The Veritest 4.2 is a simple eddy current test instrument. It is designed for the detection of flaws in tubular and wire product for in-line applications where end suppression is not needed and constant speeds are encountered.

The Veritest 4.2 is equipped with both high and low pass filters as well as two test frequencies. All of the above are pre-set at the factory per application and may be modified in the field by changing various modules.

SERIAL NUMBER: ALL units have been equipped as follows:

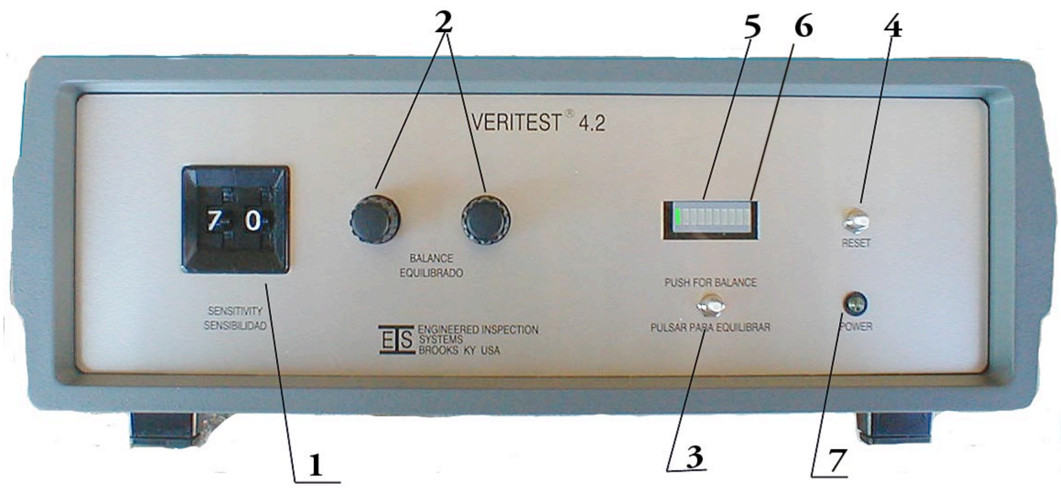
FREQUENCY: 7.7 kHz

LOW PASS FILTER: frequencies less than 200 Hz or
1500 feet/minute

HIGH PASS FILTER: frequencies greater than 0 Hz for
feedthrough speeds from 0 feet/minute up

The Veritest 4.2 is available with one of two modes of operation: 1) all-phase, which alarms on any signal of a specified amplitude, irrespective of its phase component, and 2) chord response, which allows for a de-sensitization for certain output phase conditions. The specific mode is selected at the factory and the chord response mode is the standard option.

FRONT PANEL



<u>Controls</u>

1.	Sensitivity Switch:	Used to select the system sensitivity
2.	Balance Knobs:	Used to establish a balance condition with good material
3.	Test/Balance Switch:	Used to alternate between test and balance modes
4.	Reset Button:	Used to reset the latched flaw
5.	LED Bargraph:	Red sections of the LED bargraph illuminate when a defect condition exists
6.	Flaw Latch Lamp:	The right yellow bargraph segment illuminates when a defect condition is detected and remains lit until it is reset by depressing the reset button (6) on the front panel or by sending a signal remotely through the rear panel connector
7.	Power Lamp:	Green LED indicates power on

LED Bargraph

The test meter (5) is actually a three-color LED Bargraph. (See Figure 2) Signals in the green area are non-defective conditions and can generally be ignored. Signals in the red zone are defective conditions and activate the yellow alarm segment. Defect severity is indicated by the number of red segments illuminated.

