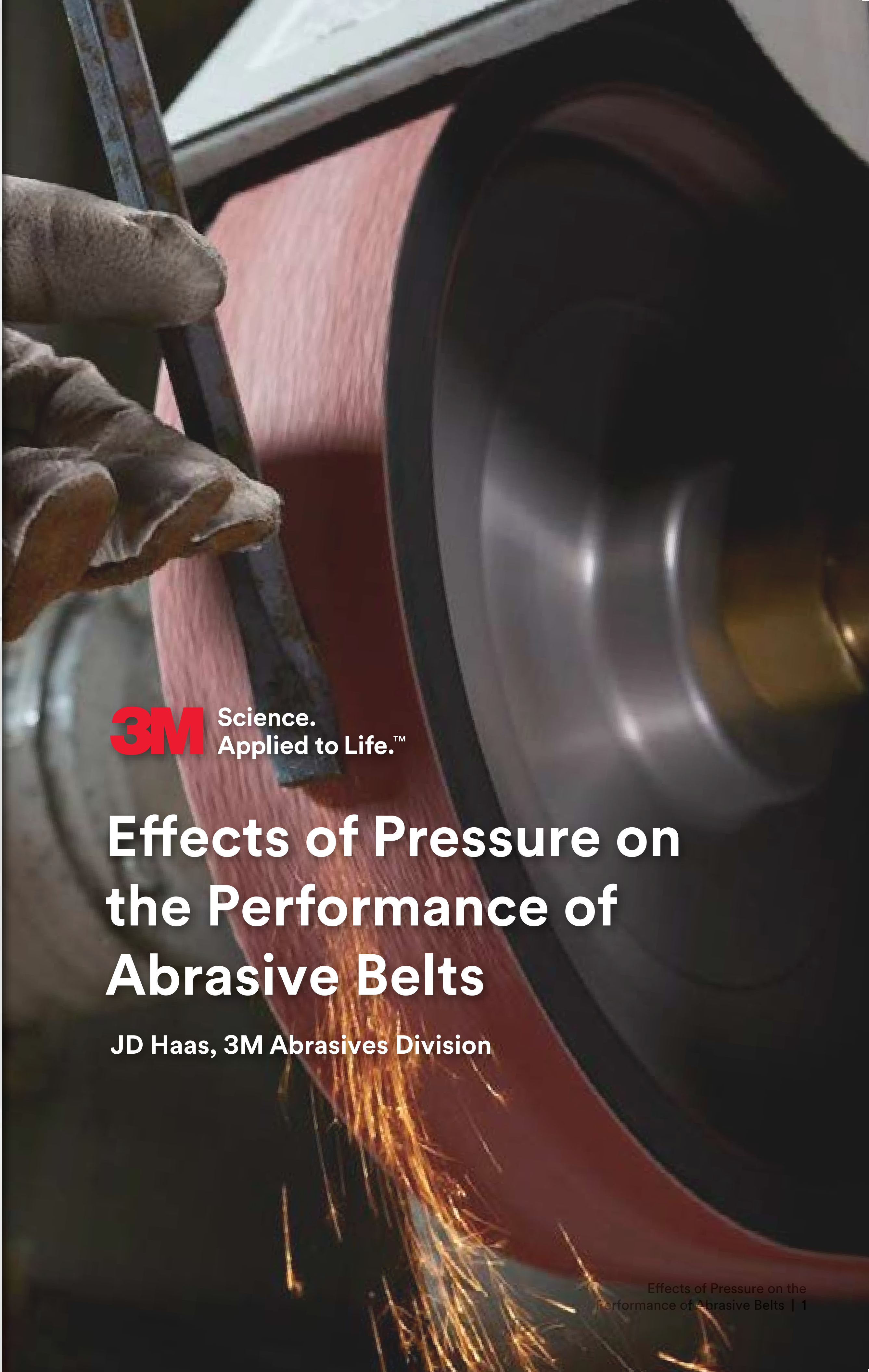

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Effects of Pressure on the Performance of Abrasive Belts

JD Haas, 3M Abrasives Division

In recent years, the abrasive industry has seen significant advancement in technology. The incorporation of new tools and innovations like Precision Shaped Grain (3M) into abrasive operations can increase efficiency and productivity. All abrasives are engineered to perform with an optimal breakdown point. That is, the abrasive grit must break down to reveal new cutting edges. However, this point is often not reached, and maximum output potential is reduced because the abrasive is applied with unsuitable pressure. If you have a product that should be lasting twice as long, but you're only seeing average output, then other mitigating factors need to be addressed. One such facet of abrasive grinding that is often overlooked or misunderstood is pressure. The two key components to ensure optimal abrasive performance include selecting the correct product and running that product at the appropriate pressure. The key is matching the product to the application's pressure. Under appropriate pressure conditions, you can ensure an optimal breakdown rate of your abrasive belts, maximizing both cutting speed and product life.

