



Kuwait 4th Flow Measurement Technology Conference

3-5 December 2019
Hilton Kuwait Resort





OFFICIAL SPONSOR



الراعي الرسمي



GAVIN MUNRO

Managing Director

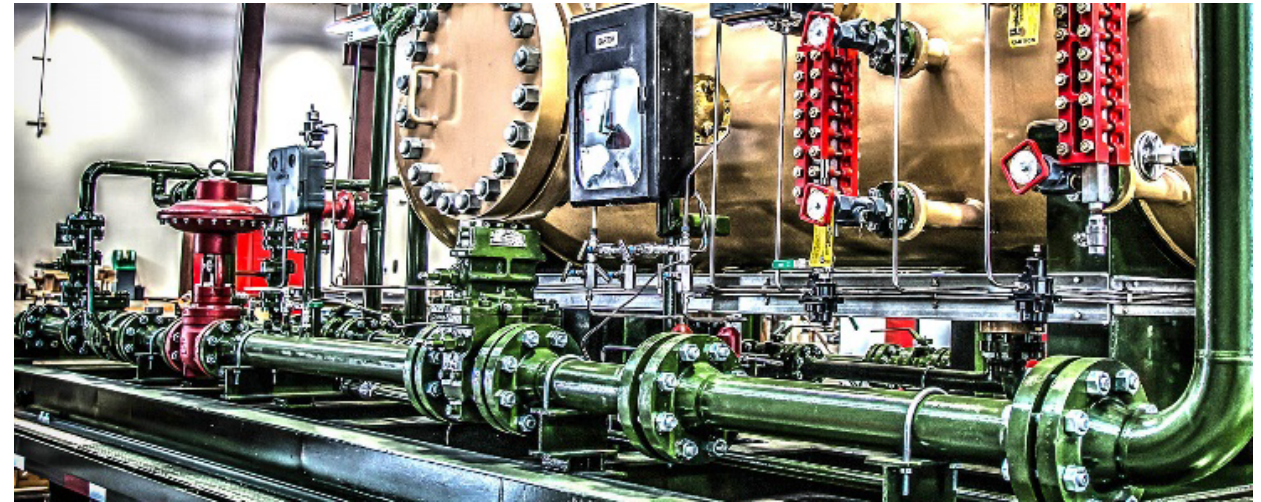
GM Flow Measurement Services Ltd

Laboratory and Field Experience of an Adjustable DP Cone Meter

User's Requirements



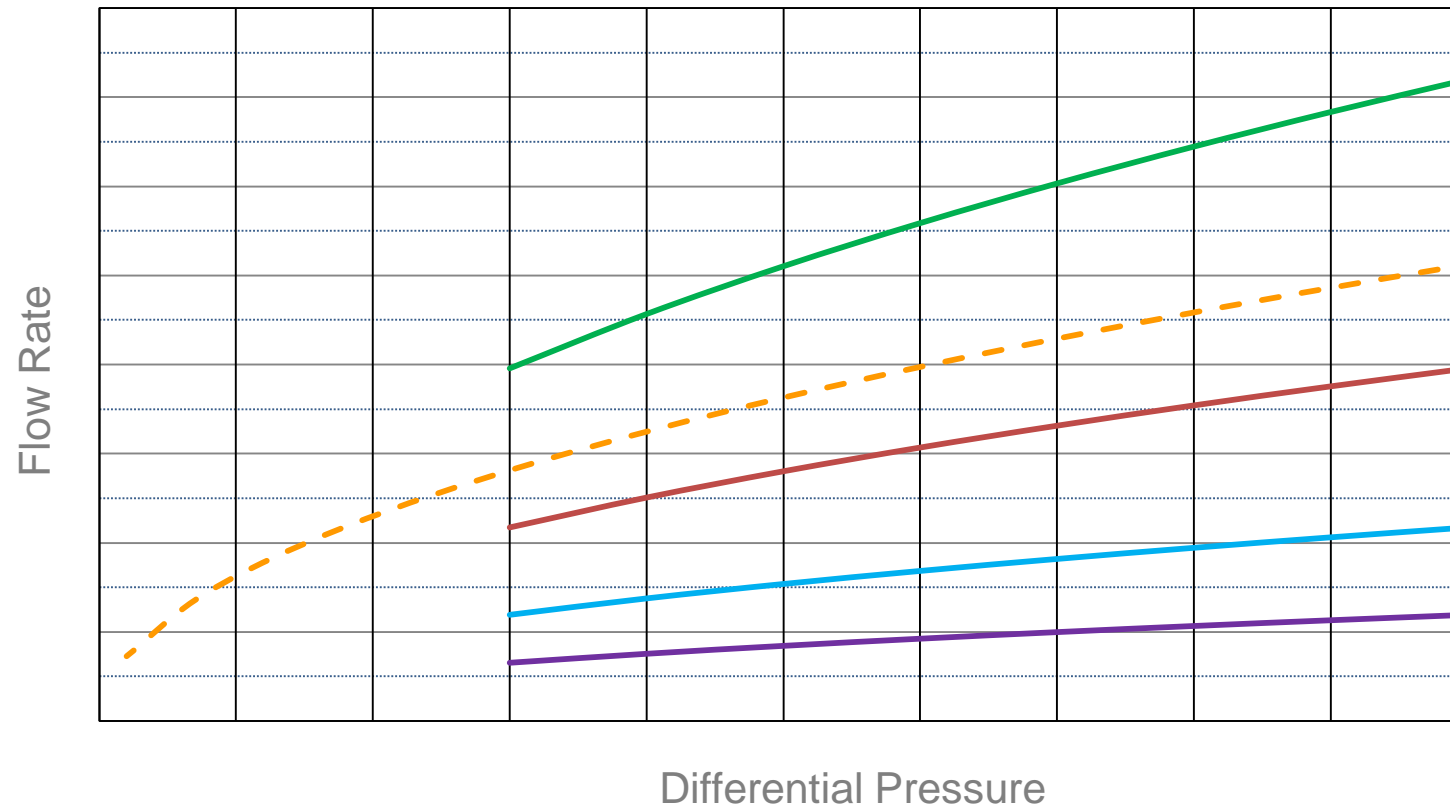
- ⑩ Zero Gas Releases – H₂S
- ⑩ Accurate
- ⑩ Zero (or Reduced) Intervention
- ⑩ Low Maintenance
- ⑩ Inspectable/Repairable



