JORDAIR
COMPRESSORS INC.

JORDAIR – "*BUILDING RELIABILITY & SAFETY*"

Safety Circular Rev. #2 - 06.02.2003 Final Drying and Purifying Chambers

- SAFETY WARNING -

DISREGARDING OF THIS SAFETY NOTICE MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH

There are a large number of final purification systems in service on breathing air compressors in Canada that have or will very soon have reached the end of the safe service life. The safe service cycle life limitation of high pressure compressed breathing air purification components became apparent as a result of failures in certain classes of aluminium alloy SCUBA and SCBA cylinders and also final separators.

The use of alloy chambers is common in the industry due to the ease of machining, lightweight and the economical use of an anodized protective coating against corrosion.

The producers of compressors have supplied either the 6061, 6082 or 7075-T6 alloy filter chambers for high pressure breathing air SCUBA and SCBA refilling applications.

- SAFETY ALERT -

Compressor final dryers and purifiers from 6061, 6082 and 7075-T6-aluminium alloy are subject to a limited cycle life and use beyond the cycle life may represent a serious safety hazard. The hazard will increase from improper maintenance and at higher pressures due to the prolonged pressure stress inherent with the application.

- SAFETY WARNING -

Do not operate a high pressure breathing air compressor with a final purification system beyond the rated life or operation service pressure of the chambers.

FILTER CHAMBERS TO BE REPLACED AT 10 or 15 YEARS

The 4", 4.25" & 5" diameter aluminium 6061, 6082 and 7075-T6 alloy filter chambers represent the greatest quantity of filters in current use. Certain manufactures have given chambers of this type a maximum 15-year life. Jordair recommends changing this type of filter based on the factors of pressure cycles and the years of service life, as both pressure cycles and static pressure effect the life of the chambers.

The inherent high strength characteristic of 7075-T6 materials is balanced by the greater susceptibility to fatigue and stress cracking corrosion leading to failure. All alloys can be affected by poor service procedures of the industry, as the filter base cap is often not removed to check the chamber for signs of corrosion and associated stress cracking. Any filter chamber showing signs of corrosion is to be replaced regardless of age. The high final operating pressure of up to 6000 PSIG in SCBA recharging applications contributes to the concerns regarding operating life span.

The filter chambers in this **SAFETY WARNING** can be identified as follows:

- **TYPE 1** drying and purifying chambers manufactured in material 7075-T6 alloys. These units are typically 3 ¾", 4" and 4 ¼" in diameter and have a top cap, a chamber and a bottom cap. The length will vary from 10" to 32" long.

- **TYPE 2** drying and purifying chambers are of larger diameters of 4 /1/2" and 5" that have been produced in 6061-T6 or 6082-T6 aluminium alloy.

- All of the chambers can be identified within these two types and size ranges with the external identifying colour characteristics of plain aluminium, red, gold, blue, brown, and black anodizing.

- Any chamber not having a CRN registry number is not legal for use in any province in Canada and should be removed from service to be replaced by a CRN registered design. See the Jordair web site for information from BC Boiler and Pressure Vessels at www.jordair.ca.

- For a chamber to be code compliant it can be identified with a nameplate that must have a CRN number, year of production, operating pressure, operating temperature, serial number and the name of the manufacture. The heat number of the alloy is stamped on the caps and the chamber

If the cycle life of a filter is unclear, Jordair recommends any filter chamber that falls in either category should be replaced based on 10 years, which is 87,600 hours of pressure cycling operation. The 10-year service life recommendation should be adopted rather than 15-years when there is insufficient data to support the number of pressure cycles and the size of the pressure range of the cycle that the filter has been subject to over time frame.

The following information is a guide to identify the average safe service life of an alloy filter chamber. This information will assist the compressor operator to access the relative safe service life of a purification system and assess when to replace a filter system.

- A 15-year service life of an aluminium filter can be safely achieved if the chamber has not reached the rated pressure cycle life and the integrity of the protective anodize coating are in tact and there is no sign of stress cracking or corrosion.

- The worst case for a filter is when it cycles from 0 PSIG to full design pressure on a repeating bases. The cycle life is calculated on the failure test conducted by cycling the chamber from 0 psig to the full operating pressure until failure. The cycle count to vessel failure is divided by a factor of 20 to reach the operating cycle life. E.g. Cycle life failure of 45,000 cycles divided by 20 = 2250 cycles.

- With a 20 to 1 safety factor and based on the extreme pressure swing; filters designed to ASME code with a 4:1design factor based on ultimate strength will have a cycle life of approximately 4500 pressure cycles calculated and tested from 0 PSIG to the highest design pressure rating. A filter built to TUV standards with a 2.5 to 1 safety factor would have a cycle life of 2200 cycles.

- Since the most common applications of filter systems record a pressure cycle over a pressure range of approximately 60% to 100% of the rated design this increases the filter cycle life by approximately double or to about 9000 cycles. This is based on a 4 to 1 design safety factor a 2.5 to 1 would be about one half the cycles.

- A typical method to confirm a filter life based on an example of a compressor filling 45 cubic foot cylinders to 4500 psig with a multiple cylinder storage system would reach 9000 pressure cycles after 9,000 operating hours. The 2.5 to 1 safety factor design would be limited to 4500 pressure cycles and 4500 hours.

- The most accurate method would be to record each cycle, however this is not practical for most operators. The basic consideration of 1 cycle per hour would be consistent with the majority of applications in breathing air.

- Typically most compressor systems will not reach 4500 to 9000 hours within a 15-year period so in this case the years of service and condition of the filter chambers become the deciding factor for replacement.

- Portable diving compressors can be an exception as the filter system and can have a pressure cycle of a more extreme nature with each cylinder being filled. In this case a count method of 3375 or 6700 cycles or dive cylinders would be an effective method to track the filter chamber life.

The filter design factors vary by supplier with some adopting ASME design of 4 to 1 and some producers using a design safety factor of 2.5 to 1. As the relative safe life is based on taking the failure cycle count and dividing by 20 the chamber design includes a generous safety margin even at the lower 2.5 to 1 design calculation.

This information combined with the pressure cycle test data supplied by Bauer and the relative theoretical effects of prolonged pressure stress over a variety of safety factor designs contributes to the conservative approach that is adopted by Jordair in this safety memo.

Filters of these design safety factors have been in service up to 20 years without a known failure in Canada. This leads Jordair to conclude; by the third party cycle test data supplied by Bauer on their filters and the field experience by Jordair of this design since 1982 that the recommended replacement cycle life and maximum service life in this "Safety Memo" are prudent and conservative figures.