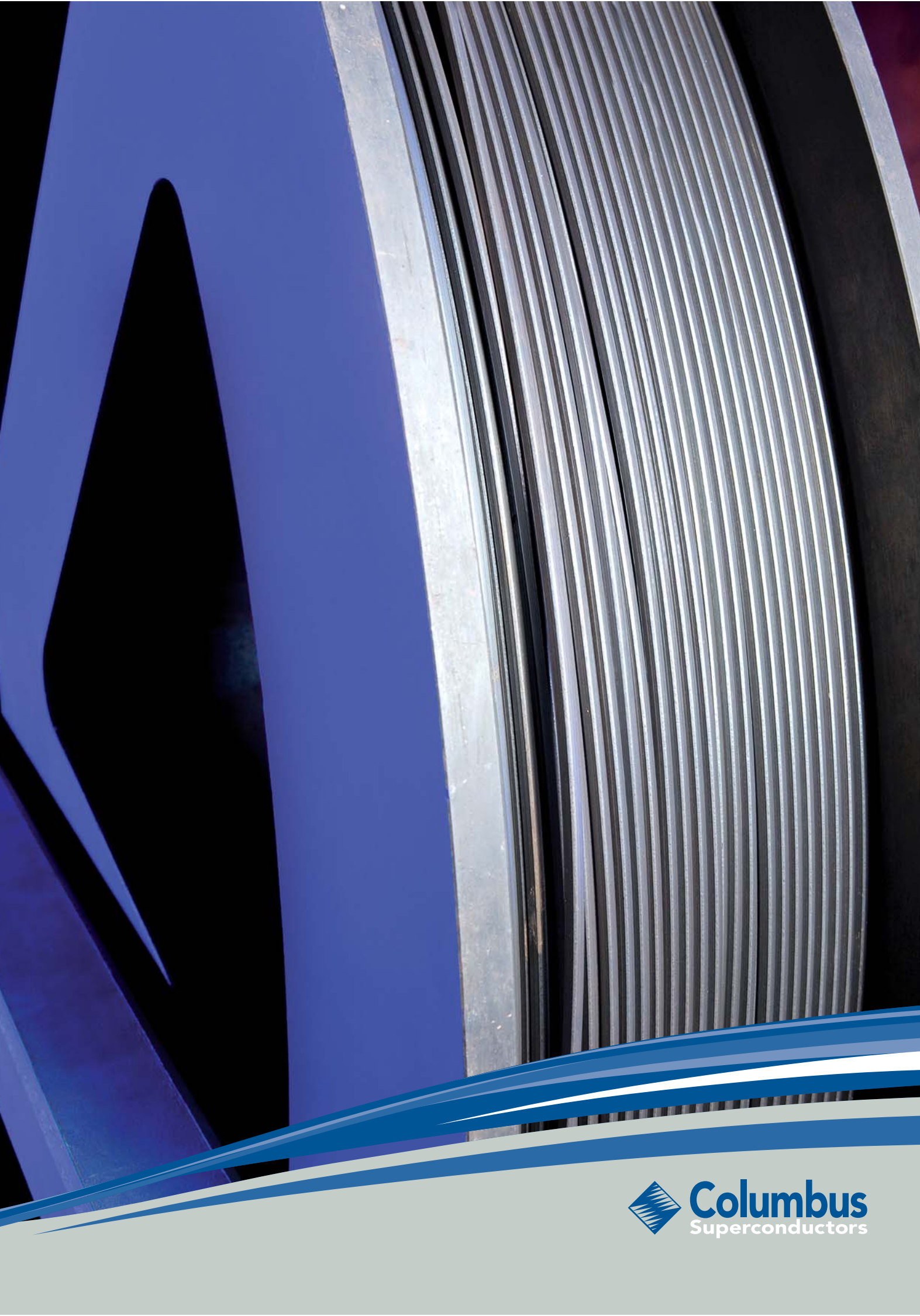
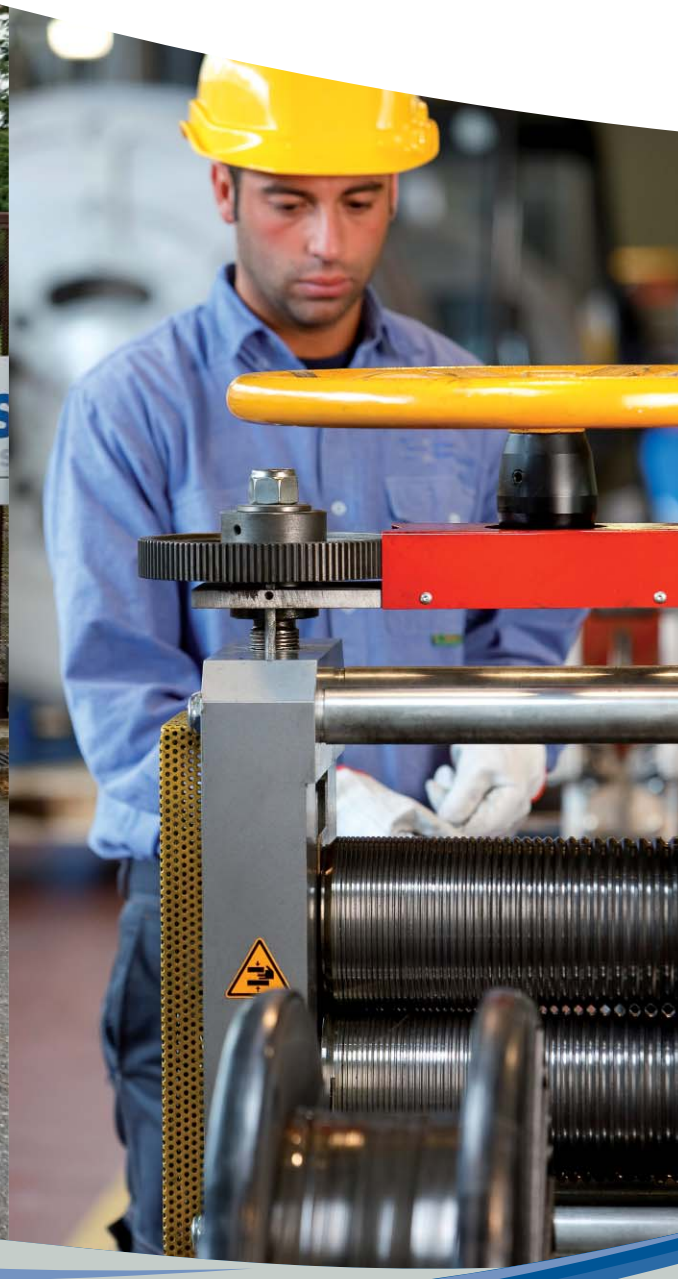


