

ABB GAS ANALYZER PROCEDURES **FOR ETHANE ANALYSES AND MAINTENANCE**

Editorial Hand-Process Changes Other Than Spelling
Require PPD/CDF Operations Department Co-Head Approval

HPC Number	Date	Section Number	Initials
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____

Approval:

(PPD/CDF Operations Department Co-Head)

(Date)

1.0 Controlled Copies of This Procedure

Four controlled copies of this procedure will exist.

One at the CDF Department Office.

One on the CDF Web Page.

One on CDF ADMIN. Server.

One in the CDF Process Systems Control Room

All other copies will be marked, "**INFORMATIONAL COPY ONLY**"

2.0 The Procedure

To execute a procedure from the checklist, obtain a copy of the appropriate section. Place the completed checklist in the ABB Gas Analyzer Logbook, located in the CDF Process Systems Control Room.

3.0 Checklists

All of the checklists below pertain to the ABB Extrel Questor Gas Analyzer at CDF.

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Ethane Sample Analysis

Name: _____ Date: _____ Time: _____

- ___ 1. **Important:** Before installing the sample cylinder in the Gas Analyzer Ethane Analysis Stand, be sure that the ethane in the sample cylinder is allowed to reach room temperature while the 200 psig safety valve is attached as described in CDF-II Procedure 320, "Ethane Gas Sampling Procedure Required for Ethane Analysis." When the ethane is at room temperature, close the inlet/outlet valves on the one liter sample cylinder and remove the 200 psig safety valve from the cylinder. Install the sample cylinder in the designated location on the test stand.
Warning: ABB Analyzer ethane sample analyses, calibrations, maintenance, or other ABB analyzer operations may not be performed during a COT System Gas Mix.
- ___ 2. Check the calibration of the Gas Analyzer before beginning the ethane sample analysis.
 - ___ 2.a. The Questor software windows which need to be open in order to check the ABB Analyzer calibration are listed below. They are opened by selecting the appropriate Questor software menu items from the Start button.
 - Host Communication
 - Instrument Status
 - Instrument Control
 - Instrument Configuration
 - Event Display (optional)
 - Analysis Logger (optional)
 - Analysis Data Display; file = C2H6ana.dsp (optional)
 - ___ 2.b. In the Instrument Status window, verify that all status lights are green except the status light for the filament not in use. In this window also verify that the Mode status is 'A' (Automatic Sequence). The Mode is set in the Instrument Control window. In the Instrument Configuration window, check to be sure that Power, a Filament, and the heater are ON.
 - ___ 2.c. Open the Calibration cylinder # 1 and #2 cylinder supply valves.
 - ___ 2.d. On the ABB Gas Analyzer iFix page, select Task Code # 2. This Task will allow checking of Calibration Cylinder #1. Wait for the 16 Port Valve Position to change to 2.
 - ___ 2.e. Monitor the flow rate allowing time for the line pressure to build. A flow in the range of 50 to 80 sccm should be reached. This flow rate is displayed on the iFix Sample System page as FE-ABB-VENT.

- ___ 2.f. Allow 10 minutes for the supply line to purge and for the values displayed in the Analyzer Measurements table on the iFix ABB Gas Analyzer page to become stable. Evaluate the data comparing it to the certified contaminant levels contained in the calibration cylinder. The values should be within the ranges listed. If they are not, a full calibration is required.

The certified impurity levels and tolerable out-of-calibration limits for Calibration Cylinder # 1 are:

CO ₂ , Carbon Dioxide	2040 ppm	(+/- 40 ppm)
CH ₄ , Methane	9800 ppm	(+/- 100 ppm)
O ₂ , Oxygen	91 ppm	(+/- 5 ppm)
Balance C ₂ H ₆ , Ethane		

- ___ 2.g. On the ABB Gas Analyzer iFix page, select Task Code # 3. This Task will allow checking of Calibration Cylinder # 2. Wait for the 16 Port Valve Position to change to 3.
- ___ 2.h. Monitor the flow rate allowing time for the line pressure to build. A flow in the range of 50 to 80 sccm should be reached. This flow rate is displayed on the iFix Sample System page as FE-ABB-VENT.
- ___ 2.i. Allow 10 minutes for the supply line to purge and for the values displayed in the Analyzer Measurements table on the iFix ABB Gas Analyzer page to become stable. Verify also that the oxygen level has fallen to a low value and that it is stable. Evaluate the data comparing it to the certified contaminant levels contained in the calibration cylinder. The values should be within the ranges listed. If they are not, a full calibration is required.

