DynOptic Systems Ltd
www.dynoptic.com

Air Supply for Optical Stack Monitor Purge Systems

Technical Note V1.1

DynOptic Systems Ltd – Furlong House, Crowfield, Brackley, Northamptonshire, NN13 5TW United Kingdom

Contents

Introduction

The performance of stack monitors based on open path optical measurement methods can be impaired by the build-up of dirt on the exposed optical surfaces from dust and soot in the flue gas. To minimise this effect it is common practice to provide an air purge system, which typically consist of an air-purge body, positioned between the optical instrument and the stack, supplied with a source of clean and dry purge air. The flow of air through the air-purge body keeps the hot, dirty and corrosive flue gas away from the optical surfaces and also helps to cool the instrument head. An illustration of such a system, using an air blower to supply purge air to two instrument heads, is shown in Figure 1.

The design of the air-purge body varies considerably from different manufacturers and to ensure correct operation the purge air supply must be correctly matched to the air-purge body. This technical note summarises some of the general issues that need to be considered when selecting an air supply and provides detailed requirements for use with DynOptic air-purge bodies. Our engineering team are also available to assist with the selection or definition of a suitable purge air supply.

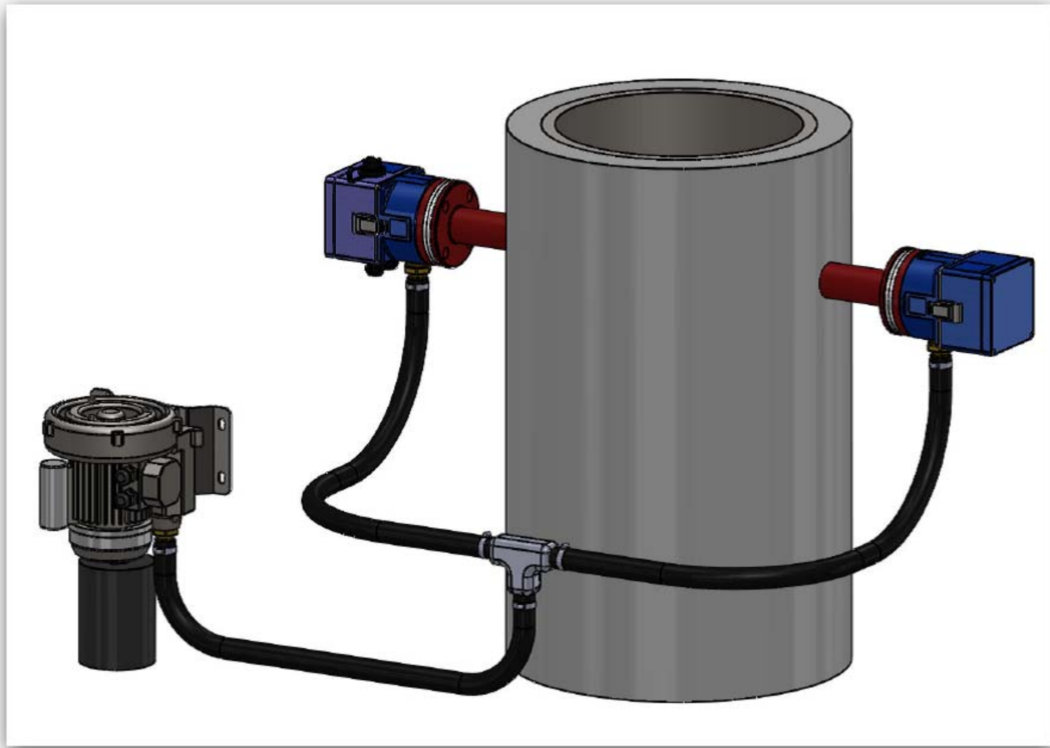


Figure 1: DynOptic stack mounted monitor, with two air-purge bodies, fed by a single blower

Purge Air Requirements

DynOptic air-purge bodies are designed to operate with an air flow into each body in the region of 50 to 200 litres/min. The lower flow rate is sufficient to overcome typical stack gas flow fluctuations and the upper flow rate is to prevent the flow of purge air from affecting the optical measurement.

Many optical stack monitors require two optical heads, one either side of the stack, as illustrated in Figure 1. In such a system it is common practice to use a single air supply to provide the purge air to both air-purge bodies. In this configuration the source of purge air must be able to supply 100 to 400 litres/min.

