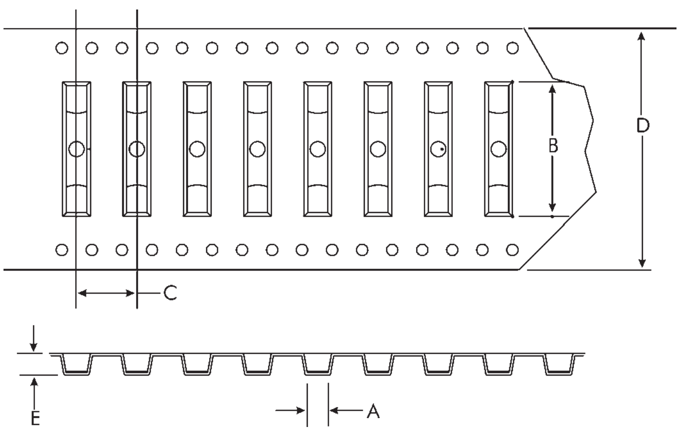
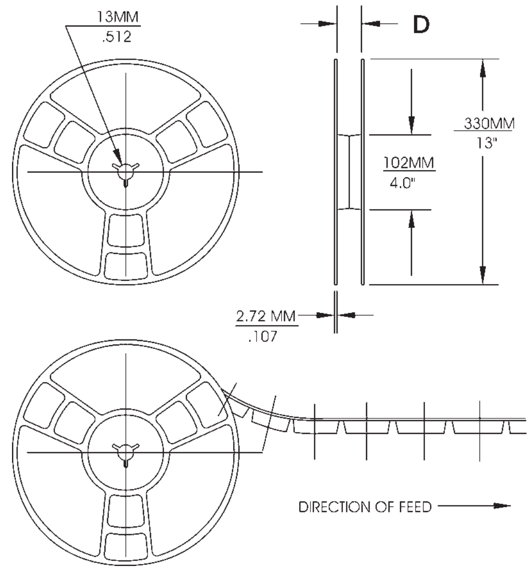
## Reed Switch Packaging

Standard packaging for uncut Reed Switches is a box containing 2000 pieces. Standard packaging for SMD Reed Switches is Tape & Reel with 2000 pieces per reel. Special trays and/or Tape & Reel are available for some types. Contact your local Coto Technology Representative with your special packaging needs. Below is a chart of Tape & Reel dimensions for standard products.



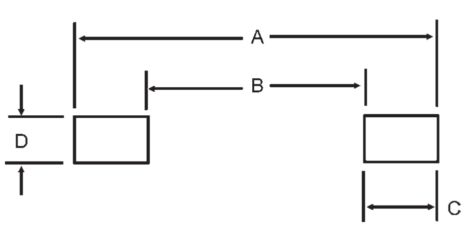




| Series | A | B | C | D | E |
|---|---|---|---|---|---|
| CT05 G1 | 2.57 | 10.92 | 8.00 | 24.00 | 2.59 |
| CT05 J1 | 2.57 | 8.64 | 8.00 | 16.00 | 2.59 |
| CT10 A2, G1 | 2.68 | 16.89 | 8.00 | 32.00 | 3.30 |
| CT10 G4 | 4.76 | 19.78 | 8.00 | 32.00 | 3.12 |
| RI-80 G1 | TBD | TBD | TBD | TBD | TBD |
| RI-80 G2 | 2.00 | 10.90 | 4.00 | 16.00 | 2.00 |
| RI-80 J | TBD | TBD | TBD | TBD | TBD |

## Recommended Pad Layouts for SMD Reed Switches

| Model | Lead Type | Figure # | Dim. A | Dim.B | Dim. C | Dim. D |
|---|---|---|---|---|---|---|
| CT05 | G1 | 1 | .424 / 10.76 | .242 / 6.14 | .091 / 2.31 | .057 / 1.45 |
| CT05 | "J1" | 1 | .330 / 8.38 | .168 / 4.27 | .081 / 2.06 | .057 / 1.45 |
| CT10 | A2 | 1 | .666 / 16.92 | .529 / 13.44 | .069 / 1.74 | .050 / 1.27 |
| CT10 | G1 | 1 | .692 / 17.57 | .520 / 13.20 | .086 / 2.18 | .041 / 1.04 |
| CT10 | G4 | 1 | .822 / 20.87 | .640 / 16.25 | .091 / 2.31 | .057 / 1.45 |
| RI-80 | G1 | 1 | .378 / 9.60 | .228 / 5.80 | .075 / 1.90 | .057 / 1.45 |
| RI-80 | G2 | 1 | .433 / 11.00 | .228 / 5.80 | .102 / 2.60 | .057 /1.45 |
| RI-80 | "J" | 1 | .315 / 8.00 | .165 / 4.20 | .075 / 1.90 | .057 / 1.45 |

FIGURE 1



## Glossary of Terms

**Dry-Reed Switch:**
A dry-reed switch is an assembly containing ferromagnetic contact blades, hermetically sealed in a glass envelope and operated by an externally-generated magnetic field, e.g., that from an actuating coil.

