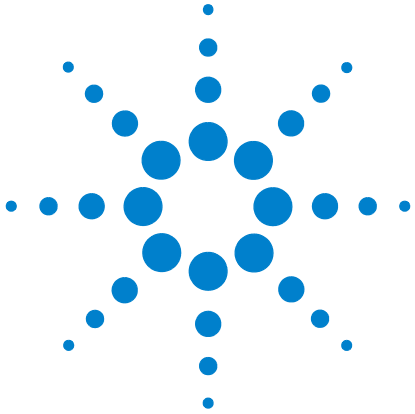

Agilent Pneumatics Router

Installation, Operation, and Maintenance

Agilent Technologies

Notices

Manual Part Number

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Safety Notices

CAUTION

A **CAUTION** notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a **CAUTION** notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Contents

Safety Precautions

The following warning and caution notices illustrate the style used in Agilent manuals for safety precaution notices and explain when each type is used:

This symbol might be used on warning labels attached to the equipment. When you see this symbol, refer to the relevant manual for the information referred to by the warning label.

WARNING **Warnings are used when failure to observe instructions or precautions could result in injury or death to humans or animals, or significant property damage.**

CAUTION Cautions are used when failure to observe instructions could result in serious damage to equipment or loss of data.

Warning notices

Observe the following precautions during installation, operation, maintenance, and repair of the instrument. Failure to comply with these warnings, or with specific warnings elsewhere in Agilent manuals, violates safety standards of design, manufacture, and intended use of the instrument. Agilent assumes no liability for customer failure to comply with these precautions.

WARNING **Persons with implanted or attached medical devices such as pacemakers and prosthetic parts must remain outside the 5-gauss perimeter from the centerline of the magnet.**

The superconducting magnet system generates strong magnetic fields that can affect operation of some cardiac pacemakers or harm implanted or attached devices such as prosthetic parts and metal blood vessel clips and clamps.

Pacemaker wearers should consult the user manual provided by the pacemaker manufacturer or contact the pacemaker manufacturer to determine the effect on a specific pacemaker. Pacemaker wearers should also always notify their physician and discuss the health risks of being in proximity to magnetic fields. Wearers of metal prosthetics and implants should contact their physician to determine if a danger exists.

Refer to the manuals supplied with the magnet for the size of a typical 5-gauss stray field. This gauss level should be checked after the magnet is installed.

WARNING **Keep metal objects outside the 10-gauss perimeter from the centerline of the magnet.**

The strong magnetic field surrounding the magnet attracts objects containing steel, iron, or other ferromagnetic materials, which includes most ordinary tools, electronic equipment, compressed gas cylinders, steel chairs, and steel carts. Unless restrained, such objects can suddenly fly towards the magnet, causing possible personal injury and extensive damage to the probe, dewar, and superconducting solenoid. The greater the mass of the object, the more the magnet attracts the object.

Only non ferromagnetic materials—plastics, aluminum, wood, nonmagnetic stainless steel, etc.—should be used in the area

around the magnet. If an object is stuck to the magnet surface and cannot easily be removed by hand, contact Agilent service for assistance.

Refer to the manuals supplied with the magnet for the size of a typical 10-gauss stray field. This gauss level should be checked after the magnet is installed.

WARNING **Only qualified maintenance personnel shall remove equipment covers or make internal adjustments.**

Dangerous high voltages that can kill or injure exist inside the instrument. Before working inside a cabinet, turn off the main system power switch located on the back of the console.

WARNING **Do not substitute parts or modify the instrument.**

Any unauthorized modification could injure personnel or damage equipment and potentially terminate the warranty agreements and/or service contract. Written authorization approved by a Agilent product manager is required to implement any changes to the hardware of a Agilent NMR spectrometer. Maintain safety features by referring system service to a Agilent service office.

WARNING **Do not operate in the presence of flammable gases or fumes.**

Operation with flammable gases or fumes present creates the risk of injury or death from toxic fumes, explosion, or fire.

WARNING **Leave area immediately in the event of a magnet quench.**

If the magnet should quench (sudden appearance of gasses from the top of the dewar), leave the area immediately. Sudden release of helium or nitrogen gases can rapidly displace oxygen in an enclosed space creating a possibility of asphyxiation. Helium will displace air from the top of a room and cold nitrogen can displace air from the lower levels of a room. Do not

return until the oxygen level returns to normal.

WARNING **Avoid helium or nitrogen contact with any part of the body.**

Cold gasses or liquids (helium and nitrogen) contacting the body can cause an injury similar to a burn. Never place your head over the helium and nitrogen exit tubes on top of the magnet. If cold gasses or liquids contact the body, seek immediate medical attention, especially if the skin is blistered or the eyes are affected.

WARNING **Do not look down the upper barrel.**

Unless the probe is removed from the magnet, never look down the upper barrel. You could be injured by the sample tube as it ejects pneumatically from the probe.

WARNING **Do not exceed the boiling or freezing point of a sample during variable temperature experiments.**

A sample tube subjected to a change in temperature can build up excessive pressure, which can break the sample tube glass and cause injury by flying glass and toxic materials. To avoid this hazard, establish the freezing and boiling point of a sample before doing a variable temperature experiment.