One Standard Cone is Equal to Approx 3-4 Orifice Plates



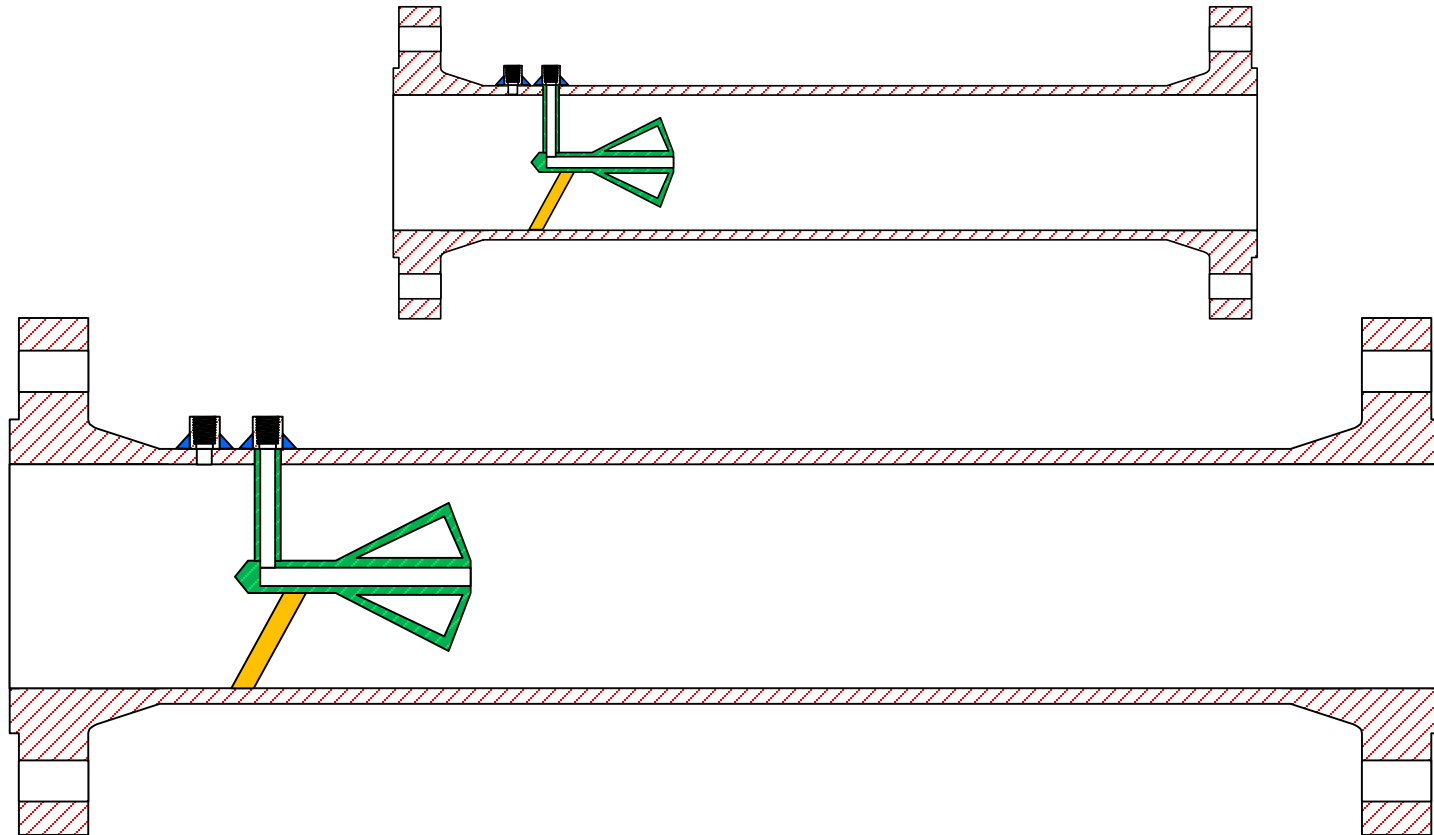
DP Cone Flow Range & Equivalent Orifice Plates



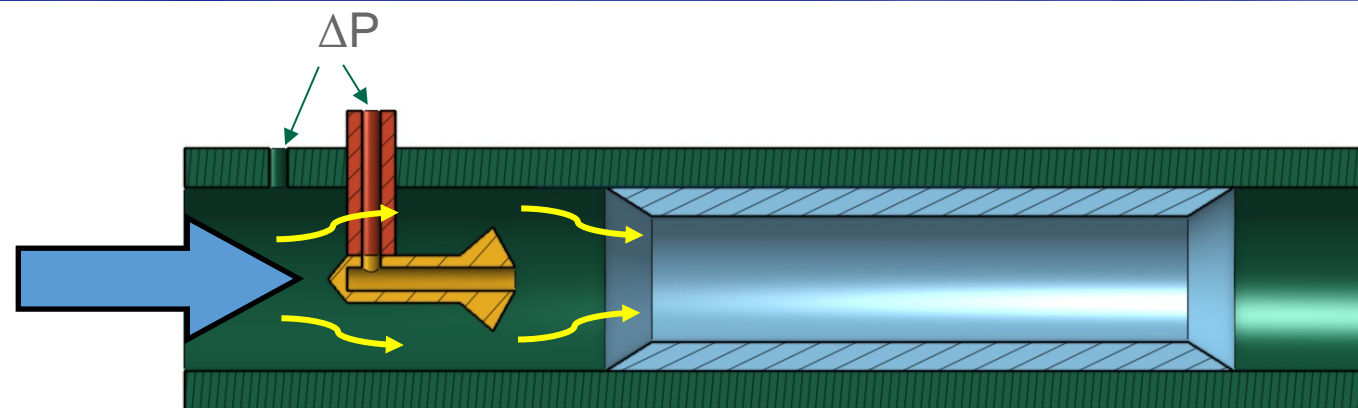
Adjustable Cone Meter Development



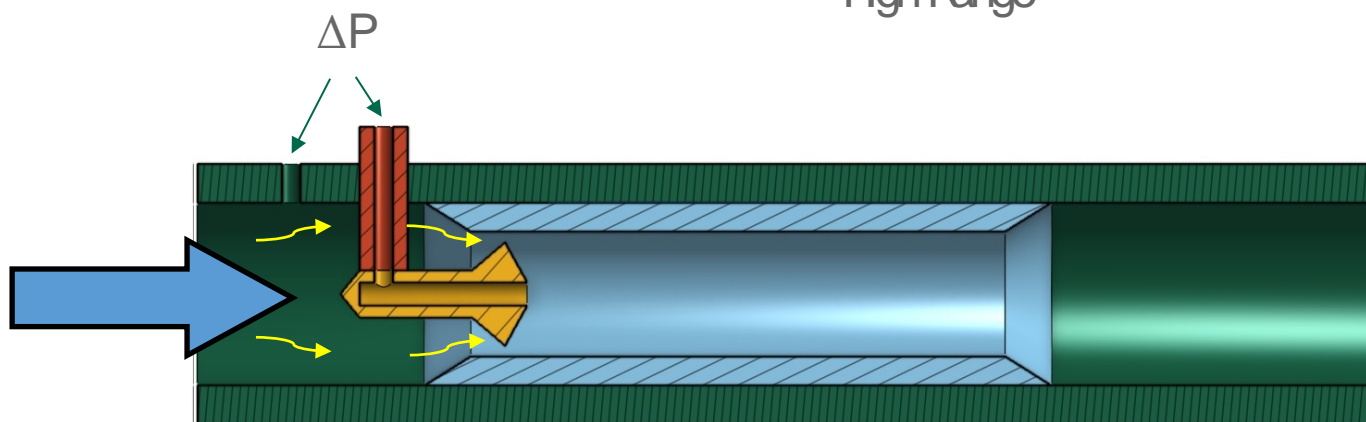
- ⑩ Two in One ?
- ⑩ Mechanism
- ⑩ Seals
- ⑩ Sizing Software