**Operate Value:**
The ampere turn value at which normally-open contacts close. Lower value reflects higher sensitivity (see Fig. 2).

**Operate Time:**
The operate time is the time between the instant of application of a magnetic field to a dry-reed switch and the instant of the first physical closing of this switch. The operate time does not include bounce time.

**Release Value:**
The ampere turn value at which normally-open contacts, held closed by a magnetic field, will reopen as field strength is reduced (see Fig. 2).

**Release Time:**
The release time is the time between the instant of removal of an applied magnetic field to a dry-reed switch and the instant of the first physical opening of this switch. The release time does not include bounce time.

**Bounce:**
Bounce is a momentary opening of a switch after initial closing, or a momentary closing after initial opening.

**Bounce Time:**
The bounce time is the interval of time between the instant of initial closing (or opening) and the instant of final closing (or opening) of the dry-reed switch.

**Dry-Reed Switch Contact Resistance:**
The dry-reed switch contact resistance is the resistance of the dry-reed switch under specified conditions of measurement.

**Saturate Value:**
The saturate value is the arbitrary defined value of the applied magnetic field at which the dry-reed switch is unaffected by further increase of the applied magnetic field (see Fig. 2).

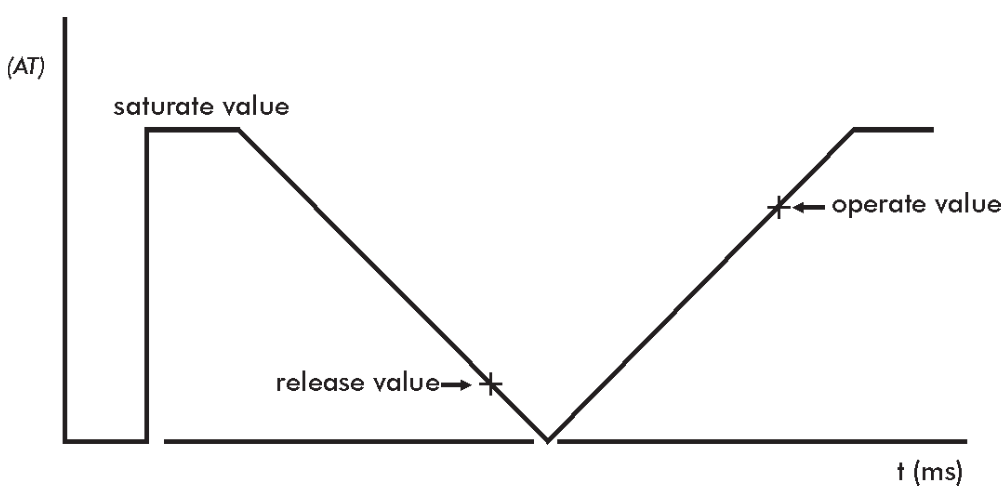



*Fig. 2: Graphical representation of parameters*

## Characteristics

**Operate and Release Values:**
Operate and release values are dependent on the measuring coil, the rate of energization (0.1 AT/ms), the detection of the operate (closing) and the release (opening) moment, the position of the measuring coil relative to the earth's magnetic field and on the environmental conditions.

**Operate and Release Times:**
The operate and release times are dependent mostly on the energization and de-energization rate. They are proportional to the R/L time of the coil. Operate time is inversely proportional to the ratio of energization to operate value. Release time is proportional to the ratio of energization to release value.

**Bounce Time:**
The bounce time is almost independent of the energization, however, a high energization gives a somewhat shorter bounce time. The bounce time is dependent on the current to be switched; above approximately 100 mA the bounce time is almost zero.

**Contact Resistance:**
The contact resistance is dependent on the wire composition, wire diameter, energization and contact layer. The published contact resistance is measured with an open contact voltage of 20 mV and a current through the closed contacts of 10 mA, using the 4-point method (Kelvin method). Distance between measuring points for all switch types is 41 mm.

**Breakdown Voltage:**
The breakdown voltage depends on the gap between the contact blades, kind of gas filling, gas pressure, material of the contact layer and the availability of free electrons in the gas. The first three items are set by the design of a particular reed switch. The last item is very dependent on ambient conditions. Therefore minimum values are given in the published data.

**Insulation Resistance:**
The insulation resistance is dependent on the condition of the inside of the glass envelope and on the environment, e.g. relative humidity, conducting layers on the outside of the glass envelope.

