



Enclosed Limit Switch

VCL-5***-** Series

User's Manual



Thank you for purchasing our product. This manual contains information for ensuring correct and safe use of this product. Please read and understand it thoroughly before using this product, and keep it nearby after installation for handy reference.

Azbil Corporation

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact the azbil Group.

In no event is Azbil Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

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SAFETY PRECAUTIONS

■ About Icons

The safety precautions described in this manual are indicated by various icons. Please be sure you read and understand the icons and their meanings described below before reading the rest of the manual.

Safety precautions are intended to ensure the safe and correct use of this product, to prevent injury to the operator and others, and to prevent damage to property. Be sure to observe these safety precautions.



WARNING

Warnings are indicated when mishandling this product might result in death or serious injury.



CAUTION

Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to the product.

■ Examples

	Use caution when handling the product.
	The indicated action is prohibited.
	Be sure to follow the indicated instructions.

WARNING



Be sure to turn the power supply of the equipment OFF before wiring the limit switch. Failure to do so might result in electric shock depending on power supply voltage or involved in unsafe condition such as unintentional machine start.



Never use or leave the limit switch unattended with the cover or conduit open.
Doing so might allow ingress of water or dust, resulting in malfunction.



This switch is not explosion-proof.
If an explosion-proof specification is required, use the VCX-5***series.

CAUTION



The environmental conditions for the safe use of this limit switch are described in the product specification sheet.
Use this limit switch within the allowable range of each characteristics.



Check the limit switch periodically to make sure that it is operating normally.



If the cover or housing of this limit switch becomes dented or cracked, replace the complete switch immediately.
Failure to do so may result in loss of seal performance.

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Conventions Used in This Manual

The following conventions are used in this manual:

! **Handling Precautions**

: Handling Precautions indicate items that the user should pay attention to when handling the limit switch.

(1), (2), (3)

: The numbers with the parenthesis indicate steps in a sequence or indicate corresponding parts in an explanation.

Chapter 1 OUTLINE

■ Features

- 2 switches are arranged as follows:
 - One each switch operates cw or ccw with center neutral.
 - 2 switches operate simultaneously in both direction.
- Sealing by V-ring for shaft and O-rings for stationary parts allows outdoor use.
- Ample space in the terminal box and G3/4 (PF3/4) conduit connection provide easy wiring.
- IP67

■ Specifications

 WARNING
 Use this switch within the specifications described below.

Item	Specifications		
	None	H	L
Installation sites	Outdoor		
Protective structure	IP67 or equivalent (JIS water-proof type)		
Operating temperature range	-10 to +70°C	-10 to +100°C	-55 to +70°C
Max. operating humidity	98%RH		

The detailed specifications for the limit switch are described in the product specification sheet. The product specification drawing Nos. are shown below. These drawings can be obtained from your Azbil Corporation representative.