In some applications the stack, or measurement chamber, can be under a positive pressure. The effect of this is to force the hot, dirty, corrosive flue gas up the flange and onto the optical head. Under such conditions the purge air supply must be capable of providing the required flow rate and also have sufficient pressure to overcome the pressure of the stack. This requires the use of compressed air.

DSL recommend two alternative sources of air purge, an air blower, or compressed air. The basic advantages and issues with each type are summarised below and further design issues are discussed in the following sections.

Air Blower	Compressed Air
Low pressure high volume source of air. Well matched to the purge body requirements.	High pressure lower volume source of air. A large compressor reservoir capacity is needed to provide the required volume air flow.
Low cost **standalone** system.	Suitable in-line particle and oil mist filters are readily available for compressed air.
Uses ambient air, requires a good filter to keep it clean. Inlet air must be dry (low humidity).	Capable of providing a high pressure flow for use in positive stack pressure applications.
Blower must be fixed relatively close to the purge bodies (<50m).	Compatible with a DSL fail safe shutter

Table 1: Summary of alternative sources of purge air

Air Blower

An air blower consists of a rotating fan arranged to suck air in to an inlet port and push air out of the outlet port. The performance of a blower is generally specified by two parameters, the maximum differential pressure it can provide at the outlet port with no air flow, and the maximum air flow with no pressure loss. Ideally the blower specification will also provide a pressure flow performance graph, an example of which is illustrated in Figure 2.

A typical requirement for a DSL air purge source is to be able to provide an air flow of at least 100 litre/min. For the blower performance illustrated below this flow rate can be achieved provided the total pressure loss in the system is less than ~90 mbar.

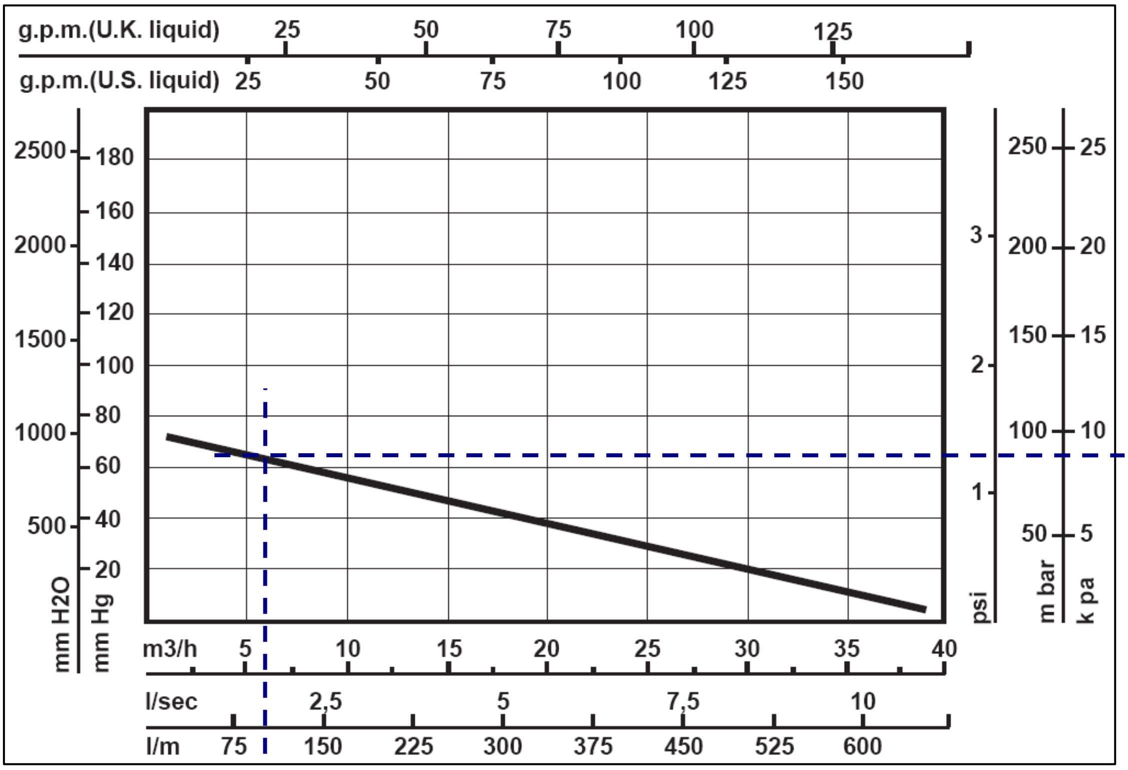


Figure 2: Example of a blower performance curve

General Blower Requirements

The main contribution to the pressure loss in an air purge system is the internal design of the air-purge body. However, some pressure is also lost in the tubing from the blower to the purge bodies. To minimise the system pressure loss the tubing should have a large internal diameter (i.e. 25mm) and the total length must be as short as practical.

