INSTRUCTION MANUAL
VIBRASWITCH MALFUNCTION DETECTOR
MODEL 366

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invensys Controls

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SECTION I – DESCRIPTION

1.1 GENERAL

The Vibraswitch Model 366, is designed to protect rotating, reciprocating, or similar equipment against serious damage from malfunctions that can be detected as an increase in vibration. A reset and holding coil is provided in the DC/AC voltage as specified, so that accidental shutdowns on starts can be prevented.

The Vibraswitch Model 366, may be used in conjunction with the Vibraswitch Monitor. The monitor is a solid-state electronic system designed to "sort-out" false signals received by the Vibraswitch so that Alarm and/or Shutdown of operating machine will not result from false transient disturbances.

1.2 MODEL IDENTIFICATION

Specify and order instrument models in accordance with the description and variations listed in the table. Dashes are used in the model number only in those spaces as indicated in the example.

366 – A – 4 – H

Table A - Key Model Numbers
Table 1 - Switch Contacts
Table 2 - Remote Option Reset
Table 3 - Special Options

TABLE A – KEY MODEL NO.	
Model No.	Description
366	Vibraswitch, CSA Certified, Enclosure 4 and 5, Equivalent; NEMA-4 & NEMA-12, Range 0-4.5 G

TABLE 1 – SWITCH CONTACTS	
Desig.	Description
A	SPDT – Single pole, Double throw load contacts
D	DPDT – (2 gang mounted SPDT load switches).
G	DPDT – (2 gang mounted SPDT load switches). Contacts are gold plated for low voltage/current applications

NOTE: Gold plated contacts not CSA Certified.

TABLE 2 – REMOTE OPTION RESET	
Desig.	Description
0	No reset coil.
2	24 volt DC reset coil voltage.
3	240 volt AC reset coil voltage.
4	48 volt DC reset coil voltage.
7	120 volt DC reset coil voltage.
8	120 volt AC reset coil voltage.

NOTE:
Other reset coil voltages available, on special order consult factory.
240 volt AC reset coil not CSA Certified.

TABLE 3 – SPECIAL OPTIONS	
Desig.	Description
E	Base painted with gray epoxy paint.
H	Space heater installed for maintaining internal area of unit moisture free.
EH	Base painted with gray epoxy paint and space heat er installed

NOTE: Space heater not available for 240 volt models with "D" switch option
Space heater with "D" switch option not CSA Certified.

ACCESSORY ITEMS	
PART NO.	Description
	* See Notes Below
260GG453	Space heater for maintaining internal of unit moisture free – 120 volt models.
260GG359	Same – 48 VDC models.
260GG220	Same – 24 VDC models.
260GG469	Same – 240 VAC models.

NOTE: #1 Model 366 can be used with Model 563A/565 Vibration Monitors.
NOTE: #2 Addition of Space Heater to "D" switch option Consult Factory.

SECTION II – SPECIFICATIONS

2.1 ENVIRONMENTAL

Housing:	
Cover	High Impact, ABS Thermoplastic
Gasket	Thermoplastic Styrene Copolymer
Base	360 Aluminum, 0.4% Maximum Copper Content
Weight	2.5 lbs.
Mounting Location	Outdoor, unprotected
Enclosure Classification	CSA Certified for enclosure 4 (Watertight) and 5 (Dust-tight) Non-hazardous. Meets NEMA 4 and 12 classifications.
Ambient Temperature Limits	-40°F to +200°F (-40°C to 93.3°C)
Humidity	To 95% RH @ 100°F (37.8°C)
Shock	40g @ 11 ms maximum.

2.2 ELECTRICAL

Contact Rating:

SPDT 7 amp. Max., 460 VAC max., 50/60 Hz Resistive Load
0.5 amp max., 120 VDC max., Resistive Load
1 amp. max., 48 VDC max., Resistive Load
2 amp max., 24 VDC max., Resistive Load.

DPDT (Designation D in Table 1)-
5 amp. max., 240 VAC max., 50/60 Hz Resistive Load.
5 amp max., 30 VDC max., Resistive Load.

DPDT (Gold Plated Contacts)-
0.1 amp max., 125-250 VAC Resistive Load.
0.1 amp max., 30 VDC Resistive Load.
1 mA min., 24 VDC Resistive Load.
2 mA min., 12 VDC Resistive Load.
5 mA min. 6 VDC Resistive Load

2.3 PERFORMANCE

Vibration Measurement Range	0 to 4.5g from 0 to 300 Hz (18,000 RPM)
Set point Range	1 turn per g
Reset Coil Power	12 VDC, 1.5 amp 24 VDC, 0.5 amp 48 VDC, 0.2 amp 120 VDC, 0.14 amp 120 VAC, 0.3 amp 240 VAC, 0.3 amp
Maximum Energized Time	4 min.
Standard Reset Coil Voltage	24 VDC, 48 VDC, 120 VDC, 120 VAC, 240 VAC, 50/60 Hz
Accuracy	± 5% of full range from 0 to 300 Hz (18,000 RPM)
Ambient Temperature Effect	± 10% / 100ºF (37.8°C) max.

