ULTRA 3000 DEFINITION SPECIFICATION

ULTRA 3000

SINGLE ORIFICE DEFINITION

STARTUP CONFIGURATION

Part Number 3-9003-301
Revision D

JUNE 1995

DANIEL

DANIEL INDUSTRIES, INC.
ULTRA 3000
AGA3 SINGLE ORIFICE DEFINITION
STARTUP CONFIGURATION

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1.0 INTRODUCTION

The Ultra 3000 AGA3 Definitions have been designed for use with orifice meters and implement the required features of natural gas flow computers.

1.1 SCOPE OF SPECIFICATION

The Ultra 3000 involves a three-tiered approach to design. This task-oriented approach involves:

- Definition -- The flow engineer defines a specific application. This includes the number of tubes, assignment of inputs to functions, choosing a flow calculation method, etc.

- Configuration -- The field technician chooses a definition which has been previously defined by a flow engineer. He then is able to calibrate inputs, set pipe sizes, collect, data, etc.

- Tool Generation Programs -- When necessary, a software engineer will be asked to create a new tool or protocol driver.

This specification provides specific information on a Ultra 3000 system which supports one of nine standard orifice definitions. Basic reference information on the Ultra 3000 system can be found in the Field Engineer's Manual and the Field Technician's Manual. A detailed description of the terminology (definitions,tools, ladders) and general procedure for generating a new definition are provided in the Flow Engineer's Manual. The Field Technician's Manual covers definitions and concepts necessary for installing, configuring, and using the Ultra 3000.

This specification includes sections on :

- Flow rate equations per API Chapter 14.3 Part 3
- Gas Chromatograph Interface Capability
- Valve Positioning Capability
- Default Security Codes
- Default Audit Logs 1 and 2 Lists
- EFM Display List
- Definition Specific Sub-Menus

- Default Alarm List
- Diagnostics Menu Representing Default Calibration Parameters
- Daniel Modbus ASCII Register List

1.2 AGA3 DEFINITION/CONFIGURATION FEATURES

The primary features of the Ultra 3000 AGA3 Definition software are as follows:

- Provides Modbus Communications for remote access
- Serves as a single orifice meter definition using AGA3 1992
- Supports AGA-8 1992 (both detail and gross methods)
- Accepts standard transducer assignments, including 36SD smart sensor for Static Pressure and Differential Pressure plus 500 OHM RTD input for Temperature
- Allows the user access to all auxiliary analog inputs and their scales
- Supports a serial interface with the Daniel Chromatograph, but will default to the use of operator entered gas quality values
- Performs valve positioning using an analog output to control corrected station flow rate (single analog outputs can be switched between valve positioning and flow rate)
- Provides an analog output proportional to station flow rate
- Provides two pulse outputs based on station volume

1.3 AGA3 SINGLE ORIFICE DEFINITION

The AGA3 Single Orifice Definition uses flow rate equations from API Chapter 14.3 which are included in this specification.

1.3.1 DEFINITION HARDWARE REQUIREMENTS

This orifice definition uses the IOU Type 1 Card. The following hardware is required to support the Single Orifice Definition, unless the inputs are using fixed values.

INPUTS	OUTPUTS	NAME	REQUIREMENT	I/O TYPE & QTY.
1		Pres1/Diff. Pres1	36SD	1 1
1		Flw Temp1	500 OHM RTD	
	1	Flow Rate/Valve Control	1-5 volts	
	2	Station Volume	Contact Closures	
ADDITIONAL UNASSIGNED I/O CONFIGURABLE USING EFMACCS DEFINITION S/W				
2		Aux. Anlg. In	1-5 volts	
4		Aux. Status In	Contact Closures	
	2	Aux. Control Out	Contact Closures	

1.3.2 DEFINITION FIELD WIRING MAP

NAME	REQUIREMENT	INPUTS	OUTPUTS	IOU BOARD #
Pres1	36SD			1
Diff Pres1	36SD			1
Aux Anlg 1	1-5 volts	Analog Input #1		1
Aux Anlg 2	1-5 volts	Analog Input #2		1
Flw Temp1	RTD			1
DIn1	Contact Closure	Digital Input #1		1
DIn2	Contact Closure	Digital Input #2		1
DIn3	Contact Closure	Digital Input #3		1
DIn4	Contact Closure	Digital Input #4		1
VP 1	Contact Closure		Digital Output #1	1
VP 2	Contact Closure		Digital Output #2	1
DOUT3	Contact Closure		Digital Output #3	1
DOUT4	Contact Closure		Digital Output #4	1
Flw Rt Out/ Valve Pos	1-5 volts		Analog Output #1	1

1.4 CALCULATIONS

The calculations in the Ultra are divided into two distinct processes. These are as follows:

- Analog input sampling and average rate calculation
- Corrected flow rate and volume and calculation

These processes are usually run independently without regard for the state of the other. When the volume calculation process begins a new cycle, it signals the sampling process for new inputs required for a flow calculation. Upon receiving this signal, the sampling process transfers the inputs that have accumulated to the calculation process, and begins new accumulations.

1.4.1 FLOW RATE EQUATIONS

The Ultra calculates volumetric flow rate using equations 3-6b and 3-7 from API Chapter 14.3 Part 3. These equations are:

$$Q_b = (14.73/P_b) * (T_b/519.67) * (Z_b/Z_s) * Q_v \qquad \text{Eqn. 3-7}$$

$$Q_v = 7709.61 * C_d * E_v * Y * d^2 * \sqrt{(P_{f1} * h_w * Z_s / (G_r * Z_{f1} * T_f))} \qquad \text{Eqn. 3-6b}$$

where :

Q_b	=	volumetric flow rate in SCFH at base conditions
Q_v	=	volumetric flow rate in SCFH at standard conditions
P_b	=	base pressure in PSIA
T_b	=	base temperature in Rankine
Z_b	=	gas compressibility at base conditions
Z_s	=	gas compressibility at standard conditions
C_d	=	orifice discharge coefficient
E_v	=	velocity of approach factor
Y	=	expansion factor
d	=	temperature corrected orifice diameter
P_{f1}	=	upstream pressure in PSIA
T_f	=	flowing temperature in Rankine
h_w	=	differential pressure in InH2O
G_r	=	real gas relative density at standard conditions
Z_{f1}	=	flowing compressibility at P_{f1} & T_f

Standard conditions = 14.73 PSIA and 519.67 Rankine

All compressibility values are calculated in accordance with AGA Report No. 8, 1992. The operator may select the DETAIL (full analysis) or GROSS (short form) method for compressibility calculation. For equations consult AGA Report No. 8.

