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# MNR-800-HPC400

## High pressure controller for hydraulic operation up to 400 MPa

### Carefree hydraulic pressure calibration up to 400 MPa (58,000 psi)

- UNIQUE, PATENTED HIGH PRESSURE CONTROL TECHNOLOGY
- HIGH SPEED OPERATION, SETS PRESSURES IN LESS THAN ONE MINUTE
- HIGH PRECISION PRESSURE CONTROL
- HIGH ACCURACY QUARTZ REFERENCE SENSORS WITH ACCREDITED CALIBRATION
- TOLERANT OF VARYING TEST VOLUME
- LOCAL TOUCH SCREEN USER INTERFACE AND FULL REMOTE CONTROL
- INTEGRATED TEST OIL FILL AND GAS PURGE SYSTEM
- VERY RELIABLE IN CONTINUOUS OPERATION, EVEN IN HIGHEST PRESSURE RANGES

## MNR-800-HPC400 HIGH PRESSURE CONTROLLER

The HPC is intended to generate and control pressure as needed to calibrate and test pressure measuring instruments in wide variety of applications. The HPC uses innovative pressure generation and control technology, developed and proven over several years in intensive operation with a major transducer manufacturer. This versatile technology (see Operating Principles, p.4) sets pressure very quickly and precisely into varying test volumes over a very wide pressure range. The very robust design provides exceptional reliability, allowing years of uninterrupted operation.

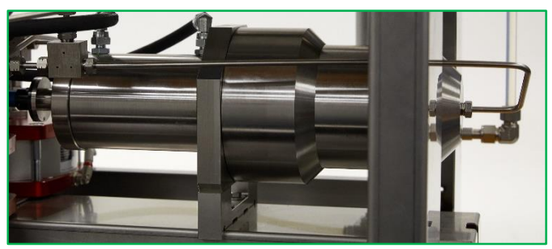

**Local user interface**
The HPC includes a color, touchscreen display mounted at a convenient angle for full function local operator interaction. Operation is straightforward and intuitive. The display can be locked out by remote command to avoid accidental interference.

**Automating tests with HPC**
HPC has remote communication capability over USB and Internet interfaces. SCPI protocol commands are used and thoroughly documented in the HPC manual. The HPC remote commands can be used in user developed software to automate calibration and testing functions.

**Integrated oil filling and gas purging system**
When using a hydraulic pressure controller, failure to fill the system under test with oil and purge trapped gases can lead to unpredictable pressure control, overshoot and premature wear of active hydraulic components. To address this problem, the HPC includes built-in capability to easily and quickly fill and purge the test system (see Operating Principles, p. 4). The operator runs a simple on-board routine to assure a solid, air free test system and excellent pressure control. In most situations, the on-board system eliminates the need for a secondary test fill set up system and procedure.

**Interchangeable pressure modules**
HPC reference pressure modules are interchanged in minutes (see p. 5). This allows optimization of the pressure measurement range to the device under test range. The modules are compact, stand-alone, plug and play devices that can be calibrated independently of the HPC so the HPC does not need to be taken out of operation or moved for recalibration.

**High pressure intensifier**
The heart of the HPC pressure control system is a high pressure piston-ratio intensifier (see Operating Principles, p. 4). The intensifier smoothly and reliably multiplies differential pressure from a powerpack, delivering high pressure to the system under test. Should the intensifier run out of stroke, it is recharged automatically, transparently to the operator and without significantly disturbing the test pressure.







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## MNR-800-HPP25 POWERPACK

Pressure on the low side of the HPC's intensifier is supplied by an industrial powerpack that continuously generates approximately 21 MPa (3,500 psi). The powerpack pressure output flows through a servo valve that controls differential pressure across the intensifier's low pressure piston (see Operating Principles, p. 4). The powerpack is a standalone unit designed for reliable operation with minimal heat and noise generation. If desired, it can be placed up to 6 m (18 ft) away from the HPC, well removed from the HPC's immediate work area.

**Ergonomic enclosure**
The HPC enclosure is designed to minimize the unit's footprint, shield operators from high pressure components and provide easy access for servicing or repairs. The user display and controls are presented on an angled front panel. The oil reservoir level can be checked and the reservoir refilled conveniently from the front. The "hood" can be lifted, providing easy access to all internal components.

