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RCV/RCR Manual and Description Sheet

Remote Controlled Valve / Remote Controlled Regulator for RCV hardware version D, manual rev. 2.5
Superceeds RCV hardware version C and manula version 2.0

Safety notice for high pressure oxygen management systems

Factors recognized as causing fires in oxygen systems

Temperature: As the temperature of a material increases, the amount of energy that must be added to produce ignition for combustion decreases. Operating an oxygen system at unnecessarily high temperatures, whether locally or generally , reduces this safety margin. The ignition temperature of the many material commonly used in oxygen systems is lowered in materials that otherwise might be self-extinguishing.

Pressure: As the pressure of oxygen in an oxygen system increases, the ignition temperatures of its components typically decrease, and the rates of fire propagation increases. Therefore, operating an oxygen system at unnecessarily high pressures increases the probability of a fire. It should be noted that a pure oxygen environment even at atmospheric pressures, may still pose a significant hazard with noncompatible materials such as hydrocarbon oils.

Contamination: Inadequate cleanliness during assembly, installation or service may cause contamination of oxygen systems. Abrasion and deterioration of system components over time may also cause contaminaion. Contaminates may be introduced as liquids, solids or gases, be highly flammable, and easily ignited. Hydrocarbon oils such as hydraulic or engine oil would be a good example. Even normally inert contaminates such as rust may produce ignition through particle impacts, friction and resonance heating effects.

Particle impact: Collisions of inert or ignitable solid particles in a high pressure oxygen enriched environment are associated with potential ignition. Such ignitions may result from the particle being flammable and igniting upon impact and, in turn, igniting other system materials. Ignition may also result from heating of the particles and subsequent contact with system polymers, from fine flammable particles produced during collision, or from the direct transfer of kinetic energy during collision. Absolute removal of particles is not possible, and systems can self generate some particles from normal operation. The RCV/RCR system has been designed where this is at a minimum and filter are present at all the high pressure inlet ports. The hazard associated with particles increases with both heat and temperatures of the system and the kinetic energies of the particles. It should be noted that the quantity of particles in a system will tend to increase with time and usage.

Heat from compression: Heat is generated from the conversion of a gas going from a low pressure to a high pressure rate. This typically occurs during a system filling operation. In addition, it occurs when high pressure oxygen is released into a dead-ended tube or pipe, quickly compressing the residual oxygen that was in the tube or pipe ahead of it. The elevated temperatures produced can ignite contaminates or elevate system components above their ignition point. The hazard of heat from compression increases with system pressure, pressurization rates and temperature.

Resonance: Acoustic oscillations (whistling-chatter) within resonant cavities are associated with rapid heating. The temperate rises more rapidly and achieves higher values where particles are present or where there are high gas velocities. Resonance phenomena in oxygen systems are well documented, but there are few design criteria.

Static electric discharge: Electrical discharge from static electricity, possibly generated by high fluid flow under certain conditions, may occur, especially where particle contaminates are present. Composite fiber wound cylinders do not present any static electricity hazards unless they are not electrically part of the metallic components of the system or have the internal envelope (liner) ungrounded. Make sure your installation includes grounding the composite would cylinder at the metallic point of the neck to the common ground point of the aircraft system.

