DyneSystems, Inc.

Midwest & Dynamatic Dynamometers

XM2000

Gas Analyzer

USER MANUAL

Job # _____

Model # _____

Serial # _____

FROM Dyne Systems, Inc.

The XM2000 Exhaust Measurement System is designed to provide a low-cost and portable tool for the analysis of exhaust gas components (HC, CO, CO_2, NO_x, and O_2). The exhaust gas components are analyzed using the Andros Model 6500 miniature automotive analyzer. These analyzers are used in service garage equipment, portable applications, and inspection and maintenance programs throughout the world. The Andros analyzer alone is not designed for continuous testing. In order to perform continuous testing of engine exhaust, the XM2000 also has a well designed sample conditioning system and heated sample line.

The XM2000 provides many of the features of high-end gas analyzers but at a small fraction of their cost.

- Heated Filter to remove large particulates from the sample
- Heated sample line to keep the sample temperature above the dew point
- Two-stage chiller to remove moisture from the sample
- Leak Check
- HC Hangup Test
- Calibration (Zero and Span)
- Zero calibration with “Zero” calibration gas or with ambient air
- Purge
- Simplified Maintenance - filter is easily replaced in the field
- Portability - can easily be moved from one test cell to another

This manual is intended for use by qualified personnel only. All Dyne Systems approved drawings (if included) and specific instructions for this equipment must take precedence over general information contained in this manual.

Thank you for purchasing this product from Dyne Systems (hereafter in this manual referred to as DS). Our staff is at your disposal, should you need information or support that is not found in this manual.

DyneSystems, Inc.
Midwest & Dynamatic Dynamometers

CONTROLS, DYNAMOMETERS, SYSTEM INTEGRATION AND TEST CELL AUTOMATION

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SECTION 1: GENERAL INFORMATION

Dyne Systems, Inc. will be referred to as DS for the remainder of this manual.

DOCUMENT REVISION HISTORY

Item #	Date	Comment
MAN-XM2000-001	22-JULY-2009	Initial Release.

PRODUCT SOFTWARE REVISIONS

This document is up to date with respect to the following versions of product software.

Product	Version
XM2000 Main Computer	1.003
Operator Control Station	1.003

SAFETY

Read your instruction manual! Electrical rotating machinery can be dangerous. Become familiar with all safety instructions and procedures. WARNING, CAUTION and special INSTRUCTION labels are used throughout the manual to remind you of the hazards that exist. Know your equipment before handling or working on it.

used to warn of the possibility of injury to personnel and damage to equipment.

used to caution of potential hazards and unsafe practices

NOTE: *used for special instructions related to safety, proper operation or maintenance*

To prevent physical injury, follow all standard safety precautions when installing, operating, and maintaining the XM2000 and all peripheral equipment. Refer to the American National Standards Institute (ANSI) or the Occupational Safety and Health Administration (OSHA) for additional safety information.

- Follow all instructions in this manual.
- Always remove all power to any component before attempting to access any internal components.
- Obey all safety signs on the equipment and in this manual.

Electrocution Hazard

This product and associated components are electrically energized. Electric shock may cause serious injury or death. Always disconnect line voltage before servicing the XM2000 or any associated components.

Electrostatic Discharge

Electrostatic discharge (ESD) can damage sensitive semiconductors on all circuit boards in the XM2000 and associated components. Always wear an ESD grounding device (e.g. a wrist strap) when handling internal components. Failure to observe ESD grounding precautions may damage sensitive components.

Burns

The heated sample line, heated filter, and heated in-line pre-filter are all heated and temperature controlled to 190 °C (374 °F). The exposed metal parts on these heated components are EXTREMELY HOT and can cause severe burns.

Poisonous Gases

The Bar 97 High calibration gas cylinder contains high concentrations of propane, carbon dioxide, carbon monoxide, and nitrogen oxides. Always make sure the cylinder valve is closed when not in use (i.e. calibrating). When flowing gas from this cylinder during span calibration, make sure the SAMPLE OUTPUT is properly ventilated.

Nitrogen oxides (i.e. NO_x) are extremely hazardous to your health and, therefore, must be properly ventilated. Exposure to high levels of nitrogen oxides can lead to swelling and burning of tissue in the upper respiratory tract, a build up of fluids in the lungs, and in extreme cases, death.

RECEIVING INSPECTION

Upon arrival of your equipment, check all items received against the packing slip to ensure the shipment is complete. Inspect for damage or any evidence of rough handling, as this may be an indication of hidden damage.

The following checks are offered to aid your inspection:

1. Inspect packaging and skid(s) for any mistreatment. Document and photograph any signs of damage.

2. Inspect housing to ensure there is no damage and that the unit is intact.

DAMAGE CLAIMS

In the event of damage, report it without delay to the Carrier and DS. Dyne System's warranty policy does not cover shipping damage or lost material. It is important to file a damage claim with the Carrier promptly. If you require assistance in settling the claim, contact DS. Refer to equipment by purchase order, model and serial number.

TRAINING

Training programs are an essential part of safe and correct operation. Training provides the know-how necessary to obtain top performance from your equipment. DS recognizes this fact and will conduct training classes on-site or at the factory to educate personnel in safe operating and maintenance procedures.

USER SERVICING

The XM2000 contains a few user-serviceable parts (e.g. replacement filter, hoses, etc.) Access to internal components should only be performed under the supervision of DS technical support specialists.

SPECIFICATIONS

Measured Gases

Gas	Description
HC	Hydrocarbons (as either n-Hexane or Propane)
CO	Carbon Monoxide
CO_2	Carbon Dioxide
NO_x	Nitrogen Oxides
O_2	Oxygen

Measurement Range

Gas	Range
HC	0 to 30,000 ppm (n-Hexane) 0 to 60,000 ppm (propane)
CO	0 to 15.00 %
CO_2	0 to 20.00 %
NO_x	0 to 5,000 ppm
O_2	0 to 25.00 %

Measurement Resolution

Gas	Resolution
HC	1 ppm
CO	0.001 %
CO_2	0.01 %
NO_x	1 ppm
O_2	0.01 %

Measurement Accuracy

Gas	Range	Accuracy
HC n-Hexane	0 to 2,000 ppm 2,001 to 15,000 ppm 15,001 to 30,000 ppm	± 4 ppm or ± 3 % of reading ± 5 % of reading ± 8 % of reading
HC Propane	0 to 4,000 ppm 4,001 to 30,000 ppm 30,001 to 60,000 ppm	± 8 ppm or ± 3 % of reading ± 5 % of reading ± 8 % of reading
CO	0.00 to 10.00 % 10.01 to 15.00 %	± 0.02 % or ± 3 % of reading ± 5 % of reading
CO_2	0.00 to 16.00 % 16.01 to 20.00 %	± 0.3 % or ± 3 % of reading ± 5 % of reading
NO_x	0 to 4,000 ppm 4,001 to 5,000 ppm	± 25 ppm or ± 4 % of reading ± 5 % of reading
O_2	0.00 to 25.00 %	± 0.1 % abs. or ± 3 % of reading

SPECIFICATIONS (CONTINUED)

Response Time (Andros Analyzer Only)

Gas	Response Time
HC	< 2 seconds
CO	< 2 seconds
CO_2	< 2 seconds
NO_x	< 5 seconds
O_2	< 10 seconds (0.10 % to 20.9 %) < 30 seconds (20.9 % to 0.10 %)

NOTE: *Add an additional 3 seconds to each of the Response Times listed above in order to account for the sampling delays due to the presence of the (standard) 10 ft heated sampling line.*

Other

Warm-up Time: 5 - 40 minutes
Sample Flow Rate: 4.0 cubic feet/hour

Operating Conditions

The XM2000 must be installed in an environment conforming to the following specifications.

Temperature: 0 °C to 50 °C (32 °F to 122 °F)

Humidity: 5 to 95% (non-condensing)

Altitude: -300 m to +2,500 m (-1,000 ft to +8,000 ft)

Atmosphere: Free of corrosive gases

Free of vapors or powders that could cause fire or explosion.

SECTION 2: INSTALLATION

The XM2000 is designed to be a portable emissions analyzer that can easily be moved from test cell to test cell; however, at each testing location, several external connections must be made. Refer to the plumbing and electrical sections which depict the requirements for each testing location in order for the XM2000 to function properly and safely.

OVERVIEW

A photo showing required external connections is shown below.

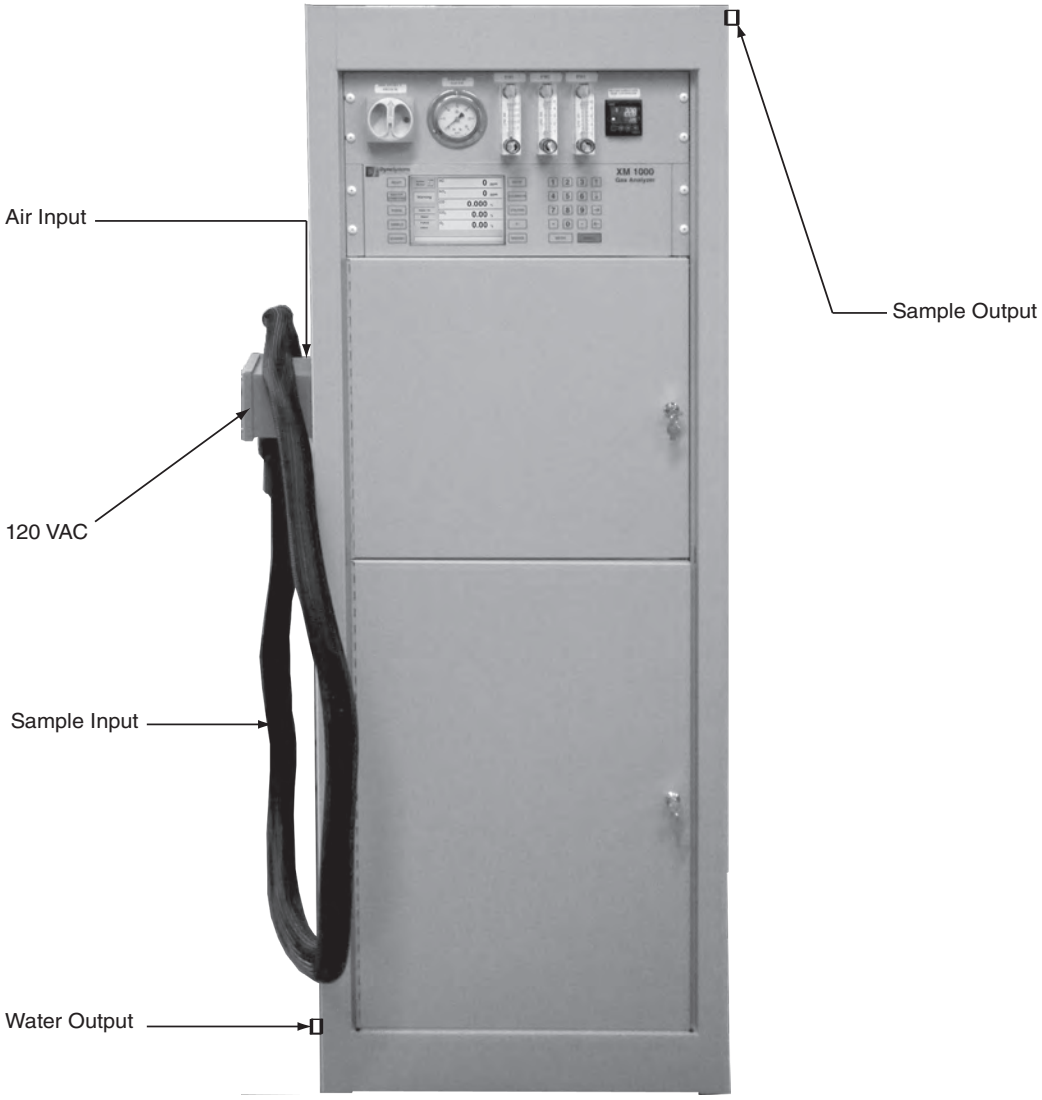


Figure 2.1: XM2000 External Connections

PLUMBING

Several plumbing connections must be made at each test location where the XM2000 operates. The following table summarizes the thread size of each connection.

Connection	Thread Size
AIR INPUT	1/4" NPTF
SAMPLE INPUT	Sample Probe
SAMPLE OUTPUT	1/4" NPTF
WATER OUTPUT	1/4" NPTF

Note: *All plumbing connections must be made before operating the XM2000.*

AIR INPUT

The XM2000 requires a source of fresh air. When operating in PURGE mode, it draws in fresh air from the external connector in order to purge the sample conditioning system and the Andros analyzer of any previously sampled gases. During calibration, this connector can be used as a source of "Zero" air, allowing the analyzer to be zeroed against ambient background concentrations in the test cell. There are several connection options for this connector.

- **Connect a source of fresh air**

A source of fresh air can be piped in from an external source. The fresh air shall not contain any background concentrations of HC, CO, etc. and can be used during calibration to zero the analyzer.

- **Connect a source of background air**

Background air from the vicinity of the device under test can be piped in. During calibration, the analyzer can be zeroed against the background concentrations of HC, CO, etc.

- **Not connected**

Do not connect and simply use the background air in the vicinity of the XM2000.

SAMPLE INPUT

The sample input connection is unique to each device under test. DS will design a sample probe to satisfy your testing requirements.

WATER OUTPUT

All moisture in the sample gas is removed by the sample chiller as described in Sample Conditioning Systems (Section 3). The collected moisture is then removed from the chiller by a dual head peristaltic pump and discharged via this connector.

Note: *The water present at this connector contains small concentrations of soluble sample gases and is corrosive. Do NOT let this liquid simply run onto the floor; it should be collected in a corrosion-resistant container and then properly disposed of.*

SAMPLE OUTPUT

All sampled gases are discharged from this connector. This connector should be connected to a pipe or tube that moves the sample gas to a place where is can be safely ventilated out of the testing area. All gases that are flowed during calibration also exit via this port. Again, many of the calibration gases are extremely harmful if inhaled; thus, the sample output must be connected to a plumbing system that safely removes these gases.

WIRING

The XM2000 requires 115 VAC from a standard outlet. This is the only required electrical connection.

SETTINGS

There are several user accessible settings within the XM2000 system cabinet. All have been properly set at the factory; however, each should be periodically monitored for long-term drift and adjusted if necessary. They are summarized below. Refer to the diagram of the Sample Conditioning System (Section 3) to locate the devices to be adjusted.

Setting	Value	Instructions
Flow Rate	4.0 SCFH	Press the PURGE button to flow air through the XM2000. Adjust the flow meter until the center of the floating ball is at the 4.0 SCFH (standard cubic feet per hour) graduation mark. NOTE: Earlier versions of the XM2000 contained flow meters with metric scales (i.e. LPM). The flow rate for these units should be set to 2.0 LPM (liters per minute).
Sample Line Pressure	5.0 psi	Press the PURGE button to flow air through the XM2000. Adjust the back pressure regulator until the pressure gauge reads exactly 5.0 psi.
Calibration Line Pressure	5.0 psi	Go to the calibration page and flow one of the calibration gases that is connected to one of the calibration ports (calibration procedures are described in Section 6). While the calibration gas is flowing, adjust the calibration gas regulator until the pressure gauge reads exactly 5.0 psi.

***Note*:** *Contact DS if you are not comfortable adjusting any of the settings.*

SECTION 3: THEORY OF OPERATION

This section describes the various components of the XM2000, what function each component performs, and how they work together to function as an emissions analyzer. The information in this section provides a basic theory of operation and should be helpful in troubleshooting a variety of high-level system issues (if any) that may be encountered during normal operation of the XM2000. This section is NOT a service manual; please contact DS for help in troubleshooting problems with individual components.

OVERVIEW

A simplified block diagram of the entire XM2000 is shown below. The six main components of the XM2000 include: the sample probe, heated sample line, sample conditioning system, Andros analyzer, the main computer, and the Operator Control Station (OCS). Each is described in the sections that follow.

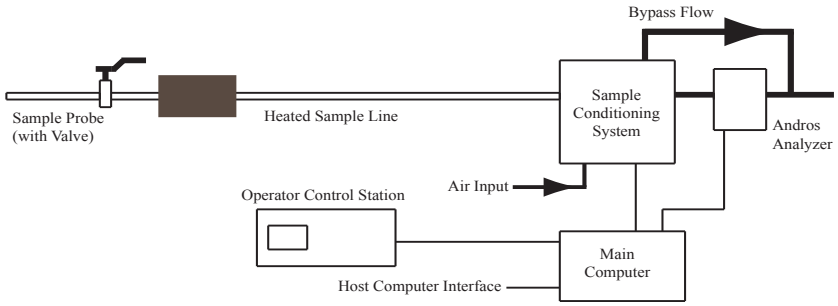


Figure 3.1: XM2000 System Components

Sample Probe

The sample probe generally consists of a stainless steel pipe and a stainless steel ball valve. The exact configuration of the sample probe and valve vary from application to application, depending on their testing needs. The length and diameter of the probe as well as any special probe mounting issues are addressed when the XM2000 is purchased. The valve is mainly used by the Leak Check utility (Section 7). The valve must be closed such that this utility can create and hold a vacuum in the sample line in order to check the sample line for leaks.

Heated Sample Line and Heated Filters

A block diagram of the heated sample line and filter is shown below. The main functions of this subsystem are:

- **Filter the Sample**

The heated pre-filter contains a reusable 2 micron stainless steel filter element. This filter should trap larger emissions debris. It can easily be removed, cleaned, and replaced as needed.

- **Prevent Condensation**

The entire subsystem is heated to 190 °C to keep the temperature of the sampled gas above the dew point of the gas - all the way from the sample probe to the sample conditioning subsystem.