All input gravity values used in the Ultra are assumed to be for reference conditions of 14.73 PSIA and 60 °F. This assumption is consistent with calculation examples given in API Chapter 14.3, Part 3. If the operator indicates that the input gravity is the ideal relative density, the ideal value is converted to G_r before the flow rate calculation is run. This value is internal to the flow calculation, and does not replace the specific gravity value the operator entered into the Ultra.

The quantity, sqrt(P_{f1} * h_w), is stored as a separate entity, FLOW EXTN, in the Ultra and is stored in the data log by default. This is in accordance with the COGM document on electronic flow meters.

1.4.2 ENERGY RATE EQUATION

The Ultra calculates volumetric energy rate using the following equation:

Erate	=	1.0E-06 * Qb * Energy
1.0E-06	=	conversion factor to convert energy from BTU to Dekatherm
Qb	=	volumetric flow rate in standard cubic feet per hour at base conditions
Energy	=	energy in BTUs at 14.73 PSIA and 60 DEGF
Erate	=	volumetric energy rate in Dekatherms at base conditions

1.4.3 RATE AND VOLUME CALCULATION

The Ultra calculates rates, volumes, and compressibility on a periodic basis, once a minute.

At the beginning of the calculation cycle, the analog input averages accumulated during the preceding I/O ladder are transferred to the CALC LADDER. Using these inputs, a new flow calculation is done. The flowing compressibility is calculated first, followed by the instantaneous flow rate. The rates and volumes are updated last.

1.4.4 LOGGING

The logging function is a part of the calculation ladder. During each cycle, the Ultra updates all of the running averages for the log. For Analog Inputs in the log, "flow averages" are kept based on flowing conditions. The meter is considered to be flowing if the differential pressure for that meter is above the cut-off value. Averaging is not performed during "no flow" conditions; this results in zero values for logging purposes.

1.5 GAS CHROMATOGRAPH INTERFACE

The Ultra 3000 supports retrieval of gas composition and gas quality from the Model 2251 Danalyzer Gas Chromatograph Controller. The Ultra polls the chromatograph if one of its serial ports has been configured for 'GC' protocol. It uses the communications parameters (baud rate, RTS delay, etc...) that are configured for that serial port.

To enable the gas chromatograph interface, three pieces of information must be programmed into the Ultra. These are the MODBUS communication address of the chromatograph, GC selected as one of the serial communications ports; and the chromatograph stream number of the data are required. The first two are configured with the Ultra 'Ports' Menu. The stream number is configured with the online Config Menu.

The Ultra initiates a poll of the GC about once every four minutes. If the poll is not successful, the poll will be retried every 4 seconds until the poll succeeds. Each poll of the GC is made up of a series of MODBUS queries for chromatograph data. If any query fails, the poll sequence is aborted.

The first poll to the GC is for the time of the current analysis. This time stamp is saved for comparison later. Next, the current stream number is read. Next a poll is issued for the BTU content and specific gravity, followed by a poll for the 11 component values supported by the Model 2251. The final poll retrieves the chromatograph alarms and the analysis time stamp again. If the alarms denoted by the chromatograph's MODBUS registers 3046 and 3047 are non-zero, or the analysis time does not match that of the first poll, the sequence is aborted. Otherwise, the data is processed and used in the Ultra.

The data read from the GC and the associated MODBUS register numbers are:

C6+	7001
Propane	7002
I-Butane	7003
Butane	7004
Neo-Pentane	7005
I-Pentane	7006
Pentane	7007
Nitrogen	7008
Methane	7009
CO2	7010
Ethane	7011
Specific Gravity	7035 (Real Gas Relative Density)
BTU Content	7033

If the retrieved value for Nitrogen exceeds 50 percent, the data is discarded and no further processing is done. The most common cause of a value greater than 50 percent for Nitrogen is the reassignment of MODBUS register numbers done when Neo-Pentane is deleted from the Model 2251 configuration. If this component must be deleted, a dummy component should be inserted in its place to preserve the register assignments as shown. This is the only check the Ultra does on the retrieved data before storing.

Since the AGA-8 equations do not support Neo-Pentane or C6+ as a single component, the retrieved data is partially processed before storing the data in the Ultra. If Neo-Pentane is present, it is considered to be Iso-Pentane (which is the most chemically similar component supported by AGA-8) and added to that component's value. Any C6+ component reported is separated into the following fractions:

Hexane	0.47466
Heptane	0.3534
Octane	0.17194

These fractions are the default values used by Model 2251 in the calculation of the reported value for BTU content.

1.6 VALVE POSITIONING

The Ultra 3000 provides flow rate control based on rate or rate with pressure over-ride and also supports differential pressure over-range protection. The Ultra controls the flow rate by means of an analog output (1-5 VDC) connected to a control valve. The valve positioning function can be configured to operate in various ways based on the value of the following configuration variables:

Valve positioning mode (VP Mode)	NONE [0]=none (disabled) FLWRT [1]=flow rate only UpPrOR [2]=rate w/upstream pressure over-ride DnPrOR[3]=rate w/downstream pressure over-ride
Flow setpoint	desired flow rate in MCFH
Deadband	in % of setpoint
Small step	step for fine control
Large step	step for fast control
Fine control error limit	in % of setpoint
Over-ride pressure	in PSIG
Differential pressure over-range limit	in InH2O
Preset valve position	valve position for DP over-ride
Update time in seconds	valve positioning update time

If the function is disabled or the Maintenance Mode(Maint Mode ENABLE[1]) is enabled, no control is done. To fix the valve position to a specific value, place the output in the fixed mode and enter the desired fixed value. This value will be maintained regardless of any configuration variables. If the function is enabled, and the valve position has not been fixed by the operator, the valve positioning function runs each I/O ladder sample time after the analog inputs have been sampled.

1.6.1 DIFFERENTIAL PRESSURE OVER-RANGE PROTECTION

The differential pressure over-range protection feature is enabled by entering a non-zero value for the DP over-range limit. When enabled, this feature takes precedence over other valve positioning modes.

Each I/O cycle, the DP on the primary meter run is compared to the over-range limit. If the DP is below the over-range limit, valve positioning continues based on the selected mode. If the DP exceeds the limit, the valve position is set to the preset valve position, and the valve positioning function is aborted. Normal valve positioning resumes with the next analog sample cycle, that shows a DP below the over-range limit.

Certain combinations of parameters will cause the valve position to oscillate when this feature is enabled.

1.6.2 FLOW RATE CONTROL (VP MODE = FLW RT[1])

The Ultra attempts to cause the measured flow rate to match a user entered flow rate setpoint. Each I/O cycle, a timer is incremented. If this timer is less than the programmed update time, the function is postponed for another cycle. After the update time has elapsed, the current flow rate is compared to the setpoint. If the difference (error) is greater than a fine control threshold, a large step is applied to the valve position. Otherwise, if the error is greater than a user programmed deadband, a small step is applied to the valve position. If the error does not exceed the deadband, no change is made to the valve position. The following example illustrates this.

