered by mud, the pump must always be placed in a flow sleeve.

Note: Do not lower or lift the pump using the motor cable.

10. Generator operation

It is safe to operate the Redi-Flo3 with a generator.

The generator must be sized 50% above the P_1 (input power) values of the pump. See the following table.

Motor [hp]	Minimum generator size [W]	Recommended generator output [W]
0.5	1200	1500
0.75	1900	2500
1.0	2600	3200
1.5	2800	3500

11. Starting the pump for the first time

When the pump has been connected correctly, the pump should be started with the discharge valve closed approximately one third.

Due to the soft start feature, the pump takes approximately 2 seconds to develop full pressure.

11.1 Motor cooling and other considerations

- Make sure the well is capable of yielding a minimum quantity of water corresponding to the pump capacity.
- Do not start the pump until it is completely submerged in the liquid.
- As the valve is being opened, the drawdown should be checked to ensure that the pump always remains submerged.
- To ensure the necessary cooling of the motor, the pump should never be set so low that it gives no water.
  If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield. The pump must immediately be stopped and the fault corrected.

11.2 Impurities in the water

If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is clean, otherwise the pump parts and the check valve may become clogged.

When the water is clean, the valve should be fully opened.

11.3 Minimum flow rate

To ensure the necessary cooling of the motor, the pump flow rate should never be set to a value lower than 0.2 gpm.

If the flow rate suddenly falls, the reason might be that the pump is pumping more water than the well can yield. The pump must immediately be stopped and the fault corrected.

WARNING: The pump's dry-running protection is effective only within the recommended duty range of the pump.

Note: Do not let the pump run against a closed discharge valve for more than 5 minutes. When the discharge valve is closed, there is no cooling flow and there is a risk of overheating in motor and pump.

11.4 Built-in functions

The motor incorporates an electronic unit which functions as follows:

- In case of overload, the built-in overload protection will stop the pump for 5 minutes. After that period, the pump will attempt to restart.
- If the pump has been stopped as a result of dry running, it will start automatically after 5 minutes.
- If the pump is restarted and the well has not recovered, the pump will stop after 30 seconds.

11.5 Resetting the pump

Switch off the electricity supply for 1 minute.

11.6 MSE 3 motors

Note: All motors are factory-set to detect dry-running conditions. However, if the maximum pump speed setting is changed, the dry running stop value must also be changed. Please refer to either the Redi-Flo3 Status Box, CU 301 or CU 300 I&O for instructions on this procedure.

11.7 Maintenance and service

The pumps are normally maintenance-free.

Deposits and wear may occur. For that purpose, service kits and service tools are available from Grundfos.

The pumps can be serviced at a Grundfos service center.

12. Assembly of pump and motor

To assemble pump end and motor, proceed as follows:

1. Place the motor horizontally in a vice and tighten it, see fig. 11.
2. Pull the pump shaft out to the position shown in fig. 10.

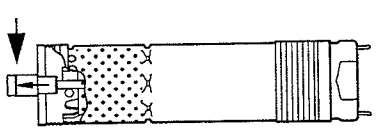


Fig. 10 Pump shaft position

3. Grease the motor shaft end with the grease supplied with the motor.
4. Screw the pump end on the motor (55 Nm).
   Note: The pump shaft must engage with the motor shaft.
   A spanner may be used on the clamping faces of the pump end, see fig. 11.
5. Fit the cable guard as described in section 7.

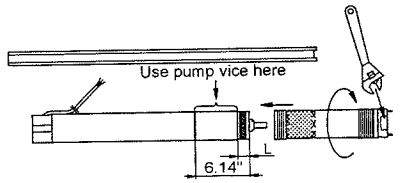


Fig. 11 Pump in vice

0.5 hp: L = 4.7".
0.75 hp: L = 4.0".
1.0 hp: L = 2.6".
1.5 hp: L = 2.6".

When pump end and motor have been assembled correctly, there must be no clearance between pump end and motor.

To disassemble, reverse procedure.

