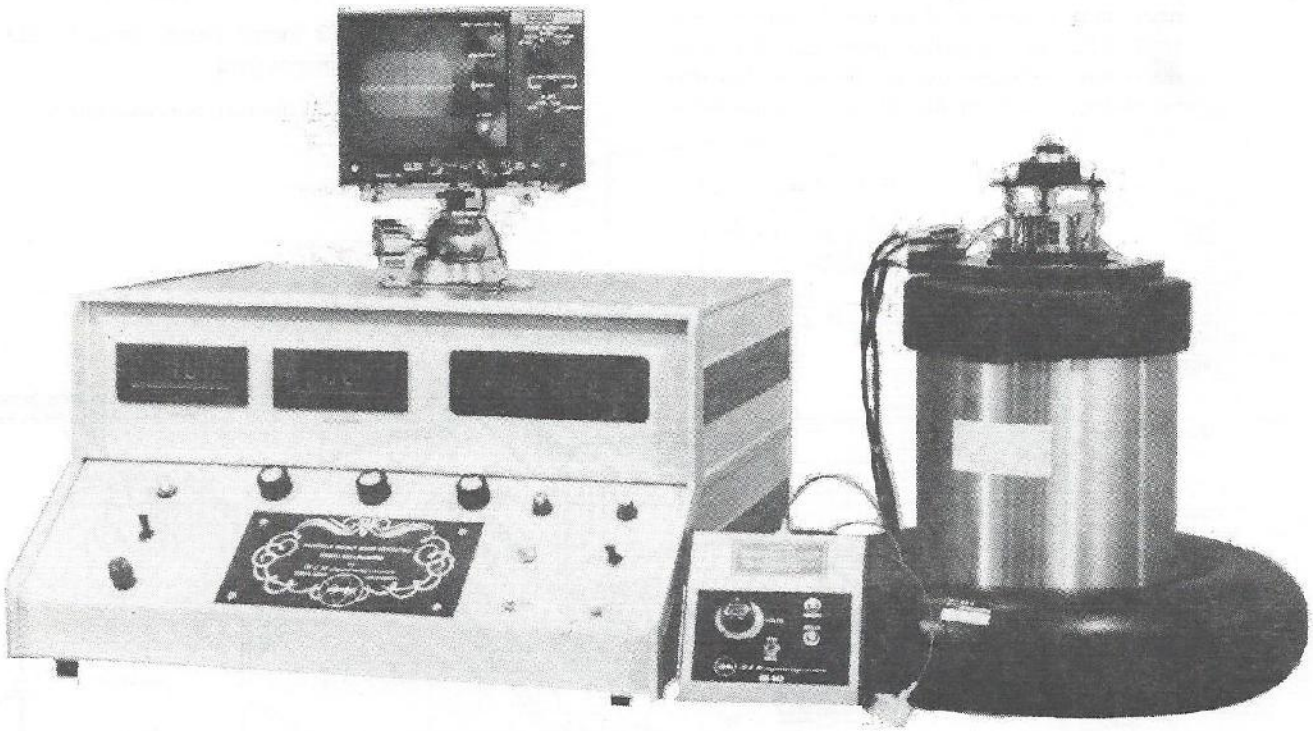
B&W
ENGINEERING CORP.

PIND

OPERATION MANUAL

MODEL BW-LPD-B2000/B2010

Particle Impact Noise Detection Test Systems



Model BW-LPD-B2000

NOTICE: This system is equipped with an additional control that allows the co-test shock to be administered with the vibration perturbed. Consult your maintenance manual for details.

Commerce Park (E-7), - 3303 Harbor Blvd., Costa Mesa, California - (714) 540-9975

SECTION I

EQUIPMENT

Particle Impact Noise Detection System
Model BW-LPD-B2000 and/or BW-LPD-B2010

1.0 The Particle Impact Noise Detection System is comprised of two major assemblies: the Electronic Control Console, and the Physical Stimulus Assembly, (Fig. 1). The specifications for these assemblies are as follows:

1.1 **Electronic Control Console**

Input Power – 115 volts A.C., 60 Hertz, 5 Amps RMS Max.

Output – 100 watts minimum, 40 to 250 Hertz, Sine Wave.

