87-900-841-01
October 1990

Instruction Manual

CURRENT MODEL IS 969-9022 9/25/95 ARR

TURBO-V200™ Pumps

Model 969-9027

Model 969-9028

REMOVED FROM SERVICE
FOR HIGH OIL CONSUMPTION
AND RETURNED TO VARIAN
2-1-94
ARR

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.

1-1 General

The Turbo-V200 pump is a turbomolecular pump suitable for a variety of vacuum applications. It evacuates chambers from atmosphere to the 10^{-9} mbar (Torr) range when backed by a two-stage mechanical pump.

It features high pumping speeds for all gases, especially heavy hydrocarbon molecules, and vapours. The mechanical structure of the pump rotor and bearings makes it resistant to accidental air inrushes. The pump is powered by the Turbo-V200 controller, a solid-state frequency converter with control features for automatic operation with other system components.

A rotary frequency converter is available to power the pump in lieu of the solid-state frequency converter and is recommended for use in environments where radiation is present, such as particle accelerators, etc. Figure 1-1 is a picture of the Turbo-V200 pump.

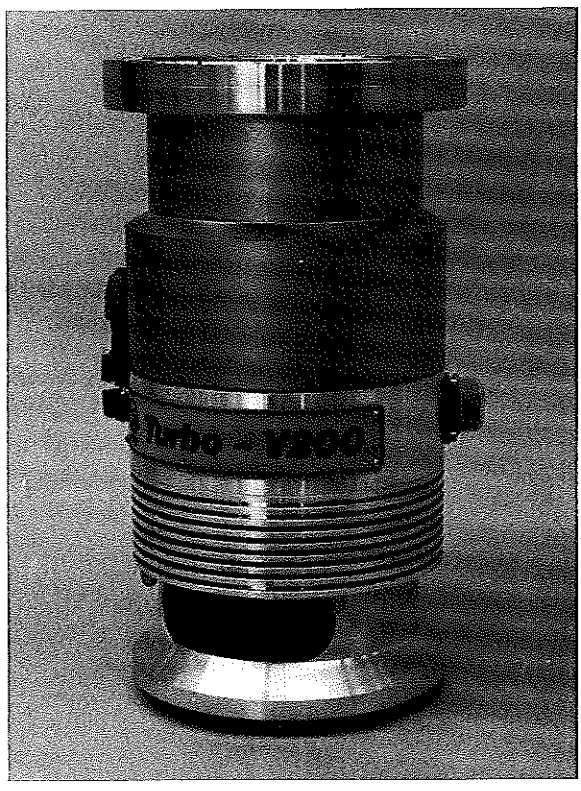

Figure 1-1 - Turbo-V200 pump

1-2 Turbo-V200 pump description

The Turbo-V200 pump is available with the following inlet flanges:

- Model 969-9027
  with an ISO-100 high-vacuum flange.
- Model 969-9028
  with a 6" O.D. ConFlat® UHV flange.

The Turbo-V200 pump incorporates a medium-frequency electric motor which drives the rotor turbine counterclockwise as observed through the inlet flange. The rotor has 12 bladed stages and achieves a speed of about 270 m/sec at the tip of the blades. The motor operates at 54 volts, 850 Hz. It starts with a frequency ramp with a higher voltage-to-frequency ratio in order to minimize slip losses during the starting stage.

A water/air cooling integrated device surrounds the pump stator and is used to cool the oil and the motor, which operates in the forevacuum region of the pump.

Thermistor sensors are mounted directly on the motor stator and pump body to prevent excessive temperatures.

The motor stator and the thermistors are wired to a 5-pin socket which accepts the pump power cable.

The turbine is made of 12 high resistance light alloy disks with the blades machined from the solid disk. The first three high vacuum stages have blade angles of 40°, while the four intermediate stages have blade angle of 30° and the lower stages in the forevacuum region have blade angles of 20°.

The turbine rotor is supported on high-precision ball bearings located on the forevacuum side of the pump and lubricated by a synthetic oil.

The pump is balanced after assembly with a residual vibration amplitude below 0.02 micrometers. Any disassembly of the turbine causes a partial loss in balance; the pump may need to be balanced again.

The stator blades are half-disks and are held in place by spacers that together support the entire stator assembly.

Lubrication is supplied by Varian T.A. oil.

On request, Varian can supply pumps specially prepared for lubrication with Fomblin fluorinated fluid. It is strongly recommended not to mix different oils due to the lack of compatibility.

The oil is centrifugally pumped from the conical nose of the shaft into the pump and is ejected above the upper and lower bearing. As it falls, it lubricates and cools the bearing, finally draining back to the transparent oil sump where any particulates are filtered by either the magnet or the small metering hole in the sump.

The pump must be mounted vertically, with a maximum allowable slope of 10°. It can be suspended by the inlet flange or rest upon its support pedestal.

An NW 25 KF flange is provided for the foreline manifold.

Cooling water is connected to the pump via two riffled nozzles on the cooling device or a fan can be mounted around the pump in different positions.

1-2-1 TurboV-200 pump specifications

High vacuum flange:	
- ConFlat®	6" O.D.
- ISO	100 (nominal diameter)
Forevacuum flange	NW 25 KF
Pumping speed for:	
- N_2	220 l/s (refer to fig. 1-2a)
- 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
- He	4×10^3
- H_2	4×10^2
Recommended forepump :	Varian SD 200 ($10\ m^3/h$ for Europe) (7 CFM for USA)
Start-up time	60 seconds
Operating:	
- Position	Vertical (max slope 10°)
- Voltage	54 Vac ±15% - 3 phase
- Frequency	850 Hz ± 2%
- Ambient temperature	20°C ± 15°C
Nominal speed	51,000 rpm
Max bakeout temperature	120°C at high-vacuum flange
Noise level	≤50 DB (A) at 1 meter
Water-cooled:	
- Flow rate	20 l/s (0.09 GPM)
- Temperature	+10°C to 25°C
- Pressure	2 to 4 mbar (30 to 60 Psig)
Air-cooled:	
- Flow rate	42 l/s (90 CFM)
- Temperature	+5°C to +30°C (see fig. 1-2b)
Lubricant type	Varian T.A. oil (Fomblin on request)
Lubricant charge	35 cm^3
Storage temperature	-20°C to 70°C
Weight	10 Kg (22 lbs)

* According to DIN 28 428, the base pressure is the pressure measured in the test dome 48 hours after bake-out using the ConFlat flanged Turbopump with the recommended forepump.

