Mensor Model 9415 Multi-Channel Pressure Test System
0017711009F Nov 29, 2023
Mensor LP, 201 Barnes Drive, San Marcos, TX, USA

Contents

1 General Information

1.1 Warranty

All products manufactured by Mensor are warranted to be free of defects in workmanship and materials for a period of two years from the date of shipment. No other express warranty is given, and no affirmation of Seller, by words or actions, shall constitute a warranty. SELLER DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSES WHATSOEVER. If any defect in workmanship or material should develop under conditions of normal use and service within the warranty period, repairs will be made at no charge to the original purchaser, upon delivery of the product(s) to the factory, shipping charges prepaid. If inspection by Mensor or its authorized representative reveals that the product was damaged by accident, alteration, misuse, abuse, faulty installation or other causes beyond the control of Mensor, this warranty does not apply. The judgment of Mensor will be final as to all matters concerning the condition of the product, the cause and nature of a defect, and the necessity or manner of repair. Service, repairs or disassembly of the product in any manner, performed without specific factory permission, voids this warranty.

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1.2 Important Notice

The product specifications and other information contained in this manual are subject to change without notice.
Mensor has made a concerted effort to provide complete and current information for the proper use of the equipment. If there are questions regarding this manual or the proper use of the equipment, contact.
Mensor at:

Mensor	WIKA Alexander Wiegand SE & Co. KG
201 Barnes Drive	Alexander-Wiegand-Straße 30
San Marcos, TX 78666	D-63911 Klingenberg / Germany
tel: 1-512-396-4200	tel: (+49) 93 72/132-5015
1-800-984-4200 (USA only)	website: www.wika.de

1.3 Radio Frequency Emission Notices

WARNING: USE SHIELDED CABLES TO CONNECT EXTERNAL DEVICES TO THIS INSTRUMENT TO MINIMIZE RF RADIATION.

1.3.1 FCC Emission Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

1.3.2 CE Emission Notice

This equipment is of the emission class A, intended for operation in industrials environments. It can cause interference under certain circumstances if operated in other environments, i.e. residential or commercial areas. In this case, the user may be asked to take appropriate measures to correct it.

1.4 Trademarks and Copyrights

Mensor is a registered trademark of Mensor, LP. All other brand and product names are trademarks or registered trademarks of their respective companies. ©2015, Mensor, LP. All rights reserved.

1.5 Software License Agreement

This product contains intellectual property, i.e., software programs, that are licensed for use by the end user/customer (hereinafter "end user").

This is not a sale of such intellectual property.

The end user shall not copy, disassemble or reverse compile the software program.

The software programs are provided to the end user "as is" without warranty of any kind, either express or implied, including, but not limited to, warranties of merchantability and fitness for a particular purpose. The entire risk of the quality and performance of the software program is with the end user.

Mensor and its suppliers shall not be held to any liability for any damages suffered or incurred by the end user (including, but not limited to, general, special, consequential or incidental damages including damages for loss of business profits, business interruption, loss of business information and the like), arising from or in connection with the delivery, use or performance of the software program.

1.6 Mensor Service Plus

If you have problems and you don't find the answer in this manual, contact Mensor at 1-800-984-4200 (USA only) or 1-512-396-4200 for personal assistance, or at any of the contact addresses listed on the rear cover of this manual. We are ready to help.

1.6.1 After the Warranty

Mensor's concern with the performance of this instrument is not limited to the warranty period. We provide complete repair, calibration and certification services after the warranty for a nominal fee.

1.6.2 Calibration Services

In addition to servicing our own products Mensor can perform a complete pressure calibration service, up to 30,000 psi, for all of your pressure instruments. This service includes an accredited calibration.

1.6.3 Certifications and Accreditations

Mensor is registered to ISO 9001:2008. The calibration program at Mensor is accredited by A2LA, as complying with both the ISO/IEC 17025:2005 and the ANSI/NCSL Z540-1-1994 standards.

1.7 Packaging for Shipment

If the product must be shipped to a different location or returned to Mensor for any reason through a common carrier it must be packaged properly to minimize the risk of damage. The recommended method of packing is to place the instrument in a container, surrounded on all sides with at least four inches of shock attenuation material such as styrofoam peanuts.

2 Safety Notices

2.1 User Responsibilities

To ensure safety, the user must make sure that:

• The system is used properly, no dangerous media are used and that all technical specifications are observed.

• The system is operated in perfect operating condition.

• This operation manual is legible and accessible to the user at the system's location.

• The system is operated, serviced and repaired only by authorized and qualified personnel.

• The operator receives instruction on industrial safety and environmental protection, and is knowledgeable of the operating instructions and the safety notices contained therein.

2.2 General Safety Notices

This Warning symbol indicates that danger of injury for persons and the environment and/or considerable damage (mortal danger, danger of

injury) will occur if the respective safety precautions are not taken.

 This Caution symbol indicates danger for the system and material if the respective safety precautions are not taken.
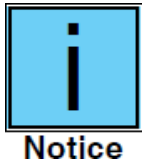
 This Notice symbol does not indicate safety notices but information for a better understanding of the facts.

2.3 Warnings and Caution Notices

 WARNING: HIGH PRESSURE! High pressure gases are potentially hazardous. Energy stored in these gases and liquids can be released suddenly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been trained in proper safety practices.

 WARNING: NOT EXPLOSION PROOF! Installation of this instrument in an area requiring devices rated as intrinsically safe is not recommended.

 WARNING: POSSIBLE INJURY! The tubing, valves, and other apparatus attached to the gauge must be adequate for the maximum pressure which will be applied, otherwise physical injury to the operator or bystanders is possible.

CAUTION: USE THE PROPER PRESSURE MEDIUM! Use only clean, dry, non-corrosive gases unless otherwise specified by Mensor. This instrument is not designed for oxygen use.

CAUTION: As with most sensitive electronic equipment, switch the power switch off before connecting or disconnecting to a power source to prevent data loss. Do not position the equipment so that it is difficult to disconnect the power jack.

WARNING: Detachable main power supply cord with inadequate ratings should not be used. See Section 4.0 - Specifications for power ratings.

WARNING: WARNING: No lines except AC mains shall be connected to the equipment exceeding a length of 30 meters or leaving the building.

CAUTION: ESD PROTECTION REQUIRED. The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge to sensitive electronic components.