Columbus
Superconductors

The company

Columbus Superconductors SpA, is a world leader in the cutting-edge technology of a superconducting material, magnesium diboride (MgB_2), and its transformation into long, versatile and very reliable superconducting wires. The company is vertically integrated, from R&D to applications, as well as production and sales.



History

Our company was founded in Genoa in 2003, out of the successful cooperation among ASG Superconductors, CNR-INFM (National Research Council) and a group of distinguished researchers. Members of our staff were among the first to develop longer and longer wire prototypes and, in 2005, they managed to set the world record with the first successful production of a 1.6 km long MgB_2 tape. This milestone event opened the way to industrial application of MgB_2-based wires and to their large scale production.

Operational plant and production

Production capacity

Our new plant can deliver more than 2000 km of superconducting wire per year, with a fully scalable output. All conductors are available with typical lengths in the range of 1 to 5 km single pieces, depending on desired conductor configuration and transverse cross-section.

The production process

Columbus Superconductors' wires are manufactured using the so-called Powder in Tube (P.I.T) ex-situ process, very effective in producing homogeneous, robust as well as long conductors. Through a first chemical phase, a controlled thermal reaction between Boron and Magnesium leads to the production of fine MgB_2 powders. By a following metallurgical step, the reacted powders are packed inside a metallic tube which undergoes several drawing and rolling processes in order to reach a monofilamentary MgB_2-based wire with the targeted cross section.

An adjustable number of monofilamentary wires, possibly together with additional wire constituents, are packed inside a second tube which in turn undergoes a similar manufacturing process to obtain the desired wire cross section, length and shape. A finishing flash heat treatment delivers its targeted transport properties.

The whole production is managed with state-of-the-art techniques of process control, combining a skilled labour with a modern manufacturing technology.