Table 2 summarises the minimum blower performance recommended for use with two DynOptic air-purge bodies when used with tubing that has an internal diameter of 25mm and a maximum length of 50m.

	Value
Maximum Flow Rate	**>0.007m^3/s >24m^3/hr >400 litres/min >14 cfm**
Maximum Differential Pressure	**>3.0x10^3 Pa >30 mbar >0.4 PSI**

Table 2: Blower performance required to supply two DynOptic air purge bodies

Blower Inlet Filter

The purge air produced by the blower must be clean, dry and free from dust and aerosols, in order to prevent it contributing to the measured stack dust or contaminating the optics. It is recommended that the air going into the blower comes from a relatively clean and dry environment. In addition a good air filter is required. The recommended performance of a filter for the blower inlet is summarised in Table 3.

Parameter	Value
Particle Filter Size	**<5µm**
Maximum working flow rate	**>0.005 m^3/s >18 m^3/hr >300 l/min >10 cfm**
Pressure Drop (at working flow rate)	**<200 Pa <2 mbar <0.03 PSI**

Table 3: Recommended performance of blower inlet filter

DynOptic Systems Blower Kit (DSL-BK40B)

DynOptic offers a standard blower kit for use with our air-purge bodies. This unit is designed for applications with a total tubing length up to 50m. A summary of the blower kit is provided below.

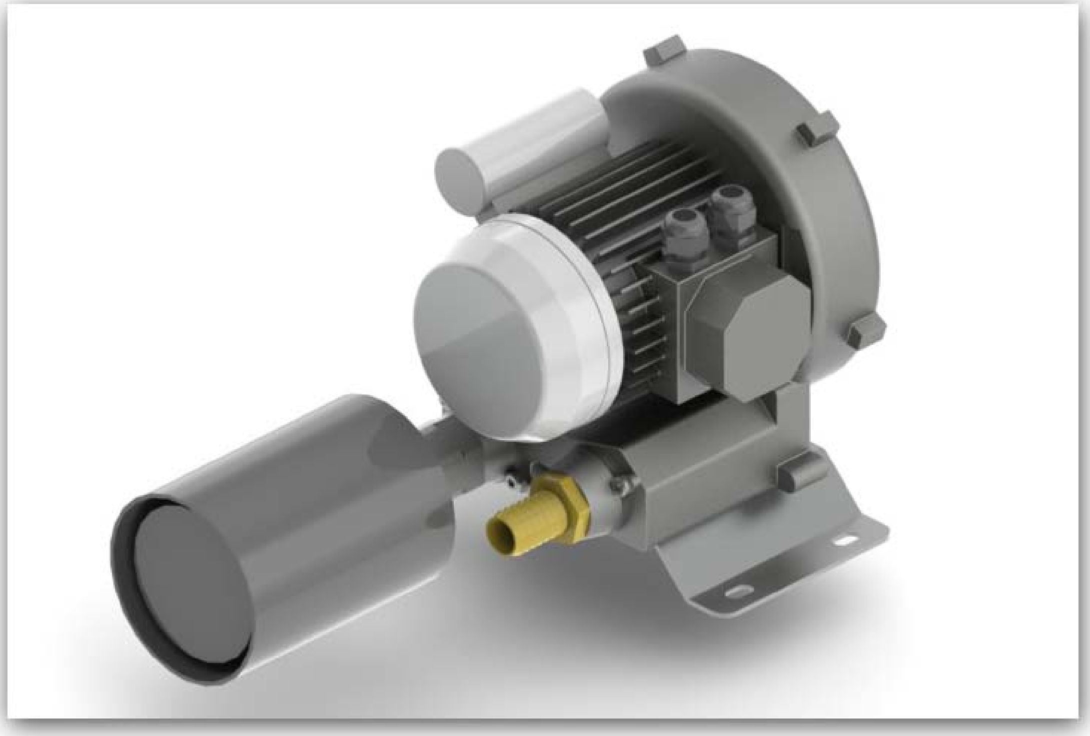
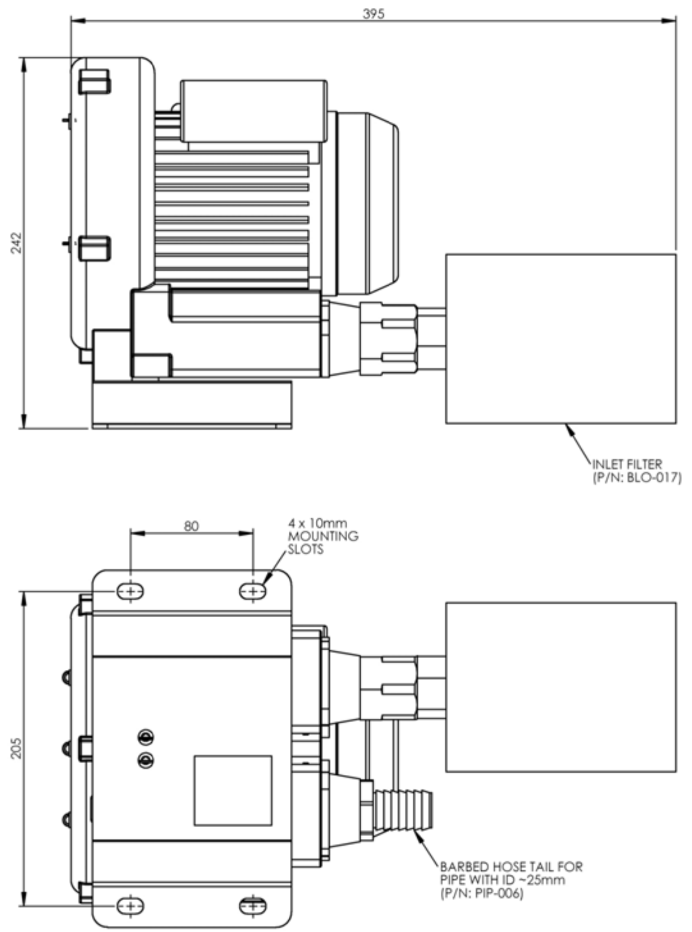


