USER MANUAL FOR

INSPECTOOL

BROKEN TOOL DETECTOR

INSPECTOOL™

INNOVATION BUILDS NATION

http://www.inspectool.in

TABLE OF CONTENTS

1 . GENERAL

- Thank you for purchasing the INSPECTOOL product broken tool detector. To obtain the best performance from your purchase be sure to read this manual carefully before use.

- The INSPECTOOL broken tool detector model BTD - SD4 - LR90 is electro pneumatically operated broken tool detector device.

- It has been designed for very accurate positive contact detection of broken tools like drills and taps. The device is compact and robust and can be operated at any desired angle.

2. PRINCIPLE OF BROKEN TOOL DETECTOR

- INSPECTOOL broken tool detector detects the normal tool or broken tool just by conforming the rotating angle of a needle. It is actuated by pneumatic compressed air energy that causes rotary motion of a shaft in 90 degrees if a tool is broken and results in generation of an input signal to stop a machining operation.

3. SAFETY PRECAUTIONS

- To ensure proper use of the product be sure to read this manual carefully before starting installation, inspection, operation and maintenance.
  This manual should be given to the person who actually uses the products and is responsible for their maintenance.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury or may result in serious injury or death. Additionally, there may be significant property damage.

⚠⚠ DANGER

Keep following item secure from danger :

1. Do not perform electrical wiring while power is ON.
2. Do not operate in combustible gas or explosive gas atmosphere.
3. Do not use in ambience of flammable products.
4. Do not decompose and modify.

The product may explode with following misuse:

1. Application of high air pressure beyond a given limit of 6.0 bar.

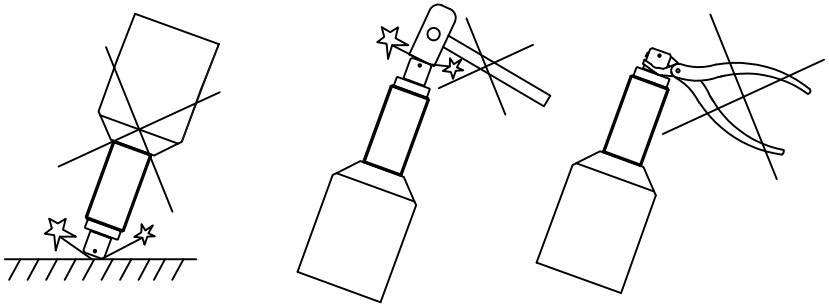
NOTICE

The product may damage with following misusages :

1. Application of unnecessary forces to tight the pneumatic fittings.
2. Application of unnecessary forces to tight the proximity sensor.
3. Forceful rotation of the needle holder / shaft to beyond 90 degrees.
4. Application of the compressed air without FRL unit.

SAFETY PRECAUTIONS

FIGURE NO. 1



DO NOT DROP DO NOT HAMMER DO NOT TWIST

NOTE :

1. Do not insert/ drop any part or other articles into the air application port, the exhaust port and the sensor port.
2. Do not perform electrical wiring while power is ON.
3. Do not use the proximity sensor, the pneumatic fittings of other specifications.
4. Perform I / O wiring correctly.
5. Perform PLC program correctly as per given ladder logic.

4. MODEL INFORMATION

Model : BTD — SD4 — LR90,

BTD	-	SD4	-	L	R	90
1		2		3	4	5

1. **(BTD)** Basic Name:
   Broken Tool Detector

2. **(SD4)** Proximity Sensor Sensing Distance :
   Sensing Distance 4mm

3. **(L)** Rotating Direction of Needle:
   Counterclockwise **(CCW)**

4. **(R)** Rotating Direction of Needle:
   Clockwise **(CW)**

5. **(90)** Rotating Angle of Needle:
   90 Degree

- With the use of model BTD — SD4 — LR90, the shaft along with the needle of the broken tool detector can rotate 90 degrees in both clockwise (CW) and counterclockwise (CCW) directions by interchanging the pneumatic tubes of application ports A1 and A2
  (for details refer page no.9).

5. SPECIFICATIONS

1.	Model	1) BTD - SD4 - LR90
2.	Proximity sensor	Size : M8, Sensing distance : 4mm, Torque : 7 N.M.
3.	Air pressure	4.0 — 6.0 bar
4.	Pneumatic straight fitting	Size : QSM - M5 - 4 - I - R Fittings two no's
5.	Needle length	Max. 160 mm round
6.	Temperature (work area)	$0^{\circ}C$ ~ + $50^{\circ}C$ (do not freeze)