SECTION III – INSTALLATION

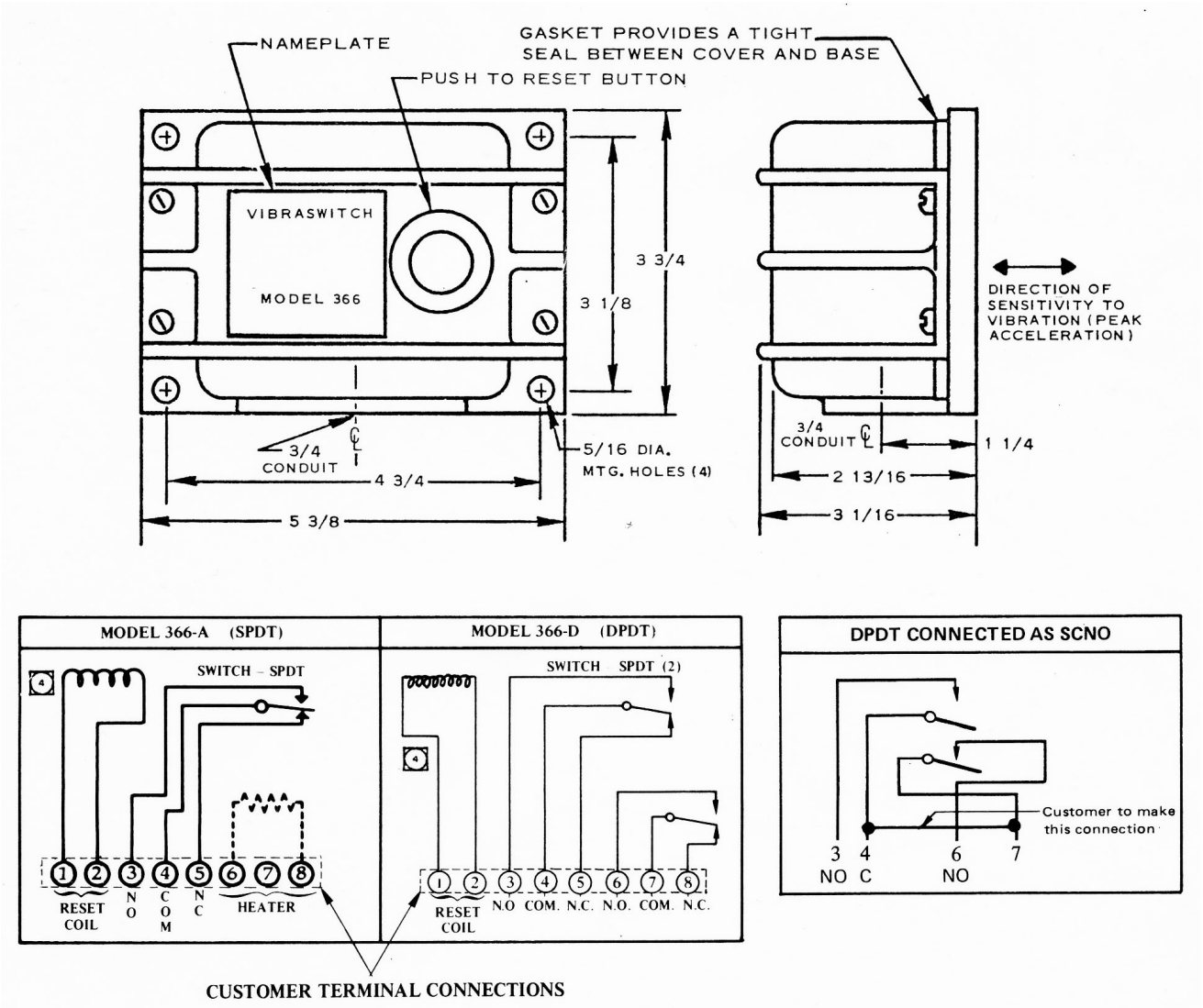
3.1 GENERAL

Examine the instrument for possible shipping damages. **IMPORTANT:** If for any reason it is determined that the equipment should be returned to the factory, please notify the nearest Robertshaw Industrial Products sales representative prior to shipment. Each unit must be properly packaged to prevent damage. Robertshaw Industrial Products assumes no responsibility for equipment damaged in shipment due to improper packaging.

Choose the location in accordance with good instrument practice, avoiding extremes of temperature, humidity, and vibration. (SEE SPECIFICATIONS, Section II.)
The Vibraswitch, Model 366, detector may be located in any non-hazardous unprotected outdoor or indoor area. CSA Certification and NEMA Classification is contained in Section II, Specifications. In locations where moisture condensation within junction boxes is a problem, a two-watt resistor may be placed across terminals 6 and 8 inside the Vibraswitch cover and wired to a source of continuous voltage to provide heat within the enclosure to reduce condensation effects. See Table 3-1 for Space Heater values.