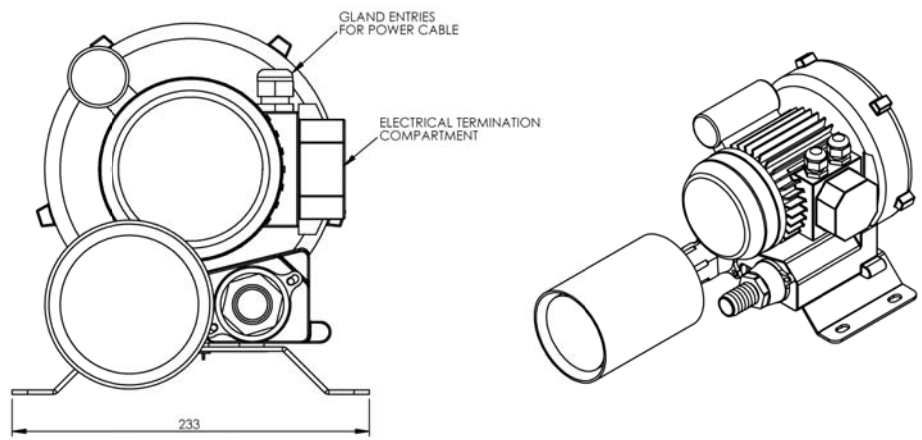
Figure 3: DSL-BK40B Blower

Part No.	Description	Quantity
Parts supplied with blower DSL-BK40B		
PIP-006	Barbed brass hosetail (1" BSPT to 25mm)	**3**
PIP-016	Plastic T-piece splitter for 25mm ID hose	**1**
HDW-223	"Jubilee" clip for securing hose connections	**6**
BLO-017	Air inlet filter	**1**
Accessories available for blower DSL-BK40B		
PIP-017	25mm ID flexible air hose. Supplied in lengths from 0.5 up to 50m.	
MTL-271	Stainless steel weather cover, powder coated, colour blue.	

Table 4: Parts Supplied & Accessories Available for the BK40B

REV.	DESCRIPTION	DATE
1	ORIGINAL	19/01/2012
2	ADD PARTS LIST TABLES	27/02/2013





Definitive list of all parts supplied with standard DSL-BK40B-XXX

Part No.	Description	Qty.
PIP-006	Barbed brass hose tail (1"BSPT to 25mm)	3
PIP-016	Plastic T piece splitter for 25mm ID hose	1
HDW-223	"Jubilee" clip for securing hose connections	6
BLO-017	Air inlet filter	1

Note: some parts are supplied loose and are not shown on this drawing

Accessories available for use with DSL-BK40B-XXX

Part No.	Description
PIP-017	Suitable 25mm ID flexible air hose - supplied in 1m lengths, to a maximum continuous length of 50m
MTL-271	Stainless steel weather cover, powder coated colour blue