3M offers a complete portfolio of low, medium and high pressure abrasives. These products are carefully designed for optimal break-down under appropriate application pressure.

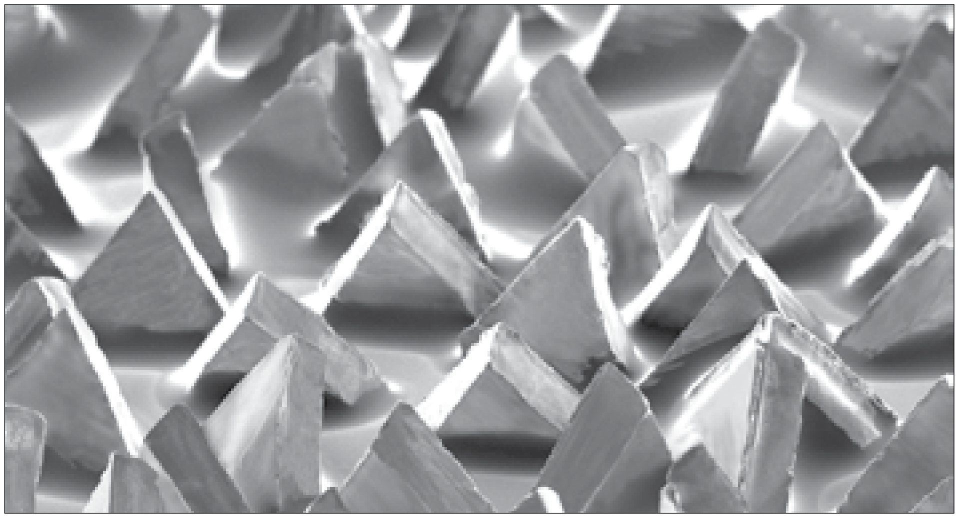

Figure 1 | *Close-up of the microtechnology of Precisely Shaped Grain (PSG).*

3M PRECISION SHAPED GRAIN

In the last several years, 3M scientists have fine-tuned innovative precision grain technology. First introduced to the industry in 2009, 3M Precision Shaped Grain (PSG) is an abrasive grain that performs at a higher capacity than traditional crushed grain. Crushed grain is manufactured by conventional crushing and screening techniques producing a varied distribution of particles in both size and sharpness. When the crushed grain is coated onto an abrasive backing, the result is a distribution of irregular shapes and heights of grain. Conversely, using PSG yields a desirable and virtually monolithic distribution of abrasive grains that are readily available to perform abrasive manipulations on work surfaces as shown in Figure 1.

The mechanism for metal grinding and chip formation is one of the key factors in fundamentally understanding why PSG products perform at such a high level. Conventional crushed ceramic grains—because of variations in grain distribution and mineral sharpness—have cutting tips that act as "plows" as they cut, which cause high frictional force and heat build-up in the substrate. The homogenous shape and sharpness of the PSG slices through metal, resulting in more efficient chip formation and metal removal while greatly reducing heat-related part damage. Figure 2 illustrates the plowing of the crushed grain versus the cutting of precision shaped grain. As with all abrasives, PSG-containing belts perform at peak capacity when operated under suitable pressure.

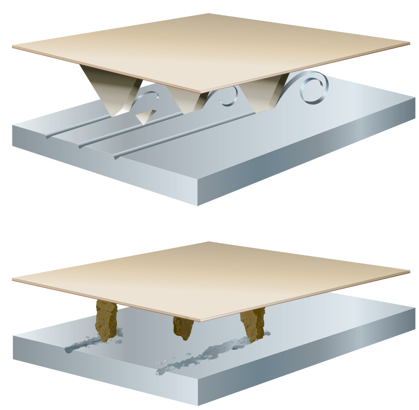

Figure 2 | *Comparative chart of Conventional Crushed Ceramic Grains plowing vs. Precision Shaped Grain cutting metal substrate.*

UNDERSTANDING BELT AND APPLICATION PRESSURE

Combining the right belt with the right application pressure is essential to reaching the optimal breakdown point of an abrasive. The wrong variable in either of these fields can lead to suboptimal results evident on the workpiece and the used belt. Using either excessive pressure or insufficient pressure during grinding can have effects on the performance of an abrasive and the materials it's grinding.

Understanding how low and high pressure abrasives operate can be visualized like a bed of nails. If a person were to lay their hand across compact, closely spaced nails, it would require lots of force and pushing against the nails to puncture the skin. Imagine now a single nail stuck through a board: significantly less force would be required for the nail to penetrate if someone pushed their palm against it. Similar to a bed of nails, high pressure belt surfaces have many grains tightly packed together and can withstand higher force during application. Low pressure belts are designed with grains placed further apart so less force is needed for them to cut through the substrate. This is the concept of application pressure: the force applied divided by the geometry of the workpiece. High application pressure requires closely spaced minerals, and low application pressure requires minerals that are further spaced out. Selecting the appropriate belt pressure—high, medium or low—for the desired surface modification is the first component for yielding optimal abrasive performance.

