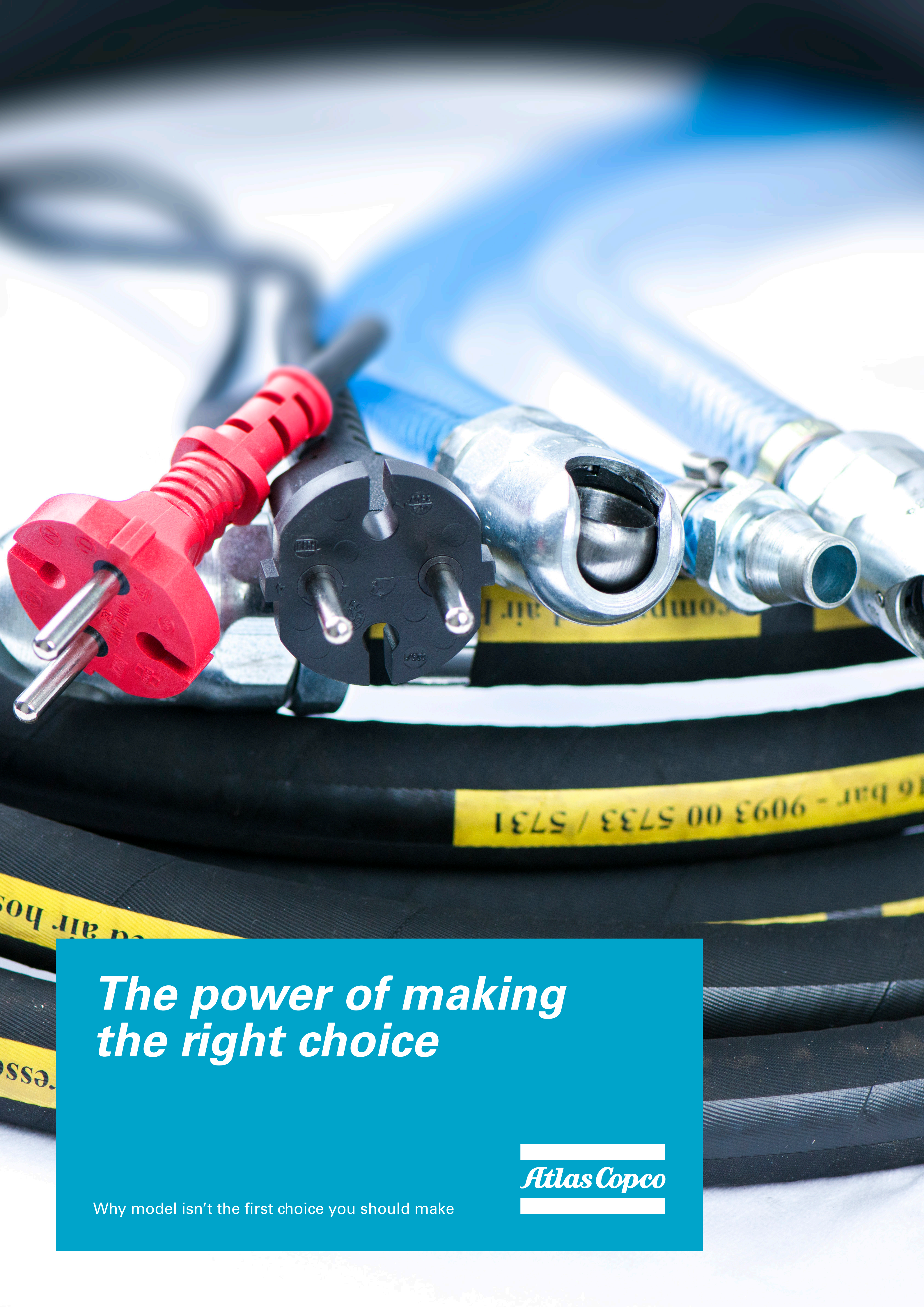


The power of making the right choice

Why model isn't the first choice you should make

1. Introduction

It's really not about the fact that you can make a choice between pneumatic grinders and electric grinders. It is actually all about realizing that you need to make that choice.

In some cases – the choice is made for you: perhaps you only have access to one type of power supply. However, most workshops and factories today, have access to both electric supplies and compressed air.

