

Introduction

When measuring oil and gas there are many designs and configurations which can be used. The uncertainty in measurement will depend on the selection of meter, the standards which are used for the calculations, the manufacturer, model and range for each item of primary and secondary instrumentation and factors such as whether density is measured using a densitometer or calculated from the composition.

Demonstrating uncertainty is a requirement. Not maintaining an uncertainty budget can result in exposure to bias error and without knowledge of uncertainty in measurement a meaningful comparison cannot be achieved.

KELTON® have over 20 years' experience in evaluating uncertainty in measurement systems and UNCERTAINTYPLUS®.net is a stand-alone application developed by KELTON®, designed for engineers to independently assess the uncertainty of a metering system for a given set of operating conditions.

Key Features

- Fully traceable uncertainty calculations
- Selection of modules available for different metering systems
- Uncertainty calculated for all common secondary instrumentation
- Uncertainty calculations can be configured and saved as files
- Full reports can be saved and printed
- Portable – access to network is not required
- Uncertainty calculated over a range of process conditions or production profiles

Benefits

- Compliance is demonstrated
- Meaningful comparisons between measurements can be made
- Calibration intervals can be optimised and uncertainty based
- Designed by KELTON® measurement consultants
- Developed and supported by KELTON® IT professionals

In summary, UNCERTAINTYPLUS®.net can:

- Define commercial exposure
- Allow data to be easily accessed and assessed
- Optimise current systems
- Identify and prevent costly errors

About KELTON®

KELTON® is an independent and accredited company specialising in flow measurement consultancy, auditing, training and the provision of specialist software. Founded in 1991, the company employs more than 50 people with 30 consultants who have over 500 man years of experience in the management, operation and maintenance of flow measurement systems. KELTON® has an outstanding reputation in the industry. Services include:

- Audit and Certification
- Uncertainty Calculations & Models
- Measurement Training
- Engineering Studies
- Metering System Documentation & Support
- Software Applications

Currently service is provided worldwide for; major oil & gas operating companies, gas transmission & distribution companies, LNG terminal operators and system integrators. Presently, service is offered from three strategic locations: UK, Qatar and Abu Dhabi.

If additional information is required on KELTON® flow consultancy services or software applications visit:

www.kelton.co.uk



Uncertainty Budget

Symbol	Source of Uncertainty	Expanded Uncertainty (U)	Probability Distribution	Divisor	Standard Uncertainty (u)	Sensitivity (c)	ci-ui
U(Cd)	Discharge coefficient	0.00301784	Normal	2	0.00150892	43.6405	0.0658502 kg/s
U(ε)	Expansibility factor	0.000134408	Normal	2	6.72041E-05	26.3622	0.00177165 kg/s
U(d)	Orifice throat diameter	0.126 mm	Normal	2	0.063 mm	0.335878	0.0211603 kg/s
U(D)	Pipe diameter	1.2 mm	Normal	2	0.6 mm	0.0261375	0.0156825 kg/s
U(Δp)	Differential pressure	1.50597 mbar	Normal	2	0.752986 mbar	0.0438694	0.033033 kg/s
U(p)	Density	0.298293 kg/m³	Normal	2	0.149147 kg/m³	0.308135	0.0459574 kg/s
U(drift)	Drift	0.0263216 kg/s	Normal	2	0.0131608 kg/s	1	0.0131608 kg/s
U(comp)	Computation	0.00263216 kg/s	Normal	2	0.00131608 kg/s	1	0.00131608 kg/s

*** UN-301 - Gas Orifice**

General | **Input / Output** | Composition | Pressure | Differential Pressure | Temperature | Density | Standard Density | Calorific Value | Flow Rate | Report

Options
DP Transmitters: 1

Inputs

Parameter	Value	Unit	Range
Pressure	60	bar	<input type="checkbox"/>
Differential pressure	300	mbar	<input checked="" type="checkbox"/>
Temperature	50	°C	<input type="checkbox"/>

