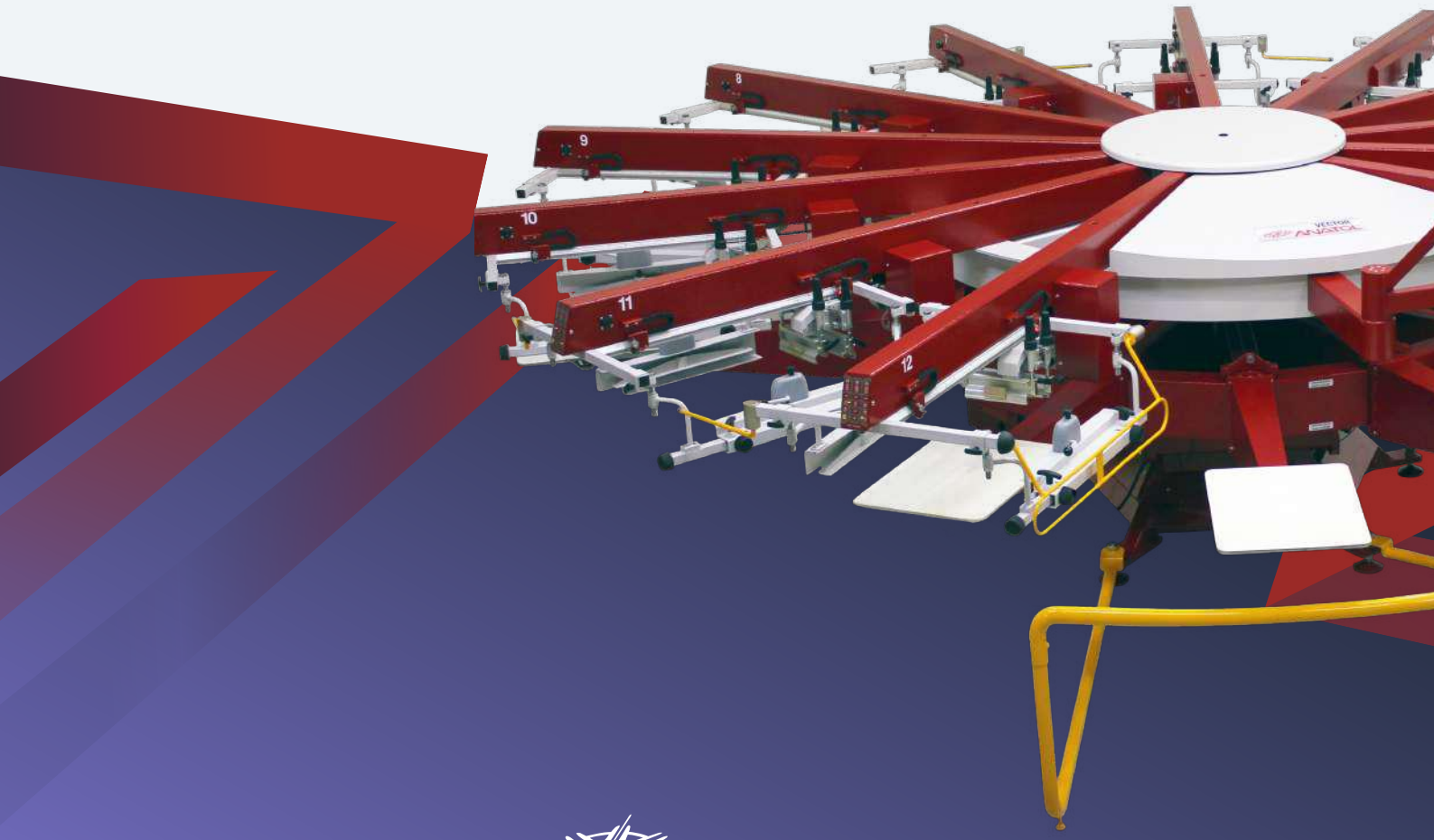
ELECTRIC AUTOMATIC PRESSES VS PNEUMATIC SCREEN PRINTING PRESSES:

