High Quality Compressed Air from Generation to Application

A Guide to ISO 8573.1:2001 Air Quality Classes

www.domnickhunter.com

domnick hunter is an international group of companies specialising in the high quality filtration, separation and purification of compressed air, gases and liquids.

domnick hunter has over 40 years of experience in the purification industry and has been instrumental in the development of both the international standards for compressed air and the standards for filter testing. domnick hunter continues to work closely on new standards with such governing bodies as British Compressed Air Society (BCAS) the International Standards Organisation (ISO), PNEUROP and the Compressed Air and Gas Institute (CAGI).

This document provides an introduction to ISO 8573.1 the international standard for compressed air quality, purification equipment required to achieve the standards and how to apply the standard to typical applications.

ISO 8573 – The compressed air quality standard

ISO8573 is the group of international standards relating to the quality of compressed air. The standard is made up of nine separate parts, part 1 specifying the quality requirements of the compressed air and parts 2 – 9 specifying the methods of testing for a range of contaminants.

In 2001, the ISO 8573.1 air quality standard was amended in an effort to provide a more stringent air quality specifications for critical applications and the latest revision is expressed as ISO8573.1 : 2001.

Within ISO8573.1 : 2001, a number of quality classes are shown in tabular form, each specifying the maximum amount of solid particulate, water and oil allowable per cubic metre of compressed air.

Class	Solid Particulate Maximum number of particles per m^3			Water Pressure Dewpoint °C	Oil (incl. vapour) mg/m^3
	0.1-0.5micron	0.5-1 micron	1.0-5micron		
1	100	1	0	-70	0.01
2	100,000	1,000	10	-40	0.1
3	-	10,000	500	-20	1
4	-	-	1,000	3	5
5	-	-	20,000	7	-
6	-	-	-	10	-

Using the classes, a maximum level can be specified for each contaminant which is expressed as

ISO 8573.1 : 2001 Class Solid Particulate - Water - Oil

For example

ISO 8573.1 : 2001 Class **1.2.1**

Which equates to

100 Solid Particles 0.1-0.5 micron/m^3

1 Solid Particle 0.5 - 1 micron/m^3

0 Solid Particles 1 - 5 micron/m^3

Water Vapour Pressure Dewpoint -40°C

Oil aerosol and vapour 0.01 mg/m^3

Solid Particulate

The changes introduced to ISO 8573.1 in 2001 were specific to particulate contamination, however the significant improvements in particulate cleanliness are not always apparent when comparing the tables from the 1991 and 2001 editions.

Extract from ISO 8573 : 1991 Part 1 for particulate (previous standard)

QUALITY CLASS	DIRT Particle size in micron	Concentration mg/m^3
1	0.1	0.1
2	1	1
3	5	5
4	15	NOT SPECIFIED

Extract from ISO 8573 : 2001 Part 1 for particulate (latest standard)

Class	Solid Particle Maximum number of particles per m^3		
	0.1-0.5micron	0.5-1 micron	1.0-5micron
1	100	1	0
2	100,000	1,000	10
3	-	10,000	500
4	-	-	1,000
5	-	-	20,000
6	-	-	-

As can be seen above, the two editions of the standard do not present particle contamination requirements in the same way.

The table from the 1991 edition shows a maximum size rating for the solid particulate and a concentration whilst the 2001 edition shows both a size rating for the particulate and the maximum number of particles allowed per cubic metre. To show the differences between the two tables and highlight the improved air quality requirements, the concentration levels shown in the 1991 edition must be converted into a quantity of particles.

Using this method, shows that class 1 from the 1991 edition permitted a maximum of 191 billion particles per cubic metre, whereas the 2001 edition only allows 101. The table below highlights exactly how much cleaner the 2001 edition is.

QUALITY CLASS	2001 EDITION X TIMES CLEANER THAN 1991 EDITION
1	1.9 billion times cleaner than 1991 Class 1
2	19 thousand times cleaner than 1991 Class 2
3	7 thousand times cleaner than 1991 Class 3
4	-

When specifying purification equipment, consideration should be given to the requirements of the user. It should not be assumed that an application that previously required particulate removal to class 1 still requires this level today.

