AIR PURGE SYSTEMS FOR STACK MONITORS

Introduction

Air purging must be considered for any optical technology analyser which is exposed to flue gases. It is important to provide air purging units both to maintain a clear boundary path and to ensure the optical system of the instrument remains clean during prolonged operation. If well designed, this can also serve to prevent corrosion of other system components by the flue gas.

Although negative pressure within a stack may appear to draw sufficient air through the air purge nozzle to prevent a build up of dust and fumes, purge air protection is recommended in all installations. Fluctuations in process conditions, operation anomalies and environmental conditions when the plant is not operational can all lead to contamination and/or damage to instrument optics. The air used must be clean, dry and oil free, to be effective in protecting the optical components of the system (e.g. mirrors and lenses).

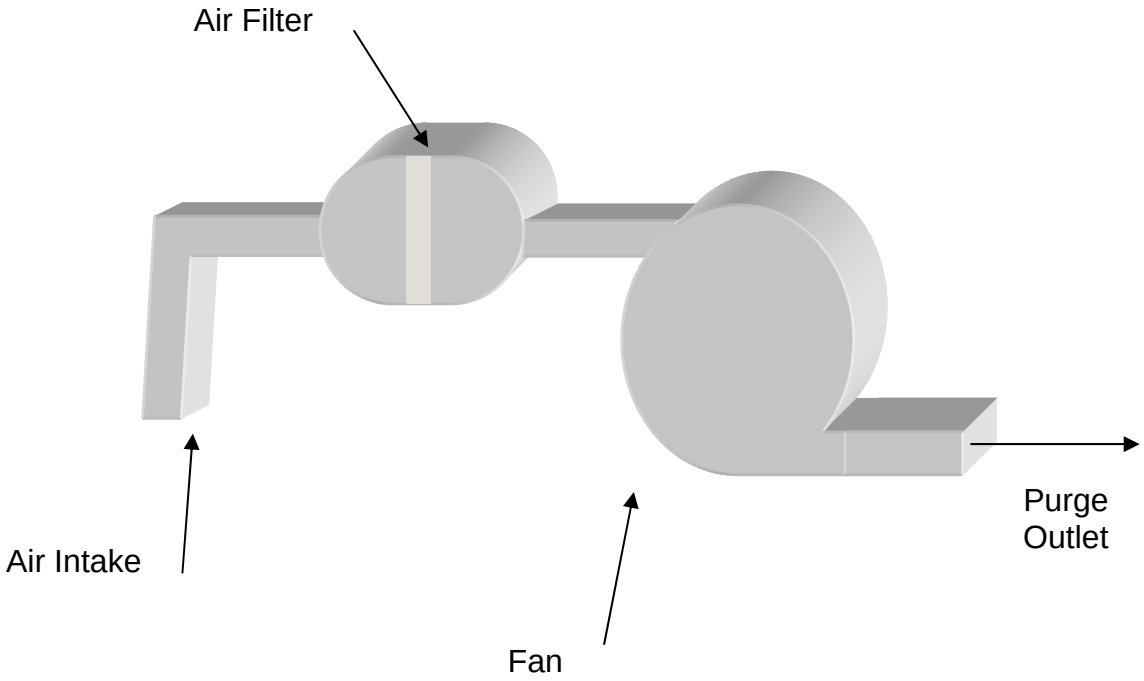
The design of the instrument purge components should ensure that however the air is delivered, the flow will be effective in keeping dirt out of the unit. Poor design can draw dirt in from the process rather than keep it out, due to complex airflow characteristics.

Two systems of air purging are typically available from instrument suppliers: Blowers (fans) and Air Eductors. In some cases compressed air can be used alone, although consumption (flow rate) usually makes this impractical.

Air Purge Blower Systems

Blowers should provide clean air to protect the optical surfaces from dirt, corrosive gases and overheating. The blower motor requires mains electricity and different device power ratings can be used to give the necessary air flow under various application conditions, duct pressures, hose lengths, etc. The flow will depend upon the type of fan and also the mains supply voltage and frequency.

