Model 120HD
Portable Hydrogen Analyzer

User Manual

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90629VE Rev. C

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Safety Notes

WARNINGS, CAUTIONS, and NOTES contained in this manual emphasize critical instructions as follows:

An operating procedure which, if not strictly observed, may result in personal injury or environmental contamination.

An operating procedure which, if not strictly observed, may result in damage to the equipment.

Important information that should not be overlooked.

Sample Gas

Potential hazards of the sample gas should be taken into consideration before connecting the sample to the analyzer. Personal protective equipment and proper ventilation should be used if sample gas is toxic, flammable, or corrosive. Check the sample line and all connections for leaks before powering up. Consult plant safety personnel for appropriate exhaust venting guidelines for specific sample gas type.

Warning Labels

These symbols may appear on the instrument in order to alert you of existing conditions.

PROTECTIVE CONDUCTOR TERMINAL
(BORNIER DE L'ECRAN DE PROTECTION)
Schutzerde

CAUTION - Risk of electric shock
(ATTENTION-RISQUE DE DÉCHARGE ÉLECTRIQUE)
Achtung - Hochspannung Lebensgefahr

CAUTION - (Refer to accompanying documents)
(ATTENTION-SE RÉFERER AUX DOCUMENTS JOINTS)
Achtung (Beachten Sie beiliegende Dokumente)

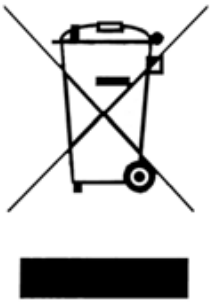
CAUTION - Hot Surface

(ATTENTION-SURFACE CHAUDE)
Achtung - Heiße Oberfläche

Environmental Information (WEEE)

This AMETEK product contains materials that can be reclaimed and recycled. In some cases the product may contain materials known to be hazardous to the environment or human health. In order to prevent the release of harmful substances into the environment and to conserve our natural resources, AMETEK recommends that you arrange to recycle this product when it reaches its "end of life."

Waste Electrical and Electronic Equipment (WEEE) should never be disposed of in a municipal waste system (residential trash). The **Wheelie Bin** marking on this product is a reminder to dispose of the product properly after it has completed its useful life and been removed from service. Metals, plastics and other components are recyclable and you can do your part by one of the following these steps:



- When the equipment is ready to be disposed of, take it to your local or regional waste collection administration for recycling.
- In some cases, your "end-of-life" product may be traded in for credit towards the purchase of new AMETEK instruments. Contact your dealer to see if this program is available in your area.
- If you need further assistance in recycling your AMETEK product, contact our office listed in the front of the instruction manual.

WARRANTY AND CLAIMS

We warrant that any equipment of our own manufacture or manufactured for us pursuant to our specifications which shall not be, at the time of shipment thereof by or for us, free from defects in material or workmanship under normal use and service will be repaired or replaced (at our option) by us free of charge, provided that written notice of such defect is received by us within twelve (12) months from date of shipment of portable analyzers or within eighteen (18) months from date of shipment or twelve (12) months from date of installation of permanent equipment, whichever period is shorter. All equipment requiring repair or replacement under the warranty shall be returned to us at our factory, or at such other location as we may designate, transportation prepaid. Such returned equipment shall be examined by us and if it is found to be defective as a result of defective materials or workmanship, it shall be repaired or replaced as aforesaid. Our obligation does not include the cost of furnishing any labor in connection with the installation of such repaired or replaced equipment or parts thereof, nor does it include the responsibility or cost of transportation. In addition, instead of repairing or replacing the equipment returned to us as aforesaid, we may, at our option, take back the defective equipment, and refund in full settlement the purchase price thereof paid by Buyer.