WARNING **Support the magnet and prevent it from tipping over.**

The magnet dewar has a high center of gravity and could tip over in an earthquake or after being struck by a large object, injuring personnel and causing sudden, dangerous release of nitrogen and helium gasses from the dewar. Therefore, the magnet must be supported by at least one of two methods: with ropes suspended from the ceiling or with the antivibration legs bolted to the floor. Refer to the *Installation Planning Manual* for details.

WARNING **Do not remove the relief valves on the vent tubes.**

The relief valves prevent air from entering the nitrogen and helium vent tubes. Air that enters the magnet contains moisture that can freeze, causing blockage of the vent tubes and possibly extensive damage to the magnet. It could also cause a sudden dangerous release of nitrogen and helium gases from the dewar. Except when transferring nitrogen or helium, be certain that the relief valves are secured on the vent tubes.

WARNING **On magnets with removable quench tubes, keep the tubes in place except during helium servicing.**

On Agilent 200- and 300-MHz 54-mm magnets only, the dewar includes removable helium vent tubes. If the magnet dewar should quench (sudden appearance of gases from the top of the dewar) and the vent tubes are not in place, the helium gas would be partially vented sideways, possibly injuring the skin and eyes of personnel beside the magnet. During helium servicing, when the tubes must be removed, follow carefully the instructions and safety precautions given in the manual supplied with the magnet.

Caution notices

Observe the following precautions during installation, operation, maintenance, and repair of the instrument. Failure to comply with these cautions, or with specific cautions elsewhere in Agilent manuals, violates safety standards of design, manufacture, and intended use of the instrument. Agilent assumes no liability for customer failure to comply with these precautions.

CAUTION Keep magnetic media, ATM and credit cards, and watches outside the 5-gauss perimeter from the centerline of the magnet.

The strong magnetic field surrounding a superconducting magnet can erase magnetic media such as floppy disks and tapes. The field can also damage the strip of magnetic media found on credit cards, automatic teller machine (ATM) cards, and similar plastic cards. Many wrist and pocket watches are also susceptible to damage from intense magnetism.

Refer to the manuals supplied with the magnet for the size of a typical 5-gauss stray field. This gauss level should be checked after the magnet is installed.

CAUTION Keep the PCs, (including the LC STAR workstation) beyond the 5-gauss perimeter of the magnet.

Avoid equipment damage or data loss by keeping PCs (including the LC workstation PC) well away from the magnet. Generally, keep the PC beyond the 5-gauss perimeter of the magnet. Refer to the *Installation Planning Guide* for magnet field plots.

CAUTION Check helium and nitrogen gas flow meters daily.

Record the readings to establish the operating level. The readings will vary somewhat because of changes in barometric pressure from weather fronts. If the readings for either gas should change abruptly, contact qualified maintenance personnel. Failure to correct the cause of abnormal readings could result in extensive equipment damage.

CAUTION Never operate solids high-power amplifiers with liquids probes.

On systems with solids high-power amplifiers, never operate the amplifiers with a liquids probe. The high power available from these amplifiers will destroy liquids probes. Use the appropriate high-power probe with the high-power amplifier.

CAUTION Take electrostatic discharge (ESD) precautions to avoid damage to sensitive electronic components.

Wear grounded antistatic wristband or equivalent before touching any parts inside the doors and covers of the spectrometer system. Also, take ESD precautions when working near the exposed cable connectors on the back of the console.

Radio-Frequency emission regulations

The covers on the instrument form a barrier to radio-frequency (RF) energy. Removing any of the covers or modifying the instrument may lead to increased susceptibility to RF interference within the instrument and may increase the RF energy transmitted by the instrument in violation of regulations covering RF emissions. It is the operator's responsibility to maintain the instrument in a condition that does not violate RF emission requirements.

Overview

This manual covers the Pneumatics Router, see Figure 1, which regulates the pneumatics used by the Agilent NMR System and has the regulation and or control functions:

- Antivibration system gas regulation and supply
- Probe, shim coil and upper barrel cooling gas regulation and supply
- Variable temperature gas control and supply
- Eject/insert, bearing, and sample rotation for liquids samples gas control and supply
- Solids high-speed spinner power supply and control
- Other system accessories gas control and supply

