

Process Data in SmartPlant Instrumentation

Fluor's SmartPlant
Implementation
Initiative



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Process Department Issues



◆ Identifying Process Customer

- The Process Data is not a project deliverable to the Client on most projects
- The Primary Process Customer is Control Systems for the Sizing and Calibration of the Inline Instrument devices
- Mechanical and Piping also use the Process Design Conditions for equipment and line sizing and material spec

◆ Additional Process Hours for SPI loading

- Process develops initial Process Data on spreadsheets using the stream data and material balance
- Additional time to enter this data into SPI is not normally estimated in the Process Home Office Man Hour Estimate
- It is the responsibility of Control Systems to make the SPI data loading as efficient as possible for Process

Process Department Issues



◆ Change Control in SmartPlant Instrumentation

- Because of the Critical and Dynamic nature of process data it is important that Change Management Procedures be in place on every project.
- The Process Engineer is the Owner of the Process Data in SmartPlant Instrumentation

◆ Process Training for SmartPlant Instrumentation

- It is the responsibility of the Control Systems SmartPlant Instrumentation administrator to Train the Process Engineers in the use of the Process Module
- Use the SPI Process Module tutorial provided by Intergraph
- Supplemental Training of Browser and Save As functions

Current Process Data Work Practices



- ◆ **Hard copied process datasheets**
 - Process issues paper copies of Process Datasheets
 - Requires Control Systems to manually load Process data into SPI and requires some interpretation by SPI users.
- ◆ **Excel Process datasheets**
 - Process can issue Excel Spreadsheet Datasheets
 - Requires Control Systems to manually load Process data into SPI but has some Cut and Paste capability
- ◆ **Process Loads Process data into another tool for import into SPI**
 - Complex method that brakes chain of data ownership
- ◆ **Process Loads Process data directly into SPI**
 - Preferred method but requires SPI trained Process users

SPI Process Data Module

- ◆ Tag data is the primary process loading method.
 - General Instrument area
 - Process Properties area
 - Additional Properties
 - Base conditions area
 - Alarm conditions area
 - API 2540 Standards
 - User Defined Fields
 - Process Notes Area

- ◆ Different Process Functions Require Different Process Data

GENERAL

Case: CASE 1		Location: Line
Service: Feed from V-8	Line number: 4-P-1501-11H	
Fluid state: Liquid	Line size: 4 in	
Fluid phase: Single phase	Line schedule: 80	
Fluid name source: User-defined		
Fluid name: Lean Feed		

PROPERTIES

Report flags:	Specific Gravity	Density	Molecular Mass
	@Minimum	@Normal	@Maximum
Volumetric flow:	25	30	32
Upstream pressure:	12	13	14
Temperature:	150	150	150
Viscosity:	0.1	0.1	0.1
Velocity:	0.936	1.12	1.2
Density:	890	890	890
Specific gravity:	0.891	0.891	0.891
Compressibility:			
Specific heats ratio:			
Vapour pressure:	0.9	0.9	0.9
Critical pressure:	1200		
Molecular mass:			

ADDITIONAL PROPERTIES

Design pressure minimum:		bar	gauge	Corrosive:	No
Design pressure maximum:	50	bar	gauge	Erosive:	No
Design temperature minimum:		°C		Toxic:	No
Design temperature maximum:	250			Colored:	
Entrained gas:		%		Transparent:	
Angle of repose:		°		Build-up tendency:	
Required range:	From: 0	To: 36	m ³ /h		
Limits on press.drop across flowmeter:			mmH2O 4°C		

BASE CONDITIONS

Pressure:	1	bar	absolute	Density:	
Temperature:	15.5	°C		Specific gravity:	
				Compressibility:	

ALARM

	Alarm	Trip	Engineering units:	m ³ /h
Low-Low-Low:				@low
Low-Low:				
Low:				
High:				
High-High:				
High-High-High:				

API 2540 STANDARD

<input checked="" type="radio"/> Density at reference temperature:		kg/m ³
<input type="radio"/> Specific gravity at reference temperature:		
<input type="radio"/> *API settings for: minimum/normal/maximum:		
Reference temperature:		°C

USER DEFINED FIELD

NOTE

Instrument Process Data Module



- ❑ Handles multiple Cases
- ❑ Fluid properties lookups
- ❑ Data entered by Tag or Line
- ❑ Unit of Measure conversion
- ❑ Copy data from other Tags
- ❑ Additional Properties
- ❑ Base Conditions
- ❑ Alarm / Trip Settings
- ❑ User Defined Fields
- ❑ Workflow control
- ❑ Process datasheets with Revisions

GENERAL									
Case name:	Case 1								
Tag number:	101-FE -100		Location:			Line			
Service:	Feed from V-9		Line number:			4'-P-1501-11H			
Fluid state:	Liquid		Line size:			4 in			
Fluid phase:	Single phase		Line schedule:			80			
Fluid name:	Lean Feed								
PROPERTIES									
	@Minimum	@Normal	@Maximum	Units					
Volumetric flow:	28	30	32	m ³ /h@flow					
Upstream pressure:	12	13	14	bar-g					
Temperature:	150	150	150	°C					
Viscosity:	0.1	0.1	0.1	cP					
Velocity:	0.936	1.12	1.2	m/s					
Density:	890	890	890	kg/m ³					
Specific gravity:	0.891	0.891	0.891						
Compressibility:									
Vapour pressure:	0.9	0.9	0.9	bar-g					
Critical pressure:	1200	bar-g							
ADDITIONAL PROPERTIES									
Design pressure min:	bar-g		Corrosive:			No			
Design pressure max:	50	bar-g		Erosive:			No		
Design temperature min:	°C		Toxic:			No			
Design temperature max:	250	°C		Colored:					
Entrained gas:	%		Transparent:						
Required range:	From: 0	To: 35	m ³ /h@flow		Bull-up tendency:				
Limits on press.drop across flowmeter:	mmH ₂ O 4°C		Angle of repose:			°			
Check Out									
BASE CONDITIONS									
Pressure:	1	bar-a		Density:			kg/m ³		
Temperature:	15.5	°C		Specific gravity:					
Compressibility:									
ALARM									
Alarm		Trip		Engineering units:			m ³ /h@flow		
Low-Low-Low:									
Low-Low:									
Low:									
High:									
High-High:									
High-High-High:									
Shutdown Code									
API 2540 STANDARD									
USER DEFINED FIELD									
NOTE									
FLOW PROCESS DATA SHEET									
Domain: DEMO									
Date: 4/13/2004									
Sheet 1 of 1									
Drawing number: 101-FE -100/P0									
Rev: 0									

