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AIR BEARINGS: TRANSFORMING THE FUTURE OF THE MEDICAL INDUSTRY

5 AIR BEARING APPLICATIONS

FOR THE NEXT GENERATION OF MEDICAL CARE

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Introduction

The medical industry has seen remarkable breakthroughs in the last decade as health care providers find innovative ways to improve quality of life as well as life expectancy. An emphasis on earlier, accurate diagnosing, as well as unique tools to manage health issues, are evident in the increased demand of:

Artificial limbs & organs | 'Smart' health devices/sensors
Diagnostic tests | Medical devices

Among this broad product spectrum, some common themes emerge in manufacturing and production requirements. To successfully deliver this next generation of products, manufacturers are receiving increasingly stringent requirements in three key areas:

Precision | Reliability | Durability

New Way® Air Bearings is no stranger to this challenging set of requirements.

New Way solved these same issues for the Coordinate Measuring Machines(CMM) industry by offering a standard line of Porous Media™ air bearings. Known for their straighter, frictionless motion, Porous Media air bearings offer exceptional precision along with a robust design. Much of the technology we now use every day is the result of the exponential growth of the precision industry from the use of air bearings.

With more than 25 years of experience, New Way is prepared to help the medical industry experience this same type of revolution.

In this eBook, you will learn how New Way Air Bearings offers a viable solution for the challenges faced by the medical industry.

To begin, we'll look at a case study on the proven use of New Way products in Computed Tomography (CT) imaging. Then, we'll extend these benefits to see how air bearings can deliver five cutting-edge applications within the medical industry.

By the end, you'll see how Frictionless Motion™ can transform the medical industry—

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Case Study: CT Imaging

Background

CT imagers have been around for decades, offering doctors unique data previously unobtainable. CT equipment which employs traditional ball-bearing systems in the rotating gantry ring experience the inherent limitations from friction:

Noise | Heat | Wear | Vibration

The cumulative effect of these limitations is an impact on rotation speed and accuracy. Ultimately, the number of patients served and the accuracy of their results is directly impacted by the choice of bearings.

Philips, a global leader in health technology, introduced the Brilliance iCT scanner in 2007 as a low friction solution to overcome these limitations. A signature feature of the iCT is the use of air bearings in the gantry ring, for their ability to move heavy parts at high speed and accelerations without friction.

But not all air bearing designs are created equal. Philips conducted a study to analyze different types of air bearings and how they responded to multiple failure scenarios as a result of air supply loss. In the event of an air bearing crash, change to the topography of the bearing face can occur, affecting both bearing and machine reliability and performance lifetime.

The data was compelling and led Philips to choose New Way's Porous Media air bearings for the Brilliance iCT scanner.

Case Study: CT Imaging

Air Bearing Wear Test Setup

Three different styles of air distribution of air bearing design were chosen for the study.

Type	Operational Pressure (bar)	Load (N)	Dimensions (mm)	Average Surface Pressure (MPa)	Air Flow Geometry
1	5.5	2000	48x143	0.29	Slots (Orifice)
2	5.5	1800	57x127	0.25	Holes (Orifice)
3	4.1	1100	50x100	0.22	Porous Media