A COMPARISON BASED ON TOTAL COST OF OWNERSHIP AND COST SAVINGS



ANATOL™

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INTRODUCTION

Advances in technology are welcomed by businesses around the world, especially when it means an improved infrastructure that leads to increased efficiency and return on investment. However, change doesn't come easily for some business owners who need to keep their positions in the current marketplace and make the best decisions for the future of their companies. Migrating away from pneumatic screen printing presses is one change that can make business operations more efficient in terms of running a project and total cost of ownership.

Let us respond intelligently to the anti-electric rhetoric. While the electric

press has many obvious benefits – offering extreme precision and control in printing – the pneumatic defenders are determined to prove that all- electric machines will never catch on and offer no real cost-saving benefits. Like many pioneering technological advances, all-electric presses like the Anatol VOLT face no shortage of critics who remain skeptical that electric screen printing presses are the future.

Pneumatic presses certainly have their place in the screen printing industry. Compared to an all-electric machine, air-driven presses require a lower initial investment, especially if the shop already has an air compressor and other equipment needed to run it.

About ANATOL
As a manufacturer of textile screen printing machines, we are passionate not only about advancing the industry, but about our customers too. We currently hold patents for a number of advancements that make our screen printing machines some of the safest and most user- friendly on the market.

Today, Anatol Equipment continues to push the boundaries of screen printing technology with products like our VOLT professional-grade electric automatic press.

Pneumatic machines are great for lower production volumes or hobbyists, but they prove difficult and expensive to maintain over a lifetime of heavy use. A professional screen printing operation filling large orders regularly will see instant benefits with an all-electric machine, while a smaller shop might take longer to see a return on the same investment. Both types of press will deliver high-quality prints, but a pneumatic machine requires more attention and more skilled operators to achieve the same results as an all- electric press.

The purpose of this paper is to determine the exact benefits an all-electric press offers over a pneumatic machine. We will consider the initial cost of both products, their features, specifications and efficiency, as well as electric utility costs, maintenance and service costs.

The VOLT
- Our latest innovation - Anatol heads the industry in the development of automatic screen printing presses.

The VOLT by Anatol is the only professional-grade electric automatic press in the world. It gives you the speed, power and reliability of a professional automatic press without the issues of a compressor or chiller.

The Initial Investment: Short Term vs Long Term

Like any decision regarding the purchase of capital equipment, the first consideration most screen printers make when choosing an automatic press involves the initial cost of investment. And because no self- respecting business owner or manager in charge of acquisitions can make a decision based solely on a number, other factors must be taken into consideration.

In the case of an all-electric screen printing press, what may seem like a high initial investment can actually bring many long-term benefits and cost savings. While the lower price of a pneumatic press is a clear short- term advantage, over the life of the machine the pneumatic will end up with a higher cost of ownership than an electric press. The initial cost of an electric screen printing press is justified by its long-term maintenance and service savings, as well as improved quality and efficiency that lead to increased profit margins.

Air and Servo Product Features: Advantages and Disadvantages

On an automatic screen printing press, there are three major systems with movement powered by either air or servo-electric motors as follows:
Indexing – the rotation of the carousel that moves pallets from print head to print head.

Carousel Lift – the separation of the pallets and screens. An important aspect of lift is off-contact, or the vertical distance between the screen and pallet. The ability to precisely adjust off-contact is vital to high-quality printing on substrates of varying thickness.

Print Head – within the print head, there are three motions: the vertical movement of the squeegee and flood bar, the horizontal movement of the print carriage stroke, and the action of the clamps that hold the squeegee, flood bar and screen in place.

There are different ways to drive the movement in each system. Machines are made that are entirely pneumatic, entirely electric or a mix of both.
The industry's most established source of powering a press is pneumatics.
However, while an air-driven press is capable of excellent printing, it requires constant attention and highly skilled operators to maintain quality production. A good print depends on steady air pressure, and pneumatics are prone to leaks and degradation. In comparison, a press driven by servo-electric motors delivers consistency and reliability with ease of use and very little maintenance.