Wet particulates are removed using a coalescing type filter which provide the additional function of removing oil / water aerosols. Dry particulate filters are also available and are typically used after adsorption dryers or at the point of use. The test methods for measuring solid particles are covered in ISO 8573.4

Water

The values for water refer to water vapour and are expressed as pressure dewpoints in degree's Celsius. Water vapour is removed using a dryer, of which there are various types available. Of the six dewpoint levels shown in the quality classes, the first three are typical of dewpoints achieved by adsorption dryers and the last three are those achieved by refrigeration dryers. The test methods for the measurement of pressure dewpoint are covered in ISO 8573.3

Oil

The ISO8573.1:2001 table shows the recommended maximum levels for oil including vapour. Oil aerosols can be removed by using a coalescing type filter, whilst oil vapour must be removed using an adsorption type filter. Removal of aerosol & vapour will require the use of both filter types. The total value for oil in a system is a combination of test results from both ISO8573.2 & ISO8573.5.

Micro-organisms

Many applications within the food and pharmaceutical industries require air which is free from micro-organisms such as bacteria, viruses, yeast and fungi. ISO8573.1 considers these as solid contaminants and is limited to identifying systems as either sterile or non-sterile. The test methods for measuring micro-organisms are covered in ISO 8573.7

Air quality & energy efficiency

Choosing purification equipment **for today's modern production facilities** that can deliver the right balance of air quality and low cost of ownership can be a daunting task.

At domnick hunter, uncompromising performance and energy efficiency are paramount and in these energy conscious days, selecting domnick hunter purification equipment not only means that you get air quality to international standards but also ensures operating costs are kept to a minimum.

domnick hunter

ISO 9001:2000 ISO 14001

BSI REGISTERED Q 05240 — UKAS QUALITY MANAGEMENT 003

ISO International Standards Organisation

BSI QUALITY ASSURANCE

INTERNATIONAL APPROVALS

CE

Lloyd's Register

CSA

CRN

ASME VIII Div 1 ASME VIII National Board

AS1210

BCAS British Compressed Air Society

Member Compressed Air and Gas Institute CAGI

pneurop

VDMA

Druckluft effizient

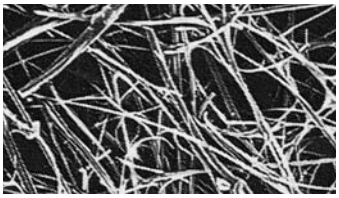
BULK LIQUID REMOVAL

GRADE WS
High Efficiency Water Separators

WS water separators employ centrifugal and impingement separation techniques for the removal of up to 99% of bulk liquid contamination.

DEPTH FILTRATION (COALESCING & DRY PARTICULATE FILTER)

Depth filters generally constitute a fibrous material made into flat sheets of randomly distributed formed nanofibres. Depth filters rely on the density and thickness of the fibre layers to trap the particulate. Removal of the particulate occurs both on the surface and within the depth of the media. The size of the particle that can be captured has finite limits dictated by the diameter of the fibres used in the media construction and the degree of free space between the fibres. By using this method of filtration, large quantities of particulate can be captured before blockage occurs.



Nanofibre filter media

GRADE AO
High Efficiency General Purpose Protection

Particle removal down to 1 micron, including water and oil aerosols.
Maximum remaining oil aerosol content : 0.6 mg/m^3 at 21°C / 0.5 ppm(w) at 70°F.

GRADE AA
High Efficiency Oil Removal Filtration

(Precede with Grade AO filter)
Particle removal down to 0.01 micron, including water and oil aerosols.
Maximum remaining oil aerosol content : 0.01 mg/m^3 at 21°C / 0.01 ppm(w) at 70°F.

GRADE AR
General Purpose Dust Filtration

Dry particle removal down to 1 micron

GRADE AAR
High Efficiency Dust Filtration

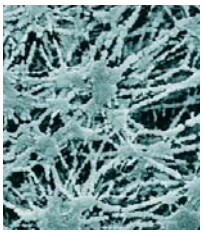
Dry particle removal down to 0.01 micron.

HIGH FLOW BIO-X
Sterile Air / Particulate Free

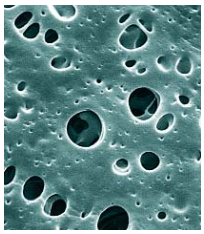
Full retention of bacteria, viruses and particulate. Based on depth filter technology. Retention correlated to an aerosol bacterial and viral challenge.

