## SPECIFICATIONS
## ISOKINETIC AIR SAMPLING SYSTEM
## COMPRISING
## DUCT FLOW MONITOR AND ISOKINETIC AIR SAMPLER

### General Description

Fixed filter air sampling (performed in accordance with ANSI N13.1-1999 and 40 CFR 60, method 1, 1A, 2 and 2A) is a method used in nuclear facilities with permanent or temporary ventilation systems to verify that radioactive particulate matter is not being discharged to the environment in excess of regulatory limits. Fixed filter air sampling is in continuous operation at all times when air is being exhausted from radiologically-controlled spaces to the environment. A small known fraction of the main exhaust duct air is passed through an analytical grade filter of known efficiency. After a set period of time, the filter is removed from the filter housing and analyzed for the radioactive pollutants captured on the filter media. The filter analysis results, run time, sample line flow rate and main exhaust duct air flow rate are used in the determination of the radioactive pollutants emitted to the environment. The isokinetic air sampler can automatically adjust its flow rate for changes in the duct flow rates and simplifies compliance with isokinetic sampling requirements. This feature improves the accuracy of the radioactive pollutant emissions reported to the regulatory agency.

The Duct Flow Monitor automatically corrects the duct flow rate to an operator selectable Reference temperature (T) and pressure (P) and computes the corrected bulk flow volume.

The isokinetic air sampler automatically corrects the sample flow rate to a Reference T and P and computes the corrected accumulated sample volume.

The acceptable method, as described in the ANSI standard, is to draw air into the sample line filter via the use of a vacuum pump. The sample system components consist of the following:
- Sampling probe located properly within the main exhaust duct line
- An in-line filter housing and filter
- An isokinetic air sampling mechanism and vacuum pump; i.e. $V_{sample}/V_{duct}$ ($V_s/V_d$) $\cong 1$
- An accurate flow measurement system
- Volume totalization mechanism
- Associated tubing/fittings

Refer to Figure 1 for a typical isokinetic air sampling setup.