This white paper aims to show the power output and productivity of the two choices, when it comes to selecting tools associated with grinding.

2. Background

Throughout the industry, electrical tools are being used in different applications. The main advantage with electric grinders is the easy installation and flexibility of the tool.

Electric

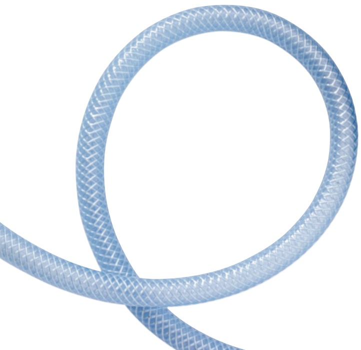
There are basically two types of electrical grinders on the market: conventional electrical grinders running on 230V or 110V 50-60Hz, taken directly from the power net – and high frequency grinders (HF) running on either 200Hz or 300Hz. They need a separate converter and consume more energy compared to conventional electrical grinders. High frequency grinders can provide enough power for industrial applications, but the required installation of a converter however, is not a flexible solution for the user. And the number of tools that can be connected to each converter is limited.

Pneumatic

Compressed air is one of the most important utilities for the industry, and is in many places used to power pneumatic tools. The main advantage of pneumatic tools, is that they develop far more power in relation to their size and weight, compared to most other motor types. Different type of air motors are available: Vane driven and Turbine. Vane is the most common solution with a sturdy design and the Turbine is an energy efficient solution. Powering pneumatic tools means having a different type of infrastructure, and it is important that you ensure efficient air distribution, optimized for the task.

Wheel sizes

As for all grinders they come with different wheel sizes: 100 mm (4"), 115 mm (4,5"), 125 mm (5"), 180 mm (7") and 230 mm (9"). The grinders in this test, all have the common size 125 mm (5").



3. Criteria of comparison

When comparing different tools, there are basically three different evaluation criteria to consider.

Performance (spindle power/weight)
Ergonomics (soft grip, handle design, trigger design, noise, vibrations etc.)
Functionality (spindle locking, adjustable wheel guard, vibration dampening)

Performance

- It is important to remember that the rated power written on the label of a tool, is different depending on how it has been measured. Does it refer to the output at the spindle, or the output of the motor?
- High performance is the most important factor to reach high productivity.

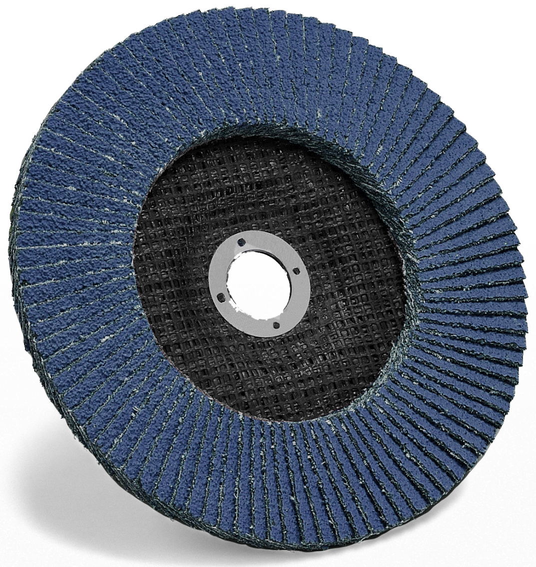
Ergonomics

- For high productivity grinders, the most important ergonomic factors are weight of the tool and vibration level. Holding a heavy grinder throughout an entire workday, puts stress and strain on the operator. If the operator also is exposed to high vibration levels from the grinder, the situation becomes even worse. The working process takes more time, and the operator runs great risks for future work related injuries with sick leave as a result.

