



DENTAL VACUUM SYSTEM

TECHNICAL MANUAL

Version 96a

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A. ABOUT THIS MANUAL

1. This manual provides *background information* on installing, operating, maintaining and troubleshooting the RAMVAC Dental Vacuum System.
2. Special information concerning equipment operation and personnel safety appear in boxes.

NOTES
Emphasized information.

WARNINGS
Personnel safety information.

CAUTIONS
Equipment integrity information.

B. OTHER INFORMATION SOURCES

In addition to this manual, the following RAMVAC documents provide more specific information about RAMVAC Dental Vacuum Systems and their components:

Document	Subject
Pre-Installation Guide	How to prepare a facility for a RAMVAC installation
User Guide	How to operate and maintain a specific RAMVAC Power Unit
"Info" List	A continuously updated list of available written information on a variety of subjects. Info List covers currently available pro-sheets, service procedures, tech sheet, and installation instructions.
ProSheets	Information on RAMVAC products and services
Service Procedures	How to perform various service procedures on specific RAMVAC products or components
Remove & Replace	How to remove and replace specific RAMVAC components
Installation Instructions	How to install specific RAMVAC equipment (step-by-step instructions)

C. HOW THE SYSTEM WORKS

1. All dental vacuum systems are transportation systems designed to move various substances from one location to another.
2. The schematics on the next pages show the transportation throughout a typical dental facility:
 - a. Treatment Room Flow (from point of vacuum use to facility piping)
 - b. Facility Piping Flow (from treatment room to vacuum source equipment)
 - c. RAMVAC Equipment Flow (from facility piping to discharge points)
3. The dental treatment room ("DTR or "operator") is the starting point for movement. Not all treatment rooms have N₂O (nitrous oxide) scavenging, vacuum sinks or vacuum cuspidors shown in the schematic. Most treatment rooms have a solids separator with attached HVE (high volume evacuator) and saliva ejectors. Some treatment rooms may also have a liquid separating device that captures liquids and prevent their entry into the facility piping.
4. Facility piping carries materials removed from the treatment room to vacuum source equipment.
 - a. If liquids run through this piping system, it is often referred to as a "wet" line. Most facilities used for general dentistry run wet lines.
 - b. Facilities used for oral surgery often employ a liquid separating device in the treatment room. These devices capture liquids and prevent their entry into the facility piping. In this case, the piping is referred to as a "dry" line.
 - c. Facility piping must be designed to allow for:
 - ◆ free flow of light materials (gases and aerosols)
 - ◆ free flow of heavy materials (liquids, sludge and debris)
 - ◆ access -- just in case a clog does occur
 - d. See Section II of this manual plus the Pre-installation Guide for information needed to construct an appropriate facility vacuum line.

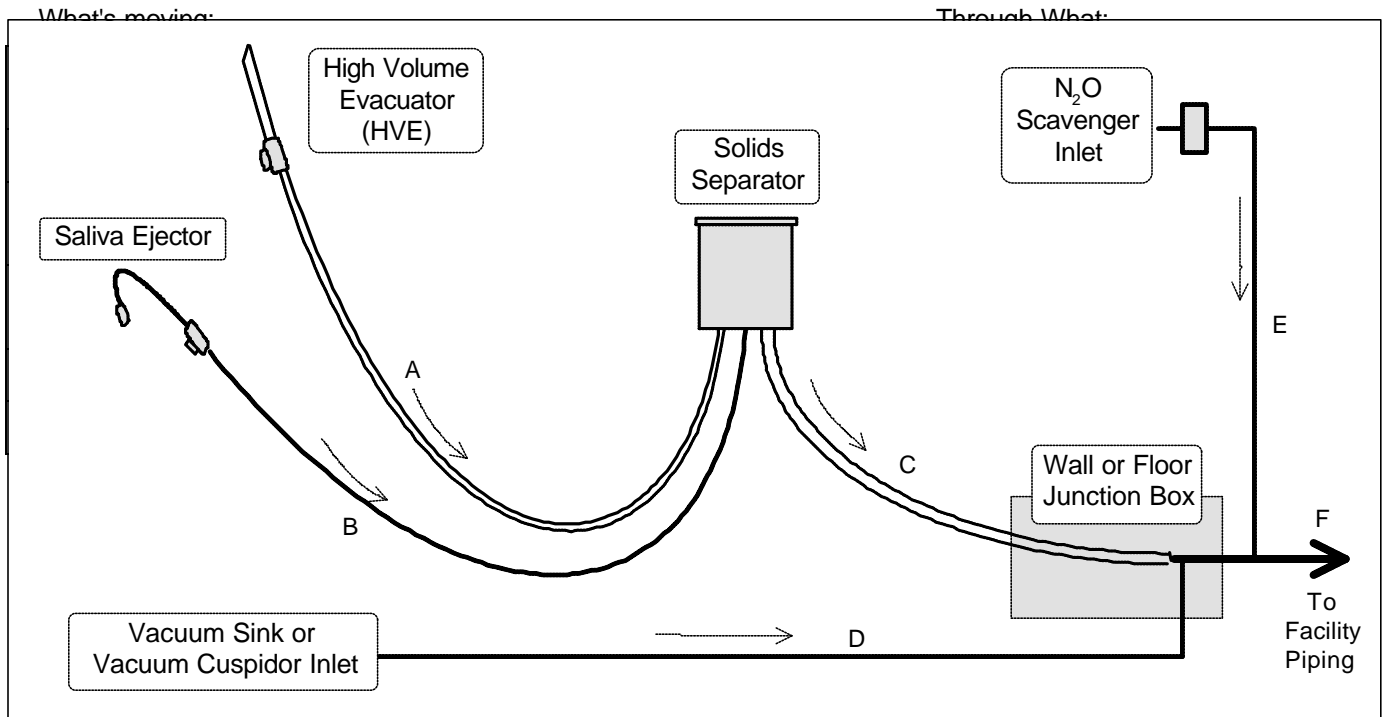
NOTE

Vacuum system performance can be limited by the weakest link: by source equipment or by piping.

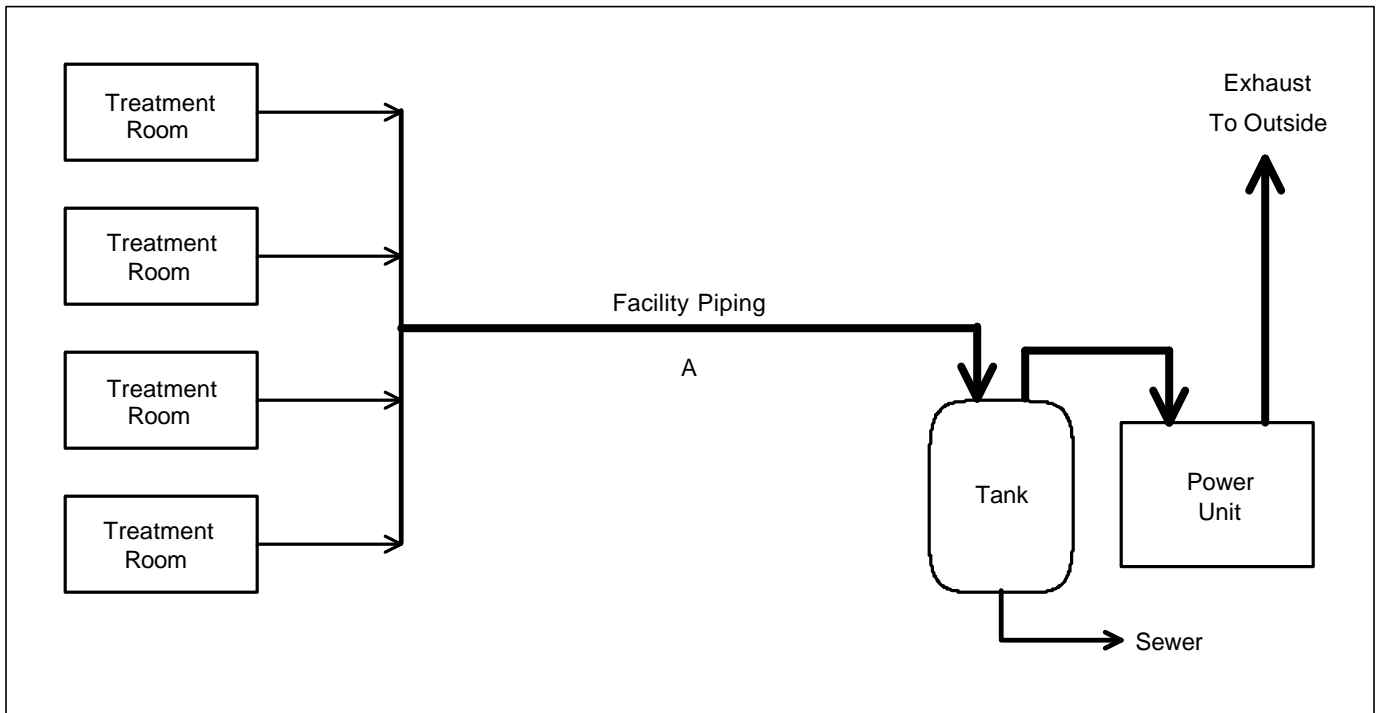
Effective piping systems are relatively inexpensive to build.
Ineffective piping systems can be very expensive to upgrade.