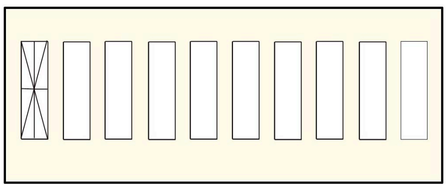


Fig. 1

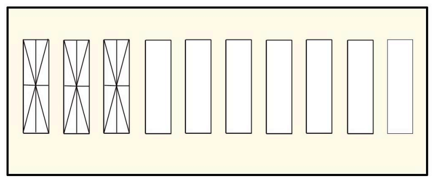


Fig. 2

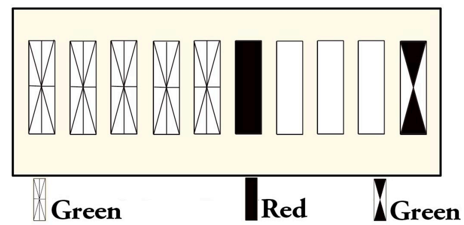
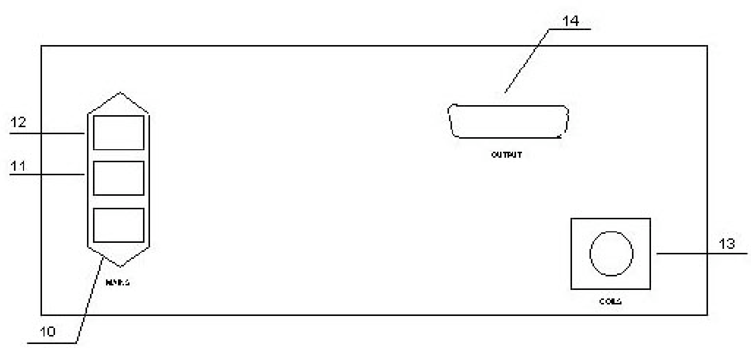


Fig. 3

REAR PANEL



The rear panel of the Veritest 4.2 consists of a power entry module (10). On the power entry module is the main power on switch (11), and two fuses (12).

The coil cable is connected to the coil connector (13) and the coil(s).

The D miniature 15 pin socket (14), through its mating connector, provides the interface for the Veritest 4.2 to transfer test information to the operator through external alarms, lamps, etc. It also is the interface to connect the Veritest 4.2 to a system P L C.

There are a variety of outputs available on the rear chassis through a D miniature connector. All the outputs are relay dry contacts with a maximum output switching of 500 milliamps at 115 volts. If the customer uses the 13.5VDC internal power supply to activate an external load the current draw should not exceed 100 ma. They are designed primarily for inputs into programmable logic controllers and are not sufficient to drive heavy loads. There is a normally open and a normally closed contact available for each of three outputs. The available outputs are described below.

The first output is a N/O and N/C contact for system energization. This is a fail-safe output which assures that the unit is at least energized when installed in an in-line operation and connected to a system P L C.

The second output is a momentary flaw output. The duration is from 50 milliseconds to the length of time a defect condition exists.

The third output is the latched flaw output. The flaw signal is latched and continuous until reset either from the front panel or by remote input through the connector located on the rear panel.

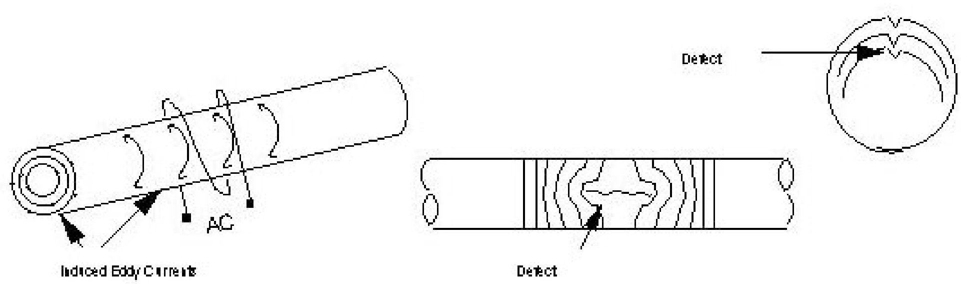
Refer to illustration # D142 for the exact hook-up arrangement of the output section.

There is also an internal horn alarm which is set at the factory to the momentary flaw. Referring to illustration # D142, the switch position for the latched flaw or continuous alarm can be selected as an alternate output for the horn.

THEORY OF OPERATION

The detection of flaws such as seams, cracks, pits, slivers, weld line defects and internal discontinuities in metallic materials can be accomplished by using encircling coil eddy current systems. This kind of equipment is most frequently used to locate surface defects in bar stock or wire products and to detect both I.D. and O.D. defects in tubing. The test is usually conducted at production speed.

The basic principles of operation in encircling or through-coil systems are simple. The "test" coil is excited by an alternating current of a given frequency which induces a flow of eddy currents around the material which is going through the coil. When a discontinuity in the material passes through the test coil, it causes a change in the flow of eddy currents or impedance as seen by the coil. It is this change which is detected by the electronics.



