

## A Guide to



## Cost Savings with Air System Maintenance

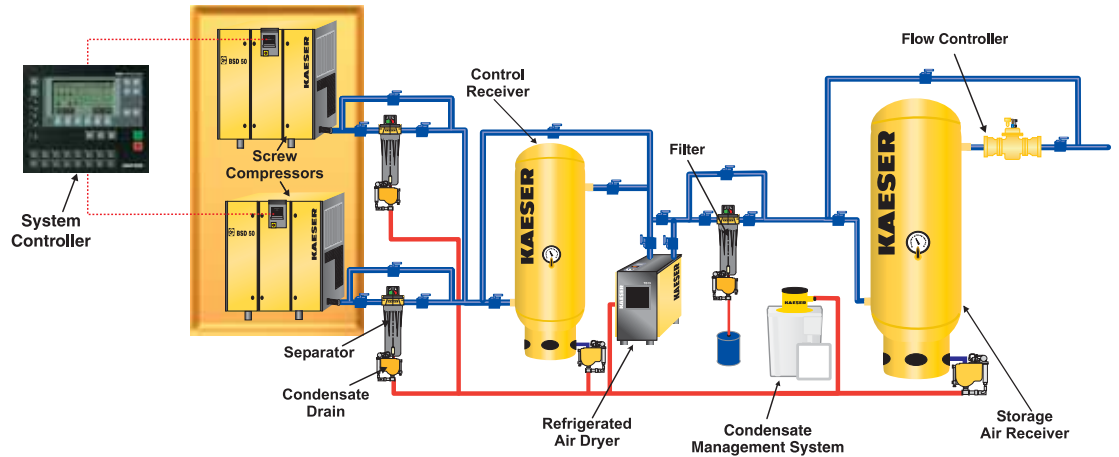


Compressor Maintenance

Compressed Air Dryer Maintenance

System Accessory Maintenance

Reference Library



## Effective Compressor Maintenance

**P**reventive maintenance is the solution to keeping your compressed air system in top condition. While the life cycle of any industrial

air compressor typically exceeds ten years, proper maintenance is crucial to maintain performance and efficiency.

Compressors can be divided into seven sub-assemblies; Pump or Airend, Motor, Drive Train, Lubricants, Controllers, Coolers, and Filters. Because these sub-assemblies are expensive components, they need to be maintained on a regular basis. In addition, the benefits of using genuine filters and maintenance parts and replacing them when needed should not be underestimated. Any contaminants not trapped in the filter will eventually damage machinery and equipment. Proper filtration and the use of quality fluids is more cost effective than repairing damaged equipment.

Compressor technology continues to improve and therefore change. Using factory-trained personnel and following OEM recommendations increases the reliability and provides the optimum performance from your compressed air investment. Today manufacturers also offer a variety of warranty programs which may help you plan and perform maintenance activities.

In addition to component maintenance, your attention to proper ventilation, ambient temperature and contaminant levels also goes a long way in avoiding problems in your compressed air system.



### Problem Solved™

**Problem:** My compressor is running too hot.

**Solution:** Clean cooler and check for any airflow restrictions. For water-cooled units, check water flow, pressure, and quality. Check the oil level and add more lubricant if required. Ensure that the area is properly ventilated and correct excessive ambient temperatures.

**Problem:** My air pressure at the point of use is too low.

**Solution:** Check for correct pressure setting on amount of pressure drop across the dryer, filters, and piping systems. Your compressed air demand may be exceeding current capacity and you will need to add more compressor capacity. Check for air line leaks and inappropriate use first.

**Problem:** My filter service life is too short.

**Solution:** Use only genuine OEM parts. Generic filters may not meet performance criteria such as micron rating, contamination capacity, and pressure drop. In high dust environments, consider using special prefilters, alternate location, or duct inlet and cooling air from clean location.





## Maintenance Checklist

### Pump or Aired

#### Piston/Pump

- ✓ Check the inlet and discharge valves for sticking due to carbon deposits.
- ✓ Check for excessive air through the crank case breather indicating worn piston rings.
- ✓ Check for low oil pressure indicating worn bearings.

