

MDP-1
Vacuum Tube Mic/DI Preamp
Operating Manual

Pendulum Audio

Pendulum Audio, Inc.

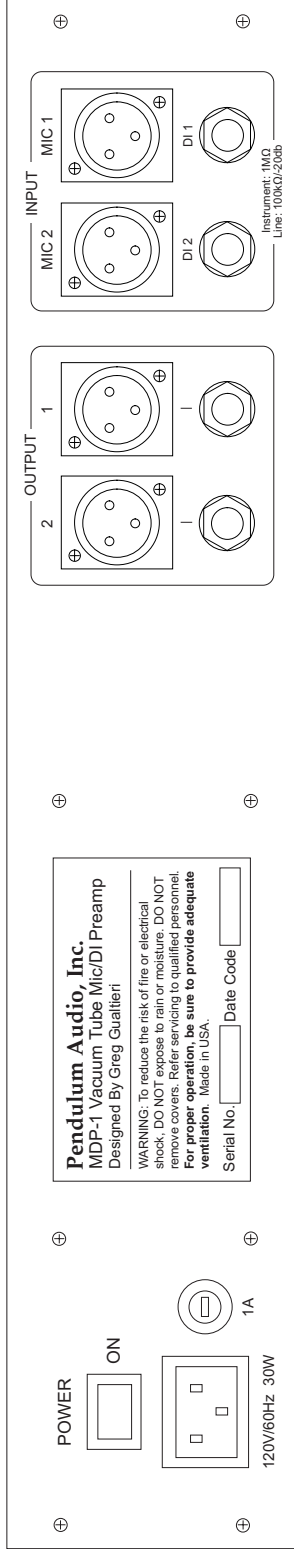
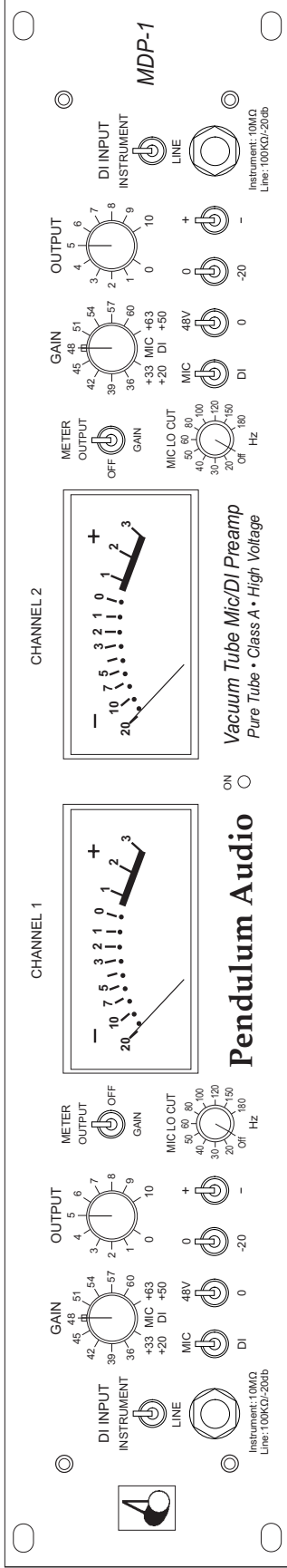
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MDP-1 Condensed Operating Instructions



- DI Input** The DI input selects between Instrument (with 10 MΩ input impedance at the front 1/4" jack, or 1MΩ at the rear jack) and Line (100KΩ input impedance, with a -20db pad at both inputs). The 1/4" front and rear panel jacks are wired so that the rear jack is disabled when the front jack is used.
- MIC/DI** Selects between the MIC input (via the XLR input connectors on the rear panel) or DI input signals (via the front or rear 1/4" input jacks).
- +48V** Supplies 48 volts to the XLR inputs for condenser microphones requiring phantom power. Do not use with dynamic, ribbon or tube mics.
- 0/-20** The -20 position inserts a 20 db pad in front of the mic input transformer.
- +/-** Mic phase reverse switch, where '+' is normal phase (input pin 2 hot), and '-' is inverted phase (input pin 3 hot).
- Mic Lo Cut** An 11 position rotary switch that provides a gentle (6db/octave) low frequency rolloff with 10 user-selectable turnover frequencies. The low cut filter does not affect the DI input signal.

