FINISHING EDUCATION UNIVERSITY

CARLISLE FLUID TECHNOLOGIES

Knowledge is Power

The Brands You Trust

BGK™ products deliver precision-engineered curing capabilities for a full range of coatings including liquid, powder, wax, UV and adhesives.

Binks® products boast innovative spray gun and air cap design along with industry leading pumps and controls.

DeVilbiss® products include low pressure manual and automatic spray guns and related spraying accessories. *DeVilbiss* products are widely acclaimed for ergonomics and innovative spray gun design.

Hosco® products deliver smooth bore, “cavity free” stainless steel fittings and accessories designed for use in paint circulating and application finishing systems.

ms® products include powder coating systems and equipment. ms is recognized throughout the world for quality, efficiency and durability.

Ransburg® manual and automatic electrostatic finishing products offer spray finishing solutions to industrial and automobile manufacturing markets.

What We Will Cover

- Refresh of terms
- Establish a benchmark
- 10 common tips for air compressor efficiency
- Go Electric
- Pump & Agitator Tips
- Upgrade spray gun aircaps

Dominic Martin

Global Product Manager
Circulation & Supply Equipment

Understanding Terms

- PSI
  - The amount of force the compressor can deliver to perform a task. Measured by the amount of pressure per square inch.
- CFM
  - The amount of air a compressor can produce at a given level of pressure. It represents the flow rate that can be delivered to perform the task continuously. To sustain flow, compressors need time to rebuild pressure in their tanks. CFM measures the ‘actual’ air flow rate.
- SCFM
  - Standard Cubic Feet per Minute (SCFM) is the rate of flow through a compressor at ‘ideal’ temperature and pressure conditions. The standard temperature for calculating SCFM flow rate ranges from 60°F to 68°F, at a pressure of 14.7psi and relative humidity of 36%. Since SCFM measures volumetric airflow at standard conditions, it will always be higher than the CFM value for an air compressor.
- HP
  - Horsepower is a measure of the motor efficiency of an air compressor at a given CFM and PSI. It describes the work that can be performed by the motor. To calculate kW, multiply HP by the constant (.746)

Establish Your Baseline

- Know you supply/demand performance indicators
  - (SCFM) Airflow at full load capacity of all running air compressors
  - (SCFM) Average airflow rate delivered to the system for demand
  - (SCFM) Peak airflow rate delivered to the system for demand
  - Energy Performance in terms of specific power – kW/ 100 scfm
  - Energy Performance in terms of air supply efficiency – SCF/kWh

- Evaluate the following operating conditions
  - Full load capacity of the running air compressors is greater than the average air demand
  - Full load capacity of the running air compressors is greater than the peak air demand
  - Avoid having a full load capacity resulting in multiple air compressors running at partial load capacity (ideal is to supply system air demand while still operating at less than full load capacity)