Process Data Module



◆ PROCESS WORK FLOW

Status	Description	Set / Changed by
Process Data not Required	Tags that do not require process data and therefore are not available to the process engineering group	Set by Instrument Engineers Changed by Instrument Engineers
Process Data Required	Tags available for process data entry by the process engineering group (in the Process Data module or Browser).	Set by Instrument Engineers Changed by Process Engineers
Lock out from Instrument	Tags marked for editing by the process engineering group and not available to the instrument group.	Set by Process Engineers Changed by Process Engineers
Release to Instrument	Tags available to the instrument engineering group following release from the process group.	Set by Process Engineers Changed by Instrument Engineers
Lock out from Process	Tags not available to the process engineering group.	Set by Instrument Engineers Changed by Instrument Engineers

Process Data Module



◆ Data Required from Process Department

- **In-lines;** Process Data for inline devices (control valves and flow elements) and analyzers are furnished by Process. Depending on the project scope, Relief Valve Process Data may be required to be furnished to Control Systems by Process Engineering.

◆ Data NOT Required from Process Department

- **Off-lines;** Data for off-line instruments (transmitters, temperature elements, pressure elements, etc.) is collected by Control Systems from the inline device data, line list, mechanical equipment data sheets and other sources. On a work share project, it may be possible to have personnel in another office, such as a GEC, enter some or all of this data. The work process for doing so will be the responsibility of Control Systems.
- **Piping In-lines;** For Thermowell velocity calculations, Control Systems will utilize the inline device data, line list and other sources for applicable installations. For those Thermowells where flow information is not available from other sources, Process will be consulted.

SPI Line Data Table



- ◆ Line Data Table maintains the piping line data as required for material and sizing

Select Line

Line type:
PROCESS Show all line types

Find line:

Line Number	P&ID Number	Stream Name	PD Exists	Pipe Standard	Pipe Ma
1"-FL-5001-15			Yes	ANSI	304 S.S
2"-C-1003-3C			Yes	ANSI	304 S.S
3"-FO-1212-4C			Yes	ANSI	PLAIN C
3"-FO-1213-4C			Yes	ANSI	PLAIN C
4"-P-1501-11H			Yes	ANSI	PLAIN C
4"-P-1502-11H			Yes	ANSI	PLAIN C
4"-P-1503-11H			No	ANSI	PLAIN C
DFD			No	ANSI	PLAIN C

OK Cancel Properties New... Change Type... Help

SPI Line Properties



- ◆ Line Properties dialog box allows the editing of line materials, Size, Schedule and dimensions

Line Number	Line Properties
1"-FL-5001-15	Line number: 1"-FL-5001-15
2"-C-1003-3C	Pipe standard: ANSI
3"-FO-1212-4C	Line size: 1 in
3"-FO-1213-4C	Internal diameter: 0.957
4"-P-1501-11H	Line schedule: 80S
4"-P-1502-11H	Wall thickness: 0.179
4"-P-1503-11H	
FDFDD	

SPI Pipe Data lookup Table



- ◆ The Pipe Data Lookup Table will allow selection of the proper Pipe Schedule for a given size from the line class specification report.

The screenshot shows a software interface with three main panels: 'Select Line', 'Line Properties', and 'Pipe Data'. The 'Select Line' panel has a 'Line type' dropdown set to 'PROCESS' and a list of line numbers including '1"-FL-5001-15'. The 'Line Properties' panel shows 'Line number: 1"-FL-5001-15' and 'Pipe material: 304 S.S.'. The 'Pipe Data' panel contains a table with the following data:

Nominal Size (inch)	Pipe Schedule	Internal Diameter (inch)	Wall Thickness (inch)
1	80S	0.9570	0.1790
1	40S	1.0490	0.1330
1	10S	1.0970	0.1090
1	5S	1.1850	0.0650
1 1/4	80S	1.2780	0.1910
1 1/4	40S	1.3800	0.1400
1 1/4	10S	1.4420	0.1090
1 1/4	5S	1.5300	0.0650

Below the table is a 'Find nominal size:' input field and three buttons: 'OK', 'Cancel', and 'Help'.

SPI Process Data Module



- ◆ Line data automatically placed in Process Data Module

The screenshot displays the 'GENERAL' dialog box for the SPI Process Data Module. The dialog box is titled 'GENERAL' and contains several fields for configuring line data. A red circle highlights the 'Line number' field, which is set to '4"-P-1501-11H'. Other fields include 'Service' (Feed from V-8), 'Fluid state' (Liquid), 'Fluid phase' (Single phase), 'Fluid name source' (Database), 'Location' (Line), 'Line size' (4 in), and 'Line schedule' (80). Below the dialog box, a table lists line data with columns for Line Number, Pipe material, Pipe spec, and Find nominal size.

Line Number	Pipe material	Pipe spec	Find nominal size
1"-FL-5001-15			
2"-C-1003-3C			
3"-FO-1212-4C			
3"-FO-1213-4C			
4"-P-1501-11H			
4"-P-1502-11H			
4"-P-1503-11H			
FDFFD			

Stream name: 1
Pipe material: 304 S.S.
Pipe spec: 1 1/4
Find nominal size: 0

Table data:

Line Number	Pipe material	Pipe spec	Find nominal size
1	SS	1.0970	0.1850
1 1/4	80S	1.2780	0.1910
1 1/4	40S	1.3800	0.1400
1 1/4	10S	1.4420	0.1090
1 1/4	5S	1.5300	0.0650

Buttons: OK, Cancel, Help

Instrument Process Data Module



- Process Engineers enter data directly into SPI for Calculations and Instrument Spec Sheets.