Pressure switches may be fitted to indicate insufficient pressure to maintain the required flow.



Typical Air Purge Blower, with filter unit

Most units consist of a fan with motor, filter housing and filter cartridge. These can be supplied mounted inside a weatherproof box. The filter cartridge should be easily accessible within the box and it's housing and must be cleaned or renewed at regular intervals.

Other Considerations for Air Blowers

Pressure Switches

Uninterrupted air blower operation is important to the reliability of all optical systems. Pressure switches can be used to indicate blower failure.

Differential Pressure Trip. This is connected to the inlet and outlet of the main filter of the air blower. As air flow through the filter a pressure drop between the inlet and outlet. In the event of fan failure, the differential pressure drops and the trip relay operates.

Low Pressure Trip. This is connected to the main filter outlet. The trip relay operates if pressure drops below a pre-set level, which can be due either to filter blockage or to fan failure.

The two pressure trips can detect three states:

System OK	Neither trip operated
Blower Failure.	Both trips are operated
Filter Blocked	Low trip operated only

Air Purge Heater Unit

A heater unit may be provided, which is used to sustain the instrument purge air at a temperature above the acid dewpoint. The heater should be thermostatically controlled to maintain a temperature around 20°C/68°F. This prevents the build up of sulphuric acid in the proximity of the instrument. The heater unit is connected to the outlet of the blower unit.

Air Hose

When calculating blower output requirements it is important to take into account pressure drop in the length of air hose connecting the blower to the instrument. Some instruments measuring cross-stack consist of two components requiring air-purge. They may share a single blower unit provided that it can deliver sufficient air to purge both units; in this case, the lengths of the blower air hoses used must be equal otherwise one side of the instrument will not be purged effectively,