20 Volt D.C., 50 Milliseconds, 5 Volts D.C. standby through Co-Test Shock control.

15 Volts D.C., Regulated, 20 Milliamperes Max.

Input Signal – Piezo Electric Accelerometer output for shaker control.

20 Millivolt noise plus signal at 150 KHz typically.

The transducer receives ultrasonic particle noise that is generated by the Sensitivity Test Unit (STU) or the device under test. The transducer has a sensitive area of .75 inches diameter minimum, and is capable of supporting a device under test (which weighs less than 3 ounces) throughout the specified vibration and shock ranges, and typically has a sensitivity of –77.50 ± 2 db re 1 volt per microbar at 150 KHz. NOTE: The center of the transducer is the most sensitive area. The STU and/or device under test must be mounted so that their centers mate as closely as possible with the center of the transducer for best results.

Indicators – Oscilloscope presentation of noise plus the signal derived from the transducer assembly and tuned to approximately 150 KHz.

Audio output of the speaker which detects pulse or noise bursts in the area of 150 KHz.

Threshold detector presenting a visual signal which latches on a lamp when signal pulses or noise bursts that are over the system noise level by the amount required in TM2020. Manual reset is provided.

Digital readout of sinewave frequency.

Digital readout of accelerometer "G" level.

Size – 23 inches height (max.); 19.5 inches wide; 20 inches long.

Weight – 75 pounds, approximately.