**Life Expectancy:**
The life of a dry-reed switch is influenced by the contact layer, the wire diameter, the load, the load circuit parameters and the applied magnetic field. The contact layer and the wire diameter are determined by the manufacturer. Load, load circuit parameters and magnetic field are determined by the user. The load should be within the maximum published values. The load circuit parameters (wiring capacitance and inductance), should be kept as low as possible and the applied magnetic field must be stronger than necessary for obtaining the maximum operate value.
**Remark:** Due to the influence of the load circuit on contact resistance and sticking, and also the influence of the applied magnetic field and used coil or magnet, life-test information can only be compared when they are the result of testing under exactly the same conditions (test equipment).

**Coils:**
Most of the electrical characteristics are measured using the Philips Standard Coil. Using another coil may change these characteristics. The measuring method e.g. speed, detection and the position of the coil with respect to the earth's magnetic field may also affect the characteristics. The definitions of the Philips Standard Coil follows:

- PHILIPS STANDARD COIL: 5000 turns of 42 SWG single enameled copper wire on a coil former of 25.4 mm winding length and a core diameter of 8.75 mm.

## Reed Switch Operation Methods

### Operation Using a Coil

Figures 3, 4 and 5 illustrate the various methods of operating the switch using a coil.

With the method given in Fig. 5, the dry-reed switch and/or permanent magnet can be placed either within or outside the coil.

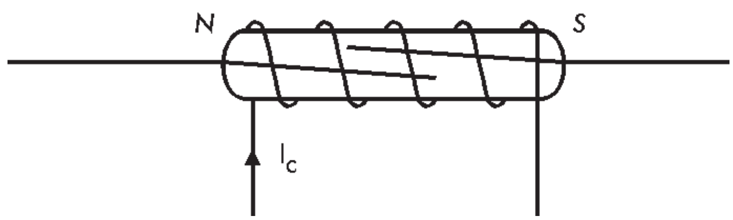



*Fig.3: A dry-reed switch mounted within a coil*

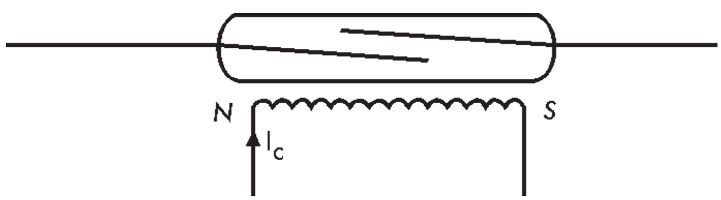



*Fig. 4: A dry-reed switch mounted outside a coil*

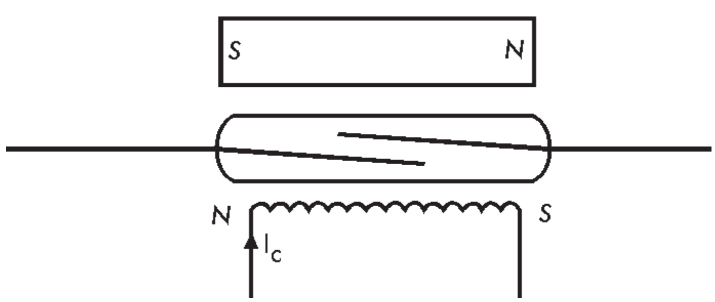



*Fig.5: A dry-reed switch biased by a permanent magnet and operated by a coil*

## Reed Switch Operation Methods

### Operation Using a Permanent Magnet

Permanent magnets are also often used to operate dry-reed switches. Figures 6, 7, 8 and 9 illustrate the various methods available.