6. DIMENSIONS OF BROKEN TOOL DETECTOR

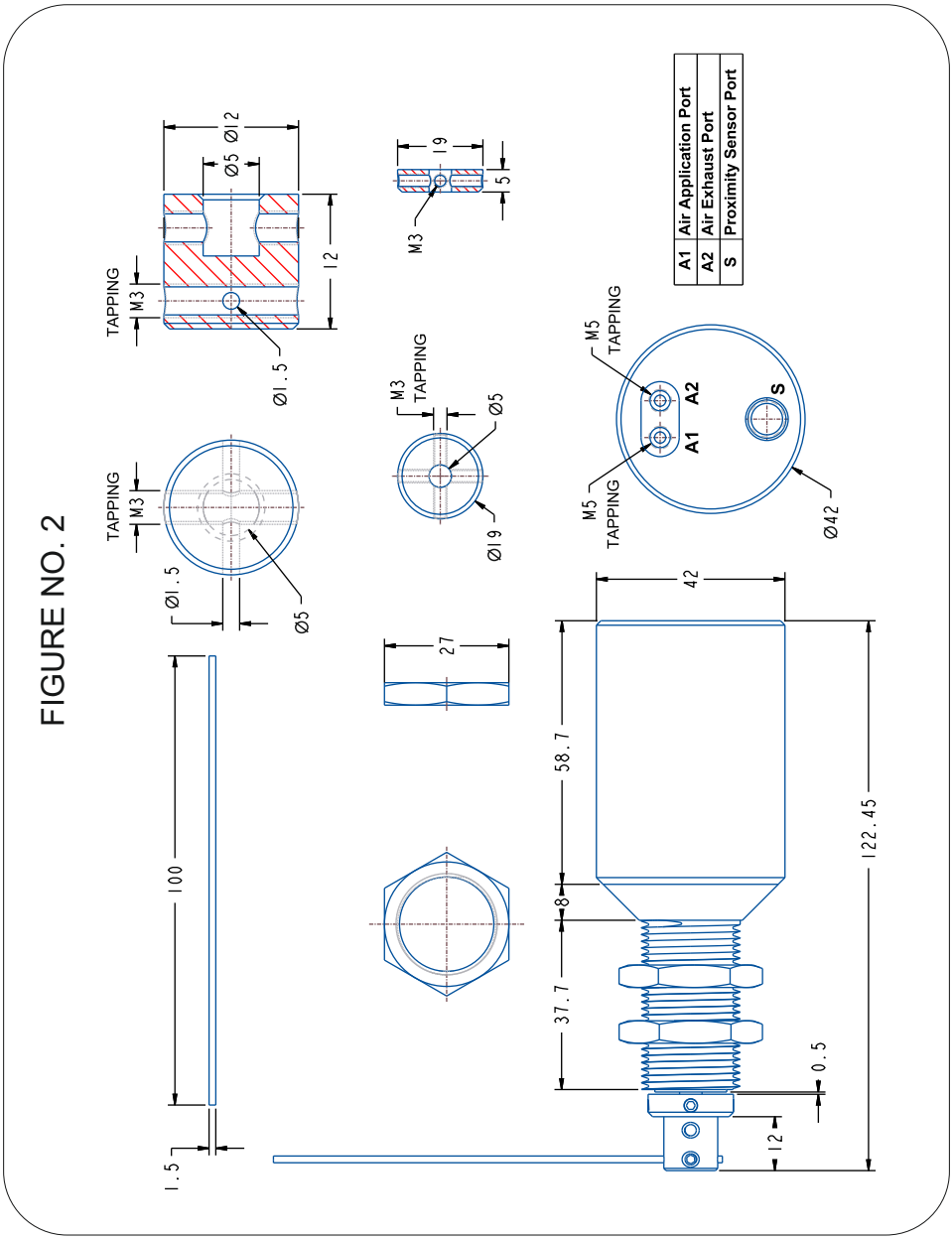


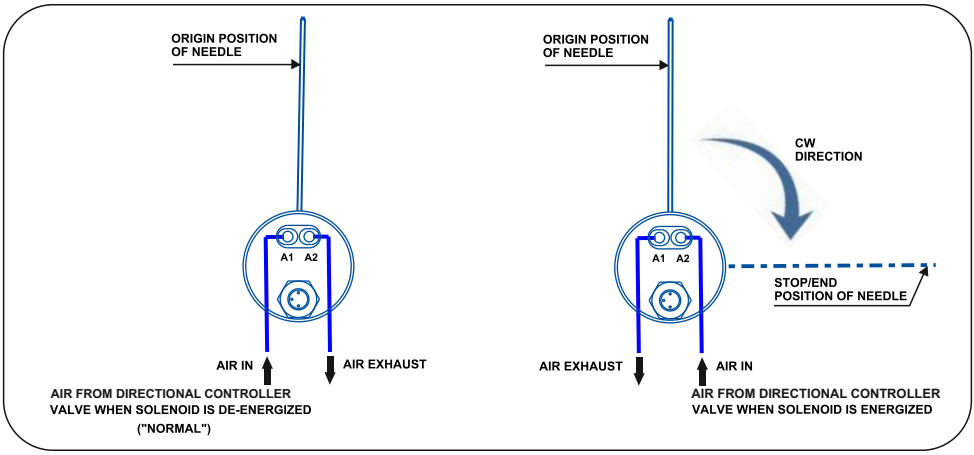
FIGURE NO. 2

7. HOW TO CHANGE ROTATING DIRECTION OF THE NEEDLE

- With the use of model : BTD — SD4— LR90, figure no. 4A and 4B shows different rotating positions of the needle from the origin / start position to the end positions.

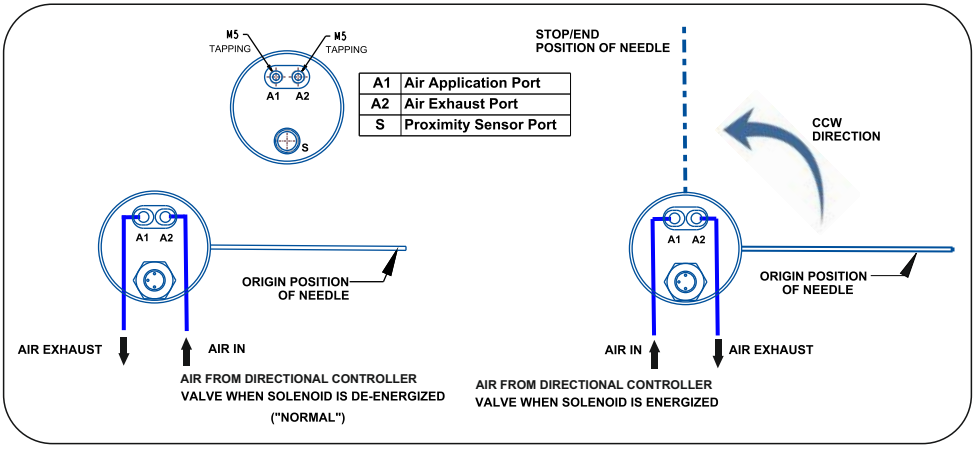
- If the compressed air from the energized directional controller valve is supplied to the application port A2 then needle will rotate in a clockwise (cw) direction as shown in **figure No. 4A**.

FIGURE NO. 4A



- If the compressed air from the energized directional controller valve is supplied to the application port A1 then needle will rotate in a counterclockwise (CCW) direction as shown in **figure no. 4B**.