MEMBRANE FILTRATION

Microporous membrane filters remove contaminants by a combination of mechanisms. Larger particles and micro-organisms are retained by size exclusion / sieve captured on the membrane surface. Smaller bacteria and viruses (as small as 0.02 micron) are fully retained within the depth of the membrane, and significant retention takes place at even smaller sizes. Membranes used for air filtration do not have such a defined pore structure as those associated with liquid applications. They have a structure that is similar to that of a depth media apart from the pores being significantly smaller in size.



Air Membrane



Liquid Membrane

HIGH FLOW TETPOR MEMBRANE FILTERS
Sterile Air / Particulate Free

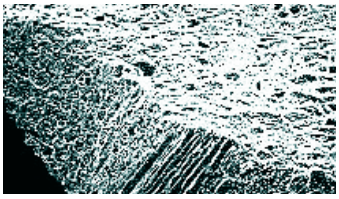
Full retention of bacteria, viruses and particulate. Based on membrane technology. Retention correlated to a liquid bacterial challenge (ASTM 838-38) as well as bacterial and viral aerosol challenge. Used for the most critical of applications including medical, pharmaceutical / aseptic packaging and electronics.

OIL-X EVOLUTION Depth filters

High Flow BIO-X Depth Filters
High Flow TETPOR Membrane Filters

ADSORPTION FILTRATION

Adsorption filter elements are made up of various materials in granular form arranged in a deep bed. This filtration technique relies on contact or dwell time between the air and the adsorption media. It is during this time that vapour molecules are attracted to and held on the surface area of the media. Activated carbon is employed for oil vapour removal using this technique with its high affinity for oil vapour and its extremely high surface area, created by its porous structure. A handfull of activated carbon has a surface area larger than a football field. Adsorption elements have a limited life, which is affected by many factors, principally temperature and relative humidity.



Activated carbon

GRADE ACS, AC & OVR
Oil Vapour & Odour Removal

(Precede Grade ACS, AC and OVR with Grade AA filter)
Maximum remaining oil vapour content : 0.003 mg/m^3 at 21°C / 0.003 ppm(w) at 70°F.

REFRIGERATION DRYING

A refrigeration dryer extracts water vapour by the application of cooling and subsequent condensation. Condensation of water vapour occurs on internal cooling surfaces and is then separated and drained. Refrigeration dryers are designed to deliver pressure dewpoints above 0°C to prevent freezing on the internal cooling surfaces. Air is reheated before it re-enters the system to prevent piping from 'sweating' in humid conditions.

Refrigeration Dryers

CRD Refrigeration Dryers Delivering Pressure Dewpoints of 3°C (37°F) & 10°C (50°F).

OVR 6000 hour Oil Vapour Removal

CRD Refrigeration Dryers

ADSORPTION DRYING

An adsorption dryer extracts water vapour from the compressed air by attraction and adhesion of molecules in a gaseous or liquid phase to the surface of an adsorbent material. The adsorbent can often be regenerated by removing the adsorbed water. Although the principle of water removal is common, various methods of regenerating the adsorption bed are available and include heatless regeneration (Pressure Swing Adsorption), heat regenerative (Thermal Swing Adsorption), vacuum regeneration and blower regeneration.

Adsorbent Desiccant Bead

High Efficiency Adsorption Dryers

Delivering Pressure Dewpoints of -70°C (-100°F) / -40°C (-40°F) / -20°C (-4°F)

A full range of PSA, TSA, Vacuum & Blower regeneration adsorption dryers are available from domnick hunter for compressor room and point of use applications.

Adsorption dryers are selected to match not only air quality requirements, but also capital and operational cost targets of the user. Dryer types include:

PNEUDRI - Modular PSA / TSA Regeneration
Classic - Twin Tower PSA / TSA & Blower Regeneration
DTV - Vacuum Regeneration

PNEUDRI Modular Adsorption Dryers

DTV and Classic Twin Tower Adsorption Dryers

High quality compressed air from generation to application

The quality of air required throughout a typical compressed air system can vary. The extensive range of purification equipment available from domnick hunter is ideal for both centralised and decentralised compressed air systems. This allows the user to tailor the quality of air for each specific application, from general purpose ring main protection, through to critical clean dry air (CDA) point of use systems.

domnick hunter can tailor its range of purification equipment to exactly match system requirements, ensuring both capital and operational costs are kept to a minimum.