The gas flow through the router is shown in Figure 2 on page 14

Figure 1 Pneumatics router

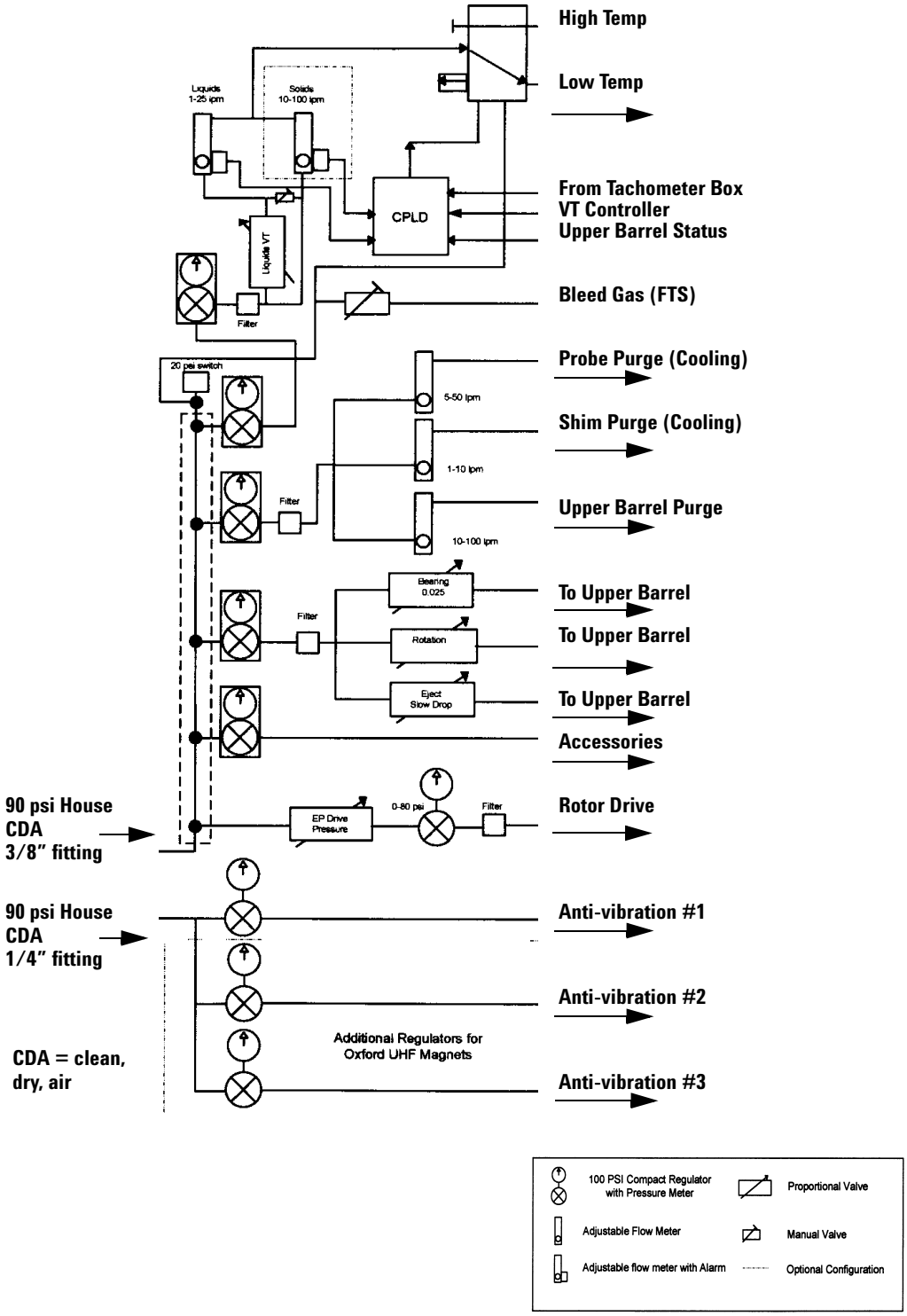


Figure 2 Pneumatic router block diagram

Installation

The Pneumatics Router is installed with the NMR system.

Installing gas filters and regulators

1 Verify that the gas supply meets the specifications listed in the *Installation Planning Guide*.

2 Connect the filter and regulator assembly, see Figure 3, to the gas supply.

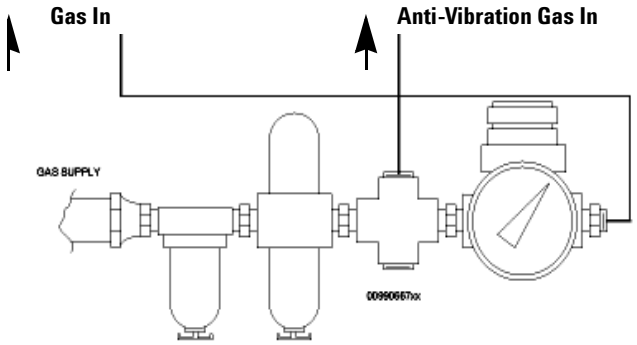


Figure 3 Pneumatics filter and regulators

3 Close the regulators and open the gas supply to the filter and regulator assembly.

4 Check for leaks.

Correct any leaks before continuing.

Connecting power and data

CAUTION Verify that the correct fuse is in place before connecting the power cord.

The router has three data connections and one power connection (Figure 4).