Process photometric analyzers, process moisture analyzers, and sampling systems are warranted to perform the intended measurement, only in the event that the customer has supplied, and AMETEK has accepted, valid sample stream composition data, process conditions, and electrical area classification prior to order acknowledgment. The photometric light sources are warranted for ninety (90) days from date of shipment. Resale items warranty is limited to the transferable portion of the original equipment manufacturer's warranty to AMETEK. If you are returning equipment from outside the United States, a statement should appear on the documentation accompanying the equipment being returned declaring that the goods being returned for repair are American goods, the name of the firm who purchased the goods, and the shipment date.

The warranty shall not apply to any equipment (or part thereof) which has been tampered with or altered after leaving our control or which has been replaced by anyone except us, or which has been subject to misuse, neglect, abuse or improper use. Misuse or abuse of the equipment, or any part thereof, shall be construed to include, but shall not be limited to, damage by negligence, accident, fire or force of the elements. Improper use or misapplications shall be construed to include improper or inadequate protection against shock, vibration, high or low temperature, overpressure, excess voltage and the like, or operating the equipment with or in a corrosive, explosive or combustible medium, unless the equipment is specifically designed for such service, or exposure to any other service or environment of greater severity than that for which the equipment was designed.

The warranty does not apply to used or secondhand equipment nor extend to anyone other than the original purchaser from us.

THIS WARRANTY IS GIVEN AND ACCEPTED IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION AND WARRANTIES OF FITNESS OR OF MERCHANTABILITY OTHER THAN AS EXPRESSLY SET FORTH HEREIN, AND OF ALL OTHER OBLIGATIONS OR LIABILITIES ON OUR PART. IN NO EVENT SHALL WE BE LIABLE UNDER THIS WARRANTY OR ANY OTHER PROVISION OF THIS AGREEMENT FOR ANY ANTICIPATED OR LOST PROFITS, INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, TIME CHANGES OR ANY OTHER LOSSES INCURRED BY THE ORIGINAL PURCHASER OR ANY THIRD PARTY IN CONNECTION WITH THE PURCHASE, INSTALLATION, REPAIR OR OPERATION OF EQUIPMENT, OR ANY PART THEREOF COVERED BY THIS WARRANTY OR OTHERWISE. WE MAKE NO WARRANTY, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF FITNESS OR OF MERCHANTABILITY, AS TO ANY OTHER MANUFACTURER'S EQUIPMENT, WHETHER SOLD SEPARATELY OR IN CONJUNCTION WITH EQUIPMENT OF OUR MANUFACTURE. WE DO NOT AUTHORIZE ANY REPRESENTATIVE OR OTHER PERSON TO ASSUME FOR US ANY LIABILITY IN CONNECTION WITH EQUIPMENT, OR ANY PART THEREOF, COVERED BY THIS WARRANTY.

MODEL 120HD HYDROGEN ANALYZER

General Description

Function

The Model 120HD portable hydrogen unit analyzes a gas sample, measures the hydrogen concentration and then digitally reports the percent volume of hydrogen in air.

Principle of Operation

The 120HD analyzer functions using the same principle as a katharometer. It operates by having two parallel tubes both of which contain gas and heating coils. The gases are examined by comparing the rate of loss of heat from the heating coils into the gas. The coils are arranged in a bridge circuit so that resistance changes due to unequal cooling can be measured. One channel normally holds a reference gas and the mixture to be tested is passed through the other channel. The thermal conductivity of a gas is inversely related to its molecular weight. For example, hydrogen has approximately six times the conductivity of nitrogen.

The known or "standard" gas used with the 120HD is moisture-saturated air that is contained in the small chambers where the "comparison" coils are located. The coils are heated by an electric current and remain in balance as long as they are surrounded by gases of similar conductivity and are at like temperatures. However, when the test coils are exposed to gases of different mixtures and different thermal conductance, their temperature changes and the bridge circuit becomes unbalanced. The result is that the digital screen readout changes based on the variation in the hydrogen concentration. In this way, it is possible to determine the percent of hydrogen present in the mixture.