To achieve the levels of cleanliness specified by ISO 8573.1 2001 a careful approach to system design, commissioning and operation must be employed.

It is highly recommended that the compressed air is treated prior to entry into the distribution system as well as at each usage point or application.

This approach to system design provides the most cost effective solution to system purification as it not only removes the contamination already in the distribution system, it ensures that only the most critical area's receive air treated to the highest level.

The typical system layout drawings included in this document show installations with purification equipment in the compressor room to protect the distribution system and also at the point of application.

In many instances the compressed air system will be supplying air to more than one application and although the purification equipment specified in the compressor room would remain unchanged, the point of use protection will vary depending upon the air quality requirements of each application.

For example, air used for the pneumatic conveying of food stuffs or ingredients will require the highest level of purification, whilst the air used to operate the pneumatics on the production machinery may only require general purpose protection.

Product Selection

Class	Solid Particulate Maximum number of particles per m^3			Water Pressure Dewpoint °C	Oil (incl. vapour) mg/m^3
	0.1-0.5micron	0.5-1 micron	1.0-5micron		
1	100	1	0	-70	0.01
2	100,000	1,000	10	-40	0.1
3	-	10,000	500	-20	1
4	-	-	1,000	3	5
5	-	-	20,000	7	-
6	-	-	-	10	-

Solid Particulate

CLASS	FILTRATION GRADES
Class 1	High Flow BIO-X / High Flow TETPOR (Requires pre-filtration)
Class 2	AO + AA (AR+AAR for dry particulate)
Class 3	AO (AR for dry particulate)

Water

CLASS	DRYER
Class 1	PNEUDRI / Classic / DTV Sized for –70°C PDP
Class 2	PNEUDRI / Classic / DTV Sized for –40°C PDP
Class 3	PNEUDRI / Classic / DTV Sized for –20°C PDP
Class 4	CRD Refrigeration Dryer Sized for +3°C PDP
Class 5	CRD Refrigeration Dryer Sized for +3°C PDP
Class 6	CRD Refrigeration Dryer Sized for +10°C PDP

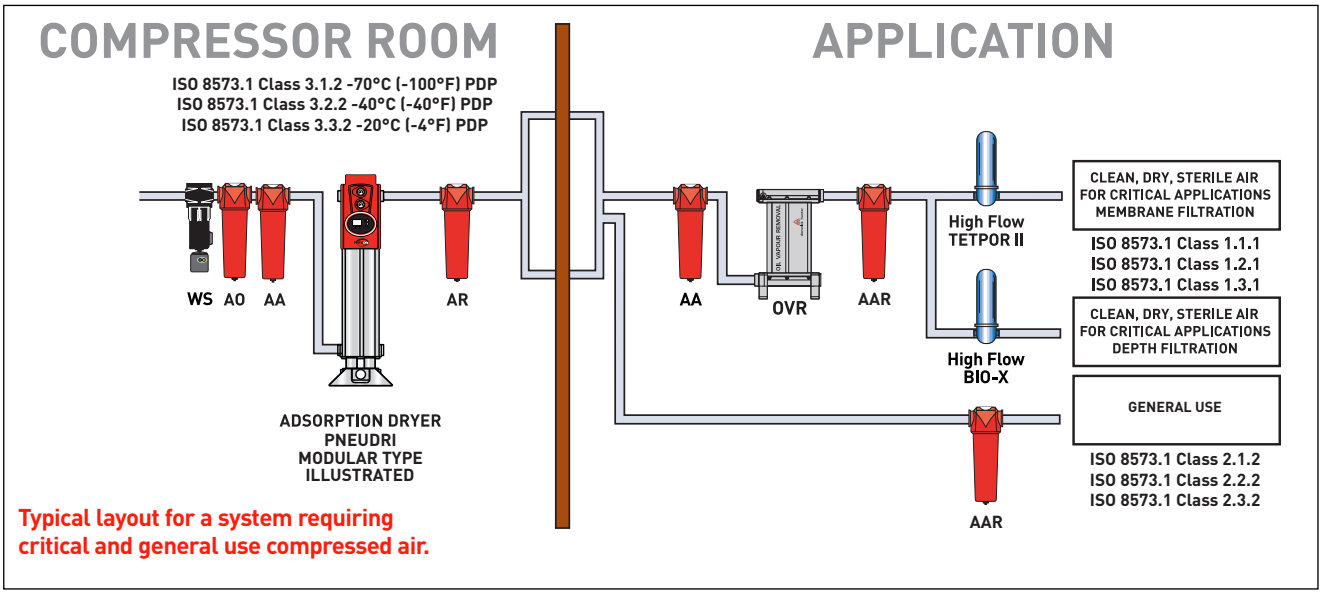
Oil

CLASS	FILTRATION GRADES
Class 1	AO + AA + OVR, AC or ACS if the maximum inlet oil vapour concentration exceeds $0.005mg/m^3$
Class 2	AO + AA
Class 3	AO
Class 4	AO

