

Elliptic Throat Flow Meter (Sensor Terminal)

Model SDR11F

User's Manual



Azbil Corporation

Copyright, Notices and Trademarks

While this information is presented in good faith and believed to be accurate, Azbil Corporation disclaims the implied warranties of merchantability and fitness for a particular purpose and makes no express warranties except as may be stated in its written agreement with and for its customer.

In no event is Azbil Corporation liable to anyone for any indirect, special or consequential damages, The information and specifications in this document are subject to change without notice.

Introduction

Thank you for purchasing our elliptic throat flow meter. This is a differential pressure sensor element of high performance and high reliability developed with our ample experience and knowhow in differential pressure flow meters. The elliptic-shaped tapered restrictor provided in the flow channel is a sensor element designed to detect differential pressure at low pressure loss. This flow meter ensures accurate measurements even for those gases, liquids, and steams that have been regarded difficult to measure.

Unpacking, Checking, and Storage

Unpacking

This is a precision instrument. Unpack it carefully to prevent an accident and damage.

Make sure that the following items are in the package:

- Main unit
 - Standard accessories (Gaskets and bolts come with differential pressure output model number “S”.)
-

Checking the specifications:

The specifications are shown on the name plate on the flow meter. Referring to Appendix A “Standard Specifications and Model Number Structure,” make sure that the specifications on name plate agree with your order. Please be sure to check the following items:

- Diameter
 - Main unit material
 - Flange rating
 - Pressure port flange type
-

Contact point for inquires:

Direct any inquiry concerning the specifications to the contact point given at the end of this manual. Make an inquiry with information about the model number and the product number. The product number is engraved on the main unit of the instrument.

Storage instructions:

In storing this instrument immediately after delivery, observe the following instructions:

- Store it in an indoor environment of normal temperature and normal humidity where the instrument is not exposed to vibration or shock.
- Store it in the state of factory packaging.

In storing this instrument after using it, observe the following instructions:

1. Rinse out the fluid completely from the main unit and dry it.
 2. Package the instrument to the state of factory packaging.
 3. Store it in an indoor environment of normal temperature and normal humidity where the instrument is not exposed to vibration or shock.
-

Safety Instructions

Introduction

Correct installation and operation and appropriate maintenance are essential to use this instrument safely. Read the safety instructions in the manual carefully to gain an accurate understanding before starting installation, operation, and maintenance work.

Symbol marks

The following symbol marks are used in this manual to ensure safety of operation:



This symbol is used when failure to observe an instruction may result in death or serious injury.



This symbol is used when failure to observe an instruction may result in slight injury or physical damage.

Structure and Contents of the Manual

Structure and contents

This manual provides operating instructions in the following order:

Section 1:

This section is concerned with the structure of the flow meter and the names of its parts.

Section 2:

This section is concerned with installation and cabling. Those who are in charge of installation, piping, and cabling are asked to refer to this section.

Section 1 Configuration of Measuring System and Structure

1

Overview of section

This section is concerned with the configuration of a measuring system using this instrument.

- The structure of the flow meter and the names and functions of its parts are also explained.

1.1. Structure and Functions of Parts

Explanation

The elliptic throat flow meter has the following function and structure:

- The elliptic throat flow meter has an elliptic tapered restrictor in the flow channel. It measures the flow rate by obtaining the differential pressure between the both sides of the restrictor.

Parts names of flow meter

Figure 1-1 shows the structure and the parts names of the elliptic throat flow meter.