FIGURE NO. 4B



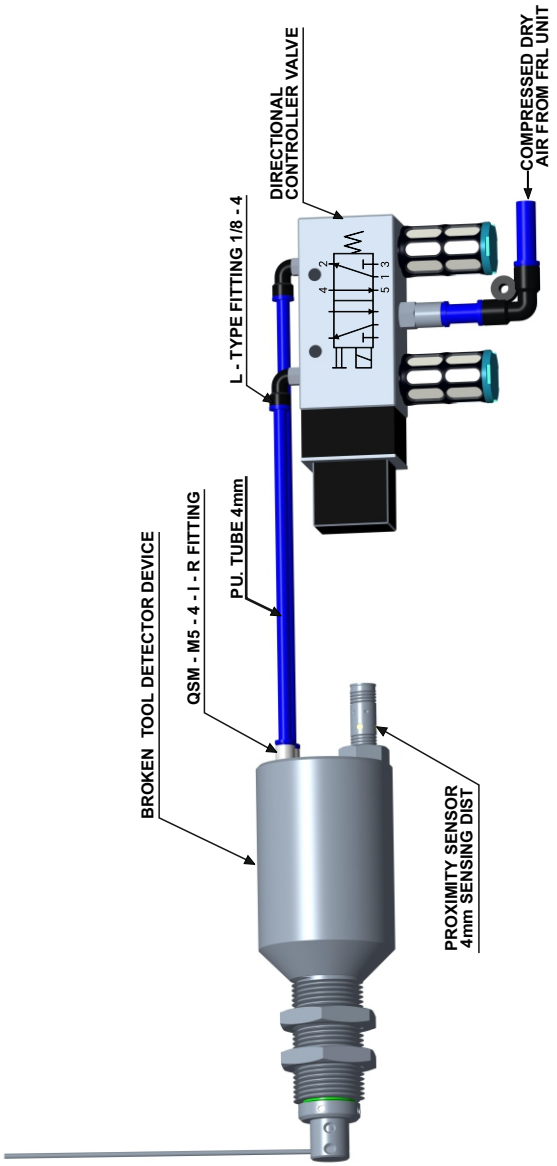

BROKEN TOOL DETECTOR DEVICE
QSM - M5 - 4 - I - R FITTING
PU. TUBE 4mm
L - TYPE FITTING 1/8 - 4
DIRECTIONAL CONTROLLER VALVE
COMPRESSED DRY AIR FROM FRL UNIT
PROXIMITY SENSOR 4mm SENSING DIST

FIGURE NO. 3

INSTALLATION

A. INSTALLATION INSTRUCTIONS

1. Tight / rotate the proximity sensor slowly into the sensor mounting port (S) until it comes to a stop then tight the lock nut as shown in **figure no. 07**.
2. Connect the connector type cable properly to the proximity sensor and then connect to the PLC.
3. Connect the pneumatic straight fitting of **QSM - M5 - 4 - I – R** properly to the port (A1) & (A2)
4. Use 5/2 single acting directional controller valve to operate the broken tool detector.
5. Connect both pneumatic tubes of the directional controller valve to the application port (A1) & (A2) **(for details refer page no.10)**.
6. Use M4 size pneumatic tube and do not use beyond 3 meter length from the directional controller valve.
7. Use dry air to FRL unit and give through directional controller valve to the port (A1) & (A2)

NOTE :

1. Do not apply unnecessary force as twisting, pulling, moment loads, etc on fitting, tubing, or on the proximity sensor.
2. Do not perform electrical wiring while power is ON.
3. Do the I / O wiring correctly as per the electric wiring diagram shown in **figure no. 12.**
4. Do the PLC programming correctly as per the PLC ladder logic diagram shown in **figure no. 13.**
5. Use only 4 mm sensing distance proximity sensor.
6. Using only 4 mm pneumatic tube is necessary.
7. Using dry air and FRL unit is necessary.
8. The bracket material for installation must have 3 mm or more thickness.
9. The needle should contact to the tool at least 2.0 mm from the tool tip.
10. Ensure that there is no restriction to the needle to rotate or move in 90 degree to check the drill or tap.

B. PROCEDURE FOR MOUNTING THE BROKEN TOOL DETECTOR DEVICE

FIGURE NO. 5

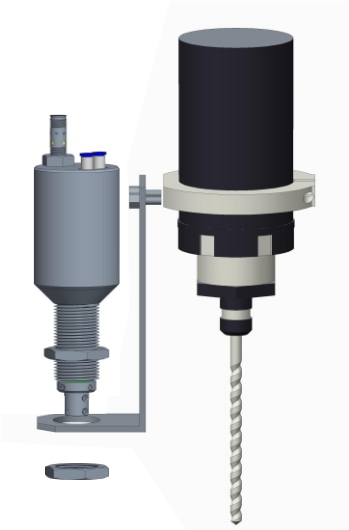
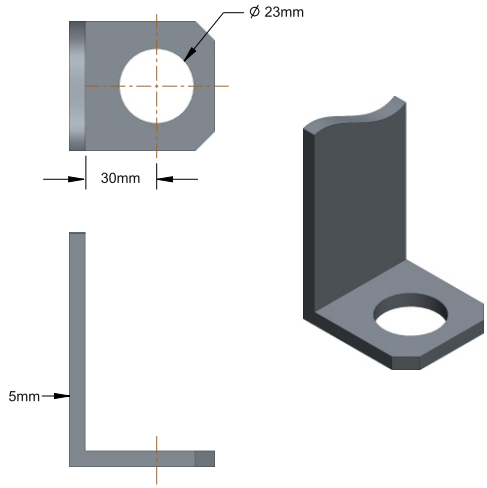


FIGURE NO. 6



1. Use L - type bracket of proper size and length as shown in **figure no.6** to set/ align the needle easily on the tip of tool.

