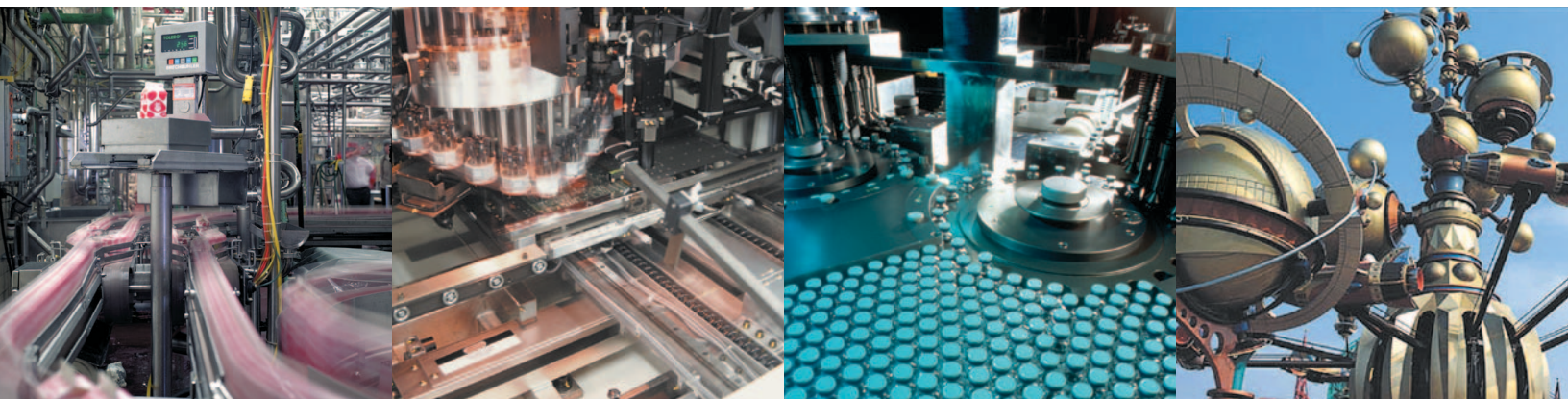


Dryer Products

Liquid Separators, Drain Valves, & Refrigeration Dryers

Catalog 603



the **total** systems approach to air preparation

Warning, Offer of Sale

**CAUTION:**

Polycarbonate bowls, being transparent and tough, are ideal for use with Filters and Lubricators. They are suitable for use in normal industrial environments, but should not be located in areas where they could be subjected to direct sunlight, an impact blow, nor temperatures outside of the rated range. As with most plastics, some chemicals can cause damage. Polycarbonate bowls should not be exposed to chlorinated hydro-carbons, ketones, esters and certain alcohols. They should not be used in air systems where compressors are lubricated with fire-resistant fluids such as phosphate ester and di-ester types.

Metal bowls are recommended where ambient and/or media conditions are not compatible with polycarbonate bowls. Metal bowls resist the action of most such solvents, but should not be used where strong acids or bases are present or in salt laden atmospheres. Consult the factory for specific recommendations where these conditions exist.

TO CLEAN POLYCARBONATE BOWLS USE MILD SOAP AND WATER ONLY! DO NOT use cleansing agents such as acetone, benzene, carbon tetrachloride, gasoline, toluene, etc., which are damaging to this plastic.

Metal bowl guards are recommended for all applications.

**WARNING**

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from The Company, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application including consequences of any failure, and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by The Company and its subsidiaries at any time without notice.

Offer of Sale

The items described in this document are hereby offered for sale by The Company, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated on the separate page of this document entitled "Offer of Sale".

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the **total** systems approach to **air preparation**

Sources of Contamination

Compressed Air and its Purification from Generation to Application

Compressed air is an essential power source that is widely used throughout industry. This safe, powerful and reliable utility can be the most important part of your production process. However, your compressed air will contain water, dirt, wear particles and even degraded lubricating oil which all mix together to form an unwanted condensate. This condensate often acidic, rapidly wears tools and pneumatic machinery, blocks valves and orifices causing high maintenance and costly air leaks. It also corrodes piping systems and can bring your production process to an extremely expensive standstill!

The quality of air required throughout a typical compressed air system can vary.

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 areas receive air treated to the highest level.

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.

In many cases this action alone is not enough, as modern production systems and processes demand an even higher level of air quality. Where required, "point of use" filtration, refrigeration or desiccant air dryers can provide the correct air quality, without the need for drying the complete compressed air installation, which can be both costly and totally unnecessary.

Sources of Contamination Found in a Compressed Air System

Contaminants in a compressed air system can generally be attributed to the following:

The quality of air being drawn into the compressor

Air compressors draw in a large volume of air from the surrounding atmosphere containing large numbers of airborne contaminants.

The type and operation of the air compressor

The air compressor itself can also add contamination, from wear particles to coolants and lubricants.

Compressed air storage devices and distribution systems

The air receiver and system piping are designed to store and distribute the compressed air. As a consequence, they will also store the large amounts of contaminants drawn into the system. Additionally, piping and air receivers will also cool the moist compressed air forming condensate which causes damage and corrosion.

Sources of Contamination

Types of Contamination Found in a Compressed Air System

Atmospheric Dirt

Atmospheric air in an industrial environment typically contains 140 million dirt particles for every cubic meter of air. 80% of these particles are less than 2 microns in size and are too small to be captured by the compressor intake filter, therefore passing directly into the compressed air system.

Water Vapor, Condensed Water and Water Aerosols

Atmospheric air contains water vapor (water in a gaseous form). The ability of compressed air to hold water vapor is dependent upon its temperature. The higher the temperature, the more water vapor that can be held by the air. During compression, the air temperature is increased significantly, which allows it to easily retain the incoming moisture. After the compression stage, air is normally cooled to a usable temperature. This reduces the air's ability to retain water vapor, resulting in a proportion of the water vapor being condensed into liquid water which is removed by a condensate drain fitted to the compressor after-cooler. The air leaving the after-cooler is now 100% saturated with water vapor and any further cooling of the air will result in more water vapor condensing into liquid water. Condensation occurs at various stages throughout the system as the air is cooled further by the air receiver, piping and the expansion of valves, cylinders, tools and machinery. The condensed water and water aerosols cause corrosion to the storage and distribution system, damage production equipment and the end product. It also reduces production efficiency and increases maintenance costs. Water in any form must be removed to enable the system to run correctly and efficiently.

Rust and Pipescale

Rust and pipescale can be found in air receivers and the piping of "wet systems" (systems without adequate purification equipment) or systems which were operated "wet" prior to purification being installed. Over time, this contamination breaks away to cause damage or blockage in production which can also contaminate final product and processes.

Micro-organisms

Bacteria and viruses will also be drawn into the compressed air system through the compressor intake and warm, moist air provides an ideal environment for the growth of micro-organisms. Ambient air can typically contain up to 3,850 micro-organisms per cubic meter. If only a few micro-organisms were to enter a clean environment, a sterile process or production system, enormous damage could be caused that not only diminishes product quality, but may even render a product entirely unfit for use and subject to recall.

Liquid Oil and Oil Aerosols

Most air compressors use oil in the compression stage for sealing, lubrication and cooling. During operation, lubricating oil is carried over into the compressed air system as liquid oil and aerosols. This oil mixes with water vapor in the air and is often very acidic, causing damage to the compressed air storage and distribution system, production equipment and final product.

