T.M. EDOCS

EDOCS-120 TECHNICAL MANUAL

Including

EDOCS 1-1 - OPERATION AND MAINTENANCE INSTRUCTION

EDOCS 1-3 – OVERHAUL INSTRUCTIONS

EDOCS 1-4 – ILLUSTRATED PARTS BREAKDOWN

EXPEDITIONARY DEPLOYABLE OXYGEN CONCENTRATION SYSTEM 120 LITERS PER MINUTE

MODEL EDOCS-120

PART NUMBERS –

792641-001 Original
793035-001 US Army - NSN 6530-01-505-0526
793090-001 MOD
793295-001 US Air Force

PRELIMINARY PHASE V RELEASE

PACIFIC CONSOLIDATED INDUSTRIES

3430 WEST CARRIAGE DRIVE

SANTA ANA, CALIFORNIA 92704

TELEPHONE 714-979-9200TELEFAX 714-436-9150

5 April 2003

T.M. EDOCS

LIST OF EFFECTIVE PAGES

Insert lasted changed pages. Destroy all superceded pages

Note: The portion of the text affected by the current change is indicated by a vertical line on the outer margins of the page

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS (73), CONSISTING OF THE FOLLOWING:

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Change 3 – February 2003 (Preliminary Phase III)
Change 4 – March 2003 (Preliminary Phase IV)

TABLE OF CONTENTS

EXPEDITIONANARY DEPLOYABLE OXYGEN
CONCENTRATION SYSTEM (EDOCS)

TABLE OF CONTENTS
(Continued)

List of Figures

List of Table

SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedure and therefore do not appear elsewhere in this technical manual. These are general safety precautions and instructions that people must understand and apply during many phases of operation and maintenance to ensure personal safety and health and the protection of Government property.

Throughout this manual you will see three types of notations, which contain special information:

NOTE: Provides additional information that may be helpful in performing a specific task.

CAUTION: Provides information about conditions, which require special attention and precautions to avoid equipment damage.

WARNING: Provides information about conditions, which require special attention and precautions to avoid serious or fatal injuries.

Be sure to read the information in the notes, cautions, and warnings carefully, and consult someone experienced in handling oxygen equipment about any issues that are unclear. Additional safety guidelines related to specific components of the DOCADS are described in the appropriate chapters.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must observe all safety requirements at all times. Do not replace components or make adjustments inside equipment with the electrical supply turned on. Under certain conditions, danger may exist even when the power control is in the off position due to charges retained by capacitors. To avoid injuries, always remove power, discharge, and ground a circuit before touching it. Adhere to all lock out/tag out requirements.

RESUSCITATION

Personnel working with or near dangerous voltage shall be trained in modern methods of resuscitation. Information and training sources may be obtained from the Director of Base Medical Services.

FINGER RINGS/JEWELRY

Finger rings have caused many serious injuries. Remove rings, watches and other metallic objects, which may cause shock or burn hazards. Unless specifically allowed by shop safety procedures, remove finger rings during all maintenance activity.

COMPRESSED AIR

Use of compressed air can create an environment of propelled particles. Do not direct air streams towards self or other personnel. Air pressure shall be reduced to less than 30 PSIG and used with effective chip guarding and personal protective equipment. Follow applicable AFOSH standards when using compressed air.

DANGEROUS PRESSURES

Care must be taken during operation to ensure that all fittings are proper and tight. All system components must be compatible with pressure applied. Personnel must be protected by a safety shield or located at a distance sufficient to prevent injury.

CLEANERS/CHEMICALS/PAINTS/ PRIMERS

Some cleaners, chemicals, paints, and primers have adverse effects on skin, eyes, and the respiratory tract. Observe manufacturer’s Warning labels, Material Safety Data Sheets (MSDS) instructions for proper handling, storage, and disposal, and current safety directives. Use only in authorized areas. Consult the local Bioenvironmental Engineer and Base Safety Office for specific protection equipment and ventilation requirements. Follow applicable AFOSH standards.

WORKING WITH OXYGEN

Oxygen is a powerful oxidizing agent that can cause a fire or explosion. A Material Safety Data Sheet is available at Pacific Consolidated Industries.

Oxygen systems must be properly cleaned and inspected, in accordance with Compressed Gas Association pamphlet G-4.1; prior to use to insure that no combustible materials remain in the connecting piping and fittings. If you are not familiar with oxygen cleaning procedures contact the Compressed Gas Association or Pacific Consolidate Industries prior to putting oxygen into your piping and distribution system. The Compressed Gas Association's web site is www.cganet.com.

Observe strict cleanliness procedures when fabricating and connecting the oxygen piping.

Only operate the oxygen generator in a well-ventilated area.

GUIDELINES FOR HANDLING CYLINDERS

While the principal function of the DOCADS is to provide gaseous oxygen for medical use, conventional oxygen cylinders are still an integral part of the system for supplying backup oxygen and for mobile oxygen requirements (for example, on board ambulances, helicopters).

Oxygen cylinders are under extremely high pressure (as much as 2250 psi) and present a number of associated hazards as a result.

WARNING: The sudden release of this pressure, whether by puncture, dropping, or loss of a pressure can easily turn the cylinder into a missile hurtling across the ground and through the air. Take extreme care when filling cylinders and when handling charged cylinders.

WARNING: Do not drag or slide cylinders or lift them by the pressure cap; this may damage the cylinders and cause the sudden release of, cylinder pressure. Use a suitable hand truck, forklift, roll platform, or similar device to move cylinders.

WARNING: Do not drop cylinders or permit them to strike against each other or other surfaces; this may damage the cylinders and cause the sudden release of cylinder pressure. Firmly secure cylinders during moving and transport.

WARNING: Do not fill cylinders too rapidly (that is, by not having enough cylinders on a charging manifold); excessive heat may build up in the gas and result in a failure of the seals in the cylinder valves and possible ignition.

WARNING: Periodically check the surface temperature of the cylinders during charging operations using the magnetically mounted temperature indicators provided with the equipment. Allowing excessive heat to build up in the gas will result in a failure of the seals in the cylinder valves and possible ignition.

WARNING: Never shut off a line without verifying that a suitably rated relief valve or bleed off valve has been installed between the two shutoff valves. Failure to do so can result in a rupture of the line and possible ignition.

WARNING: Never charge cylinders with oxygen that are marked for other gases. Always check the cylinder markings and ensure that only cylinders marked for oxygen are charged with oxygen. Failure to do so can result in contamination of the patient oxygen supply

SAFE PRACTICES FOR HANDLING AND OPERATING OXYGEN EQUIPMENT

Oxygen used in the medical profession can be very hazardous. Although oxygen does not burn, it does support combustion. A material which will not burn in air may burn in high pressure pure oxygen - such as the metal in oxygen regulators or cylinders. Comprehensive guidelines and training on safe practices for handling oxygen are available from several sources listed at the end of this section. Some general guidelines for minimizing the chance of fire are provided below:

STORAGE, MAINTENANCE AND HANDLING

- Do not allow smoking around oxygen.
- Store oxygen in clean, dry locations away from direct sunlight.
- Do not allow post valves, regulators, gauges, and fittings to come into contact with oils, greases, organic lubricants, rubber or any other combustible substance.
- Make sure that any cleaning, repair or transfilling of oxygen equipment is performed by qualified, properly trained staff.
- Do not work on oxygen equipment with ordinary

tools. Designate special tools, clean them and store them for Use With Oxygen Equipment Only.
- Ensure that any components added to the regulator, e.g., gauge guards, are installed so that they do not block the regulator vent holes.
- Use plugs, caps and plastic bags to protect "off duty" equipment from dust and dirt.
- Particulate migration from the cylinder can be minimized by the installation of a standoff tube (bayonette) at the inlet of the post valve.

USE

- Make sure that staff using oxygen equipment are adequately trained in its operation and in oxygen safety and have knowledge of manufacturers instructions for using the equipment.
- Visually inspect the post valve gasket and regulator inlet prior to installation. If they are not visually clean they should not be used.
- Momentarily open and close ("Crack") the post valve to blow out debris prior to installing a regulator.
- Ensure that the regulator is set with the flow knob in the off position before attaching it to the cylinder.
- Position the equipment so that valve is pointed away from the user and any other persons.
- Open the cylinder valve slowly and completely to minimize the heat produced and achieve the desired flow conditions within the equipment.
- Do not look at the regulator pressure gauge until the cylinder valve is fully opened.

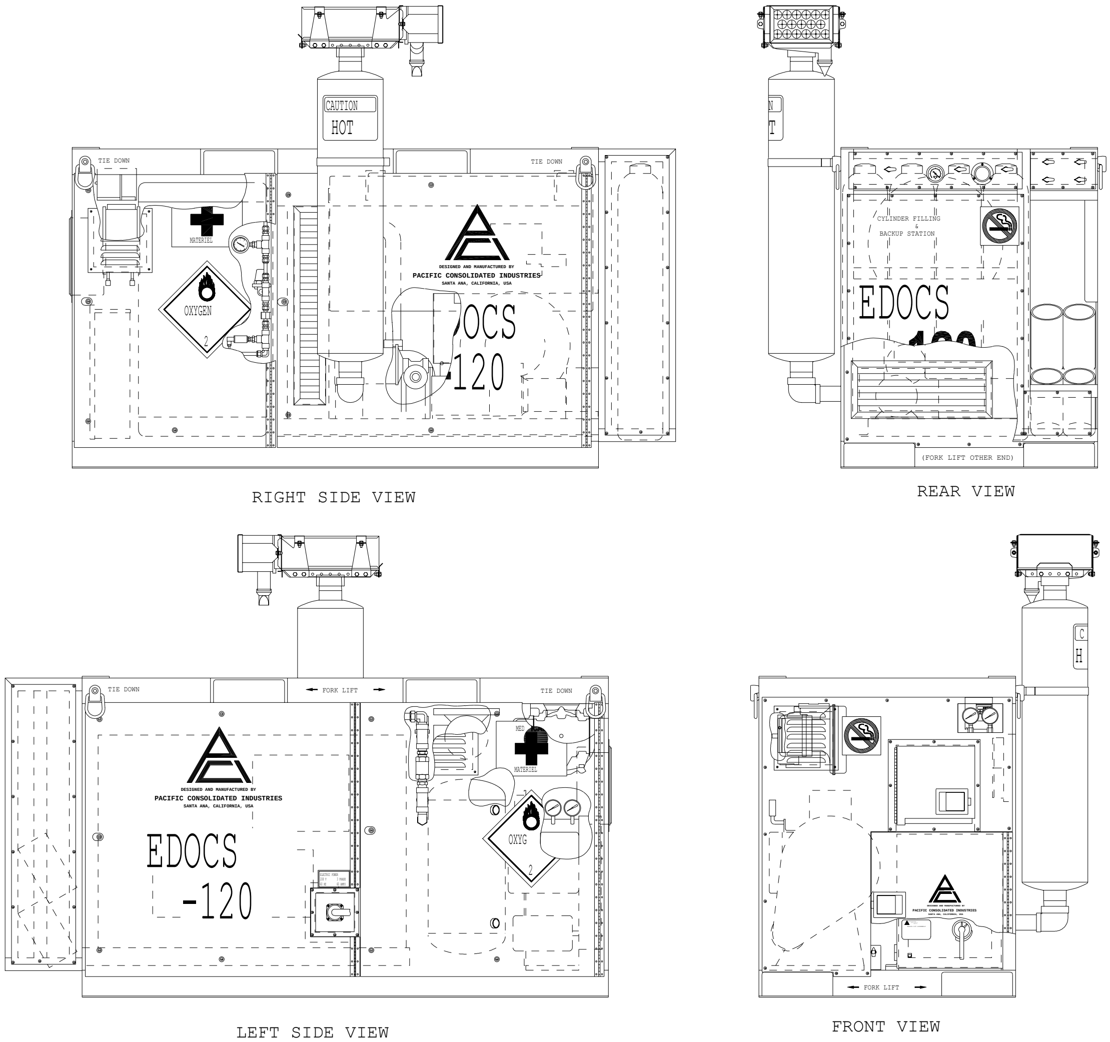

Figure 1-1

Expeditionary Deployable Oxygen Concentration System (EDOCS-120)

PCI P/N 792641-001 (Original)

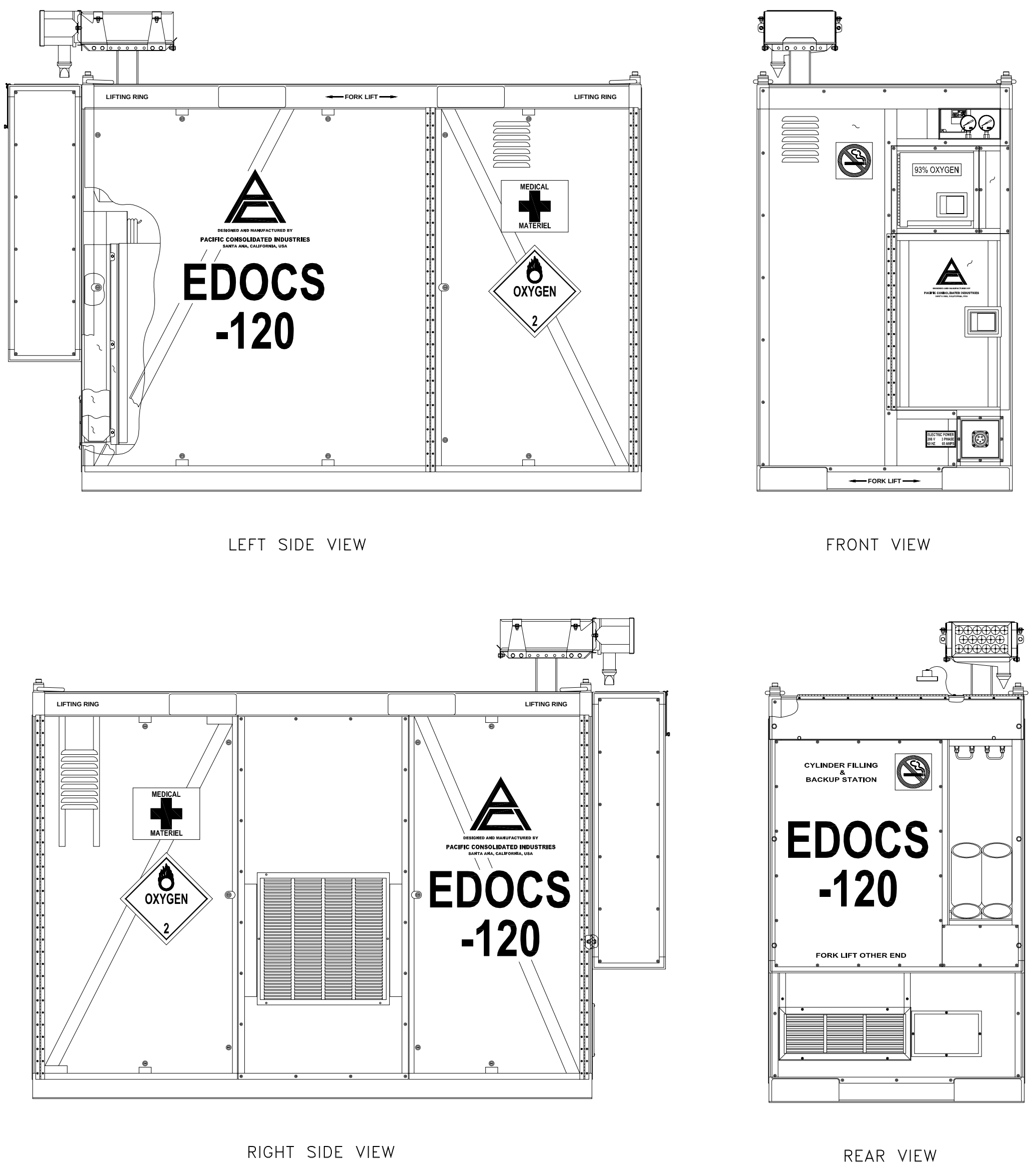

Figure 1-2

Expeditionary Deployable Oxygen Concentration System (EDOCS-120)

PCI P/N - 793035-001 - NSN 6530-01-505-0526
793090-001 ,793295-001

SECTION I

1 EQUIPMENT DESCRIPTION

1-1 INTRODUCTION

The availability of medical oxygen on the battlefield is a prime factor in saving the lives of wounded personnel.

In previous conflicts oxygen demand was met by use of high-pressure oxygen cylinders. Cylinders satisfied the demand for oxygen but created unacceptable logistical burdens associated with transportation, refill, and storage.

The introduction of liquid oxygen systems reduced the logistical problems associated with cylinders but created new problems. A central liquid oxygen generating plant was located in a rear area and cryogenic storage tanks were used to distribute the liquid to the field locations. The size and complexity of a liquid oxygen generating plant required extensive maintenance and highly trained operators.

Liquid oxygen cannot be stored nor stockpiled and transportation over long distance results in a high percentage of loss. The introduction of the modern lightweight, self contained, highly mobile military unit that can be deployed and operational with minimal logistic support meant that the old methods of supplying oxygen by cylinder or in liquid form were no longer acceptable.

The new military medical unit required a oxygen generating system that could be stored and stockpiled, ready for immediate use, transported with the unit and totally self sufficient for as long as required in the filed. It also had to be easy to operate, dependable and as small and light as possible.

1-2 SYSTEM OVERVIEW

The Expeditionary Deployable Oxygen Concentration System (EDOCS) is an innovative solution to the problem of generating oxygen at the point of use. This system, once deployed totally eliminates any re-supply requirements i.e. the logistical tail is not shortened, it is eliminated.

- An Expeditionary Deployable Oxygen Concentration System (EDOCS 120) module that generates the oxygen utilizing the Vacuum Swing Adsorber (VSA) technology.
  The EDOCS low pressure system supplies 120 lpm at 100 psi. The EDOCS high pressure system, in addition to supplying 120 lpm of oxygen at 100 psi, can also supply 60 lpm of the total 120 lpm at high pressure (2,250 psi) to refill cylinders. A vacuum pump is included with the EDOCS to evacuate cylinders prior to filling.
- A Hospital Oxygen Backup System (HOBS) consisting of eight “H” cylinders of oxygen automatically provides eight hours of oxygen backup flow at 120 liters per minute and a manifold system to recharge the cylinders if connected to an E-DOC. The HOBS can also provide emergency peak load demands of 200% of standard output, up to 240 liters per minute while maintaining a minimum of 80 psi.
- A Patient Oxygen Distribution System (PODS), consisting of a system of flow regulators to mount at patients’ bedside and multiple Teflon hoses with quick disconnect fittings to provide the distribution of the oxygen.
- A Surgical Suite Oxygen Distribution System (SSODS) to provide regulated oxygen distribution to surgical equipment.

A Hospital Provisioning Kit to provide assorted quick disconnect fittings and various length Teflon and stainless steel hoses.

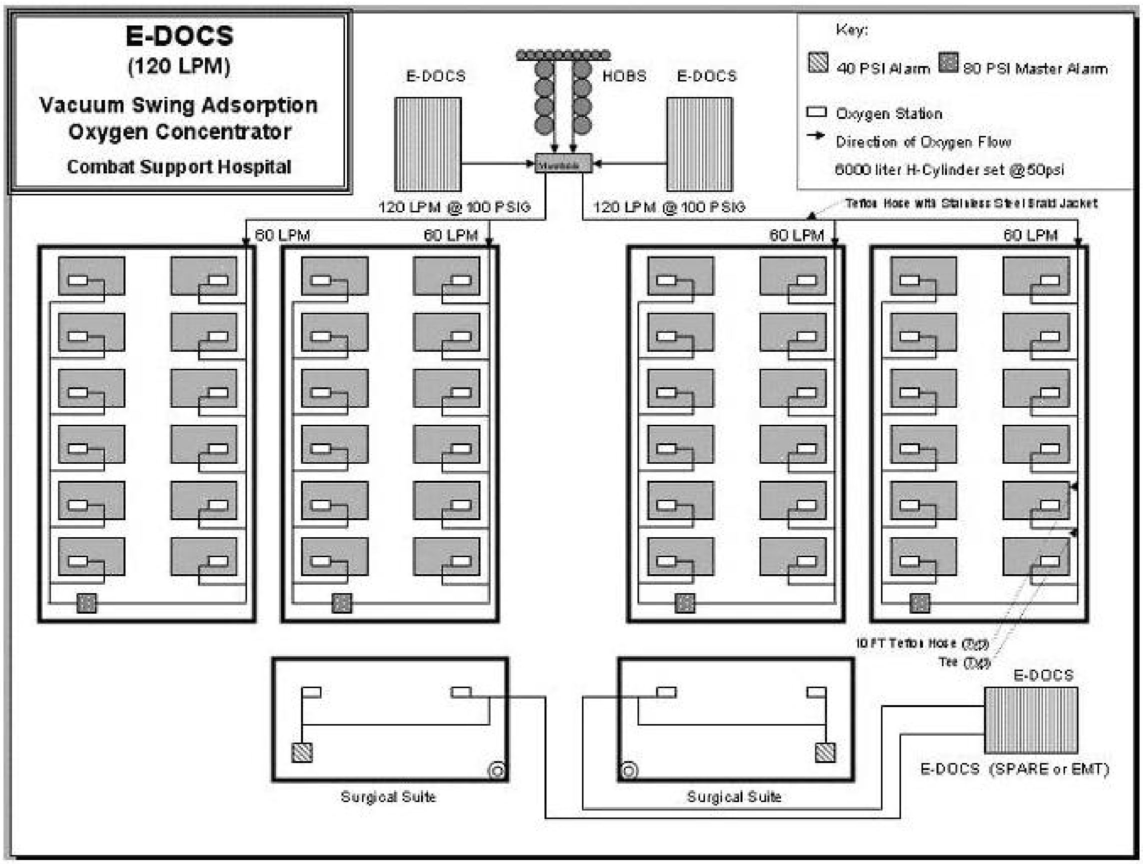

Figure 1-3

A Possible Hospital Layout

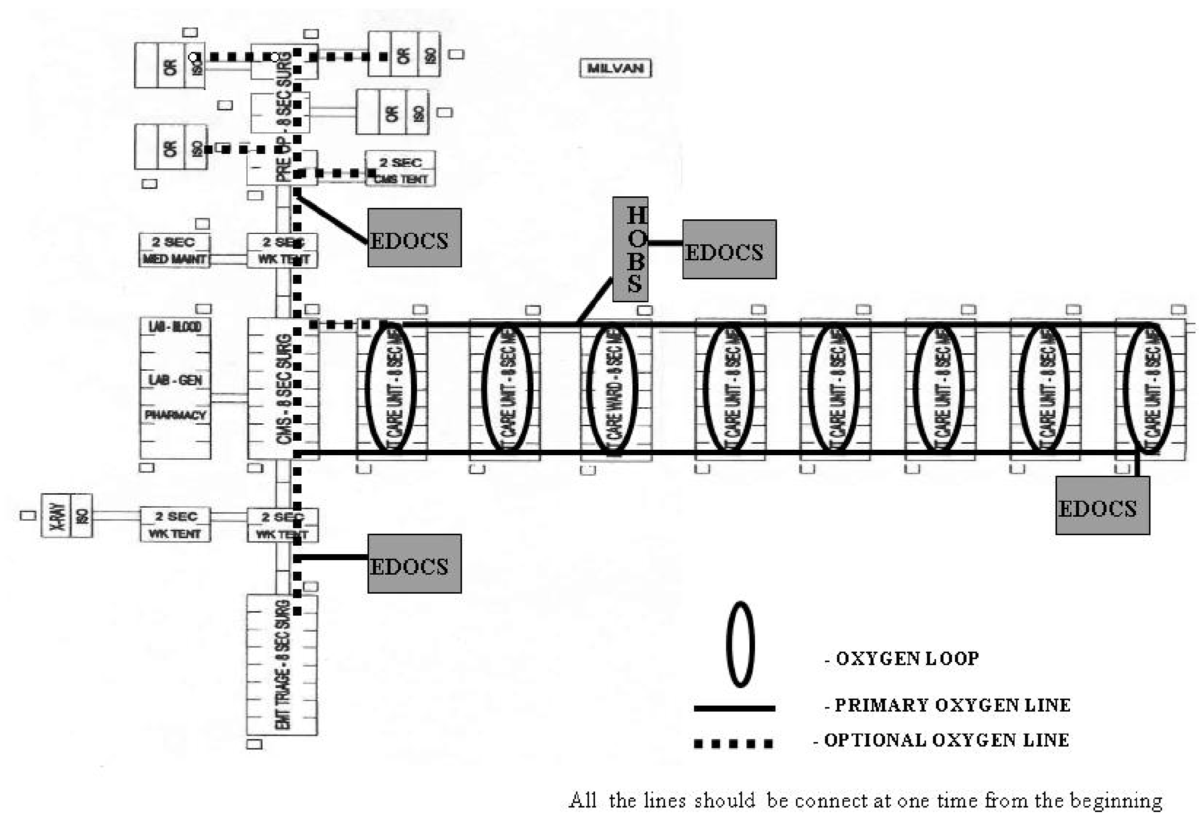

Figure 1-4

A Possible Hospital Layout 2

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1-3 PRINCIPLE OF OPERATION

The air separation capability of the EDOCS system is based upon the principle of adsorption. Adsorption is defined by Webster as “the adhesion in an extremely thin layer of molecules, as of gas, to the surface of solid bodies with which they are in contact”.

In this process, the solid bodies referred to are the particles of the molecular sieve material. The molecular sieve material may be engineered to adhere to specific elements of the gas thereby separating the elements of that gas. In this application, elements other than oxygen contained in the air such as nitrogen, water vapor and carbon dioxide adhere to the molecular sieve while the oxygen passes through to be recovered.

The adhesion of the elements to the sieve is normally assisted by the addition of heat or pressure. Lowering the temperature or lowering the pressure will reduce this adhesion and the elements are then released.

Therefore, if air is forced through a molecular sieve at high pressure, the nitrogen, water vapor and other undesirable elements will adhere to the sieve while the oxygen passes through the sieve and is captured. At a certain point the molecular sieve will become saturated with the unwanted elements. The removal of the oxygen is stopped just prior to this saturation point. The direction of flow of the incoming air is then reversed at the same time the pressure is lowered. The sieve will release the elements that adhered and the reverse airflow will blow these elements out of the waste vent. This process is called desorption.

When all the unwanted elements have been released the sieve is again clean and ready to start the process over again. This process is called, for obvious reasons, a Pressure Swing Adsorber or PSA.

Pacific Consolidated Industries utilizes a patented process that eliminates many of the design problems associated with PSA designs. The innovative Vacuum Swing Adsorber (VSA) System employed by PCI reduces the number of parts and the development of a patented molecular sieve material was the critical element that allowed the design of a VSA system.

This new sieve operates efficiently at very low pressure during the adsorption phase. During the desorption phase a small vacuum is placed on the sieve which effectively removes the unwanted elements of the air adsorbed by the sieve and vents them to the atmosphere.

The adsorption process will now efficiently operate at low pressures, (10 to 14 psi). The system utilizes a simple and reliable blower.

The blower is a rotary device that does not require seals or rings because the low pressures are easy to contain. The heat of compression is much less because the air is compressed less. Oil is not required due to the lack of friction and the low heat rise.

The low compression also means that the water is not concentrated to a point that it will condense into a liquid.

The vacuum required for the desorption phase of the process is obtained from the input side of the same blower that produces the low pressure air for the absorption phase.

The low pressure air input into the adsorber vessel in combination with the high efficiency of the vacuum applied during the desorption stage means that a single absorption vessel may be used. The blower design uses a four way rotary valve. This valve slowly rotates in one constant direction, eliminating the rapid direction changes that cause excessive wear.

The following diagram represents the process flow and the major components of the VSA system.

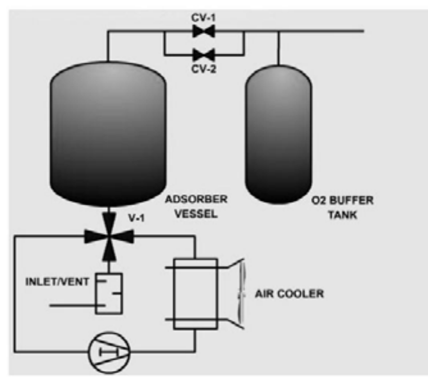

Figure 1-5.
VSA Diagram

1-4 SYSTEM CONFIGURATION

The system configuration is comprised of four (4) subsystems that have been specifically design to avoid the hazards of handling oxygen. Special attention has been paid to material selections and adiabatic compression areas. This system offers a high degree of flexibility in how the system can be used, allowing the user to reconfigure and/or relocate subsystems depending upon the scenario.

The four subsystems are:

- Expeditionary Deployable Oxygen Concentrator System (EDOCS 120)
- Hospital Oxygen Backup System (HOBS)
- Patient Oxygen Distribution System (PODS)
- Surgical Suite Oxygen Distribution System (SSODS)

1-5 EXPEDITIONARY DEPLOYABLE OXYGEN CONCENTRATOR SYSTEM (EDOCS 120)

The primary function of the Expeditionary Deployable Oxygen Concentrator System is the generation of oxygen utilizing the VSA principle. The EDOCS unit is completely contained in a rugged aluminum case.