**Rev: 05 August 2020**

# Typical Isokinetic Air Sampling Setup

DP Flow Sensor

Exhaust Duct

Duct Flow

SAMPLE LINE

GAS-100
Duct Flow
Monitor System

RS232 Out
To PC

Filter(s)   FM

RS232 Cable

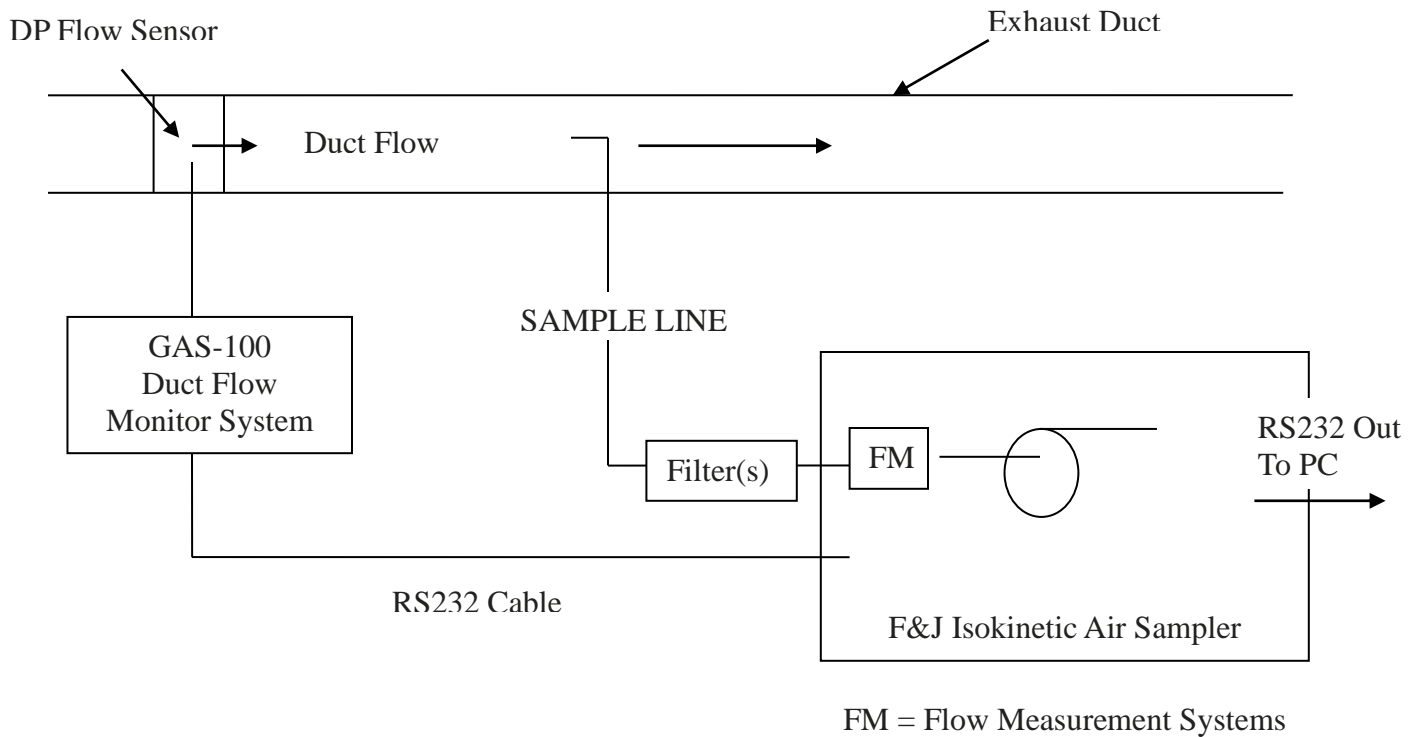F&J Isokinetic Air Sampler

FM = Flow Measurement Systems

Figure 1

The exhaust duct flow sensor readings are obtained by the duct flow monitor and transmitted to the isokinetic sampler once per second. The required flow rate through the sampling line is then automatically calculated. The isokinetic air sampler with an automatic flow control device is programmed to achieve the required sample line flow rate. The sample line system flow is adjusted automatically with changes in the main duct flow rate to ensure the air velocity entering the sample probe is equivalent to the air velocity of the air in the duct.

The F&J isokinetic air sampling system and duct flow monitor perform the following functions:
- It extracts a small percentage of air being exhausted from a ventilation duct
- It monitors, compares and totalizes airflow in both the exhaust duct line and the sample line
- It adjusts the sample line flow rate as exhaust duct flow rate changes to maintain isokinetic sampling conditions ($V_s/V_d \sim 1$)
- It totalizes run time for each flow rate range, in both the exhaust duct and the sample line
- It outputs data to a PC device via data connection (i.e. USB or Serial Port connector)
- It provides a local visual alarm in the event the velocity ratio criteria ($V_s/V_d$) is not met

## General Information:
A. Language is English
B. Units for all measured and calculated physical parameters are operator selectable
C. A data acquisition program is provided for use with both the duct flow monitor and isokinetic air sampler for setup, file archiving, report generation and remote control via PC device
D. Correction of flow rates and volumes to a reference temperature and pressure are operator selectable for both the duct flow monitor and the isokinetic air sampler

## Detailed F&J System Equipment/Components, Technical Requirements and Information
A. The isokinetic air sampling system will extract a small percentage of air being exhausted from a ventilation duct to the following criteria:
1. Sample line flow rate is based on near isokinetic sampling, which means the velocity of the air entering the sampling probe inlet must be approximately equal to the bulk stream velocity in the duct ($V_s / V_d \sim 1$). The sampling probe inlet air velocity may vary from the main duct velocity as follows:

$$0.82 \leq V_{sample}/V_{duct} \leq 1.2$$

$V_{sample} = $ Velocity of the air entering the sampling probe
$V_{duct} = $ Velocity of the air in the exhaust duct

B. The recommended sampling probe inner diameter value will be determined by analyzing the duct flow rate range and the duct inner diameter value

C. It is assumed that there is an even velocity distribution within the exhaust duct and sample line. This is an acceptable practice (i.e. acceptable to use average velocity within the duct)

D. The isokinetic air sampler automatically adjusts the sample line flow rate to a ratio of $V_s/V_d$ as close to 1 as possible when duct exhaust flow rate changes. The system is designed to maximize the allowable range of main duct flow rates for each sample line flow rate

E. Main duct line volumetric or mass flow rate is monitored

F. Sample line volumetric or mass flow rate is monitored

G. Run time is totalized in each flow rate bin, in the exhaust duct

H. Run time is totalized in each flow rate bin, in the sample line

I. All duct and sample data may be transmitted to a PC device via data connection (i.e. USB, Serial Port, optional ethernet port).

