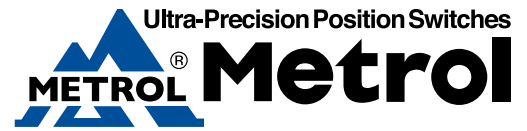


**Pneumatic Drive Type
Drill Bit Breakage Detection Sensor**



DFM3 Series

DFM



**The World's
First !!**

Pneumatic-Drive Type

Outstanding Resistance to
Coolant

Catalog / Instruction Manual

US.PAT.

Pneumatic Drive Type Drill Bit Breakage Detection Sensors

DFM3 Series

The drill bit breakage detection sensors can be installed on automated and dedicated machine tools for detecting drill bit breakage by contacting a drill, tap, reamer or other tools.

■ Differences from conventional drill bit breakage detection methods

Outstanding durability in harsh environments containing cuttings and coolant

The world's first pneumatic drive, motor-free control system eliminates malfunctions caused by coolant.
Protective Structure: IP67

■ Mechanical Specifications (Sensor Body)

(mm)

Product No.	DFM3	Minimum tool diameter	φ0.5mm *For small diameter drill bits (φ1mm or less), refer to p.3.
Drive method	Pneumatic drive type (single-action push-out air cylinder type)	Operating temperature	0 to 60°C
Signals	3 signals (refer to timing chart on p.3)	Working air pressure	0.4 to 0.5 MPa (dry air) Air tube diameter: φ4 x 2.5
Protective structure	IP67	Needle specifications	Length : 100 mm (from center of rotation) Thickness : φ1.5mm Material : Quenched SUS420 HRC50
Direction of needle rotation	Clockwise/counterclockwise	Cable	φ4 (5-core), oil resistant, 3 m
Stroke (rotation angle)	100°	Net weight	Approx. 250 g
Contact force	0.1N <small>(Static load at a distance of 100 mm from center of rotation, inertial force not included.)</small>		

■ Electrical Specifications (Connection Unit)

Type	C-DF-01N	C-DF-01P	LED display	Origin: green Judgment: red, Stroke end: yellow
Output specification	NPN	PNP	Insulation resistance	Min. 100mΩ with DC 250V megger
	Open collector		Withstand voltage	AC 500V, 50/60Hz for 1 minute between each pin and case
Power supply voltage	DC +24V		Protective circuits	Reversed power connection protection, surge protection
Current consumption	10mA			
Output rating	DC24V, 150mA (max.)			

■ Ordering Format (including options)

① Type	② Rotation direction	③ Stroke	④ Needle	⑤ Protective cover	⑥ Cable	⑦ Cable protection	⑧ Connection unit	⑨ Rubber material
DFM3	R: Clockwise (right) L: Counter clockwise (left) as viewed from the top	Blank: 100° 5: 50°	Blank: Standard φ1.5 x 100mm B8: 80mm B12: 120mm F8: Flat 80mm F10: Flat 100mm F12: Flat 120mm Custom orders are accepted in lengths of 20mm units.	Blank: For downward installation U: For upward installation	Blank: Standard φ4(5-core) 3m cable □: Length of □m	Blank: Not required W□: Wire braid cable of □m in length *Used when there is the risk of the cable sheath being damaged by cuttings (refer to p.4).	N: C-DF-01N P: C-DF-01P H: Not required Used when purchasing a sensor unit only.	V: for oil/water-soluble coolant

*Please consult the manufacturer regarding needles in excess of 160 mm or the use of special contacts (refer to p.2).

(Order Example)

DFM3-R-N-V

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
DFM3-R5-B8U-5W2-H-V

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Structure

Operation

The drive unit of this sensor drives the needle starting at the origin position when an origin signal is switched ON (LED green), and discontinues driving the needle at the stroke end position when the end signal is switched ON (LED yellow).

When the drill bit has broken (or is not present), the needle rotates to the stroke end position, a judgment signal is switched to OFF and the LED red goes out.

If the drill bit is normal, since the needle does not reach the stroke end position as a result of contacting the drill bit and stopping, the judgment signal remains ON and the red LED lights.