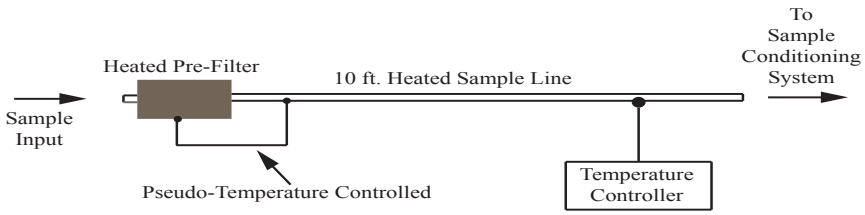


Figure 3.2: Heated Sample Line

Temperature Control

Heating of the sample line can be enabled, disabled by the use of the F1 button on the front panel of the Operator Control Station, as explained in Section 4. When enabled, the temperature controller maintains the temperature of the sample line at 190 °C. The temperature is tightly controlled and should not vary by more than ± 2 °C (depending on ambient temperature conditions). As an additional safety feature, the temperature controller will disable itself if the temperature reaches 205 °C. The controller also checks for broken RTDs (i.e. the temperature feedback source) and for problems in the heater power electronics. The controller will disable itself if problems arise.

*Do **NOT** change any of the setup parameters. The temperature setpoint, alarm settings, tuning parameters, etc. have been correctly set at the factory and should only be modified by DS personnel.*

*When enabled, the heated sample line and filter are **EXTREMELY HOT**. Be especially cautious when touching any of the exposed metal portions of the filter and/or sample line. Always let these components cool down before performing any service or maintenance procedures.*

NOTE: *The temperature of the heated pre-filter is "pseudo" temperature controlled. Its heating element is connected in parallel with the heating element in the heated sample line, so it merely follows along with what temperature controller is doing to the heated sample line. The pre-filter also has a built in over-temperature switch which helps control its temperature. The temperature of the pre-filter can vary by ± 25 °C.*

Sample Conditioning System

A block diagram of the sample conditioning system is shown below. The main function of this subsystem is to remove all moisture from the sample gas and deliver a dry sample to the Andros analyzer. It is also responsible for delivering the sample gas to the Andros at a constant flow rate and pressure.

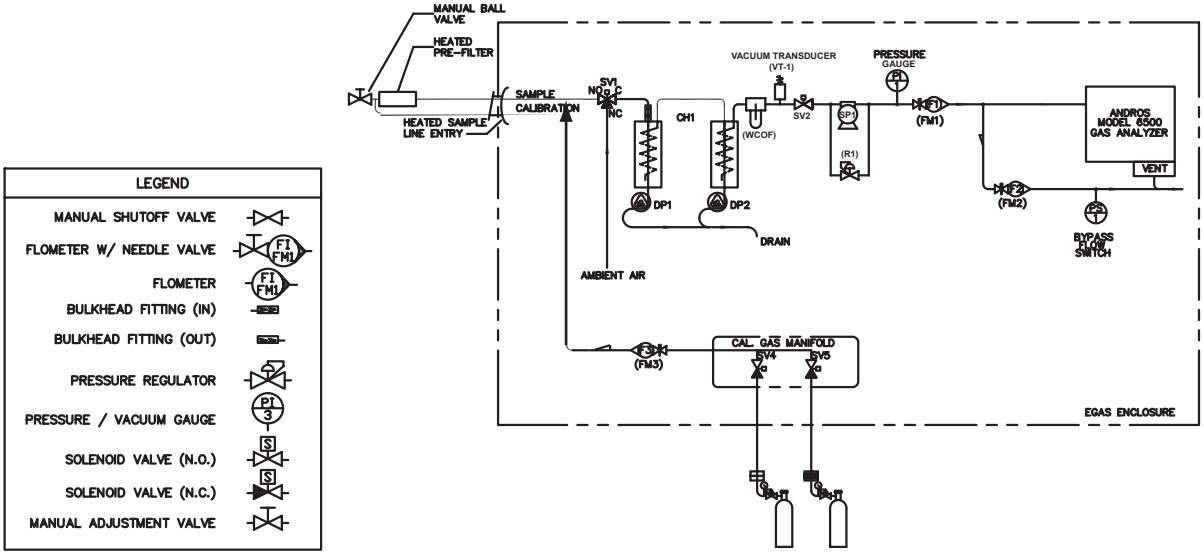


Figure 3.3: Sample Conditioning System

The various components of the sample conditioning system are described below.

- **Sample / Air Select Solenoid**

The sample conditioning system can only draw sample gas from two sources - the heated sample line or ambient air. This solenoid makes the selection. Sample gas is selected during SAMPLE and STANDBY modes of operation; it is also the default solenoid state when power is removed. Ambient air is selected during PURGE mode and when ambient air is flowed during calibration.

- **Water Condensers (passive and active)**

The two-stage chiller consists of two active water condensers. The chiller temperature is factory set at 5 °C. The chillers remove water from the sample gas with minimal loss of soluble gas. The water collects at the bottom of the chillers and is drawn away by the pumps.

- **Dual Head Peristaltic Pump**

The dual headed pump removes all water collected by the chiller. The condensation may still contain traces of soluble sample gases; therefore, it should be collected in a suitable container and properly disposed of.

- **Pressure Transducer**

The pressure transducer continuously monitors the sample line vacuum while the XM2000 is operating. The readings should typically be just a few tenths of a psi (vacuum). Higher readings indicate partial obstructions in the sample line (most likely due to dirty filters). The vacuum readings are also used during the Leak Check utility (Section 7).

- **Leak Check Solenoid**

This solenoid is only used during the Leak Check utility (Section 7). It closes immediately after the sample pump has created a high vacuum in the sample line. It then stays closed while this utility checks for up-stream leaks in the sample line by monitoring the vacuum readings.

- **Sample Pump and Back pressure Regulator**

The sample pump is responsible for pulling sample gas (or ambient air) through the sample conditioning system and on to the Andros analyzer. The Back pressure regulator is adjusted to maintain 5 psig at the downstream side of the pump.

- **Sample / Calibration Select Solenoid**

This solenoid is used during calibration to stop the flow of sample gas and to allow the flow of calibration gases to the Andros analyzer.

- **Pressure Gage**

Monitors the pressure of all gases (sample, air, or calibration) flowing in the system. When any gas is flowing in the system, the pressure should read 5.0 psi.

- **Water Filter and Sensor**

This filter and sensor make the final check for moisture as the sample enters the Andros analyzer. If any moisture is detected, the XM2000 will enter into a fault condition.

- **Flow Meter**

The adjustable flow meter is used to regulate the overall flow of gas in the system. It should be set to 4.0 cubic ft/hr.

- **Bypass Flow Switch**

The system flow rate is set at 4.0 cubic ft/hr. This flow rate provides adequate system response time and also guarantees the Andros analyzer gets a sufficient amount of gas to analyze. Since the Andros only draws sample gas at a rate of approximately 1.6 cubic ft/hr, the excess sample is bypassed through a flow switch at a rate of 2.4 cubic ft/hr (i.e 4.0 - 1.6). If the bypass flow falls below 1.2 cubic ft/hr, the XM2000 will enter into a fault condition. Clearly, this switch provides immediate detection of a blocked sample output line.

- **Calibration Gas Regulator**

Adjusts the pressure of calibration gas during calibration. Should be set at 5.0 psi.

- **Calibration Gas Solenoids and Manifold**

The manifold contains two gas solenoids which are used to select and flow calibration gases from external gas canisters. See Section 6 for a description on how to install and configure calibration gases and how to perform a calibration procedure.

THEORY OF OPERATION (CONTINUED)

Andros Analyzer

The “heart” of the XM2000 is the Andros Model 6500 Automotive Gas Analyzer. The dry sample gas leaves the sample conditioning system and enters the Andros analyzer where the HC, CO, CO_2, O_2, and NO_x concentrations are measured.

Main Computer

The main computer controls and supervises the overall operation of the XM2000. All communications with the Andros analyzer, the Operator Control Station, and (optionally) a remote computer running Cell Assistant is handled by the main computer. It also controls all pumps, solenoids, relays, etc. in the sample conditioning system. Finally, the main computer monitors many system variables (e.g. sample line and filter temperatures, sample line vacuum, etc.) and generates faults if any problems exist.

Operator Control Station

The Operator Control Station (OCS) is the main user interface device for the XM2000. The OCS is fully described in Section 4.

SECTION 4: ANALYZER OPERATION

This section describes the overall operation of the XM2000 analyzer.

TURNING ON THE ANALYZER

The front of the XM2000 contains the main power disconnect and the heated sample line control.

- **POWER**

A turn-style disconnect controls power to the entire XM2000 analyzer. Rotate the disconnect clockwise to apply power to the XM2000. The 'Heated Sample Line' will not function unless power to the entire XM2000 is established; thus, the main power disconnect must always be activated first.

Rotate the disconnect counterclockwise to remove power from the XM2000; power will also then be removed from the heated sample line.

- **HEATED SAMPLE LINE**

The F1 button controls power to the heated sample line (and the heated prefilter). Since a properly heated sample line and pre-filter are needed during normal operation of the analyzer, the F1 button should normally be pressed approximately 40 minutes prior to use.

To disable the heated line press the F1 button a second time. The status of the heated line is displayed on the Operator Control Station (OCS) display.

POWER-UP MODE

Power-Up mode is the initial mode of the XM2000 when system power is first applied. In this mode, the XM2000 checks various hardware components. The mode indicator on the main screen (see Indicators, Section 4) will display the Power-Up mode status. These hardware checks occur in just a fraction of a second, so the Power-Up mode indication may not always be visible since the XM2000 quickly transitions to Warm-Up mode afterwards.

Power-Up Requirements

The following hardware components are tested during Power-Up mode. If and when all hardware checks succeed, the XM2000 transitions to Warm-Up mode.

- Andros Analyzer

The XM2000 attempts to establish communications with the Andros analyzer. The XM2000 cannot exit Power-Up mode until the Andros analyzer responds to commands via the serial connection. A notification message is displayed on the OCS every 2 seconds if the Andros fails to respond. If this occurs, check the power and serial connections to the Andros analyzer. The XM2000 is unusable until Andros communications is established. Contact DS if this notification message appears and persists.

- Heated Sample Line and Heated Filter Temperature Controller

The XM2000 checks the status signal from the heated sample line temperature controller. The status signal will only be valid if the controller is enabled and functioning properly. The operation of the temperature controller is described in Section 3.

WARM-UP MODE

Immediately after the brief Power-Up mode, the XM2000 enters Warm-Up mode. In this mode, the XM2000 waits until the heated sample line, and the chiller reach their proper operating temperatures. A system monitor is available to monitor the progress of various components as they warm up (or cool down).

Warm-Up Requirements

The following tables lists the warm-up requirements for various components. The heated sample line must warm up to the indicated values. Similarly, the chiller must cool down to the indicated value. These values are not the normal operating values, they are merely the minimum required values that must be obtained in order for the XM2000 to exit Warm-Up mode and enter Standby mode. The normal operating values are listed later in this section.

Monitored Value	Value to Exit Warm-Up	Time
Sample Line Temperature	185 °C	40 min
Chiller Temperature	6 °C	15 min

The preceding table also lists the approximate time required to reach the Warm-Up mode exit values. The chiller reaches the respective values fairly quickly; whereas, the heated sample line is significantly slower to warm up. These times are approximate and will vary depending on the ambient temperature of the test cell where the XM2000 is located. This is especially true for the heated sample line. The heated sample line can take significantly longer to warm up if located in cooler ambient surroundings.

System Monitor

The XM2000 continuously monitors several operating parameters. The normal operating value of each parameter is listed below.

Monitored Value	Nominal Value
Sample Line Temperature	190 °C
Chiller Temperature	5 °C
Sample Vacuum	See text below.

All temperatures are electronically controlled and should be maintained within a few tenths of a degree celsius. The sample vacuum is measured in PSIV (pounds per square inch - vacuum). When the sample pump is running, the vacuum reading should be less than 0.5 PSIV. This reading will depend on the length and diameter of the sample line. A typical reading may be only 0.2 PSIV. The vacuum readings will increase over time as the sample line becomes dirty and/or the filters become clogged with exhaust debris. Experience will be gained (after some time) in how to use the sample vacuum readings to determine the necessity to clean and/or replace the filters and sample tubes.

Monitored Limits

Once the XM2000 has exited Warm-Up mode and has entered a normal operating mode, the following temperature and pressure limits are continuously monitored.

Monitored Limit	Value
Sample Line Temperature - High Limit	200 °C
Sample Line Temperature - Low Limit	180 °C
Chiller Temperature - High Limit	7 °C
Chiller Temperature - Low Limit	3 °C
Sample Vacuum - Warning Level	2.0 PSIV
Sample Vacuum - Failure Level	4.0 PSIV

If any of the monitored temperatures fall out of range, a fault condition will occur. The XM2000 will not operate until the fault condition is cleared. In addition, if the temperature of the heated sample line or the heated filter fall below their respective lower limits, the XM2000 will return to Warm-Up mode as described in this section.

A warning condition will occur if the sample vacuum reaches the listed warning level value. As explained in this section, a warning condition will be indicated in order to remind the operator of a potential problem; however, the XM2000 analyzer will continue to operate. If the sample vacuum reaches the listed failure level, a fault condition will occur and the XM2000 will no longer operate. High sample vacuum readings are typically caused by dirty and/or clogged sample lines and filters.

Displaying the System Monitor

All monitored operating parameters can be displayed in a popup dialog by touching the following button located in the upper-left corner of the main display.

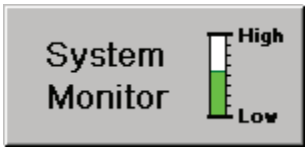


Figure 4.1 - Button Used to Display Monitored Operating Parameters

The following "System Monitor" will then be displayed. All displayed values are continuously updated. Each has been previously discussed; however, the "Analyzer Temperature" value has not been previously described and is NOT monitored by the XM2000. This temperature reading is made internally by the Andros analyzer. The Andros will report analyzer temperature errors via the "ambient temperature out of range" fault as explained in this section.

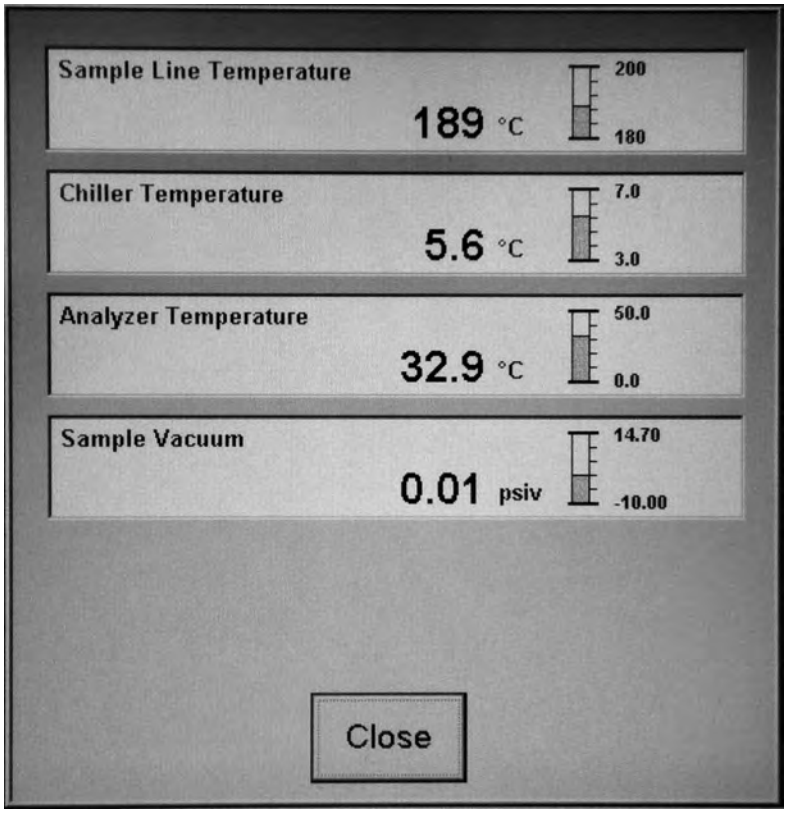


Figure 4.2 - Example of the System Monitor Display

OPERATOR CONTROL STATION

The front panel of the OCS is shown below. The two main components are the LCD display (with touch screen) and the membrane keypad buttons. Each component is discussed below.

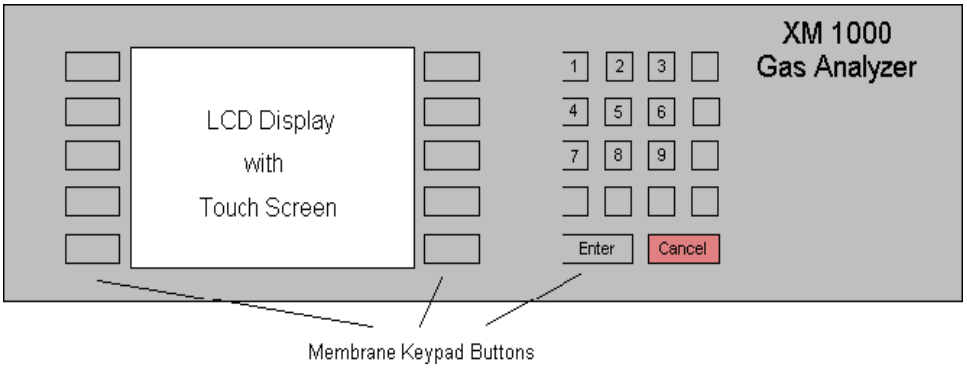


Figure 4.3 - Operator Control Station Front Panel

LCD Display with Touch Screen

The most prominent front panel component is the 6.4" active matrix LCD display. Concentration readings, analyzer status, and other information are displayed here. The layout of the main analyzer screen is described in this section. The display also contains a resistive touch screen. Touch screen buttons are large enough to be touched by a finger. On some screens, a touch screen stylus can be used for more precise manipulation of screen controls; however, the stylus is not absolutely necessary. All screen controls can easily be manipulated using various membrane keys (e.g. ENTER, CANCEL, and the arrow keys).