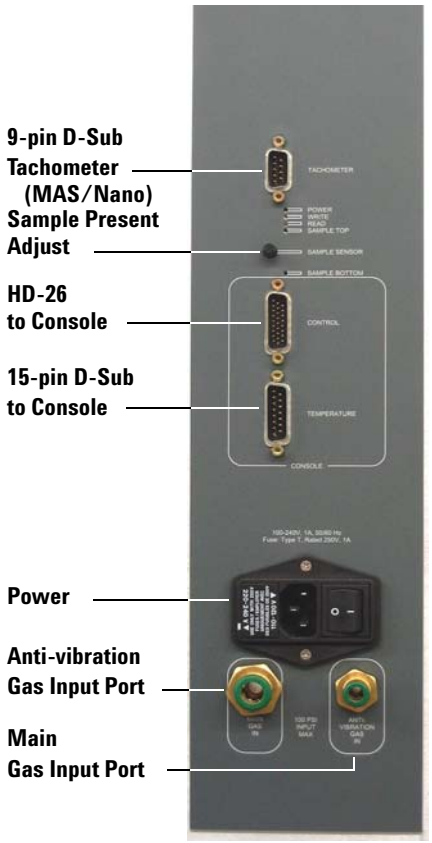


Figure 4 Power and data connections

1. Connect CONTROL and TEMPERATURE connectors using the supplied cables to the matching connectors on the Console Interface Panel on the back of the NMR console.
2. If used, connect the tachometer cable.
3. Connect the power cable to the router and to the AC power source, refer to the *Installation Planning Guide* for power requirements. Do not turn on the until the entire NMR system is ready to be turned on.

Connecting pneumatics

Connecting the gas input

Do Not exceed 100 psi of input pressure into the Pneumatics Router.

Connect gas supplies from the pneumatics filter and regulators to the each of the following router gas line input connections, see Figure 4:

- Antivibration system (1/4 inch)
- Temperature controller and upper barrel/stack, (3/8 inch)

Plumbing the pneumatics router

1 Do one of the following, Figure 5 on page 17:
   - Systems with solids temperature control upper stack – connect the purge gas and continue with step 2.
   - Liquids only systems –continue with step 2.

Figure 5 Gas output end cap

2 Connect the air lines and cable supplied from the output side panel of the Pneumatics Router to the upper barrel, following the labels.

3 Connect the shim coil purge gas line using the supplied tube adaptor.

4 Connect the probe purge gas line to the NMR probe in the magnet.

Setting up low temperature

The gas used for low temperature can be set up for one of the following:

- Liquid nitrogen heat exchanger (bucket) -- refer to "Installing the liquid nitrogen heat exchanger" on page 18
- Preconditioner unit (i.e. FTS) –refer to "Installing the gas preconditioner" on page 19

Installing the liquid nitrogen heat exchanger

The liquid nitrogen heat exchanger must have a one-way valve (see Figure 6 on page 19).

Refer to Figure 7 on page 20 when making the following connections:

1 Turn off the bleed gas output (Figure 14 on page 27) on the manual flow valve inside the router.

   Bleed gas is not used with the liquid nitrogen heat exchanger (VT bucket).

2 Connect the gas line from the router labeled LOW in the temperature section of the output panel to the input of the heat exchanger coil, see Figure 6 on page 19.

3 Connect the gas line from the router labeled HIGH in the temperature section of the output panel to the lid hose barb, see Figure 6 on page 19.

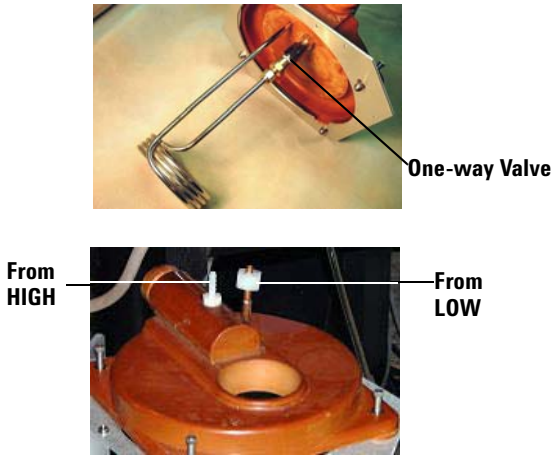


Figure 6 Liquid nitrogen heat exchanger

Installing the gas preconditioner

Do not Tee together the high and low gas supply lines coming from the router.

The preconditioner installation requires bypass kit, PN 01-915298-xx, shown in Figure 7 on page 20.

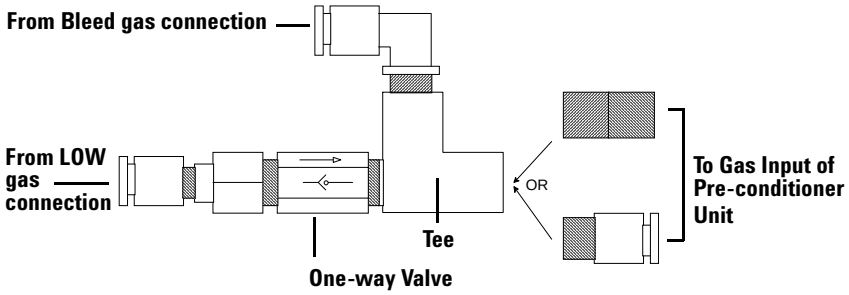


Figure 7 Gas preconditioner input assembly and connections

1 Make the following connections at the input to the pre-conditioner.

   Refer to Figure 7 on page 20 as necessary.

   a Connect the gas line from the router port labeled LOW in the temperature section of the output panel to the input of the one-way valve on the input assembly.

   b Connect the gas line from the router port labeled BLEED in the temperature section of the output panel to the Tee on the input assembly.

   c Connect the input assembly to the input of the pre-conditioner unit.