CRITICAL APPLICATIONS - Air Quality to ISO 8573.1: 2001 Class 1.1.1, Class 1.2.1, Class 1.3.1 at application

Bulk contamination is removed to an adequate level prior to the air entering the distribution system.
Point of use oil vapour removal and sterile air filtration (membrane or depth) installed for critical application at point of use.

Only air for the critical application should be treated to the highest level. For non-critical applications fed by the same distribution system, high efficiency point of use filtration should be installed.



Typical Applications

Pharmaceutical products

Silicon wafer manufacturing

TFT / LCD Screen manufacturing

Memory device manufacturing

Optical storage devices (CD, CDRW, DVD, DVDRW)

Optical disk manufacturing (CD's/DVD's):

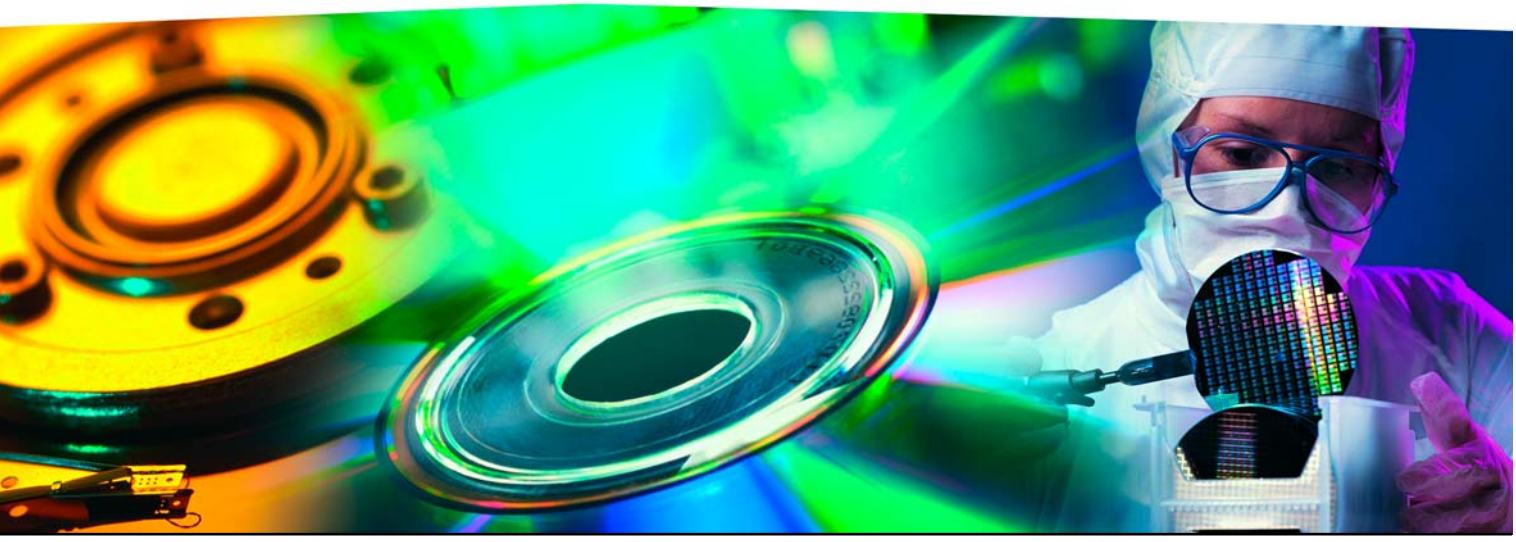
Hard disk manufacturing

Foodstuffs

Dairies

Breweries

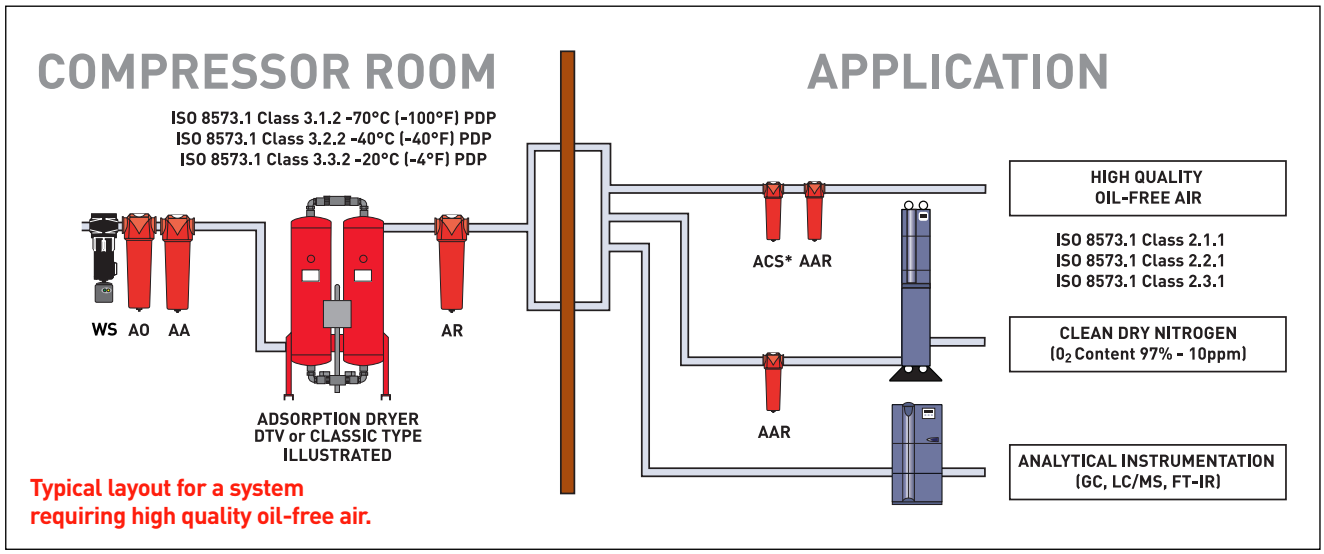
CDA systems for electronics manufacturing



HIGH QUALITY OIL FREE AIR - Air Quality to ISO 8573.1: 2001 : Class 2.1.1, Class 2.2.1, Class 2.3.1 at application

Bulk contamination is removed to an adequate level prior to the air entering the distribution system.
Point of use particulate filter(s) are used for removal of contamination within the distribution system.

*For Class 1 oil, if the maximum inlet oil vapour concentration exceeds 0.005mg/m^3, an additional oil vapour removal filter will be required.



Typical layout for a system requiring high quality oil-free air.