Establish Your Baseline

Hour of the Day	Average Airflow (scfm)	Running Capacity (cfm)	Total Power (kWh)	Operating Cost ($ / hr.)	Compressed Air Cost $ / MMCF	Compressed Air Cost $ / scfm / yr	Specific Power (kW/100 cfm)	C.A.S.E Index (scf / kWH)	Average Pressure (psig)
0:00	2060	3720	450.2	$45.02	$364.00	$190.79	21.9	274.5	93.5
1:00	2116	3720	459.7	$45.97	$362.00	$189.75	21.7	276.2	92.8
2:00	2543	3720	518.4	$51.84	$340.00	$178.21	20.4	294.4	90.8
3:00	2468	3050	475.1	$47.51	$321.00	$168.26	19.3	311.7	92.5
4:00	2508	3720	478.1	$47.81	$318.00	$166.68	19.1	314.8	90.4
5:00	2228	3720	486.8	$48.68	$364.00	$190.79	21.9	274.6	93.3
6:00	2589	3720	545.8	$54.58	$351.00	$183.98	21.1	284.6	90.6
7:00	2049	3050	437.0	$43.70	$355.00	$186.08	21.3	281.3	94.8
8:00	2750	3720	582.6	$58.26	$353.00	$185.03	21.2	283.2	90.0
9:00	2138	5220	521.4	$52.14	$406.00	$212.81	24.4	246.0	96.8
10:00	2437	3880	578.1	$57.81	$395.00	$207.04	23.7	252.9	97.0
11:00	2105	3880	514.2	$51.42	$407.00	$213.33	24.4	245.6	98.1
12:00	2388	4550	579.2	$57.92	$404.00	$211.76	24.3	247.4	98.1
13:00	2248	3880	541.8	$54.18	$402.00	$210.71	24.1	248.9	97.1
14:00	2689	3880	634.4	$63.44	$393.00	$205.99	23.6	254.3	95.9
15:00	1741	3880	446.2	$44.62	$427.00	$223.82	25.6	234.1	99.6
16:00	1481	2890	430.6	$43.06	$485.00	$254.22	29.1	206.4	104.2
17:00	1421	2890	425.7	$42.57	$499.00	$261.56	30.0	200.3	105.1
18:00	1515	2890	432.2	$43.22	$475.00	$248.98	28.5	210.3	103.6
19:00	1560	2890	433.5	$43.35	$463.00	$242.69	27.8	215.9	102.0
20:00	1579	2890	433.4	$43.34	$457.00	$239.54	27.4	218.6	101.2
21:00	1568	2890	433.9	$43.39	$461.00	$241.64	27.7	216.8	101.8
22:00	1561	2890	434.2	$43.42	$464.00	$243.21	27.8	215.7	102.1
23:00	1643	2890	444.5	$44.45	$451.00	$236.40	27.1	221.8	101.5
NOTE:	Minimum	Maximum	488.2 avg.	48.82 avg.	405 avg.	212.22 avg.	24.3 avg.	251.3 avg.	97.2 avg.

Source: https://www.airbestpractices.com/system-assessments/compressor-controls/use-baseline-measurements-improve-compressed-air-supply-perfo

Your 10 Item Checklist

To Saving Compressed Air Energy Generally

Source: https://www.cagi.org/working-with-compressed-air/benefits/10-steps-to-savings.aspx

1. Turn Off Compressor

- Benchmark full supply potential of running compressors at different times during shifts
- Unloaded and idle compressors cost money
- Identify times such as overnight, evenings and weekends where compressors could be switched off
- Rule of Thumb is that energy bills could be reduced by up to 20%

2. Fix Any Air Leaks

- Estimates suggest a ¼” air leak at 100 psi will cost in excess of $2500 annually
- Pipe systems older than 5 years can leak up to 25% of supply
- Only a fraction of the compressor kW consumed during a cycle yield air power – the rest is wasted as heat Leaks result in the air power not being utilised and reduce efficiency.
- Leaks occur at
  - o Couplings
  - o Fittings
  - o Pipe Sections
  - o Hoses
  - o Joints
  - o Drains
  - o External unloader valve
  - o (Pumps) Stuck air valves

Sound Level	CFM@ 100 PSIG	CFM@75 PSIG	CFM@50 PSIG	CFM@25 PSIG	CFM@10 PSIG
10 dB	0.5	0.3	0.2	0.1	0.05
20 dB	0.8	0,9	0.5	0.3	0.15
30 dB	1.4	t.l	0.8	0.5	0.4
40 dB	1.7	1.4	1.1	0.8	0.5
50 dB	2.0	2.8	2.2	2.0	1.9
60 dB	3.6	3.0	2.8	2.6	2.3
70 dB	5,2	4,9	3.9	3.4	3.0
80 dB	7.7	6.8	5.6	5.1	3.6
90 dB	8.4	7.7	7.1	6.8	5.3
100 dB	10.6	10.0	9.6	7.3	6.0

Source: https://what-when-how.com/energy-engineering/compressed-air-leak-detection-and-repair-energy-engineering/

3. Check Piping / Prevent New Leaks

- Regularly check for new leaks
- Clean, dry pipes indicates good quality air and no corrosion issues
- Dust in the pipe is caused by particles in the compressed air. If compressed air is not filtered, or if the filter is clogged, pressure drops will occur and the risk of end product contamination will increase.
- Sludge in the pipe is bad news and must be fixed immediately. Dust and sludge in a compressed air piping system will cause corrosion very quickly and will greatly increase the number of leaks. Dried and filtered compressed air keeps piping clean.