2 Make the following connections at the output of the pre-conditioner, Figure 8 on page 21.

   a Connect the gas line from the Pneumatics Router labeled HIGH in the temperature section of the output panel to the pre-conditioner output assembly.

   b Connect the pre-conditioner output to the pre-conditioner output assembly.

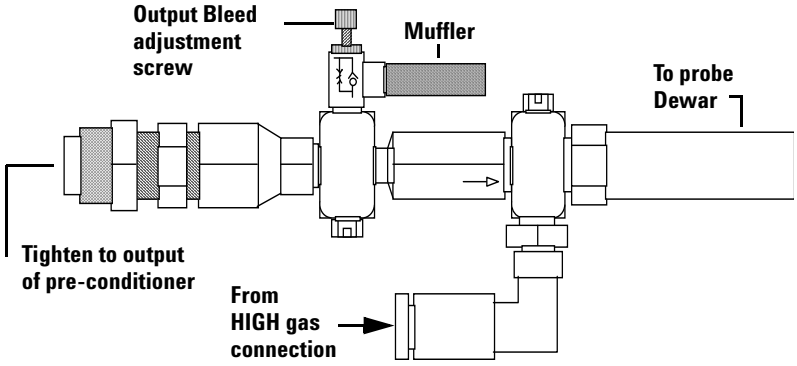


Figure 8 Pre-conditioner output assembly and connections

Optional wall mounting (01-919021-00)

Use the following procedure for wall mounting of the pneumatics router.

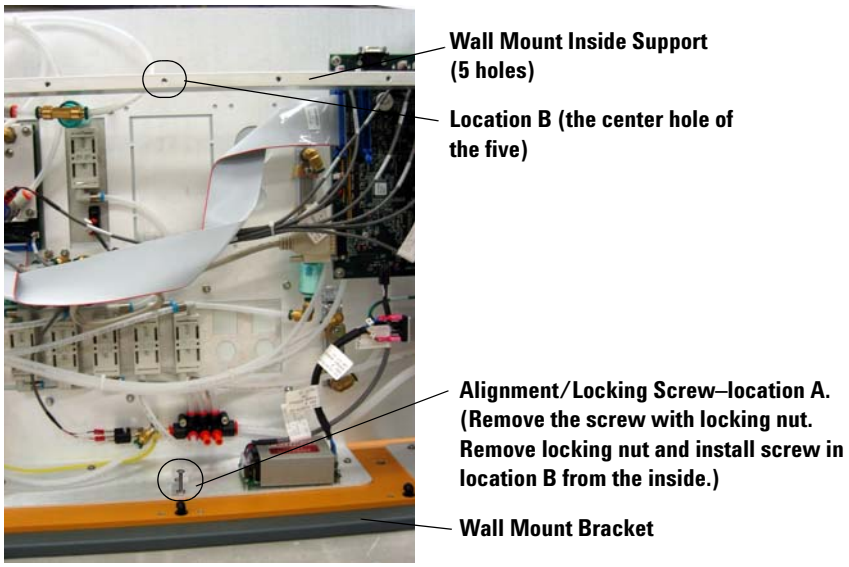


Figure 9 Pneumatics router, back-cover off

WARNING **Back injury hazard. Use two people to lift the Pneumatics Router. The unit weighs over 34.6 kg (77 pounds).**

1 Remove the covers.

2 Relocate the alignment/locking screw, refer to Figure 9 on page 21, as follows:

   a Remove the alignment/locking screw from location A.

   b Partially install the alignment/locking screw in location B from the inside. Do not screw in so that it extends beyond the support outside surface.

3 Lay the Router on its back.

4 Remove the four screws that attach the bottom plate, see Figure 10A, and remove the bottom plate, see Figure 10B. Save the screws.

   The bottom plate becomes the wall mounting bracket and has pre-drilled holes for 16-inch center wall construction.

5 Fasten the mounting plate to the wall framing (the router weighs 77 pounds).

6 Return the Router to the upright position.

7 Reinstall the back cover.

8 Install the mounting strip on the cover with the original four base plate screws, knife edge out and facing down.

   The mounting strip knife edge fits in the recessed slot in the base plate.

9 With two people, lift unit up and place in the mounting plate slot. Slide unit right in the slot until it is against the guide pin in the slot, see Figure 10C.

