HAZELRIGG INDUSTRIES

VNE

Vacuum Tube
Compression Amplifier

Operating Instructions

How to Contact us:

Telephone:

567-DWFEARN
(567-393-3276)

Shipping Address:

124 Tartan Terrace
Chalfont, PA 18914
U.S.A.

e-mail: support@hazelriggindustries.com
www.dwfearn.com

D.W. FEARN

HAND-CRAFTED PROFESSIONAL RECORDING EQUIPMENT

HAZELRIGG INDUSTRIES

124 Tartan Terrace
Chalfont, PA, U.S.A.
Tel: 567-393-3276

Certificate of RoHS Compliance

D.W. Fearn / Hazelrigg Industries is committed to manufacturing products that are fully-compliant with the EU RoHS Directive.

The following products are compliant:

D. W. Fearn
VT-1, VT-2
VT-3, VT-I/F
VT-4, VT-5
VT-7
VT-15
LP-1, PDB
VRP, VPF

Hazelrigg Industries
VNE, VLC
VDI, VPH

This declaration is based on our understanding of the current RoHS Directive and from information provided by the supplier material declarations with regard to materials contained in the component that make up our products.

Douglas W. Fearn
President

VNE Vacuum Tube Compression Amplifier
Final Test Report

Serial Number _____**Mains Voltage:**_____**VAC**

Date_____ **Tested by**_____

THD+Noise:

20 cps _____ **%**

200 cps_____**%**

2 kc/s _____ **%**

20 kc/s_____**%**

Operational Tests:

Compression Range_____

Attack _____

Release_____

HPF _____

GR Meter _____

Listening Test_____

Table of Contents

List of Illustrations

Limited 7-Year Warranty

During the warranty period, D.W. Fearn / Hazelrigg Industries will, at no additional charge, repair or replace defective parts with new parts.

This warranty does not extend to any VNE that has been damaged or rendered defective as a result of accident, misuse, or abuse; by the use of parts not manufactured or supplied by D.W. Fearn / Hazelrigg Industries; or by unauthorized modification of the VNE. Vacuum tubes are excepted from the 7-year warranty, but are warranted for 90 days from date of purchase.

Except as expressly set forth in this Warranty, D.W. Fearn / Hazelrigg Industries makes no other warranties, express or implied, including any implied warranty of merchantability and fitness for a particular purpose.

D.W. Fearn / Hazelrigg Industries shall not be liable for technical or editorial errors or omissions in this manual, nor for incidental or consequential damages resulting from the use of this material.

SPECIFICATIONS

Input	600 ohms source (nominal) balanced or unbalanced
Input Load Impedance	32K ohms, transformer balanced bridging
Nominal Input Level	+4 dBm
Max Input Level @ 20 cps	+25 dBm
Gain	unity to +15dB
Frequency Response	± 0.5 dB 20 cps to 20 kc
THD + Noise	<0.05% 20 cps to 20 kc
Signal to Noise Ratio	78 dB minimum
Output	low-Z, transformer balanced
Output source impedance	115 ohms
Maximum Output Level	+22 dBm into bridging input balanced or unbalanced
Gain reduction range	0 to 20dB
Power Requirements	120 or 220 VAC 50/60Hz, 25 W
Dimensions	19" (48.26cm) W 3.5" (13.34cm) H 14" (22.86cm) D
Weight	12.5 lbs. (5.66 kg)
Shipping weight	16 lbs. (7.26 kg)

Description

The VNE Vacuum Tube Compression Amplifier is designed to provide recording professionals with a sonically superior signal processing device. It is typically used in sound recording studios for processing individual tracks. The input and output is at line level.

The VNE is an adaptation of the D.W. Fearn VT-7 stereo tube compressor. The audio path is entirely Class-A triode vacuum tubes, similar to classic designs but updated with improved modern passive components and computer-aided circuit optimization. Because of the unique qualities of vacuum tubes, the VNE has a clarity, transparency, and warmth that solid state compressors lack. Its modern design and construction allow the VNE to exceed the performance of vintage vacuum tube compressors.

It is designed for use in the professional recording environment. It accepts a low impedance (600 ohm nominal source impedance) balanced or unbalanced line level (nominal +4dBm) signal. There are controls for compression threshold, gain, attack and release times. It is built to sound great for a long time, with top quality parts used throughout.

All five power supplies (filament, B+, and three voltages for the solid-state control circuitry and meter amp) are solid state and fully regulated.

The VNE is not mass-produced. Each one is hand-made and meticulously tested and listened to before shipment to the customer.