J.  The isokinetic sampler and duct flow totalizer are both protected from inadvertent resetting and/or loss of data in the case of:
   1. Filter change out
   2. Relocation of entire sampling system
   3. Annual system resetting
   4. System or power failure

K.  A visible alarm and a screen display notification is provided if the system is unable to maintain the sample flow rate within the specified $V_s/V_d$ criteria.



**GAS-100 / 100E**



**GAS-EDL-HP /HPE**
**With Isokinetic Sampling Option**

## Global Air Sampler Operator Selectable Features

Language Options:                                English

Sampling Mode:                                   Volumetric Flow or Mass Flow

Gas Type:                                        Air, $O_2$, $N_2$, $H_2$, CO, $CO_2$, $C_3H_6$, He, $NH_3$

Engineering Units

    Volumetric Flow:                             sccm, SLPM, SCFM, $sm^3/min$, $sm^3/hr$

    Mass Flow:                                   kg/hr, g/min, 1lbs/hr

    Temperature:                                 ºC, ºF

    Pressure:                                    In. Hg, mm Hg, bar, mbar, atm, kPa, hPa

Reference T and P

    Reference T:                                 0ºC, 15ºC, 20ºC, 21.1ºC (70ºF), 25ºC

    Reference P:                                 101.325 kPa (760 mm Hg), 100 kPa (1bar)

RS232 Data Output Frequency:                     1 sec, 1 min, 10 min, 20 min, 30 min, 1 hr

Data Storage Frequency:                          1 min, 10 min, 20 min, 30 min, 1 hr

Operating Mode:                                  Continuous or Periodic

Periodic Sampling Options:                       1 hr. (12 five minute periods), or
                                                 weekly (24 one hour periods for each of the 7 days)

Ending Mode:                                     By time, By volume

Operator Selectable Passwords:                   2 levels

Alarm Settings                                   Flow, inlet P, temperature, DP due to dust loading

Date and Time Setup                              Input of real time and date



**Duct Flow Monitor
GAS-100 Series**



**Isokinetic Air Sampler
GAS-EDL-HP / HPE**

# GASdaq: Data Acquisition Software for Isokinetic Air Sampling

The GASdaq software enables the user to connect a PC to any F&J Global Air Sampler and easily setup, monitor, transmit, and download the sample data from the instrument after the sample event or at operator selectable transmission frequencies during the sample event. Operator selectable features include the following:

1) Setup the air sampling instrument utilizing operator selectable radio button system

   a) Engineering units for measured and calculated parameters
   b) Reference temperature and pressure values for volumetric flow
   c) Alarm settings for six different parameters
   d) Operating modes
   e) Data storage averaging frequencies
   g) Data transmission frequencies

## User Settings Screen

The following two screens displays represent the Main Data Screen viewable on the PC during the sample event (measurement in process) and the Main Data Screen after sample event has been terminated.

## Main Screen



## Post Sample Main Screen

The GASdaq software enables a user to view on the PC screen and print the following reports on a Windows printer:

1) Management Report and data charts for the sample event
2) Data records report
3) Alarm settings report

## Management Report for GASdaq Isokinetic Setup

### Management Report

#### IDENTIFICATION OF AIR SAMPLER

| | | | |
|---|---|---|---|
| Serial Number: | 5041 | Company Name: | 3COMPNAM |
| Station Number: | 3STATION | Plant Site: | 3PLNTSIT |
| Filter1 ID: | 3FILTER1 | Recalibration Due: | 27 SEP 2013 |
| Filter2 ID: | 3FILTER2 | Software Version: | V01.12c |