2. Mount the L-type bracket on the spindle properly as shown in **figure no. 5.**

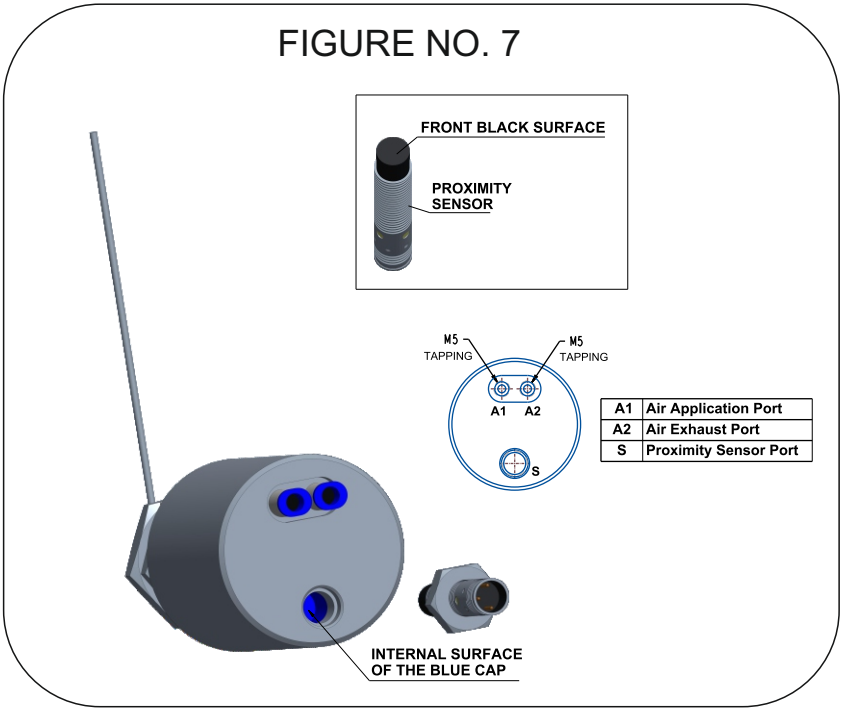
3. Mount the broken tool detector device on the L-type bracket and set the needle as the needle is capable of detecting / touching a tip of the tool in resting position as shown in **figure no. 9.**

4. After tightening the broken tool detector device, make the grub screws of needle holder loose and set the required angle of needle holder with needle as shown in **figure no. 10 and 11.** Then tight the needle holder which is capable to adjust at any position within 360 degrees.

C. PROXIMITY SENSOR SETTING METHOD

Carefully insert and rotate the proximity sensor into the sensor mounting port (S) until it stops, then tighten the lock nut.

FIGURE NO. 7

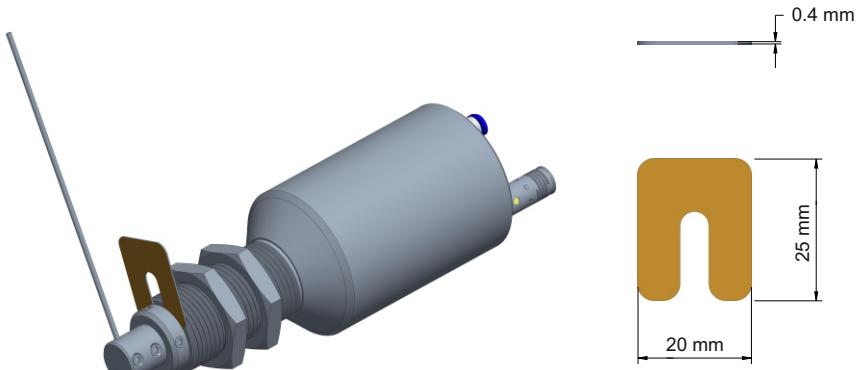


NOTE :

Avoid applying excessive force while tightening the proximity sensor. Stop rotating the proximity sensor when its front black surface touches the internal surface of the blue cap of the broken tool detector device. If you continue rotating the sensor beyond this point, you may break the inside blue cap of the broken tool detector device which will jam the needle and damage the broken tool detector device.
Make sure to stop rotating the proximity sensor when it touches the internal surface of the blue cap, and do not rotate it further. Then, tighten the lock nut.

D. COLLAR ALIGNMENT

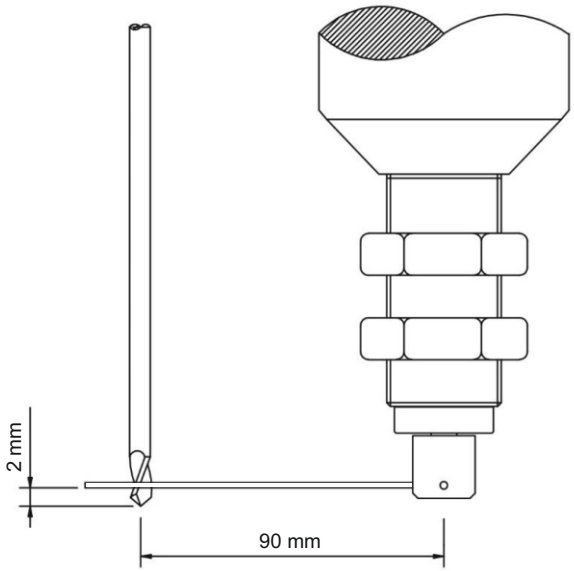
FIGURE NO. 8



If the needle holder and collar are removed for cleaning bur then after cleaning bur collar alignment is necessary. The gap required between the collar and threaded piece is 0.4 mm. Any improper alignment of the collar will result in the needle getting struck or jammed while rotating in 90 degrees.
While doing needle alignment use the given 0.4 mm seam gauge. Insert the seam gauge between collar and threaded piece till the U shape rests on the shaft. Then smoothly rest the collar to the seam gauge and tight the grub screws of the collar and remove the seam gauge.