Oil Vapor

In addition to dirt and water vapor, atmospheric air also contains oil in the form of unburned hydrocarbons. The unburned hydrocarbons drawn into the compressor intake as well as vaporized oil from the compression stage of a lubricated compressor will carry over into a compressed air system where it can cool and condense, causing the same contamination issues as liquid oil. Typical oil vapor concentrations can vary between 0.05 and 0.5mg per cubic meter of air.

Sources of Contamination

UP TO 99% OF THE TOTAL LIQUID CONTAMINATION FOUND IN A COMPRESSED AIR SYSTEM IS WATER.

Oil is perceived to cause the most problems as it is seen emanating from open drain points and exhausting valves, however, in the majority of instances, it is actually oily condensate (oil mixed with water) that is being observed.

How Much Water Can Be Found In A Typical Compressed Air System?

The amount of water in a compressed air system is staggering. A small 100 cfm (2.8m³/min) compressor and refrigeration dryer combination, operating for 4,000 hours in typical climatic conditions can produce approximately 10,000 liters or 2,200 gallons of liquid condensate per year.

If the compressor is oil lubricated with a typical 2ppm (2 mg/m³) oil carryover, then although the resulting condensate would visually resemble oil, oil would in fact account for less than 0.1% of the overall volume and it is this resemblance to oil to which a false association is made.

The example above assumes uses a small compressor to highlight the large volume of condensate produced. If a compressed air system was operated in warmer, more humid climates, or with larger compressors installed, running for longer periods, the volume of condensate would increase significantly.

Contamination and Types of Compressor

It is often believed that the level of compressed air purification equipment required in a system is dependent upon the type of compressor used. Contamination in a compressed air system originates from many sources and is not related solely to the compressor or it's lubricants. No matter what compressor type is selected, adequate filtration and separation products will be required to remove the large volume of dirty contaminated water as well as the dirt, rust, pipescale and microbiological contamination in the system.

Preventative Maintenance Provides You With The Following Benefits:

- **Lowest Operating Costs**
- **Superior Compressed Air Quality**
- **Continued Protection Of Downstream Equipment and Processes**
- **Peace Of Mind**

Purification Technologies

Compressed Air and It's Purification

Having identified the different types of contamination that can be found within a compressed air system, we can now examine the purification technologies available for it's removal.

Particle and Coalescing Filters

Coalescing filters are probably the most important items of purification equipment in any compressed air system. They are designed to remove oil and water aerosols using mechanical filtration techniques and have the additional benefit of removing solid particulate to very low levels (as small as 0.01micron in size). Installed in pairs, most users believe one to be an oil removal filter and the other to be a particulate filter, when in fact, the pair of filters both perform the same function. The first filter, a general purpose filter is used to protect the high efficiency filter against bulk contamination. This "dual filter" installation ensures a continuous supply of high quality compressed air with low operational costs and minimal maintenance time.

Bulk Liquid Removal High Efficiency Water Separators

Used to protect filters in systems where excessive cooling takes place in distribution piping. Water Separators will remove in excess of 98% of bulk liquid contamination through centrifugal separation techniques.

Adsorption (Desiccant) Dryers

Water vapor is water in a gaseous form and is removed from compressed air using a dryer, with dryer performance being measured as pressure dewpoint. Adsorption or desiccant dryers remove moisture by passing air over a regenerative adsorbent material which strips the moisture from the air. This type of dryer is extremely efficient and typical pressure dewpoint ratings are -40°F (-40°C) or -100°F (-70°C) pdp. This means that for water vapor to condense into a liquid, the air temperature would have to drop below -40°F

(-40°C) to -100°F (-70°C) respectively (the actual air temperature after an adsorption dryer is not the same as it's dewpoint).

Beneficially, a pressure dewpoint of -15°F (-26°C) or better will not only prevent corrosion, but will also inhibit the growth of microorganisms within the compressed air system.

Refrigeration Dryers

Refrigeration dryers work by cooling the air, so are limited to positive pressure dewpoint ratings to prevent freezing of the condensed liquid. Ideal for general purpose applications, they typically provide pressure dewpoints of 38°F (3°C), 45°F (7°C) or 50°F (10°C) pdp. Air is reheated before it re-enters the system to prevent piping from "sweating" in humid conditions. Refrigeration dryers are not suitable for installations where piping is installed in ambient temperatures below the dryer dewpoint i.e. systems with external piping.

Important Note Regarding Compressed Air Dryers

As adsorption and refrigeration dryers are designed to remove only water vapor and not water in a liquid form, they require the use of coalescing filters and possibly a bulk liquid separator to work efficiently.

NOTE:

For Product Ordering & Specifications, Please Reference: Wilkerson 9EM-TK-190 Catalog

Quality Standards

Compressed Air Quality Standards – ISO 8573

ISO 8573 is the group of International standards relating to the quality of compressed air and consists of nine separate parts. Part 1 specifies the quality requirements of the compressed air and parts 2 - 9 specify the methods of testing for a range of contaminants.

ISO 8573.1 : 2001 is the primary document used from the ISO 8573 series and it is this document which allows the user to specify the air quality or purity required at key points in a compressed air system.

Within ISO 8573.1 : 2001 purity levels for the main contaminants are shown in separate tables, however for ease of use, this document combines all three into one easy to understand table.

Purity Class	Solid Particulate					Water		Oil
	Maximum number of particles per m ³			Particle Size	Concentration	Vapor	Liquid	Total oil (aerosol, liquid and vapor)
	0.1 - 0.5 micron	0.5 - 1 micron	1 - 5 micron	micron	mg/m ³	Pressure Dewpoint	g/m ³	ppm (mg/m ³)
0	*	*	*	*	*	*	*	*
1	100	1	0	—	—	-94°F (-70°C)	—	0.008 (0.01)
2	100,000	1,000	10	—	—	-40°F (-40°C)	—	0.08 (0.1)
3	—	10,000	500	—	—	-4°F (-20°C)	—	0.83 (1)
4	—	—	1,000	—	—	37°F (3°C)	—	4.2 (5)
5	—	—	20,000	—	—	45°F (7°C)	—	—
6	—	—	—	5	5	50F (10°C)	—	—
7	—	—	—	40	10	—	0.5	—
8	—	—	—	—	—	—	5	—
9	—	—	—	—	—	—	10	—

* As specified by the equipment user or supplier.

Specifying Air Purity in Accordance with ISO 8573.1 : 2001

When specifying the purity of air required, the standard must always be referenced, followed by the purity class selected for each contaminant (a different purity class can be selected for each contaminant if required). An example of how to write an air quality specification is shown below :

Example:

ISO 8573.1 : 2001 Class 2.2.2

ISO8573.1 : 2001 refers to the standard document and its revision, the three digits refer to the purity classifications selected for solid particulate, water and total oil. Selecting an air purity class of 2.2.2 would specify the following air quality when operating at the standard's reference conditions:

Class 2, Particulate

In each cubic meter of compressed air, not more than 100,000 particles in the 0.1 to 0.5 micron size range are allowed in each cubic meter of compressed air, no more

than 1,000 particle in 0.5 to 1.0 micron size range is allowed in each cubic meter of compressed air, and 10 particles in the 1.0 to 5.0 micron size range are allowed.