INtools - DEMO

File Modules Edit Actions Options Framework Tools Window Help

Close Export Browser Index Inst. Specs Wiring Proc. Data Calculation Loop Dwgs. DDP Help

Flowmeter Process Data - 101-FE -100

GENERAL

Case: Case 1
Service: Feed from V-8 Location: Line
Fluid state: Liquid Line number: 4"-P-150
Fluid phase: Single phase Line size: 4
Fluid name source: User-defined Line schedule: 80
Fluid name: Lean Feed

PROPERTIES

Report flags: Specific Gravity Density Molecular Mass

	@Minimum	@Normal	@Maximum	Units
Volumetric flow:	25	30	32	m ³ /h @flow
Upstream pressure:	12	13	14	bar gage

Instrument Line Save Report Highlight Add Case Delete Case

Ready | Plant: New Refinery | Area: Crude Area | Unit: Crude unit 1 | 4/13/2004 10:12

Instrument Process Data Module



- Process Engineers may enter fluid properties manually or select from internal database.

GENERAL																		
Case:																		
Service:	Feed from V-8	Location:	Line															
Fluid state:	Liquid	Line number:	4"-P-1501-11H															
Fluid phase:	Single phase	Line size:	4 in															
Fluid name source:	Database	Line schedule:	80															
Fluid name:																		
	<table border="1"><thead><tr><th>Fluid Name</th><th>Fluid Formula</th><th>Chemical Abstracts Name</th></tr></thead><tbody><tr><td>1,2-BUTADIENE</td><td>C4H6</td><td>1,2-BUTADIENE</td></tr><tr><td>1,2-DICHLOROETHANE</td><td>C2H4CL2</td><td>ETHANE 1,2-DICHLORO-</td></tr><tr><td>1,2-DIMETHYLBENZENE</td><td>C8H10</td><td>BENZENE,1,2-DIMETHYL-</td></tr><tr><td>1,2-ETHANEDIOL</td><td>C2H6O2</td><td>1,2-ETHANEDIOL</td></tr></tbody></table>	Fluid Name	Fluid Formula	Chemical Abstracts Name	1,2-BUTADIENE	C4H6	1,2-BUTADIENE	1,2-DICHLOROETHANE	C2H4CL2	ETHANE 1,2-DICHLORO-	1,2-DIMETHYLBENZENE	C8H10	BENZENE,1,2-DIMETHYL-	1,2-ETHANEDIOL	C2H6O2	1,2-ETHANEDIOL		
Fluid Name	Fluid Formula	Chemical Abstracts Name																
1,2-BUTADIENE	C4H6	1,2-BUTADIENE																
1,2-DICHLOROETHANE	C2H4CL2	ETHANE 1,2-DICHLORO-																
1,2-DIMETHYLBENZENE	C8H10	BENZENE,1,2-DIMETHYL-																
1,2-ETHANEDIOL	C2H6O2	1,2-ETHANEDIOL																
Report flags:																		

Instrument Process Data Module



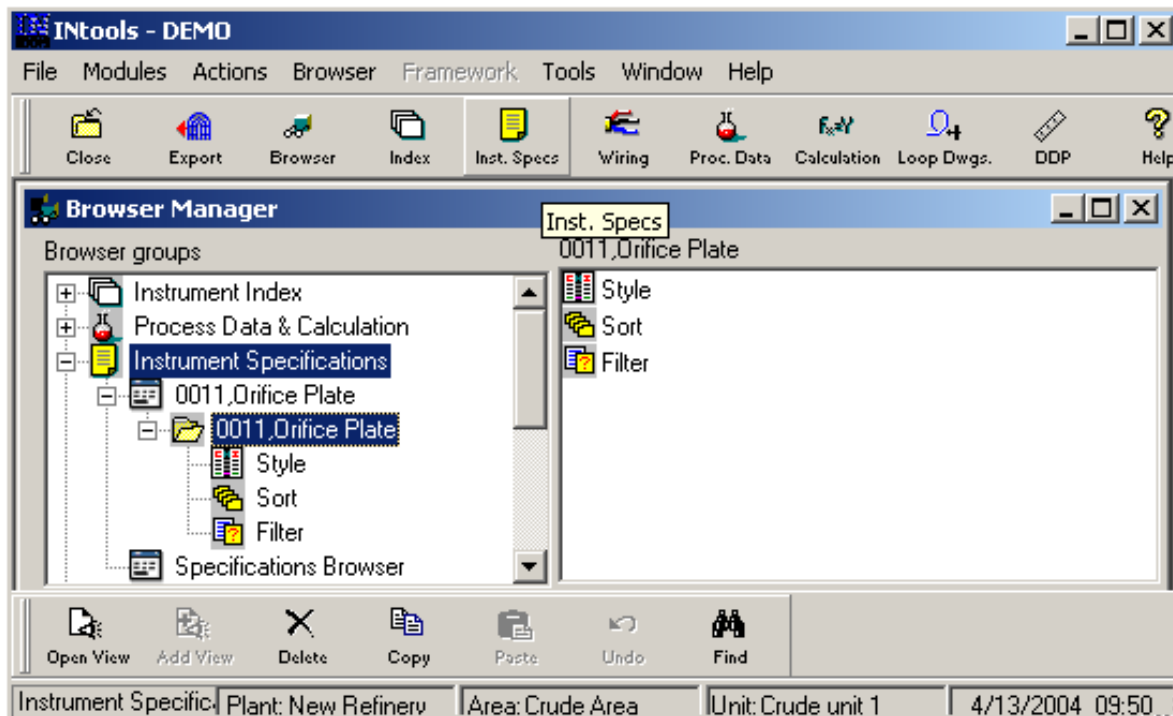
- Process Engineers may select hydrocarbon properties from the internal API 2540 table.