Flow setpoint	500 MCFH
Small step	0.1 %
Deadband	1 %
Large step	0.3 %
Fine control	
Error limit	5 %

If the observed flow rate is below 475 MCFH, 0.3 percent will be added to the valve position (above 525, 0.3 percent will be subtracted). Otherwise, if the rate is below 495 MCFH, 0.1 percent will be added to the valve position (above 505, 0.1 percent will be subtracted). If the observed flow rate is between 495 and 505 MCFH, no control will be performed.

The flow rate for determining the error is estimated from the last system flow rate generated by the calculation cycle and the current flow extension. This estimation is:

$$Q_{vp} = Q_{sys} * Ext_{vp} / Ext_{sys}$$

where:

Q_{sys} = Station flow rate in MCFH from last calculation cycle

Q_{vp} = Refers to the most recent value generated during the analog input sampling process

1.6.3 FLOW RATE CONTROL WITH PRESSURE OVER-RIDE (VP MODE = 2 0R 3)

Each I/O cycle, the instantaneous value of the pressure is compared to the over-ride pressure value. If the pressure is less than the over-ride value, normal flow rate control continues. If the pressure exceeds the over-ride value, the small step is added to the valve position for mode 2 or subtracted from the valve position for mode 3.

1.6.4 FLOW RATE OUTPUT

Ultra provides an analog output proportional to a station volumetric flow rate. This output is provided for use by external equipment which require an analog indication of the measured flow rate. The flow rate outputs are updated once each calculation cycle. The user is free to rescale this output. If the valve positioning option is used, there is not an analog output for volumetric flow rate for single boards.

1.6.5 VOLUME PULSE OUTPUT

Ultra provides two separate pulse outputs based on station volume. Each has a volume per pulse entry and a pulse period entry for configuration. For each output, a volume accumulator holds the volume since the last pulse was output. When the accumulator exceeds the volume per pulse, this volume is subtracted from the accumulator, and a pulse is output. The accumulation is done once each calculation cycle.

2.0 FIXED MENU DEFAULTS

2.1 SECURITY CODES

Defines the list of users and their security codes for the current configuration.

USER ID	LEVEL
Field Engr	255
Super Tech	200
Field Tech	100
Observer	0

2.2 EFM PARAMETERS

Allows the user to define and/or modify the following configuration parameters for the EFM.

EFM PARAMETERS	SECURITY CLEARANCE	
	READ	WRITE
EFM Parameters	0	100
EFM Security Codes	255	255
EFM Communication Ports	0	100
User Data Log	100	255
EFM Display List	0	255
Log Clear Security Level		255
User Data Log Interval	None	
Contract Hour	7	
Configuration Description	Default Configuration	
Display Inactivity Timeout	60	
Display Scroll Mode:	Blank Screen	
Display Scroll Interval		

2.3 PORTS

Configurable serial and parallel ports:

SERIAL

PORT NO.	**COMM ID.**	**USE**
1	**1**	**MODBUS DANIEL**
PARAMETERS	**DEFAULT**	
Baud Rate	9600	
Parity	Even	
Data Bits	7	
Start Bits	1	
Stop Bits	1	
RTS Required	YES	
RTS Up Delay	200	
RTS Down Delay	10	
CTS Required	NO	
CTS True Abort RTS Up	YES	
CTS False Abort RTS Down	NO	
CTS for Carrier Detect	NO	
CTS Timeout	0	

SERIAL

PORT NO.	COMM ID.	USE
2	**1**	**GC**
PARAMETERS	**DEFAULT**	
Baud Rate	9600	
Parity	Even	
Data Bits	7	
Start Bits	1	
Stop Bits	1	
RTS Required	YES	
RTS Up Delay	200	
RTS Down Delay	10	
CTS Required	NO	
CTS True Abort RTS Up	YES	
CTS False Abort RTS Down	NO	
CTS for Carrier Detect	NO	
CTS Timeout	0	

PARALLEL DEFAULTS

PORT NO.	COMM ID.	USE
1	**1**	**LOCAL**

2.4 AUDIT 1 DATA LOG - 24 HOUR

The following items are included on the data log. Audit data logs 1 and 2 are set to 24-hour and 1-hour log intervals, respectively. The default contract hour is 7:00 am. When a graph is selected the scale range must be entered.

LABEL	DECIMAL PLACES	DIGITS	GRAPH NO.
Log1 Dp1	2	6	0
Log1 Pres1	1	6	0
Log1 Temp1	1	4	0
Log1FlwTm1	2	6	0
Log1 Extn1	2	6	0
Log1 Vol1	0	6	0
Log1 Eng1	0	6	0

2.5 AUDIT 2 DATA LOG - 1 HOUR

LABEL	DECIMAL PLACES	DIGITS	GRAPH NO.
Log2 Dp1	2	6	1
Log2 Pres1	1	6	1
Log2 Temp1	1	4	1
Log2FlwTm1	2	6	0
Log2 Extn1	2	6	0
Log2 Vol1	0	6	2
Log2 Eng1	0	6	0

SCALE RANGE
Point Name: Log2 Pres1 Low Scale: 0.0 High Scale: 1000.0

2.6 USER DATA LOG - NONE

2.7 EFM DISPLAY LIST

The DISPLAY List provides for viewing the selected setup parameters and data points from the field user data set unit at any given time. The menu is for display purposes only. No changes can be made to the values displayed using this menu.

POINT NAME	UNITS
F/L Prs1	
Metr Pres1	PSIG
F/L Tmp1	
Flw Temp1	DEGF
F/L Dp1	
Diff Pres1	INH2O
Real Grav	
BTU	BTU/SCF
F/L Aux1	
Aux Anlg 1	PCT
F/L Aux2	
Aux Anlg 2	PCT
Flow Rate1	MCF/HR
Tot Vol 1	MCF
Today Vol1	MCF
Ysday Vol1	MCF
Erate 1	DTH/HR
Tot Enrgy1	DTHERM
Tdy Enrgy1	DTHERM
Ysy Enrgy1	DTHERM

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3.0 DEFINITION SPECIFIC LABELS

Descriptive labels are shown here for reference only. The column labeled DP in the table indicates the number of digits displayed past the decimal point.