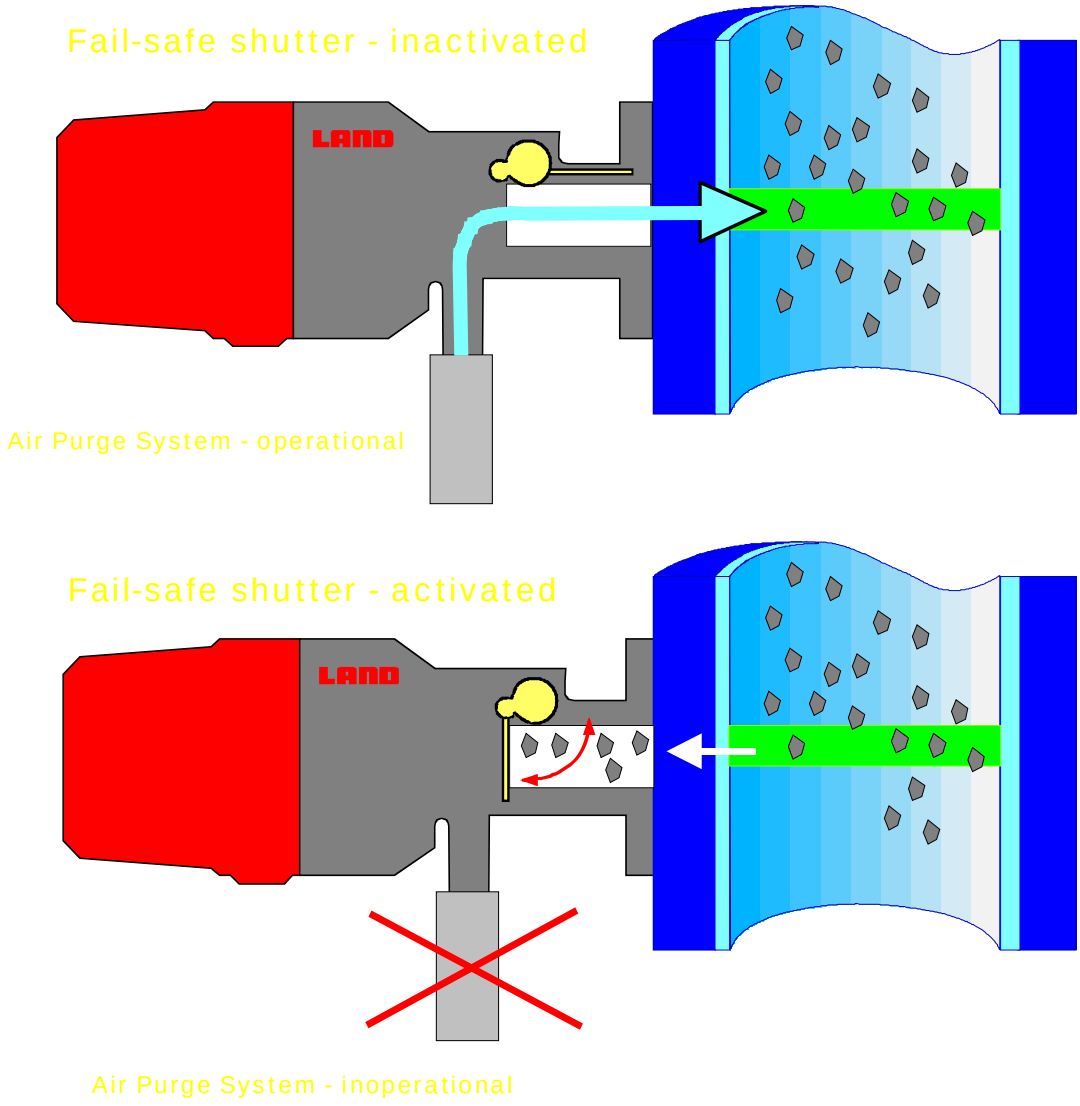
Air Inlet

The air temperature at the intake point must not exceed the upper ambient rating of the fan, which will typically be no more than 50°C (122°F). The air blower intake should be at a point where the least dust, oil or moisture accumulates.

Fail Safe Shutters

It may be prudent to fit shutters, which protect the instrument if the purge air supply fails. These are particularly important for applications where flue gas is under positive pressure, or where it is very corrosive.

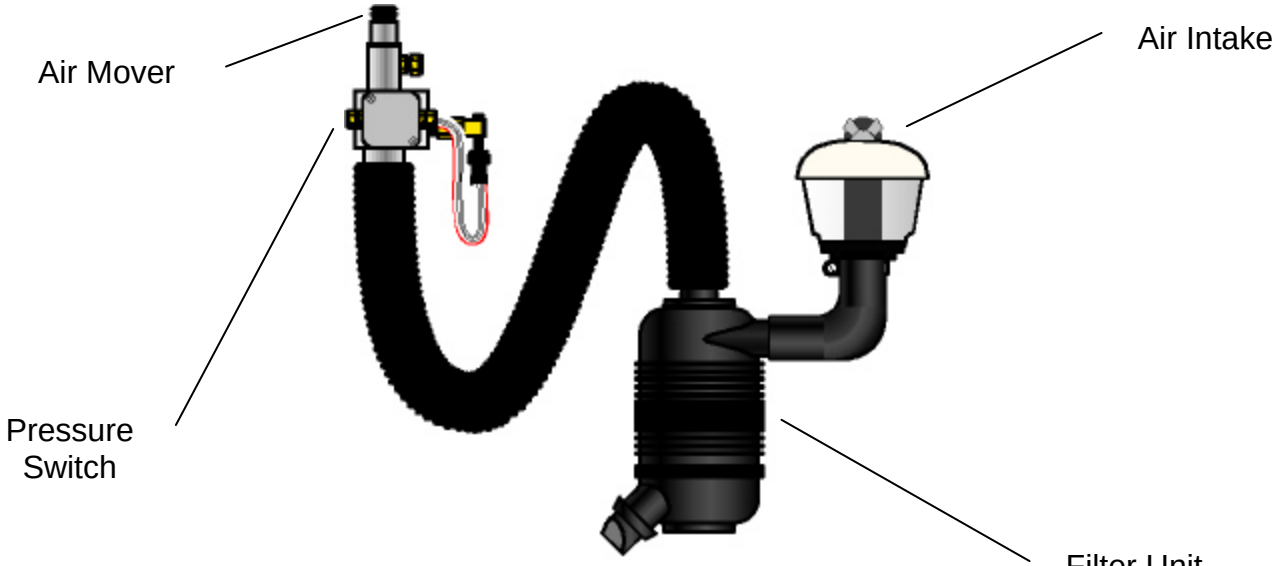
If the air purge supply fails, the instrument should be removed to avoid permanent damage. If no fail-safe shutter is fitted, and the process is still operating, the instrument should be removed immediately. With fail-safe shutters, the instrument can normally be left in place for a few days.



