87-900-816-01
May, 1991

Instruction Manual

TURBO-V200A pumps

Model 969-9024

Model 969-9025

Model 969-9026

TABLE OF CONTENTS

SAFETY SUMMARY

Operators and service personnel must be aware of all hazards associated with this equipment. They must know how to recognize hazardous and potentially hazardous conditions, and know how to avoid them. The consequences of unskilled, improper, or careless operation of the equipment can be serious. This product must only be operated and maintained by trained personnel. Every operator or service person must read and thoroughly understand operation/maintenance manuals and any additional information provided by Varian. All warnings and cautions should be read carefully and strictly observed. Address any safety, operation, and/or maintenance questions to your nearest Varian office.

The following format is used in this manual to call attention to hazards:

WARNING

Warnings are used when failure to observe instructions or precautions could result in injury or death.

CAUTION

Cautions are used when failure to observe instructions could result in damage to equipment, whether Varian-supplied or other associated equipment.

NOTE

Information to aid the operator in obtaining the best performance from the equipment.

SECTION I
DESCRIPTION

1.1 GENERAL

The Turbo-V200A pump is a turbomolecular pump suitable for a variety of vacuum applications and where the pump is required to be mounted in any orientation.

It will evacuate a chamber from atmosphere to the 10^{-10}Mbar range in conjunction with a two-stage mechanical pump.

It features high pumping speeds, especially for the heavier molecules (e.g., hydrocarbons), freedom from oil vapors, fast start-up, rugged pump construction, and is able to withstand accidental air in-rush. The pump is powered by the Turbo-V200 controller, which is a solid state frequency converter with built-in control circuits capable of automatic operation of the pump and accessories. The Turbo-V200A pump and controller should be considered as a complete unit, since the controller has been designed to optimize the performance of the pump.

Fig. 1.1 is a picture of the Turbo-V200A pump.

A rotary frequency converter (motor generator set) is available and is recommended for use where radiation may affect the circuits in the controller (typically in particle accelerators, etc.).

Fig. 1.1 - Turbo-V200A Pump

SECTION I
DESCRIPTION

1.2 TURBO-V200A PUMP DESCRIPTION

The Turbo-V200A pump is manufactured in three versions, differing only in the high vacuum connection. They are as follows:

- Model 969-9024 with the 100 ISO high vacuum flange
- Model 969-9025 with the 6" ConFlat® high vacuum flange
- Model 969-9026 with the 4" ANSI high vacuum flange.

The Turbo-V200A pump consists of a high frequency motor driving a turbine of 12 bladed stages, achieving a blade tip speed of about 270 m/s. The turbine rotates counter-clockwise as viewed from high vacuum flange end.

The turbine rotor is supported on high precision ball bearings lubricated with a proprietary process located on the fore vacuum side of the pump.
Near each bearing an oil reservoir consisting of felts and a labyrinth plate yield a flow of oil to the bearing during the pump operation, so no field maintenance is required.

The motor operates on 54 volt, 3-phase power at 850 Hz. To minimize losses during start-up, the frequency ramps up with an initially higher voltage-to frequency ratio.

An integral bronze cooling disk allows circulation of water inside the pump body to cool the bearings and the motor, which are located in the forevacuum region of the pump. An optional air cooling kit eliminates the need for water and simplifies use in portable systems or where water is not readily available.

A thermistor sensor is mounted on the motor stator to prevent overheating. This and the motor stator windings are connected to the controller through a 5-pin socket at the side of the pump.

The 12 turbine blades are made out of high strength, light weight alloy and are machined from solid disks. The top three (low pressure) blades are angled at 40°, the middle four at 30°, and the bottom (high pressure) blades are angled at 20°.

The pump assemblies are carefully checked and precisely balanced after assembly so that the vibration is less than 0.02 µm in amplitude. If the pump is taken apart, this may unbalance the blade assembly, so, for effective and safe operation, the pump will need to be balanced again.

The stator (static) blades are also machined from solid disks, then cut in half. They are supported and accurately positioned by semi-circular spacer rings.

The pump can operate in any orientation and be supported either from the high vacuum flange or the base support. The fore pump connection on the side of the pump is an NW25 KF flange. The cooling water connections are two riffled nozzles on the side of the body.

1.2.1 TURBO-V200A PUMP SPECIFICATIONS

High vacuum flange	
- ConFlat	6" OD
- ISO	100 (nominal diameter)
- ANSI	4"
Fore vacuum flange	NW25KF
Pumping speed for	
- N_2	220 l/s (see fig. 1.2 a)
- He	210 l/s
- H_2	180 l/s
Base pressure*	1×10^{-9} mbar (8×10^{-10} Torr)
Compression ratio for	
- N_2	2×10^8 (see fig. 1.2 b)
- He	4×10^3
- H_2	4×10^2
Recommended forepump	Varian SD-200 (10 m^3/h, Europe) (7 cfm, US)
Start-up time	60 seconds
Nominal speed	51,000 rpm

* According to DIN 28 428 the base pressure is the pressure measured in the test dome 48 hours after completion of test dome bakeout while evacuating with a ConFlat-flanged turbopump with the recommended forepump.

SECTION I
DESCRIPTION

Operating	
- position	Any
- voltage	54 Vac ±15%, 3 phase
- frequency	850 Hz ±2%
- ambient temperature	+5 to +35° C
Max bakeout temperature	120° C at high vacuum flange
Noise level	≤50 DB (A) at 1 meter
Water cooled:	
- Water flow rate	20 l/h (0.09 GPM)
- temperature	+10 to +30°C (see fig. 1.2c)
- pressure	2 to 4 bar (30 to 60 PSIG)
Air cooled:	
- Air flow rate	42 l/s (90 cfm)
- temperature	+5 to +30°C (see fig. 1.2 c)
Lubricant type	Permanent lubrication
Storage temperature	-20 to +70 °C
Weight	10.7 kg (24 lbs)