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
AnOutSel	(None)	0	0	Analog Out Selector 1=Valve Positioning 0=Flow Rate1
Flw Rt Out	MCF/HR	1	0.0	Analog flow rate
Valve Pos	%	1	50.0	Current valve position
Version		1	1.0	Software version
Sys Error		0	0	System alarm
Atms Pres	PSIA	2	14.73	Atmospheric pressure
Pres Base	PSIA	2	14.73	Pressure base
Temp Base	DEG F	1	60.0	Temperature base
Orif Mtrl	(None)	0	STAIN[1]	Orifice material
Pipe Mtrl	(None)	0	CARBON[0]	Pipe material
Tref Orif	DEGF	1	68.0	Reference temperature of orifice plate
Tref Pipe	DEGF	1	68.0	Reference temperature of pipe
Spec Heat		2	1.30	Specific heat ratio
SG Select		0	REAL[1]	Input specific gravity 0=ideal, 1=real
Zs1 Entry	(None)	6	1.000000	Compressibility of gas used for ideal specific gravity
AGA8 Mthd		0	DETAIL[0]	AGA-8 Method 0=detail 1=GR, CO2, BTU 2=GR, CO2, N2

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Zs		6	1.000000	Standard compressibility
Zb		6	1.000000	Base compressibility
Mol Wt		4	16.8000	Calculated by AGA-8
B		6	0.000000	AGA-8 2nd virial coeff.
C		6	0.000000	AGA-8 3rd virial coeff.
D		6	0.000000	AGA-8 reduced density
K3		6	0.000000	AGA-8 mixture size parameter
Real Grav	(None)	4	0.6000	Current Specific Gravity
BTU	(None)	2	1000.00	Current BTU
Methane	MOL%	4	95.0000	Methane MOL%
Nitrogen	MOL%	4	0.0000	Nitrogen MOL%
CO2	MOL%	4	0.0000	Carbon dioxide MOL%
Ethane	MOL%	4	5.0000	Ethane MOL%
Propane	MOL%	4	0.0000	Propane MOL%
H2O	MOL%	4	0.0000	Water MOL%
H2S	MOL%	4	0.0000	Hydrogen Sulphide MOL%
Hydrogen	MOL%	4	0.0000	Hydrogen MOL%
CO	MOL%	4	0.0000	Carbon Monoxide MOL%
Oxygen	MOL%	4	0.0000	Oxygen MOL%
I-Butane	MOL%	4	0.0000	I-Butane MOL%
Butane	MOL%	4	0.0000	Butane MOL%
I-Pentane	MOL%	4	0.0000	I-Pentane MOL%
Pentane	MOL%	4	0.0000	Pentane MOL%

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Hexane	MOL%	4	0.0000	Hexane MOL%
Heptane	MOL%	4	0.0000	Heptane MOL%
Octane	MOL%	4	0.0000	Octane MOL%
Nonane	MOL%	4	0.0000	Nonane MOL%
Decane	MOL%	4	0.0000	Decane MOL%
Helium	MOL%	4	0.0000	Helium MOL%
Argon	MOL%	4	0.0000	Argon MOL%
Chrom Addr	(None)	0	1	Chromatograph address
Chrom Strm	(None)	0	1	Chromatograph stream
VPP 1	MCF	1	100.0	Volume per pulse 1
PP 1	SEC	0	4	Pulse period 1
VPP 2	MCF	1	100.0	Volume per pulse 2
PP 2	SEC	0	4	Pulse period 2
VP Mode	(None)	0	NONE[0]	Valve positioning option 0=disabled 1=flow rate control 2=upstream pressure override 3=downstream pressure override
Flw Setpnt	MCF/HR	0	0.0	Flow rate setpoint
Deadband	PCT	1	2.0	Control deadband %
Small Step	PCT	2	0.05	Fine valve step %
Large Step	PCT	1	0.5	Coarse valve step %
Fine Cntrl	PCT	0	5	Error limit control %
Ovrd Pres	PSIG	0	0.0	Pres override limit
Preset Pos	PCT	0	50	Valve position for DP override

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Dp Limit	InH2O	0	0	DP override limit 0=disabled
Update Tim	SEC	0	10.0	Valve position update time
Orif Diam1	IN	3	4.000	Meter 1 orifice diameter
Pipe Diam1	IN	3	8.071	Meter 1 pipe diameter
Tap Lctn 1	IN	0	UPSTRM[1]	Tap location 0=downstream 1=upstream
Zflow Lim1	InH2O	2	0.50	Low flow cutoff in InH2O
Corr Od1	IN	4	0	Temp corrected orifice diameter
Corr Pd1	IN	4	0	Temp corrected pipe diameter 1
Corr Beta	(None)	5	0.00000	Temp corrected beta ratio
Ev 1	(None)	5	1.00000	Velocity of approach factor
Cd 1	(None)	6	0.600000	Coefficient of discharge
Zf 1	(None)	6	1.000000	Flowing compressibility
Y 1	(None)	6	1.000000	Expansion factor
Flw Extn1	(None)	3	0.000	sqrt(Hw*Pf)
Flw Time 1	MIN	2	0.00	Flow time
Flow Rate1	MCF/HR	1	0.0	Hourly flow rate
Dly FlwRt1	MCF/D	1	0.0	Daily flow rate
Log Vol 1	MCF	0	0	Logged accumulated volume
Today Vol1	MCF	0	0	Daily accumulated volume
Ysday Vol1	MCF	0	0	Ysday’s accumulated volume

LABEL	UNITS	DP	DEFAULT	DESCRIPTION
Tot Vol 1	MCF	0	0	Total accumulated volume (Rolls over @ 10,000,000)
Erate 1	DTH/HR	1	0.0	Energy flow rate
Log Enrgy1	DTH	0	0	Logged accumulated energy
Tdy Enrgy1	DTH	0	0	Today's accumulated energy
Ysy Enrgy1	DTH	0	0	Ysday's accumulated energy
Tot Enrgy1	DTH	0	0	Total accumulated energy (Rolls over @ 10,000,000)

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4.0 DEFINITION SPECIFIC SUBMENUS