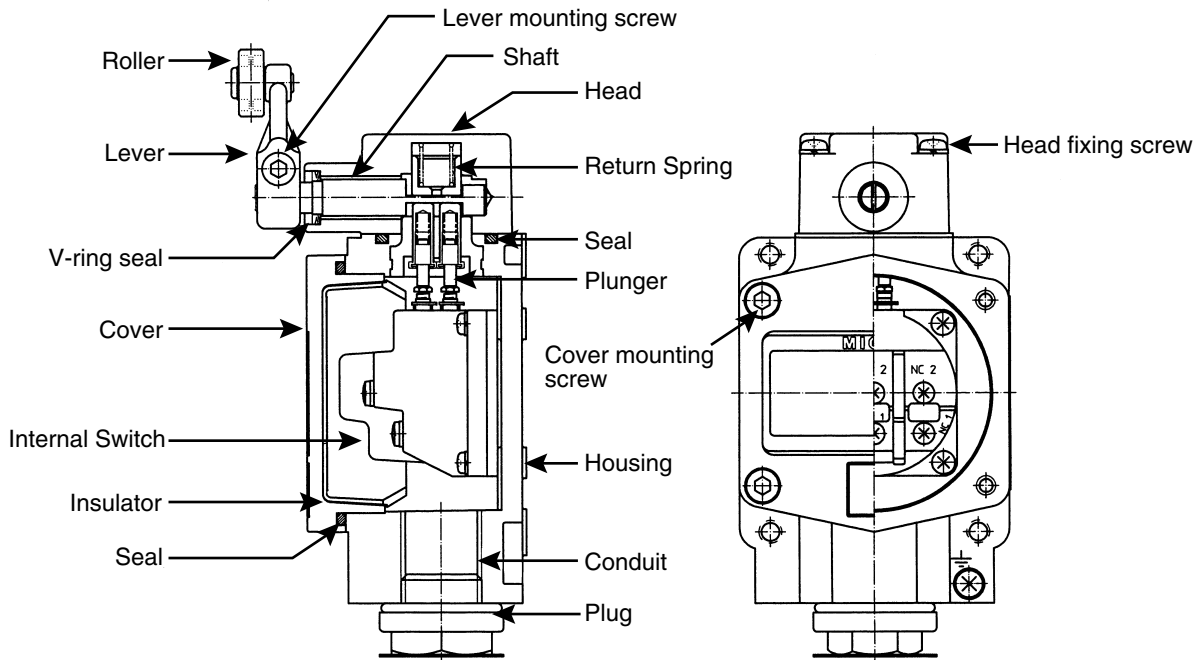
Product specification drawing No.:AD50424E

Chapter 2 NOMENCLATURE

■ Appearance and Structure of the Limit Switch

The force applied from outside the limit switch is transferred to the actuator lever → shaft → plunger → internal switches, to switch the electrical circuit.

The limit switch lever rotates both cw and ccw.



■ Model Number Construction

VCL-5 *** **

└ Ambient

Non : General use

H : For High Temperature *

L : For Low Temperature *

└ Contact

Non : General use

K : For Low voltage/current load

└ Type of actuator

01 : Standard Roller Lever

02 : No Actuator

03 : Adjustable-length Roller Lever Actuator

└ Switch Arrangement

0 : Center neutral type

1 : Simultaneous type

* These are usable temperature, refer to page 1 for the certified temperature.

Chapter 3 INSTALLATION

This chapter describes the installation procedure for the limit switch.

WARNING



This switch is not explosion-proof.
If an explosion-proof specification is required, use the VCX-5*** series.

CAUTION



Until wiring, do not remove the cover and the plug of the limit switch in order to prevent dust or liquid from entering the limit switch.
Failure to prevent this might result in malfunction or contact failure.



As soon as wiring is completed, replace the cover of the limit switch to prevent dust and/or liquid from entering the switch housing. Failure to prevent this might result in malfunction or contact failure.



Before using the limit switch for the first time, protect it using a dust-proof, water-proof sheet to prevent cement and/or paint from adhering to the switch, as this may cause lever malfunction.



Do not leave the limit switch in an atmosphere containing gases (H₂S, SO_x etc.) that may adversely affect the contact and/or other materials. Failure to observe this instruction may cause contact failure.



Do not allow limit switch to come into contact with solvent (benzene, kerosene, alcohol, etc.) that may adversely affect it. Failure to observe this instruction may result in malfunction and/or insulation failure.



Do not step on the limit switch, place heavy objects on it or hit it with a hard object. Never apply to the switch lever a force five times larger than its operation force (OF). Failure to observe this instruction may result in malfunction.



When using sealing or other locking agent on the conduit, make sure that it does not generate gasses which may cause contact failure.



The limit switch must be mounted using heat insulating materials, shielding plates, etc., so that its temperature will not exceed the working temperature range as a result of radiant heat or heat transfer.



If the limit switch is subjected to continuous vibration or impact, be sure to take the necessary measures to isolate it from vibration.

■ Installation

● Installation

The plate on which the limit switch is mounted must be sufficiently rigid, be made of an appropriate material in an appropriate shape and be thick enough to retain its shape by the operating force of the limit switch.

When mounting the limit switch, use washers to prevent the screws from working loose. The screws must be fastened according to the appropriate tightening torque shown in the table below.