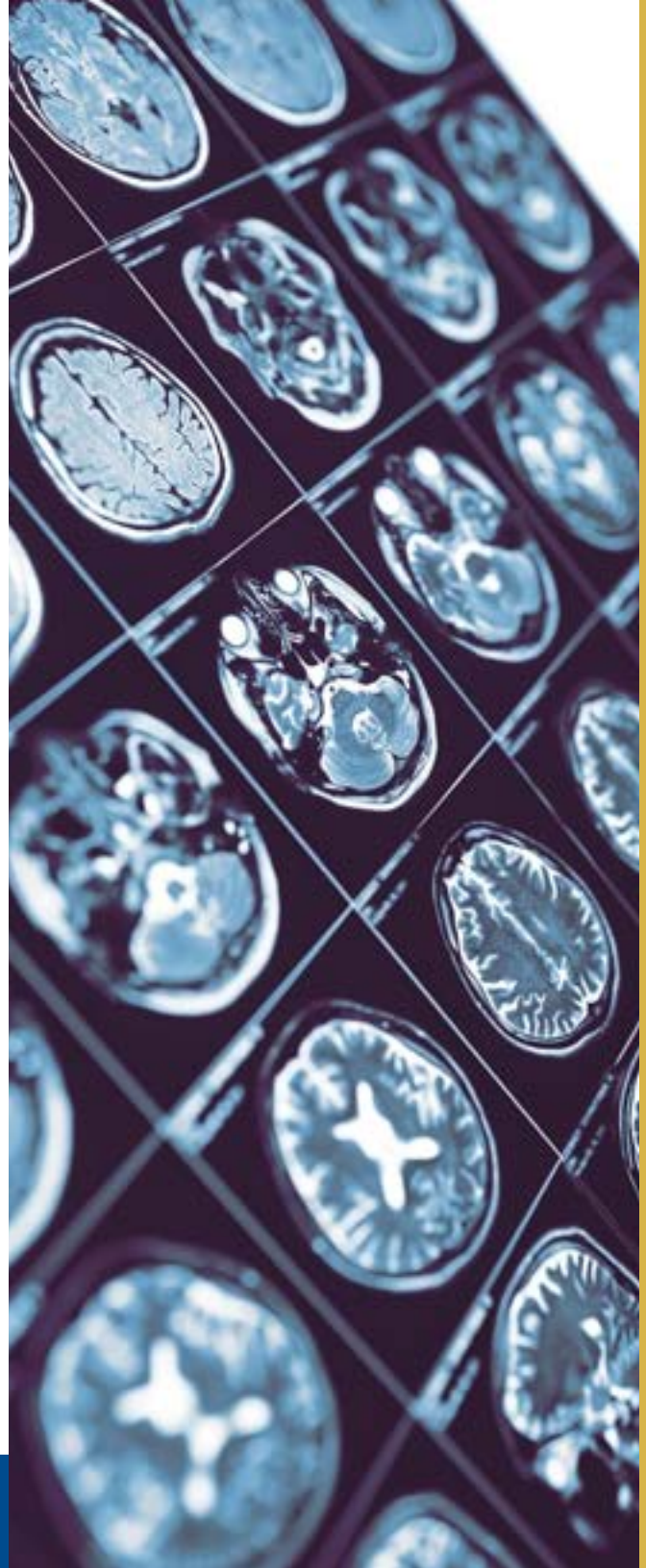
Table 1 - Characteristics of Air Bearings Tested

The study utilized real operational parameters as shown in Table 2.

Test Parameters	Values
Load	1100-2000 N
Air Pressure	4.1 and 5.5 bar
Crash Speed	1.5 m/s
Acceleration	20 m/s^2
Temperature	22 ± 5 °C
Number of Crashes	1 to max possible

Table 2 - Test Parameters Used In Crash Simulation Tests

The test setup utilized a method so the bearing would crash at the same place each time to obtain an accurate sense of wear and defects to the surface. The performance was measured by the number of crashes each bearing type could support under normal operating conditions.



Case Study: CT Imaging

Results of Air Bearing Wear Testing

Table 3 below captures the results of the test, evaluating the number of crashes as well as a measure of any defects.

Type	Number of crashes	Average Surface Pressure (MPa)	State	Height of Defects (µm)
1 (Slots)	8	0.29	Failure	20 - 25
2 (Holes)	16	0.25	Failure	18 - 36
3 (Porous Media)	50	0.22	Operational	0.2 - 0.8

Table 3 - Results of the air bearing crash test

The number of crashes for orifice-styled air bearings (Type 1 and 2) is lower than the specified lifetime of the bearings. Hence, air supply crashes carry a greater risk in long-term operational ability than the actual lifetime of the orifice-styled bearings. This data confirmed how pressure gradients prevalent in orifice-based designs impact performance and durability, particularly in an air supply failure.

In contrast, Porous Media air bearings (Type 3) continued to be operational after 50 crashes with no visible defects on the air bearing guide surface.