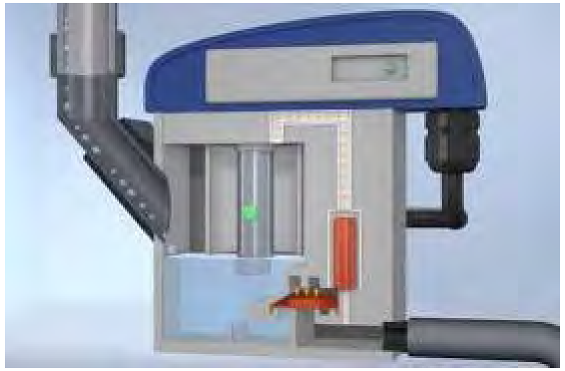
4. Reduce System Pressures

- Rule of Thumb – At 100psi, every 2 PSI increase in pressure, required energy increases by 1%
- Higher pressure = more CFM flow
  - Extra flow is called 'Artificial Demand'
  - Compressor consumes more power to compress air
  - Air leaks will lose more CFM
- Audit equipment pressures being used on the production floor (and in the paint shop) and reduce system/header pressure where possible

5. Check Condensate Drains

- Make sure condensate drains are not stuck open
  - Compressed air is continually leaking from your system
- Condensate drains on timers should be adjusted periodically to ensure they open as intended
  - If the compressor is inactive when it opens, the motor will have to start up for a short period of time (excess energy, wear and tear)
- Or replace timer drains with zero-loss drains (no air leakage) to stop wasting compressed air

Timer Based Electronic drain


Zero Loss Condensate Drain

6. Avoid Pressure Drops

- System/header pressure is usually increased to compensate for pressure drops
  - o Compressor uses more energy just to ensure production equipment can operate at the desired lower pressures
- Increasing the size of a pipe from two to three inches can reduce pressure drop up to 50 percent
- Shortening the distance air has to travel can further reduce pressure drops by about 20-40 percent
- The more flow through a pipe the greater the pressure drop will be. Pressure drop in a pipe increases with the square of the increase in flow, which means if the flow is doubled, the pressure drop will increase four times.
- Optimize pipe sizing to deliver production pressures from the compressor

7. Change/Clean Filters Regularly

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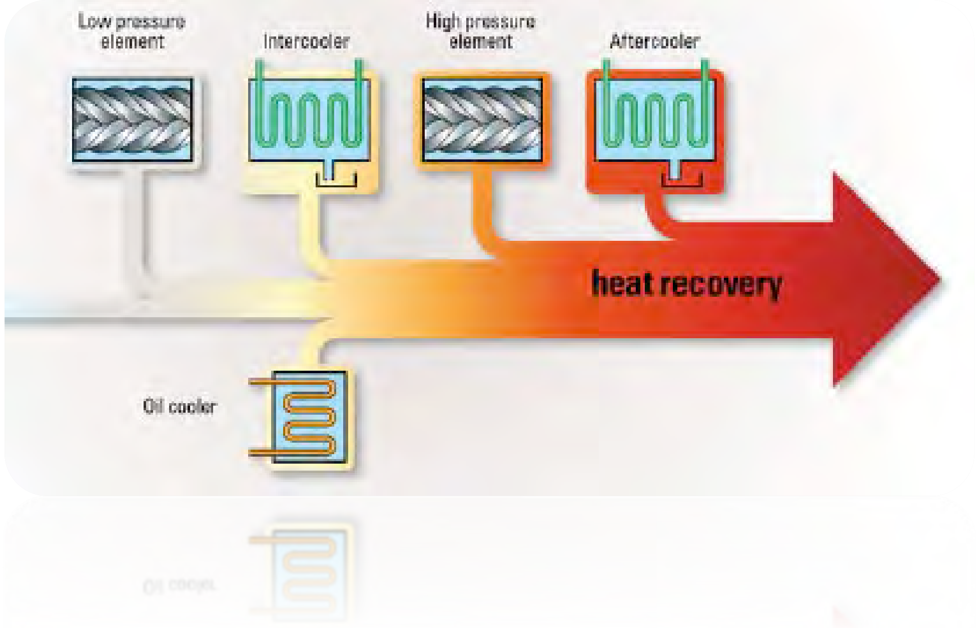
- Inspect and replace filters systematically (weekly or monthly)
  - Filters add to your pressure drop challenge
  - Stop piping being contaminated, which may be cause of new leaks in pipes or damaged equipment
- Look beyond air compressor and compressor room filters. We supply filter/regulators for the finishing process to supply guns, pumps, PPE, etc