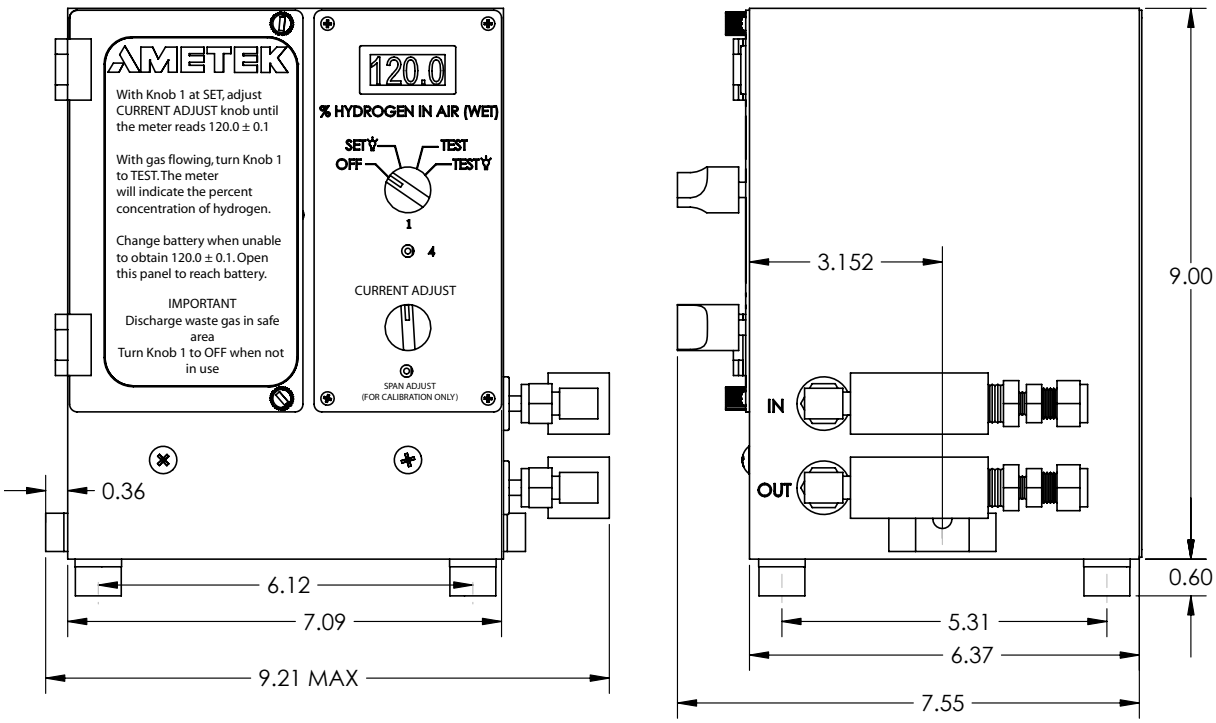


Figure 1-1.
Dimensions 120HD
Portable Analyzer.

Inspect Shipping Contents

The Model 120HD is inspected both mechanically and electronically before shipment. Unpack all items from the shipping container and check for obvious damage that may have occurred. Report any damage to the shipper. Keep the original packaging materials for use in reshipping the unit should it be necessary.

Model 120HD Hydrogen Analyzer Parts

The following parts are shipped with the Model 120HD analyzer:
(1) 120HD Analyzer * 00135086
(1) Battery Harness **

* Battery (Energizer 521) not included with analyzer.
** Spare harness provided to facilitate battery replacement.

Technical Support

AMETEK is committed to providing you the best technical support in the industry. If you need service or application assistance, please call AMETEK at (412) 828-9040.

If you need to return equipment, you will be asked to provide the following information before obtaining a Return Material Authorization (RMA) number.

- Model number
- Serial number
- Telephone number


NOTE

Before returning material, you must get an RMA number from the factory.

Installation

Mechanical Installation

The analyzer uses Swagelok 5/16″ tube fittings for both the sample gas inlet and outlet. These fittings are located on the right-hand side of the analyzer and are marked IN and OUT.