Adjustable Cone Patented Sliding Sleeve



High Range

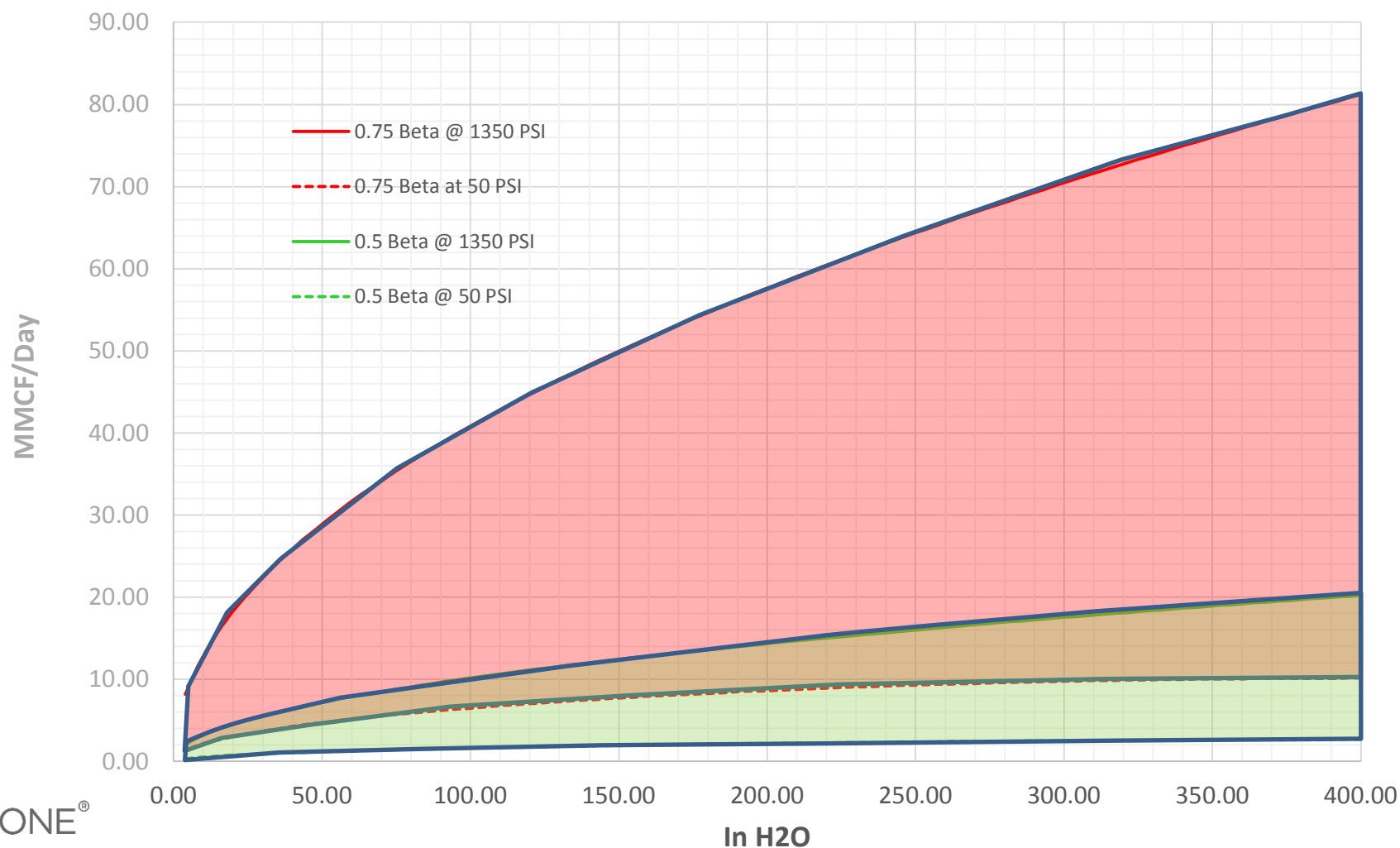


Low Range

Adjustable Cone Range is Equal to Approx 27 Orifice Plates



Adjustable Cone Flow Rate Range



Adjustable Cone Beta Ratios

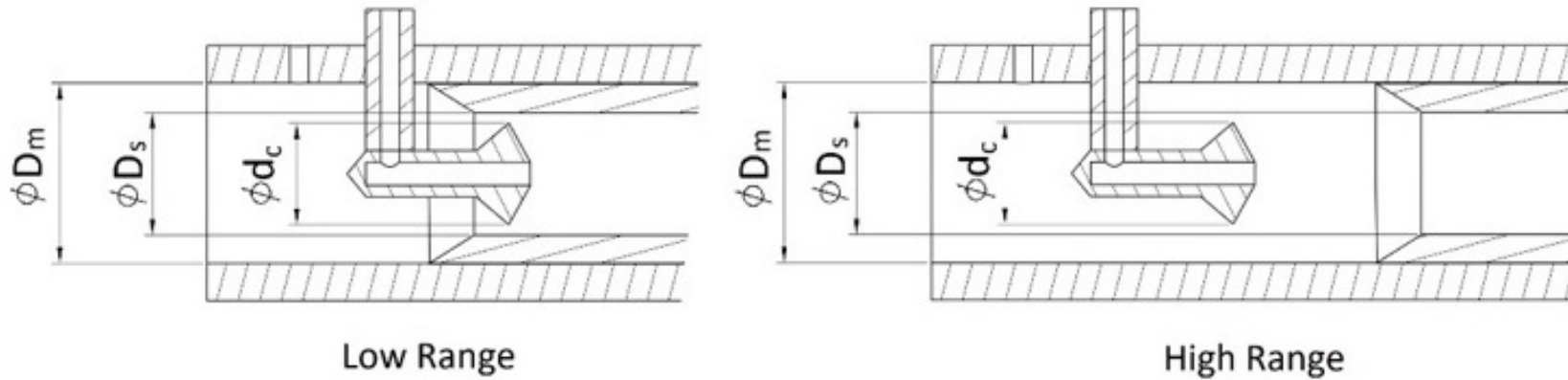


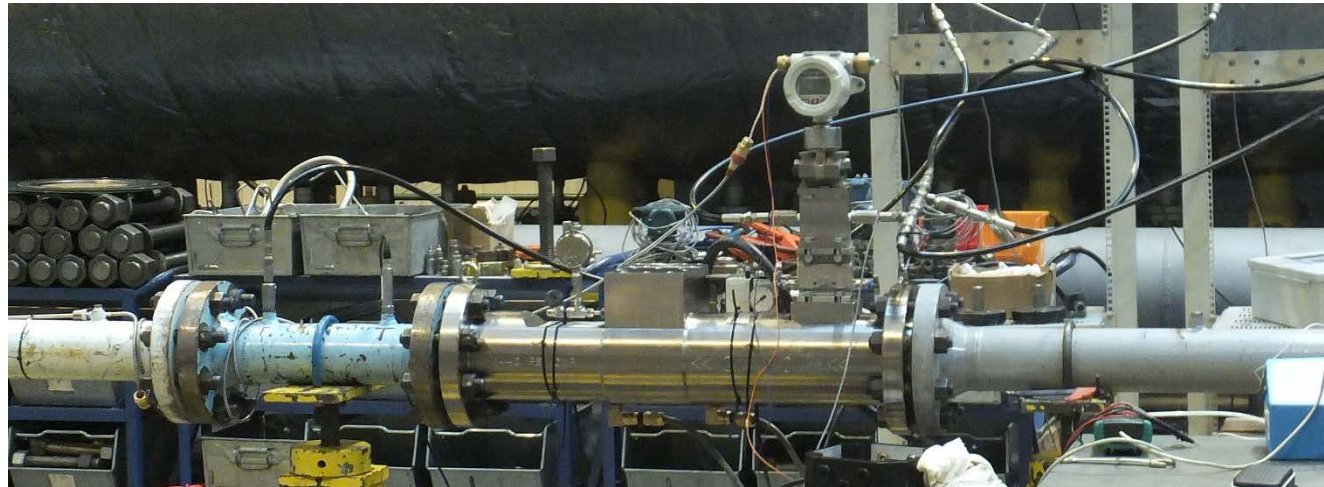
Fig. 4 – Adjustable Cone Meter - Calculation of the Beta Ratios