5. Additional information on flow through RAMVAC Equipment is found in Section II and in Pre-Installation Guides.

D. TREATMENT ROOM FLOW



E. FACILITY PIPING FLOW

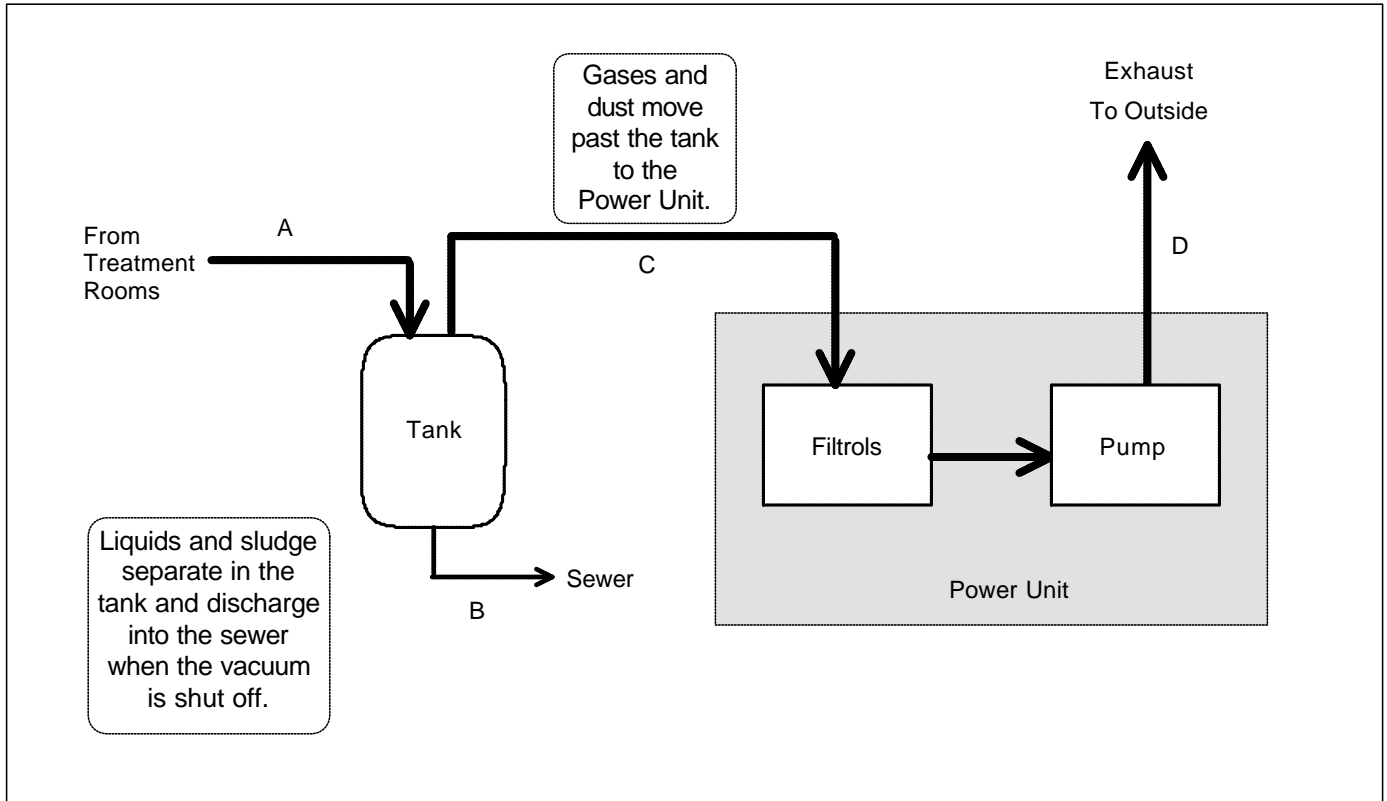


What's moving:

Through What:

A	Tooth debris, saliva, blood, water, restorative materials, amounts of room air, exhaled nitrous oxide, water from some types of cuspidors and sinks, rinse water and vacuum line cleaning solution	Facility Piping
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F. RAMVAC EQUIPMENT FLOW



What's moving:

Through What:

A	Tooth debris, saliva, blood, water, restorative materials, amounts of room air, exhaled nitrous oxide, water from some types of cuspidors and sinks, rinse water and vacuum line cleaning solution	Facility Piping
B	Heavy materials (liquids and dense solids)	Tank Drain Valve
C	Light materials such as dust, micro-organisms, and gases (mainly air plus any scavenged nitrous oxide and oxygen) Particles larger than 15 microns are stopped by the Filtrol's main air filter	Tank to Power Unit Piping
D	Materials not stopped by the main air filter	Pump and Out the Exhaust Pipe

G. RAMVAC MODELS

1. RAMVAC Dental Vacuum Systems all share certain performance characteristics and major components. Heavy duty, low speed, oil lubricated rotary vane pumps power all RAMVAC systems. Pumps in three sizes, 550, 1400 and 2800, used as singles or multiplexed, cover a wide spectrum of dental vacuum requirements.
2. See the User Guides supplied with each RAMVAC for operating and maintenance information pertaining to the specific RAMVAC model.

H. LUBRICATION SYSTEM

1. All RAMVAC pumps receive clean oil, drop by drop through an exclusive oil control mechanism that has no moving parts. Oil flow is powered by vacuum and gravity. As the pump rotates, the used oil is discharged in a mist and separated from the exhaust. Some RAMVAC systems recirculate oil. Some do not. Recirculating systems require different preventive maintenance than non-recirculating systems.
2. See the User Guides shipped with each RAMVAC for operating and maintenance information pertaining to the specific RAMVAC model.

I. COMPONENT NAMES & DESCRIPTION

Power Unit	The vacuum power source comprised of the RAMVAC vacuum pump, motor, v-belt drive, oil reservoir, "Filtrols", a vibration absorbing base, and an OSHA approved drive system enclosure.
Oil Reservoir	An oil storage, dispensing and collecting component. Two types of oil reservoirs are used: (1) recirculating and (2) non-recirculating. See the User Guides shipped with each RAMVAC for information on the specific oil reservoir supplied with that RAMVAC.
Filtrols	A RAMVAC patented air filter and vacuum controller assembly. The Filtrols' adjustable vacuum controller allows sealed suction (the vacuum strength when no flow is occurring) to be limited to a preset maximum. The vacuum controller filter cleans the air entering the system through the vacuum controller. The main air filter stops particulates larger than 15 microns from entering the RAMVAC pump. A moisture alarm probe located in the Filtrols bottom detects liquids or foam in the filter housing assembly. A vacuum gauge indicates intensity of system vacuum.
Separating Tank	This structure receives all materials transported from the operatories and separates heavier materials (solids and liquids) from lighter materials (gases and dust). Solids and liquids are held in the tank as long as vacuum is present. Gases and dust pass through to the Filtrols, the RAMVAC pump, and -- eventually, to outside the building. The tank automatically empties when the pump is turned off and vacuum no longer holds the drain valve closed.
Electrols	This component controls electrical functions and displays system status. All RAMVAC Electrols are UL 544 Listed. See the User Guide and wiring diagram shipped with each RAMVAC for information on the specific Electrols supplied with that RAMVAC.

J. ELECTROLS INDICATORS & SWITCHES

Power On Indicator	Indicates input power is available to the Electrols.
Mode Selector Switch	Controls the system's operational mode. See User Guide for details.
Alarm Indicator	Indicates an "alarm" condition that automatically turns the motor off if the Mode Selector Switch is in the "Normal On" position. See Section 4, Troubleshooting, for more information about "Alarms."
Alarm Reset	Resets the alarm system.
Overload Reset	Resets the motor starter overload. Present in 3 phase systems only.

K. DUTY CYCLE and VACUUM LIMITS

1. RAMVAC *pumps and motors* can be run continuously without adverse effects. However, tanks will only drain when no vacuum is present. Therefore, the system must be shut off or tanks must be isolated from vacuum in order to drain.
2. To avoid wasting electricity, treat a RAMVAC as you would fluorescent lights. Turn it off if you know it will not be needed for an hour or more.
3. RAMVAC pumps can produce vacuum up to 15" Hg continuously. Some motors may limit the system's upper vacuum strength limit. Do not set vacuum controllers for vacuum stronger than 9" Hg without having an amperage reading device ("Amprobe") to insure that motor load stays within rated limit.

L. KEY POINTS for TROUBLE-FREE OPERATION

- Read and understand the User Guide for the specific RAMVAC system.
- Maintain lubrication system and filters.
- Rinse lines thoroughly with a *known quantity* of liquid.
- Aspirate only non-foaming agents.
- Contact RAMVAC or an authorized dealer if you have any questions.

A. ABOUT THIS SECTION

This section provides the *background information* needed to install a RAMVAC safely and easily. Specific installation instructions are *not* included.

B. OTHER INFORMATION SOURCES

1. Pre-Installation Guides list dimensional, plumbing and electrical specifications for all models. Pre-Installation Guides are continually updated to include new models and changes.
2. Installation Instructions are shipped with applicable products. Installation Instructions are continually updated to include new models and changes.

C. INSTALLATION OVERVIEW

The process of installing a RAMVAC system is outlined below.

Component Location

Power Unit page 2

Filtrols page 3

Tank page 3

Electrols page 3

Component Set-Up page 4

Plumbing

Tank-Filtrols Vacuum Line page 5

Facility Vacuum Lines page 5

Exhaust Line page 6

Drain Line page 7

Electrical Work

Motors page 8

Electrols page 8

Connections page 9

Installation Packet page 10

D. COMPONENT LOCATION, GENERAL INFORMATION

1. The RAMVAC system includes a Power Unit, Separating Tank, and Electrols. Dimensions of these components are listed in the Pre-Installation Guide.
2. Use the background information on the following pages to understand in general how to select an appropriate location for system components.

E. POWER UNIT LOCATION

The Power Unit is the part of the RAMVAC system that includes the pump and motor. Consider the following when considering a power unit location:

Access	Provide a minimum of 2 feet (3 feet preferably) in front of the Power Unit for component access and to facilitate inspection and preventive maintenance procedures.
Temperature	<ol style="list-style-type: none"> 1. The RAMVAC Power Unit should be exposed to ambient temperatures no hotter than 104°F (40°C) and no cooler than 32°F (0°C). 2. Oil drip rates are affected by ambient temperature. When temperatures are colder than 32°F (0°C), drip rate may become too slow. 3. While RAMVAC <i>pumps</i> can operate trouble-free in very hot environments, standard RAMVAC <i>motors</i> are NEMA rated for a maximum ambient temperature of 104°F (40°C). Contact RAMVAC if a higher temperature motor is needed.
Ventilation	<ol style="list-style-type: none"> 1. The Power Unit, like an air compressor, is a source of heat and should be located in a clean, dry area: <ul style="list-style-type: none"> ◆ large enough to absorb heat without temperatures rising above the recommended maximum, or ◆ that has adequate ventilation to dissipate heat. 2. For example, if the RAMVAC Power Unit is to be located in a small enclosed room, it may be necessary to provide enough air flow to keep temperatures within the specified limits.
Noise	<ol style="list-style-type: none"> 1. Care must be taken in selecting a location so the RAMVAC will operate quietly enough to satisfy its users. 2. The Pre-Installation Guide includes important "Sound Level Considerations." 3. Sound insulation may be used effectively in sound sensitive situations. Request RAMVAC tech sheet "Sound Reduction of RAMVAC Dental Vacuum Systems" for additional information. 4. RAMVAC exhaust noise varies with the model. Smaller capacity systems are considerably quieter than larger systems. 5. Optional mufflers are available for exhaust sound sensitive situations. Mufflers are not normally needed on 550 Power Units. Mufflers will not reduce the sound created by pumps but will reduce the sound level outside the facility where the exhaust line terminates. 6. To minimize exhaust noise within a facility, exhaust lines must be run correctly. Refer to "Plumbing: Exhaust Line" in this section and in the Pre-Installation Guide for important information on correctly installing a quiet exhaust line.