Class 2, Water

A pressure dewpoint of -40°F (-40°C) or better is required and no liquid water is allowed.

Class 2, Oil

In each cubic Meter of compressed air, not more than 0.1mg of oil is allowed. This is a combined level for both aerosol and oil vapor.

Cost Effective System Design

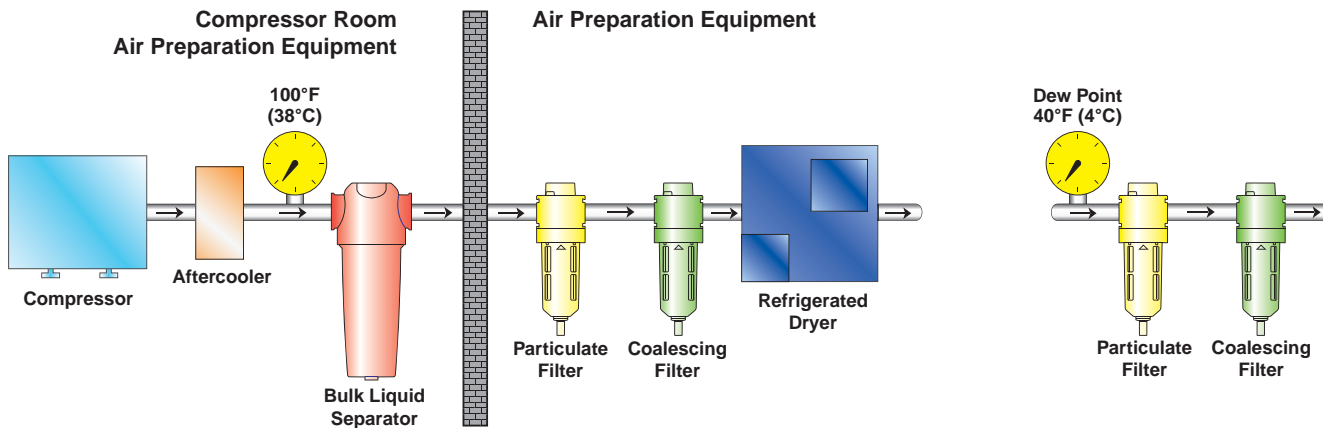
To achieve the stringent air quality levels required for today's modern production facilities, a careful approach to system design, commissioning and operation must be employed. Treatment at one point alone is not enough and it is highly recommended that the compressed air is treated prior to entry into the distribution system to a quality level suitable for protecting air receivers and distribution piping.

Point of use purification should also be employed, with specific attention being focused on the application and the level of air quality required. This approach to system design ensures that air is not "over treated" and provides the most cost effective solution to high quality compressed air.

Purity Level

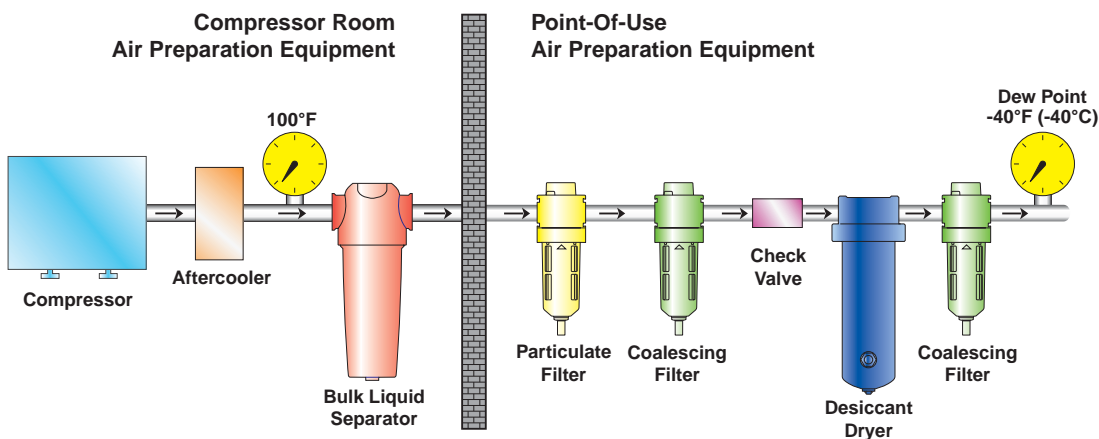
ISO Class 2.4.2

Good Purity Level



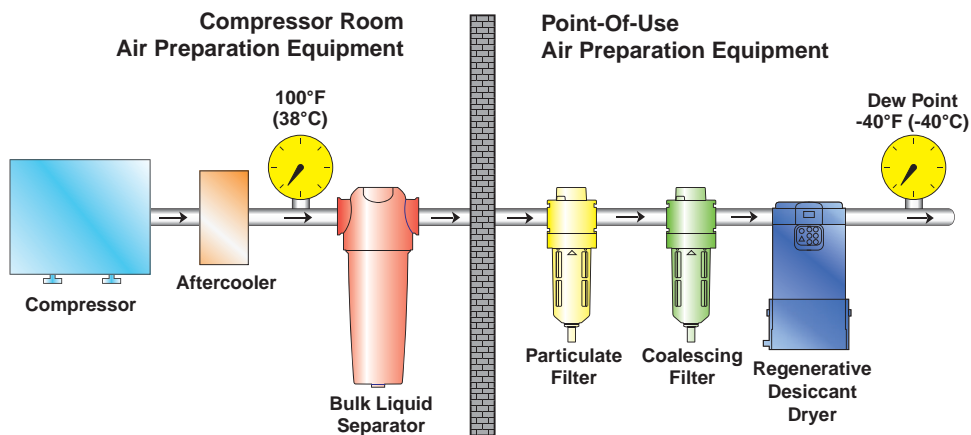
ISO Class 2.2.2

Better Purity Level



ISO Class 2.2.2

Best Purity Level



Liquid Separators WSA / WSO



Specifications

Maximum Operating Pressure	(WSA)	200 PSIG (13.8 bar)
	(WS0)	232 PSIG (16.0 bar)
Operating Temperature	(WSA)	32° to 150°F (0° to 65.5°C)
	(WS0)	35° to 176°F (1.6° to 80°C)
Pressure Differential at Rated Flow		1.0 PSID (0.07 bar)

Materials of Construction

	WSA	WS0
Housing	Zinc	Aluminum
Seals	Nitrile	Fluorocarbon

Features

- High Flow Rates
- Less than 1 PSIG Differential Pressure
- Lightweight Cast Aluminum Housing with 1" to 3" NPT Connections (WS0)
- Cast Zinc Housings with 1/4" to 1" NPT Connections (WSA)
- External Surfaces Epoxy Painted for Maximum Corrosion Protection
- Standard Equipped with Quick Disconnect Bowls for Ease of Service (WSA)
- Three (3) Optional Automatic Drains Available