Installation

The VNE is carefully packed for shipment and should survive all but the most brutal handling. If there is any damage, keep the shipping material for use during any claim for damage with the shipper.

Included in the box:
1) The VNE Instrument Interface
2) Line cord
3) This instruction manual

Mounting

The VNE is designed for installation in a standard 19-inch rack. It requires 3.5 inches of vertical space, but additional spacing between it and adjacent equipment is recommended for adequate cooling. Ideally, a ventilated panel at least 1 rack unit high (1.25 inches) should be installed above and below the VNE (and around any other heat producing equipment for that matter). Be sure the side vent slots are not blocked. Equipment that runs cool can last for a very long time.

In tight equipment enclosures, be sure there is adequate air flow. Forced air cooling will benefit all your equipment.

The VNE can also be used without a rack, placed on a table, counter, or even on the floor. Optional rubber feet are available, when requested at the time of the order.

Moderate electrical and magnetic fields in the vicinity of the VNE should not cause any degradation in noise performance, due to the well-shielded construction, but proximity to devices with motors or large power transformers (i.e. tape machines or power amps) should be avoided.

Although the vacuum tubes in the VNE are selected for minimum microphonic response, it is a good practice to avoid mounting locations that subject the VNE to very high sound or vibration levels.

Power

The VNE is designed to operate from 120 or 220-240 volt, 50/60 Hz power. The unit will be shipped wired for the voltage specified in the order, but may be changed in the field if necessary (Call the factory for detailed instructions). The ground pin of the power cord is internally connected to the chassis. This configuration is standard in professional equipment and is required by most electrical codes. A grounding screw is provided on the back panel for installations that use separate chassis grounding. If ground loop hum is detected, a careful check of the studio grounding scheme is needed. The VNE is less susceptible to grounding problems than many studio devices.

Connections (see Figure 1)

The INPUT connector is XLR-3 female wired with pin 1 ground, pin 2 "+" or "high," and pin 3 "-" or "low." The input matches 600 ohm (nominal) line level (+4dBm nominal) balanced or unbalanced signals. The input uses a top-quality Jensen line bridging transformer.

The OUTPUT connector is XLR-3 male wired with pin 1 ground, pin 2 "+" or "high," and pin 3 "-" or "low." The VNE is optimized for feeding balanced bridging inputs (Virtually all modern audio equipment has bridging inputs). The output is transformer-balanced.

The "GND" terminal is for use when an external grounding scheme is utilized.

The Fuse is a 5mm x 20mm 1 amp for 115 VAC operation, and 0.5 amp for 220-240 volts.

The AC input connector is used with the mating line cord (supplied). For 115 VAC operation, this cord is a Belden 17250 or equivalent.

The unit does not utilize any RFI filtering, and no RFI has been experienced, even when the VNE is operated in close proximity to AM, FM, and TV broadcast transmitters.

Input and Output Connections

See Figure 1. Gold-plated XLR connectors are used for inputs and outputs. The input connectors are female and the outputs male.

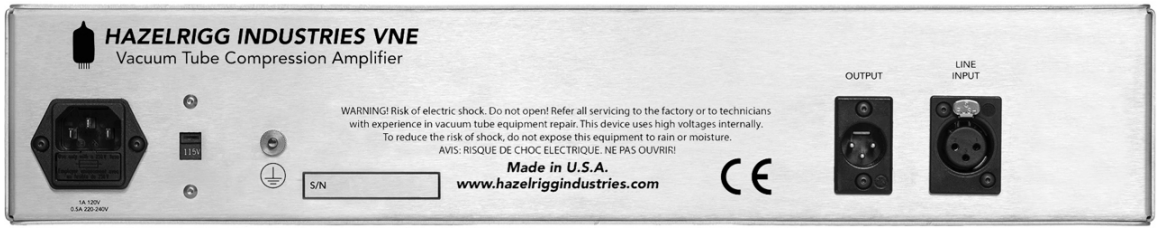

Figure 1. The VNE rear panel connectors

All connectors are wired according to AES standard: pin 1 is ground (shield), pin 2 is "high" or "+," and pin 3 is "low" or "-." A positive voltage on pin 2 of the input will result in a positive voltage on pin 2 of the output (with the Phase Reverse switch set to Normal).

Grounding and Shields

A full discussion of proper studio wiring schemes is beyond the scope of this manual, but, in general, the Input-mating XLR connector must have the cable shield connected to pin 1. With most microphones, this shield must also be connected to pin 1 at the microphone end of the cable.