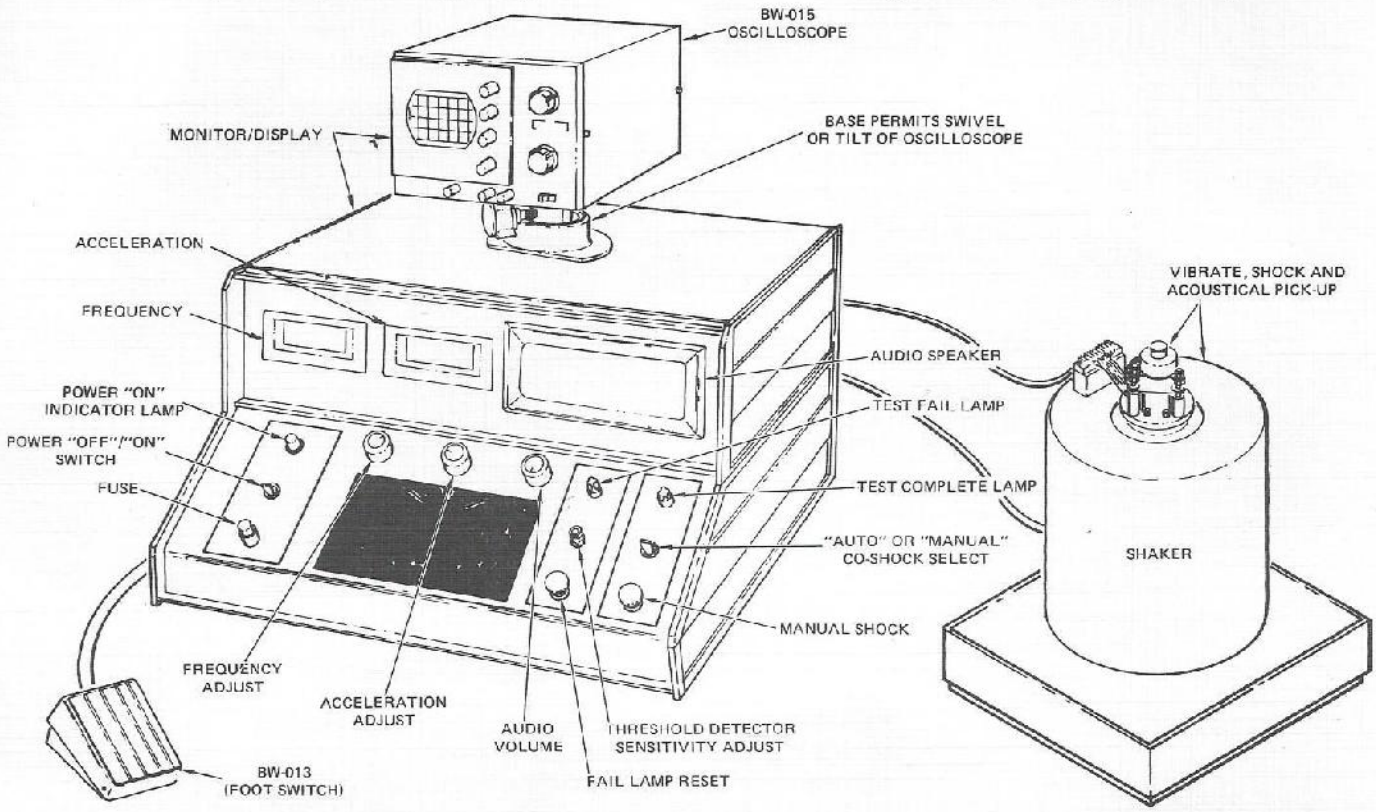


FIGURE 1. BW-LPD-B2000 AND/OR BW-LPD-B2010 PARTICLE IMPACT NOISE DETECTION SYSTEM

1.2 Physical Stimulus Assembly

Input Power – 0 to 100 watts, 40 to 250 hertz, Sine Wave.

15 Volts D.C. regulated, 20 Milliampere max.

20 Volts D.C., 50 Milliseconds, 5 Volts D.C. standby from co test shock control.

Output – Sine vibration, up to 50 force pounds, 40 to 250 hertz, 0 to 20 G's Peak, minimum.

Mechanical shock, between 500 and 1500 G's, (depending upon mass of the device under test and the adjustment of the test fixture) 1/2 sine, duration 0.1 milliseconds maximum at peak, decaying (with ringing) to zero in less than 100 Milliseconds. Shock is applied in same axis as sine vibration and may be applied simultaneously with vibration.

Amplified transducer output which contains system noise and signal at 150 KHz.

Accelerometer signal to control vibration G level.

Size – 8.0 inches diameter, 9.5 inches height to top of vibration shaker, 14 inches max. overall including BW-004 fixture.

Weight – 50 pounds maximum.

SECTION II
SYSTEM SETUP

2.0 BRIEF DESCRIPTION OF SYSTEM OPERATION

The Particle Impact Noise Detection System, Model BW-LPD-B2000 and/or B2010, is dedicated to the detection of very small particles in devices enclosing cavities but which do not contain moving parts. Detectable particles could result in a mission failure, usually manifested as a short circuit. The system permits the placement of the test unit in intimate contact with the pickup surface of a transducer (via an approved couplant) which is tuned to approx. 150 KHz. The device is then vibrated and shocked mechanically to induce motion of any loose particles in the device. The impact of the particles with the inside surfaces of the cavity is detected by the ultrasonic transducer. A sensitive amplifier, tuned to approximately 150 KHz transmits the system noise, plus any signal derived from a loose particle to three indicators, an

