A Tougher, Smarter Vacuum Vane Pump for Thermoforming

If you run a vacuum thermoforming operation, you already know why single-stage rotary vane pumps are the industry workhorse: they deliver the deep ultimate vacuum and fast evacuation speeds needed to snap hot plastic sheet tightly against a mold.

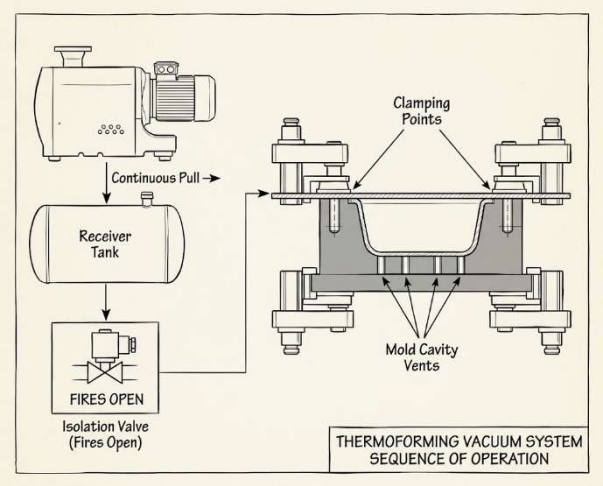
But ask your maintenance team, and they'll tell you the real story: standard rotary vane pumps in thermoforming plants take a beating. They are constantly fighting **burnt, oxidized oil, sticky varnish buildup, and water-sludge contamination.**

Whether your pumps are running hot during continuous high-vacuum cycling or ingesting moist plant air during tank drawdown, oil breakdown leads directly to stuck vanes, wash-boarded cylinders, and unexpected line shutdowns.

The **Vooner PVR EU-HWT (High Water Tolerance) Series** single-stage rotary vane pump—available with **motor-mounted Variable Frequency Drives (VFDs)**—is engineered to be a tougher, smarter solution for real-world thermoforming environments.

The Sequence of Operation: How Thermoforming Vacuum Flows

Understanding how your vacuum network interacts with your forming cycle is critical to maintaining high speeds and preventing equipment strain:



1. **Continuous Pull:** The vacuum pump continuously evacuates the receiver tank to maintain deep negative pressure.
2. **The Isolation Valve Fires:** When the heated plastic sheet is clamped over the mold cavity, the high-speed isolation valve snaps open.
3. **Instantaneous Draw:** Vacuum energy stored in the receiver tank rushes into the mold cavity, instantly snapping the hot plastic against the tool details.

Thin-Gauge vs. Heavy-Gauge Thermoforming: Material Thickness & Applications

Selecting the right vacuum pumping system depends heavily on sheet thickness, which dictates part geometry, total air volume to be evacuated, and required cycle speeds.

Thin-Gauge Thermoforming (≤ 1.5 mm / 0.060")

Thin-gauge thermoforming focuses on high-speed, high-volume automated production using roll-fed thermoplastic sheet (typically PET, PP, PS, or PVC). Because part depths are shallower and cycle speeds are fast, instant vacuum drawdown from a properly sized surge tank is critical to lock in fine tooling detail.

- **Primary Applications:** High-volume disposable packaging, food containers, medical packaging, and consumer retail displays.
- **Common End Products:**
  - Food clamshells, deli trays, and bakery containers
  - Disposable beverage cups, portion cups, and lids
  - Blister packaging and retail display clamshells
  - Medical device packaging and sterile surgical trays
  - Egg cartons and produce punnets

Heavy-Gauge (Thick-Sheet) Thermoforming (> 1.5 mm / 0.060")

Heavy-gauge thermoforming handles thick cut-sheet materials (such as ABS, HIPS, HDPE, PC, and Kydex) ranging from 0.060" up to 0.500" or more. These parts feature large surface areas and deep draws, requiring massive volumetric air displacement (CFM) to pull the heavy sheet tightly over deep mold cavities before the plastic cools.

- **Primary Applications:** Industrial housings, automotive panels, transportation enclosures, heavy material handling, and durable consumer goods.
- **Common End Products:**
    - Vehicle interior door panels, dashboards, and truck bed liners
    - Refrigerator and freezer inner door liners
    - Equipment housings for medical devices, ATMs, and outdoor machinery
    - Pallets, dunnage trays, and heavy-duty shipping containers
    - Spa shells, boat hulls, and kayak bodies

Why Choose Thermoforming?