Additional Warning and Caution notices are found throughout this manual.

Mensor Model 9415
Multi-Channel Pressure Test System

3 General Description

The Mensor Model 9415 Multi-Channel Pressure Test System is a mobile rack configured with either one four channel Model 9414 Quad Pressure Controller with four Mensor 6100 transducers, and two 9412 dual tank modules or one two channel Model 9414 Dual Pressure Controller with two Mensor 6100 transducers and one 9412 dual tank module. Both systems include a vacuum pump and related automated electrical and pneumatic switching devices. The 9412 tank modules contain either two or four ASME code pressure tanks rated for 300 psi working pressure. The full scale range on each control channel in the Model 9414 controller varies based upon the configuration selected. Refer to Series 6100 User's Manual and the Series 6180 User's Manual. A copy of the manuals can be found in the appendix of this document.

There are many different rack sizes to choose from. Depending on the system requirements two racks may be linked together. This is referred to as a "Double Bay" rack. These linked together rack do not need to be of the same size. Unless stated otherwise all racks come with caster wheels and have a black textured finish. Refer to the "General Specifications and Ratings:" section for more information on rack sizes. The weight of each system will vary based on the units that comprises it and the size of the rack itself however approximate estimates are provided under the "General Specifications and Ratings:"

There are three pressure configurations for a Model 9415 Multi-Channel Pressure Test System. These is the standard range (0 to 300 psi absolute), low pressure(0 to 160 psi absolute) and very low pressure (0 to 15 psi gauge). Refer to the "General Specifications and Ratings:" section for more information on the different pressure configurations. **Do not exceed the maximum working pressure of the system. The pressure range of the system can be identified by examining the 9414 unit(s) in the system and observing the max pressure labeling on the front.** The unit will be labeled "Model 9414", followed by "Quad

Controller" or "Dual Controller" depending on its internal configuration. This is then followed by the max operating psi rating, and this is then ended by the SCN number.

External pressure porting and electrical signal connections are provided on the left side of the rack (when viewed from the front). Pressure ports include an input for shop air and either two or four output pressure connections to connect to the Model 9418 Remote Transducer Module or directly to the device handler (DUT).   A cable access port provides entry to the rack for controlling and reading the remote transducers in the Model 9418 Remote Transducer Module (25 pin D-sub connector) and a 9 pin D-Sub connector for serial communications between the rack and a host computer. Sufficient space is allowed for other users cabling.

The rack will accept AC power (100 to 240 VAC, 47 to 63 Hz.) Power is brought into the rack to a junction box at the bottom of the rack. The power cord plug on the input to the rack can be replaced to accept other plugs or tied directly into a main feed. The power cable used is rated for 15amp service. One duplex outlet provides power to the Model 9414 Quad Pressure Controller through a fused input module and an emergency shutoff button. The switched power is then utilized internally to generate +5 volt DC and +12 volt DC to control the solenoid valves, electronics, and remote transducers. The Model 9414 utilizes universal power supplies and is fused on both the hot and neutral AC lines entering the unit.

The Mensor 6180 transducer(s) in the remote transducer module utilizes RS-485 for communications with the 9414. Control of the isolation solenoids is done internally in the 9414 controller and provided to the remote transducer module through the same 25 pin D-sub connector as the RS-485 communications. The RS-485 port communicates with the remote transducers at 19200 Baud with 8 data bits, 1 stop bit, and no parity. Communications between the Model 9414 Quad Pressure Controller and the user's computer are on a 9 pin D-Sub connector at 57,600 Baud, 8 data bits, 1 stop bit, and no parity. The command set is provided in this manual.

3.1 General Specifications and Ratings

Mechanical:	Tall Rack	Mid Sized Rack	Short Single Rack	Short Double Bay Rack
Size (Height)	~ 72" with casters	~ 52" with casters	~ 32" with casters	~ 32" with casters
Size (Width)	~ 23"	~ 23"	~ 23"	~ 46"
Size (Depth)	~ 31.5"	~ 31.5"	~ 24.5"	~ 24.5"
Weight (fully populated)	~ 550 lbs.	~ 400	~ 250 lbs.	~ 500 lbs.

Note: Additional rack sizes are available.

Pneumatic	Standard Range	Low Pressure (LP)	Very Low Pressure (VLP)

Pressure Range (9414)	0 to 300 psi Absolute	0 to 60 psi Absolute	0 to 15 psi Gauge
Control Channels	2 or 4 per 9414	2 or 4 per 9414	2 or 4 per 9414
Measurement Accuracy (9414)	0.01% of full scale	0.01% of full scale	0.01% of full scale
Standard Control Stability (9414)	0.01% of range	0.01% of range	0.01% of range
System Total Volume (per 9414 channel)	Approximately 11.8 liter using 11 liter storage tank.	Approximately 11.8 liter using 11 liter storage tank.	Approximately 11.8 liter using 11 liter storage tank.
Remote Transducer Ranges	Any range below 300 psi A.	Any range below 60 psi A.	Any range between 0 to 0.33 psi and 0 to 15 psi gauge
Remote Accuracy	0.01% IS-50	0.01% IS-50	0.03 % of FS to 0.01% of FS depending on range
Max. Number of Remote Transducer	5	5	5
General			

Instrument Versions	Tall Rack, Mid-Sized Rack, Short Single Rack, Short Double Bay Rack
Pressure Connections	Configuration Dependent
Filter Elements	The controller has 40-micron filters on all pressure ports
Wetted Parts	Aluminum: 6061-T6 / 2024-T4, Stainless Steel: 303 / 304 / 316 / 316L / 13-8 PH, Brass, Nickel,Buna-N, FKM/FPM, Tungsten carbide, Cerazur ceramic, PTFE, PEEK. Glass-filled epoxy, RTV, ceramic, silicone, silicone grease, urethane, 430FR, 300 series CRES.