Screw size	Tightening torque
M5 (Hexagon socket head cap screw)	5 to 6 N · m

● Mounting the lever

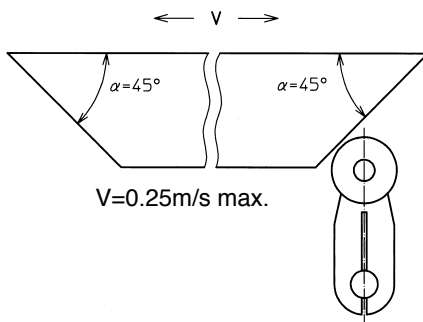
The lever mounting screw must be fastened according to the appropriate tightening torque shown in the table below.

Tightening torque
4 to 5.2 N · m

● Dog angle and speed

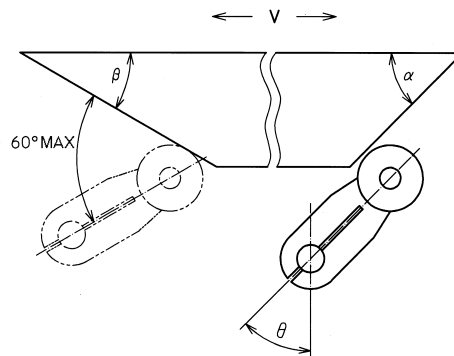
- When the dog speed is less than 0.5m/s

Set lever vertical and select dog angle(α) according to dog speed referring the table below.



- When the dog speed is faster (i.e. $0.5\text{m/s} \leq V \leq 2\text{m/s}$)

Set lever angle(θ) and dog angle(α) according to dog speed(V) referring the table below.



The dog angle(β) of the rear edge shall be set within a range of 15° to 30° to avoid the double action of lever.

$V < 0.5\text{m/s}$

V (m/s) max.	α
0.40	30°
0.25	45°
0.10	60°
0.07	75°
0.05	90°

$0.5\text{m/s} \leq V \leq 2\text{m/s}$

V (m/s) max.	α	θ
0.5	45°	45°
0.6	40°	50°
1.3	30 to 35°	55 to 60°
2.0	15 to 25°	65 to 75°

● **Dog surface finish**

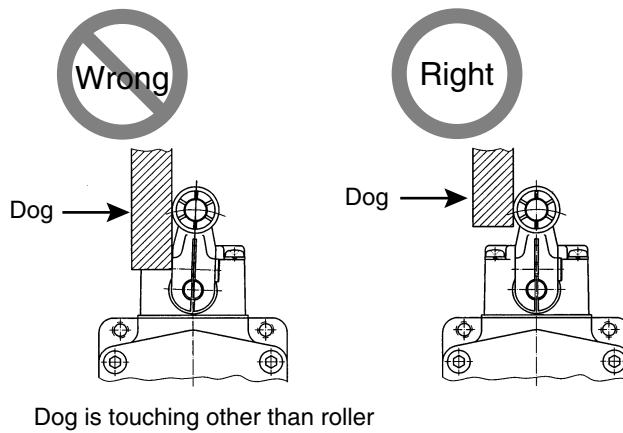
When designing the dog, its surface finish(roughness and hardness) shall be as follows:

	Suitable value
Surface Roughness	1.6a(6.3s)
Vickers hardness	Hv450

By applying grease to dog surface, smoother action of roller can be attained.

❗ **Handling Precautions**

Dog shall not touch any portion other than the roller.
The roller shall contact the mating dog with its total width.



● **Movement and force after operation**

To ensure stable operation, overtravel, defined as any movement of the limit switch lever after operation, must be adjusted within 30 to 70% of the specification value (minimum value).

❗ **Handling Precautions**

When adjusting, do not apply a force to the lever that exceeds five times the operating force. Failure to observe this instruction may result in return failure.

The table below shows the value of five times the operating force.

Force
80.0 N

Never attempt to rotate the lever beyond its operation limit.

■ Changing the Lever Direction

● Procedure

- (1) Loosen the lever mounting screw.
- (2) Turn over the lever and insert lever securely in the new position.
- (3) Fasten the lever mounting screw according to the tightening torque shown in the table below.

