V-Cone® Flow Meter
Founded in 1955 by brothers Floyd and Lloyd McCall, and brother-in-law Art Crom

- Designed a superior flow meter for irrigation
- Floyd McCall, designed the V-Cone in 1985

Located in Hemet, California USA
- Flow Measurement Specialist
- Portfolio of technologies: dP, electromagnetic, propeller
- Serving Oil and Gas, HVAC, Irrigation, Power, Chemical, Food, Pulp/Paper, Water and Waste water industries around the world
- Subsidiary of Danaher Corp.
- Values & foundation provided by Danaher Business Systems (DBS)
- DBS- management model based on continuous improvement in quality, delivery, cost and innovation

48,000 employees, $13.2 billion in revenue 2010
- Advanced differential pressure flow meter
- Self conditions the flow
- Decades of experience
- Extensive third party testing (SWRI, NEL & CEESI)
- Over 45,000 installations worldwide
- Differential Pressure
- Flow goes around outside of cone
- Velocity profile conditioned by cone
Accuracy: ± 0.5% of rate

Repeatability: ± 0.1%

Turndown: 10:1 (Typical) and greater

Typical Installation Requirements:
- 0-3 diameter upstream
- 0-1 diameter downstream

Fluids: Liquids, Gas, Steam
## Connections and Materials

### End Connections
- ANSI #150 - #4500
- RTJ & RF, Slip-on & Weld neck
- ASME B16.47
- API 5,000psi, 10,000psi, 15,000psi
- Hub Type
- DIN
- NPT
- Vitalic
- Beveled or Square End

### Process Connections
- Flanged ( ANSI, Kidney, etc.)
- NPT & Thread-o-let
- Socket & Sock-o-let
- Weld-o-let
- Nipple-o-let
- Valved

### Materials of Construction
- S304, S304L, S304H
- S316, S316L, S316H
- S321, S321H
- Chrome-moly P1, P5, P11, P22, P91
- Carbon Steel
- Low Temp. Carbon Steel
- High Tensile Carbon Steel X52, X60, X65
- Duplex 2205
- Super Duplex 2507
- Hastelloy C276
- Inconel 625
- Incoloy 825
- Monel 400, 500
- Titanium
- Lines Sizes: $\frac{1}{2}''$ to 120'' or larger
**Beta Ratio Comparison**

\[ \beta = 0.650 \]

\[ A_1 = A_2 \]

\[ \beta = \sqrt{1 - \frac{d^2}{D^2}} \]

\[ \text{Area} / \text{Area} = \beta \]

\[ \beta = \frac{d}{D} \]
- Cone contoured for low to no wear
- Boundary layers develop against the pipe wall and cone
Test Results of 12 meters showing change in Cd over time

Long Term Performance

Cd Shift vs Years Between Calibrations
Straight Pipe Requirements:
0-3 D Upstream
0-1 D Downstream

Header to Separators
Space Requirements

- For Elbows: Straight Pipe Required
  - Single Elbow with V-Cone
  - Double Elbow with V-Cone
  - 0 D Upstream
  - 0 D Downstream
Documentation is submitted in accordance with the customers and authorities requirements.
NIST Consortium members (partial list)

- McCrometer
- ChevronTexaco
- DuPont
- Dow Chemical
- Nova Chemicals
- Rosemount/Emerson
- Daniel Industries
On Orifice Plate

On V-Cone

tested at NIST

tested at McCrometer

Change in C_d, %

Change in C_f, %

Diameters from the Elbow, Z

Used with permission, NIST, USA
Double Elbow Effects

On Orifice Plate

tested at NIST

On V-Cone

tested at McCrometer

Diameters from the Elbows, Z

Diameters from the Elbow, Z

Change in C_d, %

Change in C_f, %

Used with permission, NIST, USA
V-Cone®

20 D Upstream, and 5 D Downstream

V-Cone can reduce pipe run by 85%

Orifice Plate

3 D Upstream, and 1 D Downstream
Low Headloss

Maximum Loss: 3” 1145 LPM

- Permanent Pressure Loss (kPa)
- Meter Types
  - V-Cone
  - Orifice
  - Nozzle
  - Venturi
  - Turbine Vortex
  - Foxboro Vortex
  - Micromotion Coriolis
  - Foxboro Coriolis

High Signal to Noise Ratio

V-Cone, DP = 25" wc, \( \sigma/DP = 0.0013 \)

Orifice plate, DP = 50" wc, \( \sigma/DP = 0.0038 \)

Beta = 0.75, Re = 100,000, Vel = 130 ft/sec

Signal averaged to zero ("wc"

Time (sec * 100)
Flow Comparison

Orifice Plate

V-Cone®
✓ BLM “IM” Approval
✓ API 22.2
✓ Inmetro - Brazil
✓ Measurement Canada – Custody Transfer
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- Proven Solution
- Long Term Performance
- Reduces Space
- Low Headloss
- High Signal to Noise Ratio
- Wide Range of Applications