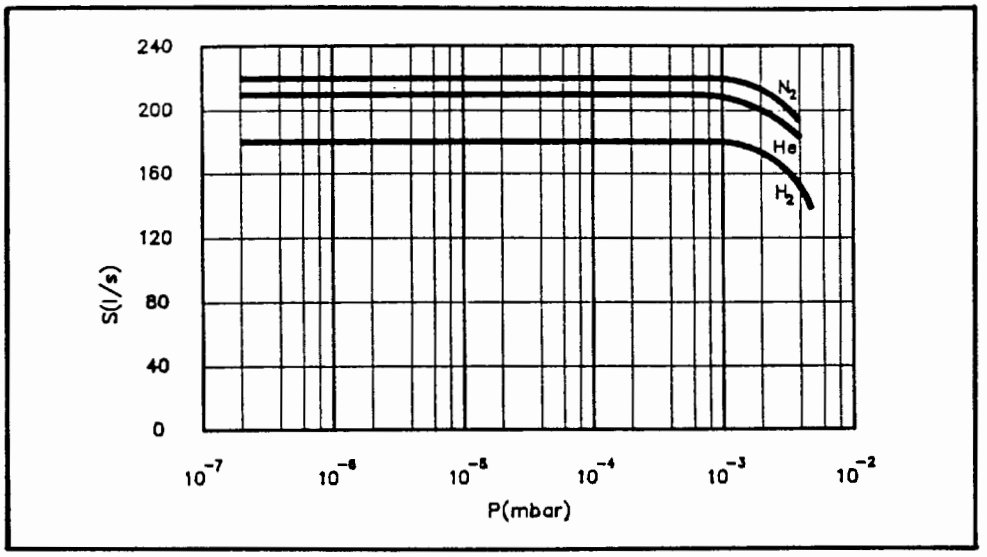

Fig. 1.2 a - Pumping Speed vs Inlet Pressure

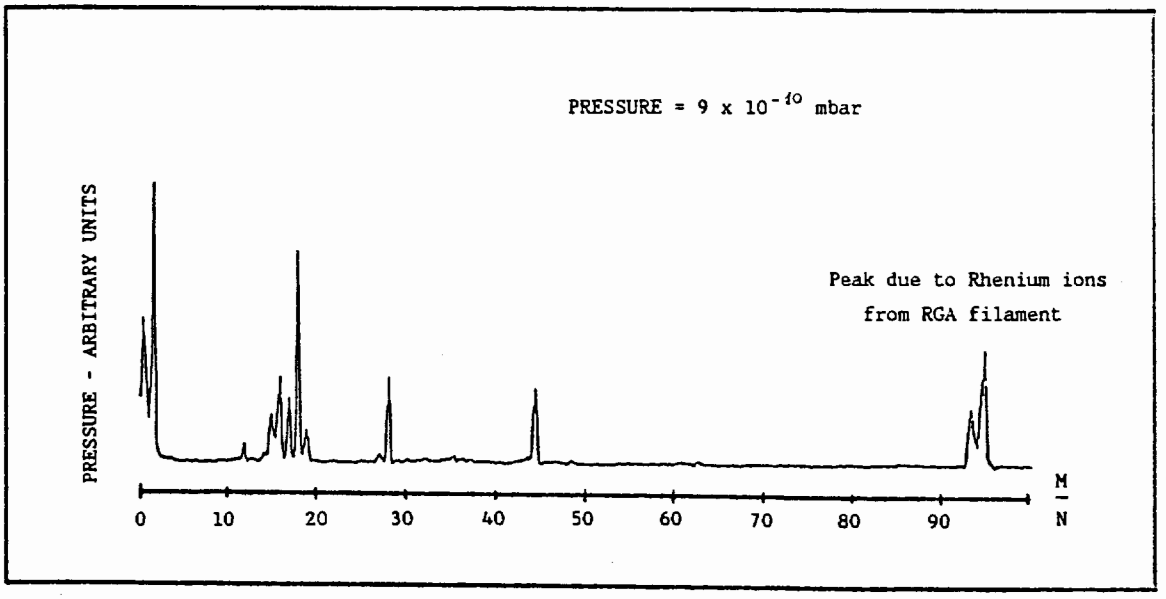

Fig. 1.2 b - Typical Residual Gas Spectrum for an Unbaked System

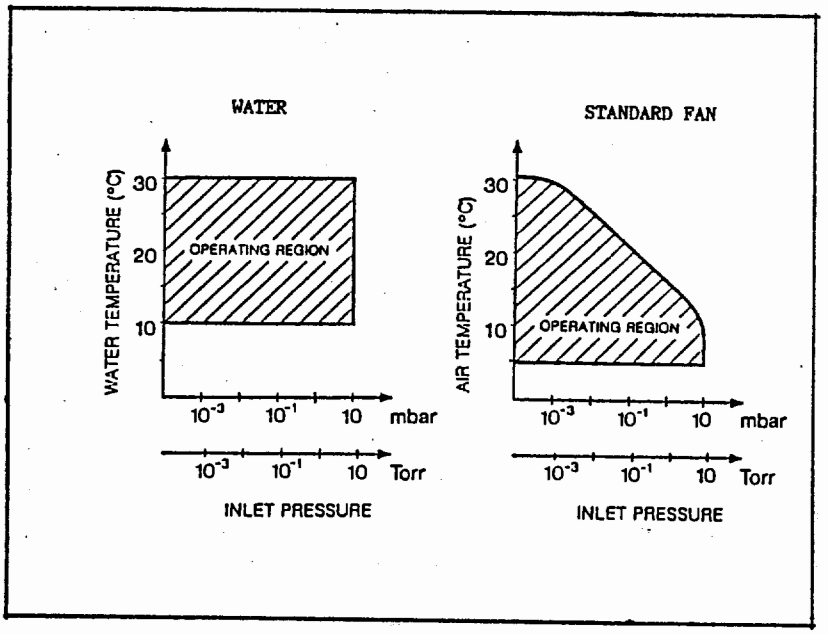

Fig. 1.2 c - Maximum Operating Pressure vs Coolant Temperature

1.2.2 TURBO-V200A PUMP OUTLINE

The outline dimensions for the Turbo-V200A are shown in Fig. 1.3.

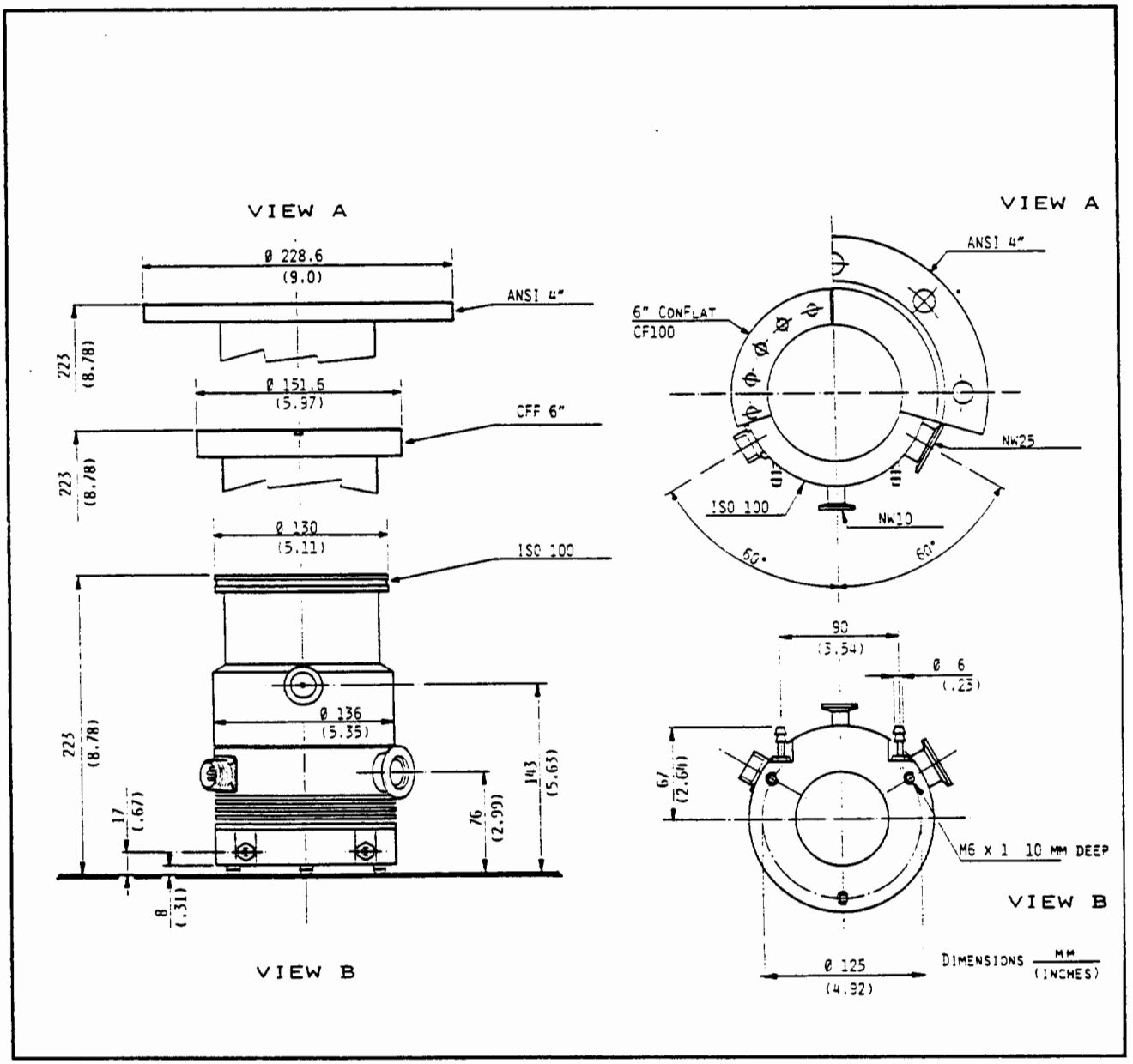

Fig. 1.3 - Turbo-V200A Pump Outline

SECTION II
INSTALLATION

2.1 TURBO-V200A PUMP INSPECTION

The pump is shipped in a special packaging; even so it is wise to inspect the pump for any damage that might have occurred during shipping.
While unpacking, take great care not to drop or jar the pump.

> **NOTE**
> Though the pump is not harmed by exposure to atmosphere, it is good vacuum practice to keep it sealed until ready for installation to the system.

> **CAUTION**
> Avoid handling parts to be exposed to high vacuum with bare hands. Always use gloves or other protection.

2.2 TURBO-V PUMP INSTALLATION

2.2.1 TYPICAL TURBO-V PUMP SET UP

Fig. 2.1 shows the typical connections between the Turbo-V and the rest of a system:

1. Turbo-V Controller
2. Pump vent valve
3. High vacuum isolation valve (optional)
4. Chamber vent valve (optional)
5. Work chamber
6. Ion gauge
7. Foreline flange
8. Forepump exhaust filter/connection
9. Forepump with "anti-suck back" valve
10. Forepump control relay
11. Cooling water connection
12. Chamber roughing line and valve (optional)
13. Turbo-V pump

