

FMP 1799

Locating Filters for Compressed Air Dryers

Compressed air dryers work better and last longer when properly positioned filters remove excess oil, water, and particulate

WILLIAM J. ULRICH, Van Air Systems, Inc., Lake City, PA

Major considerations in the selection and location of filters for compressed air dryers include the type of dryer and the application. Different guidelines apply for single-tower deliquescent, refrigerated, and regenerative dryers.

Single-Tower Deliquescent Dryers

A characteristic of single-tower dryers is their versatility in a broad range of applications. Because of this, more selection parameters are involved than with other types of dryers. Single-tower dryers are usually used with lubricated compressors that deliver air with varying amounts of oil.

Compressed air from lubricated compressors is classified into three basic categories: contamination with oil in excess of 25 ppm, contamination between 1 and 25 ppm, and applications requiring less than 1 ppm. Each condition requires a specific type of filter and filter location.

Oil in excess of 25 ppm usually occurs when using reciprocating or vane compressors

with drip-type lubrication, or screw compressors with faulty air/oil separators. Under these circumstances, a coarse coalescing prefilter should be used to remove excess oil. If a drain or separator malfunctions, the prefilter furnishes some protection from flooding.

In addition to a prefilter, a general purpose coalescing filter is recommended downstream of the dryer. This arrangement lowers the oil content in the system to 1 ppm while eliminating particles such as dirt and pipe scale.

Air systems with oil contamination between 1 and 25 ppm require a general-purpose coalescing filter installed downstream of a single-tower dryer. Since the desiccant is capable of tolerating normal amounts of oil, a prefilter should not be required.

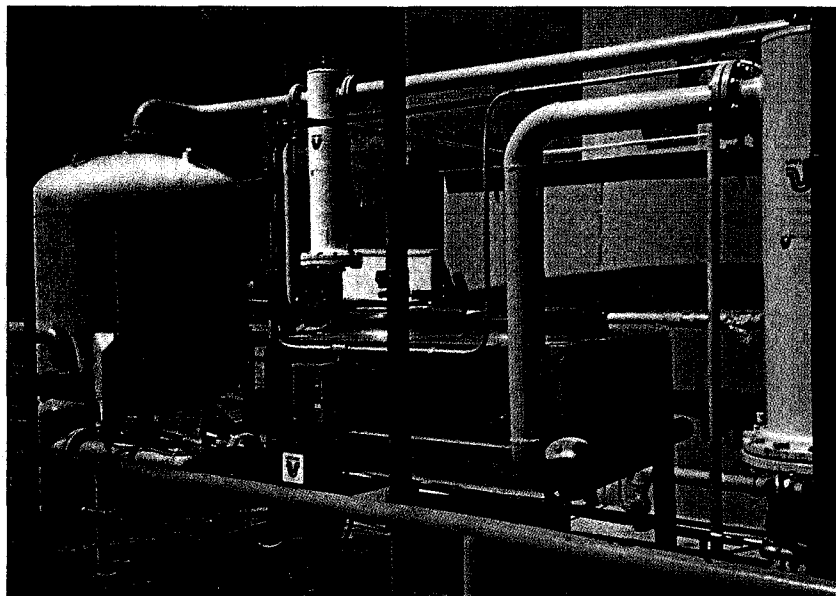
For applications requiring an oil content less than 1 ppm, an effective arrangement involves a general purpose coalescing filter, followed by a high-efficiency coalescing filter positioned downstream of the dryer. To remove hydrocarbon vapors and odors, installation of a vapor-adsorbing afterfilter may be required. It should be installed after the high-efficiency coalescing filter.