10 Screw the lock screw into the mounting plate to lock the router in place, see Figure 11 on page 23.

(A) Bottom plate and mounting strip

(B) Removal of the wall mounting strip

(C) Mounting plate guide pin

Figure 10 Bottom plate

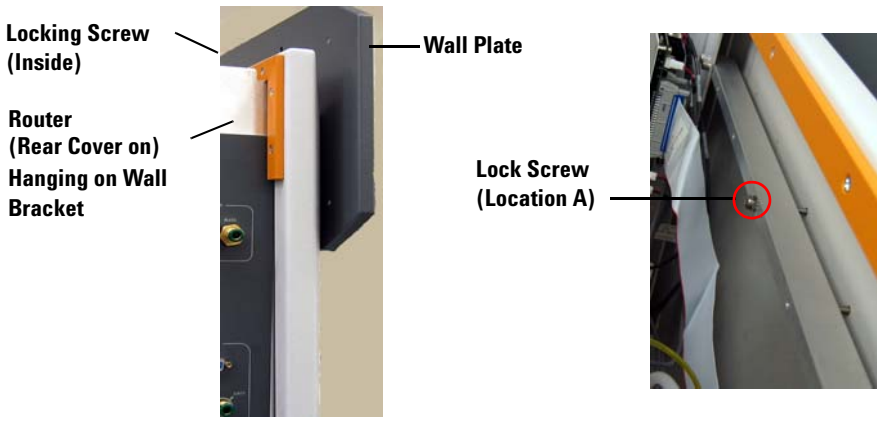


Figure 11 Router fastened to mounting bracket

Settings and Adjustments

Setting pressures and flow rates

Turn the pneumatics router on.

The pneumatics router functions and recommended settings are lised in Table 1 and the full panel with router cover removed is shown in Figure 12 on page 25. Pneumatics supply gas minimum and maximum pressures are:

- Main Input Port – Minimum 80 psi, maximum 100 psi
- Anti-vibration Port– Minimum (refer to anti-vibration leg manual - typically 60 to 80 psi), maximum 100 psi.

Table 1 Pneumatics Functions and Settings

Control / Display	Description	Recommended Setting
PURGE	Regulator and manual flow adjustments for shim coils, probe body, and upper barrel (solids upper stack) purge or cooling gas. Purge gas removes heat from the shim coils, probe body, and solids upper stack.	40 psi liquids 60 psi solids
	Probe flow rate	Refer to probe manual,
	Upper barrel flow rate	typically 6 to 10 LPM
TEMPERATURE	Temperature control regulator with SETUP/RUN switch, computer controlled temperature gas flow valve and sensor.	5 psi below PRE-REG pressure (70 psi)
LIQUIDS	Display gas flow on the meter and LEDs.	
ANTI-VIBRATION SYSTEM	Independent regulators for supplying gas to the anti vibration legs.	Refer to anti vibration leg installation manual
SHIM PURGE	Shim coil purge gas flow meter with manual flow adjustment.	4 to 6 LPM
PRE-REG	Pre temperature control gas regulator for added temperature gas stability.	5 psi below input pressure, minimum of 75 psi
UPPER BARREL	Upper barrel regulator to regulate the rotation, bearing, and eject functions.	As required to eject the sample
ACC	Separate Accessory regulator.	Refer to the accessory manual

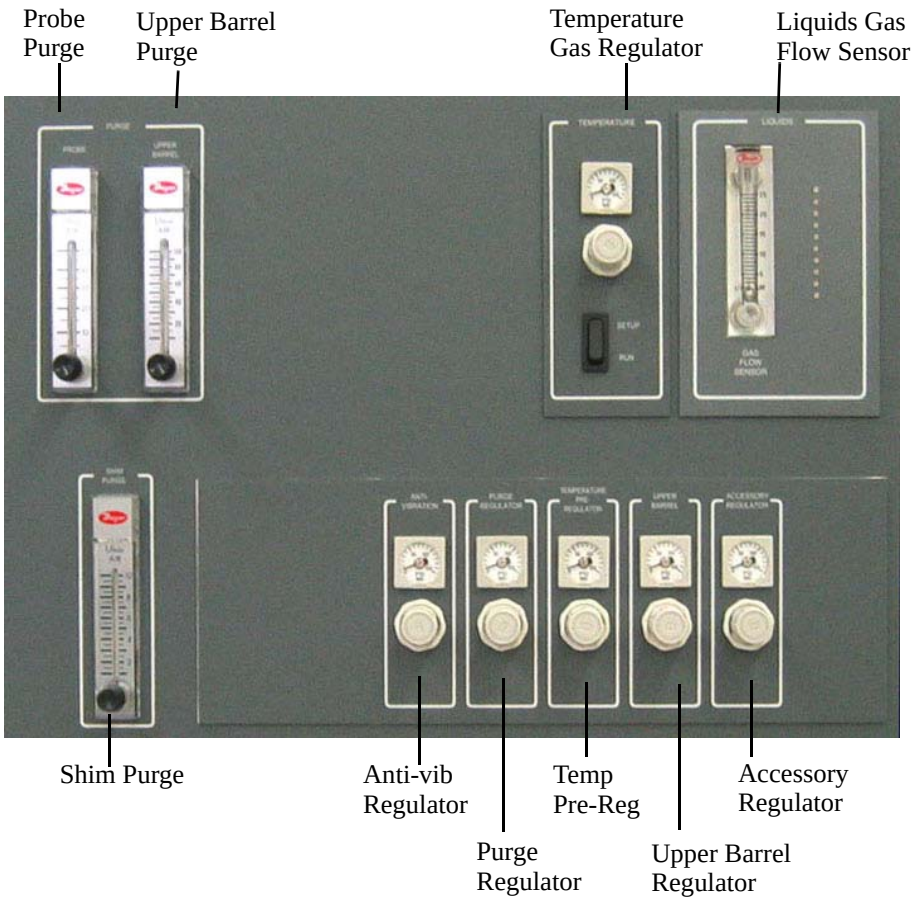


Figure 12 All pneumatics router adjustments

Setting the VT flow meter threshold

In VnmrJ:

- Select the **Start** tab.
- Select **Spin/Temp Parameter** page.
- Enter a value between 7 and 10 in the field next to **VT air flow:**

The VT flow meter threshold default value is 775 and does not need to be changed.