13. Troubleshooting

Fault	Cause	Remedy
1. The pump does not run.	a) The fuses are blown.	Replace the blown fuses. If the new fuses blow too, check the electrical installation and the drop cable.
	b) The GFI circuit breaker has tripped.	Reset the circuit breaker.
	c) No electricity supply.	Contact the electricity provider.
	d) The motor protection has cut off the electricity supply due to overload.	Check for motor/pump blockage.
	e) The drop cable is defective.	Repair or replace the pump/cable.
	f) Overvoltage has occurred.	Check the electricity supply.
2. The pump runs but gives no water.	a) The discharge valve is closed.	Open the valve.
	b) No water or too low water level in well.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	c) The check valve is stuck in its closed position.	Pull the pump and clean or replace the valve.
	d) The suction strainer is closed.	Pull the pump and clean the strainer.
	e) The pump is defective.	Repair or replace the pump.
3. The pump runs at reduced capacity.	a) The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or replace it with a smaller capacity model.
	b) The valves in the discharge pipe are partly closed/blocked.	Check and clean or replace the valves as necessary.
	c) The discharge pipe is partly choked by impurities (iron bacteria).	Clean or replace the discharge pipe.
	d) The check valve of the pump is blocked.	Pull the pump and clean or replace the valve.
	e) The pump and the riser pipe are partly choked by impurities (iron bacteria).	Pull the pump. Check and clean or replace the pump, if necessary. Clean the pipes.
	f) The pump is defective.	Repair or replace the pump.
	g) Hole in discharge pipe.	Check and repair the piping.
	h) The riser pipe is defective.	Replace the riser pipe.
	i) Undervoltage has occurred.	Check the electricity supply.
4. Frequent starts and stops.	a) The differential of the pressure switch between the start and stop pressures is too small.	Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank and the start pressure should be high enough to ensure sufficient water supply.
	b) The water level electrodes or level switches in the reservoir have not been installed correctly.	Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between start/stop cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve.
	c) The check valve is leaking or stuck half-open.	Pull the pump and clean or replace the check valve.
	d) The supply voltage is unstable.	Check the electricity supply.
	e) The motor temperature is too high.	Check the water temperature.

13.1 Instruments not allowed

Note: The use of the following instruments is not allowed during troubleshooting.

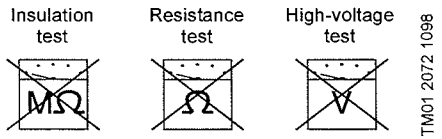
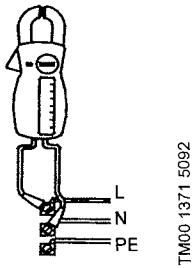
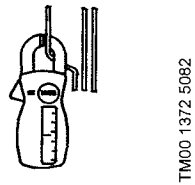


Fig. 12 Instruments not allowed

Note: When measuring, use RMS instruments.

14. Checking of motor and cable

1. Supply voltage  	Measure the voltage L1 (RMS) between phase and L2. Connect the voltmeter to the terminals at the connections.	The voltage should, when the motor is loaded, be within the range specified in section *4. Electrical connection.* Large variations in supply voltage indicate poor electricity supply, and the pump should be stopped until the problem has been corrected.
2. Current consumption  	Measure the current (RMS) while the pump is operating at a constant discharge head (if possible, at the capacity where the motor is most heavily loaded). For maximum current, see motor nameplate.	If the current exceeds the full-load current, there are the following possible faults: • Poor connection in the leads, possibly in the cable joint. • Too low supply voltage, see item 1.

15. Environment

During handling, operation, storage and transport, all environment regulations dealing with the handling of hazardous materials must be observed.

WARNING:

When the pump is taken out of operation, it must be ensured that no hazardous material is left in the pump and in the riser pipe, which can be injurious to persons and the environment.

16. Technical data

Supply voltage

1 x 100-115 V, 50/60 Hz, PE.

1 x 200-240 V, 50/60 Hz, PE.

Operation via generator

Recommended generator output must be equal to P_1 [kW] + 50% and minimum P_1 + 10%.

Starting current

The motor starting current is equal to the highest value stated on the motor nameplate.

Starting

Soft starting.

Run-up time

Maximum 2 seconds.

Motor protection

Motor overload protection against locked rotor and running-overload protection must be provided by the installer.

Power factor

PF = 1.

Service factor

0.5 hp: 1.85 at 115 V/240 V.
0.75 hp: 2.05 at 240 V.
1.0 hp: 2.25 at 240 V.
1.5 hp: 1.65 at 240 V.

Motor cable

3-wire, RHW-2, 12 AWG ETFE.
Length: 5 feet.

Motor liquid

Type SML 2 or SML 3.

pH values

5 to 9.