***Note*:** *In order to avoid ambiguity in describing the operation of some screens, the word "touch" is used to refer to the activation or pressing of touch screen buttons; whereas, the word "press" is used to refer to the pressing of membrane keypad buttons.*

Membrane Keypad

The LCD display is surrounded by groups of membrane buttons. These buttons are activated when they are firmly pressed. The membrane keypad buttons are divided into three groups.

- Analyzer Operation buttons
- Special Function buttons
- Numeric Keypad buttons

Analyzer Operation Buttons

This group of five buttons is used during normal operation of the XM2000 analyzer. They are located to the left of the LCD display. The function of each is described below.

When the RESET button is pressed, a reset command is sent to the XM2000. The reset command will attempt to clear any faults that may exist. The message lines of all connected OCS's will be cleared.

Press this button to toggle the XM2000 between Master and Computer modes. See Indicators in this section for more information on Master and Computer modes.

Press this button to purge the sample conditioning system by flowing air through the system. Purge mode is explained in Indicators, Section 4.

Press this button to flow and analyze the sample gas. Sample mode is explained in Indicators, Section 4.

Press this button to cancel purge and sample modes. Standby mode is explained in Indicators, Section 4.

Special Function Buttons

This group of five buttons provide access to special function and utilities. They are located to the right of the LCD display. The function of each is described in the sections that follow.

Press this button to gain access to XM2000 setup parameters. Accessing and modifying setup parameters is explained in Section 5.

***Note*:** *Some parameters affect the run-time operation of the XM2000; thus, access to the XM2000 setup page is denied if the XM2000 is currently operating (i.e. purging or sampling).*

***Note*:** *XM2000 setup parameters are secured; thus, a password may be required to access the XM2000 setup page. Security is discussed in Section 9.*

Press this button to gain access to all calibration features. Analyzer calibration and the setup and management of calibration gases is explained in Section 6.

Press this button to gain access to all available utilities (e.g. HC Hangup Test or Sample Line Leak Check). All system utilities are described in Section 7.

Press this button to turn On / Off the heated sample line

Press this button to gain access to all available service tools. Service tools are described in Section 8.

Numeric Keypad Buttons

These keys are used to enter numeric data (e.g. concentrations, test parameters, etc.) on many dialogs. All data entry will be entered into the appropriate edit box. The Left Arrow button can be pressed to erase the previously entered key; the CANCEL button can be pressed to erase the entire contents of the selected edit box.

The arrow keys provide many functions based on the context of the currently displayed dialog. For example, the Up and Down arrow keys are used to select items from lists. All of the arrow keys are used to navigate through the parameter tree during setup. When appropriate, the Left arrow button performs a “Backspace” function by deleting the previously entered numeric key. Each of these examples (and many more) are explained in other areas of this manual.

The ENTER button provides many functions in various contexts. For example, pressing ENTER finalizes numeric data entry. The ENTER button also duplicates the function of touch screen buttons in various situations. In each case, the function of the ENTER button should be obvious.

The CANCEL button is typically used to clear the entire contents of a numeric entry edit box. It is also used to duplicate the function of some touch screen buttons (e.g. Cancel, Quit, etc.) is some contexts. On some dialogs, the CANCEL button will do both; that is, if a data entry box is empty, pressing the CANCEL button will dismiss the currently displayed dialog by duplicating the function of a touch screen Done, Cancel, or Quit button. On the other hand, if a data entry box is not empty, pressing the CANCEL button will first clear the contents of the edit box; then pressing the CANCEL button again, will dismiss the dialog box as previously described.

MAIN ANALYZER SCREEN

The main analyzer screen (shown below) is displayed during normal operation of the XM2000. All displayed graphic objects (e.g. concentration readings, indicators, duration counter, etc.) are described in the sections that follow. The System Monitor button is described in this section.

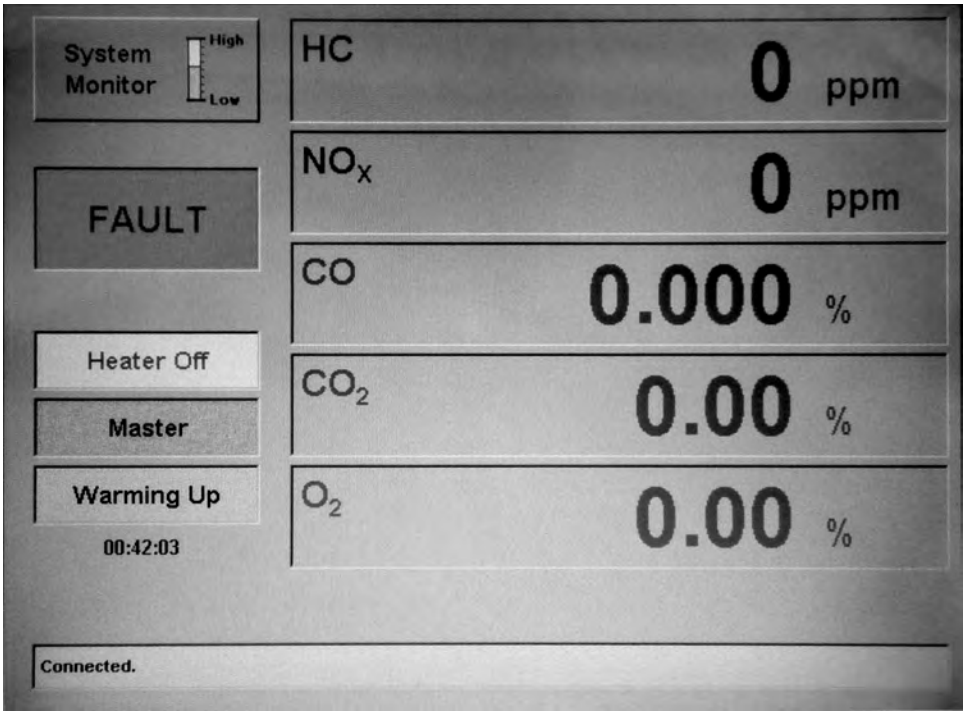


Figure 4.4 - Main Analyzer Screen

Concentration Readings

A typical concentration reading is shown below.

The name of the measured gas is located in the upper-left corner of the reading (e.g. O_2). The concentration reading is the largest displayed item in the overall reading. The units of the measured concentration value is located immediately to the right of the reading (e.g. %). The reading may also contain a status message in the lower-left corner. During normal operation of the analyzer, the status message area will be blank. A list of possible status messages is presented later in this section.

Background Colors

The background color of the reading provides additional information.

White

Default background color for all concentration readings when the XM2000 is operating (i.e. Purging or Sampling).

Light Gray

When the XM2000 is not operating (i.e. in Standby mode), the background color is light gray. This color indicates that the XM2000 is no longer acquiring concentration data from the Andros analyzer. Also, the text color of the reading value is changed from black to a dark gray to reinforce the fact that the readings are no longer being updated.

Yellow

When the XM2000 is operating, the background color of a reading will change from white to yellow when the reading for the respective gas is no longer valid. A status message will also be displayed. Status messages are described in this section. The background color of the reading will not return to white until the error condition is resolved.

Status Messages

During normal operation of the XM2000, the status message area of each concentration reading is blank; however, the following status messages may appear if error conditions exist. These status messages are reported to the XM2000 by the Andros analyzer. Refer to the Andros Product Manual for additional information about the cause of each error condition.

- Data Invalid

The Andros is reporting that the concentration readings for this gas are invalid. Refer to the table in the Andros Product Manual for possible causes.

- Span Fail

This error is reported by the Andros after a failed span calibration operation. Refer to the Andros Product Manual for possible causes.

- Zero Fail

This error is reported by the Andros after a failed zero calibration operation. Refer to the Andros Product manual for possible causes.

Indicators

The left portion of the main screen contains three indicators.

FAULT/Warning/OK

This indicator continuously shows the current error state of the XM2000. All three possible appearances are shown below. If no error or warning conditions exist, “OK” will be displayed as shown in the left example. The middle example shows the indicator state if one or more warning conditions exist. Warnings may require operator attention, but they do not interrupt the operation of the XM2000. Warnings are described in this section. The right-most example shows the indicator state if one or more fault conditions exist. Faults require immediate operator attention. XM2000 operation will be halted if any faults occur. Faults are described in this section.

***Note*:** *This indictor is also a button. When touched, a fault list dialog pops up over the main screen. The contents of the fault list dialog are discussed in analyzer operation buttons (this section).*

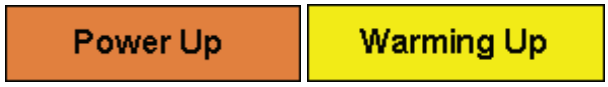
Master/Computer

Indicates the Master/Computer mode of the XM2000 as shown in the following examples. The XM2000 will typically always be in Master mode. Computer mode is only used if the XM2000 is remotely controlled by a host computer running Cell Assistant (refer to Section 11). For more information about the Master and Computer mode see Analyzer Operation buttons (this section).

Standby/Purge/Sample

Indicates the current operating mode of the XM2000. During normal XM2000 operation. This indicator will have one of the following three appearances. Standby, Sample, and Purge are the three main modes the XM2000 will be in at any given time. They are described in Analyzer Operation (this section).

Immediately after power is applied, the XM2000 enters a power-up state immediately followed by a warm-up state. The XM2000 mode indicator annunciates these states as shown below. Power-Up mode and Warm-Up mode are described in this section.



Duration Counter

The duration counter displays the amount of time (in hours, minutes, and seconds) the XM2000 operates in each mode (except Standby mode). The counter is reset to 00:00:00 whenever a new operating mode is selected. It stops whenever the XM2000 returns to Standby mode.

***Note*:** *The duration counter also runs during Warm-Up mode and stops when the XM2000 warms up and enters Standby mode. The duration counter can then be used to measure the XM2000 warm-up time.*

Fault List

A pop up dialog containing a list of all active faults and/or warnings is displayed by touching the OK/Warning/FAULT indicator. When this indicator turns bright red or yellow (as shown in Indicators (this section), the operator typically displays the fault and warning list in order to determine the exact cause (or causes) of the error condition.

A sample fault list dialog is shown below. Faults (if any) are listed first followed by all warnings (if any).

Note*: Press the RESET button to try to clear all existing faults and warnings.*

Figure 4.5 - All active faults and/or warnings are displayed by touching the OK/Warning/FAULT indicator.

Message Line

The message line displays error messages and other notifications from the XM2000. Most errors are caused by disallowed command attempts (e.g. pressing the SAMPLE button while a fault exists). Notifications, on the other hand, can appear at any time and are not necessarily caused by any recent operator input. Each message will list an error number and appropriate error text. A comprehensive list of error messages is presented in Section 12.

The message line is cleared when the RESET button is pressed.

The message line is also a button. When touched, a message list dialog pops up over the main screen.

Message List

The message line lists the most recent error or status message from the XM2000. In situations where several messages occur in quick succession, only the last message can be viewed. A queue of the previous 16 messages is maintained in the OCS. Touch the Message Line indicator to pop up a Message List dialog as shown below.

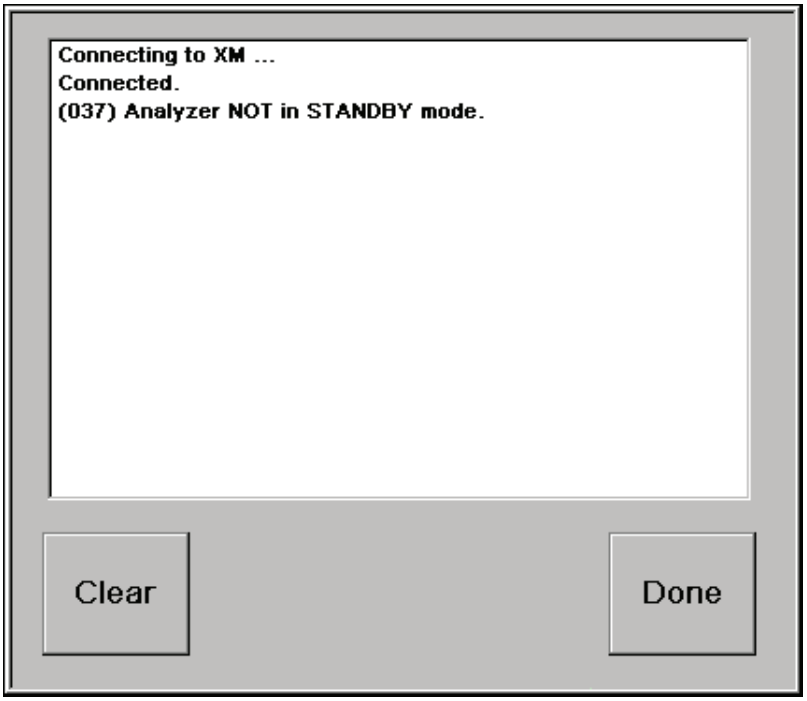


Figure 4.6 - Touch the Message Line indicator to pop up the Message List Dialog

The oldest message is at the top of the list, followed by successively newer messages. Touch the Clear button to clear the message queue and/or touch the Done button to dismiss the dialog.

***Note*:** *The message list is useful when diagnosing problems. It is rarely used during normal operation of the XM2000 because most error and status messages persist long enough in the Message Line for the operator to view them.*

ANALYZER OPERATION

Master and Computer Modes

At any given time, the XM2000 will only accept analyzer commands (e.g. purge, sample, or standby commands) from one type of external source. When in Master mode, the XM2000 will only accept commands from the OCS. When in Computer mode, the XM2000 will only accept analyzer commands from a host computer connected to the (optional) computer port on the side of the XM2000.

This feature is intended to give a host computer a higher priority over the OCS when both types of devices are connected. Whenever an analyzer command arrives from a host computer, the XM2000 is automatically switched to Computer mode. Subsequent analyzer commands from the OCS will be rejected. In order for the XM2000 to accept analyzer commands from the OCS, the OCS or the host computer must specifically command the XM2000 to return to Master mode. This usually requires a simple (but deliberate) button push on the OCS by an operator.

The Master/Computer OCS button is shown in Analyzer Operation (this section).

***Note*:** *It is rarely necessary to put the XM2000 into Computer mode. The XM2000 will automatically switch to Computer mode whenever an analyzer command is received from a host computer. This button is usually pressed to return the XM2000 to Master mode prior to issuing an analyzer command from the OCS.*

Analyzer Modes

The XM2000 is always in one of three modes: Sample, Purge, or Standby. Sample and Purge are considered to be "operating" modes since the sample pump is running and concentrations are being measured. Standby mode is the default mode when the XM2000 is not operating.

Standby

Standby mode is the default mode of the XM2000. All pumps are off and all solenoids are in their default (i.e. not energized) position. Standby mode can be commanded at any time by pressing the STANDBY button on the front panel. The XM2000 will also transition from an operating mode (i.e. sampling or purging) to standby automatically if any fault conditions are detected.

Sample and Purge Modes

Sample and Purge modes are the "operating" modes of the XM2000. The sample pump is running and drawing gas from one of two sources (i.e. sample gas or ambient air). The Andros analyzer is also running and measuring concentrations of the selected gas. Referring to Figure 3.3: Sample Conditioning System, the only difference between Sample and Purge mode is the state of the Sample/Air Select Solenoid. In sample mode, this solenoid selects gas from the "Sample Input" (which is connected to the heated sample line and filter). In purge mode, this solenoid selects gas from the "Air Input".

Enable Requirements

To command sample or purge modes of operation, press the SAMPLE or PURGE mode button respectively. Before the XM2000 will enter the selected mode, the following requirements are checked and must be satisfied. If not, the sample or purge command will be rejected and an appropriate error message will be displayed.

- XM2000 must NOT be in a special function mode (e.g. Calibrate, Service, Setup, etc.)
- XM2000 must NOT still be in Power-up or Warm-up modes (see this section).
- No faults can exist.
- Master Enable is asserted (if it is used as explained in this section).

If the previous requirements are satisfied, the XM2000 will enter the selected mode of operation. The Andros analyzer will begin to measure concentrations. All displayed readings are now valid and will be enabled (i.e. white background) as described in Background Colors (this section).

SETUP PARAMETERS

The XM2000 has very few setup parameters. Most XM2000 installations use the factory default settings, and therefore, do not require any modification of these parameters.

Path: \\XM2000\Analyzer\

Parameter	Values	Description
HC Readings	n-Hexane Propane	Selects if HC readings should be reported as HC (n-hexane) or as propane. See Andros product manual for more information. Default selection: n-Hexane.
Ignore Master Enable	Yes, No	Selects if the XM2000 requires the "Master Enable" input to be asserted in order to operate. The Master Enable input is described in Analyzer Operation Buttons, in this section. Default: Yes

FAULTS AND WARNINGS

Various errors can occur during normal operation of the XM2000 analyzer. Each error is classified as a Fault or a Warning. Faults have an immediate impact on the operation of the XM2000. When a fault occurs, the fault indicator will turn bright red as shown in Indicators (this section). If currently operating (e.g. purging, sampling, calibrating, etc.), the XM2000 will immediately return to Standby mode. The fault list should then be displayed as described in Fault List (this section). Consult the tables in this section for a description of possible causes of each listed fault. All fault conditions must be removed and the fault list must be cleared in order for the XM2000 to resume operation.

Warnings do not have an immediate impact on the operation of the XM2000. When a warning condition exists (and no fault conditions exist), the fault indicator will turn bright yellow as shown in Indicators (this section). The XM2000 will continue to operate; however, the yellow warning indicator provides a continuous reminder that a potential problem exists which should be investigated as soon as possible. Consult the tables in Faults and Warnings (this section) for a description of possible causes of each listed warning.