The Philips team concluded the Porous Media air bearings (Type 3) were a reliable candidate for high precision system applications, and consequently used New Way's radial air bearings in the gantry ring for the Brilliance iCT scanner to provide frictionless, stable rotation at high speeds, enabling them to provide:

- **Scan times reduced in half**
- **Improved image quality**
- **Less contrast dose and the amount required**
- **Minimized effects of patient motion (voluntary and involuntary)**

How Porous Media Air Bearings Deliver

New Way's Porous Media Technology™ enables air to be distributed evenly through the millions of sub-micron holes inherent to carbon graphite. The CT case study by Philips is a prime example of how this differentiating design feature allows New Way's standard air bearing product line to deliver on the three areas facing stringent manufacturing requirements.

1. Precision

With zero friction and surface averaging inherent to Porous Media, New Way products deliver nano levels of precision.

2. Reliability

The uniform air distribution is critical to repeatability, giving medical providers and patients confidence in the results.

3. Durability

Even in an air supply loss scenario, the air slowly diffuses, minimizing the chance of damage. Utilizing the entire surface area of the bearing (as opposed to just a few orifices) allows for the operation of Porous Media air bearings even if the face becomes scratched.

The choice of bearings is a critical parameter for medical providers to deliver results with precision, every time, to serve as many patients as possible.

With this data and knowledge in hand, let's look at five cutting-edge medical applications and how Porous Media air bearings are poised to deliver them.