Initial Attachment of Swagelok Sample Line Fittings

Attach the Swagelok sample line fittings as follows:

1. Insert tubing into the tube fitting. Make sure that the tubing rests firmly on the fitting shoulder and that the nut is finger tight.

2. Before tightening the nut, scribe the nut in the 6 o'clock position. This is done so that you will be able to know exactly how far to turn the nut as described in Step 3.

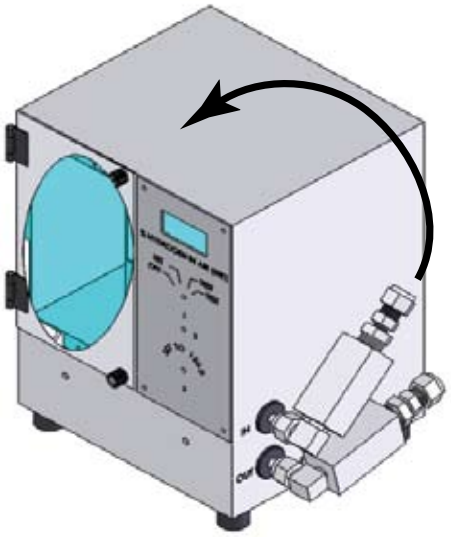
3. Hold the fitting body steady with a backup wrench and tighten the nut 1-1/4 turns. The scribe on the nut should now be in the 9 o'clock position.

Re-Tightening Sample Line Connections

The sample line connections can be disconnected and retightened any number of times.

1. Insert the pre-swaged ferrule into the fitting until the front ferrule seats in the fitting.

2. Tighten snug by hand or lightly seat the nut using a wrench. Using a wrench, tighten an additional 1/4 turn.



Repositioning the Gas Inlet/Outlet Connections

You can change the orientation of both the sample gas inlet and outlet from horizontal.

1. Locate the Swagelok fitting near the IN /OUT labels on the right-hand side of the unit.
2. Loosen the Swagelok fitting and rotate it to the new position.
3. Tighten snug by hand or lightly seat the nut using a wrench. Using a wrench, tighten an additional 1/4 turn.

Checking for Leaks

After the connections are made at the inlet and outlet, the analyzer should be pressure-checked at 10 PSIG. If the pressure drops at all over a five-minute time interval, follow the method outlined below and then check all joints for leaks using the "snoop" or soapy water method.

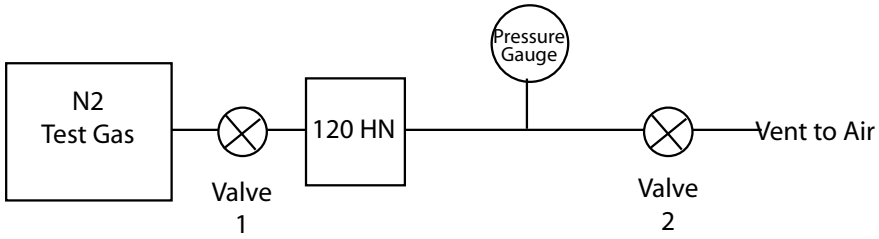


Figure 1-2.
Leak check diagram.

1. Connect the analyzer between two valves as shown in Figure 1-2.
2. Set the N_2 test gas outlet pressure to 10 PSIG.
3. Open Valves 1 and 2 and allow the N_2 gas to flow.
4. Close Valve 2, and when the pressure gauge reads 10 PSIG, close Valve 1.

If the pressure reading is above 9 PSIG after one hour, the unit is acceptable. If the pressure is below 9 PSIG , there is a leak that must be repaired.

Figure 1-2. Place the battery inside the compartment and attach the battery jack.

Installing the Battery

The Model 120HD operates on power supplied by (1) 6V No. 521 Energizer Industrial Alkaline Lantern Battery. Follow the instructions below to install the battery.