GENERAL			
Case:	<input type="text"/>		
Service:	<input type="text" value="Feed from V-8"/>	Location:	<input type="text" value="Line"/>
Fluid state:	<input type="text" value="Liquid"/>	Line number:	<input type="text" value="4''-P-1501-11H"/>
Fluid phase:	<input type="text" value="Single phase"/>	Line size:	<input type="text" value="4"/> in
Fluid name source:	<input type="text" value="API 2540"/>	Line schedule:	<input type="text" value="80"/>
Fluid name:	<input type="text"/>		
	Crude Oils and JP4 Jet Fuels, Kerosenes, Solvents Gasolines and Naphthenes Lubricating Oils Diesel Oil, Heating Oils, Fuel Oils		
Report flags:	<input type="text"/>		

SmartPlant Browser Module

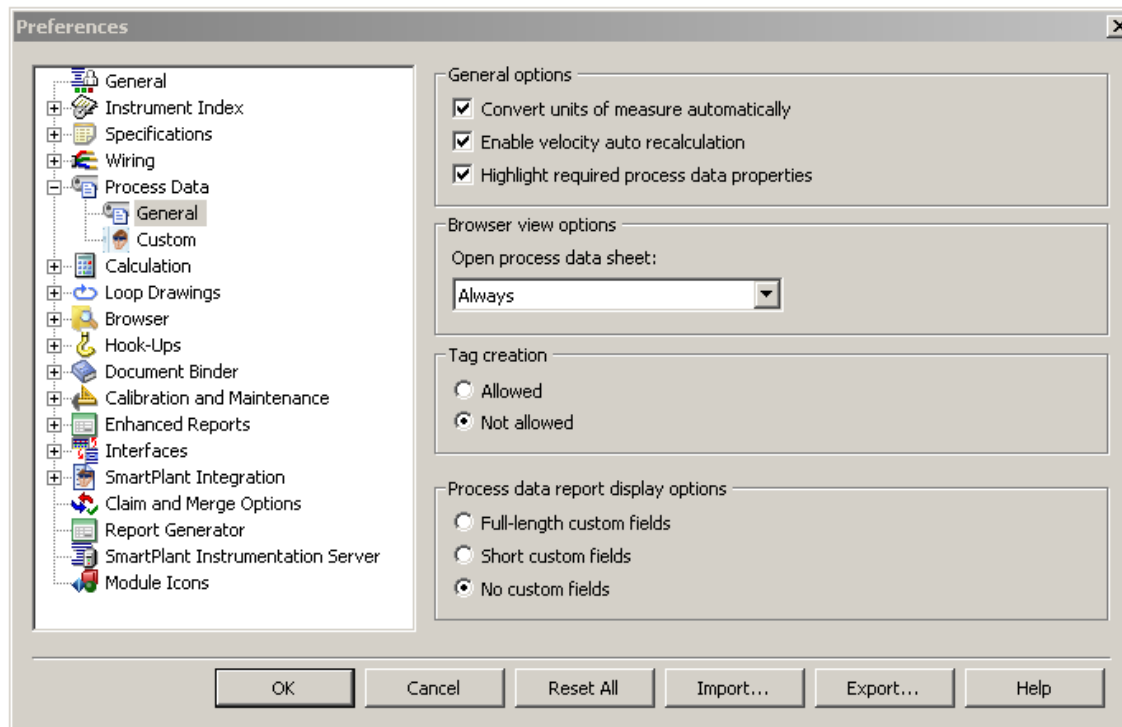


- All primary SmartPlant data tables are exposed for Browsing
- Allows users to create queries on Spec Sheets and Process Data
- Automatic Report and Export of query data from Browser



Process Data User Preferences

- ❑ Open Process Data from Browsers
- ❑ Tag Creation NOT allowed from Process Module
- ❑ No Custom Fields results in better Process Data Reports



Instrument Spec Module



- Instrument Specification
 - Form for each Spec Type
 - Edit Forms in SPI
 - Drop Down Data Windows
 - External Form Editor
 - Multi-Item forms
 - Multi-Sheet forms
 - Revision control
 - Show data from Index table
 - Link directly to Process Data
 - Export Specs to Excel or Intergraph External Editor