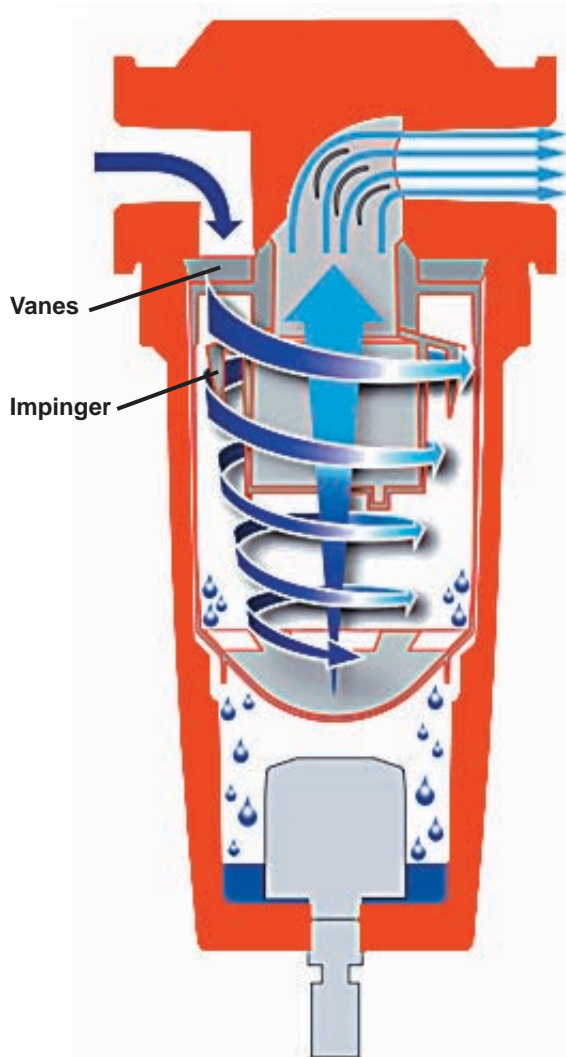
Liquid Separators

Our unique design combines the techniques of centrifugal action and other mechanical separation principles (Impingement, Separation, Laminar Flow and Stokes Law) to remove large quantities of liquid and solid contamination.

Typical applications include water separation downstream of aftercoolers, protection of refrigerant and heatless regenerative desiccant dryers, downstream of air receivers, and other liquid / gas separation duties where the volume of water and solids poses a real problem.

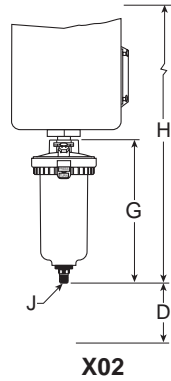
Model Number	In / Out NPT Pipe Conn.	Rated Flow (SCFM) @ 100 PSIG*	Approx. Weight lbs.	Recommended Automatic Drain
WSA-02-M00**	1/4"	25	2.2	Optional
WSA-02-FM0	1/4"	25	2.2	Internal
WSA-03-M00**	3/8"	50	2.6	Optional
WSA-03-FM0	3/8"	50	2.6	Internal
WSA-04-M00**	1/2"	50	2.6	Optional
WSA-04-FM0	1/2"	50	2.6	Internal
WSA-06-M00**	3/4"	100	6.0	Optional
WSA-06-FM0	3/4"	100	6.0	Internal
WSA-08-M00**	1"	120	6.0	Optional
WSA-08-FM0	1"	120	6.0	Internal
WS0-08-000B	1"	233	4.8	X02-04-FM0 WDV3-G
WS0-0B-000B	1-1/2"	472	11.2	X02-04-FM0 WDV3-G
WS0-0C-000B	2"	742	11.2	X02-04-FM0 WDV3-G
WS0-0E-000B	3"	1700	22.0	X02-04-FM0 WDV3-G

*1 PSID maximum differential. **Models have petcock.

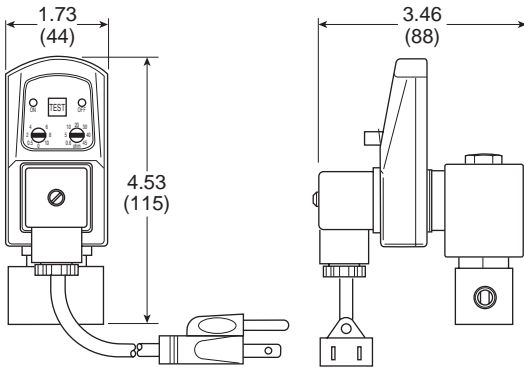
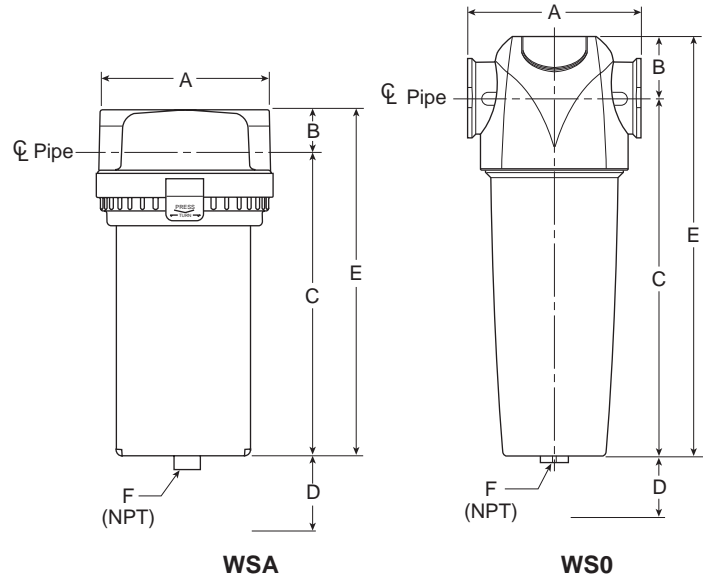


Operation

- Air Enters the Water Separator Inlet and Turns Into the Separator Module.
- The Inlet of the Separator Module Contains a Set of Fixed Vanes Which the Air Must Pass Through.
- The Vanes Force the Air to Spin Inside the Vessel.
- The Spinning Air is Then Forced to Change Direction as it Passes the Impinger.
- A Vortex is Created Which, Due to the Design of the Separator Module, Narrows and Intensifies as it Reaches the Lower Part of the Separator Module.
- Bulk Liquid is Removed From the Airstream Due to:
 - Directional Changes of the Airstream
 - Velocity Changes
 - Centrifugal Action of the Vortex
- As the Vortex Reaches the Bottom of the Module, Air is Forced Through The Center of the Vortex.
- Aerospace Turning Vanes, Located in the Outlet of the Separator Module, Turn an Inefficient Corner Into a Number of More Efficient Corners.
- Turning Vanes Reduce Turbulence, Minimizing Pressure Loss and Cost of Ownership.
- The Number of Vanes Required is Dependent Upon the Conduit Diameter.



D = Bowl Removal Clearance Dimension
J = External Drain Discharge Port (NPT)



WDV3-G

NOTE: MAXIMUM separator efficiency of 98%+ is achieved in the range of 15 to 100% of rated flow in SCFM. At flow rates of <15% or >100%, separator efficiency is reduced considerably. Consult your Wilkerson distributor or contact Wilkerson for assistance in selecting the correct separator model for your application.