The certified impurity levels and tolerable out-of-calibration limits for Calibration Cylinder # 2 are:

H ₂ , Hydrogen	420 ppm	(+/- 10 ppm)
C ₃ H ₈ , Propane	1980 ppm	(+/- 40 ppm)
Balance C ₂ H ₆ , Ethane		

- ___ 2.j. Select Task Code 13 in order to keep the gas analyzer purged with nitrogen gas. Verify that a flow in the range of 50 to 80 sccm is achieved at the analyzer exhaust. Wait for the 16 Port Valve Position to change to 16.
- ___ 2.k. If the current analysis readouts fall within the tolerances of the certified values, a calibration is not required. Close the Calibration Cylinder #1 and #2 cylinder supply valves and continue with this procedure. If a calibration is required, CDF-II Procedure 322 must be performed by trained personnel before continuing.
- ___ 3. When beginning this analysis, the manual valves on the sample line should be found as indicated below. Reference the CDF Main Floor Gas Rack Area P&I Diagram, drwg. # 2563.370-ME-405215.

Sample Cylinder Valves	Closed
MV-140-GR	Closed
MV-141-GR	Closed
MV-142-GR	Closed
MV-143-GR	Closed
MV-144-GR	Closed
FCV-E-SAMP	OFF (Closed)

The vacuum manifold valves should be found as follows.

PV-GR-VACPUMP	Closed
MV-001-GR	Closed
MV-002-GR	Closed

Note that PV-GR-VACPUMP and FCV-E-SAMP are controlled from the "Sample System" iFix page.

- ___ 4. Check the pressure in the Analyzer Vacuum Manifold, PT-GR-VM-2 on iFix, or PI-001-GR locally. If there is positive pressure in the manifold, vent it through MV-002-GR. PT-GR-VM-2 must read less than 16 psia. Close MV-002-GR.
- ___ 5. Verify that the Pfeiffer vacuum pump is properly connected with its exhaust venting to the vent line. Start the Pfeiffer vacuum pump and then open PV-GR-VACPUMP. Connect a Hastings DV-4 Gauge (0-20 torr range) to PT-GR-VM-1. Watch to see that the vacuum pressure falls to a few torr (< 5 torr).
- ___ 6. Open MV-140-GR and MV-142-GR to evacuate the sample supply tubing. Also, set the Sample Flow Controller to "Flow On" on the Sample System iFix page. Keep the sample cylinder valves and the other line valves closed. Watch for the pressure to fall below 5 torr on the DV-4 Gauge.
- ___ 7. Close MV-142-GR and PV-GR-VACPUMP. Turn off the Vacuum Pump.
- ___ 8. Open the Sample Cylinder supply valve and then MV-141-GR.
- ___ 9. Select Analyzer Task Request # 5 from the ABB Gas Analyzer iFix page. Allow a minute or so for the 16 Port Valve Position to read 5 on the ABB Gas Analyzer iFix page. Allow time for the supply line to pressurize. The analyzer vent flow as seen on the Sample System iFix page should read about 90 to 100 sccm.
- ___ 10. On the ABB Gas Analyzer iFix page, verify that the Analyzer Operating Status is Automatic Sequence Mode, ABB Online, Operating Status OK, and AC Power OK. Wait about 10 minutes for the sample line to clear. Then, print a hard copy of the analysis results (iFix ABB Gas Analyzer page). Note the trailer number and the date that the sample was taken on the Analysis Results Print-out AND in the spaces below.

_____ ETHANE TRAILER NUMBER

_____ DATE SAMPLE WAS DRAWN FROM TRAILER

- ___ 11. Select Analyzer Task Request #13 (Nitrogen Gas Purge). Keep the sample flow controller set to "Flow On" and open MV-144-GR. Note the time that MV-144-GR is opened.