Steady air pressure is an essential factor that influences the quality of a print. Unfortunately, pneumatic screen printing presses are prone to leaks and degradation and have a negative impact on the job quality. Because of that they require constant maintenance and are not energy efficient.
Electric screen printing presses, however, are very easy to use, require very little maintenance and will always deliver the same print quality.

Indexing (Carousel Rotation)

The carousel on an automatic press is powered by either air or servos. One problem with pneumatic indexing is the erratic movement of the carousel as it rotates. When the pneumatic indexer spins the carousel, it is speeding up the entire time with only a hydraulic shock absorber to slow it down. The shock absorber must be calibrated regularly, requiring down time for maintenance and a skilled operator. The indexer's short braking distance causes the machine to vibrate, which can worsen working conditions. Over time, the rough movement of an air indexer can cause registration problems and deteriorate print quality.

Indexing System - Electric	Indexing System - Pneumatic
● Servo indexer allows for clockwise, counter-clockwise and half indexing ● Smooth and quiet indexing at high speeds ● Ball bearing lead screw design with internal lubrication system ● Free-wheel capabilities	● Pneumatic indexer with clockwise direction

A machine with a servo indexer requires much less upkeep to print accurately than an air-powered press. A servo indexer is capable of precise acceleration and deceleration, without needing constant adjustments for changes in air pressure like a pneumatic machine. Unlike pneumatics which degrade over time, the accuracy of servo-driven systems will outlast the life of the machine itself – no “tuning up” is necessary. In addition to reducing labor and maintenance, the smoothness of a servo indexer reduces registration issues and wasted prints.

Carousel Lift

On a press with pneumatic lift, there is no way to control the speed of separation between the pallets and the screens. The high speed of raising and lowering the carousel causes more vibration. For the central off- contact (controlling the distance between the screen and pallet) to operate smoothly, a special mechanism must be added to the cylinder. The central off-contact mechanism is difficult to access, often requiring crawling under the arms of the machine to the center column. Also, the scope of the off-contact is limited and not always sufficient for fine printing adjustments.

Like servo indexing, servo-driven lift provides much finer control of motion than pneumatics. Because the machine does not depend on variable air pressure, vibration is eliminated. Servos allow for precise, repeatable movement without any need for adjustment, which is very important for maintaining registration in high volume printing. Off-contact can be digitally dialed in with the ease of a touchscreen, to a much more exact degree than pneumatics – as fine as a thousandth of an inch – for changing between substrates quickly and accurately.

Print Heads - Electric	Print Heads - Pneumatic
• Servo driven print heads enhance smoothness, speed and power • Front and rear stroke adjustment • Single handed tool-less squeegee / flood bar locking	• Independent flood/print speed control • Front and rear stroke adjustment • Single-handed squeegee / flood bar adjustments within range of 0°- 30° • Gauged squeegee/flood bar knobs provide easy depth adjustments

Squeegee and Flood Bar Cylinders

In the print head, the squeegee and flood bars are both raised and lowered by chopper mechanisms – levers driven by a pair of cylinders and mounted on a single profile. It can be difficult to adjust pneumatic choppers, including the squeegee pressure, which can result in low print quality.

The best way to drive the squeegee and flood bars pneumatically is with a single cylinder because it is a simple, reliable design that allows easy angle, level and pressure adjustment. It also provides parallel movement for the squeegee and flood bar. Choppers driven by multiple cylinders can move at uneven speeds because of unequal air pressure, causing one end of the squeegee or flood bar to touch the screen too early. This can cause the flood bar to cut the screen. Servo-driven choppers are an even better alternative to pneumatics. They offer consistent speed and power for high-quality, reliable printing. Adjustments can be made easily, and there is no need to worry about uneven or unsteady movement damaging your screens or wasting your prints.