Overpressure Protection	Safety relief valves are present on the controller; Relief pressure is dependent on range
Operating Temperature	15 to 40 C
Humidity	10 to 85 % RH (non-condensing)
Communications	RS-232, 57600 Baud, 8, 1, N
Warm-up Time	15 Minutes or less
Pressure Media	Clean dry non-corrosive, non-combustible, non-oxidizing gases. Not suitable for Oxygen use.
Pneumatic interface	¼" tube fittings, 7/16-20 Female SAE, 6mm Tube, or 6mm Push-To-Connect Tube Fittings
Power	100 to 240 VAC, 47 to 63 Hz, 1500 VA max, 750 VA typical
Pollution degree	Degree 2
Permissible Supply Port Pressure	110-120% FS or 10 psi (0.69 bar), whichever is greater
Permissible Measure/Control Port Pressure	105% FS transducer range

Approvals and Certificates		
Logo	Description	Country
CE	**EU Declaration of Conformity** EU Importer: WIKA, 63911 Klingenberg, Germany	European Union

Before mounting and commissioning the instrument, ensure you read the operating instructions!

CE, Communauté Européenne

Instruments bearing this mark comply with the relevant European directives.

This marking on the instruments indicates that they must not be disposed of in domestic waste. The disposal is carried out by return to the manufacturer or by the corresponding municipal authorities (see EU directive 2012/19/EU).

3.2 Precautions

Warning

Do not exceed the maximum working pressure of the system.

Warning

The system contains large pressure storage tanks that can hold large amounts of kinetic energy. User should bleed all pressure stored in the tanks before servicing, removing pressure hoses, or removing instruments. Normal shutdown and emergency shutdown should start the process, but due to the size of the tanks and the desire to maintain a safe discharge rate, this operation may take an extended period of time to achieve. Utilize the pressure gauges on the front of the 9412 Module to ensure pressure has been released from each tank.

Warning

The system uses normal power line AC voltages. User should remove the AC power cord from mains when servicing inside enclosures.

Warning

Due to the internal pressures and voltages used within the 9415 system, only qualified and properly trained personnel should service this system.

Notice

The emergency shutdown electrical system is limited in capacity to approximately 6 amps of power. It is intended to shut down the pressure portion of the system (Model 9414) and slowly release pressure from the pressure tanks in the Model 9412(s).

⚠️ **Warning**

User should orient the system in a way that the Emergency Shutoff Button, the power cord connection, and the pressure valves on the side of the rack if so, equipped should also be accessible to the operator for rapid shutdown.

⚠️ **Warning**

Special handling and carrying technics are required as some individual components in the system exceed 18 kg. A "TWO MAN LIFT" should be employed.

⚠️ **Warning**

WARNING: READ THESE INSTRUCTIONS BEFORE INSTALLATION!

4 Installation

The initial installation should include removing any packing material used in shipment and inspecting that fittings and screws are snug, and that hoses and electrical cords are not chaffed or cut. The rack system is mounted on casters and should be installed on a level surface with adequate airflow to keep the system within its 15 to 40 °C optimum operating temperature range. The emergency shutoff button on the 9414 controller, the rack power connection, and the safety valves on the side of the rack if so equipped should be accessible to the operator. Wheel chucks or threaded feet/supports should be used where appropriate to keep the unit in place. The system operates on line voltages between 100 to 240 VAC, 47 to 63 Hz. A dry, clean compressed air or nitrogen supply is required for operation. This supply should be approximately 110 % of the maximum remote transducer range, but not exceed the max operating pressure of the system. Refer to the "General Specifications and Ratings:" section for more information on the different pressure configurations.

The quad pressure output ports are located on the side of the rack and are labeled P1, P2, P3, and P4 Outputs. If a dual channel system is ordered, only P1 and P2 will be available. The fittings on the side panel are ¼" tube fittings. ¼" flexible tubing can be purchased to allow four 6 to 10 foot (~2 meter) pressure hoses to connect between the rack and pressure selection valves in either the Model 9418 Remote Transducer Module or the handler.
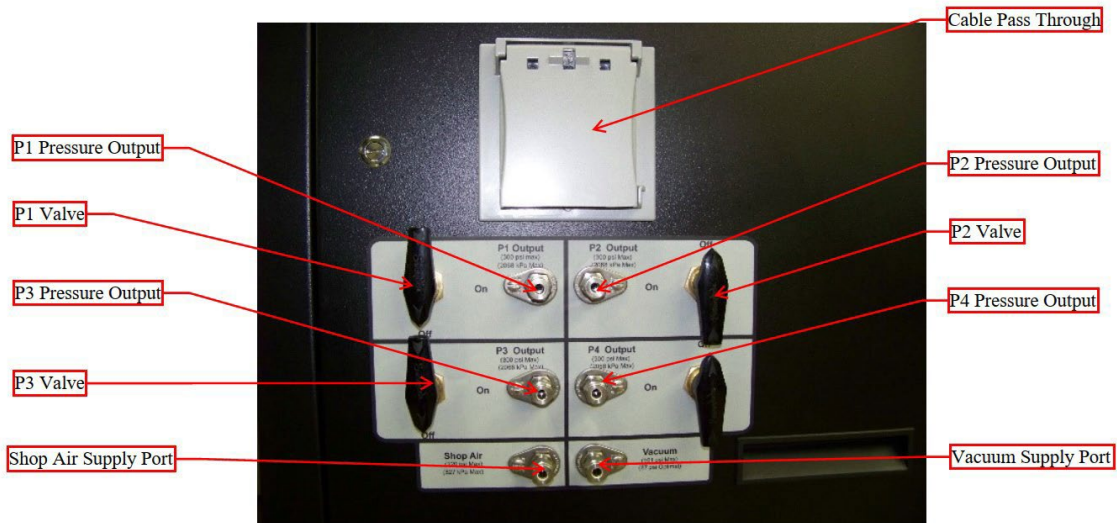
The remote transducer module Model 9418 should be mounted close to the test devices to minimize the pressure exchanges and maximize the operational speed of the system. The 9418 is electrically connected to the rack using the 25 pin d-sub cable provided. Pneumatic connections between the 9418 and the device under test should be short and with minimal volume. Alternately, the transducers and P1/P2/P3/P4 selection valves may be removed from the enclosure and mounted within the chip handler. The actual mounting location is left to the user's discretion. Optimal results will be achieved when the conditions stated above are utilized.

5 Operation

Pneumatic Schematic Example (Single Quad 9414)

Solenoids = S4 – Vacuum Control; Transducers = XDCR1; Pressure Vessels = Tank 1 to Tank 4 NO indicates a normally open valve that closes when energized or vents out the center leg.