The case measures 40" wide by 51" high by 82" long and weighs approximately 2,500 pounds.

The case is fitted with forklift slots on the bottom for ground handling. Forklift slots are also provided on the top so that the unit may be loaded over the side of a trailer or truck. A lifting ring is provided at each corner to allow the unit to be sling loaded under a helicopter. Stacking notches are located in the top and bottom of each case to allow stacking of the EDOCS. Four EDOCS units may be loaded on one 463-L standard aircraft pallet. One complete EDOCS system for the support of a 25 bed field hospital including one EDOCS unit, one HOBS, four PODS units, one SSODS unit and a Hospital Provisioning Kit may be loaded on one 463-L pallet.

1-6 EDOCS-120 CAPABILITIES

- Oxygen Purity = USP 93% monograph (93% +/- 3%)
- Oxygen purity is maintained by utilizing an oxygen sensor.
- Pressure is maintained at 100 psig under variable usage (draw) conditions by regulating.
- Purity and pressure are always the primary control points.
- Production is 120 liters per minute minimum flow.
- Pressure regulated to 85-100-psig delivery pressure from EDOCS.
- Two Low Pressure Supply Connections (C-1, C-2)
- One Vacuum Connection (C-3)
- One High Pressure Cylinder Fill Connection (C-4)
- May supply 100 psig /120 lpm directly to hospital distribution system (PODS, SSODS) without back-up system or operate through HOBS to provide back-up.
- Pressure regulator at supply connections regulates both supplies to same pressure.
- High Pressure Compressor provides 2,250 psig. @ 60 lpm or 3000 psig @ 40 lpm.
- "H" cylinder @ 2,250 psig = 7,210 liters of oxygen
- Compressor will fill one "H" cylinder in 2 hours. Vacuum Pump can evacuate one "H" cylinder from atmospheric pressure to 27 inches Mercury (Hg) in 4.5 minutes.
- Four "M" cylinders provide a 2 hour back up supply of oxygen when the cylinders are full.
- "M" cylinders capably to refill auxiliary "D" and "E" cylinders using the rear charging station.

1-7 CYLINDER FILLING

- Oxygen for filling cylinders will be available from the EDOCS units at a maximum rate of 60-lph at a pressure of 2,250 psi.
- If an EDOCS unit is connected to the HOBS and cylinders are being filled, 60 lpm of flow will be utilized by the high-pressure compressor to fill cylinders and 60 lpm will be available for hospital usage.
- If during cylinder filling operations, the hospital usage increases beyond 60 lpm, the pressure supplied to the hospital will decrease as demand exceeds supply. When the pressure drops to 85 psig, the regulator will open allowing the flow being utilized to fill cylinders to be redirected to supply hospital demand and the pressure will stabilize at 80 psi. When demand is reduced, the pressure supplied by the EDOCS will increase above 80 psig causing the regulator to close and the filling of cylinders will resume.
- "D" cylinders will be transfilled from the "M" cylinders. Transfilling ten "D" cylinders will reduce the oxygen stored in the eight "M" cylinders from 57,680 liters to 53,440 liters; this is only 7% of the capacity. That capacity can then be safely replaced in little more than one hour. The EDOCS has been engineered and designed to safely fill "D" cylinders. It also provides a method of evacuating the cylinders to maintain purity. This is a field tested, proven, safe system. The supply of oxygen to the hospital will always have priority over cylinder filling.

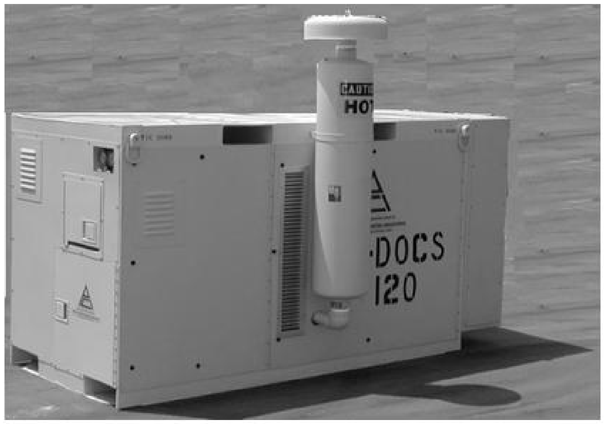

Figure 1-6.
P/N 792641-001 EDOCS-120

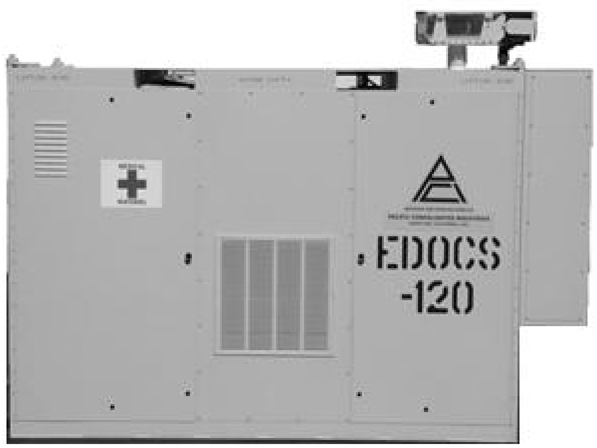

Figure 1-6A.
P/N 793035-001, 793090-001, & 793295-001 EDOCS-120

	P/N 792641-001 Commercial Unit	**P/N 793035-001 US Army**	**P/N 793295-001 (1) US Air Force**	**P/N 793090-001 UK MOD**
	Low / High Pressure Oxygen	Low / High Pressure Oxygen	Low / High Pressure Oxygen	Low / High Pressure Oxygen
Production Capacities-	120 LPM / 60 LPM **(2)**	120 LPM / 60 LPM **(2)**	120 LPM / 60 LPM **(2)**	120 LPM / 60 LPM **(2)**
Delivery Pressure-	100 psig / 2250 psig	100 psig / 2250 psig	100 psig / 2250 psig 3000 psig	100 psig / 2250 psig

Note:
(1) Unit can fill **Mobil Oxygen Storage Tank (M.O.S.T)** systems to 3000 psig @ 40 LPM rate
(2) The 60 liters is supplied from the total 120 LPM and will reduce the capacity by half when filling cylinders

Table 1-1 Production Capabilities of EDOCS-120

	Commercial Unit	**US Military Unit**	**UK MOD Unit**
Length	82 Inches	104 Inches	104 Inches
Width	40 Inches	42 Inches	42 Inches
Height	51 Inches	69 Inches	69 Inches
Weight (Approximately)	3,000 pounds	< 3,500 pounds	< 3,500 pounds
Output	120 LPM	120 LPM	120 LPM
Operation (Continuous)	24 / 7	24 / 7	24 / 7
Purity	USP 93 ± 3 %	USP 93 ± 3 %	USP 93 ± 3 %
Power Requirements	208 VAC, 3-phase, 60-Amperes, 60 hertz	208 VAC, 3-phase, 60-Amperes, 60 hertz	415 VAC, 3-phase 60-Amperes, 50 hertz
KW – Full Load	18 KW	18 KW	18 KW

Table 1-2 EDOCS-120 Characteristics

P/N 792641-001 - P&ID SCHEMATIC

TAG NO.	NOMENCLATURE	TAG NO.	NOMENCLATURE
AE-1	Oxygen Analyzer	QC-4	Vacuum Pump Quick Connect Port
B1	Buffer Tank 1	R200	VSA 4-Way Valve Controls
B2	Buffer Tank 2	S-200	VSA Blower Silencer
Blower	VSA Blower	SV-1	Buffer Tank Purge Gas Solenoid Valve
BPR-1	Buffer Tank Over Pressure Back Pressure Regulator	SV-2	Product Purity Off Specification Solenoid Valve
BPR-2	Scroll Over Pressure Back Pressure Regulator	SV-3	Booster Compressor Suction Solenoid Valve
BPR-3	B1 & B2 Buffer Tank Back Pressure Regulator	V1	Vacuum Pump
BPR-4	Scroll Back Pressure Regulator	V-3	Boost Compressor Gas Supply Isolation Valve
C-1	Scroll Compressor	V-4	Oxygen Purity Calibration Sample Valve
C-2	Booster Compressor	VF	Scroll Compressor Variable Speed Controller
C-500	Oxygen Product Receiver Tank	XT-2	Scroll Compressor Inlet Pressure Signal Transducer
CV-1	VSA Discharge Check Valve	XT-3	Scroll Compressor Pressure Transducer
CV-2	Scroll Inlet Check Valve		
CV-4	Scroll Discharge Check Valve		
F-1	Oxygen Product After Filter		
FCV-1	Oxygen Purity Off Specification Flow Control Valve		
FX 200	VSA Blower After Cooling Fan		
HX100	VSA Blower Heat Exchanger		
HX-1	Scroll Compressor After Cooler Heat Exchanger		
M100	VSA Blower Motor		
M200	4-Way Valve Stepper Motor		
PI-3	B2 Buffer Tank Discharge Pressure Gage		
PI-4	Oxygen Product Pressure Gage		
PI-5	Oxygen Distribution Box Pressure Gage		
PI-6	Booster Compressor Suction Pressure Gage		
PI-7	Booster Compressor Discharge Pressure Gage		
PI-8	VSA Compound Pressure/Vacuum Gage		
PI-9	High Pressure Cylinder Fill Pressure Gage		
PRV-1	Oxygen Distribution Box Pressure Regulator		
PRV-2	Booster Compressor Inlet Pressure Regulator		
PSIL	Booster Inlet Pressure Switch		
PSR	Booster Discharge Pressure Switch		
PSV-2	Scroll Compressor Pressure Relief Valve		
PSV-3	Booster Compressor Pressure Relief Valve		
QC-1	Oxygen Product Distribution Gas Quick Connect Port		
QC-2	Oxygen Product Distribution Gas Quick Connect Port		
QC-3	Booster Compressor Gas Distribution Quick Connect Port		

Table 1-3, Legend for Figure 1-7, Process Flow Schematic for EDOCS-120

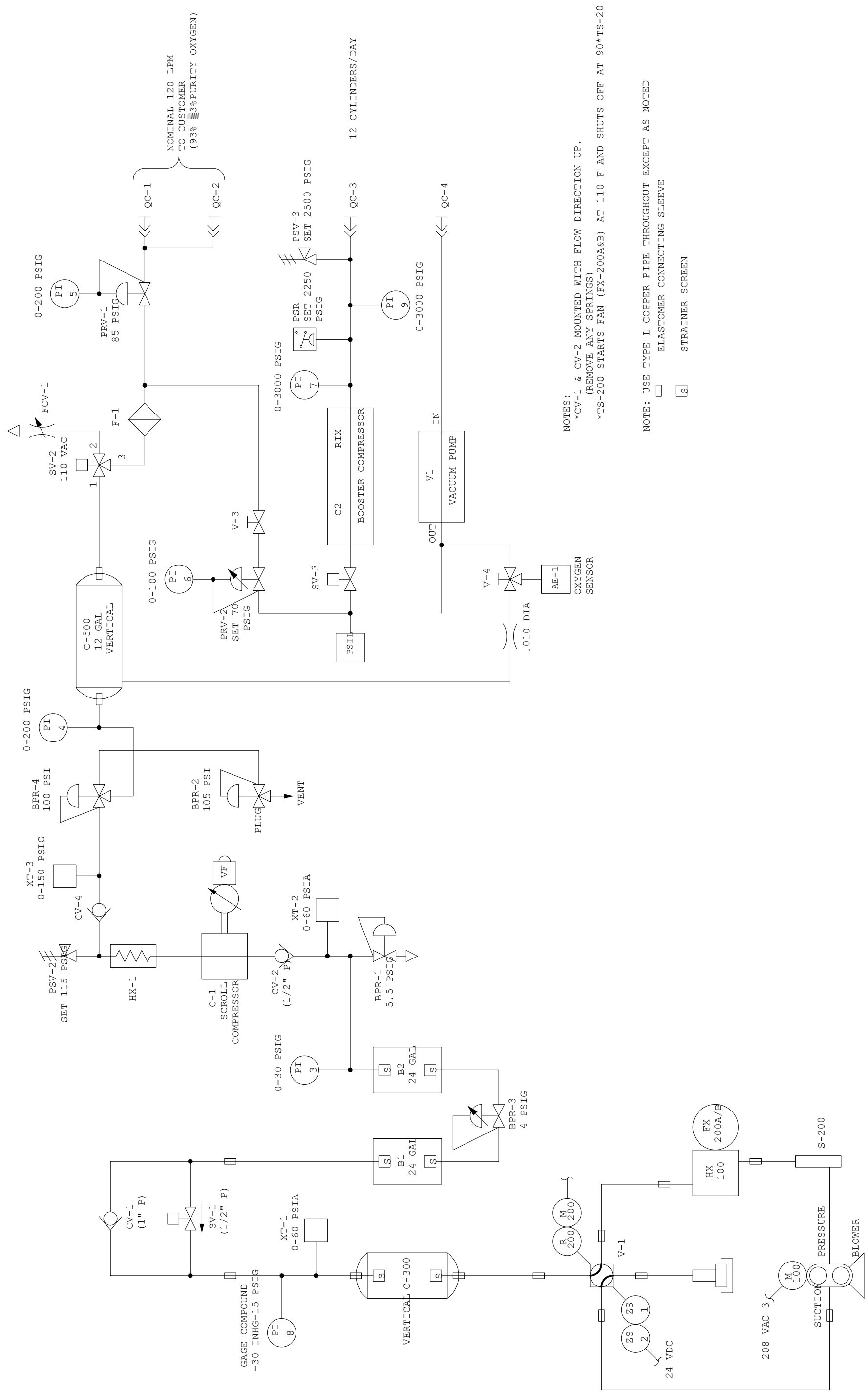

Figure 1-7.
EDOCS-120 P/N 792641-001 Process Flow Schematic

P/N 793035-001 - 793090-001 P&ID SCHEMATIC

TAG NO.	NOMENCLATURE	TAG NO.	NOMENCLATURE
AE-1	Oxygen Analyzer	QC-4	Vacuum Pump Quick Connect Port
Blower	VSA Blower	SV-1	Buffer Tank Purge Gas Solenoid Valve
BPR-1	Buffer Tank Over Pressure Back Pressure Regulator	SV-2	Product Purity Off Specification Solenoid Valve
BPR-2	Scroll Over Pressure Back Pressure Regulator	SV-3	Booster Compressor Suction Solenoid Valve
BPR-3	B1 & B2 Buffer Tank Back Pressure Regulator	V1	Vacuum Pump
BPR-4	Scroll Back Pressure Regulator	V-3	Boost Compressor Gas Supply Isolation Valve
C-1	Scroll Compressor	V-4	Oxygen Purity Calibration Sample Valve
C-2	Booster Compressor	VF	Scroll Compressor Variable Speed Controller
C-300	VSA Molecular Sieve Tank	XT-1	VSA Discharge Pressure Signal Transducer
C-500	Oxygen Product Receiver Tank	XT-2	Scroll Compressor Inlet Pressure Signal Transducer
CV-1	VSA Discharge Check Valve	XT-3	Scroll Compressor Pressure Transducer
CV-2	Scroll Inlet Check Valve		
CV-4	Scroll Discharge Check Valve		
F-1	Oxygen Product After Filter		
FCV-1	Oxygen Purity Off Specification Flow Control Valve		
FX 200	VSA Blower After Cooling Fan		
HX100	VSA Blower Heat Exchanger		
HX-1	Scroll Compressor After Cooler Heat Exchanger		
M100	VSA Blower Motor		
M200	4-Way Valve Stepper Motor		
PI-3	B2 Buffer Tank Discharge Pressure Gage		
PI-4	Oxygen Product Pressure Gage		
PI-5	Oxygen Distribution Box Pressure Gage		
PI-6	Booster Compressor Suction Pressure Gage		
PI-7	Booster Compressor Discharge Pressure Gage		
PI-8	VSA Compound Pressure/Vacuum Gage		
PI-9	High Pressure Cylinder Fill Pressure Gage		
PRV-1	Oxygen Distribution Box Pressure Regulator		
PRV-2	Booster Compressor Inlet Pressure Regulator		
PSIL	Booster Inlet Pressure Switch		
PSR	Booster Discharge Pressure Switch		
PSV-2	Scroll Compressor Pressure Relief Valve		
PSV-3	Booster Compressor Pressure Relief Valve		
QC-1	Oxygen Product Distribution Gas Quick Connect Port		
QC-2	Oxygen Product Distribution Gas Quick Connect Port		
QC-3	Booster Compressor Gas Distribution Quick Connect Port		

Table 1-4, Legend for Figure 1-8, Process Flow Schematic for EDOCS-120

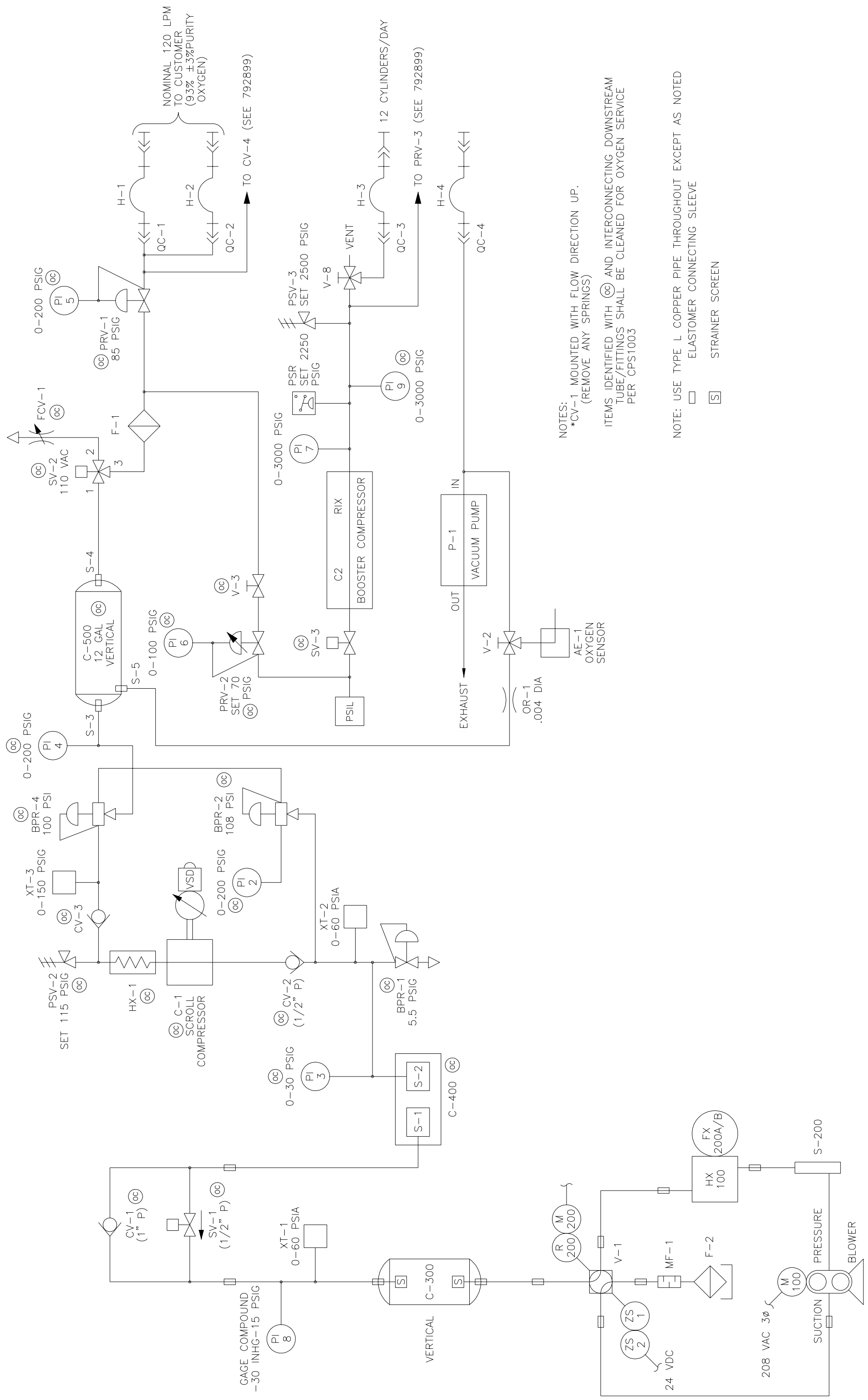

Figure 1-8
EDOCS-120 P/N 793035-001, 793090-001, Process Flow Schematic

P/N 793295-001 P&ID SCHEMATIC

TAG NO.	NOMENCLATURE	TAG NO.	NOMENCLATURE
AE-1	Oxygen Analyzer	QC-4	Vacuum Pump Quick Connect Port
Blower	VSA Blower	SV-1	Buffer Tank Purge Gas Solenoid Valve
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BPR-2	Scroll Over Pressure Back Pressure Regulator	SV-3	Booster Compressor Suction Solenoid Valve
BPR-3	B1 & B2 Buffer Tank Back Pressure Regulator	V1	Vacuum Pump
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CV-4	Scroll Discharge Check Valve		
F-1	Oxygen Product After Filter		
FCV-1	Oxygen Purity Off Specification Flow Control Valve		
FX 200	VSA Blower After Cooling Fan		
HX100	VSA Blower Heat Exchanger		
HX-1	Scroll Compressor After Cooler Heat Exchanger		
M100	VSA Blower Motor		
M200	4-Way Valve Stepper Motor		
PI-3	B2 Buffer Tank Discharge Pressure Gage		
PI-4	Oxygen Product Pressure Gage		
PI-5	Oxygen Distribution Box Pressure Gage		
PI-6	Booster Compressor Suction Pressure Gage		
PI-7	Booster Compressor Discharge Pressure Gage		
PI-8	VSA Compound Pressure/Vacuum Gage		
PI-9	High Pressure Cylinder Fill Pressure Gage		
PRV-1	Oxygen Distribution Box Pressure Regulator		
PRV-2	Booster Compressor Inlet Pressure Regulator		
PSIL	Booster Inlet Pressure Switch		
PSR	Booster Discharge Pressure Switch		
PSV-2	Scroll Compressor Pressure Relief Valve		
PSV-3	Booster Compressor Pressure Relief Valve		
QC-1	Oxygen Product Distribution Gas Quick Connect Port		
QC-2	Oxygen Product Distribution Gas Quick Connect Port		
QC-3	Booster Compressor Gas Distribution Quick Connect Port		

Table 1-5, Legend for Figure 1-9, Process Flow Schematic for EDOCS-120

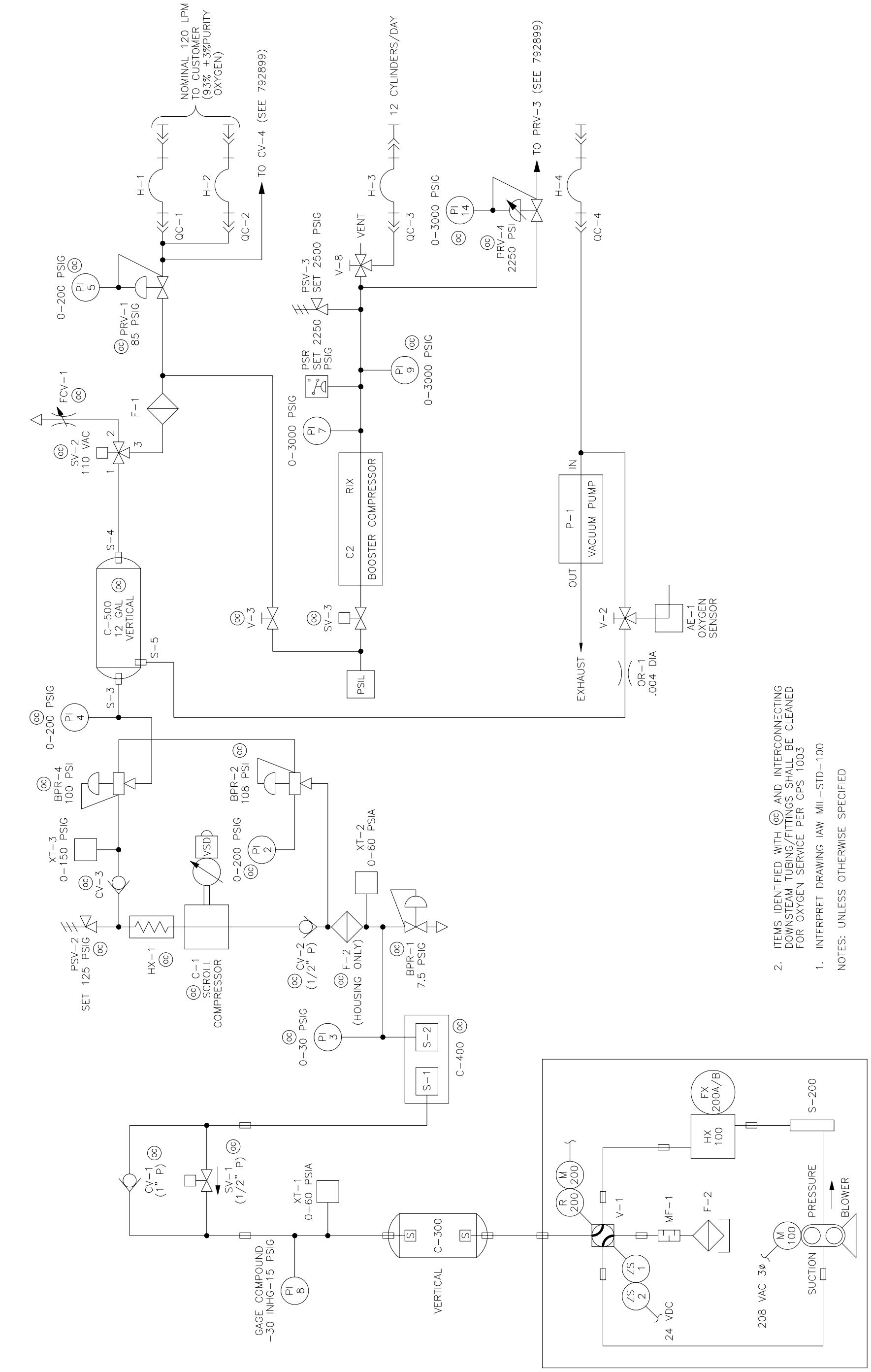


Figure 1-9
EDOCS-120 P/N 793295-001, Process Flow Schematic

P/N 792641-001 OXYGEN BACK UP & CYLINDER CHARGING STATION P&ID SCHEMATIC

TAG NO.	NOMENCLATURE		
C-1	Low Pressure Oxygen Gas Product Quick Connect Port		
C-2	Low Pressure Oxygen Gas Product Quick Connect Port		
C-3	High Pressure Oxygen Gas Product Quick Connect Port		
C-4	Vacuum Quick Connect Port		
CV-4	Low Pressure Back Up Cylinder Oxygen Gas Check Valve		
CYL-1	Back Up M Size Oxygen Supply Cylinder		
CYL-2	Back Up M Size Oxygen Supply Cylinder		
CYL-3	Back Up M Size Oxygen Supply Cylinder		
CYL-4	Back Up M Size Oxygen Supply Cylinder		
PI-5	Oxygen Distribution Box Pressure Gage		
PI-10	Back Up Low Pressure Oxygen Cylinder Pressure Gage		
PI-11	Back Up M Size Cylinder Manifold Pressure Gage		
PI-12	D & E Size Cylinder Fill Manifold Pressure Gage		

TAG NO	NOMENCLATURE		
PI-13	Cylinder Back Up Vacuum Compound Pressure Gage		
PRV-1	Oxygen Distribution Box Pressure Regulator		
PRV-3	Back Up Cylinder Oxygen Low Pressure Regulator		
V-4	M Size Cylinder Manifold Supply Shut Off Valve		
V-5	M Size Cylinder Manifold Vent Valve		
V-6	Vacuum Supply Shut Off Valve		
V-7	D & E Cylinder Manifold Supply Shut Off Valve		
V-8	D & E Cylinder Manifold Supply Shut Off Valve		
V-9	D & E Cylinder Manifold Supply Shut Off Valve		
V-10	D & E Cylinder Manifold Supply Shut Off Valve		
V-11	D & E Cylinder Charging Line Supply Shut Off Valve		
V-12	D & E Cylinder Charging Line Supply Shut Off Valve		
V-13	D & E Cylinder Charging Line Supply Shut Off Valve		
V-14	D & E Cylinder Charging Line Supply Shut Off Valve		

Table 1-6, Legend for Figure 1-10,
EDOCS, Oxygen Back Up & Cylinder Charging Station