E. NEEDLE ALIGNMENT

FIGURE NO. 9



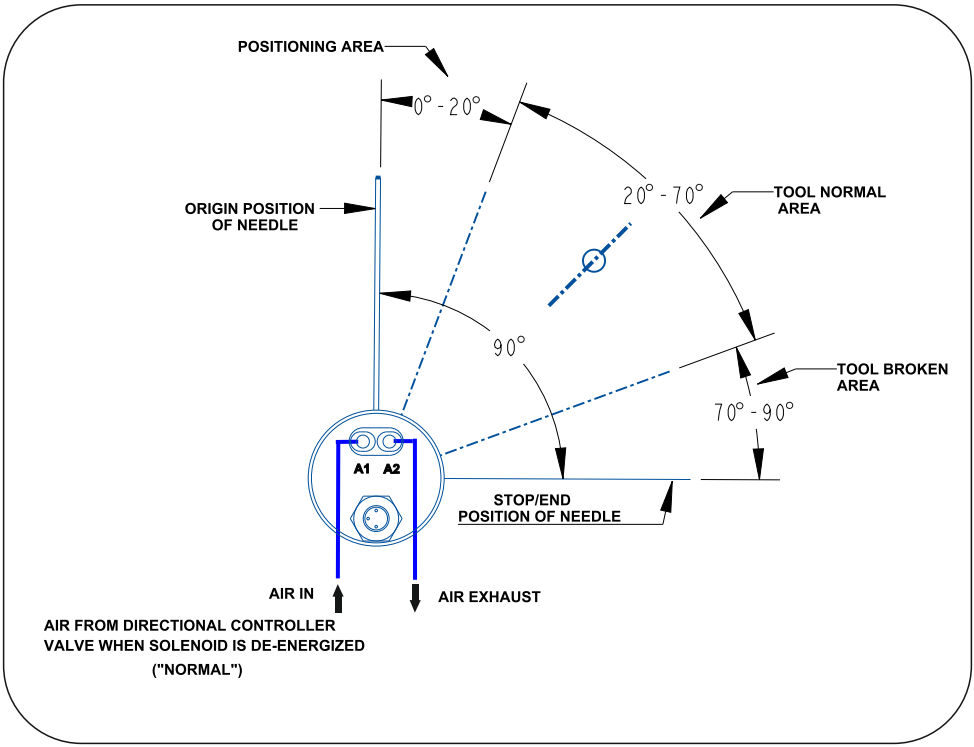
The standard length of the needle is 100 mm from the centre of axis and needle up to 160 mm in length can be used. The touching part of the needle is at least 90 mm from the centre of axis and needle should be in contact with the tool at least 2.0 mm from the tool tip as shown in **figure no. 9.**

F. ORIGIN POSITION OF TOOL DETECTOR IF NEEDLE ROTATES IN A CLOCKWISE (CW) DIRECTION

Suppose the needle rotates in a clockwise (CW) direction, and the directional controller valve solenoid is de-energized. Then the shaft, along with the needle,rests in 0 degree. In this case, the proximity sensor will generates the first input signal, indicating that the tool detector device is at the origin position and ready to be used for detection of tool breakage, as shown in **Figure. no. 10**.

G. SENSING AREA OF NEEDLE IN 90 DEGREES WHEN NEEDLE ROTATES IN A CLOCKWISE (CW) DIRECTION

FIGURE NO. 10



INSTALLATION

1. When the directional controller valve solenoid is energized. Then the shaft along with the needle rotates in a clockwise (CW) direction between 0 — 20 degrees, the proximity sensor generates the first input signal. This is origin position of the tool detector device.

2. The position of the shaft along with the needle after rotation to 0 — 20 degrees indicates movement thereof from the origin position at which the proximity sensor turns OFF. If the shaft along with the needle rotates further and stops between 20 — 70 degrees, the proximity sensor remains OFF and the position indicates that the tool is in a normal condition.

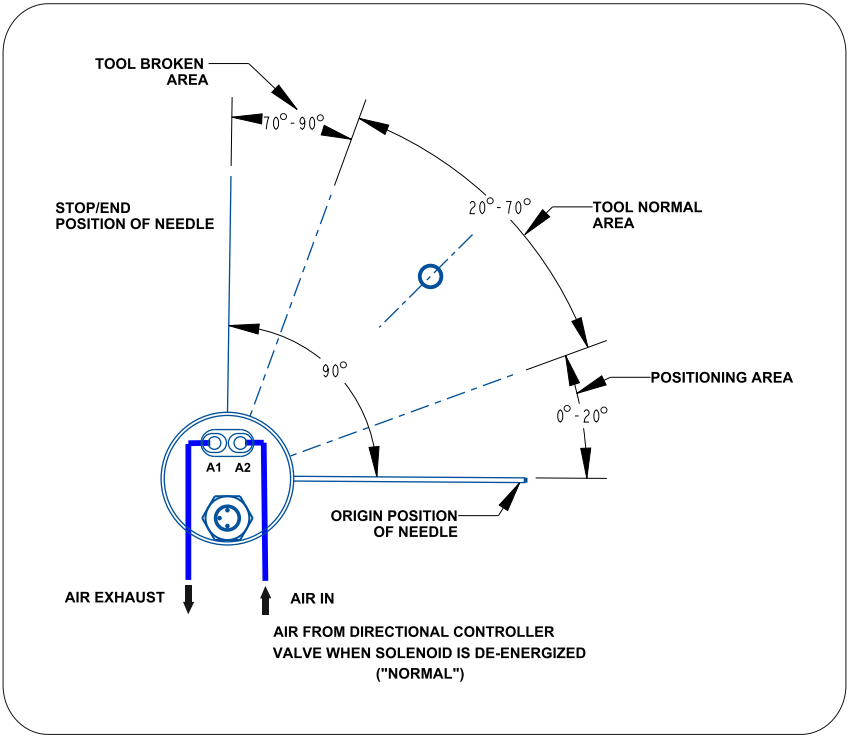
3. If the shaft along with the needle continues to rotate further to complete rotation in 70 — 90 degrees, the position indicates that the tool is broken during which the proximity sensor turns ON to generate the second input signal.

H. ORIGIN POSITION OF TOOL DETECTOR IF NEEDLE ROTATES IN A COUNTERCLOCKWISE (CCW) DIRECTION

Suppose the needle rotates in a counterclockwise (CCW) direction, and the directional controller valve solenoid is de-energized. Then, the shaft, along with the needle, rests in 0 degree. In this case, the proximity sensor will generates the first input signal, indicating that the tool detector device is at the origin position and ready to be used for detection of tool breakage, as shown in **Figure. no. 11**.