Functionality

Other aspects that should be taken into consideration, are if following things are included with the grinder and how easily operated they are:

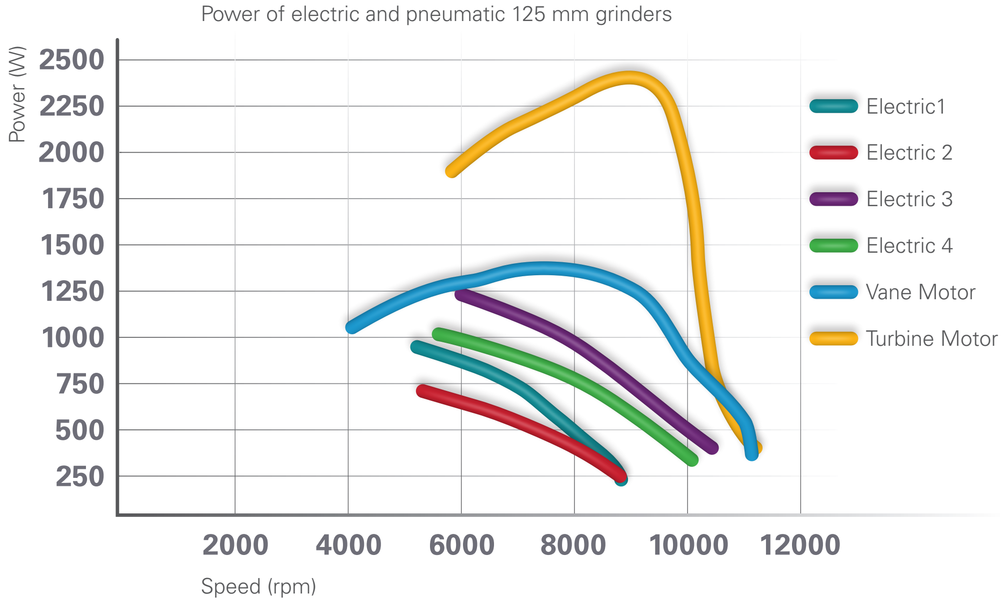
- Spindle locking (possibility to operate with working gloves, could dirt easily obstruct functionality etc.)
- Support handle (robust design, possibility to change position etc.)
- Wheel guard adjustment (possibility to operate with working gloves, how easy do the guard slide etc.)

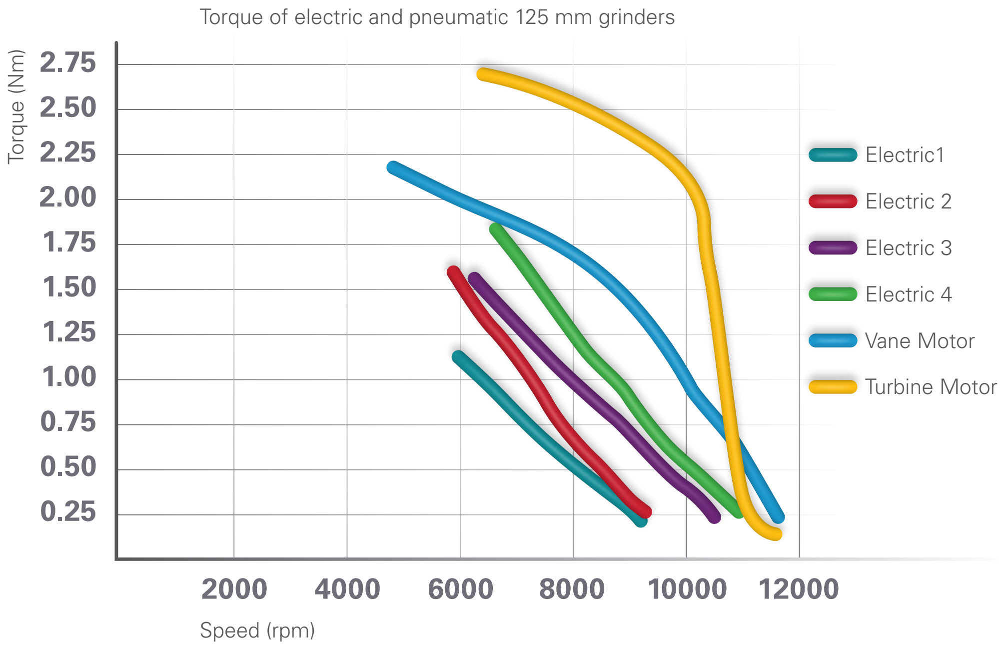


4. Solution

To show the differences between electric and pneumatic grinders, we have tested four electrical grinders, one pneumatic driven vane tool and one pneumatic turbine driven tool in a test bench. The test gives the power output at the spindle at specific rpm, and the torque at the spindle at specific rpm. All tested tools have rated speed between 11000 and 12000 rpm.

