F&J SPECIALTY PRODUCTS, INC.

The Nucleus of Quality Air Monitoring Programs

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) ≅ 1
- An accurate flow measurement system
- Volume totalization mechanism
- Associated tubing/fittings

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

Typical Isokinetic Air Sampling Setup

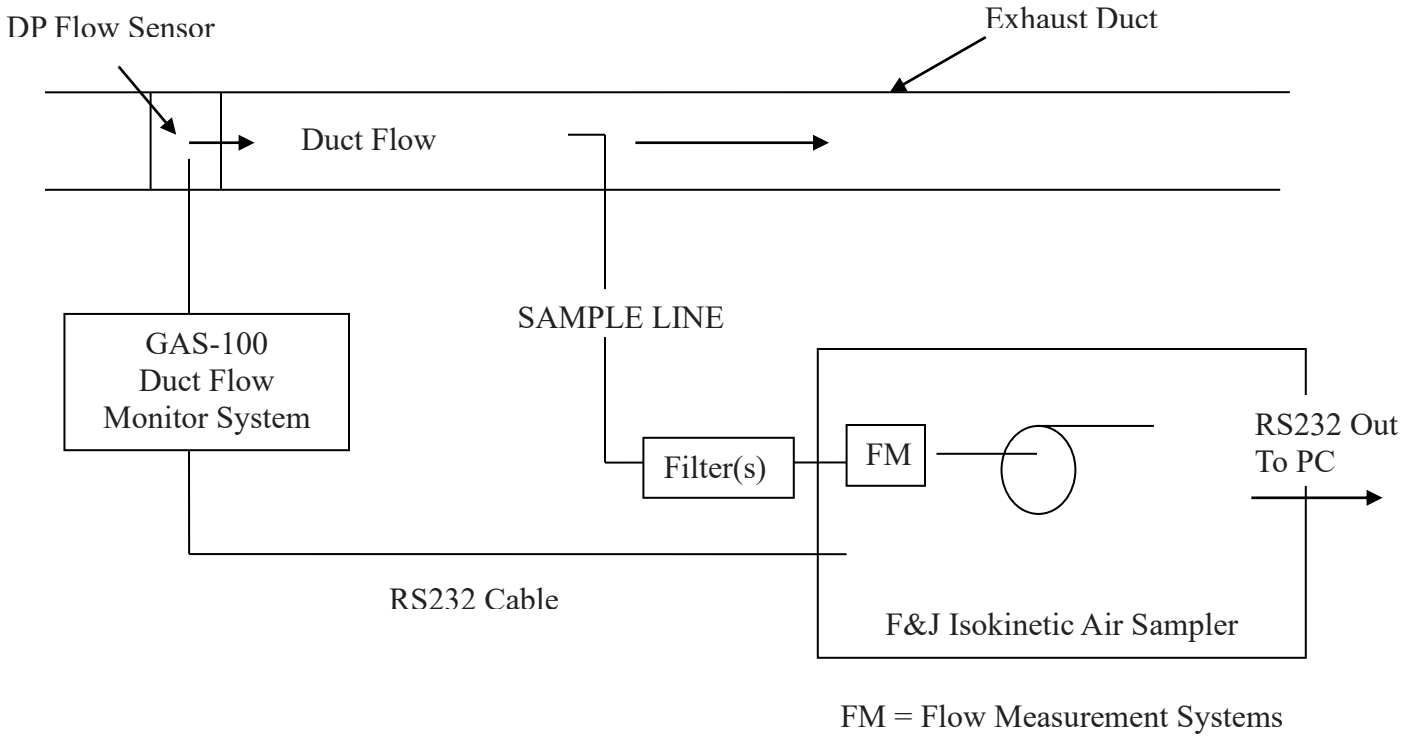


Figure 1

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 ($V_s/V_d \simeq 1$)
- 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 ($V_s / V_d \simeq 1$). 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.