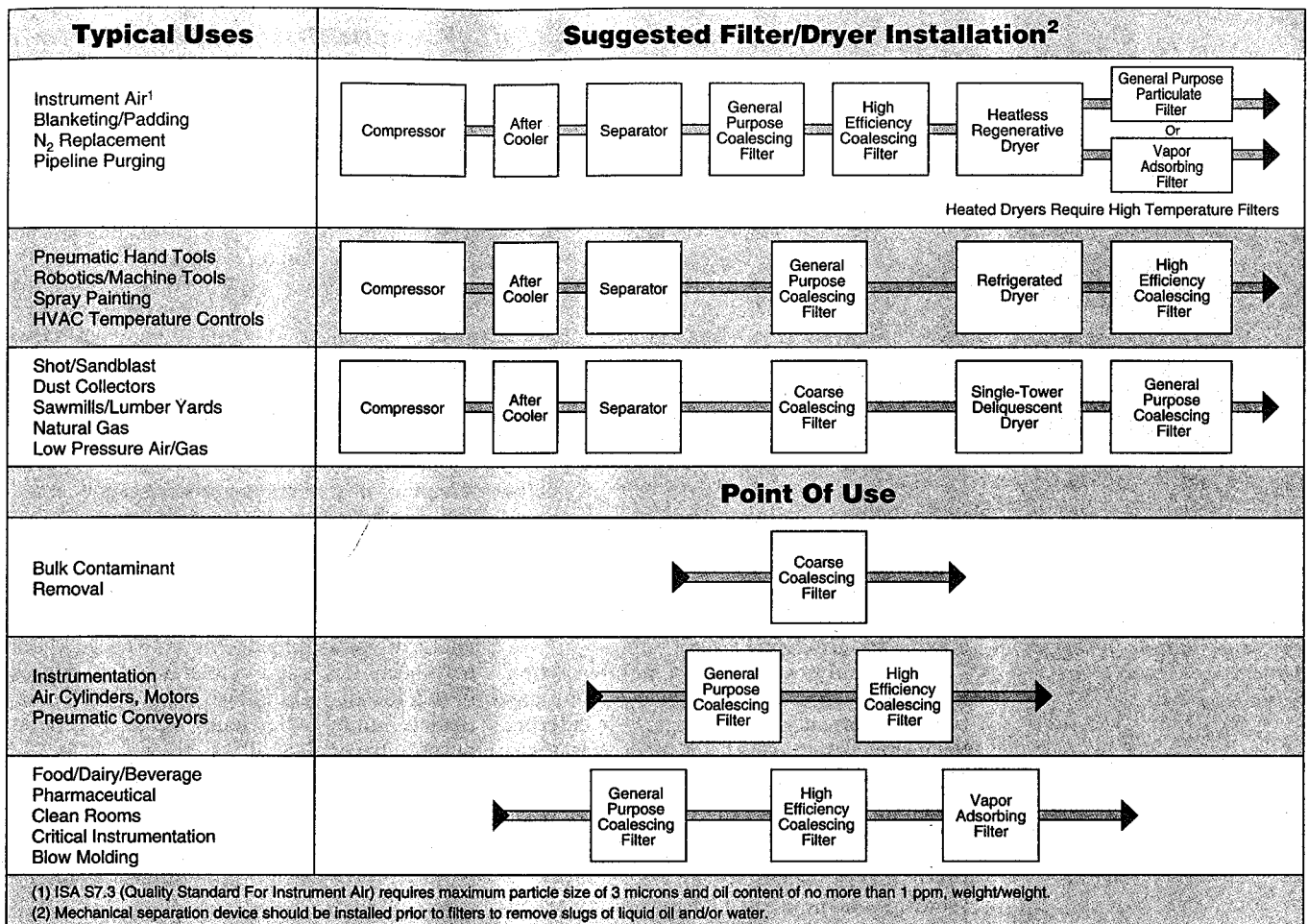
Refrigerated Dryers

Sometimes the question arises, "Should a compressed air filter be upstream or downstream of a refrigerated dryer?" The location depends on the amount of oil present, condition of the compressed air system, and quality of air required. The correct choice usually is an oil coalescing filter installed upstream of the dryer. It protects the dryer from oil contamination, dirt, pipe scale, and small amounts of water.

What may frequently be overlooked in such an application is the small amount of oil vapor that is condensed to a liquid aerosol in an air-to-refrigerant heat exchanger. The condensed oil is not easily reevaporized because of its low vapor pressure. A small amount of liquid oil may appear downstream of the refrigerated dryer even though it is usually assumed the upstream coalescing filter protects down-

Locations and types of filters in a compressed air system depend on the compressor, dryer, and air quality desired.





stream equipment from oil.

