9th October 2001

TECH TALK 45

EFFECT OF VAPOUR - RICH ATMOSPHERE

ON NITRILE ELASTOMERS SUCH AS DIAPHRAGMS

Thailand petroleum industry began converting to bottom loading recently, requiring a major refit of many tankers.

During the first half of this year over 50 diaphragms failed in the AVV3 vapour recovery vent, (mounted on the walkway of the tanker or on the manhole). Such a failure rate is unprecedented and the diaphragms were returned for inspection. (Only one was from a footvalve). Meantime, endurance tests were started using both SLV5 valves and AVV3 vents.

Test 1

2 sets of #3095 nitrile diaphragm in SLV5 footvalves. All tests 'dry', i.e. no product in valves.

1,000 cycles at 900 kPa, 3 sec open, 2 secs closed.
250 cycles at 900 kPa, 5 mins open, 2 mins closed.
Duration - 5 days.
Inspected - no damage or deterioration to either diaphragm.
Refit same diaphragms and continue.
200 cycles at 900 kPa, 5 mins open, 2 mins closed.
Duration - 4 days.
Inspected - no damage or deterioration to either diaphragm.

Test 2

#3095 diaphragm in AVV3 vent, diaphragm taken from Test 1 (already done 9 days cycling).

(a) Tested per Test 1 above, 'dry'.

(b) Breather hole from vapour vent under diaphragm was piped so that it sat in vapour above liquid petrol. Therefore each time the vent opened and closed, the diaphragm under-side would suck in air and vapour mixture.

This was to simulate a tanker converted to bottom loading but still, due to either top loading or bottom loading with the hatch open, subject to vapour filling the walkway.

Also the outside of the AVV3 top cover once a day was lightly brushed with petrol to simulate a top load spear dripping petrol over the walkway as it was removed from the fill hatch.

Cycling was 5 seconds open, 2 seconds closed, at 600 kPa air pressure.

Result

Inspection at 16,900 cycles -

Soapy feel to diaphragm under-side, one very small crack on circumference less than 1mm long.

Period was 5 days from start

Inspection at 49,500 cycles -

Diaphragm under-side material starting to perish. Small crack noted previously had not changed. However the top circumference of the diaphragm had started to crack around approximately 50% of it's length.

The diaphragm was still operating but the test was terminated.

Period 14 days from start.

Inspection

Comparison of the test diaphragm with returned Thai diaphragms showed conclusive similarities and all Thai units also smelt strongly of petrol.

Conclusion

The short life of the vapour vent diaphragms in Thailand is caused by chemical attack from petroleum vapours in the atmosphere.

This occurs only when, due to operational reasons, the tankers are being occasionally top-loaded or being loaded or unloaded with their hatches open.

The evidence for this conclusion is overwhelming. The diaphragm cannot be failed in testing on the rig even by excessive pressure or varying cycle periods. Only when petrol vapour is present does the diaphragm fail and then in identical fashion to those returned.

Solution

The breather ports of air-operated equipment should be piped with the aperture away from any vapour-rich areas*.

When the industry is completely bottom loading with vapour recovery, this is not often critical as there is normally insufficient vapour to cause a problem.

However while industry is changing from top to bottom loading, vapours are frequently present and drips from top-load spears also contribute.

Attached is a typical scheme to alleviate the problem until vapour recovery is fully implemented. By piping the breathers away to a remote point, and passing the vapour through a filter, the effect is eliminated. Similar practice in UK during their change-over period resulted in nil diaphragm changes over three years in a fleet which 'filtered' all it's breathers.

We now believe that all breathers should be piped away to a filter unit in all circumstances to protect against other modern contaminants besides petrol vapours. It is a very cheap solution to guarantee trouble free service for many years.

* Petroleum vapours are heavier than air so ensure the breather port to atmosphere is breathing fresh air, not from a vapour pool. Eg the port should be outside the walkway surround or mounted inside but at a height above any possible vapour pool.