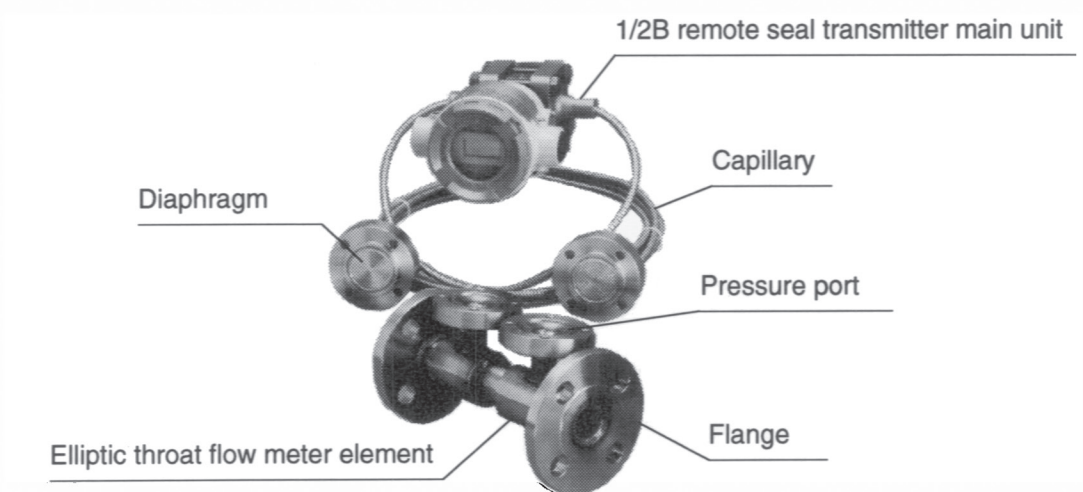



Figure 1-1. Detailed structure of elliptic throat flow meter

Parts names and explanation

The parts are explained in the following table.

Name	Explanation
1/2B remote seal transmitter main unit	<ul style="list-style-type: none"> This is a remote seal type transmitter that is connected to a flow meter to take out pressure from the pressure port. It can be mounted directly or via a stop valve.
Pressure port	<ul style="list-style-type: none"> A stop valve or a remote seal transmitter is directly mounted on this part. Differential pressure is taken out from this port.
Elliptic throat flow meter element	<ul style="list-style-type: none"> It is a differential pressure sensor having an elliptic restrictor in the flow channel. The pressure loss is only about 1/2~1/4 of the orifice.


Warning

- Do not disconnect any device from the pressure port while the flow meter is connected to a pipe.
(Steam or fluid in the pipe may gush to cause injury.)

Section 2 Installation

Overview of section

This section provides installation instructions with focus on the following:

- Flow meter installation
- Zero point adjustment
- Remarks related to installation

2.1. Instructions Related to Flow Meter Installation

Selecting installation direction:

Table 1 provides instructions related to installation of a flow meter on a horizontal pipe.

Change the differential pressure output direction according to the fluid type.

Table 1.

	Fluid type	Differential pressure output direction
Mounting on a horizontal pipe	Liquid without solids	Straight downward or downward
	Liquid with solids (without cohesive property)	Continuous process 6 Upward
		Batch process 6 Lateral
	Gas	Upward
	Steam	Upward
Mounting on a vertical pipe	All fluids excluding adhesive liquids	Lateral

⚠ Caution

- The elliptic throat flow meter element is made of SUS316 or SUS316L. Avoid using corrosive fluids.

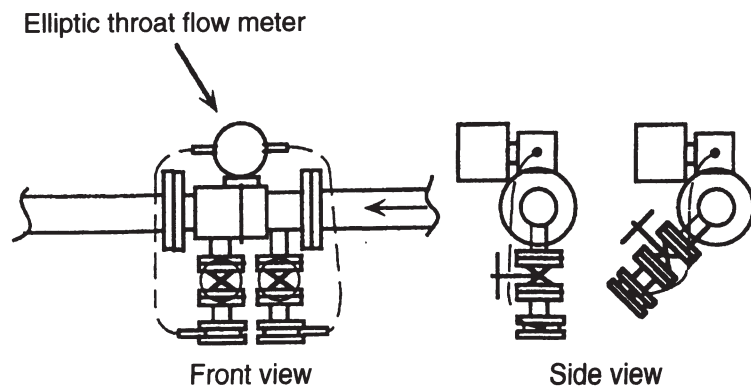
⚠ Caution

- Concerning the operating instructions and settings of the differential pressure transmitter, refer to its manual.