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-CB-100L-AC, or
Equivalent

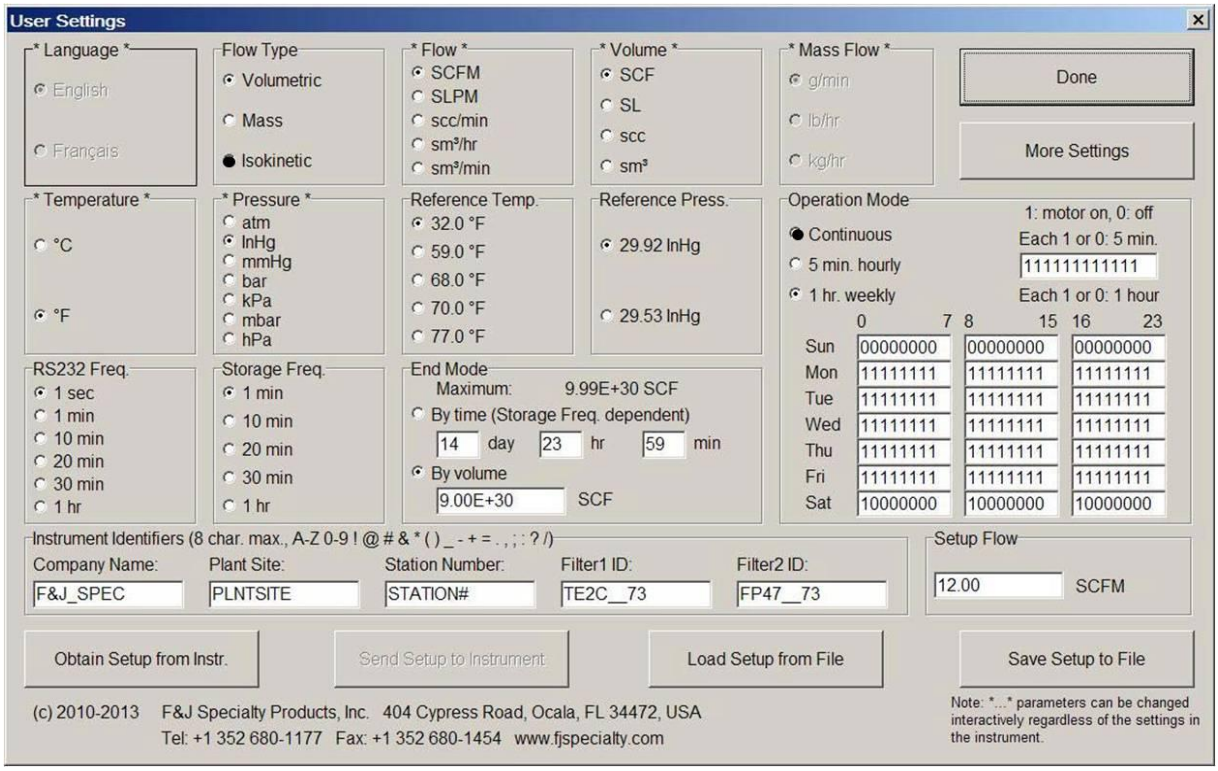
GASdaq: Data Acquisition Software for Isokinetic Air Sampling

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

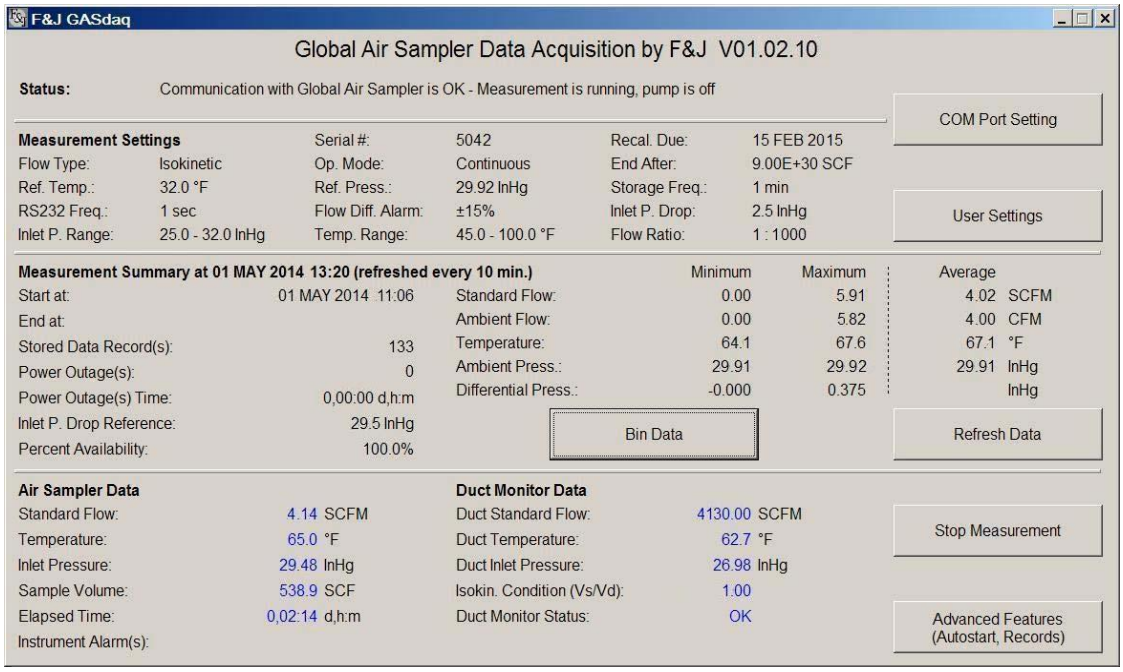
a) Engineering units for measured and calculated parameters
b) Reference temperature and pressure values for volumetric flow
c) Alarm settings for six different parameters
d) Operating modes
e) Data storage averaging frequencies
g) Data transmission frequencies