#### SETUP PARAMETERS IN AIR SAMPLER

| | | | |
|---|---|---|---|
| Flow Type: | Isokinetic | Operation Mode: | Continuous |
| Duct Flow Range: | 1000 - 6000 SCFM | Flow Ratio: | 1 : 1000 |
| Flow Unit: | SCFM | | |
| Volume Unit: | SCF | | |
| Temperature Unit: | °F | | |
| Pressure Unit: | InHg | | |
| Reference Temp.: | 32.0 °F | | |
| Reference Press.: | 29.92 InHg | | |
| End After: | 10000000 SCF | RS-232 Freq.: | 1 sec |
| | | Storage Freq.: | 1 min |
| Flow Diff. Alarm: | ±15% | Inlet P. Drop: | 3.6 InHg |
| Inlet P. Range: | 26.6 - 30.2 InHg | Temp. Range: | 55.0 - 99.0 °F |

#### MEASUREMENT SUMMARY

| | | | |
|---|---|---|---|
| Start at: | 01 FEB 2013 22:09 | Stored Data Record(s): | 640 |
| End at: | 03 FEB 2013 00:05 | Power Outage(s): | 0 |
| Elapsed Time: | 1,01:55 d,h:m | Power Outage(s) Time: | 0,00:00 d,h:m |
| Sample Volume: | 9083.1 SCF | Percent Availability: | 100.0% |
| Ambient Volume: | 8774.1 CF | Number of Alarms: | 10 |
| | | Inlet P. Drop Reference: | 28.4 InHg |

| | Minimum: | Maximum: | Average: | |
|---|---|---|---|---|
| Standard Flow: | 0.00 | 5.97 | 5.86 | SCFM |
| Ambient Flow: | 0.00 | 5.77 | 5.66 | CFM |
| Temperature: | 70.3 | 71.4 | | °F |
| Ambient Press.: | 30.23 | 30.28 | | InHg |
| Differential Press.: | 0.000 | 0.666 | | InHg |

| Duct Bin Range: [SCFM] | Volume: [SCF] | Time: [d,h:m] | Sample Bin Range: [SCFM] | Volume: [SCF] | Time: [d,h:m] |
|---|---|---|---|---|---|
| < 1000 | 75 | 0,00:00 | < 1.00 | 0.05 | 0,00:00 |
| 1000 - 1500 | 85 | 0,00:00 | 1.00 - 1.50 | 0.00 | 0,00:00 |
| 1500 - 2000 | 292 | 0,00:00 | 1.50 - 2.00 | 0.50 | 0,00:00 |
| 2000 - 2500 | 2034 | 0,00:00 | 2.00 - 2.50 | 1.97 | 0,00:00 |
| 2500 - 3000 | 1297 | 0,00:00 | 2.50 - 3.00 | 1.30 | 0,00:00 |
| 3000 - 3500 | 1128 | 0,00:00 | 3.00 - 3.50 | 1.15 | 0,00:00 |
| 3500 - 4000 | 1051 | 0,00:00 | 3.50 - 4.00 | 1.00 | 0,00:00 |
| 4000 - 4500 | 1271 | 0,00:00 | 4.00 - 4.50 | 1.75 | 0,00:00 |
| 4500 - 5000 | 789 | 0,00:00 | 4.50 - 5.00 | 1.01 | 0,00:00 |
| 5000 - 5500 | 1307 | 0,00:00 | 5.00 - 5.50 | 2.18 | 0,00:00 |
| 5500 - 6000 | 9084000 | 1,01:52 | 5.50 - 6.00 | 9073.67 | 1,01:51 |

F&J GASdaq V01.02.04

Comments:

Operator:
Date:

Approved by:
Date:

## Management Report Chart

Charts are printed according to graph selection and current zoom / chart positioning. The engineering units can be changed in User Settings.