The presence or absence of drill bit breakage can be determined by transmitting the ON or OFF status of the judgment signal (LED red lights or not light) to an external device when the stroke end signal is ON (yellow LED lit).

*Regardless of the presence/absence of breakage, the stroke end signal is switched ON everytime the needle stops.

Names of Components and Internal Structure

Sensor body DFM3

Accessories :

- Sensor mounting nuts..... × 2
- Air hose clamp..... × 1
- Needle adjustment pushing rod..... × 1

Provides added convenience since Adjustments can be made without requiring an air supply.

For 100 degrees : DF033#100
For 50 degrees : DF033#50

④ Needle

F: Flat contact for detecting turning tool

Applications:

1. Detection of turning tool
2. Detection without damaging drill bit

Note: Contacts may move accidentally depending on the manner in which contacted by coolant.

⑦ Cable protection

W: Wire braid for cable protection

⑧ Connection unit

N: C-DF-01N (NPN specifications)
P: C-DF-01P (PNP specifications)

⑤ Protective cover

Blank : for the sensor facing downward (DF032) **U:** for the sensor facing upward (DF032#1)

*When installing the sensor horizontally, please choose the suitable cover so that the metal cuttings and coolant cannot enter from the gaps between the sensor and the cover.

Electrical and Air Circuit Drawings

Sensor body DFM3

Connection unit C-DF-01(N/P)

Open collector
NPN : C-DF-01N
PNP : C-DF-01P

Outputs: GND, Origin, Judgment, End, +24V

Please use dry air. Compatible tube diameter φ4 x φ2.5

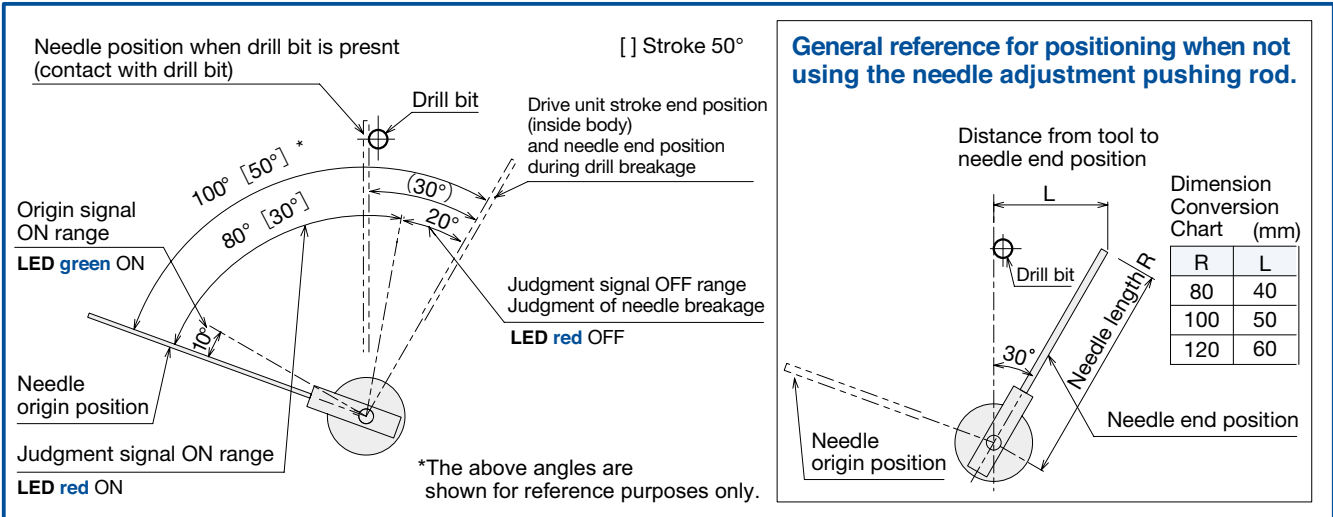
[Example of air line configuration]

*Air lines are to be provided by the user.