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5 AIR BEARING APPLICATIONS

FOR THE NEXT GENERATION OF MEDICAL CARE

Artificial Limbs & Organs

Artificial Limbs & Organs

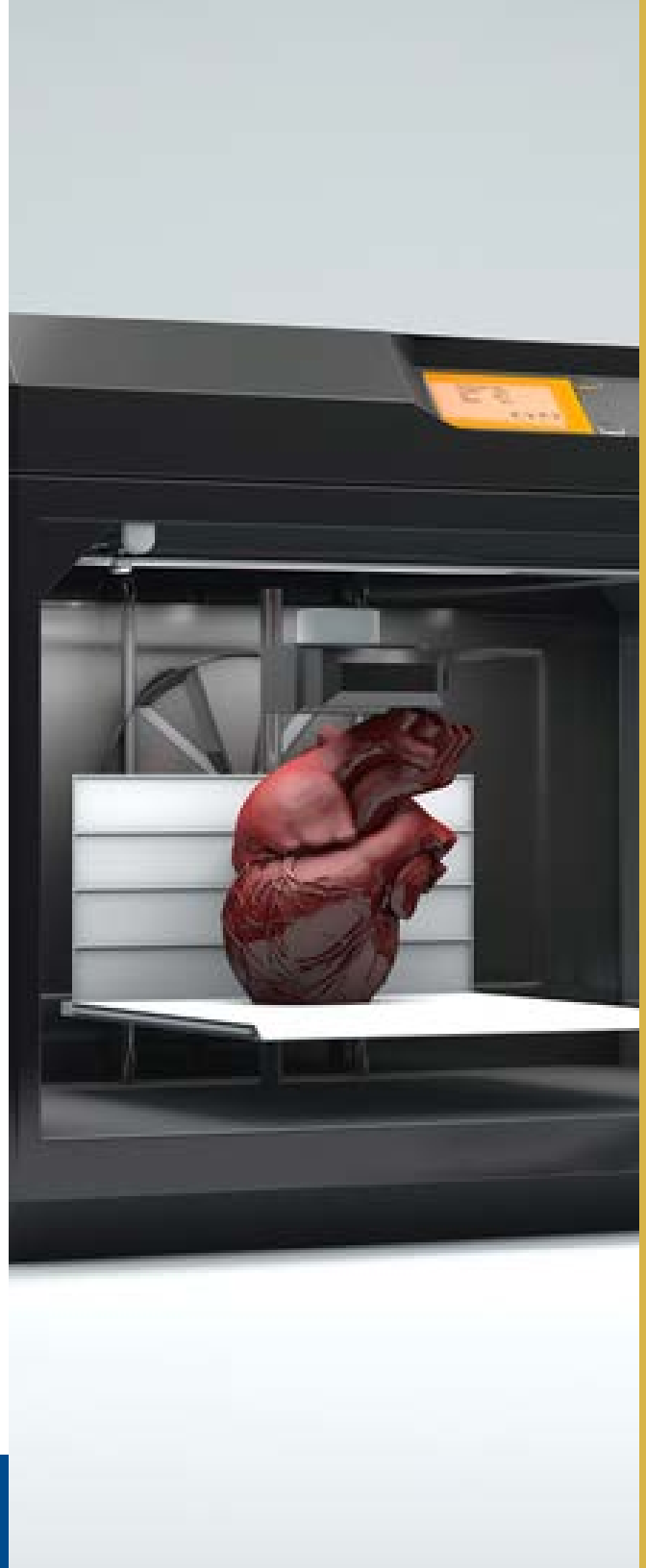
The Challenge

The need for artificial limbs and organs continues to grow. Studies show the number of Americans living without a limb alone numbers 2 million. Add this to the growing number of people who could have their lives extended through artificial vital organs like hearts, kidneys, and lungs, and you have a growing demand for larger production of artificial limbs/organs. Technology advancements continue to open the door for new orthopedic components as well as artificial tissues and ligaments available to surgeons.

3D printing offers the gateway to producing larger quantities of artificial limbs/organs, yet without sacrificing the customization needed for an individual patient. However, manufacturers face the challenge of balancing rigorous precision requirements and operational efficiency amidst a growing demand for artificial limbs/organs.

How Porous Media Air Bearings Deliver

With proven success in high-precision printing systems, New Way offers products like Flat Round Air Bearings and Linear Slides to deliver the precise linear motion required for 3D printing. The non-contact motion inherent to air bearings eliminates the misalignments found in ball bearing systems created by extraneous inertia, providing a closer fit and decreasing the chance of the body's rejection of the limb/organ. With a standard product line available, New Way makes large-scale manufacturing of medical components feasible, without sacrificing the precision needed for each patient.



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Medical Tool/Device Manufacturing

Medical Tool/Device Manufacturing

The Challenge

Whether it's a dental tool for a root canal or micro-precision tools for surgery, successful procedures are often dependent on the tools used. At the heart of these tools and devices is precision machining. As technology advances, the manufacturing tolerances for these tools become more stringent. Additionally, manufacturers struggle to find methods to accurately integrate tools with tight tolerances. Manufacturers are increasingly faced with competing requirements of precision, quantity, quality, while often also operating in a clean-room environment.

How Porous Media Air Bearings Deliver

New Way has a long history in precision machining, offering both linear and rotary motion solutions. With contact removed, machining can be more precise since operations are not impacted by the heat generated from traditional ball-bearing systems. Additionally, tool integration is improved as friction is removed as a source of error; the evenness of the air distribution ensures this is consistently achieved.

New Way's products have been demonstrated to consistently operate at ISO Class 3 cleanroom compliance. The data collected from these tests provide evidence they can be used up to ISO Class 1 as the carbon works as a sub-micron filter for any particulates.

New Way's robust air bearing design offers a solution for consistent precision and low-to-no-maintenance, offering a reliable solution to meet a litany of stringent medical machining and integration requirements.

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Medical Wearables

Medical Wearables

The Challenge

Medical wearables with biosensors offer medical providers with essential information for monitoring and screening patients. Their success and convenience are launching new ideas as well as increasing demand. Mass manufacturing of these devices has created an unprecedented set of requirements to manage flexible materials with superior precision.