3.2 MOUNTING

Figure 3-2 illustrates the methods of mounting on various pieces of equipment. Figure 3-1 shows the mounting dimensions and external wiring for the Vibraswitch, Model 366.
The vibration sensitive axis of the Vibraswitch is perpendicular to it's mounting base. Therefore, the Vibraswitch must be mounted in a plane that will detect the vibratory motion for which protection is desired. The Vibraswitch may be mounted at any location along the length of machines containing rotating shafts that are horizontal and parallel to the base of the machine: the preferable location being in line with the rotating shaft. Do not mount the Vibraswitch perpendicular to the ends of the rotating shafts unless the end-play or end-thrust measurement is desired. Normally, bent shafts, unbalanced on the rotating massof the shaft, worn bearings, and other anomalies are detected near the bearing housings and at right angles to the shaft.
The Vibraswitch may be mounted in any position between the side (vertical) or top (horizontal) of bearings or machine housings. It should be noted that when mounting Vibraswitcheson top (horizontal position) of equipment the vibration measurement range is as stated in the Specification Section. However, when the Vibraswitch is mounted on a side position (90° from the horizontal), the 1 g is subtracted from the measurement range of the instrument.
If mounting bracket assembly is used to mount the Vibraswitch due to an irregular mounting surface, it must be constructed of steel having sufficient thickness and properly reinforced so that mechanical resonances are not introduced; usually ½" steel plate is satisfactory if the dimensions of the bracket are not large. It is extremely important that all four corners of the Vibraswitch, as well as the mounting assembly, be rigidly secured to the machine. Exact location is not critical as the adjustment procedure of the Vibraswitch automatically accounts for the normal vibration at the location.



SEE 2. BELOW FOR PROPER WIRING OF RESET COIL.

1. Switch shown in normal or reset position – reverses on actuation from increased vibration.
2. Standard Coil Voltages: 24 VDC, 48 VDC, 120 VDC, 120VAC, and 240 VAC.
3. Heater resistor installed across terminals 6 and 8 (for "A" switch option) to prevent condensation in housing where climate conditions require. (Supplied only when specified.) For heater resistor with "D" switch option additional terminals (not shown) are provided.
4. If manual Reset Only is desired, do not apply power to the reset coil.
5. For Single Pole operation of the Model 366-G (gold contacts) it is recommended to connect the two poles in parallel by adding jumpers between 3 and 6, 4 and 7, 5 and 8.

Figure 3-1, Mounting Dimensions and External Wiring for the Vibraswitch, Model 366.