SIGNATURE:
STOCK RECORD UPDATED [ ]
DEFINITIVE PDF ARCHIVED WITH PRODUCTION [ ]

DynOptic Systems Ltd
(incorporating Tunnel SensorsLtd)
Furlong House, Crowfield,
Brackley, Northants, NN13 5TW
United Kingdom
www.dynoptic.com
www.tunnelsensors.com

MATERIAL:
WEIGHT:
FINISH:
STATE: CLEAN, DRY AND DEBURRED

UNLESS OTHERWISE SPECIFIED: DIMS ARE IN mm AFTER FINISHING; LINEAR TOLERANCE: +/-0.1; ANGULAR TOLERANCE: +/-0.1; SURFACE FINISH: 1.2um Ra; THIRD ANGLE PROJECTION

TITLE: DSL-BK40B-XXX BLOWER DETAILS

DWG NO: REF-020-02 | A3 | SHEET 1 OF 1

DATE: 27/02/2013 | DO NOT SCALE DRAWING | SCALE: 1:3

Blower Installation Issues

When defining the location of a blower based air purge system some other factors need to be considered.

Filter Position

The inlet air filter supplied with the blower has a weather proof cover. When the blower is mounted this filter must be positioned pointing downwards to minimise the effect of large particles falling into the filter. If the filter is to be exposed to rain position the filter away from flat surfaces to avoid rain splashing up into the filter.

T-Piece

If the air flow from the blower needs to be split, to feed air-purge bodies on either side of the stack, then this can be achieved using a simple T-piece. To minimise air flow losses it is recommended that the T-piece is mounted as close to the blower as possible. Ideally the length of any tubing from the blower outlet port to the T-piece should be less than 2m.

Tube Length Balance

If the blower is supplying air to two air-purge bodies then the tubing from the T-piece to each one should be the same length. In this way the air flow will be balanced in both air-purge bodies. If one tube length is significantly shorter than the other then the pressure losses in that tubing will be less and its flow rate will be higher.

It is not always practical to maintain equal lengths of tubing. The recommendation is that for short lengths the difference between the tube lengths should be no more than 5m and for long lengths the relative lengths of the tubing in the two sections should be less than 2:1.

Height Above Blower

If the air-purge body is significantly higher than the blower then some of the available differential pressure will be used to overcome the height difference. To prevent this reducing the efficiency of the system it is recommended that any height difference should be less than 20m.

Compressed Air

If a suitable source of compressed air is available at the stack then this can be used as the purge air, provided careful consideration is taken to cleaning and controlling the air flow.

Compressed air should never be supplied directly to the inlet of an air-purge body. The high pressure will produce very high airflows and the contamination in the compressed air is very likely to affect the optics. To use compressed air it is necessary to correctly filter the air to remove particulates and any oil mist before it enters the air purge body. At the purge body a flow restrictor is used to achieve the required flow rate from the high pressure air.

A practical system arrangement is illustrated in the figure below; all of the parts required to implement this system are available from DynOptic.