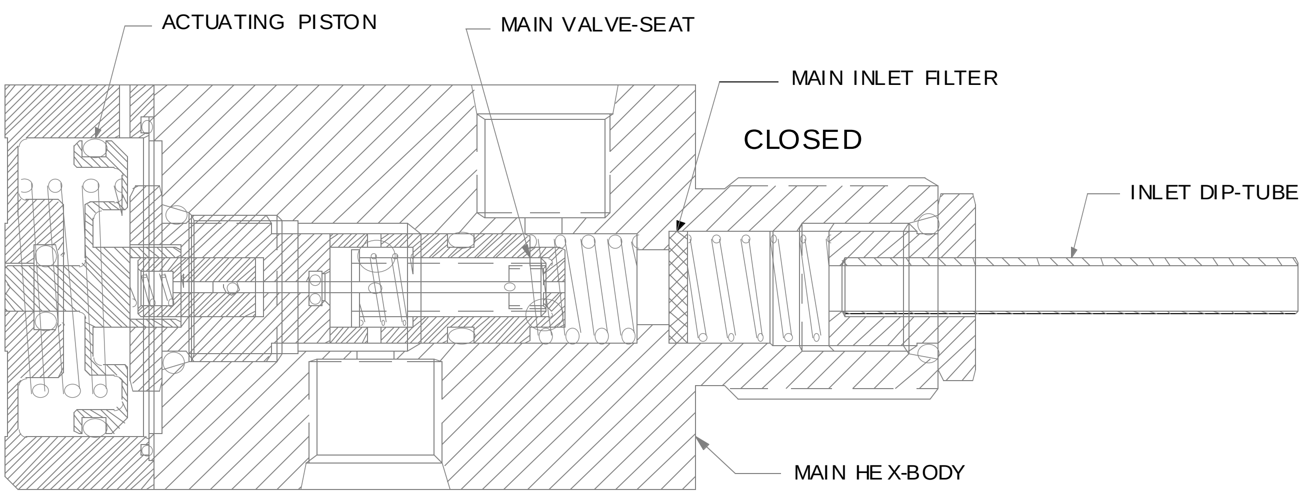
Responsibility: It is the duty of the installer and user of the system to ensure that clean and proper practices are used to install, service and use the system.

DESCRIPTION:

The **RCV/RCR** is a remote controlled oxygen valve and regulator assembly intended for use in experimental aircraft oxygen systems and related applications. The **RCV/RCR** does not comply to any known TSO nor does it have any current STCs'. The **RCV** (Remote Controlled Valve) is the "main hex-body" valve device without any regulator units mounted to any of the 3 valve ports. Once an appliance such as a regulator has been mounted to any of these ports it becomes an **RCR** (Remote Controlled Regulator). The **RCV/RCR** unit is a dual purpose remotely controlled product. It can be controlled (operated) remotely by pneumatic, electro-pneumatic or mechanical means. In addition, the **RCV/RCR** has a dual purpose inlet port system that can be directly mounted to any cylinder that has an SAE-8 (0.750-16) female service port. It can be interconnected by fittings and tubing to a pressure system or cylinder via the SAE-4 female inlet port centered just inside the SAE-8 male port.

Theory of operation:

The design of the RCV/RCR is relatively simple. It is generally operated by pneumatic means utilizing a very small amount of the pressurized oxygen supply, regulated by a pilot regulator, to provided the necessary (normally static) pressure to operate (lift) a piston that opens a high-pressure main valve-seat device inside the RCV body.



Cut-a-way view of the RCV

A mechanical operating option can be ordered with a reverse acting spring on the pistion where the action button is pressed into the top of the body to close the valve. Allowing the button to come out opens the valve for oxygen to flow. The above figure shows the RCV in the closed position with the pneumatic option.

Electrical interface connections

Suggested electrical connection on the **DE-09** connector for elctro pneumatic option are as follows:

Pin 1.	Cylinder grounding strap	(customer provided)
Pin 2.	Cylinder grounding strap	(customer provided)
Pin 3.	No connection	
Pin 4.	(-) Electric Sending unit	(factory wired if sending unit option is ordered)
Pin 5.	(-) Electro-pneumatic valve	(factory wired if sending unit option is ordered)
Pin 6.	No connection	
Pin 7.	No connection	
Pin 8.	(+) Electric Sending unit	(factory wired)
Pin 9.	(+) Electro-pneumatic valve	(factory wired)

The ports on the **RCV** are labeled as follows:

PRD (Non-resettable Pressure Relief Device)

This is an emergency over-pressure burst plug. This port cannot be used for any purpose other. It will never need to be removed for inspection or periodic replacement. It will, however, need to be replaced if it has been damaged or has popped open from an over-pressure situation.

WARNING: DO NOT REMOVE OR COVER the PRD device installed in this port.

