

TURBOMOLECULAR VACUUM PUMP PREVENTATIVE MAINTENANCE SCHEDULE

Standardized Field Servicing & Component Replacement Protocol

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EFFECTIVE: NOVEMBER 12, 2020
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REV: 2.4 (APPROVED)

Equipment ID / Tag: _____	Pump Serial #: _____	Model / Series: Leybold TURBOVAC / Pfeiffer / Agilent
Total Operating Hours: _____ hrs	Forepump Type: Rotary Vane / Dry Scroll	Facility / Bay: Cleanroom Vacuum Lab B
Assigned Lead Tech: Kadeem Manning	Last Service Date: _____	Next Due Date: _____

MANDATORY SAFETY WARNING & LOTO PROTOCOL:

- **High-Speed Rotor Hazard:** Turbomolecular pump rotors spin at **30,000 to 90,000 RPM**. Stored rotational energy can cause severe personal injury or catastrophic equipment destruction upon physical impact or vacuum collapse.
- **Electrical Isolation:** Execute full Lockout/Tagout (LOTO) on pump controller frequency converter and roughing forepump prior to servicing electrical leads or disassembling pump housing.
- **Thermal Safety & Contamination:** Pump casing and backing pump reach temperatures $>70^{\circ}\text{C}$ during continuous operation; allow to cool. Always assume internal components are contaminated with toxic or corrosive process media — wear nitrile gloves, eye protection, and safety face shield.

1. Daily / Per-Shift Routine Inspection & Operational Audits

Perform visual, acoustic, and digital parameter checks during active operation or shift changeover.

Code	Inspection Item / Parameters	OEM Target Specification	Readback / Findings	Status
D-01	Acoustic & Vibration Audit Listen for bearing grinding, rattling, or high-pitched whining.	Smooth, uniform high-pitched hum; zero mechanical vibration	Vibration: _____ mm/s Audible Noise: Normal []	[] PASS [] FAIL
D-02	Rotor Acceleration & Speed Verification Check controller display panel for nominal rotational speed %.	Rotor speed = 100% nominal (30,000 – 90,000 RPM range)	Speed: _____ % RPM: _____	[] PASS [] FAIL
D-03	Motor Drive Current Draw Monitor controller drive current in steady-state high vacuum.	Low baseline idle current ($< 1.5\text{ A} - 2.5\text{ A}$ model dependent)	Current: _____ A Power: _____ W	[] PASS [] FAIL
D-04	Cooling System Performance Verify forced-air fan operation or liquid cooling water flow rate.	Cooling water flow $\geq 1.0\text{ L/min}$; Temp $< 25^{\circ}\text{C}$; Fan spinning	Flow: _____ L/min Water Temp: _____ $^{\circ}\text{C}$	[] PASS [] FAIL
D-05	Bearing N2 Purge Gas Supply Inspect purge line regulator & flow meter for toxic/corrosive duty.	Dry N2 gas flow set to 20–30 sccm; Line pressure $\sim 2.8\text{ bar(g)}$	Pressure: _____ bar(g) Purge Flow: _____ sccm	[] PASS [] N/A
D-06	Foreline Vacuum Pressure Check Verify roughing backing pump forevacuum before turbo startup.	Foreline pressure $< 1 \times 10^{-1}\text{ Torr}$ (100 mTorr / $\sim 1\text{ mbar}$)	Pressure: _____ mbar	[] PASS [] FAIL

2. Weekly & Bi-Weekly Component Checks

Code	Maintenance Action	Target Requirement	Recorded Measurement	Status
W-01	Forepump Oil Level & Quality Inspect sight glass on rotary vane backing pump.	Midpoint mark on sight glass; clear oil without dark discoloration/milky foam	Level: _____ % Clarity: Clear / Dark	[] PASS [] REFILL
W-02	Inlet Splinter Guard Inspection Visual check of fine wire-mesh screen at ISO/CF inlet flange.	Splinter guard present, clean, debris-free, zero physical damage or mesh tearing	Guard Clean: [] Yes Debris Present: [] No	[] PASS [] CLEAN
W-03	Foreline Mist Eliminator Filter Check exhaust oil mist filter for saturation or backpressure.	Zero oil leakage around housing; differential pressure $< 0.2\text{ bar}$	Filter Condition: _____ Leakage: None []	[] PASS [] REPLACE
W-04	Vent & Gas Ballast Valve Check Verify smooth mechanical operation of controlled vent valve.	Flow-restricted venting function; tight seal upon closure without leakage	Seal Tightness: _____ Valve Ops: Smooth []	[] PASS [] FAIL

3. Monthly & Quarterly Servicing Protocol (~500 – 2,000 Hours)

Detailed fluid changes, electrical connection tightening, and filter media replacements.

Code	Servicing Item	OEM Standard / Procedure	Action Taken / Result	Status
M-01	Backing Pump Oil Change Drain contaminated oil and refill with recommended grade.	Use Leybonol LVO 130/210 or mineral oil; drain warm for complete removal	Volume Drained: ____ L Refill Grade: _____	☐ DONE ☐ N/A
M-02	Dry Scroll Tip Seal Check For oil-free scroll forepumps (e.g. Agilent IDP / Edwards).	Inspect tip seal wear; replace tip seals every 1-2 years (~8,000 hrs) or if base pressure degrades	Dust Cleaned: ☐ Yes Tip Seal Wear: ____ mm	☐ PASS ☐ SERVICE
M-03	Controller Fan & Air Filter Inspect frequency converter cooling vents and dust filter pad.	Vacuum dust buildup from heat sink; replace intake filter pad if clogged	Heat Sink Temp: ____ °C Filter Cleaned: ☐	☐ DONE ☐ REPLACE
M-04	High Vacuum Gate Valve Test Inspect seal contact, solenoid valve response, and pneumatic air.	Pneumatic supply pressure = 4.5 – 6.0 bar; VITON / copper gasket seal intact	Pneu Press: ____ bar Seal Scoring: None ☐	☐ PASS ☐ REPAIR
M-05	Helium Mass Spectrometer Leak Check Perform sniffer or vacuum leak detection on all foreline flanges.	Total system leak rate < 1×10^{-9} mbar·L/s across ISO-KF / CF joints	Measured Leak Rate: ____ mbar·L/s	☐ PASS ☐ FAIL

4. Annual & Major Preventive Overhaul (~8,000 – 24,000 Hours)

Precision internal bearing wick cartridge replacement, rotor overhaul, and sensor recalibration.