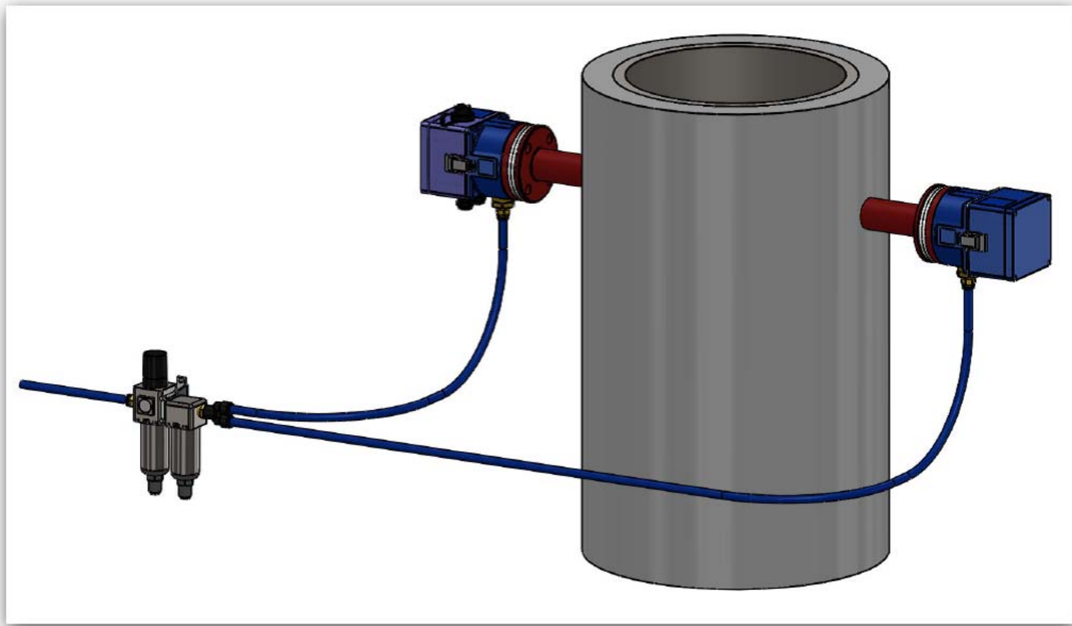


Figure 4: DynOptic stack mounted monitor, with two air-purge bodies, fed by compressed air

Flow Restrictor

The pressure available from a compressed air system is generally very high (>5bar). If this was applied directly to the inlet port of an air-purge body the air flow would too high. To control the air flow a flow restrictor is available from DynOptic (part no. MTL-327). This brass fitting attaches directly to the 1” BSPT inlet of the air-purge body as illustrated in the following drawing.

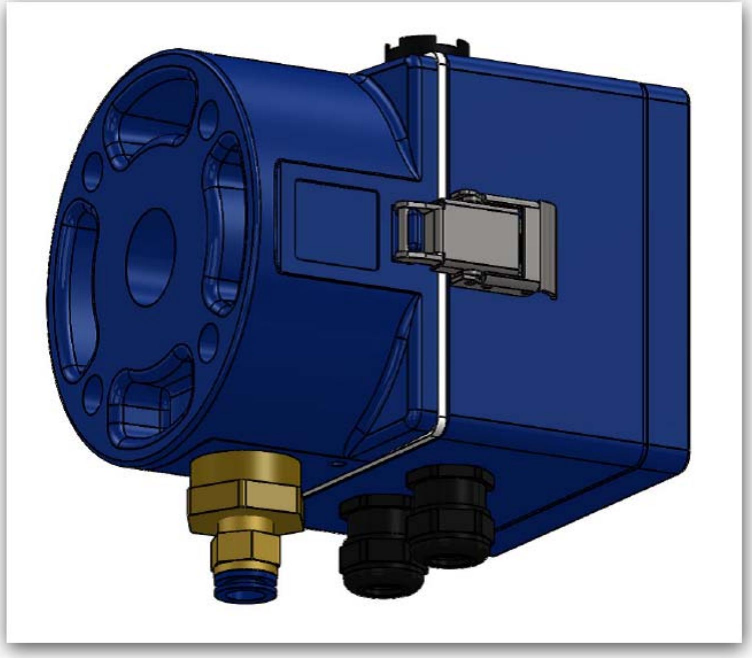


Figure 5: Air-purge body with flow restrictor

With the flow restrictor in place the desired airflow is achieved by controlling the pressure of the compressed air at the inlet. The typical variation of air flow through the air-purge body as a function of the pressure of the supplied compressed air is shown below. The recommended operating pressure is 3 to 5 bar.

If the system is operating on a positive pressure stack then a higher operating pressure will be required to overcome the gas pressure within the stack.