8. Recover Compressor Heat

- Compressing air gives off heat, and as much as 90 percent of that heat can be recovered for use in your operation.
- Recovering heat = more efficient use of kW
- To make use of the heat that emits from your air compressor, equip your system with attachments designed to convert the heat for other purposes.
  - o With a water-cooled unit, you can use the heat to produce hot water, which could be used for other purposes within your facility.
  - o If you have a radiator-cooled unit, you could convert the heat into ambient warmth, which could then be directed to the parts of your facility that need heat during certain times of the year.



- Beware of heating issues in the summer months. If an air compressor gets too hot, the lubrication on the internal parts could lose its viscosity and cause corrosion to take hold.

9. Perform Compressor Maintenance

- As with most industrial machinery, a compressor runs more efficiently when properly maintained.
- Proper compressor maintenance cuts energy costs around one percent and helps prevent breakdowns that result in downtime and lost production.
- Periodically have compressor inspected on the outside and inside
- Check fan blades for dirt or lint. If blades appear dull or cracked, have the fan replaced
- Give an belts a pull to test elasticity and look for signs of cracks or dullness
- Lubrication should have a proper color and viscosity. Excessively hot machines cause lubrication to have runny viscosities

Optimize Use Of Compressed Air

- Is compressed air the most efficient energy source for the equipment
  - Example: could a brush be used instead of an air blower
- Right size your supply. Avoid running compressors at 65% capacity or less.
- If you have one compressor with a large gap between average CFM and peak CFM, where the peak is caused by one piece of equipment.
  - Consider a separate, right-sized compressor dedicated to the equipment causing peak demand
- Large facilities with multiple compressors can designate each machine for different pressure levels. For example, low-medium pressure applications and high pressure applications.
- Variable Speed Drive compressors (vs Fixed Speed compressors), slow the compressor at partial loads to match demand
  - Prevents blowing off excess air that has cost money to produce
  - Running the compressor unloaded and not producing any compressed air