1. Example of straight downward or downward installation

Liquid without slurry

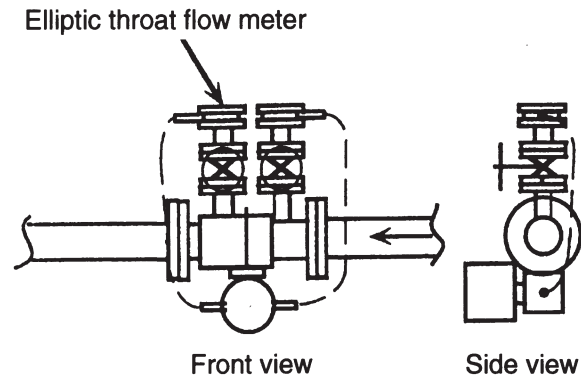
Example: Pure water, water, oil, organic solvent, food without CIP



GL

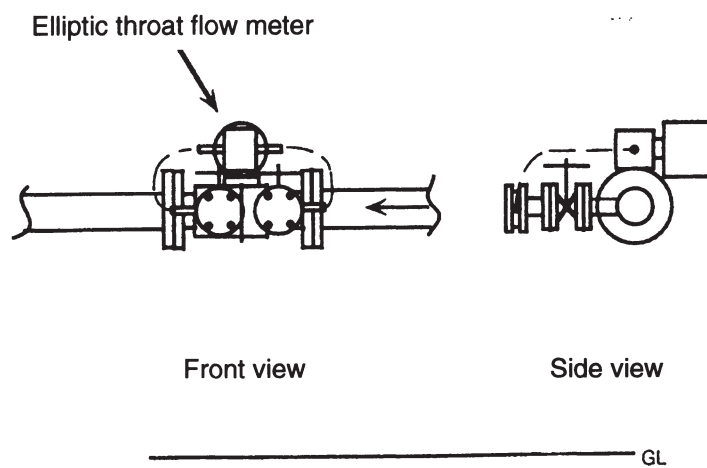
2. Example of straight upward installation

Slurry liquid (continuous process) or adhesive liquid



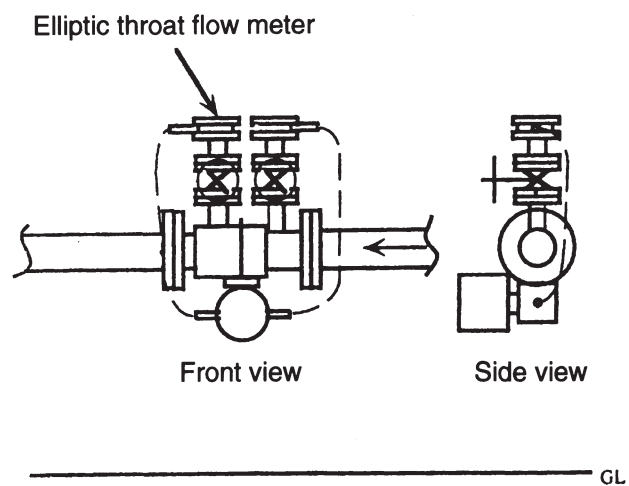
3. Example of lateral installation

Slurry liquid (batch process)



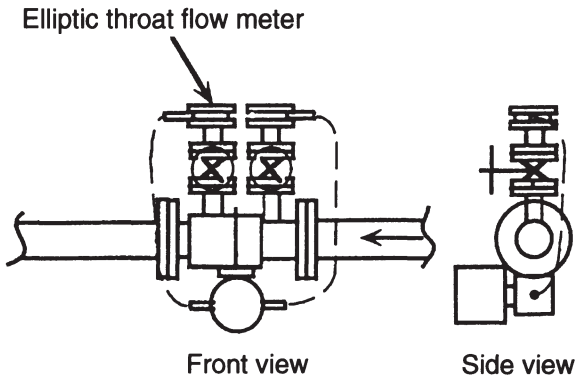
4. Example of straight upward installation

Oil and oil slurry of 180°C or higher temperature



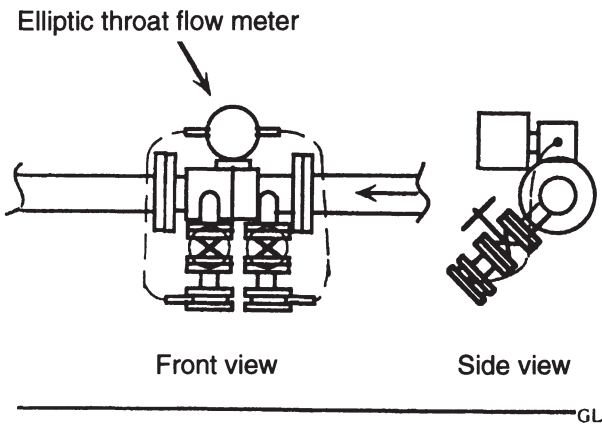
5. Example of straight upward installation

Gas and steam (up to 280°C depending on the transmitter specifications)



6. Example of downward installation at angle

Steam of 180°C or higher (up to 280°C depending on the transmitter specifications)



⚠ Caution

- Perform zero adjustment after gathering drain in the pressure receiving part or prevent gathering of drain at the pressure output by means of warming.