Liquid temperature

The temperature of the pumped liquid must not exceed 86°F.

Discharge port

10 SQE-NE: 1¼" NPT.

22 SQE-NE: 1½" NPT.

Storage conditions

Minimum ambient temperature: 4°F.
Maximum ambient temperature: 140°F.

Freeze protection

Note: The motor must not be stored without being filled with motor liquid.

If the pump has to be stored after use, it must be stored on a frost-free location or it must be ensured that the motor liquid is frost-proof.

Operating conditions

Maximum ambient liquid temperature: 86°F.

Motor dimensions

0.5 hp: 20.9" length x 2.68" diameter.
0.75 hp: 20.9" length x 2.68" diameter.
1.0 hp: 22.3" length x 2.68" diameter.
1.5 hp: 22.3" length x 2.68" diameter.

Motor weights

0.5 hp: 6.0 lbs.
0.75 hp: 7.1 lbs.
1.0 hp: 8.2 lbs.
1.5 hp: 8.2 lbs.

Pump end dimensions

Pump diameter: 2.68".
Pump diameter, incl. cable guard: 2.91".

Pump end dimensions (min. and max.)

10 SQE-NE: 10.6" to 14.8".
22 SQE-NE: 10.6" to 16.9".

Pump end weights (min. and max.)

All SQE-NE models: 2.2 lbs to 3.5 lbs.

Well diameter

Minimum 3".

Installation depth

Maximum 500 feet below static water level.

17. Accessories

Product	Product number
Redi-Flo3 Status Box	96440289
Flow sleeve	96037505
Grease	96037562
Grundfos SPP 1 potentiometer	625468
R100 remote control	625333
Submersible drop cable. 12 AWG ETFE with end cover and socket in lengths of	
25 ft	96160895
50 ft	96160896
75 ft	96160897
100 ft	96160898
125 ft	96160899
150 ft	96160900
175 ft	96160901
200 ft	96160902
225 ft	96160903
250 ft	96160904
300 ft	96160905

18. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

BE › THINK › INNOVATE ›

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

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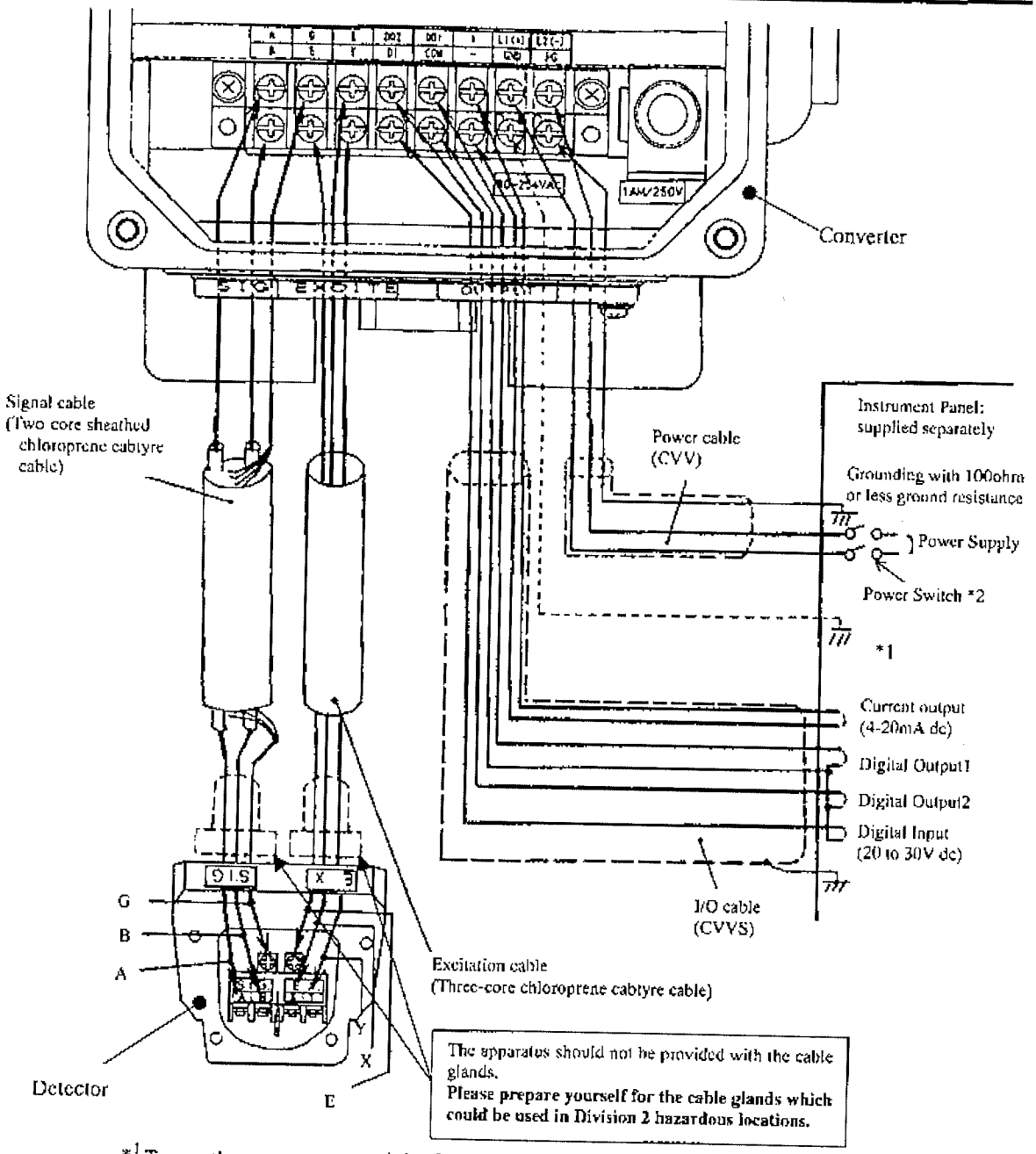


