A PORTABLE SILENCER FOR TEMPORARY VENTING OPERATIONS

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1. INTRODUCTION

Many routine maintenance operations involve work on small pressure vessels; prior to being worked on they must first be vented down and purged with an inert gas.

Where high pressures (up to 68 bar) are involved the venting operation can produce very high noise levels; in noise sensitive areas this can result in complaints of noise nuisance.

At these sites therefore some form of silencing is necessary to alleviate the problem. However the provision of permanent silencers on each vessel is not feasible due to the numbers involved and the associated costs; a temporary silencer was therefore needed to meet this requirement.

This paper describes the development of a portable silencer for use in temporary venting operations.

2. VENTING NOISE SOURCES

Noise from a vent is produced by:

- a main source associated with largest pressure drop in the system,
- the final jet efflux.

Noise from the first source propagates with the flow and is radiated from the stack exit; noise from the jet is generated in the immediate area of the stack tip as the efflux mixes with the surrounding atmosphere.

All noise thus radiates from the stack tip region; it is commonly assumed, therefore, that this is where the noise originates; in fact it is produced some distance back from the stack tip.

Any attempt to reduce vent noise must first tackle the main noise source; the final jet noise only then becomes important if it is comparable with noise from the silencer primary source.

The portable silencer was designed to reduce noise from the primary source the final exit being sized so that the jet noise was below that of the silenced primary noise source.

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3. DESIGN PRINCIPLE

Flow from an uncontrolled vent decays exponentially with time; the initial flow from this type of vent is extremely high and silencers for this type of duty have to be sized for this maximum flow condition. As a result the silencers tend to be oversized for most of the vent duration and are relatively large.

If, however, the flow at the start of a vent can be controlled at a much lower rate, then a much smaller silencer can be used; this obviously extends the vent time.

Applying this principle and manipulating flow rate, vent duration and physical dimension of the silencer, a satisfactory design of portable silencer gradually evolved.

The constant flow condition was achieved by sizing the open area of the diffuser so that this element controls the flow. By keeping a fixed pressure in the diffuser the required flow rate can be obtained.

The other dimensions of the silencer are then sized to handle this flow safely.

4. DESCRIPTION

The final design of silencer is shown in Fig 1; its main features are:

- the inlet diffuser, containing 120 x 3.18 mm holes; this passes 4400 m^3/h of natural gas at an inlet pressure of 5.1 bar gauge,
- the silencer section, 250 mm diameter and 1.0 m long lined with 50 mm of mineral wool protected by a perforated mild steel cylinder.
- a 100 mm extension stack through which the gas vents to atmosphere 7.5 m above grade.

Both diffuser and silencer section are designed and built to take the excess pressure arising from a fault putting 68 bar onto the diffuser inlet.

The silencer breaks down into three sections for easy handling and transporting from site to site; it is normally assembled in the horizontal position and then man handled to the vertical; two men easily cope with this operation.

When in its final position the diffuser is connected to the vent valve on the vessel being blown down, by a flexible high pressure hose; this is rated at 170 bar.

5. OTHER FACTORS INFLUENCING DESIGN

Other factors apart from noise reduction, had to be considered in arriving at the final design of silencer, for example, effects of overpressure, infill stripping etc; all are satisfied by the silencer described in this paper.

6. PERFORMANCE

The silencer is designed to operate with a constant 5.1 bar at the inlet diffuser; this gives a flow rate of 4400 m^3/h with natural gas and a stack exit velocity ~155 m/s.

Resulting noise levels for this and other inlet pressure conditions are given below:

	Inlet Pressure	Flow Rate	Sound Level at 20 m
	bar gauge	m^3/h	dB(A)
	3.4	3200	73
Design Condition	5.1	4400	77
	6.8	5600	82
	13.6	10,500	96
	20.4	15,400	108.5

Noise levels from the silenced vent operating at the design condition, are compared in Fig. 2 with those for an unsilenced vent doing similar duty; the effective noise reduction is > 20 dB(A).

Satisfactory reports have been received from many end-users and silencers to this design are now widely used within British Gas.

7. CONCLUSIONS

7.1 A portable vent silencer has been developed for use during blow-down operations on small pressure vessels containing natural gas at up to 68 bar gauge.

7.2 The silencer enables a 10 m^3 vessel to be blown down from 68 bar to atmosphere in about 10 minutes.

7.3 The noise level from a vent when fitted with this silencer is less than 80 dB(A) at 20 m; this is some 20 dB(A) quieter than a comparable unsilenced vent.

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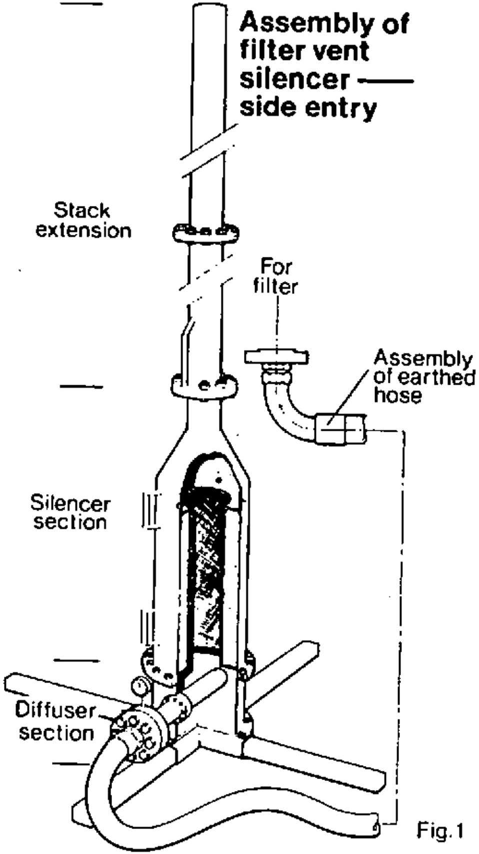
Assembly of filter vent silencer — side entry
Stack extension
For filter
Assembly of earthed hose
Silencer section
Diffuser section

Fig.1

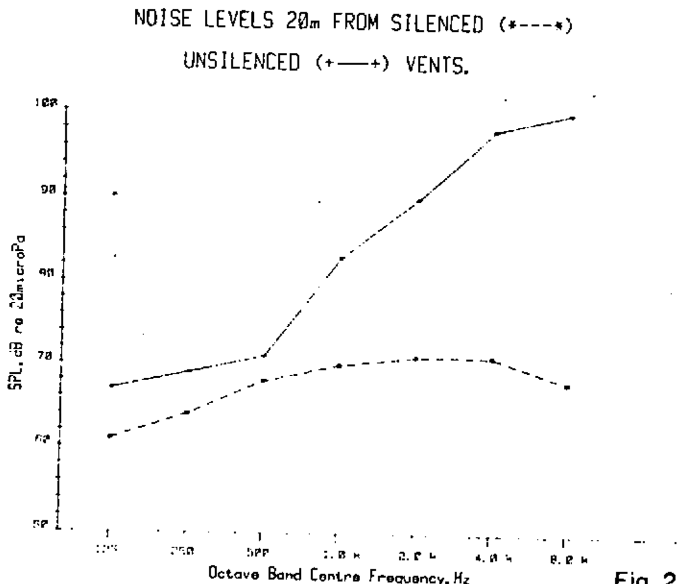
NOISE LEVELS 20m FROM SILENCED (*---*)
UNSILENCED (+——+) VENTS.
SPL, dB re 20microPa
Octave Band Centre Frequency, Hz

Fig. 2