SECTION II
INSTALLATION

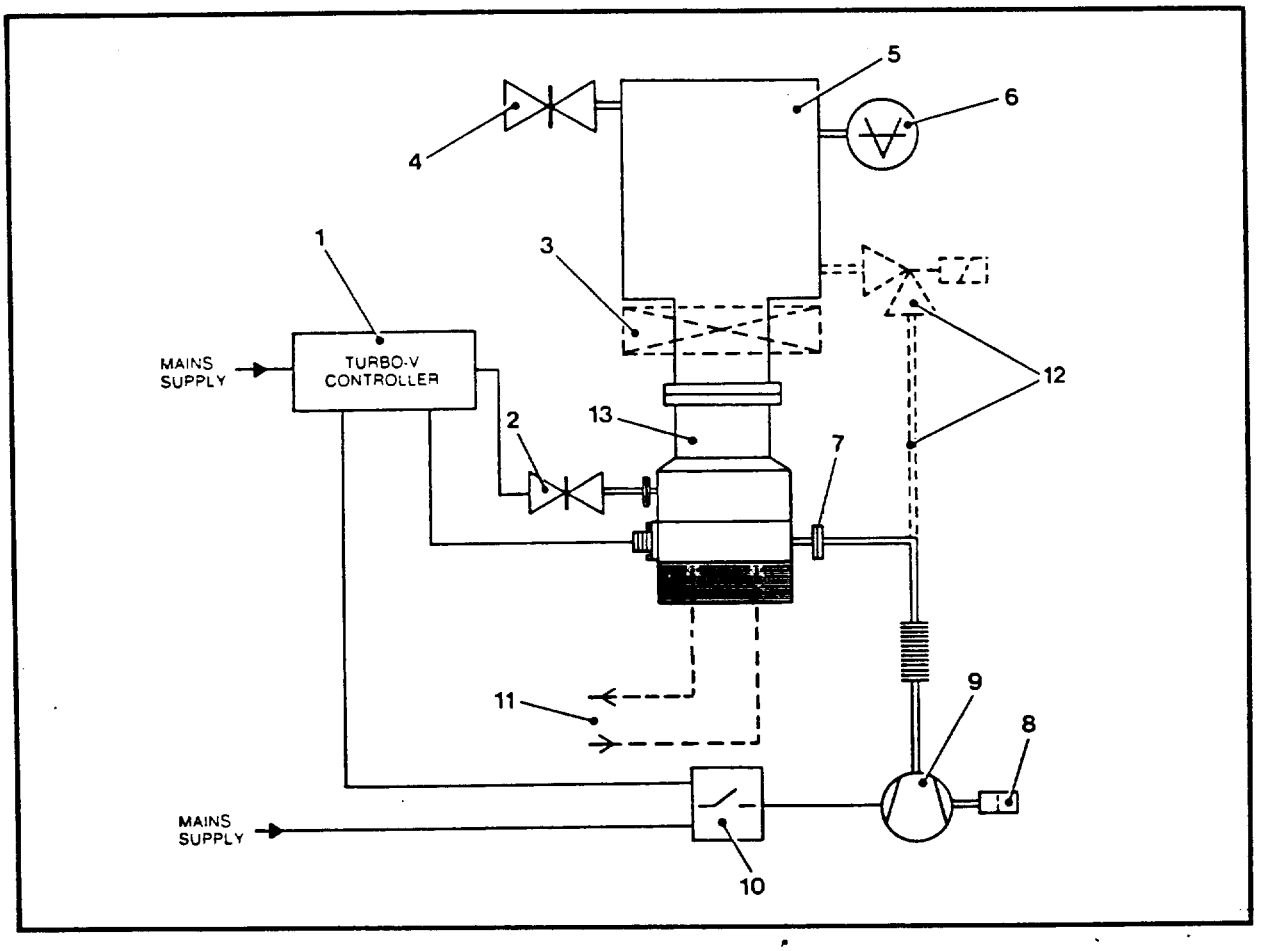

Fig. 2.1 - Typical Turbo-V Pump Interconnections

2.2.2 HIGH VACUUM FLANGE CONNECTION

The pump can be installed in any orientation, or suspended by the high vacuum flange.

If a metal bellows is used to connect the pump to the chamber, the pump must be securely fixed in place.

WARNING

To avoid injury to personnel and damage to the equipment, when using the rubber feet to support the pump it will be necessary to make sure that the pump cannot tip over. If necessary, the pump can be fixed to a bench or frame by bolting it on, using the M6 threaded holes in the bottom flange (accessed by removing the rubber feet). These holes are located on a 125 mm (4.9 inches) diameter.

If the pump is to be used in a magnetic field, precautions must be taken. Please contact your local Sales/Service office for application assistance.

When ready to connect the high vacuum flange, first remove the shipping flange. Be careful not to allow any debris to fall into the pump. Next, inspect the mating flanges, to make sure both are clean and free from scratches. Apply a high temperature lubricant to the screw threads, since this will ease assembly and disassembly. A recommended lubricant is Fel-pro C100.

NOTE

Lubricant is necessary to prevent seizure of the screw threads, especially after bake-out.

2.2.3 FOREPUMP CONNECTION

An NW25 KF flange is provided to connect the Turbo-V pump to the forepump. A flexible hose or vacuum-rated tubing can be used. If a rigid pipe is employed, a bellows must be installed on the line to isolate the vibration generated by the mechanical pump.

NOTE

If the Turbo-V pump is not installed in the vertical position, to avoid system contamination due to the mechanical pump oil backstreaming, the pump should be oriented so that the roughing port is facing downwards. If this is not possible, we recommend the use of a dry mechanical pump or to install a foreline trap between the turbo and an oil sealed mechanical pump to intercept oil backstreaming.

If an oil sealed mechanical pump is used it must be a two-stage pump with an "anti-suck back" valve.

2.2.4 VENT VALVE CONNECTION

If the Turbo-V vent device model 969-9831 is used, the pump will be vented once the delay time has elapsed after power failure or normal shut down.

An inlet filter can be used to prevent any particulate admission into the pump when venting to air, or the pump can be vented with dry gas.

2.2.5 WATER COOLING CONNECTION

Two riffled nozzles suitable for 6 mm ID (1/4" I.D.) rubber or plastic tubing are provided on the cooling jacket. The cooling water can be connected with either nozzle as supply or return.

Water temperature should be between 10°C and 30°C with a pressure between 2 and 4 bar and a minimum flow rate of 20 l/hour. Both open and closed circuit cooling systems may be used; however, it is advisable to make sure the tubing is fixed by clamps to ensure the tubes do not detach during operation.

CAUTION

To prevent excessive electrochemical corrosion, the cooling water must have a resistivity greater than 2×10^4 ohm-cm. Water not meeting this specification may corrode and obstruct the fittings and damage the cooling jacket.

The Turbo-V pump can run for a maximum of 20 minutes without cooling water, but it is recommended to mount a water flow switch to give an early alarm signal and/or interlock the controller.
If a flow switch is not installed in the water line, the thermistor in the pump itself will switch off the power when the internal pump temperature exceeds 60°C, to prevent damage occurring to the pump.

2.2.6 AIR COOLING

Optionally, Varian offers provision for air cooling with a Turbo-V Fan that can be mounted around the pump in any of three different positions. In any case, whenever practical, water cooling is recommended for its efficiency, and it is necessary for high gas load applications.

Operation of the fan is made directly from the controller (see the relative Turbo-V controller Instruction Manual).

Detailed installation instructions are supplied with the Turbo-V Fan.

2.2.7 ELECTRICAL CONNECTIONS

The Turbo-V pump is connected to the controller through a 5-pin connector. Pins B, C and D are for the 3 phase power to the motor and pins A and E are connected to the thermistor (resistance is less than 300 ohm at 20 °C).
If the thermistor is disconnected the pump will not start.

Connect the ground cable between the pump and the controller.

WARNING

Before connecting the power cable to the pump, ensure that the pump is properly grounded through the controller with the ground cable supplied.

This page in intentionally

left blank

SECTION III
OPERATING INSTRUCTIONS

3.1 GENERAL

Make all vacuum manifold and electrical connections as directed in Section II and refer to Turbo-V controller Instruction Manual prior to operating the Turbo-V pump.

CAUTION

Avoid shocks or sudden change of position to the Turbo-V pump when running.

NOTE

The forepump and the Turbo-V pump can be switched on at the same time if a pressure less than 1 mbar (0.75 Torr) is obtained in the chamber within the Turbo-V pump start-up time.
If the vacuum chamber is larger, it must be roughed down before starting the Turbo-V pump.

3.2 BAKEOUT OPERATION

To reach base pressure in the chamber or system, in the shortest possible time, it is recommended to bake it out.

CAUTION

The maximum permissable temperature at the high vacuum flange is 120°C. Make sure this temperature is never exceeded.

An optional heating mantle for the pump is available. Switch it on while the Turbo-V pump is running. If the pump overheats for any reason, the thermistor in the pump will stop the pump. Before proceeding, the pump and the chamber should be allowed to cool to room temperature.

NOTE

Do not bake out the Turbo-V pump when it is operating at a pressure above 10^{-4} mbar or it is air cooled.

This page is intentionally

left blank

SECTION IV
MAINTENANCE

4.1 GENERAL

Replacement pumps are available on an advance exchange basis through Varian Service.

4.2 TURBO-V PUMP MAINTENANCE

> **WARNING**
>
> To avoid injury to personnel, wait until the Turbo-V pump is completely stopped before disconnecting it from the chamber.

4.2.1 CLEANING

If the pump is slightly contaminated and is taking too long to pump down the required vacuum, it will be necessary to clean the pump, to remove contaminants from the internal surfaces. To clean the pump follow the procedure below:

1) Prepare a very clean container (large enough to put the pump in) and fill it with suitable solvent.

2) Make sure that the cables and water cooling pipes are disconnected from the pump, then undo the high vacuum flange and empty any water left in the cooling jacket. Turn the pump upside down (see Fig. 4.2) and dip it into the solvent up but not beyond 15-20 mm (1/2" - 3/4") from the end of the stainless steel envelope.

> **CAUTION**
>
> Do not dip the pump any further into the solvent, otherwise possible damage may occur to the bearings.

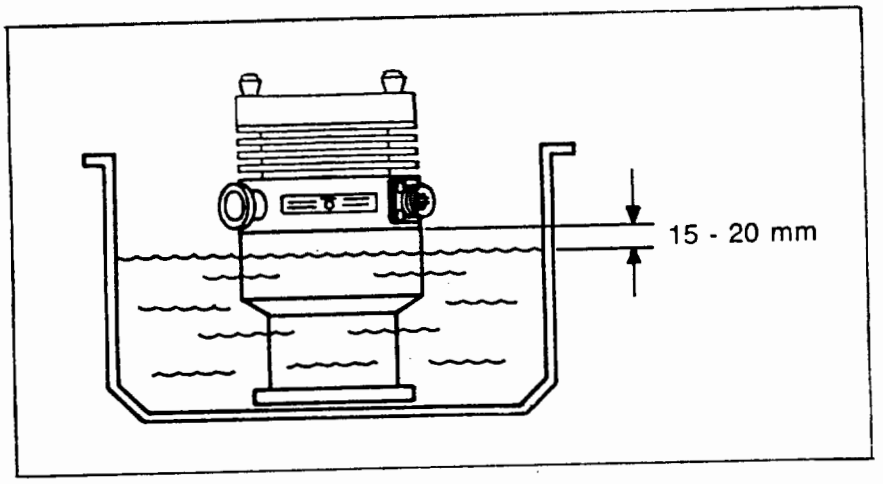

Fig. 4.2 - Assembly Pump Cleaning

3) While the pump is in solvent, gently lift and lower it several times to remove the majority of contaminants from the blades and other surfaces of the pump.