Compared to injection molding, thermoforming requires significantly fewer tool components and simpler mold assemblies. This dramatically lowers upfront capital investment, making it one of the most economical plastic manufacturing methods available. Key advantages include:

- **Accelerated Time-to-Market:** Faster tooling fabrication leads to quicker production runs.
- **Rapid Prototyping:** Mold iterations and design modifications can be made efficiently and affordably.
- **Superior Design Versatility:** Easily accommodates complex geometries, custom textures, and varying undercut designs.
- **Pre-Colored Materials:** Eliminates secondary painting or coating steps by using pre-pigmented sheet stock.
- **Exceptional Structural Efficiency:** Delivers lightweight finished parts with high strength-to-weight performance.

Sizing Your System: Calculating Required Receiver Tank Volume

To ensure your machine achieves that instantaneous "snap-back" without dropping below your target pressure, proper tank sizing is essential.

Here is a real-world calculation example based on a **2.50 cu ft mold and piping volume**, an initial tank vacuum of **28.5 inHgV**, and a target equalized forming vacuum of **23.0 inHgV**:

Given Parameters & Conversions

- **Mold & Piping Volume (V_{mold}):** $2.50\ \text{ft}^3$

- **Atmospheric Pressure (P_{atm}):** 14.70 PSIA (0.00 inHgV)
- **Initial Tank Vacuum (P_{tank}):** 28.50 inHgV → 0.69 PSIA *(Calculated as: $14.70 \times \left(1 - \frac{28.50}{29.92}\right) = 0.698$ PSIA)*
- **Target Equalized Vacuum ($P_{equalized}$):** 23.00 inHgV → 3.40 PSIA *(Calculated as: $14.70 \times \left(1 - \frac{23.00}{29.92}\right) = 3.398$ PSIA)*

Step-by-Step Calculation

1. **Calculate Pressure Drop Ratios:**
   - *Numerator (Pressure differential to draw down the sheet):* $P_{atm} - P_{equalized} = 14.70 - 3.40 = 11.30$ PSIA
   - *Denominator (Remaining vacuum capacity in the receiver tank):* $P_{equalized} - P_{tank} = 3.40 - 0.69 = 2.71$ PSIA
2. **Calculate Required Tank Volume in Cubic Feet (V_{tank}):**

$$V_{tank} = 2.50 \times \frac{2.71}{11.30} = 10.42 \text{ ft}^3$$

3. **Convert Cubic Feet to Gallons:**

$$V_{gallons} = 10.42 \text{ ft}^3 \times 7.48052 \text{ gal/ft}^3 = 77.95 \text{ gallons}$$

- **Result:** You will need a receiver tank of at least **78 gallons**. A standard **80-gallon** (or 120-gallon) commercial receiver tank is the recommended choice to provide a safety buffer for line losses and air temperature changes.

The Double Threat: Heat and Moisture

Thermoforming subjects rotary vane pumps to a brutal operational loop that standard pumps simply aren't built to handle long-term:

1. Extreme Heat & Burnt Oil (Thermal Oxidation)

Between forming shots, fixed-speed vacuum pumps continue running at full RPM against high vacuum or near-dead-head conditions. Combined with the heat generated by rapidly compressing air during every drawdown surge, internal temperatures spike. Standard pump oil oxidizes and bakes into dark, sticky varnish, clogging lubrication passages and causing vanes to stick inside rotor slots.

2. Ambient Humidity & Water Sludge (Emulsification)

While the plastic sheet itself is hot, large volumes of ambient air drawn from vacuum receiver tanks carry relative humidity. In unconditioned plants or around sweating chilled molds ($45°\text{F} - 55°\text{F}$ water loops), water vapor compresses and condenses inside cooler areas of the oil reservoir, forming a milky sludge that destroys lubrication film strength.

Engineered Tougher: The EU-HWT Advantage

The Vooner EU-HWT series provides the aggressive draw performance of a wet rotary vane pump while actively defending against both thermal and moisture breakdown:

- **Smart Thermal Control Prevents Varnish:** Designed with optimized thermal management and heavy-duty lubrication pathways, the EU-HWT resists thermal oxidation. Oil stays fluid, keeping vanes sliding freely in their slots without carbon buildup.
- **Double the Water Vapor Capacity:** Delivers up to **twice the water vapor handling capacity** of standard rotary vane pumps, purging ambient moisture out the exhaust as vapor before it can condense into sludge.
- **Hardware Protection:** Clean, unburnt, un-emulsified oil maintains proper film strength, eliminating cylinder wall wash-boarding, vane breakage, and sudden pump seizures during peak production runs.