Optional 3rd and 4th Pressure Outputs
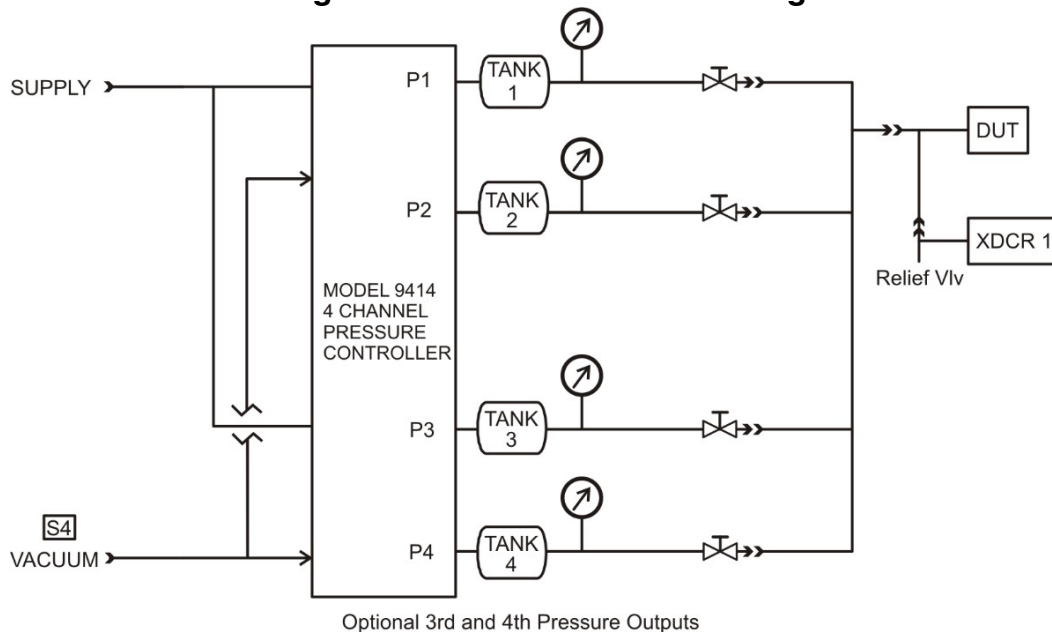
Generally, the system once configured requires power, clean dry shop air or nitrogen, and a vacuum source. Start up operation commences when power is applied. The normally open vent valves should be energized to close and supply

pressure and vacuum (if needed) should be enabled to charge the storage tanks in preparation for operation.

5.1 Operation of Model 9414

The 9414 was designed for predominately remote operation but can be operated in most instances from the front panel through the LCD touchscreen interface. On power up, the unit will initialize with all channels in the measure mode. All solenoid valves will be in their de-energized state.

The front panel display is divided into four main areas. Across the top of the LCD, the model number and instrument description are displayed. On the left side of the display below the model number is the main controller area. Space is provided in this area to display the channel set point, the actual pressure reading, and the mode of operation for each of the four
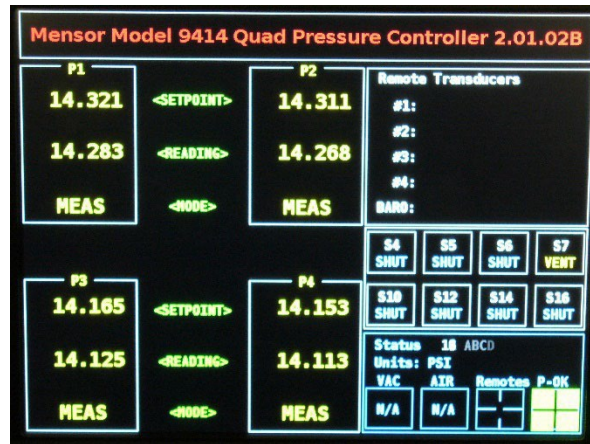
channels. If the 9414 is populated with only two channels, the bottom two areas will be blank. In the lower right corner is a status window. This window displays the units of measure, a window to display the number of remote transducers found by querying the remote transducer module, a window to optional solenoid control (S4 is Vacuum ON/OFF), and a window indicating the control status of P1, P2, P3, and P4. A P-OK status of green indicates the controller is within the allowed tolerance window of the control set point. A red square indicates that the controller is out of the tolerance window. The fourth window is dynamic, and changes based on the process state. Typically, it displays the reading of any remote transducers found during the initial power up. If one of the four setpoints is being edited, the remote transducer window will become a keypad for entering new values or control points into the selected channel. Once the setpoint is entered (by pressing the '=' button) the window will revert to displaying the remote transducer readings. If the mode of operation is being edited, this window will allow the mode selection of measure,

control, vent, or standby. Once the mode has been selected, the window will revert to displaying the remote transducer readings.

To change a setpoint, touch over the current setpoint value for the desired channel (P1, P2, P3, or P4) and the keypad menu will appear on the right. Press the keys for the new value and then end by pressing the equal key ('=') to enter the value. The new value should appear in the setpoint window. Values that are outside of the control range will not be accepted and the user must again touch over the current setpoint value and re-enter a valid pressure. **Note: it is possible to enter a value up to a maximum of 300 psi (2088 kPa). It is the user's responsibility to ensure that the attached devices can handle the full pressure.**

To change the mode of operation for a channel, touch the currently displayed mode for the particular channel (P1, P2, P3, or P4). Four buttons will be displayed to the right allowing the modes of measure (MEAS), control (CTRL), vent (VENT), or standby (STBY) to be selected. Once the mode has been pressed, the mode will be changed on the control screen and the remote transducer readings will be re-displayed.

A typical start process should include the following steps:

1. Turn Power ON – with the Main disconnect switch on the panel above Model 9414 (disregard if the system does not include a Main disconnect power switch) and with the rear panel power switch. If the EMERGENCY SHUTOFF button has been pressed, this should be rotated clockwise to disengage. The normally open vent valves will automatically close. The system will interrogate the 9414 for installed control channels. This will typically be either two or four. The system will then check for remote transducers. The system can have one to four attached transducers. Internal transducers will be displayed on the main control screen with their setpoint, reading and mode. If no internal transducer is found for a particular channel, the setpoint, reading and mode will be blank. Remote transducers will be displayed in the lower right status window under REMOTE as 1, 2, 3, 4, and B. The reading will also be displayed in the remote transducer reading window on the

right side of the screen. Remote transducers are addressed as 1, 2, 3, and 4. If a barometric transducer is included in the system, this will be addressed as 5 but will be displayed on the status window as 'B' for barometer.