Required oil removal is accomplished by locating a single high-efficiency coalescing filter downstream of the dryer. It also provides insurance against liquid water carryover from separator flooding or inadequate draining.

Most manufacturers of dryers and filters recommend combining a coarse or general purpose coalescing-type filter upstream of the dryer with a general purpose or high-efficiency coalescing filter downstream of the dryer. For oil-free systems, applying a particulate filter upstream is generally acceptable.

Combining upstream and downstream coalescing filters on a refrigerated dryer application improves reliability and reduces maintenance a number of ways.

- The prefilter protects the dryer and maintains heat exchanger efficiency. It enables the dryer to keep delivering the required pressure dew point.
- The prefilter guards the higher efficiency after-filter from dirt, increases its element life, and minimizes pressure drop.
- The after filter performs three key functions: removes residual oil from vapor condensation, eliminates contamination of downstream equipment, and minimizes the risk of downstream water from drain or separator failure.

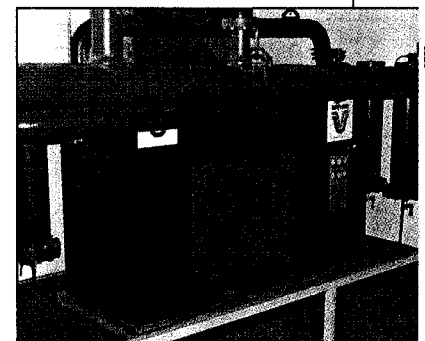
Regenerative Dryers

Both a prefilter and after filter are required for regenerative dryers. Selection of the appropriate filters depends on system requirements. Applying a prefilter ensures efficient dryer performance at rated conditions by reducing oil/water loading of the desiccant bed and preventing wear of inlet valving and clogging of flow diffusers from rust and pipe scale.

A single, high-efficiency coalescing prefilter (99.9999% at 0.6 micron) is recommended for heatless dryers on air systems with lubricated compressors that produce less than 50 ppm of oil. In typical service, rotary screw compressors generate less than 10 ppm and reciprocating compressors generate less than 25 ppm of oil. Select the combination of a general and a high-efficiency coalescing prefilter if a lubricated compressor is generating amounts of oil in excess of 50 ppm.

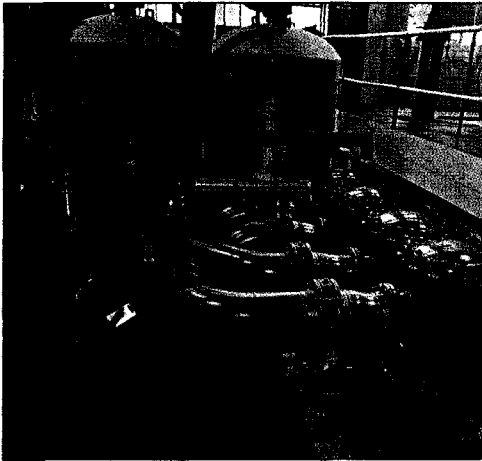
Position the general purpose coalescing filter (99.99% at 0.06 micron) upstream of the high-efficiency filter (99.9999% at 0.06 micron). This reduces the amount of oil to the high-efficiency filter and allows it to coalesce properly. Without the general purpose prefilter preceding it, element life on the high-efficiency filter is reduced. Excessive pressure loss occurs, as well as oil carryover into the

High-efficiency prefilter and after filter straddling a single tower dryer protect the compressed air system from oil and particulate contamination.



A particulate prefilter, general purpose coalescing prefilter, and high-efficiency coalescing after filter are used with a refrigerated dryer.

General purpose coalescing prefilters remove water, rust, and pipe scale from oil-free compressors



Redundant prefilters and after filters, used with a regenerative dryer, eliminate any interruption in service while filter elements are being replaced.

desiccant bed.

Such problems are most likely to occur when using compressors with drip-type lubricators. They release large amounts of oil into the system. Oil-lubricated rotary screw compressors with defective air/oil separators also pass large amounts of oil.