***Note*:** *After all faults and warnings have been investigated, press the RESET button to clear the list. Any fault or warning conditions that persist will not be cleared.*

***Note*:** *The XM2000 will not operate (e.g. sample, purge, calibrate, etc.) until all fault conditions have been removed and the fault list has been cleared.*

Faults

A description of all XM2000 faults is presented in the tables that follow.

Fault	Description
lost OCS (and Host) communication	While operating (e.g. purging, sampling, calibrating, etc.), the XM2000 has determined that all connected OCS's and/or host computers are no longer communicating with the XM2000. This is not allowed. While operating, at least one OCS or host computer must continuously communicate with the XM2000. If not, the XM2000 will generate this fault and return to Standby mode.
heated line is not enabled	The heated sample line has not been turned on or the temperature controller is disabled due to an error. If no errors exit in the temperature controller hardware, the heated sample line must be enabled or bypassed (as explained in Section 4) in order for the XM2000 to operate. If the heated sample line has disabled itself due to an error, refer to Theory of Operatioon (Section 3). The theory of operation of the temperature controller is presented there along with some troubleshooting information. The temperature controller hardware contains no user serviceable components; contact DS for additional help.
heated line over-temperature	The temperature of the heated sample line has risen above the allowable limit (listed in Monitor Limits this section). This fault will persist until the temperature decreases and returns to the normal operating range. If the temperature continues to increase, the temperature controller hardware will eventually shut down the heated sample line as described in Monitor Limits (this section).
heated line under-temperature	The temperature of the heated sample line has dropped below the allowable limit shown in Monitor Limits (this section). The XM2000 will return to warm-up mode until the temperature increases. .
chiller temperature too high	The temperature of the chiller has risen above the allowable limit (this section). This fault will persist until the temperature decreases and returns to the normal operating range. An improperly cooled chiller creates the risk of moisture entering the remainder of the sample conditioning system.
chiller temperature too low	The temperature of the chiller has dropped below the allowable limit (this section). The chiller and/or chiller electronics may be malfunctioning. Contact DS for additional help.
no signal from vacuum transducer	The vacuum transducer is disconnected, is broken, or has lost its +24 vdc excitation.
sample vacuum too high	The sample vacuum has exceeded the allowable limit (listed in this section). Check the heated sample line and all filters for obstructions. Clean or replace the filters as needed. Make sure the check valve is fully open.
insufficient bypass flow	The bypass flow switch has tripped. Check for obstructions at or near the SAMPLE OUTPUT port. If there are no obstructions, review Settings (Section 2) and check that the Flow Rate is set correctly.
water detected in water slip filter	Moisture has been detected in the Water Carry Over Filter (WCOF). Verify that the sample chiller is operating properly since the chiller should remove all water from the incoming sample.
loss of master enable input	The Master Enable input signal was de-asserted while the XM2000 was operating (i.e. purging or sampling). The Master Enable signal is described in Analyzer Operation Buttons (this section).
calibration timeout	During calibration, a ZERO or SPAN operation MUST be initiated within 90 seconds after the respective calibration gas has started to flow. Excessive flowing and discharge of span gases is generally unnecessary and wasteful and perhaps dangerous (if not properly vented). This timeout prevents an operator from starting a calibration process (i.e. flowing calibration gas) and then "walking away" and forgetting to complete the process and stop the flow of calibration gas.

FAULTS AND WARNINGS (CONTINUED)

The faults listed in the following table are detected and reported by the Andros analyzer. Consult the **Andros Product Manual** for additional information regarding possible causes and remedies of each fault.

Fault	Description
in-flow fault	There has been a substantial reduction in inlet-side pressure.
out-flow fault	There may be an occlusion at the output of the Andros analyzer.
infrared (IR) signal lost	IR signal is lost or weak.
ambient temperature out of range	The ambient temperate is outside the range 0 to 50 °C.
system fault	An Andros hardware failure has occurred.
IR source temperature exceeds 75 °C	IR source temperature is too high. Power down the XM2000 for approximately 1/2 hour to let the Andros cool and then re-apply power. If the problem persists, contact DS.

Warnings

A description of all XM2000 warnings is presented in the following table.

Warning	Description
zero calibration requested	This warning is periodically generated by the Andros analyzer. A zero calibration procedure should be carried out as soon as possible as described in Zero Calibration (Section 6). The Andros issues this warning for many reasons review the section in Zero Calibration (Section 6).
new NO_x sensor required	The full-scale output of the NO_x sensor has dropped significantly since it was installed. The NO_x sensor should be replaced as soon as possible.
new O_2 sensor required	The output of the O_2 sensor has dropped significantly since it was installed. The O_2 sensor should be replaced as soon as possible.
sample vacuum at warning level	The sample vacuum has exceeded the warning limit (listed in Monitor Limits (this section). Check the heated sample line and all filters for obstructions. Clean or replace the filters as needed. Make sure the check valve is fully open.
previous leak check failed	The previous leak check of the sample line failed. The XM2000 will still operate; however, there is a risk that the sampled gases are being diluted with ambient air. Perform another leak test (see Section 7) as soon as possible and correct any leaks that exist in the sample line and connections.

SECTION 5: SETUP

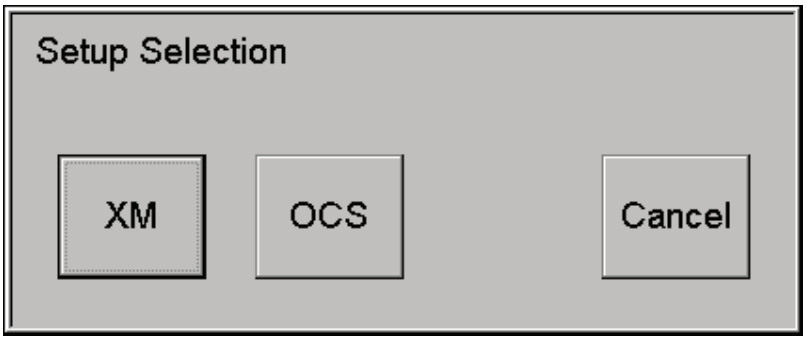
XM2000 SETUP PARAMETERS

The XM2000 contains many parameters that can be modified by an operator. Most only need to be changed one time when the XM2000 is initially installed and set up. It is important for the operator to understand the organization of these parameters, how to navigate through them to find the parameter of interest, and how to change the selected parameter.

Accessing the XM2000 setup Page

The XM2000 setup parameters are accessed as follows.

1. Press SETUP. The system displays the Setup Selection dialog box.



2. Touch the “XM2000” button. The system displays the main setup page.

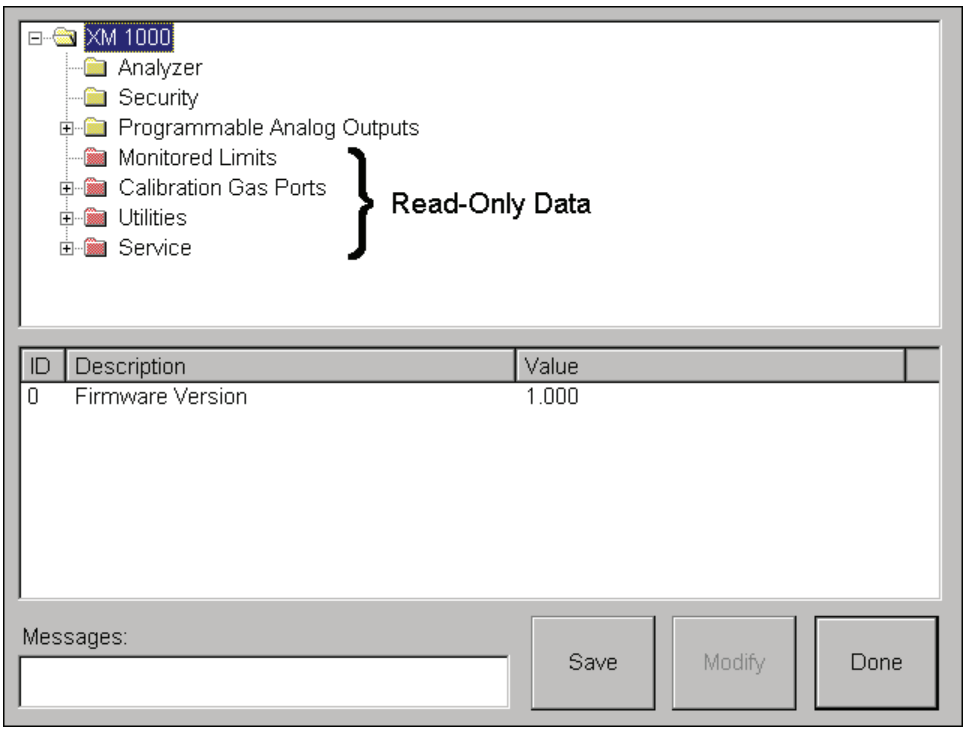


Figure 5.1 - Main Setup Screen

Setup Tree Basics

All XM2000 configuration parameters are organized using a standard Windows™ style configuration tree (top portion of previous figure). Each folder may contain configuration parameters and/or other sub-folders. If a folder does contain configuration parameters, these parameters will appear on the Parameter List (bottom portion of previous figure) when the folder is selected. Some folders only contain other sub-folders (i.e. they contain no parameters).

Folder Colors

Yellow is the standard color for all property folders; however, some folders appear in red. Red folders contain only non-modifiable data items (i.e. they are for display/information purposes only). Additional information about various non-modifiable data types is provided in Section 5.

Parameter List

The parameters in a selected folder (if any) are listed on the lower portion of the Setup page. The parameter list has three columns.

- ID
- Description
- Value

Setup Tree and Parameter List Navigation

If a stylus is available, the setup tree and the parameter list can be manipulated just as a computer mouse is used to manipulate standard Windows™ controls. In most cases, a stylus is not available and/or is not practical due to the small size of the display objects. In this case, membrane keys are used to navigate the parameter list. Each navigation method is described below.

Stylus Navigation

Setup tree folders can be expanded and collapsed by touching the +/- boxes to the left of each folder. Folders with no sub-folders do not have a +/- box next to them. Parameter list items are selected by touching the parameter ID field of the appropriate parameter. Double-click the parameter ID field to modify the current value.

Keypad Navigation

Complete navigation of the setup tree, selection and editing of parameter values can be accomplished without a pointing device (i.e. a stylus). Keypad and touch screen keys provide the same functionality.

Selecting a Folder

When the cursor is on the setup tree, the following keypad keys are used to navigate through the entire setup tree.

Moves the cursor to the previous folder. All parameters (if any) in this folder are displayed in the parameter list.

Moves the cursor to the next folder. All parameters (if any) in this folder are displayed in the parameter list.

Expands the selected folder.

Collapses the selected folder.

Collapses the entire setup tree and places the cursor on the top-level folder.

***Note*:** *Because of the limited viewing space available, it is often easier to collapse the entire setup tree and navigate to another parameter than to use the arrow keys to go from one folder to another.*

Selecting a Parameter

When you have selected the folder containing the parameter(s) you wish to modify, press the ENTER key. The cursor will move to the first parameter in the list. The following keypad keys can now be used to navigate through the parameter list.

Moves the cursor to the previous parameter.

Moves the cursor to the next parameter.

Returns the cursor to the setup tree.

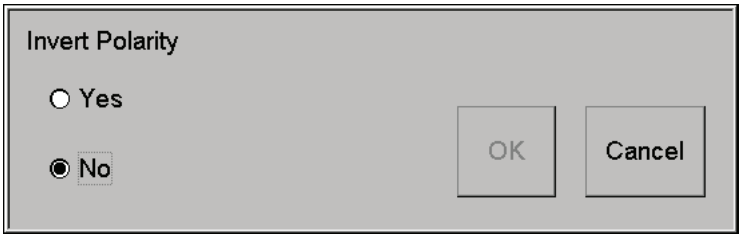
When you have selected the parameter you wish to modify, press the ENTER key or touch the Modify button. An appropriate dialog will pop up that allows the parameter to be modified. The various types of parameters and the associated dialogs that modify each data type are discussed in the next section.

Data Types

Every XM2000 parameter is stored as one of four possible data types. Each data type and the dialog presented to modify it are discussed below.

Binary

This data type is a logic value that can only have one of two possible values (e.g. YES or NO, ON or OFF, etc.). The following figure shows the pop up dialog for modifying binary data types. The parameter name is displayed in the upper-left corner of the dialog.



Press the Up and Down arrow keys to toggle between the two available values. Touch the OK button to accept the parameter change; touch the Cancel button to quit without making any changes.

Note: *The ENTER and CANCEL keypad buttons duplicate the function of the OK and Cancel touch screen buttons.*

Number

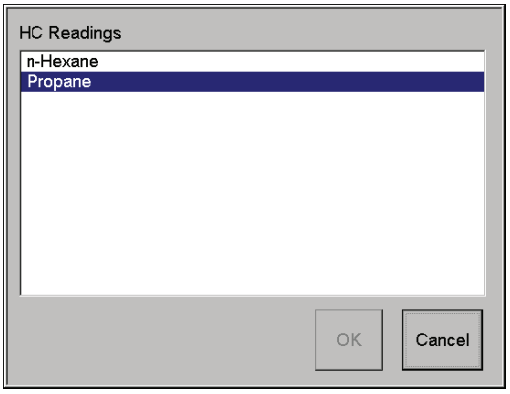
This data type is a decimal number. The allowable range and decimal precision depends on the specific parameter. The following figure shows the pop up dialog for modifying number data types. The parameter name is displayed in the upper-left corner of the dialog.

Press the numeric keys to enter a new value. Press the Left arrow key to erase the previously entered digit or press the CANCEL button to erase all previously entered digits. Touch the OK button to accept the parameter change; touch the Cancel button to quit without making any changes.

Note: *The ENTER and CANCEL keypad buttons duplicate the function of the OK and Cancel touch screen buttons. The CANCEL button must be pressed twice - the 1st press clears the entered data and the 2nd press dismisses the dialog box.*

List

This data type can have one of several values that can be selected from a list of allowable values. The following figure shows the pop up dialog for modifying list data types. The parameter name is displayed in the upper-left corner of the dialog.

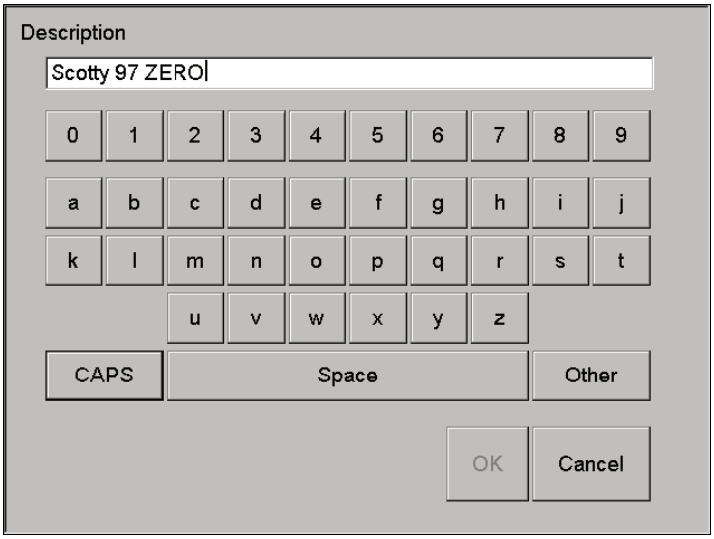


Use the Up and Down arrow keys to change the selection. Touch the OK button to accept the parameter change; touch the Cancel button to quit without making any changes.

***Note*:** *The ENTER and CANCEL keypad buttons duplicate the function of the OK and Cancel touch screen buttons.*

String

This data type is simply a string of printable characters. The maximum string length allowed depends on the parameter type; the maximum length is typically 40 characters. The following figure shows the pop up dialog for string data types. The parameter name is displayed in the upper-left corner of the dialog.



This dialog presents a virtual keypad for entering alphanumeric data and other printable characters. Touch the CAPS key to access upper-case letters. Touch the "Other" button to access punctuation marks and other unique printable characters. A Space bar is also available. When done, touch the OK button to accept the parameter change or touch the Cancel button to quit without making any changes.

***Note*:** *The ENTER and CANCEL keypad buttons duplicate the function of the OK and Cancel touch screen buttons. The CANCEL button must be pressed twice - the 1st press clears the entered data and the 2nd press dismisses the dialog box.*

***Note*:** *The numeric keypad buttons can also be pressed to enter numeric strings.*

Non-Modifiable Data Types

Many data items are present in the tree/list of configuration parameters which are not really configuration parameters at all (e.g. part numbers, revision numbers, test results, etc.) These data items cannot be changed by the user and/or cannot be changed from the Setup page. Any attempt to modify them will result in one of the following error messages.

- **Read-only parameter. Modification not allowed.**
  Parameter is for display and documentation purposes only (e.g. the Firmware Version number cannot be changed).

- **Factory setting. Modification not allowed.**
  Factory settings such as temperature and pressure limits cannot be changed.

- **Parameter is managed by another page.**
  Some data items can be changed, but not from the Setup page. For example, calibration gas concentrations are listed in the Setup tree but can only be modified from the appropriate calibration page.

***Note*:** *Some property folders contain only non-modifiable data items. These folders are colored red in the property tree. The red-colored folder serves as a reminder that none of the data items contained in the folder can be modified. See Folder Colors in this section for additional information.*

Saving Setup Parameters

Touch the Save button in order to save ALL setup parameters to onboard non-volatile memory. Do this as often as necessary to avoid accidental loss of parameter changes. Parameter changes take affect immediately after they are made; however, if the changes are not saved to non-volatile memory, they will be lost when power to the XM2000 is removed.