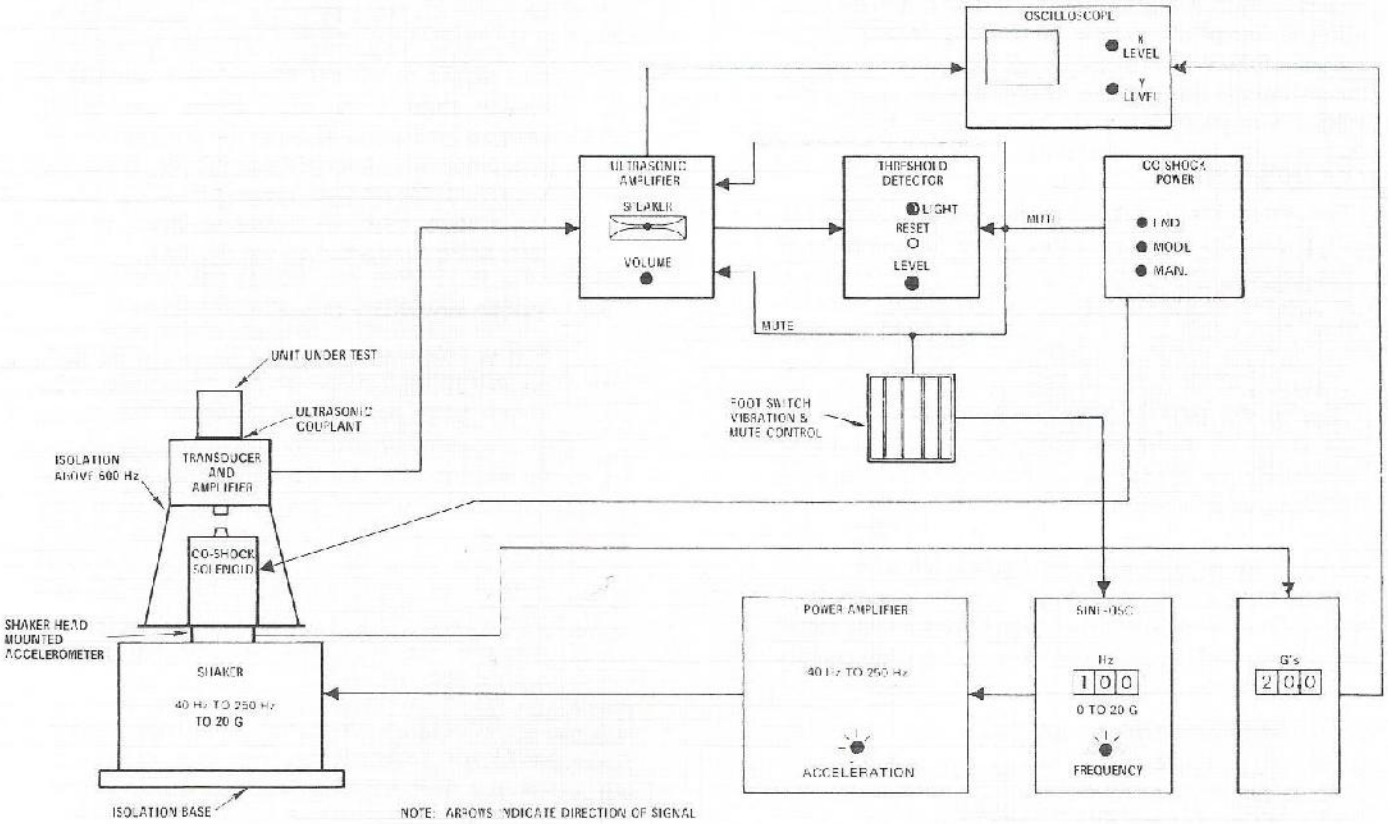


FIGURE II BW-LPD-B2000 AND/OR BW-LPD-B2010 PARTICLE IMPACT NOISE DETECTION SYSTEM

oscilloscope, a loud speaker, and a latching threshold detector (Lamp). We feel that the prime failure indicator is the threshold detector, however, an experienced operator will be assisted in evaluating equipment failure by proper use of the other indicators. The system includes a Sensitivity Test Unit which assists in the setting of the desired indicator detection levels. The Sensitivity Test Unit consists of a duplicate transducer (same as pickup transducer) to which an adjustable test signal pulse, in microvolts, may be applied. When the two transducers are coupled face to face with an ultrasonic couplant media, such a signal pulse can be detected on the oscilloscope, is usually detectable through the audio, and will usually latch on the threshold detector. Empirical test data has indicated this pulse (when 250 microvolts is used) represents the noise generated by a very small particle. The pulse should consistently generate signals which are approximately 2 to 1 over the system noise level when the equipment is operating properly.

Location of Equipment for Best Results

As is noted in the brief description of operation, this system relies on audio/visual indications to determine the acceptability of the device under test. To a certain extent, this equipment may pick up acoustical energy and high frequency pulse energy, causing a false indication of test device failure. Physical location in the test area should consider these factors. It is best to locate the equipment in a relatively quiet area, away from noise and pulsed electrical equipment. This allows for minimal distraction of the test operator and erroneous test results. The optimal location is in a screened room with a filtered power source. B & W provides a bench top screen enclosure, as an option, in the event our customers cannot provide a suitable environment.

Equipment Setup

The system block diagram on the previous page (Fig. II) shows the interconnections and relationships of the various sub-system components. Cabling should be routed on the test bench so that it does not conflict with operation of the test equipment and does not require constant movement. Due to the noise associated with most connectors and plugs, the fittings to the transducer/amplifier/co-test shock head are made via a terminal block. Please follow the instructions for proper cable attachment as shown in the Maintenance Manual.

2.1 Pre-setting Controls for System Setup

For clarity, the front panel controls are called out as they relate to their subsystem component.