F. FILTROLS LOCATION

1. Filtrols are part of the RAMVAC Power Unit. Filtrols are normally left in position as shipped.
2. Filtrols can be relocated to any accessible remote location to reduce "standard" (non-Bulldog) Power Unit overall width. This new location does not have to be near the Power Unit, although Filtrols must be plumbed into the line between the Separating Tank and pump. See Section I, page 5. An accessory bracket is available for easily mounting a relocated Filtrols. Tech Sheet "Relocating Filtrols" is available on request.

G. SEPARATING TANK LOCATION

Access	Provide enough working room to facilitate initial plumbing and for convenient access to the drain valve. See Pre-Installation Guide for specific tank dimensions. Custom tanks are available for unusual situations.
Elevation	<ol style="list-style-type: none"> 1. The Separating Tank <i>drain valve must be higher than its sewer line connection.</i> 2. It may be necessary to increase the tank height above floor level if a floor drain is not available. Some RAMVAC Tanks can be suspended from above or supported from below. See Pre-Installation Guide and Installation Instructions for additional details on specific tanks.
Proximity to Power Unit	<ol style="list-style-type: none"> 1. The Tank does not have to be near the Power Unit. Several hundred feet of distance will not interfere with proper operation if the connecting vacuum line is appropriately sized. 2. See Pre-Installation Guide for additional installation possibilities.
Multiple Tanks	<ol style="list-style-type: none"> 1. Large clinics or "add-on" facilities often can be best served by systems with more than one tank. 2. Tanks may be located together or may be placed in separate locations. Please call RAMVAC for assistance with multiple tank installations.

H. ELECTROLS LOCATION

Access	For convenience and to <i>comply with electrical codes</i> , the ELECTROLS must be within sight and easy reach of the Power Unit.
Moisture	Electrols are <i>not waterproof</i> and should be protected from exposure to water.

WARNING
Comply with all applicable codes.
Protect Electrols from water.

I. POWER UNIT SET-UP

Details	For a correct, easy and safe installation, follow the Installation Instructions packed with the Power Unit.
Weight	<ol style="list-style-type: none">1. Power Units weigh several hundred pounds! A strong helper and a hand-truck is desirable. Carry handles are available and useful for moving some models. Call RAMVAC for details.2. Lift standard models only from the base. Bulldogs can be lifted from any structural part.
Mounts	Rubber mounts support the Power Units and provide vibration dampening. These mounts are very strong in compression. They're designed to support hundreds of pounds -- but they are weak in shear. Sideways loads can tear them. <i>Lift and place, rather than slide Power Units to avoid damaging the mounts.</i>

NOTE

Power Unit shipped with mounts detached should be positioned before attaching mounts. Access for attaching mounts may be gained by tipping the power unit. Sliding the power unit after the mounts are attached may damage the mounts.

J. SEPARATING TANK SET-UP

Details	For a correct, easy and safe installation, follow the Installation Instructions packed with the tank.
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K. ELECTROLS SET-UP

Details	<ol style="list-style-type: none">1. For a correct, easy and safe installation, follow the Installation Instructions packed with the Electrols.2. To insure the Electrols function correctly, and to complete the installation thoroughly, use the "Electrols Check-Out" sheet packed with the Electrols.
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NOTE

Position components ***before*** completing plumbing or electrical work.

L. PLUMBING TANK to FILTROLS

The vacuum line from the Separating Tank to the Filtrols must be fabricated during installation *except* for systems ordered with the RAMVAC "Stand" and for Bulldogs ordered with the Box Tank.

Materials	<ol style="list-style-type: none"> 1. PVC schedule 40 or equivalent ABS pipe 2. PVC or ABS DWV fittings
Size	Refer to Pre-Installation Guide for recommendation specific for the particular model.
Removable Joints	Use connectors provided to connect to Filtrols and Tank.
Sequence	<ol style="list-style-type: none"> 1. Confirm position of Tank and Power Unit. 2. Cement all non-removable joints. 3. Tighten clamps on all removable joints.

M. PLUMBING FACILITY VACUUM LINES

1. The vacuum lines that connect operatory (treatment room) vacuum equipment to the inlet of the RAMVAC Separating Tank are collectively referred to as "Facility Vacuum Lines."
2. These lines should be built as drain or sewer lines.

Materials	<ol style="list-style-type: none"> 1. PVC schedule 40 or equivalent ABS pipe. 2. PVC or ABS DWV fittings. 3. PVC and/or copper for junction box connections to treatment room hoses.
Size	Refer to Pre-Installation Guide for recommendation specific to the particular pump model.
Slope	Vacuum lines should be run like drain or sewer lines : Slope downwards from operatories to a low point at the RAMVAC Separating Tank inlet.
Low Spots	Try to avoid any in-line low spots . If an in-line low spot must occur, place it in an accessible location and incorporate a "clean-out."
Seal	Make all joints waterproof.
Smooth	<ol style="list-style-type: none"> 1. Avoid kinks, sharp bends and sharp edges particularly in small diameter plumbing. 2. Use DWV fittings rather than fittings that leave internal shoulders.
Catches	<ol style="list-style-type: none"> 1. Avoid shoulders that face "upstream." 2. Use DWV fittings.
Temperature	Vacuum lines normally carry room temperature materials.
Pressure	Vacuum lines will be subjected to negative pressures of up to 15 inches of mercury (approximately -7.5 psi).
Sequence	Place all lines before cementing joints.

N. PLUMBING EXHAUST LINE

1. The exhaust line carries exhausted gases to *outside the building*.
2. Exhaust lines may be a source of vibration and must be run correctly to avoid undesirable noise.
3. Exhaust lines carry odors, microorganisms, and oil vapor. *They must be made oil tight.*

Length	Keep as short as possible.
Material	Refer to Pre-Installation Guide for recommendation specific for the particular pump model.
Noise	<ol style="list-style-type: none"> 1. A low intensity, mellow sound will be emitted from most exhausts. 2. Larger capacity systems product significantly louder exhausts. Route and terminate accordingly.
Insulate	<ol style="list-style-type: none"> 1. Route line carefully to avoid contact with solid structures such as walls, floors, joists, studs, duct work or other plumbing. 2. Support line with flexible hangers. 3. Caulk exterior wall/exhaust line opening.
Outside End	<ol style="list-style-type: none"> 1. Locate the outside end of exhaust lines away from doors, windows or ventilation intakes to keep exhaust gases from entering building. 2. Locate the outside end in an inconspicuous site such as a roof top, on a wall behind shrubs, or away from main traffic areas. 3. Extend the line beyond the roof top or outside wall about six inches. 4. Terminate the line with a horizontal run, at least 2" long, that points away from prevailing winds and will clear snow or other obstructions. 5. Attach the flapper valve (supplied with non-Bulldog models only) so it hinges at the top. 6. Refer to Pre-Installation Guide and Installation Instructions for specific details.

NOTE

Do not connect exhaust line to plumbing vent line.

WARNING

Terminate exhaust line in a location that prevents exhaust from entering the building.

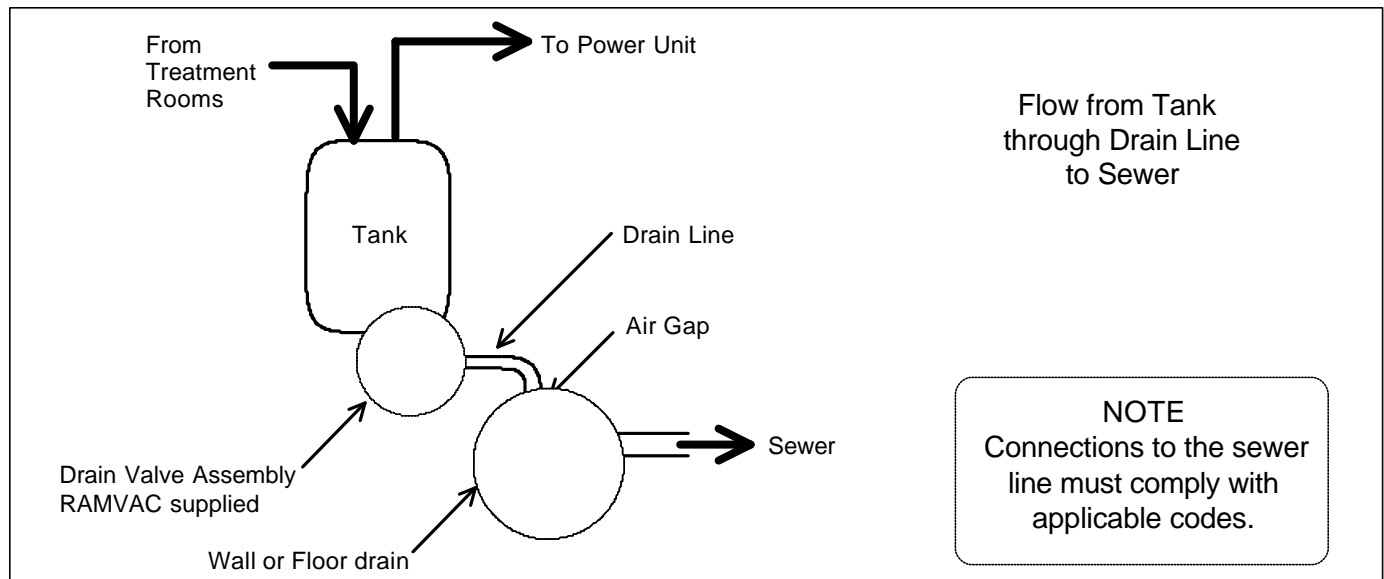
PLUMBING EXHAUST LINES, Continued

Inside End	Attach pipe to Power Unit at oil reservoir top using the oil-resistant hose shipped with Power Unit. Refer to Pre-Installation Guide or Installation Instructions for specific details.
Sequence	<ol style="list-style-type: none"> 1. Build exhaust line. 2. Remove protective dust cap. 3. Attach exhaust line to Power Unit at the top of the oil reservoir using the supplied connector.
Temperature	Exhaust temperatures of some systems may cause PVC pipe to sag. Observe Pre-Installation Guide "Exhaust Line Material" recommendations.
Pressure	Exhaust line pressure may reach +5 psi.