User Settings Screen

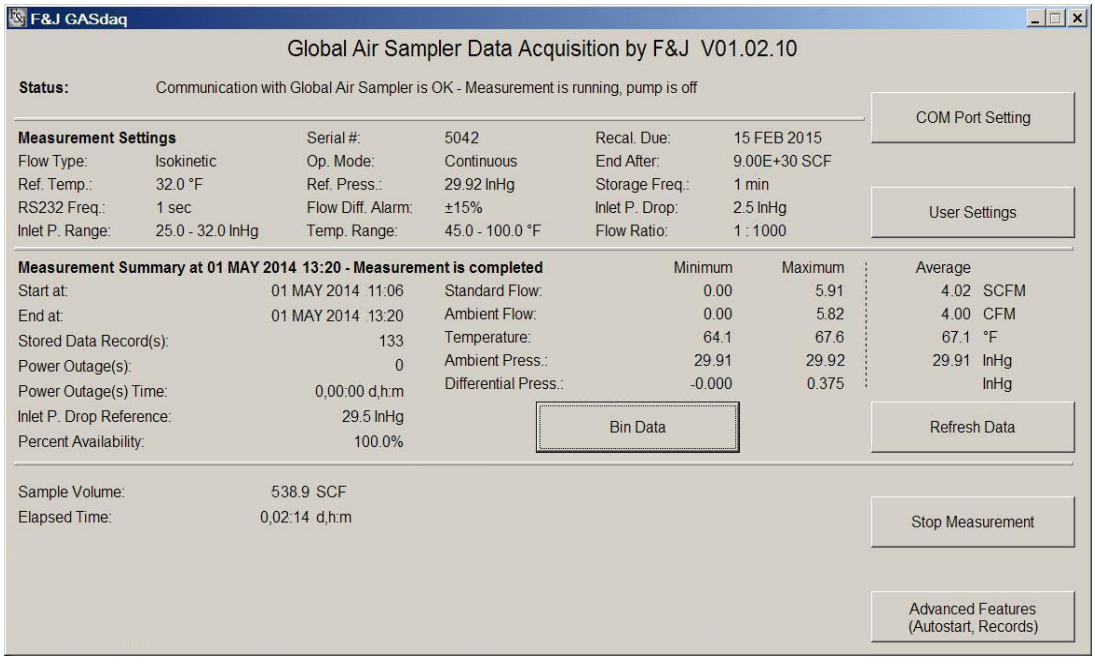


The following two screens displays represent the Main Data Screen viewable on the PC during the sample event (measurement in process) and the Main Data Screen after sample event has been terminated.