Inquire us about other installation methods.

2.2. Zero Point Adjustment Procedure

1. Liquid without solids

Stop the process when the pipe is filled with liquid and then perform zero adjustment.

- Performing zero adjustment without filling the pipe will cause an error.
 - A flow meter installed in the straight downward or oblique downward position does not require air venting. Perform zero adjustment after venting air when a flow meter cannot be installed in the recommended position due to some restrictive piping conditions or when an adaptor for a 1/2B remote seal transmitter is mounted.
-

2. Liquid containing solids (including a process in which liquid is heated to prevent adhesion)

2.1 Continuous process

Stop the process when the pipe is filled with liquid and then perform zero adjustment. Perform zero adjustment after venting air when an adaptor for a 1/2B remote seal transmitter is mounted.

- Performing zero adjustment without filling the pipe will cause an error.

2.2 Batch process in which the pipe becomes empty after operation

Stop the process after filling the pipe for the first time and then perform zero adjustment. Perform zero adjustment after venting air when an adaptor for a 1/2B remote seal transmitter is mounted.

- The zero point will shift when the pipe becomes empty, but this will not influence measurement accuracy. The zero point shifts due to the difference between the filled and empty state of the pipe.

2.3 Batch process in which the pipe is filled with liquid even after operation

Stop the process when the pipe is filled with liquid and then perform zero adjustment. Perform zero adjustment after venting air when an adaptor for a 1/2B remote seal transmitter is mounted.

3. Adhesive liquid

Do not vent air because the diaphragm surface is protected with air. Perform zero point adjustment when the pipe is filled with liquid.

- Performing zero adjustment without filling the pipe will cause an error.

Caution: Vertical piping is not possible for adhesive liquid.

**4. Vertical piping
(Liquid containing
no solids, liquid
containing liquids)**

Stop the process when the pipe is filled with liquid and then perform zero adjustment.

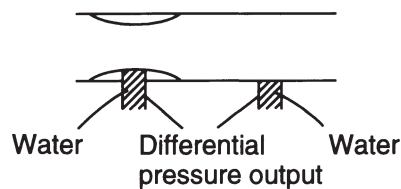
When an adaptor for a 1/2B remote seal transmitter is mounted, perform zero adjustment after venting air.

→ Performing zero adjustment without filling the pipe will cause an error.

5. Gas and steam

Horizontal piping: Perform zero adjustment as soon as installing this flow meter.

In measuring the flow rate after gathering drain in the pressure receiving part, make sure that drain is as illustrated below before performing zero adjustment.



Vertical piping: Perform zero adjustment as soon as installing this flow meter.

2.3 Remarks related to installation

Pipe vibration

Make sure that pipe vibration is below 19.6 m/s^2 (2G) and within the range of 0~400 Hz. The vibration conditions of the pressure receiving part and the remote seal unit depend on the specifications of the transmitter.

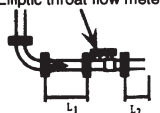
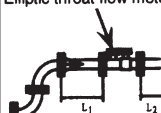
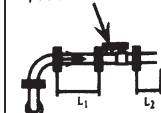
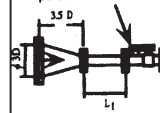
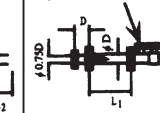
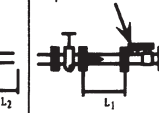
Flow direction

- (1) The elliptic throat flow meter has an elliptic restrictor which requires fluid flowing in a fixed direction. Make sure that a fluid flows in the direction of the arrow engraved on the side of the sensor terminal.
- (2) In case of vertical piping, run a fluid in the upward direction.

