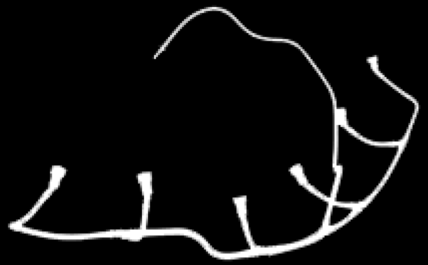
Welcome

In this lecture, we explore real volumetric test data obtained from a vent pipe.

We will:

- Input parameters of a vent pipe used by a major truck manufacturer
- Illustrate how a good reference volume can be used to filter good parts from bad
- Illustrate how reference volume effects the integrity of leak rates
- Discuss how this can be scaled upwards for bigger spatial industries

Ventilation Pipe



Ventilation Pipe via Automotive Industries

Ventilation pipes can be complex objects in terms of volumetric data sets. They incorporate numerous cylinders and multiple surpluses.

In pressure testing industries, good reference volumes allow products to be tested accordingly to an agreed quality standard. The procedure will have its own specification of what is acceptable and what is not. Its not uncommon for distinct companies to have their own set standards and manufacturers will follow these.

In reality, there exists no perfect seal and the terminology tightness is used to refer to how well fitted a particular part is. Leak testing equipment exists as a step in the firewall chain to prevent poor quality parts reaching global ecosystems. Natural crystallisation processes can and do work to seal minute microscopic leaks which often always go unnoticed in industries which utilise fluid powers.

Leak testing hardware in industry commonly requires a barometer unit (NA often use psi), reference test volume and a max leak rate. Aside from these three additional properties include the time parameters. Adequate amounts of time need be given for parts to be adequately tested. Often, these are the fill, stabilisation and test windows. The leak rate is emitted by a sensor which measures the vibration (a wobble) upon test part pressurisation upon the test window entry.

Ventilation Pipe Measurement

Untitled X | Ventilation … X

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Cylinder	Diameter	Length	Unit	Volume
X1_1	6 mm	75 mm	mm^3	2120.5750411731105
X1_2	6 mm	75 mm	mm^3	2120.5750411731105
X2_1	6 mm	60 mm	mm^3	1696.4600329384884
X2_2	6 mm	60 mm	mm^3	1696.4600329384884
X2_3	6 mm	60 mm	mm^3	1696.4600329384884
X2_4	6 mm	60 mm	mm^3	1696.4600329384884
X3	6 mm	209 mm	mm^3	5909.335781402401
X4	6 mm	212 mm	mm^3	5994.158783049325
X5_1	6 mm	163 mm	mm^3	4608.716422816226
X5_2	6 mm	163 mm	mm^3	4608.716422816226
X6	6 mm	806 mm	mm^3	22789.11310914036

Object	Unit	Volume
5x FITTING_1	mm^3	2513.2741228718
1x FITTING_2	mm^3	589.0486225481
1x Intake Coil	mm^3	6000
1x Test Circuitry	mm^3	10000

The dataset (seen left) is a real measurement standard for a real life vent pipe used by a major truck manufacturer.

Our platform simplifies the entire process of making complex volume datasets. Without volume.cc, a complicated spreadsheet needs to be utilised, maintained and only serves the need of one technician. These spreadsheets become outdated, corrupt and cannot easily be shared.

This part (described left) in particular has eleven cylinders with multiple surpluses. Most reasonable people would agree the volume requirements become extensive as the complexity of a part increases.

Our service is of great benefit because it can act as a transparent layer between public and private industries. As the complexities within supply chains increase, so does the need for a quality protocol which can manage, store and distribute volumetric datasets.