O. PLUMBING DRAIN LINES

The drain line provides for disposal of liquid and solid debris.

Material	The drain valve will accept 1½" plastic pipe.
Flow	<ol style="list-style-type: none"> 1. Drain lines must easily carry a rapid liquid discharge equal to the capacity of the tank. 2. Provide an air gap between the drain line and the sewer line.
Elevation	<ol style="list-style-type: none"> 1. For the most simple installation, position the tank to gravity drain. This means the tank valve must be slightly higher than the sewer line connection. 2. If a floor drain is not available, the tank may have to be raised to insure that it will be higher than the available sewer line connection.



P. RAMVAC MOTORS

Voltage	<ol style="list-style-type: none"> 1. See "Electrical Specifications" (Section 5) for allowable motor voltages. 2. Motors are shipped wired for the voltage specified on the purchase order. 3. Motors must be used with the proper voltage.
Phase	<ol style="list-style-type: none"> 1. Single phase or three phase motors are available for 1 hp to 3 hp models. 2. Motors must be used with the proper phase power. 3. Motors cannot be rewired to operate on different phase power.

Q. ELECTROLS

Power	<ol style="list-style-type: none"> 1. Use a dedicated circuit protected according to Electrical Specifications, Section 5. 2. Wire Electrols power through a (user supplied) disconnect.
Voltage	<ol style="list-style-type: none"> 1. Electrols will operate ONLY with the proper voltage. 2. See Electrical Specifications (Technical Manual Section 5) or Electrols placard.
Phase	<ol style="list-style-type: none"> 1. Electrols will operate ONLY with the proper phase. 2. See Electrical Specifications (Technical Manual Section 5) or Electrols placard.
Remote Control	<ol style="list-style-type: none"> 1. Electrols supplied after March 1996 have standard 24v remote control circuits. 2. Other remote control circuit voltage options are available.
Check Out	See "Electrols Check-Out" sheet packed in Electrols.

WARNING

**All electrical work must comply with local and national codes.
All motors should contain a proper ground.
INSUFFICIENT GROUNDS CAN BE DANGEROUS.
Ground according to Electric Code.**

R. ELECTRICAL CONNECTIONS

1. Refer to the wiring diagram located inside the cover of the Electrols.
2. *Voltage and phase must be correct for the motor.*

Motor	Use ONE of the following methods to connect RAMVAC motors to Electrols <ul style="list-style-type: none"> ◆ Connect motor cord directly to Electrols, or ◆ If the RAMVAC supplied 6 ft. cord is not long enough, connect motor cord to user supplied junction box. Then connect junction box to Electrols.
Remote	<ol style="list-style-type: none"> 1. Remote control switching is optional. The RAMVAC may be turned on and off using the Electrols "Mode Selector Switch" or by using a breaker. 2. The Electrols Installation Instructions shows how to connect a remote switch to the Electrols terminal board. 3. A variety of 24v remote control switches, illuminated or non-illuminated, can be used. Be sure to follow Installation Instructions.
Line	Connect power from disconnect to Electrols input terminals as shown in the Electrols Installation Instructions.
Ground	Connect ground to Electrols ground lug as shown in the Electrols Installation Instructions. The ground lug is labeled.

NOTE

Wire size and circuit protection are listed in Electrical Specifications, Section 5. Fuses must have time delays, dual elements or be otherwise suitable for motor circuits.

WARNING

**All motors MUST have proper ground.
INSUFFICIENT GROUNDS CAN BE DANGEROUS.
All work must comply with applicable codes.
Ground according to Code.**

CAUTION

Incorrectly connecting remote control wiring can cause equipment damage.

S. INSTALLATION PACKET

1. A prominently identified "Installation Packet" is taped to every RAMVAC Power Unit shipped.
2. This packet contains important installation information.

Installation Instructions	<ol style="list-style-type: none"> 1. Information for installing the Power Unit easily and safely. 2. Read and understand these instructions if unfamiliar with RAMVAC installations 3. Check these instructions for changes even if you have done previous installations.
Installation Checklists	<ol style="list-style-type: none"> 1. Two copies of the INSTALLATION CHECK LIST are supplied with the RAMVAC pump. 2. One copy should be completed by the installer and kept by the owner/end user. 3. The other copy of the CHECKLIST must be completed by the pump installer and mailed to RAMVAC. A pre-addressed, stamped envelope is provided. 4. Enter all requested model numbers and serial number. See note below for serial number locations. 5. The Installation must be completed and returned to RAMVAC to initiate the warranty.
User Guide	<ol style="list-style-type: none"> 1. This document should be presented to the end user. 2. Review the User Guide with the person responsible for maintenance to complete the Installation Checklist.
Warranty Initiation Statement	This document must be completed and returned by the end user to RAMVAC to initiate the warranty.

NOTE

Component	Serial Number Location
Pump Serial Number	<ul style="list-style-type: none"> ◆ On blue foil label located on belt guard top. ◆ Also on plate attached to back of pump.
Tank Serial Number	On blue foil label located on tank top.
Electrols Serial Number	<ul style="list-style-type: none"> ◆ On blue foil label located inside Electrol cover. ◆ Also on Electrols data label located on Electrols top.

A. WHAT YOU NEED TO DO

1. Preventive Maintenance for the RAMVAC Dental Vacuum System primarily involves servicing the lubrication system, filters and vacuum lines.
2. To start down the decades-long road of trouble-free operation, operators and maintenance personnel need to be well informed. The most common source of problems are personnel who fail to understand what can help or what can hurt the system.
3. Follow the operation and maintenance procedures specified in the User Guide supplied with each RAMVAC. Use the Installation Checklist and other briefing materials packed with the RAMVAC to make sure the right people get the right information.

B. CLEANING VACUUM SYSTEM PLUMBING

1. Clean vacuum plumbing to keep pipes, hoses and solids separator free from debris that could obstruct flow or create obnoxious odors. No single cleaning routine is best for all situations. Requirements vary according to frequency of use and type of materials aspirated.
2. Of the most common intentionally aspirated substances, prophy paste and fluoride gels are the most likely to cause clogs. Many service techs feel the most economical and effective method for clearing lines of prophy paste and fluoride gels is to aspirate a solid slug of hot water.
3. When caught in tight or rough areas, unintentionally aspirated items, such as cotton rolls, cotton tipped applicators, and (yes) 2x2 cotton sponges can cause clogs. Blockages created by these materials are best avoided since they will often require the services of a plumber to correct. ***Building all vacuum line like "drain lines" is the most important step you can take towards prevention.***
4. **Daily: Rinse and Clean Vacuum Lines**
 - a. Just before turning off the RAMVAC, rinse vacuum lines by drawing **hot** water through vacuum lines -- approximately one quart through each high volume line and a few ounces through each saliva ejector line.
 - b. Then aspirate a few ounces of a dental vacuum line cleaner through each vacuum line. Your vacuum line cleaner should be non-foaming, de-odorizing, anti-microbial, and able to dissolve organic debris. RAMCLEAN[®] is an excellent product with these qualities and is highly recommended.
 - c. Cleaning requirements will vary according to activity. It is recommended that after surgical procedures a

NOTE

Many cleaners claim to be "non-foaming" . . . but they are NOT!
Test by shaking the mixed solution.

few ounces of an appropriate vacuum line cleaner such as RAMCLEAN[®] be drawn through the vacuum line.

5. Weekly: Clean Treatment Room Solids Separator

The cleaning interval for the treatment room solids separator will vary with the amount and type of use. More or less frequent cleaning may be required for your particular situation.

C. LUBRICATION - GENERAL INFORMATION

1. One of the reasons your RAMVAC outlasts every other dental vacuum system is its lubrication system. Under normal operating conditions, a continuous flow of clean oil lubricates the RAMVAC rotor and vanes.
2. The lubrication system is extremely dependable since oil is transported to moving parts by vacuum and gravity. Used oil leaves the pump as a mist which is then separated, in the oil reservoir, from the rest of the exhaust.
3. Some RAMVAC systems recirculate used oil; some do not. Recirculating systems require different preventive maintenance than non-recirculating systems. See the User Guides shipped with each RAMVAC for detailed maintenance information pertaining to the specific RAMVAC model.

D. LUBRICATION - WHAT YOU NEED TO DO

Standard Non-Recirculating 550 Systems	Standard Non-Recirculating 1200,1400 & 2800 Systems
<p>1. Drain Used Oil Monthly</p> <p>Completely drain <i>used</i> oil reservoir. If more than a quart of used oil has accumulated, drain oil more frequently.</p> <p>2. Add New Oil If new oil level is below the middle of the oil level sight gauge.</p>	<p>1. Drain Used Oil Weekly</p>

Standard Recirculating Systems and All Bulldog Systems
<p>1. Change oil. Drain oil. Add new oil. See user Guide for intervals.</p> <p>2. Service Oil Filter Remove, clean if necessary, or replace.</p>

NOTES

Use only recommended oil.
See User Guide for specifications.

Dispose of used oil responsibly.
Take to an oil recycling center.
Do not discard in trash or on the ground.