The following submenus are found: Access → Edit → Menus

4.1 ALARMS

The ALARMS SUBMENU allows the user to view alarms and to edit and/or view the alarm limits.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Maint Mode	0		0	100
CutOffAlm	0		0	N/A
Zf Zero	0		0	N/A
Sys Error	0		0	N/A
Prs1 LoAlm	0		0	N/A
Prs1 HiAlm	0		0	N/A
Tmp1 LoAlm	0		0	N/A
Tmp1 HiAlm	0		0	N/A
Dp1 LoAlm	0		0	N/A
Dp1 HiAlm	0		0	N/A
Batt LoAlm	0		0	N/A
Aux1 LoAlm	0		0	N/A
Aux1 HiAlm	0		0	N/A
Aux2 LoAlm	0		0	N/A
Aux2 HiAlm	0		0	N/A
Rate1LoAlm	0		0	N/A
Rate1HiAlm	0		0	N/A
Prs1 LoLmt	0.0	PSIG	100	100
Prs1 HiLmt	1010.0	PSIG	100	100
Tmp1 LoLmt	0.0	DEGF	100	100
Tmp1 HiLmt	151.5	DEGF	100	100
Dp1 LoLmt	0.00	INH2O	100	100
Dp1 HiLmt	151.50	INH2O	100	100
Batt LoLmt	5.50	BATT	100	100
Aux1 LoLmt	-1.00	PCT	100	100
Aux1 HiLmt	101.00	PCT	100	100
Aux2 LoLmt	-1.00	PCT	100	100
Aux2 HiLmt	101.00	PCT	100	100
Rate1LoLmt	0.0	MCF/HR	100	100
Rate1HiLmt	5000.0	MCF/HR	100	100

4.1.1 LOGGED ALARMS

The Logged Alarms can be viewed via the View Logs sub-menu of the Main Menu of the Electronic Flow Meter Definition and Configuration System. The number of transitions until logging begins have been defaulted to 5 for all logged alarms. Other alarms, such as, CutOffAlm, Zf Zero, etc. do not generate alarm log entries.

LOGGED ALARMS
Prs1 LoAlm
Prs1 HiAlm
Tmp LoAlm
Tmp1 HiAlm
Dp1 LoAlm
Dp1 HiAlm
Aux1 LoAlm
Aux1 HiAlm
Aux2 LoAlm
Aux2 HiAlm
Batt LoAlm
Rate1LoAlm
Rate1HiAlm

4.2 ANALOGS

The ANALOGS submenu of this definition provides for toggling between LIVE and FIXED values of the following analogs.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Metr Pres1	0.0	PSIG	0	100
Flw Temp1	-50.0	DEGF	0	100
Diff Pres1	0.00	INH2O	0	100
Aux Anlg 1	0.00	PCT	0	100
Aux Anlg 2	0.00	PCT	0	100
Battery	12.00	BATT	0	100
Flow Rate1	0.0	MCF/HR	0	100
Valve Pos	0.0	PCT	0	100
Inst Prs1	####.#	PSIG	100	100
Inst Tmp1	###.#	DEGF	100	100
Inst Dp1	###.##	INH2O	100	100
Inst Aux1	###.##	PCT	100	100
Inst Aux2	###.##	PCT	100	100
Inst Batt	##.##	BATT	100	100
Pct Flow 1	0.00	%OPEN	100	100
F/L Prs1	LIVE[0]		100	100
Man Pres1	485.27	PSIG	100	100
F/L Tmp1	LIVE[0]		100	100
Man Temp1	109.0	DEGF	100	100
F/L Dp1	LIVE[0]		100	100
Man Dp1	20.00	INH2O	100	100
F/L Aux1	LIVE[0]		100	100
Man Aux1	0.00	PCT	100	100
F/L Aux2	LIVE[0]		100	100
Man Aux2	0.00	PCT	100	100

- represents live values

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
F/L AOut 1	LIVE[0]		0	100
Man AOut1	0.00	%OPEN	0	100
Maint Mode	DISABL[0]		100	100

- represents live values

4.3 SCALES

The high- and low-scale values for the analogs shown in the following table can be modified in the SCALES submenu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
M Pres1/Lo	0.0	PSIG	100	100
M Pres1/Hi	1000.0	PSIG	100	100
M Temp1/Lo	0.0	DEGF	100	100
M Temp1/Hi	150.0	DEGF	100	100
D Pres1/Lo	0.00	INH2O	100	100
D Pres1/Hi	150.00	INH2O	100	100
Aux 1 Lo	0.00	PCT	100	100
Aux 1 Hi	100.00	PCT	100	100
Aux 2 Lo	0.00	PCT	100	100
Aux 2 Hi	100.00	PCT	100	100
Battery Lo	0.00	BATT	100	100
Battery Hi	15.83	BATT	100	100
Flw Rt Low	0.0	MCF/HR	0	100
Flw Rt Hi	5000.0	MCF/HR	0	100

4.4 DIGITALS

The DIGITALS submenu provides for viewing and/or editing the digital inputs and outputs.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
DIn1	0		0	N/A
DIn2	0		0	N/A
DIn3	0		0	N/A
DIn4	0		0	N/A
PP 1	4	SEC	100	100
pplowlim1	10	SEC	100	100
max_puls1	100		100	100
VP 1	0		0	N/A
PP 2	4	SEC	100	100
pplowlim2	10	SEC	100	100
max_puls2	100		100	100
VP1 2	0		0	N/A
Dout1	0		0	100
Dout2	0		0	100
Dout3	0		0	100
Dout4	0		0	100
F/L Dout1	LIVE[0]		100	100
Man Dout1	OFF[0]		100	100
F/L Dout2	LIVE[0]		100	100
Man Dout2	OFF[0]		100	100
F/L Dout3	LIVE[0]		100	100
Man Dout3	OFF[0]		100	100
F/L Dout4	LIVE[0]		100	100
Man Dout4	OFF[0]		100	100

4.5 CONFIG

The following default parameters can be changed in the CONFIG submenu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Orif Diam1	4.000	IN	0	100
Pipe Diam1	8.071	IN	0	100
Zflow Lim1	0.50	INH2O	0	100
Tap Lctn 1	UPSTRM[1]		0	100
Atms Pres	14.73	PSIA	0	100
Pres Base	14.73	PSIA	0	100
Temp Base	60.0	DEGF	0	100
AGA8 Mthd	DETAIL[0]		0	100
SG Select	REAL[1]		0	100
Real Grav	0.6000		0	100
Zs1 Entry	1.000000		0	100
Orif Mtrl	STAIN[1]		0	100
Pipe Mtrl	CARBON[0]		0	100
Tref Orif	68.0	DEGF	0	100
Tref Pipe	68.0	DEGF	0	100
Chrom Strm	1		0	100
Version	2.00		0	N/A

4.6 CONTROL

The CONTROL submenu provides for entering the control values for the pulse outputs.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
VPP 1	100.0		0	100
PP l	4	SEC	0	100
VPP 2	100.0		0	100
PP 2	4	SEC	0	100
VP Mode	NONE[0]		0	100
Flw Setpnt	0	MCF/HR	0	100
Deadband	2.0	PCT	0	100
Small Step	0.05	PCT	0	100
Large Step	0.5	PCT	0	100
Fine Cntrl	5	PCT	0	100
Ovrd Pres	0	PSIG	0	100
DP Limit	0	INH2O	0	100
Preset Pos	50	PCT	0	100
Update Tim	10	SEC	0	100
Valve Pos	0.0	PCT	0	100
F/L VP Out	FIXED[1]		0	100
FixdVP Val	50	PCT	0	100
AnOutSel	1		0	100
Inst Rate	0.0	MCF/HR	0	100
Flow Rate1	0.0	MCF/HR	0	100
Diff Pres1	0.00	INH2O	0	100
Metr Pres1	0.0	PSIG	0	100
Maint Mode	DISABL[0]		0	100

4.7 CALCULATED DATA

The CALC DATA submenu allows the user to determine the calculated values for specified inputs. The values shown here are typical values and not default values.

