JSC/EC5 U.S. Spacesuit Knowledge Capture (KC) Series Synopsis

All KC events will be approved for public using NASA Form 1676.

This synopsis provides information about the Knowledge Capture event below.

Topic: Mike Lawson's Stories and More

Date: December 16, 2010 **Time:** unknown **Location:** JSC/B5S/R3204

DAA 1676 Form #: 29673

This is a link to all lecture material and video: \\js-ea-fs-01\pd01\EC\Knowledge-Capture\FY11 Knowledge Capture\20101216 M. Lawson KC-Then Some\For 1676 Review & Public Release

*A copy of the video will be provided to NASA Center for AeroSpace Information (CASI) via the Agency's Large File Transfer (LFT), or by DVD using the USPS when the DAA 1676 review is complete.

Assessment of Export Control Applicability:

This Knowledge Capture event has been reviewed by the EC5 Spacesuit Knowledge Capture Manager in collaboration with the author and is assessed to not contain any technical content that is export controlled. It is requested to be publicly released to the JSC Engineering Academy, as well as to CASI for distribution through NTRS or NA&SD (public or non-public) and with video through DVD request or YouTube viewing with download of any presentation material.

* This PDF is also attached to this 1676 and will be used for distribution.

For 1676 review use Synopsis Lawson Stories & More 12-16-2010.pdf

Presenter: B. Mike Lawson

Synopsis: Mike Lawson briefly discussed pressure drop for aerospace applications and presented short stories about adventures experienced while working at NASA and General Dynamics, including exposure to technologies like the Crew and Equipment Translation Aid (CETA) cart and the SWME.

Biography: Mike Lawson was graduated from the University of Texas with a master of science in mechanical engineering with an emphasis in heat transfer and thermodynamics. He originally worked for General Dynamics, specializing in the environmental control and heat transfer systems for the F-16 fighter aircraft. He came to work for NASA in 1980 and worked on EVA, thermal and environmental control, and life support systems. Lawson retired from NASA in December 2010.

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Pressure Drop

Mike Lawson

12-16-2010

Pressure Drop

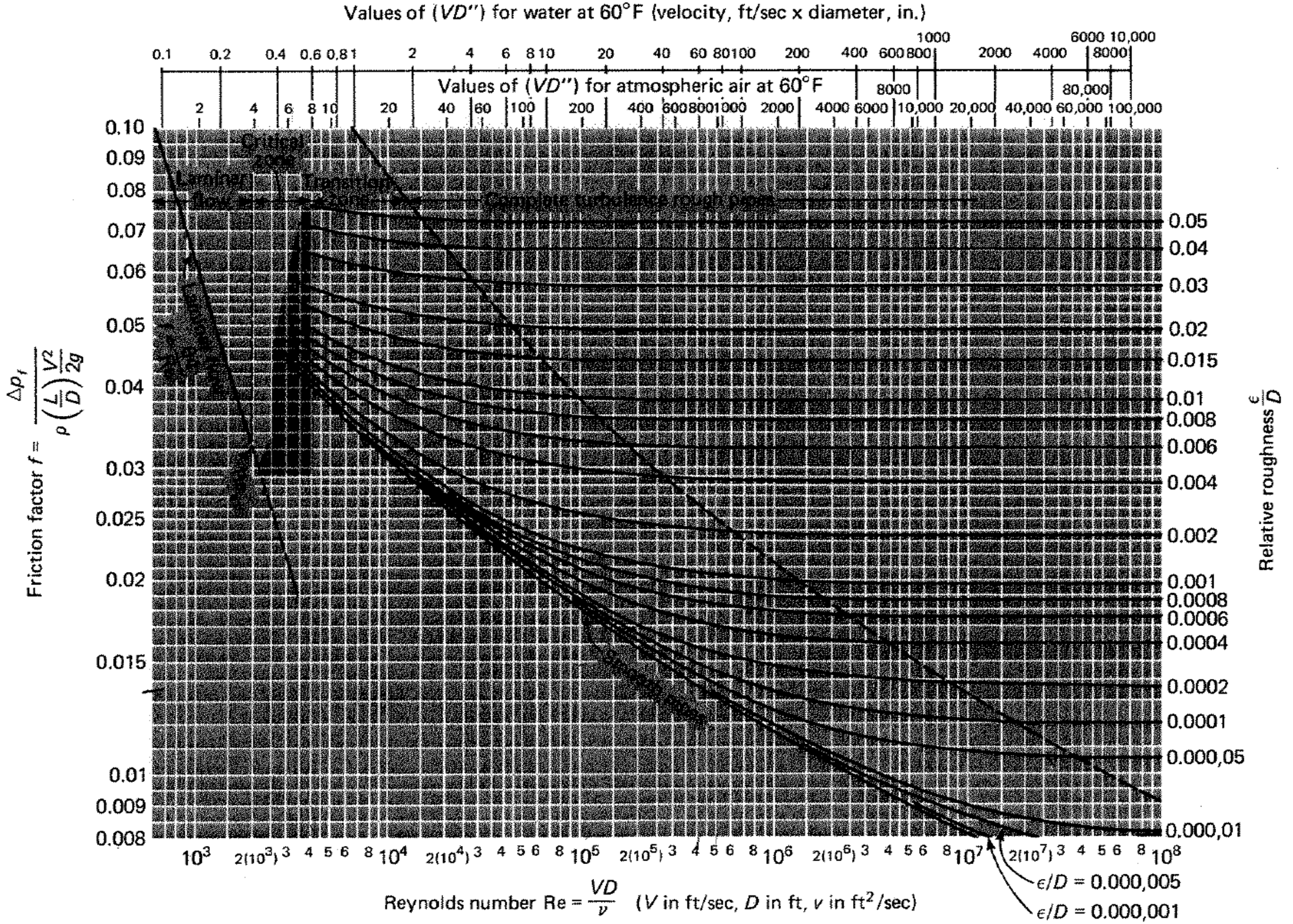
- Pressure drop for ideal gasses in tubes is usually of the form