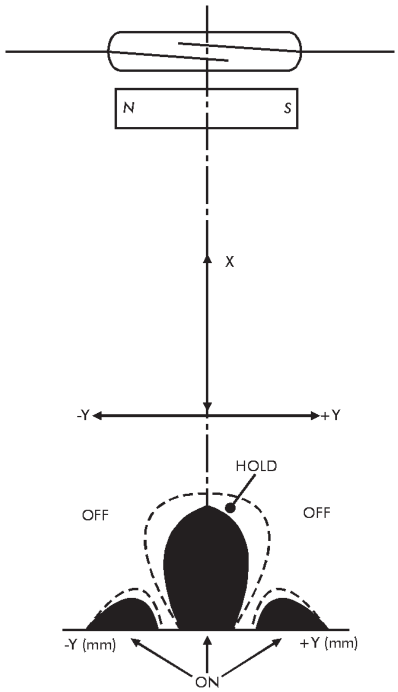



*Fig. 6: Movement, with the magnetic field parallel to the dry-reed switch*

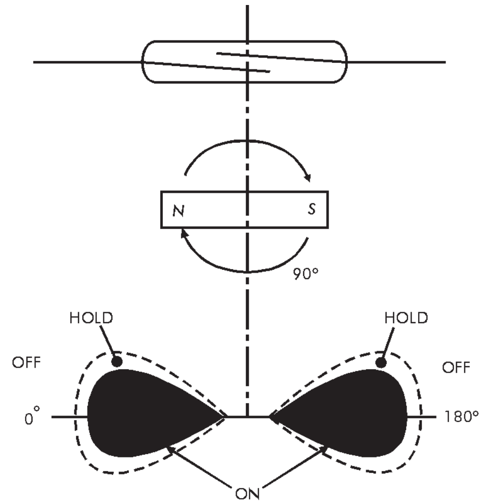



*Fig. 8: Rotational movement with a bar shaped permanent magnet*

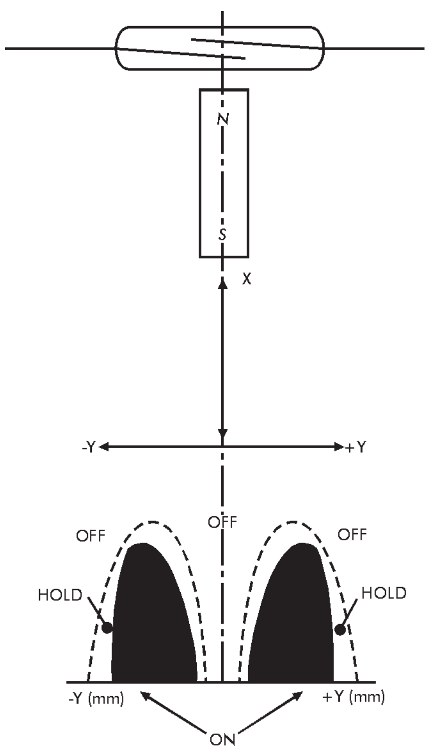



*Fig. 7: Movement, with the magnetic field perpendicular to the dry-reed switch*

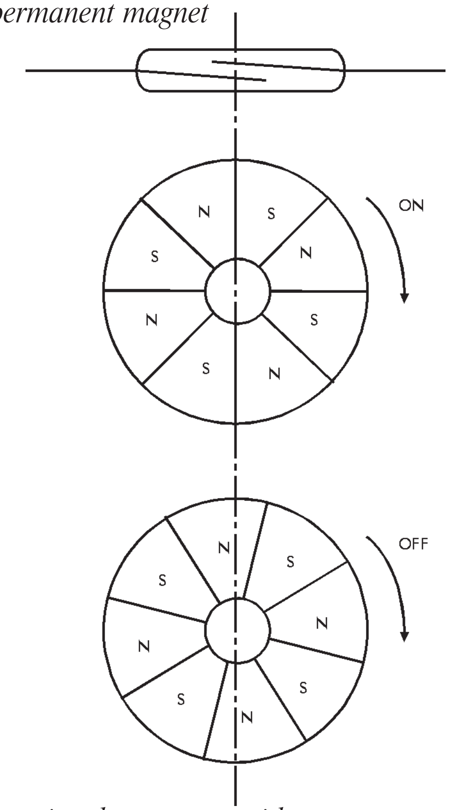



*Fig. 9: Rotational movement with two or more pole ring magnets*

## Reed Switch Operation Methods

### Shielding

Ferromagnetic materials which shunt the magnetic fields may be used to shield a dry-reed switch (see Fig. 10).

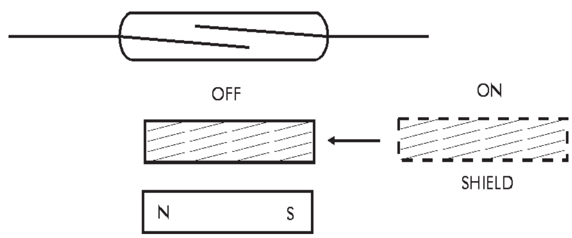



*Fig. 10: Shielding a magnetically operated switch*

### Magnetic Application

There are many applications for dry-reed switches used in combination with a permanent magnet. Figure 11 shows the relationship between the Gauss values of a permanent magnet and the AT values of Coto dry-reed switches in the Philips Standard Coil. It enables the customer to determine which reed switch AT range can be used in combination with a specific permanent magnet.