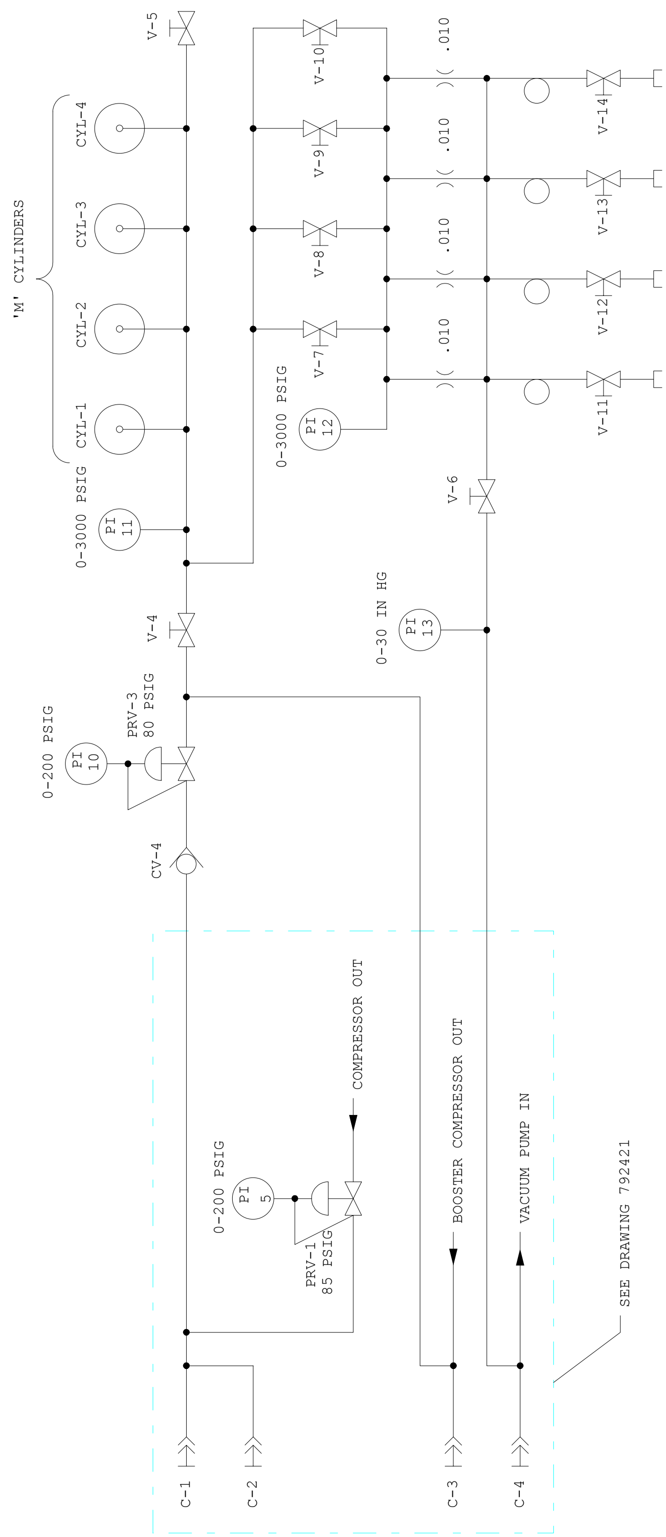


Figure 1-10
P/N 792641 Oxygen Back Up & Cylinder Charging Station

P/N 793035-001 & 793090-001 OXYGEN BACK UP & CYLINDER CHARGING STATION P&ID SCHEMATIC

TAG NO.	NOMENCLATURE		
C-1	Low Pressure Oxygen Gas Product Quick Connect Port		
C-2	Low Pressure Oxygen Gas Product Quick Connect Port		
C-3	High Pressure Oxygen Gas Product Quick Connect Port		
C-4	Vacuum Quick Connect Port		
CV-4	Low Pressure Back Up Cylinder Oxygen Gas Check Valve		
CYL-1	Back Up M Size Oxygen Supply Cylinder		
CYL-2	Back Up M Size Oxygen Supply Cylinder		
CYL-3	Back Up M Size Oxygen Supply Cylinder		
CYL-4	Back Up M Size Oxygen Supply Cylinder		
PI-5	Oxygen Distribution Box Pressure Gage		
PI-10	Back Up Low Pressure Oxygen Cylinder Pressure Gage		
PI-11	Back Up M Size Cylinder Manifold Pressure Gage		
PI-12	D & E Size Cylinder Fill Manifold Pressure Gage		
PI-13	Cylinder Back Up Vacuum Compound Pressure Gage		
PRV-1	Oxygen Distribution Box Pressure Regulator		
PRV-3	Back Up Cylinder Oxygen Low Pressure Regulator		
V-4	M Size Cylinder Manifold Supply Shut Off Valve		
V-5	M Size Cylinder Manifold Vent Valve		
V-6	Vacuum Supply Shut Off Valve		
V-7	D & E Cylinder Manifold Supply Shut Off Valve		
V-8	D & E Cylinder Manifold Supply Shut Off Valve		
V-9	D & E Cylinder Manifold Supply Shut Off Valve		
V-10	D & E Cylinder Manifold Supply Shut Off Valve		
V-11	D & E Cylinder Charging Line Supply Shut Off Valve		
V-12	D & E Cylinder Charging Line Supply Shut Off Valve		
V-13	D & E Cylinder Charging Line Supply Shut Off Valve		
V-14	D & E Cylinder Charging Line Supply Shut Off Valve		

Table 1-7, Legend for Figure 1-11, EDOCS-120, Oxygen Back Up & Cylinder Charging Station

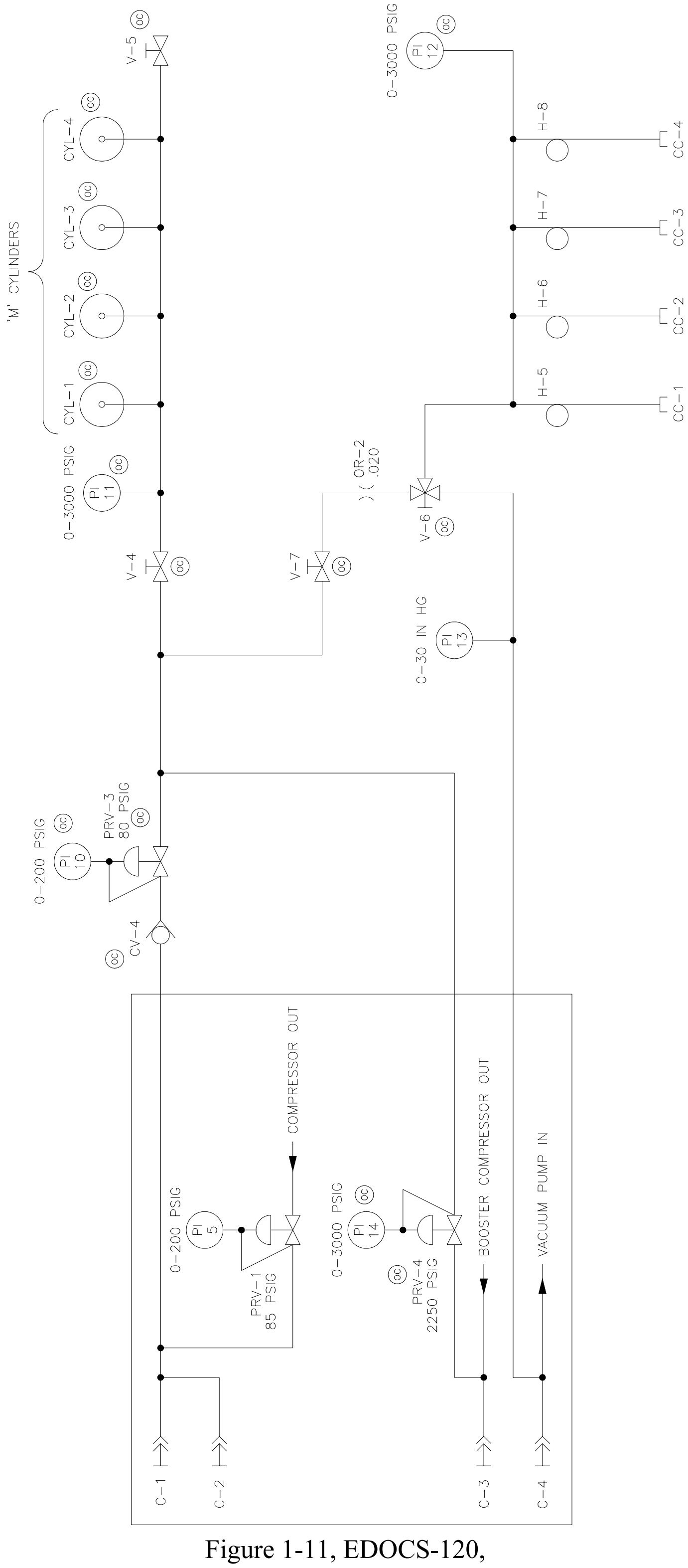


Figure 1-11, EDOCS-120,
Oxygen Back Up & Cylinder Charging Station
P/N 793035-001 & 793090-001

OXYGEN
BACK UP & CYLINDER CHARGING
STATION P&ID SCHEMATIC

TAG NO.	NOMENCLATURE
C-1	Low Pressure Oxygen Gas Product Quick Connect Port
C-2	Low Pressure Oxygen Gas Product Quick Connect Port
C-3	High Pressure Oxygen Gas Product Quick Connect Port
C-4	Vacuum Quick Connect Port
CC-1	D & E Cylinder Yoke Connection
CC-2	D & E Cylinder Yoke Connection
CC-3	D & E Cylinder Yoke Connection
CC-4	D & E Cylinder Yoke Connection
CV-4	Low Pressure Back Up Cylinder Oxygen Gas Check Valve
CYL-1	Back Up M Size Oxygen Supply Cylinder
CYL-2	Back Up M Size Oxygen Supply Cylinder
CYL-3	Back Up M Size Oxygen Supply Cylinder
CYL-4	Back Up M Size Oxygen Supply Cylinder
H-5	D & E Cylinder Hose
H-6	D & E Cylinder Hose
H-7	D & E Cylinder Hose
H-8	D & E Cylinder Hose
OR-2	Fill Rate Orifice .020 Diameter
PI-5	Oxygen Distribution Box Pressure Gage
PI-10	Back Up Low Pressure Oxygen Cylinder Pressure Gage
PI-11	Back Up M Size Cylinder Manifold Pressure Gage
PI-12	D & E Size Cylinder Fill Manifold Pressure Gage

TAG NO.	NOMENCLATURE
PI-13	Cylinder Back Up Vacuum Compound Pressure Gage
PRV-1	Oxygen Distribution Box Pressure Regulator
PRV-3	Back Up Cylinder Oxygen Low Pressure Regulator
QC-5	HOBS Quick Connect Fitting
V-4	M Size Cylinder Manifold Supply Shut Off Valve
V-5	M Size Cylinder Manifold Vent Valve
V-6	Vacuum / High Pressure Supply Shut Off Valve
V-7	High Pressure Oxygen Fill Valve To D & E Size Cylinders
V-9	HOBS Connection Supply Shut Off Valve
PRV-1	Oxygen Distribution Box Pressure Regulator
PRV-3	Back Up Cylinder Oxygen Low Pressure Regulator
QC-5	HOBS Quick Connect Fitting

Table 1-8, Legend for Figure 1-12, USAF EDOCS-120, Oxygen Back Up & Cylinder Charging Station

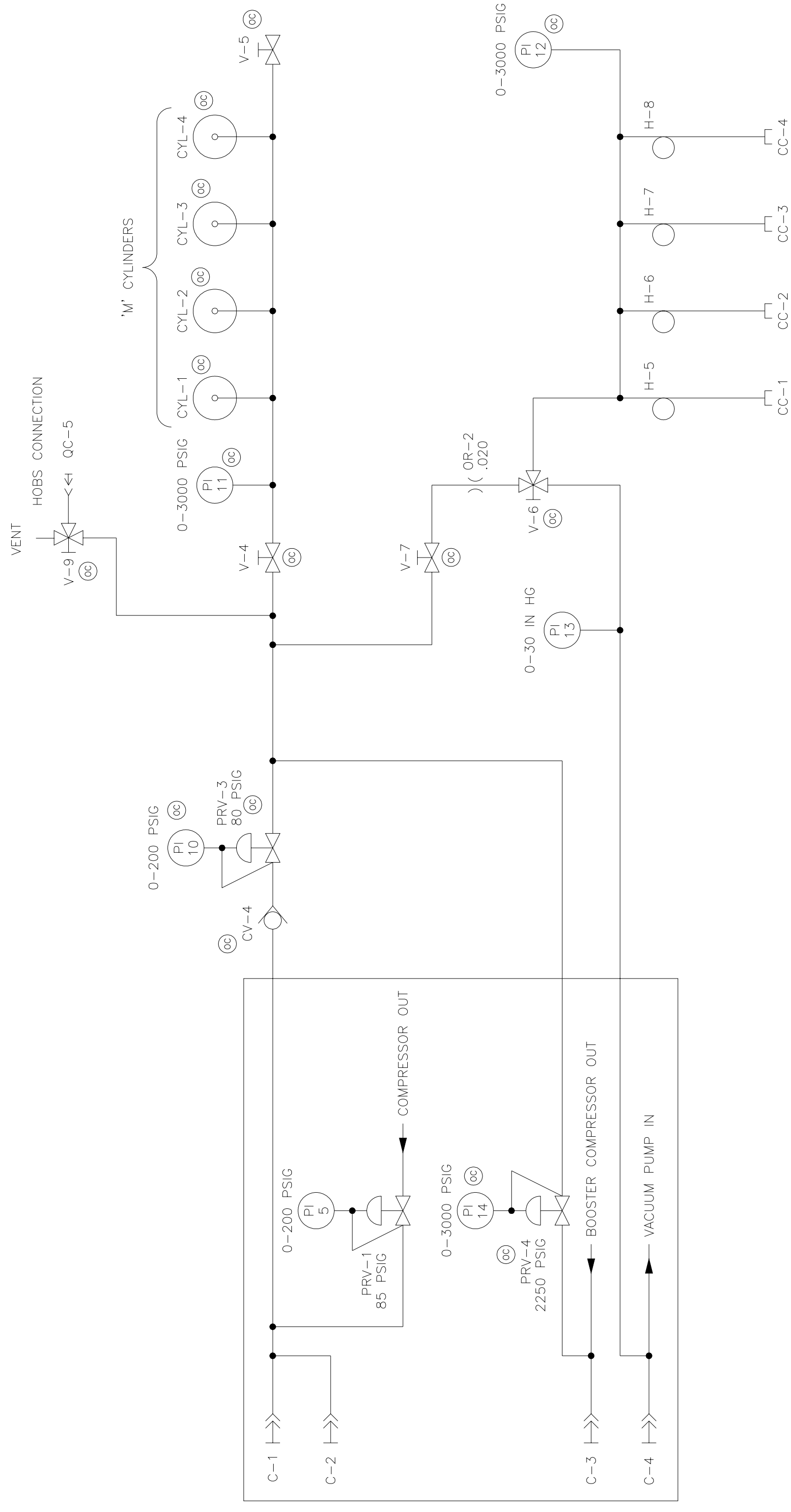


Figure 1-12
USAF 3000 PSIG EDOCS-120,
Oxygen Back Up & Cylinder Charging Station P/N 793295-001

BOOSTER COMPRESSOR EDOCS-120 P/N 792641-001

TAG NO.	NOMENCLATURE	TAG NO.	NOMENCLATURE
TDR	Timer Delay Relay, ½ Second	M	Motor, 1 ½ HP
TDR	Timer, 30 Second	M-1	Motor Starter
START	Pushbutton, Start	LG	Light, Run, Green
R	Resistor, 50K Ohms	HOA	Hands, Off Auto Switch
PSR	Pressure Switch, Regulating, 2200 lbs.	HM	Hour Meter
PSIL	Pressure Switch, Low Inlet, 30 lbs.	F	Fan
OL	Overload Heater		

Table 1-9, Legend for Figure 1-13, Booster Compressor – Electrical Schematic

MAIN ELECTRICAL CONTROL BOX SCHEMATIC EDOCS-120 P/N 792641-001

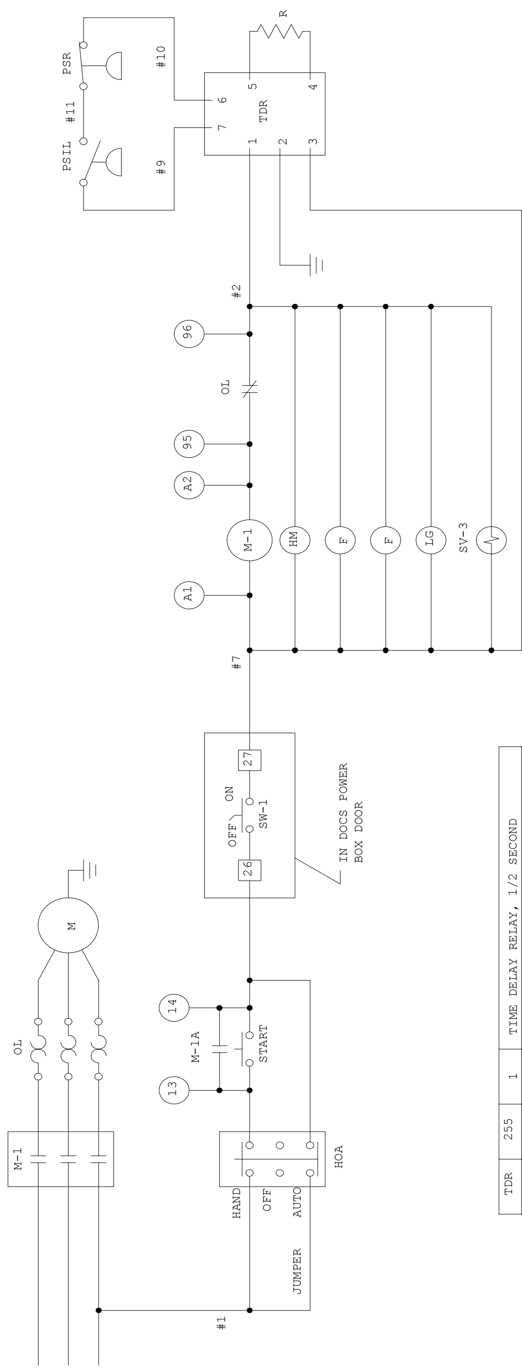
TAG NO.	NOMENCLATURE	TAG NO	NOMENCLATURE
AE-1	Oxygen Purity Analyzer	PB-2	Pushbutton, Push-To-Test
AI	Analog Input Module, PLC	PB-3	Pushbutton, Purity Override
AO	Analog Output Module, PLC	Phase Protector	Voltage Polarity Protector
CB-1	Main Circuit Breaker	R101 Coil	Scroll, Contact Coil
CPU	Central Processing Unit, PLC	R101 Contact	Scroll, Normally Open Contact
FU-1	Fuse, Slow Blow -10A	RCA Jack	Purity Test
FU-2	Fuse, 10A	Receptacle	Electrical Power, 5-Pin Connector
HM	Hour Meter	Scroll VSD	Scroll, Variable Speed Drive
LT-1	Low Purity Light	SV-1	Solenoid Valve,
LT-2	Low Pressure Light	SV-2	Solenoid Valve,
LT-3	General Fault Light	SW-1	Vacuum Pump, On/Off Selector Switch
LT-4	Purity Override	SW-3	Oxygen Calibrate Switch
M-1	Scroll Motor	VI	AC Volt Input Module, PLC
M-2	Vacuum Pump Motor	VO	AC Volt Output Module, PLC
M-3A	Cooling Fan 1	XT-1	Pressure Transducer – VSA
M-3B	Cooling Fan 2	XT-2	Pressure Transducer – Scroll Inlet Pressure
M-4	Damper Motor	XT-3	Pressure Transducer – Scroll Outlet Pressure
PB-1	Pushbutton, Push-To-Test		

Table 1-10, Legend for Figure 1-14, Main Electrical Control Box Schematic

VSA POWER BOX EDOCS-120 P/N 792641-001

TAG NO.	NOMENCLATURE
CB-112	Circuit Breaker 3 Amp, Motorized Ball Valve
CB-114	Circuit Breaker 2 Amp, Transformer Input Connections
CB-116	Circuit Breaker 1.6 Amp, Transformer Output Connections
CR-124	Blower Motor Contactor Coil
CR-124	Contactor & Overload
CR-124	Normally Closed Contacts
CR-145	Motorized Ball Valve Contactor Coil
CR-145	Motorized Ball Valve Contact
HR	Blower Motor Hour Meter
M100	Blower Motor
M200	Motorized Ball Valve Motor
Phase Protector	Voltage Polarity Protector
SW-3	Blower Selector On/Off Switch
T-115	VSA Transformer
TB1	Terminal Board

Table 1-11, Legend for Figure 1-15, VSA Electrical Schematic



SYM	B/M	QTY	DESCRIPTION
TDR	255	1	TIME DELAY RELAY, 1/2 SECOND
TDR	247	1	TIMER, 30 SECOND
START	248	1	PUSHBUTTON, START
RC	REF	1	REMOTE CONTACT (BY CUSTOMER)
R	256	1	RESISTOR, 50K OHMS
PSR	219	1	PRESSURE SWITCH, REGULATING, 2200#
PSIL	224	1	PRESSURE SWITCH, LOW INLET INLET, 30#
OL	205	1	OVERLOAD HEATER
M	201	1	MOTOR, 1 1/2 HP
M-1	241	1	MOTOR STARTER
LG	245	1	LIGHT, RUN, GREEN
HOA	243	1	HANDS, OFF AUTO SWITCH
HM	202	1	HOUR METER
F	226	2	FAN

Figure 1-13
EDOCS-120 P/N 792641-001
Booster Compressor-Electrical Schematic

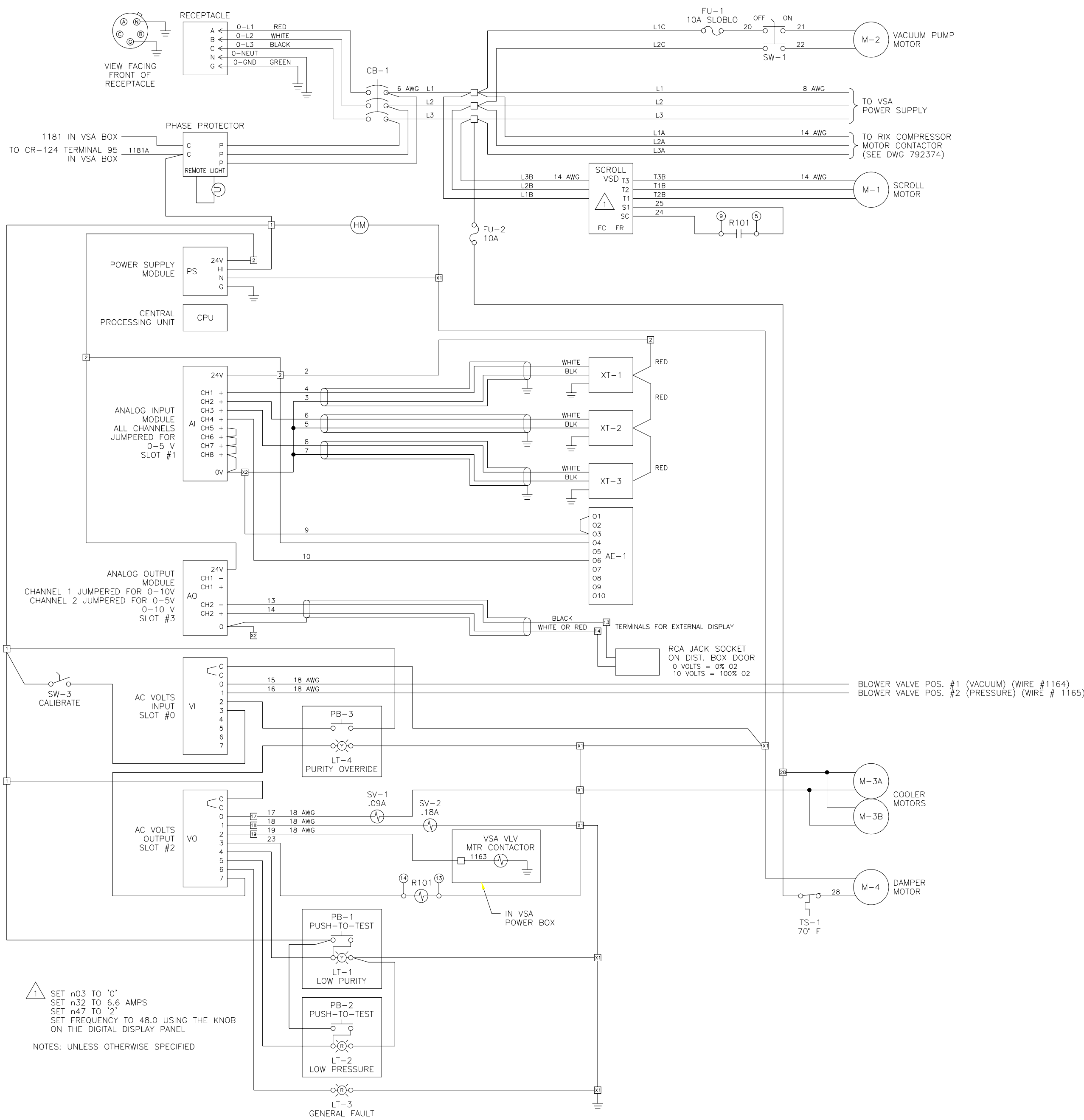


Figure 1-14
EDOCS-120 P/N 792641-001
Main Electrical Control Box Schematic

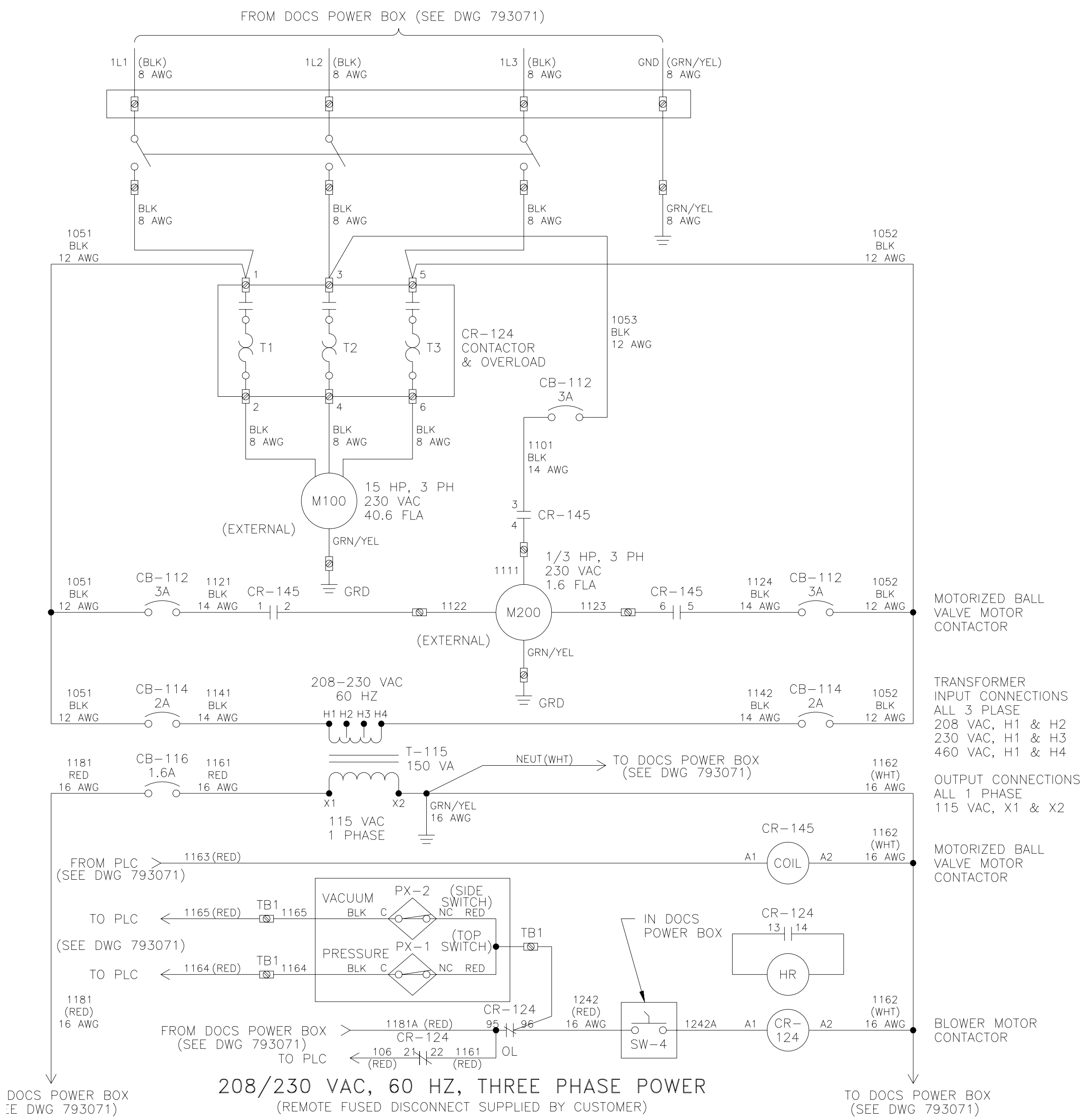


Figure 1-15
EDOCS-120 P/N 792641-001
VSA Electrical Schematic

BOOSTER COMPRESSOR P/N 793035-001 & 793295-001

TAG NO.	NOMENCLATURE	TAG NO.	NOMENCLATURE
TDR	Timer Delay Relay, ½ Second	M	Motor, 1 ½ HP
TDR	Timer, 30 Second	M-1	Motor Starter
START	Pushbutton, Start	LG	Light, Run, Green
R	Resistor, 50K Ohms	HOA	Hands, Off Auto Switch
PSR	Pressure Switch, Regulating, 2200#	HM	Hour Meter
PSIL	Pressure Switch, Low Inlet, 30#	F	Fan
OL	Overload Heater		