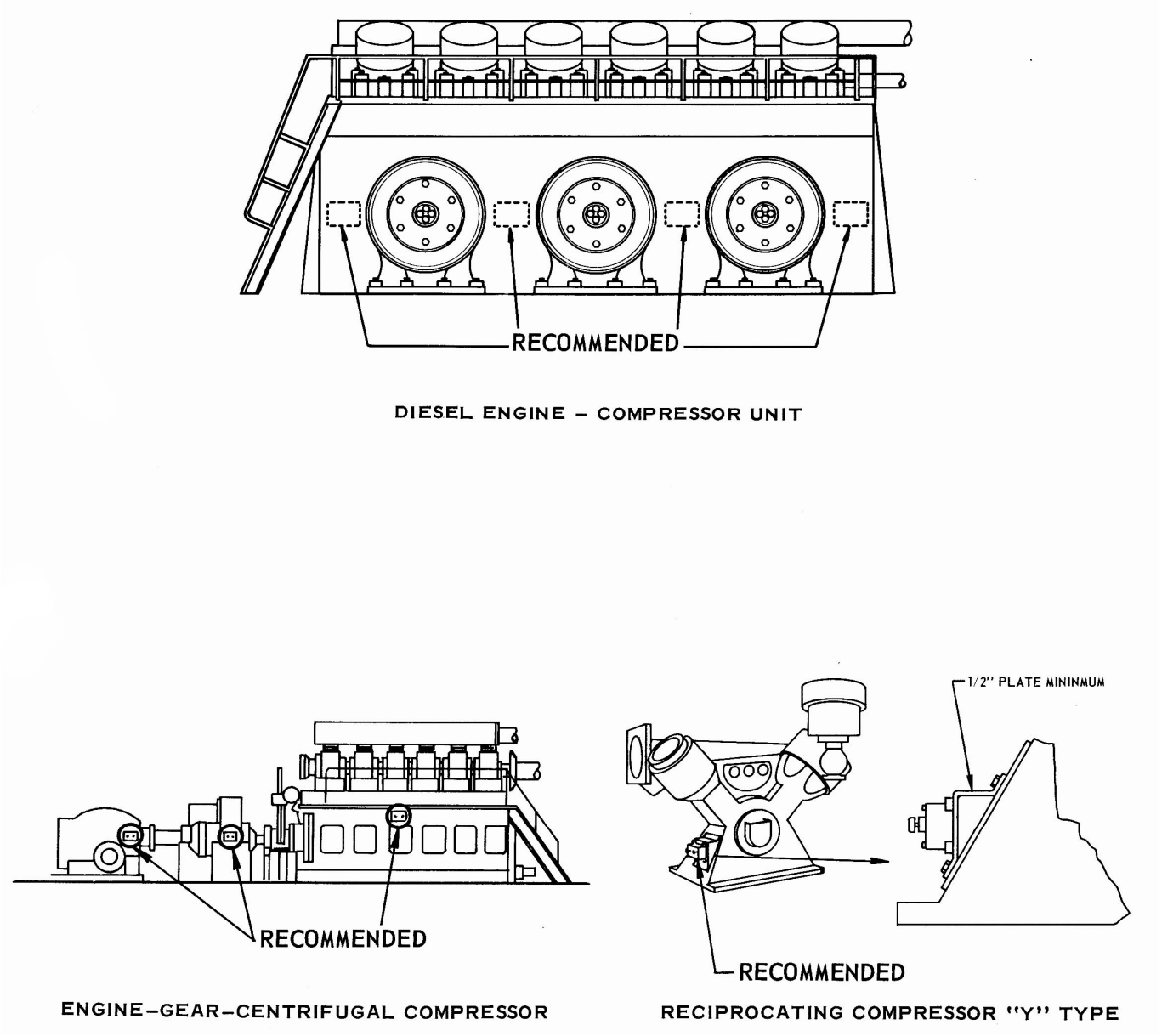
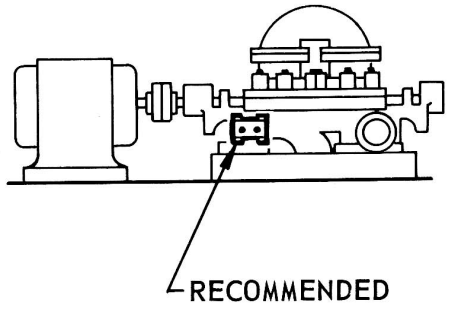
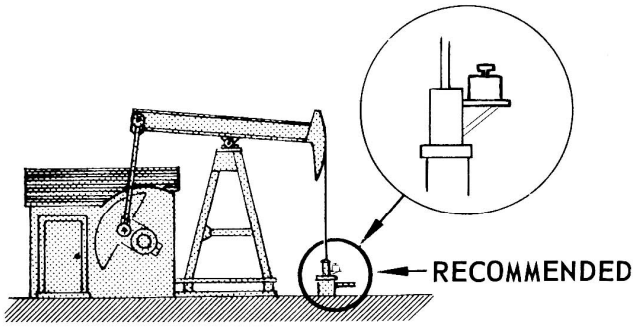


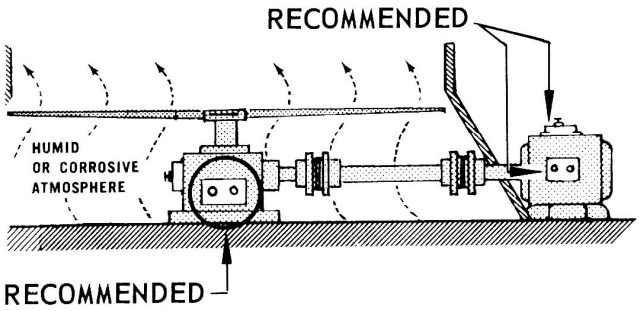
Figure 3-2, Methods of Mounting the Vibraswitch, Model 366. (Sheet 1 of 2).



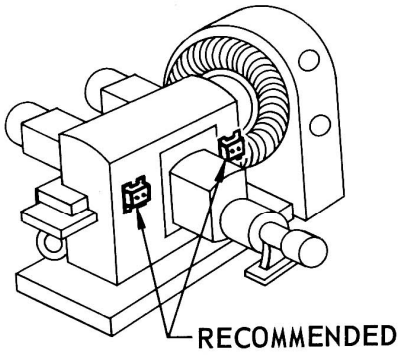
CENTRIFUGAL PUMP



PUMPING UNIT



COOLING TOWER FAN



HORIZONTAL OPPOSED
RECIPROCATING COMPRESSOR

Figure 3-2, Methods of Mounting the Vibraswitch, Model 366. (Sheet 2 of 2).

The Vibraswitch, when properly adjusted, trips on a relative increase in vibration.

When installing the Vibraswitch on existing equipment where conventional mounting positions are available, it is advisable to check the existing vibration level at each possible position before permanently mounting the unit. The Vibraswitch can be used to measure existing vibration by holding or clamping it against the running machine and determining the trip point as described under "ADJUSTMENT" in this manual. Should normal vibration exceed the range of the Vibraswitch, it is recommended that consideration be given to a Robertshaw Model 566, Continuous Motor Unit which is capable of monitoring higher g-levels.