1. Turn Knob 1 to the **OFF** position.
2. Loosen the two thumbscrews on the front left-hand panel so that you can open the door to the battery compartment. Slide the door up and off of the hinges to remove it and allow easier access to the battery compartment.
3. Inside the battery compartment there will be a battery installation harness that consists of a jack and two terminal wires.
4. Remove the terminal screw covers from the battery and attach the terminal wires from the battery harness to the battery. The red terminal wire is the positive (+) terminal. The black terminal wire is the negative (-) terminal.

NOTE

Be sure to observe polarity as marked on the battery.

5. Replace the terminal screw covers on the terminal posts.
6. Slide the battery into the battery compartment with the terminals facing outward towards you.
7. Plug the jack from the battery harness into the jack outlet on the right-hand side of the battery compartment.
8. Slide the door to the battery compartment back onto the hinges, close the door and tighten the thumbscrews.

CAUTION

Before closing the battery compartment door, arrange the terminal wires in such a way so that they are clear of the tab on the inside of the door and it does not press against them.

9. Turn Knob 1 to **SET**. The display should turn on. If it does not, the battery is not connected correctly. Turn Knob 1 to **OFF** and check the battery connections.

Replacing the Battery

1. Turn Knob 1 to the **OFF** position.

2. Loosen the two thumbscrews on the front left-hand panel so that you can open the door to the battery compartment. Slide the door off its hinges by lifting upward for easier access to the battery compartment.

3. Unplug the battery jack from the side of the battery compartment and pull out the spent battery.

4. Attached to the spent battery will be a battery installation harness that consists of a jack and two terminal wires.

5. Remove the terminal screw covers from the terminals and detach the battery harness terminal wires.

6. Attach the terminal wires from the battery harness to the new battery. The red terminal wire is the positive (+) terminal. The black terminal wire is the negative (-) terminal. Replace the terminal screw covers on the terminal posts.


NOTE

Be sure to observe polarity as marked on the battery.

7. Slide the battery into the battery compartment with the terminals facing outward towards you. See Figure 1-2.

8. Plug the jack from the battery harness into the jack outlet on the right-hand side of the battery compartment.

9. Slide the door to the battery compartment back onto the hinges, close the door and tighten the thumbscrews.


CAUTION

Before closing the battery compartment door, arrange the terminal wires in such a way so that they are clear of the tab on the inside of the door and it does not press against them.

10. Turn Knob 1 to **SET**. The display should turn on. If it does not, the battery is not connected correctly. Turn Knob 1 to **OFF** and check the battery connections.

Electrical Circuit

The Model 120HD analyzer's electronic circuits include five power supplies, a linearization circuit, a digital display, and the hydrogen sensor.

Power Supplies

The circuit requires five power supplies: +5V, -5V, +1.25 and -1.25 V, and a 120 mA constant current source.

Hydrogen Sensor

The hydrogen sensor is a thermal conductivity-type sensor. It has a zero (Screw #4) and a gain (CURRENT ADJUST) adjustment. The output of the hydrogen sensor is non-linear.

Hydrogen Sensor Circuit

The hydrogen sensor requires a 120 mA constant current source. **CURRENT ADJUST** is used to adjust the value of the current source.

A two-degree polynomial . . .

$$\text{Display Input} = (a + bx + cx^2)$$

is used to linearize the hydrogen sensor output.

x = Amplified output
x^2= Multiplier output
a = Fixed reference voltage

The summing amplifier adds the fixed reference (a), the amplified sensor output (bx), and the squared sensor output (cx^2). This output provides the linearized output signal to the digital display.

Components on the PCB interconnect board used in linearization are R21 whose adjustment cancels offset voltages in the multiplier circuit, and R24 which is used to cancel offset voltages in the summing amplifier. These components should not be adjusted by the user.