4) Repeat the cleaning procedure 2 or 3 times with fresh solvent each time.

5) Pull the pump out of the solvent and leave it upside down to drain and dry on a clean surface for about 20 minutes.

6) After drying, reinstall the Turbo-V pump on the system.

4.2.2 BEARING REPLACEMENT

The bearings are the only parts subject to wear in normal use and they have to be replaced when they become too noisy and exceed the noise specifications.

Service training is necessary to replace bearings as special techniques and tools should be used to correctly replace bearings. A dust-free clean room (class 10,000 or better) and the capability to rebalance the rotor are required to correctly service the pump in the field.

Contact Varian Service Centers for more detailed information.

SECTION V
TROUBLESHOOTING AND SPARES

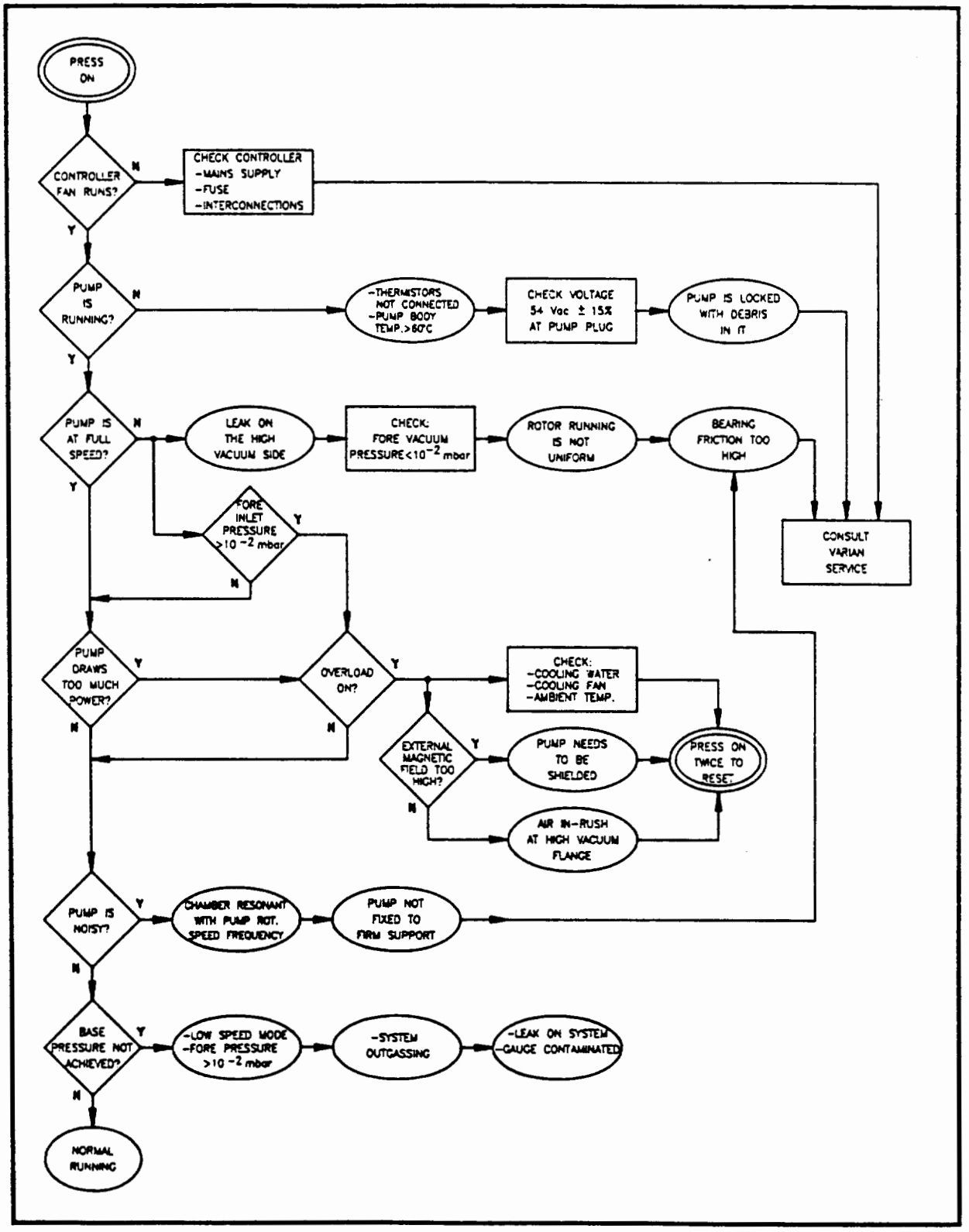

Fig. 5-1 Turbo-V Pump Troubleshooting Chart

SECTION V
TROUBLESHOOTING AND SPARES

5.1 ACCESSORIES

Description	Part Number
Inlet screen	969-9302
Pump heater 120 Vac	969-9804
Pump heater 220 Vac	969-9803
Mating ISO 100 blank flange	969-9121
Centering ring ISO 100 (with O-ring)	969-9122
ISO Clamp Kit (Q.ty 4)	969-9113
Mating ConFlat flange (bored)	954-5080
Screws, nuts, washers (Q.ty 25)	953-5022
Threads lubricant Fel-pro C100	953-0031
Vibration isolator ISO 100	969-9343
Vibration isolator 6" CFF	969-9332
Forepump SD 300, 220 V, 50 Hz, 1 phase	949-0867-250
Forepump SD 300, 120 V, 60 Hz, 1 phase	0422-P1221-307
Turbo-V Vent device 120 V, 50-60 Hz	969-9831
Turbo-V Fan, 120 V, 50-60 Hz	969-9322
Rotary converter 50 Hz	969-9621
Rotary converter 60 Hz	969-9721

For a complete overview of Varian's extensive vacuum product line, please refer to the Varian Vacuum Catalog.

Varian S.p.A. - Vacuum Products Torino
Via Varian 54, 10040 Leinì (Torino) - Italy
Tel. (39) 11 9979111 - Telefax: (39) 11 9979350 - Telex: 210297

Varian Vacuum Products Lexington
121 Hartwell Avenue - Lexington, MA 02173 USA
Tel.: (617) 861-7200 - Telefax: (617) 860-5437 - Telex: 710-321-0019

FRANCE

Varian S.A.
Quartier de Courtaboeuf
B.P. 12
F-91941 Les Ulis-Cedex
Tel.: (33) 16 9863838
Telefax: (33) 16 9282308

GERMANY, AUSTRIA

Varian GmbH
Vacuum Products
Kuehnstrasse 71 D
22045 Hamburg
Tel.: (49) 40 6696033/34
Telefax: (49) 40 6682282
Telex: 211798

U.K.

Varian Ltd.
28 Manor Road
GB-Walton-on-Thames
Surrey KT1 2QF
Tel.: (44) 932 243741
Telefax: (44) 932 228769
Telex: 928070

ITALY

Varian S.p.A. - VP Sales Office
Via Varian 54
I-10040 Leinì (Torino)
Tel. (39) 11 9979111
Telefax: (39) 11 9979330
Telex: 210297

INDIA

Varian Vacuum Products
No. 7 Community Center, 1st Floor
Basant Lok, Vasant Vihar
New Delhi 110057, India
Tel.: (91) 11 6883391
Telefax: (91) 11 6873664
Telex: 3182038

KOREA

Varian Korea Ltd.
433-1 Mogok-Dong, Songtan
Kyungi-Do, Korea 459-040
Tel.: (82) 333 6655171
Telefax: (82) 333 6650118
Telex: VARKOR K 28663

JAPAN & OTHER ASIAN COUNTRIES

Varian, Vacuum Products Japan
Sumitomo Shibaura Bldg.
4-16-36 Shibaura
Minato-ku, Tokyo, 108 Japan
Tel.: (81) 3 5232 1253
Telefax: (81) 3 5232 1263

USA, SOUTH & CENTRAL AMERICA

Varian Vacuum Products
121 Hartwell Avenue
Lexington, MA 02173
Tel.: (617) 861 7200
Telefax: (617) 860 5437
Telex: 710 321 0019
Toll free nr.: 1-800-882-7426

CANADA

Varian Canada Inc.
6705 Millcreek Drive, Unit 5
Mississauga, Ontario L5N 5R9
Tel.: (416) 819 8188
Telefax: (416) 819 8348
Toll free nr.: 1-800-663-2727

AUSTRALIA

Varian Australia Pty Ltd
6/81 Frenchs Forest Road
Frenchs Forest NSW 2086
Australia
Tel.: (61) 2 451 9133
Telefax: (61) 2 452 2600

OTHER COUNTRIES

Varian S.p.A. - VP. Sales Office
Via Varian 54
I-10040 Leinì (Torino) - Italy
Tel.: (39) 11 9979111
Telefax: (39) 11 9979 330
Telex: 210297

SECTION I
DESCRIPTION

1.2.2 Turbo-V200A pump outline

The outline dimensions for the Turbo-V200A are shown in Fig. 1.3.

