

TECHNICAL BULLETIN

The latest news and updates from Buckley Systems



**BUCKLEY
SYSTEMS**

Ingenious at work



(Image: Bill Buckley-left of picture in early 1980s)

Bill Buckley always had a desire to build “big things”, frequently taking on projects that others thought impossible. A chance meeting in the ‘70s with PhD student, Hilton Glavish, gave him the opportunity to make equipment for the fledgling ion implantation industry. It was the start of a 50 plus year journey that has seen Buckley Systems grow to be the premier supplier of magnets, vacuum chambers, and accessories to the silicon wafer processing industry. It has not always been easy, but Bill’s determination and ability to innovate solutions for every challenge thrown his way has resulted in a business that can now offer a complete, in-house design and build service for ion implantation, medical science and research facilities.

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DOUG LENNON – CFO

Doug Lennon navigates the complex financial and technological landscape of Buckley System as CFO, strengthening both the Finance and Information Systems and Technology teams since he joined in February 2017. Prior to this role, Doug worked in the private sector, including notable stints in the U.K. and Asia. His background has been key in enhancing the company's financial governance, a critical task for a privately owned company where customer trust depends on robust fiscal responsibility. Under his supervision, financial statements receive strict annual audits by one of the Big Four international accounting firms, ensuring transparency and confidence in Buckley Systems' sustainability.

Doug enjoys being part of a cohesive executive team that has overseen a period of high growth in the business, something that has required careful planning and financial management. He attributes the company's ongoing success to the reinvestment strategy championed by founder Bill Buckley and the Board. A highlight of his tenure was the successful implementation of a new ERP software package two years ago. Although the transition was challenging, the new system has laid a solid foundation for future growth, improving manufacturing control and operational efficiency.

Managing risk is another critical part of Doug's role. His years of experience have been invaluable in foreseeing potential issues and acting before they impact the business. From IT security to treasury management, from supply chain to business continuity plans, these are all on Doug's radar.

While typically preferring to work behind the scenes, Doug stepped out earlier this year to attend the SEMICON West conference in the USA. This opportunity allowed him to connect with our key customers in person, further strengthening relationships and showcasing Buckley Systems' commitment to innovation.

Outside of work, Doug lives a fulfilling personal life. He is married with four adult children and awaiting the arrival of his first grandchild. Most weekends you will find him fishing and scuba diving at his favorite spots off the Northland coast, New Zealand.



RECENT CONFERENCES



(Buckley Systems & D-Pace booths at IPAC 2024)

Buckley Systems representatives have been travelling the world to keep in touch with our customers and engage with those curious about what we have to offer.

We had the pleasure of co-exhibiting with D-Pace at IPAC'24, the leading conference for the global particle accelerator industry, which was held in Nashville, Tennessee. This collaboration with D-Pace was mutually beneficial, demonstrating the added value of our complementary services to attendees seeking a complete turn-key system.

Our executive team attended SEMICON West 2024 in San Francisco, California. This key industry event was a fantastic platform for discussing the future of the semiconductor industry, addressing the current challenges, and catching up with familiar faces.

Our global connections continued at CARRI-SNEAP 2024 in Fort Worth, Texas, an international conference on accelerators in research and industry, where Buckley Systems had a joint booth with D-Pace.

We are always happy to connect with customers via video link or schedule an in-person meeting whenever we're in your area. We look forward to the next opportunity to connect.

BALANCING PRECISION AND COST

How We Manage One-off & Prototype Coil Manufacturing

Buckley Systems manufactures a wide range of copper coils wound from wire, strip and hollow core conductor. Here, a single concept can evolve into a custom prototype or scale up to thousands of units, each crafted with precision. With large production runs, it is worthwhile designing tooling that provides efficiency and repeatability. However, for one-offs and prototypes, the challenge is different. At Buckley Systems, we balance the need for precision with cost control, avoiding the expense of tooling that might be used only once.

With over 35 years of history in manufacturing coils, we have an enormous amount of highly specialised coil winding machinery and jigs at our disposal. When approached for a new coil design, our engineering team will often model the winding process on SolidWorks and look for ways to adapt existing jigs and machinery to do the job. Even with advanced modelling software, the combined decades of coil design experience are still invaluable in knowing not just what is possible but what is practical.

The initial work performed by the design team can make it much easier for the winding and infusion teams to do their job better and faster. Our expansive machine shop allows us to rapidly prototype jigs, fixtures and formers, incorporating real-time feedback to iterate the tools. If the job subsequently becomes a production one, these can be used as the basis for designing better, more permanent tooling.