PROMPT	SAMPLE VALUES		SECURITY CLEARANCE
			READ
Flow Rate1	426.4	MCF/HR	0
Ev 1	1.03162		100
Cd 1	0.603111		100
Y 1	0.999521		100
Flw Extn 1	100.000		0
AGA8 Mthd	DETAIL[0]		0
Zs	0.997811		0
Zb	0.997811		0
Zf 1	0.948103		0
B	-0.0517398		100
K3	0.100912		100
Mol Wt	16.7444		100

4.8 LIVE GAS DATA

Data retrieved from the Gas Chromatograph can be read in this menu.

PROMPT	DEFAULT		SECURITY CLEARANCE
			READ ONLY
Chrom Strm	1		0
BTU	0.00	BTU	0
CO2	0.0000	MOL%	100
Ethane	0.0000	MOL%	100
I-Butane	0.0000	MOL%	100
I-Pentane	0.0000	MOL%	100
Methane	0.0000	MOL%	100
Nitrogen	0.0000	MOL%	100
N-Butane	0.0000	MOL%	100
N-Heptane	0.0000	MOL%	100
N-Hexane	0.0000	MOL%	100
N-Octane	0.0000	MOL%	100
N-Pentane	0.0000	MOL%	100
Propane	0.0000	MOL%	100
Spec Grav	0.0000		100
GC Fail	0		100
F/L GC	FIXED [1]		100
GC timeout	120 SEC		100

4.9 FIXED GAS DATA

Entries for gas specific parameters can be edited in this submenu.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Spec Grav	0.6000		0	100
BTU	1000.00	BTU/SCF	0	100
CO2	0.0000	MOL%	100	100
Nitrogen	0.0000	MOL%	100	100
Spec Heat	1.30	MOL%	100	100
Methane	95.0000	MOL%	100	100
Ethane	5.0000	MOL%	100	100
Propane	0.0000	MOL%	100	100
Water	0.0000	MOL%	100	100
H2S	0.0000	MOL%	100	100
Hydrogen	0.0000	MOL%	100	100
CO	0.0000	MOL%	100	100
Oxygen	0.0000	MOL%	100	100
I-Butane	0.0000	MOL%	100	100
N-Butane	0.0000	MOL%	100	100
I-Pentane	0.0000	MOL%	100	100
N-Pentane	0.0000	MOL%	100	100
N-Hexane	0.0000	MOL%	100	100
N-Heptane	0.0000	MOL%	100	100
N-Octane	0.0000	MOL%	100	100
N-Nonane	0.0000	MOL%	100	100
N-Decane	0.0000	MOL%	100	100
Helium	0.0000	MOL%	100	100
Argon	0.0000	MOL%	100	100

4.10 RATES AND VOLUMES

The RATES AND VOLUMES can be monitored on this screen.

PROMPT	DEFAULT		SECURITY CLEARANCE	
			READ	WRITE
Flow Rate1	0.0	MCF/HR	0	N/A
Dly FlwRt1	0.0	MCF/D	0	N/A
Today Vol1	0	MCF	0	N/A
Ysday Vol1	0	MCF	0	N/A
Tot Vol 1	0	MCF	0	N/A
Erate 1	0.0	DTH/HR	0	N/A
Tdy Enrgy1	0	DTHERM	0	N/A
Ysy Enrgy1	0	DTHERM	0	N/A
Tot Enrgy1	0	DTHERM	0	N/A

4.11 DIAGNOSTICS

The DIAGNOSTICS SUBMENU allows the user to edit and /or view the calibration parameters.

PROMPT		DEFAULTS		SECURITY CLEARANCE	
				READ	WRITE
Inst Prs1		####.#	PSIG	100	100
RawLS Prs1		10000	COUNTS	100	100
RawHS Prs1		50000	COUNTS	100	100
Tol Prs1		25		100	100
CalPtsPrs1		0		100	100
AsFndPrs1	ARRAY			100	100
AsLeftPrs1	ARRAY			100	100
RAsLftPrs1	ARRAY			100	100
OfstUsPrs1	NO [0]			100	100
OfAsFdPrs1		0	PSIG	100	100
OfAsLfPrs1		0	PSIG	100	100
Inst Tmp1		###.#	DEGF	100	100
RawLS Tmp1		39173	COUNTS	100	100
RawHS Tmp1		44436	COUNTS	100	100
Tol Tmp1		25		100	100
CalPtsTmp1		0		100	100
AsFndTmp1	ARRAY			100	100
AsLeftTmp1	ARRAY			100	100
RAsLftTmp1	ARRAY			100	100
OfstUsTmp1	NO [0]			100	100
OfAsFdTmp1		0	DEGF	100	100
OfAsLfTmp1		0	DEGF	100	100
Inst Dp1		###.##	INH2O	100	100
RawLS Dp1		10000	COUNTS	100	100
RawHS Dp1		50000	COUNTS	100	100
Tol Dp1		25		100	100
CalPtsDp1		0		100	100

DIAGNOSTICS (CONTINUED)

PROMPT		DEFAULTS		SECURITY CODES	
				READ	WRITE
AsFndDp1	ARRAY			100	100
AsLeftDp1	ARRAY			100	100
RAsLftDp1	ARRAY			100	100
OfstUsDp1	NO [0]			100	100
OfAsFdDp1		0	INH2O	100	100
OfAsLfDp1		0	INH2O	100	100
Inst Aux1		###.##	PCT	100	100
RawLS Aux1		36056	COUNTS	100	100
RawHS Aux1		49214	COUNTS	100	100
Tol Aux1		25		100	100
CalPtsAux1		0		100	100
AsFndAux1	ARRAY			100	100
AsLeftAux1	ARRAY			100	100
RAsLftAux1	ARRAY			100	100
OfstUSAux1	NO [0]			100	100
OfAsFdAux1		0	PCT	100	100
OfAsLfAux1		0	PCT	100	100
Inst Aux2		###.##	PCT	100	100
RawLS Aux2		36056	COUNTS	100	100
RawHS Aux2		49214	COUNTS	100	100
Tol Aux2		25		100	100
CalPtsAux2		0		100	100
AsFndAux2	ARRAY			100	100
AsLeftAux2	ARRAY			100	100
RAsLftAux2	ARRAY			100	100
OfstUsAux2	NO [0]			100	100
OfAsFdAux2		0	PCT	100	100
OfAsLfAux2		0	PCT	100	100
Inst Batt		##.##	BATT	100	100
RawLS Batt		0	COUNTS	100	100
RawHS Batt		255	COUNTS	100	100
To1 Batt		25		100	100