TANK PORTS 1 & 2 (always live!! connected directly to the cylinder/inlet port):

These are high pressure non-regulated and non-valved SAE-4 female ports. They pneumatically connect directly into the inlet port of the **RCV** unit at all times, which is usually connected to a cylinder. These are for connecting a refill fitting, remote refill station, remote pressure gauge or manifold interconnecting all the above to the system or to another (cascade) cylinder system. These ports are SAE-4 7/16-20 UNF-2B straight female threads. Any SAE-4 male fitting must be used with a size 2-904 Viton o-ring. Tank port #1 will have the pilot regulator mounted to it. This regulator provides about 2 bars (30 psig) of pressure to operate the pneumatic actuator. It has a small flow-rate that is sufficient to operate the system in static modes and not suitable for operation in a constant-flow mode.

VALVE PORTS 1, 2 & 3 (on/off valved outlet ports):

These are high pressure valved non-regulated ports. They are identical in form and function and are switched on and off via the pneumatic, electro-pneumatic or mechanical operator. Once the valve is open, they connect directly into the cylinder while the valve is in the on (open) state. These ports have SAE-4 7/16-20 UNF-2B straight female threads. Any SAE-4 male fitting must be used with a size 2-904 Viton o-ring. The **OFF** setting is when the small red button on the top center of the **RCV** hex cap is pressed into the valve body (mechanical option) or is allowed to go into the cap (pneumatic option). It presses the valve plunger into the inlet valve-seat shutting off the oxygen supply from the cylinder to ports labeled valve 1, 2 & 3. The **ON** setting is such that this red button is allowed to move back out (mechanical option) or moved out (pneumatic option) of the hex cap, thus allowing the flow of oxygen directly from the cylinder to be present at the three (3) valve ports. A pressure reducing regulator is not involved at this point.

INLET PORT (not labeled)**:**

The inlet port is a dual threaded port. The 3/4-16 (0.750-16 UNF-2A) straight male threads are for connecting directly to a cylinder of that same thread type. In addition, a female 7/16-20 UNF-2B straight thread (SAE-4) port is useful in applications where the **RCV**/**RCR** unit will not be directly mounted to the cylinder, but to a surface with an angle bracket. A fitting will connect the unit to the cylinder pneumatically. The male 3/4-16 UNF-2B (SAE-8) threads can then be used to secure the **RCV** unit to the bracket via a jam-nut (AN-924) or of that thread type.

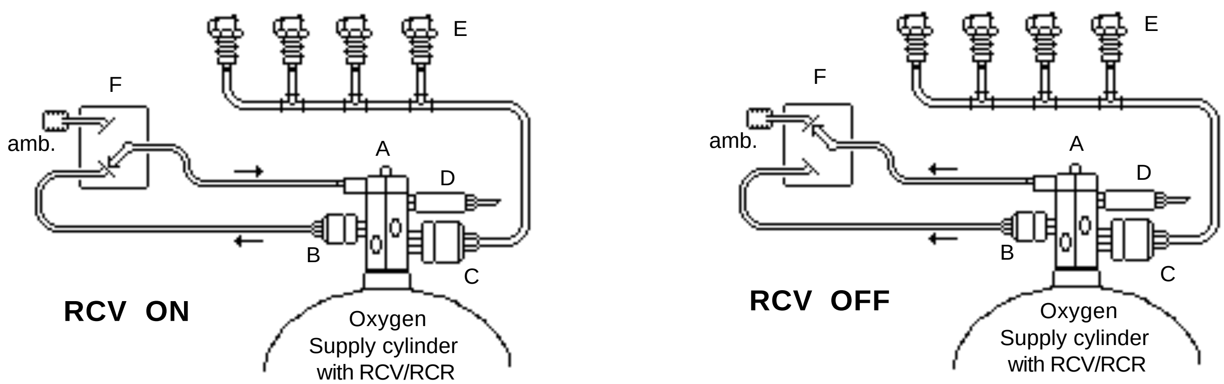
APPLICATION HINT

The three "VALVE" ports are identical in form and function and differ only in physical position. They are to help satisfy multiple regulator requirements that may be calibrated at a different pressures and/or flow. The ports can provide easy and safe applications where two separate non-interfering secondary systems may need to operate from one cylinder.