Code	Overhaul Maintenance Task	OEM Standard / Interval	Findings & Action Log	Status
A-01	Ceramic Bearing Oil Wick / Felt Replacement Replace operating fluid reservoir & wicks (e.g. Pfeiffer / Leybold).	Annual (~8,000 hrs): Extract old Porex rods/felt wick with tweezers; insert new OEM reservoir (TL 011 / Leybonol)	Reservoir Part #: _____ Old Wick Status: Dark ☐	☐ COMPLETED ☐ PENDING
A-02	Ceramic Ball Bearing Mechanical Replacement Full mechanical ceramic bearing changeout (mechanically suspended models).	Every 2 to 3 Years (~16,000–24,000 hrs): Replace precision hybrid ceramic ball bearings using dedicated service puller tools	Bearing Kit Part #: _____ Runout Check: < 0.002 in	☐ COMPLETED ☐ N/A
A-03	Magnetic Levitation Sensor Calibration For 5-axis active magnetic bearing pumps (e.g. TURBOVAC MAG / TwisTorr).	Every 2 to 3 Years: Calibrate magnetic position sensors, zero-axis levitation offset, and backup emergency safety bearings	Sensor Zero Offset: OK ☐ Backup Bearing Wear: OK ☐	☐ COMPLETED ☐ N/A
A-04	Internal Turbine Rotor Cleaning Clean rotor blades and stator discs if outgassing deposits accumulate.	Wipe surfaces gently with lint-free cloth moistened with pure Isopropyl Alcohol or Acetone. <i>Never use abrasive tools!</i>	Solvent Used: Isopropanol ☐ Deposit Level: Low / Mod	☐ COMPLETED ☐ SKIPPED
A-05	Ionization Gauge Recalibration Factory calibration check of high vacuum Pirani / Penning / Bayard-Alpert gauges.	Calibrate against secondary standard to ensure accurate vacuum readouts below 1×10^{-3} Torr to 1×10^{-8} Torr	Gauge Serial #: _____ Zero Span Adj: ____ %	☐ COMPLETED ☐ PASSED

5. Consumable Parts Replacement & Inventory Log

Document all OEM replacement parts, lubricants, and gaskets installed during this servicing event.

Item #	Component Description	OEM Manufacturer & Part Number	Qty Installed	Lot / Serial #	Tech Init
1	Ceramic Bearing Lubricant Reservoir	Pfeiffer / Leybold (TL 011 / LVO 700)	1 Kit	LOT-2020-0982	KM
2	Porex Absorber Rods (Set of 8)	PFEIFFER PV M40 569 / Equivalent	1 Set	PRX-8821	KM
3	Foreline Rotary Vane Vacuum Oil	LEYBONOL LVO 130 Mineral Oil	2.5 Liters	LVO-130-1092	KM
4	ISO-KF 25 Centering Ring & Viton O-Ring	Leybold ISO-KF 25 Viton Gasket	2 Pcs	VT-KF25-01	KM
5	CF 100 Copper Flange Gasket (OFHC)	Kurt J. Lesker / Agilent CF 6.0 in	1 Pc	CU-CF100-99	KM
6	Exhaust Oil Mist Filter Element	Leybold FE 16-25 Exhaust Element	1 Pc	FE-1625-X	KM

6. Technician Field Notes & Corrective Actions Log

Technician Observations & Maintenance Findings:

Routine 8,000-hour preventative maintenance performed on Turbomolecular Vacuum Unit #TMP-02. Drained 2.2L of dark forepump oil and flushed housing with clean LVO 130. Replaced ceramic bearing lubricant reservoir and 8 Porex wicks using OEM tool PV M40 569. Inspected inlet splinter guard — verified mesh intact without debris contamination. Re-sealed foreline KF-25 flanges with fresh Viton O-rings. Performed helium leak check — ultimate leak rate confirmed at 4.2×10^{-10} mbar-L/s (PASS). System powered up, accelerated to 100% nominal speed (54,000 RPM) within 4.5 minutes. Motor current draw stabilized at 1.42 A in high vacuum (1.8×10^{-7} Torr). Unit ready for continuous production service.

7. Authorization & Return-to-Service Sign-Off

Lead Maintenance Technician:	Kadeem Manning	Signature: <i>Kadeem Manning</i>	Date: Nov 12, 2020
Vacuum Systems Supervisor:	Dr. Marcus Vance, PE	Signature: <i>Marcus Vance</i>	Date: Nov 12, 2020
Final Equipment Status:	☒ APPROVED — RETURN TO FULL SERVICE ☐ CONDITIONAL SERVICE (SEE NOTES) ☐ LOCKED OUT / TAGGED OUT (DEFECTIVE)	Next Scheduled PM: MAY 12, 2021 (4,000 HR CHECK)	QA Stamp / Badge: QA-VAC-7718