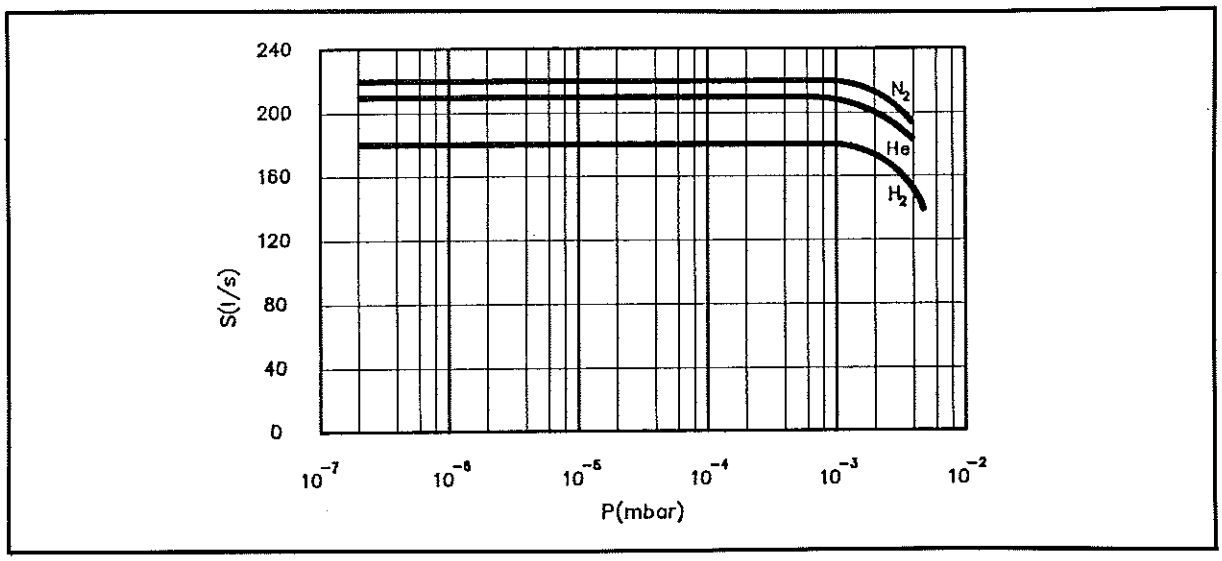

Figure 1-2a) - Pumping speed vs inlet pressure

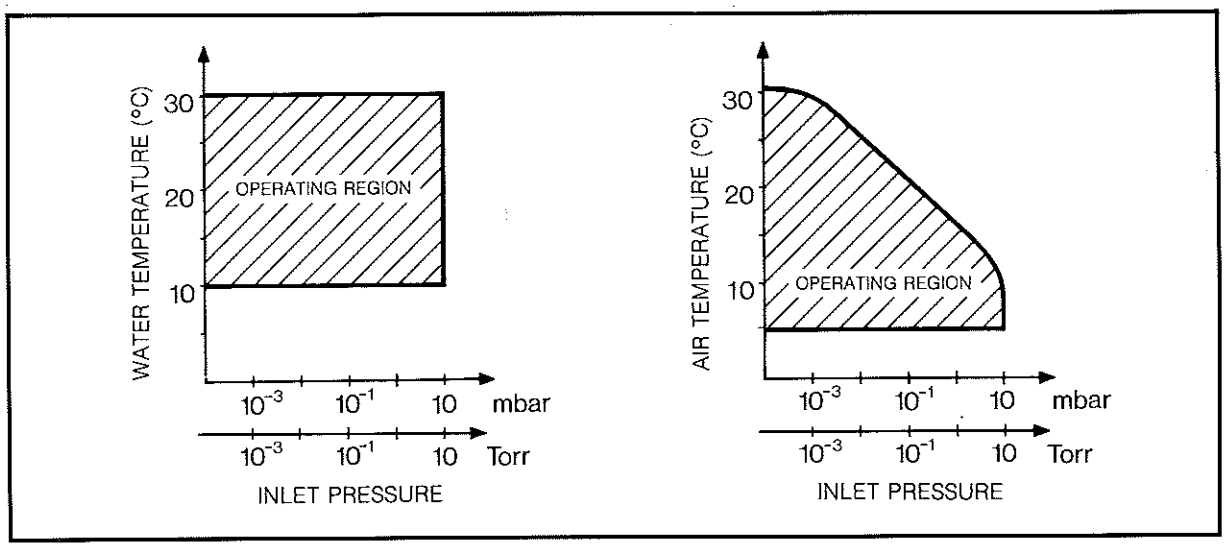

Figure 1-2b) - Maximum operating pressure vs coolant

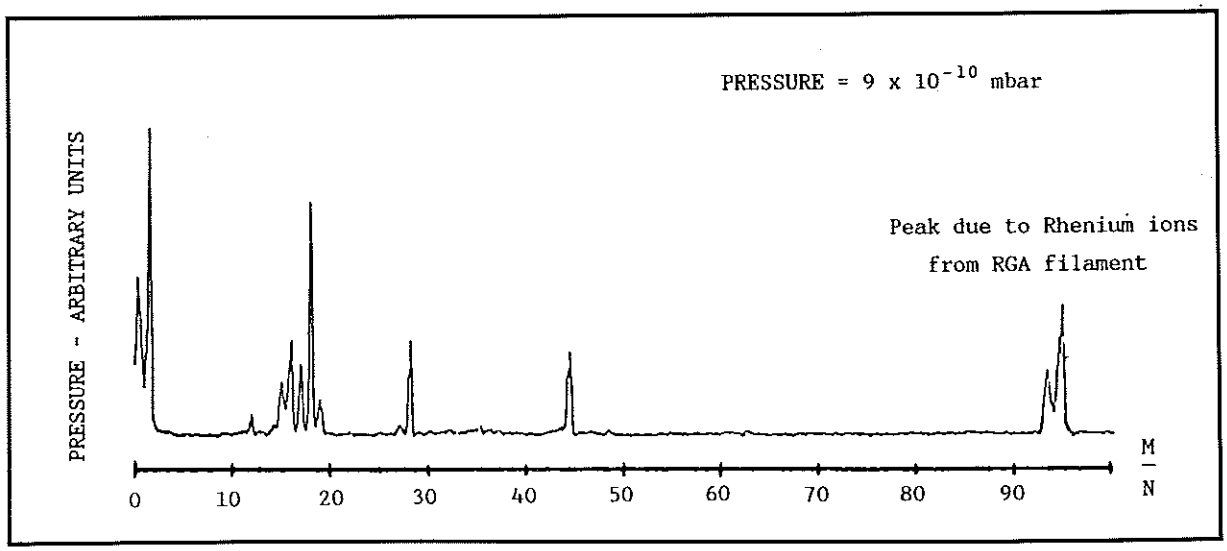

Figure 1-2c) - Typical residual gas spectrum for an unbacked system

1-2-2 TurboV-200 pump outline

The outline dimensions for the TurboV-200 are shown in figure 1-3.