***Note*:** *In some situations, it may be desirable to make temporary parameter changes and deliberately NOT save the changes to non-volatile memory. The XM2000 power can then be cycled in order to remove the temporary changes and, thus, restore all parameters to their original state.*

***Note*:** *Touching the Save button saves ALL setup parameters to non-volatile memory. It is not possible to make several temporary parameter changes and then later try to make (and save) some permanent parameter changes. Pressing the Save button at this time will save ALL previous changes to non-volatile memory.*

Backing Up and Restoring Setup Parameters

The entire contents of non-volatile memory (i.e. all setup parameters) can be saved to and restored from a disk file if necessary. There are several reasons to do this.

- **Recover from catastrophic hardware failure.**
  If the non-volatile memory device is damaged or destroyed, all setup parameters can be restored after the hardware is repaired.

- **Recover from accidental parameter changes.**
  The XM2000 has built-in security features to prevent unauthorized personnel from changing setup parameters; however, if parameters are still accidentally changed for any reason, they can be restored from the disk file.

The software application that provides the backup/restore capability explained above is called "Cell Assistant". This application runs on a Windows™ NT computer. It communicates via a serial cable connected to one of the (optional) host computer ports on the side of the XM2000. See Section 11 for information on Cell Assistant.

***Note*:** *Another backup/restore software utility is available to customers not requiring the Cell Assistant product. Contact DS for more information.*

When saving all setup parameters to a disk file, the default file name is "XM2000_Config.xm". Change the filename to something more descriptive and informative prior to saving; however, do not change the *.xm file extension.

Top Structure of the Setup Tree

It is important for the person (or persons) responsible for setup and configuration of the XM2000 to become familiar with the organization of all setup parameters. Complete familiarity with the organization of the setup tree will make it easier to locate parameters of interest as needed. The top of the setup tree is shown below. Parameter searches typically begin from this level since this is the initial tree state when the setup page is first displayed.

***Note*:** *Pressing the CANCEL button collapses the tree to the state shown below. It is often easier to collapse the tree and start from the beginning when searching for and modifying several parameters.*

SECTION 6: CALIBRATION

OVERVIEW

In order to maintain the short-term and long-term accuracy of all concentration readings, the XM2000 analyzer must be periodically calibrated. This section describes how to manage calibration gases and how to use them to zero and span the analyzer.

Zero Calibration

Zero calibration compensates for short-term conditions that affect gas concentration measurements (e.g. changes in ambient temperature). The Andros analyzer Product Manual recommends a zero calibration be performed as follows:

- Immediately prior to each automotive exhaust gas emissions test.
- Immediately prior to taking any important set of gas concentration data.
- Immediately prior to performing a span calibration.

In addition to the previously mentioned reasons, the XM2000 will generate a “zero calibration requested” warning (see Section 4) whenever the Andros reports that a zero calibration should be performed. The Andros will make this request under the following conditions:

- Immediately after power is applied.
- After being in Standby mode for more than 2 minutes.
- After a ± 5 °C change in ambient temperature.
- After 30 minutes since the last zero calibration.

As described in Calibrate Analyzer (Section 5), the zero calibration procedure requires a “zero gas” to be flowed through the Andros analyzer. The XM2000 provides up to two choices for this gas. First, ambient air from the AIR INPUT port can be flowed and used as a zero gas. This selection is always available during calibration. Optionally, a canister containing a zero gas can be connected and configured as explained in Managing Calibration Gasses (Section 5)

***Note*:** *Because the Andros analyzer spans O_2 during a zero calibration procedure, each source of “zero” gas must contain 20.90% O_2.*

Span Calibration

Span calibration compensates for normal long-term component drift during the normal operating life of the analyzer. The Andros analyzer Product Manual recommends a span calibration be performed as follows:

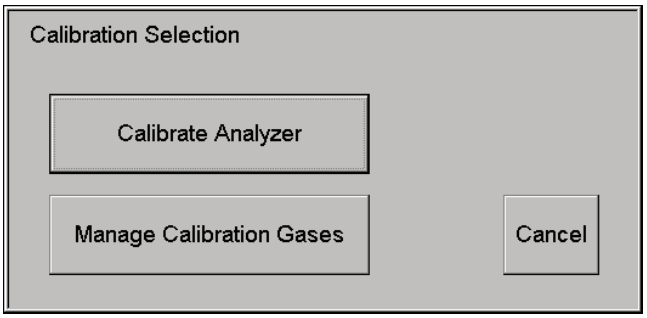
- As mandated by government programs (regarding your test).
- HC, CO, and CO_2 channels: once every 6 months.
- NO_x channel: after replacement of the NO_x sensor and once a month during normal operation.
- Immediately after any span calibration has failed.

As described in Calibrate Analyzer (Section 5), the span calibration procedure requires a "span gas" to be flowed through the Andros analyzer. The XM2000 provides two calibration ports to connect canisters containing various blends of span gases. Configuring span gas data is explained in Managing Calibration Gases (Section 5).

***Note*:** *The Andros analyzer spans O_2 during zero calibration.*

Accessing Calibration

Press the CALIBRATE button on the front panel of the Operator Control Station. A dialog box containing all available calibration selections will be displayed. Touch the appropriate button to launch the desired selection.



MANAGING CALIBRATION GASES

The XM2000 has connections for two external calibration gas canisters. Replace Calibration Gas Cylinder (Section 10) explains how to connect and/or replace a calibration gas canister. Once connected (or replaced), the operator must proceed to this page and define the contents of the calibration gas.

The following procedure describes how to define the contents of the gas canisters (if any) that are connected to each calibration gas port.

(Next Page)

1. Select the "Gas Port" to be configured by touching the "Port 1" or "Port 2" buttons.

Optionally, the Left and Right arrow keys can be pressed to select the appropriate calibration gas port.

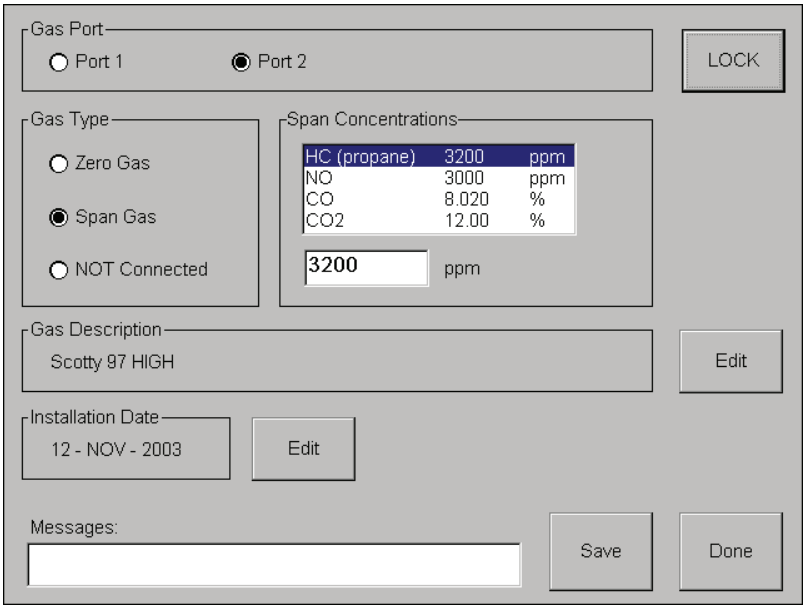


Figure 6.1 - Defining the Contents of the Gas Canisters

2. Touch the “UNLOCK” button to enable access to all data for the selected port. The lock feature is used as an attempt to prevent accidental modification of calibration data.

3. Select the “Gas Type” for the selected port. The following table explains each choice.

Gas Type	Description
Zero Gas	The canister connected to this port contains a zero gas. A zero gas typically contains pure nitrogen (i.e. zero concentrations of HC, CO, CO_2, and NO_x). Note that the Andros always spans O_2 when it zeros the analyzer; therefore, any connected zero gas must contain 20.90% oxygen.
Span Gas	The canister connected to this port contains a blend of span gases. The concentration of each gas must be entered.
NOT Connected	Nothing is connected to this port. Touch the "Save" button followed by the "LOCK" button and configuration is complete for this port.

4. If a span gas canister is connected, enter the concentrations of each of the four listed gases. Enter ’0’ if the canister does not contain the specified gas. Use the Up and Down arrow keys to select the various gases, use the numeric keypad to enter the appropriate concentrations, and then press the ENTER key set the concentration of the selected gas.

5. Touch the “Edit” button to enter a description for the connected gas. This description will be displayed as a calibration selection on the actual calibration page.

6. Touch the other “Edit” button to set the installation date of the canister.

7. Touch the “LOCK” button when all data has been entered.

8. Touch the “Save” button to save all configured calibration gas data in non-volatile memory.

CALIBRATE ANALYZER

The following procedure describes how to calibrate the analyzer.

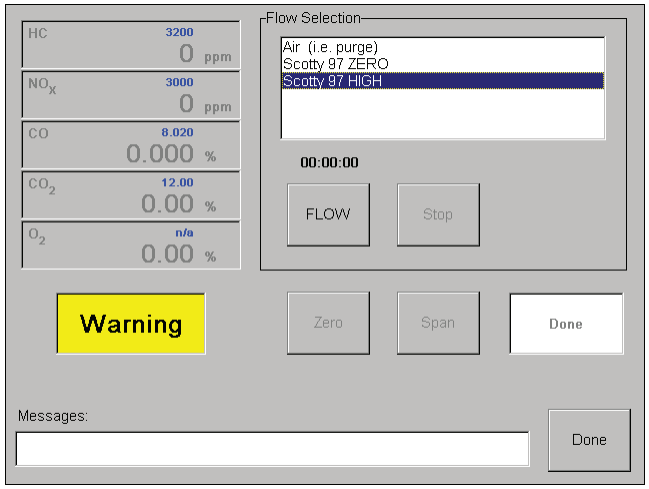


Figure 6.2 - Main Calibration Screen

1. Make a “Flow Selection” using the Up and Down arrow keys. The first item in the list (i.e. Air) is always present and can be used as a source for zero calibration. One or two additional flow selections will exist depending on how the calibration ports have been configured. Each calibration gas canister that has been connected and configured as described in Managing Calibration Gases (Section 5) will appear in this list.
   Notice that the configured concentrations for the current flow selection appear in blue just above each concentration reading.

2. If gas from a calibration gas canister is selected, check that the canister valve is open.

3. Touch the FLOW button. The indicator will display “Wait”.

4. Wait for the indicator to change to “Ready to Zero” or “Ready to Span” (which depends on the type of selected calibration gas that is currently flowing). This time period is controlled by the Andros analyzer. When the Andros is ready, the indicator will change to one of these messages.

5. When ready, manually check the readings and wait for them to stabilize. A minimum of 30 seconds is typically required for span gas concentrations to stabilize. Additional waiting may achieve greater stabilization; however, waiting more than 60 seconds is typically unnecessary (and a waste of calibration gas).

6. When the readings are stable, touch the ZERO or SPAN button (only one will be enabled depending on the type of calibration gas that is currently flowing). The indicator

will change to “Zeroing” (or “Spanning”).

7. Wait for the indicator to change to “Done”.

8. Touch the “STOP” button to stop the flow of calibration gas.

9. Close the valve on the calibration gas canister (if needed).

***Note*:** *Make sure the valves on all calibration gas canisters are closed when calibration is complete.*

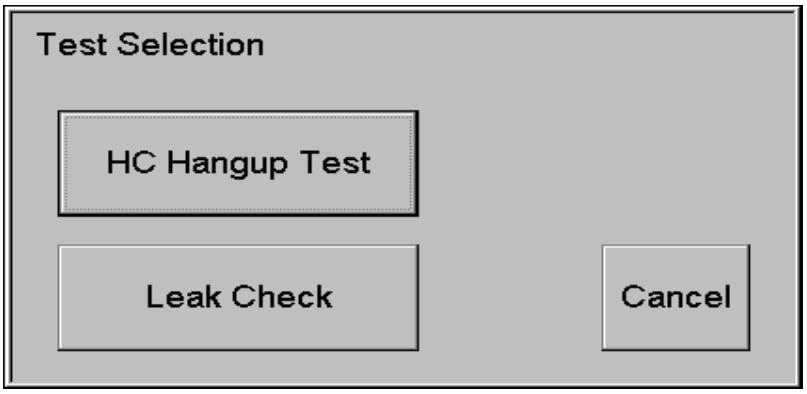
***Note*:** *The ZERO or SPAN button MUST be touched within 90 seconds after the respective calibration gas has started to flow. If not, a “calibration timeout” fault will occur. Additional information for this fault is presented in Faults (Section 4).*

SECTION 7: UTILITIES

The XM2000 utilities are a collection of tests that should be run periodically to check the integrity of various XM2000 system components.

ACCESSING UTILITIES

Press the UTILITIES button on the front panel of the Operator Control Station. A dialog box containing all available utilities will be displayed. Touch the appropriate button to launch the desired utility.



HC Hangup Test

The HC Hangup test is used to measure the magnitude of residual hydrocarbons that have accumulated (i.e. are “hung up”) in the sample line. This build up of hydrocarbons cannot be zeroed out during calibration; thus, all HC concentration readings are continually affected. The HC Hangup test should be run periodically to monitor the magnitude of hung up hydrocarbons. When the HC reading becomes unacceptable, the teflon tube in the sample line should be cleaned and/or replaced.

The main test screen for the HC Hangup test is shown below.

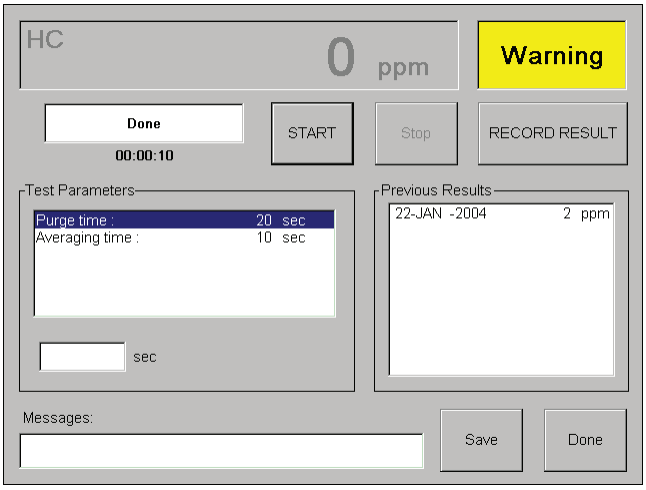


Figure 7.1 - Main Test Screen for HC Hangup Test

Test Sequence

The indicator displays the current state of the test. The various test states are described in the following table.

Test State	Description
Ready	Initial test state when the HC Hangup test screen is initially displayed. The test is waiting for the operator to touch the START button.
Purging	The first phase of the test. The sample pump is turned on to draw fresh air through the sample line. The HC readings are not monitored during this test phase. NOTE: The "Purging" phase of this test is NOT the same as Purge mode for the XM2000. When the XM2000 is in Purge mode, it draws fresh air from the AIR INPUT port and through the sample conditioning system (i.e. it only purges the sample conditioning system). The purge state of this test assumes the sample probe is removed from the device under test and is connected to (or near) a source of fresh air such that the sample conditioning system AND the sample line are both purged.
Averaging	After the configured "Purge time" has expired, the test begins to average the HC readings for a fixed period of time (specified by the "Averaging time" parameter).
Done	The "Averaging time" has expired so the test is done. The final average HC reading is displayed and can be saved if necessary.
Failed	The test has been terminated due to an internal error.

Test Parameters

The following test parameters can be modified as needed. In general, the duration of the purge and average states should be adjusted as needed to get the most stable readings. For example, longer sample lines may require the Purge time to be increased. Each test parameter is changed by first selecting the parameter using the Up and Down arrow keys, entering the new value, and then pressing the ENTER button. Finally, touch the Save button to save the new parameter value in nonvolatile memory.

Test Parameters	Range	Description
Purge time	10 to 600 sec	The length of time the test purges the entire sample line and sample conditioning system before it begins to measure (and average) the HC concentration readings. Default = 30 sec
Averaging time	2 to 300 sec	The length of time the test measures (and averages) the HC concentration readings. Default = 10 sec

Performing the Test

The HC hangup test is performed as follows.

1. Remove the sample probe from the device under test and place it at (or near) a source of fresh air. This ensures that all HC readings are due to hung up hydrocarbons in the sample line and are not coming from another source.

2. Touch the START button. Wait for the test to complete.

3. If you are NOT interested in recording the result, touch the “Done” button to exit the test.

4. If you wish to save the result for comparison with other tests in the future, touch the RECORD RESULT button. The HC reading will be added to the list of “Previous Results”.

5. Touch the Save button to guarantee the recorded results are saved into non-volatile memory.

6. Touch the Done button to exit the test.

***Note*:** *Touch the STOP button at any time to cancel the test.*

Previous Results

The results from up to ten previous tests can be displayed here. Recording and saving the results of previous tests is optional. They are only used for comparison with future tests to estimate the amount and the accumulation rate of residual hydrocarbons.

Leak Check

In order for the XM2000 to accurately measure the concentrations of collected sample gases, it is imperative there be no leaks in the system such that ambient air enters the system and dilutes the sample. The sample conditioning system is leak tested at the factory; however, many of the external components in the sample path are routinely handled for many reasons (e.g. filter replacement) and can easily develop leaks at one or more connection point.

The leak check tests the following components and all associated connection points. Refer to figure 3.3: Sample Conditioning System (Section 3) to identify the location of each component.

- Sample line valve
- Heated pre-filter
- Sample line
- Sample/Air select solenoid
- Chillers
- Peristaltic pump hose
- Pressure transducer
- Leak check solenoid.