**Management Report**

Serial Number: 1000          Data Records: 1439          Start at: 13 DEC 2012  08:05
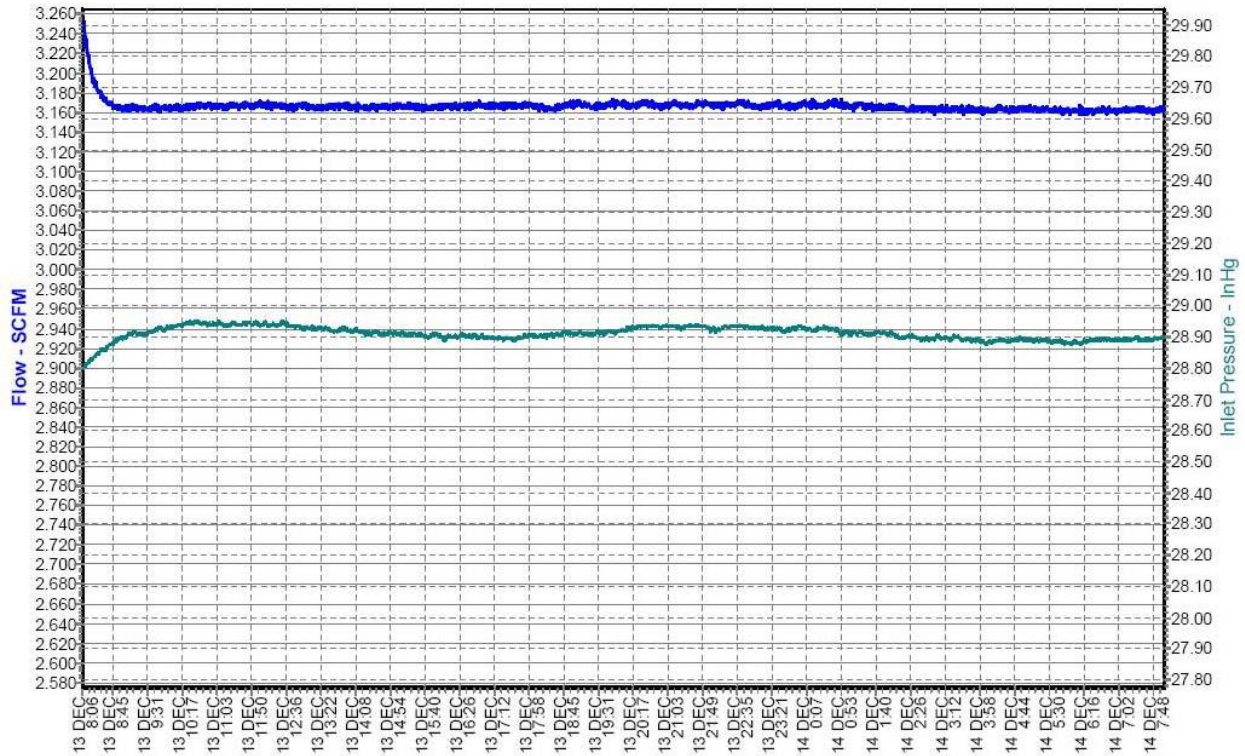


F&J GASdaq  V01.02.04

Depending on the alarms, errors, and instrument options the chart header may contain error-related information.

| Serial Number: 5041 | | **Management Report** | | Start at: 01 FEB 2013  22:09 | |
|---|---|---|---|---|---|
| Data Records: | 640 | Records with Alarms/Errors: | 21 | Number of Alarms/Errors: | 10 |
| (x) Flow % Alarm: | 3 | (x) Pressure Alarm: | 3 | (_) Temperature Alarm: | 0 |
| (_) Pressure Drop Alarm: | 0 | (x) Isokin. Condition Alarm: | 2 | (x) Communication Error: | 2 |
| (_) Data Record Error: | 0 | NOTE: (x) marks alarm(s) depicted on the chart | | | |

## GASdaq (Con't.)

## Data Records Table in Isokinetic Mode

**Data Records**

Data Records: 481
Records with Alarms/Errors: 7
Number of Alarms/Errors: 9
(Flow: 3, Press: 3, Temp: 0)
(pDrop: 0, Isokin: 2, Comm. error: 1, Record error: 0)