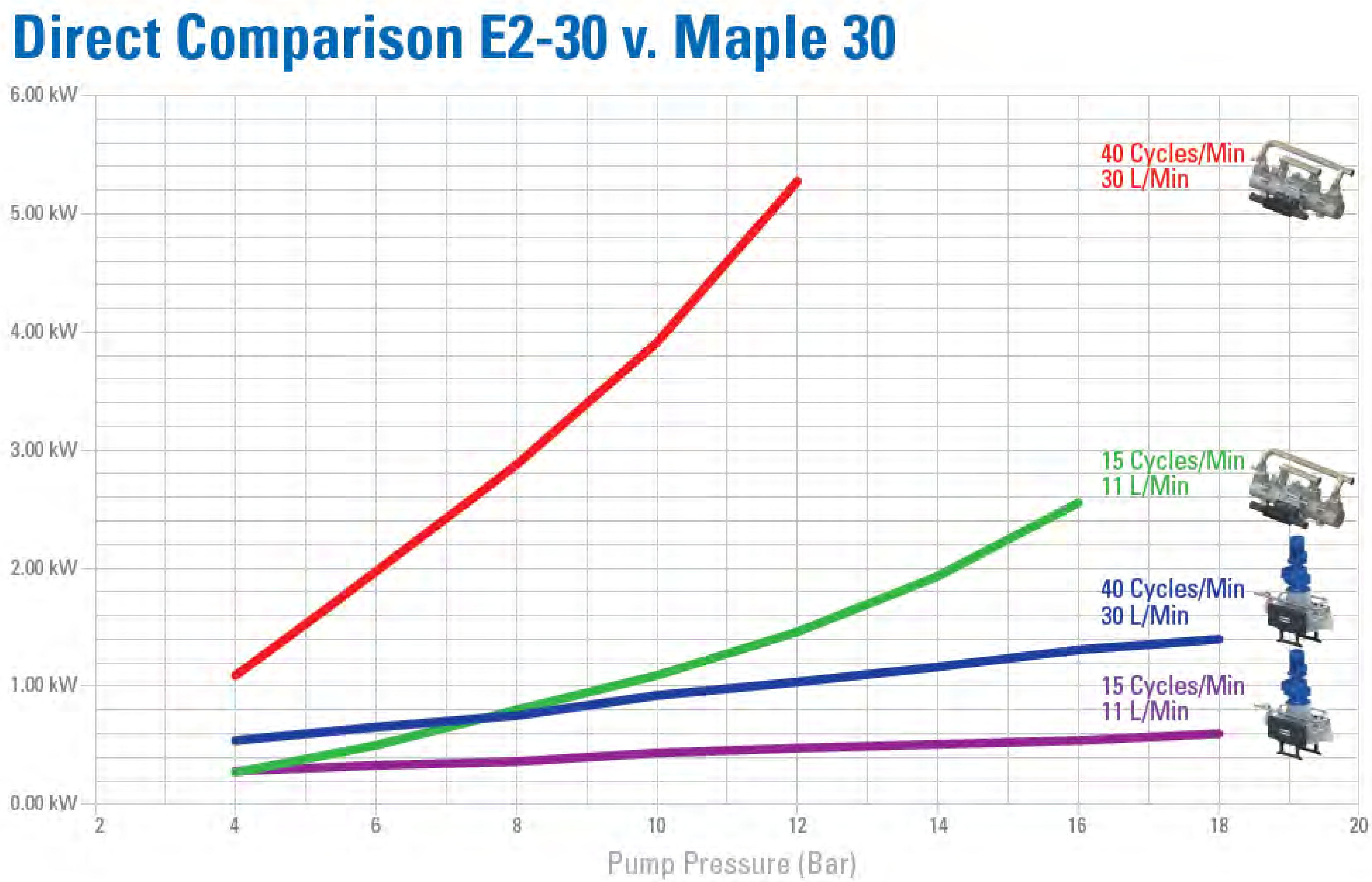
Reductions In The Finishing Process

Go Electric!

- Cut out the middleman and power pumps and agitators with electric motors directly.
  - 4CFM produced @90PSI = 1HP
  - To operate a 1-horsepower (hp) air motor at 100 pounds per square inch gauge (psig), approximately 7-8 hp of electrical power is supplied to the air compressor.
- Pump Pressure 12 bar Flow Rate 35.3 L/min 24/7 Operation (Average of ‘Clearcoat & Hardener’ Systems)
  - Pneumatic Pump uses 33 cfm Air to achieve 12 bar @ 35.3 L/min
  - Power required to produce air at the compressor 5cfm (8.5M³/hr) @ 100 psi (7.0 bar) requires 1kW of Energy (1cfm 0.2kW)
- Air Pump Calculated Power 33 x 0.2 = 6.6 kWh
- Electric Pump E4-60 - 12 bar at 35.3 L/min requires 1.5kWh (Measured Power)