PRECISION CUTTING WITH WIRECUT EDM



(Wirecut Part)

With an increasing demand for precision, our wirecut EDM machines are an essential step in producing fine-tolerance components. Wirecut EDM operates in a similar way to a bandsaw, but instead of a blade, cutting is done using a brass wire. Millions of tiny electrical discharges from the wire, erode the workpiece without the wire ever directly contacting it. A dielectric fluid (deionised water) flushes the waste away and keeps the wire and the workpiece cool.

Although EDM wire cutting is a relatively slow process - it can take over a hundred and fifty hours to machine the profile of a large multipole magnet - it is perfect for applications that demand extremely fine tolerances. This makes it ideal for multipole electromagnets where even small discrepancies can affect the homogeneity of the field.

An additional advantage is that because there is no physical contact between the wire and workpiece, no additional stresses or deformation are imparted to the material resulting in long-term dimensional stability. For laminated steel, the burrs caused by conventional machining can cause crosstalk between laminations. Wire-cutting avoids this issue and potentially produces a cleaner field.

Buckley Systems was a pioneer in using wirecut EDM for high precision electromagnets, first implementing the technique for magnets used in the Australian 3 GeV synchrotron. The results set new accuracy standards for multipole magnet performance, leading to subsequent orders from the Brookhaven and Taiwan light sources. Our four Sodick brand wirecut EDM machines use linear motors to control the position of the wire. Linear motors offer instantaneous positional feedback, eliminating any mechanical play that can potentially cause interpolation inaccuracy when machining complex shapes. This technology is only available on the highest specification machines.

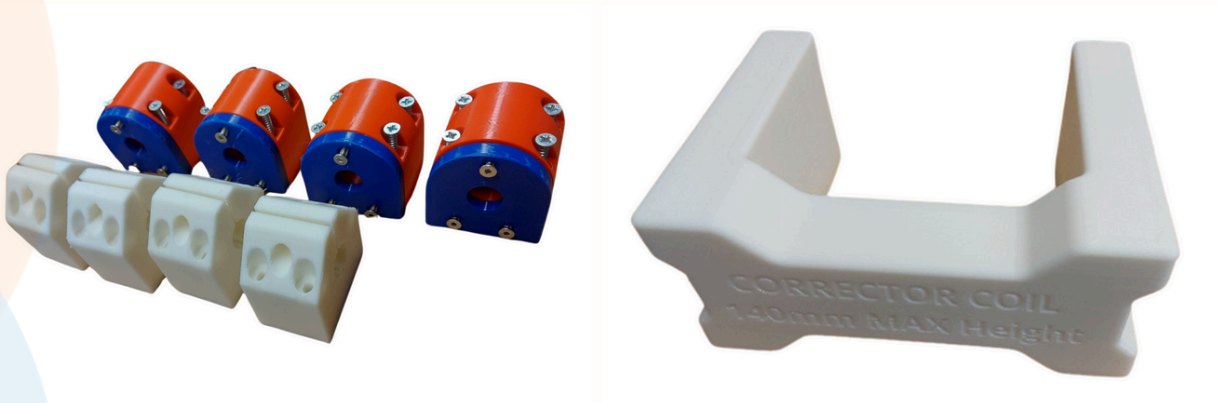
Wirecut EDM is suitable for all conductive materials regardless of hardness, including aluminium, high permeability alloys and even tungsten carbide. Although laminated steel can cause cutting issues with the non-conductive glue between the laminations interfering with the spark erosion process, our experience and careful control of the cutting parameters effectively overcome this issue.

If you are looking for high precision, multipole magnets, contact our physics/design team (Email: info@buckleysystems.com) to discuss your requirements.

3D PRINTING IN ACTION

Our 3D printers are assisting some of our manufacturing processes with a range of innovative solutions. Among some of the applications are tools and formers for bending copper tubes, jigs for positioning parts, insulation components, and moulds for silicone seals. Even simple things like 3D printed, ergonomic handles for regularly lifted jigs and tools have made a difference to staff. They can now lift things safely, without hurting themselves on sharp edges or risking crushed fingers.

A recent project involved 3D printing a plastic mould to form a silicone mould, which was in-turn used to cast reinforced resin filler blocks. The blocks were used for aligning and supporting hollow core conductor tails during infusion resulting in a neater job and making it easier to align and terminate the tails afterwards.



(3D Printing plastic mould)

Investigation is also underway to 3D-metal print the base of a small but complex magnet we currently make for a customer. The new design will mean that cooling passageways are printed in place rather than drilled and plugged. 3D printing allows a more complex cooling passage to be designed, resulting in enhanced cooling efficiency. Plus, because plugs are no longer used, potential leaks are eliminated. Samples have already been printed in plastic and cut apart to analyse the design before a printed metal version is made.

The potential of 3D printing continues to grow, we're eager to see how these advancements will further improve our manufacturing processes and open new possibilities.

