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when it's too fast to see, and too important not to.®

CASE STUDY

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JOHNS MANVILLE USES PHANTOM® MIRO™ IN HIGH-PERFORMANCE R&D APPLICATION

WHEN IT'S TOO FAST TO SEE, AND TOO IMPORTANT NOT TO®

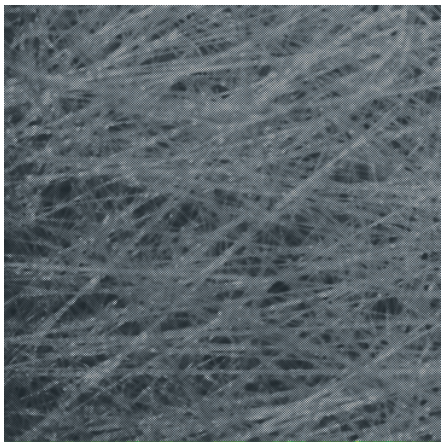
VISION RESEARCH HIGH-SPEED CAMERA HELPS ENGINEERS DEVELOP CUTTING-EDGE NEW MATERIALS FOR HIGHER PERFORMANCE CARPET TUFTING

Take a look down at the floor - if it's carpeted, it's safe to say that your feet are resting on tufted carpet. It's currently estimated that more than 95% of the carpet manufactured in the United States is tufted. Tufting is a highly-reliable manufacturing process which utilizes specially treated yarn and large, multi-needle sewing machines to create a carpet surface. Threaded with yarn, each needle punctures a woven fabric backing where a hook holds the yarn in place forming a tuft, or loop, as the needle is removed. Once the needle is extracted and begins to move to the next stitch, the hook releases the loop and the machine pulls the yarn back to create the correct sized loop for the desired pattern. This process takes place at extremely fast speeds and has a proven track record for producing high-quality floor coverings.

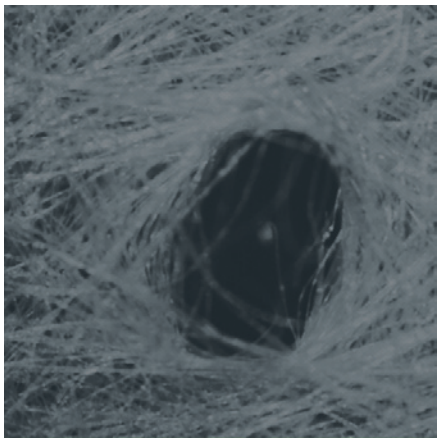
Tufting is also used to manufacture carpet tiles, which are a much-welcomed alternative to wall-to-wall carpeting and are the flooring option of choice for today's "do-it-yourself" consumer. Carpet tile is less expensive to install, completely modular and is ideal for a myriad of applications. Furthermore, they can easily be replaced, cleaned and repaired – a significant benefit should only a portion of floor be damaged due to stain or wear. However, as simple and routine as carpet tile may seem to the average person, these tufted squares are actually quite high-tech, with a significant amount of R&D and engineering devoted to their unique designs and manufacture.

Backing Materials

Although woven polypropylene fabric backing has proven to be the ideal material of choice for carpet manufacturing, unfortunately it is not the best material for the manufacture of carpet tile. One of the drawbacks of using this woven fabric backing material for carpet tiles is that it has a tendency to react to varying



Trial - Frame 1



Trial - Frame 2

About Johns Manville

Johns Manville (JM), a Berkshire Hathaway company (NYSE: BRK.A) (NYSE: BRK.B), is a leading manufacturer and marketer of premium-quality products for building insulation, mechanical insulation, commercial roofing, and roof insulation, as well as fibers and nonwovens for commercial, industrial and residential applications. JM serves markets that include aerospace, automotive and transportation, air handling, appliance, HVAC, pipe and equipment, filtration, waterproofing, building, flooring, interiors, and wind energy. In business since 1858, the Denver-based company has annual sales of $2 billion and holds leadership positions in all of the key markets that it serves. JM employs approximately 7,000 people and operates 40 manufacturing facilities in North America, Europe and China. Additional information can be found at *www.JM.com*.

environmental conditions such as changes in temperature or humidity. It also has a tendency to fray at cut edges. As wall-to-wall carpet is stretched, bound and tacked, this reaction doesn't affect this type of installation; however, as carpet tile is simply laid down using adhesive or loose lay, a woven backing can cause the tufted carpet tile to expand and contract forming gaps in the seams or causing the carpet to bow. Frayed ends of the woven material can also become visible. With this in mind, carpet tile manufacturers usually forgo the use of a standard woven backing, and instead utilize a non-woven, polyester-based material that offers a much-better resistance to expansion or contraction in varying environments and does not fray at the edges. Unfortunately, the non-woven polyester-based backing isn't the be-all-end-all solution as it too has drawbacks, specifically its inability to repair itself after each needle puncture. In order to produce a quality tuft and ultimately a quality carpet, the backing material must be able to quickly repair itself and close the hole remaining after the needle threads yarn through the material and departs, something which woven carpet backings do very efficiently.

Unfortunately, without any real alternatives, the carpet tile industry utilizes this type of backing material which is accompanied by limitations in regard to tufting patterns and manufacturing speeds. With that in mind, Johns Manville, a leading research and development firm and manufacturer of fibers and non-wovens for commercial, industrial, and residential applications, set out on a mission to develop a new, non-woven backing material that would offer both non-woven and woven performance benefits. In short, a non-woven fabric that reacts like a woven fabric in high-speed tufting processes.