- GAIN** An 11 position rotary switch that controls the gain of the tube stage in 3dB steps. The range is: +33 to +63dB for the mic input, +20dB to +50dB for the DI instrument input, and 0 to +30dB for the DI line input.
- OUTPUT** A passive attenuator that controls the output level to the XLR and 1/4" (parallel) output connectors. By increasing the Gain (driving the tubes harder) and lowering the Output level, subtle variations in the character of sound are possible. For the 'cleanest' sound, set the OUTPUT control to 10, and adjust the GAIN setting for the proper signal level.
- METER** In the **Output position**, the VU meter indicates the signal level at the XLR and 1/4" output connectors (post-Output control). The meter is electronically isolated from the signal path, and is calibrated to 0VU = +4dBu (1.23Vrms).

- In the Gain position**, the VU meter indicates the signal level of the tube gain stage (pre-Output control). The meter is electronically isolated from the signal path, and is calibrated to 0VU = +20dBu (7.75 Vrms).

MDP-1 Vacuum Tube Mic/DI Preamp

Features

- All tube, short signal path design
- Pure class A, high voltage circuitry
- Transformerless tube output stage capable of delivering +35dBu
- Low noise, wide bandwidth and superior transient response
- Choice of mic input transformer for 'full' or 'focused' sound
- 30dB gain range in 3dB steps
- Fully transformerless DI with 100k Ω , 1M Ω and 10M Ω input impedances
- Ten position mic lo-cut filter (20-180Hz)
- Large illuminated VU meters fully buffered from the signal path for low distortion.
- Soft-start warm-up with output muting
- Gold-plated switch contacts, I/O connectors and tube sockets
- Fully regulated high voltage (300V) and filament dc power supplies
- Custom toroidal power transformer with shield for minimum hum
- Polypropylene capacitors and metal film resistors (pairs matched to 0.1%)
- Single-sided pc boards to minimize capacitive interaction

Introduction

Thank you for purchasing the Pendulum MDP-1, a modern two channel vacuum tube Mic/DI preamp designed to be the ultimate way to get your mic or source directly to tape or hard disk. Unlike vintage or hybrid designs, the MDP-1 uses a pure tube, class A high voltage circuit topology with a transformerless output stage to deliver an open, intimate sound with a level of detail that meets the requirements of the most demanding recording applications. Our short signal path design excels in audio performance, delivering extremely wide bandwidth, low noise, and high headroom. The MDP-1 has all the things you'd expect in a full-featured mic preamp, including phantom power, phase reverse, input pad, a mic lo cut filter with 10 frequencies and large, illuminated VU meters. In addition, the full-featured DI input on each channel is has an entirely transformerless signal path, and accepts line and instrument level signals at a variety of input load impedances.

Since a key component of the sound of any tube mic preamp is the input transformer, a choice of two low turns-ratio transformers is available. The MDP-1A is equipped with two Jensen 13K7 transformers for a 'full', open sound with plenty of sparkle in the high end and a deep low end - perfect for recording all sources, especially instrumental music. The MDP-1B is equipped with two custom-wound transformers for a more 'focused' sound for extra presence and clarity in the midrange - ideal for a vocal sound that easily distinguishes itself in a mix. The MDP-1C is configured with a Jensen 13K7 in channel 1, and a custom transformer in channel 2.

Unpacking

The unit was carefully packed at the factory to protect against damage in transit. Nevertheless, be sure to inspect the unit and shipping carton for any signs of damage that may have occurred during shipment. If there is any damage, notify us immediately for further instructions. It's also a good idea to save the carton and packing materials should you ever need to return the unit for repair. The shipping carton should contain the following items: the MDP-1 Mic/DI Preamp, an IEC 3 prong power cord, and this operating manual.

Mounting

The MDP-1 uses two EIA-standard rack spaces, and can be mounted in any standard 19 inch (483mm) equipment rack. If the MDP-1 is mounted in a mobile rack or road case, it is important that the rear of the chassis is supported to prevent possible damage from mechanical shock and vibration. Excessive shock and vibration can cause damage or premature failure of the vacuum tubes, or cause them to shaken loose from their sockets. Please avoid rough handling.