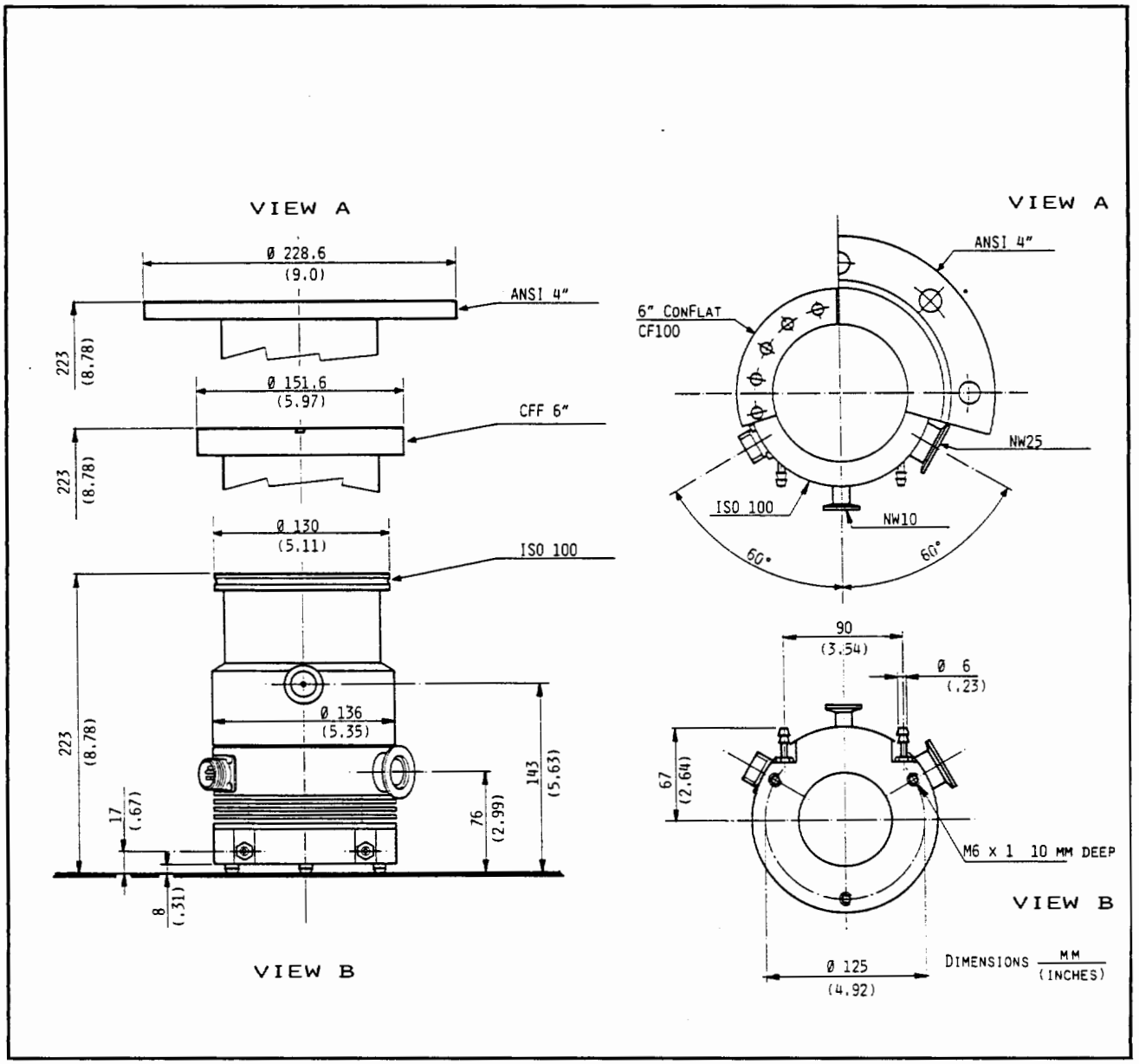

Fig. 1.3 - Turbo-V200A Pump Outline

SECTION II
INSTALLATION

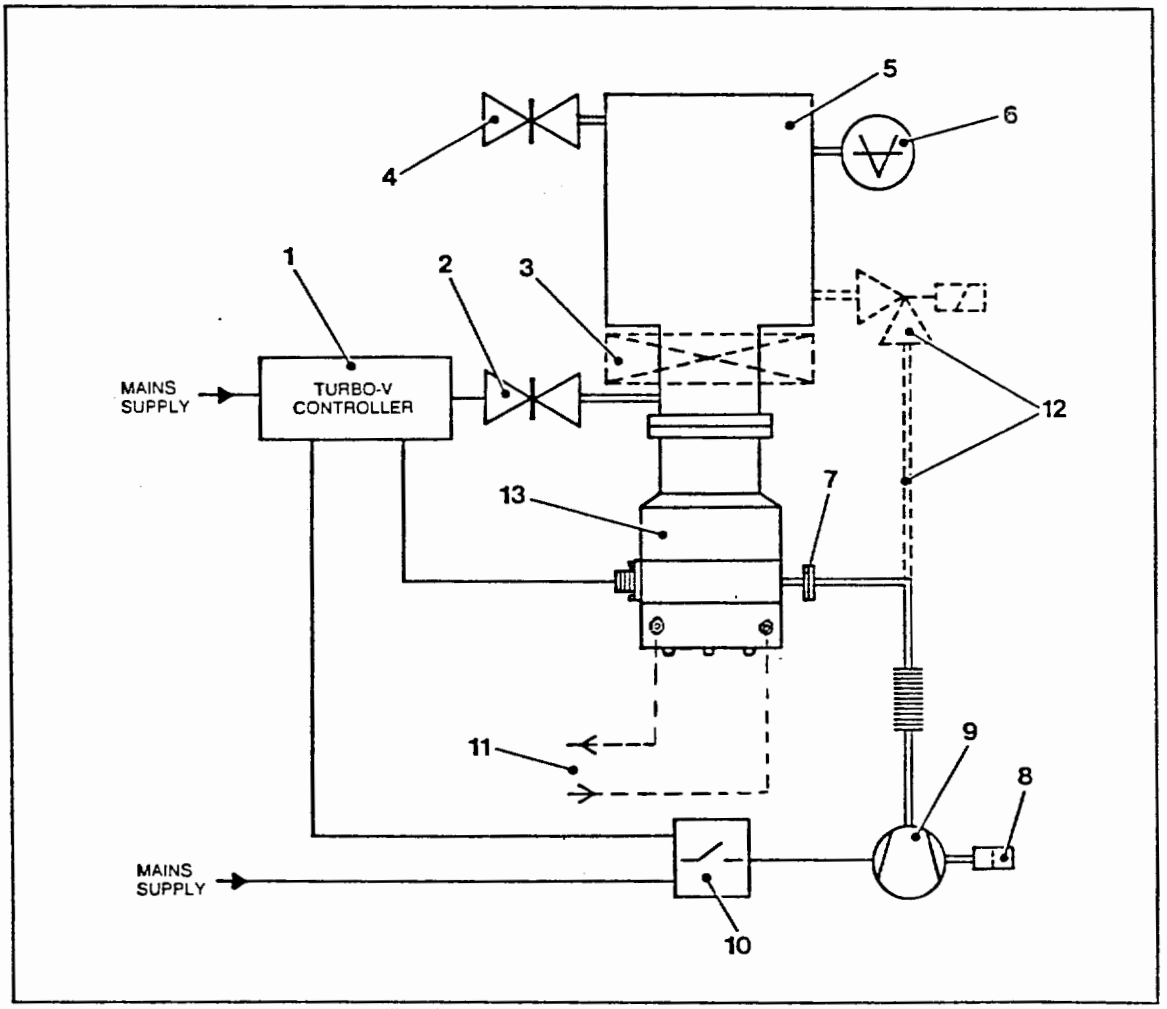

Fig. 2.1 - Typical Turbo-V Pump Interconnections

2.2.2 High vacuum flange connection

The pump can be installed in any orientation, or suspended by the high vacuum flange.

If a metal bellows is used to connect the pump to the chamber, the pump must be securely fixed in place.