GENERAL OPERATING OPTIONS

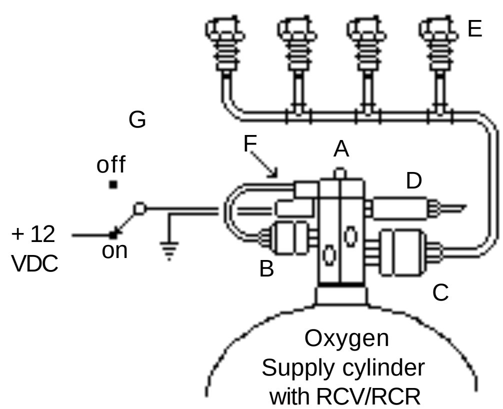
The **RCV** (Remote Controlled Valve) can be actuated (operated) by two main means. They are; 1: pneumatically and 2: electro-pneumatically. (*Mechanical option will be available in the future*)

1. PNEUMATIC: The **RCV** (abstract figure below) unit has a built-in pneumatic actuating piston that allows remote operation of the **RCV** by two basic pneumatic means. They are; 1: an external pressure supply of about 2 bars (30 psig.) being applied to the actuation port of the actuating manifold on the **RCV**, 2: the screw-on pilot regulator, calibrated to 2 bars (30 psig.), provides the actuating pressure in which a simple 3-way valve is plumbed and remotely mounted to operate the **RCV** unit. The pilot regulator taps a small amount of the oxygen supply for *static* pneumatic actuating needs. It is always active and does not allow gas to flow, except for a very small amount during the state changes from on to off and visa versa. Once the **RCV** has setteled in the on or off state the pilot regulator automatically shuts off holding the interface tubing at the calibrated pressure. A small vent port releases a very small amount of gas as the electro-pneumatic valve is released to the off state. At the users option, a small 4mm. OD X 2.4 mm. ID tube may be connected to this port to provide an overboard vent. The amount of gas released by this vent port (during turn-off phase only) is about 10 cc. for the interface manifold. The actual volume vented during the turn-off phase will be a function of the size of the actuating pneumatic interconnecting tubing used for that installation. 2 to 4 mm. (1/16 to 1/8") Dia. line recommended.



The basic pneumatic actuating method for the RCV. A: RCV unit, B: Pilot reg., C: Main reg., D: optional cylinder pressure sending unit, E: oxygen check-valve outlets, F: remote pneumatic 3-way on/off valve.

2. ELECTRO-PNEUMATIC: The remote electro-pneumatic method (abstract figure below) probably offers the most convenient method of operation. Applying current turns the **RCV** on and removing the current turns the **RCV** off. The electro-pneumatic valve can be ordered in three voltage ratings. They are: 5V, 12V and 24V The 12 volt valve requires about 0.85 A to initially turn on the **RCV**. The sustain current thereafter can then be about 1/2 of that. The screw-on pilot regulator, calibrated to at 2 bars (30 psig.), is required and is directly plumbed to the actuating manifold. A small vent port releases a very small amount of gas as the electro-pneumatic valve is released to the off state. At the users option, a small 4mm. OD X 2.4 mm. ID tube may be connected to this port to provide an overboard vent. The amount of gas released by this vent port (during turn-off phase only) is about 10 cc. for the interface manifold.



Basic RCV electro-pnuematic schematic. A: RCV unit, B: Pilot reg., C: Main reg., D: optional cylinder pressure sending unit, E: oxygen check-valve outlets, F: electro-pneumatic 3-way on/off valve, G: electrical on/off switch.

1. PNEUMATIC RCV/RCR PACKAGE: This basic package comes with the following items:

1 ea. RCV assembly with a firmly mounted PRD unit for 1,800 psig. oxygen service. The pneumatic interface manifold pre-mounted to the hex end-cap.