Recommended Rebuild: 5,000-10,000 Hours

#### Rotary Screw Aired

- ✓ Check for mechanical seal leakage.
- ✓ Check for inlet valve wear.
- ✓ Check for excessive bearing "play".

Recommended Rebuild: 50,000-100,000 Hours

#### Motor

- ✓ Grease motor bearings with the right type of grease.
- ✓ Replace bearings on a conservative schedule.
- ✓ Check amp draw to prevent motor overload.
- ✓ Ventilate compressor room and limit ambient temperature to increase motor life.

### Drive Coupling

#### Direct Drive

- ✓ Verify that the direct drive system is perfectly aligned.
- ✓ Check frame and mounting block for "settling" which may cause misalignment and coupling damage.
- ✓ Check drive coupling for contamination and signs of wear and tear.

#### Gear

- ✓ Check spray bar for excessive contaminants and plugged orifices.
- ✓ Check for wear and "backlash".
- ✓ Ensure proper lubrication.

### Lubricants

Lubricants cool, seal, lubricate and remove contaminants from a compressor.

- ✓ Use proper grade (see manual).
- ✓ Drain existing lubricant before refilling.
- ✓ Draw routine oil samples to determine maximum lubricant life.
- ✓ Use synthetic lubricant for maximum service life.

### Filters

#### Air

Any contaminants not trapped in the filter will eventually damage machinery and equipment.

- ✓ Use proper micron rating as specified by OEM.
- ✓ Check pressure differential and, if necessary, carefully "counter flow" compressed air through the filters to clean them.
- ✓ Check for worn/damaged seals.
- ✓ Check structural integrity.
- ✓ Replace after filter has been cleaned 2 or 3 times.

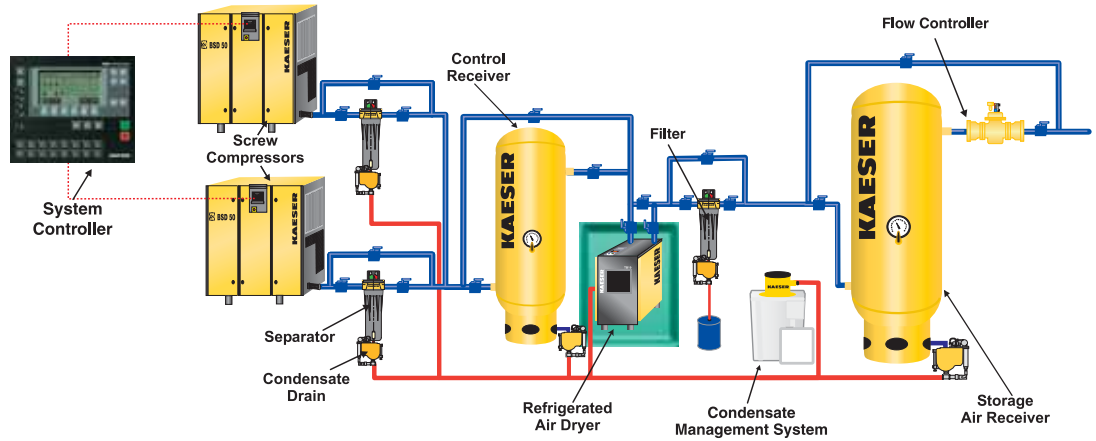
#### Lubricant Filter and Lubricant Separator

- ✓ Use only genuine replacement parts.
- ✓ Change when maximum pressure differential is reached or at each lubricant change, whichever occurs first.

#### Coolers

- ✓ Check for visible contamination and clean regularly.
- ✓ Keep clean and dry.





## Dryer Maintenance Solutions

**H**ot compressed air contains large amounts of water vapor. When traveling downstream, the water vapor condenses into liquid and causes corrosion in piping, components, air tools and production equipment. Compressed air dryers remove harmful moisture and are an indispensable part of any clean air treatment process.

### Problem Solved™

**Problem:** What are the parameters for sizing dryers?

**Solution:** There are many parameters affecting dryer sizes. Always check your instruction manual for proper sizing. Some general rules of thumb are to go up in size when you have lower air pressure and higher ambient and air inlet temperatures than the rated conditions. You may get away with a smaller size if you have opposite conditions.