3.3 SPACE HEATER

In some outdoor installations, it may ne necessary to install a space heater to prevent moisture condensation. A small conventional carbon 2-watt resistor should be installed across terminals 6 and 8 in the detector. Proper values are shown in Table 3-1.

Table 3-1, Space Heater Resistor Values

Voltage (AC or DC)	Space Heater Resistor (Ohms)
240	56,000.
120	12,000
48	2,200
24	620

3.4 WIRING

The Vibraswitch Model 366, is equipped with a threaded hun for ¾" conduit. When the vibration amplitude is large (i.e., greater than 5 mils.) it is good practice to use a short length of flexible conduit to serve as an isolator between the rigid conduit and the Vibraswitch. Wiring into the unit should be done with #18 stranded wire although #14 can be used where necessary. The Vibraswitch was not designed for wiring with heavy solid wire. However, where necessary to use heavier wire as in low voltage DC units, a junction box near the Vibraswitch should be used.

For instruments with a 240 VAC reset coil, any large field wiring which may come into contact with the large resistor located inside of the Vibraswitch should be rated 125°C or higher.

NOTE:

The instrument housing must be sealed at the conduit outlets with a suitable compound or "trap" to prevent infiltration of moisture-laden air or corrosive gases into the housing.

NOTE:

All instrument installation wiring must be done in accordance with local codes and commonly accepted practices.

To avoid unnecessary difficulty in wiring the unit, the following procedure should be followed in detail:

a. When installing conduit and mounting the Model 366, it is recommended that the cover be left on the unit.
b. If the Model 366 is to be mounted in unprotected or dusty areas, a dust-tight or water-tight seal should be made at the conduit entrance.
c. With all mounting complete, remove cover and insert wires through conduit entrance with sufficient length to reach the terminal block.
d. Strip wires back ¼ inch and install solderless terminals.
e. Connect wires to terminals as shown in Figure 3-1.

For instruments with gold plated contacts it is recommended to connect the two poles in parallel when only one pole is required (for SPDT or SPST operation) as specified in Table 3-2 below.

Table 3-2, Jumpers for SP Operation with Gold Contacts
CONNECT TERMINALS
3 TO 6 (NO)
4 TO 7 (COM)
5 TO 8 (NC)

SECTION IV – OPERATION

4.1 OPERATION

The Vibraswitch, Model 366 (Refer to Figure 4-1), is sensitive to vibration in a direction (the sensitive axis) perpendicular to its mounting base. It contains a vibration detecting mechanism, which also functions as a "mechanical amplifier" to activate a snap-action switch when the selected level of vibration is exceeded and the detecting mechanism "trips".

The detecting mechanism consist of an armature suspended on a flexure pivot which is restrained from motion by a permanent magnet (the hold down magnet). In the "armed" condition, the armature is held against the stop pin by the hold down magnet. The stop pin maintains a precise air gap between the armature and the hold down magnet. On the opposite end of the armature, the compression spring provides an adjustable force to oppose the force of the hold down magnet. Whenever the peak vibration inertial force (mass x acceleration) plus adjustable compression spring force exceeds the force of the holding magnet, the armature is released and is pulled into the latching magnet ("tripped" position). Simultaneously, it activates the snap-action switch. This detecting Mechanism has a uniform response from 0 to 300 Hz over a range of 0 to 4.5 g's.

The mechanism may be reset to the "armed" position manually (locally) or electrically (remotely). Manually, depress the reset button to move the armature away from the latching magnet ("tripped" position) until it is held against the stop pin ("armed" position). Electrically, the reset coil may be activated to pull the armature into the "armed" position against the stop pin.

A reset and holding coil is provided, in the DC/AC voltage as specified, so that accidental shutdowns on starts can be prevented. External time-delay relay circuits are required to maintain voltage at the holding coil during the startup period and then release this voltage when operation is normal. At full voltage the reset coil should not be energized for more than four minutes to prevent overheating. Then, the reset coil must be de-energized for a period of 10 minutes before re-energizing. For longer hold-in requirements the reset coil should be energized at full voltage and then held-in at one-half the rated voltage.

The Vibraswitch, Model 366, may be used in conjunction with the Vibraswitch Monitor. The Monitor is a solid-state electronic system designed to "sort-out" false signals received by the Vibraswitch so that alarm and/or shutdown of the operating machine will not result from false transient disturbances. Examples of transient disturbances are closing of pipeline check valves on pumping application, the start-up of additional pumps on a line, and the initial start-up of various operating machines. These disturbances may cause the Vibraswitch to "trip-out" if the vibratory shock level is in excess of its Set point.

The purpose of the Vibraswitch Monitor is to "supervise" and "sort-out" the transient disturbances so that the Alarm or Shutdown is not falsely imposed on the machine being monitored; but any continuous vibration level which exceeds the Setpoint of the Vibraswitch will cause Alarm and/or Shutdown.