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

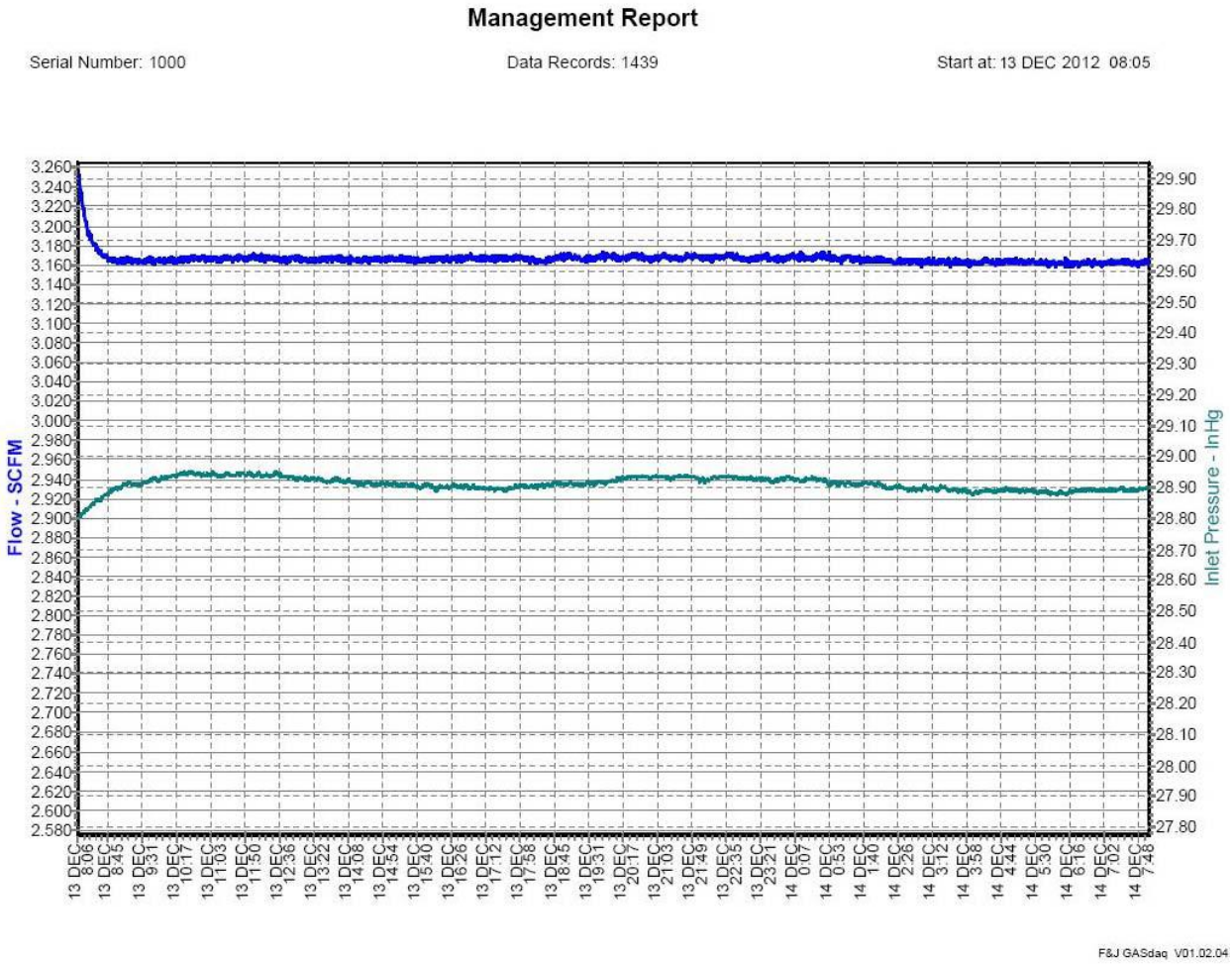
Comments:

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.