$$\beta_{low} = \sqrt{1 - \frac{d_c^2}{D_s^2}} \quad (1)$$

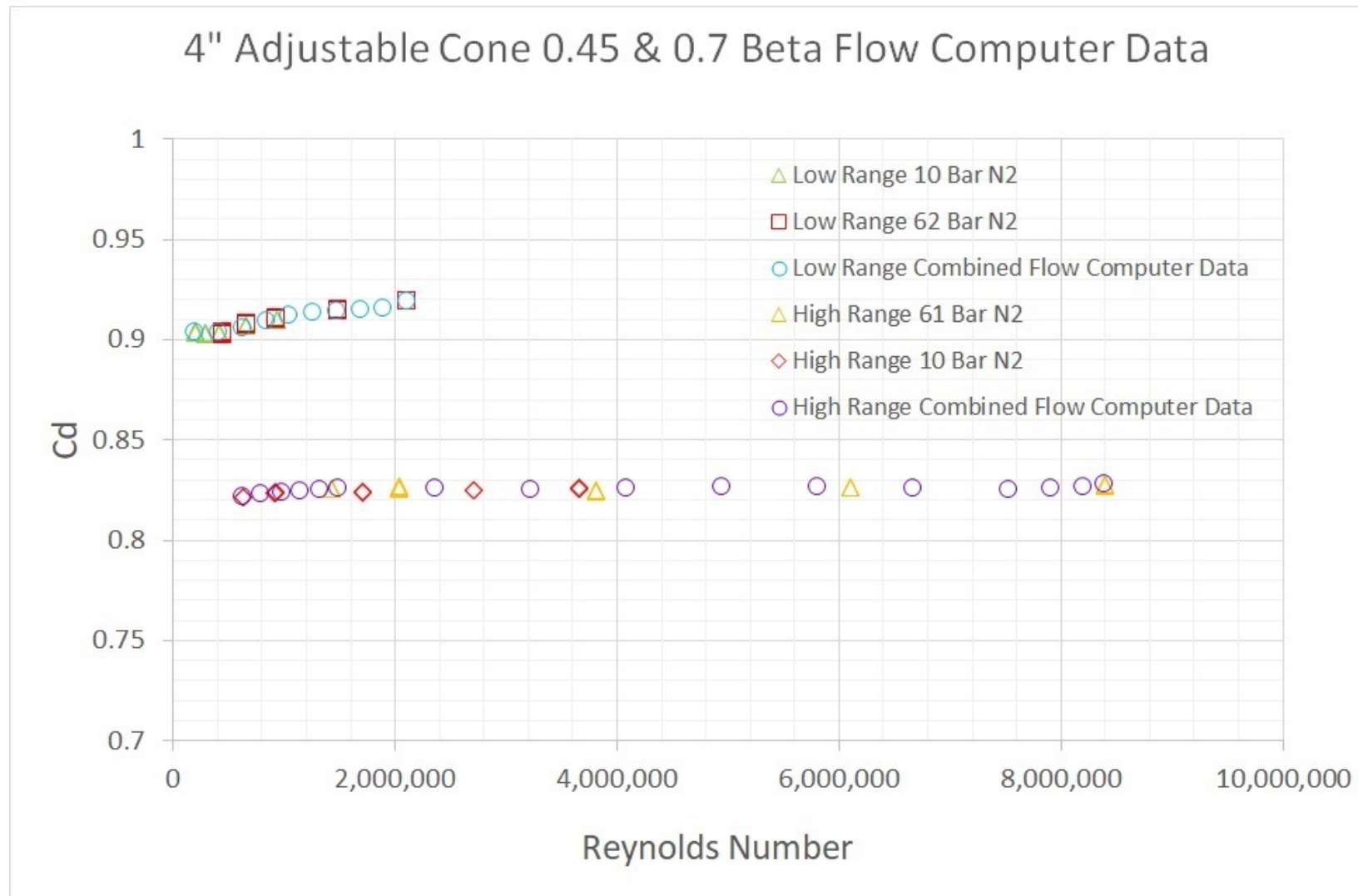
$$\beta_{high} = \sqrt{1 - \frac{d_c^2}{D_m^2}} \quad (2)$$

4" Meter Dry & Wet Gas Calibration

- ⑩ Dry Calibration in N₂
- ⑩ Wet Gas Calibration w/ 795 Kg/m³ Oil
- ⑩ 10 & 62 bar(g)
- ⑩ 0.45 & 0.7 β w/ Automatic Adjustment