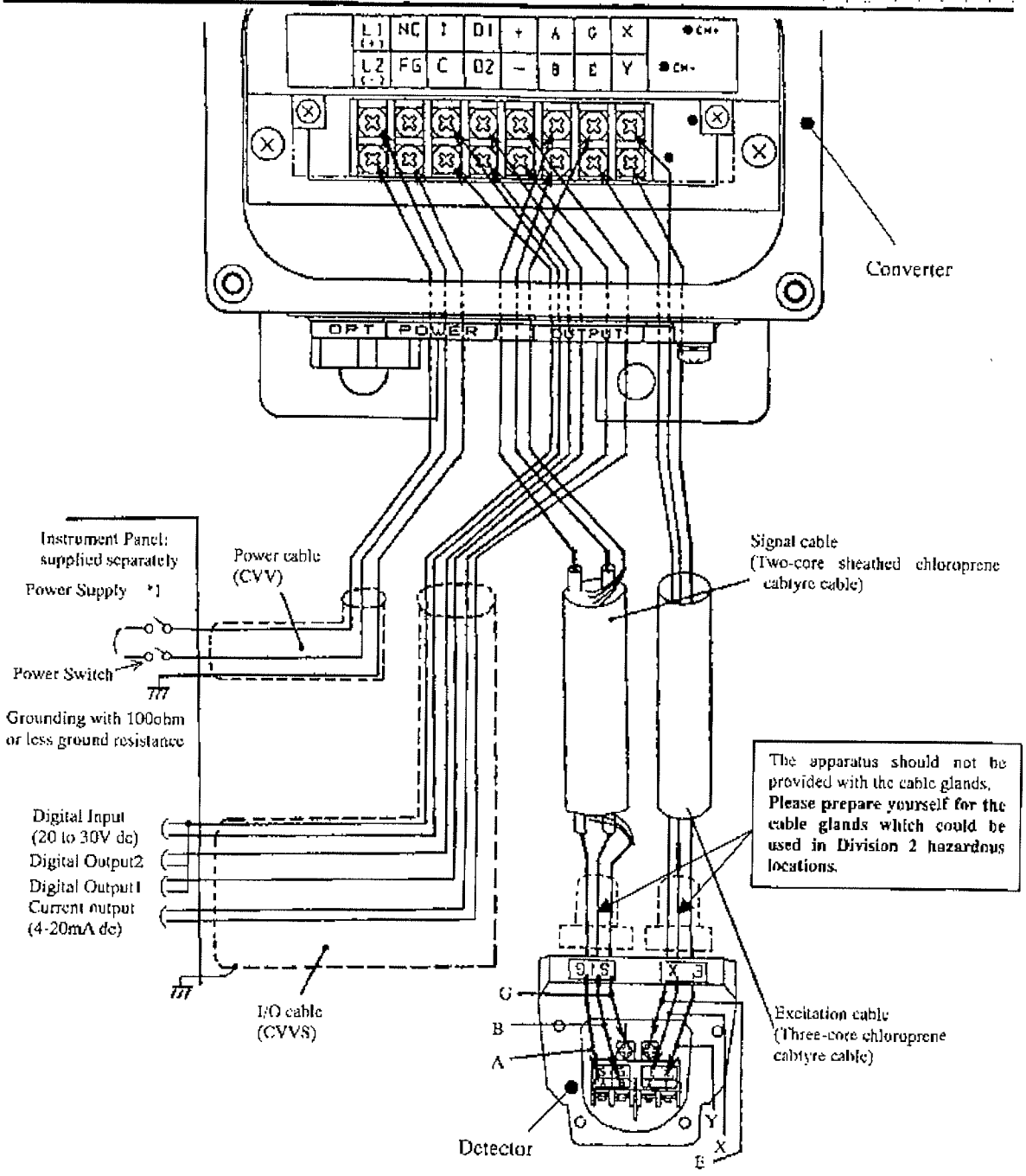
*1 To use the arresters, ground the GND terminal using a wire shown in broken line.