I. SENSING AREA OF NEEDLE IN 90 DEGREES WHEN NEEDLE ROTATES IN A COUNTERCLOCKWISE (CCW) DIRECTION

FIGURE NO. 11



INSTALLATION

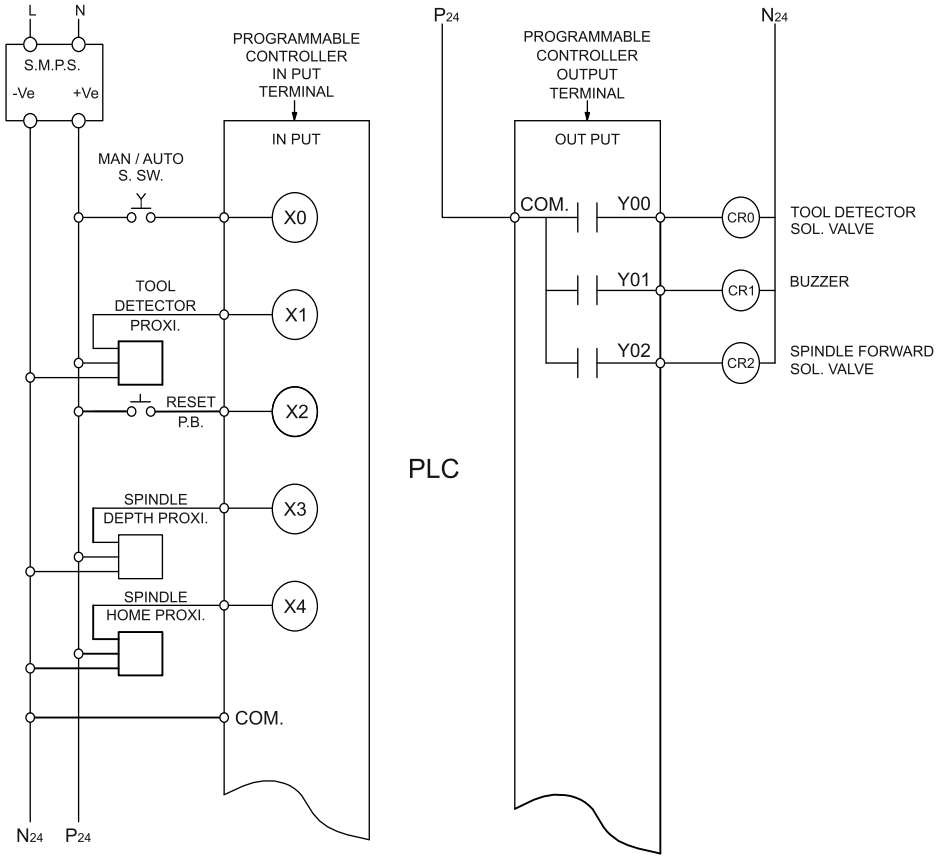
1. When the directional controller valve solenoid is energized. Then the shaft along with the needle rotates in a counterclockwise (CCW) direction between 0 — 20 degrees, the proximity sensor generates the first input signal. This is origin position of the tool detector device.

2. The position of the shaft along with the needle after rotation to 0 — 20 degrees indicates movement thereof from the origin position at which the proximity sensor turns OFF. If the shaft along with the needle rotates further and stops between 20 — 70 degrees, the proximity sensor remains OFF and the position indicates that the tool is in a normal condition.

3. If the shaft along with the needle continues to rotate further to complete rotation in 70 — 90 degrees, the position indicates that the tool is broken during which the proximity sensor turns ON to generate the second input signal.