$$\Delta P = \frac{k\rho v^2}{2}$$

where

V= $\frac{Q}{A}$ k= $\frac{fl}{d}$ For Laminar flow f= $\frac{64}{Re}$ Re= $\frac{vd}{\mathrm{v}}$

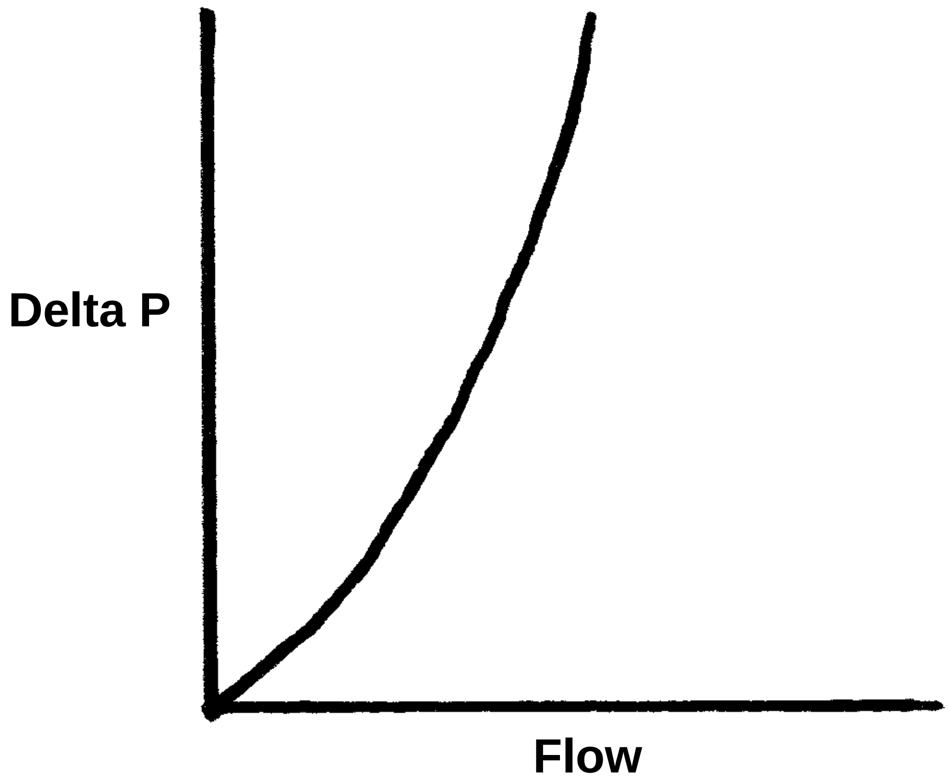
For turbulent flow…empirical



Values of (VD") for water at 60°F (velocity, ft/sec x diameter, in.)
Values of (VD") for atmospheric air at 60°F
Critical zone
Laminar flow
Transition zone
Complete turbulence rough pipes
Friction factor $f = \frac{\Delta p_f}{\rho \left(\frac{L}{D}\right)\frac{V^2}{2g}}$
Relative roughness $\frac{\epsilon}{D}$
Reynolds number $Re = \frac{VD}{\nu}$ (V in ft/sec, D in ft, ν in ft²/sec)
ε/D = 0.000,005
ε/D = 0.000,001