Probable flow of eddy currents around a defect

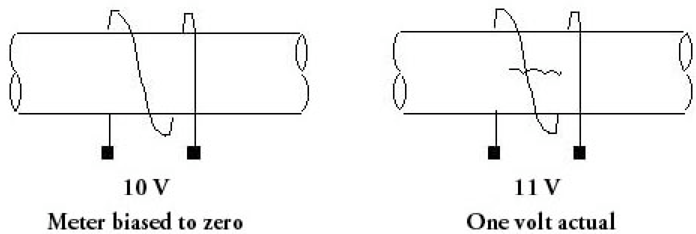
When testing materials such as carbon steel, austenitic stainless, alloy steels, etc., with a permeability higher than 1, permeability changes as seen by the coil can exceed those caused by other discontinuities. As changes in permeability can be caused by handling or straightening processes, it is usually desirable to eliminate them and concentrate only on changes due to physical discontinuities. To do this, an intense magnetic field is applied to the material to magnetically saturate it. In this manner, magnetic variations are equalized; and a test based on eddy currents can be accomplished as with non-permeable materials such as copper, brass, stainless, etc..

In actual testing, a single coil system (absolute mode) or a system of two or more coils which electrically subtract from each other (differential mode) may be used to detect defects.

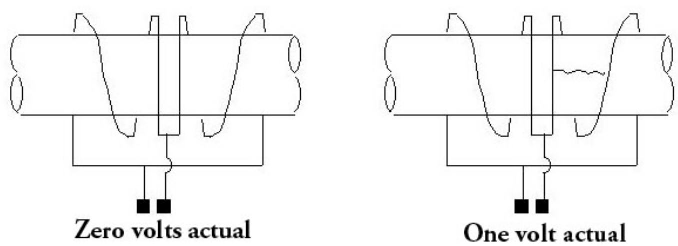
When the absolute mode is used, the output of the coil containing acceptable material is fed into the electronics; and variations from this norm are detected. When the coils are connected in the differential mode, they continually test and compare adjacent segments of the material as it passes through the coils. If there is good material in both coils, the resulting difference is zero.

In electronic terms, when the absolute mode is used, the change that the electronics sees is the difference between the biasing voltage output for good material and the change in this voltage caused by a defect passing through the coil. For example, if a defect causes a change of 1 volt in the output of the coil, and the normal output of the coil is 10 volts, the electronics sees a 10% change. When using the differential mode, the same defect would theoretically produce an infinite change as the difference; and the electronics would register 1 volt as compared to zero. The two modes are illustrated in the diagram below.

ABSOLUTE MODE



DIFFERENTIAL MODE



It is generally accepted that a differential mode system is more sensitive to intermittent defects because one section of material is being compared to the adjacent section of material. However, in the case of long, uniform discontinuities, a differential mode system may indicate only the beginning and the end of a discontinuity and nothing in between. Conversely, the absolute mode would signal for the complete length of the defect. However, the ability of the differential mode to detect smaller changes and to produce a better flaw signal-to-noise ratio makes it more suitable for general application.

When using eddy current encircling coil systems, two parameters define the degree to which eddy currents will effectively penetrate the material: namely, the frequency of the excitation current and the conductivity of the material being tested. The lower the frequency of the excitation current, the deeper the effective penetration. The lower the conductivity of the material being tested, the deeper the penetration at a given frequency. The depth of penetration is described as the depth at which the magnetic field strength or intensity of induced eddy currents has decreased to 37% of its surface value. It should also be noted that a defect occurring below the 37% value may be detected.

Differences in dimensions, variations in cold working, permeability, grain size, etc. will also affect the output of the coil system. Their resultant signal is called noise. If there are no selective circuits and the noise is of a greater magnitude than the desired defect signals, then a valid test cannot be performed. The type and function of the selective circuits is described as follows.

FREQUENCY SELECTION

The ability to select between a wide range of frequencies permits an eddy current tester to vary the depth of penetration and to discriminate between signals caused by conditions such as noise, handling marks, and defects. The proper frequency for testing a given material is determined by the conductivity, the type of defects to be detected, the diameter, and in the case of tubing, the wall thickness.