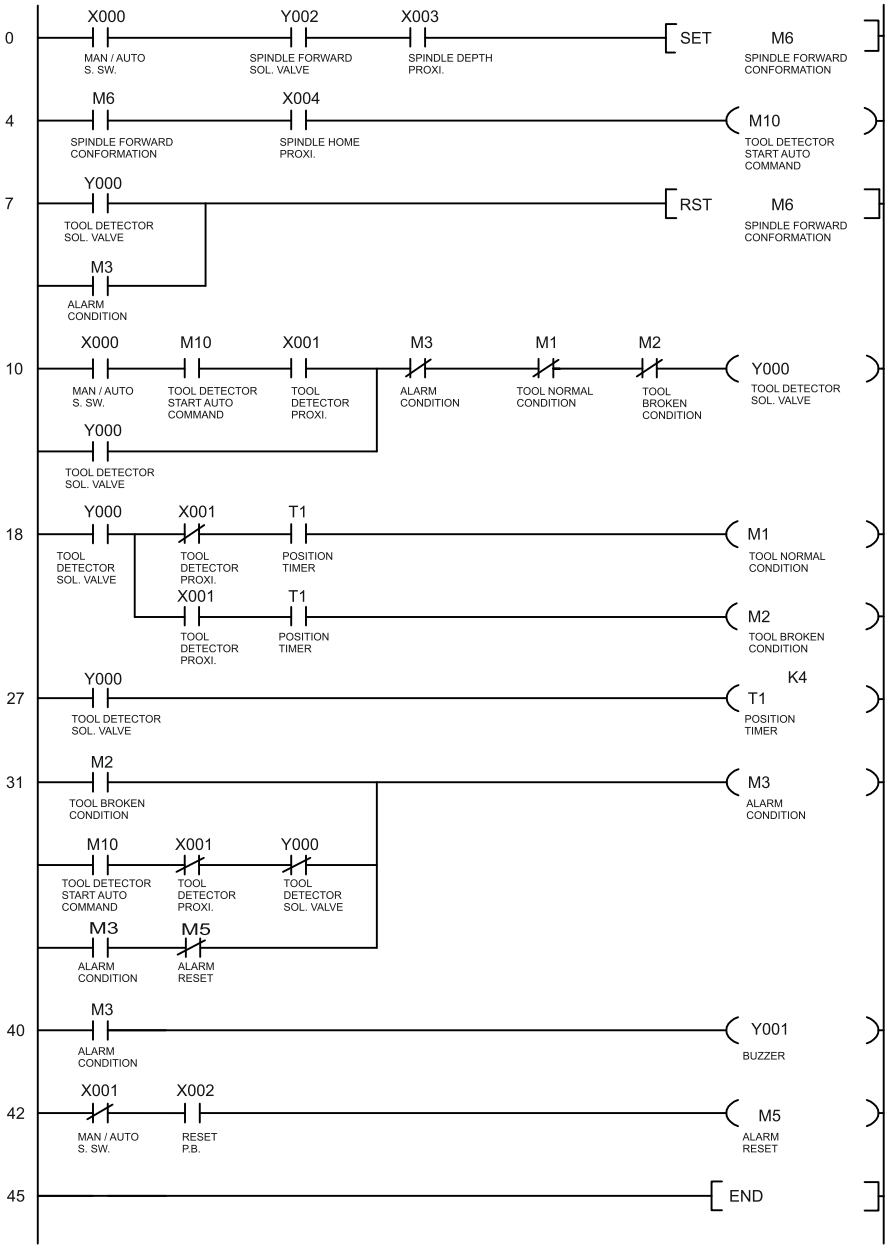
9. ELECTRIC WIRING DIAGRAM

FIGURE NO. 12



10. PLC LADDER LOGIC DIAGRAM

FIGURE NO. 13



11. COMMISSIONING OF BROKEN TOOL DETECTOR

1. Make sure installation is properly done.
2. Make sure electrical hard wiring is properly done.
3. Make sure PLC programming is correctly done as per given ladder logic.
4. Make sure proximity sensor generating first input signal is in origin / start position.
5. Before connecting the pneumatic tubes to the broken tool detector device check the needle movement by hand. In 0 — 20 degrees, proximity sensor should remain on and generate first input signal. In 20 — 70 degrees, proximity sensor should turn off and in 70 — 90 degrees, proximity sensor should turn ON and generate second input signal.
6. Make sure the needle alignment is properly done with referring the needle alignment shown in **figure no. 9**.
7. Make sure the angle of the needle is properly set as shown in **figure no.10 or 11**.
8. Make sure air supply is given from FRL unit.
9. Make sure the pneumatic tubes are properly connected, and ensure that the air supply is ON with a pressure between 4.0 - 6.0 bar.
10. For normal tool detection trial in auto mode after completion of drilling operation, the needle detects / touches a tip of normal tool that restricts complete rotation to 90 degree. The slight rotation of the shaft along with the needle between 20 — 70 degrees as a result proximity sensor does not generate the second input signal indicating that the tool is in the normal condition.
11. For broken tool trial slightly take needle back ward from the holder as the needle does not detect / touch the tool tip.
    For broken tool trial in auto mode, the shaft along with the needle undergoes complete rotation to 90 degrees as the needle does not detect / touch the tool tip (the tool tip being broken fails to restrict rotation of the needle) and the proximity sensor generates the second input signal indicative of tool breakage resulting in discontinuation of the machining operation.

NOTE :

1. The needle will wear out because it touches the cutting blade directly, so it is necessary to check it regularly.
2. Accurate detection will not be obtained if the lock nut of the broken tool detector is loosened or if the grub screws of the collar and needle holder are loosened.
3. Regular inspection is necessary.

12. ALARM CONDITIONS

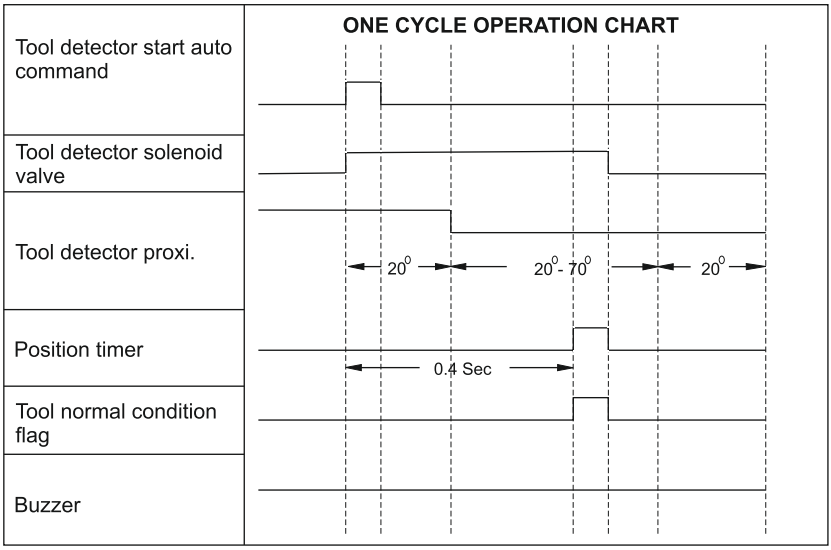
The broken tool detector gives following alarm conditions with use of the PLC logic.

SR. NO.	CONDITIONS	ALARM
1.	Tool in normal condition.	No alarm
2.	Tool in broken condition.	Alarm active
3.	Proximity sensor short - circuit / continuous on.	Alarm active
4.	Proximity sensor open - circuit condition.	Alarm active
5.	Proximity sensor cable open - circuit condition.	Alarm active
6.	The shaft along with needle is struck in between 0 — 90 degrees.	Alarm active

13. TIMING DIAGRAM

A. TOOL NORMAL CONDITION TIMING DIAGRAM

FIGURE NO. 14

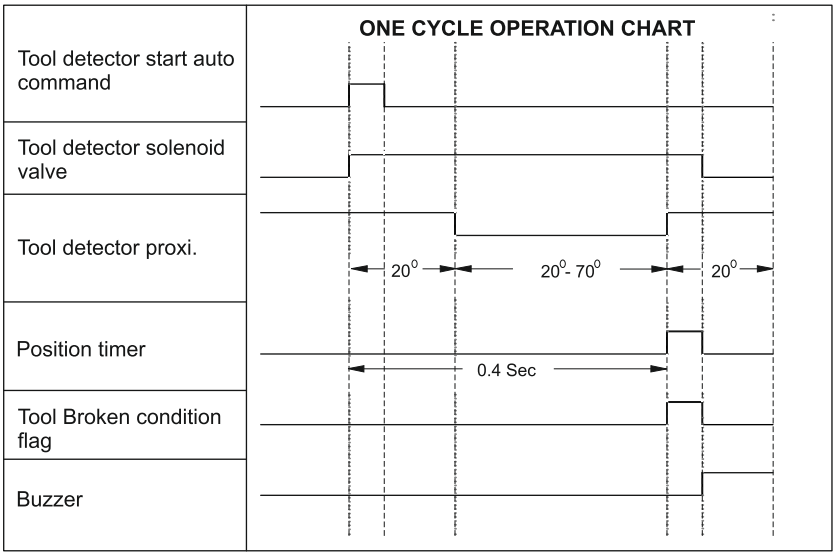


NOTE :