Table 1-12, Legend for Figure 1-16, Booster Compressor – Electrical Schematic

MAIN ELECTRICAL CONTROL BOX SCHEMATIC P/N 793035-001 & 793295-001

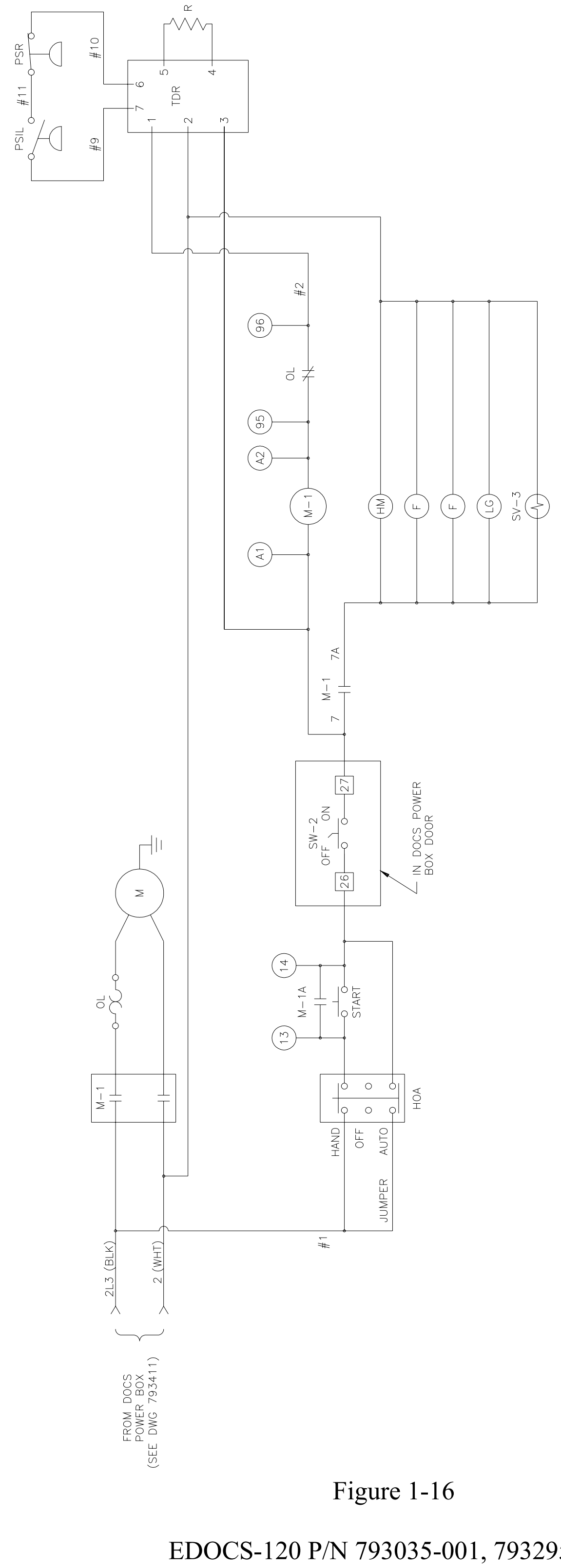
TAG NO.	NOMENCLATURE	TAG NO	NOMENCLATURE
AE-1	Oxygen Purity Analyzer	PB-2	Pushbutton, Push-To-Test
AI	Analog Input Module, PLC	PB-3	Pushbutton, Purity Override
AO	Analog Output Module, PLC	Phase Protector	Voltage Polarity Protector
CB-1	Main Circuit Breaker	R101 Coil	Scroll, Contact Coil
CPU	Central Processing Unit, PLC	R101 Contact	Scroll, Normally Open Contact
FU-1	Fuse, Slow Blow -10A	RCA Jack	Purity Test
FU-2	Fuse, 10A	Receptacle	Electrical Power, 5-Pin Connector
HM	Hour Meter	Scroll VSD	Scroll, Variable Speed Drive
LT-1	Low Purity Light	SV-1	Solenoid Valve,
LT-2	Low Pressure Light	SV-2	Solenoid Valve,
LT-3	General Fault Light	SW-1	Vacuum Pump, On/Off Selector Switch
LT-4	Purity Override	SW-3	Oxygen Calibrate Switch
M-1	Scroll Motor	VI	AC Volt Input Module, PLC
M-2	Vacuum Pump Motor	VO	AC Volt Output Module, PLC
M-3A	Cooling Fan 1	XT-1	Pressure Transducer – VSA
M-3B	Cooling Fan 2	XT-2	Pressure Transducer – Scroll Inlet Pressure
M-4	Damper Motor	XT-3	Pressure Transducer – Scroll Outlet Pressure
PB-1	Pushbutton, Push-To-Test		

Table 1-13, Legend for Figure 1-17, Main Electrical Control Box Schematic

VSA POWER BOX P/N 793035-001 & 793295-001

TAG NO.	NOMENCLATURE
CB-112	Circuit Breaker 3 Amp, Motorized Ball Valve
CB-114	Circuit Breaker 2 Amp, Transformer Input Connections
CB-116	Circuit Breaker 1.6 Amp, Transformer Output Connections
CR-124	Blower Motor Contactor Coil
CR-124	Contactor & Overload
CR-124	Normally Closed Contacts
CR-145	Motorized Ball Valve Contactor Coil
CR-145	Motorized Ball Valve Contact
HR	Blower Motor Hour Meter
M100	Blower Motor
M200	Motorized Ball Valve Motor
Phase Protector	Voltage Polarity Protector
SW-3	Blower Selector On/Off Switch
T-115	VSA Transformer
TB1	Terminal Board

Table 1-14, Legend for Figure 1-18, VSA Electrical Schematic



SYM	B/M	QTY	DESCRIPTION
SV-3		1	COMPRESSOR INLET SHUTOFF VALVE
TDR	255	1	TIME DELAY RELAY, 1/2 SECOND
TDR	247	1	TIMER, 30 SECOND
START	248	1	PUSHBUTTON, START
RC	REF	1	REMOTE CONTACT (BY CUSTOMER)
R	256	1	RESISTOR, 50K OHMS
PSR	219	1	PRESSURE SWITCH, REGULATING, 2200#
PSIL	224	1	PRESSURE SWITCH, LOW INLET INLET, 30#
OL	205	1	OVERLOAD HEATER
M	201	1	MOTOR, 1 1/2 HP
M-1	241	1	MOTOR STARTER
LG	245	1	LIGHT, RUN, GREEN
HOA	243	1	HANDS, OFF AUTO SWITCH
HM	202	1	HOUR METER
F	226	2	FAN

Figure 1-16

EDOCS-120 P/N 793035-001, 793295-001
Booster Compressor-Electrical Schematic

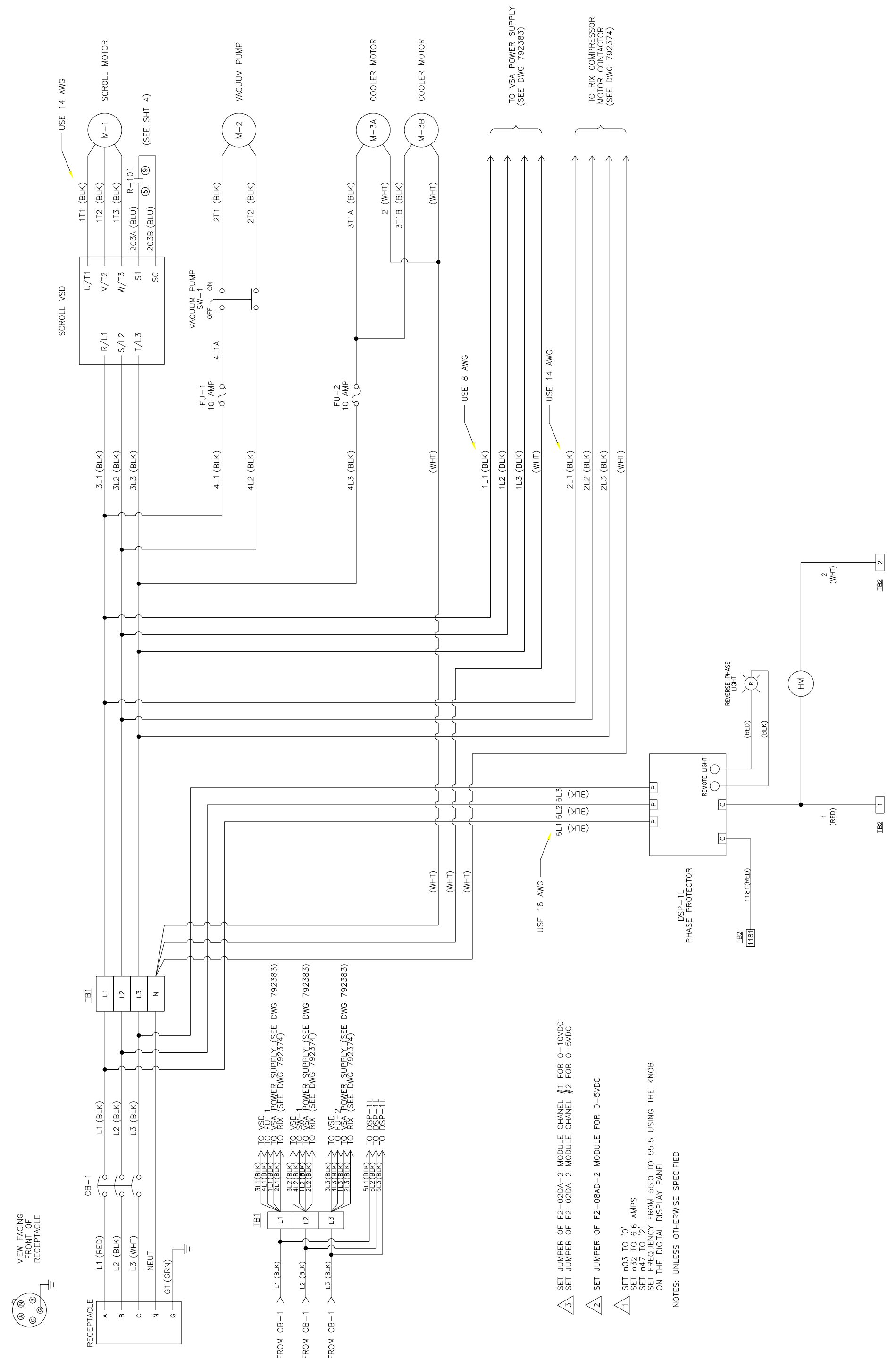


Figure 1-17
1 of 3
Main Electrical Control Box Schematic
P/N 793035-001 & 793295-001

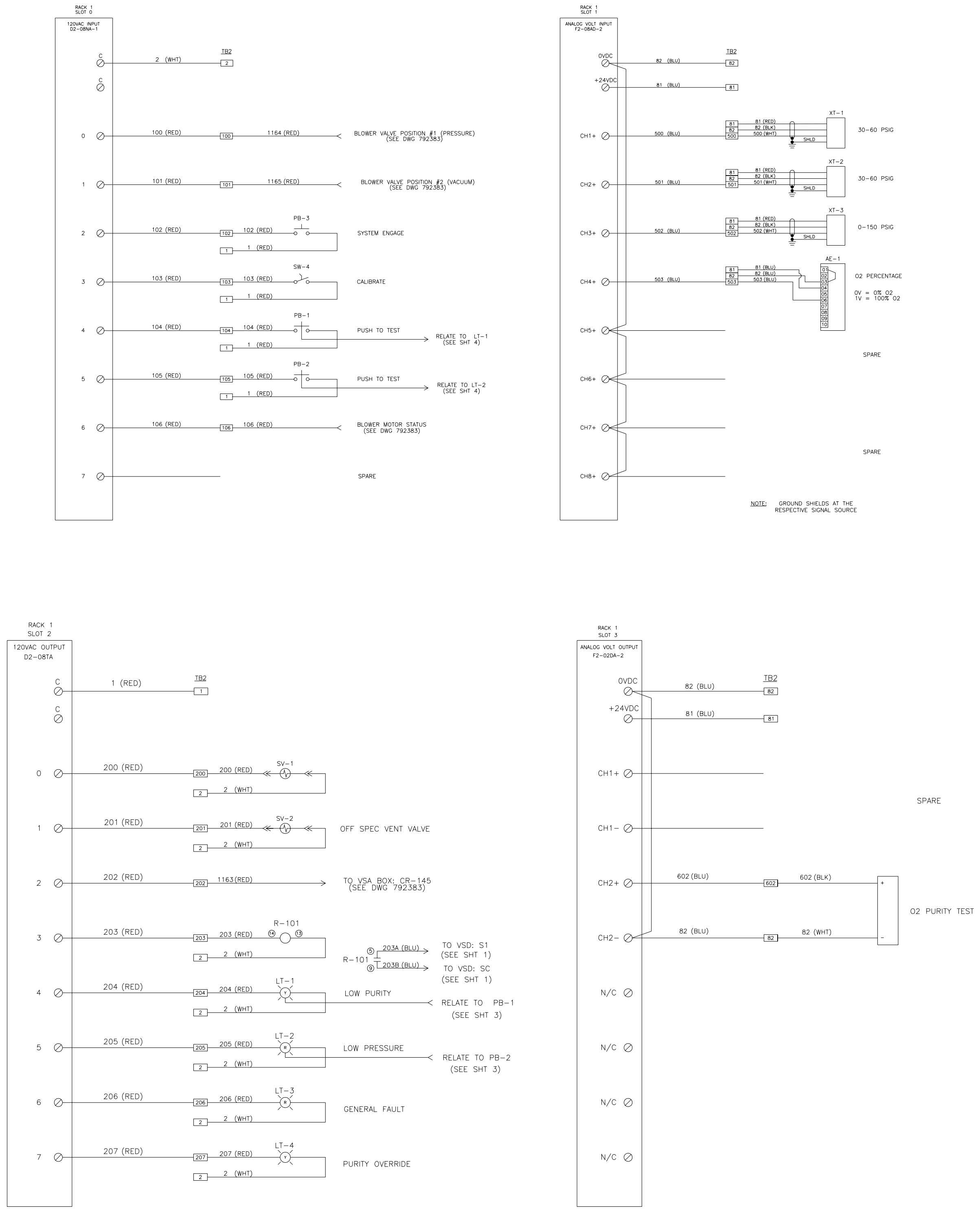
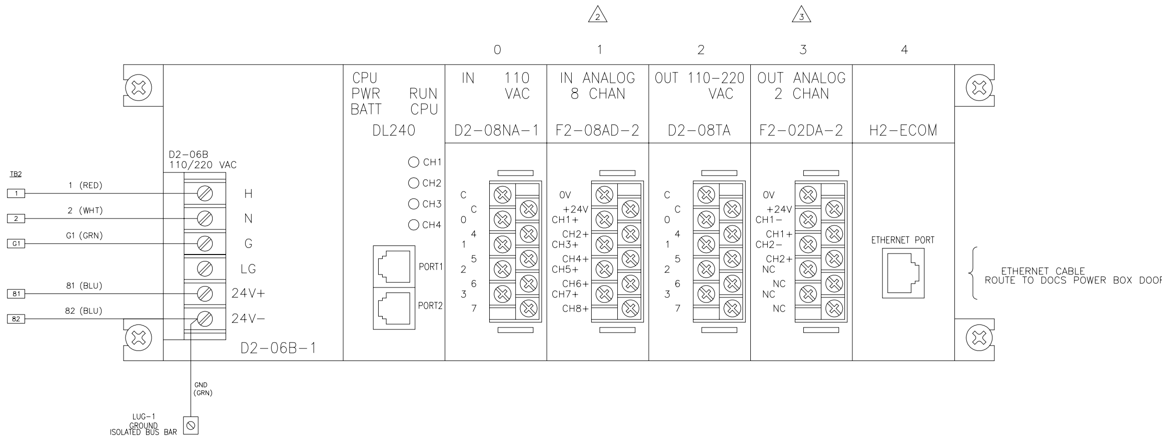


Figure 1-17
2 of 3
Main Electrical Control Box Schematic
P/N 793035-001 & 793295-001



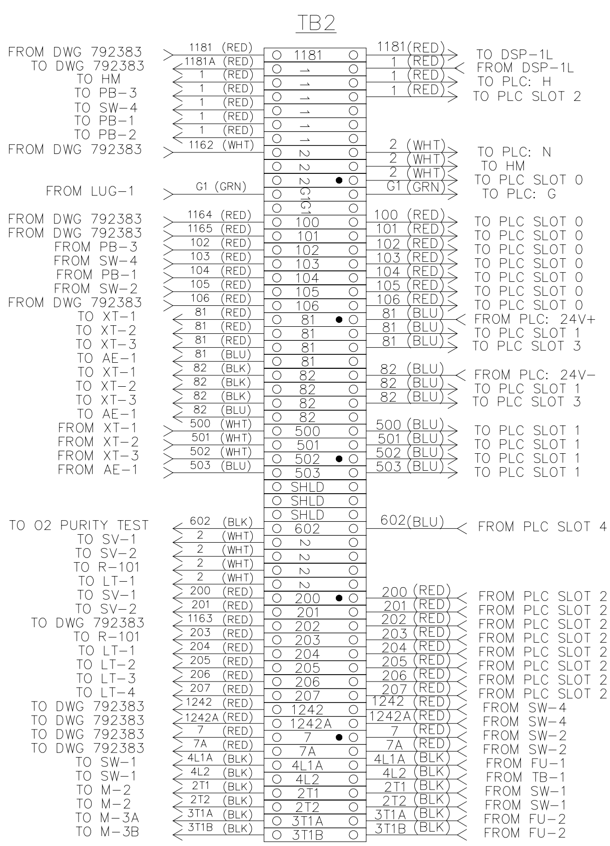


Figure 1-17
3 of 3
Main Electrical Control Box Schematic
P/N 793035-001 & 793295-001

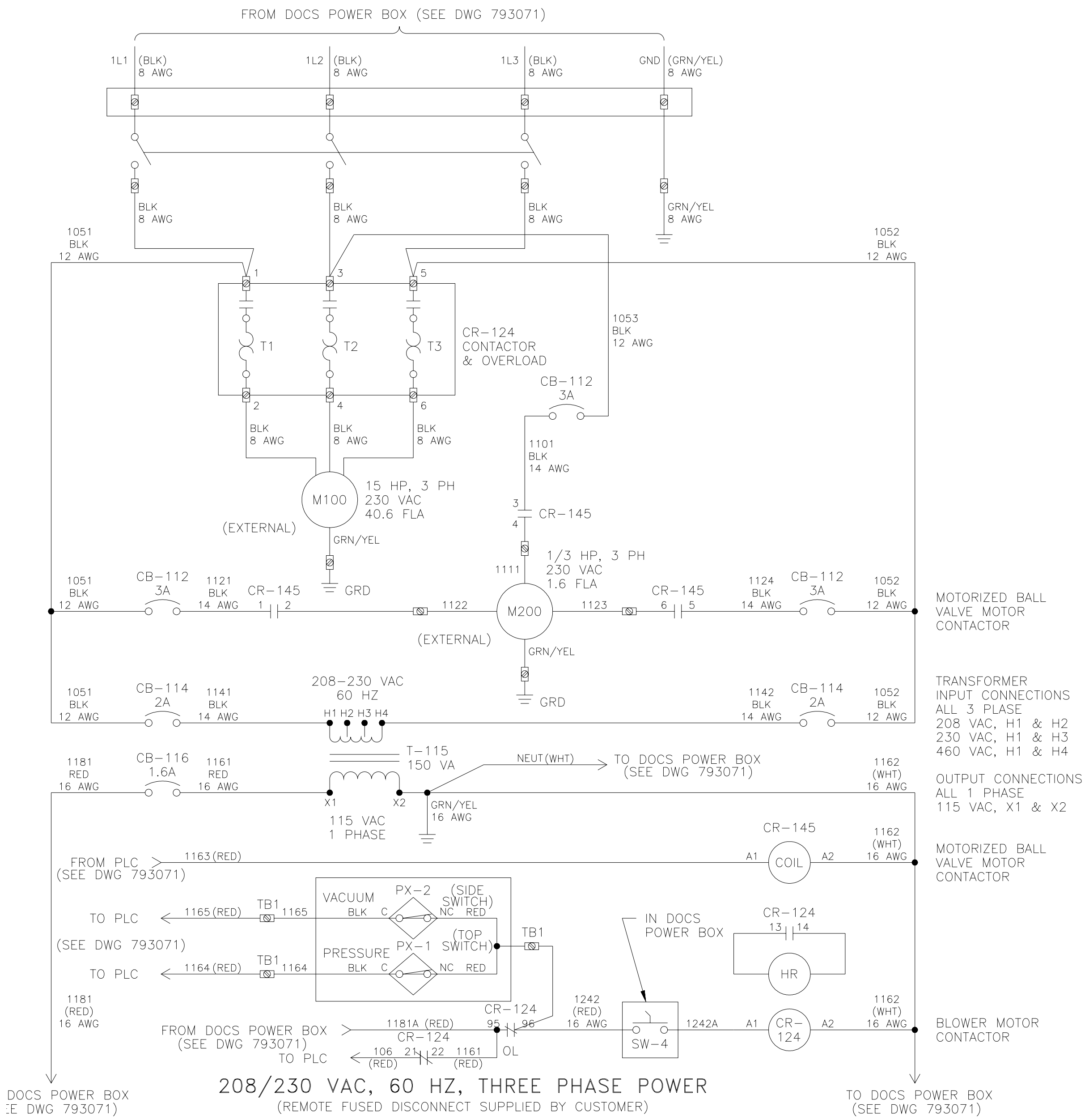


Figure 1-18
3 of 3
Main Electrical Control Box Schematic
P/N 793035-001 & 793295-001

BOOSTER COMPRESSOR P/N 793090-001

TAG NO.	NOMENCLATURE	TAG NO.	NOMENCLATURE
TDR	Timer Delay Relay, ½ Second	M	Motor, 1 ½ HP
TDR	Timer, 30 Second	M-1	Motor Starter
START	Pushbutton, Start	LG	Light, Run, Green
R	Resistor, 50K Ohms	HOA	Hands, Off Auto Switch
PSR	Pressure Switch, Regulating, 2200#	HM	Hour Meter
PSIL	Pressure Switch, Low Inlet, 30#	F	Fan
OL	Overload Heater		

Table 1-15, Legend for Figure 1-19, Booster Compressor – Electrical Schematic

MAIN ELECTRICAL CONTROL BOX SCHEMATIC P/N 793090-001

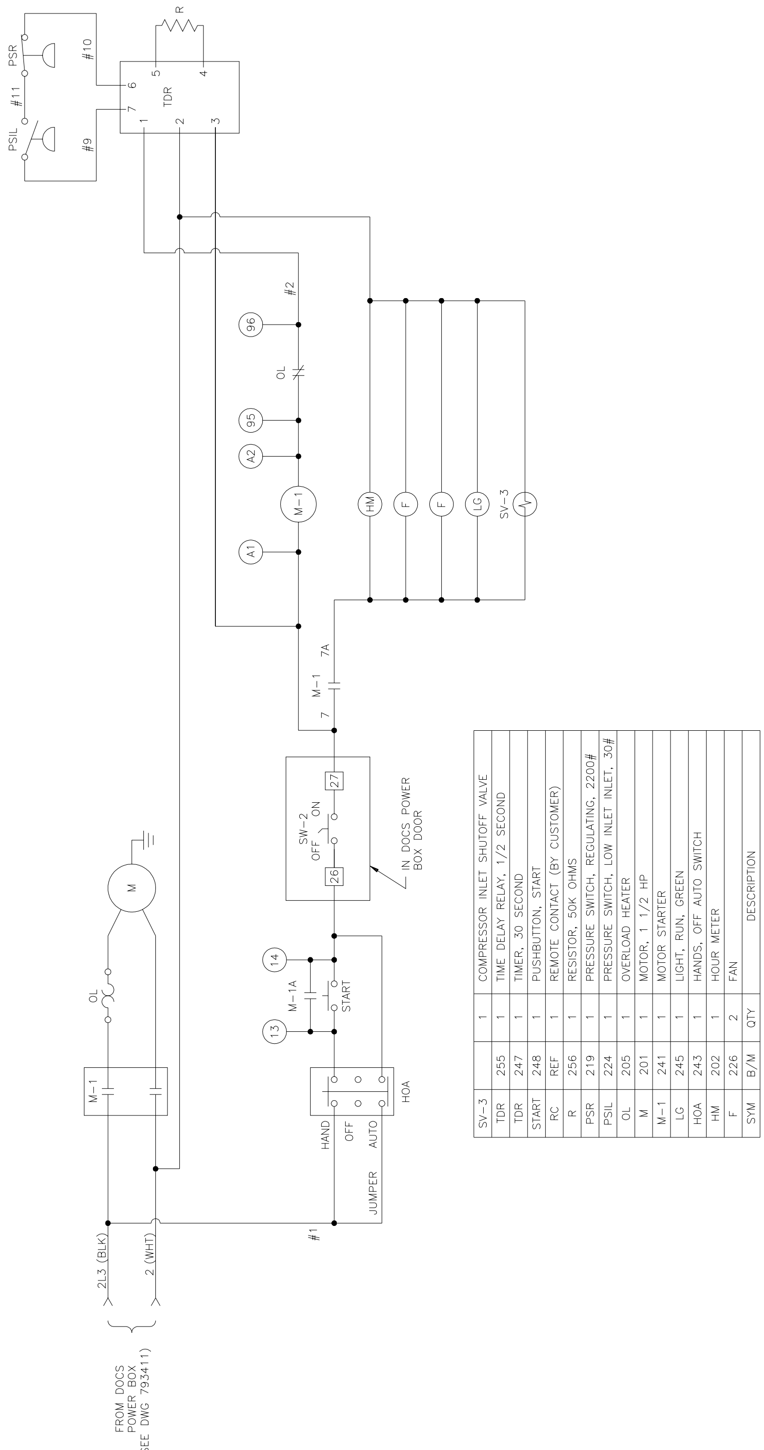
TAG NO.	NOMENCLATURE	TAG NO	NOMENCLATURE
AE-1	Oxygen Purity Analyzer	PB-2	Pushbutton, Push-To-Test
AI	Analog Input Module, PLC	PB-3	Pushbutton, Purity Override
AO	Analog Output Module, PLC	Phase Protector	Voltage Polarity Protector
CB-1	Main Circuit Breaker	R101 Coil	Scroll, Contact Coil
CPU	Central Processing Unit, PLC	R101 Contact	Scroll, Normally Open Contact
FU-1	Fuse, Slow Blow -10A	RCA Jack	Purity Test
FU-2	Fuse, 10A	Receptacle	Electrical Power, 5-Pin Connector
HM	Hour Meter	Scroll VSD	Scroll, Variable Speed Drive
LT-1	Low Purity Light	SV-1	Solenoid Valve,
LT-2	Low Pressure Light	SV-2	Solenoid Valve,
LT-3	General Fault Light	SW-1	Vacuum Pump, On/Off Selector Switch
LT-4	Purity Override	SW-3	Oxygen Calibrate Switch
M-1	Scroll Motor	VI	AC Volt Input Module, PLC
M-2	Vacuum Pump Motor	VO	AC Volt Output Module, PLC
M-3A	Cooling Fan 1	XT-1	Pressure Transducer – VSA
M-3B	Cooling Fan 2	XT-2	Pressure Transducer – Scroll Inlet Pressure
M-4	Damper Motor	XT-3	Pressure Transducer – Scroll Outlet Pressure
PB-1	Pushbutton, Push-To-Test		

Table 1-16, Legend for Figure 1-20, Main Electrical Control Box Schematic

VSA POWER BOX P/N 793090-001

TAG NO.	NOMENCLATURE
CB-112	Circuit Breaker 3 Amp, Motorized Ball Valve
CB-114	Circuit Breaker 2 Amp, Transformer Input Connections
CB-116	Circuit Breaker 1.6 Amp, Transformer Output Connections
CR-124	Blower Motor Contactor Coil
CR-124	Contactor & Overload
CR-124	Normally Closed Contacts
CR-145	Motorized Ball Valve Contactor Coil
CR-145	Motorized Ball Valve Contact
HR	Blower Motor Hour Meter
M100	Blower Motor
M200	Motorized Ball Valve Motor
Phase Protector	Voltage Polarity Protector
SW-3	Blower Selector On/Off Switch
T-115	VSA Transformer
TB1	Terminal Board