Digital Display

The digital display is a 3-½ digit backlit LCD display. The backlighting of the display is selectable by using the second **TEST** position with the "light bulb" icon. All three decimal points light up to indicate "low battery" voltage.

SPECIFICATIONS

Operating Range:

0 to 25% hydrogen in water-saturated air.

Accuracy:

±4% full scale (± 1% H_2).

Response Time:

< 1 minute for 90% step change.

Repeatability:

± 2% full scale (±0.5% H_2).

Environment:

Ambient Temperature:
50 to 100°F

Relative Humidity:
0% to 100%, relative

Sample Gas Flow Rate:

50 ml/min

Sample Pressure:

5 PSIG

Power Supply:

(1) 6V Industrial Alkaline Lantern Battery (Energizer No. 521)


NOTE

An alternative battery can be substituted for the suggested battery. The battery should last at least 120 hours at an operating current of 225 mA. Battery capacity required is 27,000 mA hours.

Battery Life (Approximate)

120 hours minimum with backlight.
(Analyzer can be used until unable to set to 120.0.)

Power Drain:

210 mA, 6V (with backlight)
170 mA, 6V (without backlight)

Weight:

Less than 15 lb with battery.

OPERATION

Initial Start-Up

NOTE

The 120HD analyzer has a backlit digital display. When Knob 1 is turned to the SET position or to the second TEST position there is an icon of a light bulb that indicates that the display screen will be backlit when using these functions. Use the backlit TEST function to perform tests when the lighting is dim and the display is difficult to view.

Current Adjustment

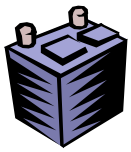
The analyzer requires that constant current be supplied to the coils.

- Turn Knob 1 to the **SET** position. Adjust the **CURRENT ADJUST** knob until the digital readout displays 120.0 ±0.1. See Figure 3-1.

NOTE

This adjustment should be made before each reading.

Low Battery Warning



All three decimal points appear on the digital display to indicate a "low battery" voltage. The analyzer can be used with this low-battery indicator displayed, but when the battery voltage reaches the point at which it is impossible to adjust the readout to the 120.0 ± 0.1 position, you must replace the battery. Follow the procedure in Chapter 1 "Replacing the Battery."

NOTE

The Low Battery indicator appears when the battery voltage reaches 4.25V or approximately 150 hours of use. It will maintain 120 mA current without adjustment until the voltage reaches 4.025V or approximately 159 hours.

Electrical Zero Adjustment

NOTE

This adjustment must be made before the analyzer is used for the first time but is necessary only occasionally after that.

For the *initial electrical zero adjustment* and all subsequent electrical zero adjustments, *if the digital display does not read zero,* continue with the steps below.

1. Provide a low pressure (<5 PSIG), low flow rate source of air/nitrogen to purge the gas passages in the analyzer of any residual gases from previous tests.