The indicators have four states:

- Off – Current flow rate
- Green – Safe flow rate
- Orange – Unsafe flow rate

- Red — Fault - flow is at unsafe level

Safe VT gas flow is indicated when the ball is between the orange indicators.

Each sensor of 10 sensors along the flow meter represents a power of 2. The top indicator represents 2^0, the bottom indicator represents 2^9, and when all the indicators are lit it represents a decimal value of 1023.

The VT flow meter threshold is set by the parameter `vtairlimits` (refer to the *VnmrJ Command and Parameter Reference* manual for details and syntax). The example in Figure 13 shows the LED display with `vtairlimits` set to 927 (or as a binary array with the top at the left, bottom to the right, of 1110000011, 1= orange, 0 = any other color and off).

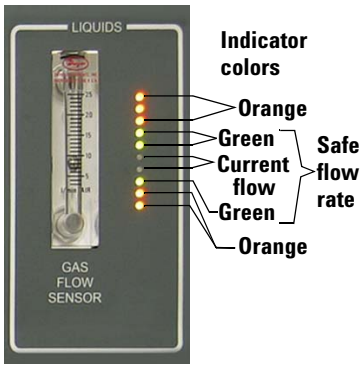


Figure 13 Gas flow sensor and LED display

Adjusting the bleed gas

This procedure establishes the proper gas flow to the preconditioning unit when the system is regulating the sample at temperatures above the temperature set in the parameter **`vtc`**. The main variable temperature gas is flowing out of the HIGH port of the Pneumatics Router through the one-way valve to the probe Dewar or solids stack. Some gas is bled off by the bleed regulator inside the Pneumatics Router, (see Figure 14 on page 27), and supplied to the pre-conditioner unit (FTS) to keep the pre-conditioner regulated even when not in use. The gas flow exits the pre-conditioner unit through a flow control valve and muffler.

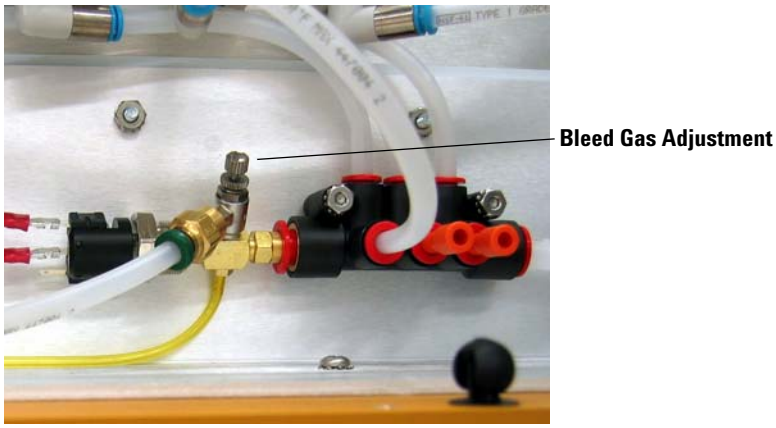


Figure 14 Bleed gas adjustment (inside pneumatics router)

1. Close the bleed gas regulator inside the Pneumatics Router, see Figure 14.
2. Open the bleed gas regulator inside the Pneumatics Router cabinet ¾ to 1 full turn from fully closed.

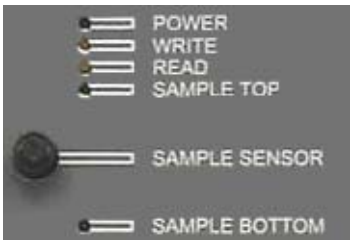
   This should cause a small amount of VT gas to flow in the bleed gas line (the gas hissing should be just audible).
3. Set the VTC parameter to 25 and the temperature parameter to 26.

   The main VT gas flow will go directly to the probe and a small amount of bleed gas is routed to the pre-conditioner unit (FTS) input.
4. Close the valve located on the output of the pre-conditioner unit, see Figure 8 on page 21.
5. Open the valve located on the output of the pre-conditioner unit until no further increase in the sound of the bleed gas as it exits the muffler is heard.

   Do not open the output bleed valve of the pre-conditioner too far. During normal low temperature operation, the VT gas will flow out of the bleed muffler and not into the probe see Figure 8 on page 21.
6. Check that the bleed gas has enough flow to allow the pre-conditioner to regulate.

   Adjust the bleed gas regulator inside the Pneumatics Router and the output bleed adjustment screw as necessary to allow the pre-conditioner to regulate.

Adjusting the sample sensor



1. Insert a sample in the magnet.
2. Turn the **SAMPLE SENSOR** knob until the green LED next to **SAMPLE BOTTOM** lights.
3. Eject the sample (do not remove the sample from the upper barrel) and verify that the green LED next to **SAMPLE BOTTOM** is off.