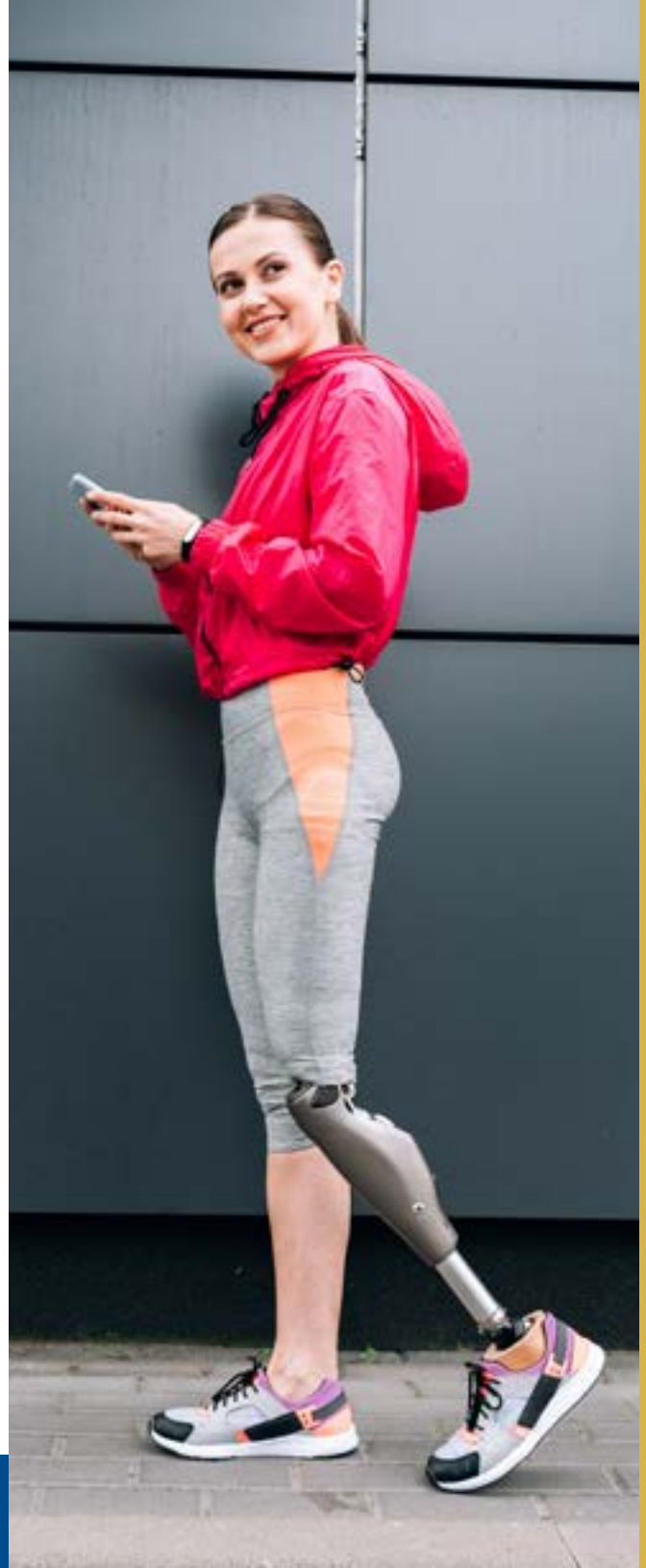
Manufacturers who employ traditional roll-to-roll methodologies for medical wearables often face issues with contamination or damage of the flexible substrates. They also struggle to provide the precision to position and inspect the sensor data on the material. Overcoming these challenges is critical for manufacturers to efficiently produce medical wearables to meet the growing demand.

How Porous Media Air Bearings Deliver

Air bearings offer a unique solution for the production of medical wearables. The non-contact design removes friction to allow for proper positioning and inspection, but the even film of air ensures there is no contamination/damage to the substrate.

New Way offers Air Turns as a non-contact method of web handling for flexible materials. Air turns use the uniform air to "turn" or move the web through production without making contact or wrinkles. Manufacturers can modify web tension and fly height based on the substrate by simply adjusting the air pressure. Air turns are versatile and can be used in place of rollers and turn, tension, or spreader bars.

With standard sizes available, New Way Air Turns offer a viable method for manufacturers to meet the growing demand of these ground-breaking medical devices, as well as position themselves for the future of medical wearables.