Typical Applications

Blow Moulding of Plastics e.g. P.E.T. Bottles

Film processing

Critical instrumentation

Advanced pneumatics

Air blast circuit breakers

Decompression chambers

Cosmetic production

Medical air

Dental air

Lasers and optics

Robotics

Spray Painting

Air bearings

Pipeline purging

Measuring equipment

Blanketing

Modified atmosphere packaging

Pre-treatment for on-site gas generation

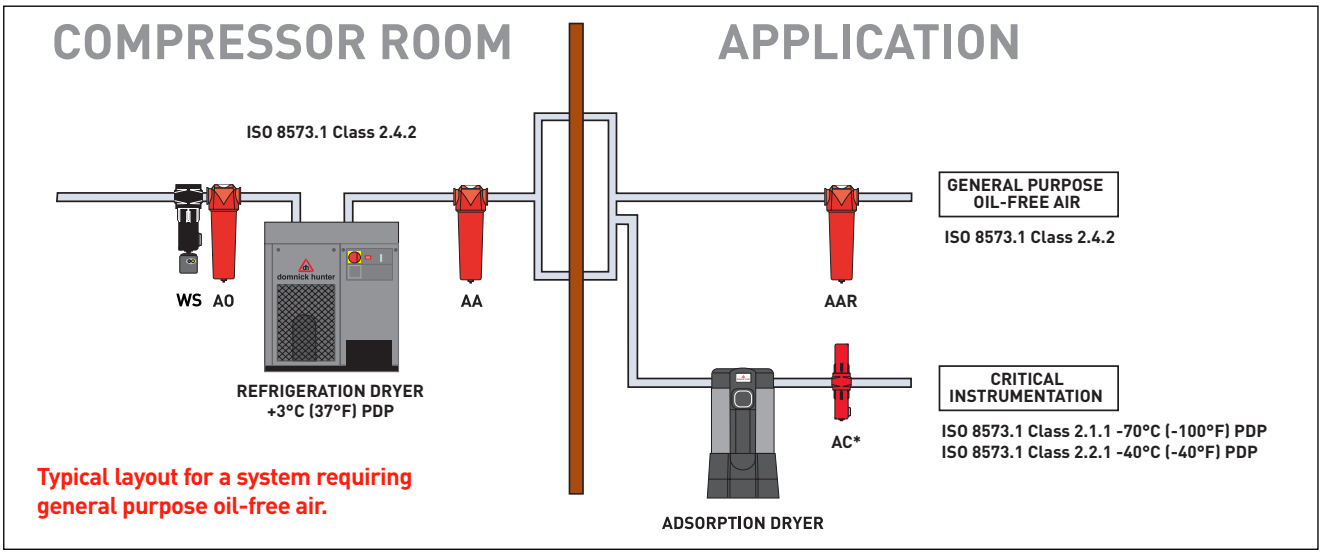
GENERAL PURPOSE OIL FREE AIR - Air Quality to ISO 8573.1: 2001 Class 2.4.2. at application

Bulk contamination is removed to an adequate level prior to the distribution system.

Point of use particulate filter(s) are used for removal of contamination within the distribution system.

Point of use adsorption dryer installed where lower dewpoints are required.

*For Class 1 oil, if the maximum inlet oil vapour concentration exceeds 0.005mg/m^3, an additional oil vapour removal filter will be required.



Typical Applications

General ring main protection

Pre-filtration to point of use adsorption air dryers

Plant automation

Air Logistics

Pneumatic tools

General instrumentation

Air conveying

Air motors

Temperature control systems

Blow guns

Gauging Equipment

Raw material mixing

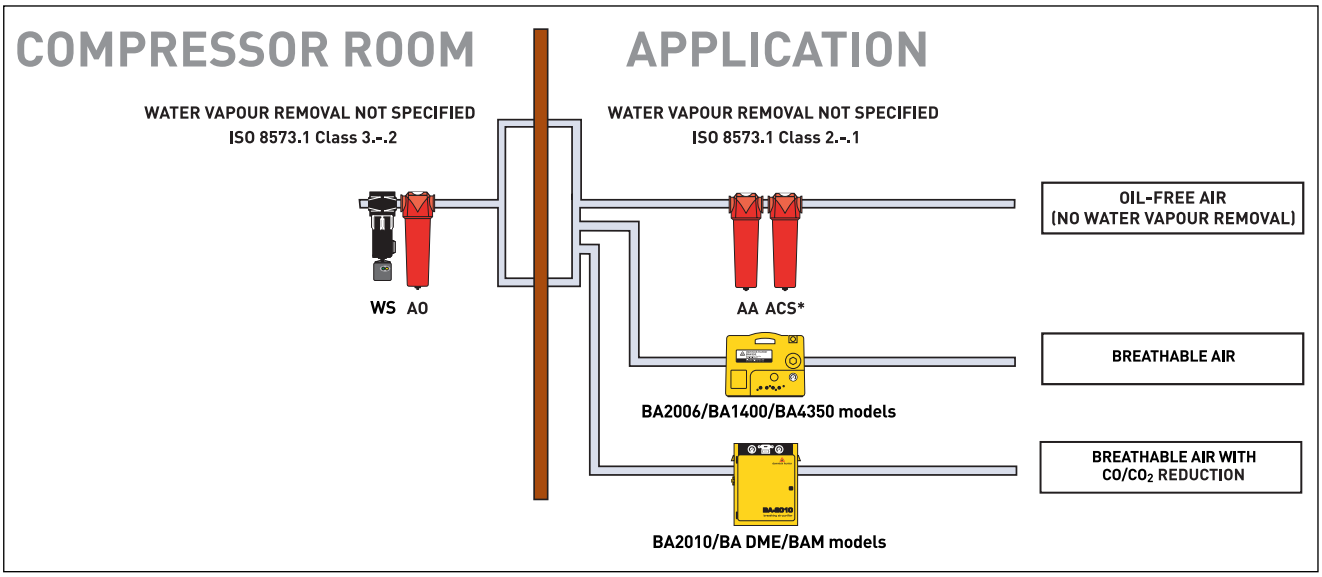
Sand / bead blasting

GENERAL PURPOSE OIL-FREE AIR - Air Quality to ISO 8573.1: 2001 Class 3.-.2, Class 2.-.1. (water vapour removal not specified)

Bulk contamination is removed to an adequate level prior to the distribution system.