DIAGNOSTICS (CONTINUED)

PROMPT		DEFAULTS		SECURITY CODES	
				READ	WRITE
CalPtsBatt				100	100
AsFndBatt	ARRAY			100	100
AsLeftBatt	ARRAY			100	100
RAsLftBatt	ARRAY			100	100
OfstUsBatt	NO [0]			100	100
OfAsFdBatt		0	BATT	100	100
OfAsLfBatt		0	BATT	100	100

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5.0 COMMUNICATIONS

5.1 DANIEL MODBUS ASCII REGISTER LIST

703	Log1 Accs
704	Log2 Accs
705	LogU Accs
720	LogE Accs
1005	VP 1
1006	VP 2
1013	DIn1
1014	DIn2
1015	DIn3
1016	DIn4
1025	Batt LoAlm
1026	Prs1 Alarm
1028	Tmp1 Alarm
1029	Dp1 Alarm
1031	Aux1 Alarm
1032	Aux2 Alarm
1033	Flw Rt Alm
1034	Sys Error
1098	F/L Prs1
1100	F/L Tmp1
1101	F/L Dp1
1103	F/L Aux1
1104	F/L Aux2
1105	F/L AOut1
1201	Batt LoAlm
1203	Prs1 LoAlm
1204	Prs1 HiAlm
1207	Tmp1 LoAlm
1208	Tmp1 HiAlm
1209	Dp1 LoAlm
1210	Dp1 HiAlm
1213	Aux1 LoAlm
1214	Aux1 HiAlm
1215	Aux2 LoAlm
1216	Aux2 HiAlm

1217	Maint Mode
1218	Rate1LoAlm
1219	Rate1HiAlm
3002	Log1 Recno
3004	Log2 Recno
3011	Contr Hour
4094	Cur Year
4095	Cur Month
4096	Cur Day
4097	Cur Hour
4098	Cur Min
4099	Cur Sec
7005	VP 1
7006	VP 2
7019	Battery
7020	Metr Pres1
7022	Flw Temp1
7023	Diff Pres1
7025	Aux Anlg 1
7026	Aux Anlg 2
7027	Flow Rate1
7028	Valve Pos
7029	Version
7030	Sys Error
7033	Atms Pres
7034	Pres Base
7035	Temp Base
7036	Orif Mtrl
7037	Pipe Mtrl
7038	Tref Orif
7039	Tref Pipe
7041	Spec Heat
7042	SG Select
7043	AGA8 Mthd
7044	Zs
7045	Zb

7046	Mol Wt
7047	B
7050	K3
7051	Real Grav
7052	BTU
7053	Methane
7054	Nitrogen
7055	CO2
7056	Ethane
7057	Propane
7058	Fixed H2O
7059	Fixed H2S
7060	Hydrogen
7061	Fixed CO
7062	Fixed O2
7063	I-Butane
7064	N-Butane
7065	I-Pentane
7066	N-Pentane
7067	N-Hexane
7068	N-Heptane
7069	N-Octane
7070	Fixed Nona
7071	Fixed Deca
7072	Fixed He
7073	Fixed Ar
7075	Chrom Strm
7076	VPP 1
7077	PP 1
7078	VPP 2
7079	PP 2
7091	VP Mode
7092	Flw Setpnt
7093	Deadband
7094	Small Step
7095	Large Step
7096	Fine Cntrl
7098	Ovrd Pres
7099	Dp Limit

7100	Preset Pos
7101	Update Tim
7120	Orif Diam1
7121	Pipe Diam1
7122	Tap Lctn 1
7123	Zflow Lim1
7124	Corr Od1
7125	Corr Pd1
7126	Corr Beta1
7127	Ev 1
7128	Cd 1
7129	Zf 1
7130	Y 1
7131	Flw Extn 1
7132	Flw Time 1
7133	Flow Rate1
7134	Dly FlwRt1
7135	Log1 Vol1
7136	Today Vol1
7137	Ysday Vol1
7138	Tot Vol 1
7139	Erate 1
7140	Log1 Eng1
7141	Tdy Enrgy1
7142	Ysy Enrgy1
7143	Tot Enrgy1
7210	Stn Flw Rt
7211	Dly StnRt
7212	St Log Vol
7213	St Tdy Vol
7214	St Ysy Vol
7215	St Tot Vol
7216	Stn Erate
7217	St Log Eng
7218	Tdy St Eng
7219	Ysy St Eng
7220	Tot St Eng
7261	Battery Lo

7262	Battery Hi
7263	M Pres1/Lo
7264	M Pres1/Hi
7267	M Temp1/Lo
7268	M Temp1/Hi
7269	D Pres1/Lo
7270	D Pres1/Hi
7273	Aux 1 Lo
7274	Aux 1 Hi
7275	Aux 2 Lo
7276	Aux 2 Hi
7277	Flw Rt Low
7278	Flw Rt Hi
7301	Batt LoLmt
7304	Prs1 LoLmt
7305	Prs1 HiLmt
7310	Tmp1 LoLmt
7311	Tmp1 HiLmt
7313	Dp1 LoLmt
7314	Dp1 HiLmt
7319	Aux1 LoLmt
7320	Aux1 HiLmt
7322	Aux2 LoLmt
7323	Aux2 HiLmt
7325	Rate1LoLmt
7326	Rate1HiLmt
7401	Inst Batt
7402	Inst Prs1
7404	Inst Tmp1
7405	Inst Dp1
7407	Inst Aux1
7408	Inst Aux2
7409	Flow Rate1
8001	Hardwre ID
8002	F/L Prs1
8003	Inst Prs1
8004	Man Pres1