9th October 2001

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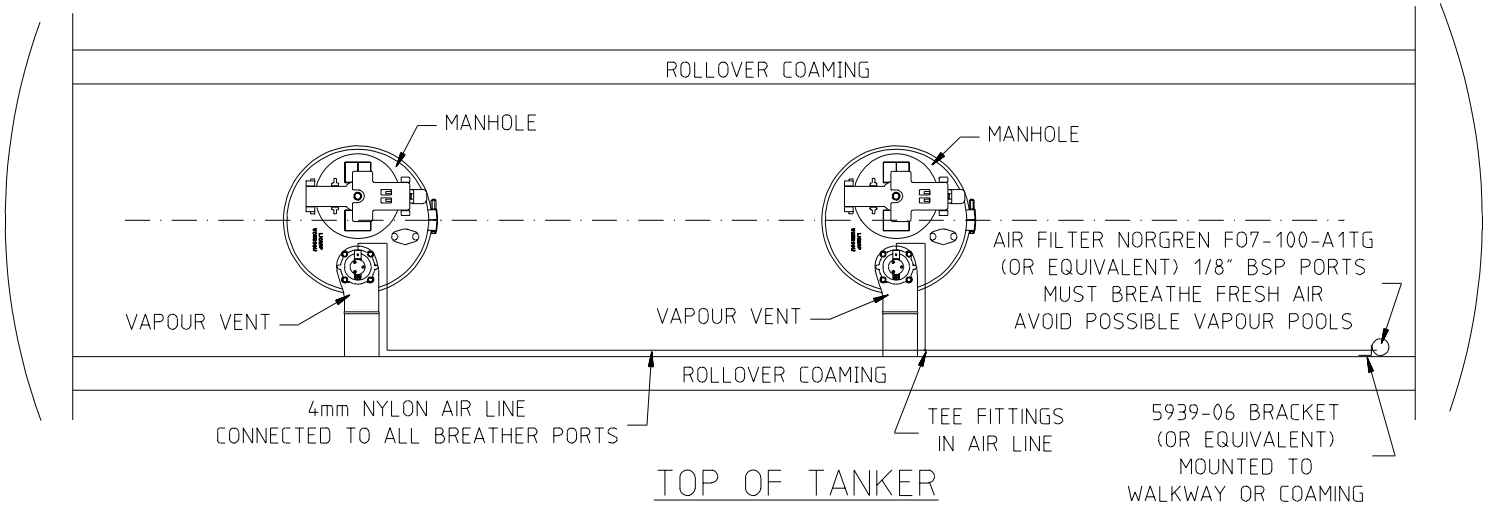
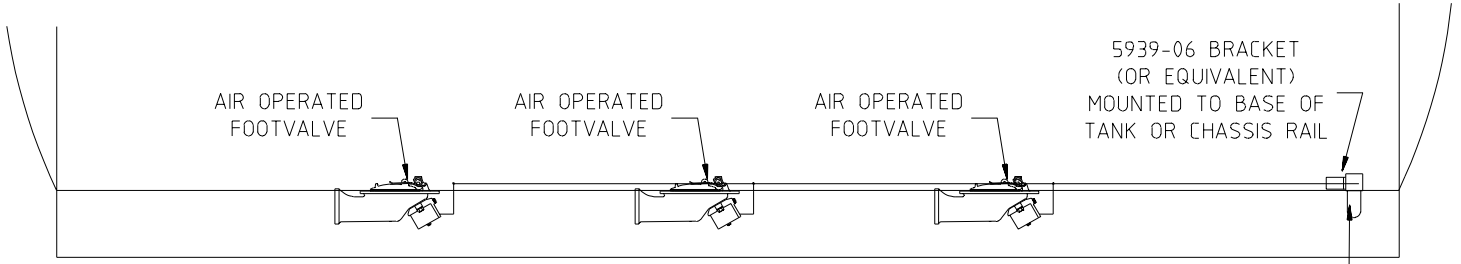
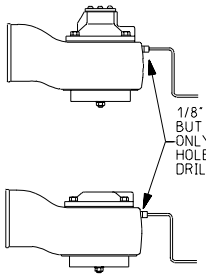
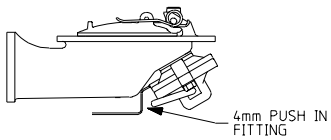
BREATHER LINE EXTENSION FOR AIR OPERATED EQUIPMENT

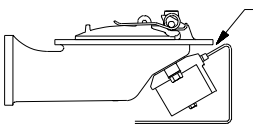
TO PREVENT THE INGRESS OF FOREIGN OBJECTS, WATER AND POTENTIALLY DAMAGING VAPOURS, ALL AIR OPERATED EQUIPMENT IS RECOMMENDED TO HAVE ITS BREATHER PORT CONNECTED TO AN AIR LINE THAT RUNS ALONG THE LENGTH OF THE TANK AT THE TOP, BOTTOM OR BOTH. AT THE END OF THIS AIR LINE SHOULD BE A FILTER SUCH AS A PAPER ELEMENT FILTER WHICH SHOULD BE ATTACHED TO THE TANK OR FRAMEWORK TO MINIMISE MOVEMENT. ALL JUNCTIONS INTO THIS SINGLE AIR LINE SHOULD BE BY PUSH-FIT TEE FITTINGS, AND CONNECTIONS TO THE BREATHER PORTS OF AIR OPERATED EQUIPMENT WILL USUALLY BE BSP SCREWED FITTINGS. **NOTE: ANY EXHAUST PORTS SHOULD BE SHIELDED & PIPED AWAY FROM AIR ACTUATOR**

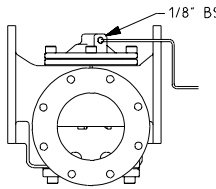


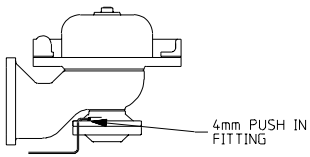












NOTE:
THIS LAYOUT IS NOT TYPICAL OF A TANKER. IT IS MEANT ONLY TO INDICATE AIR OPERATED EQUIPMENT THAT MAY UTILISE A BREATHER LINE EXTENSION.

IMPORTANT
Not a certified drawing
Do not use for detail design

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Issue: C