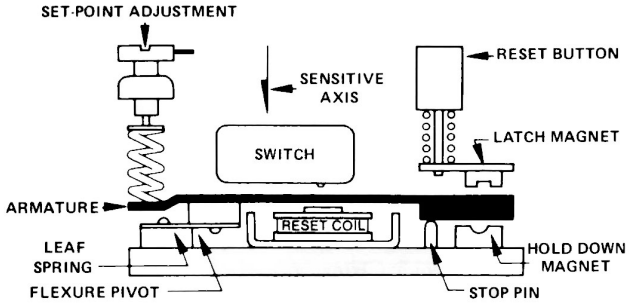


Figure 4-1,Operating Principle for the Vibraswitch, Model 366.

4.2 ADJUSTMENT OF OPERATING SETPOINT

The operating set point for the Vibraswitch varies with the type of machine and its location (measurement point) on the machine. The set point adjustmants suggested in this instruction manual are for machines which are functioning in a "good" or "normal" condition. The method follows the concept of vibration tolerance for the machine and in this case is dependent upon an individual who is experienced in the operation of the machine to define the vibration as "normal", "fair", "slightly rough", etc. These various degrees of machine vibration are, therefore, based on the individual's physical perception between normal and abnormal roughness while the machine is operating.

It is agreed that this method can lead to differences in the classification of degree of vibration between individual observers. It is Robertshaw's contention, and experience bears out this conclusion, that if the machine is operating satisfactorily as previously defined and the acceleration as measured by the Vibraswitch is within certain limits, the settings as outlined in the instructions will offer protection to the machine and prevent catastrophic failure

For example, assume that a relatively new machine which, in the experience of the operator, is operating as "smooth" or "good" regarding vibration and the Vibraswitch measures this acceleration level to be 0.25 g above its static condition (zero). Experience suggests that a reasonable level for alarm conditions would be a minimum of twice this value or 0.5 g. It must be acknowledged that such a definition of upper vibration limits (alarm condition) on the machine may not have adequately defined the upper tolerance limit of the machine before major repairs or excessive machine damage occurs. It does, however, define a limit which, in our experience, has proven to be safe. As the user becomes more adept in using the Vibraswitch as a monitoring device, his experience may dictate a higher set point more in keeping with the experience he has gained on the particular machine.

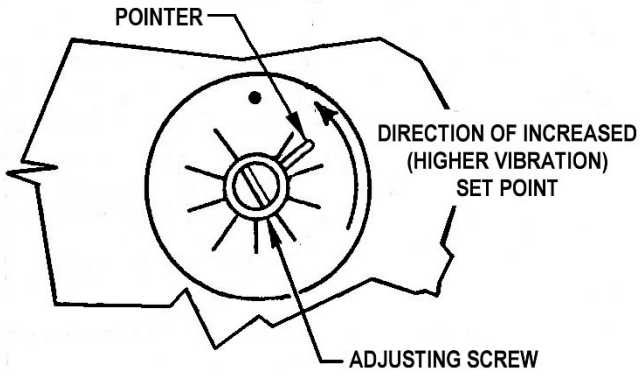
The Model 366 Vibraswitch is adjusted by a simple, three-step procedure. In making these measurements the cover must be removed to gain access to the set point adjusting screw. (Ref. Figure 4-2).

a. Zero Vibration Level Measurement

With the equipment on which the Vibraswitch is mounted not operating, back-off the set point adjusting screw counterclockwise (CCW) two turns and press the reset button. Then, turn the set point adjusting screw slowly clockwise until actuation occurs (the armature assembly is against the magnet, Figure 4-1). **This is the zero vibration point**, or actuation point, with the machine not operating. A mark should be made with a lead pencil or other convenient means to permanently record this "zero vibration point." Subsequent measurements are made relative to this point.

b. Normal G-Level Measurement

With the machine (equipment) operating, back off the set point adjusting screw one turn CCW and reset. If it will not reset, back off the set point adjusting screw two turns CCW, etc. Again turn the set point adjusting screw slowly clockwise until actuation occurs. Mark this position with a lead pencil or other convenient means. **The difference between the two actuating points in step a and b is the normal g-level of the operating machine in scale divisions.** One scale division is 0.1 g; one full revolution is 1.0 g.