2. Check and adjust the **CURRENT ADJUST**, if necessary.

3. Turn Knob 1 to the **TEST** position needed - either standard display or backlit display (Figure 3-1).

4. Flow air or nitrogen through the analyzer.

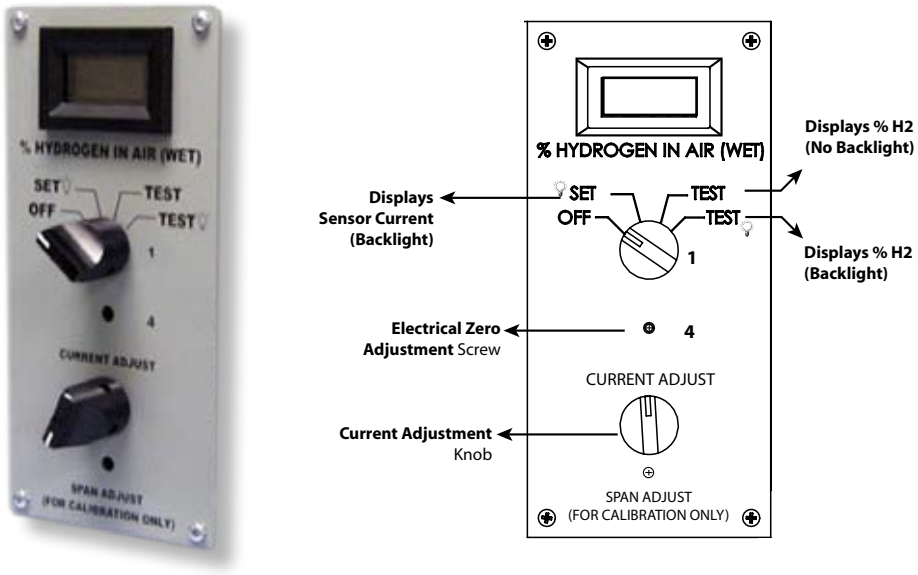


Figure 3-1. Front display with adjustment knobs.

5. The digital readout should settle at 0.0 within five minutes. If it does not, adjust the Electrical Zero Adjust Screw #4 (Figure 3-1) until the reading is 00.0. The 120HD is now ready to analyze a gas sample.

Analyzing a Gas Sample

Hydrogen gas is flammable, and in a mixture with air concentrations above 4% - 5%, it is explosive. Vent the gas from the outlet to a safe area - outdoors, if possible. Always make sure the workplace is well-ventilated.

Taking a Reading

1. Make sure that you have performed the **Current Adjustment** and **Electrical Zero Adjustment** if necessary.

2. Connect the inlet gas Swagelok tube fitting to the source gas to be tested.

3. Turn Knob 1 to either **TEST** position (non-backlit/backlit).

4. Set the flow through the analyzer at a rate of about 50 ml/min. A continuous, steady, flow rate of gas through the analyzer is preferred since it will not affect the reading.

The rate of gas flow is not critical. However, do not take a digital reading while hand pumping the gas sample. The pulsing could create a flow effect that might alter the reading.

5. The reading is stable when the digital readout does not increase for 30 to 60 seconds.

A decrease in the reading may indicate that there is a leak in the system and should be invesitgated. Follow the procedure "Checking for Leaks" in Chapter 1.

If the sample gas is forced through the analyzer by pressure at the source (rather than hand pumping), and then vented to atmosphere, connect a short piece of rubber tubing (12" x 18" long) to the outlet gas Swagelok tube fitting as a precaution against ambient air diffusing back into the analyzer.

6. Provide a low pressure (<5 PSIG), low flow rate source of air/nitrogen to purge the gas passages in the analyzer of any residual gases.

*When the analyzer is not in use, be sure to turn Knob 1 to the **OFF** position, otherwise the battery life will be decreased.*

Recalibration

Recalibration requires a known mixture of hydrogen and air or hydrogen in nitrogen. Hydrogen gas is flammable, and in a mixture with air concentrations over 4% - 5%, it is explosive. For this reason, mixtures of 20% hydrogen in air generally can't be obtained from commercial sources.

Do not attempt to make such a mixture and recalibrate the analyzer unless proper equipment, personnel, and expertise is available.

Follow these steps to recalibrate the analyzer.

1. Make sure that you have performed the **Current Adjustment** and **Electrical Zero Adjustment** if necessary.
2. Connect the inlet gas Swagelok tube fitting to the calibration gas.
3. Turn Knob 1 to either **TEST** position (non-backlit/backlit).
4. Set the flow through the analyzer at a rate of about 50 ml/min. A continuous, steady, flow rate of gas through the analyzer is preferred.

Calibration at 10% provides the most accurate results. However, calibration at intermediate values (5 - 15%) should result in acceptable performance.

5. The reading is stable when the digital readout does not increase for 30 to 60 seconds. If the reading is different from the calibration gas value, you must adjust the **SPAN ADJUST** screw (Figure 3-2) until the display reads the calibration value.