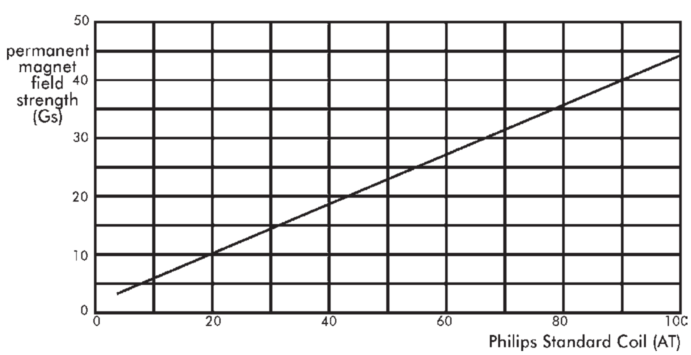



*Fig. 11: Relationship between the field strength of a permanent magnet and the ampere-turn values of Coto reed switches in the Philips Standard Coil*

## Switching Considerations

### Application Information

Should your application require further information, please consult your nearest Coto Technology sales office.

### Contact Protection

Unless stated otherwise, the published life-expectancy data is based on resistive loads. For inductive, capacitive or lamp loads, inrush current or reverse voltage can affect the life of a reed switch. For a maximum lifetime, contact protection is advised.

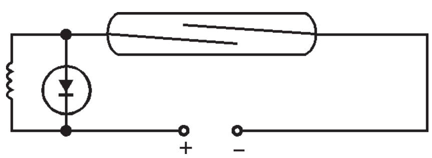



*Fig. 12: DC voltage contact protection*

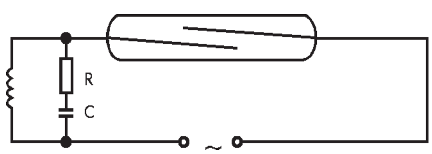



*Fig. 13: AC voltage contact protection*

### Inductive Loads

To reduce the high reverse voltage produced when a reed switch opens, the following contact protection can be applied:

DC voltage: a diode parallel to the load or the reed switch (see Fig. 12).

AC voltage: An RC-network parallel to the load or the reed switch (see Fig. 13).

$$C = \frac{I^2}{10}$$

and

$$R = \frac{U}{10\left(1 + \frac{50}{U}\right)}$$

where: C in µF; I in A; R in Ω; U in V.

### Capacitive Loads

To reduce the high inrush current when a reed switch closes, a resistor must be connected in series with the capacitance or the reed switch.

When wiring a load and reed switch over a long distance, electrostatic capacitance, arising from the cable, can influence the reed switch. To protect against this capacitance a series surge protector (L) or a resistor should be connected in series.

### Lamp Loads

To reduce the high inrush current when a cold incandescent lamp has to be switched by a reed switch (closing only), a resistor must be connected in series with the lamp or parallel to the reed switch.

# Technical & Applications Information [Switches]

## Cutting and Bending Switches

### Introduction

A dry-reed switch can be defined as an assembly that contains two ferromagnetic NiFe contact blades, hermetically sealed in a glass envelope and filled with an inert gas. The inert gas atmosphere protects the contact resistance of the reed switch, which is one of its most important electrical performance characteristics. The inert atmosphere is maintained by the integrity of the critical glass-to-metal seal of the switch. This seal is defined as a "residual stress seal," which means that the seal is sensitive to handling. When properly made, this seal with maintain the inert gas atmosphere of the reed switch for a minimum of thirty (30) years. However, improper handling of the switch and the application of excessive mechanical force during modification of the switch leads may result in a loss of the seal hermeticity. If damage is caused, it might be immediately visible as a glass crack in the seal area with or without the evidence of chipped glass particles. Or a latent defect may be created that will deteriorate the seal hermeticity over time due to the residual stress of the seal being altered through the improper application of a mechanical force. Once the seal integrity is compromised, atmospheric oxygen and other contaminants will degrade the contact resistance and the life expectancy of the switch will be severely impacted.

### Switch Lead Modification Recommendations

It is recommended that the lead bend of switches be no less than 1.0 mm from the glass seal to prevent cracking of the seal or destruction of the residual stress within the seal. For applications requiring the bending, cutting or modification of the switch leads, it is advisable to contact Coto Technology to achieve an optimal solution.

### Achieving an Optimized Switch Modification

The glass seal has a very high resistance to pressure, but a low resistance to pull forces. The ability of the seal to properly withstand a switch lead modification is dependent on several factors: the relation of the wire-to-glass dimensions, the length of the seal, the pull force or type of modification to be performed, and the distance and direction of the mechanical force in relation to the seal itself.

Therefore, the proper support and clamping of the leads is necessary to avoid damage to the seal. Even then, the plastic deformation strain of the NiFe lead wires can be transmitted through the clamping area and into the seal. Depending on the combination of the force and the distance of the clamping area to the seal, damage may still result.

In Figures #14, #15 & #16 (opposite page), a cutting example is given. Figure #14 is an example of lead modification without any clamping of the switch. While in this case, it is impossible to build up stresses where small dimensions and tight tolerances are required, this is not a practical method.

Figure #15 is an example of a properly clamped lead to avoid improper stresses.