Two prefilters are recommended when lubricated compressor outlet air temperature exceeds 250 F. The problem is usually encountered with older reciprocating compressors operating at elevated temperatures. High outlet temperatures

cause compressor oils to break down into solid particles of carbon or varnish. These contaminants, up to 0.1 micron, adversely affect high-efficiency filter media.

Two prefilters are recommended when heated regenerative dryers are used with any type of lubricated compressor. Air entering the heated dryers must be as oil-free as possible. Any amount of oil carrying over from general purpose prefilters is adsorbed by the desiccant. This represents a potential fire hazard due to the relatively high temperatures involved in regeneration. Efficient oil removal is achieved and the risk of fire greatly reduced when a general purpose prefilter is located before a high-efficiency prefilter.

There are several reasons to install a general purpose coalescing prefilter with an oil-free compressor. A coalescing prefilter removes liquid water if the separator fails or floods because of inadequate draining. With an air temperature of 100 F at the compressor outlet, condensation is inevitable unless the ambient air temperature is 100 F or greater.

The prefilter also removes rust and pipe scale that clogs, jams, or leads to excessive wear of the inlet valving or clogging of flow diffusers on regenerative dryers. Most types of condensed hydrocarbons entering the system with ambient air are removed by pre-filters.

On systems including a lubricated backup compressor that may be used over extended periods of time, a high-efficiency prefilter for heatless dryers should be used. A general purpose and high-efficiency prefilter should be used with heated dryers.

Locate particulate-type after filters downstream from regenerative dryers to remove desiccant dust. The selection of after filters depends on the type of regenerative dryer (heated or heatless) and the end-use for the compressed air.

Most end-use applications with heatless dryers provide for the installation of a gener-

al purpose particulate after filter. Applications include operations where pneumatic power or instrument air is required. The Instrument Society of America Specification ISA S7.3 specifies air with solid particles no larger than 3 microns and an oil content no greater than 1 ppm w/w (weight per weight).

Some point-of-use applications for process air are oil sensitive. A small amount of oil in a vaporous state could contaminate products. To avoid contamination problems, select an activated carbon after filter. It removes both desiccant dust and hydrocarbon vapors.

Never use general purpose particulate or vapor-adsorbing filters immediately downstream of heated regenerative dryers because they cannot withstand elevated temperatures. At the point-of-use, inlet temperatures must not exceed the filter's temperature rating.

Select a high temperature particulate after filter (99.95% at 0.6 micron) for end-use applications with heated dryers. These filters have been developed to tolerate temperatures in the 400-to-500 F range. They provide particulate removal efficiency equal to general purpose particulate filters.

Regardless of the size or grade of prefilter selected, liquid oil and water accumulate in the sump or filter bowl. These liquids must be drained regularly, either automatically or manually, to prevent contamination of the desiccant beds.

Without draining, virtually all the compressor lubricant and water reaches the desiccant bed. The results are reduced dryer capacity and poor pressure dewpoint, in addition to a fire hazard in heated units.

After the correct prefilters and after filters are installed for an application, the following precautions should be implemented:

- Establish a preventive maintenance schedule based on manufacturer's recommendations
- Monitor pressure drop in relation to manufacturer's specifications for coalescing and particulate filters
- Change activated carbon elements on a regular basis or when hydrocarbons are detected downstream.

These procedures maximize performance, minimize downtime, and increase the operating life of air system components.

For more information . . .

Questions about this article may be directed to the author at 814-774-2631.