The NW 10 KF vent flange shown is an optional item.

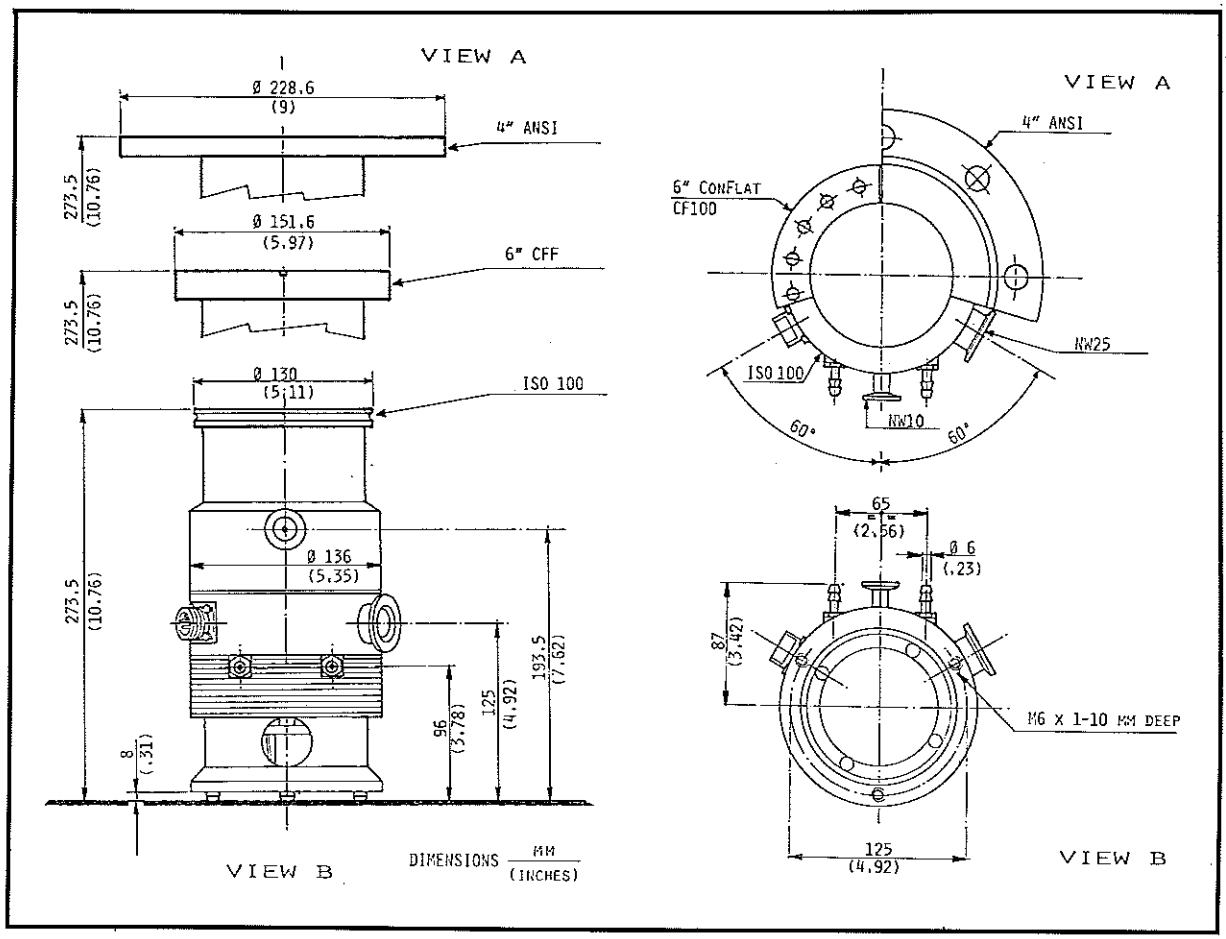

Figure 1-3 - TurboV-200 pump outline

—OIL—

..... LEVEL WHEN RUNNING JUST AFTER PROPER FILL 5/93 APR
—MIN—

2-1 Turbo-V200 pump inspection

The Turbo-V200 pump is shipped with the oil packaged separately to avoid contamination. The packaging of the Turbo-V200 pump is designed to minimize the possibility of shipping damages.