*2 Locate an external double-pole power switch on the power line near the flowmeter and within easy operation. Mark on the switch as the disconnecting device for the flowmeter.

Use the proper switch as follows.

Recommended switch rating;	Rating	AC250V 6A or more
	Inrush current	15A or more

Figure 5.1 In Case Of LF424 Terminal Board Connections



*1 Locate an external double-pole power switch on the power line near the flowmeter and within easy operation. Mark on the switch as the disconnecting device for the flowmeter. Use the proper switch as follows.

Recommended switch rating; Rating AC250V 6A or more
Inrush current 15A or more

Figure 5.2 In Case Of LF424 With Terminal Box Terminal Board Connections

■Excitation Cable

Remove each core coating for cable as shown in Figure 5.6. Next, attach the M3.5 insulating sleeve crimp-style terminals. Then, connect to terminal block X and Y. Also, connect the red cable core to terminal block E

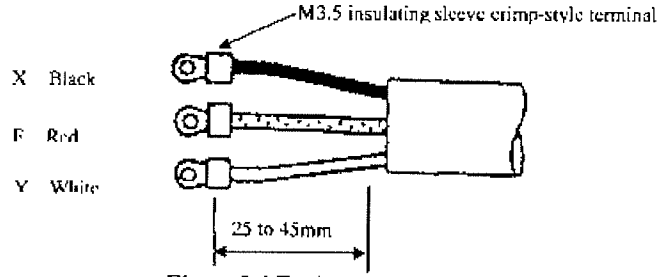


Figure5.6 Excitation cable and processing

■Power and communication signal Cable

The contractor should prepare the necessary cables.

Remove each core coating for cable. Next, attach the M3.5 insulating sleeve crimp-style terminals. Then, connect to terminal block L1 and L2, and connect the communication signal cable to terminal block + and -.