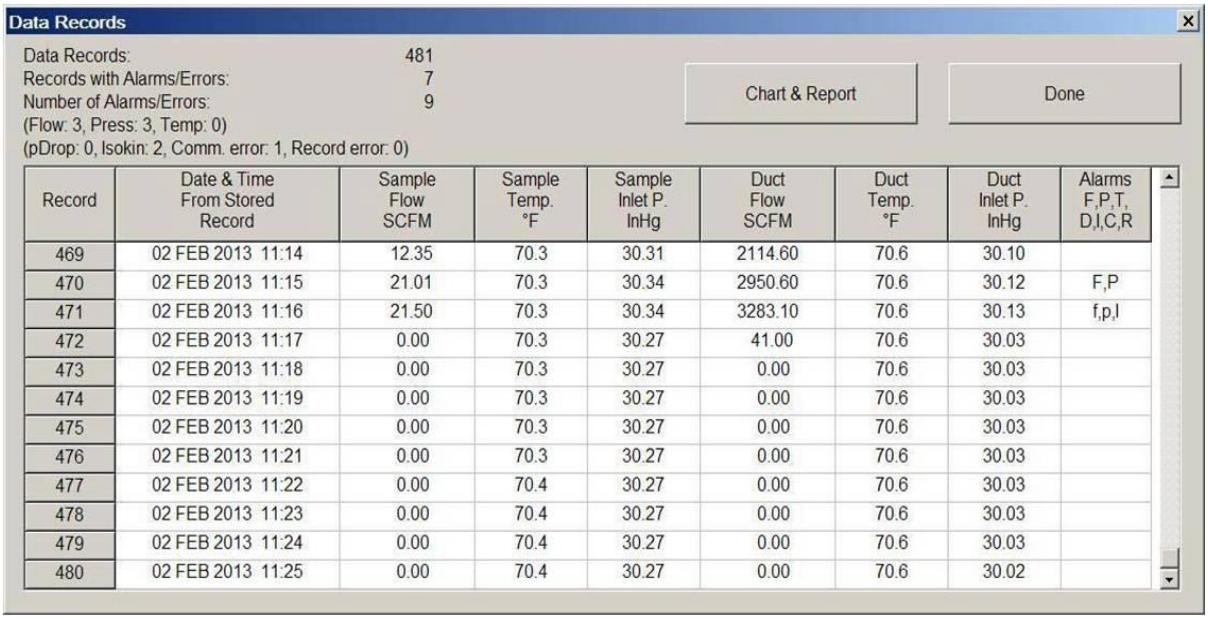
Depending on the alarms, errors, and instrument options the chart header may contain error-related information.

