

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



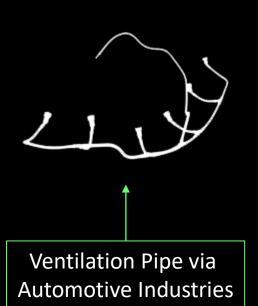
Ventilation Pipe

Ventilation 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.

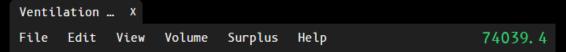
In reality, there exists no perfect seal and the terminology tightness is used to refer to how well fitted a particular part is. Leak testing equipment exists as a step in the firewall chain to prevent poor quality parts reaching global ecosystems. Natural crystallisation processes can and do work to 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



Cylinder	Diameter	Length	Unit	Volume	
X1_1	6 mm	75 mm	mm ³	2120. 575041	רֻ⊅ֱװ
X1_2	6 mm	75 mm	mm ³	2120. 575041	רֻ \$ ₪
X2_1	6 mm	60 mm	mm ³	1696. 460033	רֻ ⊅ ₪
X2_2	6 mm	60 mm	mm ³	1696. 460033	ב' \$ ₪
X2_3	6 mm	60 mm	mm ³	1696. 460033	רֻ \$ ₪
X2_4	6 mm	60 mm	mm ³	1696. 460033	רֻ \$ ₪
Х3	6 mm	209 mm	mm ³	5909. 335781	רֻ מְיִי װוֹ
Х4	6 mm	212 mm	mm ³	5994. 158783	רֻ \$ ₪
X5_1	6 mm	163 mm	mm ³	4608. 716423	רֻ מְיִי 🗑
X5_2	6 mm	163 mm	mm ³	4608. 716423	רַ \$ ₪
Х6	6 mm	806 mm	mm ³	22789. 113109	רֻ מְיִי וֹיִי מְיִי

Object	Unit	Volume	
5x FITTING_1	mm ³	2513. 2741228718346	
1x FITTING_2	mm ³	589. 0486225480862	Î
1x Intake Coil	mm ³	6000	Î
1x Test Circuitry	mm ³	10000	Î

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.



Sound Reference Volumes

11-24		/-	
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

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

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.



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 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 caught after given a satisfactory reference volume – this part had been dispatched and had passed a prior test standard. It was found that the pressure was correct but the reference volume was not satisfactory





Discussion

Pressurisation and leak technologies are very interesting. They are fundamentally important for the successful execution of spatial industries. The only difference between the technologies we're using 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 mm³/s so given that our reference volume was 74100 mm³/s with a permitted leak tolerance of 20 mm³ the manufacturer would not accept a deviation greater than: 20 / 74100 = 0.0002%

This really puts things into perspective. The quality of the part is indeed tight when correctly fitted and often very close (0.0002) to the original master sample which is verified (signed for) by manufacturing management.

In the next lecture, we explore verification.