E. OIL DRIP RATE

1. Oil feeds into the RAMVAC pump at a very slow rate -- drop by drop. The oil "drip rate" is the RAMVAC's heart beat. Check this important "vital sign" with the pump warmed up, running and pulling "normal" vacuum.
2. Look for the oil drip through the site glass in the lower portion of the dripper assembly. See the User Guide supplied with the RAMVAC for the sight glass location on that particular model.
3. Check oil drip rate monthly for the first 3 months of operation. Thereafter check every 6 months.
4. "Normal" drip rates are listed in the table below. Higher vacuum and/or temperatures will increase the drip rate. Lower vacuum and/or temperatures will decrease the drip rate.
5. If the drip rate is too low, refer to Section 4.

Vac	Temp	Drips per Minute with Standard Metering Cartridge					
		550	1200	1400	2800		
7" Hg	70°F	Each Dripper		2 to 3	4 to 6	2 to 3	4 to 6
		Minimum	Total of all Drippers	4	8	6	10
		Maximum		6	10	10	15
7" Hg	80°F	Each Dripper		3 to 4	5 to 8	3 to 4	5 to 8
		Minimum	Total of all Drippers	6	10	9	13
		Maximum		8	16	13	26
7" Hg	90°F	Each Dripper		4 to 5	7 to 10	4 to 5	7 to 10
		Minimum	Total of all Drippers	8	13	10	19
		Maximum		10	21	17	32
10" Hg	70°F	Each Dripper		4 to 5	7 to 10	4 to 5	7 to 10
		Minimum	Total of all Drippers	8	13	10	19
		Maximum		10	21	17	32
10" Hg	80°F	Each Dripper		5 to 6	8 to 12	5 to 6	8 to 12
		Minimum	Total of all Drippers	10	15	13	22
		Maximum		12	25	20	38
10" Hg	90°F	Each Dripper		6 to 7	9 to 13	6 to 7	9 to 13
		Minimum	Total of all Drippers	12	17	16	25
		Maximum		14	27	23	41

6. If the drip rate is too high, contact RAMVAC Corporation.
7. Metering cartridges for other than "standard" drip rate are available.

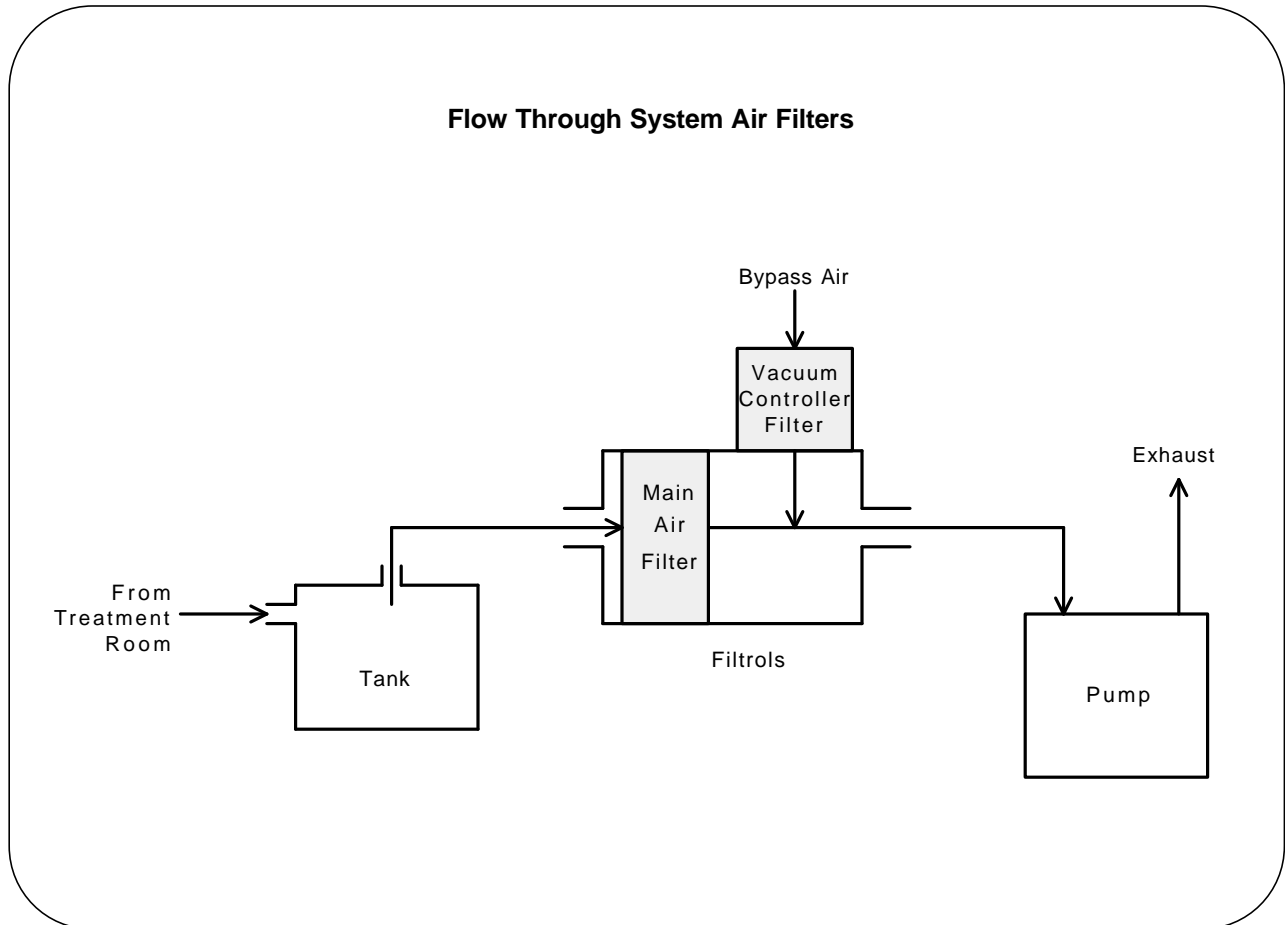
F. GENERAL CONDITION

The general condition of the system should be checked for cleanliness, tightness of hoses, and unusual sounds.

G. AIR FILTERS - GENERAL INFORMATION

The RAMVAC system uses two air filters to help insure abrasive materials do not enter the pump.

1. The vacuum controller filter cleans air entering through the vacuum relief (vacuum controller) valve.
2. The main air filter cleans the air entering the pump that comes from treatment rooms.



H. AIR FILTERS - WHAT YOU NEED TO DO

1. Check filters, during "normal" operating conditions, at least every 6 months.

NOTES

1. "Normal" conditions means the RAMVAC is running in a clean, relatively dust-and dirt-free environment.
2. New construction sheet rock dust or outside installations will require more frequent service of the vacuum controller filter element.
3. Use of abrasive cavity preparation equipment or aspiration of unusual quantities of dusty material from the treatment room will require more frequent service of the main air filter element.

2. Clean or replace filter when visibly dirty.
3. Dirty filters may be reused by washing in detergent and water.
4. Order replacement filters from RAMVAC.

	Standard Systems	Bulldog Systems
Vacuum Controller Filter	RAMVAC Part No. 710,710	RAMVAC Part No. 780,710
Main Air Filter	RAMVAC Part No. 710,715	RAMVAC Part No. 780,715

I. V-BELTS - GENERAL INFORMATION

1. V-belt drives allows the use of standard rpm, common NEMA frame motors, to operate pumps at variety of speeds. RAMVAC 1750 rpm (one of the most common speeds in the US) motors drive RAMVAC pumps at even slower speed to increase pump service life. Direct drives lock pump speed to motor rpm. V-belt allows a given pump to be set up for different speeds and creates model upgradability.

J. V-BELT TENSION

1. RAMVAC pre-stretches v-belts during factory test runs so belts will typically not need tension adjustments during the belt's service life. However, it is a good practice to inspect v-belt condition yearly. If the v-belt(s) slips or squeaks when the pump is first turned on, tension is too loose.
2. Access for belt inspection varies with the RAMVAC model:

Standard Power Units	All Bulldog Power Units
Inspect belt through door on drive enclosure.	Inspect belt though belt guard grill.

NOTES

1. If belt tension must be adjusted, insure that pulley alignment is maintained.
2. Misalignment can cause premature belt wear, excessive bearing loads and unnecessary electrical power consumption.
3. Follow the applicable Service Procedure for correct pulley alignment and belt tension.
4. Use v-belt tension tester, RAMVAC product 800,452.

K. V-BELT REPLACEMENT

1. Replace v-belt(s) at the end of their typical service life or earlier if cracked or frayed.
2. See "Component Specifications", Section 5, for the description of a specific model's v-belt.
3. V-belts service life will vary with specific loads and environmental conditions. Service life anticipated under "typical" conditions are:

Standard Power Units	All Bulldog Power Units
10 Years	20 Years

L. Routine Maintenance for Bulldogs

Once-a-Year for "Normal" Service Conditions:

- ◆ vacuum setting weaker than 10" Hg, or
- ◆ ambient temperature cooler than 90° F, or
- ◆ less than 40 hours of operation per week

Twice-a-Year for "Heavy Duty" Service Conditions:

- ◆ vacuum setting stronger than 10" Hg, or
- ◆ ambient temperature hotter than 90° F, or
- ◆ more than 40 hours of operation per week

Lubrication

See Bulldog User Guide, page 3 & 4, for illustrations and details.

Drain Oil

- ◆ Oil drains better when hot.
- ◆ Place empty oil container (minimum 5 quarts) under oil drain tube.
- ◆ Open oil drain valve. When oil stops draining, close valve. Complete draining may take up to 15 minutes.

Oil Filter

- ◆ Unscrew oil filter and remove filter element. Be prepared for a small amount of oil to drip.
- ◆ If visibly dirty, clean element in solvent and shake dry.
- ◆ Re-assemble oil filter. Hand tighten only.

Replace Oil

- ◆ Remove oil filler cap.
- ◆ Pour Mobil 1, 15w50, into reservoir until site gage is 1/2 to 3/4 full. Typically, this takes less than 5 quarts. **Do NOT Overfill.**
- ◆ Securely re-install oil filler cap.
- ◆ Dispose of used oil at a gas station or lubricant recycling station.

Air Filters

See Bulldog User Guide, page 2, for illustrations and details.

Vacuum Controller Filter

- ◆ Clean or replace when visibly dirty.
- ◆ Dirty filters may be reused by washing in detergent and water, or replace with RAMVAC part no. 780,710.