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



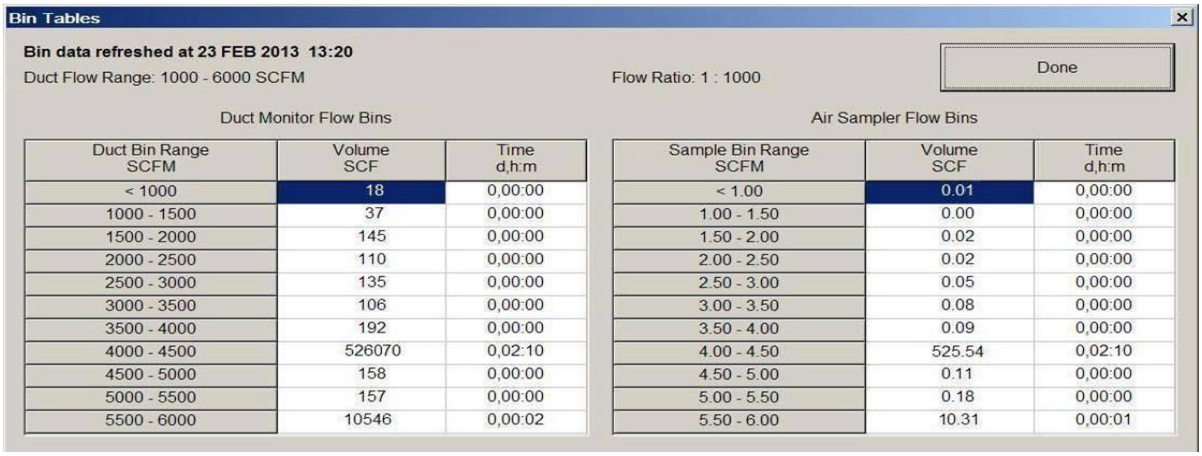
Data Records

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

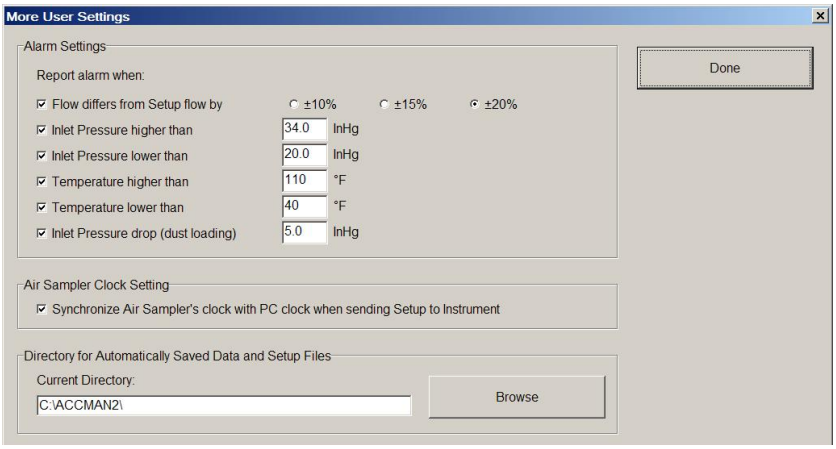
Duct Monitor Flow Bins

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:
- ☑ 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

Done

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

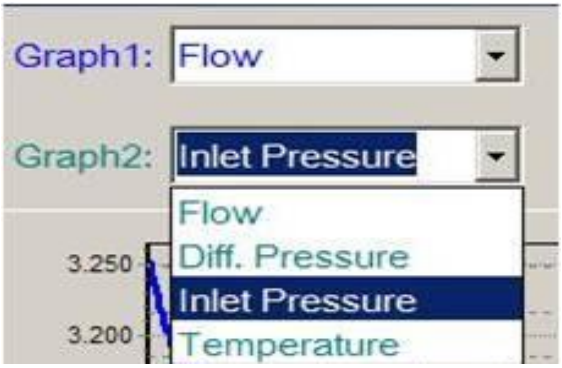
Directory for Automatically Saved Data and Setup Files
Current Directory: C:\ACCMAN2\ Browse

Operator selectable alarms are available for:

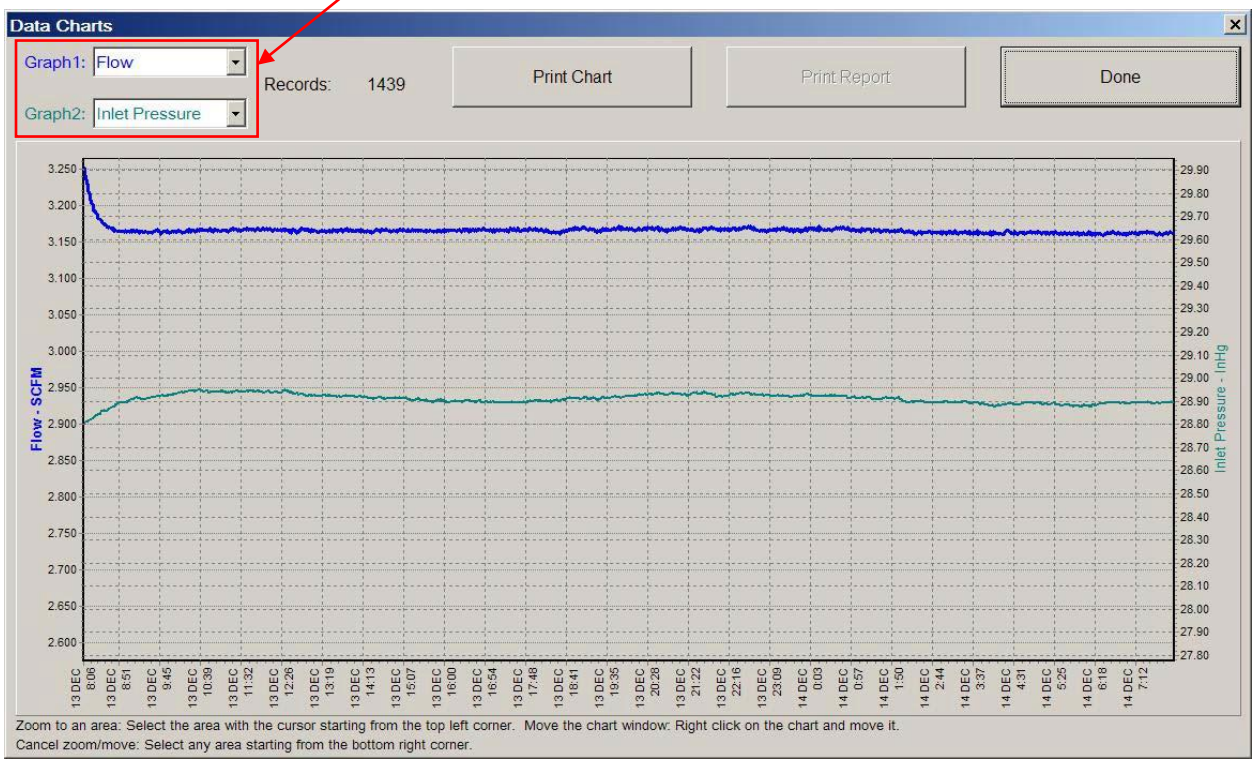
1. Flow deviation
2. High inlet pressure
3. Low inlet pressure
4. High temperature
5. Low temperature
6. Inlet pressure drop due to dust loading