Model Number	A	B	C	D	E	NPT F	G	H	NPT J
WSA-02-M00*	3.00	.90	5.51	3.50	6.41	1/8	—	—	—
WSA-02-FM0	3.00	.90	5.51	3.50	6.41	1/8	—	—	—
WSA-03-M00*	3.35	.98	6.36	3.50	7.34	1/8	—	—	—
WSA-03-FM0	3.35	.98	6.36	3.50	7.34	1/8	—	—	—
WSA-04-M00*	3.35	.98	6.36	3.50	7.34	1/8	—	—	—
WSA-04-FM0	3.35	.98	6.36	3.50	7.34	1/8	—	—	—
WSA-06-M00*	4.62	1.00	9.00	3.50	10.00	1/8	—	—	—
WSA-06-FM0	4.62	1.00	9.00	3.50	10.00	1/8	—	—	—
WSA-08-M00*	4.62	1.00	9.00	3.50	10.00	1/8	—	—	—
WSA-08-FM0	4.62	1.00	9.00	3.50	10.00	1/8	—	—	—
WS0-08-000B	5.10	1.60	9.20	3.00	10.80	1/2	5.90	18.00	1/4
WDV3-G	—	—	—	—	—	—	1.73	13.83	—
WS0-0B-000B	6.70	2.00	15.00	4.00	17.00	1/2	5.90	18.00	1/4
WDV3-G	—	—	—	—	—	—	1.73	13.83	—
WS0-0C-000B	6.70	2.00	15.00	4.00	17.00	1/2	5.90	24.50	1/4
WDV3-G	—	—	—	—	—	—	1.73	20.33	—
WS0-0E-000B	8.10	2.40	17.50	4.72	19.90	1/2	5.90	28.90	1/4
WDV3-G	—	—	—	—	—	—	1.73	24.73	—

*Models have petcock.

Automatic Electrical Drain Valve – WDV3-G



WDV3-G

The WDV3 Electrical Drain is designed to remove condensate from compressors, compressed air dryers and receivers up to any size, type or manufacturer.

The WDV3 offers true installation simplicity and it is recognized as the most reliable and best performing condensate drain worldwide. The large orifice in the direct acting valve, combined with its sophisticated timer module ensure many years of trouble-free draining of condensate.

Benefits

- Does Not Air-Lock During Operation.
- Compressed Air Systems Up to Any Size.
- Also Available In Stainless Steel.
- The Direct Acting Valve Is Serviceable.
- Suitable for All Types of Compressors.
- TEST (Micro-Switch) Feature.
- High Time Cycle Accuracy.
- Large (4.5mm) Valve Orifice.

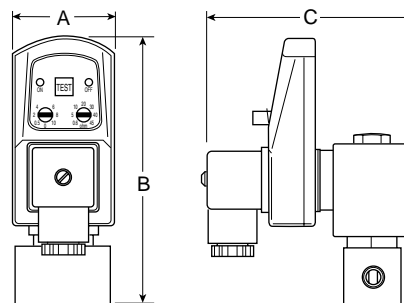
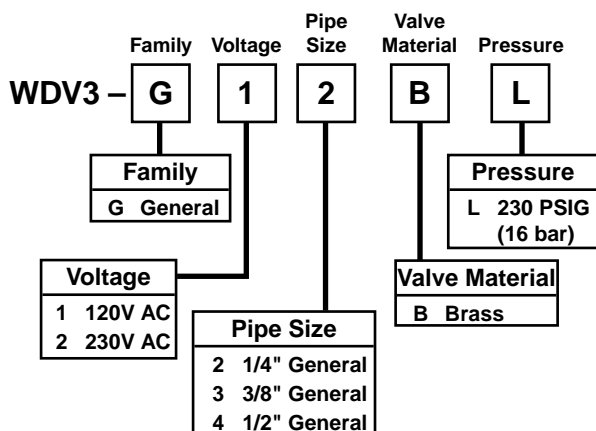
Specifications

- Operating Pressure**..... 230 PSIG (15,9 bar)
- Ambient Operating Range Temperature:**
34° to 130°F (1.1° to 54°C)
- Coil Insulation**
Class H 340°F (171.1°C)
- Voltages**
AC 115, 230/50-60
- Timer:**
Open Time5 to 10 sec., Adjustable
Cycle Time..... .5 to 45 min., Adjustable
- Maximum Current Rating** 4mA Max.
- Port Size**..... 1/4, 3/8, 1/2 NPT
- Weight** 1.8 lb. (0.8 kg)

Materials of Construction

- Valve Body** Brass / Stainless Steel
- Enclosure (IP65 / NEMA 4)** ABS Plastic
- Internal Parts** Brass / Stainless Steel
- Valve Seals**..... FPM (Fluorocarbon)

Ordering Information



Model Selection and Dimensions

Model Number	A	B	C
WDV3-G**BL	1.73 (44)	4.53 (115)	3.46 (88)

Zero Loss Drain – WDV2



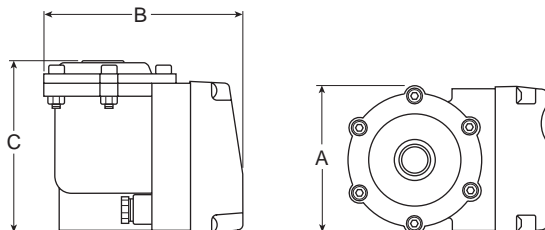
WDV2-425

Features

- Zero Air Loss.
- Automatically Self-Adjusting for Voltages from 110 to 230V.
- Sensor Device with No Moving Parts.
- Sophisticated Electronic Controls.
- Alarm with Remote Contacts.
- Large Inlet Port to Eliminate Clogging.
- Manual Push-to-Test Button.
- Automatically Clears Slugs.

Benefits

- Energy Efficient.
- World-Wide Applications.
- Long Life.
- High Reliability.
- Versatility, Early Warning.
- Low Maintenance.
- On Demand Operation.
- Maintenance Free.



Model Selection and Dimensions

Model Number	A	D	C
WDV2-425	3.23 (82)	4.61 (117)	4.65 (118)

Specifications

Drain Volume0.01 Gallons / Cycle
Maximum Fluid Temperature 150°F (60°C)
Voltage 110 to 240V, 50/60 Hz
Inlet Ports (2) 1/2" NPT
Outlet Ports (1) 5/16" (8mm) I.D. Hose

Operating Conditions

Ambient Temperature33° to 140°F (0° to 60°C)
Maximum Operating Pressure..... 232 PSIG (16 bar)

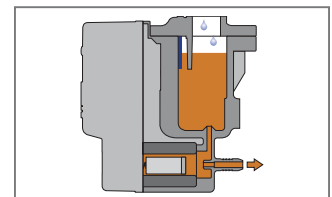
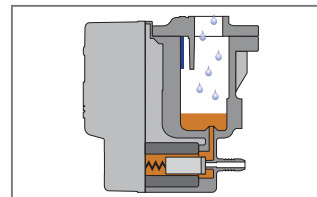
The WDV2 Electronic Demand Drain Valves, with zero air loss, are suitable for all compressed air system applications from aftercoolers to filters to receivers to refrigerated dryers. These drain valves activate automatically and are both reliable and economical.