Tightening torque
4 to 5.2 N · m

! Handling Precautions

Fasten screw within the specified torque value, over tightening may strip screw threads.

■ Changing the Head Position

For application flexibility lever position can be changed in following direction(s):

For VCL-50** : 180° from original position.

For VCL-51** : 90° cw or ccw, 180° from original position.

● Procedure

- (1) Remove the four head fixing screws.

! Handling Precautions

The O-ring between head and housing may come off while removing the head assembly. Be sure to place it in original position, otherwise sealing performance is lost.

- (2) Remove the head assembly and position in the desired position.
- (3) Securely tighten the four screws according to the tightening torque shown in the table below.

Tightening torque
1.3 to 1.7 N · m

Chapter 4 WIRING

This chapter describes the wiring of the limit switch.

⚠ WARNING



Be sure to turn the power supply of the equipment OFF before wiring the limit switch. Failure to do so might result in electric shock due to high power supply voltage.

⚠ CAUTION



Firmly tighten cover so that it contacts with the housing. Insufficient tightening of the cover may impair the seal performance of this limit switch.



Do not use silicon rubber insulated cables. Using such cables may result in contact failure.

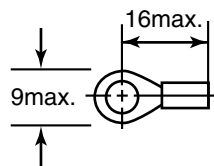


Use seal connector for conduit to get sealing performance better than IP67 or equivalent.

ⓘ Handling Precautions

- Select electric wires or cables that are suitable for the installation environment.
- Use insulated ring-type crimp terminal for the electric wire.
- The table below shows the nominal cross-sectional area of the electric wire to be used and the size of the crimp terminals.

Crimp terminal size	Cross-sectional area
For M3 screw	2mm ² max *



* Four 3.5mm² wires can be accepted if used.

- Make sure that the crimp terminal and the electric wire do not touch the cover.
- Make sure that the electric wire does not touch the plunger(s). If the wire touches the plunger(s), this may result in malfunction.
- Do not excessively bend crimp terminals.
- When installing flexible piping, make sure that the electric wires inside do not twist.

● **Wiring**

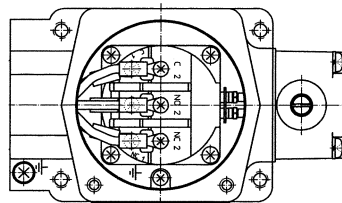
⚠ CAUTION



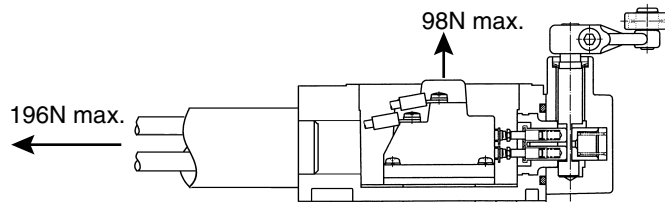
Correctly wire the limit switch referring to the circuit drawing on the inside of the cover or the Product Specification Sheet.

- The terminal screw must be fastened according to the tightening torque shown in the table below.

Screw size	Tightening torque
M3	0.6 to 0.8 N · m



- Tensile strength of the terminal
After wiring is completed, do not pull the wire(s) with a force exceeding 196N to the conduit direction, 98N to the other direction.



⚠ Handling Precautions

The same value (force) applies to both single wire and multiple wires.

● **Mounting the cover**

When the wiring has been completed, mount the cover .

Fasten the four M5 cover mounting screws evenly and in turn, diagonally, taking care to observe the appropriate tightening torque shown in the table below.

Screw size	Tightening torque
M5	5 to 6 N · m

⚠ Handling Precautions

- When mounting the cover, make sure that the cover does not touch the electric wire(s) and/or terminal(s), also, do not bind the wire insulation.
- Fasten screws within the specified torque value, over tightening may strip screw threads.

● **Circuit tester for checking electrical continuity**

A circuit tester with a measuring current of 100 mA or less must be used to check the limit switch's operation.