Ventilation

For proper operation, it is *very* important that adequate ventilation is provided. Vacuum tubes produce a significant amount of heat that must be removed from inside the chassis. The side panel vent holes and top panel slit vents should never be blocked in any way. Never mount the MDP-1 below a rack unit with a depth greater than 7 inches (178mm). Do not mount the MDP-1 near other heat-producing equipment such as power amplifiers or other vacuum tube products. If possible, leave open at least one rack space above the unit, and use a rack spacer with a ventilation grille. Never operate the MDP-1 inside a road case where the side panels are cushioned in foam.

Preventing Ground Loop Hum

One of the reasons the MDP-1 sounds so good is that unlike many other vacuum tube products, it operates single-ended, Class A without an output transformer. However, it does not benefit from the galvanic isolation provided by an output transformer. For this reason, a few precautions are necessary to insure hum-free operation:

- Isolate the front panel from the rack rails. Use plastic shoulder washers to prevent electrical contact between the rack ears of the MDP-1 and the metal rails of the equipment rack.
- Isolate the MDP-1 from units mounted above or below it in the rack. Make sure the front panels are not in electrical contact and that the top or bottom cover screws of the MDP-1 are not touching those of any other units.
- Connect the 3 prong IEC power cord to the single-point star grounded electrical source for your facility.

The idea here is to make sure the MDP-1 seeks ground at only one point. For safety reasons, do not lift the ground at the IEC power cord. Keep in mind that in a properly grounded hookup, the MDP-1 does not hum. Please, take the time to do this right, and you will be rewarded with hum-free operation. Call us if you have any questions. Please note that pin 2 is hot.

Power Requirements

The MDP-1 is equipped with a 3-prong IEC power connector and detachable cord. Never operate the MDP-1 with the ground on the power cord defeated. Unless otherwise stated, this unit operates from 120V/60 Hz at 30W. The ac fuse is accessible from the rear panel and is rated at 1A/250V (3AG) SLO-BLO. To check or replace the fuse, make sure the unit is unplugged. Operation at 240V/50Hz is available as an option. Please contact us for more information.

Servicing

Other than changing the tubes, the user should not attempt to service the MDP-1 beyond that described in this manual. Never remove the covers or attempt to replace the tubes until the unit has been disconnected from the ac power source, and all circuits inside have been allowed to discharge for a period of at least 30 minutes. The vacuum tubes become very hot once the unit has been turned on, and they should not be touched until they have cooled to room temperature. To reduce the risk of fire or electrical shock, do not expose to rain or moisture, or operate it where it is exposed to water. Since potentially lethal voltages are present inside the unit, it should only be opened by qualified service personnel. Refer all servicing, or any questions about servicing, to Pendulum Audio, Inc.

Operation

While the operation of the MDP-1 may appear to be rather straightforward, there are a few features which may differ from what you're accustomed to seeing on other stand-alone mic preamps. You may find it useful to refer to the Condensed Operating Instructions at the beginning of this manual to quickly identify the operation of the front panel controls. However, we suggest you read through this section to take advantage of all its features, and to make sure you are operating the MDP-1 in the way most appropriate for the type of recording you're doing.

Hookup

Please refer to the rear panel layout (see the Condensed Operating Instructions) for the location of the inputs, outputs, ac power inlet and power switch. Make all connections to the MDP-1 before applying power.

Inputs

- On the right hand side of the rear panel are the input jacks for channels 1 and 2. The female XLR connectors on top are the transformer-balanced mic inputs. Connect microphones to these inputs using standard balanced XLR mic cables. Pin 1 = ground. Pin 2 = + (positive phase), pin 3 = - (negative phase). Note: these inputs may be +48v phantom powered, as selected by the '+48' switches on the front panel. Do not use phantom power on a microphone that does not require it! (e.g. dynamic, ribbon, or tube microphones). Make all mic connections before applying phantom power!
- The two 1/4" jacks below the XLR connectors are the unbalanced DI input connectors for channels 1 and 2. The input impedance of these jacks is $1M\Omega$ when the DI input switch on the front panel set to Instrument, or $100K\Omega$ with a 20dB pad when the DI input switch set to Line. These inputs can be used for connecting an instrument directly to the rear panel, or for connecting the MDP-1 to an unbalanced patch bay. The two 1/4" inputs on the front panel can be used for either instrument ($10M\Omega$) or line level ($100k\Omega/-20dB$) signals.