1 ea. Main regulator assembly (unit) firmly mounted to the RCV unit and calibrated to 15 psig. @ 25 liter/min. with 6 mm. poly-tube ferrule fitting firmly mounted (not shown) to the axial regulator outlet cap. The emergency lanyard pull-on version can be added by option. Specify this requirement when ordering.

1 ea. SAE-4/MS to 1/8" OD tube fitting (Swagelok® B-200-1-4ST) to connect to a fill station and/or gauge.

2 ea. SAE-4/MS 9/16 HEX utility plugs.

1 ea. Document package with 2-904 & 2-908 o-ring kit

2. ELECTRO-PNEUMATIC RCV/RCR PACKAGE: This basic package comes with the following items:

1 ea. RCV assembly with a firmly mounted PRD unit for 1,800 psig. oxygen service. The electro-pneumatic interface manifold and electro-pneumatic valve pre-mounted to the **RCV** assembly.

1 ea. Main regulator assembly (unit) firmly mounted to the RCV unit and calibrated to 15 psig. @ 25 liter/min. with 6 mm. poly-tube ferrule fitting firmly mounted (not shown) to the axial regulator outlet cap. The emergency lanyard mechanical pull-on version can be added by option. Specify this requirement when ordering.

1 ea. SAE-4/MS to 1/8" OD tube fitting (Swagelok® B-200-1-4ST) to connect to a fill station and/or gauge.

2 ea. SAE-4/MS 9/16 HEX utility plugs.

1 ea. Document package with 2-904 & 2-908 o-ring kit

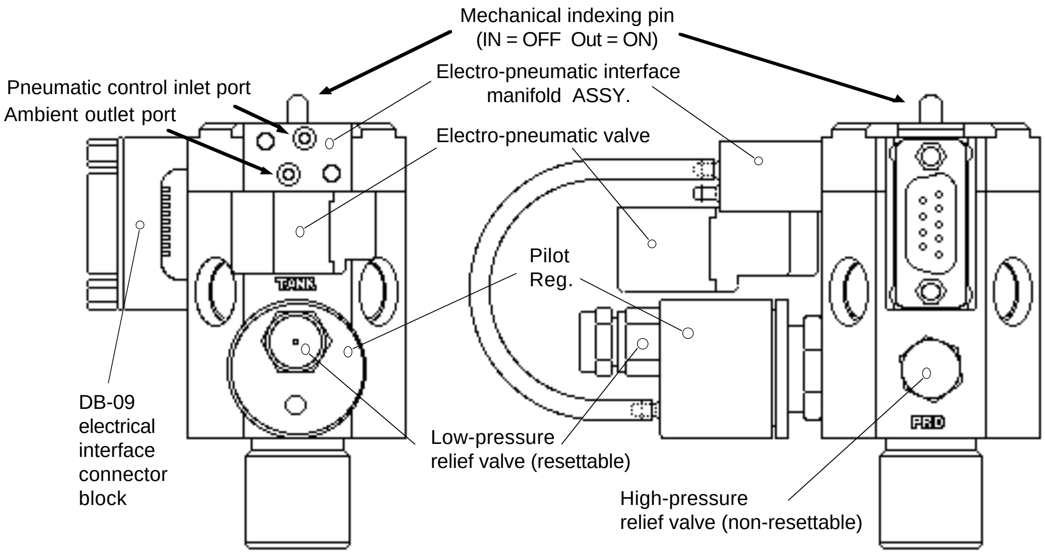
Optional Equipment: (See catalog for details)

Remote Fill station (MS 22066 compatible). This allows the filling of the system through a remotely mounted station. The station is available in two types. 1: SAE Tee style and a deluxe gauged version.