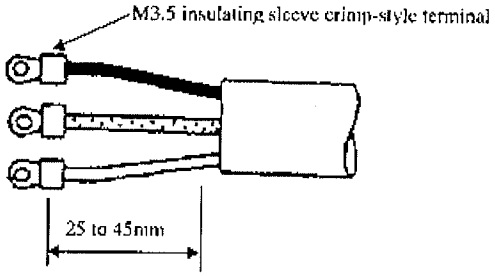
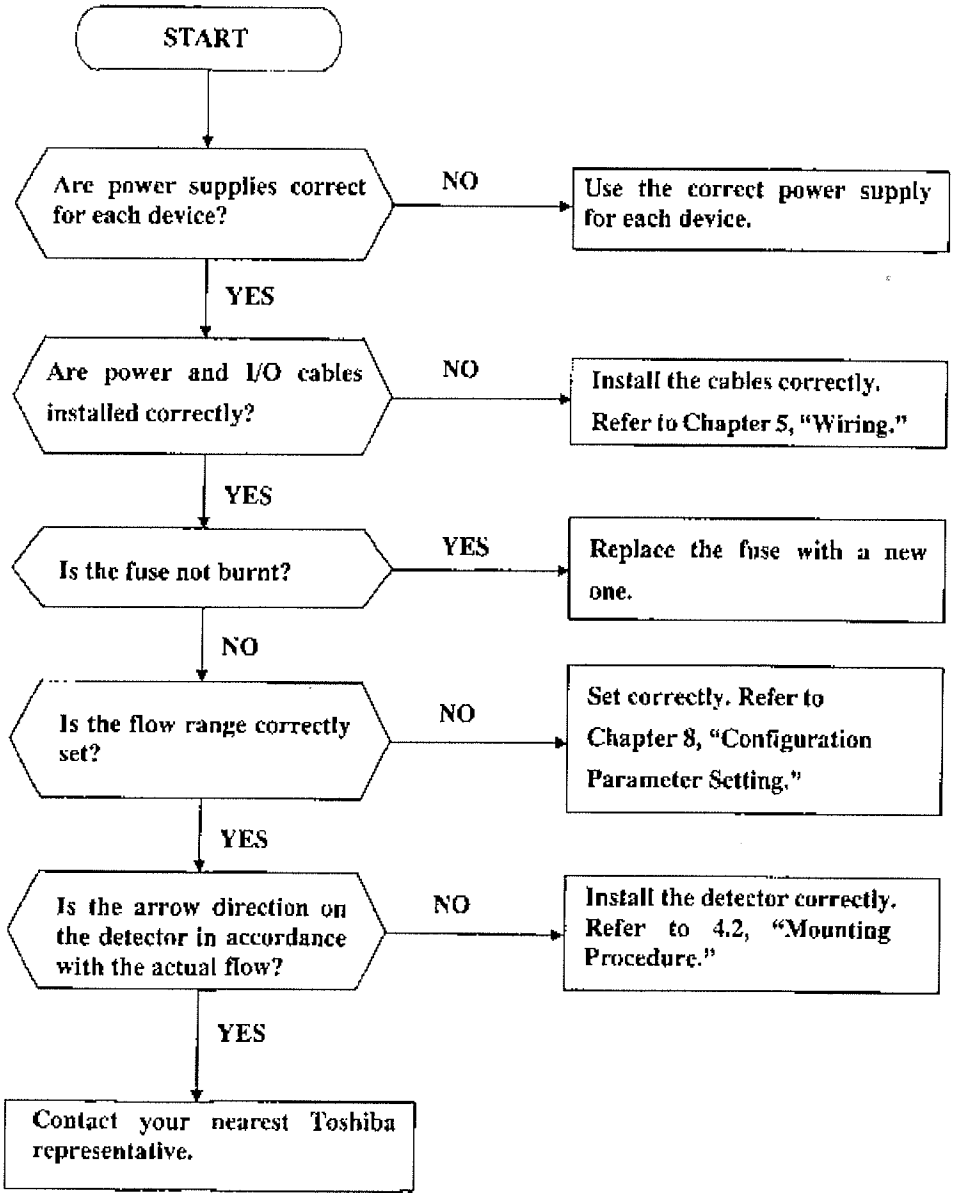