GENERAL	1	Tag No.	101-EV -100			
	2	Service	Feed from V-B			
	3	Line No.	4-P-1901-11H			
	4	Area Classification	Class 1, Division 2, Group CAD			
	5	Ambient Temperature:	Min.	Max.	Class 1, Division	
	6	Allowable Sound Pressure Level	dBA	80		
	7	Tightness Requirements	ANSI IV (standard)			
	8	Available Air Supply Pressure:	Min.	Max.	80 psig	
	9	Power Failure Position	Close			
	10					
PIPE LINE	11	Line Size and Schedule	Inlet	Outlet	4" 80 4" 80	
	12	Pipe Material	Carbon steel			
	13	Pipe Insulation	No			
	14	Process Fluid	Lean Feed			
PROCESS	15	Upstream Condition	Liquid			
	16	Differential Pressure	bar			
	17		Units	@ Max. Flow	@ Norm. Flow	@ Min. Flow
	18	Flow Rate	gpm	30	25	
	19	Inlet Pressure	bar-g	14	13	12
	20	Pressure Drop	bar	3	8	8
	21	Inlet Temperature	°C	150	150	150
	22	Inlet Density / Specific Gravity / Molecular Mass	kg/m ³	890	890	890
	23	Inlet Compressibility Factor				
	24	Inlet Viscosity	cP	0	0	0
CONDITIONS	25	Inlet Specific Heats Ratio				
	26	Inlet Vapor Pressure	bar-g	1	1	1
	27					
	28	Flow Coefficient Cv		20	13	10
	29	Travel	%			
	30	Sound Pressure Level	dBA	65	69	78
	BODY AND TRIM	31	MFR	Model	Fisher	EZ
		32	Body Type	Single Seat Globe		
		33	Body Size	Trim Size	2 in	By Mfr
		34	Rated Cv	Characteris.	By Mfr	By Mfr
35		End Connec. & Rating	300 # RF			
36		Body Material	CS			
37		Bonnet Type/ Material	Integral	SS		
38		Flow Direction	By Mfr			
39		Flow Action To	By Mfr			
40		Lubricator	Isolat. Valve	No		
ACTUATOR	41	Guiding	No. of Ports	By Mfr	1	
	42	Trim Type				
	43	Rated Travel				
	44	Plug/ Ball/ Disk Material	SS			
	45	Seat Material	SS			
	46	Cage	Stem Material	SS		
	47	Gasket Material	By Mfr			
	48					
	49	MFR	Model	Fisher	667	
	50	Type	Diaphragm			
RESULTS	51	Size	Area	By Mfr	By Mfr	
	52	Air Failure Valve	Close			
	53	Handheel Location	not required			
	54	Batch Range	By Mfr			
	55					
	56	MFR	Model	By Mfr	By Mfr	
	57	Signal	Inlet	Outlet	3-15 psig	
	58	Increase Signal Valve	Opens			
	59	Cam Characteristic	S-C			
	60	Bypass	Gauges	Yes	Yes	
PURCHASE	61					
	62					
	63					
	64	Type	SOLENOID VALVE			
	65	When De-Energ. Valve	86			
	66					
	67	MFR	Model	By Mfr	By Mfr	
	68	Contacts / Rating	SWITCHES			
	69	Switching Position	70			
	71					
INSTRUMENT SPECIFICATION	72	MFR	Model	By Mfr	By Mfr	
	73	Std Pressure	By Mfr			
	74	Filter	Gauge	Yes	Yes	
	75					
	76	Hydro. Pressure	TESTS			
	77	Leakage	78			
	78					
	79	Manufacturer	FISHER			
	80	Model	ES			
	81	Purchase Order Num.	T.R.E.S.P.002/98			
82	Price	Item Number	0250 5 3			
83	Serial Number					
Notes: 1. Valve to be supplied fully assembled, marked, with certificate						
INSTRUMENT SPECIFICATION						
Control Valve						
No.	MS	11/22/1998	For bids	Code: 1	Sheet 1 of 1	
By	Date	Revision	Dwg. No.	101-21-1999/1	Rev: 0	

Spec Sheet Module



- ◆ Given proper rights – the process data may be edited from the Spec Sheets
 - Automatic Unit conversion does NOT work from Spec Sheets
 - Only selected process data is visible on Spec Sheets
 - Rights can be set to prohibit editing of process data from Spec Sheets
 - Multi case process data can be accessed on the Spec Sheet from the process Module
- ◆ **Editing Process Data From Spec Sheets is NOT Recommended**

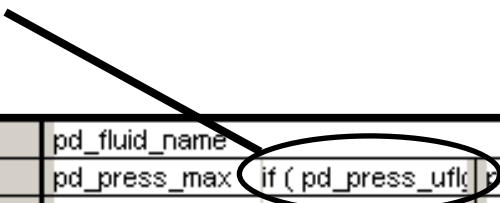
PROCESS CONDITIONS	7	Fluid	Light Naphtha				
	8	Oper. Temperature	Max. Temperature	85	°C	85	°C
	9	Oper. Pressure	Max. Pressure	12	bar-g	12	bar-g
	10	Vibrations					
	11						

Spec Sheet Module



- ◆ Type and number of Process variables available for Spec Sheets are different for each process function
- ◆ Units of Measure (UID) are separated from the variable
- ◆ Some Units of Measure are Computed fields
 - Pressure unit of measure psi-g is two fields

if (pd_press_uflg = 'G', rightTrim (pd_press_uid) + '-g', if (pd_press_uflg = 'A' , rightTrim (pd_press_uid) + '-a', "))



PROCESS CONDITIONS	9	Fluid		pd_fluid_name			
	10	Pressure Max	Oper.	pd_press_max	if (pd_press_uflg	pd_press_nor	if (pd_press_uflg
	11	Temperature Max.	Oper.	pd_temp_max	pd_temp_uid	pd_temp_nor	pd_temp_uid
	12	Oper. Spec. Gravity	Oper. Viscosity	pd_spec_grav_nor		pd_visc_nor	pd_visc_uid
	13	spec_udf_c51		spec_udf_c07			
	14	spec_udf_c15		spec_udf_c16			

Spec Sheet Module



- ◆ Different Process variables available for Process Function

Process Fluid	PD_FLUID_NAME
Max. Pressure	PD_PRESS_MAX
Oper. Pressure	PD_PRESS_NOR
Max. Temperature	PD_TEMP_MAX
Oper. Temperature	PD_TEMP_NOR
Temperature Unit Of Measure	PD_TEMP_UID
Process Vibrations	PD_VIBRATION

TEMPERATURE

Spec Sheet Module



- ◆ Different Process variables available for Process Function

Process Fluid	PD_FLUID_NAME
Max. Pressure	PD_PRESS_MAX
Oper. Pressure	PD_PRESS_NOR
Max. Temperature	PD_TEMP_MAX
Oper. Temperature	PD_TEMP_NOR
Temperature Unit Of Measure	PD_TEMP_UID
Oper. Viscosity	PD_VISC_NOR
Viscosity Unit Of Measure	PD_VISC_UID
Max. Range	PD_P_RANGE_MAX
Oper. Spec. Gravity	PD_SPEC_GRAV_NOR
Calibration Range	PD_P_RANGE_MIN

PRESSURE

Spec Sheet Module



◆ Different Process variables available for Process Function

	Reference Leg Fluid Density Level	PD_ABOVE_REF
	Density Upper	PD_DENS_NOR
	Density Unit Of Measure	PD_DENS_UID
Process F	Designed Temperature	PD_DESIGN_TEMP_MIN
Max. Pres	Temperature Unit Of Measure	PD_DESIGN_TEMP_UID
Oper. Pres	Fluid Upper	PD_FLUID_NAME
Max. Pres	Density Lower	PD_LOWER_DENSITY
Oper. Pres	Density Unit Of Measure	PD_LOWER_DENSITY_UID
Max. Temp	Fluid Lower	PD_LOWER_FLUID_NAME
Oper. Temp	Designed Pressure	PD_PRESS_DES
Max. Temp	Max. Pressure	PD_PRESS_MAX
Oper. Temp	Oper. Pressure	PD_PRESS_NOR
Temperature	Reference Line (Tangent / Center)	PD_REFERENCE
Process V	Max. Temperature	PD_TEMP_MAX
	Oper. Temperature	PD_TEMP_NOR
	Temperature Unit Of Measure	PD_TEMP_UID