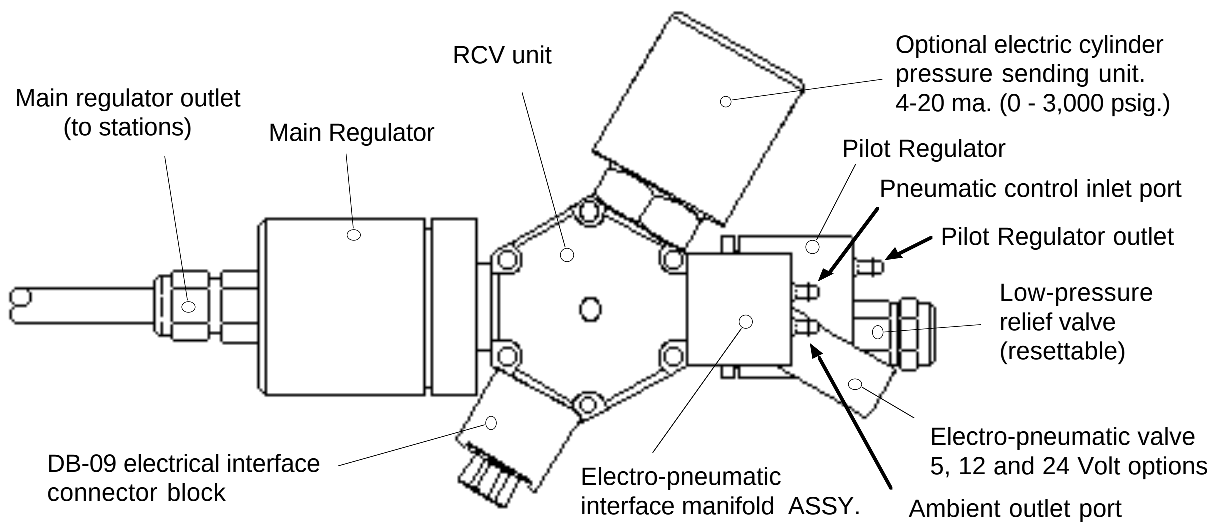
Fill fitting (MS 22066 compatible) to SAE-4/MS with cap & chain. This fill fitting mounts directly to the RCV hex body. It is recommended for applications only where the RCV/RCR assembly is easily accessible for refills.

HPQD system. A High-Pressure-Quick-Disconnect system allowing you to disconnect the main high-pressure system of the aircraft (gauge, fill station and cascade equipment) from the cylinder and regulator assembly for complete removal from the aircraft without emptying the cylinder.

Remote cylinder contents pressure gauge kits. Pneumatic gauge and capillary tubing kits are available The all electronic version with the 4-20 ma. sending gauge version will be available Q3-1999.



RCV unit with electro-pneumatic actuating option
(main regulator and 4 mm. pilot regulator coupling tube loop shown)



End view of a full-dress RCV/RCR ASSY. with optional cylinder pressure sender.
(4 mm. pilot regulator coupling tube loop and mechanical actuator not shown)

CAUTION ***Each RCV / RCR unit is fully tested for operation and specifications at 2,000 psig. @ 25° C before they are packaged and released to the customer. If SAE-4 plugs and fill fitting are shipped installed into the RCV body they may be finger tight only.***

MAIN REGULATOR:

The **RCR-1** unit is equipped with one main regulator ASSY. unit. It has one 1/8 ANPT-F outlet port on the end in axis of the regulator. It is calibrated to deliver oxygen at 15 psig. @ approx. 35 liters/minute. It is intended to be used with the **A3**, **A4** or **EDS** unit as the secondary (final) regulator device. If the **RCR-1** is to be used with the **A34-2ip** or **A34-3ip** this regulator must be calibrated to deliver approx. 35 psig @ 25 liters / min. This is a factory fabrication and calibration procedure. The **RCR-1** can be specially ordered with a high-pressure, high-flow regulator. This unit is equipped with a special inlet seat, piston and spring. It is calibrated to deliver 50 to 65 psig @ approx. 85 to 95 liters/min. The standard issue 15 psig. regulator unit **CANNOT** be made to regulate these high-pressures and flows without changing the internal parts. This is a factory fabrication and calibration procedure. All regulators will be calibrated to the 1 bar (15 psig.) standard unless otherwise specified by the buyer at time of order.