Print Carriage

All pneumatic print carriages have the same structure – the cylinder pushes the carriage when flooding and pulls the carriage during printing. One weakness of air-driven print carriages is that they move with inconsistent speed, starting slower as the air pressure builds in the cylinder. The carriage also moves at low speed.

Servo-driven carriages don't have problems with speed consistency, as they don't have to wait for pressure to build in a cylinder to move the carriage. Front and rear stroke adjustments are simple to make, letting the operator print only the distance needed and saving time.

Clamps

The last powered system within the print head is the clamps that hold the squeegee, flood bar and screen in place. In the past, these clamps have usually been driven pneumatically. However, over time the repeated motion of the squeegee and flood bar can wear the air lines out, causing leaks requiring time-consuming maintenance. Pneumatic screen holders can fail as heat from flash cures expands and damages tubing. Some screens are held in place with manually-operated threaded knobs, a time consuming and tedious method.
As screen printing technology has advanced, some manufacturers have removed troublesome air from the equation entirely. Instead, mechanical clamps like Anatol's Speed Clamps offer an easy-to-use solution that won't break under heavy use. Mechanical clamps don't rely on varying air pressure like pneumatics, so they deliver constant pressure and keep screens, squeegees and flood bars firmly in place without regular service or attention.

Compressed air is one of the most expensive sources of energy in a plant. The over-all efficiency of a typical compressed air system can be as low as 10%-15%."

Source: U.S. Department of Energy: Energy Tips – Compressed Air

Efficiency and Electric Utility Costs: Is it Worth It?

As strange as this may sound, air is not free – not the compressed air required to power a pneumatic press, anyway. Many end users are not able to determine how much it actually costs to run their compressors, and even more importantly whether their pneumatic presses are operating at maximum efficiency. Even though a pneumatic press may seem like a good investment for many years to come, the initial purchase cost can be exceeded by electricity costs in as little as two years. Bottom line: air compressors are an inefficient source of energy and very expensive to run compared to electric motors. A compressed air system can have an efficiency as low as 10-15%, especially when the system is behind on its maintenance or experiencing leaks.

To operate a single horsepower (1 hp) air motor, the air compressor actually needs around 7-8 horsepower of electrical power. That is a big difference. Anyone can easily be fooled by the actual efficiency of a compressed air system when the facts are not clear.

To avoid any further misunderstanding between the efficiency and the annual energy cost required to run a compressed air system compared to an electric motor, we will use a formula applied to a screen printing facility. The below example is for an average 12 station pneumatic cylinder press and a comparable all-electric press. This is assuming the compressor and cylinders are not faulty. With air leaks, the cost would be higher.

$$\text{Cost(\$)} = \frac{\text{(bhp) x (.746) x (\# of operating hours annually) x } (\frac{\$}{\text{kWh}}) \text{ x (\% full load bhp)}}{\text{Motor efficiency}}$$

Source: US Department of Energy: Energy Tips – Compressed Air

Where:

bhp – compressor shaft horsepower (frequently higher than the motor nameplate horsepower – check equipment specification) % time – percentage of time running at this operating level % full load bhp – bhp as a percentage of full-load bhp at this operating level Motor efficiency – motor efficiency at this operating level

Example

A typical screen printing facility has a 10 hp compressor (which requires 10.75 bhp) that operates for 2,500 hours annually. It is fully loaded 85% of the time (motor efficiency = 95%) and unloaded the rest of the time (25% full-load bhp and motor efficiency = 90%). The aggregate electric rate is $0.12/kWh.

$$\frac{\text{(10 bhp) x (.746) x (2500 hours) x } (\frac{\$0.12}{\text{kWh}}) \text{ x (0.85) x (1.0)}}{\text{0.95}} = \$2002.42$$

$$\frac{\text{(10.75 bhp) x (.746) x (2500 hours) x } (\frac{\$0.12}{\text{kWh}}) \text{ x (0.15) x (0.25)}}{\text{0.95}} = \$94.97$$

Compressed air annual energy cost = $2002.42 + $94.97 = $2097.39

$$\frac{(\$2097.39) \times (0.15)}{0.95} = \$331.17$$

Why is there such a big need for electricity when running a compressor? The process of compressing air with electricity is inherently inefficient, as the majority of power is lost as heat and not properly recovered. As we can see from this formula applied to a screen printing facility, the annual energy costs when using an electric press are significantly lower than the energy costs of a compressed air system.

