



Exploration & Production

GENERAL SPECIFICATION

INSTRUMENTATION

GS INS 162

**Pressure / Temperature Compensated Flow
standard function
- GCF -**

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1. Scope

The purpose of this document is to define the Standard Function used to compensate the gas flow in function of the pressure and temperature.

In order to assist in understanding, this document should be read in conjunction with **GS INS 150**, Design Method for System Configuration Standard Functions.

This Standard Function includes two options:

- GCF : raw flow measured directly by means of a flowmeter
- GCF_SQ : raw Flow measured by means of a differential pressure measurement

The acquisition of process flow value is achieved directly from corresponding analogue input.

The acquisition of process pressure and temperature numerical values are achieved through AI or RAI Standard Functions.

This Standard Function may be used in relationship with other Standard Functions (e.g. PID, TOT (flow totalizer)

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
Not applicable	

Professional Documents

Reference	Title
Not applicable	

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

**Other documents**

Reference	Title
Not applicable	

Total General Specifications

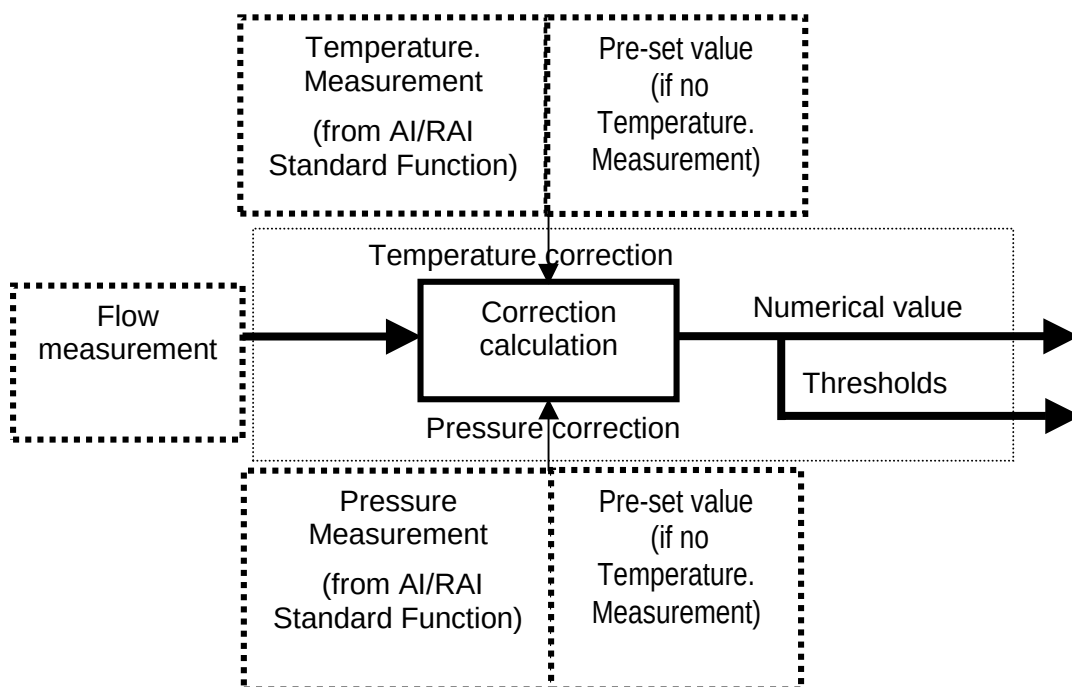
Reference	Title
GS INS 150	Design Method for System Configuration Standard Functions

3. General Description Of Functions

3.1 List of main functions

- Acquisition of the three numerical values.
- Calculation of the flow corrected by pressure and temperature measurements
- Input fault detection.
- Maintenance inhibit

3.2 Functional scheme



4. Interface description

INPUTS				OUTPUTS		
Field	HMI	Internal		Internal	HMI	Field
●			Raw Flow value			Value in engineering unit
		●	Pressure value			Control thresholds
		●	Temperature value			
		●	Maintenance inhibit status of flow input		Alm	Alarm thresholds
	Opt	●	Maintenance inhibit status of pressure input		Alm	Input fault status (corrected flow)
	Opt	●	Maintenance inhibit status of temperature input			Maintenance inhibit status
		●	flow input fault			
	Opt	●	pressure input fault			
	Opt	●	temperature input fault			
●			Threshold values			
●			Z/K coefficient			
Opt	●		Pressure fall-back value			
Opt	●		Temperature fall-back value			
	Opt	●	Automatic threshold masking			
			Standard function <u>GCF</u> Opt = Optional (if the measure exists, for P & T) Alm = Alarm			

5. Detailed description of functions

5.1 General points

The compensated Flow in pressure / temperature is calculated from three numerical values:

- the raw flow measured from an analogue input (a differential pressure measurement or a flow measurement according to the used analogue value),
- the pressure from either an analogue input or a pre-set value

- the temperature from either an analogue input or a pre-set value.