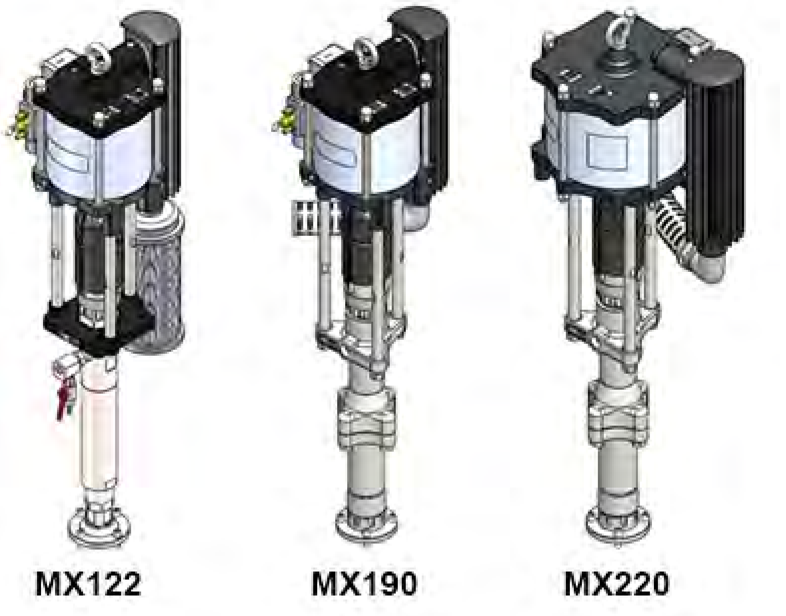
Go Electric: Maple vs Smart

Comparison tests against similar Pneumatic actuated fluid sections have demonstrated substantial energy savings.



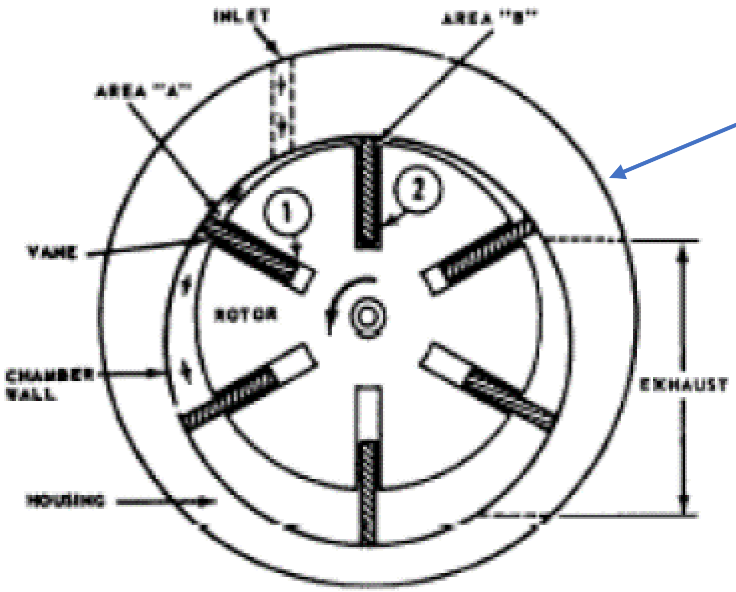
Optimize Your Pneumatic Pumps

- Piston pumps: If you’re operating it at 94psi – 116psi, consider both pressure ratio and air motor CFM consumption for your process
- Leave 1 bar (15psi) difference between pump pressures and any fluid regulators
  - The pump will consume more energy to produce the required flow at a pressure that the fluid regulator is going to reduce anyway.
- Some Water Based paints don’t really need circulation or agitation. If they don’t, no need to run the equipment
  - Check with your paint supplier
- Pipe Sizing: size pipes to delivery the correct paint velocity (for particle suspension) at the lowest possible pressure
  - Generating unneeded pressures is wasting air energy