Whether the shield is connected to pin 1 of the output connector depends on the standard in your studio. The shield should be connected to ground at only one end of the output cable; however, although not recommended, the shields can often be connected at both ends without a problem.

OPERATION

Input

Since the input cable will be carrying high quality audio, it is important that a well-shielded cable is used. You should strive to minimize the number connectors, patch jacks, switches, etc. between the source and the VNE input.

Output

The output of the VNE is line level, transformer balanced. Note that vacuum tube equipment is more sensitive to load impedance than solid state units. The VNE design was optimized for feeding a balanced bridging input (20k ohms or greater). When feeding a 600 ohm load, there may be a slight degradation of some of the specifications. In modern studio equipment, bridging line inputs are universal. If the device being fed by the VNE has an input termination switch, that switch should be in the “off” position.

The VNE can feed balanced or unbalanced inputs with no need for any modification in output wiring. Either pin 2 or 3 can be grounded, although pin 2 is normally used as the ”hot” and pin 3 grounded in unbalanced configurations.

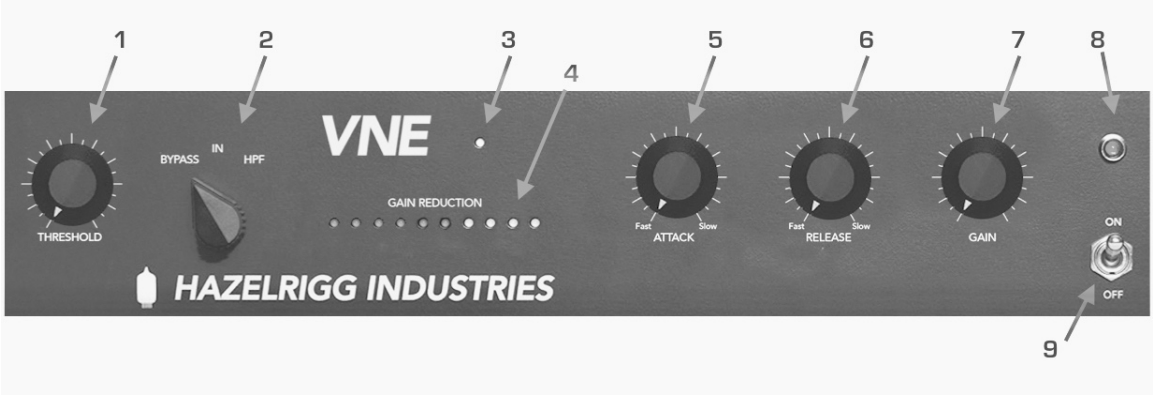

Figure 2. VNE front panel controls and indicators

CONTROLS (see Figure 2.)

Threshold (1)

The Threshold control adjusts the point where compression begins. With the control all the way down, there is no compression and the VNE operates as a straight amplifier. As the control is turned clockwise, the amount of compression increases. This can be monitored on the Gain Reduction meter, or by ear.

Input switch (2)

The input switch has 3 positions: Bypass, In, and HPF. While in Bypass, audio comes into the VNE, then immediately goes back out without going through any internal circuitry. In the 'In' position, audio will go through the amplifiers and compression circuitry. In the HPF position, a high-pass (low cut) filter is inserted in the sidechain. This makes the compression less bass-sensitive and may be useful on sources that have a very heavy bass content. The roll-off of bass sensitivity is a very gentle curve (about 6dB per octave) and has little effect above 150Hz. When the VNE is powered off audio will simply bypass.

Output Signal Indicator (3)

The bi-color LED (8) displays output directly from the secondary of the output transformer, through an isolation amplifier. Ideally, the indicator should show green while recording signal.

The LED is calibrated to turn red when nearing the upper input level of most digital audio convertors.

Gain Reduction indicator (4)

The Gain Reduction meter consists of 10 LEDs calibrated to give an intuitive sense of the amount of compression. The LEDs are scaled so that the first 7 LEDs represent approximately 1dB of compression each, while final 3 LEDs cover the range to about 15dB of compression.

Attack (5)

This control adjusts the time it takes the VNE gain reduction circuitry to react to a signal. It might seem that the faster the attack time, the better, but very fast attack times will result in significant distortion on material with a lot of low frequency content (this is true of all compressors). As the control is turned clockwise, the attack time becomes longer. Often with percussive sounds it is advantageous to have fairly long attack times to allow the initial transient of the sound to pass through the VNE without gain reduction. Experiment with the Attack control on percussive material to see how it changes the sound. Generally speaking, a fast attack time is best when complete control of the maximum instantaneous level is required. This might be desirable to protect a digital input from overload. However, a more natural sound is usually obtained with a slightly slower attack time. Long attack times can be useful as an effect, adding power to percussive instruments.