4" Adjustable Cone Meter Calibration Data



4" Calibrated Range



β Ratio	Pressure Bar(g)	Min q_m (Kg/sec)	Max q_m (Kg/sec)	Turndown Ratio	Calibrated Turndown Ratio
0.45	10	0.22*	1.01	4.6	54.5**
0.45	61	0.52	2.41	4.6	
0.7	10	0.86	4.96	5.8	
0.7	61	2.04	12.00*	5.9	

⑩ 0.45 β = 0.478 % Total Uncertainty @ 95% Confidence Level (NEL)

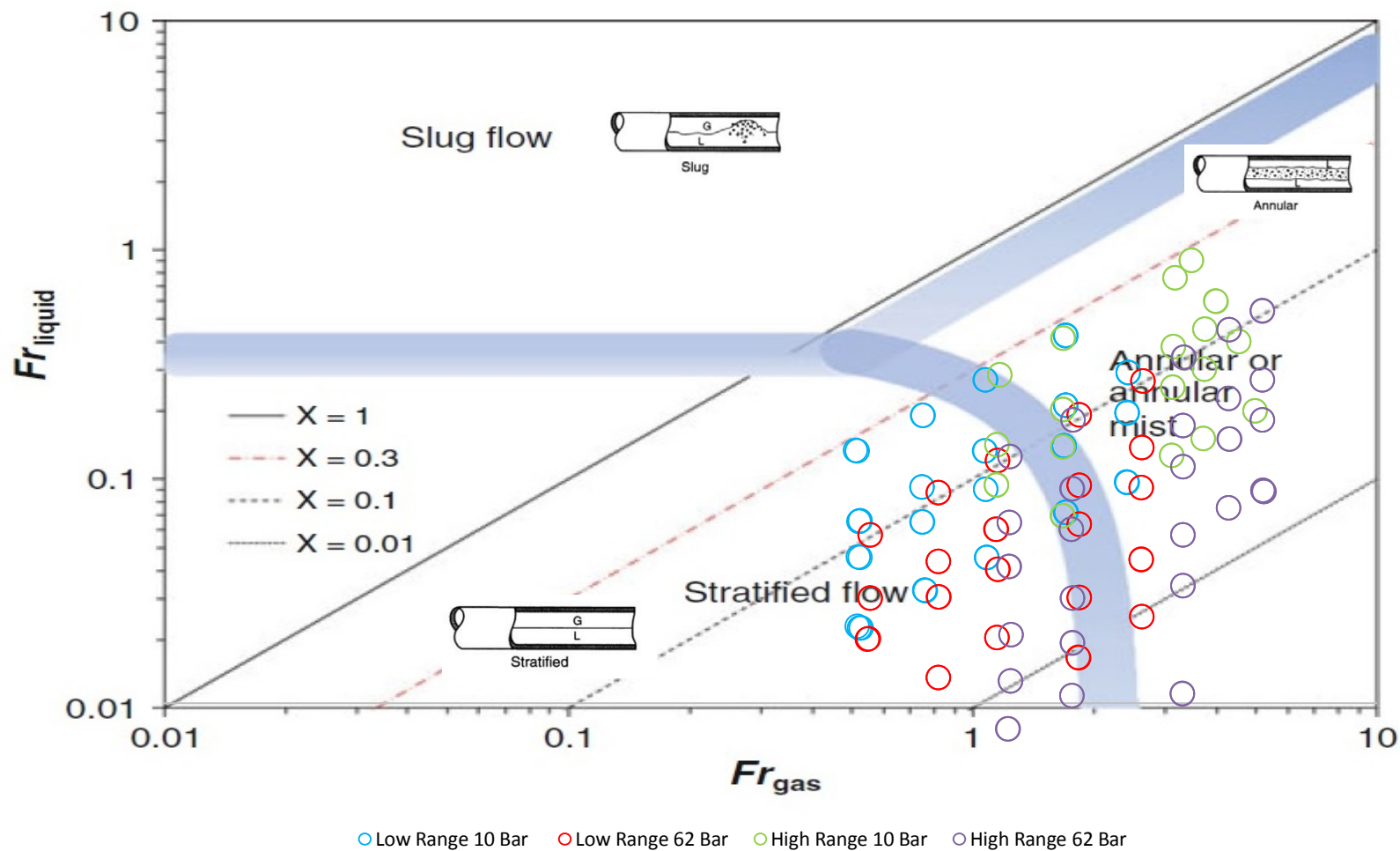
⑩ 0.7 β = 0.668% Total Uncertainty @ 95% Confidence Level (NEL)

** 54.5 = 12.00 / 0.22

Wet Gas Testing



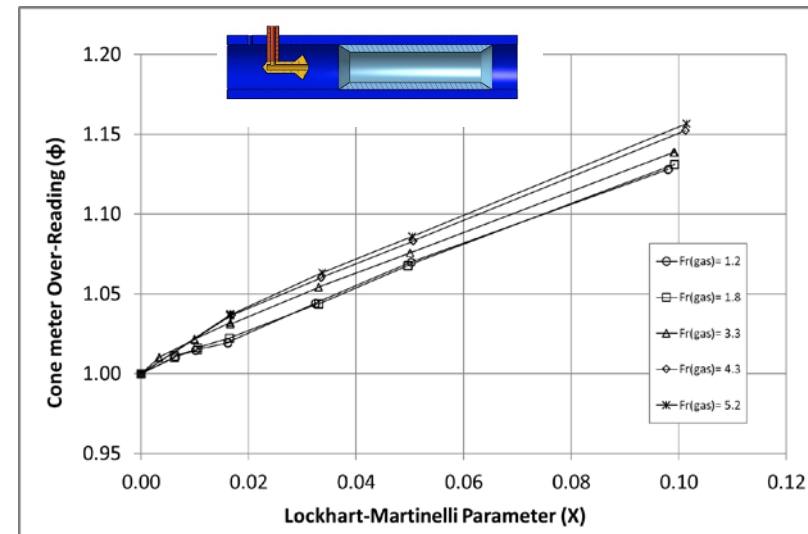
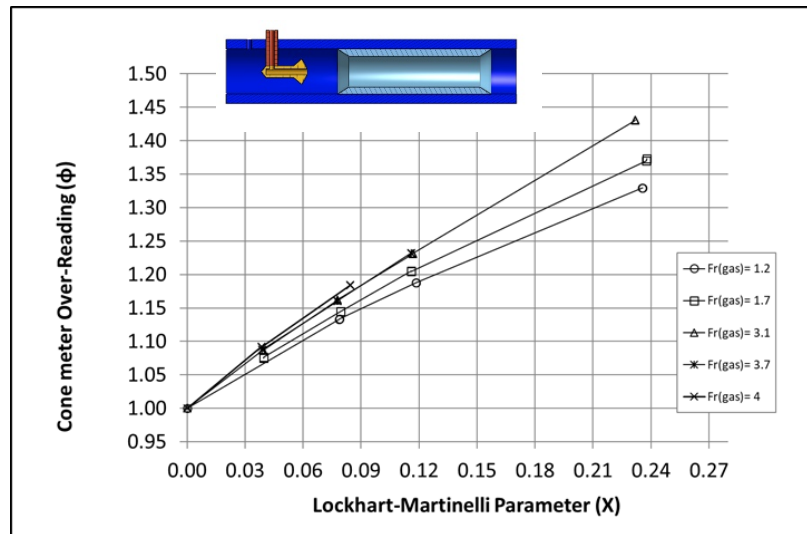
4" Meter Test Flow Regimes