Chapter 5 ADJUSTMENT PROCEDURE

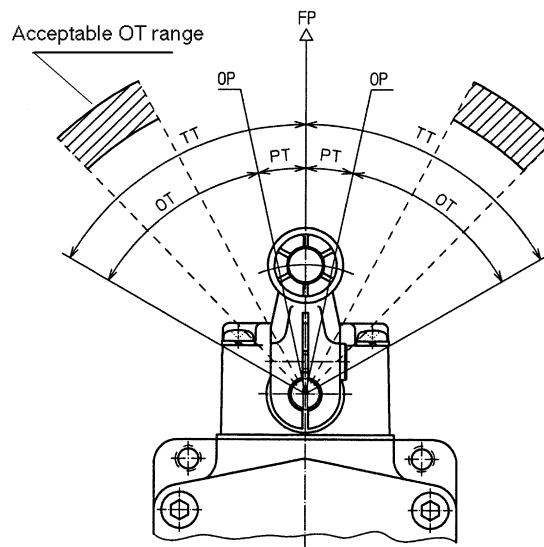
■ Items to be Checked before Operation

Check the following items before operating the limit switch:

- (1) Wiring must be completed correctly.
- (2) Mounting screws, lever mounting screw, and cover mounting screws must be fastened tightly.
- (3) Seal connector or flexible piping must be used for the conduit to ensure the appropriate sealing performance.

■ Adjustment

- (1) Adjust the operating position of the limit switch either by changing the position of the dog of the equipment or by shifting the limit switch mounting.



- (2) To ensure stable operation, overtravel, defined as any movement of the limit switch lever after operation, must be adjusted within 30 to 70% of the specification value (minimum value).

❗ Handling Precautions

- When adjusting, do not apply a force to the lever that exceeds five times the operating force. Failure to observe this instruction may result in return failure.

The table below shows the value of five times the operating force.

Force
80.0 N

- Never attempt to rotate the lever beyond its operation limit.
- Adjustments can be carried out by sliding the mounting position of the limit switch lever. However, adjustment by this method cannot be carried out repeatedly as the knurled section of the shaft bites into the lever.

Chapter 6 MAINTENANCE & INSPECTION

⚠ CAUTION



After inspecting the limit switch, firmly tighten the cover and conduit. Insufficient tightening for some reason such as corroded threads will degrade sealing performance, which can cause problems such as breakdown of insulation, leading to the unsatisfactory functioning of this limit switch.



Periodically inspect the limit switch to ensure safe use. More frequent inspection may be required depending on the service condition.

■ Maintenance Checklist

The table below shows the inspection items for maintenance of the limit switch.

As a guideline, the service life of the limit switch is about five years.

However, this may vary according to the environmental conditions.

● Required tools and equipment for inspection

- Screwdriver
- Insulation resistance tester (Megger)
- Circuit tester
- Hexagon socket screw key