Fail Safe Shutter Air Purge Unit

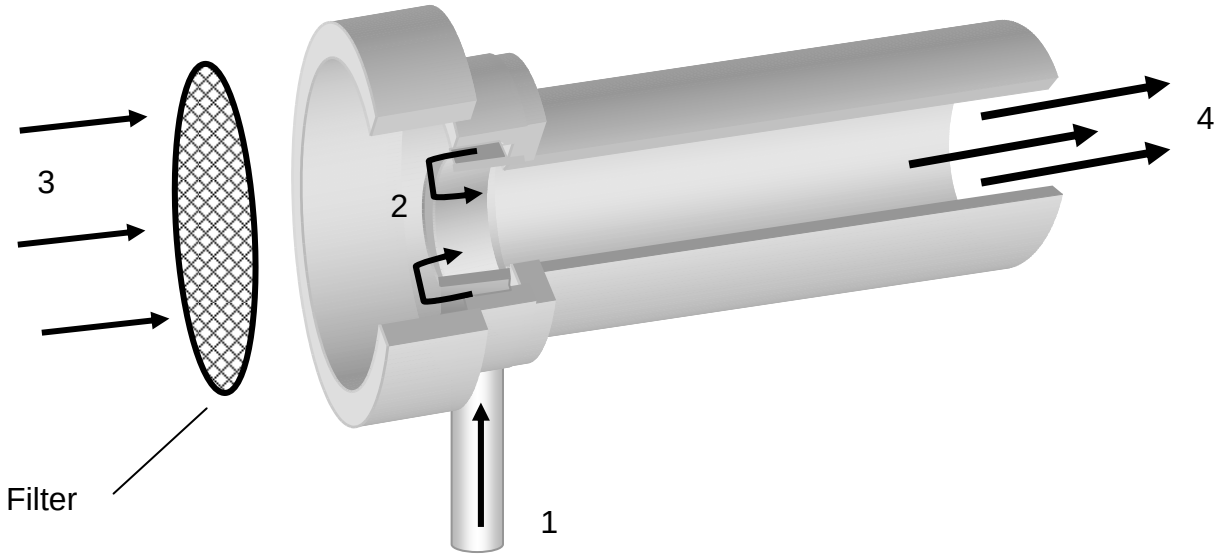
Air Movers

An air mover system may be used as a low cost alternative to air purge blower units, in order to maintain clear optical components and sight path. These typically generate lower pressure and air flow than blowers and can therefore only be used when there is little or no back pressure.



Filtered Air Mover with Pressure Switch

An air mover operates on the venturi principle, whereby a small volume of high velocity air (from a compressed air source) is connected to the side of the casting (1). This passes out through the nozzle jets, creating a venturi action (2), which induces a large volume of low velocity air (3) through the venturi and out of the air diffuser (4). The ratio of air supplied is dependent upon the design of the air mover casting.



Other Considerations for Air Movers

Ambient Dust Levels

In relatively clean environments it is feasible to use an air mover without a filter. A gauze filter is normally attached to the ambient air intake at the inlet of the air mover unit, to remove larger particles. Nevertheless, it is generally prudent to use a filter whatever the environmental conditions, as a precaution.