LEVEL

Spec Sheet Module



◆ Different Process variables available for Process Function

		Flow Full Scale	PD_F_RANGE_MAX
		Max. Flow	PD_FLOW_MAX
	Reference Leg	Min. Flow	PD_FLOW_MIN
	Density Upper	Flow Operating	PD_FLOW_NOR
	Density Unit O	Process Fluid	PD_FLUID_NAME
	Designed Tem	Process State	PD_FLUID_PHASE
Process F	Max. Pres	Temperature U	pd_gas_sg_as_mm
Process F	Oper. Pres	Fluid Upper	pd_molecular_mass
Max. Pres	Max. Temp	Density Lower	Base Press.
Oper. Pre	Oper. Tem	Density Unit O	Press Unit Of Measure
Max. Tem	Temperatu	Fluid Lower	Max. Pressure
Oper. Tem	Oper. Visc	Designed Pres	Oper. Pressure
Temperatu	Viscosity I	Max. Pressure	Spec. Gravity at Base
Process V	Max. Rang	Oper. Pressure	Oper. Gravity at Base
	Oper. Spe	Reference Line	Base Temp
	Calibration	Max. Temperat	Temp Unit Of Measure
		Oper. Tempera	Max. Temperature
		Temperature U	Oper. Temperature
			Temperature Unit Of Measure
			Viscosity at Operating Conditions
			Viscosity Unit Id.

FLOW

Spec Sheet Module



◆ Different Process variables available for Process Function

				% Allowable Overpressure	PD_ACCUMULATION
			Flow Full Scale	Conventional, Bellow, Pilot Operated	PD_CALC_CODE
			Max. Flow	Compressibility Factor	PD_COMPRES_FLOW_NOR
		Reference Leg	Min. Flow	Back Pressure Constant	PD_CONST_BACK_PRES
		Density Upper	Flow Operating	Ratio of Specific Heats	PD_CP_CV_NOR
		Density Unit O	Process Fluid	Relief Density	PD_DENS_RELIEF
	Process F	Designed Tem	Process State	Dens Relief Unit Id	PD_DENS_RELIEF_UID
	Max. Pres	Temperature U	pd_gas_sg_as m	Process Fluid	PD_FLUID_NAME
Process P	Oper. Pres	Fluid Upper	pd_molecular ma	Process State	PD_FLUID_PHASE
Max. Pres	Max. Temp	Density Lower	Base Press.	Latent Heat of Vaporization	PD_LATENT_HEAT_NOR
Oper. Pre	Oper. Tem	Density Unit O	Press Unit Of Me	Latent Heat Unit Id	PD_LATENT_HEAT_UID
Max. Tem	Temperatu	Fluid Lower	Max. Pressure	Body and Bonnet	PD_MATERIAL
Oper. Tem	Oper. Visc	Designed Pres	Oper. Pressure	Required Capacity	PD_MAX_DISCHARGE
Temperatu	Viscosity I	Max. Pressure	Spec. Gravity at B	pd_molecular mass	PD_MOLECULAR_MASS
Process V	Max. Rang	Oper. Pressure	Oper. Gravity at B	Oper. Pressure	PD_PRESS_NOR
	Oper. Spe	Reference Line	Base Temp	RelievingTemperature	PD_RELIEF_TEMP
	Calibration	Max. Temperat	Temp Unit Of Me	Temperature Unit Of Measure	PD_RELIEF_TEMP_UID
		Oper. Tempera	Max. Temperature	Oper. Temperature	PD_TEMP_NOR
		Temperature U	Oper. Temperature	Temperature Unit Of Measure	PD_TEMP_UID
			Temperature Unit	Process Set Pressure	PD_VAL_SET_PRES_MIN
			Viscosity at Oper	Back Pressure Variable	PD_VAR_BACK_PRES
			Viscosity Unit Id.	Relief Viscosity	PD_VISC_RELIEF
				Viscosity Relief Unit Id	PD_VISC_RELIEF_UID

RELIEF VALVE

Spec Sheet Module

◆ Different Process variables available for Process Function

pd_compres_flow_max	PD_COMPRES_FLOW_MAX
pd_compres_flow_min	PD_COMPRES_FLOW_MIN
pd_compres_flow_nor	PD_COMPRES_FLOW_NOR
pd_cp_cv_max	PD_CP_CV_MAX
pd_cp_cv_min	PD_CP_CV_MIN
pd_cp_cv_nor	PD_CP_CV_NOR
pd_dens_max	PD_DENS_MAX
pd_dens_min	PD_DENS_MIN
pd_dens_nor	PD_DENS_NOR
pd_dens_uid	PD_DENS_UID
Power Failure Position	PD_FAILURE_ACTION
Flow Rate@Max. Flow	PD_FLOW_MAX
Flow Rate@Min. Flow	PD_FLOW_MIN
Flow Rate@Norm. Flow	PD_FLOW_NOR
Process Fluid	PD_FLUID_NAME
Upstream Condition	PD_FLUID_PHASE
Differential Pressure	PD_MAX_SHUT_OFF_PRESS_DIF
Pressure Unit Of Measure	PD_MAX_SHUT_OFF_PRESS_DIF_UID
pd_molecular_mass	PD_MOLECULAR_MASS
Pressure Drop@Max. Flow	PD_PRESS_DRP_MAX
Pressure Drop@Min. Flow	PD_PRESS_DRP_MIN
Pressure Drop@Norm. Flow	PD_PRESS_DRP_NOR
Pressure Drop Units	PD_PRESS_DRP_UID
Inlet Pressure@Max. Flow	PD_PRESS_MAX
Inlet Pressure@Min. Flow	PD_PRESS_MIN
Inlet Pressure@Norm. Flow	PD_PRESS_NOR
Tightness Requirements	PD_SEAT_LEAK
pd_spec_grav_max	PD_SPEC_GRAV_MAX
pd_spec_grav_min	PD_SPEC_GRAV_MIN
pd_spec_grav_nor	PD_SPEC_GRAV_NOR
Inlet Temperature@Max. Flow	PD_TEMP_MAX
Inlet Temperature@Min. Flow	PD_TEMP_MIN
Inlet Temperature@Norm. Flow	PD_TEMP_NOR
Inlet Temperature Units	PD_TEMP_UID
Inlet Vapour Pressure@Max. Flow	PD_VAP_PRESS_MAX
Inlet Vapour Pressure@Min. Flow	PD_VAP_PRESS_MIN
Inlet Vapour Pressure@Norm. Flow	PD_VAP_PRESS_NOR
Inlet Viscosity@Max. Flow	PD_VISC_MAX
Inlet Viscosity@Min. Flow	PD_VISC_MIN
Inlet Viscosity@Norm. Flow	PD_VISC_NOR
Inlet Viscosity Units	PD_VISC_UID

