

STANDARD OPERATING PROCEDURE	DOC ID: SOP-VAC-2021-12	REV: 1.1
SUBJECT: Drive & Mechanical Inspection Protocols	EFFECTIVE DATE: August 14, 2021	CATEGORY: Preventive Maintenance
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Rotary Vane & Mechanical Roughing Pump Drive Assembly & Mechanical Component Inspection SOP

Standardized Guidelines for Belt Tensioning, Coupling Alignment, Shaft Seal Verification, Motor Thermal Management, and Valve Deck Maintenance

1. Purpose & Scope

This Standard Operating Procedure (SOP) defines the non-negotiable requirements for inspecting, servicing, and verifying the drive assemblies and mechanical components of oil-sealed rotary vane, dry scroll, and mechanical roughing vacuum pumps. Routine mechanical degradation—such as loose drive belts, misaligned shaft couplings, hardened shaft seals, clogged motor cooling fins, and carbon buildup on exhaust valve decks—directly causes catastrophic motor failure, elevated operating temperatures, and severe vacuum depth loss. This procedure applies to all Tier II vacuum technicians and field specialists across commercial, industrial, and laboratory processing facilities.

2. Environmental Health & Safety (EHS) Protocols

- **OSHA Lockout/Tagout (LOTO):** Mandatory compliance with OSHA 29 CFR 1910.147. Electrical power must be isolated at the breaker and zero-energy state verified with a multimeter before removing drive guards or touching rotating couplings.
- **Rotational Hazard Warning:** Never operate a belt-driven or direct-coupled vacuum pump without all belt guards and coupling shrouds fully installed and bolted secure.
- **Personal Protective Equipment (PPE):** Safety glasses with side shields (ANSI Z87.1) and 6 mil powder-free nitrile gloves are required for all mechanical disassembly.
- **Thermal Hazards:** Allow pump casing and motor housing to cool below 40°C prior to inspecting motor cooling fins or touching valve decks.

3. Drive & Mechanical Acceptance Tolerances

Component / Parameter	Nominal Specification	Acceptable Tolerance / Action Limit
Drive Belt Tension	1/2 inch (12.7 mm) deflection	1/4" to 1/2" deflection under 5–8 lbs thumb force
Shaft Coupling Alignment	Parallel < 0.005", Angular < 0.05°	Re-align if runout > 0.010" or spider insert worn
Shaft Seal Weeping	Zero fluid leakage	Replace seal immediately if oil film or droplets form
Motor Current Draw	Nameplate Full Load Amps (FLA)	Must not exceed ±5% of FLA at base vacuum
Vibration Level (ISO 10816)	Baseline < 1.8 mm/s RMS	Investigate bearings/coupling if > 2.8 mm/s RMS
Exhaust Valve Deck	Clean, carbon-free, flexible spring	6-month clean; replace flappers if warped or pitted

4. Step-by-Step Mechanical Servicing Sequence

Phase 1: Isolation, LOTO & Pressure Relief

1. Close main roughing valve to isolate the pump from the vacuum chamber.
2. Disconnect electrical power at the main breaker, apply Lockout/Tagout lock/tag, and perform zero-energy test.
3. Safely vent the pump interior to atmospheric pressure using dry N₂ or ambient air vent valve.

Phase 2: Belt Drive & Pulley Maintenance (Belt-Driven Models)

1. Unbolt and remove the drive belt protective guard.
2. Inspect drive belt for severe wear, glazing, cracking, fraying, or oil saturation. Replace if damaged.
3. Check pulley alignment using a straightedge across motor and pump sheaves; adjust keyway set screws if misaligned.
4. Measure belt deflection midway between pulleys. Adjust motor mounting slide bolts until 1/4" to 1/2" deflection is achieved under moderate thumb pressure (approx. 5–8 lbs force).

Phase 3: Direct Coupling & Shaft Alignment (Direct-Drive Models)

1. Remove direct-drive coupling housing shroud.
2. Inspect the flexible elastomer spider insert for cracking, shedding, or compression set. Replace if degraded.
3. Verify shaft set screws on both pump and motor hubs are torqued tight.
4. Rotate the pump shaft manually by hand for 3 full turns to verify smooth rotation without binding, metal-on-metal grinding, or excessive play.

Phase 4: Shaft Seal & Casing Integrity Inspection

1. Visually examine the shaft seal housing behind the drive pulley/coupling for oil weeping or thermal scoring.
2. Check casing assembly bolts and anti-vibration rubber isolation feet for tightness and compression set.
3. Tighten mounting bolts to OEM torque specs per SMRP Best Practice 2.2.

Phase 5: Motor Assembly & Thermal Management Servicing

1. Inspect motor cooling fan shroud and finned housing. Use compressed air or brush to remove dust/oil buildup.
2. Check cooling fan blades for cracks or loose hub attachment.
3. Test motor winding insulation resistance with a megohmmeter (acceptable if $> 5 \text{ M}\Omega$).

Phase 6: Valve Deck, Solenoid & Anti-Suckback Maintenance

1. Unbolt top exhaust cover to access the internal valve deck every 6 months.
2. Clean oil reservoir, valve deck plate, and solenoid plunger housing using lint-free cloths and solvent.
3. Inspect exhaust flapper valves and spring plates for carbon buildup, pitting, or loss of spring tension.
4. Test electro-pneumatic anti-suckback valve seating; ensure closure time is $< 20 \text{ ms}$ upon power loss.

Phase 7: Re-commissioning, Guard Re-installation & Performance Audit

1. Re-install all belt guards, coupling shrouds, and electrical junction covers securely.
2. Remove LOTO devices, restore electrical power, and start pump with inlet isolated.
3. Measure motor operating current using a digital clamp meter; confirm current matches nameplate FLA $\pm 5\%$.
4. Measure ultimate base pressure at pump inlet using a calibrated Pirani gauge ($< 100 \text{ mTorr}$ / $10\text{--}20 \text{ microns}$).

5. Preventive Maintenance Interval Matrix

Frequency	Servicing Task / Inspection Focus	Acceptance Benchmark
Daily / Per-Run	Visual & acoustic audit; motor fin airflow check	No unusual knocking; clean cooling fins
Monthly (100–500 hrs)	Drive belt tension check; shaft seal leak inspection	$1/4\text{--}1/2\text{'}$ deflection; zero oil weeping
Semi-Annual (2,000 hrs)	Clean oil reservoir, valve deck, and solenoid valve	Zero carbon buildup on exhaust flappers
Annual (4,000 hrs)	Coupling spider insert swap; motor winding megohmmeter test	Winding resistance $> 5 \text{ M}\Omega$; smooth alignment

6. Document Control & Quality Authorization

Role	Name & Title	Signature	Date
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