NOTE: Each Scale Division is 0.1g
One Full Revolution is 1.0 g

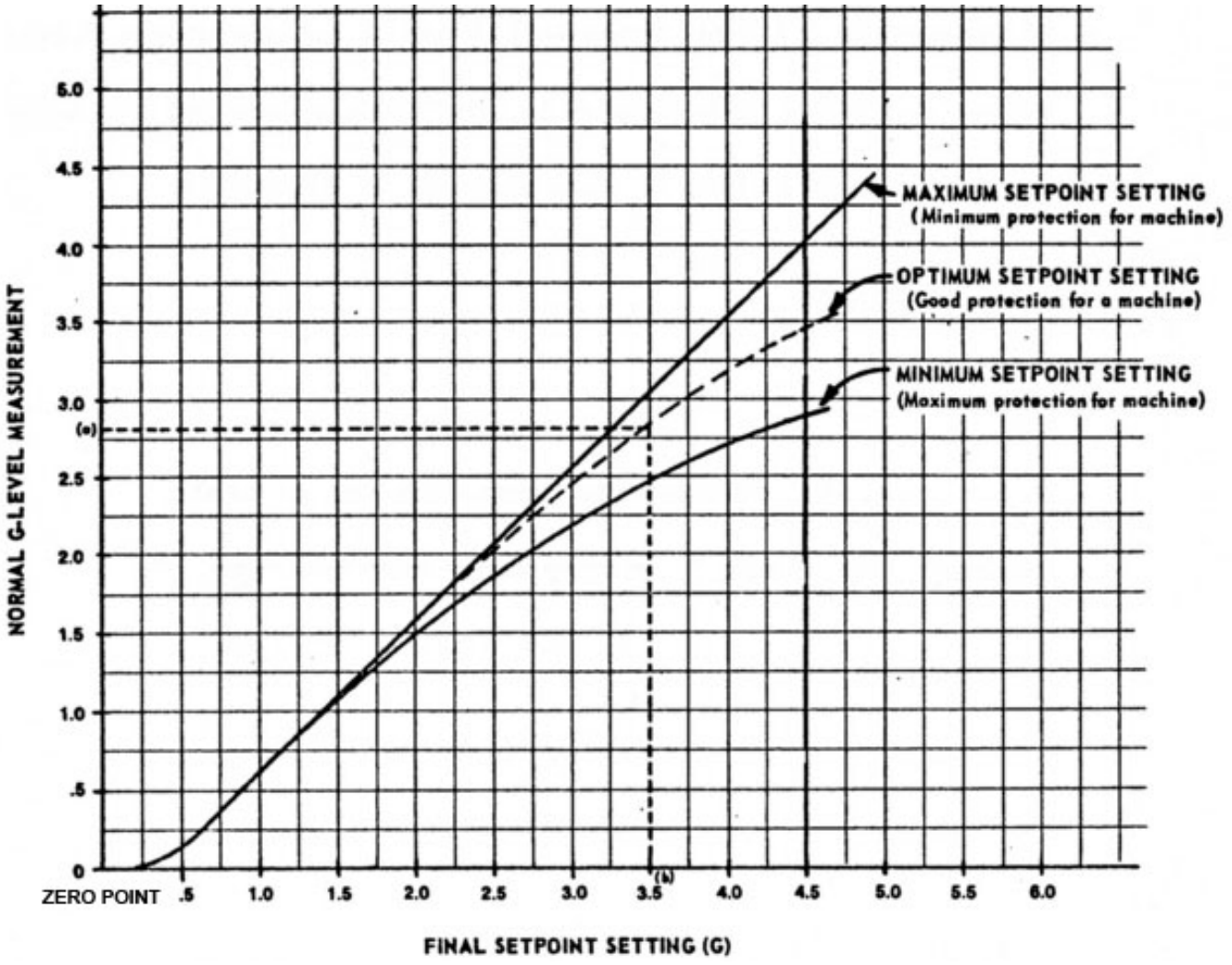
Figure 4-2, Set Point Adjustment

c. Final Set Point Adjustment

If the normal g-level is less than 1.0 g above the zero level, rotate the set point adjusting screw CCW 0.5 g (five graduations) from the point where actuation occurs in step b above. If the "normal" g-level is greater than 1.0 g refer to figure 4-3 for the proper final set point setting with respect to the "normal g-level vibration point" obtained in step b. See example on figure 4-3.

NOTE:

In the preceding adjustments, actuation can be heard as an audible "click". In very noisy surroundings, it may be necessary to use an ohmmeter or wire the Vibraswitch to the control circuit to tell when actuation occurs or observe visually that the armature is in the up (latched) position.



EXAMPLE: **If the normal g-level (a) is 2.8 q above the Zero Vibration Level, the Final set point settings (b) should be set at 3.5 g above the Zero Vibration Level. Therefore, advance the set point pointer CCW .7 g (3.5g – 2.8 g = .7 g) or 7 divisions (one scale division (one scale division is .1 g) from the normal g-level.**

Figure 4-3,Set point Alarm Settings.

SECTION V – MAINTENANCE

TROUBLESHOOTING

Vibraswitches do not normally require repair; however, listed below are some of the possible malfunctions that may occur and their recommended solutions (Ref. Figure 4-1).

a. Functional Test – (Ref. Figure 4-1)

1. With the Vibraswitch cover removed, place Vibraswitch on a table with its mounting surface down.
2. Press reset button. If switch does not reset (armature latched on stop pin), turn set point adjustment screw CCW until switch can be manually reset.
3. Slowly turn set point adjustment screw CW until switch trips. This is the zero trip point which is the amount of spring tension required to overcome the 1 g force exerted by the earths gravitational pull.
4. Note set point setting. One complete turn equals approximately 1 g. Set point scale is marked in 0.1 g increments. Turn set point adjustment screw 1 complete turn CCW. This is a 1 g setting above earth's gravitational pull.
5. Manually reset the switch (press reset button).
6. With the reset button to your right hand and the adjustment screw to your left, slowly rotate the Vibraswtich toward you 90°. The switch will trip when the mounting surface is in a vertical plane and the earths gravitational pull is not aiding the lower magnet to hold the armature against the stop pin.