SECTION I
DESCRIPTION

Operating	
- position	Any
- voltage	54 Vac ±15%, 3 phase
- frequency	850 Hz ±2%
- ambient temperature	+5 to +35° C
Max bakeout temperature	120° C at high vacuum flange
Noise level	⩽50 DB (A) at 1 meter
Water cooled:	
- Water flow rate	20 l/h (0.09 GPM)
- temperature	+10 to +30°C (see fig. 1.2c)
- pressure	2 to 4 bar (30 to 60 PSIG)
Air cooled:	
- Air flow rate standard fan	42 l/s (90 cfm)
- flow rate low profile fan	14 l/s (29.7 cfm)
- temperature	+5 to +30°C (see fig. 1.2 c)
Lubricant type	Grease type G2
Storage temperature	-20 to +70 °C
Weight	10.7 kg (24 lbs)

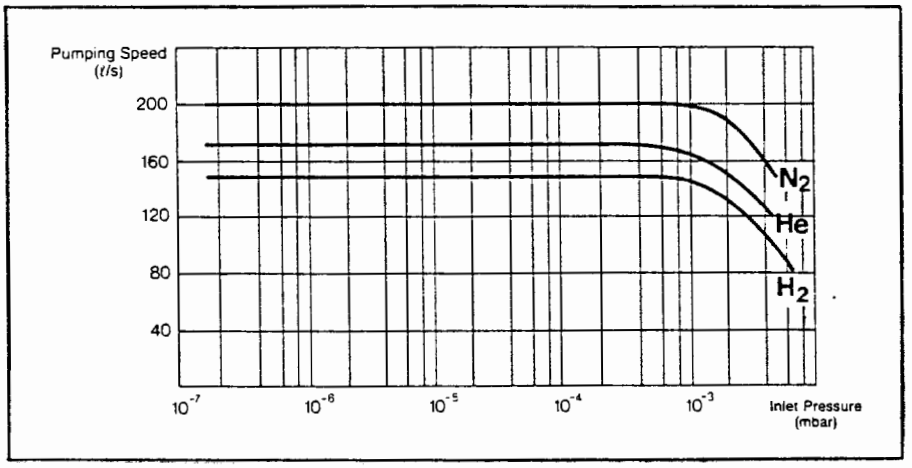

Fig. 1.2 a - Pumping Speed vs Inlet Pressure

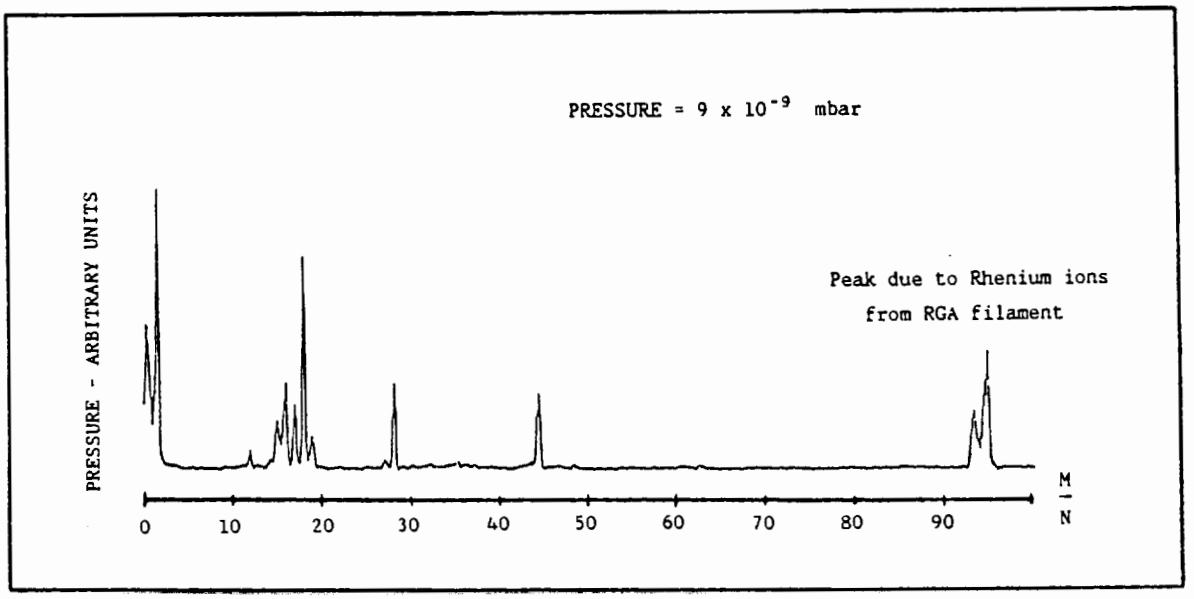

Fig. 1.2 b - Typical Residual Gas Spectrum for an Unbaked System

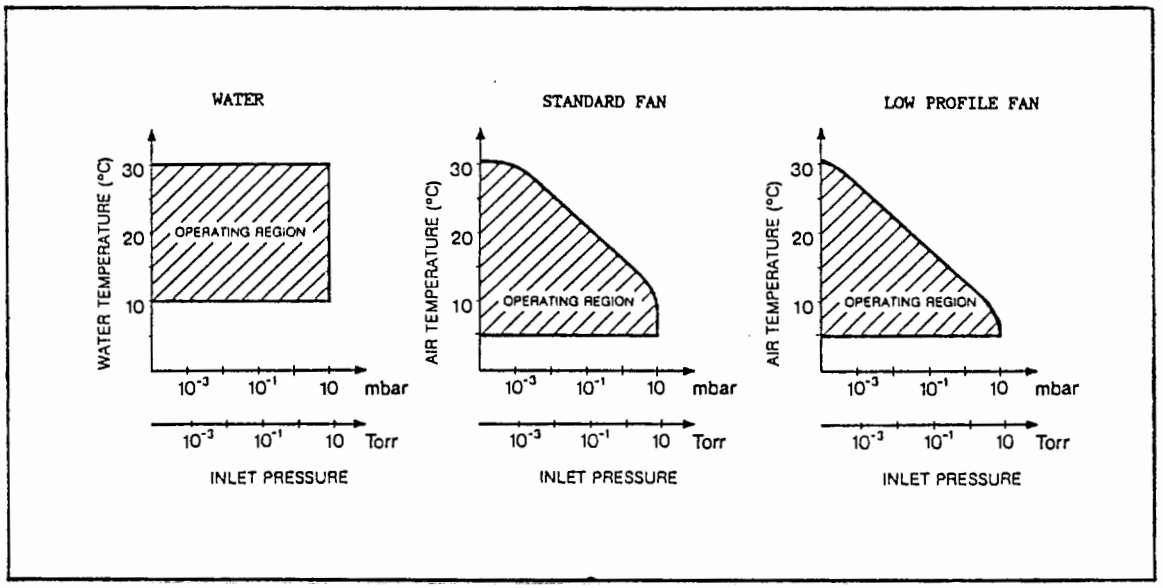

Fig. 1.2 c - Maximum Operating Pressure vs Coolant Temperature

SECTION II
INSTALLATION

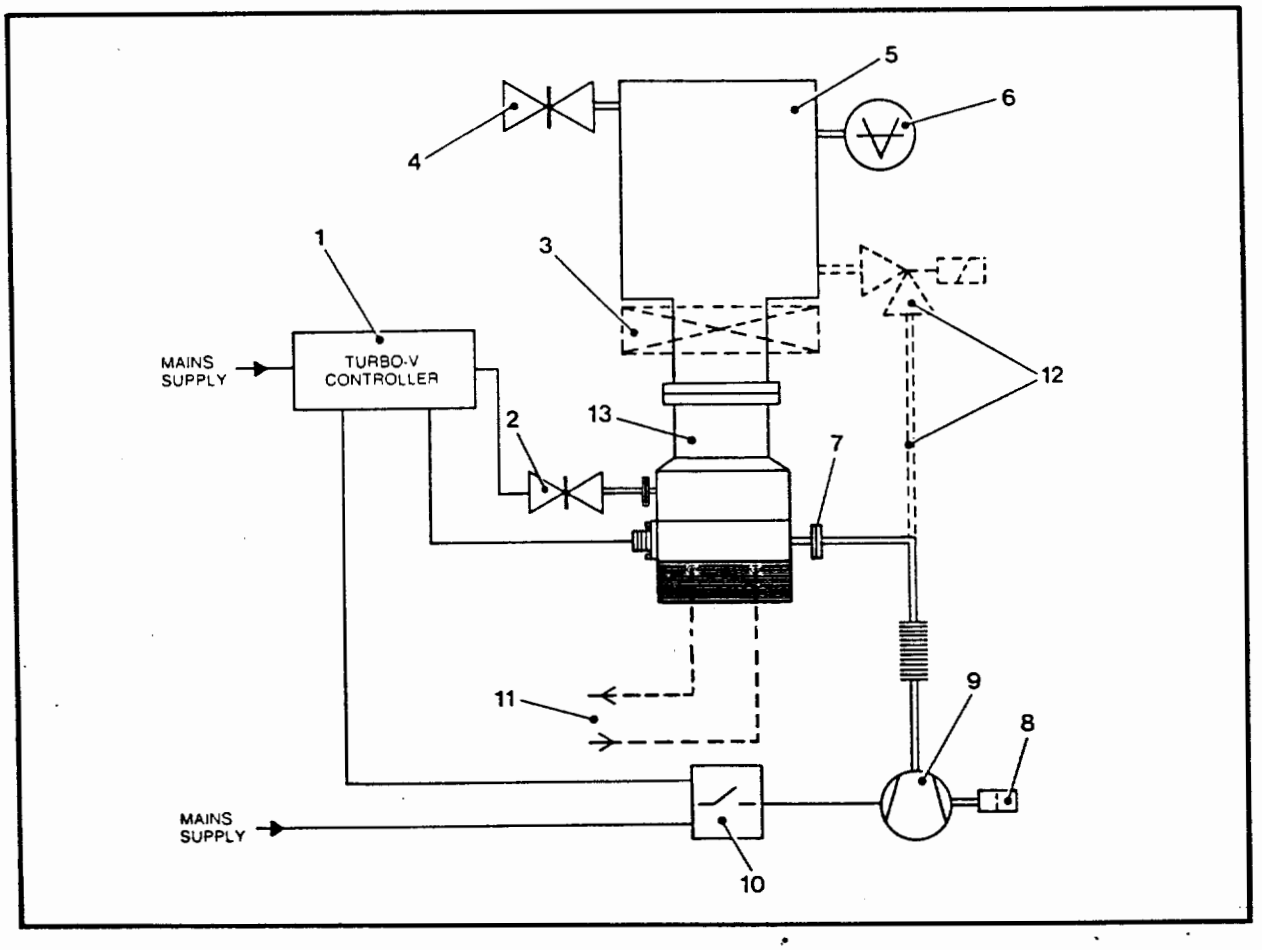

Fig. 2.1 - Typical Turbo-V Pump Interconnections

2.2.2 HIGH VACUUM FLANGE CONNECTION

The pump can be installed in any orientation, or suspended by the high vacuum flange.