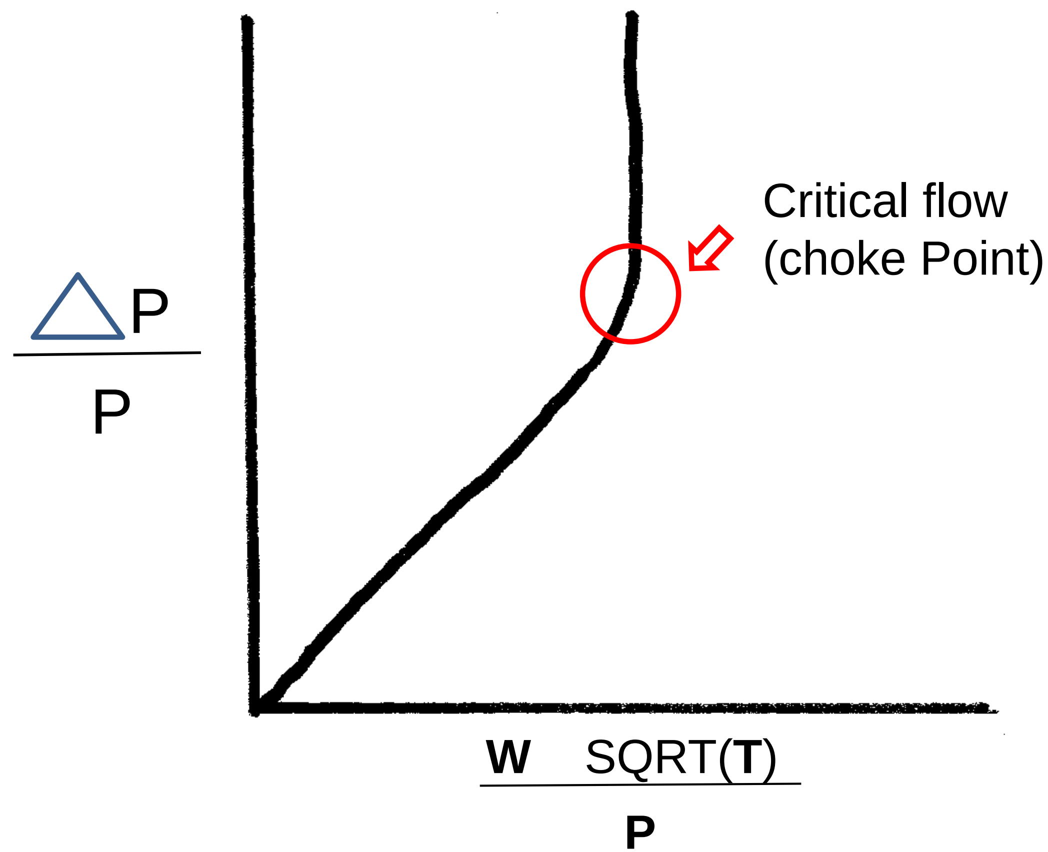
Pressure Drop

- If you plot pressure drop it will look like this…



Pressure Drop

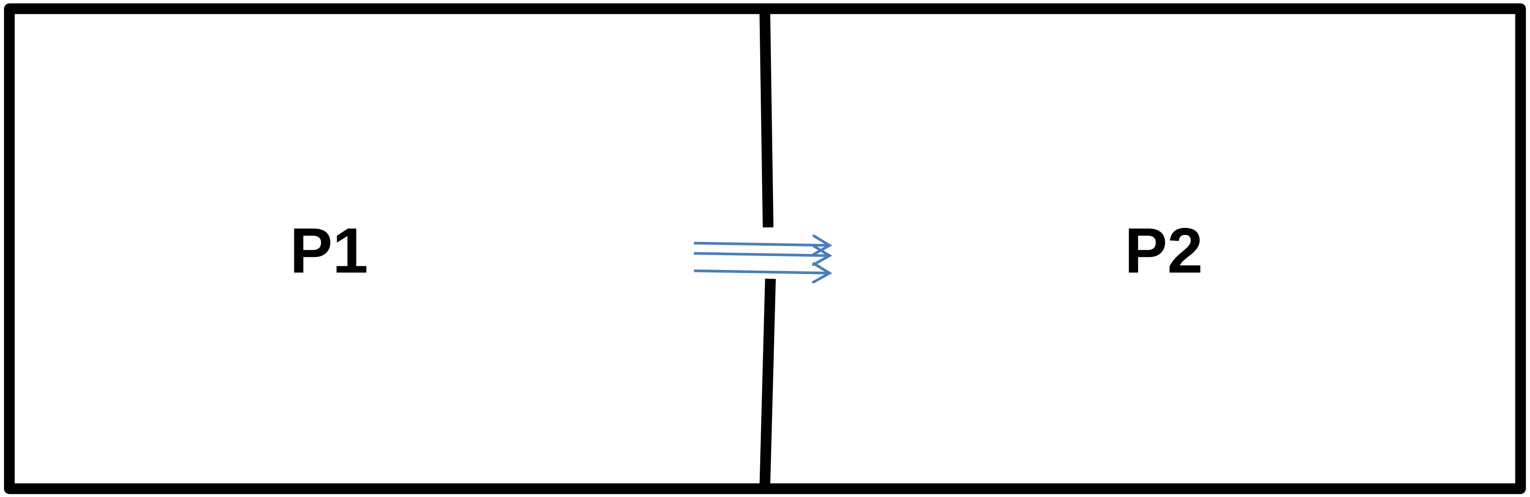
- You can plot it on semi- log scale and it will look like this…



Pressure Drop

- System layout should be broken into a series of pressure drop components
  - Bends
  - Lengths of line
  - Sudden contraction
  - Sudden expansion
- Pressure drop of line configurations can be obtained in many handbooks or in pre-packaged software.
  - Each configuration and material are different.
  - Surface roughness can be a major contributor

Pressure Drop



for air

for oxygen

$$\frac{w\sqrt{T}}{pA} = \textbf{constant}$$

$$\frac{w\sqrt{T}}{pAc} = \textbf{.53177}$$

$$\frac{w\sqrt{T}}{pAc} = \textbf{.559}$$

W=lb/sec A= ft2 T=deg R p=lb/ft2

Pressure Drop

If the Pressure is not “choked” the flow is dependant on the upstream and downstream pressure and is a much more complicated equation.

$$W = \frac{8.02 P_1 A C}{\sqrt{R' T_1}} \sqrt{\frac{k}{k-1}\left[\left(\frac{P_2}{P_1}\right)^{\frac{2}{k}} - \left(\frac{P_2}{P_1}\right)^{\frac{k+1}{k}}\right]}$$

R’= specific gas constant   k= ratio of specific heats

Pressure Drop

Critical Ratio

$$\frac{p2}{p1} = \left(\frac{2}{k+1}\right)^{\frac{k}{k-1}}$$

=.528 (or inverse is 1.89) for air and oxygen
k is temperature dependant!