The why of MgB_2

There are many reasons that make this material so special, vis-à-vis other superconducting materials:

- Low cost and wide availability of raw materials.
- High superconducting critical temperature (T_C=40K) which allows MgB_2-based systems to be cooled by modern cryocooling devices, avoiding costly, problematic and hazardous use of liquid Helium.
- Excellent chemical and mechanical compatibility with various pure elements and common alloys, so that different materials can be used as MgB_2-based wire components.
- Potential for very good performance in high fields (H_{C2} > 60 T reached in thin films): achieving this goal into long wires would make this material to be used virtually in any known practical application of superconductivity.
- Low anisotropy and potential for persistent mode operation (high n-value, low current decay at medium magnetic fields), as well as low AC losses (ideal for motors, generators, and other AC applications).

So…. Why not?

R&D - Research and development

Design

Since its inception, Columbus Superconductors' solid R&D roots continue to influence its strategy and development. The selection of the appropriate route to manufacture optimal MgB_2 powders is a critical step for

the achievement superior transport properties. It is also fundamental to set the most appropriate sequence of cold working steps within the production process to achieve a fast wire forming, keeping in mind that the choice of the materials surrounding the superconductor, of the final section and shape are crucial points for the wire design.

Our researches pay close attention to these planning aspects always bearing in mind the final performances expected for the conductor.

Look into the future

Beyond design activities, the company mission is to carry and actively support R&D in order to reach superior wire current carrying performances to broaden the applicability of MgB_2. In this field, a survey of various cost-effective technologies for the wire manufacturing as well as several alternatives to produce and improve MgB_2 are under study. Most of today's efforts are concentrated on reliability demonstration and on scaling-up technologies.

Practical applications

Nowadays, Columbus Superconductors' wires can be applied in a number of present and future practical applications:

Medical field:

MRI Magnets: cooperation between Columbus, ASG and Paramed has brought to life a new generation of cryogen-free, "open-sky" MRI system. Use of MgB_2-based magnets bypasses the need of a cryogenic coolant, reducing encumbrance, servicing cost and refill time.
After this successful demonstration, our MgB_2 wires are now available to all MRI customers.

Energy production:

Superconducting motors and generators, especially into hydroelectric and wind energy field, to improve efficiency and considerably reduce encumbrance and weight.

Power quality and storage:

Superconducting Fault Current Limiters (SFCL) for a more protected network and **Superconducting Magnetic Energy Storage (SMES)** to make the distribution of energy generated by alternative sources more stable over time.

High efficiency industrial process:

Induction Heaters and Magnetic filtering: superconducting materials enable an improvement in the efficiency of electromagnetic processes combined with low environmental impact.

Transportation:

Marine superconducting motors, which allows for a considerable improvement from both the weight and efficiency point of view **and magnetic levitation trains**, for high-velocity transportation.

High energy physics

Superconducting magnets for **particle accelerator** and **nuclear fusion experiments** mean power saving and dimension reduction of the facilities, together with great efficiency improvement (detector sensitivity & instrumental resolution).

Customer care

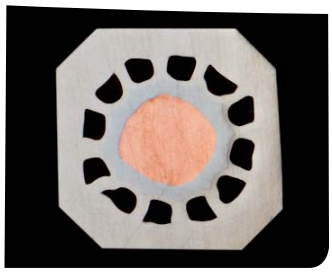
Our mantra: "We are customer oriented"

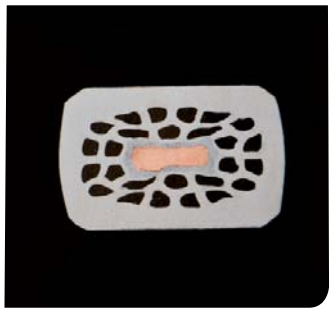
MgB_2-based conductors can be designed in a number of drastically different configurations, according to customers specs.
Members of our staff offer ongoing customer support during all the design steps, in order to clearly comprehend the requirements and choose the right materials, shape and section of the dedicated wire.

Great product flexibility

Flat tapes are superior in term of bending properties while round, square and rectangular wires present better behavior in external magnetic fields.
Conductors can be designed and produced for use both in DC and AC conditions. Copper is usually added for higher electrical and thermal protection, particularly of large superconducting magnets.
Therefore, in Columbus Superconductors' MgB_2 wires, copper is tipically present but it is not placed in direct contact with the superconductor.
Nonetheless, non-copper wires are also manufactured, if required by the specific application. Outer sheath can be Nickel, Monel and other alloys (either ferric or non) to increase mechanical strength. Moreover wire twisting and insulation are also available on request.