2

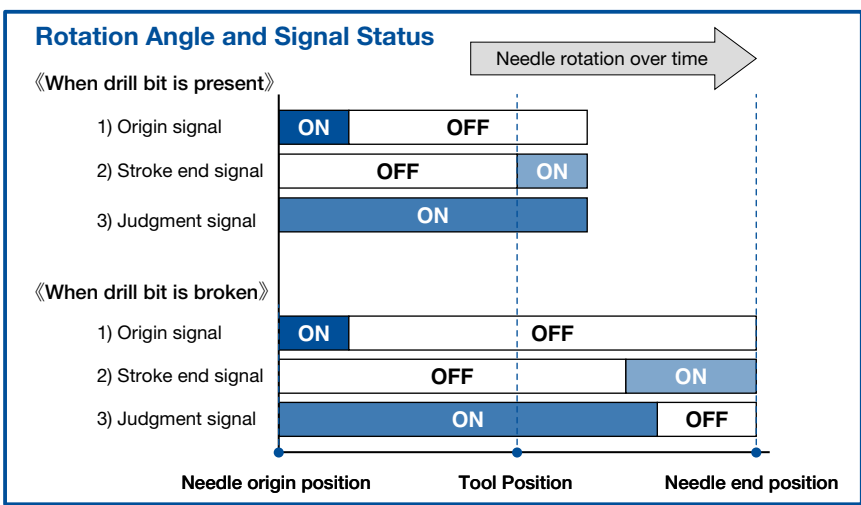
Signal Setting Procedure

Needle Position (Angle) and Sensor Operation (Clockwise Rotation)



Electrical Control Method

- 1) Input the air after confirming that the needle is at the origin position by checking the Origin signal.
 - 2) Confirm with the Stroke end signal whether the needle rotates properly and reaches to the end position.
 - 3) Confirm with the Judgment signal whether a tool is present or broken.
- Confirmation of the Judgment signal must be done a second after the Stroke end signal is ON.



Precautions Regarding Special Specifications

Note1 : Precautions when detecting small diameter drill bits (φ1mm or less)

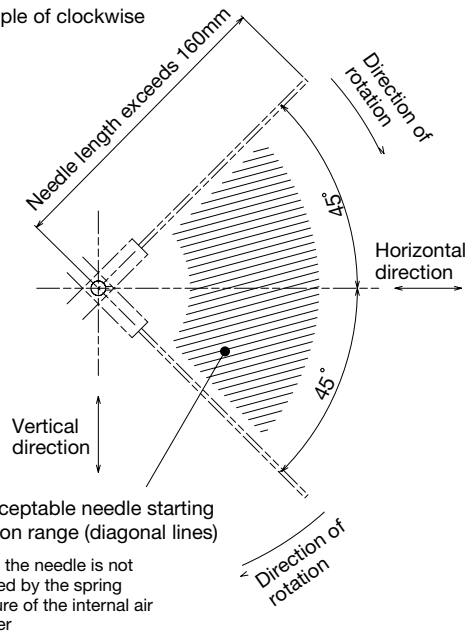
- 1) The contact force of the needle when it meets the drill bit is the sum of the inertial force resulting from rotation added to the spring pressure of the sensor (0.1N for a needle length of 100mm). In order to eliminate the effects of this inertial force, reduce speed with a speed controller.
- 2) Please consult the manufacturer when it is necessary to reduce the sensor spring pressure itself (such as when desiring to minimize deflection of the drill bit).

Note2 : Precautions when needle length exceeds 160mm

- 1) Chattering signals may occur due to the rebound caused by the inertia of the needle when the needle is stopped at the starting position or stroke end position after rotating. It is recommended to take countermeasures to avoid this effect such as by using a timer for electrical processing.
- 2) When using the sensor in the horizontal direction, avoid using an installation such that the needle starting position falls within the range indicated by diagonal lines in the drawing at right. Since return force is attributable to the spring, the moment load of the needle increases in the case of a long needle, which may prevent it from completely returning to the starting position.