Outputs

- To the left of the input jacks are the output jacks for channels 1 and 2. The male XLR connectors on top are 3 pin unbalanced outputs, with Pin 1 + Pin 3 = ground, and Pin 2 = output. Connect these outputs to 3 pin balanced console, converter, or tape inputs. If you encounter ground loop hum when connecting to active-balanced inputs, lift the shield from Pin 1 on the input end of the cable. When connecting to a balanced patch bay, be sure that Pin 2 = Tip. For connection to transformer-balanced inputs, do not lift the ground at either end of the cable.
- The two 1/4" jacks below the XLR connectors are unbalanced output connectors, wired in parallel to the XLR outputs, with Tip = Pin 2, Ring = Pin 1. Use them for connecting the MDP-1 to unbalanced inputs.

AC Power

- On the left side of the rear panel is the IEC input socket. Connect to a 120V/60Hz receptacle with the 3 prong IEC power cable supplied with the MDP-1. For safety reasons, do not lift the ground on the power plug by using a 3-to-2 ground lift adapter.
- Turn on the power to the unit using the ac power switch located above the power inlet socket. Although it might seem a bit awkward to put the ac power switch on the rear panel of the MDP-1, there is a very good reason for it. By keeping the ac away from the front panel, hum induced by the ac line into the front panel circuitry can be virtually eliminated. This is especially important with the MDP-1, since the DI instrument input jacks on the front panel operate at $10M\Omega$, and are very susceptible to ac hum.
- If necessary, replace the 1A/250v 3AG SLO-BLO fuse only with the same type and rating.

Power-up Sequence

- To prolong tube life, the MDP-1 goes through a soft-start sequence for gently applying power to the tubes and stabilizing the circuit before engaging the outputs. When the power switch is turned on, the outputs are relay-muted to ground and the dc voltage on the tube filaments is ramped up to 12.6Vdc. Next, the high voltage supply is slowly increased to 300V and the circuit is allowed to stabilize for about 2 minutes. Finally, the relays lift the outputs from ground and the blue 'on' led on the front panel is illuminated. For best results, please allow the MDP-1 to warm up for at 10 minutes or longer before using.

Using the MDP-1 as a Mic Preamp

Please refer to the front panel layout (see the Condensed Operating Instructions) for the location of all switches and controls discussed below. The operation of both channels is identical. All switch contacts that pass audio are gold-plated for high reliability.

Input Mode: MIC

With the input switch in the 'MIC' position, the MDP-1 is configured as a mic preamp, with the XLR input connectors enabled and the DI inputs on both the front and rear panels disabled. In this mode the signal path consists of the input transformer followed by a Class A tube gain stage with a transformerless output. The nominal source impedance is 150Ω. When the MDP-1 is used with a transformerless microphone with a very low output impedance (50Ω or less), an external impedance-matching network (available from us) may be necessary to improve transient response.

Phantom Power: +48V/0

In the +48V position, 48 volts is supplied to pins 2 and 3 of the XLR input. The phantom voltage is applied via two 6.81kΩ metal-film resistors that are hand-matched to better than 0.1%.

Mic Input Pad: 0/-20

In the -20 position, a 20dB impedance-matched resistive pad is inserted in front of the input transformer to prevent overload. To optimize common-mode rejection, the metal-film resistors are hand-matched to better than 0.1%. Use this position when recording with mics placed on sources with high sound pressure levels such as drums, guitar amps, or when close-micing a singer with a high output mic. Use if distortion is heard, or if the output level of the preamp is too high with the GAIN selector switch at its lowest setting (+33dB). For the best noise performance, use only when necessary.

Phase: +/-

In the - position, the phase of the mic signal is inverted at the secondary of the input transformer. Configured this way, the phase of the mic can be switched without interrupting the dc voltage to a mic requiring phantom power. Positive phase is Pin 2 hot.