**Problem:** I have water and/or oil at the point of use. What should I look for?

**Solution:** With refrigerated dryers check separator/drain traps and look for contaminated condenser. Desiccant dryers require prefiltration to maintain dryer performance and periodical desiccant change. Check drain trap operation and proper filter sizing. Ensure that system is designed for peak flows (i.e. surge conditions).

### Refrigerated Dryers

Refrigerated dryers are very reliable and the most commonly used dryer type. They remove water from compressed air by cooling it so that the water vapor condenses and is separated. A refrigerated dryer consists of heat exchangers, refrigeration compressor, condenser, separator/drain and control system.

### Desiccant Dryers

Desiccant dryers are used for applications where extra dry air as low as  $-100^{\circ}\text{F}$  pressure dew point is needed. Desiccant (1/8 to 1/4 inch spherical alumina) adsorbs moisture onto its porous surface, which needs to be de-sorbed periodically by purge air. Depending on the purge design, desiccant dryers are categorized in two major groups, heated and heat-less (cold-regenerated). Both designs feature twin pressure vessels filled with desiccant, connected with piping. Compressed or purge air is alternately directed through the towers via switching valves.

### Membrane Dryer

Membrane dryers use the selective porosity of special fibers to "permeate" water vapor to the outside, drying the compressed air flowing through it. They are completely maintenance free, however require reliable pre-filtration. See pre-filtration and drain check list for desiccant dryers.





## Maintenance Checklist

### Refrigerated Dryers

#### Condenser Unit

Clogged condensers account for most dryer problems.

- ✓ Periodically clean the fins with compressed air or a bristle brush to ensure enough refrigerant is transformed into a liquid state, for proper heat removal in the evaporator. Do not bend or damage the fins of the heat exchanger during cleaning.

#### Separator/Drain

The most critical area for dryer performance is proper drain function at the separator. Separated water needs to be discharged from the system frequently to avoid re-entrance into the air system.

- ✓ Check separator and drain function regularly by monitoring discharge amount. On an average day a 100 cfm dryer discharges about 6 gallons during a 3 shift operation. Even the best drain needs to be serviced or rebuilt at least once a year.

#### Controls

Controls are very reliable and typically do not need any adjustments.

- ✓ Check pressure switch setting if condenser fan is not running during full load operation.

#### Heat Exchangers

Most modern heat exchangers are non-fouling and do not require any pre-filtration or cleaning.

- ✓ Ensure that ambient air does not contain traces of ammonia or acidic substances. Water and ammonia can create an acid that destroys copper heat exchangers.

### Desiccant Dryers

#### Filtration

Pre-filtration is essential to protect the desiccant from oil and bulk water.

- ✓ Check pressure drop across filters and change filter cartridge when pressure drop exceeds 8-10 psid.
- ✓ Check drains for proper operation and rebuild them at least once a year.

#### Desiccant

Desiccant is very sensitive to oil as well as "dusting", which occurs when subjected to excessive air flow through the dryer.

- ✓ Sample desiccant (drain port on bottom of tower) and examine for proper size (dusting reduces size) and discoloration, indicating oil contamination.
- ✓ Replace desiccant every 2 to 3 years.

#### Valving

Proper valve operation is critical for desiccant dryer operation.

- ✓ Check diaphragms and seals of switching and check valves for wear and replace at least once a year. A higher than normal pressure gauge reading on pressure vessels during "purge" cycle can indicate excessive leaks.
- ✓ Periodically check for dew point if dryer is not equipped with a dew point monitor.

### Control System

Control systems consist of either reliable solid-state timers or a PLC.

- ✓ Both provide means to manually step through a complete operating cycle and verify proper valve sequence.

### Purge Mufflers

- ✓ Check purge mufflers for excessive desiccant dust, indicating desiccant breakdown. Replace when necessary.
- ✓ Check purge line for obstruction and excessive pressure drop.