Release (6)

The Release control adjusts how long it takes for the gain to return to normal after a sound ceases (or drops in level). Fast release times add more energy to the sound, but can add distortion to low frequency sounds. (This is true of all compressors.) A fast release time adds density to the sound, often with the compression becoming more obvious. Long release times make the compression less obvious and more natural, but can "punch holes" in the lower level audio under certain conditions of high percussive levels.

Gain (7)

Whenever compression is applied, the signal is reduced in level by the amount of gain reduction. The Gain control allows you to make up the lost gain as necessary. The maximum gain available is about 15dB.

Power switch and indicator (8 & 9)

Primary power is applied to the VNE circuits when the Power switch (9) is in the up position. The red pilot lamp (8) indicates that the unit is on. It take about twenty seconds for the compressor to start working, but it is suggested that you turn on the power at least five minutes prior to use. The tubes are often noisy until all the internal elements reach a stable operating temperature.

Initial Set-Up

The VNE should be installed as detailed in the Installation section. With the outputs connected to an appropriate destination (typically to audio recorder inputs or as a mixer insert), configure the studio to monitor the VNE output. Apply power and wait about twenty seconds for the tube filaments to get up to temperature. Check for hum, buzz, or other noise. For the first few minutes after a cold start it is not unusual for the VNE to produce hiss, pops, and micro- phonic "clanks" as the internal elements of the tubes expand from the heat. Correct any ground loop problems before proceeding.

The controls should be set as follows. The numbers refer to Figure 2 on page 12.

- **Power(9).....On**
- **Threshold(1).....9 o'clock**
- **Input selector(2)…….…..IN**
- **Attack(5).....1 o'clock**
- **Release(6).....9 o'clock**
- **Gain(7).....9 o'clock**

The best indication of proper operation of the VNE is how it sounds. This compressor has a wide operating range and many different settings can provide a wide variety of effects.

Be certain that the output level of the VNE is appropriate for the device connected to the output. +4 dBm is the accepted standard level for all professional recording equipment. Some older equipment may be designed for 0 dBm or +8 dBm, either of which can be easily accommodated by the VNE.

Semi-professional equipment frequently uses a reference level of -10 dB (roughly 14 dB lower than pro equipment).

SUGGESTIONS:

You have chosen to use the VNE because of the superior sound it provides. To gain the maximum benefit from your investment, it is important that you hook up the VNE so that other factors do not adversely affect the sound quality.

Except for extremely short Attack and Release times, the VNE will provide quality sound with any settings. But like any instrument, you will find the best adjustment of the controls by experimenting. The starting adjustments listed above will get you started. Now play with the controls to find the sound that fits your project perfectly.

THEORY OF OPERATION

Input section

Line level (low source impedance, balanced, +4 dBm nominal) audio enters through the XLR-3 female INPUT connector to a bridging input transformer. The load imposed on the source is 32k ohms and is constant regardless of the frequency.

Input transformer

The input transformer is made by Jensen Transformers, Inc. and represents the state of the art in transformer design. It exhibits extremely flat frequency response, low phase shift, excellent square wave response, low distortion, and high noise immunity. The secondary of is connected directly to the grid of the first amplifier stage.

Input Amplifier

First stage

The first stage is a 6072a configured as a Class A voltage amplifier with a gain of approximately 20. Negative feedback from the plate of the second stage reduces distortion, flattens the frequency response, and makes the gain of the first two stages less dependent on individual vacuum tube characteristics.

Second stage

The output of the first stage is coupled to the grid of the second stage through a polypropylene capacitor. This stage operates as a Class A voltage amplifier with a gain of approximately 15.

Output Stage

The output stage operates as a cathode follower, presenting a comparatively low output impedance (approximately 450 ohms). The cathode output is coupled through a polypropylene capacitor to the Pulse Width Modulator board.

Pulse Width Modulator

This board contains the pulse generation and control circuitry, and the gain reduction element. The loss through the board is about 20dB with no gain reduction, rising to about 50dB with maximum gain.

Output Amplifier

First stage

The first stage is a 6072A configured as a Class A voltage amplifier with a gain of approximately 30. Negative feedback from the plate of the second stage reduces distortion, flattens the frequency response, and makes the gain of the first two stages less dependent on individual vacuum tube characteristics.

Second stage

The output of the first stage is coupled to the grid of the second stage through a polypropylene capacitor. This stage operates as a Class A voltage amplifier with a gain of approximately 20.