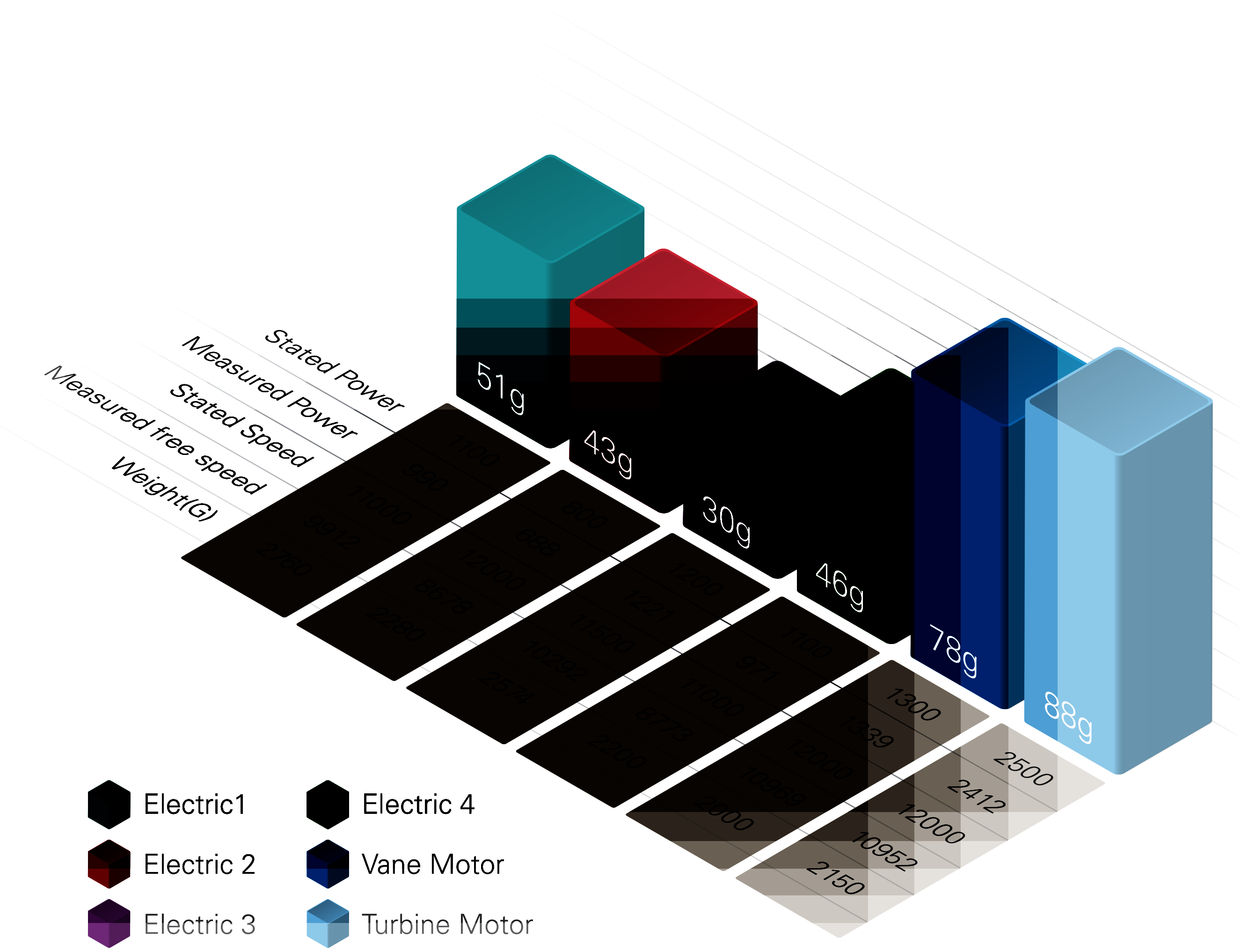
We have also conducted a test showing performance in material removal. This test was done during 1 minute of operation, with 5 different operators, measuring the removal of the work piece. The test was done with four electric grinders, one pneumatic vane tool and one pneumatic turbine tool.





The power curves show the linear characteristics of the electric motor, the output increases continually as the motor gets more load. This would continue further, giving more power until the motor breaks. The same applies on the torque curves. To avoid damage to the motors, the test was stopped as the tool got hot. For one of the tools this was done too late, causing the motor to burn.