. . . Joseph L. Foszcz, Senior Editor, 708-390-2699

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MAINTENANCE

Tips and Tricks
page 70

FLUID HANDLING

Compressed Air Filters
page 76

ENVIRONMENTAL

Cleaning Up The Dirt
page 80

MATERIAL HANDLING

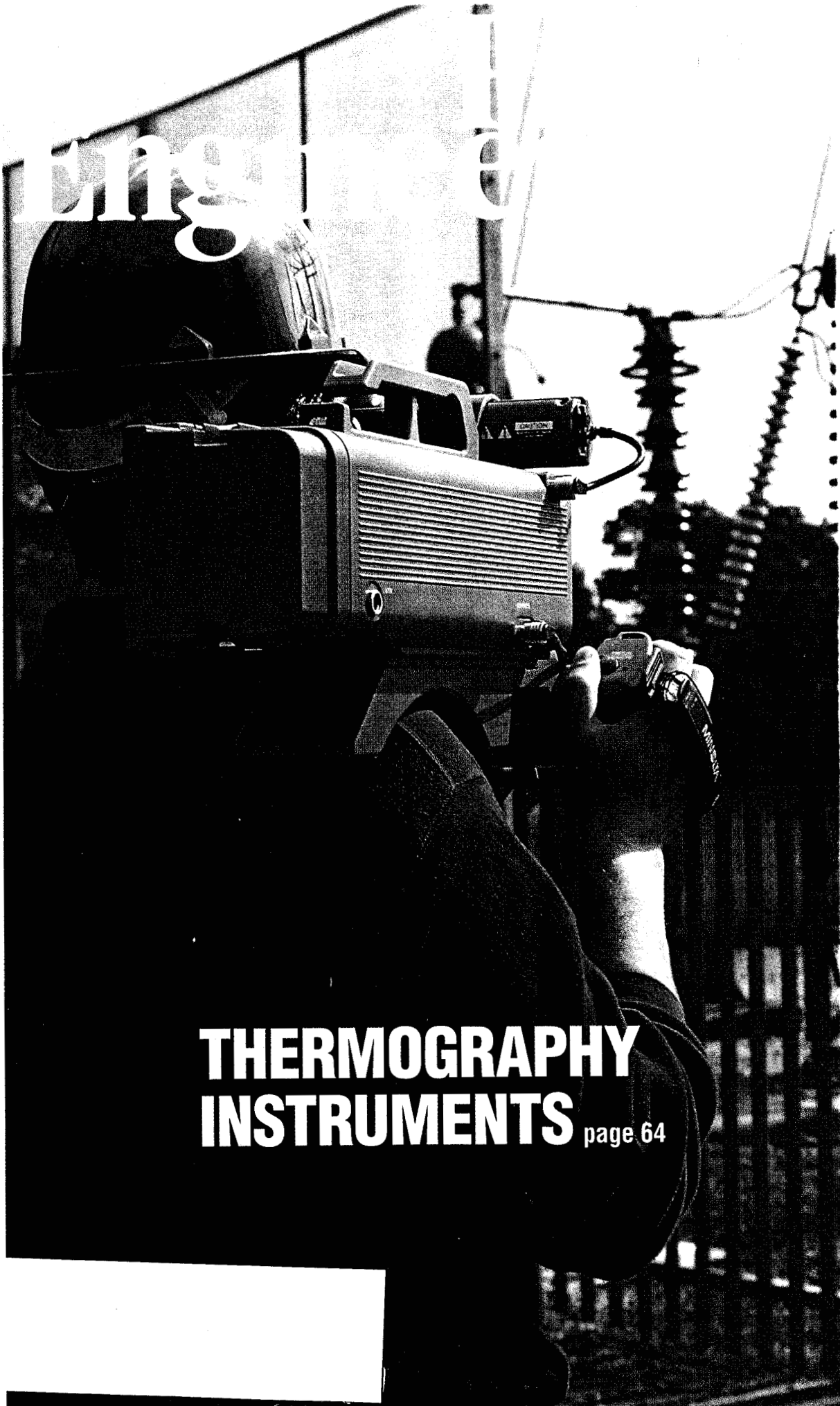
Evaluating AGVS
page 86

ELECTRICAL

Demand-Peak Sharing
page 94

DEPARTMENTS

- Editorial p 9
- News p 11
- Backtalk p 21
- Suggestions & Solutions p 22
- New Equipment p 31
- Human Side Of Engineering p 53
- Case Studies p 101
- New Literature p 1
- Data File p 117
- Management Side Of Engineering p



Engineering

THERMOGRAPHY INSTRUMENTS page 64