### Heater and Temperature Controls

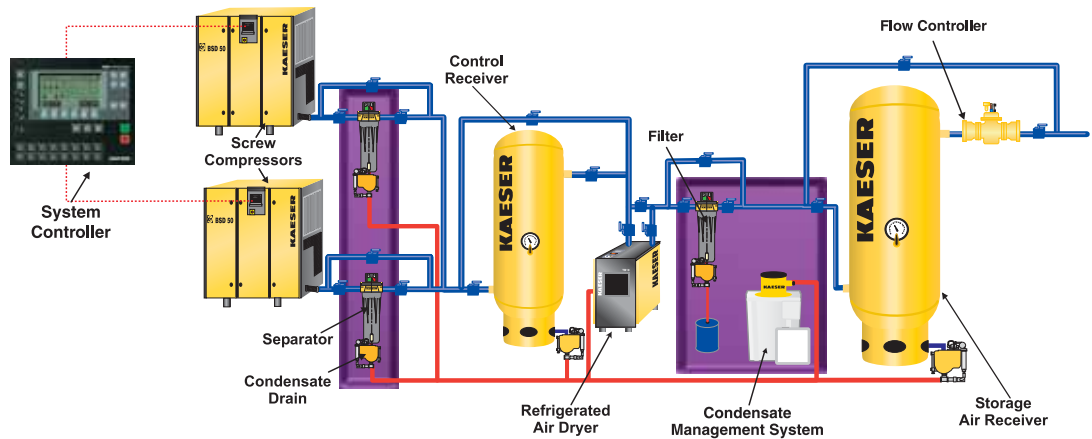
- ✓ Check operation and temperature settings of thermostat (typically between 350-450°F) to avoid heater element burn out. Check safety temperature switch for proper operation.

### Blower

- ✓ Service blower motor per instruction manual. Grease or replace motor bearings as necessary.
- ✓ Clean or replace blower air inlet filter.

### Membrane Dryer

No maintenance needed. However, check requirements for pre-filtration and drain traps and service per instruction manual.



## Aftercooler, Drains, and Filters

Aftercoolers reduce the air temperature caused by the compression process close to ambient levels, where the air can be treated further. Aftercoolers are either air or water-cooled and eliminate up to 80% of all water vapor.

### Filters

Filter technology has steadily advanced to provide reliable removal of solid particles, oil aerosols, water, and hydrocarbon vapors. It is possible to

produce air thousands of times cleaner than the air we breathe. When selecting filters, ensure that the liquid loading (amount of water or oil) as well as the solid particle size does not exceed the filter rating. Typically, you should start with a bulk filter to remove contaminants at the aftercooler, followed by a fine or extra-fine filter after the refrigerated or before a desiccant dryer. If any hydrocarbon vapors, tastes or smells need to be removed, install a carbon-activated filter last. Note that any liquid water going through a carbon filter greatly hinders its effectiveness. See a typical filtration sequence in the above diagram.

### Condensate Drains

Condensate drains are a vital element in any clean air treatment system and are often overlooked. Improper operation virtually always renders the complete system useless. There are four styles of drains available: manual drains, timed electric drains, float drains, and electronic demand drains. Considering that separators or filters need to be drained up to 10 times an hour, manual drains should never be considered. Timed electric drains are not the ideal choice since they have to be set for the maximum drain demand, opening unnecessarily in low drain periods. They also create unwanted emulsions, which are hard to treat. Electronic demand or magnet operated float drains offer the highest reliability and efficiency and often include automatic malfunction alarms.