Take care when unpacking to avoid dropping or jarring the pump.

NOTE

The pump is not harmed by exposure to atmospheric pressure although it is good vacuum practice to keep it sealed until it is installed on the system.

CAUTION

Avoid handling parts exposed to high vacuum with bare fingers. Always use gloves or other protection to avoid pump contamination.

2-2 Turbo-V200 pump installation

2-2-1 Oil fill

Prior to installation of the pump, the oil sump must be filled with oil.

a) Remove the four socket screws at the bottom of the pump and detach the empty oil sump.

b) Check the cleanliness of the sump, then fill it with the recommended oil up to the marked level.

NOTE

The oil level will be lower than the OIL mark when the pump is in operation.

c) Insert the magnet in the outer annulus of the sump (fig. 2-1).

d) Place the O-ring into the seat and reattach the sump immediately to avoid particulate contamination of the oil. Do not overtighten the screws to prevent breakage of the plastic flange.

CAUTION

To avoid equipment damage, never operate the Turbo-V200 pump if the oil level is below the MIN level mark when the pump is running.

NOTE

When the pump is first operated with a new charge of oil, for some minutes after starting a foam formation due to outgassing will be visible through the oil sump. After several minutes the oil will become clear and will drip back into the sump.

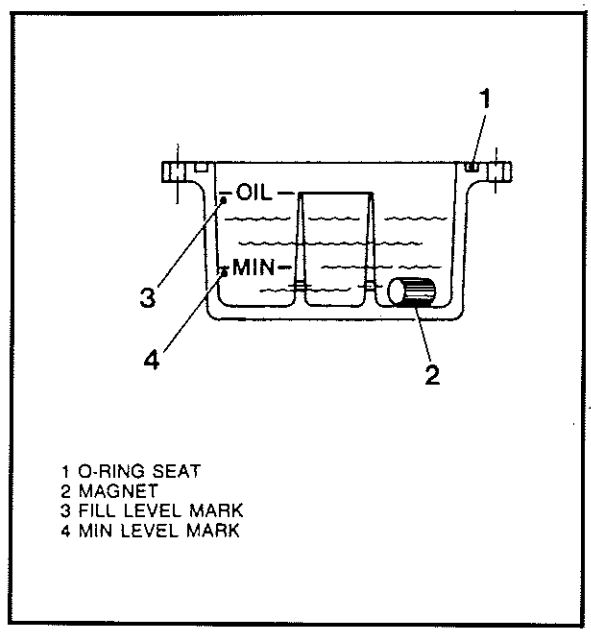

Figure 2-1 - Oil sump

2-2-2 Typical Turbo-V pump interconnections

Figure 2-2 shows the typical pump interconnections.

1) Turbo-V controller

2) Pump vent valve

3) High vacuum isolation valve (optional)

4) System vent valve (optional)

6) Ion gauge

7) Foreline flange

8) Forepump exhaust mist eliminator

9) Forepump with internal anti-suck back valve

10) Forepump control relay

11) Cooling water connections

13) Turbo-V200 pump

2-2-3 High-vacuum flange connection

The pump must be installed vertically with a maximum slope of 10°. The pump can either rest on its support pedestal or it can be suspended from the high-vacuum flange.
If a vibration isolator or a metal bellows is used to connect the pump to the chamber, the pump must be securely anchored in place.

WARNING

To avoid injury to personnel and damage to the equipment, if the pump is supported by its pedestal, make sure it is steady and unable to tip over. If necessary, attach the pump pedestal to the bench using the M6 threaded holes in the pedestal where the rubber feet are installed.
These holes are located on a 122-mm (4.8") diameter.

