



AEROSPACE INFORMATION REPORT

AIR4994**REV. A**

Issued 1996-01
Reaffirmed 2007-11
Stabilized 2013-11

Superseding AIR4994

High Pressure Pneumatic Compressors Users Guide For Aerospace Applications

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

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1. SCOPE:

Gas compressors (air and other compressible fluids) have been used sporadically since the 1940's for various utility functions in aerospace applications. They have been used to provide power to gun purge and drive systems, engine or APU starters (recharge accumulators), reservoir pressurization, cockpit pressurization, braking systems, canopy seals, engine control devices, landing gear activation, and boosted flight controls (see Table 1). In current state-of-the-art aircraft, most pneumatic system power is extracted from a stage of compression in the turbo-jet engine. As more and more demands are put on new generation engines for fuel economy and performance there is an increasing need for a new source of pneumatic power. This document is intended to describe current state-of-the-art technology in compressors, define the limitations, discuss enhancements needed and attempt to predict the needs of the future.

1.1 Purpose:

The information contained herein was compiled to describe what technology level currently exists, typical applications, user experience and limitations and recommendations for development of new technology necessary to meet projected demands of the future. Those who should benefit from this document would be:

- a. System integrators responsible for utilizing gas compressors in new aircraft systems.
- b. Designers not familiar with the capabilities and limitations of airborne compressors.
- c. Advance systems development designers needing trade-off information for new systems concepts.
- d. Compressor design engineers with responsibility for up-grading existing designs.

1.2 Field of Application:

This SAE Aerospace Information Report (AIR) establishes the characteristics of high pressure piston type pneumatic compressors. The focus is to document data and recommendations for use in aerospace applications.

TABLE 1 - High Pressure Compressors
Airborne Applications

Aircraft	Function	Capacity (SCFM)	Pressure psi/kPa	Drive	Weight (lb/kg)	Comments
Lockheed Electra	Utility Power	4.4	3400/23 400	Hyd. motor	23.4/10.6	
DC-8		4.0	3000/20 640	Hyd. motor	22.0/10.0	
F-4	Canopy Seal	2.4	3000/20 640	Hyd. motor	14.0/6.4	
F-27	Flight and Utility	2.0	3300/22 700	Eng. G/Box]	10.5/4.8	All pneumatic aircraft
KC-135		2.4	3000/20 640	AC motor	31.4/14.2	Includes moisture separator
707 (USAF)	Utility Functions (Emergency)	4.6	3000/20 640	Hyd. motor	34.5/15.6	Includes moisture separator and purification system
F-227	Flight and Utility Power	2.0	3300/22 700	Eng. G/Box]	22.0/10.0	All pneumatic aircraft
C-5A		2.4	3000/20 640	Hyd. motor	28.6/13.0	Includes moisture separator and purification system
C-17	Nitrogen Supply OBIGGS	1.0 (#/min)	3000/20 640	Hyd. motor	115/52	Integrated into package
B-2	APU start	0.34 (#/min)	1000/6880	APU-Bleed	32.4/14.7	Integrated into package
F-117	APU start	0.34 (#/min)	1000/6880	APU-Bleed	20.2/9.2	Integrated into package
F-22	APU/EPU start	0.08 (#/min)	4800/33 024	Hyd. motor	16.2/7.3	Integrated into package
AH-64 (Mod)		TBD	1000/6880	Trans.	TBD	IPAS - Integrated Pressurized Air Sub-System

1.2.1 Classification: High pressure reciprocating piston compressors are positive displacement devices with two or more stages with output pressures of 1000 psi (6890 kPa) and above. Typical compressors are two to four stages with output pressures up to 3000 psi (20 700 kPa). See Figure 1.

1.2.2 Types: This document will focus on piston-type, positive-displacement compressors rather than rotary-screw or roots-type which are typically used in much higher flow applications.

1.3 Lubrication:

1.3.1 Wet Sump: Lubrication and cooling provided by a wet sump which lubricates the pistons, connecting rods, and bearings.

1.3.2 Oil-free: Includes piston-type activating mechanisms with no lubrication on the pistons or valves. Bellows type seals and wipers are used to isolate the pistons from the sump oil.