2. Turn the vacuum source ON (if one is present)

3. Turn the supply pressure ON

4. The channels that are going to be used in the control mode should have their setpoints entered.

5. The manual output valves on the side of the rack should be opened once connections have been made to the device under test and the remote transducer module.

6. Once the setpoints are entered, the channel mode should be set to control. The channel will drive to the setpoint. Once within the setpoint window, the P-OK status window will change from red to green. The orientation of the four status squares matches the main window. P1 is in the upper left, P2 is in the upper right, P3 is in the lower left, and P4 is in the lower right. Failure to achieve a green status can be caused by a pressure leak, or because of insufficient pressure. The time it takes to reach an initial setpoint is mainly determined by the size of the internal storage tanks, but can also be dependent on the load and the delta pressure change.

6 Communication Protocol

Communications between the user's external computer and the 9414 System Control Module is standard RS-232 serial communications with a protocol of 57600 baud, 8 data bits, 1 stop bit, and no parity. The 9414 will accept both upper and lower case ASCII commands. A complete command set can be found below.

Communications between the 9414 System Control Module and the Remote Transducer Module is full duplex RS-485 serial communications with a protocol of 19200 baud, 8 data bits, 1 stop bit, and no parity. The 9414 handles all communication with the transducer(s) inside the module as well as providing the 12 volt DC power to the transducer(s) and controls isolation solenoid valves when multiple transducers are present. To calibrate the Mensor 6100/6180 transducer(s) inside the Remote Transducer Module use the command set described in the Series 6100 User's Manual and the Series 6180 User's Manual. A copy of the manuals can be found in the appendix of this document.

6.1 Command Set

All commands should terminate with a linefeed. Carriage Returns are ignored on incoming commands and should be avoided to reduce communication traffic. Responses are terminated with a carriage return followed by a linefeed. Commands are accepted in either uppercase or lowercase characters. Protocol is set at 57,600 baud, 8 data bits, 1 stop bit, no parity. Communication is RS-232 on a 9 pin D-sub.

The Model 9414 Quad Controller has a color LCD touchscreen display that allows the setting of control pressures, monitoring of controller readings, and remote transducer readings. Front panel touchscreen operation can be locked out using commands over the communications port. (See PanelLock and PanelUnlock commands below.)

The following command set is an extension of the older Model 9411 System Controller. Where applicable, this command set is maintained in the 9414 System Controller/ Quad Pressure Controller. Model 9411 commands that have limited use in the 9414 based system or have been deprecated in this model are italicized.

Command	Description	Example
Status?	Returns the status of the sixteen solenoid valves drive signals. A '1' indicates enabled, and a '0' indicates disabled. The solenoids are labeled from left to right as S1 to S16. On Model 9414 units only the 8 external solenoid valves are shown. The solenoids are labeled from left to right as S1 to S8.	Returns: 1001000000000000 Indicates that valves one and 4 are energized and all others are de-energized. Returns: 11001010 Indicating valves 1, 2, 5 and 7 are enabled.

x1?	Returns pressure reading from transducer 1, the highest range Mensor 6100 remote transducer.	Returns 8 character value string in the current pressure units
x2?	Returns pressure reading from transducer 2, a higher range Mensor 6100 remote transducer.	Returns 8 character value string in the current pressure units
x3?	Returns pressure reading from transducer 3, a lower range Mensor 6100 remote transducer.	Returns 8 character value string in the current pressure units
x4?	Returns pressure reading from transducer 4, a lower range Mensor 6100 remote transducer.	Returns 8 character value string in the current pressure units
xhi?	Returns pressure reading from both high pressure transducers (x1 and x2)	Returns two sets of 8 character values with 3 fractional digits separated with a comma and space. Reading 1 is first and reading 2 is second.
xlo?	Returns pressure reading from both low pressure transducers (x3 and x4)	Returns two sets of 8 character values with 3 fractional digits separated with a comma and space. Reading 3 is first and reading 4 is second.
Xbaro?	Returns the pressure reading of the barometric reference transducer if installed in system.	
X5?	Returns the pressure reading of the barometric	

	reference transducer if installed in system.	
xall?	Returns pressure reading from all four pressure transducers (1, 2, 3 and 4) and the barometric reference transducer if installed.	Returns 4 sets of 8 character values with 3 fractional digits separated by a comma and space. Reading 1 is first followed by readings 2, 3 and 4 and than the barometric reference if installed.
serialno?	Returns the serial number of the control module	Returns the system control module serial number of 'SN 990194'
s4on	Energizes vacuum pump	
S4off	De-energizes vacuum pump	
s5on	Energizes solenoid 5 (V5)	
s5off	De-energizes solenoid 5	
s6on	Energizes solenoid 6 (V6)	
s6off	De-energizes solenoid 6	
s7on	Energizes solenoid 7 (V7)	
s7off	De-energizes solenoid 7	
s10on	Energizes solenoid 10	
s10off	De-energizes solenoid 10	
s12on	Energizes solenoid 12	
s12off	De-energizes solenoid 12	
s14on	Energizes solenoid 14	
s14off	De-energizes solenoid 14	
s16on	Energizes solenoid 16	
s16off	De-energizes solenoid 16	
id?	Returns the system identification string	Returns: 'Mensor System 9415, Unit 9414, SN: 990194'

Commands set of the pressure controller portion of the 9414.