[Chart & Report]  [Done]

| Record | Date & Time From Stored Record | Sample Flow SCFM | Sample Temp. °F | Sample Inlet P. InHg | Duct Flow SCFM | Duct Temp. °F | Duct Inlet P. InHg | Alarms F,P,T, D,I,C,R |
|---|---|---|---|---|---|---|---|---|
| 469 | 02 FEB 2013 11:14 | 12.35 | 70.3 | 30.31 | 2114.60 | 70.6 | 30.10 | |
| 470 | 02 FEB 2013 11:15 | 21.01 | 70.3 | 30.34 | 2950.60 | 70.6 | 30.12 | F,P |
| 471 | 02 FEB 2013 11:16 | 21.50 | 70.3 | 30.34 | 3283.10 | 70.6 | 30.13 | f,p,I |
| 472 | 02 FEB 2013 11:17 | 0.00 | 70.3 | 30.27 | 41.00 | 70.6 | 30.03 | |
| 473 | 02 FEB 2013 11:18 | 0.00 | 70.3 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 474 | 02 FEB 2013 11:19 | 0.00 | 70.3 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 475 | 02 FEB 2013 11:20 | 0.00 | 70.3 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 476 | 02 FEB 2013 11:21 | 0.00 | 70.3 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 477 | 02 FEB 2013 11:22 | 0.00 | 70.4 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 478 | 02 FEB 2013 11:23 | 0.00 | 70.4 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 479 | 02 FEB 2013 11:24 | 0.00 | 70.4 | 30.27 | 0.00 | 70.6 | 30.03 | |
| 480 | 02 FEB 2013 11:25 | 0.00 | 70.4 | 30.27 | 0.00 | 70.6 | 30.02 | |

## Duct and Sample Flow BIN Table

**Bin Tables**

Bin data refreshed at 23 FEB 2013 13:20
Duct Flow Range: 1000 - 6000 SCFM          Flow Ratio: 1 : 1000          [Done]

**Duct Monitor Flow Bins**

| Duct Bin Range SCFM | Volume SCF | Time d,h:m |
|---|---|---|
| < 1000 | 18 | 0,00:00 |
| 1000 - 1500 | 37 | 0,00:00 |
| 1500 - 2000 | 145 | 0,00:00 |
| 2000 - 2500 | 110 | 0,00:00 |
| 2500 - 3000 | 135 | 0,00:00 |
| 3000 - 3500 | 106 | 0,00:00 |
| 3500 - 4000 | 192 | 0,00:00 |
| 4000 - 4500 | 526070 | 0,02:10 |
| 4500 - 5000 | 158 | 0,00:00 |
| 5000 - 5500 | 157 | 0,00:00 |
| 5500 - 6000 | 10546 | 0,00:02 |

**Air Sampler Flow Bins**

| Sample Bin Range SCFM | Volume SCF | Time d,h:m |
|---|---|---|
| < 1.00 | 0.01 | 0,00:00 |
| 1.00 - 1.50 | 0.00 | 0,00:00 |
| 1.50 - 2.00 | 0.02 | 0,00:00 |
| 2.00 - 2.50 | 0.02 | 0,00:00 |
| 2.50 - 3.00 | 0.05 | 0,00:00 |
| 3.00 - 3.50 | 0.08 | 0,00:00 |
| 3.50 - 4.00 | 0.09 | 0,00:00 |
| 4.00 - 4.50 | 525.54 | 0,02:10 |
| 4.50 - 5.00 | 0.11 | 0,00:00 |
| 5.00 - 5.50 | 0.18 | 0,00:00 |
| 5.50 - 6.00 | 10.31 | 0,00:01 |

## Alarms Settings

**More User Settings**

Alarm Settings

Report alarm when:                                      [Done]

☑ Flow differs from Setup flow by     ○ ±10%   ○ ±15%   ◉ ±20%
☑ Inlet Pressure higher than     [34.0] InHg
☑ Inlet Pressure lower than      [20.0] InHg
☑ Temperature higher than        [110] °F
☑ Temperature lower than         [40] °F
☑ Inlet Pressure drop (dust loading)  [5.0] InHg