Oscilloscope, Model BW-015

Intensity	—	Preset
Focus	—	Preset
Variable-Volts/Cm	—	Preset/ 1 10MV/ Division
Input	—	AC
Vertical Position	—	Center of rotation
Horizontal Position	—	Center of rotation
Sweep Variable/ Ext. Gain	—	Center of rotation
Sweep Range	—	External
Sync.	—	External
DC-AC	—	DC

PIND Amplifier and Stimulus Controls

Audio Gain	—	Full clockwise (or comfortable level)
Threshold Sensitivity	—	Preset by Calibration

Co-Test Shock Control

Mode Switch	—	Manual

Frequency and Acceleration Controls

Oscillator frequency at desired level in compliance with TM-2020.

Power Control

Acceleration	—	Counterclockwise
ON-OFF	—	ON (Last Operation)

a. Allow 10 minutes for system warm up. Be alert for any malfunction observed through sight, sound, or smell. In general, the system should be passive.

NOTE: The accelerometer amplifier can be adjusted to correlate the 20 G display with the visual reading as required. After the adjustment at 63 Hertz, the accelerometer can be used to establish the level at other frequencies. Whenever a new frequency is used, the level should be brought to 20 G's without any increase in system noise being experienced, and no increased generation of mechanical noise, due to resonance of associated assemblies, being experienced. Should an increase in noise occur, the system must be corrected prior to any tests being conducted on the product.

2.2 System Sensitivity Check

B & W Engineering supplies, as part of the basic system, a device named the "Sensitivity Test Unit" (STU) part number BW-012. This device is primarily intended for use by the operator in setting up the system and periodic system check-out, however it may be used by metrology as a calibration tool as well. The BW-012 will provide either a millivolt or microvolt pulse which can be selected to be either positive or negative going. For the BW-012 to operate properly the self-contained dry cell battery must supply 1.5 volts.

The BW-012 complies with TM-2020 requirements for a Sensitivity Test Unit (STU). To use as a STU, connect the provided transducer to the BNC termination of the BW-012, using the cable provided for that purpose. The transducer of the BW-012 is then mounted face to face with the transducer of the system test fix-

ture, using the specified ultrasonic couplant at the interface between the two transducers. An example would be to set the digital knob of the BW-012 at 250 and depress the "MICRO" switch, the result will be a 250 microvolt pulse being induced into the test system. This pulse may be either positive or negative going depending upon where the polarity switch is positioned. Operate the "MICRO" Switch several times and adjust the trigger level variable as required to obtain a synchronized trigger from the STU pulse. The pulse generated by the STU must appear as a spike on the scope which exceeds the 1 CM system noise by the amount specified in TM-2020, as a minimum. The pulse will also be heard on the audio monitor and the threshold detector should latch on.

SECTION III
OPERATION

3.0 PRE-SETTING CONTROLS FOR DEVICE TESTS

Change the controls as noted below. Those not changed shall remain as set in 2.1 above.

Oscilloscope

Sweep range — Ext.
Sweep variable/Ext. Gain — Set for 4 CM at 20 Gs

Adjust presentation controls for normal oscilloscope operation.

3.1 Operation of the System to Detect Particle Impact Noise in Devices Under Test

General: The equipment shall be adjusted as indicated for device tests (prior paragraph) except as noted. It is assumed the test procedure is in accordance with MIL-STD-883, Method 2020. Other tests may require special procedures. Please refer to the chapter on Calibration, in your Maintenance Manual for more detailed information, particularly as respects the shock pulse.

a. Select the vibration frequency from the tables contained in the specification as related to the dimensions of the device to be tested, and the contract.

b. Select the proper test adaptor to use between the device and the transducer pickup, if an adaptor is required.

c. Bring the G level up to the specified level then depress the foot pedal.

d. Apply a small amount of ultrasonic couplant to the pretest shock fixture platen and to the transducer pickup platen. An embedment of .005 inches of couplant is usually adequate. Pre-test shock the device to be tested, then install it on the transducer/pickup platen, of the PIND Test System, as close to the center of the platen as possible.

e. If you desire to apply the "pre-test" shock pulse with the DUT mounted on the test fixture (vs the use of another shock machine) merely depress the "SHOCK" switch, on the front panel, prior to releasing the foot pedal.

f. Increase the vibration level from zero to the pre-set level, by removing the foot from the pedal, observing indications on the oscilloscope, listening for noise bursts on the loudspeaker, and watching the threshold detector for a latch-on" indication. When the "MANUAL" co-test shock mode is selected, maintain vibration for 3 to 5 seconds, then press the co-test shock control switch. Wait 3 to 5 seconds and repeat for a total of 3 co-test shocks. During the electrically applied co-test shocks, the threshold detector is muted, however the oscilloscope is not. A true indication of particle impact noise will latch the threshold detector and be visible on the oscilloscope, and heard on the audio. A false indication may not repeat in the same stimulus sequence, whereas true indications ususally repeat when restimulated.