Volume.cc

Sound Reference Volumes

Unit	cc/m	cc/s	mm3/s
1	11.02	0.1837	183.67
2	10.99	0.1832	183.17
3	10.80	0.1800	180.00
4	10.67	0.1778	177.83
5	10.73	0.1788	178.83
6	10.62	0.1770	177.00
7	10.67	0.1778	177.83
8	10.69	0.1782	178.17
9	10.80	0.1800	180.00
10	10.77	0.1795	179.50
11	10.69	0.1782	178.17
12	10.72	0.1787	178.67
13	10.62	0.1770	177.00
14	10.51	0.1752	175.17
15	11.13	0.1855	185.50
16	10.81	0.1802	180.17
17	10.80	0.1800	180.00
18	10.80	0.1800	180.00
19	10.69	0.1782	178.17
20	10.67	0.1778	177.83

Pressure tested @ 59.1cc

Unit	cc/m	cc/s	mm3/s
1	13.56	0.2260	226.00
2	13.36	0.2227	222.67
3	13.32	0.2220	222.00
4	13.36	0.2227	222.67
5	13.36	0.2227	222.67
6	13.30	0.2217	221.67
7	13.40	0.2233	223.33
8	13.52	0.2253	225.33
9	13.50	0.2250	225.00
10	13.44	0.2240	224.00
11	13.40	0.2233	223.33
12	13.42	0.2237	223.67
13	13.36	0.2227	222.67
14	13.36	0.2227	222.67
15	13.30	0.2217	221.67
16	13.40	0.2233	223.33
17	13.44	0.2240	224.00
18	13.42	0.2237	223.67
19	13.48	0.2247	224.67
20	13.44	0.2240	224.00

Pressure tested @ 74.1cc

The test data available when a bad vent pipe undergoes a repeated pressure test shows really how important a satisfactory reference volume is. In fact, the evidence is clear that if the reference volume is not satisfactory, the manufacturer is simply not testing them to any reasonable standard. Mean (average) leak rates of a part will differ in respect to its reference volume. Higher reference volume means more volume loss per second. This is a technique to identify problematic gradual leaks and also ensures a more stringent test.

Gradual leaks are defined as a test sensor which vibrates (the wobble) upon its first feed pressurisation phrase and then stops wobbling. The part has been pressurised to the correct bar and no wobble thereafter exists because the part is now stable and thereby verified to be leak free.

Good parts will inherit a volume loss very close but not equal to zero upon its pressurisation interval.

Volume.cc

Sound Reference Volumes

The test data also shows us that when good quality parts are tested, the sensor will vibrate a tiny 2.n cubic millimetres. Its not noticeable but given an extensive amount of data, it indicates that the sensor is one which is indeed actually very well calibrated. Leak detection technologies from leak testing hardware are an excellent piece of engineering.

And because the data trend is repeatable, we get that consistency which we can recall from lecture 2. Consistency makes everyone comfortable with everything because it works and continues to work.

The manufacturer will communicate what volume loss is unacceptable accordingly to their own set of standards. The volume loss (pressure decay) will only be accurate if the reference volume is satisfactory.

	cc/m	cc/s	mm3/s
Max:	0.47	0.0078333	7.83333333
Min:	0.01	0.0001667	0.16666667
Mean:	0.12625	0.0021042	2.10416667

To the observer, the leak rate is equal to zero but given a further resolution it really isn’t

Leak captured when given a satisfactory reference volume

4.50 4.17 1.17 1.33 1.67 2.67 1.33 1.50 4.00 2.00 1.00 5.00 1.83 0.67 1.83 4.33 2.83 2.50 2.00 4.83 0.67 1.50 0.50 2.67 2.67 1.17

Volume.cc

Discussion

Pressurisation and leak detection technologies are important. They are fundamentally important for the successful execution of spatial industries. Spatial industries encompass any manufacturer using technology to measure spatial domains. And the only difference between the technologies used currently and the challenges out there awaiting us within space is the scale.

Star ships and multi planetary bases will all inherit distinct geometric shapes, they will all use pressurisation technologies and the pressurisation technology will rely upon sound leak free verification techniques.

Some side notes:

… in the context of leak detection hardware, a reference volume is not always equal to the physical volume of an object
…… we have to consider the test circuitry itself and coil inputs before the actual part is considered
… in the case of the ventilation pipe, the manufacturer communicated a tolerated max leak rate of 20 mm^3/s
…… so given that our reference volume was 74100 mm^3 with a permitted leak tolerance of 20 mm^3
……… the manufacturer would not accept a deviation greater than: 20 / 74100 = 0.0002%

Putting things into perspective. The quality of the part is exceptional when correctly fitted and often very close (0.9998) in terms of the pressurisation quality to the original master sample which would have be verified (signed for) by manufacturing management.

In the next lecture, we explore verification.