Straight pipe length

The length requirements of a straight pipe are given in the following table:

It is the minimum length requirement of the straight pipe mounted between an elliptic throat flow meter and a joint on the upstream or downstream side of the flow meter. Each of the figures in the table means a multiple of the pipe diameter.

Diameter ratio β	Upstream side L_1						Downstream side L_2
	 One 90°C bend	 Two or more 90°C bends on the same plane	 Two or more 90°C bends on different planes	 Contraction pipe	 Expansion pipe	 Gate valve (full open)	All joints shown on the left
0.40	0.5	1.5	40	2.5	1.5	2.5	0.6
0.50	1.5	2.5	40	5.5	2.5	3.5	1.0
0.60	3.0	3.5	40	8.5	3.5	4.5	1.5
0.70	4.0	4.5	40	10.5	5.5	5.5	2.0

Note 1: The curvature diameter of a bend should be at least equal to the inner diameter of the pipe.

Note 2: The straight pipe length on the upstream side and the downstream side is the distance measured from the upstream and downstream flanges of the elliptic throat flow meter, respectively.

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.

You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place. Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

- (1) Failure caused by your improper use of azbil product (noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
- (2) Failure caused for other reasons than Azbil Corporation's product;
- (3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
- (4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
- (5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
- (6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

- (1) Regulations and standards or laws that your Equipment is to comply with.
- (2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
- (3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use

Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down. You are required to provide your Equipment with safety design such as fool-proof design,^{*1} and fail-safe design^{*2} (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance,^{*3} fault tolerance,^{*4} or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.

*2. A design that is safe even if the device fails.

*3. Avoidance of device failure by using highly reliable components, etc.

*4. The use of redundancy.

3. Precautions and restrictions on application

3.1 Restrictions on application

Please follow the table below for use in nuclear power or radiation-related equipment.

	Nuclear power quality ^{*5} required	Nuclear power quality ^{*5} not required
Within a radiation controlled area ^{*6}	Cannot be used (except for limit switches for nuclear power ^{*7})	Cannot be used (except for limit switches for nuclear power ^{*7})
Outside a radiation controlled area ^{*6}	Cannot be used (except for limit switches for nuclear power ^{*7})	Can be used

*5. Nuclear power quality: compliance with JEAG 4121 required

*6. Radiation controlled area: an area governed by the requirements of article 3 of "Rules on the Prevention of Harm from Ionizing Radiation," article 2 2 4 of "Regulations on Installation and Operation of Nuclear Reactors for Practical Power Generation," article 4 of "Determining the Quantity, etc., of Radiation-Emitting Isotopes," etc.

*7. Limit switch for nuclear power: a limit switch designed, manufactured and sold according to IEEE 382 and JEAG 4121.

Any Azbil Corporation's products shall not be used for/with medical equipment.

The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.

3.2 Precautions on application

you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below. Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

- (1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
- (2) For use of specific purposes, such as:
 - * Nuclear energy/radiation related facilities
[When used outside a radiation controlled area and where nuclear power quality is not required]
[When the limit switch for nuclear power is used]
 - * Machinery or equipment for space/sea bottom
 - * Transportation equipment
[Railway, aircraft, vessels, vehicle equipment, etc.]
 - * Antidisaster/crime-prevention equipment
 - * Burning appliances
 - * Electrothermal equipment
 - * Amusement facilities
 - * Facilities/applications associated directly with billing
- (3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
- (4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
- (5) Machinery or equipment that may affect human lives, human bodies or properties
- (6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification. Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used. Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals. System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts. For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason. For inquiries or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice. After manufacturing is discontinued, we may not be able to provide replacement products even within the warranty period.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts. For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service. Accordingly, a separate fee will be charged in any of the following cases:

- (1) Installation, adjustment, guidance, and attendance at a test run
- (2) Maintenance, inspection, adjustment, and repair
- (3) Technical guidance and technical education
- (4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

Document Number:	CM2-SDR100-2001
Document Name:	Elliptic Throat Flow Meter (Sensor Terminal) Model SDR11F User's Manual
Date:	1st edition: Sep. 1999 3rd edition: Jan. 2020
Issued/Edited by:	Azbil Corporation

Azbil Corporation