Table 1-17, Legend for Figure 1-21, VSA Electrical Schematic



SYM	B/M	QTY	DESCRIPTION
SV-3		1	COMPRESSOR INLET SHUTOFF VALVE
TDR	255	1	TIME DELAY RELAY, 1/2 SECOND
TDR	247	1	TIMER, 30 SECOND
START	248	1	PUSHBUTTON, START
RC	REF	1	REMOTE CONTACT (BY CUSTOMER)
R	256	1	RESISTOR, 50K OHMS
PSR	219	1	PRESSURE SWITCH, REGULATING, 2200#
PSIL	224	1	PRESSURE SWITCH, LOW INLET INLET, 30#
OL	205	1	OVERLOAD HEATER
M	201	1	MOTOR, 1 1/2 HP
M-1	241	1	MOTOR STARTER
LG	245	1	LIGHT, RUN, GREEN
HOA	243	1	HANDS, OFF AUTO SWITCH
HM	202	1	HOUR METER
F	226	2	FAN

Figure 1-19,
Booster Compressor – Electrical Schematic P/N 793090-001

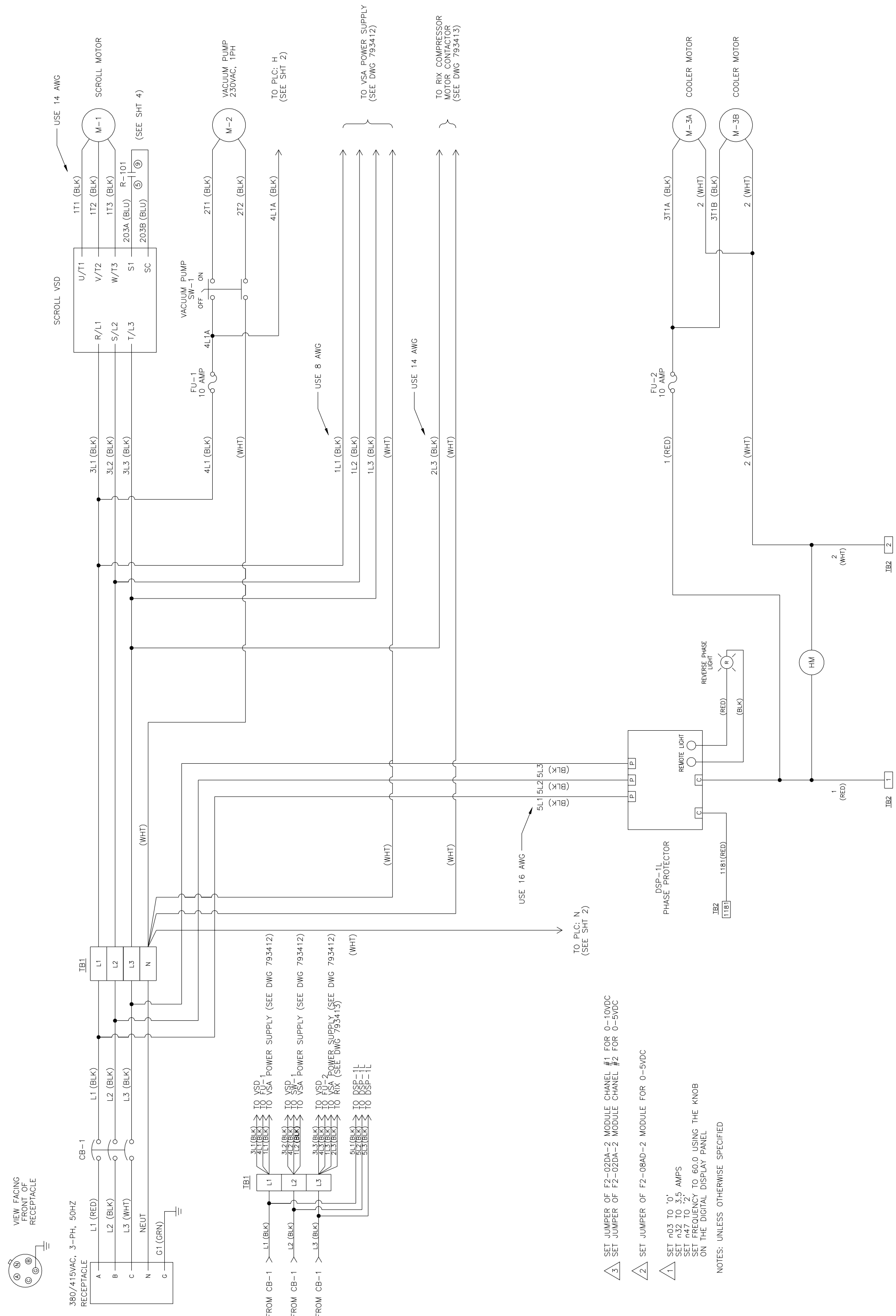


Figure 1-20,
1 of 3
Main Electrical Control Box Schematic P/N 793090-001

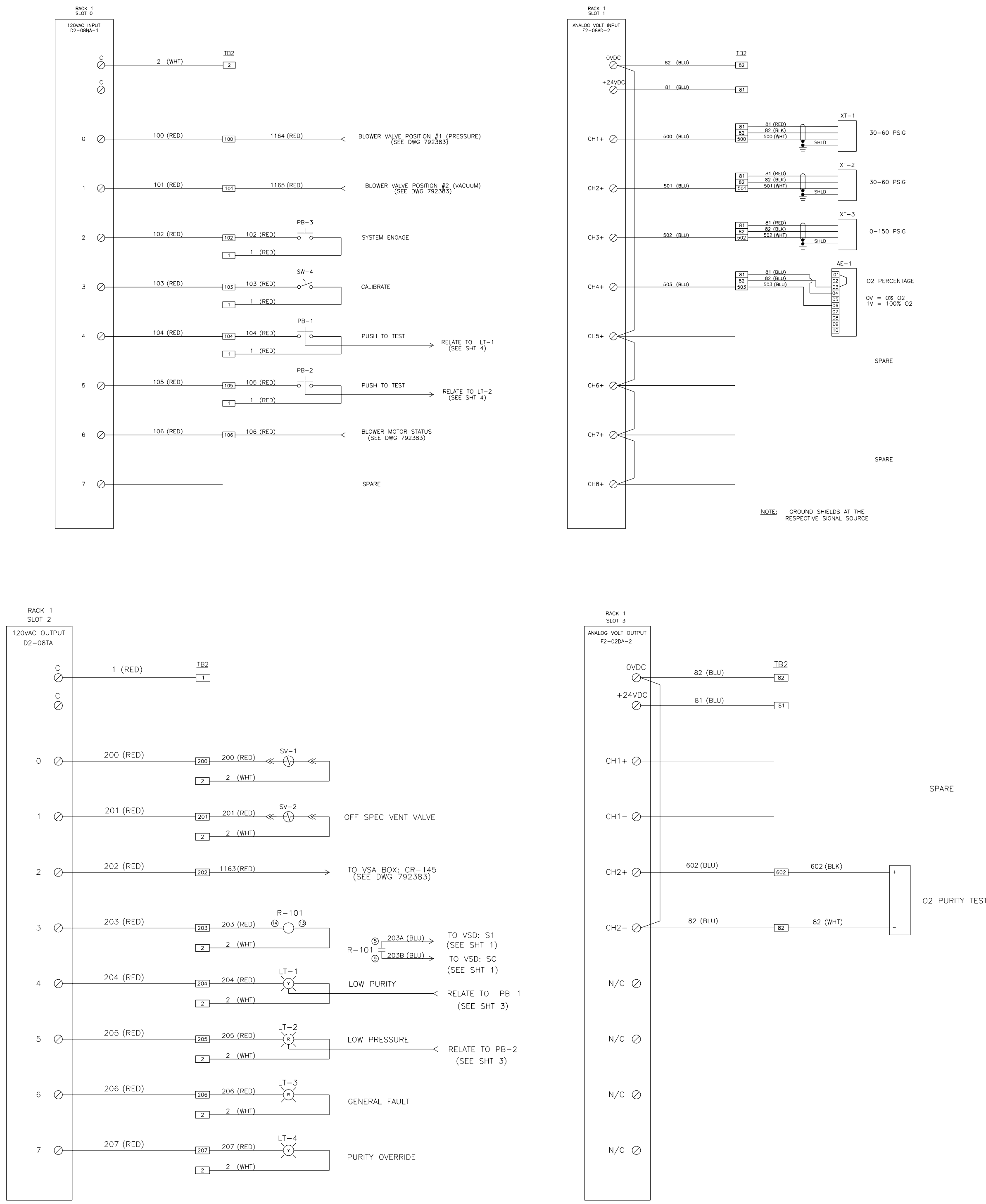
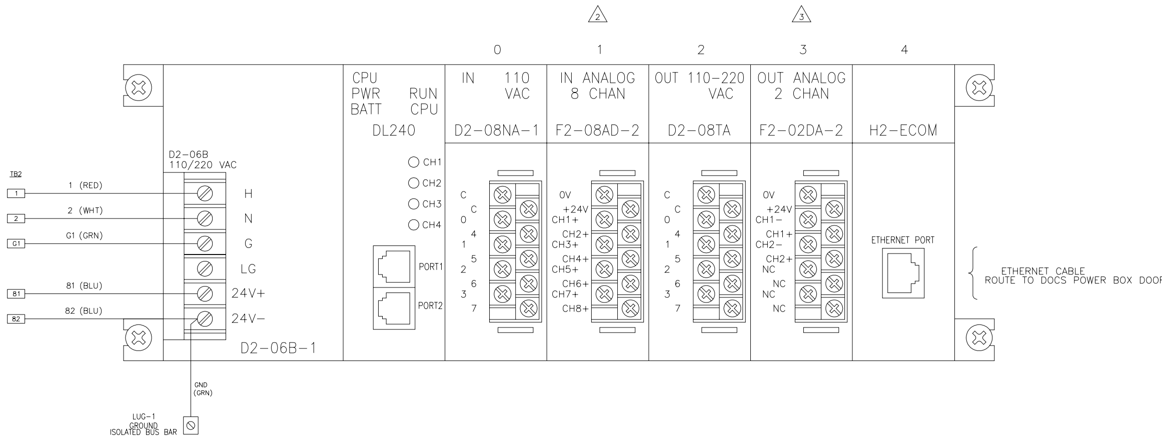


Figure 1-20,
2 of 3
Main Electrical Control Box Schematic P/N 793090-001



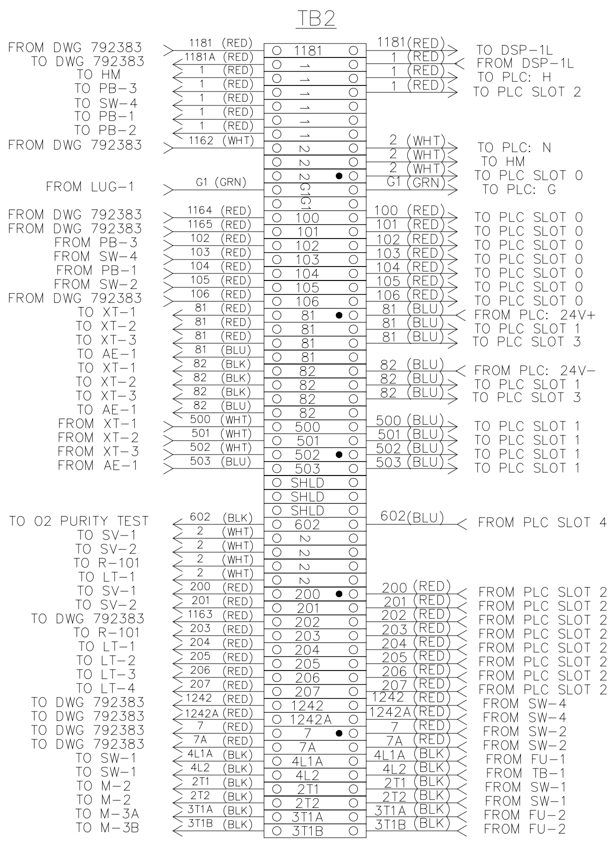


Figure 1-20,
3 of 3
Main Electrical Control Box Schematic P/N 793090-001

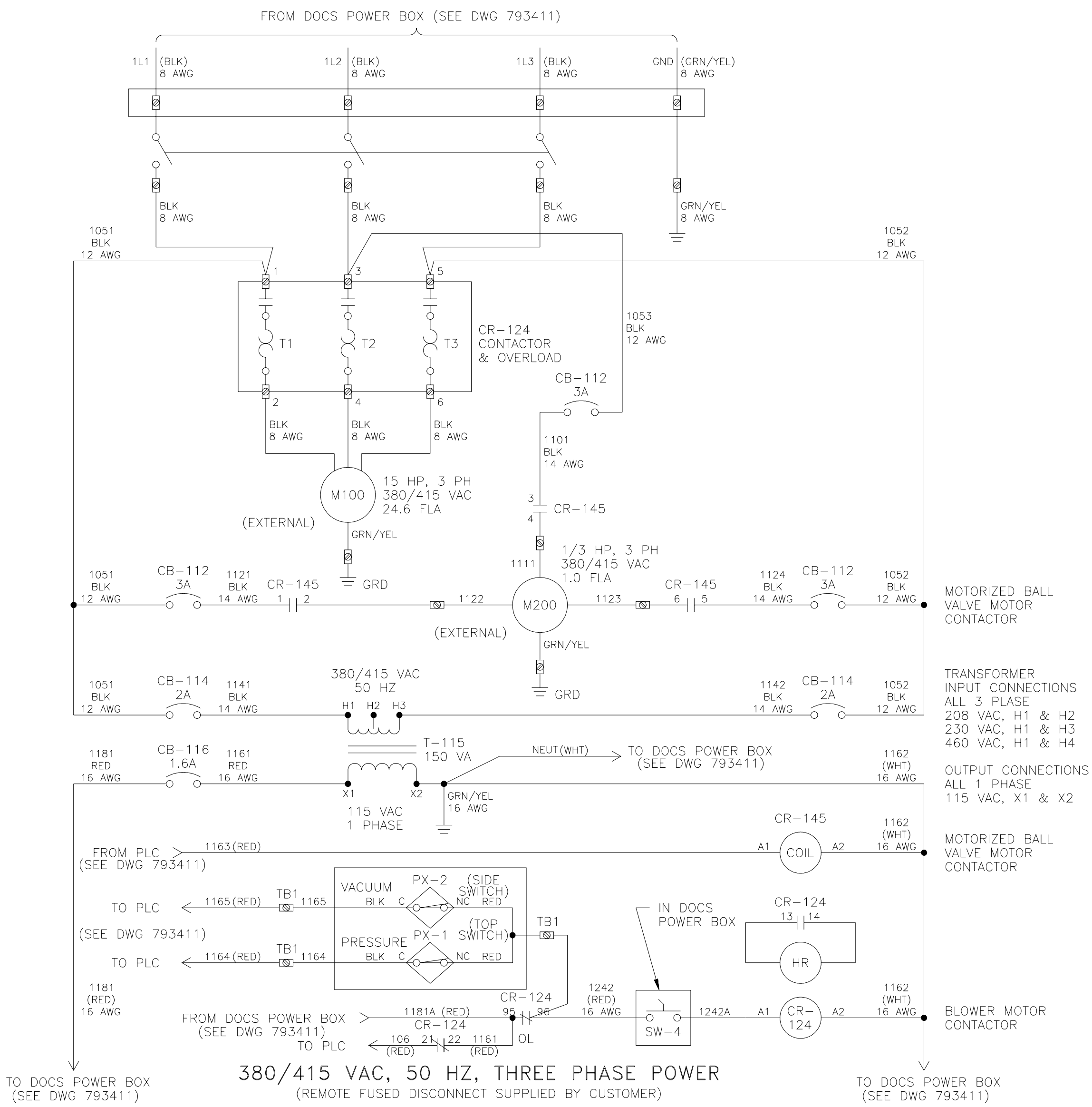


Figure 1-21,
VSA Electrical Schematic P/N 793090-001

SECTION II

2 FUNCTIONAL DESCRIPTION

2-1 GENERAL

The following paragraphs describe the modules and the function of the modules and sub-assemblies that form the **EXPIDITIONARY DEPLOYABLE OXYGEN CONCENTRATION SYSTEM (EDOCS)**. Individual functional components are discussed in the approximate order of operation.

2-2 VSA OPERATION DESCRIPTION

The patented S3 (Single blower, Single valve, Single bed) VSA operation is simple and very robust. The start of a cycle begins with the blower pushing air into the adsorber C-300. The molecular sieve material in the adsorber selectively adsorbs nitrogen while allowing oxygen and argon to pass through the bed. When the pressure in the adsorber becomes greater than the pressure in the buffer tank, oxygen will flow into the buffer tank through a check valve until the feed timer switches off. This switch change causes the valve V-1 to rotate 90 degrees connecting the blower inlet to the adsorber.

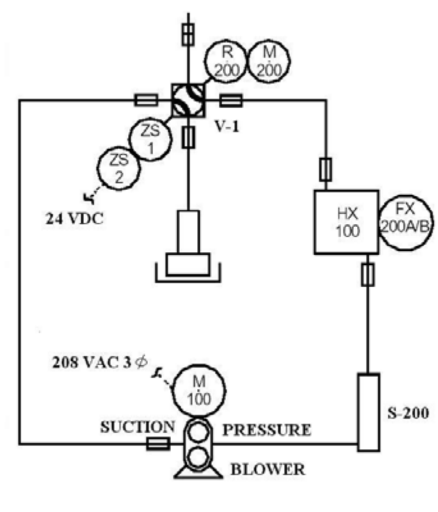


Figure 2-1
VSA Simple Design

As vacuum is pulled on the adsorber, adsorbed water, other containments, and nitrogen are desorbed and exhausted. This deep vacuum step is the key design feature in the generator.

By pulling a vacuum the adsorbent is cleaned each cycle, which allows operation in environments that would damage a PSA adsorbent bed. When the vacuum in the adsorber is low enough, CV-2 opens to purge any remaining nitrogen from the bed. This purge continues until the feed timer switches on, causing the valve to rotate 90 degrees and beginning the cycle again.

There are only two things that can be field adjusted to modify the performance of an S3 VSA.

The first adjustment is the product flow rate controlled by the patient demand. Too much product flow will result in more air feed then the adsorber bed can handle. The adsorber bed can only adsorb a certain amount of nitrogen and any additional nitrogen will pass through the bed causing the product oxygen concentration to drop. Valve FCV-1 should be adjusted such that the average of the high and low flows is equal to the design capacity.

The second adjustment is the amount of product that is used for purging the adsorber bed, controlled by SV-1. If this valve is opened too long there will be an excessive amount of purge that can have the same effect as taking too much product. If this valve is opened too little, not all of the nitrogen will be purged from the adsorber and this nitrogen will end up in the product. This valve is factory set when the unit is tested and normally it will not require adjustment.

2-3 ADSORBER BED (C-300)

Figure 2-2
Adsorber Bed C-300

The Adsorber Bed C-300 is a vertically mounted chamber filled with molecular sieve material. As air enters the chamber on the positive pressure cycle, the molecular

sieve material in the adsorber selectively adsorbs nitrogen, water vapor, and CO_2 while allowing oxygen and argon to pass through the bed.
The nitrogen that is collected during the positive pressure cycle is exhausted out to atmosphere during the vacuum pressure cycle (Purge) to prepare the bed for the next pressure cycle. The molecular sieve material inside Adsorber Bed C-300 should last for the life of the unit.

2-4 BUFFER STORAGE TANKS B1 AND B2 (C-400)

The BUFFER STORAGE TANKS are chambers filled with molecular sieve material as in the Absorber Bed C-300. This provides storage for the concentrated oxygen that will be used for both the purge gas on the vacuum cycle through B1 tank and for the oxygen gas through B2 tank to the patient.

Figure 2-3
Buffer Storage Tanks (B1 & B2)

Figure 2-4
Buffer Storage Tanks(C-400)

2-5 (C-1) SCROLL COMPRESSOR

The compressor element consists of a fixed scroll-shaped housing and a scroll-shaped rotor. Oxygen enters the compressor element through inlet opening (1). Once the oxygen is drawn in, the orbiting scroll (4) seals the inlet opening and forces the oxygen into a continuously decreasing space. As the scroll (4) keeps orbiting, this process of compression is constantly repeated; resulting in the discharging of oil-free compressed oxygen through outlet opening (3).

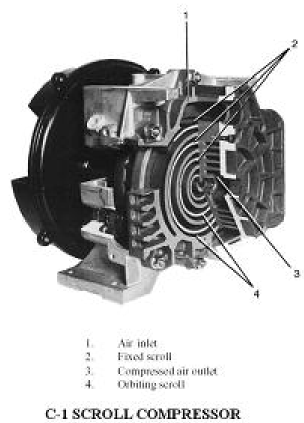


Figure 2-5
Scroll Compressor (C-1)

2-6 OXYGEN STORAGE TANK (C-500)

The Oxygen Storage Tank C-500 is a vertical 12-gallon storage tank that receives the 100 psig compressed oxygen from the C-1 Scroll Compressor.

Figure 2-6
OXYGEN STORAGE TANK C-500

2-7 PROGRAMMABLE LOGIC CONTROLLER (PLC)

The programmable logic controller is a ladder logic device that has a program written to an electronically erasable programmable read only memory chip (EEPROM). It consists of a power supply base, a central processing unit (CPU), an AC volts input module, an AC volts output module, an analog input module, and an analog output module. Each module is plugged into the power supply base and can be removed without disconnecting any wires or using any tools.

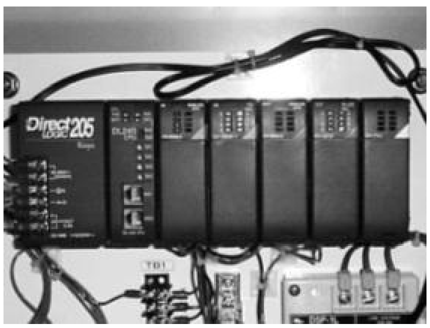


Figure 2-7
PROGRAMMABLE LOGIC CONTROLLER (PLC)

The CPU contains the EEPROM with the program and controls all of the actions of the plug-in modules. The AC volts input module monitors the state of the inputs (whether switches are on or off), which allows the PLC to take action according to the program instructions.

The AC volts module provides voltage to components as directed by the PLC program. The analog input module receives a voltage signal from the oxygen sensor and converts it to a digital signal for the PLC program to manipulate. The analog output module receives digital data from the PLC program, converts it to a voltage signal and outputs the voltage signal to the components connected to the analog output module.

2-8 OXYGEN ANALYZER

Figure 2-8
OXYGEN ANALYZER

The oxygen sensor measures the percentage of oxygen in the sample and outputs the value as a voltage to the PLC analog input module (the voltage is exactly proportional to the percent of oxygen in the sample. This value is sent to test connector on the control box through one channel of the PLC analog output module. The PLC also compares the oxygen content in the sample to the required oxygen content of USP (93% ± 3%) and sends varying voltage to the C1 Scroll Compressor variable speed drive through one channel of the PLC analog output module. It also uses the purity to determine if the valve (SV-2) should be open to allow the required oxygen gas to flow to the patient or be vented to the atmosphere through valve (FCV-1).

2-9 (C-2) BOOSTER COMPRESSOR

Figure 2-9
C-2 BOOSTER COMPRESSOR

The compressor is an air cooled reciprocating, oil-less, two cylinder, two stage, single-acting, opposed design. The two compression cylinders consist of a 1st stage piston of 1-1/4" diameter, and a 2nd stage 1/2" with a 2" piston stroke. The 1st stage piston assembly is the heart of the compressor. The piston assembly has the 1st stage on the bottom end and the 2nd stage on the top.

The pistons for these cylinders use rings of glass & MoS_2 filled Poly-tetrafluoroethylene (TFE or Teflon plastic), which gives a good seal and is self-lubricating. Linear motion is imparted to the piston assembly from the rotary crankshaft by means of a connecting rod attached to the piston, which alternately compresses in its respective cylinder. The 1st stage rider rings guide one end of the assembly while the 1-3/4" diameter rider ring on the 2nd stage end guides the other. The main bearings and connecting rod bearings are all sealed, grease packed for life, and serf-lubricating. The compressor valves are stainless steel reed type, normally closed and pressure-activated open.

2-10 (P-1) CYLINDER VACUUM PUMP

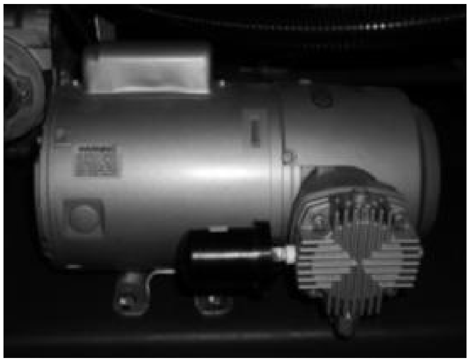


Figure 2-10
(P-1) CYLINDER VACUUM PUMP

CONSUMABLE MATERIAL

Table (2-1) lists the consumable items that are necessary for maintaining the continuous operation of the Expeditionary Deployable Oxygen Concentration System. Included in the list are lubricating oils, greases, solvents, and sealants.

PART NO	DESCRIPTION	USA Model	USAF Model	UK Model	QTY REQ	USAGE
W49100-011	Gear Oil, Synthetic	X	X	X	1 Quart	Blower
W46040-777	Grease, Synthetic	X	X	X	I Tube	Blower
582321-001	V-Belt, Super HC			X	3	VSA Blower
582321-002	V-Belt, Super HC	X	X		3	VSA Blower
582184-001	Belt 1 Band	X	X	X	2	Scroll Comp.
582250-001	Seal Kit, SF-1	X	X	X	2	Scroll Comp.
580863-005	Element, Filter- Dynacell	X	X	X	2	Inlet/Discharge
582327-001	Belt, Micro-V	X	X	X	2	High Pressure Comp.
582380-001	Grease, Oxygen Comp.	X	X	X	2 Ounces	High Pressure Comp.
580886-004	Fuse, 10 Amp	X	X	X	7	Main Electrical Box
582381-001	Filter, Interstage	X	X	X	1	High Pressure Comp.
792253-001	Filter, Particulate (F-3)	X	X	X	2	Scroll Comp. Suction
214290-001	Molybedenum Disulfide Grease per MIL-G-21164	X	X	X	As Required	Thread Lubricant
W14420-050	Teflon Tape	X	X	X	As Required	Pipe Threads

Table 2-1
Consumable Material

TIME CHANGE COMPONENTS
Table (2-2) lists the components in the EDOCS-120 that require changing on a set time intervals.

PART NO	DESCRIPTION	REPLACEMENT PERIOD	QUANTITY	USAGE
W49100-011	Gear Oil, Synthetic	First 100 Hours/ Every 1000 Hours	New Grease	Blower
W46040-777	Grease, Synthetic	250 Hours (10 Days)	6.8 Oz (200ml)	Blower Bearings
582321-001	V-Belt, 50 Hz	1 year or as Required	3	VSA Blower
582321-002	V-Belt, 60 Hz	1 year or as Required	3	VSA Blower
582184-001	V-Belt	1 year or as Required	1	Scroll Compressor
582327-001	V-belt	1 year or as Required	1	Booster Compressor
581889-003	Air Filter	1000 Hours	2	VSA Inlet Filter Element
582381-001	Filter, Intergrated	2000 Hours	1	Booster Compressor
792253-001	Scroll Suction Filter	1000 Hours	2	Scroll Compressor
582204-002	After Filter Element	1000 Hours		Oxygen Gas Product
582250-001	Seal Kit	1000 Hours	2	Scroll Compressor

Table 2-2
Time Change Components

END OF SECTION II – INTENTIONALLY LEFT BLANK

SECTION III

3 EQUIPMENT SETUP

3-1 SELECTING AND PREPARING THE SITE

When selecting the site to locate the EDOCS system, the operator and maintainer must ensure the following.

a. The area must be free of trash and debris that may cause a fire hazard or trip hazard.
b. No open flames or smoking within 50 feet of the equipment.
c. The area should be protected and free access limited to authorized personnel only.
d. The equipment should be located away from motor pools, fuel farms, and other similar hydrocarbon emitting areas.
e. The area should have sufficient space around the equipment to provide access for operation and maintenance tasks.
f. The unit should be shaded if high temperatures are expected, this should not reduce the air circulation around the unit.

3-2 SETTING UP EQUIPMENT OUTSIDE THE HOSPITAL

The equipment should be placed outside the hospital in an area closest to the expected hi demand requirement. This will ensure that the line pressure is maintained at the maximum pressure and minimize any pressure drops.