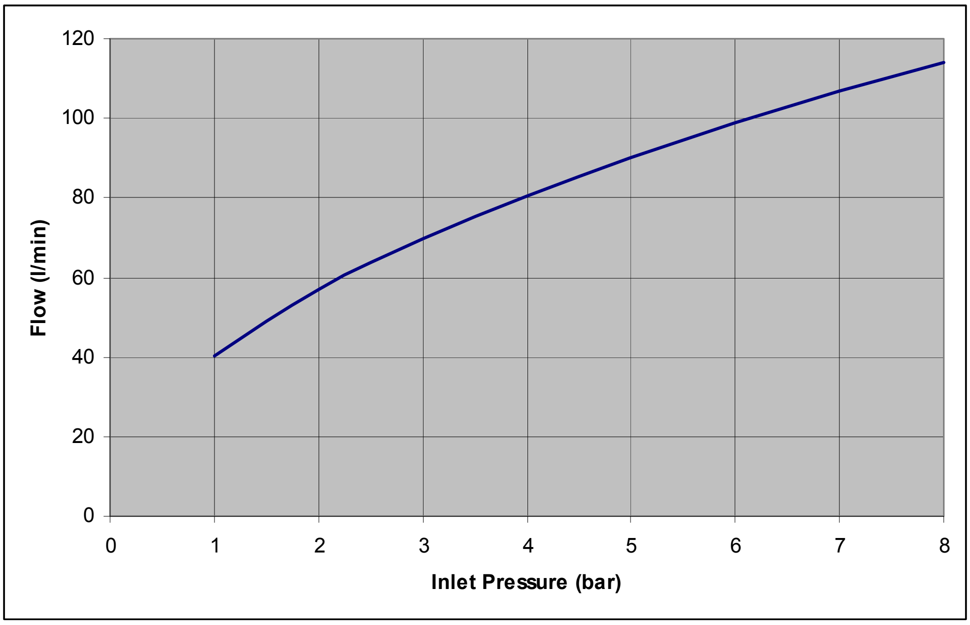


Figure 6: Airflow in a DynOptic air-purge body with flow restrictor, as a function of input air pressure

Pressure Regulator

To control the pressure, and hence the air flow, at the inlet to the air-purge body, it is recommended that a pressure regulator is used at the input to the filtering stage. The basic requirements for such a pressure regulator are summarised below.

Parameter	Value
Minimum Adjustment Range	**3 to 5 bar (44 to 73 psi)**
Flow Rate	**>0.003 m^3/s >12 m^3/hr >200 l/min >7 cfm**

Table 5: Recommended performance of pressure regulator

Filtering

Industrial compressed air is not usually clean enough to use directly as purge air, it can contain water and oil as well as particulates, all of which can affect the optical measurements. It is therefore necessary to provide a well filtered compressed air supply for air purge applications. The ideal filtration stage should consist of a 5µm particulate filter, to remove the larger particles, followed by a fine oil mist filter. The purity level and flow rate required at the output of the filtration stage is summarised below.

Parameter	Value
Particle Filter Size	**0.01µm**
Filtered Oil Level	**0.1 mg/m^3**
Flow Rate	**>0.003 m^3/s >12 m^3/hr >200 l/min >7 cfm**

Table 6: Recommended performance of compressed air in-line filter

DynOptic Systems Compressed Air Kit (ASY-181)

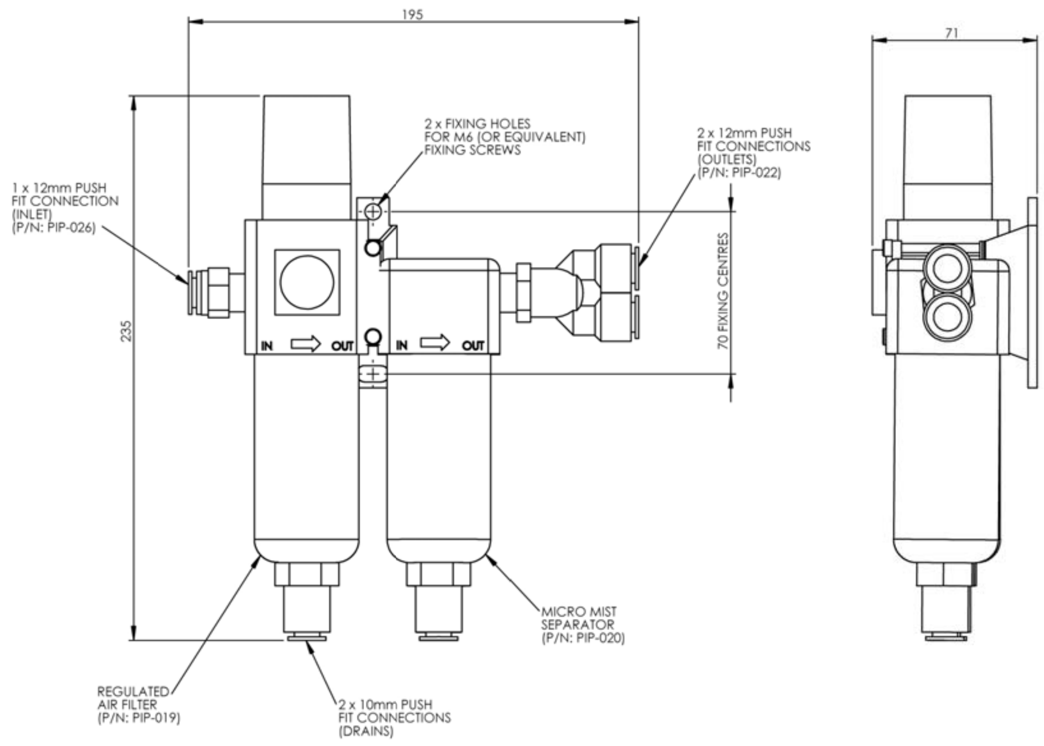
DynOptic provide a kit of parts that simplifies the design and implementation of a compressed air based purge air system. The basic kit contains the flow restrictors and a regulated air filter assembly (ASY-180) as illustrated below. The regulator dial measures the line pressure in units of MPa (1bar = 0.1MPa) and the line connection ports are 12mm push fit.