Smarter Control: Integrated Motor-Mounted VFD Technology



To turn a tough pump into an intelligent process asset, Vooner offers **direct motor-mounted VFD drives**. By mounting the drive directly on the pump motor, you eliminate bulky floor-standing control cabinets and long wiring runs.

- **Match Flow to Demand (Energy Savings):** Instead of running at 100% speed during heating and indexing cycles, the smart drive automatically ramps pump RPM up during mold drawdown and dials it back when holding vacuum receiver tanks, slashing electrical power consumption by **up to 30% to 50%**.
- **Lower Operating Temperatures:** Reducing motor speed during idle times prevents dead-head friction heat from baking pump oil, extending lubricant life and protecting vanes.
- **Soft Starting:** Eliminates high electrical current surges of hard-across-the-line starts, reducing mechanical wear on the drive coup

Technical Specifications: EU-HWT Series

Note: Adding the booster to the vacuum pump can add up to 5 times the volumetric flow rate the pump is capable of achieving on it's own.

Model	Nominal Pumping Speed (CFM)	Water Vapor Capacity (lbs/hr)	Motor Power (HP)	Smart Drive Option
EU 47 HWT	~33 CFM	Up to ~2.2 lbs/hr	1.5 - 2 HP	Motor-Mounted VFD
EU 67 HWT	~47 CFM	Up to ~3.0 lbs/hr	2 - 3 HP	Motor-Mounted VFD
EU 105 HWT	~76 CFM	Up to ~6.6 lbs/hr	4 HP	Motor-Mounted VFD
EU 160 HWT	~147 CFM	Up to ~15.0 lbs/hr	7.5 - 10 HP	Motor-Mounted VFD
EU 300 HWT	~211 CFM	Up to ~30.0 lbs/hr	15 HP	Motor-Mounted VFD

(Capacities scale up to 465 CFM and 50 lbs/hr of water vapor capacity for heavy-duty applications.)

Engineered Tougher: The DRY Claw Advantage

The Vooner PVR Dry Claw series vacuum pumps provides the aggressive draw performance of a wet rotary vane pump while actively defending against both thermal and moisture breakdown as no oil is present in the compression chamber. The Vooner Dry claw vacuum pumps are also available with VSD and set point control for exact vacuum control and highest power efficiencies.



(Capacities scale up to 671 CFM and associated water vapor capacity for heavy-duty applications.)

Technical Specifications: DRY Claw Series

Model	Nominal Pumping Speed (CFM)	Continuous Ultimate Vacuum (inHgV / Torr)	Motor Power (HP)	Smart Drive / Control Option
DRY C 60	~42 CFM	25.5" HgV (112.5 Torr)	2.0 - 3.0 HP	Motor-Mounted VFD Available
DRY C 100	~70.6 CFM	25.5" HgV (112.5 Torr)	3.0 - 5.0 HP	Motor-Mounted VFD Available
DRY C 157	~105.9 CFM	28.4" HgV (37.5 Torr)	5.0 - 7.5 HP	Motor-Mounted VFD Available
DRY C 250	~166 CFM	24.0" HgV (150 Torr)	7.5 - 10 HP	Motor-Mounted VFD Available
DRY C 300	~211.8 CFM	24.0" HgV (150 Torr)	10 - 15 HP	Motor-Mounted VFD Available
DRY C 400	~282.5 CFM	26.9" HgV (75 Torr)	15 - 20 HP	Motor-Mounted VFD Available
DRY C 500	~353.1 CFM	26.9" HgV (75 Torr)	20 - 25 HP	Motor-Mounted VFD Available

Stop Losing Production Hours to Oil Breakdown and Wasted Power

Upgrade your plant with a vacuum pump that handles extreme moisture, eliminates burnt oil, and automatically adjusts to your machine's cycle speeds.

Contact Our Application Engineers Today

Let’s review your cycle times, receiver tank volumes, and electrical loads to configure the ideal smart EU-HWT system for your plant.

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