General Specifications

Weight: with electro pneumatic option and one main regulator unit & fittings	0.454 kg. (16 oz.)
Dimensions:	See reference drawings
Voltage options for electro pneumatic valve: RCV is on during sustained current and off with no current (ballast recommended)	5, 12, 24 volts @ 0.5, 1, 2 Watts
RCV Max. allowable leakage (Air): Test condition with RCV and electro pneumatic option and one main regulator	≈ 0.01 cc / Hr.
HPRD (High pressure relief device):	165°F fusible metal and burst disc for 124 bar (1,800 psig.) service
Number of primary ports (unvalved, direct or wild):	2 (two)
Primary port type:	O-ring type seal SAE-4-F (7/16-20 UNF 3B)
Number of secondary ports (controlled by valve):	3 (three)
Secondary port type:	O-ring type seal SAE-4-F (7/16-20 UNF 3B)

Operational

Operating inlet pressure (full cycle):	≈193 bar (2,800 psig.) @ operating temp
Nominal operating inlet pressure:	≈138 bar (2,000 psig.) @ operating temp
Inlet pressure range for pilot regulator:	≈345 to 207 bar (500 to 3,000 psig.) @ operating temp
Outlet pressure for pilot regulator:	≈2 bar (30 psig.) @ 225 ml/min.
LPRD (low pressure relief device):	5 - 5.5 bar (70 - 80 psig.) automatic resetting poppet
Inlet pressure range for main regulator:	≈345 to 207 bar (500 to 3,000 psig.) @ operating temp
Outlet pressure for main regulator:	≈1 bar (15 psig.) @ 20 liters/min.
Optional LPRD (low pressure relief device):	5 - 5.5 bar (70 - 80 psig.) automatic resetting poppet
Operating temperature (electro pneumatic option):	0°C to 55°C (32° F to 130° F)
Operating temperature (pneumatic only):	-20°C to 60°C (32° F to 130° F)

Service

RCV MTBO:	3 years or 1,500 full cycle operations
Regulator units MTBO:	5 years or 10,000 full cycle operations
Torque for the SAE-8-M (3/4-16 UNF 2A) inlet cylinder mounting port:	CW. 35 to 40 ft. lbs.
Torque for SAE-4-F (7/16-20 UNF 3B) service ports for fittings	CW. 4 - 8 ft. lbs.
Torque for SAE-4-F (7/16-20 UNF 3B) service ports for regulators	CW. 3 - 6 ft. lbs.

Data: Oxygen weighs 16 g. per liter @ 21° C @ 1.0 Atm. (0.08281 Lb. per cu. ft. of volume @ 70° F @ 1.0 Atm.)

Material Compatibility and system design Statement

Materials such as aluminum, iron, steel, polymers and brass commonly used in any oxygen systems may ignite and burn under certain severe and adverse conditions. Although these conditions may be rare they are non-the-less possible in a high pressure pure oxygen environment. Design and manufacturing rules have been applied to this product to ensure the maximum amount of safety and compatibility with high pressure oxygen. The RCV/RCR system has been designed with maximum margin of safety while providing the most capable and lightest system suitable for aircraft applications.

Material & Design: To ensure the best margin of operational safety the main body of the RCV unit is made from 6061-T651 PER QQ-A-225/8 Aluminum and is anodized per MIL-A-8625 TYPE II, CLASS 2 GREEN. The wetted parts (parts that come in direct contact and control high pressure oxygen) are made from CDA-360 brasses or 303 or 304 stainless steels. Where applicable the design guidance and rules for the RCV/RCR pertain to ASTM standard guide for designing systems for oxygen service G88-90 also G63, G93 and G94. Cleaning protocol was adopted from SAE-AIR1176A and other documents from CGA and ASTM. The regulators (appliance) devices are designed, manufactured and cleaned to the same criteria. In addition, the RCV unit and each regulator have a serviceable sintered bronze porous metal filter on the high-pressure inlet ports. It is therefore, the duty of the installer and user of the system to ensure that clean and proper practices are used to install, fill and use the system.