A decrease in the reading may indicate that there is a leak in the system and should be invesitgated. Follow the procedure "Checking for Leaks" in Chapter 1.

If the sample gas is forced through the analyzer by pressure at the source and then vented to atmosphere, connect a short piece of rubber tubing (12" x 18" long) to the outlet gas Swagelok tube fitting as a precaution against ambient air diffusing back into the analyzer.

*When the analyzer is not in use, be sure to turn Knob 1 to the **OFF** position, otherwise the battery will be decreased.*

20% hydrogen in air is explosive. Vent the gas from the outlet outdoors, if possible. Always make sure that the workplace is well-ventilated.

WARNING

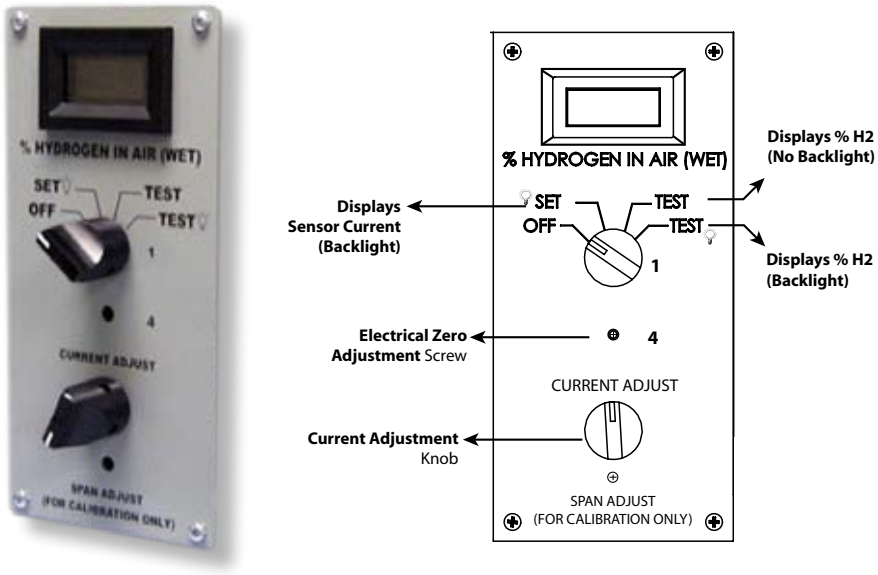


Figure 3-2.
SPAN ADJUST - for calibration only.

6. **SPAN ADJUST**

Do not perform this adjustment except during a calibration.

CAUTION

Make sure that Knob 1 is in the **TEST** position.

Using a screwdriver, adjust the **SPAN ADJUST** (Figure 3-2) so that the digital display reads a concentration identical to the calibration test gas value.

Turning the screw clockwise will increase the display value in $\%H_2$. Turning the screw counter-clockwise will decrease the display value in $\%H_2$.

NOTE

7. Repeat until the Zero and Span readings remain constant and unchanged and the calibration reading is within the repeatability specification (±0.5% H_2).

8. The analyzer is now calibrated.

Maintenance

Battery

The 120HD analyzer uses (1) 6V No. 521 Energizer Industrial Alkaline Lantern Battery. When the low battery warning indicator lights up and the battery runs down to the extent that it is impossible to adjust the digital display to 120.0 ±0.1, replace the battery following the procedure described in Chapter 1.

Repairs

Check the calibration following any repairs. Recalibration requires a known mixture of hydrogen and air or nitrogen. Hydrogen gas is flammable, and in a mixture with air concentrations over 4% - 5%, it is explosive. For this reason, mixtures of 20% hydrogen in air generally can't be obtained from commercial sources.

Do not attempt to make such a mixture and recalibrate the analyzer unless proper equipment, personnel, and expertise is available. Send the analyzer back to the AMETEK factory for recalibration.

Uncontaminated failed units or electrical subassemblies should be returned to AMETEK for failure evaluation by securing an RMA following the procedure in Chapter 1 under "Technical Support."