CONTROL VALVE

Process F	Flow Full Scale	% Allowable Overp
Max. Pres	Max. Flow	Conventional, Bello
Oper. Pres	Min. Flow	Compressibility Fa
Max. Pres	Flow Operating	Back Pressure Co
Oper. Pres	Density Upper	Ratio of Specific H
Max. Temp	Density Unit O	Relief Density
Oper. Temp	Designed Tem	Dens Relief Unit Id
Max. Temp	Temperature U	Process Fluid
Oper. Temp	Fluid Upper	Process State
Temperature	Density Lower	pd_gas_sg_as m
Process V	Density Unit O	pd_molecular ma
	Fluid Lower	Base Press.
	Designed Pres	Press Unit Of Me
	Max. Pressure	Max. Pressure
	Oper. Pressure	Oper. Pressure
	Reference Line	Spec. Gravity at
	Max. Temperat	Oper. Gravity at
	Oper. Tempera	Base Temp
	Temperature U	Temp Unit Of Me
		Max. Temperature
		Oper. Temperature
		Temperature Unit
		Process Set Press
		Back Pressure Va
		Relief Viscosity
		Viscosity Relief U

Spec Sheet Module

- ◆ Supplemented with Computed and Process Function Fields

Flow Rate Units	COMP_FLOW_UOM
Inlet Pressure Units	COMP_PRESS_UOM
Inlet Vapour Pressure Units	COMP_VAP_PRESS_UOM
No. of Ports	CV_NUM_PASSAGES
Sound Pressure Level@Max. Flow	CV_SOUND_LVL_MAX
Sound Pressure Level@Min. Flow	CV_SOUND_LVL_MIN
Sound Pressure Level@Norm. Flow	CV_SOUND_LVL_NOR
Travel@Max. Flow	CV_TRAVEL_MAX
Travel@Min. Flow	CV_TRAVEL_MIN
Travel@Norm. Flow	CV_TRAVEL_NOR
Body Size	CV_VALVE_DIAM
Size Unit Of Measure	CV_VALVE_DIAM_UID
Body Type	CV_VALVE_TYPE
Flow Coefficient Cv@Max. Flow	CV_VLV_CV_MAX
Flow Coefficient Cv@Min. Flow	CV_VLV_CV_MIN
Flow Coefficient Cv@Norm. Flow	CV_VLV_CV_NOR

pd_compres_flow_max	PD_COMPRES_FLOW_MAX
pd_compres_flow_min	PD_COMPRES_FLOW_MIN
pd_compres_flow_nor	PD_COMPRES_FLOW_NOR
pd_cp_cv_max	PD_CP_CV_MAX
pd_cp_cv_min	PD_CP_CV_MIN
pd_cp_cv_nor	PD_CP_CV_NOR
pd_dens_max	PD_DENS_MAX
pd_dens_min	PD_DENS_MIN
pd_dens_nor	PD_DENS_NOR
pd_dens_uid	PD_DENS_UID
Power Failure Position	PD_FAILURE_ACTION
Flow Rate@Max. Flow	PD_FLOW_MAX
Flow Rate@Min. Flow	PD_FLOW_MIN
Flow Rate@Norm. Flow	PD_FLOW_NOR
Process Fluid	PD_FLUID_NAME
Upstream Condition	PD_FLUID_PHASE
Differential Pressure	PD_MAX_SHUT_OFF_PRESS_DIF
Pressure Unit Of Measure	PD_MAX_SHUT_OFF_PRESS_DIF_UID
pd_molecular_mass	PD_MOLECULAR_MASS
Pressure Drop@Max. Flow	PD_PRESS_DRP_MAX
Pressure Drop@Min. Flow	PD_PRESS_DRP_MIN
Pressure Drop@Norm. Flow	PD_PRESS_DRP_NOR
Pressure Drop Units	PD_PRESS_DRP_UID
Pressure@Max. Flow	PD_PRESS_MAX
Pressure@Min. Flow	PD_PRESS_MIN
Pressure@Norm. Flow	PD_PRESS_NOR
Seal Leakage Requirements	PD_SEAT_LEAK
spec_grav_max	PD_SPEC_GRAV_MAX
spec_grav_min	PD_SPEC_GRAV_MIN
spec_grav_nor	PD_SPEC_GRAV_NOR
Temperature@Max. Flow	PD_TEMP_MAX
Temperature@Min. Flow	PD_TEMP_MIN
Temperature@Norm. Flow	PD_TEMP_NOR
Temperature Units	PD_TEMP_UID
Inlet Vapour Pressure@Max. Flow	PD_VAP_PRESS_MAX
Inlet Vapour Pressure@Min. Flow	PD_VAP_PRESS_MIN
Inlet Vapour Pressure@Norm. Flow	PD_VAP_PRESS_NOR
Inlet Viscosity@Max. Flow	PD_VISC_MAX
Inlet Viscosity@Min. Flow	PD_VISC_MIN
Inlet Viscosity@Norm. Flow	PD_VISC_NOR
Inlet Viscosity Units	PD_VISC_UID