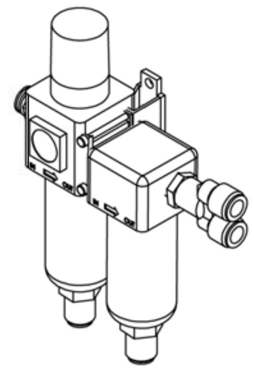
Figure 7: Regulated filter assembly (ASY-180)

Part No.	Description	Quantity
Parts supplied with compressed air kit ASY-181		
PIP-019	Regulated air filter assembly	**1**
PIP-020	Micro mist separator assembly	**1**
PIP-021	Mounting bracket assembly	**1**
PIP-022	Y-piece tube fitting (3/8” BSP male to 12mm push-fit)	**1**
PIP-026	Straight tube fitting (3/8” BSP male to 12mm push-fit)	**3**
PIP-030	Sealing bung for 12mm push fitting	**1**
MTL-327	Flow restrictor (1” BSPT male to 3/8” BSP female)	**2**
Accessories available for the compressed air kit		
ASY-182	Replacement filter element pack. 5 off air filter elements and 5 of micro mist separator elements	
PIP-025	20m reel of nylon pneumatic tubing. 12mm OD	
PIP-033	Cutting tool for tubing	

Table 7: Parts supplied with compressed air kit ASY-181

REV.	DESCRIPTION	DATE
1	ORIGINAL	05/02/2013
2	ADD PARTS LIST TABLES	27/02/2013
3	ADD TUBE CUTTING TOOL TO SUPPLIED PARTS LIST	22/03/2013
4	MOVE TUBE CUTTING TOOL TO ACCESSORY TABLE	25/03/2013





Definitive list of all parts supplied with standard ASY-181

Part No.	Description	Qty.
PIP-019	Air filter assembly	1
PIP-020	Micro mist separator assembly	1
PIP-021	Mounting bracket assembly	1
PIP-022	Y piece tube fitting (3/8" male to 12mm push-fit)	1
PIP-026	Straight tube fitting (3/8" male to 12mm push-fit)	3
PIP-030	Sealing bung for 12mm push-fit fitting	1
MTL-327	Flow restrictor (1" BSPT male to 3/8" female)	2

Note: some parts are supplied loose and are not shown on this drawing

Accessories and spares available for use with ASY-181

Part No.	Description
ASY-182	Replacement filter element pack, 5off air filter elements and 5off micri mist separator elements
PIP-025	20m reel of nylon pneumatic tubing, 12mm OD
PIP-033	Cutting tool for 12mm tubing

SIGNATURE:
STOCK RECORD UPDATED [ ]
DEFINITIVE PDF ARCHIVED WITH PRODUCTION [ ]

DYNOPTIC TUNNEL SENSORS
DynOptic Systems Ltd
(incorporating Tunnel SensorsLtd)
Furlong House, Crowfield,
Brackley, Northants. NN13 5TW
United Kingdom
www.dynoptic.com
www.tunnelsensors.com

CONFIDENTIAL

MATERIAL:
WEIGHT:
FINISH:
STATE: CLEAN, DRY,AND DEBURRED

UNLESS OTHERWISE SPECIFIED: DIMS ARE IN mm AFTER FINISHING; LINEAR TOLERANCE: +/-0.1; ANGULAR TOLERANCE: +/-0.1; SURFACE FINISH: 1.2um Ra; THIRD ANGLE PROJECTION

TITLE: ASY-181, REGULATED COMPRESSED AIR FILTER ASSEMBLY DETAILS

DWG NO: REF-054-04

A3

SHEET 1 OF 1

DATE: 25/03/2013

DO NOT SCALE DRAWING

SCALE: 1:2

Revision Control

Version	Revision Date	Revision Details	Author
V1.0	23/04/2013	Original.	Colin Edge / Dominic Sheedy
V1.1	8/11/2013	Included positive pressure stack information to the compressed air section.	Colin Edge

All technical details and specifications are subject to change without notice