The leak check is performed by creating and holding a vacuum in the sample line and other components listed above. The change in vacuum is continuously monitored for a fixed period of time. If the final vacuum drop is less than a predefined limit, the leak check has passed; otherwise, the leak check is considered a failure.

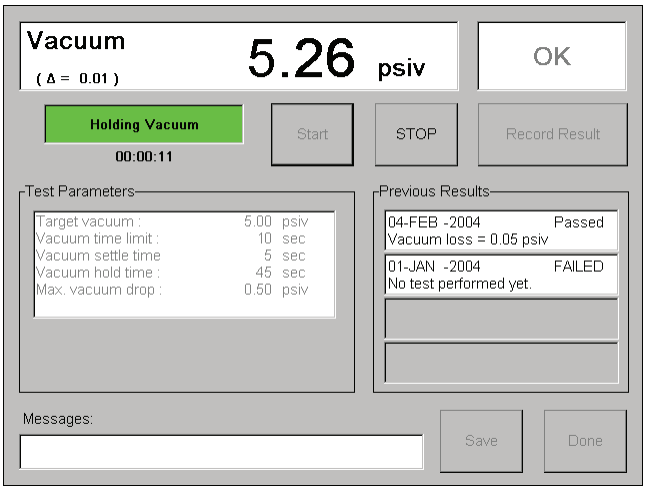
Note: *If the previous leak check failed (and the failed results are recorded), the XM2000 will continuously generate a "previous leak check failed" warning as explained in Warnings (Section 4). This warning serves as a continuous reminder that all concentration readings are suspect since ambient air may be leaking into the sample line and diluting the measured gases.*

If enabled, the heated sample line is VERY HOT. Use extreme caution when attempting to tighten up fittings, re-seat filters, etc., in order to fix any leaks in the various components.

Note: *Improperly installed filters are a frequent source of leaks. If a filter has recently been cleaned or replaced, check that it has been properly seated.*

Also, the rubber O-ring in the heated pre-filter is a common source of leaks. Make sure the O-ring is clean and properly seated when closing the pre-filter.

The main screen for the leak check utility is shown below. The vacuum in the sample line is continuously displayed. The change in vacuum (i.e. Δ vacuum) is shown in parentheses. It is only displayed during the "Holding Vacuum" portion of the test; otherwise, it is blank.



Test Sequence

The indicator displays the current state of the test. The various test states are described in the following table

Test State	Description
Ready	Initial test state when the leak check screen is initially displayed. The test is waiting for the operator to touch the START button
Creating Vacuum	The sample pump is enabled in order to create the initial "Target vacuum" in the sample line. As soon as the target vacuum is achieved, the leak check solenoid is closed and the sample pump is turned off.
Vacuum Settling	The test pauses for a few seconds immediately after achieving the target vacuum in order to let the vacuum reading settle. After the settling time has expired, the initial vacuum reading is made. All changes to the vacuum reading that occur during the remainder of the test are referenced to this initial reading.
Holding Vacuum	The test waits and monitors any drop in the initial vacuum reading.
Passed	The "Vacuum hold time" has expired and the final computed vacuum loss is within acceptable limits.
FAILED	The test was cancelled or the "Vacuum hold time" has expired and the final computed vacuum loss is NOT within acceptable limits.

Test Parameters

The following test parameters are set at the factory and cannot be modified.

Test Parameters	Value	Description
Target vacuum	5.0 PSIV	The initially created vacuum that must be held during the test.
Vacuum time limit	10 sec	The test is given this amount of time to create the target vacuum. If the time limit expires before the target vacuum is achieved, the test has failed. The operator should look for one or more significant leaks in the system.
Vacuum settle time	5 sec	After the target vacuum is achieved, the sample pump is turned off and the leak check solenoid is closed. Afterwards, the XM2000 pauses for the specified amount of time in order to give the vacuum reading time to settle. When the settling time has expired, the XM2000 makes the initial vacuum reading. All computed changes in vacuum are referenced to this initial reading.
Vacuum hold time	45 sec	The leak check test waits for the specified time while continuously monitoring the drop in vacuum.
Max. vacuum drop	0.5 PSIV	The maximum allowable vacuum loss during the test. If the vacuum loss after 45 seconds is greater that this value, the test is considered a failure. Depending on the final magnitude of the vacuum loss, check for small leaks at all connection points. Tighten up all connections and repeat the test as often as needed.

Performing the Test

A leak check of the sample line is performed as follows.

1. Close the valve at the end of the sample line.

2. Touch the START button. Wait for the test to complete.

3. If you are NOT interested in recording the result, touch the “Done” button to exit the test.

4. If you wish to save the result for comparison with other tests in the future, touch the RECORD RESULT button. The results of this test will then be added to the list of “Previous Results”.

5. Touch the Save button to guarantee the recorded results are saved into non-volatile memory.

6. Touch the Done button to exit the test.

***Note*:** *Touch the STOP button at any time to cancel the test.*

Previous Results

The results from the four previous tests are displayed here. Recording and saving the results of previous tests is optional. They can be used for comparison with future tests.

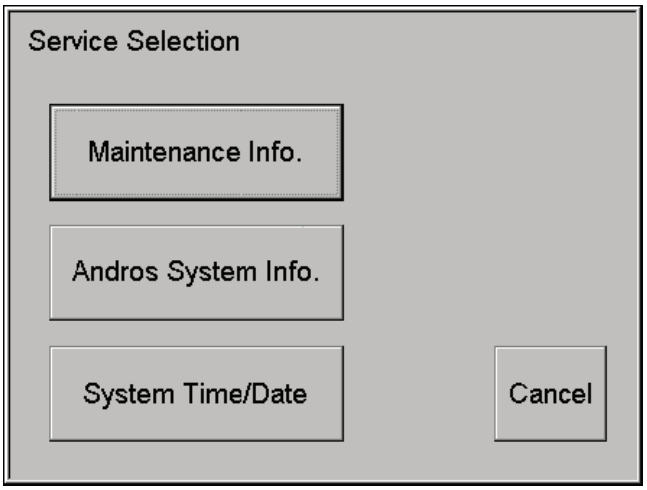
SECTION 8: SERVICE

OVERVIEW

Service tools provide access to system settings and system features that rarely need to be modified during normal operation of the XM2000.

Accessing Service Tools

Press the SERVICE button on the front panel of the Operator Control Station. A dialog box containing all available service tools will be displayed. Touch the appropriate button to launch the desired service tool. Each tool is explained in the sections that follow.



MAINTENANCE INFORMATION

The maintenance information page provides replacement instructions for both of the replaceable Andros sensors (i.e. the NO_x and O_2 sensors). The installation date and the expected life of each sensor is displayed allowing an operator to anticipate approximately when a new sensor should be ordered. Eventually, the XM2000 itself will generate a warning when either of the senors is in need of replacement.

The maintenance page is shown below. Replacement instructions for the NO_x sensor are currently displayed. Press the down arrow key to display the replacement instructions for the O_2 sensor. The replacement procedures for both sensors is also listed in Maintenance Procedures (Section 10). The last step of each procedure requires the operator to return to this page, select the appropriate sensor, and then touch the “Installation Complete” button.

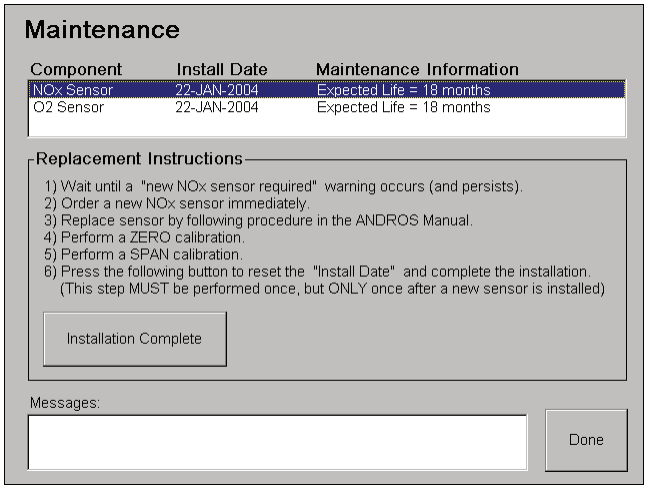
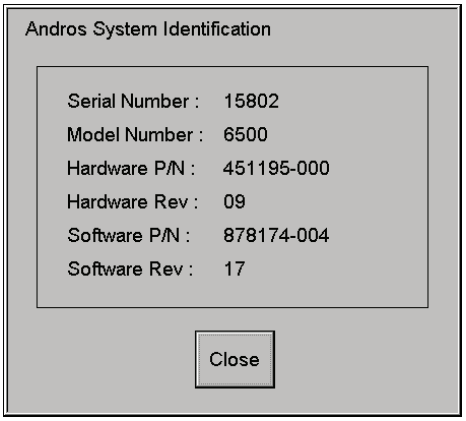


Figure 8.1 - Maintenance Screen

ANDROS SYSTEM INFORMATION

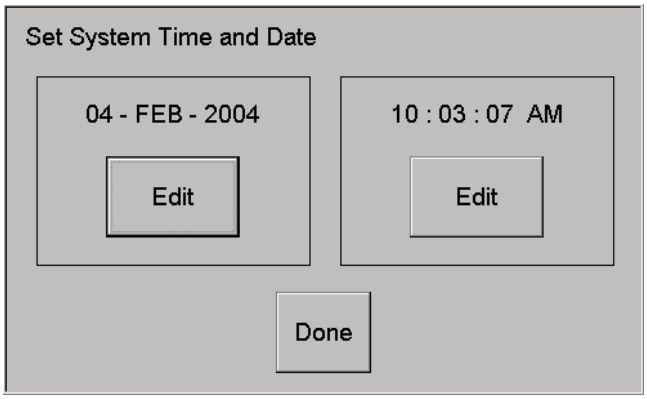
The Andros system identification data is retrieved from the Andros analyzer when the XM2000 is powered up. This information may be useful in some service situations; however, it typically will NOT be needed during the normal operating life of the XM2000.



SET SYSTEM TIME/DATE

The system time and date are initially set at the factory. Immediately after delivery of your XM2000, the time and date may need to be adjusted due to changes in the time zone where the XM2000 is located. Adjustments for “day light savings” may also be necessary during the year. Finally, small adjustments to the system time may occasionally be needed due to clock drift.

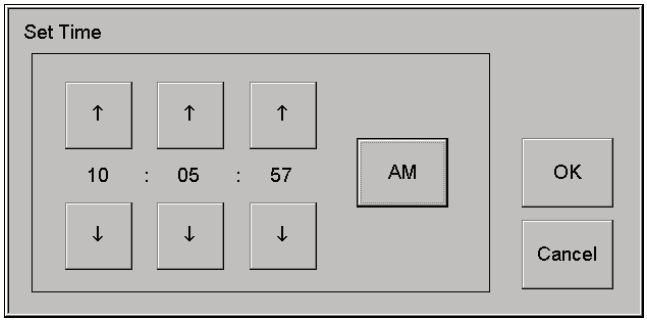
The following page displays the current system time and date. Touch the appropriate “Edit” button to modify the date or time.



System Time

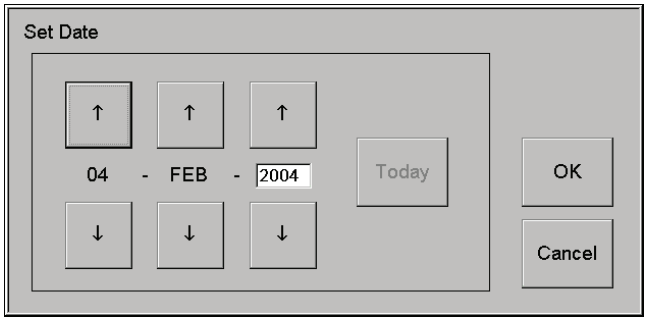
The following dialog is used to change the system time. Touch the appropriate up and down arrow buttons to adjust the hours, minutes, and seconds. Touch the AM button to toggle the AM/PM setting.

Note: *The "seconds" value will continue to increment allowing the hours and minutes value to be changed without modifying the seconds value; however, once the seconds value is modified, it will stop updating and the new value will take effect after the OK button is touched.*



System Date

The following dialog is used to change the system date. Touch the appropriate up and down arrow buttons to adjust the day, month, and year. The keypad can also be used to manually enter the year value.



Note: *The "Today" button (shown in a disabled state in the previous figure) is used when editing installation dates for calibration gas canisters. An operator can manually enter an installation date or simply touch the "Today" button to use the current date.*

SECTION 9: SECURITY

Setup, Calibration, Utilities, and Service are secured features in the XM2000. Each can be individually secured giving the XM2000 administrator total control over which features and functions are available to an ordinary operator.

SETUP PARAMETERS

All security parameters and their location are listed below.

Path: \\XM2000\Security\

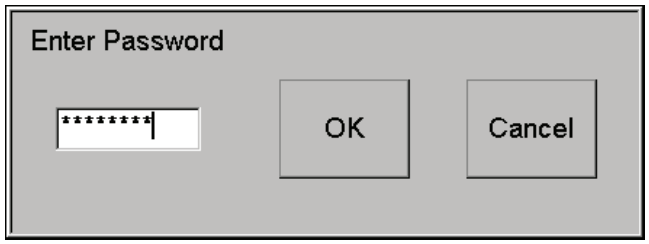
ID	Description	Values	Description
0	Secure Mode	On, Off	Displays the current security state of the system. Must be set to "On" to secure selected features.
1	Password	********	Existing password. Consists of 4 to 10 digits. Factory default = "1234".
2	Secure SETUP?	Yes (always)	Access to SETUP parameters is always secure when "Secure Mode" is set to "On".
3	Secure CALIBRATE?	Yes, No	Selects if calibration functions are secured when "Secure Mode" is set to "On".
4	Secure UTILITIES?	Yes, No	Selects if utility functions are secured when "Secure Mode" is set to "On".
5	Secure SERVICE?	Yes, No	Selects if service tools are secured when "Secure Mode" is set to "On".
6	Powerup Secure Mode	On, Off	Initial security state of the XM2000 at power up.

ACCESSING A SECURE SYSTEM

To access a secure system, follow the procedure listed below.

1. Press SETUP.

2. Touch the XM2000 selection button. The “Enter Password” dialog box is displayed.



3. Enter the password using the numeric keypad buttons and touch OK. If the entered password is correct, the XM2000 main setup page will be displayed.

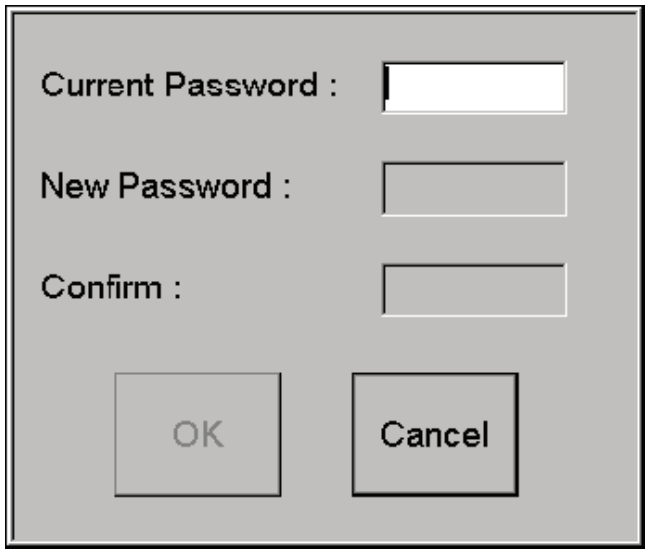
***Note*:** *The factory default password is “1234”. If the security feature is going to be used, the default password should be changed to a more secure value as soon as possible.*

***Note*:** *If the existing password is misplaced or forgotten, contact DS.*

When the previous procedure has been successfully completed, the XM2000 is no longer in secure mode. The operator has full access to all XM2000 features including setup parameters, calibration, utilities, and service tools. When all changes have been made, the XM2000 can be re-secured as described in Securing the XM2000 (Section 9).

Changing the Password

When a password modification is attempted, the XM2000 displays the following dialog box.



1. Enter the current password and press ENTER.

2. Enter the new password. It must be a 4 to 10 digit number. Press ENTER.

3. Enter the new password again in the Confirm field.

4. Touch OK.

***Note*:** *When done, touch the "Save" button on the main setup page to guarantee that the new password is saved in non-volatile memory.*

Securing the XM2000

The XM2000 security feature can be (re-)enabled as follows.

1. Set the "Secure CALIBRATE?" parameter to the desired value.
2. Set the "Secure UTILITIES?" parameter to the desired value.
3. Set the "Secure SERVICE?" parameter to the desired value.
4. Set the "Secure Mode" parameter to "On".
5. If this is the first time the security feature is being enabled, the "Powerup Secure Mode" parameter must be set to "On".

***Note*:** *When done, touch the "Save" button on the main setup page to guarantee that all new security settings are saved in non-volatile memory.*

***Note*:** *Be sure to set the "Powerup Secure Mode" parameter to "On" to totally secure the XM2000. If not, the XM2000 can be put in a non-secure mode by simply cycling the power.*

SECTION 10: MAINTENANCE PROCEDURES

OVERVIEW

There are many maintenance procedures that must be periodically performed throughout the normal operating life of the XM2000. Each is described in this section.

MAINTENANCE PROCEDURES

Clean or Replace Pre-Filter Element

The filter element in the heated pre-filter element can be replaced (or removed for cleaning) as described below:

1. Power down the XM2000 and unplug the power cord.
2. Wait for the heated in-line pre-filter to cool down.

Note: *The heated pre-filter and the internal filter element can be EXTREMELY HOT! Wait for the filter and the filter element to completely cool before attempting to replace the filter element.*

3. Firmly grasp the pre-filter outer shell. Grasp the valve and sample probe assembly and turn counter-clockwise. The top of the in-line filter should screw out. Do not lose the O-ring. The filter element will simply fall out.
4. Clean the stainless steel filter element (or replace) as needed.
5. Re-attach the top of the in-line pre-filter. Hand tighten only; it should not be necessary to use excessive forces (e.g. pipe wrenches).
6. Power up the XM2000.
7. Perform a leak check (Section 7) to make sure all connections are properly sealed.