By properly choosing the excitation frequency for a given material, it is often possible to generate a phase shift between the signal for noise, the signal for handling marks, and the signal for a defect. When testing tubing, if the excitation frequency is increased, the phase angle between the signal for a defect on the O.D. and the signal for a defect on the I.D. will increase. However, the signal amplitude for the I.D. defect will decrease as compared to the signal amplitude of the O.D. defect when the excitation frequency is increased. Thus, if the excitation frequency is too high, the detection of I.D. defects becomes impossible.

SENSITIVITY SELECTION

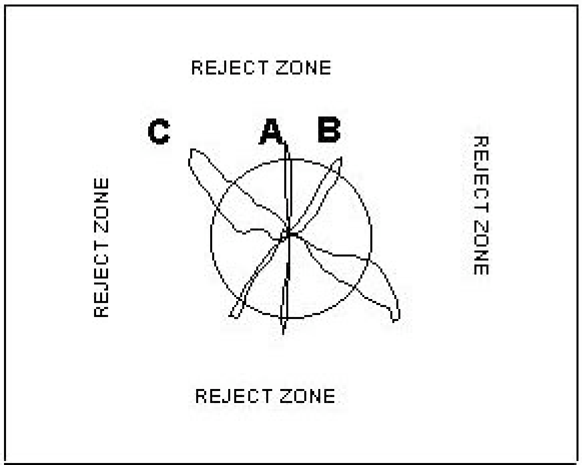
The sensitivity control provides a means to adjust the amplitude of a defect signal to a point whereby the alarm circuits will function.

FILTER SELECTION

The speed at which a defect passes through the coil produces a change in the flow of eddy currents at a very distinct rate. This rate of change can be equated to a given frequency known as the flaw frequency. By the application of special circuitry called filters to pass only these signals, one can ignore signals which are due to non-defective discontinuities.

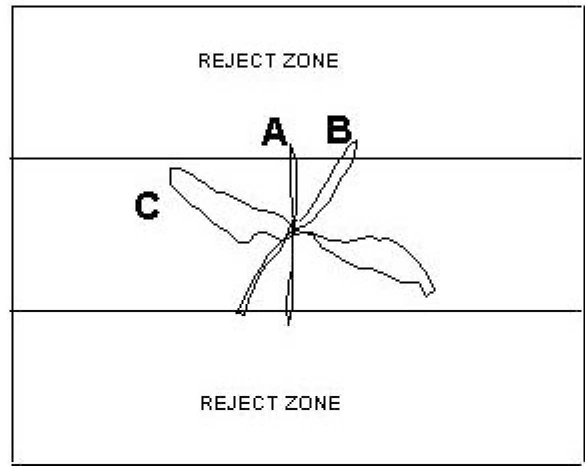
PHASE SELECTION

The phase control option allows the rotation of all signals 360 degrees. This permits the rotation of desired signals to a place where they will fall within the threshold limits and activate appropriate alarm circuitry. If a signal for an I.D. defect is smaller in amplitude than an equivalent O.D. defect, it is usually possible to adjust the phase control so that both defects activate the alarm circuits equally. This phase rotation, as well as phase limiting capabilities covered next, is illustrated in the following diagram.



All Phase

A-B-C = Rejects



Chord

A-B = Rejects C = Accept

PHASE LIMITING SELECTIVITY

Phase limiting selectivity provides a means of processing signals without altering their basic characteristics. With phase limiting it is often possible to discern between types of discontinuities and reject only those having detrimental effects in the material. The information from the signals can be limited to specific phase angles and specific amplitudes with separate outputs. Another option is the capability to reject all signals irrespective of their phase component.

COIL SELECTION

The coils can be either absolute mode or differential mode. Some equipments provide the capability of using both methods simultaneously. Coils can be wound with different physical characteristics such as the spacing between the differential coils, the actual width of the coils, and the use of multiple coils electrically connected in different configurations. The purpose of these different coil systems is to improve the detection of specific types of defects. In order to ensure equal test results on a product that does not have a round cross section, coils may be manufactured to conform to the cross section of the product.

The Veritest 4.2 is supplied with differential coils in one of two configurations. For sensitivity to principally short discontinuities such as butt welds, pitting, inclusions, laps, slivers, etc., a one-coil differential set-up is used. Here both sides of the coil are mounted in the same housing and in close proximity to each other. This configuration, as previously discussed, is more sensitive to small defects.