### Problem Solved™

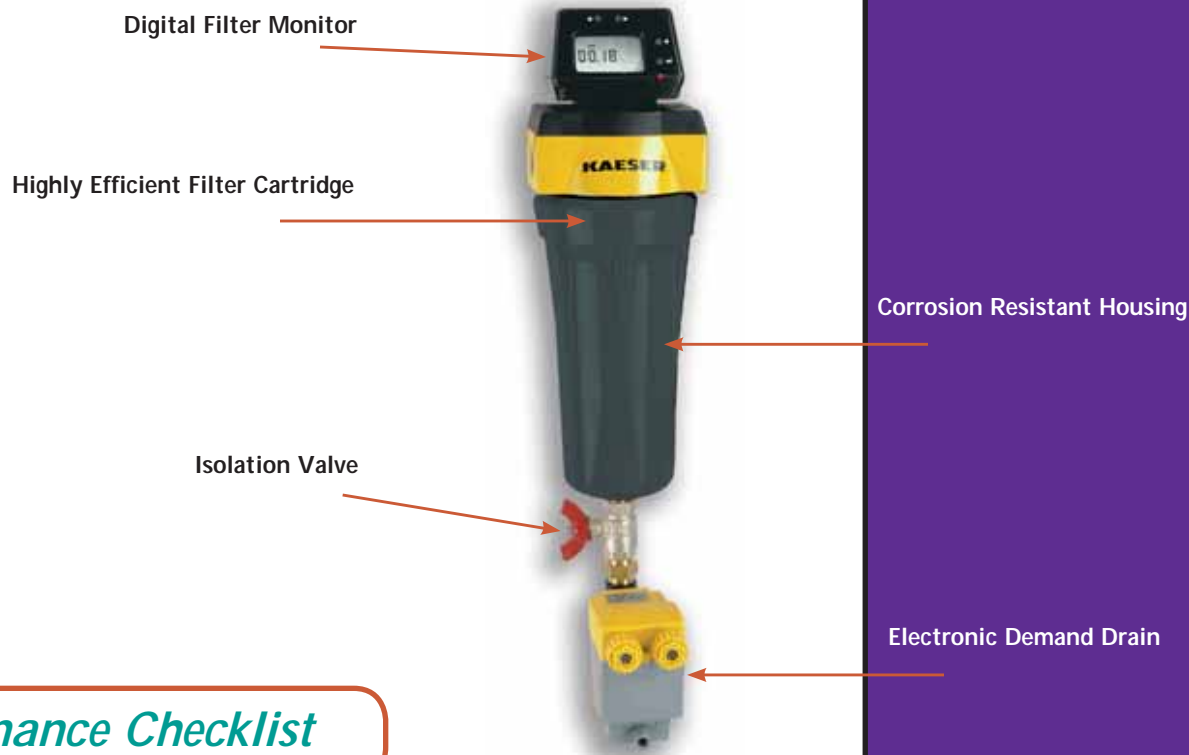
**Problem:** My filter cartridges only last two months.

**Solution:** Check for proper sizing and/or installation sequence of the filter. Place a coarser filter ahead of your existing filter to take up the bulk liquid or particulate loading. Remember the finer the filter, the less liquid and particulate loading the filter can endure. Using high quality drain traps prevents liquid slugs from reaching filters downstream.

**Problem:** Even with a dryer, there is still water in my air lines.

**Solution:** The problem may be as simple as a failed drain trap. Always use high quality traps and rebuild them annually. Proper dryer selection and sizing for maximum operating conditions is also crucial.





## Maintenance Checklist

### Air-cooled Aftercoolers

- ✓ Clean heat exchanger fins with compressed air or a bristle brush. Be careful not to damage or bend fins.

### Water-cooled Aftercoolers

- ✓ Check for proper water pressure and inlet/outlet temperatures.
- ✓ Check heat exchanger on water and air side for fouling. Mineral deposits on water side negatively influence heat transfer. Clean or flush with special cleaning solvent if necessary.

### Moisture Separator with Drain

- ✓ Check separator filter element for pressure drop.
- ✓ Check drain for proper function. Rebuild mechanism if necessary.
- ✓ Check that air flow does not exceed rated flow. Excessive air flow can damage filter elements and reduce filtration performance.
- ✓ Do not install an extra-fine filter as a "catch all" right after an aftercooler. It cannot remove the contaminant load at this point and will create significant pressure drop.

- ✓ Check pressure drop regularly or use an electronic filter monitor to indicate optimum element replacement.

- ✓ Check drain function periodically.

### Vapor Adsorbers

Activated carbon is often used to remove unpleasant tastes or smells. These filters always need to be installed downstream of a dryer and an extra fine oil removal filter.

- ✓ Check for any liquid water, which renders the carbon ineffective.
- ✓ Carefully open drain valve and check for smell. Change cartridge when smell is detected or on cartridge style filters after 1000 hours and on "tower" style filters after 10,000 operating hours, whichever occurs first.

In addition, on carbon "tower" style filters, a fine after-filter to remove carbon dust needs to be installed.