Replace Water Carry-Over Filter

When the water filter element becomes clogged, flow faults will occur. This filter element is replaced as explained below.

1. Power down the XM2000 and unplug the power cord.
2. Unscrew the bowl assembly.
3. Unscrew the filter retainer screw.
4. Replace the filter.
5. Repeat steps 2 and 3 (in reverse order) to seal the new filter element.

Replace Calibration Gas Cylinder

Calibration gas cylinders eventually become empty and must be replaced as follows:

1. Power down the XM2000 and unplug the power cord.

2. Close the valve on the gas cylinder to be replaced.

3. Using a 9/16” open-end wrench, disconnect the regulator assembly from the canister.

4. Connect the regulator assembly to the new canister.

***Note*:** *These disposable (Non-Refillable) Compressed Gas Cylinders MUST be properly disposed of (per U.S. Regulations). See the Scott Gas website (www.scottgas.com) or call Scott Technical Service at (877) 715-8651 for information regarding the proper disposal of the canisters.*

Replace O_2 Sensor

The O_2 sensor in the Andros analyzer is an electro-chemical sensor. It has a limited life that begins when the sensor is removed from its storage container. The Andros analyzer will inform the XM2000 main computer when a new sensor should be installed. The XM2000 will then generate a warning. Additional information available in Maintenance Information (Section 8). When this warning occurs, a new O_2 sensor should be ordered as soon as possible.

***Note*:** *The replacement procedure for an O_2 sensor is also presented in Maintenance Information (refer to Section 8).*

A new O_2 sensor is installed as follows:

1. Power down the XM2000 and unplug the power cord.

2. Remove the existing O_2 sensor. Follow the instructions in the Andros Product Manual.

3. Install the new O_2 sensor. Follow the instructions in the Andros Product Manual.

4. Power up the XM2000.

5. Perform a zero calibration procedure (Section 6).

6. Go to the Maintenance Information page (Section 8) and select the O_2 sensor.

7. Touch the “Installation Complete” button to record the installation date.

Replace NO_x Sensor

The NO_x sensor in the Andros analyzer is an electro-chemical sensor. It has a limited life that begins when the sensor is removed from its storage container. The Andros analyzer will inform the XM2000 main computer when a new sensor should be installed. The XM2000 will then generate a warning (Section 4). When this warning occurs, a new NO_x sensor should be ordered as soon as possible.

The replacement procedure for a NO_x sensor is also presented in the Maintenance Information page (Section 8).

A new NO_x sensor is installed as follows:

1. Power down the XM2000 and unplug the power cord.
2. Remove the existing NO_x sensor. Follow the instructions in the Andros Product Manual.
3. Install the new NO_x sensor. Follow the instructions in the Andros Product Manual.
4. Power up the XM2000.
5. Perform a zero calibration procedure (Section 6).
6. Perform a span calibration procedure for NO_x (Section 6).
7. Go to the Maintenance Information page (Section 8) and select the NO_x sensor.
8. Touch the "Installation Complete" button to record the installation date. This button also sends a "New NO_x Sensor" command to the Andros. The Andros then measures the full-scale output voltage of the new sensor and stores the value in non-volatile memory. It later uses this value to determine when the sensor output voltage has sufficiently diminished such that a new sensor should again be installed.

Note: *The "Installation Complete" button should ONLY be touched one time immediately after a new NO_x sensor has been installed. It should NEVER be touched again during the operating life of the existing sensor.*

Replace Peristaltic Pump Hose

The peristaltic pump hose may eventually develop leaks due to fatigue from the constant compression by the peristaltic pump heads. These leaks will typically cause the periodic leak checks of the sample line to fail (see Section 7). If leak checks are not being performed at regular intervals, the XM2000 cabinet should be opened periodically and inspected for signs of water leaking onto the bottom of the cabinet.

Note: *Leak checks (Section 7) should be run at regular intervals. Also, the XM2000 cabinet should be opened periodically to check for water leaks. The goal is to discover leaks in the pump hose as soon as possible since this water will eventually damage the bottom of the XM2000 cabinet if undetected for long periods of time.*

The peristaltic pump hose can be replaced as follows:

1. Power down the XM2000 and unplug the power cord.
2. Disconnect the bottom end of the pump hose(s) from the Y-connector.

3. Disconnect the upper end of the pump hose(s) from the respective chiller element. Save the compression rings and note their position so they can be replaced on the new hose(s).

4. Remove the four wing-nuts from the pump heads.

5. Carefully remove the pump heads.

6. Remove the old hose(s) and install the new hose(s). A special tool (provided by the pump head manufacturer) is required in order to install the new hose. This tool is included with the XM2000 documentation packet.

7. Re-assemble the pump heads. Make sure the keyed ends are properly aligned and fit together such that both pump heads rotate.

8. Re-connect the bottom hose end(s) to the Y-connector.

9. Replace the compression rings on the upper end of the pump hose(s) and reconnect to the respective chiller element.

10. Power up the XM2000.

11. Perform a leak check (Section 7) to make sure all connections are properly sealed.

12. Press the PURGE button and observe that both pump heads are rotating.

SECTION 11: CELL ASSISTANT FOR WINDOWS™

OVERVIEW

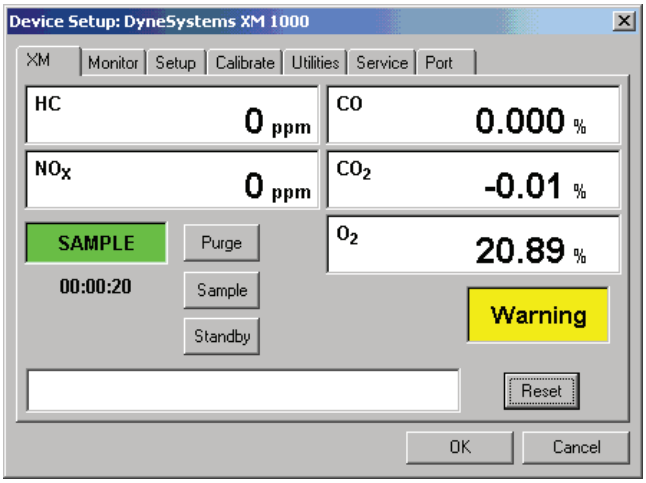
Cell Assistant for Windows™ is a data acquisition and control software package developed by DS. Many device drivers are available allowing Cell Assistant to acquire data from, and to control, many devices such as PLC's, gas analyzers, fuel systems, etc. This section describes the Cell Assistant device driver for the XM2000 Gas Analyzer. Familiarity with Cell Assistant is assumed throughout this section.

DEVICE SETUP PAGES

As with all Cell Assistant device drivers, several "Device Setup" pages are available to configure the XM2000 and to test all communications with the XM2000. The tabs for these pages are summarized below. Each is described in more detail in the sections that follow.

XM2000 Page

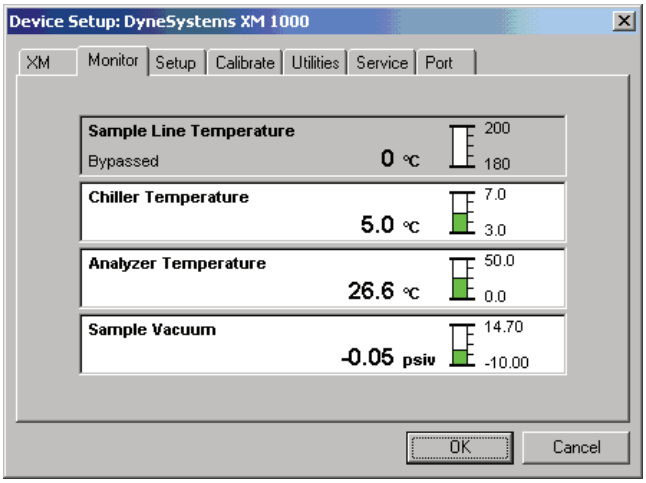
This page duplicates the functionality of the main analyzer screen on the Operator Control Station (see Section 4) allowing the XM2000 to be operated from this page. In addition, the "Warning" indicator (shown below) is also a button. Click on this indicator with the mouse and a Fault List dialog box will pop up. The fault list is described in Section 4.



***Note*:** *Issuing any XM2000 command (e.g. Purge, Sample, etc.) from this page will put the XM2000 into Computer mode. Master and Computer modes of operation are explained in Section 4).*

System Monitor Page

This page duplicates the functionality of the system monitor dialog on the Operator Control Station. See Operator Control Station (Section 4) for information regarding which data values are monitored and why.



Setup Page

This page provides one local setup parameter as well as access to the XM2000 setup parameters. The Setup page is shown below.

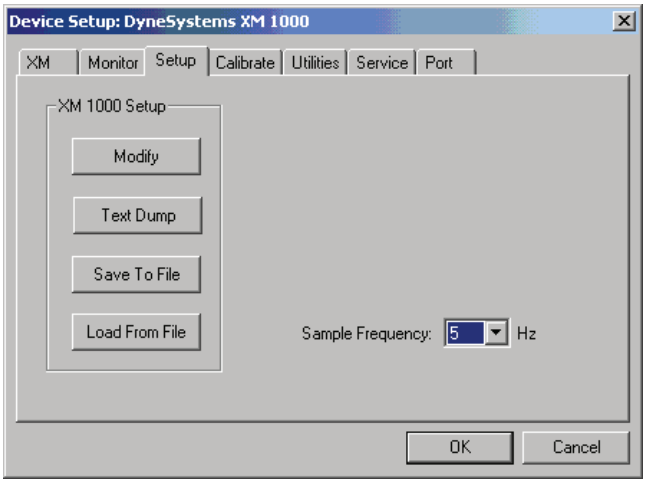


Figure 11.2 - Cell Assistant for Windows Setup Screen

The “Sampling Frequency” should be set as needed. This parameter determines the rate at which Cell Assistant acquires concentration readings and other data from the XM2000.

The “XM2000” group of buttons provide access to the XM2000 setup parameters. The function of each button is explained below.

Button	Function
Modify	Provides access to all XM2000 setup parameters. Pops up a dialog containing the standard parameter tree and parameter list as shown in XM2000 Setup Parameters (Section 5).
Text Dump	Dumps a text version of all setup parameters to a file. This file is for documentation purposes only. A comprehensive list of parameters shown in the System Parameter Hierarchy (Section 12) was created using this feature.
Save To File	Saves a binary version of all setup parameters to a file. This file can be loaded into the XM2000 later on if necessary.
Load From File	Restores all setup parameters from a binary file.

Calibrate Page

This page is identical (in appearance and function) to the Calibration Selection page described in Accessing Calibration (Section 6).

Utilities Page

This page is identical (in appearance and function) to the Utilities Selection page described in Accessing Utilities (Section 7).

Service Page

This page is identical (in appearance and function) to the Calibration Selection page described in Accessing Service Tools (Section 8).

DEVICE CHANNELS

The XM2000 device driver for Cell Assistant presents a large list of physical device channels to a running Test Plan. Contact DS for an up-to-date list of all device channels.

SECTION 12: REFERENCE

SETUP PARAMETER HIERARCHY

This section contains a comprehensive list of all configurable parameters in the XM2000. The factory default value of each parameter is listed.

```
+-[ XM2000 ]
|   0 Firmware Version = 1.002
|
+----[ Analyzer ]
|      0 HC Readings = n-Hexane
|      1 Ignore Master Enable = Yes
|
+----[ Security ]
|      0 Secure Mode = Off
|      1 Password = **********
|      2 Secure SETUP ? = Yes (Always)
|      3 Secure CALIBRATE ? = Yes
|      4 Secure UTILITIES ? = Yes
|      5 Secure SERVICE ? = Yes
|      6 Powerup Secure Mode = Off
|
+----[ Monitored Limits ]
|      0 Sample Line Temperature - High Limit = 200.0 °C
|      1 Sample Line Temperature - Low Limit = 180.0 °C
|      4 Chiller Temperature - High Limit = 7.0 °C
|      5 Chiller Temperature - Low Limit = 3.0 °C
|      6 Sample Vacuum - Warning Level = 2.0 PSIV
|      7 Sample Vacuum - Failure Level = 4.0 PSIV
|
+--+-[ Calibration Gas Ports ]
|  |
|  +----[ Port 1 ]
|  |      0 Connected Gas Type = Not Connected
|  |      1 Description =
|  |      2 Installation Date = 01-JAN-2004
|  |      3 Concentration - HC = 0 ppm
|  |      4 Concentration - NO = 0 ppm
|  |      5 Concentration - CO = 0.0 %
|  |      6 Concentration - CO2 = 0.0 %
|  |
|  +----[ Port 2 ]
|         0 Connected Gas Type = Not Connected
|         1 Description =
|         2 Installation Date = 01-JAN-2004
|         3 Concentration - HC = 0 ppm
|         4 Concentration - NO = 0 ppm
|         5 Concentration - CO = 0.0 %
|         6 Concentration - CO2 = 0.0 %
|
+--+-[ Utilities ]
|  |
|  +--+-[ HC Hangup Test ]
|  |  |    0 Purge time = 20 sec
|  |  |    1 Averaging time = 10 sec
|  |  |
```

```
| | +----[ Previous Result 1 ]
| |       0 Test date = 01-JAN-2004
| |       1 HC reading = 0 ppm
| |
| +--+-[ Leak Check ]
|    |   0 Target vacuum = 5.0 PSIV
|    |   1 Vacuum time limit = 10 sec
|    |   2 Vacuum settle time = 5 sec
|    |   3 Vacuum hold time = 45 sec
|    |   4 Max. vacuum drop = 0.5 PSIV
|    |
|    +----[ Previous Result 1 ]
|          0 Test date = 01-JAN-2004
|          1 Status = FAILED
|          2 Information = No test performed yet.
|
+--+-[ Service ]
   |
   +----[ Maintenance Information ]
   |      0 NOx Sensor = Install date = 26-FEB-2004
   |      1 O2 Sensor = Install date = 26-FEB-2004
   |
   +----[ Andros System Information ]
          0 Serial Number = 15802
          1 Model Number = 6600
          2 Hardware P/N = 451195-000
          3 Hardware Rev = 09
          4 Software P/N = 878174-004
          5 Software Rev = 17
```

ERROR MESSAGES

The XM2000 may return errors in response to operator actions; these errors are referred to as synchronous errors because they are synchronized to a button press or other operator action. The error message text directs the operator towards a solution. The XM2000 may also return asynchronous errors and notifications; these errors may appear at any time. Asynchronous errors are sent when the XM2000 detects an error condition that is not due to an immediate operator action (e.g. sample line over-temperature fault).

The format of all error messages and notifications is displayed below.

```
(nnn) text.
```

nnn is a 3-digit error code. This code should be used to look up the error in this manual if additional information is needed. This code should also be referenced when contacting DS for additional assistance.

The text field gives a brief single-line explanation of the error. Section 12 should be consulted for additional information.

ERROR CODES

Error codes are logically organized into the groups listed below.

Notification Codes (1 – 29)

The XM2000 returns these codes to the OCS when it needs to be notified of an event.

Error Code	Text	Description
1	Boot errors exist	Sent to all connected OCS's when the XM2000 is initially powered up and one or more fatal hardware errors have been detected. Each OCS then polls the XM2000 for a detailed list of the boot errors that were detected and displays them to the operator. No XM2000 commands will be accepted until all boot errors have been corrected. The XM2000 must be rebooted to clear out this error condition.
2	XM2000 settings have changed	Sent to all connected OCS's when one of the OCS's has entered setup mode and changed a parameter. Each OCS will refresh the currently displayed page in order for the configuration changes to take effect.
3	EEPROM erase completed	Sent only to the OCS that issued an erase EEPROM command to the XM2000. This is a factory mode operation that can only be performed at DS.
4	Configuration erase completed	Sent only to the OCS that issued an erase configuration command to the XM2000. This is a factory mode operation that can only be performed at DS.
5	Configuration save completed	Sent after the "Save" button has been pressed in setup mode and all configuration data has been successfully saved to non-volatile memory. Only sent to the OCS that issued the save command.
6	<blank line>	This notification code is never displayed since it is a blank line. It is sent to all connected OCS's when the Reset button is pressed in order to clear the message line.
7	Password required	Sent to an OCS that attempts to enter setup mode and secure mode is active. The OCS will then display the "Enter Password" dialog requiring the operator to "log in" before any changes to the current setup can be made.
8	Andros not responding, still trying ...	Sent every 2 seconds during power-up mode while the XM2000 main computer tries to establish communications with the Andros analyzer. This message is typically never seen since Andros communications is typically established on the first attempt with no errors. If this message is displayed, check that the Andros power cable and serial port cable are properly connected.
9 - 29	UNDEFINED	

Analyzer Run-Time Errors (30 – 79)

These errors are usually returned after a button press or operator action that is not permitted at this time due to existing errors or other conditions.

