



Velan cast steel valves at work.

# Zeroing in on zero emissions

One of the most important technical demands currently facing the valve manufacturing industry is controlling fugitive emissions, particularly from stem seals. In this article, Luc Vernhes and Alia Rahman of Velan, a world-leading valve manufacturer, describe how their company is meeting this challenge in concrete, measurable ways.

*By Luc Vernhes and Alia Rahman, Velan*

Fugitive emissions in the United States have been estimated to account for upwards of 300,000 metric tonnes of industrial waste per year, making them responsible for one-third of the total organic compounds released by chemical and petrochemical plants. What's more, valves alone account for 50% of the loss in pipes and fittings. This situation is mirrored in Europe, and is likely much worse in other parts of the world where environmental standards and levels of policing are less stringent.<sup>1</sup> Environmental devastation aside, petrochemical resources are becoming ever more valuable, and plants can no longer afford to operate wastefully. In addition to the visible cost of emissions,

invisible costs include labor and material needed to repair leaks, wasted energy, low plant efficiency, environmental clean up and potential fines, loss of market share due to poor public perception, and, increasingly, claims due to personal injury.

Industries worldwide are facing enormous pressure to establish programs that will help minimize potential harm to the environment. On the vanguard of industry regulations are two major standards, ISO15848-1 and API622, which were released in 2005 and 2006 respectively. The ISO15848-1 standard classifies valves into three tightness classes (A, B, C), with class A valves having the lowest leak rate. The API622 standard, on

the other hand, classifies the packing arrangements used in the valve.

## Bringing FE standards home

At Velan's R&D facilities in Montreal, Canada, our off-the-shelf API600 gate valve easily passed tightness class C standards of ISO15848-1. The API622 packing arrangement requirements for fugitive emissions were tested at the Yarmouth Research & Technology Institute in Maine, U.S.

## ISO15848-1 results

In accordance with the ISO15848-1, a standard 3", 150 class, Velan API600 gate valve successfully passed low leakage requirements. The graphite packing

<sup>1</sup> ESA Fugitive Emissions Working Group <http://www.europeansealing.com/workinggroups/fugem.htm>

arrangement used for this design was likewise qualified according to ISO15848-1.

Other qualification results include:

- Tightness class: The maximum leakage remained under 10-2 mg.s-1.m-1, qualifying the valve as class C.
- Number of times retorqued: 1.
- Endurance class: 1,500 mechanical cycles and three thermal cycles. The endurance class is CO2.
- Temperature class: The applied temperature is 400°C: The temperature class is T400.
- Performance class: ISOFECH-C02-SSA1-T400 -CL150-ISO15848-1.

**API622 results**

API622 FE tests were performed on a test bench, as well as on a standard Velan 4", 300 class, gate valve (Fig. 1).

It's interesting to note the influence of the packing chamber design and the manufacturing quality on the test results. In addition, measurements performed on a standard gate valve outperformed results from the test fixture.

The Velan API600 gate valve, 4", 300 class, was successfully tested according to the API622 and is qualified based on the Northern California Limits (100ppm maximum).

**ISO15848-1 and API622 comparison**

The API622 FE measurement method could be considered both a sniffing

method and a flushing method. Based on the conversion method described in ISO15848-1, FE measurements performed using the flushing method can be expressed in parts per million (ppm) and in mg/sec. When considering API622 measurements performed using the flushing method, the measurements can be expressed in mg/sec, as compared to the ISO15848-1 measurements, which are expressed in units of atm·cc/sec. Both test results have been plotted in

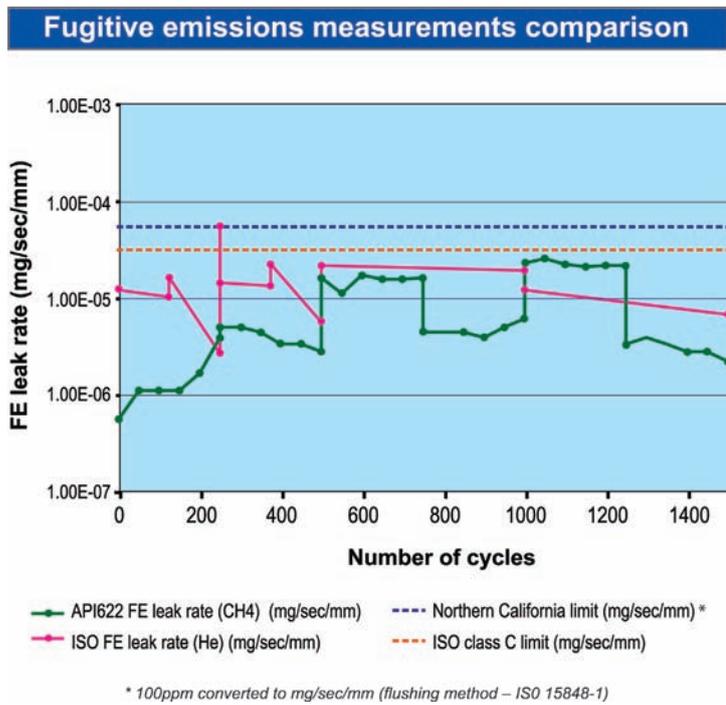


Figure 1 - Fugitive emissions measurement comparison.