# OPERATING PRINCIPLES

## HPC operating principle

Low pressure (21 MPa) is generated by the powerpack (1). The low pressure flows through a servo valve (2) and back to the powerpack. The two sides of the servo valve are connected to two sides of the intensifier's low pressure piston (3a, 3b). By adjusting flow, the servo valve (2) controls the differential pressure across the low pressure piston (3a, 3b). The intensifier's piston assembly will move to maintain equilibrium between the force on the low pressure piston (3a, 3b) and the force on the high pressure piston (4). As the intensifier has a ratio of 20:1, the system is in equilibrium when the high pressure (4) is 20x the differential pressure across (3a) and (3b). So, the high pressure as measured by control sensor (5) is generated and controlled by a patented fast pressure control loop that steers servo-valve (2) to control the differential pressure across the low pressure piston (3a, 3b). The servo valve is fast and precise and the piston assembly moves with very low friction, resulting in excellent control of the high pressure.

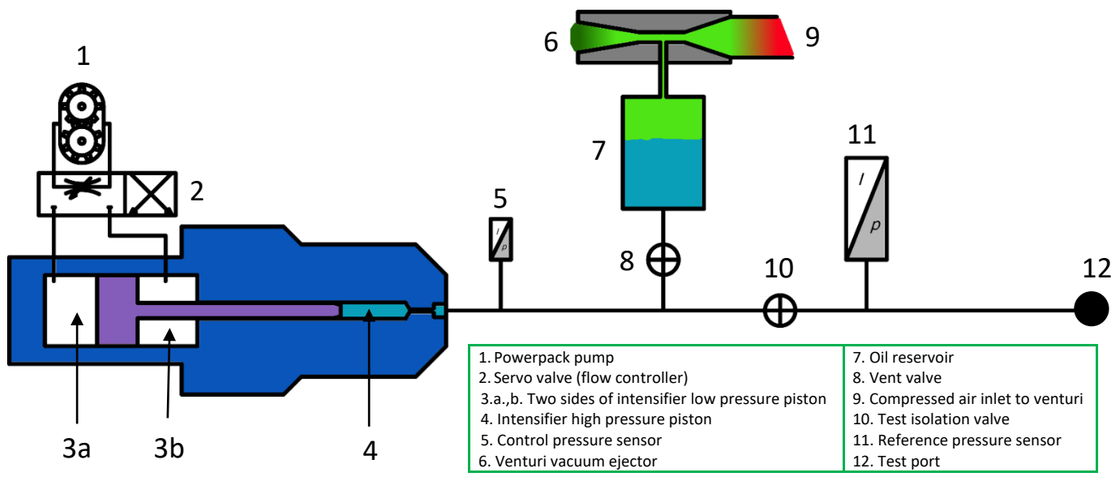
If the piston runs out of stroke during a test, the controller automatically resets the piston position. Test isolation valve (10) closes to maintain the set pressure in the system (12). Servo valve (2) moves the piston assembly to lower the pressure. Vent valve (8) is opened to the reservoir (7). Servo valve (2) moves the piston to the desired position. Vent valve (8) is closed. Servo valve (2) is used to generate pressure as read by control sensor (5) back to the level of pressure in the system under test as read by the reference sensor (11). Once the two pressures (5, 11) are equal, isolation valve (10) is opened and the test continues. The piston resetting routine is normally only used in unusual situations such as large test volumes, trapped air, or if there is a small leak in the test system that must be compensated for by the intensifier piston assembly movement.

## Oil fill and air purge system

The preferred procedure is to use a two-step process. First the system under test, connected at (12), is filled with oil. Then the HPC's built-in vacuum system is used to pull any remaining trapped air out of the system under test.

The oil fill process is controlled from the front panel user interface. After the device or system under test is connected (12), a fitting or purge port at a high point in the system under test is opened and the on-board fill routine is launched. The vent valve (8) is closed. Then the servo valve (2) is used to slowly move the intensifier piston assembly forward, driving oil into the test system. When the operator observes oil at the purge port, they tighten the open fitting. Once the fitting is tightened the movement of the HPC intensifier piston assembly causes the pressure to begin to rise. When the pressure measured by the control sensor (5) reaches about 0.4 MPa (60 psi), the fill routine ends.

The air purging process is launched from the front panel user interface or by remote command. A device connected to (12) has already been filled with oil using the fill function. Vent valve (8) and isolation valve (10) are opened. Then a pneumatic valve is opened at (9) to allow compressed air to flow through the venturi (6). The flow through the venturi causes a vacuum to be applied to the top of the reservoir (7). The vacuum pulls air from the device or system under test (12). After a fixed time (typically 5 minutes), the compressed air valve (9) is closed and the purging process is complete.




| | |
|---|---|
| 1. Powerpack pump | 7. Oil reservoir |
| 2. Servo valve (flow controller) | 8. Vent valve |
| 3.a.,b. Two sides of intensifier low pressure piston | 9. Compressed air inlet to venturi |
| 4. Intensifier high pressure piston | 10. Test isolation valve |
| 5. Control pressure sensor | 11. Reference pressure sensor |
| 6. Venturi vacuum ejector | 12. Test port |







# MNR-800-HPM REFERENCE PRESSURE MODULES

MNR-800-HPM pressure modules are used by the HPC for high accuracy measurement of the pressure set by the controller. The modules are offered in various pressure ranges and two different performance classes to best meet the requirements of the calibration or test being conducted. The module in use is installed in an easily accessed area on the front of the HPC (see p. 2) and modules can be interchanged in a minute or two.