Case of horizontal sensor installation with a needle length in excess of 160 mm

Example of clockwise



Installation and Signal Adjustment

1. Mounting of Sensor Body

- 1) Temporarily install the sensor body (M22 x 1.5) on the mounting bracket provided by the user using the nuts provided.
- 2) Attach a protective cover in the case the sensor body is used horizontally or facing downward.

Insert the protective cover from the leading end of the sensor body and fasten it in position with the screws on the sensor body (M22 x 1.5).

- 3) Attach the head (needle) to the shaft on the leading end of the sensor body and fasten it in position with the head mounting screws.

Be careful not to apply excessive force to the shaft at this time.

2. Signal Setting Procedure (refer to p.3)

- 1) Place the drill bit (or other tools) at the predetermined location.
- 2) Position the sensor at a height such that the needle passes the drill bit at a location about 5 mm away from the end of the drill bit and fasten it in position by turning the nut.
- 3) Insert the mounting adjustment pushing rod into the hose nipple and push all the way in.
The needle stops at 30 degrees before the stroke end*.
- 4) While in this state, turn the sensor body so that the stroke end side of the needle contacts the drill bit, raise it up until the needle contacts the drill bit, and then fasten it in position with the nut.

*Procedure when not using the mounting adjustment pushing rod:

When the air line has been connected and air pressure is applied, the needle stops at the stroke end position.

In the case of clockwise rotation as shown in the drawing on p.3 turn the sensor body so that the needle is located roughly 30 degrees to the right of the drill bit (refer to the Dimension Conversion Chart), raise it up until the needle contacts the drill bit, and then fasten it in position with the nut.

Supply with air for confirmation of the Stroke end signal and the Judgment signal.

3. Connection of the Air Line

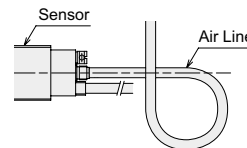
- 1) Pass the air hose clamp over the air hose in advance.
- 2) Securely insert the air hose into the hose nipple on the back of the sensor body.
- 3) Fasten the air hose clamp at the base of the air hose nipple by turning the screw.

Note: Use dry air at a pressure of 0.4 to 0.5Mpa.

Note: Since the contact force of the needle when it contacts the drill bit is the sum of the inertial force resulting from rotation added to the spring pressure of the sensor (0.1N for a needle length of 100mm), reduce the speed with a speed controller as necessary to eliminate the risk of damaging the drill bit.

4. Cautions for plumbing

- 1) Use dry air.
- 2) In the case that the sensor is located a distance from devices such as air filters, dryers, or separators, the air inside the hose can get wet by temperature change due to coolant, etc.
- 3) When the air supply is located higher than sensor, at least some part of the hose is set lower than the sensor to stores liquid.
(The dew condensation may occur even using dry air)



- 4) Coolant may enter into the sensor through the piping connection part. Do not use the part which has been repeatedly inserted and extracted.

5. Connection of the Cable

- 1) Install the connection unit inside the distribution panel.
- 2) Connect the cable by referring to the circuit drawing on p.2.
- 3) Since the sensor elements may be damaged if current beyond the rated current is allowed to flow through the sensor as a result of induction of noise or surge, run the cable at an adequate distance from power lines and other noise sources.
- 4) Do not pull on the cable sheath or core wires with excessive force (30N or more). In addition, clamp the cable at suitable locations.
- 5) The bending radius of the cable should be R7 or larger.
- 6) Be careful not to damage the cable during wiring. Damage to the cable may impair water resistance.
- 7) Do not connect the cable at the place where coolant may splash on the cable.