Mic Lo Cut: Off to 180Hz

The MIC LO CUT is an 11 position rotary switch that provides a 6dB per octave rolloff with 10 user-selectable turnover frequencies: 20, 30, 40, 50, 60, 80, 100, 120, 150 and 180Hz. It offers a greater selection of frequencies and gentler low frequency contouring than the low cut filters on most mics or mixers. In the 'Off' position, the filter circuit is removed from the signal path. Note that the Mic Lo Cut filter affects only the mic input, and not the DI input.

GAIN: +33 to +66dB

The GAIN Control is an 11 position rotary switch that adjusts the gain of the tube stage from +33dB to +66dB in precise 3dB increments. The 1% metal-film resistors that determine gain are selected for precise matching between the two channels. At low gain settings, there is more global feedback in the tube circuit, which offers a more 'accurate' and 'controlled' sound. At higher gain settings, the sound is a little more 'open' and 'harmonically rich'. Used in conjunction with the OUTPUT control (discussed below), subtle variations in the character of sound can be achieved.

OUTPUT: 0 to 10

The OUTPUT Control is a passive attenuator positioned between the final tube stage and the output connectors. It can be used in conjunction with the GAIN control to adjust the level that is sent to a tape machine or hard disk recorder. For the cleanest sound, set the OUTPUT control fully clockwise (completely out of the signal path) and use the GAIN control to set the overall signal level. To add more 'harmonic content' by driving the tubes at a higher signal level, set the GAIN control to

a higher gain setting and use the OUTPUT attenuator to bring the output level down to a more useable range. Or, use the OUTPUT control to make fine adjustments (within the 3dB range of the GAIN switch settings) to the level sent to a tape machine. Use the VU meter GAIN setting (discussed below) to monitor how hard the tubes are being driven. Used sparingly, this gentle tube 'overdrive' can create subtle changes in the harmonic balance of the source. Used to excess, it will cause audible distortion. Proceed with caution. With the OUTPUT attenuator set to mid-range, the level of attenuation is 20dB for load impedances greater than 10k Ω .

Note: Our use of a resistive output attenuator after a low impedance tube output stage is sure to raise an eyebrow. First, the output impedance is increased from 600 Ω up to as much as 5k Ω at the 3:00 position of the output potentiometer. Second, a higher output impedance may in principle cause problems when attempting to drive a long run of high-capacitance cable.

If this moderate increase in output impedance troubles you, keep the output control turned all the way up, use the GAIN control exclusively and the MDP-1 will deliver a true 600 Ω output impedance with high output drive capability and good stability. In practice however, when the preamp is used in a typical control room and connected by a reasonable length of cable to a tape or A to D converter input, the OUTPUT control offers a very convenient way to make minor level adjustments, or to create subtle variations in the character of sound. Try it, and you may like it.

METER: OUTPUT/GAIN

The illuminated ANSI VU meters are electronically isolated from the signal path, and can be switched to measure levels at two points in the signal path. Keep in mind that a VU meter is a mechanical device, designed in accordance with a well-accepted ballistic standard, to indicate an average loudness level. On the other hand, the led meters on your digital recorder are reading a peak program level, and faithfully register all those short transient spikes that add little to the perceived loudness of the program material. The ratio of the peak to average levels can be 20dB or greater depending on the source (e.g. drums). So, if you're wondering why the led meters on your recorder are dancing around zero, but the VU meters on the MDP-1 are hovering at or below -10, you're simply seeing the difference between the peak and average program level.

OUTPUT

When the METER switch is in the OUTPUT position, the VU meter indicates the signal level at the XLR and 1/4" output connectors (post - OUTPUT attenuator). The meter is calibrated to 0VU = +4dBu (1.23vrms). Use this setting to monitor the average program level sent to a tape machine or console input.

GAIN

When the METER switch is in the GAIN position, the VU meter indicates the signal of the tube stage (pre - OUTPUT attenuator). The meter is calibrated to 0VU = +20dBu (7.75vrms). Use this setting to monitor how hard the tube stage is being driven, and to gauge the onset of audible distortion.

OFF

The center position of the METER switch turns off the VU meter.