Figure #16 demonstrates the creation of a stress component in the direction of the seal, which is the result of not clamping. This is an unacceptable method of modification.

Figures #17 and #18 illustrate bending of the leads. Improper lead bending can be even worse than only cutting. The risk of plastic deformation strain in the NiFe wire leads is very high. Thus, supporting or clamping the lead wire is necessary to avoid damage of the glass seal.

Any form of bending, cutting or modification of the switch leads requires approriate tooling and fixturing to minimize the introduction of mechanical stress on the glass seal area. Many years of experience has proven that switch damage can be avoided when lead modification is required by proper fixturing and the avoidance of any modification less than 1mm from the glass seal.

## Cutting and Bending Switches

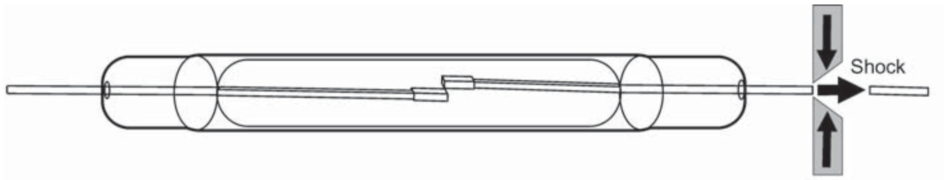



*Figure #14*

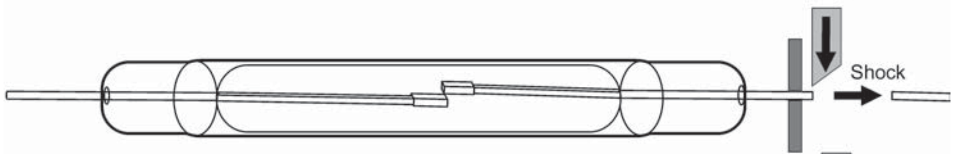



*Figure #15*

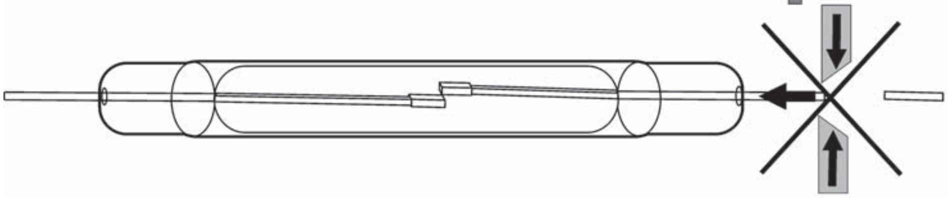


*Figure #16*

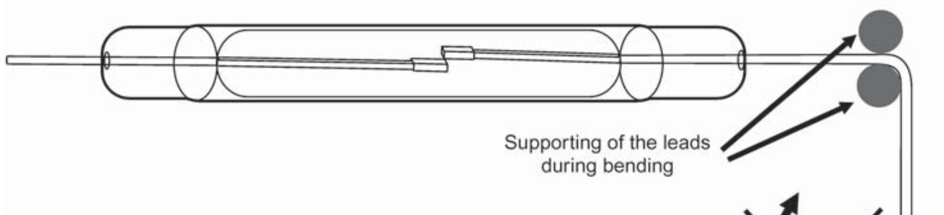



*Figure #17*

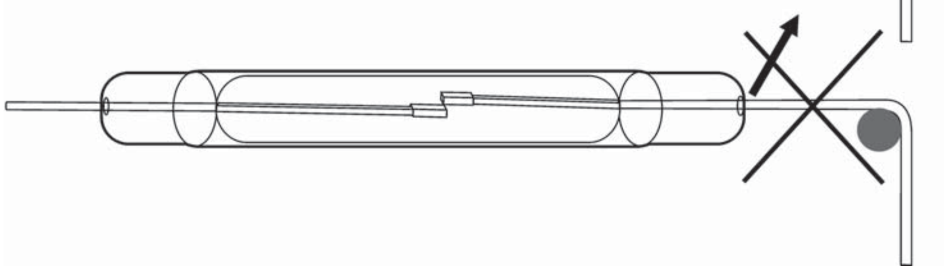


*Figure #18*

## Quality Control

### Quality

Dry-reed switches are designed for, and used in, the most demanding applications; these include computer keyboards, telephone equipment, automatic test equipment and automobiles. Therefore their quality must be exceptionally high with regard to conformity and reliability. This quality is built into our dry-reed switches during every stage of their design and manufacture.

Quality methods are generally in accordance with *"IEC 68"*, with procedures corresponding to *"CECC 19000"* (although CECC release is not available).