Precautions

- 1) Use a cable protective wire braid when there is the risk of the cable being damaged by cuttings.
Furthermore, check bends in the cable to make sure that the cable has not been damaged by cutting due to the formation of gaps between the braid wires at those locations.
Use clamps at intermediate locations to ensure that excessive force and weight are not applied near the end of the cable.
- 2) Although the protective structure is IP67, add a separate protective cover when problems occur in movement of the needle due to the particular conditions of use (such as the orientation at which the sensor is installed or the presence of cuttings).
- 3) The drain port on the bottom of the sensor body is plugged with a screw. Drain water as necessary by removing the screw and then returning the screw to its original position when finished.
Please consult the manufacturer when it is necessary to change the location of the drain port due to the mounting position of the sensor.
- 4) Changing the head (needle)
The head is fastened to the rotating shaft and fastened in position with a mounting screw. When tightening, be careful not to apply excessive force to the inside of the shaft.
- 5) Since driving by an air cylinder is employed, be careful so that the sensor does not suddenly begin to operate when the power and air supply are turned on.

Terms of Warranty

We strive to achieve zero claims and complaints with respect to quality assurance.

Although malfunctions are a problem that comes before the warranty and even one should be prevented, malfunctions cannot be prevented through our efforts alone. We would therefore like to request that our customers have an understanding of the functions and specifications of applicable products as indicated in our catalogs, instruction manuals and web site to ensure that they are used properly.

Furthermore, applicable products are designed and manufactured primarily for general industrial use. Therefore, we would also like to request that our customers cooperate in employing a safe design for preventing accidents, fires and the like through the providing of failsafe measures, preventing operational errors and employing redundant designs.

1) Applicable Products

The warranty defined below is applicable to products manufactured and sold by Metrol (to be referred to as the "applicable products").

2) Warranty Period

The warranty period for applicable products is one year and three months following purchase or following delivery to the location designated by the customer.

*The initial three months are assumed to be a preparation period until use of the products following purchase.

3) Range of Coverage

a. A replacement product will be provided or the malfunctioned product will be repaired free of charge in the case a malfunction has occurred in an applicable product that is attributable to the responsibility of the manufacturer within the warranty period.

However, applicable products are not covered by the warranty in the case of the following malfunctions even though said malfunctions have occurred within the warranty period.

- (I) Malfunctions having occurred due to use of a product in a manner that deviates from standards, specifications, environments, usage procedures or usage precautions described in the catalog, instruction manual or specifications.
- (II) Malfunctions having occurred for reasons other than those attributable to a delivered product.
- (III) Malfunctions having occurred due to modifications or repairs made by persons other than the manufacturer.
- (IV) Malfunctions having occurred due natural disasters, fires or other force majeure.

b. The range of coverage is limited to warranty of the applicable product only, and secondary damage attributable to a malfunction of an applicable product is not covered by the warranty.

c. Please be aware that charges for service calls (including installation, on-site confirmation and repairs) are not included in the price of products.

4) Applications

Applicable products are designed and manufactured as general-purpose products used in ordinary industrial environments.

In the case of incorporating an applicable product in an apparatus, machine or system, please confirm the suitability of the application along with any related standards, regulations and restrictions.

With respect to the applications indicated below in particular, customers are requested to conduct necessary tests on an actual product in advance after consulting with the manufacturer regarding usage conditions and other details.

- a. Applications for which usage conditions or environment are outside those presumed by the manufacturer or applications unable to be confirmed as being appropriate by the manufacturer when using applicable products.
- b. Applications likely to have an effect on human life or property (such as nuclear power equipment, transportation machinery or medical devices), applications used in public utilities (such as electricity, gas or water lines), or applications applying correspondingly thereto.
- c. Applications in harsh environments (special environments requiring heat resistance, vacuum and the like)

**Although Metrol believes that sound reliability in harsh environments is one of the characteristics of our products, there are still cases in which it is difficult to ascertain actual circumstances.*

Since there is the potential for accidents in such cases, customers are requested to have an understanding of protective structures, materials and so forth and provide additional covers and other equipment as necessary.

5) Other Matters

The contents of this catalog, including types, specifications, and other matters, are subject to change without notice.

Help desk

We accept inquiry regarding sensor selection, exclusive specification, and technical matter through website, FAX, and TEL listed below.

<http://www.metrol.co.jp/en>

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The specifications and descriptions are subjected to change without notice due to improvements in products.