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Medical Supplies

Medical Supply

The Challenge

Mass production of medical supplies such as bandages, adhesives, and the plastics associated with them require efficient means of conveying to meet quantity and quality demands. Roll-to-roll and converting manufacturers are constantly searching for ways to improve their manufacturing. A huge barrier for converting manufacturers is the friction between components as well as the maintenance associated with them. The choice of bearings alone can end up greatly affecting the efficiency in operations.

How Porous Media Air Bearings Deliver

New Way offers several products for use in the manufacturing of medical supplies, accommodating a large range of product types. Our Spherical Bearings and Thrust Bushings can replace traditional roll-to-roll components, while Air Bars provide a stiff method for conveying materials. With the use of air between the components, friction and the associated heat generation is eliminated. Operations efficiency is improved with no maintenance periods for frequent lubrication or component replacement from wear. With a wide array of products built on the same foundation, New Way has Porous Media air bearing solutions to increase and enhance the production of medical supplies.

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Enhanced Product Quality

Enhanced Product Quality

The Challenge

Many of the medical industry applications noted so far carry a common theme of demanding precision or manufacturing tolerance requirements. An additional challenge is ensuring the quality of these products, often driving additional stringent requirements on inspection and test equipment.

X-ray technology is popular for the inspection of critical devices like pacemakers. The quality of the pacemaker, for example, is only as good as the test equipment's ability to detect defects. Manufacturers find friction masks the true performance or quality of a product; removing it is critical to provide confidence the end product is meeting requirements. In this example, someone's life may depend on it.

How Porous Media Air Bearings Deliver

New Way offers Servo-Driven Rotary Stages as a solution for X-ray inspection systems. Servo-Driven Rotary Stages feature a New Way Air Spindle integrated with a spotless, brushless motor and a standard or high-resolution rotary encoder. This one-stop solution simultaneously delivers precision along with a robust, crash-resistant design unobtainable by other air bearing technologies. With friction removed, defects previously undetected are identified. Manufacturers are able to increase inspection throughput without maintenance downtime.

In addition, New Way's suite of Porous Media air bearing products offers customers the ability to create the test setup they need. New Way engineers have worked with numerous companies across industries to develop test suites, creating a "gold standard" by which to measure products. Through the use of Porous Media air bearings, manufacturers gain a true read on product performance.

Equipped for the Future of the Medical Industry

Air Bearings Offer Solutions to the Challenges Facing the Medical Industry

The future of the medical industry is bright! From bandages to prosthetics and artificial hearts, the medical industry continues to expand with an incredible range of products. There's no doubt medical technology will continue to break through barriers to improve life.

Yet, a common theme develops while bringing these solutions to life. Removing friction and the method in which it is done can pose a challenge to the feasibility of a medical solution or its end performance. The choice of bearings not only affects manufacturing operations—but patients who depend on their accurate operation.

As captured in this eBook, New Way has proven technology and solutions to serve the three biggest demands facing the medical industry:

Precision | Reliability | Durability

With a broad range of products available off-the-shelf, medical manufacturers using New Way products can confidently tackle today's challenges, while strategically positioning themselves for the future of the medical industry.

When you are ready to learn more about using air bearings in your medical industry application, visit us online at www.newwayairbearings.com or contact us directly for a complimentary consultation.

About Drew Devitt

Drew Devitt founded New Way Air Bearings in 1994 to realize business success through the commercialization of Porous Media Air Bearing Technology.

From the time of New Way's founding, Devitt, as CTO, has maintained its research efforts, and its connections with research and academic institutions, in order to foster the continued development of air bearing technology and the dissemination of the knowledge gained. Devitt is a major figure in the world of precision and was elected President of the ASPE for the 2007 calendar year. He holds a Bachelor's Degree in Business Administration.

About New Way Air Bearings

New Way® Air Bearings, Inc. is the world's leading independent designer and manufacturer of modular air bearing products, and the recognized provider of Porous Media™ air bearing solutions, sold in over 30 countries worldwide. The company manufactures a standard line of modular, off-the-shelf components as well as custom products, and is ISO 9001:2015 Certified. New Way is headquartered in Aston, Pennsylvania, USA, just 15 minutes from Philadelphia International Airport.