Flow, Temperature and Pressure values association shall be specified in functional analysis.

The corrected value will be used instead of the flow measurement by other Standard Functions (e.g. TOT,...)

5.2 Instantaneous corrected flow formula for flow measured by vortex system (linear)

The PTZ flow will be corrected by the DCS as per the following formula, where the PI is indicated in absolute bars and the TI in °K:

$$Q = Q_i \times \frac{PI \times T_0}{P_0 \times TI} \times K$$

$$K = \frac{Z_0}{Z} \quad (\text{K is a coefficient which is entered by Method people})$$

$$PI = PI \text{ measure} + P_0$$

$$T_0 = 288,15 \text{ °K}$$

$$P_0 = 1,01325 \text{ bar (a)}$$

$$Z_0 = 1$$

Z is the gas average Z value under process condition (modifiable variable on the Flow meter parameter display). This variable may differ depending on the corrected Flow.

Each Z value will be calculated by Method Specialist, taking into account the start up simulation phase data. A default value of "1" will be used during FAT.

5.3 Instantaneous corrected flow formula for flow measured by differential pressure (square root extraction, GCF_sq option)

The flow will be corrected by the DCS as per the following formula, where the differential pressure (PDI) is indicated in Pa, the pressure (PI) in absolute bars and the temperature (TI) indicated in °K :

$$PI = PI \text{ measurement} + 1,01325$$

$$Q = K * \sqrt{PDI} * \sqrt{\frac{PI}{TI}}$$

K is a coefficient which is calculated by Method specialist.

5.4 Handling of thresholds

Handling of thresholds is similar to threshold handling for one analogue input (AI). The corresponding treatment applies to the corrected flow value.

5.5 Maintenance inhibit of the corrected flow

The corrected flow is considered in maintenance inhibit status when the raw flow measure is in maintenance inhibit.

NUMERICAL VALUE	CONTROL THRESHOLDS	ALARM THRESHOLDS
HMI shows actual value of the corrected flow (in engineering unit) Used corrected value is the last healthy value (before inhibit). Associated PID controller calculation is stopped with last calculated output. Automatic control sequences still run (with the used corrected value).	xCL and xCH are deactivated and forced to their <i>NORMAL</i> state	xAL and xAH are deactivated and forced to their <i>NORMAL</i> state

The corrected flow input fault is no more alarmed when Maintenance inhibit is active.

5.6 Corrected flow fault

The corrected flow is considered in fault when the flow input is in fault.

INPUT VALUE	SIGNAL STATUS	DISPLAYED VALUE
Signal < 0,8 mA	IN FAULT	- 20 %
0,8 mA ≤ signal ≤ 23,2 mA	HEALTHY	Current value
Signal > 23,2 mA	IN FAULT	120 %
Card fault	IN FAULT	Last value

INPUT VALUE is the value of raw flow analogue input.

DISPLAYED VALUE is the value of corrected flow.

–20 % and 120 % values concerns the corrected flow scale.

5.7 Handling of fall-back values

There is a fall-back value for the Pressure and Temperature measurements.

This value replaces the measurement when the corresponding analogue input is considered in fault or in maintenance inhibit (when pre-set values of pressure and temperature are used, input fault and maintenance inhibit handling for the pressure and temperature do not apply)

Calculated fall-back values are available to the operator in method access level, who may change them within corresponding sensor scale limits.

5.7.1 Fall-back value of pressure measurement

The fall-back value is the last healthy slide average.

The slide average is normally calculated during one hour, with a sampling period of two minutes (30 value memorised). The slide average is only calculated if the corresponding measurement is healthy and not in maintenance inhibit.

Upon next activation of the healthy status and removal of the maintenance inhibit, the slide average is initialised : all memorised values are loaded with the new healthy measurement.

Note :

Number of memorised values and sampling time are adjustable (in method access level).

5.7.2 Fall-back value for temperature

The fall-back value is the last healthy value.

6. Tuning parameters and variables

PARAMETER	ACCESS LEVEL
Alarm threshold FAH in engineering unit	Method
Alarm threshold FAL in engineering unit	Method
Fall-back value for temperature measurement	Method
Fall-back value for pressure measurement	Method
Time duration for pressure slide average	Method
Scale minimum value	Engineer
Scale maximum value	Engineer
Control threshold (FCH) in engineering unit	Method
Control threshold (FCL) in engineering unit	Method
Threshold hysteresis	Engineer
K coefficient (or Z gas coefficient)	Engineer
Pre-set value for temperature (if no available measurement)	Engineer
Pre-set value for pressure (if no available measurement)	Engineer

7. Representation and animation description (HMI)

7.1 Events and values to be recorded

7.1.1 Events

Alarm thresholds,

Corrected flow input fault

Maintenance inhibit command

7.1.2 Analogue values

Corrected value in engineering unit.

