Client:	Marsh Industries	Report Ref:	15545v2
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Evaluation of Whisspurr AVR units

1. Introduction

WRc has completed independent testing of two Marsh Industries Whisspurr AVR units. The testing was undertaken to establish:

A. If the installation of the AVR units results in any pressure drop and potential impact to the performance of the compressor or air diffuser.

B. The sound reduction achieved with the AVR units installed.

All equipment, with the exception of the digital pressure sensor, flow meter and sound meter, was provided to WRc by Stephen Marsh Boyer. The testing was undertaken by Simon Bridgman and signed off by Dr Leo Carswell.

Figure 1 AVR unit 1 (smaller of the two tested)

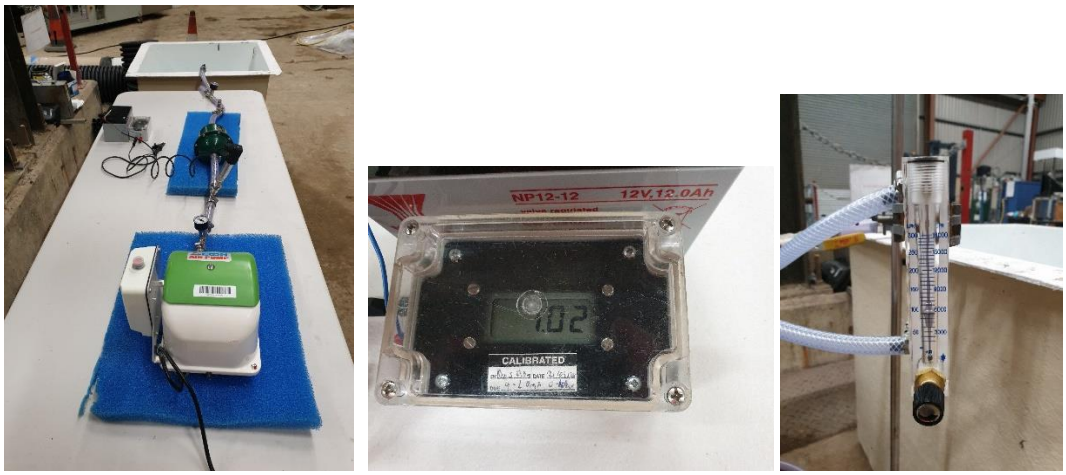
2. Testing Approach

2.1 Pressure monitoring

The following procedure was followed:

- Measurement of the pressure upstream and downstream of the Whisspurr AVR units (unit 1 and unit 2) using a digital pressure sensor. Note the same sensor was used for both measurements to remove any errors associated with different sensors.
- Testing undertaken with two different air pumps (SECOH JDK-80 and LINEAR ETP 60A).
- Both air pumps were tested without the AVR units to provide background reading.
- The above testing was then repeated with a variable area flow meter in the line before the air diffuser. The bore of the flow meter was 12 mm, introducing a flow restriction, and was therefore not used for the initial tests. The flow was then varied, and the pressure measured at each flow.

Figure 2 Test set up, pressure measurement readout and air flow measurement.



The pressure sensors calibration was verified prior to the testing commencing. The sensor used has a range of 0-6 Bar with an accuracy of +/- 0.25% full scale of range.

The flow gauge was used to provide a measure of the air flow and has a much greater uncertainty and should therefore not be used as an absolute figure.

2.2 Sound measurement

The same experimental set up as shown in Figure 2 was used when testing for sound reduction. All elements of the set up (pump, hose, fittings and AVR) were positioned on foam to prevent vibration from the pump.

An RS Pro DT-8852 Sound level meter was used to accurately measure the sound level.

Sound level measurements were made at the following distances from the pump and air diffuser:

- 0.1 metres
- 1.0 metres
- 2.0 metres
- 3.0 metres
- 5.0 metres

The testing was undertaken in WRc's large experimental testing facility. All other test equipment was turn off to reduce background sound levels.

3. Results – Pressure Measurement

3.1 Baseline without AVR

The pressure in the air line without an AVR installed was measured at 0.109 Bar.

3.2 Pressure drop with AVR

All figures reported are an average of several measurements.

Figure 3 Pressure drop measurement – SECOH JDK-80 air pump*

AVR	Upstream pressure (Bar)	Downstream pressure (Bar)	Pressure drop (Bar)
Unit 1	0.124	0.104	0.020
Unit 2	0.127	0.101	0.026

*Airflow not measured but estimated at 75 l/min.

Figure 4 Pressure drop measurement – Linear ETP 60A air pump*

AVR	Upstream pressure (Bar)	Downstream pressure (Bar)	Pressure drop (Bar)
Unit 1	0.102	0.091	0.011
Unit 2	0.103	0.093	0.010

*Airflow not measured but estimated at 40 l/min.