MgB_2 is available now!.... Make the right choice!

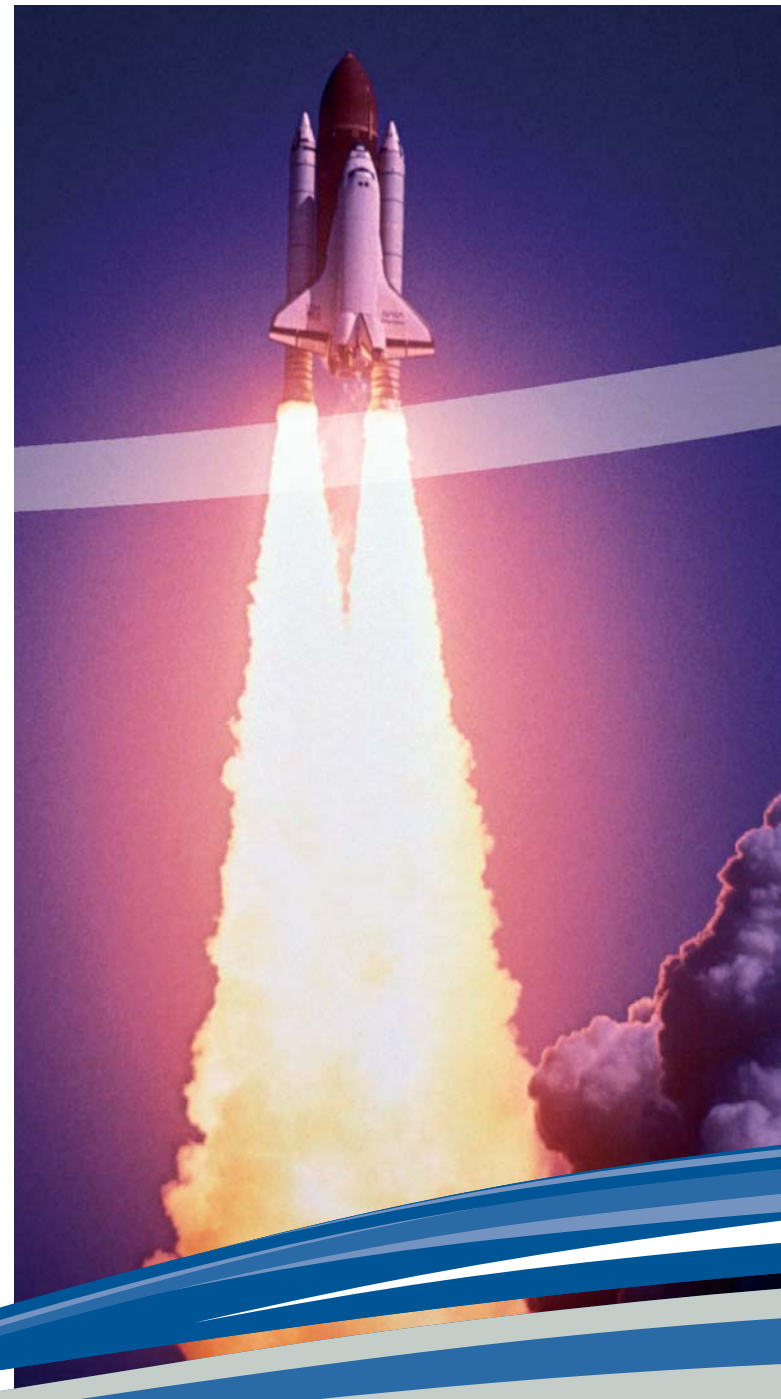




What the future will bring

MgB_2 wire performances are constantly increasing, prompted by the push of physicists and engineers towards the everlasting goal of high-temperature and easy-of-use superconductivity. The future wire will finally enable applications of superconductivity to new strategic fields, like rocket propulsion, while keeping alive (and more at reach) the dream of clean and cheap power generation and distribution.

At Columbus Superconductors, we are ready… are you?



Petergraf

Stampa Microart's - Recco (Ge) 07/2009

Columbus Superconductors

Columbus Superconductors spa

16133 Genova - Italy
Via delle Terre Rosse, 30
Tel +39 010 8698100 - Fax +39 010 8698110

www.columbussuperconductors.com
e-mail: info@columbussuperconductors.com