Alarm Mode

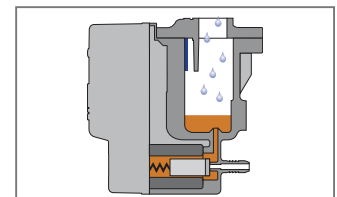
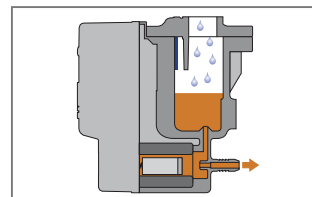
Should the drain fail to discharge due to an excessive volume of condensate or blocked outlet piping, an alarm condition is activated. During the alarm condition, the drain cycles continuously in an attempt to remove the excess condensate. At the same time, the volt free alarm contacts change state and the normally green power LED flashes to indicate a problem. When the excess condensate or blockage has been cleared, the drain will resume normal operation.

Operation

1. Upon power up, the outlet valve is closed and sensor is constantly monitoring for presence of liquid.
2. When condensate is detected by the sensor, the outlet valve is opened for a pre-set time.



3. The condensate is discharged from the outlet port, due to the system pressure acting on the top of the liquid.
4. The outlet valve is closed after a pre-set time has expired. The opening time has been calculated to always ensure a small amount of liquid remains in bowl. This liquid acts as a seal, preventing air loss.



Level monitoring and discharge operation are continuous.

Refrigeration Dryers – WDRD



WDRD10 - 175

Key Features:

- “Plug & Play” Design for Easy Installation and Operation (WDRD10 - WDRD125).
- Small Space Saving Design.
- Oversized Demister Separator Resulting in Excellent Liquid Removal Over all Operating Conditions.
- Low Pressure Differential Across The Dryer (1.45 PSIG Average).
- Environmentally Friendly Refrigerant.
- Oversized Condenser to Operate in Ambients to 122°F (50°C).
- All Models Incorporate a Dewpoint Indicator.

Why Refrigeration Dryers?

Compressed air is an important provider of energy for industry; what is often overlooked however is the need to provide quality treatment for this air. Compressed air contains condensate which, when cooled, will turn into water, causing extensive damage to both the compressed air network and the finished product itself. WDRD refrigeration dryers actively remove this condensate to achieve near perfectly dry compressed air. The benefits are notable: less system downtime, reduced costs and maintenance, and an improved finished product. WDRD, thanks to its PlusPack heat exchanger (patent pending) and the most compact dimensions on the market, will prove a major asset in your factory.

Model Selection

Model Number	Pipe Size	Recommended Filtration†
WDRD10	1/2" NPT-F	F2804WDRD
WDRD15	1/2" NPT-F	
WDRD25	1/2" NPT-F	
WDRD35	1/2" NPT-F	
WDRD50	3/4" NPT-F	F2806WDRD
WDRD75	3/4" NPT-F	
WDRD100	3/4" NPT-F	
WDRD125	1-1/2" NPT-F	F3908WDRD
WDRD150	1-1/2" NPT-F	
WDRD175	1-1/2" NPT-F	

† Consists of: Particle & Coalescing Filter Assembly with Mounting Bracket.

**PlusPack Heat Exchanger
(patent pending)**

The revolutionary PlusPack features a 3-in-1 aluminum design with integral air connections. All models include an air-to-air freecooler, while the unique "slowflow" demister ensures perfect dewpoints whatever the operating conditions.

Demister Separator

A high capacity demister separator is employed for the removal of condensed liquids. This lowers the air velocity which maximizes the condensate separation from the air, even when the dryer is not operating at maximum flow. This design also ensures the differential pressure across the dryer is kept to a minimum.

**Refrigerant Condenser**

Oversized high efficiency air cooled condenser. Re-positioned to improve reliability and reduce the risk of dirt contamination.

Refrigerant Compressor

Maintenance free hermetically sealed refrigerant compressor. Low refrigerant charge eliminates the requirement for pre-heating on start up & prevents any liquid refrigerant returns.

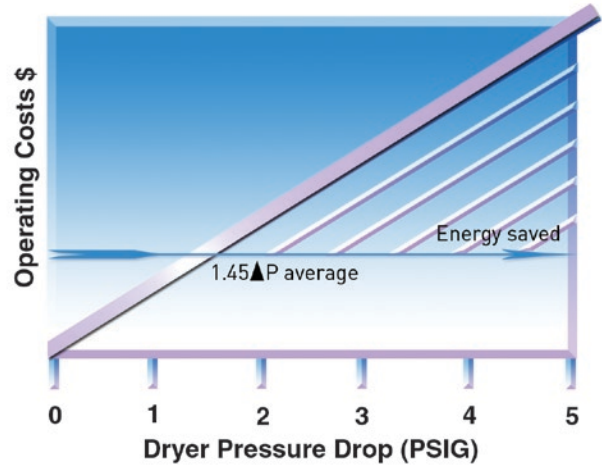
Condensate Drain Niche

The WDRD Refrigeration Dryer range comes standard with a level sensing automatic float drain. Other drains are available upon request. The positioning of the drain niche allows for easy access to the drain without the requirement of removing panels.

Assured Quality & Performance

Every dryer undergoes sophisticated testing, including dewpoint tests with compressed air flow. Multiple helium leak testing, again on every dryer, ensures years of trouble-free operation.

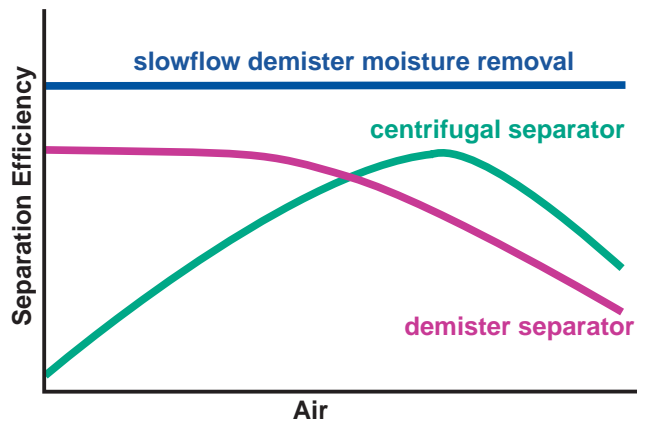
Energy Efficiency



Poorly constructed heat exchangers and liquid separators create a high pressure differential across the dryer which leads to high operational costs and poor dewpoint performance.

The WDRD dryer range utilizes advanced heat exchanger and demister separation technology and delivers uncompromising performance at the lowest cost of ownership.

Moisture Separation Technology



The oversized “slowflow” demister is non-velocity sensitive and therefore offers excellent liquid separation whatever the airflow.

Technical Information

Maximum Ambient Temperature 122°F (50°C)

Maximum Inlet Temperature –
 Models WDRD10 thru WDRD175:..... 149°F (65°C)

Minimum Ambient Temperature 41°F (5°C)

Maximum Inlet Pressure –
 Models WDRD10 thru WDRD175:.....232 PSIG (16 bar)

Refrigerant –
 Models WDRD10 thru WDRD175:.....R134a

Model Number	Pipe Size	Nominal Flow*			Primary Voltages	Recommended Filtration†
		SCFM	Nm ³ /hr	Nm ³ /min		
WDRD10-115160	1/2" NPT-F	10	17	0.3	115V/1ph/60Hz	F2804WDRD
WDRD15-115160	1/2" NPT-F	15	26	0.4	115V/1ph/60Hz	
WDRD25-115160	1/2" NPT-F	25	43	0.7	115V/1ph/60Hz	
WDRD35-115160	1/2" NPT-F	35	60	1.0	115V/1ph/60Hz	
WDRD50-115160	3/4" NPT-F	50	85	1.4	115V/1ph/60Hz	F2806WDRD
WDRD75-115160	3/4" NPT-F	75	127	2.1	115V/1ph/60Hz	
WDRD100-115160	3/4" NPT-F	100	170	2.8	115V/1ph/60Hz	
WDRD125-115160 WDRD125-230160	1-1/2" NPT-F	125	212	3.5	115V/1ph/60Hz & 230V/1ph/60Hz	F3908WDRD
WDRD150-115160 WDRD150-230160	1-1/2" NPT-F	150	255	4.2	115V/1ph/60Hz & 230V/1ph/60Hz	
WDRD175-230160	1-1/2" NPT-F	175	297	5.0	230V/1ph/60Hz	

† Consists of: Particle & Coalescing Filter Assembly with Mounting Bracket.