### Organized for Quality

The exceptional quality of our dry-reed switches is founded at every stage of their design, development, manufacture and application. Responsibilities and communication paths are well defined. Quality control is independent but integrated with production and development. The importance of continual education and training is fully recognized and implemented. The quality achieved is evident from:

- Uniform product characteristics from batch to batch
- Rugged construction
- Long life
- Low early-failure rate

The high quality of our dry-reed switches is constantly being improved. Our comprehensive quality improvement program features:

- Close collaboration with customers to satisfy specific application requirements
- Production-processing spread reduction
- Stabilization of process conditions with rigorous significant change procedures
- Involvement of everyone in improvement activities
- Statistical process control
- Well understood quality indicators.

Our working environment is designed to encourage quality awareness with:

- Close collaboration between individuals and departments
- Close cooperation between Marketing, Quality, Development and Production departments
- Clearly defined responsibilities
- ISO 9000 certified and procedures guiding all activities
- In-depth training
- High-grade support from service departments
- Effective dissemination of information at all levels.

### Quality Procedures

Properly documented procedures are essential to the achievement, maintenance and improvement of high product quality. They help to ensure that all aspects of our dry-reed switch activity, from development to customer service, are carried out thoroughly and that maximum information is available to refine designs, processes and to generate new designs.

### Release Procedures

Before dry-reed switches can be delivered, even as samples to customers, they must be granted an approval for delivery (AFD), in accordance with our release procedure.

The release of an AFD is considered after representatives from the Development, Marketing, Production and especially, Quality departments, have reviewed sample data.

Once an AFD is granted, small scale production is sanctioned. Quality evaluation during this stage provides data for a release report. This report is examined at a release meeting, before release for (full scale) production (RFP) is granted. Release for production is also required for new cropped and/or pre-formed lead versions of existing dry-reed switches.

### Manufacturing Instructions

The routing of dry-reed switches through the production process is fully documented in the manufacturing instructions for each type. These instructions also describe incoming and on-line inspection, quality control methods and requirements.

### Calibration Procedures

Accurate test and measuring equipment is an essential pre-requisite for the maintenance and improvement of

## Quality Control

product quality. Calibration procedures are laid down in the quality manual. Basic requirements include regular calibration of all equipment, with clear reporting of accuracy.

Deviations from the required accuracy of any equipment must be clearly reported and acknowledged. Nature of the deviation must be specified and responsibility for the equipment defined, so that its rectification can be verified.

### Quality Reporting

**Quality Reporting Requirements are laid down for:**

- Incoming material and component inspection
- Production yield
- Sampling inspection (quality control) results
- Customer returns
- Quality improvement planning
- Process and performance changes.

**Quality in Dry-Reed Switch Production**

Inspection and quality control are integrated into our dry-reed switch production. Quality control inspections are carried out both by the operators and line inspectors. The quality department monitors quality control, inspection, process conditions and carries out final acceptance and qualification testing. Test equipment is checked by line inspectors and calibrated by the quality service department (see Fig. 19).

**Incoming Inspection**

Wire used in the manufacture of dry-reed switches is checked for:

- Appearance
- Diameter
- Chemical composition
- Magnetic characteristics
- Scoring and cracking.

After the annealing process is complete, the expansion coefficient of the wire is checked, and the magnetic characteristics are measured again.

Glass tubing used in the manufacture of dry-reed switches is checked for:

- Appearance
- Dimensions.

After these checks the glass tubes are ultrasonically cleaned and dried.

**Quality Control Inspection**

As shown in Fig. 19, inspection or quality control is performed after each mechanical or chemical process stage. In addition, to ensure product uniformity, the critical process conditions are monitored of:

- Gold plating
- Gold diffusion
- Ruthenium plating or sputtering
- Sealing
- Appearance
- Dust levels in the clean room.

**Acceptance Testing**

After final inspection, samples of dry-reed switches are taken from each batch in accordance with the requirements of *"MIL-STD 105D (ISO 2859)"*. These samples are subjected to in-depth evaluation to ensure that all requirements are fully met before dispatch.

**Acceptance Tests**

Using the Philips Standard Coil, samples of dry-reed switches from each batch are tested for:

- Dynamic contact resistance
- Operate range individual ampere-turns value
- Release range individual ampere-turns value
- Static contact resistance
- Visual inspection
- Solderability
- Gauge check (dimensions).

**Life Tests**

Samples of dry-reed switches are subjected to the life tests and all failures are analyzed to provide additional corrective action data.

**Remark:** Due to wiring inductance and capacitance, switching waveforms in the loaded life tests include an initial, very short, high current pulse component. It is necessary to specify and control the amplitude of this pulse, since it can have a marked effect on the results of the life tests.

**Laboratory Tests**

Samples are tested for conformance to the published data at six monthly intervals, and the results recorded.