Both AVR units showed a very small pressure drop. The pressure drop is on average 0.02 Bar with the SECOH air pump and 0.01 Bar with the Linear air pump. These values are consistent although they are so low, they are close to the accuracy of the sensor.

3.3 Pressure drop with AVR and flow measurement

Testing was also undertaken to look at the impact of greater backpressure and reduced flow.

Note the flow measurement adds backpressure due to the restriction from 18mm to 12mm airline. The pressure range from the pumps for these tests were between 0.1 – 0.25 Bar.

Note, both graphs the 75l/min flow for the SECOH pump is estimated based on the manufacturer's specification.

Figure 5 Pressure drop versus flow for AVR 1

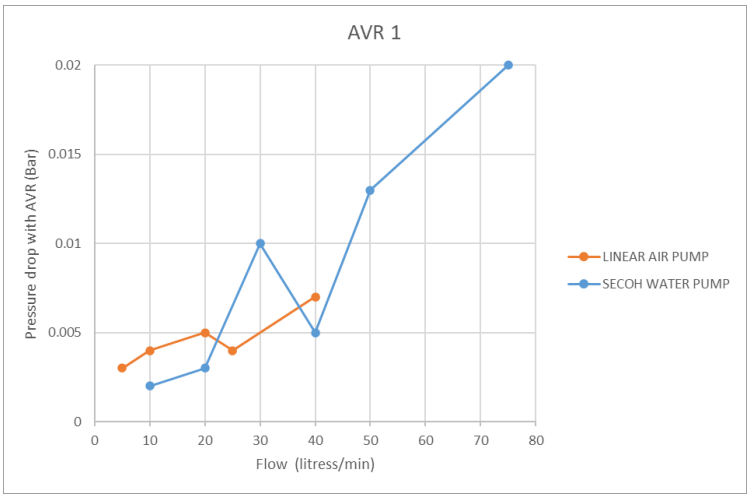
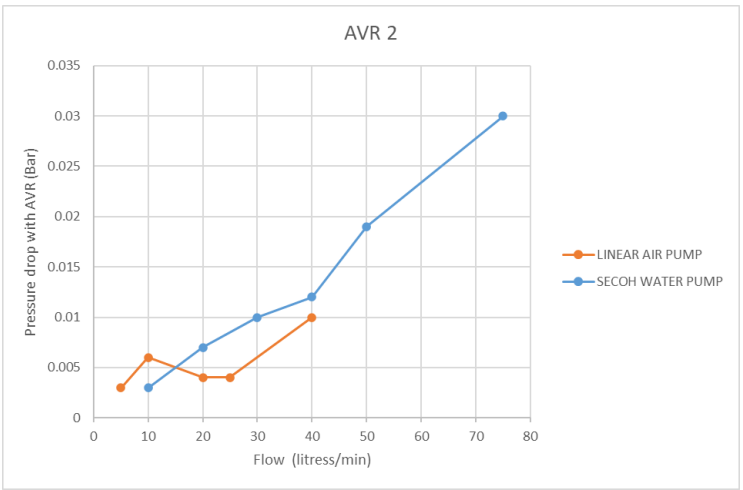


Figure 6 Pressure drop versus flow for AVR 2



The two graphs above show the pressure drop is a function of flow, with a larger pressure drop seen for both pumps and both AVR units at higher flow. However, as stated before the pressure drop is in all cases very small.

4. Results – Sound Reduction

4.1 Measurements

The background sound level with the pump switched off, is around 48 dB. For comparison average noise level inside a home is around 40 dB and normal conversation is around 60 dB.

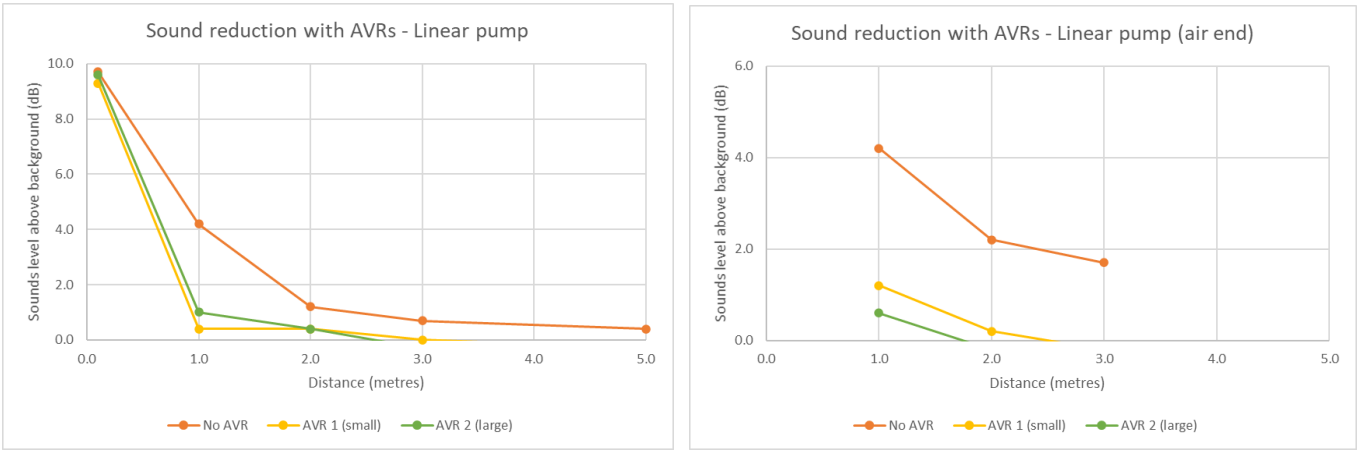
With the pump on, the sound level with no AVR at 0.1m from the pump is 57 – 58.5 dB.