   If the LED remains lit, adjust the **SAMPLE SENSOR** knob until the LED goes out, repeat step 1 through step 3.
4. Verify that the yellow LED next to **SAMPLE PRESENT** on top of the upper barrel is illuminated when the green LED next to **SAMPLE BOTTOM** is lit.

Troubleshooting

Table 2 Pneumatics Router Troubleshooting Guide

Problem	Cause	Solution
Sample will not eject	Not enough eject air	Adjust the upper barrel regulator while trying to eject the sample.
Sample will not insert	Too much bearing gas, liqbear parameter set incorrectly	Create and set `liqbear`, value also stored in probe file, if the probe file already exists, update the probe file. See the `liqbear` entry in the *VnmrJ Command and Parameter Reference*
Sample will not spin	Not enough bearing gas, liqbear parameter set incorrectly.	Create and set liqbear, value also stored in probe file, if probe file already existed, do an update probe file. See the `liqbear` entry in the *VnmrJ Command and Parameter Reference*
Sample does not stop spinning	Too much bearing gas, liqbear parameter set incorrectly	Create and set `liqbear`, value also stored in probe file, if probe file already exists, do an update probe file. See the `liqbear` entry in the *VnmrJ Command and Parameter Reference*
Sample present light does not turn on when sample is present	Sample Sensor adjustment on the side of the Pneumatics Router.	Refer to "Adjusting the sample sensor" on page 28.
Sample present light does not turn off when sample is not present	Sample Sensor adjustment on the side of the Pneumatics Router.	Refer to "Adjusting the sample sensor" on page 28.
Cannot run a VT experiment, Red Led always on the VT controller.	Pneumatics Fault line has tripped.	Reset the VT controller by pressing the **Reset VT** software button in VnmrJ. Reset the Pneumatics Router by pressing the **Reset Pneumatics** software button in VnmrJ. Check that the Pneumatics Router is powered on. Verify that the cable (or in solids, jumper plug), is connected to upper barrel.
Cannot find the "Reset Pneumatics" button in VnmrJ software panel	Using non-standard or custom software panels	Enter **`sethw('pneufault','clear')`** on the command line.
`go` or `ga` gives error message Pneumatics pressure fault (< 20 psi)	Input air pressure is too low.	Increase the gas pressure at the wall supply.
	Mis-adjusted Purge regulator	Adjust the PURGE regulator on the front of the Pneumatics Router to greater than 30 psi.

Table 2 Pneumatics Router Troubleshooting Guide (continued)

Problem	Cause	Solution
	Software and Pneumatics Router out of sync	Click the **Reset Pneumatics** button in the Temp page -OR- enter `sethw('pneufault','clear')` on the command line
`go` or `ga` gives error message Pneumatics pressure fault (< 20 psi)	one or more internal DC voltages are out of spec.	Power cycle Pneumatics Router, check that the Green **POWER** Led is lit otherwise, Call service
`go` or `ga` gives error message*: VT airflow threshold exceeded*	VT flow meter has latched a flow error.	Insure that gas flow is within green band on flow meter, press the **Reset Pneumatics** software button in the **Temp** panel.
`go` or `ga` gives error message: *Narrow bore stack fault*	Nothing connected to liquids Upper barrel or solids stack,	Make sure that the 15 Pin D-sub cable is connected between the Pneumatics Router and the liquids upper barrel or if used, the Narrow bore upper stack.
	Wide bore solids shorting plug missing.	When doing wide bore solids experiments, make sure shorting plug in connected to the upper barrel STATUS socket of the Pneumatics Router.
	Narrow bore solids stack either too hot or too cold.	Determine reason and correct before continuing.
Cannot set VT air flow	Using non-standard or custom panels	see vtairflow command in the command and parameter reference manual
Want different flow alarm areas	Experimental	see vtairlimits command in the command and parameter reference manual.
LED's do not light on liquids flow meter	System in Solids mode	Set `spintype='liquids'`, see `spintype` in the command and parameter reference manual.
VT controller does not shut down even with no VT gas flow.	VT flow meter in setup mode	Move the Temperature switch to the RUN position on the front of the Pneumatics Router.
VT flow meter LED's flashing	Indicates that a VT gas flow error has occurred and has not been reset.	Insure that gas flow is within green band on flow meter, press the **Reset Pneumatics** software button in the **Temp** panel.
Hissing sound from inside Pneumatics Router when trying to eject sample	Normal operation of the Eject Booster valve.	Normal operation.
Constant hissing sound from inside Pneumatics Router.	Leaking connection inside Pneumatics Router	Remove the power cord and look for leak.
VT gas exiting from one way valve inside Pneumatics Router.	high and low temp gas lines tied together without a second one way valve.	Insure that the one way valve is installed on the input to the pre-conditioner unit, or fitted to the VT bucket, refer to “Installation” section of this manual.

Table 2 Pneumatics Router Troubleshooting Guide (continued)

Problem	Cause	Solution
Eject switch on top of upper barrel is in eject position, but sample not ejecting (or vise-versa)	Possible that Pneumatics Router and console software are out of sync.	Move the eject switch to other position to synchronize the software.

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