In some cases too much pressure can be applied to an abrasive. This is more likely to occur in an automated system, although it can occur in an off-hand application as well. Typically, it is more likely to occur in automated or robotic grinding systems where application pressure is high to achieve high removal rates. A telltale sign to look for in this instance would be shelling. Figure 3 depicts an example of a belt where too much pressure was applied and shelling occurred. The shelling can be noticed first at the splice. If shelling occurs before optimal abrasive life is reached, it is likely that application pressure is too high. In these cases, selecting a product with a higher application pressure range would be appropriate. An abrasive like 3M™ Cubitron™ II 984F Abrasive Belt performs well under these very high pressure conditions and diminishes the likelihood of shelling.

In most cases, the application pressure is too low for the product selected. Applying too low of pressure results in different visual cues. The telltale sign of insufficient pressure is when glazing, or capping, occurs on the abrasive. Figure 4 shows an example of an abrasive belt where glazing occurred. In the side-by-side comparison, it is evident the belt on the right appears capped with metal from the workpiece. This happens because pressure that is too low causes the abrasive to rub, rather than cut, the substrate. The friction incurred from the rubbing increases the heat between the belt and the workpiece. This can result in pieces of the workpiece being welded to the abrasive. Glazing, or capping, can occur after one application if the pressure is insufficient, and will effectively curtail the lifespan of the abrasive. The appearance of shelling or glazing on used abrasive belts are visual cues that the belt selection, application pressure, or both should be altered.

Figure 3 | *Image depicts an example of shelling, which can result from applying too much pressure.*

Figure 4 | *Image depicts an example of glazing which can result from not applying enough pressure.*

RECOMMENDED TESTING PROCEDURES

Appropriate pressure can vary depending on the material of the workpiece and the desired stock removal. To determine whether both the pressure of the belt and the application pressure are suitable for peak abrasive performance, running diagnostic tests and evaluating the belt feedback is recommended. If there is uncertainty surrounding which belt pressure to select, 3M recommends starting with a medium grain belt like the new 3M™ Cubitron™ II Abrasive Belt 784F. This versatile belt is designed for medium pressure grinding and dimensioning on a variety of metals.

By completing a trial grinding of the workpiece, an operator can ensure the optimal force is being applied. Pressure adjustments can then be made where necessary. Inspect the belt after the test for signs of shelling or glazing. If shelling is apparent, either lower the pressure that is being applied or move up to a higher pressure belt, such as the 3M™ Cubitron™ II Abrasive Belt 984F. When performing off-hand applications, insufficient pressure is common. If there is capping of the mineral, rising heat on the workpiece, or you can visually identify glazing, then try switching to a lower pressure belt, such as the 3M™ Cubitron™ II Abrasive Belt 384F.

Figure 5 | *Reference chart for testing and selecting recommended 3M belt based on pressure.*

SUMMARY

Pressure, as it concerns the abrasive grain of the belt and the application force, affects the optimal breakdown of an abrasive. Identifying optimal breakdown helps extract the full potential of the abrasive and lowers the costs of operations. Like all abrasives, the technology of 3M's Precision Shaped Grain (PSG) belts will perform at a higher capacity under suitable application pressure conditions. If unsure of application pressure, starting with a medium pressure belt and observing belt feedback for cues of too much or too little pressure, and then adjusting accordingly, can achieve the utmost value from the abrasive.

The innovative technology behind 3M PSG was developed in 3M laboratories, where dedicated scientists use their expertise to develop abrasive solutions to improve customer outcomes.

For more information on belts and other PSG-containing products, visit *3M.com/metalworking.*

Contact Wheel

The material and configuration of a contact wheel is an important factor when determining optimal grinding pressure. Contact wheels are available in many different variations, each designed to serve a different purpose in abrasive applications. Materials like steel or hard rubber yield higher application pressure than will softer wheels like cloth and soft rubber. Additionally, the configuration of the contact wheel affects application pressure, with serrated wheels causing significantly higher pressure than smooth wheels. If the operating contact wheel is cloth or soft rubber, it is best suited for low pressure, less aggressive processes like refining and finishing the workpiece, or where undercutting is a concern. When testing for appropriate pressure and abrasive breakdown, it is critical to take the material of the contact wheel and its configuration into consideration.

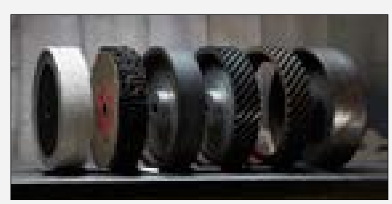

Figure 6 | *Image illustrating the range of materials and configurations of contact wheels.*

3M Abrasive Systems Division
3M Center, Building 21-1W-10
St. Paul, MN 55144 USA

Phone 1-866-279-1235
Web 3M.com/metalworking