Place the diesel-powered generator used to power the EDOCS unit at least 25 feet away from the unit. Use disconnects and cabling rated at or above 208 V AC, 3-phase, 60-amp power, regardless of the power source used. The power cord itself must be no smaller than A WG 8, include 4 wires plus a ground, and have a 5-pin electrical connector (MS90557MIL-C-22992, Class L).

Ground the unit to the nearest electrical ground with no smaller than A WG 12 stranded or solid copper insulated (green insulation color) electrical wire. Verify the ground connection using an ohmmeter.

WARNING: Never activate the main power disconnect handle before connecting the electrical plug on the EDOCS unit to the source power and ground. Doing so can cause arcing at the electrical outlet as the connection is being made, possibly resulting in ignition.

3-3 POSITIONING THE EDOCS 120

Position the EDOCS unit no more than 15 feet from the hospital ward using a forklift, helicopter, or crane. Allow sufficient space between the units for the HOBS manifold and cylinders and to allow access to all associated lines and fittings. Ensure that the location of the EDOCS permits truck access within 10 feet.

3-4 PERFORMING A PREOPERATIONAL INSPECTION

Visually inspect the EDOCS for missing parts and any damage that may have occurred during loading, in transit, or during unloading. Prior to setting up the unit for service, inspect the following

1. Inspect for structural damage to the frame assembly, blower, buffer tanks, vacuum pump, tubing, and access doors. Damage includes rust, dents, and cracks.
2. Make sure all valves are operational.
3. Ensure that all valve handles are present and in good working order.
4. Check all gauges to make sure the needles are intact and are at zero.

After the EDOCS unit is connected to a power supply

1. Test the blower by turning it ON and then OFF.
2. Turn the vacuum pump ON and then OFF, listening for the sound of the working pump and for any unusual noises.

END OF SECTION III – INTENTIONALLY LEFT BLANK

SECTION IV

4 OPERATION

4-1 PRE-START CHECKS

This chapter details the procedures for the normal use of the EDOCS system, and evacuating and recharging cylinders. Before performing any of the following procedures, be sure to perform the Preoperational inspections detailed in Chapter 3.

4-2 EDOCS 120 START-UP PROCEDURE

1. Plug in the power cable.

   a. Turn "On" main power circuit breaker CB-1. Check the phase reversal light to ensure proper voltage phase is connected. If the phase light is illuminated, turn power off and switch any two main power leads on the line side of the circuit breaker.
   b. Turn "On" VSA start switch SW-3. The VSA absorber gauge (PI-8) should start-up in vacuum mode.

2. VSA Operation

   a. The feed pressure should reach at least 7 to 9 psig on gauge PI-8.
   b. The vacuum pressure should reach 12-16" Hg on gauge PI-8.
   c. The Scroll Compressor will start automatically after 5 cycles of the VSA. The discharge pressure will rise in the product receiver tank after approximately 10 minutes. When the pressure at PI-4 gauge reaches 80-psi minimum, the oxygen product is ready to be delivered to the hospital via the distribution lines.
   d. Monitor VSA purity via the test purity points on the front of the electrical box. Allow VSA to reach 90% purity. Once the purity has risen above the minimum purity, the SV-2 solenoid will de-energize and allow gas to flow to the patient.

3. Vacuum Compressor Operation

The EDOCS on-board vacuum compressor is utilized to pull a vacuum on the H, M, D, and E size cylinders prior to filling the cylinders with oxygen gas product.

   a. the lines to the cylinders requiring a vacuum pulled prior to filling the cylinder with high-pressure oxygen gas.
   b. Turn "On" the Vacuum Compressor switch SW-1.
   c. Evacuate cylinders to -25" HG as read on the EDOCS cylinder fill station vacuum gauge.

4. Booster Compressor Operation

The EDOCS on-board Booster Compressor is utilized to replenish (fill) the H, M, D, and E size cylinders with 93 ±3% oxygen gas product.

NOTE: The Booster Compressor will start automatically when the "M" size cylinder pressure drops below 1800-psi. The cylinder pressure can be monitored on gauge PI-9 on the front side of the unit. The Booster Compressor will stop when the pressure reaches 2200-psi.

   a. Verify the Booster Compressor "Hand/Off/Auto" switch is in the "AUTO" position before operating.
   b. Turn the Booster Compressor "On/Off' switch (SW-2) *to* the "ON" position.
   c. Open valve V-3 and allow 60 lpm of suction gas to the Booster Compressor. The compressor will start automatic.
   d. Open valve V-4 on the back of the charging station to fill the on board M size cylinders.
   e. Once the cylinders are fully charged, the Booster Compressor will turn off automatically and wait on standby until required in the future.

5. Shut Down Procedure

   a. Close the V-4 valve.
   b. Close the V-3 valve.
   c. Turn "off" SW-2 if no further gas pumping is required.

NOTE: The entire unit can be stopped by turning the "Main Power" lever (CB 1) *to* the "Off' position. This will remove voltage from the VSA and thus shutting down the unit.

   d. Turn CB 1 *to* the "Off' position.

e. Remove the voltage supply (turn off) *to* the EDOCS from the generator or electrical distribution panel.
f. Disconnect the power cable connected *to* the EDOCS.

4-3 SUPPLYING LOW-PRESSURE OXYGEN TO THE HOSPITAL

The Expeditionary Deployable Oxygen Concentration System (EDOCS) is an interface and backup device for supplying oxygen *to* the hospital or surgical suite. Two low-pressure oxygen inputs are provided on the EDOCS to allow pass-through oxygen flow *to* the hospital. The oxygen delivery pressure is set by adjusting pressure regulator (PRV-I) *to* 85-psi. If the oxygen pressure drops below 85-psi, then the back-up system regulator (PRV-3) will engage at 80-psi and provide the oxygen flow *to* the hospital automatically.

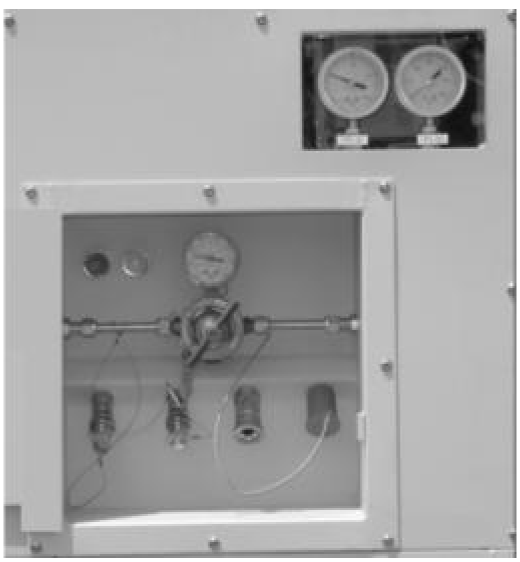


Figure 4-1
P/N 792641-001
EDOCS, Oxygen Distribution Box

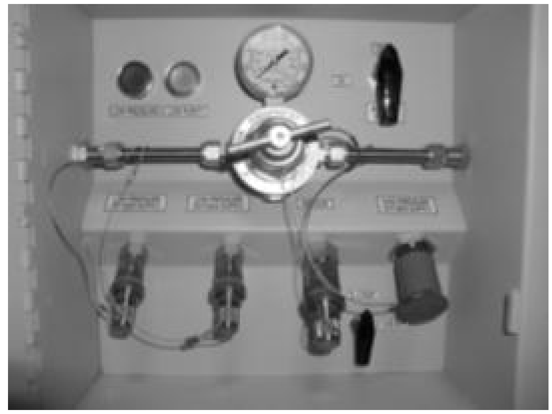


Figure 4-2
P/N 792641-001
EDOCS, Oxygen Distribution Box

4-4 EVACUATING HIGH-PRESSURE "H", "D" AND "E" SIZE CYLINDERS USING THE EDOCS **(Original Unit) P/N 792641-001**

CAUTION: Never subject the vacuum pump to positive pressure. Always vent the cylinders to the atmosphere before connecting them to the vacuum pump.

CAUTION: Prior to evacuating any cylinder, ensure that the cylinder to be serviced in still within hydrostatic test date. Cylinders that are out of serviceable condition must be removed from service and retested.

To evacuate the cylinders:

1. Vent to atmosphere all cylinders to be evacuated by slowly opening the vent valve V -5 on the cylinder fill station. If evacuating "D" & “E” cylinders, open valves V-7, V-8, V-9, V-l0, V-11, V-12, V-13, V-14 and the individual "D" & “E” cylinder valves as well.
2. After 0 psi is indicated on pressure gauge PI-11 manifold pressure gauge (and if evacuating "D" cylinders PI-12), close the vent valve (V-5).
3. Start the EDOCS vacuum pump. Open the vacuum valve V -6 and evacuate all cylinders connected until the vacuum pressure gauge PI-13 reaches a minimum of 25 inches Hg. Hold the vacuum for 15 minutes to ensure proper evacuation.
4. Close vacuum valve V-6.

WARNING: Never open vacuum valve V-6 when the pressure in any cylinder is above 15-psi. If the cylinders exceed 15-psi, an over pressurization to the vacuum circuit will occur and personnel and equipment damage will result!

4-5 RECHARGING HIGH-PRESSURE "H", "M" AND "D" SIZE CYLINDERS USING THE EDOCS **P/N 792641-001**

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: If any of the cylinders to be charged are completely empty, or are suspected to contain anything other than oxygen gas, they should be evacuated using the vacuum pump unit prior to recharging.

CAUTION: Make sure the EDOCS unit is properly grounded. Plug the power cord into a compatible power source (See *Selecting and preparing the site,* Chapter 3.)

1. Verify that the cylinders to be recharged have been properly prepared i.e. have proper positive pressure inside of cylinders or have been evacuated and have been connected properly.
2. Turn Booster Compressor "On/Off"" switch SW-5 to "On". The Booster Compressor will start automatically and start filling the cylinders connected.
3. Open EDOCS cylinder recharging valve V-4.
4. Monitor the pressure increase in the cylinders on either pressure gauges PI-9, PI-11 and PI-12 depending on the type of cylinder that is being filled.
5. The Booster Compressor will stop automatically when the discharge pressure reaches 2200-psi.

NOTE: The "M" cylinders are now filled to the rated pressure and can be used for over draw back-up, trans filling "D" or "E" cylinders.

6. Leave recharging valve V-4 open throughout the entire EDOCS operation unless the cylinders or manifold requires maintenance or evacuation.

4-6 TRANSFILLING HIGH-PRESSURE "D" AND “E” CYLINDERS USING THE EDOCS **P/N 792641-001**

NOTE: Prior to the trans filling operation being performed, the operator must ensure that the cylinder to be transfilled still has positive pressure remaining in the cylinder.

1. Place the "D" or "E" size cylinder in the charging tubes on the EDOCS.
2. Connect the charging lines to each of the cylinders to be transfilled.
3. Open the cylinder valve on the cylinders to be transfilled.
4. Open slowly the manifold valves V-11, V-12, V-13 and V-14 that are connected to cylinders.
5. Slowly open the transfill manifold valves V-7, V-8, V-9 and V-l0 that are connected to cylinders.
6. Monitor the cylinder pressure increase on pressure gauge PI-12. When the pressure has equalized from the "M" size cylinder manifold the Transfilling operation is complete.

NOTE: The individual cylinder pressure can be verified by isolating each cylinder and opening only one cylinder at a time.

7. Close all valves that are connected to the transfilling station. Disconnect the cylinders and stow the charging lines in the charging tubes.

4-7 EVACUATING HIGH-PRESSURE "H", "D" AND "E" SIZE CYLINDERS USING THE EDOCS **P/N 793035-001**

CAUTION: Never subject the vacuum pump to positive pressure. Always vent the cylinders to the atmosphere before connecting them to the vacuum pump.

CAUTION: Prior to evacuating any cylinder, ensure that the cylinder to be serviced in still within hydrostatic test date. Cylinders that are out of serviceable condition must be removed from service and retested.

To evacuate the cylinders:

1. Vent to atmosphere all cylinders to be evacuated by slowly opening the vent valve V -5 on the cylinder fill station. If evacuating "D" cylinders, open valves V-7, V-8, V-9 and V-l0 and the individual "D" cylinder valves as well.
2. After 0 psi is indicated on pressure gauge **PI-II** manifold pressure gauge (and if evacuating "D" cylinders PI-12), close the vent valve (V-5).
3. Start the EDOCS vacuum pump. Open the vacuum valve V -6 and evacuate all cylinders connected until the vacuum pressure gauge PI-13 reaches 27 in. Hg. Hold the vacuum for 15 minutes to ensure proper evacuation.
4. Close vacuum valve V-6.

WARNING: Never open vacuum valve V-6 when the pressure in any cylinder is above 15-psi. If the cylinders exceed 15-psi, an over pressurization to the vacuum circuit will occur and personnel and equipment damage will result!

4-8 RECHARGING HIGH-PRESSURE "H", "M" AND "D" SIZE CYLINDERS USING THE EDOCS **P/N 793035-001**

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: If any of the cylinders to be charged are completely empty, or are suspected to contain anything other than oxygen gas, they should be evacuated using the vacuum pump unit prior to recharging.

CAUTION: Make sure the EDOCS unit is properly grounded. Plug the power cord into a compatible power source (See *Selecting and preparing the site,* Chapter 3.)

1. Verify that the cylinders to be recharged have been properly prepared i.e. have proper positive pressure inside of cylinders or have been evacuated and have been connected properly.
2. Turn Booster Compressor "On/Off' switch SW-5 to "On". The Booster Compressor will stm1 automatically and stmt filling the cylinders connected.
3. Open EDOCS cylinder recharging valve V-4.
4. Monitor the pressure increase in the cylinders on either pressure gauges PI-9, PI-11 and PI-12 depending on the type of cylinder that is being filled.
5. The Booster Compressor will stop automatically when the discharge pressure reaches 2200-psi.

NOTE: The "M" cylinders are now filled to the rated pressure and can be used for over draw back-up, trans filling "D" or "E" cylinders.

6. Leave recharging valve V-4 open throughout the entire EDOCS operation unless the cylinders or manifold requires maintenance or evacuation.

4-9 TRANSFILLING HIGH-PRESSURE "D" AND "E" CYLINDERS USING THE EDOCS **P/N 793035-001**

NOTE: Prior to the trans filling operation being performed, the operator must ensure that the cylinder to be transfilled still has positive pressure remaining in the cylinder.

1. Place the "D" or "E" size cylinder in the charging tubes on the EDOCS.
2. Connect the charging lines to each of the

cylinders to be transfilled.

3. Open the cylinder valve on the cylinders to be transfilled.
4. Open slowly the manifold valves V-11, V-12, V-13 and V-14 that are connected to cylinders.
5. Slowly open the transfill manifold valves V-7, V-8, V-9 and V-l0 that are connected to cylinders.
6. Monitor the cylinder pressure increase on pressure gauge PI-12. When the pressure has equalized from the "M" size cylinder manifold the Transfilling operation is complete.

NOTE: The individual cylinder pressure can be verified by isolating each cylinder and opening only one cylinder at a time.

7. Close all valves that are connected to the transfilling station. Disconnect the cylinders and stow the charging lines in the charging tubes.

4-10 EVACUATING HIGH-PRESSURE "H", "D" AND "E" SIZE CYLINDERS USING THE EDOCS **P/N 793090-001**

CAUTION: Never subject the vacuum pump to positive pressure. Always vent the cylinders to the atmosphere before connecting them to the vacuum pump.

CAUTION: Prior to evacuating any cylinder, ensure that the cylinder to be serviced in still within hydrostatic test date. Cylinders that are out of serviceable condition must be removed from service and retested.

To evacuate the cylinders:

1. Vent to atmosphere all cylinders to be evacuated by slowly opening the vent valve V -5 on the cylinder fill station. If evacuating "D" cylinders, open valves V-7, V-8, V-9 and V-l0 and the individual "D" cylinder valves as well.
2. After 0 psi is indicated on pressure gauge **PI-II** manifold pressure gauge (and if evacuating "D" cylinders PI-12), close the vent valve (V-5).
3. Start the EDOCS vacuum pump. Open the vacuum valve V -6 and evacuate all cylinders connected until the vacuum pressure gauge PI-13 reaches 27 in. Hg. Hold the vacuum for 15 minutes to ensure proper evacuation.
4. Close vacuum valve V-6.

WARNING: Never open vacuum valve V-6 when the pressure in any cylinder is above 15-psi. If the cylinders exceed 15-psi, an over pressurization to the vacuum circuit will occur and personnel and equipment damage will result!

4-11 RECHARGING HIGH-PRESSURE "H", "M" AND "D" SIZE CYLINDERS USING THE EDOCS **P/N 793090-001**

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: If any of the cylinders to be charged are completely empty, or are suspected to contain anything other than oxygen gas, they should be evacuated using the vacuum pump unit prior to recharging.

CAUTION: Make sure the EDOCS unit is properly grounded. Plug the power cord into a compatible power source (See *Selecting and preparing the site,* Chapter 3.)

1. Verify that the cylinders to be recharged have been properly prepared i.e. have proper positive pressure inside of cylinders or have been evacuated and have been connected properly.
2. Turn Booster Compressor "On/Off' switch SW-5 to "On". The Booster Compressor will stm1 automatically and stmt filling the cylinders connected.
3. Open EDOCS cylinder recharging valve V-4.
4. Monitor the pressure increase in the cylinders on either pressure gauges PI-9, PI-11 and PI-12 depending on the type of cylinder that is being filled.
5. The Booster Compressor will stop automatically when the discharge pressure reaches 2200-psi.

NOTE: The "M" cylinders are now filled to the rated pressure and can be used for over draw back-up, trans filling "D" or "E" cylinders.

6. Leave recharging valve V-4 open throughout the entire EDOCS operation unless the cylinders or manifold requires maintenance or evacuation.

4-12 TRANSFILLING HIGH-PRESSURE "D" AND "E" CYLINDERS USING THE EDOCS **P/N 793090-001**

NOTE: Prior to the trans filling operation being performed, the operator must ensure that the cylinder to be transfilled still has positive pressure remaining in the cylinder.

1. Place the "D" or "E" size cylinder in the charging tubes on the EDOCS.
2. Connect the charging lines to each of the cylinders to be transfilled.
3. Open the cylinder valve on the cylinders to be transfilled.
4. Open slowly the manifold valves V-11, V-12, V-13 and V-14 that are connected to cylinders.
5. Slowly open the transfill manifold valves V-7, V-8, V-9 and V-l0 that are connected to cylinders.
6. Monitor the cylinder pressure increase on pressure gauge PI-12. When the pressure has equalized from the "M" size cylinder manifold the Transfilling operation is complete.

NOTE: The individual cylinder pressure can be verified by isolating each cylinder and opening only one cylinder at a time.

7. Close all valves that are connected to the transfilling station. Disconnect the cylinders and stow the charging lines in the charging tubes.

4-13 EVACUATING HIGH-PRESSURE "H", "D" AND "E" SIZE CYLINDERS USING THE EDOCS **P/N 793295-001**

CAUTION: Never subject the vacuum pump to positive pressure. Always vent the cylinders to the atmosphere before connecting them to the vacuum pump.

CAUTION: Prior to evacuating any cylinder, ensure that the cylinder to be serviced in still within hydrostatic test date. Cylinders that are out of serviceable condition must be removed from service and retested.

To evacuate the cylinders:

1. Vent to atmosphere all cylinders to be evacuated by slowly opening the vent valve V -5 on the cylinder fill station. If evacuating "D" cylinders, open valves V-7, V-8, V-9 and V-l0 and the individual "D" cylinder valves as well.
2. After 0 psi is indicated on pressure gauge **PI-II** manifold pressure gauge (and if evacuating "D" cylinders PI-12), close the vent valve (V-5).
3. Start the EDOCS vacuum pump. Open the vacuum valve V -6 and evacuate all cylinders connected until the vacuum pressure gauge PI-13 reaches 27 in. Hg. Hold the vacuum for 15 minutes to ensure proper evacuation.
4. Close vacuum valve V-6.

WARNING: Never open vacuum valve V-6 when the pressure in any cylinder is above 15-psi. If the cylinders exceed 15-psi, an over pressurization to the vacuum circuit will occur and personnel and equipment damage will result!

4-14 RECHARGING HIGH-PRESSURE "H", "M" AND "D" SIZE CYLINDERS USING THE EDOCS **P/N 793295-001**

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: Serious or fatal injury may occur if cylinders are over pressurized. Determine the rating of all cylinders being charged before commencing charging operations.

WARNING: If any of the cylinders to be charged are completely empty, or are suspected to contain anything other than oxygen gas, they should be evacuated using the vacuum pump unit prior to recharging.

CAUTION: Make sure the EDOCS unit is properly grounded. Plug the power cord into a compatible power source (See *Selecting and preparing the site,* Chapter 3.)

1. Verify that the cylinders to be recharged have been properly prepared i.e. have proper positive pressure inside of cylinders or have been evacuated and have been connected properly.
2. Turn Booster Compressor "On/Off' switch SW-5 to "On". The Booster Compressor will stm1 automatically and stmt filling the cylinders connected.
3. Open EDOCS cylinder recharging valve V-4.
4. Monitor the pressure increase in the cylinders on either pressure gauges PI-9, PI-11 and PI-12 depending on the type of cylinder that is being filled.
5. The Booster Compressor will stop automatically when the discharge pressure reaches 2200-psi.

NOTE: The "M" cylinders are now filled to the rated pressure and can be used for over draw back-up, trans filling "D" or "E" cylinders.

6. Leave recharging valve V-4 open throughout the entire EDOCS operation unless the cylinders or manifold requires maintenance or evacuation.

4-15 TRANSFILLING HIGH-PRESSURE "D" AND “E” CYLINDERS USING THE EDOCS **P/N 793295-001**

NOTE: Prior to the trans filling operation being performed, the operator must ensure that the cylinder to be transfilled still has positive pressure remaining in the cylinder.

1. Place the "D" or "E" size cylinder in the charging tubes on the EDOCS.
2. Connect the charging lines to each of the cylinders to be transfilled.
3. Open the cylinder valve on the cylinders to be transfilled.
4. Open slowly the manifold valves V-11, V-12, V-13 and V-14 that are connected to cylinders.
5. Slowly open the transfill manifold valves V-7, V-8, V-9 and V-l0 that are connected to cylinders.
6. Monitor the cylinder pressure increase on pressure gauge PI-12. When the pressure has equalized from the "M" size cylinder manifold the Transfilling operation is complete.

NOTE: The individual cylinder pressure can be verified by isolating each cylinder and opening only one cylinder at a time.

7. Close all valves that are connected to the transfilling station. Disconnect the cylinders and stow the charging lines in the charging tubes.

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SECTION V

5 EQUIPMENT BREAKDOWN FOR TRANSPORT

This chapter details the procedures necessary to disassemble the EDOCS system at a deployed site for transport and subsequent redeployment in the near term.

5-1 EDOCS 120

1. Turn "Off' the main power circuit breaker.
2. Turn "Off' the main power supply to the EDOCS.
3. Carefully disconnect the low-pressure hose from the EDOCS unit at the QC-1 or QC-2 connection on the front panel of the EDOCS unit. Coil the hose neatly and place the hose inside the respective PODS box.
4. Disconnect the electric power cable from the EDOCS and the power supply source. Neatly coil the cable and stow in proper place.

5-2 HOBS (Optional)

1. Disconnect the stainless-steel braided hoses at the QC-3 connection on the EDOCS. Coil neatly, and return the hose to the PODS and/or SSODS cases.
2. Close all individual cylinder valves.
3. Disconnect the yokes from the "D" cylinders and replace the protective caps over the ends of the lines.
4. Remove the "D" cylinders from the rack.
5. Lift the rack off of the rear of the unit and set aside.
6. Close the individual "H" cylinder valves V-3A through V -3H.
7. Disconnect the individual CGA540 connectors from the "H" cylinders and place protective caps over the ends of the connectors.

WARNING: Be careful not to drop cylinders or let them hit against one another or any other objects. Do not place cylinders in a position where they may roll or be accidentally knocked over.

8. Remove securing chains one at a time and remove the "H" cylinders, and place them in a safe location.
9. Remove the retaining pins, remove the center crossbar from the legs, and set it aside.
10. Remove the retaining pins, remove the crossbars from each leg assembly, and set them aside.
11. With an assistant holding up one side of the frame, remove the retaining pins, remove the leg assemblies from that side, and set them aside.
12. Lower the frame to the ground, remove the retaining pins on the other side, and remove the other leg assemblies.
13. Place the HOBS manifold and all frame parts in the transport crate and secure them with the hold-down pins removed during assembly.

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SECTION VI

6 MAINTENANCE AND REPAIR

This chapter details maintenance and repair procedures for the EDOCS, the (optional) Hospital Oxygen Backup System (HOBS), the Patient Oxygen Delivery System (PODS), and the Surgical Suite Oxygen Delivery System (SSODS).

Before performing any maintenance or repair procedures on any of the equipment in the EDOCS, be sure you have read and understand all the information provided in Chapter I: Safety Information.

The major components of the EDOCS require minimal maintenance in normal use. Maintenance largely consists of thorough inspections of key components at regular intervals. Be sure to perform the inspections indicated when prescribed. If diligently executed, the inspection procedures detailed below will enable field technicians to correct minor problems before they cause equipment downtime or hazardous conditions.

In the event a component becomes inoperative, procedures are provided for repairing and/or replacing all field-serviceable components.

6-1 TOOLS, SUPPLIES, AND TEST EQUIPMENT

WARNING: Do not use common tools on oxygen equipment. Use only designated tools, which be used only for the EDOCS system. Be sure to keep all tools free of debris, dirt, rust, and hydrocarbons. Clean tools after each use.

At a minimum, the following items should be available for performing service on oxygen equipment:

- PCI Tool Box P/N (582144-002) (Supplied With Each Unit)
- PCI Miscellaneous Tools P/N (793417-001)
- Inch-pound torque wrench
- Foot-pound torque wrench
- Latex rubber gloves (for handling small parts on a bench top only)
- Clean, lint-free cleaning cloths
- Soap solution and brush (for testing fittings for leaks only: do not use to clean any part of the oxygen equipment)
- Oakite No. 34 (for cleaning nonmetallic, anodized, or plated pans)
- Oxygen-compatible solvent (for cleaning fittings and other metal parts)
- Low-pressure compressed air or dry nitrogen source (for drying parts after cleaning)

6-2 GENERAL CLEANING INSTRUCTIONS

All parts of the EDOCS system must be kept clean to prevent harmful contamination and equipment corrosion. In addition, organic and inorganic materials such as oils, greases, paper, fiber rags, wood pieces, solvents, weld slag, dirt, and sand can cause a combustion reaction in an oxygen-rich atmosphere and must be removed if present. While cleaning small parts (such as the internal parts of a valve) on a bench top, handle all parts with clean latex rubber gloves. Refer to Compressed Gas Association pamphlet G4.1, Cleaning Equipment for Oxygen Service, for additional information on cleaning equipment, supplies, solvents, procedures, and techniques.

CAUTION: Check all solvents for cleanliness before use. Used solvent may be considered clean if there is no distinct color difference between it and new solvent.

Mechanically clean heavily soiled parts with scrapers or stainless-steel brushes. Brush welds until they are bright. Then perform vapor &greasing or steam cleaning and rinsing with a solvent to clean these pans.

Blow dry all parts after cleaning using clean, dry, oil-free air or dry nitrogen. Do not use shop air for drying parts.

Clean moderate or lightly soiled parts by washing or flushing with a suitable oxygen-compatible solvent.

CAUTION: Rubber, neoprene, and some plastic tubing, including polyvinylchloride (PVC), may have its plasticizer extracted by the solvent and deposited on the surface being cleaned. Do not clean these types of tubing with solvent or use these types of tubing for cleaning oxygen equipment with solvents

Clean plastic, nonmetallic, anodized, or plated parts by immersing them in Oakite No. 34 and rinsing with clean water. To ensure the cleanliness of parts used in oxygen service, all parts not immediately used must be sealed and identified with a caution label that bears the following (or equivalent) notice: "CLEANED FOR OXYGEN SERVICE. DO NOT OPEN UNTIL LINIT IS TO BE INSTALLED." Note the date the unit was cleaned on the label.

Seal small parts or assemblies in two 4-mil or heavier polyethylene bags with the caution label placed inside the second bag with the part. Immediately heat-seal the bag.

Seal larger parts or assemblies by wrapping them in 6-mil or heavier polyethylene sheeting with the caution label taped to the outside. Immediately heat-seal all seams.
For larger assemblies (such as vaporizers, piping assemblies), seal all ports with plastic caps or plugs and attach the caution label where it will be clearly visible.

6-3 EDOCS

Perform the preoperational inspection detailed in Section 3 before first use after the equipment has been taken out of storage, and at least quarterly thereafter.

Perform the preoperational adjustment procedures detailed in Section 4 before first use after the equipment is taken out of storage, whenever a regulator is replaced, or whenever low pressure cannot be obtained. Perform the following inspections and/or procedures as indicated below.