Air Sampler Clock Setting

☑ Synchronize Air Sampler's clock with PC clock when sending Setup to Instrument

Directory for Automatically Saved Data and Setup Files

Current Directory:
[C:\ACCMAN2\]                    [Browse]

**Operator selectable alarms are available for:**

1. Flow deviation
2. High inlet pressure
3. Low inlet pressure
4. High temperature
5. Low temperature
6. Inlet pressure drop due to dust loading

The GASdaq software enables a user to view and print data charts vs. time of two operator selectable measured parameters in still mode, moving chart mode, or in zoom mode. The data charts illustrate alarm events, if any.
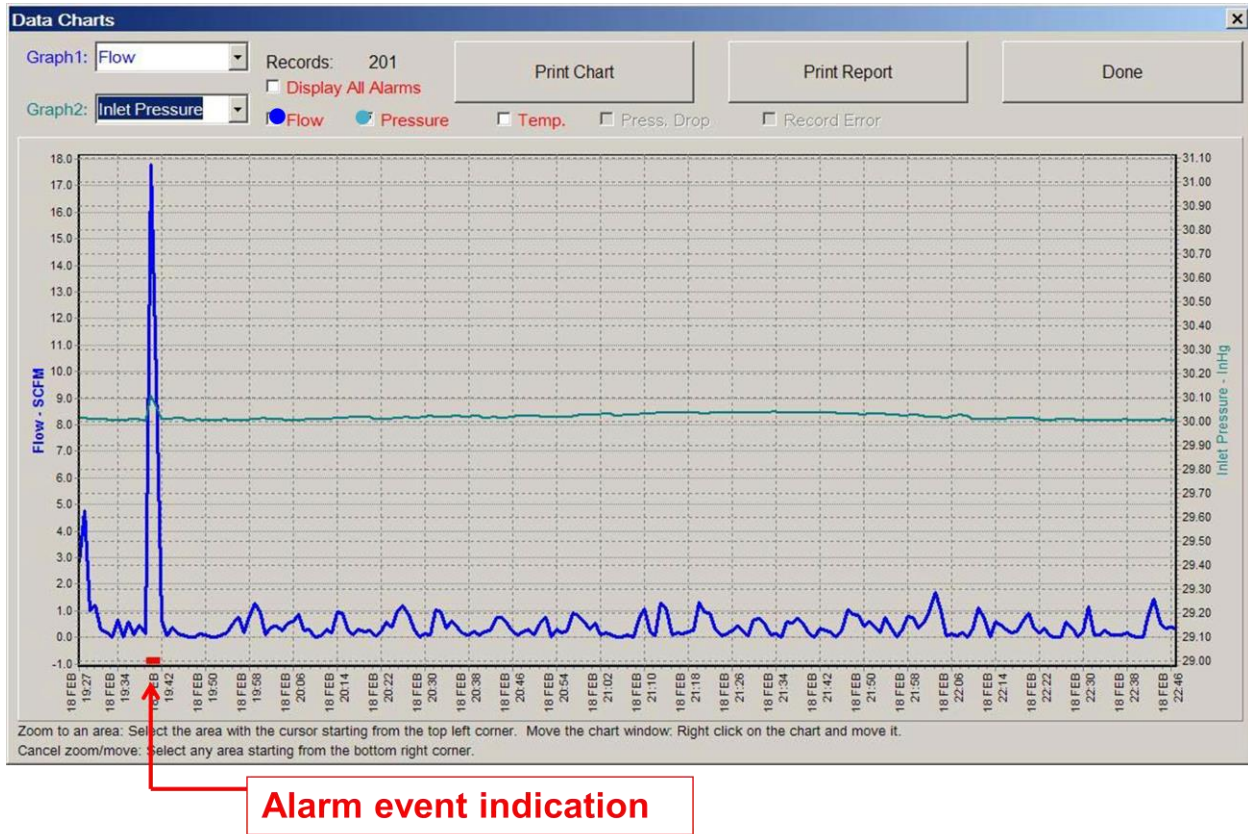
**Data Chart Selection Option**
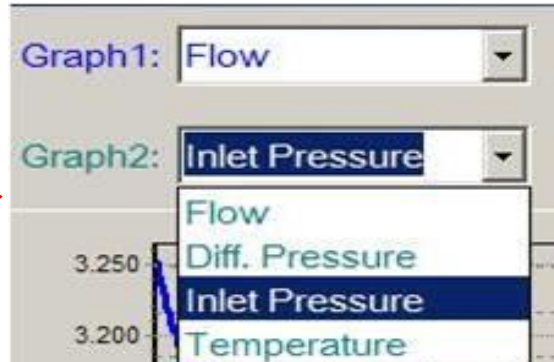