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.

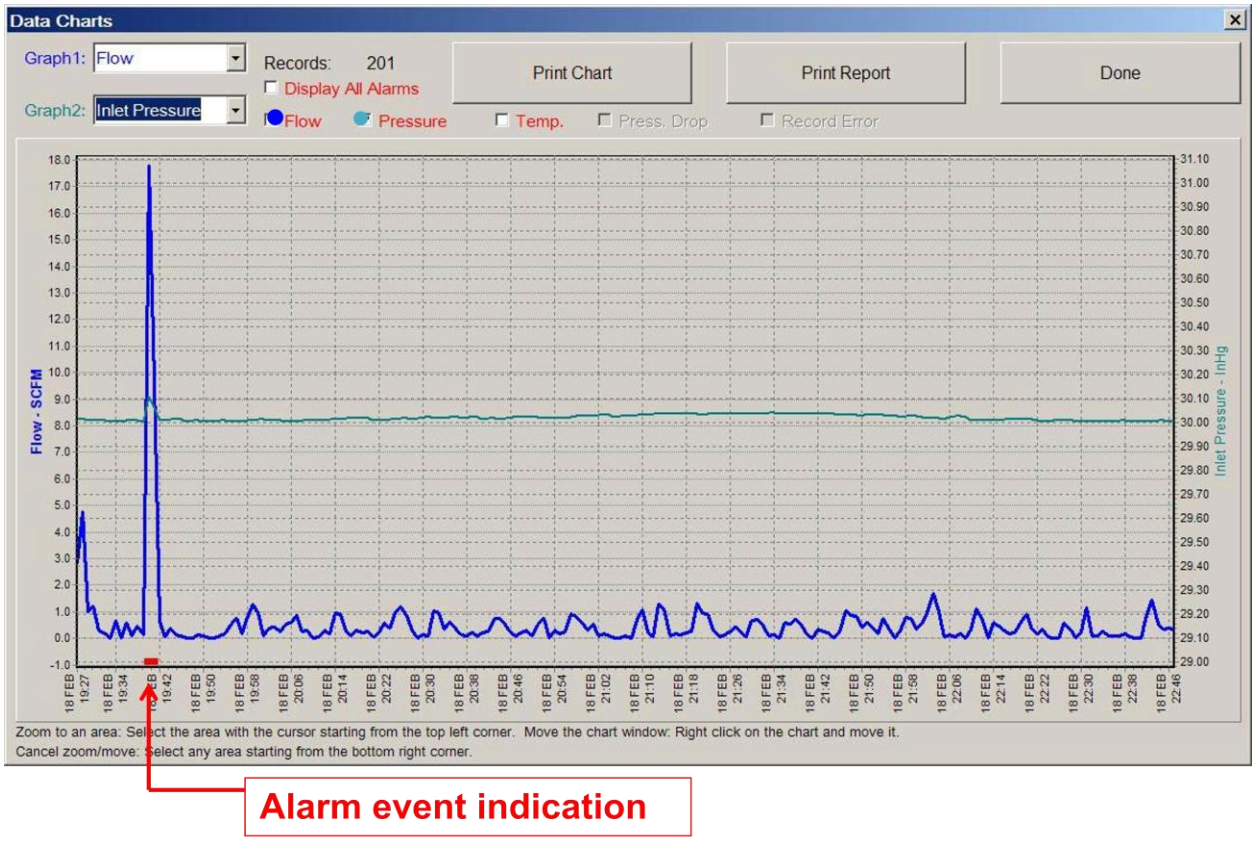
Data Chart Selection Option



Data Chart



Data Chart with Alarm Event



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.