Output stage

The output stage operates as a cathode follower, followed by an output transformer. The output impedance is 115 ohms.

Power supplies

Primary power from the AC mains is connected to the VNE through a standard IEC power input connector. The Power switch energizes all five power supplies. A fuse, accessible on the IEC input connector, protects the VNE. The power transformer is a toroidal unit custom-made for the VNE and has primary taps for 115 and 220-240 volt operation. A switch on the rear makes it quick and easy to go between voltages. Be sure to also change the fuse to the appropriate value.

Filament supply

The power transformer output is rectified by a bridge rectifier and filtered before being regulated to 12.0 volts by a three-terminal regulator. The negative output of this supply is grounded.

Although the tube filament is rated for 12.6 volts, utilization of 12.0 volts has no effect on the operation of the VNE.

Low-voltage Supplies

This supply provides +15, -15, and +5 volts for the solid-state circuitry in the Pulse Width Modulator.

B+ supply

Two separate regulated voltages are required for the plates of the VNE. The B+ is filtered with long-life, low-leakage computer-grade filter capacitors before being regulated and extensively bypassed and decoupled. The negative side of the supply is grounded.

MAINTENANCE

The VNE is built with only the highest quality parts and will prove to be extremely reliable. Vacuum tubes and electrolytic capacitors, however, have a finite useful life and must be periodically replaced.

Top Cover Removal

Removing the top cover allows access to the vacuum tube. Eighteen 4-40 machine screws must be removed.

Vacuum Tubes

Four 6072A tubes are used in the VNE. There can be as much as a 15 dB difference in noise level among an assortment of tubes, and the tubes used in the first position should be carefully chosen to maintain low noise. Selected low-noise tubes are available from Hazelrigg Industries.

Tube life is difficult to predict, but it will probably be measured in years. Catastrophic tube failure is rare with this type of device, but a gradual increase in noise, microphonics, distortion, or a reduction in headroom, should indicate the need for replacement.

Tubes sometimes develop a microphonic response — they will respond to ambient noise and vibration. This can be an insidious problem since measurements in a quiet room will indicate perfect performance. Gently tapping the tube shields while listening to the output at a normal monitor level should reveal nothing more than a slight “clank.” On a peak-reading meter connected to the VNE output, with 50 dB gain, any microphonic response above -55 dBm is excessive. Replacement is indicated unless the VNE always operates in a quiet and vibration-free environment.

Although you could purchase a batch of 6072A tubes and select the quietest one(s) for the first tube position, it may be cost effective to buy a low-noise tube from us. Current prices are $51.00 for a selected low-noise 6072A, and $25.00 for a tested but less rigorous noise-spec 6072A. We test the tubes in a VT-2 after a burn-in period and grade them according to noise, microphonic response, distortion, and other characteristics. A low-noise tube from us will meet the original VNE specifications.

The base pins of vacuum tubes supplied by Hazelrigg Industries have been chemically treated for low contact resistance and oxidation prevention. When handling these tubes, care should be taken to avoid removing or contaminating the treatment. Use a lint-free cloth or paper towel to avoid direct contact between any part of the tube and your fingers.

Remember that vacuum tubes may be quite hot during operation. Protect your fingers during tube replacement. The preamplifier should be turned off before removing tubes. Allow at least one minute for the filter capacitors to discharge before tube removal or insertion. Tubes are made of glass and will break if dropped or even bumped in a critical area. Handle with care.

Electrolytic Capacitors

Hazelrigg Industries products are designed and built to last for a long, long time, and it is possible that some components (e.g. electrolytic capacitors) may reach the end of their life long before the equipment becomes obsolete. The electrolytic capacitors used in the VNE typically will last at least twenty years. If there is a measurable and/or audible increase in 120 cps noise, the filter capacitors should be suspected. They should be replaced with new capacitors of equivalent capacitance and voltage rating, and the replacements should be specified for a minimum ten-year service life. Electrolytic capacitors are also used as plate and cathode de-couplers. In choosing a replacement, the same considerations as with the filter capacitors should be followed.

TROUBLESHOOTING

Most problems will be traced to defective vacuum tubes. However, if normal tests do not easily reveal the problem, feel free to call the factory for assistance. If you lack access to a qualified service technician with vacuum tube equipment repair experience, you may return the VNE to the factory for repair. Call first, however, for shipping information.

WARRANTY REPAIR

If the VNE should develop a problem during the 7-year warranty period, call the factory for return shipping instructions. We will repair and return your VNE quickly. Note that the warranty does not cover vacuum tubes, which must be periodically replaced.