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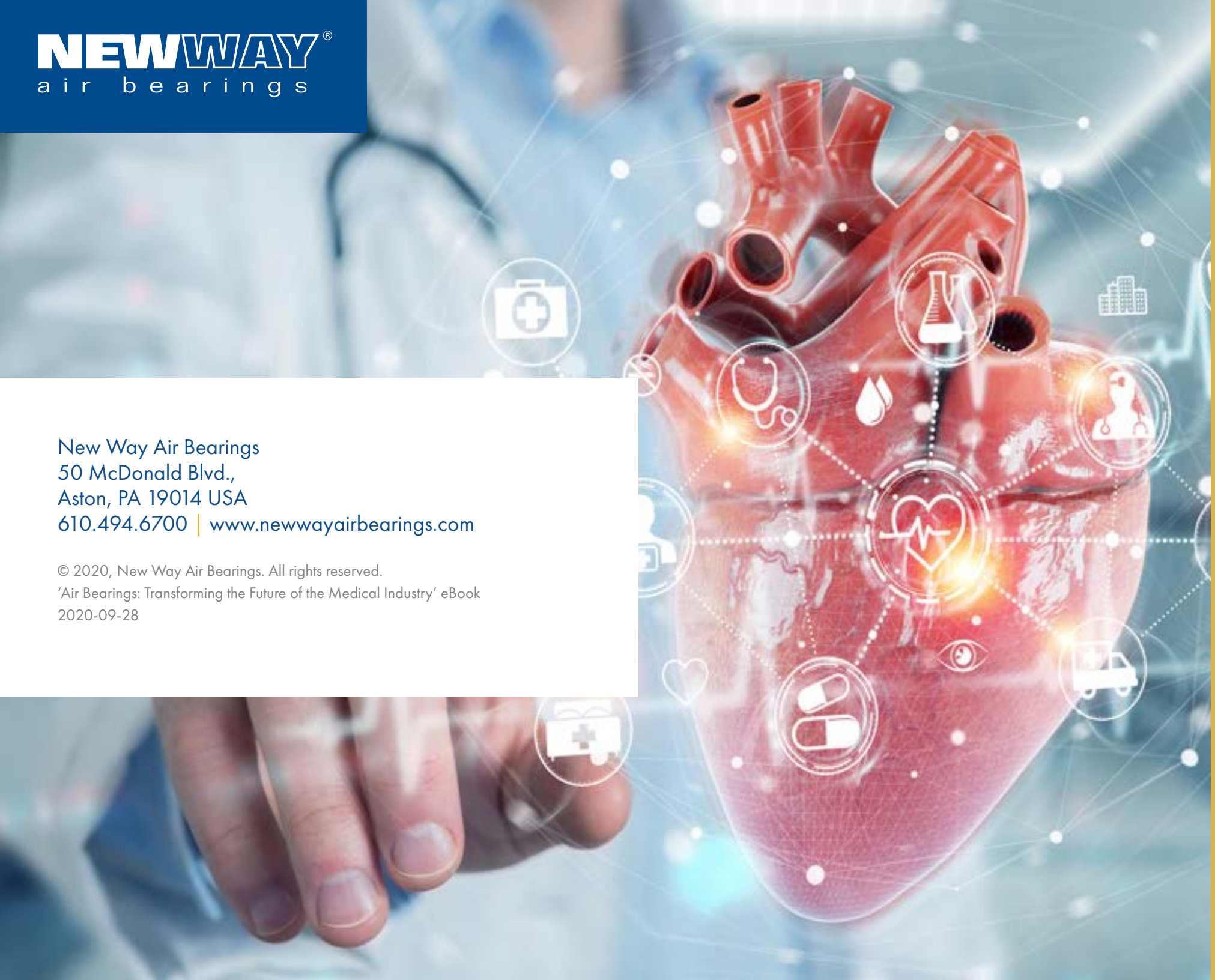

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