If, on the other hand, the primary discontinuities searched for are significantly longer than the spacing in a normal differential coil, we supply a split differential coil arrangement (comparator coils). In this case both halves of the coils are mounted in separate housings and are continuously compared to each other. One is refered to as the reference coil and the other as the test coil. Defects such as missing conductors, butt welds, tie-ups, etc. lend themselves to detection with a split coil.

SET-UP

1. Connect the appropriate coil(s) to the test cable.

2. Insert a good section of test material into the coil(s).

3. Depress and hold down the balance/test (4) push button switch.

4. The proper balance condition exists when the LED bargraph (Figure 1-3)is minimum at the sensitivity selected for testing. Increase the sensitivity (1) until a disbalance condition is indicated by the bar (Figure 4). A disbalance condition is indicated by any increase in number of segments illuminated. If the bar is full scale decrease the sensitivity (1) until the bar lit is less than 9. Alternately adjust each balance control (3)until a minimum bar display is shown on the bargraph (Figure 3).

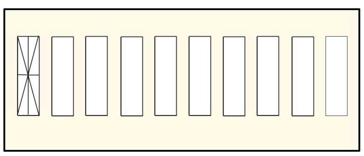


Fig. 3

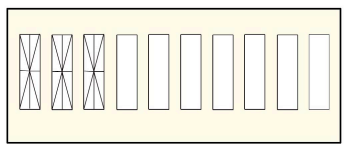


Fig. 4

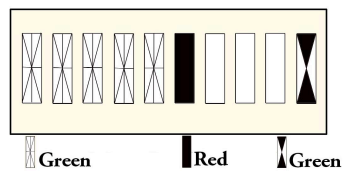


Fig. 5

5. Release the balance/test push button and verify the amplitude of the display bar does not increase significantly (Figure 3). If the Veritest 4.2 is equipped with a high pass filter for static operation (0 Hz), going to test mode may indicate some disbalance. Refer to page one of this manual to determine the high pass setting for your unit. If a disbalance is noted, re-adjust the balance controls in test mode to minimize this signal.

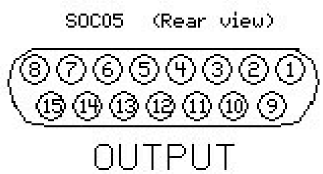
   Establish the necessary sensitivity to reliably detect the defect standard. The bad material should give a bar display of at least one illuminated segment on the LED bargraph. Remember that whenever you increase the sensitivity (1), you should re-verify the amount of disbalance (Step 5).

6. The alarm level of the unit has been set for the first red LED segment. When the first red LED is lit, it will activate the yellow LED, indicating a defective condition. The yellow LED will remain illuminated until reset either remotely or by depressing the Reset push button (3) on the front panel.

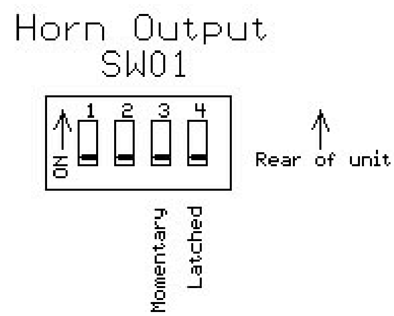
7. Pass a defective piece of material through the test coil and verify that at least one red segment is lit. If not increase the sensitivity until the defect is detected.

8. Set-up is complete.

▪



1 - Black	+13.5VDC		
2 - White	Ground		
3 - Red	CR01 - Common	System Energized	
4 - Green	CR01 - NC		
5 - Orange	CR01 - NO		
6 - Blue	CR02 - Common	Flaw	
7 - Wh/Bk	CR02 - NC		
8 - Rd/Bk	CR02 - NO		
9 - Gn/Bk	No Connection		
10 - Or/Bk	No Connection		
11 - Bl/Bk	No Connection		
12 - Bk/Wh	Remote Reset Input (13.5VDC max)		
13 - Rd/Wh	CR03 - NO	Latched Flaw	
14 - Gn/Wh	CR03 - NC		
15 - Bl/Wh	CR03 - Common		



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021023	Update/DLB			Output Cable Layout Veritest 4.0/4.2			
		material:					
			Dwn by DLB	sz	ident no.	drawing no. D142	
next assy	used on						
application			25Jan94	scale	N/A	sheet 1 OF 1	