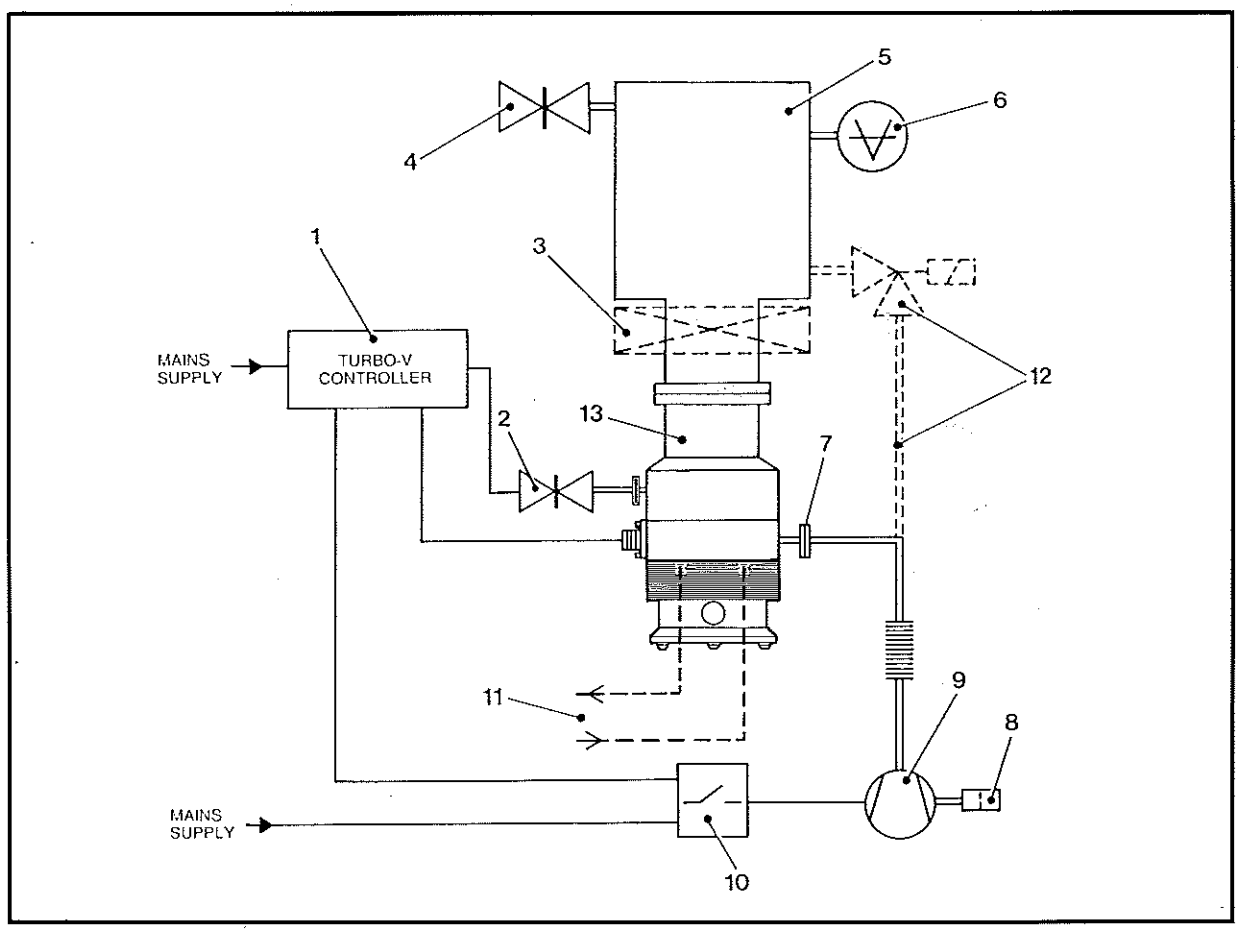

Figure 2-2 - Typical Turbo-V pump interconnections

If the pump is operated in the presence of a magnetic field, precautions must be taken. Please contact Varian sales to assist you on this application.

When ready to install the pump, remove the shipping cover. Do not allow any foreign material to fall into the pump. Inspect mating hardware for cleanliness before connection to pump.

Apply high-temperature lubricant to the screw threads before installation, as proper lubrication simplifies sealing and disassembly.
Fel-Pro C-100 is recommended for this application.

NOTE
Lubrication is essential to prevent galling of the screw after bakeout.

2-2-4 Forepump connection

An NW 25 KF flange is provided at the foreline port. A flexible hose or vacuum tubing can be used to connect to the mechanical pump. If a rigid pipe is used, bellows must be installed in order to minimize the vibration transmitted from the mechanical pump to the turbomolecular pump.

The forepump must have an integral anti-suck back valve to prevent backstreaming oil into the turbomolecular pump.

2-2-5 Vent valve connection

If the pump is to be vented through the vent port, remove the screw plug and install the (optional) vent flange, than connect the vent valve.

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

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.

2-2-6 Water-cooling connection

Two riffled nozzles that accept 6 mm ($^1/_4$") I.D. rubber or plastic tubing are provided on the cooling jacket for the water connections.
The two nozzles are interchangeable as to supply/return connection.

The pump can be cooled by an open circuit with water drainage system or by a closed-loop refrigerated system. In either case the water temperature must be between +10°C and +25°C.

CAUTION
To prevent excessive electrochemical corrosion, the resistivity of the cooling water must be greater than 2 x 10^{-3} ohm-cm. Water not meeting this specification may corrode or obstruct the fittings and damage the cooling jacket.

The Turbo-V200 pump can operate for about 10 minutes without water, but a water flow switch can be installed to interlock the controller and/or to give an early alarm.

If no flow switch is installed on the water line, the thermistor mounted inside the pump will switch off the power to prevent pump damage when the internal temperature exceeds 60°C.

2-2-7 Air cooling

To allow complete flexibility in the installation of a Turbo-V200, a water/air cooling integrated device is provided and a fan can be mounted around the pump in any of three different positions.

The fan is operated directly from the controller (see relevant Turbo-V controller instruction manual).

In any case, whenever practical, water cooling is recommended for its efficiency and it is necessary for high gas load applications.

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

2-2-8 Electrical connection

WARNING

Before connecting the Turbo-V200 pump to the controller make sure that the required ground connection has been made.
Connect the controller ground terminal to the pump ground through the ground cable .

The electrical connection to the Turbo-V200 pump is through a 5-pin connector, where pins B, C and D are used for the motor and pins A and E for the thermistor (resistance is approximately 200 ohms at 20°C).

If the thermistor is disconnected, the pump cannot start.

3-1 General

Make all vacuum manifold and electrical connections as directed in Sect. II and refer to Turbo-V Controller Instruction Manual to operate the Turbo-V pump.

WARNING

To avoid injury to personnel, operate the Turbo-V pump only when the pump inlet is connected to the system or blanked off.

CAUTION

To avoid equipment damage, never operate the Turbo-V200 pump if the oil level is below the MIN level mark when the pump is running.

CAUTION

To prevent damage to the turbomolecular pump when the pump is running, avoid shocks or sudden change of position of the Turbo-V pump .

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 may be roughed down before starting the Turbo-V200 pump.

3-2 Bakeout procedure

Varian recommends that the system chamber and the pump flange are heated to shorten the pumpdown time to base pressure.

CAUTION

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

If the pump accessory heater is used, switch it on upon start-up to bake out the turbopump during pumpdown. If the pump becomes overheated for any reason, the thermistor will remove power from the pump. To achieve best ultimate vacuum, wait until the chamber cools to room temperature after bakeout.

NOTE

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

4) With the pump immersed in Freon to the indicated level, slowly rotate the rotor by turning the conical shaft by hand. This turning motion wipes the rotor blades clean of any contamination.

5) Repeat this cleaning operation 2 or 3 times, replacing the solvent each time with new Freon.

6) Remove the pump from the Freon and rest it on a flat, clean surface still in the inverted position for at least 10 minutes, to allow the pump interior to dry properly. Take care not to scratch the inlet flange sealing area.