When the test is complete depress the foot pedal. This reduces the shaker G level to zero while at the same time the audio is muted (for operator comfort) and the threshold detector is reset to a "light out" condition. Remove the unit from the test fixture and mount the next unit to be tested. Remove the foot from the pedal and the shaker will return to the previously set frequency and G level. Repeat the test sequence.

g. When the "AUTO" co-test shock mode is selected, the shock pulses are automatically applied at the correct time intervals. When the foot pedal is released a shock pulse will be applied about five seconds after the shaker reaches full amplitude, followed by two more pulses at four second intervals. After the third shock pulse another five second time period elapses and a "TEST COMPLETE" lamp is lighted.

When a failure occurs (as evidenced by lighting of the "FAIL" lamp) the system precludes the administering of any further shock pulses, however the shaker continues at the preset test level.

The operator must monitor the oscilloscope and audio system and evaluate noise bursts which may be evident although below the trigger level of the "THRESHOLD DETECTOR".

When used in "AUTO" mode, the timer is reset to the beginning of the time cycle each time the foot pedal is depressed.

h. Mark the devices tested in accordance with the specification as to pass, fail, or possible retest.

3.2 **Factory modifications available for PIND testers**

Your PIND test system may include one or more of the following modifications required by your purchase order. The block will be checked to indicate the one or more provided.

☐ a. **Modification # 1** – Changes the oscillator frequency limits controlling the vibration shaker from 40 to 250 hertz to 30 to 250 hertz. Acceleration is limited to 10 G's from 30 to 40 hertz.

☐ b. **Modification #2** – Automatically provides pre-test shock on release of foot pedal when in the "AUTO" shock mode.

☐ c. **Modification #3** – Automatically provides the pre-test shock on release of the foot pedal when in the "AUTO" shock mode and has two "AUTO" modes; MODE "A" has 3 to 5 second intervals between shocks, MODE "B" has 1 to 2 second intervals between shocks. A rotary front panel switch provides selection of "MANUAL", "MODE A", or "MODE B".

SECTION IV
TROUBLESHOOTING

Non-repeatable failure indications may be the result of environmental influences of your test location. A noisy power source, radiated RF, loud audio noise, static discharge when the operator touches the equipment, all are possible sources of false failure indications by the test equipment. Usually a device that contains a particle, particularly a particle that has a mass equivalent to a 1 mil gold ball or greater, will repeat as a failure. Normally the false failure indication is not repeatable if environmentally stimulated. Such conditions must be carefully evaluated and the problems resolved.

Such things as loose screws, nuts, foreign particles and/or circuitry failures can result in equipment generated false failures. For more details on this aspect please refer to the MAINTENANCE MANUALS that come with your tester.

Other false failure indications may be generated by the Device Under Test (DUT). Insure that leadwires are not touching each other or any other object, and that they are not being vibrated at a resonant frequency. Some large flat packs may experience flexing (oil canning) of the enclosure. Internal wires or parts may move or the DUT may not be properly coupled to the test transducer.

In general we have found that resolution of the above problems have solved most of our customers troubles. If you cannot locate your problem, please feel free to call our engineers, they will work with you in every reasonable way they can.

SECTION V
ACCESSORIES

BW-004 (A) FIXTURE – this modification involves a clamp that holds down devices which have sufficient mass to preclude their staying on the test fixture via the couplant media alone.