6-4 MAINTAINING VALVES AND FITTINGS

Inspect all valves and fittings for leaks or other malfunctions at least quarterly. If a valve is leaking through the packing, tighten the packing nut to see if the leakage will stop before removing the valve If a valve is suspected to be defective, replacement, rather than repair, is recommended. If a replacement valve is not available, use the following procedure to repair a valve:

1. Release pressure from the EDOCS.
2. Remove the defective valve, and cover the exposed pipe openings on the equipment with plastic caps or clear plastic film to prevent contamination from entering the lines.
3. Remove the valve seat assembly.
4. Disassemble the valve and inspect all parts for corrosion or other damage. Replace all worn, deformed, or damaged parts.

6-5 MAINTAINING GAUGES

Inspect all gauges at least annually to ensure proper operation. Most gauge problems are the result of a leak in the gauge line. Always check for leaks in the gauge line before suspecting a gauge fault. The gauges themselves are not field repairable and must be replaced with a new unit if they are found to be defective.

6-6 ROOTS TYPE BLOWER (B-100)

The blower is a double lobe type. Drive shaft (sheave side) end bearings are grease lubricated using two zirk type fittings with two hydraulic pressure relief fittings. The relief fittings vent any excess grease preventing grease induced seal failure. It is normal to have grease vent from relief fittings during lubrication and during blower startup after lubrication. The timing gear and bearing side is splash lubricated using an oil slinger. Periodic greasing along with lubricating oil change and belt inspection is the extent of maintenance required to maximize blower life. Drive belt inspection, change-out and troubleshooting should be performed per drive belt vendor information found at the end of this section.

NOTE: Observing a liquid oil film around the roots blower base is an indication of oil leakage. If leak source cannot easily be found, increased monitoring of blower oil level will be required until repairs or replacement blower is installed. *A common leak source is the blower oil drain plug not tightened correctly from previous oil change.* Operating blower without oil or grease will lead to total failure of blower.

6-7 BLOWER LUBRICATION

Grease: Any NLGI#2 premium grade grease, high temperature (300□F) petroleum grease.

Oil: Preferred: Roots high temperature synthetic lubricating oil or equivalent. Alternates: Mobil SHC 630, Mobil DTB BB, Texaco R&O 220, Amoco 220 or equivalent.

NOTE: For grease fitting locations, oil capacities & maintenance intervals see literature at the end of this section.

CAUTION: Blower and fan operation is through a thermostat. When power is applied to oxygen generator, the thermostat will start fans automatically. When working on or near fans, the power must be shut off at disconnect.

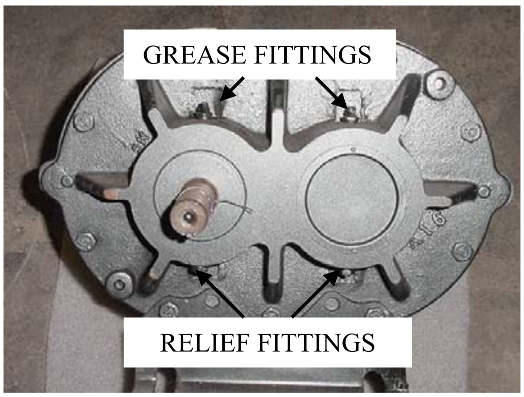

Figure 6-1
Grease Fittings

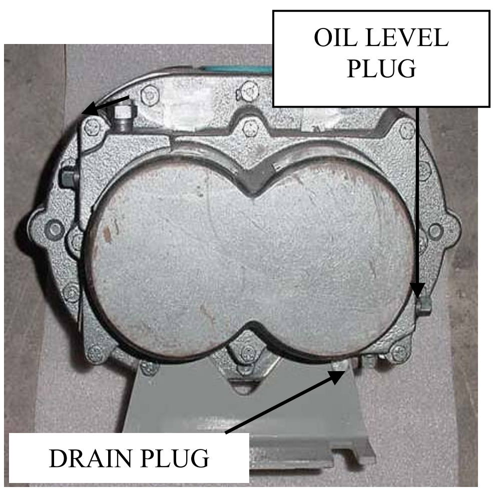

Figure 6-2
Oil Fill & Drain Ports

6-8 MOTORIZED VALVE

Position of V-1 is controlled by the PLC monitoring two cam-following position switches mounted on the gear reducer end opposite valve V-1. Each switch rides on a cam with two cams machined at 180°. The cam sets are machined offset at 90°to each other. When a position switch roller drops into a cam depression, the switch closes creating a PLC input state change. The PLC will then determine length of time at valve position based on an internal setting.

A correct operating valve requires the following:

1. Correct wiring of valve position limit switches and ensuring jumper installed.

2. Secure mounting of limit switches and cam.

3. V-1 valve port switches at 90°intervals (Damaged or bent limit switches will affect operation).

4. Limit switch operation indicates on PLC as switch roller rolls over the cam depression (Input Slot#0 input s#0 & 1 light on PLC).

5. Valve in vacuum position (Input #0 light lit on PLC) at startup or valve moves to light #0 at startup, during testing, before shipment to customer, the above items were checked to ensure proper operation of V-1. Damage during shipment to cams, position switches or wiring may affect valve operation at startup. Position limit switches and cam mounted on gear reducer R-200 opposite valve V-1.

6-9 JOGGING V-3 MOTORIZED VALVE 90°

With the unit power switch in the OFF position, and power supply energized to unit (through disconnect), jog V-1 by opening the VSA Main Electrical Box enclosure and momentarily sliding tab on CR-145 to the left. This will operate valve motor M-200. Let the motor turn valve V-1 until the first of both position switch rollers drops into a cam depression. This should be less than a 90 °jog (Input #0 light lit on PLC).

NOTE: *Limit switch rollers must continue riding flat on cam surface. Twisting or excessive bending of a limit switch arm will not resolve operational problems!*

Slide tab to left to jog V-3

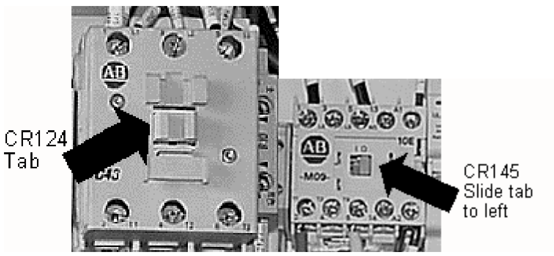

Figure 6-3,
V-3 Contactors

Turn power switch to on position, unit should now startup in evacuation mode. Oxygen generator should be operational. If unit does not startup when power switch is turned to ON position refer to troubleshooting in Section

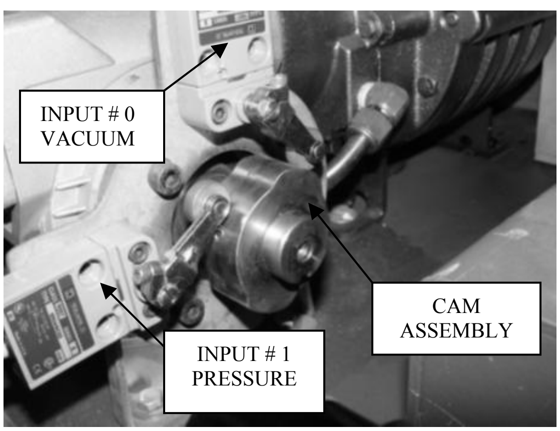

Figure 6-4
Limit Switches & Cam
P/N 792641-001

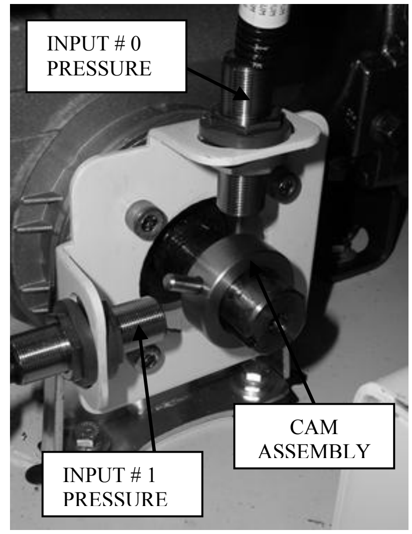

Figure 6-5
Proximity Switches
P/N 793035-001, 793090-001, & 793295-001

6-10 Preventative Maintenance

The following recommended information covers the routine preventative maintenance that will maintain the VSA subsystem of the EDOC-120 (See Table 6-1)

Frequency	Task
Daily	Visual inspection for any unusual noises or vibrations.
250 hours 10 days	**Check blower and valve drive units for any oil leakage.** Any evidence of oil leakage from the blower or valve drive reducer may mean that a seal has failed, in which case, the unit should be repaired or replaced as soon as possible.
	Grease the two-blower end bearing Zirk fittings. For grease, any NLGI#2 premium grade, high temperature (300°F, 115°C) grease. Using a pressure gun, force new grease into each bearing until traces of clean grease come out of the relief fitting.
First 100 hours and every 1000 hours following	**Change blower oil.** High temperature synthetic lubricating oil such as Valvoline Full Synthetic 75W-90; Mobil SHC 630; Mobil DTB BB; Texaco R&O 220; Amoco 220 or equivalent. If the oil appears to have broken down, increase the oil change frequency. Oil capacity of the 4005 blower is **6.8 oz (200 ml).** Always fill the gear housing until oil drips out of the oil level hole. Replace plugs in their respective holes. Following this procedure will ensure proper oil level.
	Inspect belt tension. The proper belt tension will give approximately 1/2 inch of deflection when moderate force is applied to the center of the belts. If either of the belts are worn both belts should be replaced as a set. The belts are model **5Vx530.**
	Inspect inlet filter. (Should not need replacement in normal environment.)
	Inspect valve limit or proximity switches depending on model for mounting tightness. Any movement of the limit or proximity switches will cause the valve to stop in a different position causing leakage from the blower discharge to the blower inlet and loss of performance. If loose, the limit switches will need to be adjusted to ensure that when the valve stops it is aligned with the piping.
First 100 hours and every 1000 hours following	**Check piping to ensure all connections are tight.** **Check for proper valve alignment; Adjusting cam & limit switches for proper valve alignment. Adjusting Proximity limit switches & split ring for proper valve alignment.** (Misalignment of the 4-way ball valve can lead to insufficient pressure and vacuum levels causing poor performance.)
1000 hours	**Change the VSA air filter F-2**. This will ensure proper operation of the VSA
As required during periodic inspections	**Check and Change the VSA drive belts**. This will ensure proper performance and reduce the possibility of belt slippage.

Table 6-1,
VSA Preventative Maintenance

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SECTION VII

7 BOOSTER COMPRESSOR MAINTENANCE

7-1 INTRODUCTION

The purpose of this chapter is to provide the operator with the scheduled maintenance required to insure a long service life of the RIX Compressor, Model 2PS2B-.85. This chapter covers the procedures for performing examinations, tests, replacements, preventive maintenance tasks, and overhauls. Material and test equipment requirements are covered in the following paragraphs for each specific task. The chart is arranged with the most frequently performed tasks covered first, the less frequent tasks later. Where maintenance tasks require significant disassembly, they are referenced here for scheduling and explained in the Rix Manual Chapter 6 - Corrective Maintenance. Also, any corrective maintenance required as a result of any preventative maintenance inspections is covered in Chapter 6. On a daily basis, visually inspect the operating compressor. Check gas pressures, gas, temperatures, and for any leaks or unusual noises.

WARING: The compressor may start at any time when in automatic mode. Before attempting any repairs or adjustments, de-energize the Machine by putting the selector switch to OFF, disconnect power to the system (to avoid shock hazard), vent pressure by opening hand valves and give the discharge piping time to cool down (discharge air lines are hot and can cause burns).

WARING: Before performing any of the cheduled maintenance tasks in Chapter 4, the compressor should be shut off and tagged **Out of Service**. This is to prevent an inadvertent start which could cause injury to personnel or damage to the equipment. After completing the maintenance action, the compressor should be restored to full operation and the tags removed.

WARNING: To prevent **FIRE, SERIOUS INJURY, and/or DEATH**, it is the User's responsibility to ensure all parts used in the compression assembly, gas plumbing of this RIX Oxygen compressor and any other existing portions of the gas stream that may be exposed during the installation of new or replacement parts are cleaned for Oxygen Service prior to installation. Any work to be done on the compressor where the gas stream may be exposed must be done in accordance with **safe Oxygen Equipment handling procedures.** No attempt should be made to work on the machine without full knowledge of Oxygen equipment handling and the potential hazards of contamination. Factory Oxygen cleaned parts are denoted by an "X" prefix at the beginning of the part number. It is the User' s responsibility to maintain the cleanliness of factory cleaned parts and any other existing portions of the gas stream that may be exposed during the initial installation, start up, or during installation of replacement parts.

RIX Industries recommends the customer establish a procedure for working with oxygen machinery. Refer to Compressed Gas Association, Inc. publication number CGA G-4.1, Cleaning Equipment for Oxygen Service.

7-2 FILTER CLEANING

Every 2000 hours of running time the external interstage filter should be cleaned. Failing to clean the filter as scheduled may result in improper operation of the compressor valves.

PROCEDURE

A. Remove external filter shown on Figure (?).
B. Clean and thoroughly dry filter.
C. Reinstall the filter with the flow in the proper direction.

Figure 7-1,
Filter Intergrated

7-3 COMPRESSION VALVE INSPECTION AND RECONDITIONING

Every 4000 hours the compressor valves should be removed and reconditioned. Step by step procedures for removing and servicing the valves are given in the Rix Manual Paragraph 6-4. As a minimum during the 4000 hour maintenance action, the O-rings should be replaced with new parts and the valve seat resurfaced to remove any and all defects. It is recommended to maintain a stock of spare valves so that servicing can be as simple as possible. This allows the service man to change out the valves and reduce the down time during this maintenance action. The used valves may then be reconditioned as time permits so that they are ready for the next change out.

7-4 PRESSURE RELIEF VALVES

The pressure relief valves should be removed from the compressor and tested for correct set-point every 4000 hours. If a valve fails to lift at its rated pressure, it must be readjusted and if necessary, serviced per Paragraph 6-13.

7-5 BELT ADJUSTMENT

Belt tension should be checked every 2000 hours of operation or if slipping occurs.

PROCEDURE

A. Shutdown the compressor, bleed off pressure.
B. Remove belt guard.
C. Loosen motor bolts
D. Push down on the motor sheave and tighten motor bolts. Belt should deflect ½ - ¾” at mid span with approximately 10 lb. force.

NOTE: Alignment is critical to ensure proper belt life.

E. Replace belt guard.

7-6 GAS SYSTEM PIPING

Every 2000 hours of running time or any time the piping system is disturbed, such as during a corrective maintenance action, the piping should be examined for leaks. Any obvious leaks should be dealt with as they are Detected. Leak testing the piping requires that the compressor is pressurized, and therefore running.

NOTE: The test is simplified if the compressor is allowed to cool, then restarted, immediately prior to running the leak test, since the hot discharge pipes can boil away the leak test soap solution, making detection of leaks difficult or impossible.

WARING: Hot discharge lines can produce painful burns. Be careful to avoid making contact with hot pipes while performing tests and repairs. If a leak is detected, it should be noted or conspicuously marked so that it can be repaired at the next convenient shutdown period.

A soapy solution in a squirt bottle works best for locating leaks in a gas system. The gaskets and O-rings needed for the specific repair should be on hand prior to attempting to fix a leak.

PROCEDURE

A. Restart compressor after it has been allowed to cool down. See Rix Manual Chapter 2 - Operation.
B. Systematically move from joint to joint and fitting to fitting in the gas system piping, spraying the leak test solution.
C. Observe for the formation of bubbles. Mark the location of any detected leaks. Large leaks may blow the soap solution away as quickly as it is applied. These may be detected by feel, again being careful of hot discharge lines.
D. Test relief valves by forming a bubble across the outlet opening and observing if the bubble grows.
E. Leaks at fitting joints may, in some cases, be corrected by tightening the joint.
F. O-ring joints cannot be corrected by additional tightening. In most every case, the leaking o-ring must be discarded and a new one installed. Always inspect the surfaces that seal against the O-ring for defects and correct them as required.

CAUTION: Avoid over-tightening as this can produce distortion and make the problem more severe. If the joint is tight and still leaks, the gasket must be replaced.

7-7 PREVENTATIVE MAINTENANCE TIME INTERVALS IN HOURS

OPERATION		2000	3000	4000
Filter Cleaning		X		
Compressor Valves Inspection and Reconditioning				X
Pressure Relief Valves				X
Belt Adjustment			X	
Gas System Piping			X	
Bearing Inspection:	1st Stage		X	
	2nd Stage	X		

Table 7-1
Booster Compressor Maintenance

7-8 BEARING INSPECTION

Every 2000 hours inspect the main ball bearings, connecting rod ball bearing, and connecting rod needle bearing to verify adequate lubrication and smooth rotation. If replacement is necessary, follow the procedures given in the Rix Manual Paragraphs 6-8 and 6-9. Failure to replace the bearings could result in a bearing failure which would cause further damage to the compressor.

7-9 PISTON RING REPLACEMENT

Every 2000 hours, the 2nd stage floating piston, including new compression rings, rider rings, and O-rings, should be replaced following the procedures given in the Rix Manual Paragraph 6-7. Every 3000 hours the 1st stage rings should be checked and replaced as necessary. If the piston rings are allowed to wear beyond their service life, the compressor output will be reduced, causing more frequent compressor operation and unnecessary wear on other components. There is also the risk of damaging the cylinder walls if the rings wear out completely.

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SECTION VIII

8 SCROLL COMPRESSOR MAINTENANCE

8-1 GREASING COMPRESSOR BEARING

A. Remove the plastic dust cap. Use only one of two locations found on the air end (See Figure 8-1).
B. Rotate the compressor pulley until the grease fitting is visible through the dust cap hole (See Figure 8-1). This will allow re-greasing of the main bearing.
C. Use a grease gun extension adapter to engage the grease fitting and supply the proper volume of grease as indicated on the grease delivery chart (See Grease Delivery Chart Figure ?).
D. Replace plastic dust cap.

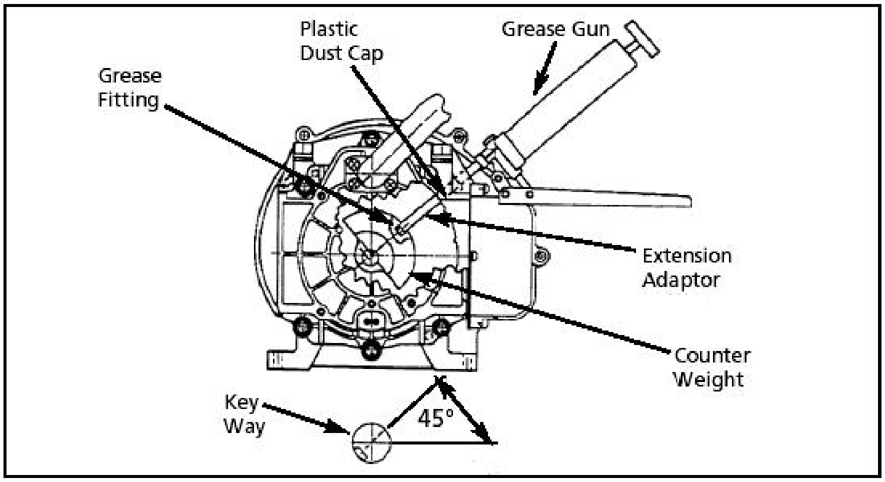


Figure 8-1
Greasing Compressor Bearing

8-2 GREASING PIN CRANK BEARINGS

NOTE: The bearings on the scroll compressor are regreaseable to allow extended compressor life. Service should be performed every 5,000 hours of operation (See Figures 8-2, 8-3, and 8-4).

A. Remove the V-Belt and the fan cover.
B. Remove the air end pulley and cooling fan with a gear puller.
C. Remove the fan duct shroud.
D. Remove the three grease caps. **Do not attempt to loosen or tighten the bolt.**
E. Grease all the three pin crank bearings
F. Replace grease caps, fan shroud, pulley, ect.

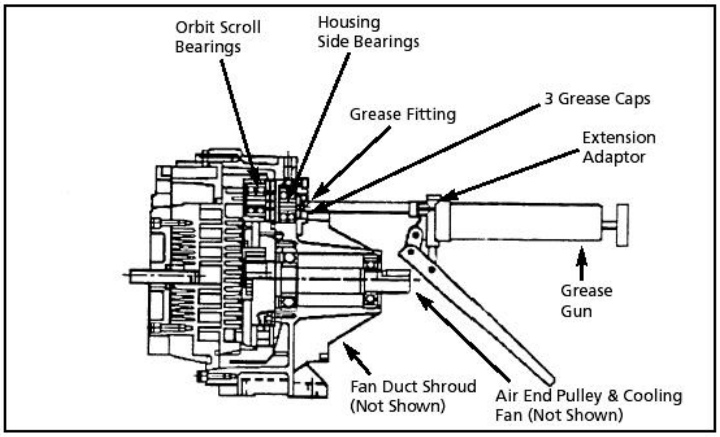


Figure 8-2
Grease Pin Crank Bearings

GREASE DELIVERY

Bearing	SLAE03 1st Time	SLAE03 2nd Time	SLAE05 1st Time	SLAE05 2nd Time
Orbit Scroll Bearing	5 Times	3 Times	6 Times	4 Times
Pin Crank Bearing Orbit Scroll Side	5 Times	3 Times	6 Times	4 Times
Pin Crank Bearing Housing Side	5 Times	3 Times	6 Times	4 Times

NOTE: Each pump of the grease gun equals 0.65 grams of grease.

Figure 8-3
Grease Delivery

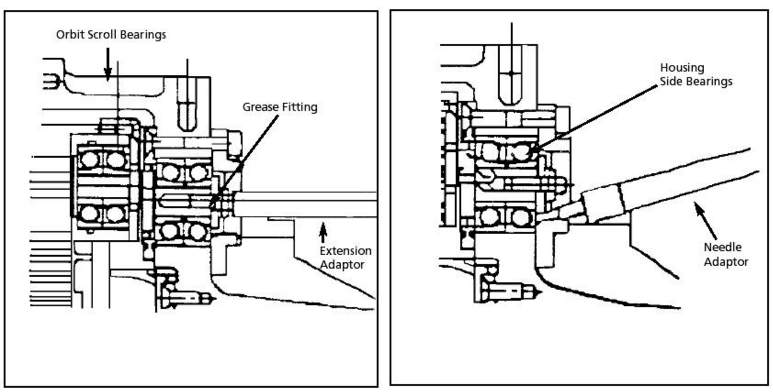


Figure 8-4
Grease Pin Locations

8-3 TIP SEAL SET REPLACEMENT

The tip seal on the scroll compressor is self-lubricated and allows the unit to operate efficiently without oil and expensive filtration. The tip seal should be replaced every 10,000 hours of operation or as needed due to harsh environmental conditions.

A. Confirm that the tip seal you are replacing is correct for the air compressor you are repairing.

Item No.	Description	Qty.
1	HP tip seal for FS	1
2	LP tip seal for FS	1
3	HP tip seal for OS	1
4	LP tip seal for OS	1
5	Dust Seal	1
6	Backup Tube	1

HP = High Pressure LP = Low Pressure
FS = Fixed Scroll OS = Orbital Scroll

Figure 8-5
Tip Seal Parts List

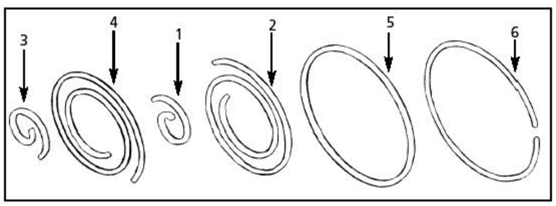


Figure 8-6
Tip Seals

B. Remove the six nuts with T-type wrench and then FS (Fixed Scroll) set from the air end.

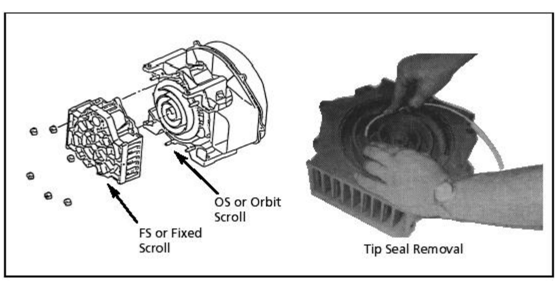


Figure 8-7
Tip Seal Removal

C. Remove LP and HP tip seals from the FS (Fixed Scroll) set and OS (Orbit Set). Using the tip of a ball-point pen at the start will make it easy to remove.

D. Remove any dust from the scroll with a clean cloth and compressed air.

NOTE: Tips seals for the FS (Fixed Scroll) and OS (Orbit Scroll) have opposing seal cut angles. In order to distinguish between the tip seal for Fixed Scroll and the tip seal for Orbit Scroll, place the tip seal as shown below then view from the arrow direction and refer to the figure.

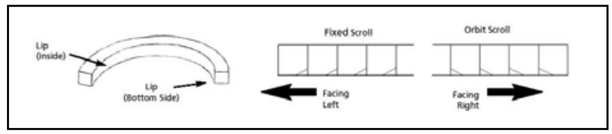


Figure 8-8
Tips Seal Angle Alignment

E. Insert the tip seal so that the lip of the tip seal is on the bottom of the seal grove and the inner side of the involute and the direction of the lip faces the center of the involute (curving spiral).This is to be done for both the FS and OS sets.

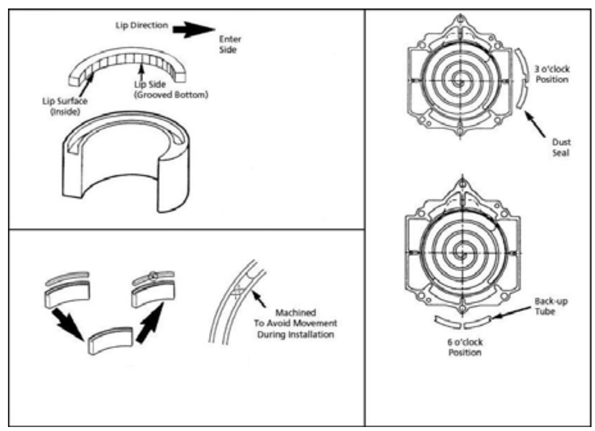


Figure 8-9
Tip Seal Installation

CAUTION: Be very careful not to tear or distort the lip.

F. Insert the new HP (High Pressure) tip seal from the center section for the OS (Orbit Scroll) so that there will be no clearance at the tip (start) section.

G. Insert the new LP (Low Pressure) seal so that it will contact closely with the HP tip seal inside the Scroll Groove.

CAUTION: Insert approximately half of the LP tip seal and remove the tip seal to confirm that the notch in the tip seal has been achieved. This will prevent movement during installation.

H. Repeat the same procedure for FS (Fixed Scroll) tip seal set, remove both the dust seal and the back up tube located on the outermost side of the FS set.
I. Insert the new back up tube in the FS in the 6 o'clock position (See Figure ?).
J. Insert the new dust seal on the back up tube. Place the face seamed section of the dust seal in the 3 o'clock position (See Figure ?).
K. After replacing the tip seal set, re-assemble the Fixed Scroll set to the Orbit Scroll. Tighten the 6 nuts temporarily snug. Confirm that the crankshaft rotates smoothly by hand and then torque the 6 nuts first to **15 inch pounds** and then to **175 inch pounds** of torque.

NOTE: Assemble so that the dust seal and tip seal will not drop between the Orbit Scroll set and Fixed Scroll set.

8-4 PODS AND SSODS

Repair of the PODS and SSODS components is by replacement only. Inspect flow-meters, fittings, and tubing regularly to ensure that they are clean and free from dirt, grease, or oil. Use only clean water to clean any of these parts, as some soap have an oil base.

CAUTION: Do not clean fittings with alcohol. While the PODS and SSODS are in service, check the water level in the containers on the bottom of each flow-meter and top them up as necessary.

8-5 CORRECTING A PRESSURE LEAK

Immediately unplug the faulty line or fitting at the nearest connection. Since the quick-connect fittings are self-sealing, this will isolate those parts of the system on either side of the leak and prevent a total loss of pressure while a new line or fitting is installed.

WARNING: If a hose or fitting is leaking, the entire line will experience a rapid loss of pressure. Immediately unplug the faulty line at its nearest connection to isolate the rest of the system.

8-6 MOVING AND TRANSPORT INSTRUCTIONS

If the EDOCS units are to be moved by crane or transported by helicopter, stack them no more than two units high and position the slings as shown in figure

WARNING: Helicopters produce high levels of static electricity charges in normal operation that may be conducted to cargo carried in slings. This charge may damage the EDOCS units and deliver an electrostatic discharge that could injure or kill someone coming in contact with the cargo after transport. Be sure the slings and EDOCS units are properly grounded when preparing them for transport.