Premium modules use very high performance quartz pressure sensors to deliver the highest accuracy available and standard modules are based on more economical silicon-on-sapphire sensors.

Pressure modules are stand alone units that can be operated separately from the HPC allowing them to be calibrated without downtime or moving of the HPC.


| HPM Pressure Measurement Specifications | | | | | | |
|---|---|---|---|---|---|---|
| | **Standard Class** | | | **Premium Class** | | |
| Ranges (gauge) | MNR-800-HPM70S<br>MNR-800-HPM140S<br>MNR-800-HPM200S<br>MNR-800-HPM280S<br>MNR-800-HPM400S | 70 MPa<br>140 MPa<br>200 MPa<br>280 MPa<br>400 MPa | 10 kpsi<br>20 kpsi<br>30 kpsi<br>40 kpsi<br>58 kpsi | MNR-800-HPM70P<br>MNR-800-HPM140P<br>MNR-800-HPM200P<br>MNR-800-HPM280P | 70 MPa<br>140 MPa<br>200 MPa<br>280 MPa | 10 kpsi<br>20 kpsi<br>30 kpsi<br>40 kpsi |
| | | | | | | |
| HPM Range | 70, 140, 200, 280 MPa | 400 MPa | | 70, 140, 200 MPa | 280 MPa | |
| Measurement uncertainty | ± 0.05% FS | ± 0.08% FS | | ± 0.01% FS | ± 0.018% FS | |
| Uncertainty resolution | To 1 ppm FS | | | | | |
| Precision | ± 0.015% FS | ± 0.03% FS | | ± 0.008% FS | ± 0.01% FS | |
| Predicted one year stability | ± 0.025% FS | ± 0.04% FS | | ± 0.005% FS | ±0.006% FS | |
| Calibration | Delivered with ISO/IEC 17025 accredited calibration report | | | | | |



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# APPLICATIONS

## Pressure sensor manufacturing & testing



HPC can be used in the development, compensation and final calibration of various pressure measuring instruments. It sets pressure quickly and precisely even in large test manifolds and is engineered to support long and complex, fully automated test sequences. Most test manifolds can be filled and purged using HPC's on-board capabilities.

## Downhole sensor calibration and validation

HPC covers the very high pressure ranges found in today and tomorrow's oil & gas downhole applications. It is rugged and reliable, very well suited to use in remote locations and difficult environments where downhole transducers and tools are supported.


## General calibration lab and shop use


HPC can serve as a versatile and easy to use calibration tool to cover a very wide range of hydraulic pressure with low uncertainty in all kinds of calibration facilities.

## Analog gauge calibration in a calibration lab or manufacturing environment

HPC can execute large pressure changes quickly and make small pressure changes very precisely in just a few seconds. This makes analogue gauge calibration much easier and faster than with a deadweight tester, manual pressure generators or other controllers that lack this capability.



## Pressure control component in an automated piston gauge system


HPC's reliability, speed and ability to make very small changes in volume predictably by moving its intensifier piston make it the perfect solution for hydraulic control in an automated piston gauge system. HPC's remote command set includes function necessary to support integration into an automated piston gauge system. Contact Minerva for additional information.





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# PRODUCT CONFIGURATOR

## To put together your HPC system:



### 1. Select an HPC pressure controller.

At this time there is only one model, **MNR-800-HPC400**.
**MNR-800-HPC400** will operate up to 400 MPa, but also handles ranges as low as 70 MPa.

### 2. Select an HPP powerpack.

For 230 V, 50 Hz, use **MNR-800-HPP25-230-50**.
For 110 V, 60 Hz, use **MNR-800-HPP25-110-60**.
For 200 V, 50Hz, use **MNR-800-HPP25-200-50**
For 200 V, 60Hz, use **MNR-800-HPP25-200-60**

### 3. Select a powerpack interconnection kit.

This kit makes the hydraulic and electrical connections between the HPC controller and the HPP powerpack. The length of the interconnection kit determines the maximum distance between the HPC pressure controller and the HPP powerpack when they are installed.
For **2** meters, use **MNR-800-HPP25-2**.
For **4** meters, use **MNR-800-HPP25-4**.
For **6** meters, use **MNR-800-HPP25-6**.