Figure 1 using the same units (mg/sec). While ISO15848-1 and API622 test protocols are slightly different (number of cycles, medium, etc.), the test results are nonetheless consistent. A valve design that is qualified according to the ISO15848-1 class C with helium should be able to qualify according to the API622 standards with CH4 (methane) within the Northern California limit, and vice versa.

**Conclusion**

Velan's production of the off-the-shelf API600 gate valve design has been successfully tested according to the most current FE standards: API622 and ISO15848-1. These results are considered to be a success, particularly for a mass production product.

Furthermore, packing performance should not be judged on FE performance alone. The standard packing used in mass production valves has exhibited strong mechanical and anti-corrosional behavior. It is also well known for its "wiper" capability, whereby the packing can wipe away dust particles that accumulate on the stem after long-term atmospheric exposure. Such particulates are the primary source of stem/packing chamber damage (scratches), which can lead to a dramatic increase in fugitive emissions.

Velan API622 test results				
All tests performed with Velan OEM packing, and standard packing stress				
Date (Project)	Test device	Leakage (ppmV)		Packing adjustment
		Maximum	Average	
Feb-07 (20724)	Test fixture	361	46	2 times
May-07 (20756)	Standard Velan production valve (4" # 300 API600 Gate)	46	13	zero

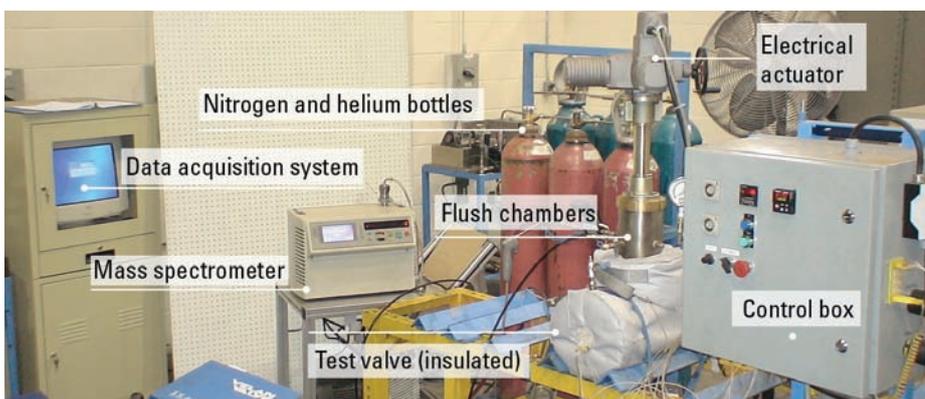


Figure 2 - Fugitive emissions testing in action.

Today, Velan is actively pursuing the development of low FE standard packing by evaluating the performance of a variety of packing technologies. Based on continued R&D and testing, Velan can deliver extra-low FE valves using non-standard packing (i.e., ISO15848-1 class B) upon request.

Awareness is the first step in eradicating excess industrial pollution. Valve manufacturers need to collaborate with chemical and petrochemical plants to reduce emissions. Both intensive R&D and simple on-site maintenance can play significant roles in the battle to minimize spurious leakage.

After all, both the consumer and manufacturer alike benefit from FE reduction. As the low emission seal is increasingly in demand, it only makes sense to increase valve certification. And from a philanthropic standpoint, certification is a concrete step for the greater common good: respect for the environment and sustainability for generations to come.

### About the Authors



**Luc Vernhes** is the Velan R&D Group Leader. He has a Masters in mechanical engineering from the École nationale d'ingénieurs (France), and is member of the Ordre des Ingénieurs du Québec (OIQ). Luc is currently pursuing graduate studies in physics specialising in nano-coating at the École polytechnique de Montréal, and has four years of experience at Velan in R&D, focusing on project management and experimental analysis.



**Alia Rahman** is an engineering intern at Velan, working for the R&D group. She is currently pursuing an honours undergraduate degree specializing in environmental engineering at the University of Waterloo (Ontario, Canada). Her forte lies in technical writing and mathematics. Alia has been working at Velan since March 2007, assuming responsibility for such areas as Cv and fugitive emission testing.

### About Velan

Velan is one of the world's leading manufacturers of industrial steel valves, with thirteen specialized manufacturing plants worldwide, including five in Canada and the U.S., five in Europe, and three in Asia. Velan employs over 1,800 people, the majority of whom are located in North America. Velan's expertise in fugitive emissions control dates back to the 1950s, when the company introduced the first-ever hermetically sealed bellows seal valve. This innovative trend continued throughout the 1960s and 70s, culminating in the development of a new generation of low-emission packing chambers for nuclear valves. Fifty years after the manufacture of its first emission-free valve, emissions control continues to be a key design requirement for all Velan valves. Today, the company continues to only launch products after they've undergone extensive design analysis and functional qualification testing in accordance with the latest industry standards.