Error Code	Text	Description
30	XM2000 in SETUP mode	All analyzer run-time commands are rejected when the XM2000 is in setup mode. This error occurs when multiple OCS's are connected to the XM2000 and one OCS is currently accessing setup parameters. No run-time commands (e.g. sample or purge) will be accepted from any of the other attached OCS's until setup is exited.
31	XM2000 in CALIBRATE mode	All analyzer run-time commands are rejected when the XM2000 is in calibration mode. This error occurs when multiple OCS's are connected to the XM2000 and one OCS is currently calibrating the analyzer. No run-time commands (e.g. sample or purge) will be accepted from any of the other attached OCS's until calibration is exited.
32	XM2000 in UTILITIES mode	All analyzer run-time commands are rejected when the XM2000 is in utilities mode. This error occurs when multiple OCS's are connected to the XM2000 and one OCS is currently running a utility. No run-time commands (e.g. sample or purge) will be accepted from any of the other attached OCS's until the utility is exited.
33	XM2000 in SERVICE mode	All analyzer run-time commands are rejected when the XM2000 is in service mode. This error occurs when multiple OCS's are connected to the XM2000 and one OCS is currently accessing a service function. No run-time commands (e.g. sample or purge) will be accepted from any of the other attached OCS's until the service function is exited.
34	XM2000 in FACTORY mode	All analyzer run-time commands are rejected when the XM2000 is in factory mode. This error occurs when multiple OCS's are connected to the XM2000 and one OCS is currently accessing factory information. No run-time commands (e.g. sample or purge) will be accepted from any of the other attached OCS's until factory mode is exited. NOTE: Factory mode is only available to in-house technicians at DS. This error should not occur at a customer site
35	XM2000 is busy processing a previous command	This error may occur if an operator tries to save setup data to non-volatile memory while a previous save is still in progress. It should rarely occur and is harmless. Simply wait a few seconds and retry the command.
36	Secure mode enabled: function not allowed	Setup, calibration, utilities, and service functions may not be allowed when the XM2000 is in secure mode. Contact the person responsible for XM2000 security. A password is required to take the XM2000 out of secure mode.

ANALYZER RUN-TIME ERRORS (CONTINUED)

Error Code	Text	Description
37	Analyzer NOT in STANDBY mode	Requests to enter setup, calibration, utilities, or service modes are denied when the analyzer is currently operating (i.e. purging or sampling). Put the analyzer into standby mode and try again.
38	Analyzer NOT in MASTER mode	Many analyzer commands (e.g. purge, sample, or standby) are rejected if the analyzer is not in Master mode. Press the Master/ Computer button to return the analyzer to Master mode, then retry the original command.
39 - 49	UNDEFINED	
50	Analyzer is in power-up mode	Requests to operate the analyzer, perform calibration, or run analyzer utilities will be denied when the analyzer is in power-up mode. The XM2000 is only in power-up mode for a fraction of a second when the XM2000 is powered up so it is unlikely that this error message will ever occur. If this error does occur, the XM2000 is probably stuck in power-up mode. See Power-Up Mode (Section 4) for more information regarding what conditions must satisfied for the XM2000 to get out of power-up mode.
51	Analyzer is in warm-up mode	Requests to operate the analyzer, perform calibration, or run analyzer utilities will be denied when the analyzer is in warm-up mode. Wait for the XM2000 to warm up and enter normal operating mode. Warm-up requirements are described in Warm-up Requirements (Section 4).
52	Master enable input not asserted	The XM2000 is wired and configured to use the Master Enable input; however, the input signal is not present. The XM2000 will not operate (i.e. sample or purge) until this signal is asserted. Master Enable wiring and configuration is discussed in (Section 2).
53	Analyzer fault exists	Requests to operate the analyzer, perform calibration, or run analyzer utilities will be denied if any analyzer faults exist. All faults must be cleared before the request will be accepted.
54 - 69	UNDEFINED	
70	Invalid time/date value	An invalid date or time value was entered when setting the system date and time of the XM2000.
71 - 79	UNDEFINED	

Setup Errors (80 – 99)

These errors are displayed when the XM2000 is in setup mode and invalid parameter values are entered.

Error Code	Text	Description
80	Invalid character has been entered	When entering a numeric value, the only allowable characters are '0' through '9', '+', '-', and '.'
81	No value entered	The input value was blank.
82	Read-only parameter. Modification not allowed.	Some XM2000 parameters (e.g. the Firmware Version) are read-only and cannot be changed.
83	Factory setting. Modification not allowed.	Many factory settings (e.g. system monitoring limits) are listed in the setup property tree for documentation purposes only and cannot be changed. This error is returned if an operator attempts to modify a factory setting from the setup page.
84	Parameter is managed by another page	Some data items (e.g. test parameters for some utility tests) are listed in the setup property tree for documentation purposes only and cannot actually be modified from the setup page; instead, these parameters must be modified from the respective utility page. This error is returned if an operator attempts to modify one of these parameters from the setup page.
85	Incorrect password	Password entered is not correct. Try again. If the password is lost or forgotten, contact DS.
86	Password characters must be digits 0 to 9	Password must be numeric.
87	Password length must be 4 to 10 digits	Password must be 4 to 10 digits in length.
88 - 99	UNDEFINED	

Utilities Errors (100 – 129)

These errors are reported by various XM2000 utilities.

Error Code	Text	Description
100	Minimum Purge time is 10 sec	The "Purge time" test parameter for the HC Hangup test must be at least 10 seconds.
101	Maximum Purge time is 600 sec	The "Purge time" test parameter for the HC Hangup test cannot exceed the specified value.
102	Minimum Averaging time is 2 sec	The "Averaging time" test parameter for the HC Hangup test must be at least 2 seconds.
103	Maximum Averaging time is 300 sec	The "Averaging time" test parameter for the HC Hangup test cannot exceed the specified value.
104 - 129	UNDEFINED	

Calibration Errors (130 – 159)

These errors are reported during calibration and the management of calibration gases.

Error Code	Text	Description
130	No span gases defined for this port	The span button was pressed; however, no concentrations have been defined for the currently flowing span gas (i.e. they are all set to 0). Go to the 'Manage Calibration Gases" page and enter one (or more) non-zero gas concentration values for the selected span gas.
131 - 149	UNDEFINED	
150	No calibration gas is flowing	A zero or span command was issued; however, no calibration gas is currently flowing.
151	Calibration port is not connected	Cannot calibrate the Andros analyzer because the 'Gas Type' for the selected calibration gas is set to 'NOT Connected'.
152	Port is not connected to a 'zero' gas	Cannot zero the Andros analyzer because the 'Gas Type' of the currently selected calibration gas is NOT configured as a 'Zero Gas'.
153	Port is not connected to a 'span' gas	Cannot span the Andros analyzer because the 'Gas Type' of the currently selected calibration gas is NOT configured as a 'Span Gas'.
154	Cannot span when flowing 'Air'	Cannot span the Andros analyzer when flowing 'Air' from the purge input port.
155	Andros is not ready to zero	A command to zero the Andros analyzer will be rejected if the Andros is not in 'Normal' mode (see Andros manual). This error should really never occur since the calibration page will not allow a zero command to be issued until the Andros is ready.
156	Andros is not ready to span	A command to span the Andros analyzer will be rejected if the Andros is not in 'Normal' mode (see Andros manual). This error should really never occur since the calibration page will not allow a span command to be issued until the Andros is ready.
157 - 159	UNDEFINED	

OCS Communications Errors (160 – 169)

These errors are typically due to bad cabling, bad shielding, and/or severe electrical noise.

Error Code	Text	Description
160	Packet checksum error	Command packet is corrupt.
161 - 169	UNDEFINED	

Hardware Configuration Errors (170 – 179)

These errors are boot errors and must be corrected before the XM2000 accepts analyzer commands.

Error Code	Text	Description
170	Configuration version newer than firmware	This error is most likely to occur if someone attempts to upload a set of XM2000 configuration parameters (see Back Up and Restoring Setup Parameters (Section 5) that was created using the latest version of XM2000 software into an XM2000 that contains older software. This is not allowed. Contact DS to get an upgrade for the XM2000 software.
171	EEPROM version newer than firmware	The version number of the XM2000 parameters stored in EEROM is newer than the version number of the XM2000 software itself. This error is most likely to occur if someone installs a new A/D converter board (which contains the serial EEPROM chip) that was initialized using the latest version of XM2000 software into an XM2000 that contains older software. This is not allowed. Contact DS to get an upgrade for the XM2000 software.
172 - 179	UNDEFINED	

Hardware Errors (180 – 199)

These errors are caused by defective or failing hardware.

Error Code	Text	Description
Error Code	Text	Description
180	Invalid configuration blocks in Flash	The configuration FLASH chip contains an invalid data block. The FLASH part must be replaced and/or erased. The XM2000 should be returned to DS for repair.
181	Flash erase failed	A data block in the configuration FLASH chip failed to erase. Press the save button again to see if the erase failure is intermittent. If the problem persists, the XM2000 should be returned to DS for repair.
182	Flash write failure	A write error occurred while saving configuration data to FLASH. Press the save button again to see if the write failure is intermittent. If the problem persists, the XM2000 should be returned to DS for repair.
183	EEPROM is damaged	The contents of the EEPROM are invalid. The XM2000 will automatically try to erase and re-initialize the EEPROM. All data in the EEPROM will be reset to factory default values. If the problem persists, the XM2000 should be returned to DS for repair.
184	EEPROM contents have been initialized	This message is sent as a reminder that the contents of the EEPROM have been initialized (i.e. reset to factory default values).
185	EEPROM Write Timeout	A write operation to the EEPROM failed to complete. The serial EEPROM probably needs to be replaced. Contact DS.
186	Serial Port 1 not detected	This error is logged at power-up if the XM2000 fails to detect the hardware for the specified serial port. This is a boot error; thus, the XM2000 will not function on until this problem is fixed.
187	Serial Port 2 not detected	"
188	Serial Port 3 not detected	"
189	Serial Port 4 not detected	"
190	File open error	The data file containing all configuration data could not be accessed in the non-volatile memory device. The memory device may be damaged. The XM2000 should be returned to DS for repair.
191	File write error	An error occured while writing configuration data to the non-volatile memory device. The memory device may be damaged. The XM2000 should be returned to DS for repair.
192	File read error	An error occurred while reading configuration data from the non-volatile memory device. The memory device may be damaged. The XM2000 should be returned to DS for repair.
193 - 199	UNDEFINED	

INTERNAL SOFTWARE ERRORS (200 – 249)

Internal software errors are generally due to programming errors in the XM2000. They are also due to programming errors in one of the connected OCS's. They are intended to catch programming errors that occur during product development; they should never occur in the final release of this product.

None of these errors are documented in this manual; instead, DS should be contacted if an error code in this range is detected.

REPLACEMENT PARTS

The XM2000 contains several components that need to be periodically replaced during the operating life of the XM2000. They are summarized in the following table. Contact DS and provide the appropriate part number(s). The maintenance procedures to replace these components are given in Section 10.

Part	Dyne Systems P/N
Stainless Steel 2 micron pre-filter element.	XM2000-FILTERS-0000
Water Filter Cartridge, 2 micron	XM2000-FILTERS-0100
Peristaltic Pump Tubing, 25 ft. piece	XM2000-TUBING-00000
O_2 Sensor	XM2000-ANDROS-01000
NO_x Sensor	XM2000-ANDROS-01001
Bar 97 High Calibration Gas	XM2000-CALGAS-00000
Bar 97 Zero Air	XM2000-CALGAS-00002

FUSES

Function	Location	Value
System Controller	CB #1	3A
System Power Supply	CB #2	3A
Analyzer Power Supply	CB #3	3A
Sample Pump	CB #4	3A
Peristaltic Pump	CB #5	3A
Temperature Controller	CB #6 & CB #7	10A
10" Cooling fan	CB #8	5A
Chiller Power Supply	CB #9	3A

FIGURES, DRAWINGS, AND SCHEMATICS

The following A-size (8½ x 11 in) drawings are included at the end of this manual (printed version only) or in the file XM2000_Drawings_SizeA.pdf (included on CD).

Drawing No.	Description
NONE	NONE

The following B-size (11 x 17 in) drawings are included at the end of this manual (printed version only) or in the file XM2000_Drawings_SizeB.pdf (included on CD).

Drawing No.	Description
DWG SCH 001	XM2000 CONTROL
ASC522-00 SHEET 01	EGAS DRAWING DIRECTORY
ASC522-01 SHEET 01	EGAS GENERAL INFORMATION
ASC522-02 SHEET 01	EGAS CABINET INTERIOR ELEVATION & LAYOUT DRAWINGS
ASC522-02 SHEET 02	EGAS CABINET EXTERIOR ELEVATION & LAYOUT DRAWINGS
ASC522-03 SHEET 01	EGAS SAMPLE LINE TERMINATION DETAILS, TB1
ASC522-04 SHEET 01	EGAS SYSTEM FLOW DIAGRAM
ASC522-05 SHEET 01	EGAS MAIN LOAD CENTER WIRING DETAILS
ASC522-06 SHEET 01	EGAS IMRC50, DIGITAL I/O BOARD WIRING DETAILS
ASC522-06 SHEET 02	EGAS IMRC25, ANALOG I/O BOARD WIRING DETAILS
ASC522-07 SHEET 01	EGAS TERMINATION BLOCK WIRING DETAILS, TB2
ASC522-07 SHEET 02	EGAS TERMINATION BLOCK WIRING DETAILS, TB3
ASC522-08 SHEET 01	EGAS CHILLER WIRING DETAILS
ASC522-08 SHEET 02	EGAS SOLENOID VALVE WIRING DETAILS
ASC522-08 SHEET 03	EGAS SOLID STATE RELAY WIRING DETAILS
ASC522-08 SHEET 04	EGAS TEMPERATURE CONTROLLER WIRING DETAILS
ASC522-08 SHEET 05	EGAS VACUUM TRANSDUCER & FLOW SWITCH WIRING DETAILS
ASC522-08 SHEET 06	EGAS POWER SUPPLY WIRING DETAILS
ASC522-08 SHEET 07	EGAS RELAY WIRING DETAILS, K1 & K2
ASC522-08 SHEET 08	EGAS POWER DISCONNECT SWITCH WIRING DETAILS
ASC522-08 SHEET 09	EGAS INLINE POWER INLET CONNECTION WIRING DETAILS
ASC522-08 SHEET 10	EGAS WATER CARRY-OVER FILTER DETAILS

PRODUCT WARRANTY

WARRANTY, REMEDIES AND LIMITATIONS: Dyne Systems, Inc. warrants the following equipment will conform to published specifications and be free from faulty material or workmanship for the listed time period from date of shipment or onsite repair:

New Controls	12 Months
Repaired Controls	3 Months
Service Calls	3 Months

This warranty covers properly installed equipment used within specified limits and ambient conditions and is limited to repair or replacement of equipment proving defective at Dyne Systems. For warranty to be valid, Buyer must conform to Dyne Systems' factory specifications. If applicable, terms of Warranty Validation and Delivery Certification must be met for warranty to be valid. This warranty does not apply to experimental, developmental or non-standards Goods and Products which are sold "as is", "where is". Dyne Systems shall not be liable for labor costs associated with removing, reinstalling or delivering any equipment. Transportation costs associated with delivering products to Dyne Systems under the warranty are the responsibility of the Customer. Transportation costs associated with returning products to the Customer under the warranty are the responsibility of Dyne Systems. If warranty service is deemed necessary and product (i.e. controls, small dynamometer, etc) can be shipped to Dyne Systems then it is expected that product be sent to Dyne Systems; however, if Customer wants warranty work to be performed onsite and Dyne Systems deems it feasible then Customer will be responsible for travel hours and travel / transportation costs. Dyne Systems is not liable for costs incurred such as loss of work time or production time or for loss of profits or other damages, including, but not limited to consequential damage.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND ARE GIVEN AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE REMEDIES OF BUYER FOR ANY BREACH OF WARRANTY SHALL BE LIMITED TO THOSE PROVIDED HEREIN, AND FOR DELAY OR NON-DELIVERY WHICH IS NOT EXCUSABLE, TO THE PURCHASE PRICE OF THE GOODS IN RESPECT OF WHICH THE DELAY OR NON-DELIVERY IS CLAIMED, TO THE EXCLUSION OF ANY AND ALL OTHER REMEDIES. IN NO EVENT SHALL DYNE SYSTEMS BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOSS OF USE OR PROFITS. NO AGREEMENT VARYING OR EXTENDING THE FOREGOING WARRANTIES, REMEDIES OR THIS LIMITATION WILL BE BINDING UPON DYNE SYSTEMS UNLESS IN WRITING SIGNED BY A DULY AUTHORIZED OFFICER OF DYNE SYSTEMS. DYNE SYSTEMS' LIABILITY FOR FAILURE TO COMPLY WITH ANY WARRANTY OR REPRESENTATION HEREUNDER SHALL BE LIMITED TO THE VALUE OF THE GOODS SOLD HEREUNDER.

Excluding equipment made for integrated systems supplied or made by Dyne Systems, Dyne Systems makes no warranty on the use of the equipment in combination with other products or in the practice of any process and if a claim, suit or action is based thereon, Buyer shall defend, indemnify and save Dyne Systems harmless therefrom.

LIMITATION OF LIABILITY: Dyne Systems' liability for defective or nonconforming products, whether based on breach of warranty negligent manufacture or product liability, is exclusively limited to repair or replacement, at Dyne Systems' election, of such products. Dyne Systems assumes no risk and shall be subject to no liability for any damages or loss resulting from the specific use or application made of the Products. Dyne Systems' liability for any other claim, whether based on breach of contract, negligence or product liability, relating to the products shall not exceed the price paid by Buyer for such Products. In no event will Dyne Systems be liable for any special, incidental or consequential damages, including loss of use, loss of profit, claims of third parties, or damages arising from bodily injury, or death, however caused, whether by the negligence of Dyne Systems or otherwise.

EQUIPMENT MADE BY OTHERS: Any items supplied that are not manufactured by Dyne Systems are covered by the original manufacturer's warranty and not by a Dyne Systems warranty.

CUSTOMER SUPPLIED PRODUCT: Dyne Systems accepts customer provided equipment as a courtesy only. Dyne Systems is not responsible for determining suitability of customer's equipment for a particular purpose. Repair or configuration of customer-supplied equipment will be charged at Dyne Systems normal rate.