Research and Development

As carpet tufting occurs at extremely fast speeds, Johns Manville's ability to essentially "slow down time" was crucial to the R&D process. In order to do so, Johns Manville's team of engineers turned to the experts from Vision Research for guidance and a reliable, cost-effective high-speed imaging solution that would fit the need in their newly developed tufting mimic device. Working closely with Vision Research's engineers, Johns Manville was able to identify the right digital high-speed camera for the application, one which would give their team the ability to closely observe exactly how woven and non-woven materials react to a needle puncture and extraction.

"Thanks to the Vision Research Phantom Miro 4 digital high-speed camera, our team was able to determine just how poor most non-woven backing materials are for tufting," said Les Aseere, Senior Application Engineer at Johns Manville. "In ultra-slow-motion, we were able to precisely see how a non-woven backing

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– Les Aseere,
Senior Application Engineer at Johns Manville

Phantom Miro 4
Digital High-speed Camera

reacts after being punctured by a tufting needle, and more importantly, the speed at which a needle punctures and then exits the material."

Continued Aseere, "As non-woven backing is a continuous filament material with no weave or memory, it has very little tendency to close when punctured by a tufting needle. Since the needle makes a hole large enough for itself and two strands of yarn, the result is a hole that is essentially too big to hold the yarn in place properly after the needle leaves. After sticking a badge pin into the fabric of your shirt [a woven fabric) and removing it, the hole will close up and disappear. If you do the same thing into a piece of paper [a non-woven fabric], the hole remains the same size as the penetration. Also impressive is the speed at which the tufting needle travels. Using the Vision Research Miro 4 camera as well as TEMA's motion analysis software, our engineers were able to determine that during a tuft, a needle takes 15 milliseconds to puncture and then 15 milliseconds to exit the backing material. With this data, our team had a clear understanding of our objective – create a non-woven carpet backing material that has the ability to repair itself at least 50% from a needle puncture within fewer than 15 milliseconds."

The Benefits of the Miro 4 Digital High-Speed Camera

In searching for a digital high-speed imaging solution for its R&D of a new non-woven carpet backing material, Johns Manville engineers were drawn to the Vision Research Miro 4 due to a number of stand-out features that separated it from competitive offerings. Most notable was the camera's rechargeable battery, portability – thanks to its handheld form factor – as well as touchscreen LCD, which gave Johns Manville engineers the ability to use the camera without having to be connected to a computer or monitor if desired.

"This was a significant investment for Johns Manville," said Aseere. "In order to justify the purchase, we needed to be certain that the camera would be able to be integrated into other R&D applications moving forward. Portability and the ability to operate the camera without having to rely on a monitor were paramount. That coupled with the incomparable service and support provided by Vision Research made this an easy decision for our company, one which will undoubtedly give us the ability to take our R&D efforts to a new level."

At its maximum resolution of 800 x 600, Vision Research's Miro 4 digital high-speed camera can record at a top speed of over 1,200 frames-per-second. Combined with the camera's impressive 2 microsecond shutter, the Miro 4 provides excellent detail and minimizes blur, which is especially useful when recording extremely fast events such as those that occur throughout Johns

CASE STUDY

CARPET TUFTING

Manville's carpet tufting research. Johns Manville determined 640 x 480 at 1,000 frames-per-second worked perfectly for its application.

The Miro 4's touchscreen LCD also offers users the added convenience of immediately reviewing footage directly on the camera. This is an extremely useful feature as it will allow the operator to immediately know whether or not they got the shot needed. Furthermore, the Miro 4 gives users the ability to record directly to removable CompactFlash® memory cards. This non-volatile memory makes it easy to move and view saved recordings on a computer and is a safe method to transport and store important files.

The Result

After several rounds of re-engineering and testing based on the ultra-slow-motion footage captured by the Vision Research Miro 4, Johns Manville was able to effectively modify the formulation of a new non-woven synthetic backing in a way that would make it respond to a needle puncture more like that of a woven backing. By optimizing the binders and polymers, Johns Manville's engineers were able to get their new non-woven synthetic backing to repair itself within the 15 millisecond window, with a hole closure consistently above 50 percent.

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About Vision Research:

Vision Research designs and manufactures high-speed digital imaging systems used in applications including defense, automotive, engineering, science, medical research, industrial manufacturing and packaging, sports and entertainment, and digital cinematography for television and movie production.

The Wayne, N.J.-based company prides itself on the sensitivity, high-resolution and image quality produced by its systems, robust software interfaces, and reliability and versatility of its camera family – all which continue to stand as benchmarks for the high-speed digital imaging industry.

Vision Research digital high-speed cameras add a new dimension to the sense of sight, allowing the user to see details of an event *when it's too fast to see, and too important not to®*. For additional information regarding Vision Research, please visit *www.visionresearch.com*.

Vision Research is a business unit of the Materials Analysis Division of AMETEK Inc., a leading global manufacturer of electronic instruments and electromechanical devices.

VISION RESEARCH
An AMETEK® Company

100 Dey Road
Wayne, NJ 07470 USA
+1.973.696.4500
phantom@visionresearch.com

www.**vision**research.com