Maintenance and service costs: How much do they matter?

We can calculate the annual energy cost for each individual leak with the following formula:

Annual cost of a leak = Leakage rate (cfm) x kW/cfm x operating hours x $/kWh

Source: U.S. Department of Energy

One of the biggest threats to the efficiency of pneumatic presses is air leaks. Over time, the movement of air-driven systems on the press puts wear and tear on seals and tubing and leaks become inevitable. As a result, pneumatic presses can be costly to maintain and their performance can suffer as air systems degrade. Even small, indiscernible leaks can increase the need for electrical power in order to compensate. In fact, the United States Department of Energy estimates that the average compressed air system can lose up to 20% of output to leaks. Using a complex equation that uses estimated cubic feet per minute air loss, load and duty cycles, run time and the kilowatt per hour cost of electricity, the cost of leaks can be monetized. The need to adjust flow or regulation of air and repair or replace different parts of a compressed air system has a negative impact on the screen printing process, causing a decrease in quality and production volume. In order to avoid a more severe breakdown of the pneumatic machine and to assure consistent operation, a screen printing facility may opt for preventative maintenance. While a regular repair schedule can keep a pneumatic press running, it requires increased time and effort which cost money and should be factored in to the press's total cost of ownership.

A major benefit of an electric screen printing press is that it needs little maintenance – internally lubricated actuators make ongoing attention unnecessary. An electric machine doesn't require a compressor, chiller, regulator, dehumidifier or lubrication system that needs to be replaced and is characterized through modularity.

What this actually means is that if one part of the electric system breaks, only that specific part needs to be replaced. An electric press offers substantial savings in terms of maintenance and service costs, lowering the total cost of ownership. Owning electric equipment offers long-term savings through efficiency and reliability.

Example:

Let's assume a typical compressor efficiency of 18kW/100cfm (.18kW/cfm), an electric rate of $0.05 per kWh, 100 psig and nearly continuous operation. The annual energy cost, depending on the size of the leak would be:

Size of Leak	Cost perYear
1/16"	$468
1/8"	$1.872
1/4"	$7.488

CONCLUSION: Deciding based on cost of ownership

Taking into consideration the substantial long-term energy and maintenance savings of an electric press, it becomes apparent that choosing an electric machine can help increase profit, print quality and production volume for a screen printing business looking for an automatic press. While total cost of ownership is always a hot topic when making a decision for new equipment, the full criteria for developing a TCO model is up for debate and a somewhat abstract concept, with both logic and emotions attached. However, if business owners approach it from a product life cycle cost and performance based logic, assigning real numbers to this equation makes it very valuable to the purchasing process:

Total Cost of Ownership = initial purchase cost + years of service x (annual maintenance/repair costs + annual energy costs + annual wasted product + annual lost production).

The total cost of ownership over the lifetime of an electric press is its true value. The lower initial cost of a pneumatic press will save money in the short run. However, over the lifetime of the pneumatic machine, increased utility and maintenance/repair costs, as well as wasted product due to inconsistent printing, will make a pneumatic press more expensive to run than an electric machine. The lower repair costs for an all-electric press are the result of superior reliability and less downtime experienced during repair. In fact, these two factors alone more than offset a considerably lower contracted repair cost in comparison to a pneumatic press. As long as technology differentiators exist between competitor manufacturing and purchasing managers are pressured with making long- term decisions that work today and in the future, understanding the total cost of ownership becomes even more critical to the success of any screen printing businesse.