Figure 5.7 Termination of cables

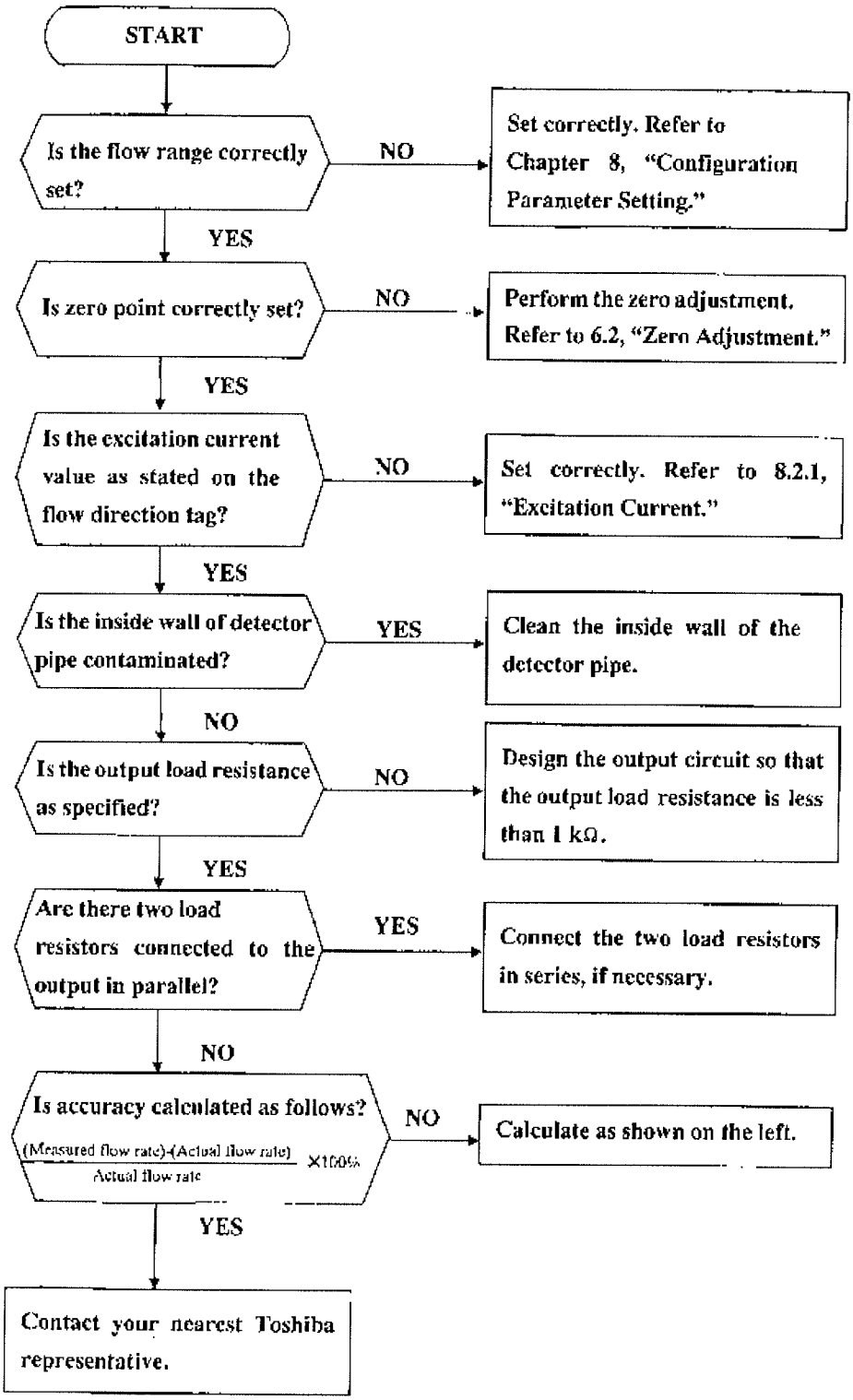
13.2 Troubleshooting

If a problem occurs while using the LF424, follow the flowcharts described below. You may find a way to solve the problem. The flowcharts are based on three symptoms (1) to (3). If you cannot solve the problem, contact your nearest Toshiba representative.