No	Inspection point	Inspection item	Inspection method	Maintenance method	Inspection cycle
1	Roller lever	<ul style="list-style-type: none"> • Operating position • Switch dislodged • Loose mounting screws • Roller rotation 	<ul style="list-style-type: none"> • Check for loose lever mounting screws, improper roller rotation or other problems or damage. 	<ul style="list-style-type: none"> • Re-tighten loose mounting screws. • For details on tightening torque, see Chapter 3. • If other defects are found, replace the limit switch. 	<ul style="list-style-type: none"> • Tighten screws to the correct torque whenever necessary • At least every 6 months for other items.
2	Head	<ul style="list-style-type: none"> • Loose head mounting screws • Damage to the exterior 	<ul style="list-style-type: none"> • Check that the head mounting screws are fastened tightly. • Check the exterior of the head is not damaged. 	<ul style="list-style-type: none"> • Re-tighten loose mounting screws at the correct torque. • For details on tightening torque, see Chapter 3. • If other defects are found, replace the limit switch. 	<ul style="list-style-type: none"> • Tighten screws to the correct torque whenever necessary • At least every 6 months for other items.
3	Cover	<ul style="list-style-type: none"> • Loose cover mounting screws • Damage to the exterior 	<ul style="list-style-type: none"> • Check that the cover mounting screws are fastened tightly. • Check the exterior of the head is not damaged. 	<ul style="list-style-type: none"> • Re-tighten loose mounting screws at the correct torque. • For details on tightening torque, see Chapter 4. • If other defects are found, replace the limit switch. 	<ul style="list-style-type: none"> • Tighten screws to the correct torque whenever necessary • At least every 6 months for other items.
4	Housing	<ul style="list-style-type: none"> • Damage to the exterior 	<ul style="list-style-type: none"> • Visually check that the housing exterior is not damaged. 	<ul style="list-style-type: none"> • Replace the limit switch. 	<ul style="list-style-type: none"> • At least every 6 months for other items.
5	Terminal box (Internal switch)	<ul style="list-style-type: none"> • Electrical continuity 	<ul style="list-style-type: none"> • Check the electrical continuity of all the terminals using the circuit tester. 	<ul style="list-style-type: none"> • Replace the limit switch. 	<ul style="list-style-type: none"> • At least every 6 months for other items.
		<ul style="list-style-type: none"> • Insulation 	<ul style="list-style-type: none"> • Check that each terminals properly insulated using the insulation resistance tester. 	<ul style="list-style-type: none"> • Replace the limit switch. 	<ul style="list-style-type: none"> • At least every 6 months for other items.
		<ul style="list-style-type: none"> • Loose screws • Corrosion 	<ul style="list-style-type: none"> • Check for loose terminal screws, any potentially serious cracking, rust, etc. 	<ul style="list-style-type: none"> • Re-tighten loose terminal screws at the correct torque. • For details on tightening torque, see Chapter 4. 	<ul style="list-style-type: none"> • At least every 6 months for other items.
6	Check operation	<ul style="list-style-type: none"> • Check operation 	<ul style="list-style-type: none"> • Check over-travel. 	<ul style="list-style-type: none"> • Readjust over-travel. 	<ul style="list-style-type: none"> • At least every 6 months for other items.
		<ul style="list-style-type: none"> • Check operation. Manually operate the roller lever and check that it operates smoothly. 	<ul style="list-style-type: none"> • Replace the limit switch. 		

Revision History

Printed Date	Manual Number	Edition	Revised pages	Description
99-01	CP-SP-1049E	1st Edition		
03-09		2nd Edition	6 7 9 10	<p>Fonts changed.</p> <p>RESTRICTIONS ON USE changed.</p> <p>● Movement and force after operation was moved to 5 pages.</p> <p>A part of expression was changed.</p> <p>The 2nd item of "CAUTIONS" was deleted.</p> <p>The 3rd item of "Handling Precautions" was added.</p> <p>The 2nd item of "CAUTIONS" was deleted.</p> <p>The head was added to the table.</p>
10-07		3rd Edition	End paper	RESTRICTIONS ON USE deleted, terms and conditions added.
12-04		4th Edition		Company name changed.

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 (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 products has any failure attributable to azbil during the aforementioned warranty period, azbil 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 Corporation's products (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 products;
- (3) Failure caused by any modification or repair made by any person other than azbil or azbil's subcontractors;
- (4) Failure caused by your use of Azbil Corporation's products 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 us 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 products 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 Corporation 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 fool-proof design, fail-safe design, anti-flame propagation design, safety design, or the like so that the said Equipment may satisfy the level of the reliability and safety required in your use, whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth.

3. Precautions and restrictions on application

Azbil Corporation's products other than those explicitly specified as applicable (e.g. azbil Limit Switch For Nuclear Energy) shall not be used in a nuclear energy controlled area (radiation controlled area). Any Azbil Corporation's products shall not be used for/with medical equipment.

In addition,

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 Corporation's products 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 and other designs of protection/safety circuit on your own responsibility to ensure the 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
[For use outside nuclear energy controlled areas] [For use of Azbil Corporation's Limit Switch For Nuclear Energy]
 - * 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
- (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.

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 Corporation are subject to change without notice for improvement or for any other reason.

For inquires 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 products may be discontinued without notice.

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 field instruments, we may not be able to undertake parts replacement for similar reasons.

azbil

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Specifications are subject to change without notice. (09)

1st edition: Jan. 1999 (M)
4th edition: Apr. 2012 (M)