Using the Mic Preamp Without the Input Transformer

Here's another tip that may raise an eyebrow. The MDP-1 can be used with high output tube microphones as a fully transformerless mic preamp. Simply connect the mic to the rear panel DI input using an XLR to 1/4" adapter, and switch the input mode to DI. Increase the GAIN about 20dB to compensate for the lack of transformer gain and the 6dB loss when running the mic unbalanced. The noise performance suffers a bit, but when used for recording vocals with a high output microphone (e.g. Neumann M149), the results are superb. Keep the mic cable as short as possible.

Using the MDP-1 as a DI Preamp

The MDP-1 features a full-function DI with a signal path that is entirely transformerless. Please refer to the front panel layout (see the Condensed Operating Instructions) for the location of the switches and inputs discussed below. The operation of both channels is identical. All switch contacts that pass audio are gold-plated for high reliability.

Input Mode: DI

With the input switch in the 'DI' position, the MDP-1 is configured as a line-level DI preamp, with the DI inputs on both the front and rear panels enabled and the XLR mic input connectors disabled. In this mode the signal path consists of a Class A tube line stage with a transformerless output. The input impedance is 100k Ω for line level inputs, or 1M Ω and 10M Ω for instrument inputs. The front and rear panel jacks are wired so that the rear jack is disabled when a 1/4" plug is inserted into the front jack.

DI Input: Instrument

With the DI INPUT switch on the front panel in the INSTRUMENT position, the 1/4" input jacks on the front and rear panels are configured to accept unbalanced high impedance sources. The GAIN range is +20 to +50dB in 3dB increments.

- The front panel jack has an input impedance of 10M Ω , which is ideal for very high impedance sources such as piezo transducers. Use this input when minimum loading of the source is desired.
- The rear panel jack has an input impedance of 1M Ω , which is ideal for moderate impedance sources such as passive magnetic guitar or bass pickups. Use this input when light loading of the source is desired. Loading the magnetic coil of a bass guitar pickup with 1M Ω can sometimes tighten up the low end, adding definition. Since this effect depends on the inductance any given pickup, try it both ways and see which sounds the best.

DI Input: Line

With the DI INPUT switch on the front panel in the LINE position, the 1/4" input jacks on the front and rear panels are configured to accept unbalanced high level sources.

- The input impedance is 100k Ω for both front and rear input jacks, with a -20dB resistive pad inserted between the input and the tube line stage.
- The range of the GAIN control is 0 to +30dB, which is ideal for line-level sources such as -10dBV unbalanced consumer audio equipment or keyboard outputs.
- Use the rear panel jacks to connect the DI inputs to an unbalanced patch bay.

Gain and Output Controls

See 'Using the MDP-1 as a Mic Preamp' for a discussion of how to use the GAIN and OUTPUT controls to achieve subtle changes in the character of the sound of the DI. Note that while the MDP-1 can in principle be softly 'overdriven' like an guitar preamp, it doesn't have the same tone-shaping EQ. However, the MDP-1 can be used to overdrive the front end of a tube guitar amp.

Replacing the Tubes

All vacuum tubes have a limited life due to reduced electron emission from the oxide coating on the cathode and/or a buildup of impurity gases in the bulb. The life of the preamp tubes in the MDP-1 is estimated to be several years. If you notice the sound quality deteriorating - higher distortion, muddiness, or microphonic behavior - it's time to change the tubes. We recommend changing all the tubes at once. If you are uncomfortable with replacing the tubes yourself, please have it done by qualified service personnel. Replacement tubes are available directly from us.

1. Unplug the MDP-1 and wait at least 30 minutes for the high voltage in the unit to discharge and for the tubes to cool to room temperature.
2. Remove the top cover by removing the nine #6-32 Phillips-head screws.
DO NOT remove the bottom cover.
3. Note the position of the four tubes (V1-V4) in the porcelain sockets.
 - The input tubes are ECC83/12AX7A (V1 and V3)
 - The output tubes are 6922/6DJ8 (V2 and V4)
4. Remove each tube and replace with the same type removed from the each socket.
DO NOT install the tubes in the wrong positions!
5. Reinstall the top cover and screws.

There are a large variety of ECC83/12AX7s available. Each type has slightly different internal structure and design. Consequently, each type has its own sonic signature. Sometimes the differences are subtle - sometime not. You are encouraged to sample the different varieties and pick the one that sounds the best to you.