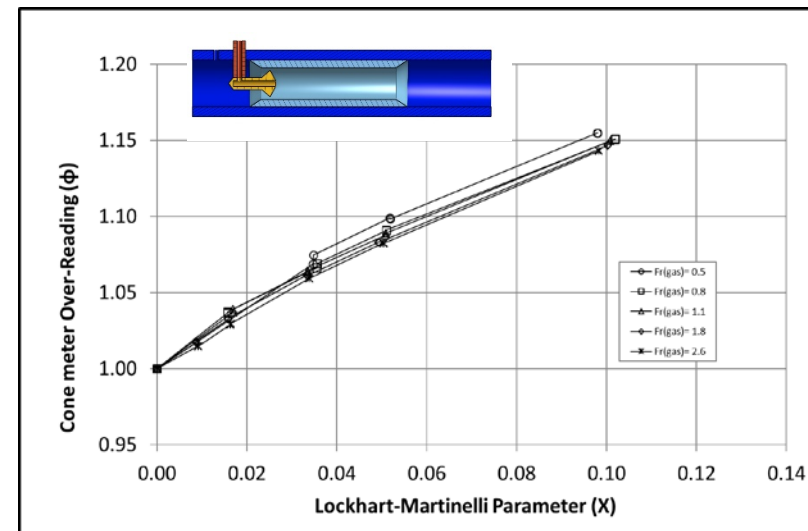
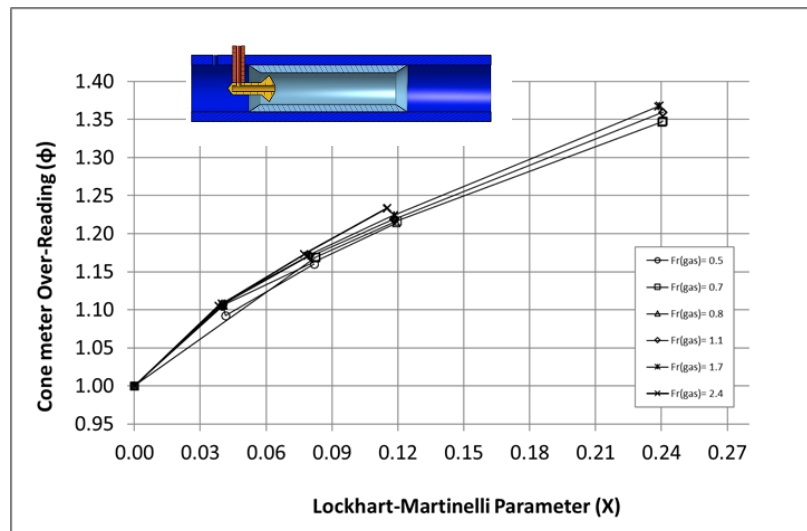
Source Reader-Harris: Orifice Plates & Venturi

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Wet Gas Over-Read

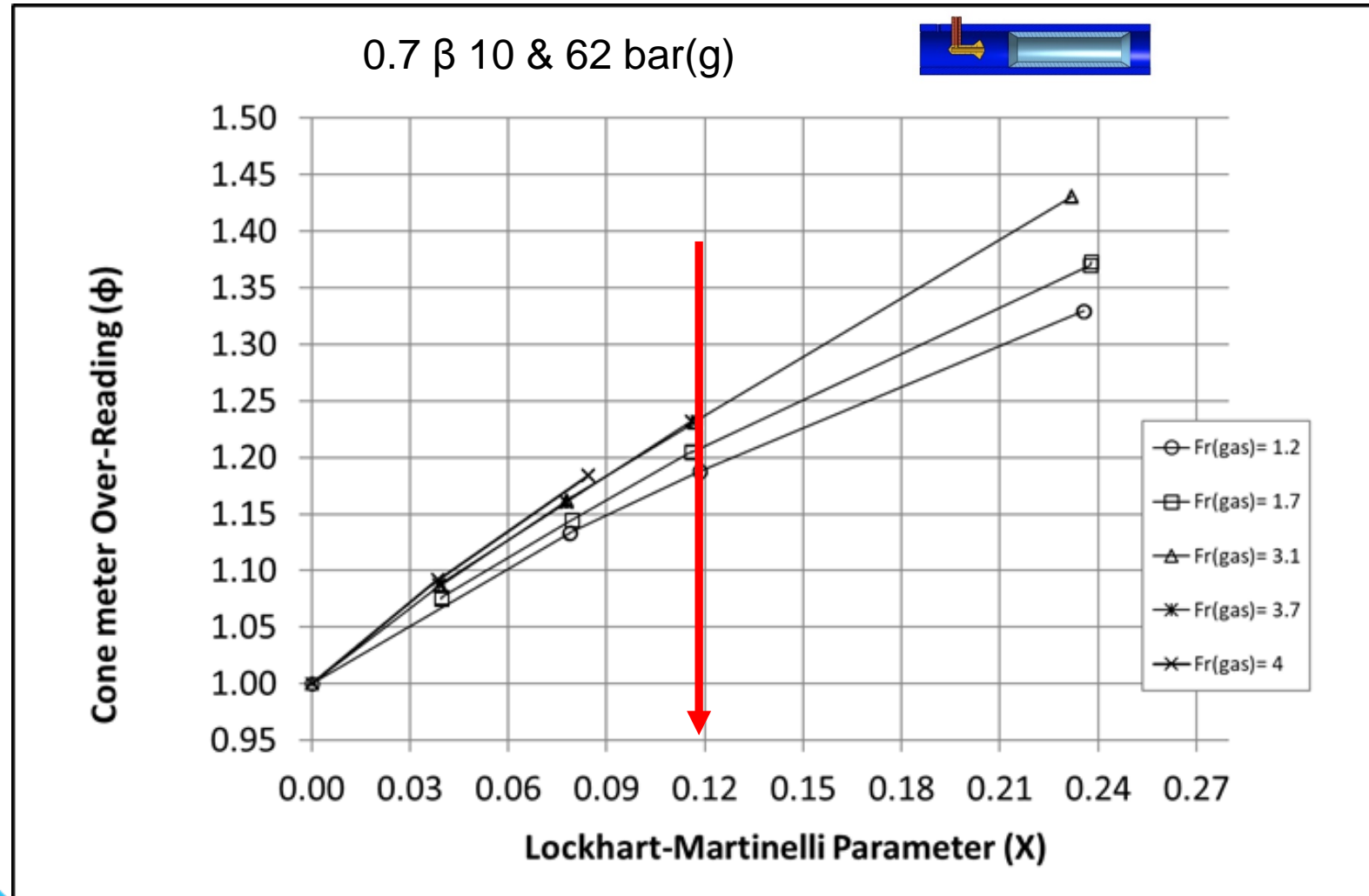


0.7 β 10 & 62 bar(g)