All dB figures quoted are the sound level above the background.

4.2 Sound reduction using Linear pump with AVR installed

Figure 7 shows the reduction in sound with distance using the Linear ETP 60A pump. The graph on the left shows the reduction with distance from the pump itself, the right graph shows the same but measured from above the tank containing the air diffuser.

Figure 7 Sound reduction using Linear pump.

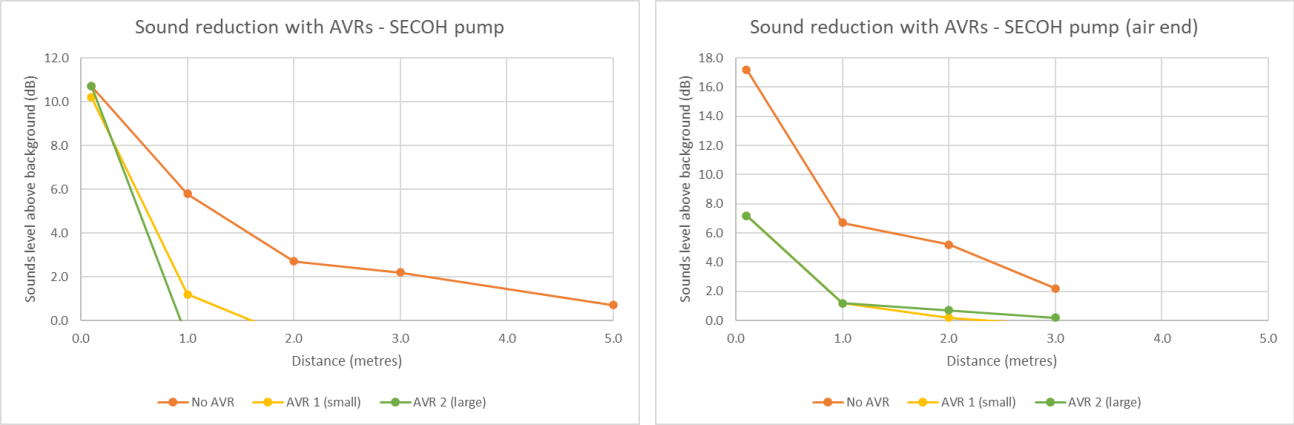


Both graphs show the addition of the AVRs results in dramatic reduction in sound at 1+ metres from the source.

4.1 Sound reduction using SECOH pump with AVR installed

Figure 8 shows the reduction in sound with distance using the SECOH JDK-80 pump. The graph on the left shows the reduction with distance from the pump itself, the right graph shows the same but measured from above the tank containing the air diffuser.

Figure 8 Sound reduction using SECOH pump.



Again, both graphs show the addition of the AVRs results in dramatic reduction in sound at 1+ metres from the source.

4.2 Summary

	Distance from sound source			
	1m	**2m**	**3m**	**5m**
No AVR	4-7 dB	2-5 dB	1-3 dB	Approx. 1 dB
AVR 1	Approx. 1 dB	Below detection	Below detection	Below detection
AVR 2	Approx. 1 dB	Below detection	Below detection	Below detection

Figures are the elevated sound level above background noise. Note the accuracy of the sound meter means figures <1 dB are considered as 'below detection'.

5. Conclusions

The pressure drop observed for both Whisspurr AVR units is very small 0.03 Bar or less for all pumps and flow conditions. With such a small pressure drop any impact on the pump and or air diffuser efficiency will be insignificant and not observable without detailed scientific measurement.

The use of the AVR 1 and 2 units results is a significant drop in the sound level, and the distance the sound travels from the source. In addition to the scientific sound measuring equipment this reduction was very clear to the persons undertaking the testing.