The power curve of the pneumatic tool shows a peak and as the rpm drops, the power eventually decreases while the torque continues to increase.



5. What it all comes down to – material removal

The material removed by the electric grinders was between 30-51 grams, seen on the left side in the graph above. The material removal of the pneumatic tools was 77 grams for the vane motor and 88 grams for the turbine – both seen on right side of the graph. The results of the material removal test clearly corresponds to the power curves. The tool with the highest measured power output, also has the biggest material removal, or in other words – the highest productivity.

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6. Result

Make a choice

To make the right choice you need to consider:

- How much the tools will be used.
- What maintenance intervals your current set up has?
- The frequency of new tool purchases?

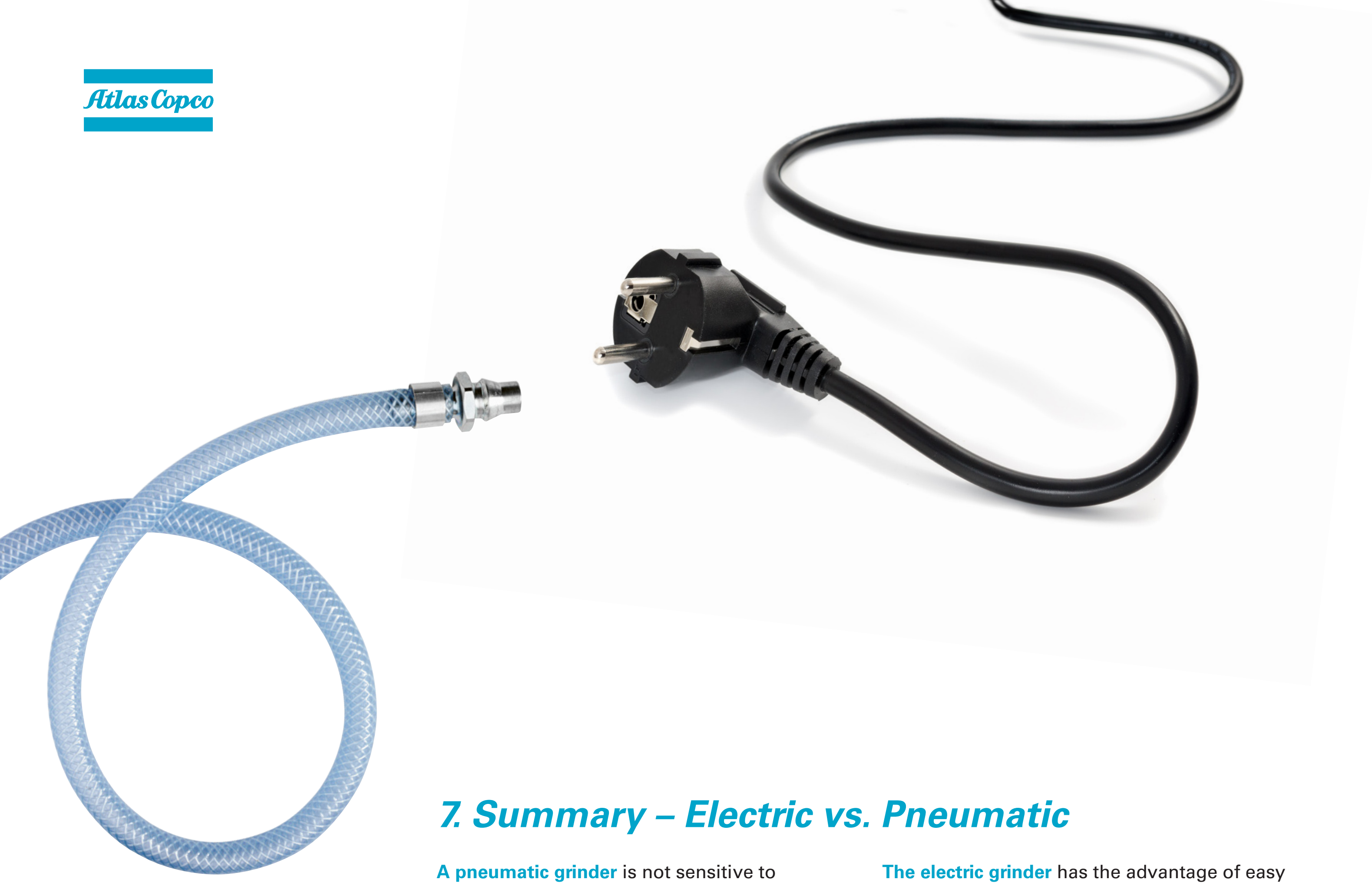
This report is not looking at ergonomic or functional factors of the tested tools.