SetP1=	Enters the control pressure setpoint for P1 in the current units of measurement. Must be between the minimum and maximum pressure range of the system. Typically 0 to 300 psia or approximately 0 to 2068 kPa.	Example: SetP1= 450 To set the setpoint to 450 kPa.
SetP2=	Enters the control pressure setpoint for P2 in the current units of measurement. Must be between the minimum and maximum pressure range of the system. Typically 0 to 300 psia or approximately 0 to 2068 kPa.	Example: SetP2= 600 To set the setpoint to 600 kPa.
SetP3=	Enters the control pressure setpoint for P3 in the current units of measurement. Must be between the minimum and maximum pressure range of the system. Typically 0 to 300 psia or approximately 0 to 2068 kPa. Command is ignored if optional P3 channel is not installed.	Example: SetP3= 750 To set the setpoint to 750 kPa.
SetP4=	Enters the control pressure setpoint for P4 in the current units of measurement. Must be between the minimum and maximum pressure range of the system. Typically 0 to 300 psia or	Example: SetP4= 1450 To set the setpoint to 1450 kPa.

	approximately 0 to 2068 kPa. Command is ignored if optional P4 channel is not installed.	
SetP5=	Enters the control pressure setpoint for P5 in the current units of measurement. Command is ignored if optional P5 channel is not installed.	Example: SetP5= 2000 To set the setpoint to 2000 kPa.
SetP6=	Enters the control pressure setpoint for P6 in the current units of measurement. Command is ignored if optional P6 channel is not installed.	Example: SetP6= 2500 To set the setpoint to 2500 kPa.
SetP1?	Returns the pressure setpoint for P1 in the current units of measurement.	Example: SetP1? 450 kPa
SetP2?	Returns the pressure setpoint for P2 in the current units of measurement.	Example: SetP2? 600 kPa
SetP3?	Returns the pressure setpoint for P3 in the current units of measurement.	Example: SetP3? 750 kPa

SetP4?	Returns the pressure setpoint for P4 in the current units of measurement.	Example: SetP4? 1450 kPa
SetP5?	Returns the pressure setpoint for P5 in the current units of measurement.	Example: SetP5? 2000 kPa
SetP6?	Returns the pressure setpoint for P6 in the current units of measurement.	Example: SetP6? 2500 kPa
SetAll?	Returns setpoint pressures for all controller channels, P1	SetAll?

	through P6, comma separated.	450, 600, 750, 1450, 2000,2500 kPa
ReadyP1?	Returns the status of P1 pressure channel. Returns YES if P1 pressure is within pressure window setting or NO if not within window. See SETWINDOW command.	ReadyP1? Yes
ReadyP2?	Returns the status of P2 pressure channel. Returns YES if P2 pressure is within pressure window setting or NO if not within window. See SETWINDOW command.	ReadyP2 Yes
ReadyP3?	Returns the status of P3 pressure channel. Returns YES if P3 pressure is within pressure window setting or NO if not within window. See SETWINDOW command.	ReadyP3? Yes
ReadyP4?	Returns the status of P4 pressure channel. Returns YES if P4 pressure is within pressure window setting or NO if not within window. See SETWINDOW command.	ReadyP4 Yes
ReadyP5?	*Returns the status of P5 pressure channel. Returns YES if P5 pressure is within pressure window setting or NO if not within window. See SETWINDOW command.*	*ReadyP5 Yes*

ReadyP6?	*Returns the status of P6 pressure channel. Returns YES if P6 pressure is within pressure window setting or NO if not within window. See SETWINDOW command.*	*ReadyP6* *Yes*
RdgP1?	Returns reading of P1 Controller transducer in the current units of measurement	349.23 kPa
RdgP2?	Returns reading of P2 Controller transducer in the current units of measurement	450.10 kPa
RdgP3?	Returns reading of P3 Controller transducer in the current units of measurement	751.00 kPa
RdgP4?	Returns reading of P4 Controller transducer in the current units of measurement	1449.99 kPa
RdgP5?	*Returns reading of P5 Controller transducer in the current units of measurement*	*1999.99 kPa*
RdgP6?	*Returns reading of P6 Controller transducer in the current units of measurement*	*2499.99 kPa*
Rdgall?	*Returns reading of P1, P2, P3 P4, P5, P6 pressure controller transducers in the current units of measurement*	*349.23, 450.10, 751.00, 1449.99, 1999.99, 2499.99 kPa*

ModeP1=	Sets P1 channel to Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	ModeP1= Ctrl
ModeP2=	Sets P2 channel to Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	ModeP2= Vent
ModeP3=	Sets P3 channel to Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	ModeP3=STBY
ModeP4=	Sets P4 channel to Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	ModeP4=stby
ModeP5=	*Sets P5 channel to Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).*	*ModeP5=stby*
ModeP6=	*Sets P6 channel to Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).*	*ModeP6=stby*
ModeP1?	Returns mode setting of P1 channel, Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	Ctrl
ModeP2?	Returns mode setting of P2 channel, Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	Vent
ModeP3?	Returns mode setting of P3 channel, Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	Stby

ModeP4?	Returns mode setting of P4 channel, Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).	Stby
ModeP5?	*Returns mode setting of P5 channel, Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).*	*Stby*
ModeP6?	*Returns mode setting of P6 channel, Measure (MEAS), Control (CTRL), Vent (VENT), or Standby (STBY).*	*Stby*
HoldP1	Changes the P1 control set point to match the current measured pressure. Effectively stops controller from slowly drifting into the original set point.	
HoldP2	Changes the P2 control set point to match the current measured pressure. Effectively stops controller from slowly drifting into the original set point.	
HoldP3	Changes the P3 control set point to match the current measured pressure. Effectively stops controller from slowly drifting into the original set point.	
HoldP4	*Changes the P4 control set point to match the current measured pressure. Effectively stops controller from slowly drifting into the original set point.*	

HoldP5	*Changes the P5 control set point to match the current measured pressure. Effectively stops controller from slowly drifting into the original set point.*	
HoldP5	Changes the P5 control set point to match the current measured pressure. Effectively stops controller from slowly drifting into the original set point.	
SetWindow=	Sets the pressure window value in current units of measurement. Value is used to determine if the pressure reading is within tolerance for a stable P-OK indication.	SetWindow= 20
SetWindow?	Returns the tolerance for determining the ready state of each controller	SetWindow? 20 kPa
Ver?	Returns the version of the internal software	Returns: Version: 1.01
Sn?	Returns the unit serial number	Returns: SN: 990248
Lockpanel	Disables the front panel touchscreen on the 9414. Must be re-enabled over the serial port using the 'Unlockpanel' command or power must be cycled	Lockpanel
Unlockpanel	Enables the front panel touchscreen on the 9414. This is the default power up mode.	Unlockpanel
RouteP1	Connects pressure P1 to Device Under Test (DUT) if	RouteP1