7) Place the pump in upright position. Clean the sump and fill it with a new charge of oil. Insert the magnet in the outer annulus and mount the sump on the pump.

8) The pump is ready to be installed.

4-2-3 Bearing replacement

The bearings are the only parts of the pump subject to wear and they must be replaced about every 15,000 hours or when noise exceeds the specification values.

Bearing replacement can only be carried out using special tools by Varian Service-trained technicians.

Bearing replacement must be done in a dust-free environment. Contact Varian Service for detailed information.

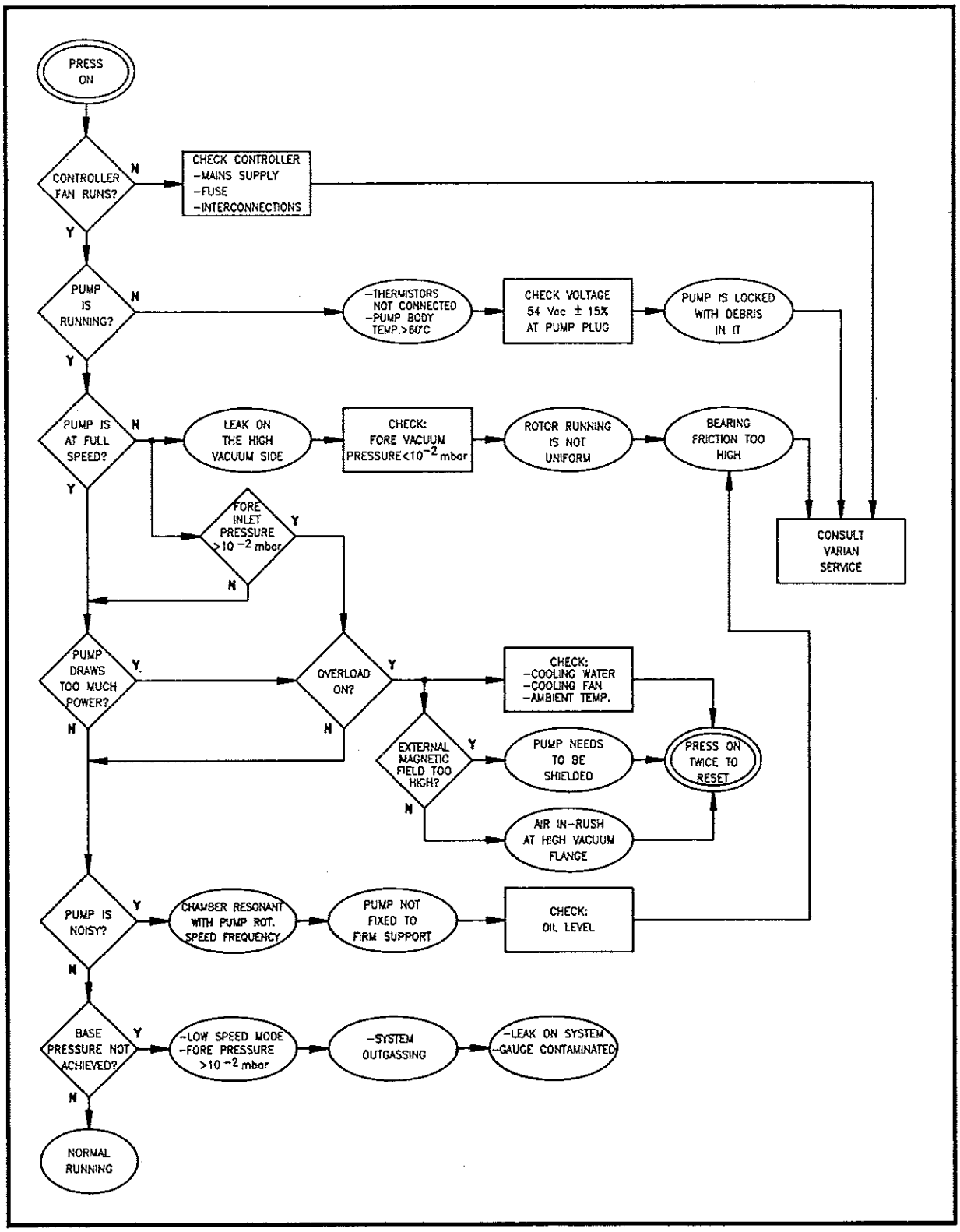

Figure 5-1 - Turbo-V pump troubleshooting chart using Turbo-V controller 969-9421 or 969-9521