If a metal bellows is used to connect the pump to the chamber, the pump must be securely fixed in place.

Self-adhesive labels are provided with the relubrication kit. Fill in the date and the operating hours shown on the hour counter of the Turbo-V controller and attach the label to the Turbo-V pump.

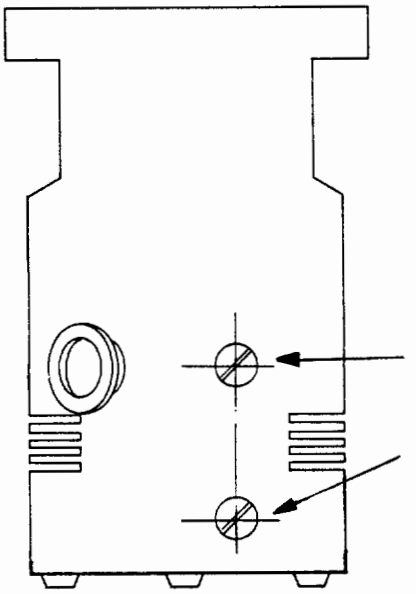

Fig. 4.1 - Relubrication Ports

4.2.2 Cleaning

If the pump is slightly contaminated and is taking too long to pump down the required vacuum, it will be necessary to clean the pump, to remove contaminants from the internal surfaces. To clean the pump follow the procedure below:

1) Prepare a very clean container (large enough to put the pump in) and fill it with Freon TF or 113.

CAUTION

Use only Freon TF or 113 as any other solvent could damage the pump.

2) Make sure that the cables and water cooling pipes are disconnected from the pump, then undo the high vacuum flange and empty any water left in the cooling jacket. Turn the pump upside down (see Fig. 4.2) and dip it into the Freon up but not beyond 15-20 mm (1/2" - 3/4") from the end of the stainless steel envelope.

CAUTION

Do not dip the pump any further into the Freon, otherwise possible damage may occur to the bearings.

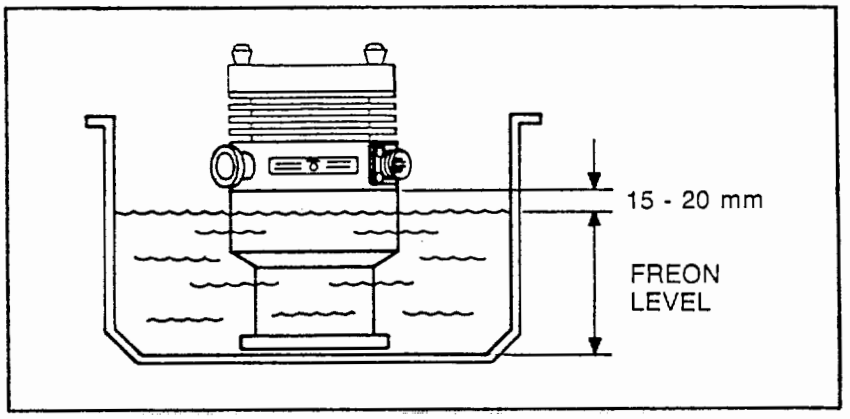

Fig. 4.2 - Assembly Pump Cleaning

3) While the pump is in Freon, gently lift and lower it several times to remove the majority of contaminants from the blades and other surfaces of the pump.

4) Repeat the cleaning procedure 2 or 3 times with fresh Freon each time.

5) Pull the pump out of the Freon and leave it upside down to drain and dry on a clean surface for about 20 minutes.

6) After drying, reinstall the Turbo-V pump on the system.