SECTION IX

9 TROUBLESHOOTING

9-1 VSA

PROBLEM	POSSIBLE CAUSE	SOLUTION
Unit starts up, but then shuts down.	Customer power loss.	Check main disconnect for blown fuses or tripped breaker
	Control cabinet disconnect in off position.	Position handle in the on position.
	CR-124 overload tripped in control cabinet.	Push reset button on overload.
	CR-124 contactor not closing. (Qualified electrician may be required.)	Check for 120vac across coil of CR-124 contactor. Check for 120vac across the secondary of T-115 transformer.
Unit starts up, but then shuts down	M-100 motor overload set too low. (CR-124 overload)	Set overload to the FLA of the blower motor. Refer to sec.4.5
	Feed time set too long causing excessive adsorber (C-300) pressure.(15 psig & higher)	Reduce feed time setting to 15 sec. by turning the inner orange dial on the timer. Increasing time will raise pressure; adjust to achieve 8-10psig in C-300 tank. reset CR-124 overload.

Table 9-1
VSA Troubleshooting

TROUBLESHOOTING (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
Unit starts up, but then shuts down.	4-way valve (V-3) not rotating and stuck in pressure mode.	Diagnose motor/gearbox problem. Check for F-112 blown fuse. Reset CR-124 overload.
	M-100 motor shorted out.	Replace motor.
	CR-145 not being activated.	Disable CR-124 coil and push reset button on overload. Check for 120vac on CR-145 coil. Check limit switches
	4-way valve (V-3) not rotating and stuck in Vacuum mode.	Diagnose motor/gearbox problem. Check for F-112 blown fuse. Reset CR-124 overload
	Flow restriction causing backpressure.	Check for crimped hose or stuck check valves CV-1 & CV-2.
	Excessive adsorber (C-300) pressure. (15 psig & higher)	Very little purge or none at all open V-1 one turn open. Reset CR-124 overload. Check valve CV-2 not opening, replace. Reset CR-124 overload.
Low oxygen purity	Excessive product flow. (Over designed flow rate)	Adjust off take so the average of the high and low flows are equal to the design capacity of 120 lpm.
	Leaks in system piping.	Leak-check all piping with soap solution during pressure cycle.
Low oxygen purity	Vacuum time too short.	Increase vacuum time setting to around 24 seconds by turning the outer green dial on the timer. Adjust accordingly so the vacuum in C-300 tank reads around 17 "Hg.
	4-way valve (V-3) misalignment.	type of switch used in your unit.

TROUBLESHOOTING (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
	Blower drive belt slipping.	Hearing the blower slow down at the end of the feed cycle indicates belt slippage. Adjust belt tension to eliminate slippage.
Pressure gauge PI-1 reads low	Pipe connection leakage.	Check for loose hose pipe connections.
	4-way valve misaligned	See sec.6.1 or 6.2

9-2 MD BLOWER

PROBLEM	POSSIBLE CAUSE	SOLUTION
Loss of oil.	Gear housing not tightened properly.	Tighten gear housing bolts.
	Lip seal failure.	Disassemble and replace lip seal.
	Insufficient sealant.	Remove gear housing and replace sealant.
Excessive bearing or gear wear.	Improper lubrication.	Correct oil level. Replace dirty oil
	Excessive belt tension.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Coupling misalignment	Check carefully, realign if necessary.
Lack of volume.	Lack of volume.	Check belt manufacturer's specifications for tension and adjust accordingly.
	Worn lobe clearances.	Check for proper clearances
	Speed too low.	Increase blower speed within limits.
	Obstruction in piping.	Check system to assure an open flow path.

Table 9-2
MD Blower Troubleshooting

TROUBLESHOOTING (Continued)

PROBLEM	POSSIBLE CAUSE	SOLUTION
Knocking.	Unit out of time. Distortion due to improper mounting pipe strains. Excessive pressure differential. Worn gears.	Re-time. Check mounting alignment and relieve pipe strains. Reduce to manufacturer's recommended pressure. Examine relief valve and reset if necessary. Replace timing gears.
Excessive blower temperature.	Too much or too little oil in gear reservoir. Too low operating speed. Clogged filter or silencer. Excessive pressure differential. Elevated inlet temperature. Worn lobe clearances.	Check oil level. Increase blower speed within limits. Remove cause of obstruction. Reduce pressure differential across the blower. Reduce inlet temperature. Check for proper clearances
Rotor end or tip drag.	Insufficient assembled clearances. Case or frame distortion. Excessive operating pressure. Excessive operating temperature.	Correct clearances Check mounting and pipe strain. Reduce pressure differential. Reduce pressure differential or reduce inlet temperature.
Vibration.	Belt or coupling misalignment. Lobes rubbing. Worn bearings or gears. Unbalanced or rubbing lobes. Driver or blower loose. Piping resonance.	Check carefully, realign if necessary. Check cylinder for hot spots, then check for lobe contact at these points. Correct clearances Check condition of gears and bearings; replace if necessary Possible buildup on casing or lobes, or inside lobes. Remove buildup and restore clearances. Check mounting and tighten if necessary. Check pipe supports, check resonance of nearby equipment, check foundation.

TROUBLESHOOTING (Continued)

9-3 BOOSTER COMPRESSOR

PROBLEM	ACTION	POSSIBLE CAUSE	SOLUTION
High pressure on 1st Stage.	Continue running and monitor pressures.	Defective suction or discharge valve in the next higher stage.	Remove, clean, repair or replace suspect valves as necessary.
First stage relief valve is "popping".	Shutdown the compressor.	Defective relief valve.	Reset or replace the relief valve.
High pressure on 2nd Stage.	Continue running and monitor pressure.	Pressure switch improperly set or inoperative.	Reset or replace switch.
Second stage relief valve is "popping".	Shutdown the compressor.	Discharge lines or back pressure valve is restricted.	Clean back pressure valve and/or lines.
		Defective relief valve.	Reset or replace the relief valve.

PROBLEM	ACTION	POSSIBLE CAUSE	SOLUTION
Low pressure on 1st stage.	Continue running and monitor pressures until a convenient time to shut the compressor down.	Worn or broken rings in the 1st stage.	Replace piston rings and inspect cylinder for wear or scoring.
		Blown valve O-ring in that stage.	Replace O-ring.
		Suction or discharge valve on 1st stage is leaking.	Clean, repair, or replace suspect valve as necessary.
		Piping leaks.	Repair piping leaks.

Table 9-3
Booster Compressor Troubleshooting

9-4 ELECTRICAL TROUBLESHOOTING FLOWCHART

START-UP

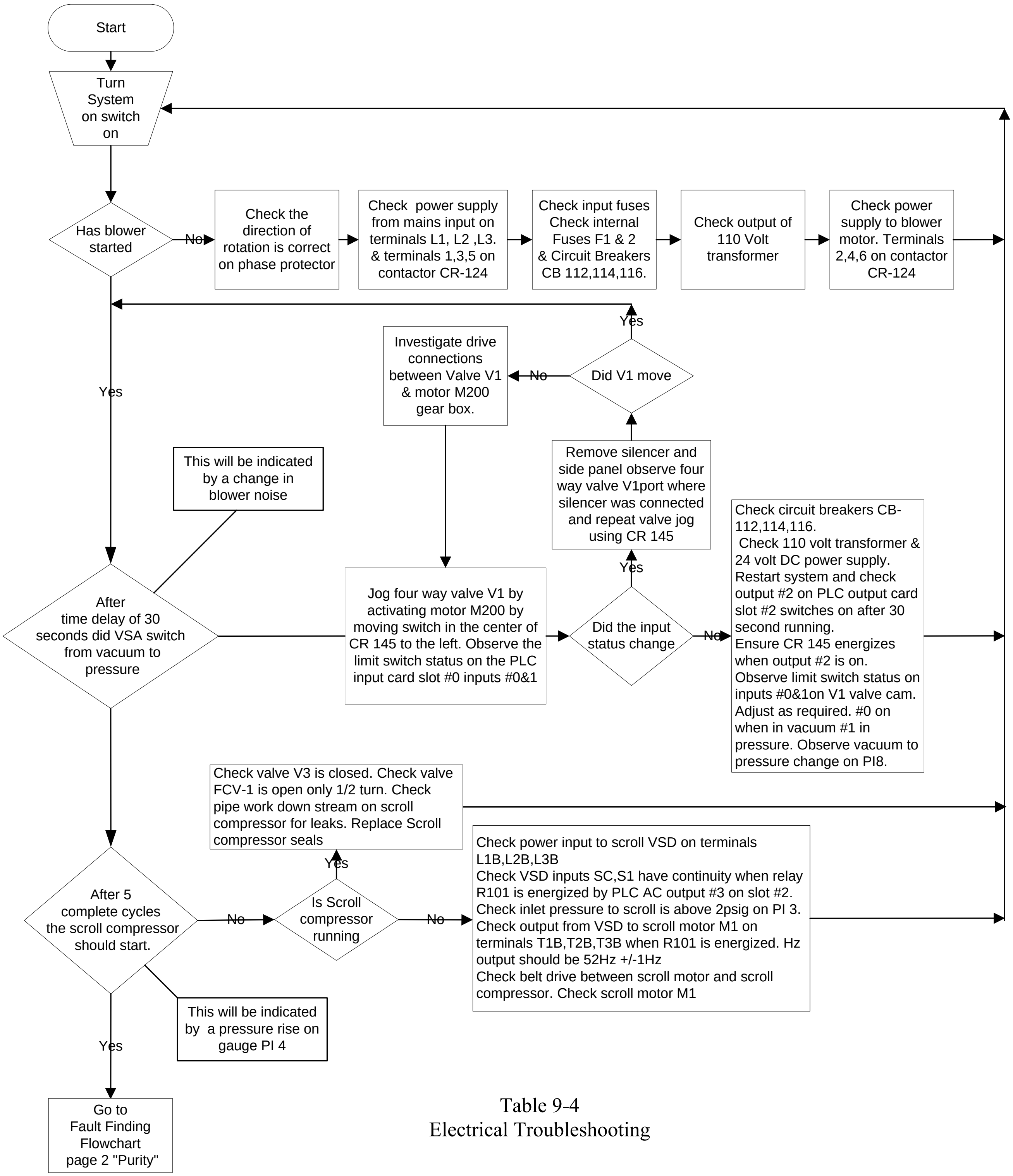
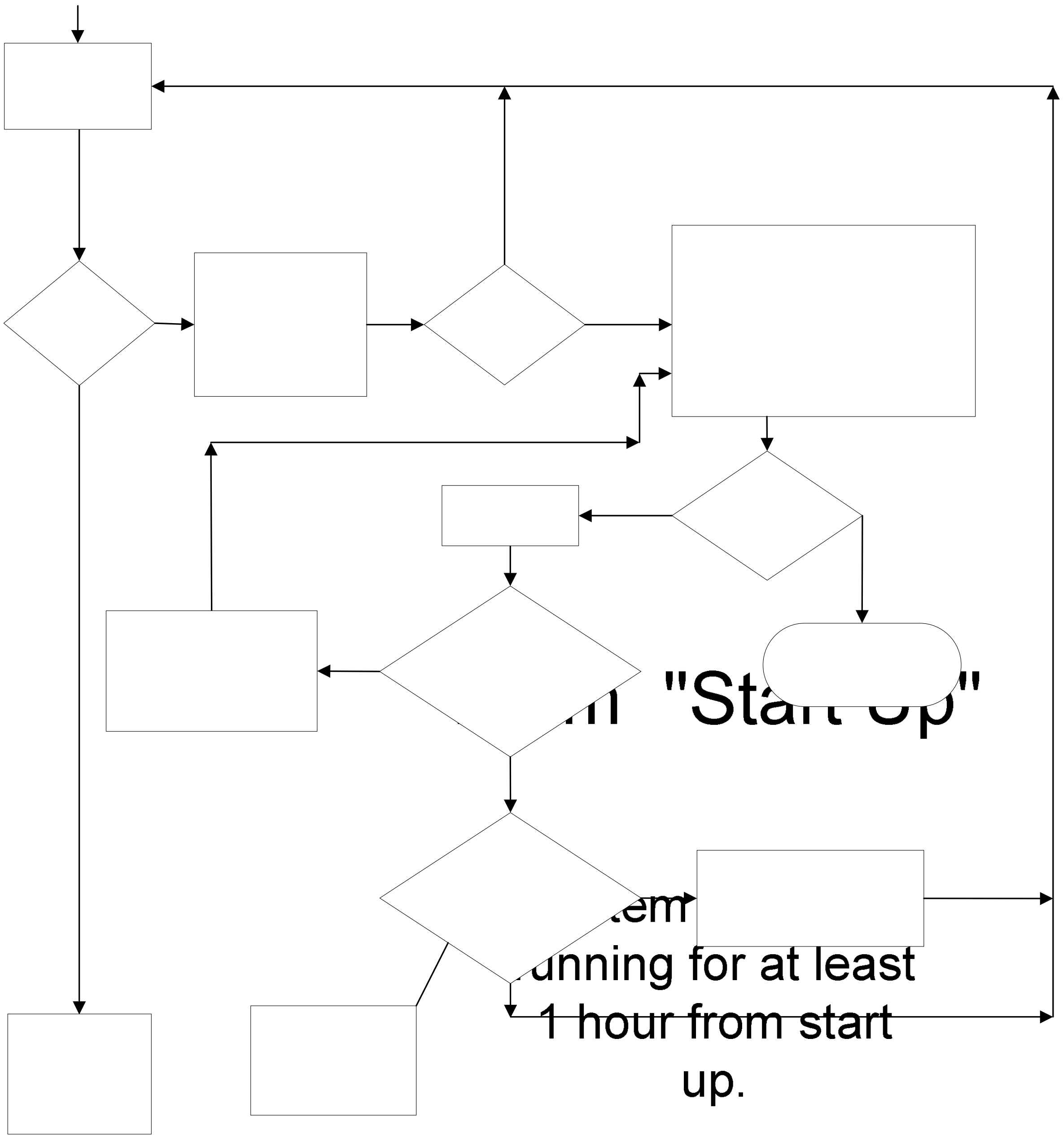
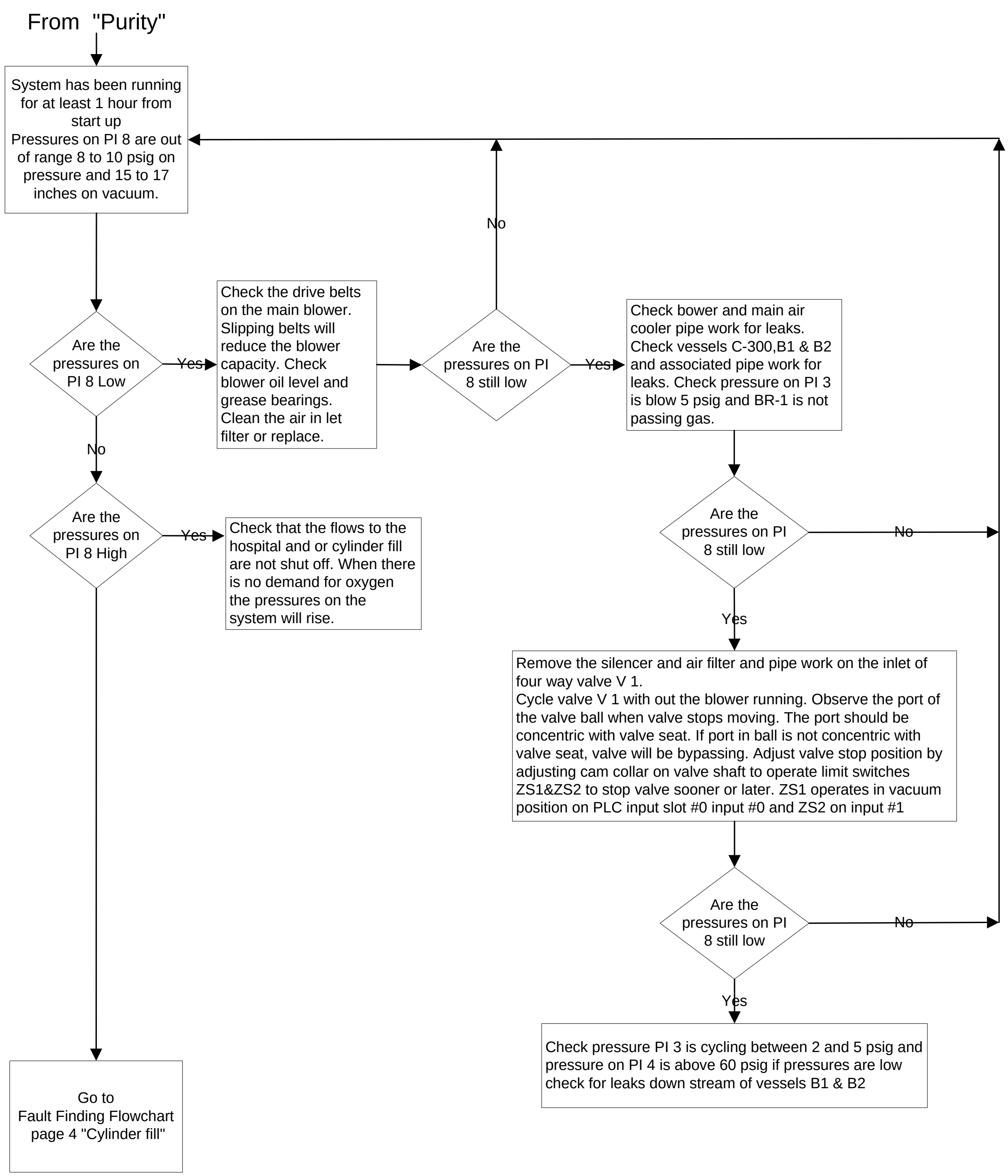


Table 9-4
Electrical Troubleshooting

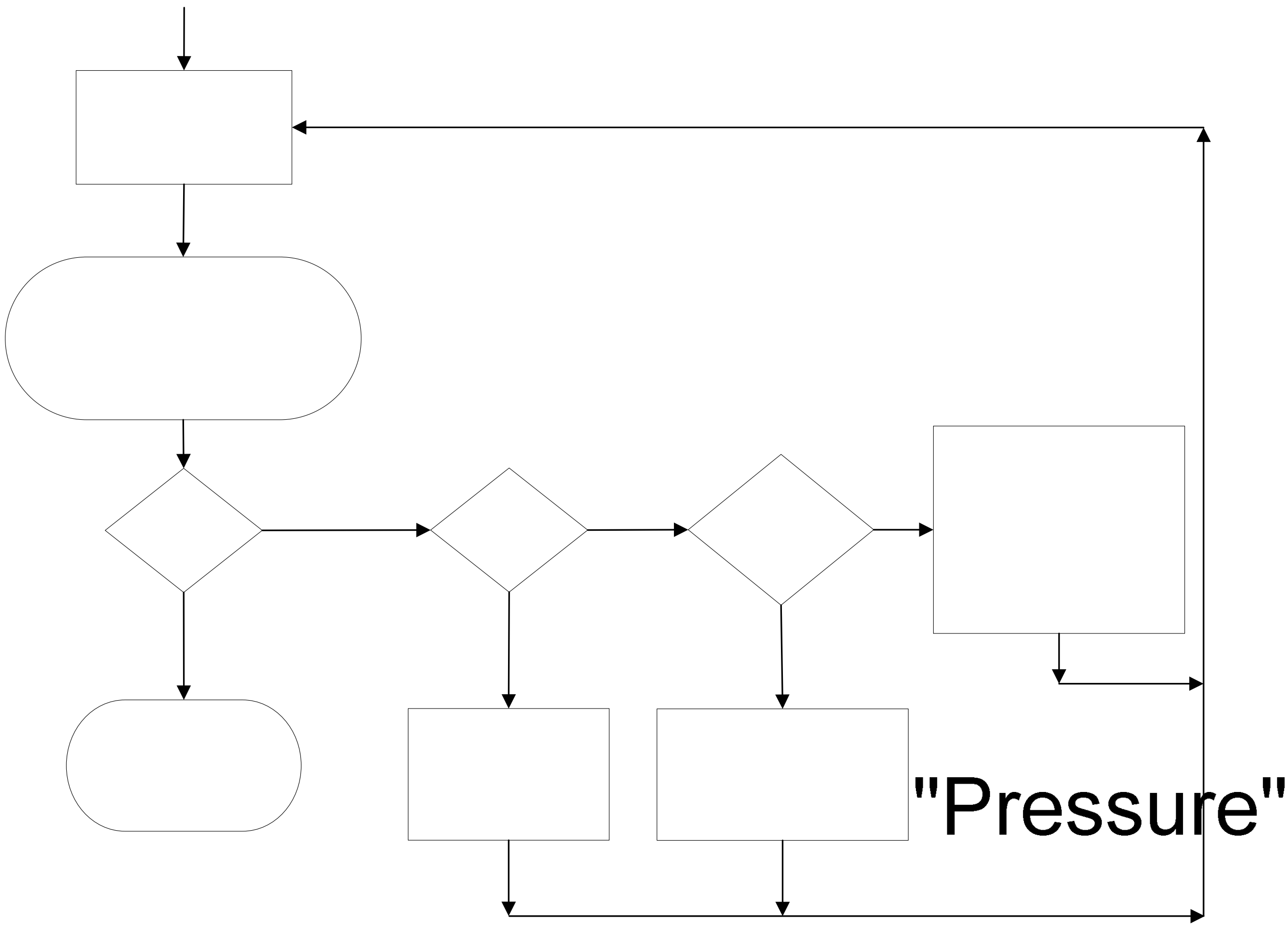
PURITY



PRESSURE


From "Purity"
System has been running for at least 1 hour from start up
Pressures on PI 8 are out of range 8 to 10 psig on pressure and 15 to 17 inches on vacuum.
Are the pressures on PI 8 Low
Yes
No
Check the drive belts on the main blower. Slipping belts will reduce the blower capacity. Check blower oil level and grease bearings. Clean the air in let filter or replace.
Are the pressures on PI 8 still low
No
Yes
Check bower and main air cooler pipe work for leaks. Check vessels C-300,B1 & B2 and associated pipe work for leaks. Check pressure on PI 3 is blow 5 psig and BR-1 is not passing gas.
Are the pressures on PI 8 High
Yes
Check that the flows to the hospital and or cylinder fill are not shut off. When there is no demand for oxygen the pressures on the system will rise.
Are the pressures on PI 8 still low
No
Yes
Remove the silencer and air filter and pipe work on the inlet of four way valve V 1.
Cycle valve V 1 with out the blower running. Observe the port of the valve ball when valve stops moving. The port should be concentric with valve seat. If port in ball is not concentric with valve seat, valve will be bypassing. Adjust valve stop position by adjusting cam collar on valve shaft to operate limit switches ZS1&ZS2 to stop valve sooner or later. ZS1 operates in vacuum position on PLC input slot #0 input #0 and ZS2 on input #1
Are the pressures on PI 8 still low
No
Yes
Check pressure PI 3 is cycling between 2 and 5 psig and pressure on PI 4 is above 60 psig if pressures are low check for leaks down stream of vessels B1 & B2
Go to
Fault Finding Flowchart
page 4 "Cylinder fill"

CYLINDER FILL



System has been running
for at least 1 hour from
start up
Pressures & Purity are
normal

FORMULA CONVERSION

Weight of Liquid or Gas		Volume of Liquid at Boiling Point		Volume of Gas at 21° C (70° F)		
U.S. Unit	EU Unit	U.S. Unit	EU Unit	U.S. Unit		EU Unit
Pound	Kilograms	Gallons	Liters	Gallons	Cubic Ft.	Liters
1.00	0.4535	0.11	0.39	90.3	12.08	342.0
2.2046	**1.00**	0.23	0.87	199.2	26.3	754.1
2.5154	1.141	0.26	**1.00**	227.3	30.4	860.5
9.5188	4.317	**1.00**	3.78	850.4	115.0	3256.8
1.1066	0.501	0.12	0.43	**100.0**	13.4	376.5
8.27447	3.753	0.87	3.29	748.5	**100.0**	2831.6
2.9213	1.325	0.31	1.16	264.17	35.3	**1000.0**

Table 9-5
Formula Conversion

CONVERSION FACTORS

To Convert From	Multiply by	To Equal
Pounds	0.4535924	Kilograms
Kilograms	2.204623	Pounds
Gallons - Liquid	3.785412	Liquid Liters
Liters - Liquid	0.264172	Liquid Gallons
Gallons - Liquid	0.1336806	Liquid Cubic Feet
Liters - Liquid	0.035315	Liquid Cubic Feet
Pounds - Liquid	90.335	Gallons - Gas
Gallons - Gas	0.011054	Pounds - Liquid
Liters - Liquid	860.5	Liters - Gas
Gallons - Liquid	860.4	Gallons - Gas

Table 9-6
Conversion Factors

CAPACITIES OF STORAGE DEVICES

Cylinders	Pressure	Gas Volume		
“D” Cylinder	**2015**	**15.0 Ft³**	**424 Liters**	**105 Gallons**
“E” Cylinder	**2015**	**24.9 Ft³**	**704 Liters**	**186 Gallons**
“M” Cylinder	**2217**	**125.0 Ft³**	**3540 Liters**	**935 Gallons**
“H” Cylinder	**2492**	**282.0 Ft³**	**7986 Liters**	**2110 Gallons**
“J” Cylinder	**2640**	**337.0 Ft³**	**9543 Liters**	**2521 Gallons**

Table 9-7
Capacities Of Storage Devices

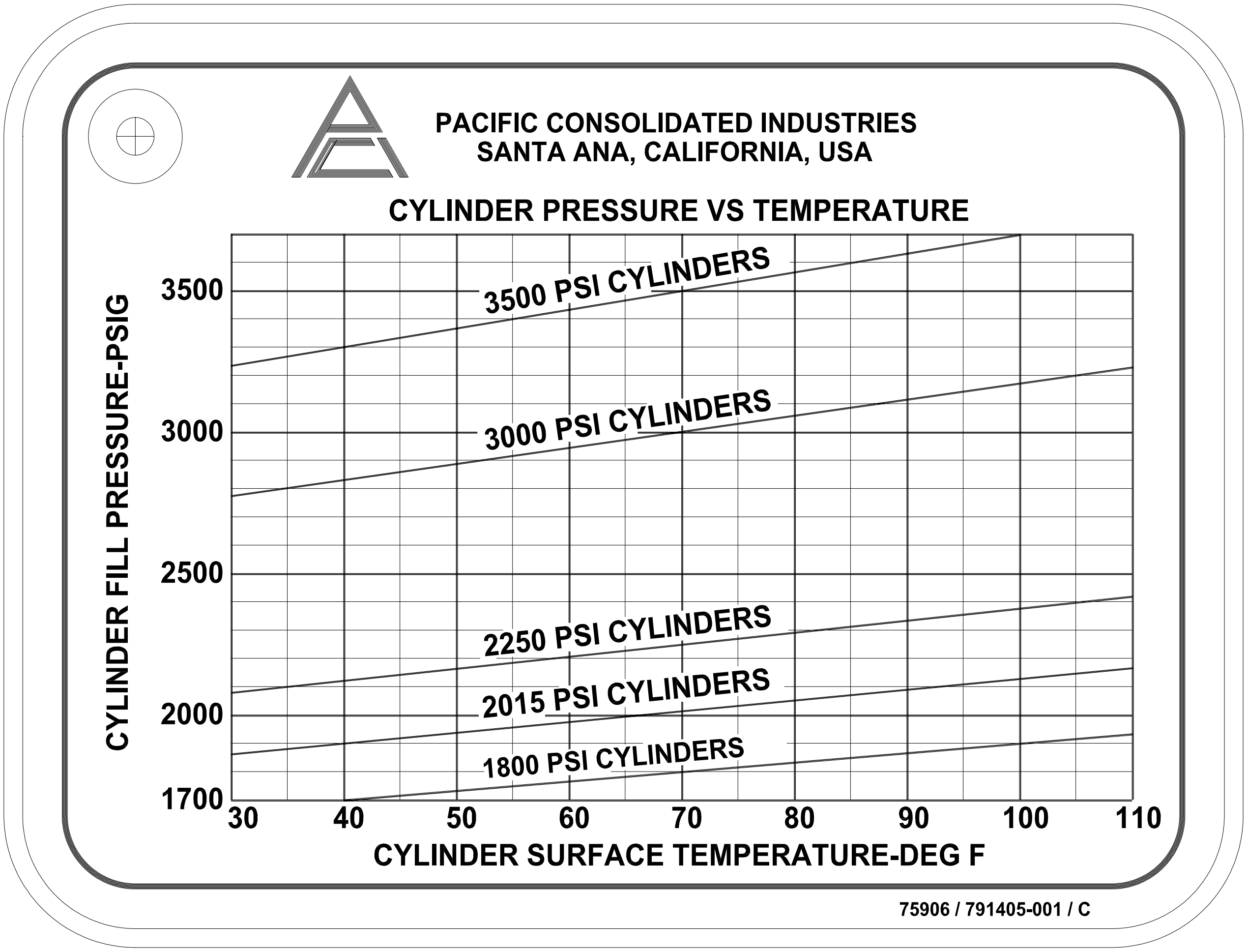


Table 9-8
Cylinder Filling
Pressure Versus Temperature Chart