Instrument Calculation Module



- Control Valve Sizing
- Relief Valve Sizing
- Flow Meter Sizing
- Thermowell Parameters

- Uses excepted standard formulas
- Documents calculation basis
- Direct access to Process Data
- Generates Calculation Reports with Revisions

101-FV -100				
Feed from V-8				
CONTROL VALVE: Cv Calculation				
The Control Valve is sized according to ISA-75.01 (1995)				
Hydrodynamic Noise is calculated according to Masoneilan OZ 3000E (1984)				
State: LIQUID				
FNK: Lean Feed				
	Unit	@ Min. Flow	@ Normal Flow	@ Max. Flow
Flow	m ³ /h	25	30	32
Upstream pressure	bar-g	12	13	14
Downstream pressure	bar-g	4	7	11
Downstream pressure	bar	8	6	3
Temperature	°C	150	150	150
Specific gravity		0.890	0.890	0.890
Viscosity	cP	0.1	0.1	0.1
Vapour pressure	bar-g	0.9	0.9	0.9
Critical pressure	bar-g	1200		
Line size & Schedule 4 in. sch 80				
Pipe inside diameter / Wall thickness		3.825 / 0.337		in
Valve diameter		2		in
Valve type		Single Globe		
Results and Coefficients		@ Min. Flow	@ Normal Flow	@ Max. Flow
Calculated Cv	(Cv)	9.68	13.5	20.4
Flow regime or condition		1000-Turb.	Turbulent	Turbulent
Valve Reynolds number	(Re)	3966731	3960334	5193193
Reynolds number factor	(F _R)	1	1	1
Orifice velocity	[m/s]	0.936	1.12	1.2
Hydrodynamic noise	[dB(A)]	77.9	69.4	65.1
Pressure recovery factor	(F _P)	0.96	0.96	0.96
Pressure recovery factor	(F _{1P})	0.8775	0.8552	0.8491
Flow geometry factor	(F _G)	0.9974	0.995	0.9886
Critical pressure factor	(F _C)	0.9488	0.9488	0.9488
Caution Index	(I _C)	0.7207	0.4959	0.229
Valve caution Index	(I _{CV})	0.9636	0.9636	0.9636
Max. allow. diff. pressure	[psd]	8.277	9.012	9.737
Valve style modifier	(F _S)	1		
Inlet L. lead coefficient	(L ₁)	1.189		
Total L. lead coefficient	(L _T)	0.7922		
- Barometric Pressure: 1.00 atm @ sea level				
		CONTROL VALVE SIZING CALCULATION SHEET		INTERGRAPH Process & Building Solutions
0	MIS	11/19/98	For piping	Sheet 1 of 1
No	By	Date	Revised	Dwg. No.: 101-FV -100/CL Rev.: 0

Process Data Issues



- ◆ Types of Process Data
 - Process Design Conditions
 - Process Operating Conditions
 - Process Ranges
 - Process Alarms and Trips
- ◆ Process Workflow needs to be different for Inline vs. Offline Devices
- ◆ Process Data Workflow may be circumvented using Process and Spec Browsers
- ◆ Process notes often required on Spec Sheet (create spec sheet notes page for Inline devices)
- ◆ Smart Instrumentation may need the Process Data to be defined on both Inline and Offline instruments
- ◆ Getting Process Group to use SPI for data entry can be a challenge

Process Data in SmartPlant Instrumentation



- Value Added by placing Process Data directly into SmartPlant Instrumentation:
 - Timely Access to Process Data by Control Systems
 - Data Centric Control of Process Data
 - Management of Change
 - Real Process Data Becomes Deliverable
- Alternative is to use the External Process Data Editor

GENERAL									
Case name:	Case 1								
Tag number:	101-FE -100								
Service:	Feed from V-9			Location:			Line		
Fluid state:	Liquid			Line number:			4'-P-1501-11H		
Fluid phase:	Single phase			Line size:			4 in		
Fluid name:	Lean Feed			Line schedule:			80		
PROPERTIES									
	@Minimum	@Nomal	@Maximum	Units					
Volumetric flow:	25	30	32	m³h@flow					
Upstream pressure:	12	13	14	bar-g					
Temperature:	150	150	150	°C					
Viscosity:	0.1	0.1	0.1	cP					
Velocity:	0.936	1.12	1.2	m/s					
Density:	890	890	890	kg/m³					
Specific gravity:	0.891	0.891	0.891						
Compressibility:									
Vapour pressure:	0.9	0.9	0.9	bar-g					
Critical pressure:	1200	bar-g							
ADDITIONAL PROPERTIES									
Design pressure min:	bar-g			Corrosive:			No		
Design pressure max:	bar-g			Erosive:			No		
Design temperature min:	°C			Toxic:			No		
Design temperature max:	°C			Colored:					
Entrained gas:	%			Transparent:					
Required range:	From: 0		To: 36		m³h@flow		Bull-up tendency:		
Limits on press drop across flowmeter:	mmH ₂ O			°C			Angle of repose:		
Check Out:									
BASE CONDITIONS									
Pressure:	bar-a			Density:			kg/m³		
Temperature:	°C			Specific gravity:					
Compressibility:									
ALARM									
Low-Low-Low:	Alarm			Trip			Engineering units:		
Low-Low:	m³h@flow								
Low:									
High:									
High-High:									
High-High-High:									
Shutdown Code:									
API 2540 STANDARD									
USER DEFINED FIELD									
NOTE									
							FLOW PROCESS DATA SHEET		INTERGRAPH Process • Power • Offshore
				Domain: DEMO		Date: 4/13/2004		Sheet 1 Of 1	
No.	MS	11/19/1998	For Instrumentation	Date: 4/13/2004		Drawing number: 101-FE -100/PD		Rev: 0	

Process Data in SmartPlant Instrumentation



Best Practice

Enter Process Data directly into SmartPlant Instrumentation

Questions?