SECTION VI
SPARE PARTS LIST

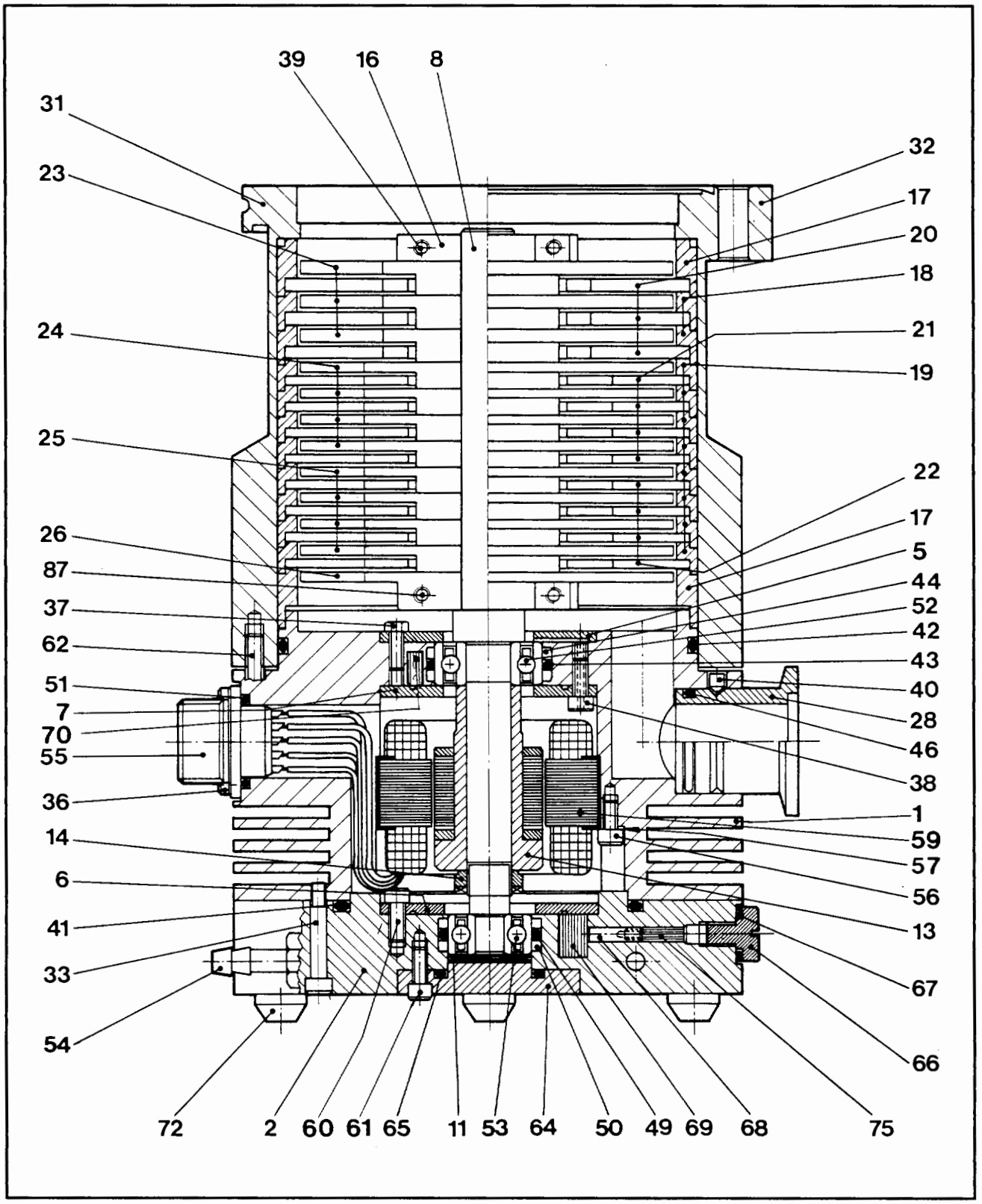

Fig. 6.1 - Sectional View of Turbo-V200A Pump

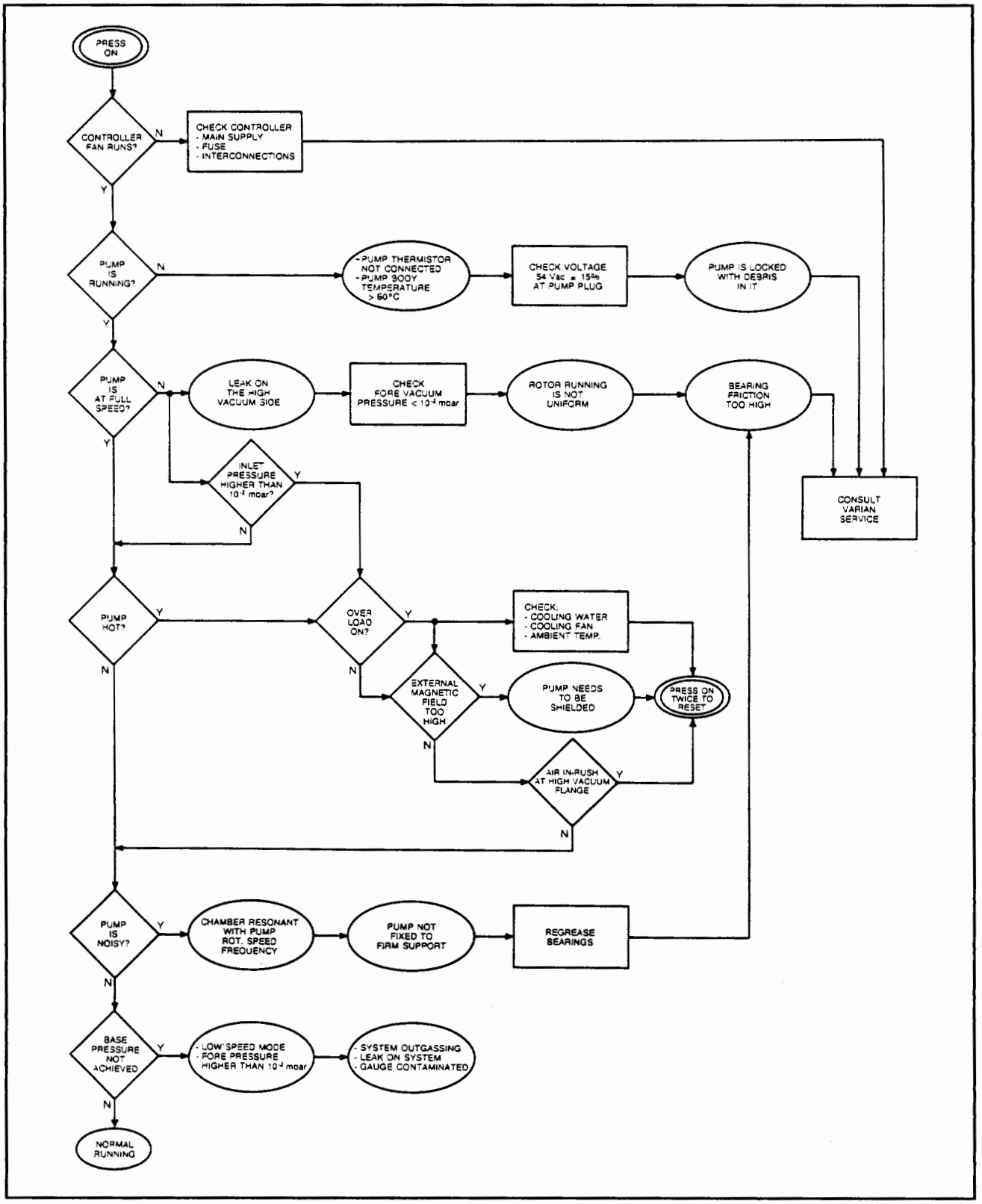

Fig. 5.1 - Turbo-V Pump Troubleshooting Chart (using Turbo-V Controller 969-9422 or 969-9522)

Operating ambient temperature	+5 to +35° C
Max bakeout temperature	120° C at high vacuum flange
Noise level	⩽50 DB (A) at 1 meter
Water cooled:	
. Water flow rate	20 l/h (0.09 GPM)
. Water temperature	+10 to +30°C (see fig. 1.2 c)
. Water pressure	2 to 4 bar (30 to 60 PSIG)
Air cooled:	
. Air flow rate standard fan	42 l/s (90 cfm)
. Air flow rate low profile fan	14 l/s (29.7 cfm)
. Air temperature	+5 to +30°C (see fig. 1.2 c)
Lubricant type	Grease type G2
Storage temperature	-20°C to +70°C
Weight	10.7 kg (24 lbs)

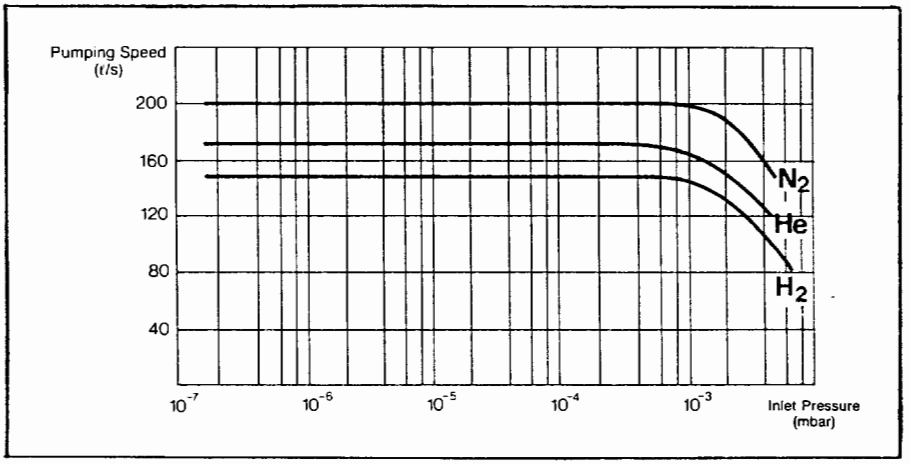

Fig. 1.2 a - Pumping Speed vs Inlet Pressure

SECTION I
DESCRIPTION

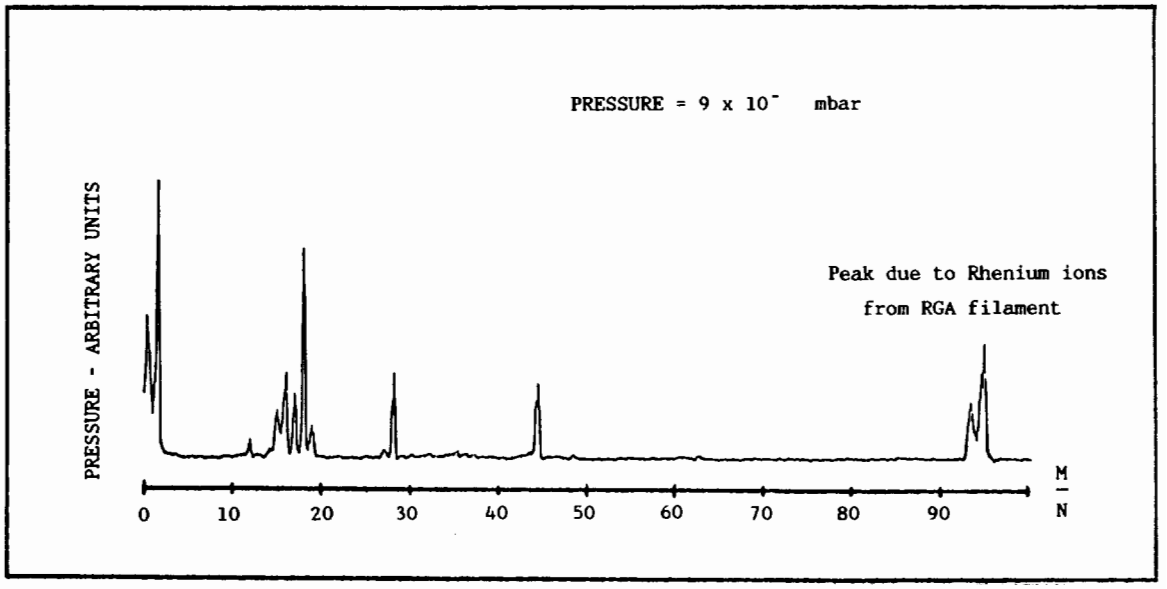

Fig. 1.2 b - Typical Residual Gas Spectrum for an Unbaked System

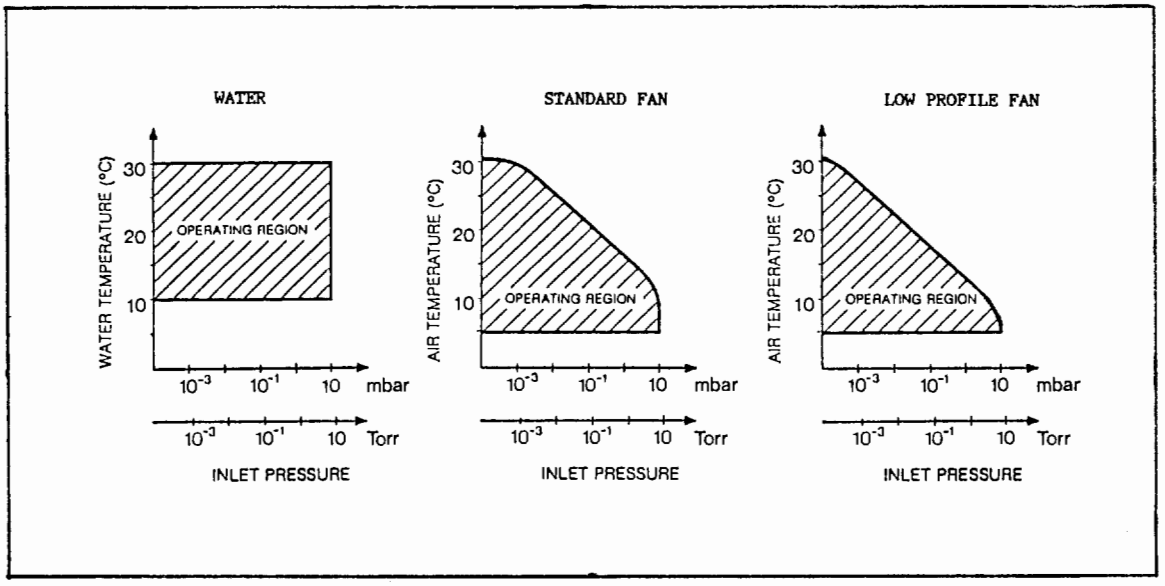

Fig. 1.2 c - Maximum Operating Pressure vs Coolant Temperature