*Capacities are based upon:

Ambient Temperature 100°F (38°C)

Inlet Temperature 100°F (38°C)

Working Pressure 100 PSIG (7 bar)

Air Flow Correction Factors

Capacity correction factors to be used when operating conditions differ from those shown below. To obtain dryer capacity at new conditions multiply nominal capacity* x C1 x C2 x C3

**Models WDRD10 - WDRD175
Ambient Temperature (C1)**

°F	60	70	80	90	100	110	120
°C	16	21	27	32	38	43	49
Correction Factor	1.34	1.26	1.17	1.09	1.00	0.91	0.82

Inlet Temperature (C2)

°F	90	100	110	120	140	149
°C	32	38	43	49	60	65
Correction Factor	1.24	1.00	0.81	0.67	0.45	0.43

Working Pressure (C3)

PSIG	60	80	100	125	150	175	200	230
bar	4	6	7	9	10	12	14	16
Correction Factor	0.83	0.93	1.00	1.07	1.12	1.13	1.19	1.22

*Capacities are based upon:
 Ambient Temperature.....100°F (38°C)
 Inlet Temperature..... 100°F (38°C)
 Working Pressure..... 100 PSIG (7 bar)

Example: Using Air Flow Correction Factors

The WDRD dryers on page 16 have been sized for the following conditions with the stated flows listed in SCFM and Nm³.

Ambient Temperature = 100° F
 Inlet Temperature = 100° F
 Working Pressure = 100 PSIG

However, many applications are not under these conditions, so we need to understand the use of the "Air Flow Correction Factors". These factors allow you to adjust for changes in the ambient temperature, inlet temperature and working pressure.

The formula is simple to use, new dryer capacity = nominal dryer flow x C1 (correction factor for ambient temperature) x C2 (correction factor for inlet temperature) x C3 (correction factor for working pressure).

We have selected a WDRD25 for our initial dryer for conditions of 100° F ambient temperature, 100° F inlet temperature and 100 PSIG working pressure.

We find, however, that the applications' conditions really are:
 Ambient Temperature = 90° F
 Inlet Temperature = 120° F
 Working Pressure = 125 PSIG

Using the correction factors from the tables:
 Nominal Flow = 25 SCFM

C1 = 1.09
 C2 = .67
 C3 = 1.07
 25 x 1.09 x .67 x 1.07 = 19.53 SCFM

Or, our 25 SCFM capacity dryer, under these new conditions, will have a new flow capacity of only 19.53 SCFM. If we truly needed to flow 25 SCFM of air, we need to adjust our selection to a bigger dryer.

A WDRD35 would have a flow capacity of 27.35 SCFM, making it the proper selection.

It is very important to understand the operating conditions under which your refrigerated dryer will function, to make a selection that will give you the desired performance.



Weights and Dimensions

Model Number	Dimensions Inches (mm)			Weight lbs (Kg)
	A	B	C	
WDRD10	8.3 (210)	17 (430)	17.7 (450)	42 (19)
WDRD15	8.3 (210)	17 (430)	17.7 (450)	42 (19)
WDRD25	8.3 (210)	19.9 (505)	19.7 (500)	52 (24)
WDRD35	8.3 (210)	19.9 (505)	19.7 (500)	52 (24)
WDRD50	8.9 (225)	22.3 (565)	20.5 (520)	58 (27)
WDRD75	8.9 (225)	22.3 (565)	20.5 (520)	68 (31)
WDRD100	8.9 (225)	22.3 (565)	20.5 (520)	77 (35)
WDRD125	16.7 (425)	23.8 (605)	21.8 (555)	115 (52)
WDRD150	16.7 (425)	23.8 (605)	21.8 (555)	128 (52)
WDRD175	16.7 (425)	23.8 (605)	21.8 (555)	132 (60)

Safety Guide For Selecting And Using Pneumatic Division Products And Related Accessories

WARNING:

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF PNEUMATIC DIVISION PRODUCTS, ASSEMBLIES OR RELATED ITEMS (“PRODUCTS”) CAN CAUSE DEATH, PERSONAL INJURY, AND PROPERTY DAMAGE. POSSIBLE CONSEQUENCES OF FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THESE PRODUCTS INCLUDE BUT ARE NOT LIMITED TO:

- Unintended or mistimed cycling or motion of machine members or failure to cycle
- Work pieces or component parts being thrown off at high speeds.
- Failure of a device to function properly for example, failure to clamp or unclamp an associated item or device.
- Explosion
- Suddenly moving or falling objects.
- Release of toxic or otherwise injurious liquids or gasses.

Before selecting or using any of these Products, it is important that you read and follow the instructions below.

1. GENERAL INSTRUCTIONS

- 1.1. Scope:** This safety guide is designed to cover general guidelines on the installation, use, and maintenance of Pneumatic Division Valves, FRLs (Filters pressure Regulators and Lubricators), Vacuum products and related accessory components.
- 1.2. Fail-Safe:** Valves, FRLs, Vacuum products and their related components can and do fail without warning for many reasons. Design all systems and equipment in a fail-safe mode, so that failure of associated valves, FRLs or Vacuum products will not endanger persons or property.
- 1.3. Distribution:** Provide a copy of this safety guide to each person that is responsible for selection, installation, or use of Valves, FRLs or Vacuum products. Do not select, or use Wilkerson valves, FRLs or vacuum products without thoroughly reading and understanding this safety guide as well as the specific Wilkerson publications for the products considered or selected.
- 1.4. User Responsibility:** Due to the wide variety of operating conditions and applications for valves, FRLs, and vacuum products Wilkerson and its distributors do not represent or warrant that any particular valve, FRL or vacuum product is suitable for any specific end use system. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The user, through its own analysis and testing, is solely responsible for:
 - Making the final selection of the appropriate valve, FRL, Vacuum component, or accessory.
 - Assuring that all user's performance, endurance, maintenance, safety, and warning requirements are met and that the application presents no health or safety hazards.
 - Complying with all existing warning labels and / or providing all appropriate health and safety warnings on the equipment on which the valves, FRLs or Vacuum products are used; and,
 - Assuring compliance with all applicable government and industry standards.
- 1.5. Safety Devices:** Safety devices should not be removed, or defeated.
- 1.6. Warning Labels:** Warning labels should not be removed, painted over or otherwise obscured.
- 1.7. Additional Questions:** Call the appropriate Wilkerson technical service department if you have any questions or require any additional information. See the Wilkerson publication for the product being considered or used, or call 269-629-2550, or go to www.wilkersoncorp.com, for telephone numbers of the appropriate technical service department.