0.45 β 10 & 62 bar(g)

Wet Gas Over-Read



Example

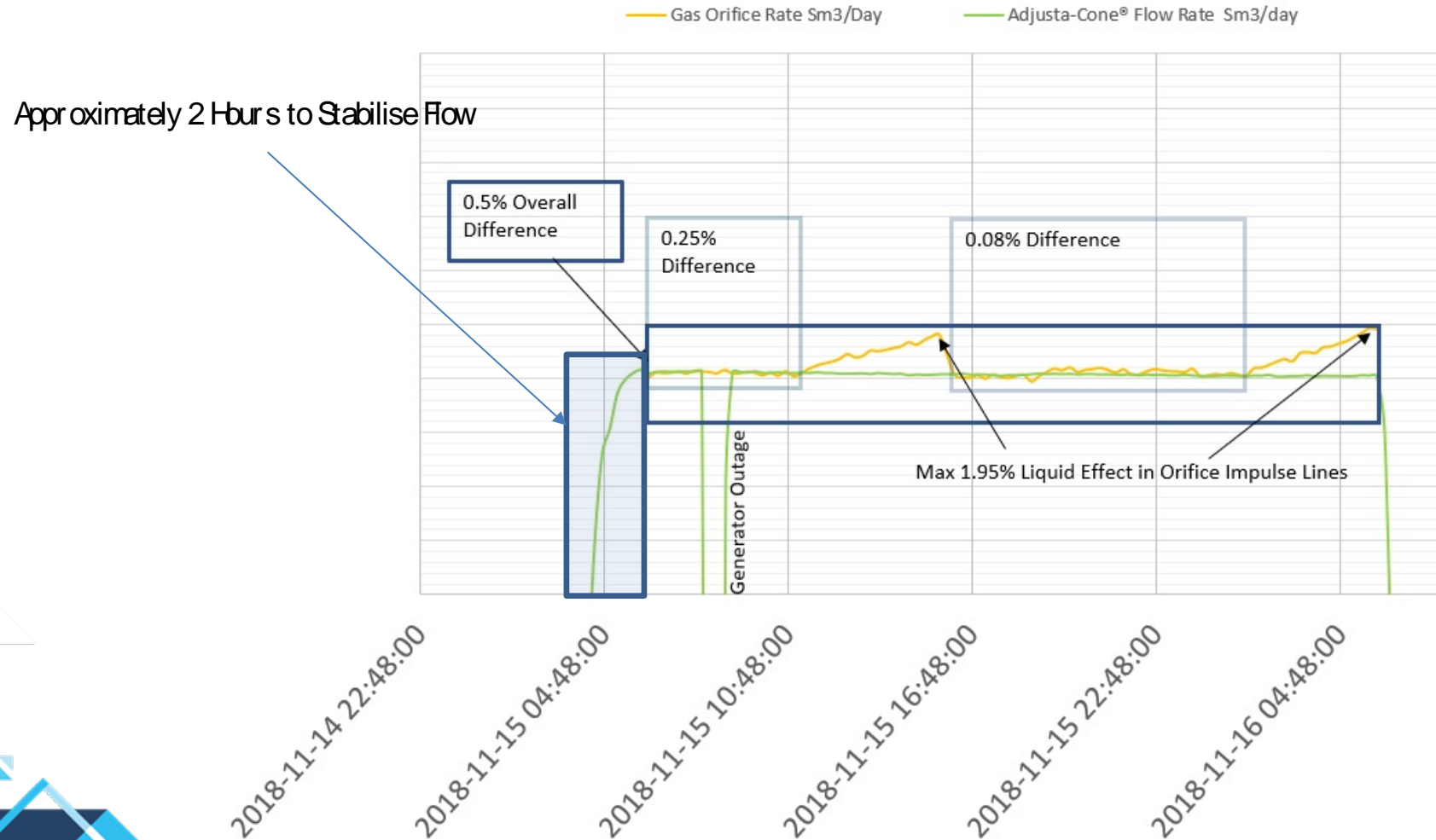
0.12 L-M Parameter = 85 BBL/MMSCF

Field Tests in Dry Gas

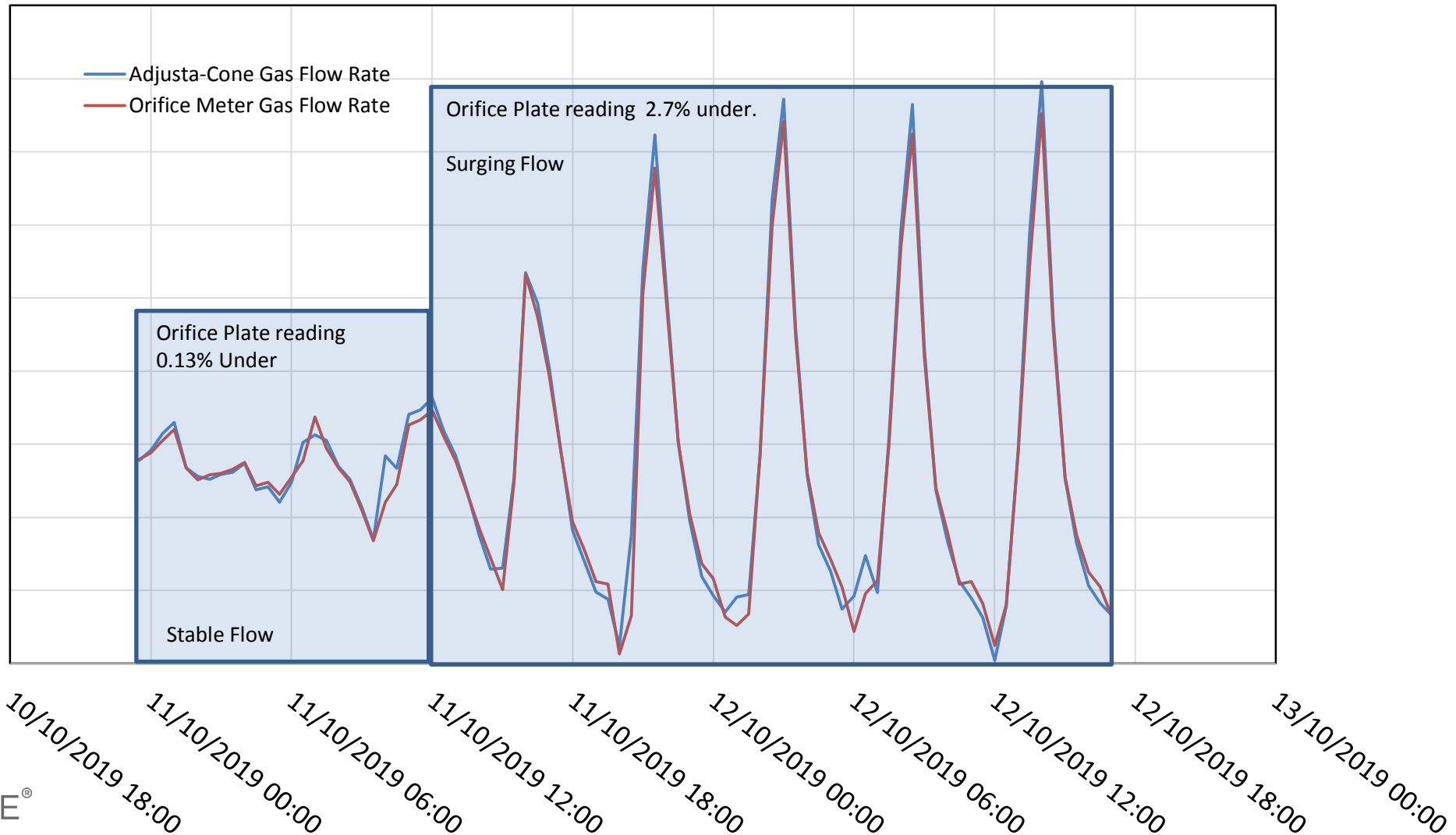


Field Test Data: Well #1 Flowing to Production Line at 1000 PSIG

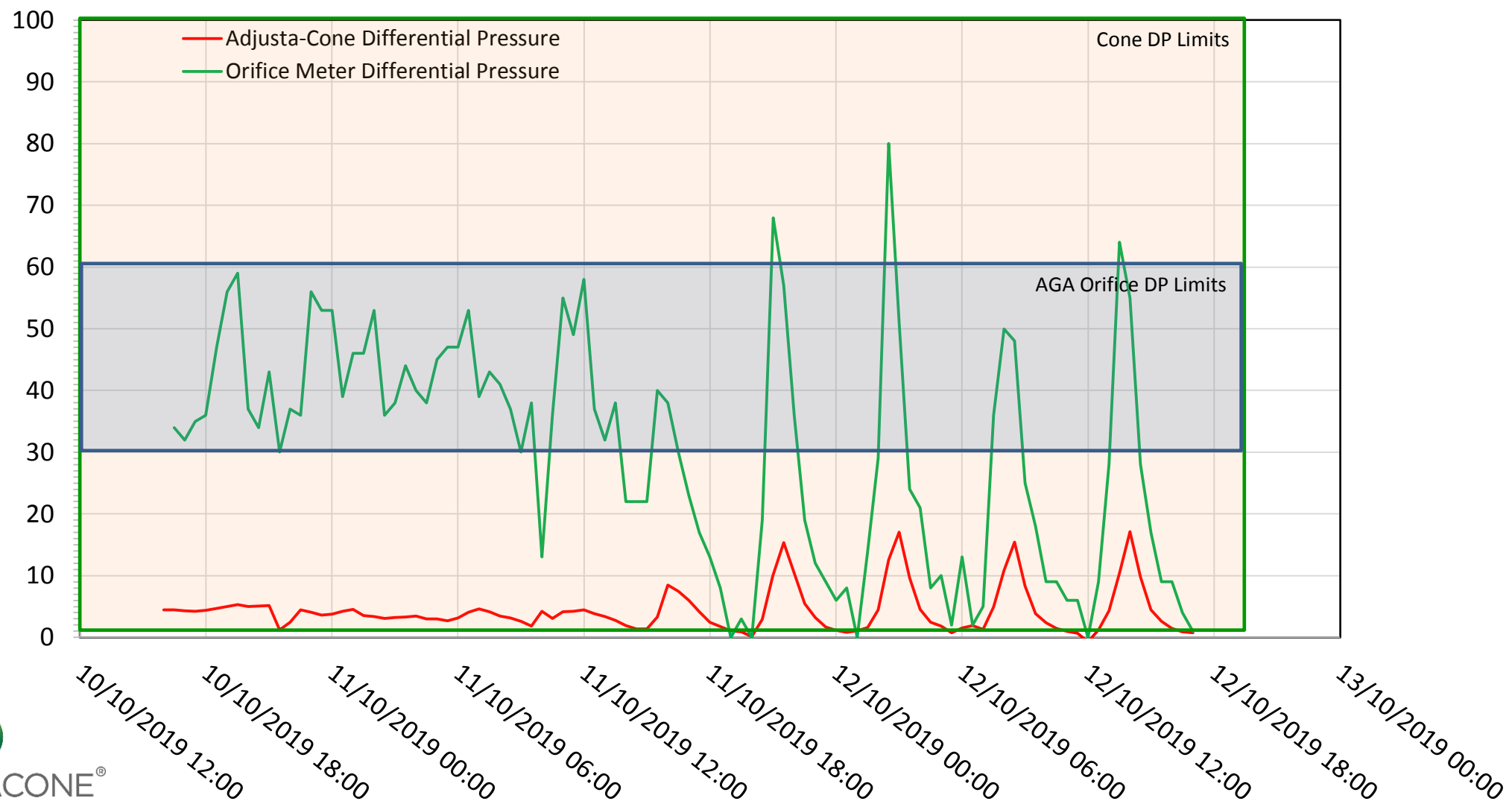
Adjusta-Cone & Orifice Meter Gas Rate Comparison



Field Test Data: Well #2 Flowing to Flare at 100 PSIG



Field Test Data: Well #2 DP Comparison



Test Conclusions



- Orifice flow meters:

- Limited Flow Range per Plate
- Hazardous Gas Releases
- Hands On Device
- Manual Operation
- Stabilised Flow
- Plate Selection



- Adjustable Cone Meter:

- Flow Range = 27 Plates (250:1 turndown)
- No Gas Releases
- Hands Off Device
- Automatic Operation
- Non Stabilised Flow
- Saves 60-90 Mins per Plate Size




ADJUSTACONE®
By GM FLOW

Future Work



- ⑩ 4" Field Trials in Oman - Complete
- ⑩ Examine Wet Gas Test Results in Detail
- ⑩ Run Field Trials in Wet Gas
- ⑩ Compare with CFD – water, N2, Wet N2
- ⑩ 3" Wet and Dry Gas Testing



THANK YOU