Main Air Filter

- ◆ Lift vacuum controller out of Filtrols.
- ◆ Slide main air filter out from under inlet pipe
- ◆ Clean or replace filter when visibly dirty.
- ◆ Dirty filters may be reused by washing in detergent and water, or replace with RAMVAC part no. 780,715.

M. Routine Maintenance for Standard Power Units with Non-Recirculating Lubrication Systems

Lubrication

See User Guide for illustrations and details.

Drain Used Oil

- ◆ Oil draining can be done with pump running.
- ◆ Place oil drain tube in empty oil jug.
- ◆ Open drain valve.
- ◆ Close valve when oil stops flowing.
- ◆ Bring used oil to service stations for recycling.

Once-a-Month for 550 Pumps with "normal" drip rate.

Once-a-Week for 1400 Pumps with "normal" drip rate.

Drain used oil more frequently for elevated drip rates.

See section III, page 3 for "normal" drip rates.

"Normal" conditions are 7" Hg and 70°F.

Add New Oil When Less Than 1/2 Full

- ◆ Oil replenishing can be done with pump running.
- ◆ Remove oil filler cap.
- ◆ Slowly pour RAMVAC pump oil into filler pipe.
Changes in oil level sight glass occur slowly.
Allow time to avoid overfilling.
- ◆ Keep oil level below upper white arrow.
- ◆ Replace filler cap.

For Optimum Service: DO NOT REUSE OIL

Use only RAMVAC Pump Oil part no. 310,703

Mobil Delvac 1300 or 1200 Super 15w40

or Shell Rotella T 15w40

Air Filters

See User Guide for illustrations and details.

Check air filters every 6 Months under normal conditions.
Check filters more frequently if conditions are unusually dirty .

Vacuum Controller Filter

- ◆ Clean or replace when visibly dirty.
- ◆ Dirty filters may be reused by washing in detergent and water, or replace with RAMVAC part no. 710,710.

Main Air Filter

- ◆ Peel rubber ring up from around middle of Filtrols.
- ◆ Remove Filtrols upper section.
- ◆ Remove main air filter.
- ◆ Clean or replace filter when visibly dirty.
- ◆ Dirty filters may be reused by washing in detergent and water, or replace with RAMVAC part no. 710,715.
- ◆ Reinstall filter by placing side hole over Filtrols-to-pump pipe.

N. Routine Maintenance for Standard Power Units with Recirculating Lubrication Systems

Lubrication

See User Guide for illustrations and details.

Drain Old Oil

- ◆ Place oil drain tube in empty oil jug.
- ◆ Open drain valve.
- ◆ Close valve when oil stops flowing.
- ◆ Bring used oil to service stations for recycling.

CHANGE OIL EVERY 6 MONTHS
for "normal" drip rates.

Drain used oil more frequently for elevated drip rates.
See section III, page 3 for "normal" drip rates. "Normal"
conditions are 7" Hg and 70°F.

Oil Filter

- ◆ Unscrew oil filter and remove filter element. Be prepared for a small amount of oil to drip.
- ◆ If visibly dirty, clean element in solvent and shake dry.
- ◆ Re-assemble oil filter. Hand tighten only.

Add New Oil

- ◆ Remove oil filler cap.
- ◆ Pour 5 quarts RAMVAC pump oil into filler pipe.
- ◆ Changes in oil level sight glass occur slowly. Allow time to avoid overfilling.
- ◆ Keep oil level below upper white arrow.
- ◆ Replace filler cap.

For Optimum Service: DO NOT REUSE OIL
Use only RAMVAC Pump Oil part no. 310,703
Mobil Delvac 1300 or 1200 Super 15w40
or Shell Rotella T 15w40

Air Filters

See User Guide for illustrations and details

Check air filters every 6 Months under normal conditions.
Check filters more frequently if conditions are unusually dirty .

Vacuum Controller Filter

- ◆ Clean or replace when visibly dirty.
- ◆ Dirty filters may be reused by washing in detergent and water, or replace with RAMVAC part no. 710,710.

Main Air Filter

- ◆ Peel rubber ring up from around middle of Filtrols.
- ◆ Remove Filtrols upper section.
- ◆ Remove main air filter.
- ◆ Clean or replace filter when visibly dirty.
- ◆ Dirty filters may be reused by washing in detergent and water, or replace with RAMVAC part no. 710,715.
- ◆ Reinstall filter by placing side hole over Filtrols-to-pump pipe.

Problem	Possible Cause	Corrective Action	Reference
Vacuum too high	Vacuum Controller Adjustment	Adjust Vacuum Controller	Page 1
Oil drip rate low	Low Oil Temperature Low Vacuum Setting Dirty Oil Filter Improper Oil	Adjust Ambient Temperature Adjust Vacuum Controller Clean Filter Change to Recommended Oil	Page 1 Page 1 Page 1 User Guide
Oil drip rate high	High Oil Temperature High Vacuum Setting Improper Oil	Adjust Ambient Temperature Adjust Vacuum Controller Change to Recommended Oil	Page 1 Page 1 User Guide
Low or no vacuum (motor running ok)	Dirty Oil Reservoir Full Drain Valve Blocked Open Clogged Vacuum Line Vacuum Leaks Loose Drive Belt Stuck Vanes	Drain Dirty Oil Clean Drain Valve Locate and Remove Clog Locate and Fix Leak Tighten Belt Clean and Lubricate Vanes	Page 2 Page 2 Page 2 Page 2 Page 2 Page 3
Motor does not run	"Popped" Breaker or Fuse "Popped" Thermal Overload Moisture Alarm Low Oil Level Alarm Motor Failure Failed Control Component	Reset Breaker/Replace Fuse Reset Thermal Overload Perform Moisture Alarm Procedure Add Oil Replace Motor Bypass and Replace Failed Component	Page 4 Page 5 Page 7 Page 7 Page 5 Page 6
Alarms	Tank Overfilled Drain Valve Stuck Foaming Line Cleaner Used Cold Sterilizing Solution Aspirated Low Oil Level Alarm Board Failure	Drain Tank Clean Drain Valve Use "RAMCLEAN" Line Cleaner Don't Do That! Add Oil Bypass/Replace Moisture Alarm Board	Page 7 Page 7 Page 7 Page 7 Page 7 Page 6
Oil Comes Out Exhaust	Dirty Oil Reservoir Overfull Pump Flodded Backwards Rotation @ Shut-Down No Exhaust Check Valve	Drain Dirty Oil Check Moisture Alarm System Install/Replace Exhaust Check Valve Install Exhaust Check Valve	User Guide Install. Instructions Install. Instructions Install. Instructions

* Pages are in Section 4

A. ABOUT THIS SECTION

The information in this section provides organized responses to trouble conditions listed on the Troubleshooting Chart.

B. VACUUM TOO HIGH - Adjust Vacuum Controller

1. The vacuum controller adjusts sealed suction strength.
2. *Close all vacuum lines before adjusting vacuum controller.*
3. Adjust vacuum controller by loosening the hex lock nut and turning the knurled adjustment nut.
4. Use the Filtrols vacuum gauge to evaluate changes.
5. Tighten lock nut after adjustment is complete.

NOTES

1. The vacuum controller can also be adjusted to increase sealed suction strength up to 15" Hg **with the appropriate horsepower motor**.
2. The vacuum controller should not be adjusted for vacuum intensity greater than the maximum specified for the installed motor.
3. See Section I, page 7, "Duty Cycle and Vacuum Limits."
4. Optional motors are available for applications that require higher vacuum intensities.

C. OIL DRIP RATE LOW

1. Low drip rates may be caused by low oil temperatures, low vacuum settings, a dirty oil filter or by using improper oil.
2. Clean oil filter cartridge by unscrewing the oil filter, removing the filter element and washing the element in solvent. Dry and replace the element.

D. OIL DRIP RATE HIGH

1. High drip rates may be caused by high oil temperatures, high vacuum settings, or by using improper oil.
2. High drip rates will require more frequent servicing of models that do not recirculate oil.
3. High drip rates may cause oil to come out the exhaust.

NOTES

1. For additional lubrication system details, see:
 - a. Section I, page 5
 - b. Section III, pages 2 and 3
2. For oil recommendations, see User Guides

E. LOW or NO VACUUM (motor running okay)**Step 1**

- a. Check vacuum at all vacuum stations.
- b. If vacuum is adequate at one or more stations, the problem involves operatory plumbing or operatory vacuum equipment.
- c. Be sure to check for clogged solids separators.
- d. If low vacuum is observed at all stations, continue with Step 2.

Step 2

- a. If this is a problem with vacuum at *each* station being somewhat weaker than the users prefer, and the Filtrols vacuum gauge reads 7½" Hg *sealed* suction, and the installation is new installation, the vacuum controller should be adjusted for stronger sealed suction.
- b. See "**Vacuum Too High - Adjust Vacuum Controller**" paragraph (previously page). If this is not the cause, continue with Step 3.

Step 3

- a. For non-oil-recirculating models (see Section I, page 6: "RAMVAC Models"), check to see that dirty oil has been drained when new oil has been added. Failure to drain used oil eventually will interfere with pump operation and could cause damage to equipment.
- b. If dirty oil has been drained properly, proceed with Step 4.

Step 4

- a. If a sudden, dramatic loss in vacuum has occurred, the tank drain valve may be blocked open. See "Drain Valve Leaks" on page 9 in this section.
- b. Other vacuum leaks or plumbing clogs may be responsible for lost or diminished performance. If the Filtrols vacuum gauge shows normal vacuum (usually 5-7" Hg), suspect clogged plumbing. Again, please refer to page 9.
- c. If leaks or clogs are ruled out, proceed to Step 5.

Step 5

- a. Turn the Power Unit off (see User Guide) and remove the hose from the pump inlet.
- b. Turn on Power Unit and place hand over pump inlet.
- c. If strong vacuum (much stronger than you would expect from a good vacuum cleaner) is felt, return to Step 4; a vacuum leak or plumbing clog exists.
- d. If weak or no vacuum is felt, proceed with Step 6.

LOW or NO VACUUM (motor running okay), continued**Step 6**

- a. Check for a loose drive belt and adjust if needed. See Section III, page 6.
- b. If problem persists, proceed to Step 7.