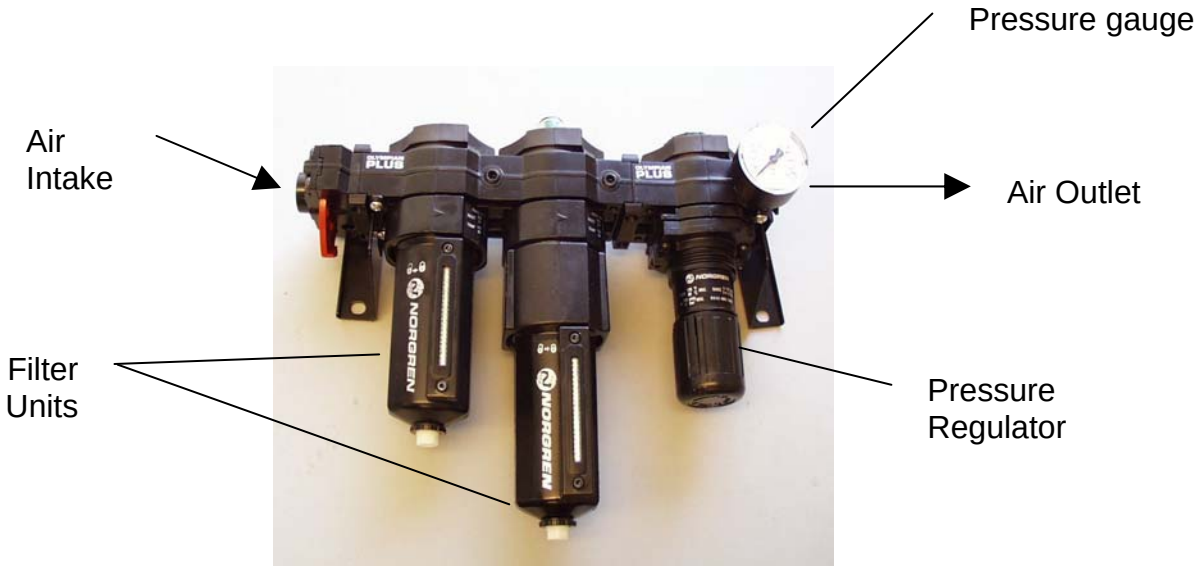
It is usually advisable to fit a filter system that provides double pass filtration, which is most suitable for high ambient dust levels. Ambient air first passes through a pre-filter where the larger dust particles are removed and collected, and then passes through a screen filter element which removes the smaller particles.

Pressure Switches

Uninterrupted purge operation is important to the operational reliability of all optical systems. Failure of the air mover can lead to contamination of the optics due to ingress of flue gas. A pressure switch can be used to indicate air failure and is set to operate when the airflow falls below a pre-set value (typically around 400 l/min). This contact closure can then be used to signal an alarm or to operate protective shutters on the instrument.

Compressed Air Filter System

It is essential that the compressed air supply is clean, dry and oil free. Filter systems are readily available to achieve this if the plant supply cannot be guaranteed in this respect. For obvious reasons, the ambient air must also be clean, which may require a suitable filter (see above).