Section V
Troubleshooting

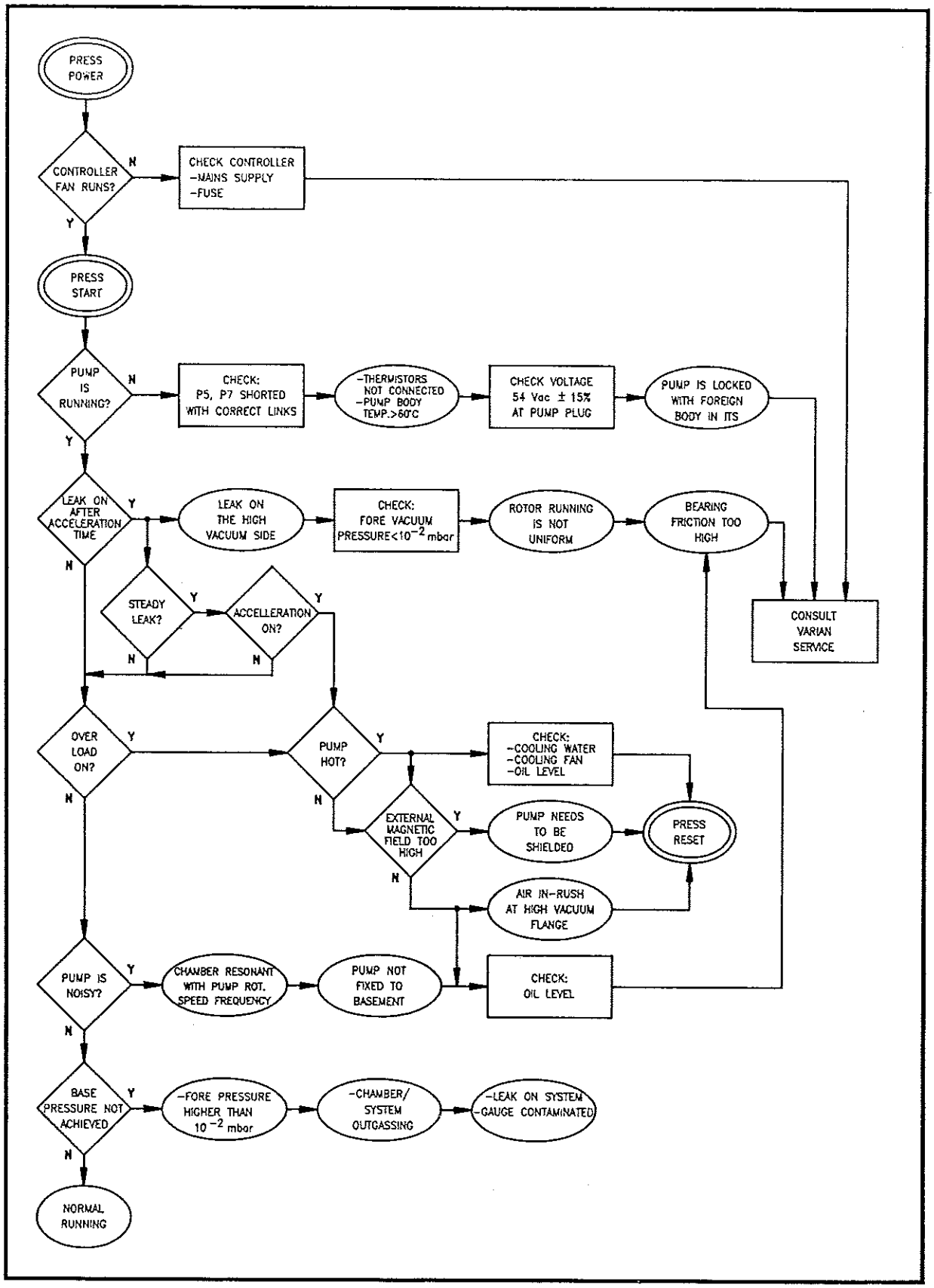

Figure 5-2 - Turbo-V pump troubleshooting chart using Turbo-V controller 969-9422 or 969-9522

6-1 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
Centre ring ISO 100 (with O-ring)	969-9122
ISO clamp kit (pkg./4)	969-9113
Mating ConFlat flange (bored)	954-5080
Screws, nut, washers (pkg/25)	953-5022
Thread lubricant Fel-Pro C100	953-0031
Vibration isolator ISO 100	969-9343
Vibration isolator 6" CFF	969-9332
Forepump SD 200, 220V, 50 Hz, 1 ph.	949-0867-320
Forepump SD 200, 1 ph. universal motor	421-P1221-307
Vent flange NW 10 KF	969-9109
Turbo-V vent device 120V, 50-60 Hz	969-9831
Emergency vent valve	969-9832
Air cooling kit 120V, 50-60 Hz	969-9322
Varian T.A. oil 100 cc	969-9901
Varian T.A. oil 1000 cc	969-9902
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.

France
Varian S.A.
Quartier de Courtaboeuf
B.P. 12
F-91941 Les Ulis-Cedex
Tel:.0033(16)9863838
Telefax: 9282308
Telex: 603769

West Germany, Austria
Varian GmbH
Zettachring 10
Postfach 810649
D-7000 Stuttgart 80
Tel.:0049(711)72068-0
Telefax: 7206810
Telex: 7255614

Varian GmbH
Cuxhavenerstrasse 152
D-2104 Hamburg 92
Tel.:0049(40)7962951/2
Telefax: 7962940
Telex: 217728

Varian GmbH
Arnulfstrasse 44
D-8000 Munich 2
Tel:.0049(89)551705-0
Telefax: 596593
Telex: 522523

U.K. and Eire
Varian Ltd.
28 Manor Road
GB-Walton-on-Thames/Surrey
Tel.:0044(9322)43741
Telefax: 28769
Telex: 928070

Italy
Varian SpA
VP Sales Office
Via Varian 54
I-10040 Leinì (Torino)
Tel.:0039(011)9968086
Telefax: 9969002
Telex: 210297

Varian S.p.A.
Via della Nocetta 71
I-00164 Roma
Tel.:0039(06)6257707
Telefax: 6257341
Telex: 622401

Eastern Europe, Middle East, Africa & Mediterranean Countries, India, Pakistan
Varian SpA
VP Sales Office
Via Varian 54
I-10040 Leinì (Torino)
Tel.:0039(011)9968086
Telefax: 9969002
Telex: 210297

INTERNATIONAL SALES AND SERVICE REPRESENTATIVES

- Finland
DCA Instruments
Data City
Lemminkaisenkatu 14-18A
PSF 20520 Turku
Tel.: 00358 (21) 328-131 / 717-740
Telefax: 513735,Telex: 62004

- Greece
International Technology Corp.
7 Agiou Mina Street
P.O.Box 865
Thessaloniki
Tel.:0030(31)517304
Telefax: 542556, Telex: 412090

-India
H. Fillunger & Co.Pvt.Ltd.
Regd.Office
'Om Chamber, 1st floor
Near Jangali Maharaj Temple
Shivajinagar, Pune - 411005
Tel.: 0091 (212)54 092
Telefax: 52954, Telex: 0145429

- Israel
I.S.I. - Israel Scientific
Instruments Ltd.
17 Pinhas St.
Ramat Gan
Tel.:00972(3)772051
Telefax: 770808, Telex: 341790