Step 7

- a. With the power off, the drive system enclosure cover removed and the inlet hose off, rotate pump in each direction by turning the pump pulley by hand.
- b. If vanes remain flush with rotor, proceed to Step 8.
- c. If vanes move away from a position flush with the rotor surface, call your dealer or RAMVAC Corp.

Step 8 STUCK VANES**a. General Information**

- ◆ Vanes can get stuck from insufficient oil flow or gross contamination of the pump with debris.
- ◆ It is important to detect and eliminate the cause of stuck vanes to prevent a recurrence of the condition which, in addition to being inconvenient, could shorten pump life.

b. Loosen Stuck Vanes as follows:

- ◆ Standard models: disconnect the hose from the pump intake
Bulldog models: remove the stainless steel elbow from the pump intake
- ◆ Look through the intake port into the pump as the pump pulley is hand rotated. With every 90 degrees of rotation a vane slot will appear on the moving surface of the pump rotor. Extra light directed into the port may help illuminate the vane slots.
- ◆ Spray liberal amounts of "WD-40" at the vane slots or pour an ounce of diesel fuel or

NOTE

1. On Standard models, hand rotate the pump by reaching through the belt check door on the belt guard and moving the v-belt.
2. On Bulldog models, remove 8 belt guard screws and move belt guard away from back plate. Hand rotate the pump by moving the pump pulley.

kerosene on the vanes. Move the rotor manually until the vanes loosen and vane movement is observed.

- ◆ Reconnect hose or elbow, secure belt guard, and start up pump.
- ◆ ***Change oil as soon as possible.*** Refer to "Contaminated Oil Change" procedure described on page 8 of this section.

F. MOTOR DOES NOT RUN

1. This condition involves an electrical problem of some sort.
2. RAMVAC circuitry is straightforward and allows for easy troubleshooting.
3. Use the following table to get started.

Condition:	Go To:
Amber "Power On" Indicator on Electrols is not ILLUMINATED	Page 4, Step 1
Amber "Power On" Indicator is ILLUMINATED and Red "Alarm" Indicator is not ILLUMINATED	Page 5, Step 2
Motor only runs when "Mode Selector" switch is placed in the "Manual" position	Page 6, Step 5
Red "Alarm" Indicator on Electrols is ILLUMINATED	Page 7, "Alarms"

Step 1 - Power not reaching RAMVAC

- a. An electrical problem may exist in your building.
- b. Check the circuit breaker or fuse that protects the RAMVAC circuit.
- c. Reset or replace if needed. It is important to detect and correct the cause of a "popped" circuit breaker or "blown" fuse to prevent a recurrence, which in addition to being inconvenient, could lead to equipment failure.
- d. If the circuit breaker has "popped" or fuse "blew", check for the following possible causes:
 - ◆ circuit breaker or fuse too small
 - ◆ combined load on circuit too great (see note below)
 - ◆ low incoming voltage (brown-outs), loss of one leg of high voltage power or other power company problem

NOTE

1. Supply RAMVAC power from an independent circuit that serves *no other equipment*.
2. See Section V, page 2, "Electrical Specifications", for recommended wire size and circuit protection.

MOTOR DOES NOT RUN, continued**Step 2**

- a. Position the mode selector switch to "manual," then "off," then "auto."
- b. If the motor fails to run with the switch in any position, proceed to Step 3.
- c. If the motor runs only with the switch in the "manual" position, proceed to Step 5.

Step 3

- a. RAMVAC motors are protected by devices that shut off the motor if an overload is detected.
- b. If an overload has occurred, it may be necessary to reset the overload protection device.
- c. It is important to identify and eliminate the cause of the overload to prevent recurrence, which in addition to being inconvenient, could lead to a motor failure.
- d. The following are possible causes for motor overloads:
 - ◆ clogged filters
 - ◆ insufficient oil
 - ◆ rapid on/off cycling of motor
 - ◆ vacuum controller set too high
 - ◆ insufficient line voltage
 - ◆ high ambient temperature
 - ◆ debris in pump
- e. Some RAMVACs are equipped with thermal protective devices (overloads) built into the motor. Some three phase motors have built-in overloads that automatically reset. Overloads on single phase motors must be reset manually. To reset manual overloads, depress the red button located on the side of the motor. Cooling time may be required before overloads will reset.
- f. All three phase motors are protected by an overload relay which is part of the motor starter. The overload relay will open if a current overload is sensed, if three phase "legs" become grossly out of balance or a "leg" is lost. Reset by depressing the large red button located on the outside of the Electrols enclosure.
- g. If motor protection devices are not a source of power interruption, proceed with Step 4.

WARNING

**Thermal overload protectors used in *some* motors may reset automatically.
These motors may *restart without warning!***

MOTOR DOES NOT RUN, continued

Step 4

WARNING

SOME PROCEDURES MAY INVOLVE WORKING WITH LIVE CIRCUITS!

**PROCEDURES SHOULD BE PERFORMED ONLY BY INDIVIDUALS
COMPETENT TO SAFELY WORK WITH LIVE CIRCUITS.**

- a. Check for power at the starter/contactor "load" terminals.
- b. If power is available, a motor failure has occurred and the motor must be replaced.
- c. If power is not available proceed with Step 5.

Step 5

- a. An electrical control component has failed and must be replaced.
- b. The RAMVAC has been designed to provide for operation with a failed control component.
- c. Use the wiring diagram located inside the cover of the RAMVAC Electrols to assist in locating the failed component.
- d. Use the following chart:

FAILED COMPONENT	ACTION
Moisture Alarm Relay Board	Leave mode switch in "manual"
Remote On/Off Switch	Leave mode switch in "manual"
Low Voltage Control Relay	Leave mode switch in "manual"
Low Voltage Transformer	Leave mode switch in "manual"
Starter/Contactor	Place jumpers to bypass

NOTE

Placing jumpers or leaving the mode selector switch in "Manual" will:

- 1. Disable remote on/off switching capabilities.
- 2. Require the pump motor to be turned on and off from the circuit breaker.
- 3. Allow moisture to enter the pump if the Separating Tank overfills.
- 4. Require the RAMVAC to be turned off several times during the day to allow Separating Tank to drain, and to reduce the possibility of tank overfilling.

G. ALARMS

1. All RAMVACs are equipped with a Moisture Alarm System while some have, in addition, a Low Oil Alarm System.
2. The "Alarm" indicator will illuminate if a Moisture Alarm or a Low Oil Alarm occurs.
3. **Moisture Alarms**
 - a. The Moisture Alarm System is designed to protect the RAMVAC against pump flooding.
 - ◆ The most likely cause of flooding is aspiration of substances that foam excessively. Some vacuum line cleaners and many cold sterilizing solutions create large quantities of foam.
 - ◆ Flooding can also be caused by inadequate tank draining time, obstruction of the drain valve or drain line, or aspiration of water in a quantity that exceeds tank capacity.
 - ◆ Pump flooding can cause "stuck vanes" and oil contamination. Sustained, gross flooding can activate motor overload protectors and result in motor shut-down.
 - b. The Moisture Alarm System consists of a moisture sensor probe located in the bottom of the Filtrols assembly, wiring to connect to the Electrols, and solid state circuitry located in the Electrols box.
 - c. The Moisture Alarm System becomes activated when an excess amount of liquid and/or foam enters the Filtrols and changes the electrical resistance between the moisture sensor electrodes.
 - d. Moisture Alarm System activation will:
 - ◆ switch the pump motor off -- if the Electrols Mode Selector Switch is in the "NORMAL ON" position
 - ◆ switch on the red "Alarm" Indicator
4. **Moisture Alarm Reset**
 - a. Depress Alarm Reset Pushbutton on the Electrols panel.
 - b. If excess moisture remains in the Filtrols, removal will be necessary in addition to depressing the Reset Pushbutton.
 - ◆ Moisture will automatically drain from Bulldog Filtrols.
 - ◆ Clear moisture from standard model's Filtrols according to the procedure stated in the User Guide.

NOTE

Moisture Alarms are **not** normal events.
Detect and correct the **cause** of any Moisture Alarm.

ALARMS, continued**5. Low Oil Alarms**

- a. The Low Oil Alarm System is designed to protect the RAMVAC against running out of oil.
- b. All 1400 and 2800 models come standard with this system.
- c. System components include a low oil level switch located in the oil reservoir, wiring that connects with the Electrols, and solid state circuitry located in the Electrols box.
- d. The Low Oil Alarm System becomes activated when the oil level drops below where it can be seen in the oil level sight glass and closes the low oil switch.
- e. Low Oil Alarm System activation will:
 - ◆ switch the pump motor off -- if the Electrols Mode Selector Switch is in the "NORMAL ON" position
 - ◆ switch on the red "Alarm" Indicator.

H. CHECKING FOR LEAKS AND CLOGS

1. Where to start:
 - a. If a sudden, dramatic loss of vacuum has occurred, refer to "Drain Valve Leaks."
 - b. If a slow or slight reduction of vacuum has occurred, refer to "Locations to Check for Leaks and Clogs."
2. How to check for leaks:
 - a. A major vacuum leak usually occurs suddenly and is associated with a dramatic loss of vacuum. Major leaks typically make easily noticed noise.
 - b. Smaller leaks may exist for a long time and may gradually accumulate in number, slowly degrading vacuum strength. Small leaks may be difficult to hear so use the following techniques to help.
 - ◆ Move your hand around suspicious components (see "Locations to Check for Leaks and Clogs"). As your hand passes near a vacuum leak, a noticeable change in the sound of moving air involved with the leak may be heard.
 - ◆ The noise from small leaks may be amplified by holding one end of a hose to your ear and the other end near the location to be inspected, or by the use of a stethoscope.

I. LEAKS AND CLOGS - LOCATIONS AND CAUSES

Likely leak locations and causes:	Likely clog locations:
<ul style="list-style-type: none"> ◆ tank drain valve ◆ Filtrols sealing ring on standard model (not in place) ◆ moisture sensor probe (not in place) ◆ operatory vacuum equipment (particularly vacuum valves) ◆ plumbing connections ◆ vacuum controller (set too low or malfunctioning) 	<ul style="list-style-type: none"> ◆ operatory vacuum equipment such as solids separators, hoses, hose to solid plumbing connections ◆ plumbing low spots or clean-outs ◆ main air filter ◆ plumbing turns and joints ◆ exhaust line (check for rodents, birds and insects)

J. DRAIN VALVE LEAKS

1. Tank Drain obstructions can prevent the valve from closing properly and cause a major vacuum loss.
2. To check for debris that might be blocking the valve open, remove the valve from the tank by unscrewing the ribbed collars at each end and sliding the valve off the connecting pipes
3. When reinstalling the valve, be sure to position the valve correctly according to the arrows embossed on the side of the valve body: the "up" arrow must point up and the "flow" arrow must point downstream (towards the sewer).

