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TECHNICAL BULLETIN
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DISCHARGE PERFORMANCE

Recently some designer - installers of ETI reported some difficulties during discharge tests with discharge time exceeding the allowable deviation of 20% from design ideal or 3.2 litres per minute per nozzle. Bear in mind the application rate is 4.1 litres per minute per square metre. The ETI design process allows for this which effectively limits each ETI nozzle to 0.75 square metres to achieve this relationship.

NOZZLE THEORY

A very important feature of ETI system is that it is engineered and is classified as an 'ENGINEERED FOAM SYSTEM'. Another extremely important aspect to recognise about this is that ETI nozzles are manufactured to our specification, to be listed for its designed purpose and fire tested. You may have noticed that the spray from ETI sytems is a coarse spray rather than the fine spray seen in 'Pre-Engineered' fire systems. Australian Standard AS 5062 – 2006 recognises this and actually classifies pre-engineered systems as a FOAM WATER SPRAY SYSTEM. The nozzles used in these have typically been developed for agricultural spray applications and have been adapated to pre-engineered fire systems. The fine spray is very good in agricultural applications because:-

1) It allows the droplets to be suspended in air and float over large distances when being delivered to crops.
2) It also allows nozzles to perform at very low pressures which is often the the preferred case in irrigation.

However, for ETI engineered standards, these were deemed unsuitable because heavier or coarser droplets have better ballistic properties to reach the target as we wish to minimise the effect of any adverse air flows or thermal drafts and hence the ETI nozzle, while being similar in appearance to pre-engineered nozzles, is not a water spray nozzle, but it is a DELUGE SPRAY NOZZLE! However I also point out that these nozzles do not necessarily perform well if discharge pressure drops to an unacceptable level, the tendancy being to slow down discharge rate.

In a QA process of looking at customer concern on some instances of poor performance, it was investigated thoroughly with extensive testing and I would like to make the following comments and also release some alternate fill ratios for our cylinders.

DISCHARGE HYDRAULICS :-

is a very complex science involving applied theory of fluid flow, viscosity, temperature and friction losses caused by restrictions, pipework, fitting designs and nozzle resistance. The ETI design process uses simplified rules to predict likely performance in line with our tested and listed fire fighting performance.

Our design rules aim at an average performance of 3.2 litres per nozzle per minute with a plus or minus 20% deviation as a practical test tolerance for actual acceptance test. This simply means that the discharge time should be within 20% of the ideal discharge time. This performance was audited by NFPA representation as part of our 'Engineered' Fire System listing.

The 20% deviation is allowed because there is an infinite number of variations of practical design factors that can effect actual discharge time.The acceptance test is done as a means of verifying that performance is within acceptable limits. There have been occasions reported where these results have been outside limits. This is good because we can react, review and rectify the performance which is exactly the intended outcome according to AS 5062-2006.

RESULTS OF ETI REVIEW

A number of tests on the ETI simulator revealed that it was possible in some combinations of cylinder, nozzle and pipework installations, to get an unacceptable flow performance in some cases. Our testing revealed that the key contributor to this was the ETI style nozzle requiring higher pressures than pre-engineered spray nozzles; and therefore the amount of gas pressure during discharge, sometimes was on the lower side of normal. The ETI system uses nitrogen gas space in the cylinder compressed to 1375 Kpa during charging. This gas effectively stores energy and is the pump which powers the discharge performance. The ratio of this space to fire agent is known under the pressure vessel standards as Ullage Space.

It is also noted that the ETI dual actuation valve, when LOP actuated does not necessarily travel the full stroke, as is the case when ROP actuated. This is normal. Testing has showed that this can contribute to a limited restriction of flow because the piston is in line with the discharge port. However this effect was minimal and determined not to be a significant contributor. The valve has been tested to achieve maximum flow demand, even when LOP actuated.

It was determined that the fill ratios in the ETI design rules were currently representative of the maximum fill ratios for our cylinders. In a case where below acceptable flow rates were found, this could be rectified by reducing the foam fill and increasing the ullage ratio to provide more hydraulic energy! So simply put, less foam and more nitrogen will improve poor discharge performance. Of course designers need to ensure that the total foam requirements still meet the design minimum as per the ETI technical manual edition 4 and 5 and the ETI design program releases 10 and 11.

Therefore, below are fill ratio tables for our cylinders that are approved to use, to adjust tested discharge performance within acceptable limits.

106 LITRE CYLINDER . actual volume 107L	MAXIMUM FILL - 85 LITRES		MEDIUM FILL - 78 LITRES		MINIMUM FILL - 70 LITRES	
	WATER	FOAM	WATER	FOAM	WATER	FOAM
	79.9	5.1	73.3	4.7	65.8	4.2

65 LITRE CYLINDER. Actual vol 69L	MAXIMUM FILL - 50 LITRES		MEDIUM FILL - 47.5 LITRES		MINIMUM FILL - 45 LITRES	
	WATER	FOAM	WATER	FOAM	WATER	FOAM
	47.0	3.0	44.6	2.9	42.3	2.7

45 LITRE CYLINDER	MAXIMUM FILL - 35 LITRES		MEDIUM FILL - 30 LITRES		MINIMUM FILL - 27 LITRES	
	WATER	FOAM	WATER	FOAM	WATER	FOAM
	32.9	2.2	28.1	1.9	25.3	1.7

27 LITRE CYLINDER	MAXIMUM FILL - 22 LITRES		MEDIUM FILL - 20 LITRES		MINIMUM FILL - 18 LITRES	
	WATER	FOAM	WATER	FOAM	WATER	FOAM
	20.7	1.3	18.8	1.2	16.9	1.1

15 LITRE CYLINDER	MAXIMUM FILL - 11.5 LITRES		MEDIUM FILL - 10.0 LITRES		MINIMUM FILL - 9.0 LITRES	
	WATER	FOAM	WATER	FOAM	WATER	FOAM
	10.7	0.8	9.4	0.6	8.5	0.5

NEW NOZZLE

I would also like to announce the release of a new nozzle. Due to customer requests, ETI has now released a wide angle 120 degree nozzle. Please be aware that this nozzle still has a nominal flow rate design of 3.2 litres per minute and a nominal maximum area of 0.75 square metres. Therefore there are no design rule changes needed. This nozzle option is aimed at solving the practical problems of spraying at close range. The wider angle allows the nozzle to deliver at much closer ranges. Note also that AS 5062-2006 and ETI design rules require that the certificate of acceptance and related design documentation record the specification and location of the chosen nozzles used. For this purpose the part number reference from the ETI design manual suffices.

PART NOZCAPBR60

Nominal 60 degree spray pattern through a 2.6mm diamater orifice giving an average typical flow of 3.2 litres per minute when installed in a typical system. Design range Range Nozzle Tip to aiming Point 700mm minimum to 1100mm maximum.

PART NOZCAPBR120

Nominal 120 degree spray pattern through a 2.6mm diamater orifice giving an average typical flow of 3.2 litres per minute when installed in a typical system. Design range nozzle tip to aiming Point 235mm minimum to 365mm maximum.

Sincerely

L D Waldon

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