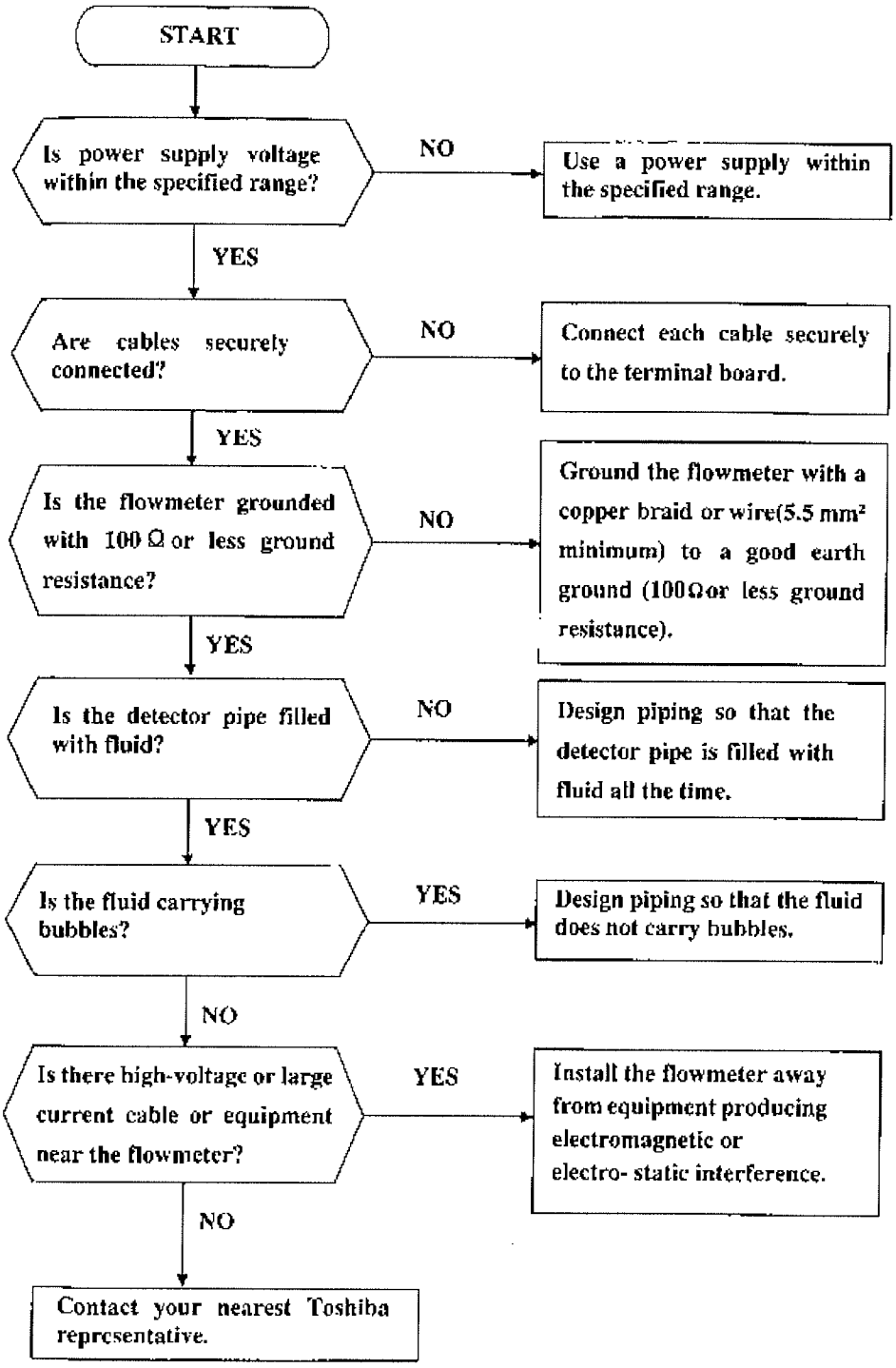
(1) Flow rate is not indicated.



(2) Flow rate indication is not correct.



(3) Flow rate indication is not stable.



Appendix C

Photographic Log of Recovery Well RW-1

Recovery well RW-1 and sample port A4487 (shown with a red sample identification tag).

Recovery well RW-1.

Figures

COLORADO AVE. S

1ST AVE. S

HUDSON BUILDING

MW-13

RW-3

MW-4

MW-5

MW-1

MW-6

MW-7

MW-8M

MW-8S

RW-2

MW-12

MW-19M

EPI-MW-1S

EPI-MW-1D

EPI-MW-4S

EPI-MW-3S

EPI-MW-4D

EPI-MW-2S

EPI-MW-2D

EPI-MW-3D

MW-14D

MW-14M

MW-11

WESTERN CARTAGE

MW-20M

MW-10

RW-1

MW-3

FORMER GEAE PLANT

MW-2

2ND AVE. S

3RD AVE. S

MW-9

MW-17D

MW-17M

MW-21S

MW-15D

MW-15M

MW-16M

MW-16D

MW-18D

MW-18M

S DAWSON STREET

N

50 0 100

SCALE IN FEET

NOTES:

1. MONITORING WELLS MW-8, MW-14S, MW-15S, AND MW-16S HAVE BEEN RENAMED MW-8S, MW-14M, MW-15M, AND MW-16M.

LEGEND

- MONITORING WELL
- GROUNDWATER EXTRACTION WELL
- ON-SITE AREA
- OFF-SITE AREA

ENSR | AECOM

Merged with ENSR in 2007

RETEC

GEAE - S. DAWSON STREET

GE001-19314-735

SITE LOCATION MAP

DATE: 06/04/07 | DRWN: E.M./SEA | **FIGURE 1-1**

File: H:\19314\19314S125.dwg Layout: FIGURE 1-1 User: emarshall Plotted: Jun 04, 2007 - 11:22am Xref's: