JAYMOR
INDUSTRIES LTD

Jetscreen

METAL DETECTOR

www.jaymor.co.nz

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1.0 INTRODUCTION

The Jaymor Jetscreen Metal Detector employs radio frequency to detect tramp metal of any type. Its primary function is used in conjunction with conveyor systems transporting material to processing machines. Detection of foreign metal prevents both contamination of the product and damage to any processing machinery. The detector light indicates the presence of metal. Either by stopping the conveyor, sounding an alarm or a combination of these functions.

A standard detection and control system is used as a basis for all of our systems. This can have an additional module fitted to allow for automatic dumping control and auto reset.

1.1 SENSING HEADS

Several options on sensing heads are available and these are usually custom built to suit individual situations, and can be made in contoured shapes to fit **trough shaped conveyors** if desired.

The **standard flat sensing head** although cheaper, has some limitations as to installation because it is sensitive on all surfaces and is not now generally recommended as a sensing head that can be installed without certain precautions. These limitations can be overcome simply by using a **screened head,** which is only sensitive on the surface facing the belt.

Screened heads have a thickness of 200mm and would require sufficient clearance below the belt to accommodate this.

Enclosed-screened sensing heads have an aperture through which the material passes. Whereas a flat head has a diminishing sensitivity proportional to the distance between the material and the head surface, the least sensitive area of an enclosed head is the centre of the aperture, as the complete inside surface is most sensitive.

One of the disadvantages of an enclosed head is that the belt has to be vulcanised in situ.

Special heads are also available for material chutes of ducts in square, rectangular or circular section. Jaymor will supply a complete non-metallic section incorporating the sensing head when required. This is normally fabricated from Formica or fibreglass and can be made to comply with hygiene regulations in food or meat processing plants.

Similar sections are also manufactured for conventional belt conveyors. In cases such as these consult the manufacturer giving full details of application and environment.

Communication at design stage is a definite advantage as Jaymor is prepared to make available their experience in the field and thus ensure the installation can utilise the detector to its maximum performance.

1.2 TRAMP METAL DISPOSAL

Jaymor are able to provide circuitry to activate metal disposal systems after detection and to automatically reset the detector when this has been done. These include sweep arm disposal, trap door and conveyor reverse systems. Consult the manufacturer for recommendations when the additional facility is required.

1.3 GENERAL

The Jaymor Jetscreen is designed as an inherently stable unit in order to prevent spurious alarms due to voltage fluctuations or electrical noise while still retaining a high degree of sensitivity. The minimum size of the foreign object that the Jetscreen is capable of detecting is set by a rotary control inside the alarm unit. It must be emphasised that in certain applications the maximum setting of 10 will not be achieved without instability. The control should be set by trial until stability is achieved within the required detection range.

2.0 INSTALLATION & OPERATING INSTRUCTIONS

2.1 SENSING HEAD

The most critical position is that of the sensing head.

When used in conjunction with belt conveyor the head should be mounted at right angles to the direction of belt travel.

Choose a position between rollers, preferably no closer than 600mm, and mount as close as possible to the underside of the belt.

Make sure head will be clear of the belt in loaded condition and also clear, in all cases of surface surge.

Where special heads are used the manufacturer will supply appropriate instructions for fitting and these must be followed to ensure maximum performance.

It must be realised the further away from the belt the head is located, and thus the distance from transported tramp metal, the less sensitive the detector will be. While increasing the sensitivity control to a higher level can compensate for this, the resulting operating condition is sometimes accompanied by a reduction in stability.

The design characteristics of a Jetscreen metal detector allows it to self adjust to the surroundings in which it is installed. Detection takes place the instant a change of this state occurs, e.g. the moment a metallic object is introduced to or removed from the sensing head's magnetic field. Change of state caused by nearby ill fitting metallic joints in conveyor systems can also cause the detector to 'trip'. On the completion of installation the general surroundings should be inspected to ensure that vibrations normally to be expected do not cause the detector to trip. Particular attention in this respect should be paid to loose fitting roller axles etc. which can intermittently alter the path of electrical current induced by the sensing head in the general surroundings.

Where shock loading is present due to material dropping on conveyor all sections must be firmly braced to prevent vibration and movement.

2.2 CONTROLLER UNIT

The standard length of shielded cable from sensing head to controller is five metres and it will be necessary to locate the two units within these limits. However, should this not be possible, cables of special lengths are available on request. This shielded cable should be securely saddled or run in conduit and mounted separate from all other cables. If the cable length is altered during installation it is important that the inner green conductor and the braided shield are joined only where they are connected to the control unit.

The controller should be mounted in a well-ventilated position, free from vibration and mechanical damage, with some form of roof above to prevent direct rain, direct sunlight or hosing reaching the unit. Vibration damping mounts are available on request.

2.3 WIRING

A 230V 50-Hertz single-phase supply is necessary to power the controller. A 400V to 230V step-down transformer is available on request should 230V not be readily available.

Terminals are mounted on the controller panel for alarm and motor starter control. The alarm terminals N and A adjacent provide 230V AC when the detector is in the sensing configuration with no supply available in the detector activated configuration. The alarm terminals NEU, AL and AL have 230V AC outputs to suit a NO or NC requirement.

The STA terminals C and NO provide a closed circuit for a motor starter coil in the sensing position and an open circuit in the activated position. Terminals C and NC are reverse configuration. In this instance it is not possible to start the conveyor motor with the detector off or in an activated state. When detector is reset and sensing, motor may be started. When the detector is activated by metal the motor will stop and the alarm will ring.

The flashing red light on the controller is off when the controller is in a sensing configuration and is illuminated when the unit has been activated by tramp metal.

2.4 OPERATION

Turn on isolating switch, supplying power to detector and red light should flash.

Depress reset button firmly for one or two seconds and release. The red light should remain off.

Should an alarm be connected this will sound or light as soon as the isolating switch is closed and turn off when the red light is out.

The sensitivity control should be set by trial and error to the desired level by placing a piece of metal on the belt and allowing it to pass over the sensing head.

Use metal of the minimum size to be detected and set the control to a position at which it activates each time the metal passes but does not activate at a setting two units below this. A simple method is to have two pieces of test metal, one which should activate the unit and a smaller piece which should not activate the unit.

Settings of 7.5 and below are more stable than higher settings and should be used if possible. However, a little experience will soon indicate the optimum position of the control.

It must be emphasised that in certain applications the maximum setting of ten will not be achieved without instability. The control should be set by trial until stability is achieved within the required detection range.

3.0 SERVICING

Little servicing should be required. However, should the control relay prove faulty it may be withdrawn and replaced with one of similar configuration and voltage (12V DC).

The safety fuse is readily accessible under the cover and is of a 2amp rating. This should never be exceeded.

In the event of a printed circuit or electronic component failure we recommend replacement of the PC unit with a factory replacement. To remove the PC unit isolate the controller electrically, remove the 16 spade terminals from the PC terminal board. Remove the four mounting screws at each corner of the board and lift out the PC unit. When replacing make sure the spacing washers under the mounting screws are in position to prevent deformation during assembly.

Make sure the cover is tightly closed to prevent dust or moisture from entering the controller.

The MK4 controller has a plug in connector for the lid components so that the lid may be easily separated from the main frame if desired.

4.0 RELAY CONFIGURATIONS

R1 is latched on by the electronics card when the detector is in the armed state.

R2 is activated by either a manual, remote, or auto reset contactor.

R3 is controlled by R1 and drops out when the detector is in the disarmed state. Because it controls motor starting and alarms, it can be removed during servicing to isolate these outputs if desired.

Further actions of relays are explained in the Auto Dump Module section. The description of the Auto Dump Unit is confined to its most popular version. Other sequences are available and descriptions on their functions are supplied with handbooks for that particular installation.

5.0 ENGINEERING SPECIFICATION

5.1 SCOPE

This document specifies physical and electrical characteristics of the metal detector. When used in a system with a standard head design the detector will perform satisfactorily within the limits of the following specification.

5.2 FUNCTIONAL DESCRIPTION

System

The unit is designed to detect the presence of tramp metal in products passing over the sensing head. The presence of such metal is indicated by a L.E.D. on the PC board as well as providing a latched contact closure via a relay. The contact closure may be used for any desired control function or alarm indication external to the unit.

The unit is armed via the front panel pushbutton or can be armed via an external contact closure.

The sensitivity is set by the potentiometer provided with a scale of 0-10.

Mechanical

The electronic control unit is housed in a waterproof, wall mounted, metal box with a hinged opening door on the front. The manual reset button is mounted on the door.

Cable entry for mains input and control circuitry is through the bottom of the box via glands.

The sensing head coil is encapsulated in fibreglass with a five metre screened cable fixed at one end.

Electrical

The power requirements of the system are 230 volts AC at 50HZ 100VA. This mains voltage is fed to the power transformer and to the relay for alarm voltage switching.

Operation

The operating principle of this unit relies on the fact that the field generated by the search head produces eddy currents in any nearby metal object. The energy used to produce these eddy currents is taken from the oscillator formed around TRI. This oscillator is a high power Hartley design using the search coil as the inductance. This drain of energy, which finally produces heat in the metal, results in a reduction in the amplitude of the oscillations. The signal is taken from the top of C2, which is the resonating capacitor, and rectified by D1.The peak value of this signal is stored in C3 and C4. Any change in the DC voltage will be amplified by TR2 and TR3. TR2 serves to reduce the impedance from the detector circuit to a level, which is more acceptable to the input circuit of TR3.

A positive going voltage at the collector of TR3, resulting from metal detection, will cause the output of TR4 to drop. The amount of this drop is dependant on the amount of signal allowed to pass through the sensitivity control. Eventually if the metal object detected is large enough the signal will be great enough to cause TR4 to drop to a level which causes the bi-stable circuit formed by TR5, TR6, TR7 and TR8 to activate.

Under normal armed conditions TR5, TR6 and TR7 are off while TR8 is in the conducting stage, energising the relay. When the circuit is tripped all of these conditions reverse. The circuit is reset by the reset contacts causing TR5 to turn off, thus allowing TR6 to do the same, after which the circuit returns to normal.
Two separate voltage regulator circuits provide power supply voltages. An integrated circuit regulator LM35OK that is supplied by a pre-regulator provides the 24-volt supply. This pre-regulator is provided to absorb any major fluctuations in the unregulated filtered DC. The sensitivity of the amplifier circuits requires that the 24-volt supply be extremely stable on short-term drift. A 20mV variation on this supply can trigger the detector.

The second regulator provides simple regulation to 12 volts for the latch and relay output circuits. Regulation is not so critical in this part of the circuit as it is only necessary to smooth out voltage variations in the order of 1 volt, which would cause the latch circuit to operate incorrectly.

Electronics

All silicon.

5.3 ENVIRONMENTAL

Non Operating

Temperature:	-45 degrees C to 71 degrees C
Altitude:	0 - 50,000ft.
Shock:	The unit withstands shock and vibration encountered during normal installation and shipping.

Operating

Temperature:	2 degrees C to 50 degrees C
Altitude:	0 - 20,000ft.
Humidity:	10 to 95 percent non condensing.

5.4 INTERFACE

A connector strip is provided for connection to both the electronic PC board and the external control circuit.

5.5 POWER SUPPLY

220 - 240V 50HZ 100W

5.6 TYPICAL PERFORMANCE DETAILS

The following table indicates the typical sensing distance obtained for tramp metal using a flat-screened head.

TABLE 5.6.1: Typical Tramp Metal Detection Distances

750mm Belt @ 33 metres/min
Distance in millimetres from belt

CONTROL SETTINGS	10	7	5
TRAMP METAL			
75mm Steel Nail	115mm	85mm	50mm
100mm Steel Nail	145mm	110mm	70mm
10 SWG Weld Electrode	150mm	115mm	95mm
8mm Steel Nut	90mm	50mm	25mm
8 x 50mm Bolt	140mm	95mm	70mm
12.5 x 50mm Bolt	150mm	110mm	90mm
250mm Crescent	230mm	180mm	160mm
95 x 10 x 65mm Steel Block	250mm	220mm	190mm
250 x 50 x 12mm Aluminium Bar	250mm	200mm	100mm
40 X 20.0mm Brass Tube	160mm	115mm	70mm

6.0 TOUBLESHOOTING

Jaymor Jetscreen Metal Detector Tests.

Most faults are a faulty controller card, faulty lead, faulty detector head or faulty installation.

6.1 Check the CBS cable for.

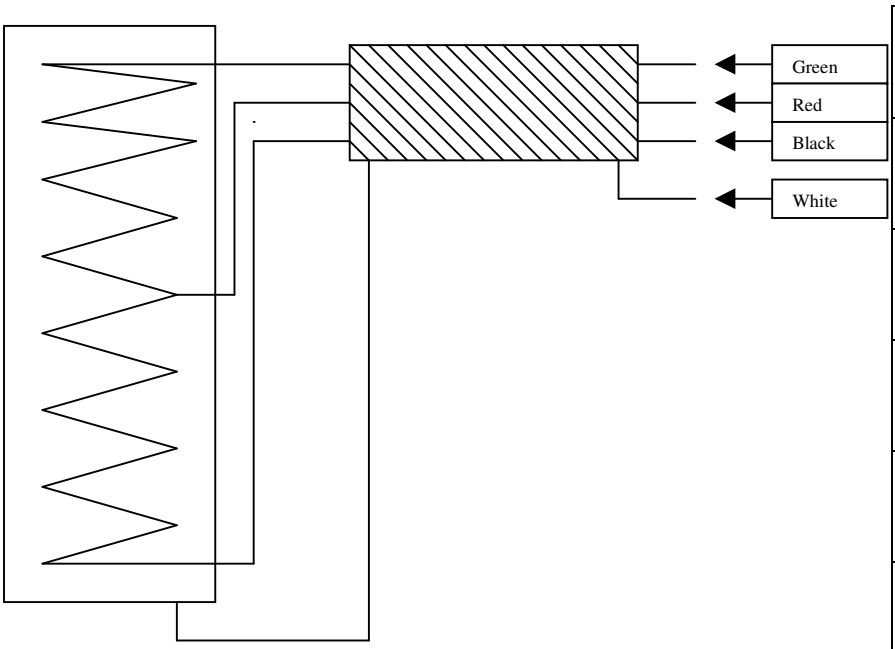
- Max length 10 meters.
- No joins in the CBS flex.
- No damage to the outside sheath of the CBS flex.
- Check around the gland where the cable enters the head for damage.
- Check for any evidence of water at either end of the cable terminations.
- The cable must be fixed firm. Make sure that the cable is not “flapping” about.
- When testing the unit make sure the cable is clear of any moving metal and that the cable is not moved or able to be vibrated when testing.
- Physically check that the earth shield is connected at both ends or even better, ohm test between a stud on the metal box of the controller and a stud on the case of the detector head. This should result in zero ohms.

6.2 Check the head for any physical damage.

- Water is a problem, so if the head is cracked or worn this could be a problem.
- Check closely around the edges to see if the layers of glass have delaminated or separated from the metal case.

6.3 Electrical tests.

Disconnect the detector from the controller and carry out the following electrical tests.



Tests	Continuity Ω's X 1	Insulation Test 250 V
Green to Red	1-2 Ω	N/A
Red to Black	2-3 Ω	N/A
Black to Green	3-4 Ω	N/A
White to Ground	0 Ω	N/A
Green, Red, Black, to ground	∞	Really high. Min. 50 meg Ω

6.4 Controller Tests.

There are not many tests to carry out if the detector CBS flex or the detector head tests out OK.

- Check to see if the small 1/8th nuts holding the controller card in place have not vibrated loose.
- Check that the fiber washers under the controller card and under the nut are still in place.
- Check to see if the top left 8mm nut holding the base plate in place is clear of the controller card.
- Check to see if any legs of any components have not corroded and broken due to either an excessive corrosive atmosphere or excessive vibration.

If these do not improve the fault then the best bet is to just replace the controller card in the controller or send it back for testing. The controller card is the smaller card at the top where a lot of wires connect.

The base card seldom gives any problems. There have been cases when moisture/water has blown the tracks at the back of the card. But this is quite visual and easily picked up.

Further tests that can be carried out with the controller connected to the detector.

6.5 Does it reset?

With the sensitivity potentiometer set to 8.

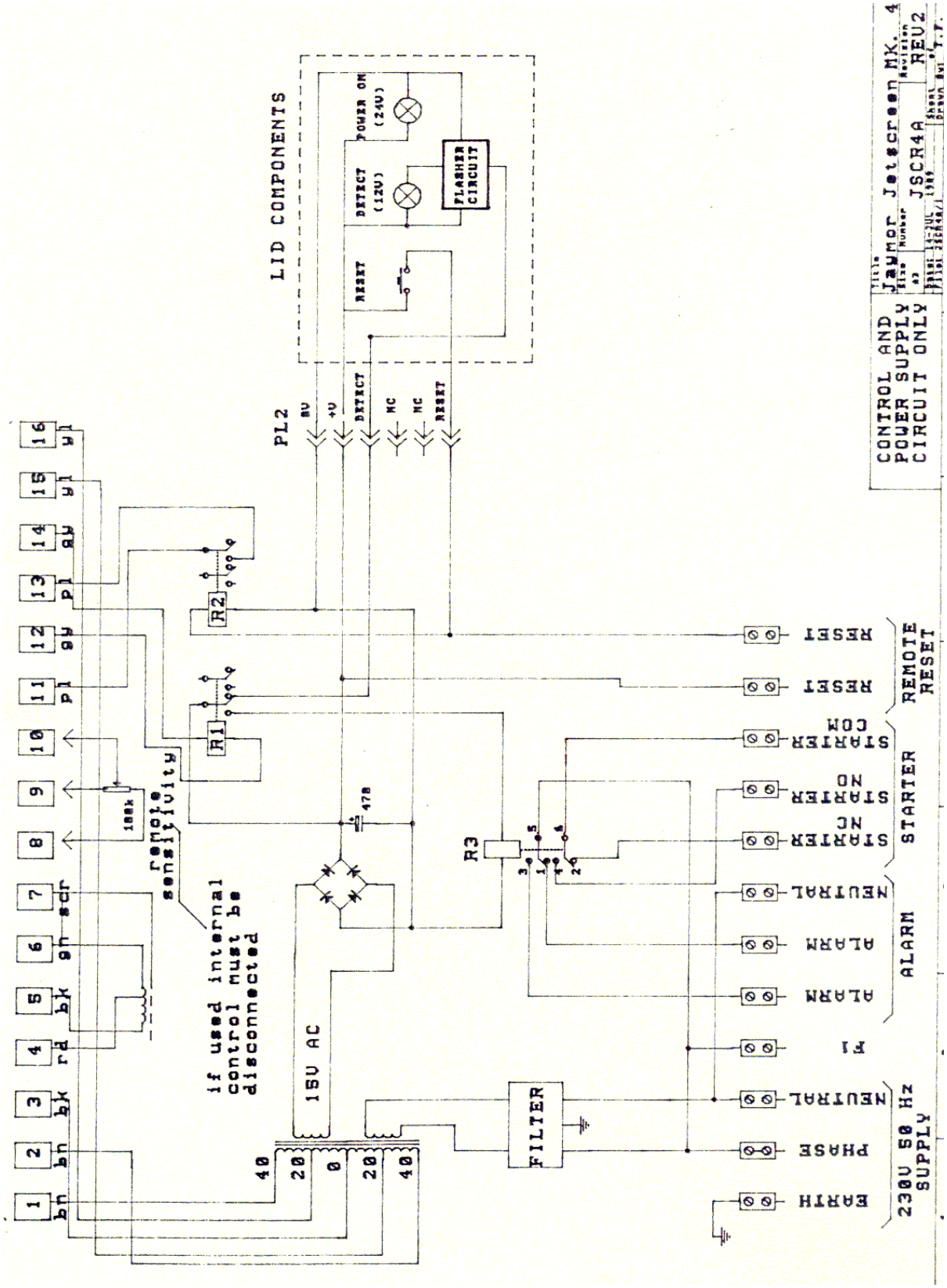
Push the reset button.
The top right right-hand relay should energize.
The top right left-hand relay should energize.
The relay in the middle of the base PCB should energize.
The small LED on the top right hand corner of the controller card should light.

Release the reset button after about 3-5 seconds.
The top right right-hand relay should drop out.
The top right left-hand relay should stay energized.
The Relay in the middle of the base PCB should stay energized.
The small LED top right of the controller card should stay lit.

The detector is now armed and in the detect state.

6.6 Detector Test.

Move a sizeable metal object within a few inches, over the top of the detector head. Don't move too slow across, at least the speed of a conveyor belt.
The controller should detect the metal.
The small red LED goes out. The top right left-hand relay de-energizes. The relay in the middle of the base PCB de-energizes.


CONTROL AND POWER SUPPLY CIRCUIT ONLY
Jaymor Jetscreen MK. 4
JSCR4A
REV2
LID COMPONENTS
POWER ON (24V)
DETECT (12V)
FLASHER CIRCUIT
RESET
PL2
8V
+V
DETECT
NC
NC
RESET
R1
R2
R3
188k
remote sensitivity
if used internal control must be disconnected
15V AC
40
20
0
20
40
FILTER
REMOTE RESET
RESET
RESET
STARTER
STARTER COM
STARTER NO
STARTER NC
ALARM
NEUTRAL
ALARM
ALARM
FI
230V 50 Hz SUPPLY
NEUTRAL
PHASE
EARTH