   Return the Vibraswitch to the factory if it does not pass the above test.

b. Vibraswitch Will Not Reset

1. **Dirt and/or metal chips on magnets –** clean magnets without removing or rotating them.
2. **Broken leaf spring** (Ref. Figure 4-1) – Return Vibraswitch to factory for repair.
3. **Open reset coil** – check for continuity and proper coil resistance (Ref. Table 5-1)

Table 5-1, Reset Coil Resistance	
Nominal Voltage	Resistance (Ohms ±10%)
48 VDC	230
24 VDC	55
120 VAC 240 VAC	Check for continuity. (diode prevents actual resistance reading)
120 VDC	850

If coil fails continuity/resistance check replace coil or return the Vibraswitch to the factory for repair.

c. Unable to adjust Set Point Setting to Obtain Tripping – Improper air gap between hold down (lower) magnet and armature. Return the Vibraswitch to the factory for repair.

d. Switch Does Not Actuate – Defective Switch – Verify by manually moving the armature between the latched (tripped) position and the armed (reset) position and listen for an audible click of the switch. Verify contact by performing a continuity check.

If the switch is defective and requires adjustment it is recommended that the Vibraswitch be returned to the factory for repair. If the switch is to be replaced or adjusted in the field make sure that the actuation point occurs at mid travel of the armature (lever).

REPLACEMENT PARTS

Parts are common to all models unless noted.

Description	Part Number
Coil, Reset (366A/D2)	160KB047-09
Coil, Reset (366A/D3)	160KB044-06
Coil, Reset (366A/D4	160KB047-08
Coil, Reset (366A/D7	160KB047-12
Coil, Reset (366A/D8)	160KB047-11
Cover (Includes*)	040KB132-10
*Gasket, Cover	560KB052
*Grommet, Cover	159KB091-10
Resistor, Space Heater, 12 V**	904GC402-01
Resistor, Space Heater, 24 V**	904GC402-02
Resistor, Space Heater, 48 V**	904GC402-03
Resistor, Space Heater, 120V**	904GC402-04
Resistor, Space Heater, 240V**	904GC402-05
Resistor, Space Heater, 460V**	904GC402-06
Resistor, Voltage Dropping (240 V)	260KB030-40
Screw, Binding Head, Green, 6-32 x .25	435KB276-08
*Screw, Captive, 10-24 x .62	435KB293
Switch Assembly (366-A)	909GM142-05
Switch Assembly (366-D)	909SA647-01
Switch Assembly (366-G)	900SA726-02
Varistor, 120 V	904GC341
Varistor, 240 V	904GC341-01
Washer, Lock, Int Tooth, #6 (366-d)	447GD006
*Washer, Lock Int Tooth, #10	447GD110

** Space heater resistors are not available for models 366-D3 and 366-G3. Space heater resistors for all other models 366-D and 366-G Vibraswitches must be factory installed initially but may be replaced in the field.

REPAIRS

It is recommended that Vibraswitches be returned to the factory for repair. The factory has the special equipment and gages for making the critical adjustments and calibrations that may be required, replacement parts that may be needed, and the technical knowledge required for evaluating and repairing Vibraswitches. Contact your local Robertshaw representative or the factory for a return authorization and instructions.

In some cases it may be necessary to replace parts in the field. When this is the case only the parts listed in Table 5-2 should be replaced in the field. All other parts require replacement at the factory.

Warning – When replacing parts in the field, do not remove or readjust the magnets, stop pin, leaf springs, armature, or any parts associated with the armature. (See Figure 4-1).

If an internal switch is to be replaced, the new switch should be adjusted so that it trips when the armature (lever) is at mid travel.

ROUTINE MAINTENACNE

Vibraswitches do not normally require any maintenance, however, a periodic simple functional test and visual inspection is recommended. This should be performed at least once a year.

Functional test and visual inspections should be performed with the supply circuit to the Vibraswitch disconnected and the equipment on which the Vibraswitch is mounted not running.

a. Simple Functional Test

1. Remove the Vibraswitch cover.
2. Note the position of the set point adjusting screw.
3. Press the reset button to make sure that the Vibraswitch is in the armed position.
4. Slowly turn the set point adjusting screw CW until the switch trips. This can usually be determined by hearing an audible click.
5. 5. Rotate the set point screw CCW until it is in the original position.
6. Press the reset button. The Vibraswitch should now be in the armed (reset) position.

b. Visual Inspection

1. Inspect the Vibraswitch mechanism for signs of corrosion and moisture.
2. Replace the Vibraswitch cover.

c. Recalibration

This should not be necessary, however, if it is felt that the setpoint may not be correct refer to paragraph 4.2.

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