	Pressure Select Manifold is present in remote transducer module. Closes vent valve along with P2, P3 and P4 valves.	
RouteP2	Connects pressure P2 to Device Under Test (DUT) if Pressure Select Manifold is present in remote transducer module. Closes vent valve along with P1, P3 and P4 valves.	RouteP2
RouteP3	Connects pressure P3 to Device Under Test (DUT) if Pressure Select Manifold is present in remote transducer module. Closes vent valve along with P1, P2 and P4 valves.	RouteP3
RouteP4	Connects pressure P4 to Device Under Test (DUT) if Pressure Select Manifold is present in remote transducer module. Closes vent valve along with P1, P2 and P3 valves.	RouteP4
RouteVent	If the pressure select manifold is present in the remote transducer module, closes P1, P2, P3 and P4 pressure selection valves and opens vent valve to allow pressure in the Device Under Test (DUT) to escape.	Routevent
RouteNone	If the pressure select manifold is present in the remote transducer module,	Routenone

	all valves will be closed sealing pressure in the Device Under Test (DUT).	
EchoON	Turns command echo on	Echoon
EchoOFF	Turns command echo off	Echooff
Echo?	Returns the state of echo command.	Returns: Echo ON or Echo OFF
Gains?	Returns the stored control gain settings for the pressure regulators.	Returns: Offset: 0.7000, 1.3000, 2.0000,-0.7000,-1.1000, -2.0000 mult: 1.000
Mult=	Increases or decreases the overall gain of the pressure regulators. Default value is 1.0. Values less than 1 decrease the sensitivity of the system and values greater than 1 increase the sensitivity.	MULT=1.25
Vp1=	Increase or decrease the overall sensitivity of the fine positive control valve. See 'gains?' Command for an initial starting value. Vp1 must be positive value, but less than vp2 and vp3	Vp1=0.009
Vp2=	Increase or decrease the overall sensitivity of the medium positive control valve. See 'gains?' Command for an initial starting value. Vp2 must be positive value, > vp1 and < vp3	Vp2= 1.01

Vp3=	Increase or decrease the overall sensitivity of the course positive control valve. See 'gains?' Command for an initial starting value. Vp3 must be positive value > vp2.	Vp3= 2.3
Vn1=	Increase or decrease the overall sensitivity of the fine exhaust control valve. See 'gains?' Command for an initial starting value. Vn1 must be a negative value that is smaller than vn2 and vn3.	Vn1=-.09
Vn2=	Increase or decrease the overall sensitivity of the medium exhaust control valve. See 'gains?' Command for an initial starting value. Vn2 must be a negative value that is smaller than vn3 and greater than vn1.	Vn2=-1.0
Vn3=	Increase or decrease the overall sensitivity of the course exhaust control valve. See 'gains?' Command for an initial starting value. Vn3 must be a negative value that is greater than vn1 and vn2.	Vn3=-2.2

7 Normal Operation

Once power is applied,

1. Each channel should be supplied a pressure setpoint (SetP1=, SetP2=….)
2. Turn vacuum on (if one is present)
3. Turn supply pressure on
4. Each channel to be used should be placed in the control mode (ModeP1=CTRL…..)
5. The sequence type should be selected. This determines whether the tank remains in the system when readings are taken, or if the controller is still controlling when readings are taken, etc.
6. The SETWINDOW= command should be set to the allowed pressure window. This determines an acceptable control tolerance and the recharge time.
7. The normal operation loop should consist of
   A. Checking to see if the channel is ready and returns a Yes to the ReadyP1? (ReadyP2?, ReadyP3?…) query
   B. Place the channel in the standby mode (ModeP1=STBY, ModeP2=STBY….)
   C. Read the remote transducer using X1? Or X2? Query
   D. Place the channel back into the control mode (ModePx=CTRL) and Go to next pressure….(step 7A)

7.1 Normal Shutdown Sequence

- The normal shutdown mode should start by setting each channel in the control mode with a set point pressure of near atmospheric pressure (14.5 psi, 100 kPa, 1 bar, 1000 mbar, etc). Once each channel reaches the setpoint, the vacuum and supply pressure can be removed or shut off. Remote transducers should be isolated or vented. Power can be removed from the system or left on. If power is removed, the system will default to a save mode with pressure and vacuum supplies disabled and will start venting the storage tanks at a safe discharge rate. Discharging the tanks, especially at higher pressures, may take a few minutes.

7.3 Emergency Shutdown Sequence

- The emergency shutdown mode is entered when the red emergency shutdown switch on the Model 9414 unit is depressed. This

effectively removes power from the electronics and de-energizes solenoid valves. The effect is that the source air and vacuum are shut off, internal source pressures are vented through the booster, and the two to four storage tanks are discharged at a safe discharge rate. If the manual shutoff valves on the rack are closed, this procedure can trap a small amount of air in the lines between the rack and the device under test. The volume involved is typically small and usually dissipates as the fittings are loosened. This can also be manually vented by opening the manual shutoff valves once the tank pressures are near atmospheric pressure.

- Rotating the emergency shutdown button clockwise allows power to be re-applied to the system. The normal power up sequence should be followed to re-establish operating conditions.

7.4 Notes on Remote Transducers

- The remote transducers are each read at approximately 10 msec intervals. When a request for pressure is made, the most current reading is immediately returned. Since the Mensor 6100 and 6180 reading rate is 50 readings per second, it is possible to get two consecutive readings alike, but this does guarantee that the readings will be within 20 milliseconds of the time of the request. Production simulation tests indicated that the system stabilizes in approximately 50 readings to 0.02%.

8 Calibration

Calibration of the pressure equipment should be performed periodically. The main pressure standards for the system are Mensor Series 6180 Digital Pressure Transducers mounted in the remote transducer module. The range of these transducers is application specific. The Mensor Model 9414 Quad Controller normally incorporates four absolute Series 6100 transducers internally. The Mensor Series 6100 Digital Pressure Transducer(s) should be initially checked at 180 day intervals until confidence in the devices has been established. The Mensor CPT 6180 Transducers should have an initial calibration interval of 1 year.

As each application is slightly different so are the requirements that go with the application. The calibration interval can be extended or compressed based on needs and test results.

The transducers in the 9414 are not intended as the primary pressure standard in the system. They are intended to operate as feedback devices for the pressure regulators. If calibration of these devices is desired, they can be calibrated in the unit or even in the rack. (Contact Mensor if this option is preferred.) The 9414 allows commands to it to pass to the transducers using the 'PASS=' command prefix. In order to read the zero offset of transducer A, send "PASS=#AZC?" (#AZC? is the 6100 command to read the zero correction from the transducer addressed as A.) The Mensor Series 6100 operator's manual describing the calibration process is included in the appendix.