The samples are tested for:
- Operate and release ampere-turns
- Operate/release ampere-turns ratio
- Dynamic and static contact resistance
- Static contact resistance stability
- Insulation resistance
- Capacitance
- Operate, bounce and release times
- Breakdown voltage with pre-ionization
- Bemanence
- Tensile test.

**Packing and Labeling**

After a batch is accepted according to the specification, the dry-reed switches are packed and labelled with the production week number for traceability.

**Customer Returns**

The efficient processing of returned dry-reed switches is regarded as vitally important, both to our customers and to ourselves. Our in-depth examination of rejected switches provides valuable additional data for our own quality improvement activities, helps to guide the development of new or improved switches, and extends our knowledge of their behavior in real applications.

## Quality Control

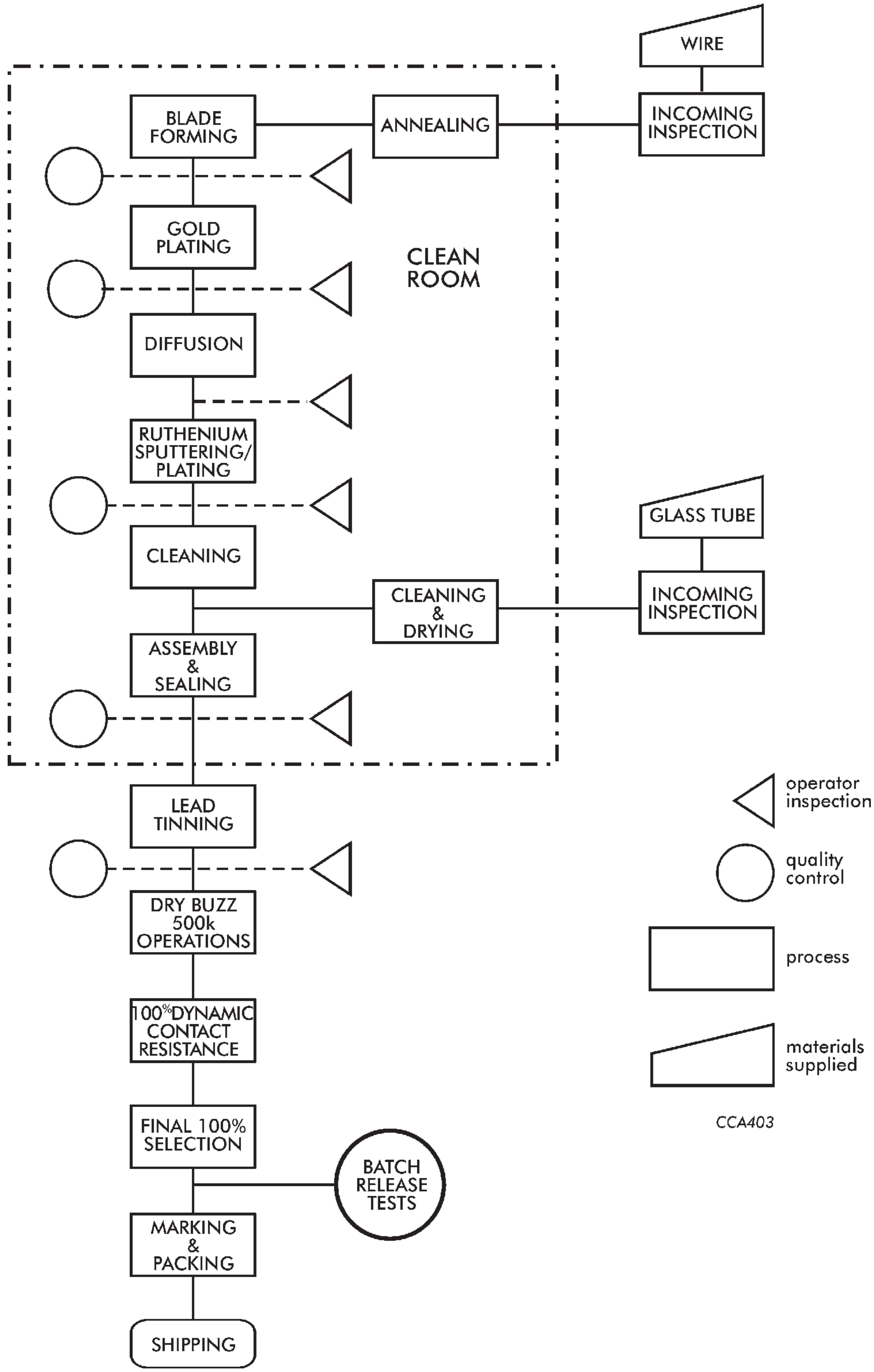



*Fig. 19: Quality control and inspection flow chart for the production cycle. By integrating Quality Control fully with inspection and production, we are able to maintain and progressively improve the quality of our dry-reed switches.*