The stated power of the electric tools can be reached, but this should only be done during very intermittent use. When the tool is under constant load, the motor will get damaged when maintaining stated power. The user has to be careful not to overload the tool, but in a rough grinding environment this is not easy, explaining why electric tools have a high repair frequency in heavy usage.

The stated power of a pneumatic tool however is easily reached and there is no risk of overloading. Finding where you have the optimal power and speed is an operator skill – listening to the tone of the motor and the sounds of the process – and have a good feeling of the tools performance. The pneumatic motor can, compared to an electric motor, be stalled indefinitely without damaging the motor.

All tested tools were designed for the same size of abrasives, the variation in output of the different tools differs though, with close to 100%.

The material removal test clearly shows the productivity increase you get with a pneumatic tool. And that the best productivity is achieved with a turbine driven tool.



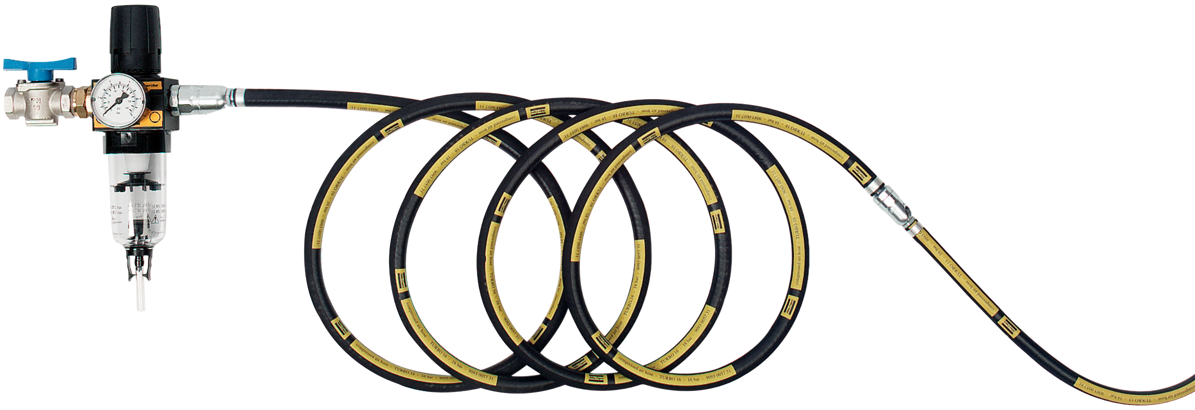
7. Summary – Electric vs. Pneumatic

A pneumatic grinder is not sensitive to overloads and can maintain stated power, giving a higher production rate. With the higher productivity, two clear conclusions can be drawn; you will either produce more, or have workers less exposed to ergonomic factors such as vibration.

The electric grinder has the advantage of easy installation. In constant use the operator has to be careful not to overload the tool, as this will damage the motor – leading to repairs or replacement of the tool.

Advantages for pneumatic grinders:
Power to weight, giving better ergonomics and productivity
Not sensitive to overload
Lower maintenance cost over time
Safety – pneumatic tools can work in wet environments
Lower abrasive cost, due to higher process speed

Advantages for electric grinders:
Existing infrastructure giving ease of installation
Availability - electric tools are offered in a larger extent to the end user



8. Addendum on Pneumatic grinders

Compressed air is very much about optimization and efficiency.

Optimization is using the available equipment in best possible way. It can be to control the compressors in best possible way, minimizing leakage and securing correct pressure. If there are big pressure drops in the air line, the compressors have to be set at higher working pressure – resulting in wear.

Efficiency is about making sure that the most effective technique is used. An on/off compressor could be changed to an rpm controlled one. The biggest effect is achieved through an energy recovery system. Efficiency of a good compressor is approximately 0,1 kWh/m3 – with an energy recovery system this can be improved to 0,02kW/m3 .