K. CONTAMINATED OIL CHANGE

1. General Information

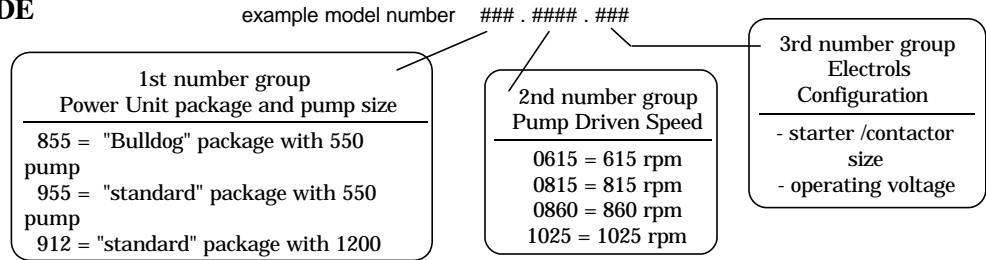
- a. During normal operation, the non-oil-recirculating RAMVAC will require no oil change other than what occurs from the oil replenishment procedure described in Section 3. Recirculating models require oil changes as also described in Section 3.
- b. In case oil contamination has occurred all oil should be drained.

2. Procedure

- a. **Standard Oil Recirculating Systems and all Bulldog Systems:** change oil and service oil filter as described in Section 3.
- b. **Standard Non-Recirculating Systems:** Drain used oil by holding a container under the drain valve and opening the valve. Close the valve when oil no longer flows. Then, continue as follows:
 - ◆ Position a pan, with a minimum capacity of 1 1/2 gallons, under the drain plug* located on the underside of the oil reservoir assembly.
 - ◆ Remove the drain plug* (on 1400, 2800, taking care not to place excessive force on the RAMVAC platform mounts. Grasp the oil filler pipe securely to oppose the torque of loosening the drain plug.
 - ◆ When oil stops flowing, clean the plug*, coat the threads with a sealing agent, replace plug* and tighten securely.
 - ◆ Remove oil filter element by unscrewing the lower portion of the oil filter (see Figure 2). Clean the filter element by washing in solvent. Dry the filter element, replace it and securely refasten the lower portion of the oil filter.
 - ◆ Replenish oil supply with new RAMVAC pump oil.

* The drain plug is replaced by a low oil level switch on models equipped with the low oil alarm system.

A. MODEL NUMBER CODE



B. POWER UNITS

	Pump		Motor			V-Belt					Ship Wt. lb. (Kg).
	Size	RPM	Hp	1ph Frame	3ph Frame	Length	Width	Type	Gates #	Qty.	
855.0615	550	615	1.0	56/56H	56	650mm	7mm	Polyflex	2/7M 650	1 ea	260
955.0615	550	615	1.0	56/56H	56	46"	1/2"	"A"	A45	1 ea	260
855.0815	550	815	1.5	56/56H	56	670mm	7mm	Polyflex	2/7M 670	1 ea	265
955.0815	550	815	1.5	56/56H	56	47"	1/2"	"A"	A46	1 ea	265
855.1025	550	1025	To be announced							1 ea	275
955.1025	550	1025	3.0	184T	182T	49"	1/2"	"A"	A47	1 ea	275
912.0860	1200	860	3.0	184T	182T	48"	1/2"	"A"	A46	1 ea	325
914.0615	1400	615	3.0	184T	182T	45"	1/2"	"A"	A43	2 ea	325
914.0815	1400	815	3.0	184T	182T	46"	1/2"	"A"	A44	2 ea	325
914.1025	1400	1025	5.0	n/a	184T	48"	1/2"	"A"	A46	2 ea	325
928.0615	2800	615	5.0	n/a	184T	59"	1/2"	"A"	A57	3 ea	375
928.0815	2800	815	7.5	n/a	213T	59"	1/2"	"A"	A57	3 ea	380
928.1025	2800	1025	10	n/a	215T	60"	1/2"	"B"	B57	3 ea	390

C. FILTERS

	Vacuum Controller		Main Air		Oil	
	Type	Part No.	Type	Part No.	Type	Part No.
Bulldog Models	washable foam	780,710	washable foam	780,715	metal screen	310,715
Standard Models	washable foam	710,710	washable foam	710,715	metal screen	310,715

NOTE
The above are normal production specifications. Some variations exist.
For other specifications, see Pre-Installation Guide or documents supplied with a specific model or have model and serial number ready and call RAMVAC.

D. ELECTRICAL SPECIFICATIONS

- ◆ See Pre-Installation Guide for most current update of specifications.
- ◆ Wiring Diagrams are placed inside Electrols doors.
- ◆ Electrical Specification for particular Power Units are listed on each Electrols top.

POWER UNIT Model Number	Motor Hp	Motor Voltage ¹	Motor Phase	Motor Max Amps	THHN Wire Size ²		Overload Relay Setting ³	Fuse- tron ⁴	Circuit Breaker ²	ELECTROLS Model No.
					50 ft.	100 ft				
855 or 955.0615.11	1.0	115	1	13.2 @ 115 v	12 ga.	10 ga.	n/a	FRN 25	20 amp	655,911
855 or 955.0615.22	1.0	208-230	1	6.6 @ 230 v	12 ga.	12 ga.	n/a	FRN 8	15 amp	655,922
855 or 955.0615.30	1.0	208-230	3	3.4 @ 230 v	12 ga.	12 ga.	3.4	FRN 5	15 amp	610,930
855 or 955.0815.11	1.5	208-230	1	9.0 @ 230 v	12 ga.	12 ga.	n/a	FRN 15	15 amp	655,911
855 or 955.0815.30	1.5	208-230	3	4.8 @ 230 v	12 ga.	12 ga.	4.8	FRN 7	15 amp	610,930
855.1025.11	2.0	208-230	1	12.0 @ 230 v	12 ga.	12 ga.	n/a	FRN 15	20 amp	655,911
855.1025.30	2.0	208-230	3	6.4 @ 230 v	12 ga.	12 ga.	6.4	FRN 8	15 amp	610,930
955.1025.11	1.5	208-230	1	9.0 @ 230 v	12 ga.	12 ga.	n/a	FRN 15	15 amp	655,911
955.1025.30	1.5	208-230	3	4.8 @ 230 v	12 ga.	12 ga.	4.8	FRN 7	15 amp	610,930
955.1025.23	3.0	208-230	1	16.0 @ 230 v	10 ga.	10 ga.	n/a	FRN 25	25 amp	610,923
955.1025.33	3.0	208-230	3	8.4 @ 230 v	12 ga.	12 ga.	8.4	FRN 12	15 amp	610,930
912.0860.23	3.0	208-230	1	16.0 @ 230 v	10 ga.	10 ga.	n/a	FRN 25	25 amp	610,923
912.0860.30	3.0	208-230	3	8.4 @ 230 v	12 ga.	12 ga.	8.4	FRN 12	15 amp	610,930
912.0860.40	3.0	460	3	4.2 @ 460 v	12 ga.	12 ga.	4.2	FRS 5	15 amp	610,940
914.0615.23	3.0	208-230	1	16.0 @ 230 v	10 ga.	10 ga.	n/a	FRN 25	25 amp	610,923
914.0615.30	3.0	208-230	3	8.4 @ 230 v	12 ga.	12 ga.	8.4	FRN 12	15 amp	610,930
914.0615.40	3.0	460	3	4.2 @ 460 v	12 ga.	12 ga.	4.2	FRS 5	15 amp	610,940
914.0815.23	3.0	208-230	1	16.0 @ 230 v	10 ga.	10 ga.	n/a	FRN 25	25 amp	610,923
914.0815.30	3.0	208-230	3	8.4 @ 230 v	12 ga.	12 ga.	8.4	FRN 12	15 amp	610,930
914.0815.40	3.0	460	3	4.2 @ 460 v	12 ga.	12 ga.	4.2	FRS 5	15 amp	610,940
914.1025.37	5.0	208-230	3	14.0 @ 230 v	12 ga.	12 ga.	14.0	FRN 25	20 amp	615,937
914.1025.47	5.0	460	3	7.0 @ 460 v	12 ga.	12 ga.	7.0	FRS 10	15 amp	615,947
928.0615.37	5.0	208-230	3	14.0 @ 230 v	12 ga.	12 ga.	14.0	FRN 25	20 amp	615,937
928.0615.47	5.0	460	3	7.0 @ 460 v	12 ga.	12 ga.	7.0	FRS 10	15 amp	615,947
928.0815.327	7.5	208-230	3	21.6 @ 230 v	8 ga.	8 ga.	21.6	FRN 25	30 amp	628,932
928.0815.47	7.5	460	3	10.8 @ 460 v	12 ga.	12 ga.	10.8	FRS 15	15 amp	615,947
928.1025.337	10.0	208-230	3	25.6 @ 230 v	6 ga.	6 ga.	25.6	FRN 30	30 amp	628,933
928.1025.47	10.0	460	3	12.8 @ 460 v	12 ga.	12 ga.	12.8	FRS 15	20 amp	615,947

Standard remote control circuit is 24v. Other remote control circuit voltages are available.

¹ Special order motors are available for other voltages and/or 50 cycle power. Standard motors are 60 Hz.

² Recommendation only. Insure compliance with National and Local Codes.

³ For 208v Overload Setting, add 10% to 230v setting

⁴ Fuses must have time delays or be otherwise suitable for motor circuits.

Motor Nameplate Voltage	Minimum Running Voltage	Maximum Running Voltage
115 v	104 v	127 v
208-230 v	187v	253 v

WARNING

**All electrical work must comply with national and local codes.
Disconnects must be supplied and installed by a licensed electrician.
INSUFFICIENT GROUNDS CAN BE DANGEROUS.**