*For Class 1 oil, if the maximum inlet oil vapour concentration exceeds 0.005mg/m^3, an additional oil vapour removal stage will be required.

The requirements for breathable quality air are not covered in ISO 8573.1:2001. Refer to breathing air standards for the country of installation.



Typical Applications (Water Vapour Removal Not Specified)

General ring main protection

Metal stamping

Forging

General industrial assembly (no external pipework)

Pre-filtration to point of use breathing air systems

Workshop

Garage

System Recommendations

To achieve the levels of cleanliness specified by ISO 8573.1:2001 a careful approach to system design, commissioning and operation must be employed.

It is recommended that the compressed air is treated prior to entry into the distribution system and also at critical usage points / applications. This ensures that contamination already in the distribution system is removed. Installation of compressed air dryers to a previously wet system could result in additional dirt loading for point of use filters for a period whilst the distribution system dries out. Filter elements may need to be changed more frequently during this period.

For installations where oil-free compressors are used, both general purpose Grade AO and high efficiency Grade AA should be used. The general purpose filter must be installed to protect the high efficiency filter from bulk water aerosols and solid particulate.

Install purification equipment at the lowest temperature above freezing point downstream of aftercoolers and air receivers. This allows a greater amount of oil and or water vapour to condense out for removal by water separators & coalescing filters prior to a dryer.

Point of use purification equipment should be installed as close to the application as possible. This ensures that the maximum amount of rust and pipe scale is removed prior to the application.

Purification equipment should not be installed downstream of quick opening valves and should be protected from possible reverse flow or other shock conditions.

Purge all piping leading to the purification equipment before installation and all piping after the purification equipment is installed and before connection to the final application.

If by-pass lines are fitted around purification equipment, ensure adequate filtration is fitted to the by-pass line to prevent contamination of the system downstream.

Provide a facility to drain away collected liquids from the purification equipment. Collected liquids should be treated and disposed of in a responsible manner.

In critical applications, membrane filters should be used at point of use to ensure no particulate is carried over to the application.

The lifetime of oil vapour removal filter elements is affected by the inlet oil concentration, relative humidity and temperature of the compressed air. For critical applications or systems where frequent element changes are not possible, domnick hunter OVR oil vapour removal systems should be installed.

The piping used downstream of membrane filters should be electro-polished stainless steel and be crevice free at all joints. Clean down time for a newly commissioned system will depend upon the surface area of the system, the system flow rate and the initial cleanliness of the piping and fittings. Clean down can be achieved by high flow clean air purging for extended periods of time during which all air should be purged to atmosphere.

Sterile Air

If running an aseptic process (i.e. free from microbiological contamination) it is essential that a sterile filter is installed at the point of use. This may either be based on glass nanofibre depth media or membrane.

Sterility can only be guaranteed and maintained if the filter and associated downstream process equipment are sterilised and maintained in accordance with manufacturers instructions. This is normally achieved using steam sterilisation but chemical sterilisation techniques such as vapour hydrogen peroxide can also be used.

It is recommended that sterile filters are tested for efficiency on a regular basis.

Maintaining System Efficiency

Regular service is essential to maintaining system performance. To maintain your guaranteed compressed air quality, purification equipment must be maintained annually with genuine domnick hunter parts. Failure to maintain your purification equipment will invalidate performance guarantees and could result in reduced production performance, degrading air quality and increased running costs. Preventative maintenance provides you with the following benefits:

- **Lowest running costs**
- **Guaranteed compressed air quality**
- **Continued protection of downstream equipment and processes**
- **Peace of mind**

After sales care package

For peace of mind, domnick hunter can manage your compressed air quality and guarantee future performance with a world-wide aftersales care package. Further details can be found on www.servicereminder.com

service

ISO 9001:2000
Q 05240

ISO 14001

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