### 4. Select one or more HPM pressure modules.

Select as needed to support the ranges and uncertainties desired. See **MNR-800-HPM** pressure modules, p. 5.

| HPC system components standard delivery | | |
|---|---|---|
| **MNR-800-HPC400 pressure controller** | **MRN-800-HPP25 powerpack** | **MNR-800-HPM pressure module** |
| The **HPC pressure controller** and:<br>➢ Spare filter element<br>➢ Seal kit<br>➢ Funnel for reservoir filling<br>➢ 4 x gland and collar, AE250C, HIP HF4<br>➢ 2 x gland blind plug, AE250C, HIP HF4 (installed on ports)<br>➢ 5 l Sebacate hydraulic fluid<br>➢ Ethernet cable 5 m<br>➢ USB cable 3 m<br>➢ General accessories USB stick with manual and test report | The **HPP powerpack** and:<br>➢ Power cable, 3 m, 2 wire + ground 4 mm2, pigtail end<br>➢ Funnel for reservoir filling<br>➢ 2 x 20 l can of Castrol hyspin AWS hydraulic fluid, 32ISO | The **HPM pressure** module and:<br>➢ RS232 cable including 24 V power supply<br>➢ Short nipple with AE250C, HIP HF4 plastic cap installed<br>➢ ISO/IEC accredited calibration report |



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# TECHNICAL SPECIFICATIONS

| | |
|---|---|
| **General system specifications and requirements** | |
| Operating pressure range | 0.2 to 400 MPa (30 – 58,000 psi) |
| Electrical power | 230 V DC / 50 Hz or 110V DC / 60 Hz depending on HPP power pack model, 2.2 KW |
| Drive air | 500 – 1000 kPa / 300 l/m (70 to 150 psi / 11 cf/m), clean and dry |
| Operating temperature | 10 to 30 °C (50 to 90 °F) |
| Remote communication | USB (RS232 simulated), Ethernet |
| Test pressure connection | high pressure coned and threaded (AE F250C, HIP HF4) |
| Drive air connection | ¼" NPT F |
| Compliance | Compliant with all applicable CE directives |
| **HPC Pressure Controller Specifications** | |
| Pressure control | |
| Pressure range | Atmosphere to 400 MPa (58,000 psi) |
| Lowest controllable pressure | 0.2 MPa (30 psi) |
| Pressure Control precision | To +/- 0.01 MPa |
| Default pressure hold limit | +/- 0,01% of HPM(reference pressure transducer)full scale or 0,01 MPa whichever is larger |
| Pressure set time | 60 sec typical pressure ready to pressure ready, ,10 sec. ready to ready for pressure steps ,0,4 MPa(60 psi). |
| Control (test) volume | 0 to 300 $cm^{3,}$,consult factory about larger test volumes |
| **Other HPC specifications** | |
| Electrical power | 24 V DC / 60 W (supplied by HPP) |
| Remote communication | USB (RS232 simulated), Ethernet |
| Drive air (valve, purge pump actuation) | 500 to 700 kPa @ 300 lpm (70 to 100 psi @ 10 cfm), clean & dry |
| Intensifier | 20:1 ratio, 150 mm stroke, 22 $cm^3$ displacement on high pressure side |
| Reservoir (HPC) | 0,75 L |
| Operating medium | Sebacate (consult factory about alternate media) |
| Internal sensor | 0 – 400 MPa (58,000 psi), 0,1 % full scale, ISO/IEC 17025 accredited calibration optional |
| Dimensions | (L x W x H) 900 x 550 mm x 690 mm |
| Weight | 150 kg (330 lb) |
| **HPP powerpack** | |
| Electrical power | 2.2 KW single phase AC. 110V / 60 Hz, 230 V / 50 Hz, 200V / 50Hz, 200V / 60Hz |
| Control | From HPC (24V) |
| Operating temperature | 10 to 30 °C (50 to 90 °F) |
| Reservoir | 50 liter |
| Operating medium | Castrol hyspin AWS hydraulic fluid, ISO 32 |
| Compliance | Compliant with all applicable CE directives |
| Dimensions | (L x W x H) 897 x 300 mm x 805 mm |
| Weight | 80kg (176lb) |
| **HPM High Pressure Reference Module Specifications** | |
| Ranges | 0 – 70 MPa (10,000 psi) to 0 – 400 MPa (58,000 psi) gauge and absolute modes |
| Electrical power | 24 V DC / 1 W (supplied by HPC) |
| Remote communication | RS232 dedicated protocol |
| Dimensions | (L x W x H) 240 mm L x 70 mm x 70 mm |
| Weight | 1.2 kg (2.6 lbs) |

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