The 6922 is a rugged, military style 6DJ8. Since it is used as a high current output driver, we recommend replacing it with the same type and rating. The 6922 used in this fashion has much less influence on the sound of the MDP-1 than the 12AX7A input tube.

MDP-1 Specifications

Circuit Type:	Class A vacuum tube signal path with transformerless output
Mic Preamp	
Input Gain:	+33 to +63dB in 3dB steps
Input Impedance:	1500 Ω transformer balanced and floating
Frequency Response:	-1.0dB 6Hz and 65kHz with 10K Ω load, +45dB gain -1.0dB 20Hz and 65kHz with 600 Ω load, +45dB gain
Noise:	EIN less than -125dBu with 150 Ω input load, unweighted (Jensen 13K7) EIN less than -118dBu with 150 Ω input load, unweighted (Custom Transformer)
Distortion:	THD+N less than 0.03% from 100Hz-10kHz, less than 0.07% at 20Hz, measured with -20dBu input, +10dBu output, +45dB gain
DI Preamp	
Input Gain:	+20 to +50dB (Instrument), 0 to +20dB (Line) in 3dB steps
Input Impedance:	10M Ω or 1M Ω (Instrument), 100k Ω with 20dB pad (Line)
Frequency Response:	-1.0dB 5Hz and 250kHz with 10K Ω load, +20dB gain -1.0dB 20Hz and 300kHz with 600 Ω load, +20dB gain
Noise:	EIN less than -116dBu with input shorted, unweighted
Distortion:	THD+N less than 0.04% from 20Hz-10kHz measured with +10dBu output, +40dB gain
Output Level:	+35dBu into 10k Ω load, Output control at maximum +25dBu into 600 Ω load, Output control at maximum
Meter:	selection of output level (0VU = +4dBu) or tube gain (0VU = +20dBu)
Phantom Power:	+48Vdc applied to pins 2 and 3
Mic Pad:	-20dB pad at the primary of the mic input transformer
Mic Phase:	inverts the phase at the secondary of the mic input transformer
Mic Lo Cut:	6 dB/octave rolloff from 20-180Hz in 10 steps
Polarity:	input and output XLR connectors are pin 2 hot
Vacuum Tubes:	(2) ECC83/12AX7A, (2) 6922
Power:	120Vac, 30W (240Vac optional)
Power Supplies:	+300Vdc and +12.6Vdc, fully regulated with soft-start warm-up and output muting
Dimensions:	2U enclosure, 19" x 3.5" x 12.5" (48.2 x 8.8 x 31.8 cm)
Weight:	14lbs (6.4kg)

Limited Warranty

Pendulum Audio, Inc. warrants to the first purchaser of a new Pendulum MDP-1 Vacuum Tube Mic/DI Preamp that the unit is free of manufacturing defects in materials and workmanship for a period of one (1) year from the date of purchase. Pendulum Audio, Inc.'s sole obligation under this warranty shall be to provide, without charge, parts and labor necessary to remedy defects, if any, which appear within one (1) year from the date of purchase. All warranties expressed or implied made by Pendulum Audio, Inc., including warranties of merchantability and fitness, are limited to the period of this warranty. Pendulum Audio, Inc. is not responsible for indirect, incidental or consequential damages arising from the use or failure of this product, including injury to persons or property.

This warranty does not cover damage due to: misuse, abuse, modification, accident or negligence. The warranty does not apply if the unit is repaired or altered by persons unauthorized by Pendulum Audio, Inc. in such a manner as to injure, in Pendulum's sole judgment, the performance, stability or reliability of the unit. The warranty does not apply if the unit is connected, installed or used otherwise than in accordance with the instructions furnished by Pendulum Audio, Inc. There is no warranty on vacuum tubes.

If the equipment requires warranty repair, return authorization must be obtained from Pendulum Audio, Inc. prior to shipment. Equipment should not be shipped to Pendulum Audio, Inc. until return authorization and the proper shipping address is obtained from us. The equipment (with all its components parts and connecting cables) must be suitably packaged, including a note with the owner's name, address, telephone number and a description of the reason for return. The owner pays two-way shipping (we recommend UPS), and we suggest that the shipment be insured for its full value.

This limited warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for us any liability in connection with the sale of our products than set forth herein. This limited warranty gives you specific legal rights, and you may also have other rights which vary from state to state.