2. PRODUCT SELECTION INSTRUCTIONS

- 2.1. Flow Rate:** The flow rate requirements of a system are frequently the primary consideration when designing any pneumatic system. System components need to be able to provide adequate flow and pressure for the desired application.
- 2.2. Pressure Rating:** Never exceed the rated pressure of a product. Consult product labeling, Pneumatic Division catalogs or the instruction sheets supplied for maximum pressure ratings.
- 2.3. Temperature Rating:** Never exceed the temperature rating of a product. Excessive heat can shorten the life expectancy of a product and result in complete product failure.
- 2.4. Environment:** Many environmental conditions can affect the integrity and suitability of a product for a given application. Pneumatic Division products are designed for use in general purpose industrial applications. If these products are to be used in unusual circumstances such as direct sunlight and/or corrosive or caustic environments, such use can shorten the useful life and lead to premature failure of a product.
- 2.5. Lubrication and Compressor Carryover:** Some modern synthetic oils can and will attack nitrile seals. If there is any possibility of synthetic oils or greases migrating into the pneumatic components check for compatibility with the seal materials used. Consult the factory or product literature for materials of construction.
- 2.6. Polycarbonate Bowls and Sight Glasses:** To avoid potential polycarbonate bowl failures:
 - Do not locate polycarbonate bowls or sight glasses in areas where they could be subject to direct sunlight, impact blow, or temperatures outside of the rated range.
 - Do not expose or clean polycarbonate bowls with detergents, chlorinated hydro-carbons, ketones, esters or certain alcohols.
 - Do not use polycarbonate bowls or sight glasses in air systems where compressors are lubricated with fire resistant fluids such as phosphate ester and di-ester lubricants.

Safety Guidelines

2.7. Chemical Compatibility: For more information on plastic component chemical compatibility see Pneumatic Division technical bulletins Tec-3, Tec-4, and Tec-5

2.8. Product Rupture: Product rupture can cause death, serious personal injury, and property damage.

- Do not connect pressure regulators or other Pneumatic Division products to bottled gas cylinders.
- Do not exceed the maximum primary pressure rating of any pressure regulator or any system component.
- Consult product labeling or product literature for pressure rating limitations.

3. PRODUCT ASSEMBLY AND INSTALLATION INSTRUCTIONS

3.1. Component Inspection: Prior to assembly or installation a careful examination of the valves, FRLs or vacuum products must be performed. All components must be checked for correct style, size, and catalog number. DO NOT use any component that displays any signs of nonconformance.

3.2. Installation Instructions: Wilkerson published Installation Instructions must be followed for installation of Wilkerson valves, FRLs and vacuum components. These instructions are provided with every Wilkerson valve or FRL sold, or by calling 269-629-2550, or at www.wilkersoncorp.com.

3.3. Air Supply: The air supply or control medium supplied to Valves, FRLs and Vacuum components must be moisture-free if ambient temperature can drop below freezing

4. VALVE AND FRL MAINTENANCE AND REPLACEMENT INSTRUCTIONS

4.1. Maintenance: Even with proper selection and installation, valve, FRL and vacuum products service life may be significantly reduced without a continuing maintenance program. The severity of the application, risk potential from a component failure, and experience with any known failures in the application or in similar applications should determine the frequency of inspections and the servicing or replacement of Pneumatic Division products so that products are replaced before any failure occurs. A maintenance program must be established and followed by the user and, at minimum, must include instructions 4.2 through 4.10.

4.2. Installation and Service Instructions: Before attempting to service or replace any worn or damaged parts consult the appropriate Service Bulletin for the valve or FRL in question for the appropriate practices to service the unit in question. These Service and Installation Instructions are provided with every Wilkerson valve and FRL sold, or are available by calling 269-629-2550, or by accessing the Wilkerson web site at www.wilkersoncorp.com.

4.3. Lockout / Tagout Procedures: Be sure to follow all required lockout and tagout procedures when servicing equipment. For more information see: OSHA Standard – 29 CFR, Part 1910.147, Appendix A, The Control of Hazardous Energy – (Lockout / Tagout)

4.4. Visual Inspection: Any of the following conditions requires immediate system shut down and replacement of worn or damaged components:

- Air leakage: Look and listen to see if there are any signs of visual damage to any of the components in the system. Leakage is an indication of worn or damaged components.
- Damaged or degraded components: Look to see if there are any visible signs of wear or component degradation.
- Kinked, crushed, or damaged hoses. Kinked hoses can result in restricted air flow and lead to unpredictable system behavior.
- Any observed improper system or component function: Immediately shut down the system and correct malfunction.
- Excessive dirt build-up: Dirt and clutter can mask potentially hazardous situations.

Caution: Leak detection solutions should be rinsed off after use.

4.5. Routine Maintenance Issues:

- Remove excessive dirt, grime and clutter from work areas.
- Make sure all required guards and shields are in place.

4.6. Functional Test: Before initiating automatic operation, operate the system manually to make sure all required functions operate properly and safely.

4.7. Service or Replacement Intervals: It is the user's responsibility to establish appropriate service intervals. Valves, FRLs and vacuum products contain components that age, harden, wear, and otherwise deteriorate over time. Environmental conditions can significantly accelerate this process. Valves, FRLs and vacuum components need to be serviced or replaced on routine intervals. Service intervals need to be established based on:

- Previous performance experiences.
- Government and / or industrial standards.
- When failures could result in unacceptable down time, equipment damage or personal injury risk.

4.8. Servicing or Replacing of any Worn or Damaged Parts: To avoid unpredictable system behavior that can cause death, personal injury and property damage:

- Follow all government, state and local safety and servicing practices prior to service including but not limited to all OSHA Lockout Tagout procedures (OSHA Standard – 29 CFR, Part 1910.147, Appendix A, The Control of Hazardous Energy – Lockout / Tagout).
- Disconnect electrical supply (when necessary) before installation, servicing, or conversion.
- Disconnect air supply and depressurize all air lines connected to system and Pneumatic Division products before installation, service, or conversion.
- Installation, servicing, and / or conversion of these products must be performed by knowledgeable personnel who understand how pneumatic products are to be applied.
- After installation, servicing, or conversions air and electrical supplies (when necessary) should be connected and the product tested for proper function and leakage. If audible leakage is present, or if the product does not operate properly, do not put product or system into use.
- Warnings and specifications on the product should not be covered or painted over. If masking is not possible, contact your local representative for replacement labels.

4.9. Putting Serviced System Back into Operation: Follow the guidelines above and all relevant Installation and Maintenance instructions supplied with the valve FRL or vacuum component to insure proper function of the system.

The items described in this document and other documents and descriptions provided by The Company, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. Terms and Conditions. Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document issued by Buyer.

2. Price Adjustments; Payments. Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.

6. LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

7. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

10. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.

11. Improper use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright

infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

12. Cancellations and Changes. Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

13. Limitation on Assignment. Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

14. Force Majeure. Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure") Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.

15. Waiver and Severability. Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

16. Termination. Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) the dissolves or liquidates all or a majority of its assets.

17. Governing Law. This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

18. Indemnity for Infringement of Intellectual Property Rights. Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

19. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act. Buyer agrees to comply with all applicable laws and regulations, including those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which the Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

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