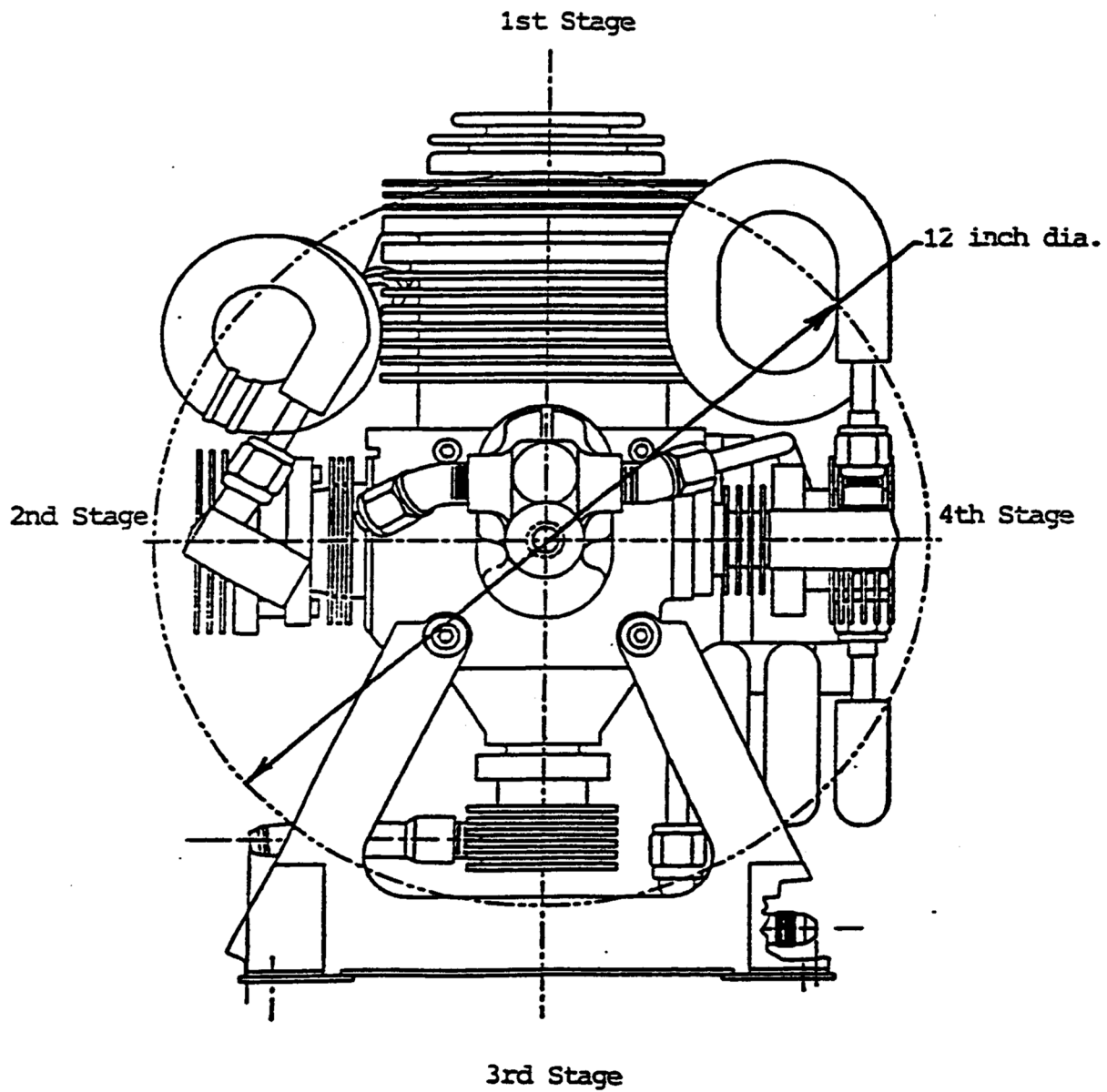


FIGURE 1 - Typical 3000 psi Aerospace Compressor (4 Stage)