8005	M Pres1/Lo
8006	M Pres1/Hi
8007	Prs1 LoLmt
8008	Prs1 HiLmt
8009	F/L Tmp1
8010	Inst Tmp1
8011	Man Temp1
8012	M Temp1/Lo
8013	M Temp1/Hi
8014	Tmp1 LoLmt
8015	Tmp1 HiLmt
8016	F/L Dp1
8017	Inst Dp1
8018	Man Dp1
8019	D Pres1/Lo
8020	D Pres1/Hi
8021	Dp1 LoLmt
8022	Dp1 HiLmt
8023	F/L Aux1
8024	Inst Aux1
8025	Man Aux1
8026	Aux 1 Lo
8027	Aux 1 Hi
8028	Aux1 LoLmt
8029	Aux1 HiLmt
8030	F/L Aux2
8031	Inst Aux2
8032	Man Aux2
8033	Aux 2 Lo
8034	Aux 2 Hi
8035	Aux2 LoLmt
8036	Aux2 HiLmt
8037	Inst Batt
8038	Battery Lo
8039	Battery Hi
8040	Batt LoLmt
8044	F/L Aout1

8045	Pct Flow 1
8046	Man Aout1
8050	Flw Rt Low
8051	Flw Rt Hi
8052	Rate1LoLmt
8053	Rate1HiLmt
8501	F/L GC
8502	LiveGCData
8503	GC Fail
8504	Chrom Strm
8505	BTU
8506	CO2
8507	Ethane
8508	I_Butane
8509	I_Pentane
8510	Methane
8511	Nitrogen
8512	N_Butane
8513	N_Heptane
8514	N_Hexane
8515	N_Octane
8516	N_Pentane
8517	Propane
8518	Spec Grav
8519	Methane
8520	Nitrogen
8521	CO2
8522	Ethane
8523	Propane
8524	Water
8525	H2S
8526	Hydrogen
8527	CO
8528	Oxygen
8529	I-Butane
8530	N-Butane
8531	I-Pentane

8532	N-Pentane
8533	N-Hexane
8534	N-Heptane
8535	N-Octane
8536	N-Nonane
8537	N-Decane
8538	Helium
8539	Argon
8540	SG Select
8541	Spec Grav
8542	Zs1 Entry
8543	GC timeout
8601	AnOutSel
8602	VP Mode
8603	Flw Setpnt
8604	Deadband
8605	Small Step
8606	Large Step
8607	Fine Cntrl
8608	Ovrd Pres
8609	Dp Limit
8610	Preset Pos
8611	Update Tim
8612	Valve Pos
8613	F/L VP Out
8614	FixdVP Val

6.0 AGA8 NOMINAL RANGES FOR THE DETAIL AND GROSS CHARACTERIZATION METHODS

QUANTITY	RANGE		
Relative Density	0.56	to	0.87
Gross Heating Value	477	to	1150 Btu/Scf
Methane Mole%	45.2	to	98.3
Nitrogen Mole%	0.3	to	53.6
Carbon Dioxide Mole%	0.04	to	28.94
Ethane Mole%	0.24	to	9.53
Propane Mole%	0.02	to	3.57
Butanes Mole%	0.01	to	1.08
Pentanes Mole%	0.002	to	0.279
Hexanes Plus Mole%	0.0005	to	0.1004
Helium Mole%	0.0	to	0.158
Hydrogen Mole%	0.0		
Carbon Monoxide Mole%	0.0		
Argon Mole%	0.0		
Oxygen Mole%	0.0		
Water Mole%	0.0	to	0.05
Hydrogen Sulfide Mole%	0.0	to	0.02

Gross Method - Temperatures from 32.0 to 130.0 DegF
Pressures from atmospheric to 1200 Psia

Detail Method - Temperatures from -200.0 to 760 DegF
Pressures from atmospheric to 40,000 Psia

Reference - AGA8 Nov 1992 Manual

AGA3 NOMINAL RANGES
Orifice Diameters greater than 0.45 inches
Pipe Diameters 2.0 inches and greater
Pipe Reynolds numbers greater than or equal to 4000
Beta ratios of 0.10 to 0.75
Temperatures -50.0 to 350.0 DegF
Pressures 0.0 to 5000.0 Psig
Differential Pressures 0.0 to 750.0 InH2O

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WARRANTY CLAIM REQUIREMENTS

To make a warranty claim, you, the Purchaser, must:

1. Provide Daniel with proof of the Date of Purchase and proof of the Date of Shipment of the product in question.

2. Return the product to Daniel within twelve (12) months of the date of original shipment of the product, or within eighteen (18) months of the date of original shipment of the product to destinations outside of the United States. The Purchaser must prepay any shipping charges. In addition, the Purchaser is responsible for insuring any product shipped for return, and assumes the risk of loss of the product during shipment.

3. To obtain Warranty service or to locate the nearest Daniel office, sales, or service center call (713) 467-6000, Fax (281) 897-2901, or contact:

   Daniel Measurement and Control
   P. O. Box 55435
   Houston, Texas 77255

   When contacting Daniel for product service, the purchaser is asked to provide information as indicated on the following "Customer Problem Report".

   Daniel Measurement and Control offers both on call and contract maintenance service designed to afford single source responsibility for all its products.

   Daniel Industries, Inc. reserves the right to make changes at any time to any product to improve its design and to insure the best available product.

DANIEL INDUSTRIES, INC.
CUSTOMER PROBLEM REPORT

FOR FASTEST SERVICE, COMPLETE THIS FORM, AND RETURN IT ALONG WITH THE AFFECTED EQUIPMENT TO CUSTOMER SERVICE AT THE ADDRESS INDICATED BELOW.

COMPANY NAME:_____

TECHNICAL CONTACT:_____ PHONE:_____

REPAIR P. O. #:_____ IF WARRANTY, UNIT S/N:_____

INVOICE ADDRESS:_____

_____

_____

SHIPPING ADDRESS:_____

_____

_____

RETURN SHIPPING METHOD:_____

EQUIPMENT MODEL #:_____ S/N:_____FAILURE DATE:_____

DESCRIPTION OF PROBLEM:_____

_____

_____

WHAT WAS HAPPENING AT TIME OF FAILURE?_____

_____

ADDITIONAL COMMENTS:_____

_____

_____

REPORT PREPARED BY:_____ TITLE:_____

IF YOU REQUIRE TECHNICAL ASSISTANCE, PLEASE FAX OR WRITE THE MAIN CUSTOMER SERVICE DEPARTMENT AT:

DANIEL MEASUREMENT AND CONTROL
ATTN: CUSTOMER SERVICE
19203 HEMPSTEAD HIGHWAY
HOUSTON, TEXAS 77065

PHONE: (281) 897-2900
FAX: (281) 897-2901

The sales and service offices of Daniel Industries, Inc. are located throughout the United States and in major countries overseas. Please contact Daniel Measurement and Control at P. O. Box 55435, Houston, Texas 77255, or phone (713) 467-6000 for the location of the sales or service office nearest you. Daniel Measurement and Control offers both on-call and contract maintenance service designed to provide single-source responsibility for all Daniel Measurement and Control products.

DANIEL