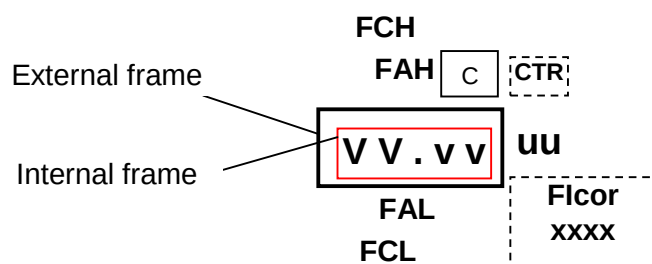
7.2 Alarm handling

Alarm description	Priority
Alarm thresholds (FAH, FAL)	Level 1
Corrected flow input fault	Level 1

7.3 Control display

This description gives examples of representation. However, they may be amended dependant on the DCS features.

7.3.1 Displayed data representation



V V . v v = numeric value (in engineering unit),

Target area for the corrected flow face plate display (alarm thresholds tuning),

uu = engineering unit (KSm³/j),

CTR = Process control (only appears on operator request by means of a soft key),

Target area for the corrected flow face plate display (control thresholds tuning),

Flcor xxxx = Corrected flow tag name (only appears on operator request),

Target area for the maintenance inhibit command of flow transmitter,

FCH = high control threshold activated,

(can be also displayed near the associated equipment),

FAH = high alarm threshold activated,

FAL = low alarm threshold activated,

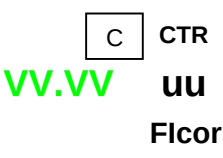
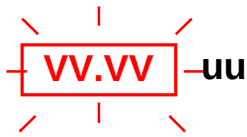
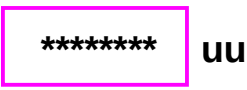
FCL = low control threshold activated,

(can be also displayed near the associated equipment),

As a basis, control thresholds shall not be displayed on process views.

All existing threshold (s) on process views are displayed in white colour on operator request (hidden if not active).

7.3.2 Analogue value display

Internal data	Display	Text	Frame
Symbol  Numeric value = <i>NORMAL</i> Label + CTR Units		White / hidden Green White / hidden White	NA
Numeric value = <i>ALARM</i>		Colour steady (dependent on alarm priority level)	NA
Maintenance inhibit = <i>INHIBITED</i>		As above	External frame : Steady Yellow
Flow input fault = <i>IN FAULT</i> And unacknowledged		Steady Red	Alarm frame(internal) : Flashing Red
Flow input fault = <i>IN FAULT</i> And acknowledged		Steady Red	Internal frame : Steady Red
Flow input fault occurred after Maintenance inhibit activation		Steady Red	External frame : Yellow Alarm frame (internal) : Red
Communication fault = <i>ACTIVATED</i>		White	External frame : Steady Magenta

The events which drive these frame displays may not be mutually exclusive. Therefore, the precedence on the display, from most to least important, shall be : magenta, white, blue, yellow

Symbol  is used as target area for the Detailed display.

7.3.3 Detailed display

Flow measured by Vortex system (linear) :

Raw flow	Corrected flow	Correction Pressure	Fall-back pressure	Correction Temperature	Fall-back temperature	Coefficient K/Z
FT xxxx FF.FF Km ³ /j	Ficor xxxx VV.VV KSm ³ /j	PT xxxx PP.PP bar	PP.PP	TT xxxx TT.TT °C	TT.TT	ZZ.ZZ

Flow measured by differential pressure (GCF_SQ option) :

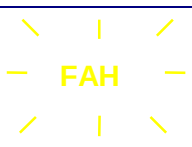
Differential pressure	Corrected flow	Correction pression	Fall-back pressure	Correction temperature	Fall-back temperature	Coefficient K
PDT xxxx PP.PP mbar	Ficor xxxx VV.VV KSm ³ /j	PT xxxx PP.PP bar	PP.PP	TT xxxx TT.TT °C	TT.TT	KK.KK

- ☐ Target area on raw value (FT in Km³/j or PDT in mbar) for the loop face plate display of raw measurement (the raw measurement is a differential pressure measurement or a flow measurement).
- ☐ Target area on pressure (PT) value for the loop face plate display.
- ☐ Target area on pressure fall-back value for changing the fall back value (in method access level).
- ☐ Target area on temperature (TT) value for the loop face plate display.
- ☐ Target area on temperature fall-back value for changing the fall-back value (in method access level).

The formula coefficient (K) is only displayed (not entered).

7.4 Thresholds Display

7.4.1 Alarm thresholds display

Internal data	Display	Text	Frame
Alarm threshold = <i>NORMAL</i>		Hidden	NA
Alarm threshold = <i>ALARM</i> And unacknowledged		Flashing Yellow	NA
Alarm threshold = <i>ALARM</i> And acknowledged		Steady Yellow	NA

7.4.2 Control thresholds display

Internal data	Display	Text	Frame
Control threshold = <i>NORMAL</i>		Hidden	NA
Control threshold = <i>ACTIVE</i>		Green	NA

7.5 Trend curves and Bar graph

Similar to AI Standard Function.