- The Netherlands
DeMaCo
Vacuümtechniek
Handelsstraat 6 A
NL-1703 AB Heerhugowaard
Tel.: (31) 02207 - 44724
Telefax: (31) 02207 - 40247

- Norway
Vakuum-Service A.S.
Industrivn. 26
N-2020 Skedsmokorset
Tel.:0047(6)878120
Telefax: 879655, Telex: 79483

- Pakistan
Imtiaz Chemineers
3/II Shadman Plaza
Shadman Market
Lahore-3
Tel.: 0922(42)270322
Telefax: 871530, Telex: 44390

- South Africa
VACUTEC c.c.
P.O.Box 48488
Roosvelt Park 2129
Johannesburg SA
Tel.: 0027(11)476-4202
Telefax: 476-4203

- Spain
Alava Ingenieros S.A.
Estebanez Calderon 5
E-Madrid 28020
Tel.:0034(1) 5720440
Telefax: 2702661, Telex: 43183

- Sweden
VSW
Scientific Instruments Svenska AB
P.O. Box 7014
Söderleden 4
58007 Linköping
Tel.: 0046 (13) 140174
Telefax: 100501

- Switzerland
SemiSupply AG
St. Adrianstrasse 22
6318 Walchwil
Tel.: 0041 (42) 772430
Telefax: 771083

- Yugoslavia, Hungary, Czechoslovakia
Franc Vreel, Trade Agency
Dorfstrasse 62,
8401 Graz-Kalsdorf, Austria
T... ...533914
Telefax: 38-61-484961

VARIAN VacuumProducts - USA
121 Harwell Avenue
Lexington, MA 02173
Tel.: (617) 861-7200
Telex: 710-321-0019
Telefax: 617-860-5437

Albuquerque
Varian / VP District Office
822 La Mirada Road, NE, Suite 200
Albuquerque, New Mexico 87109
Tel.: (505) 275-2060
Telefax: 275-9750

Bloomington
Varian / VP District Office
Metro Financial Center
1550 East 79th Street, Suite 550
Bloomington, Minnesota 55420
Tel.: (612) 854-4770

Boston
Varian / VP District Office
One Ferncroft Road
Danvers, Massachusetts 01923
Tel.: (508) 777-7330
Telefax: 777-1406

Chicago
Varian / VP District Office
708 Landwehr Road
Northbrook, Illinois 60062
Tel.: (312) 480-0300
Telefax: 480-0305

Clearwater
Varian / VP District Office
12360 66th Street, North, Suite F4
Largo, FL 33541
Tel.: (813) 539-1590

Cleveland
Varian / VPD District Office
333 Babbitt Road
Euclid, Ohio 44123
Tel.: (216) 289-6365

Dallas
Varian / VP District Office
405 International Parkway,
Suite 203
Richardson, Texas 75081
Tel.: (214) 235-4588

Knoxville
Varian / VP District Office
6025 Brookvale Lane, Suite 140
Knoxville, Tennessee 37919
Tel.: (615) 588-3252
Telefax: 588-3894

Los Angeles
Varian / VP District Office
10440-2 Pioneer Blvd.
Santa Fe Springs
California 90670
Tel.: (714) 739-5891,
Telefax: 944-7138

New York
Varian / VP District Office
25 Commerce Drive
Cranford, New Jersey 07016
Tel.: (201) 499-7444
Telefax 276-9521

Phoenix
Varian / VP District Office
615 South River Road
Tempe, Arizona 85281
Tel.: (602) 966-5400
Telefax: 829-4012

San Francisco
Varian / VP District Office

Syracuse
Varian / VP District Office
4914 West Genesee Street
Camillus, New York 13031
Tel.: (315) 488-0217

Washington, D.C.
Varian / VP District Office
1655 North Fort Myer Drive
Suite 650
Arlington, Virginia 22209
Tel.: (703) 525-3883
Telefax: 522-1360

VARIAN International

Australia
Varian Pty. Ltd.
6/8 Frenchs Forest Road (East)
Frenchs Forest , New South Wales
Sidney, Australia 2086
Tel.: 451-9133 - Telex: AA 24503
Telefax: 452-2600

Brazil
Varian Industria e Comercio Ltda.
Avenida Dr.Cardoso de Melo 1457
CEP 04548
Sao Paulo, Brazil
Tel.: 533-0444
Telex: 24314

Canada
Varian Canada Ltd.
332 Guelph Street
Georgetown, Ontario L7G 485
Tel.: 416-873-1611
Telex: 069-7502

Eastern Canada
Varian Canada
955 Green Valley, Suite 150
Ottawa, Ontario, Canada K2C 3V4
Tel.: 723-0330

Hong Kong
Varian Pacific Inc.
Room 1018-20, Tower A
Mandarin Plaza
14 Science Museum Road
Tsimshautsui East, Kowloon
Tel.: 3724-2836
Telex: 35626
Telefax: 694280

Japan
Varian, Vacuum Products
c/o Toyo Menka Kaisha Ltd.,
TKWVR
C.P.O. 183, Tokyo 100-91, Japan
Tel.: 81-3-588-9732
Telefax: 81-3-588-9925

Korea
Varian Korea Ltd.
Nari Building, 6th Floor
831-45, Yeoksam Dong
Kangnam-Ku
Seoul, Korea
Tel.: 557-2648 - Telex: K28663
Telefax: 552-4361

Mexico
Varian S.A.
Francisco Petrarca 336-302
Col. Polanco
Mexico 5, D.F.11570
Tel.: 905-531-31-70
Telex: 177-4410

Taiwan
Scientek Corporation
10 F-1, 180 Nanking East Road,
Sec.4
Taipei, Taiwan R.O.C.
Tel.: 886-2-731-2911 - Telex: 27598
Telefax: 886-2-752-9793

Printed in Italy/October 90/300