_____ time

- ___ 12. Immediately close MV-141-GR. The flow from the sample cylinder as read by FE-E-SAMP must be about 100 sccm.

- ___ 13. Select Manual Control on the O2 - PPM iFix page. Allow the Oxygen PPM reading to "zero" on the Zero position (default). Allow the reading to fall to around 20 ppm or lower. Also, monitor the sample cylinder pressure while purging to be sure it does not drop to zero.

- ___ 14. When the oxygen ppm reading is "zeroed" and after MV-144-GR has been open and MV-141-GR is closed for at least 15 minutes with "Flow On", select the Ethane Sample from the Manual Control menu on the O2 - PPM iFix page.

- ___ 15. Wait a minimum of 20 minutes and record the O2 PPM value on the hard copy of the ABB analysis results. Next, set the Oxygen Analyzer to SCAN mode.

- ___ 16. Close MV-144-GR and the sample cylinder supply valve. Set the sample flow controller to "Flow Off".

- ___ 17. Verify that the Sample Line and the Vacuum Manifold valve positions are set as follows:

Sample Cylinder Valves	Closed
MV-140-GR	Closed
MV-141-GR	Closed
MV-142-GR	Closed
MV-143-GR	Closed
MV-144-GR	Closed
FCV-E-SAMP	OFF (Closed)
PV-GR-VACPUMP	Closed
MV-001-GR	Closed
MV-002-GR	Closed

- ___ 18. If desired, the sample cylinder may be vented, evacuated, and backfilled with nitrogen gas via the vacuum manifold. Be sure that the Pfeiffer Vacuum Pump is used for this purpose and that its exhaust is attached to the exhaust line. When finished, be sure that all valves are isolated as indicated in step 17.

Gas Analyzer Start Up, Shut Down, and Maintenance Instructions

1. Warning: Ethane sample analyses, calibrations, maintenance, or other ABB analyzer operations may not be performed during a COT System Gas Mix.
2. In order to startup the ABB Gas Analyzer, follow the procedure outlined in the ABB Extrel Operations Manual located in the Hardware section of the manual, page 5-3, "Startup After Performing Maintenance." Also, reference the Software section page 1-12, "Component Power On/Off."
3. To shutdown the ABB Gas Analyzer, follow the procedure outlined in the ABB Extrel Operations Manual located in the Hardware section of the manual, page 5-2 and 5-3, "Venting the Vacuum System." Also, reference the Software section page 1-12, "Component Power On/Off."
4. Perform Routine Maintenance as outlined in the ABB Extrel Operations Manual located in the Hardware section of the manual, Chapter 5, "Routine Maintenance." The Recommended Maintenance is summarized on page 5-1 of this chapter. Log all maintenance performed in the table provided.

Gas Analyzer Maintenance Log

Perform maintenance on the ABB Gas Analyzer per the ABB Extrel Questor GP Hardware Manual Chapter 5 and the Maintenance Instructions within this procedure. Log all maintenance in the table below.

Name	Date	Type of Maintenance Performed	Maintenance Notes

4.0 DEVIATIONS

None are allowed.

5.0 Required Training and Authorized Training Personnel

CDF Gas Systems Engineer
CDF Gas Systems Manager

The training should be documented on a standard Fermilab Training Form and the Training Expiration date should be tied to the end date of the Collider Run (e.g. "the end of Collider Run II"). The completed forms must be inserted in the CDF Department Office copy of this procedure.

6.0 Training Materials

This procedure covering the operation and maintenance of the ABB Gas Analyzer must be read and understood. Review of the Gas Analyzer Piping and Instrumentation Drawing # 2563.370-ME-405215 is required.

The authorized training personnel must give a training lecture on the use of the ABB Questor Analyzer.

7.0 List of Trained People for this Procedure

A list of trained personnel for this procedure is to be kept in a separate section at the end of the CDF Department copy of the procedure.

8.0 References and Supporting Documentation

For a layout of the ABB Gas Analyzer piping and instrumentation, see Fermilab drawing # 2563.370–ME-405215. Additional supporting documentation includes the ABB Extrel Questor GP Software/Hardware Manual.