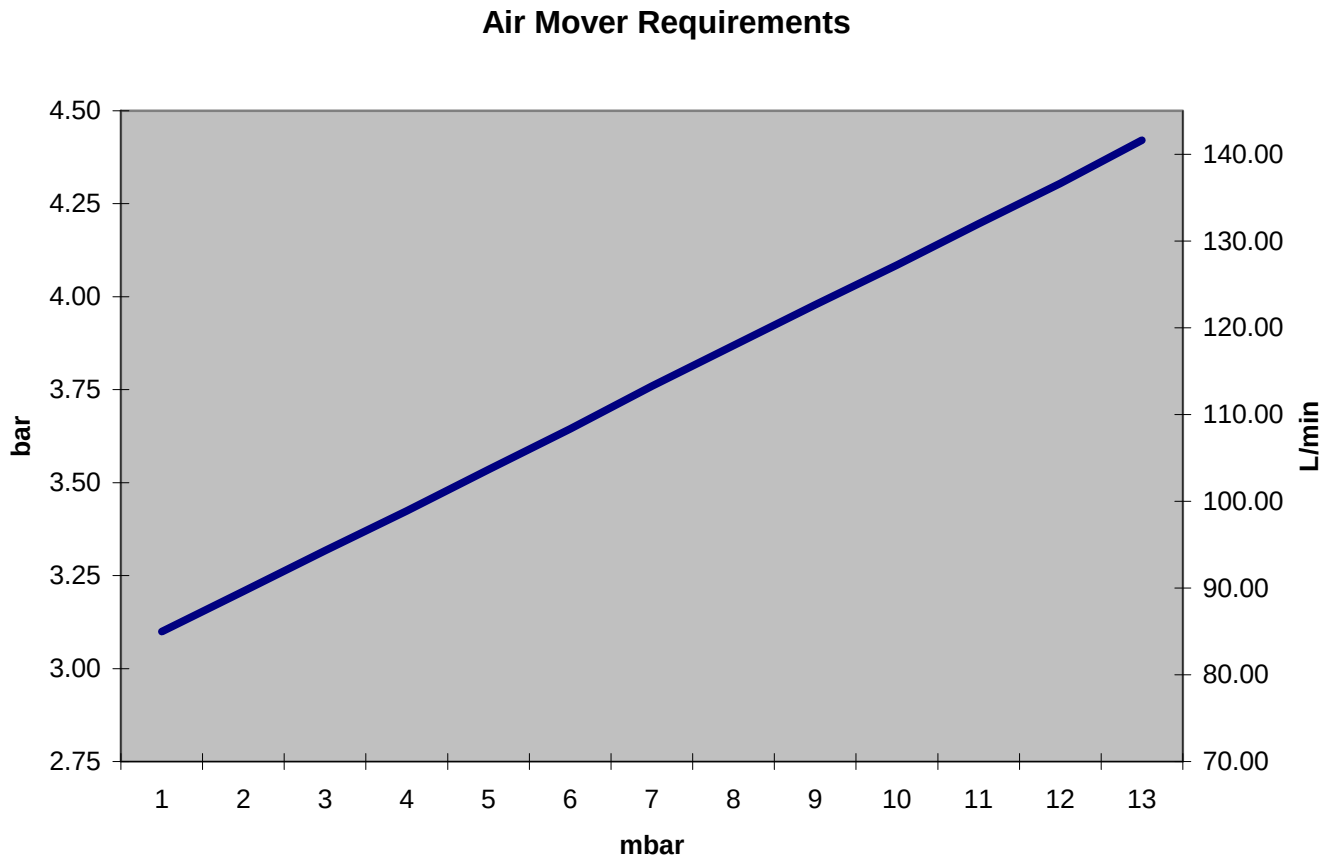


RECOMMENDATIONS FOR USING AIR MOVERS

It is important that the pressure and flow characteristics of the air mover system provide adequate supply to the air purge unit. There is no adjustment on the air mover system itself, all control is provided via the regulated compressed air supply.

Determining compressed air requirements

In order to set the flow and pressure correctly it is important to know the barometric pressure inside the duct or stack. Once this value is determined it is then possible to infer the required air pressure for the purge system. The graph below provides a useful indication of the required air pressure necessary to create adequate purge airflow for different duct pressures. The consumption of compressed air is also shown. This is a guide only, and detailed characteristics for the chosen device will need to be considered.



Graph showing Minimum air pressure (supplied to purge) vs. duct pressure and air consumption

Summary

This document is an overview, giving guidance on the basic issues of air purging. For further advice on specific applications, or more details, please contact Land Combustion or your local supplier.