### Condensate Drains

- ✓ Check for clogged strainer installed ahead of drain. Note that a high-quality drain does not require a strainer.

- ✓ Periodically clean off excessively large contaminants, which did not pass through the drain.

- ✓ Annually rebuild drains. Drains can open up to 250,000 times a year.

- ✓ Ensure drain is installed per instruction manual. Vent lines are often necessary to provide reliable operations.

- ✓ Never feed more than one drain line into drain.

### Condensate Management System

- ✓ Ensure that condensate is properly treated before being discharged into sewer systems. Failure to do so could result in severe fines.
- ✓ Most oil-water separators are gravity feed devices which have replaceable filter bags or elements. Check instruction manual for maintenance schedule.



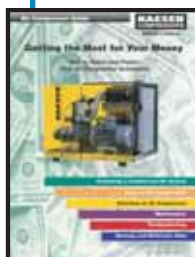


Kaeser Compressors, Inc. has been in business for more than 85 years providing quality compressed air products to a worldwide market. Its development of the high efficiency Sigma Profile for rotary screw compressors marked a major technological advance in compressor design. Kaeser also manufactures blowers, vacuum systems, portable air compressors, as well as reciprocating compressors, booster compressors, and oil-less compressors featuring the same high-quality standards as their screw compressors. For clean air treatment, Kaeser offers a complete line of equipment including: refrigerated and desiccant air dryers, particulate filters, oil removal filters, oil vapor adsorbers, and condensate management systems.

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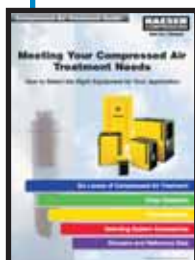
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### Air Compressor Guide



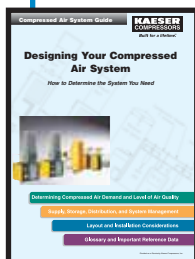
*Getting the Most for Your Money*, details types of air compressors. It also discusses evaluating, selecting, maintaining, and troubleshooting your compressed air system.

### Compressed Air Treatment Guide



*Meeting Your Compressed Air Treatment Needs*, assists you in selecting the right equipment for your application. This issue features: What to Look for When Selecting Dryers, Filters, and Drain Traps.

### Compressed Air Systems Guide



*Designing Your Compressed Air System*, covers Evaluating a Compressed Air System, Selecting an Air Compressor, Maintenance and Troubleshooting.

### Energy Savings Guide



*Energy Savings in Compressed Air Systems*, discusses how to evaluate your compressor efficiency, cost-cutting solutions, waste heat recovery and the importance of maintenance.

### Compressed Air Controls



*Compressed Air Controls: A Comprehensive Guide to Compressor Settings and System Management*, discusses how to select compressor controls and optimize performance.

## 5 Five Steps to Save Money with Maintenance

1. Use only genuine OEM parts for maximum service life and equipment efficiency.
2. Follow a routine maintenance plan or negotiate a preventative service agreement with a reputable service company.
3. Perform a leak survey at least annually. On average, over 35% of all air used is wasted to leaks.
4. Use synthetic compressor fluids to reduce friction and extend change intervals.
5. Even the best maintained equipment has a finite service life or becomes obsolete.

## Rules of Thumb

- Air compressors normally deliver 4 to 5 cfm per horsepower at 100 psig discharge pressure.
- Depending on the size of the system, compressed air costs about 25 to 30 cents per thousand cubic feet of free air ingested by the compressor (including operating and maintenance costs).
- Every 2 psi pressure drop costs 1% of compressor horsepower in efficiency.
- Power cost for each 1 horsepower operating constantly for one year at 10 cents per kWh is about \$750.
- A 50 horsepower compressor rejects heat at approximately 126,000 btu per hour.
- Size air receivers for a minimum of 1 gallon capacity for each cfm of compressor output.
- Typical compressor discharge air temperature before aftercooling:  
Rotary Screw: 175°F  
Single Stage Recip.: 350°F  
Two-stage Recip.: 250°F
- The water vapor content at 100°F of saturated compressed air equals about 2 gallons per shift for each 100 cfm of compressed air.