Outputs

Name	Value	Absolute Uncertainty (k=2)	Relative Uncertainty (k=2)	Range
Mass flow	26.3216 kg/s	0.183426 kg/s	0.696865 %	<input checked="" type="checkbox"/>
Standard volume flow	35.292 Sm³/s	0.271801 Sm³/s	0.770149 %	<input checked="" type="checkbox"/>
Energy flow	1360.35 MJ/s	11.3163 MJ/s	0.831865 %	<input checked="" type="checkbox"/>

Repeat Occurrences: 10 | Minimum: 50 | Maximum: 500 | **Update**

Differential pressure (mbar)		Mass flow		Standard volume flow		Energy flow	
Run	Value	Value	Uncertainty	Value	Uncertainty	Value	Uncertainty
1	50	10.7696 kg/s	1.607 %	14.4399 Sm³/s	1.64011 %	556.593 MJ/s	1.66998 %
2	100	15.2206 kg/s	0.982421 %	20.4077 Sm³/s	1.03569 %	786.627 MJ/s	1.08237 %
3	150	18.6326 kg/s	0.815768 %	24.9826 Sm³/s	0.879196 %	962.967 MJ/s	0.933733 %
4	200	21.5066 kg/s	0.748701 %	28.836 Sm³/s	0.81735 %	1111.5 MJ/s	0.875747 %
5	250	24.0364 kg/s	0.715533 %	32.2279 Sm³/s	0.787081 %	1242.24 MJ/s	0.847565 %
6	300	26.3216 kg/s	0.696865 %	35.292 Sm³/s	0.770149 %	1360.35 MJ/s	0.831865 %
7	350	28.4214 kg/s	0.685379 %	38.1073 Sm³/s	0.759772 %	1468.87 MJ/s	0.822267 %
8	400	30.3742 kg/s	0.67784 %	40.7257 Sm³/s	0.752978 %	1569.79 MJ/s	0.815994 %
9	450	32.2068 kg/s	0.672644 %	43.1829 Sm³/s	0.748304 %	1664.51 MJ/s	0.811683 %
10	500	33.9388 kg/s	0.668926 %	45.5051 Sm³/s	0.744964 %	1754.02 MJ/s	0.808605 %

Home | New Calculation | Open Calculation | Save

*** UN-301 - Gas Orifice**

General | **Input / Output** | Temperature | Density

UNCERTAINTYPLUS.net | **KELTON**

UN-301 Gas Orifice

Site: Alpha | Prepared By: Mark Hay
System: Gas Export | Date: 20/12/2016
Reference: D123

Options
DP Transmitters: 1

Inputs
Pressure: 50 bar
Differential pressure: 300 mbar
Temperature: 50 °C

Outputs

	Value	Absolute Uncertainty k = 2	Relative Uncertainty k = 2
Energy flow	4440630 MJ/hr	37640.5 MJ/hr	0.847839 %
Mass flow	85.9226 tonne/hr	0.61488 tonne/hr	0.715621 %
Standard volume flow	115205 Sm³/hr	906.847 Sm³/hr	0.787161 %

Repeat Data

Differential pressure	Mass flow	Value	Uncertainty
50 mbar	35.1838 tonne/hr	1.81346 %	
100 mbar	49.8963 tonne/hr	0.995028 %	
150 mbar	60.8332 tonne/hr	0.831439 %	
200 mbar	70.2123 tonne/hr	0.785978 %	
250 mbar	78.4871 tonne/hr	0.733729 %	
300 mbar	85.9228 tonne/hr	0.715621 %	
350 mbar	92.7719 tonne/hr	0.70451 %	
400 mbar	98.1403 tonne/hr	0.697235 %	
450 mbar	103.113 tonne/hr	0.692238 %	
500 mbar	110.794 tonne/hr	0.688674 %	

69%