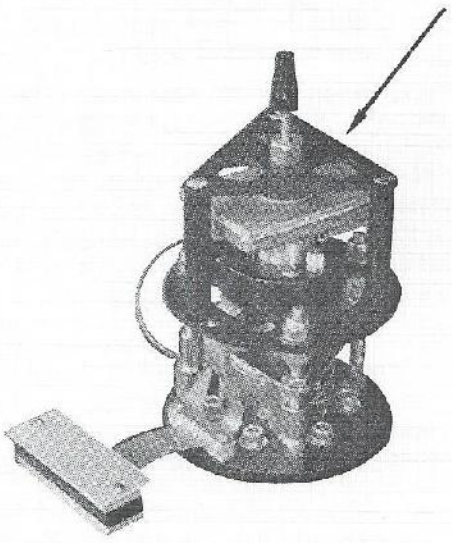


FIGURE III. BW-004 (A)

RF SCREEN ENCLOSURES — several configurations available, depending upon the system you purchase. These attenuate ambient RF noise by about 50 db at 150 KHz.

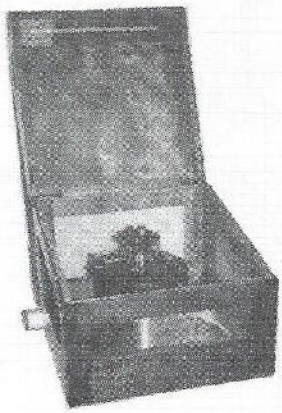


FIGURE IV. BW-018

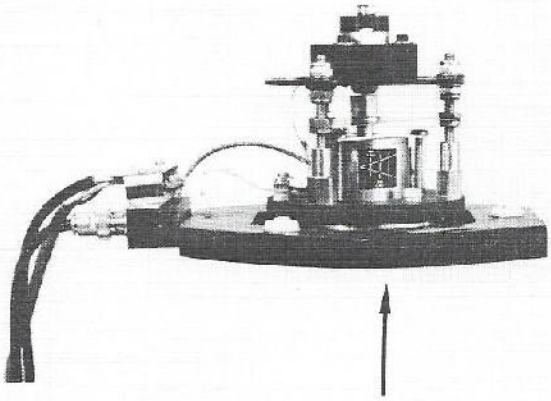


FIGURE V. BW-020

DEGAUSSING MAGNETS — that reduce the magnetic field, at the point where the test specimen is mounted, to less than 5 gauss.

BW-017 TEST BENCH —was developed as the result of some customers experiencing problems in providing a work station which did not provide the desired level of operator comfort. This is particularly true when the shaker is located on an isolation device which increases the height of the mounting surface of the test transducer, thereby causing the operator to have to reach, or stand. This bench has the isolation device recessed into the top, which lowers the work area by about five inches.

FIGURE VI. BW-017 TEST BENCH

B & W ENGINEERING CORP.

(Hereinafter referred to as B & W)

Statement of General Conditions of Warranty

B & W warrants its Particle Impact Noise Detection System (hereinafter referred to as PIND Tester) to be free from defects in material and workmanship for a period of 180 days after shipment to the customer. This warranty does not cover B & W equipment unless it is properly installed and operated in accordance with current B & W instructions and manuals of B & W, and maintained by the purchaser in accordance with the provisions of such instructions and manuals.

Warranty is limited to supplying the purchaser with replacement or repair of any part or parts which in B & W's opinion, are defective. Commercial products purchased by B & W installed and made a part of B & W's PIND Test System will carry the original manufacturer's warranty only. B & W reserves the sole right to determine whether defective parts or products will be repaired or replaced.

Maintenance service and service beyond that specified herein shall be provided at B & W's prevailing Service Rate or by Service Contract Agreement.

Warranty is expressly in lieu of any and all other warranties or representations, expressed or implied, and of any obligations or liabilities of B & W to the purchaser arising out of the use of said products, and no agreement or understanding varying or extending the same shall be binding upon B & W unless in writing, signed by an authorized officer of B & W.

Warranty shall not apply to any product which in the judgement of B & W has been subjected to misuse or neglect, or has been repaired or altered by the purchaser.

B & W reserves the right to make changes in design or additions to, or improvements in, the PIND Test Systems at any time without imposing any liability on itself to install the same in any product manufactured or supplied prior hereto.

This warranty does not include reimbursement for customer assembly, disassembly, setup or teardown time. All packing and shipping costs related to warranty return items shall be borne by the purchaser.

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B & W Engineering Corp., 3303 Harbor Blvd., Suite E-7, Costa Mesa, California 92626 - Phone (714) 540-9975