**Data Chart**
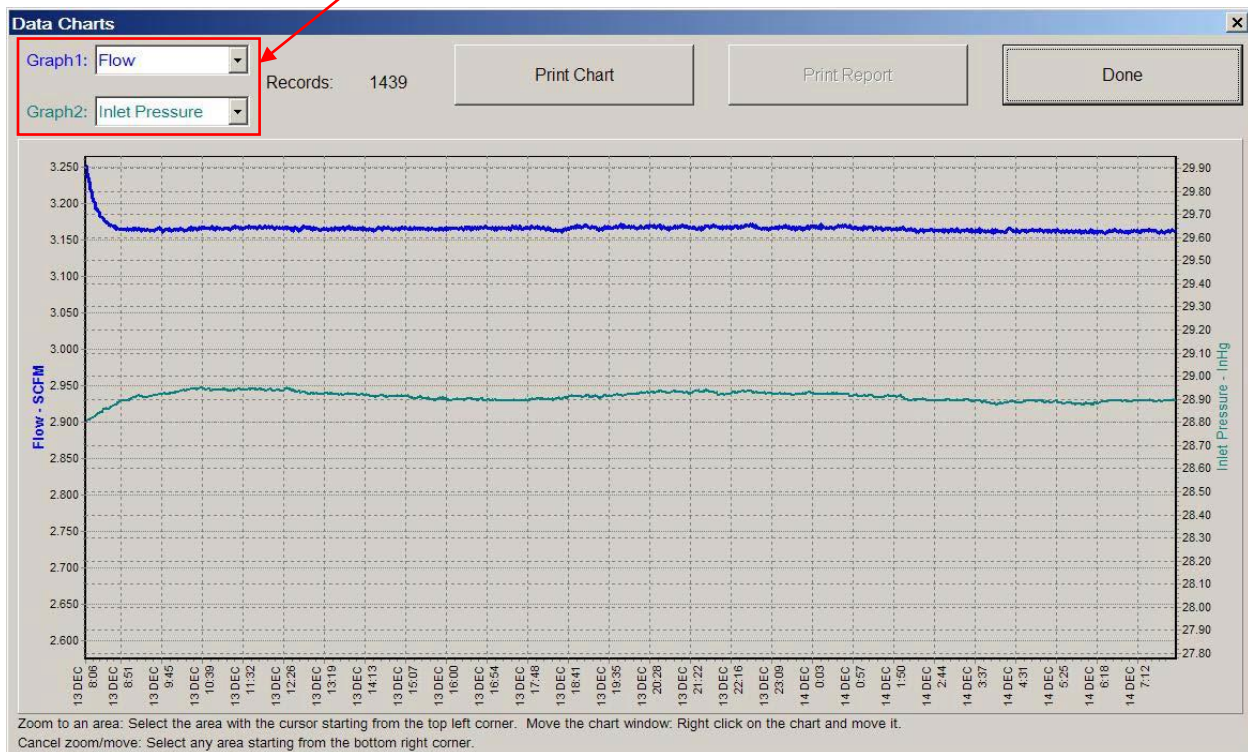
## Data Chart with Alarm Event



**Alarm event indication**

F&J provides purchasers of GAS systems with the computer commands necessary to control the air sampler in the field via direct connection or remotely. The command set includes the following functions:

      1) Start/stop
      2) Send stored data since last transmission
      3) Send data continuously at operator selectable frequency

The command set enables purchasers to create their own software programs to interact with GAS field air sampling instruments in lieu of the GASdaq software.

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