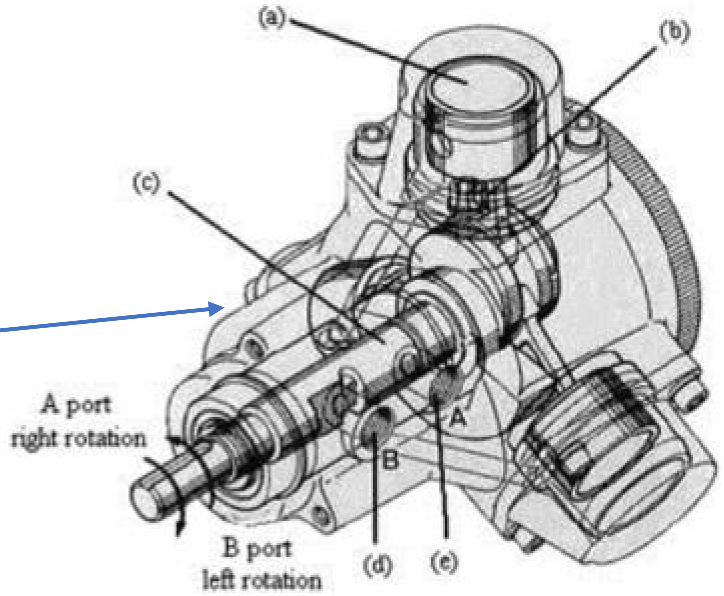
Use More Efficient Agitators

- If you're not blending paint, you don't need high RPM agitation
- At 100 RPM, a back geared vane agitator could be using 6 CFM more air to do the same work as a rotary piston agitator!



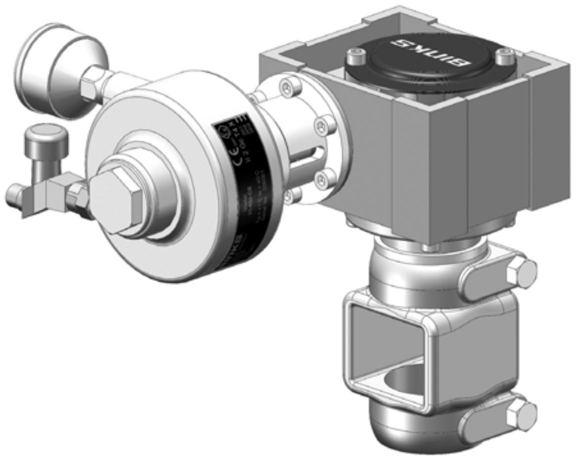
In vane style air motor there is a large volume of air bypass.

There is minimal to no air slippage past pistons on rotary style. Thus the lower air consumption



Typical piston air motor: No air bypass thus lowering air consumption

Rotary Piston Agitators – July



Exclusive supply agreement with Circle Dynamics Inc.

Paint Agitator Energy Costs

Agitator Speed Typical 50 - 150 RPM

Power required to produce air at the compressor 4cfm @ 90 psi (6.0 bar) requires .746kW of Energy (**1cfm 0.1865kW**)

Air Agitator (Rotary Piston Type) Calculated Power 0.1865 x 0.38 **= 0.07 kWh**

Air Agitator (Vane Type) Calculated Power 0.1865 x 6 = **1.19kWh**

Electric Agitator 70 RPM Typical speed requires **0.12 *kWh*** *(Measured Power)*

Cost kWh	0.140	Average Day/Night Cost	Currency	Utility Company Charge
Power kW	1.19	Pneumatic Agitator	$1,455.42	Annual Energy Cost only to generate compressed air for Agitator
Power kW	0.12	Electric Agitator	$146.76	Annual Energy Cost to run ITW Agitator
		Energy Annual Saving	$1,308.65	Per Agitator
	24	Agitator Mix Room	$31,407.67	Basic Annual Saving

Swap Out Your Spray Gun Air Caps

Spray Gun Fluid Feed Type	Air Cap Technology	Air Consumption (slpm)	Air Consumption (cfm)
Pressure-Fed Guns	Older HVLP Air Caps	510 - 710	18 - 25
	New HVLP Air Caps	400 - 510	14 - 18
	Older LVMP Air Caps	340 - 510	12 – 18
	New LVMP Air Caps	280 - 370	10 - 13
Gravity-Fed Guns	Older HVLP Air Caps	450 - 570	16 - 20
	New HVLP Air Caps	340 – 430	12 - 15
	Older LVMP Air Caps	280 – 400	10 – 14
	New LVMP Air Caps	230 - 340	8 - 12

- Savings could be ~$65 per year to upgrade from the older HVLP to newer LVMP guns
- Use tools like AG360 Air Cap Selection Guide

Thank you!

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