In tool normal condition, the needle should touch the normal tool tip in between 20 — 70 degrees before 0.4 sec. from the tool detector solenoid valve becomes energized. If the needle does not touch the normal tool tip in between 20 — 70 degrees before 0.4 sec, then consider that the needle is jam or bur enters into the gap between the collar and threaded piece or the collar alignment is disturbed.

B. TOOL BROKEN CONDITION TIMING DIAGRAM

FIGURE NO. 15



NOTE :

In tool broken condition, the needle should complete the rotation in 0 — 90 degrees before 0.4 sec. from the tool detector solenoid valve becomes energized. If the needle does not complete the rotation in 0 — 90 degrees before 0.4 sec, then consider that the needle is jam or bur enters into the gap between the collar and threaded piece or the collar alignment is disturbed.

14. ADVANTAGES, DISADVANTAGES & APPLICATIONS

A. ADVANTAGES

1. The broken tool detector is a robust electro-pneumatic device.
2. The broken tool detector suffers no frequent breakdowns and hence has a long life.
3. The proximity sensor and pneumatic fittings are easily replaceable.

B. DISADVANTAGES

1 . In case of low air pressure below 4.0 bar, chances of malfunctioning are possible.

C. APPLICATIONS

1 . CNC, VMC, and SPM machines.
2. Drill machine tool break detection.
3. Part confirmation application.

15. MAINTENANCE AND TROUBLE SHOOTING

SR. NO.	PROBLEM	PROBABLE CAUSES	SOLUTION
1.	The shaft along with the needle is not in origin position or gets jam in between 90 degrees.	1. No gap between collar and threaded piece.	1 . Adjust 0.4 mm gap between collar and threaded piece with the help of seam gauge by referring **figure no. 8.**
		2. Entry of heavy bur into the gap between collar and threaded piece.	2. Remove needle holder and collar and clean bur by blowing air and tight the collar by adjusting 0.4 mm gap between the collar and the threaded piece with the help of seam gauge and set the angle of needle holder by referring **figure no. 9 and figure no. 10** respectively and then tight the needle holder.
		3. Air supply is not given from FRL unit.	3. Give the air supply from FRL unit.
		4. Needle stuck up to an object or coolant pipe.	4. Separate out the object or coolant pipe and make the path clear to rotate the needle in 90 degrees.

SR. NO.	PROBLEM	PROBABLE CAUSES	SOLUTION
2.	Tool detector device does not operate.	1. Incorrect electrical hard wiring. 2. Incorrect PLC programming. 3. "Air supply is turned OFF or if the air supply tube is bent or kinked." 4. The directional controller valve may be stuck or faulty.	1. Check electrical hard wiring is correct. 2. Check PLC programming is correct. 3. Check the air supply is turned ON and the air supply tubes are not kinked or bent. 4. "Manually operate the directional controller valve and check if the shaft, along with the needle, rotates 90 degrees in both directions. If the shaft, along with the needle, does not rotate in both directions, then the directional controller valve may be faulty."

SR. NO.	PROBLEM	PROBABLE CAUSES	SOLUTION
3.	Alarm generation without any operation of the tool detector device.	1. Disconnected or loose proximity sensor cable. 2. Proximity sensor was not switched ON or not generating first input signal. 3. Proximity sensor cable is open / short circuited. 4. Air pipe has come out from fitting. 5. Cut or heavy air leakage in air pipe. 6. Low air pressure.	1. Check proximity sensor cable is properly connected. 2. Check for proximity sensor setting by referring to **figure no. 7**, and if it is faulty, replace it. 3. Check proximity sensor cable if it is faulty, replace it. 4. Connect air pipe properly to the fitting. 5. Replace the air pipe. 6. Increase air pressure upto 4.0 — 6.0 bar.
4.	Alarm generation without complete rotation of needle in 90 degrees.	1. Needle stuck between 0 — 20 degrees to an object or coolant pipe.	1. Separate out the object or coolant pipe and clear the path for free rotation of the needle.

SR. NO.	PROBLEM	PROBABLE CAUSES	SOLUTION
5.	Tool detector device does not detect the broken tool.	1. Needle stuck between 20 — 70 degrees to an object or coolant pipe while operating.	1. Separate out the object or coolant pipe and clear the path for free rotation of the needle.
		2. Entry of bur into the gap between collar and threaded piece.	2. Remove needle holder and collar and clean bur by blowing air and tight the collar by adjusting 0.4 mm gap between the collar and the threaded piece with the help of seam gauge and set the angle of needle holder by referring **figure no. 9 and figure no. 10** respectively and then tight the needle holder.
6.	Generation of tool broken alarm when the tool is normal.	1. Improper alignment of needle w.r.t. the tool tip.	1. Do the alignment of needle properly to the tool tip.
		2. Short length of needle.	2. Replace the needle.

SR. NO.	PROBLEM	PROBABLE CAUSES	SOLUTION
7.	Proximity sensor does not become ON.	1. Improper fitment of proximity sensor or the proximity sensor has become loose. 2. Proximity sensor is faulty. 3. Proximity sensor cable is faulty.	1. Tight / rotate the proximity sensor slowly into the sensor mounting port (S) until it comes to a stop then tight the lock nut. **(Refer page no. 13)** 2 Replace the proximity sensor. 3. Replace the proximity sensor cable.

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