The Mensor 6180 transducer(s) can be calibrated in the remote transducer module with or without the 9414. If the 9414 is used, commands for setting the zero and span of the unit can be found in the command set. If the remote transducer module is removed, a user will require a PC with full duplex RS-485, and a cable to provide 12 volt DC supply. (Contact Mensor for assistance if this is the intended calibration mode.) A pneumatic schematic can be found on the front of the module along with a connector pin table. Power, RS-485 serial data lines, and 12 vdc isolation valve enables are provided on a single 25 pin d-sub connector. Normal operation allows pressure applied to the front ¼" tube fitting to be routed to the transducer in single transducer configurations. In multi-transducer configurations, pressure is routed to the highest range transducer. All remaining transducers are isolated with solenoid valves. Twelve volt power must be applied to the solenoid in order to enable input pressure to lower range transducers. In this mode, the user must ensure that the pressure is within the range of the sensor before opening (energizing) the valve. The highest pressure transducers are addressed as '1' and the low pressure transducers are addressed in sequence as '2', '3', and '4'. A barometric reference transducer if included is addressed as '5'. The 6100 operator's manual describing the calibration process and the commands can be found in the appendix if calibrated outside the system.

The following commands can be used to calibrate the Mensor Series 6100 transducers in the system.

Command	Description	Example
Pass=	Passes the command information directly from the 9414 serial interface to the transducer communication bus. This allows any command found in the Mensor Series 6100 manual to be directly sent to a transducer. This is useful in calibrating or troubleshooting transducers in the 9414 or attached remote transducer module.	Pass= #1id?
Zc0?	Returns the stored zero offset value of transducer 0 (control channel P1)	
Zc0=	Sets a new zero offset value in transducer 0 (control channel P1). This value must be saved with the 'save0=' command to be retained through power down cycles.	
Zc1?	Returns the stored zero offset value of transducer 1 (control channel P2)	
Zc1=	Sets a new zero offset value in transducer 1 (control channel P2). This value must be saved with the 'save1=' command to be retained through power down cycles.	

Zc2?	Returns the stored zero offset value of transducer 2 (control channel P3)	
Zc2=	Sets a new zero offset value in transducer 2 (control channel P3). This value must be saved with the 'save2=' command to be retained through power down cycles.	
Zc3?	Returns the stored zero offset value of transducer 3 (control channel P4)	
Zc3=	Sets a new zero offset value in transducer 3 (control channel P4). This value must be saved with the 'save3=' command to be retained through power down cycles.	
Sc0?	Returns the stored span multiplier value of transducer 0 (control channel P1)	
Sc0=	Sets a new span multiplier value in transducer 0 (control channel P1). This value must be saved with the 'save0=' command to be retained through power down cycles.	
Sc1?	Returns the stored span multiplier value of transducer 0 (control channel P2)	
Sc1=	Sets a new span multiplier value in transducer 0 (control channel P2). This value must be saved with the	

	'save1=' command to be retained through power down cycles.	
Sc2?	Returns the stored span multiplier value of transducer 0 (control channel P3)	
Sc2=	Sets a new span multiplier value in transducer 0 (control channel P3). This value must be saved with the 'save2=' command to be retained through power down cycles.	
Sc3?	Returns the stored span multiplier value of transducer 0 (control channel P4)	
Sc3=	Sets a new span multiplier value in transducer 0 (control channel P4). This value must be saved with the 'save3=' command to be retained through power down cycles.	
Id0?	Returns the transducer ID string for P1 transducer.	
Id1?	Returns the transducer ID string for P2 transducer.	
Id2?	Returns the transducer ID string for P3 transducer.	
Id3?	Returns the transducer ID string for P4 transducer	
Save0=	Saves calibration data changes on transducer P1	
Save1=	Saves calibration data changes on transducer P2	
Save2=	Saves calibration data changes on transducer P3	

Save3=	Saves calibration data changes on transducer P4	

9 Storage and Transportation

The system can be stored for a reasonable amount of time without any adverse effects. Storage temperature should not exceed 70C or drop below -20 C. The humidity should not be so high as to cause condensation in the system. Once the system is brought back online, it should be allowed to stabilize within its normal operating temperature range before power is applied. The pressure ports should be covered, but not completely sealed to prevent contamination in the system.

Extended storage should ensure that no water vapor is trapped within the storage tanks. The output ports on the tank are near the bottom of the tank and will allow excess water to drain into the tubing. If moisture is suspected, it can be checked and removed by applying a small pressure to the input port on the 9412 with the 9412 output lines open. In normal operation, water should not be a problem if a clean dry air supply is provided to the system.

10 Maintenance

Standard maintenance may include checking for loose fittings and screws and bent or kinked hoses for safety. Any maintenance or repair functions should be performed by qualified personnel and adhere to warnings previously provided in this manual including but not limited to excessive weight of some components, stored pneumatic pressure, and high AC voltages.

General housekeeping should include verifying the operation of the cooling fan in the 9414 and removing anything that might block the flow of air into the rack and controller.

The calibration of the Mensor Series 6100 and 6180 Digital Pressure Transducers should be periodically checked. The 6180 transducers are used as the measurement standards and should be initially checked annually. The 6100 transducers found in the 9414 are only used to generate the desired pressure. They should only need to be checked when the controlled pressure measurement on the front panel of the 9414 differs significantly from the 6180 reading.

The pressure storage tanks used in the system are ASME-certified tanks rated for 300 psi working pressure. The tanks should be inspected periodically per ASME recommendations.

If a lubricated vacuum pump is included in the system, if should be periodically checked for low or contaminated pump oil. The recommendations found in the manufacturer's manual should be followed.

Excessive loss of oil or excessive pump vapor in the rack (if a lubricated pump is installed) is an indication of over driving the vacuum pump. Operating procedures should be reviewed to minimize the amount of air being digested by the pump. Additional or bigger exhaust relief valves may reduce or eliminate this problem.

Appendix

ASME Tank Data
Mensor Series 6100 DPT Manual

ASME Tank Data   (as viewed on typical tank plate)

Tanks Certified by Manchester Tank – IN
MAWP: 300 psi @ 650 F
RT- NO   MDMT- 20F@300 psi
CAT: 306319   YR- 2005
CRN:
SH   .094   GAL 3
HD   .094   2:1 SE

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