NEW KICKER MAGNET GOES OPERATIONAL AT PROTON THERAPY FACILITY IN ASIA

A high-speed kicker magnet, designed and manufactured by Buckley Systems is now operational in a medical synchrotron at a proton therapy facility in Asia. Designed to inject ions into the synchrotron, the magnet needed to produce a field that ramped up in under a microsecond, was maintained for a fraction of a microsecond and then ramped down again just as quickly. To achieve this performance, the yoke was made from CMD5005 NiZn ferrite, chosen for its high permeability, high resistivity and narrow BH loop properties. The copper coil consisted of a single loop running at well over two thousand Amps to provide sufficient magnetic field in the shortest possible time. The magnet was contained inside a vacuum chamber with multiple ceramic feedthroughs employed to carry the current and withstand high voltage. To achieve such high operating current in such a short time, a special pulse-forming network power supply was designed and supplied by OCEM Power Electronics, providing the required flat-top pulse needed for optimal insertion. Working with the customer, power supply manufacturer and our mechanical design team, our Physics team was a key part in ensuring the success of the project. This achievement underscores our ongoing commitment to delivering cutting-edge solutions to the medical industry worldwide.

REDESIGNING MAGNETS TO IMPROVE PERFORMANCE AND REDUCE COSTS

When two of our customers came to us with the challenge of improving their magnet designs, our Physics and Design teams leapt at the opportunity. Here's how we turned these technical challenges into high-performance solutions.

Stronger Fields, Lower Operating Costs

The first project was for a large dipole magnet that required a higher strength field. Using Opera magnetic modelling software, a new coil was designed containing more turns. The number of turns was increased not just to meet the stronger field requirement but to reduce the overall power needed to produce it. The cost of extra turns will pay for itself over long-term operational savings. The magnet still needed to fit within the same envelope as the original design, so it was not just a case of adding turns to the outside of the existing coil. While the design was under review, the physicists also took the opportunity to remodel the pole profile to improve the optics.

Better Performance, Easier Manufacturing

The second project was to design a pair of X and Y scanning magnets used for a customer's next-generation radiotherapy device. The customer had previously supplied drawings for the earlier generation magnets but was keen to use our design experience to improve the product. Starting with a clean sheet of paper allowed both the Physics and Design teams to optimise the magnets for both magnetic performance and efficient manufacture. Having design freedom meant that where possible, machined parts were optimised to take advantage of standard material sizes. The new design included a rigid box-section ladder frame for the magnets, mounted on two stands with multi-axis adjustment including pitch and yaw. Another smart use of the frame was mounting the water manifolds and copper bus bars on it. This helps minimise vibration and harmonics associated with AC magnets. Lifting points for the frame as well as each individual magnet were included to allow for easy installation and servicing, plus a grid of M6 tapped holes on the sides of the frame were added for easy fitting of any covers, brackets, cable holders or devices that may be needed for commissioning. These are relatively inexpensive and easy to do during machining but are much harder to do after.

Buckley Systems thrives on turning challenges into opportunities. Whether you need a complete design service or just some practical advice, we're here to make your magnet systems better, more efficient, and easier to manage.



BOOST OPERATION EFFICIENCY WITH MATRIX AUTOMATED TOOL DISPENSERS

In a busy machine shop with over 45 CNC machines, keeping control of tooling is a critical part of ensuring production runs smoothly. Tooling is a major investment for the business, and efficiently managing this investment requires a delicate balance: preventing overstock while avoiding production halts due to shortages.

Tooling suppliers offer thousands of options for cutters, drills, taps and reamers suitable for different materials, removal rates and surface finishes. Through experience, and by having quite a specialised range of commonly machined materials, we still have well over a thousand regularly stocked tools. For high-volume operations, where a single tool might require up to fifteen replaceable tungsten carbide tips, managing inventory becomes even more challenging.

At Buckley Systems, we recognize the value of smart solutions for smooth operations, we're committed to efficiency and precision, which is why we continuously invest in advanced systems to streamline tooling management.

One such investment is the Matrix Automated Tool Dispenser Systems, which we have relied on for years to manage tooling for over 35 CNC machines. Based around specialised storage cabinets, linked via a software package, it keeps track of stock while allowing operators to access the tools and equipment they need 24/7. When a staff needs a tool, they simply scan their fingerprint or enter their ID number. They can then search for the tools they need by machine, operation, or the tools used previously for manufacturing the part. Once the tool and quantity needed are selected, the appropriate drawer unlocks and opens the bin, but only one bin at a time which reduces the risk of accidentally taking the wrong tool. With Matrix's stock monitoring, daily ordering suggestions are automatically generated for the tooling manager, ensuring that we're always stocked up without excess.

Incoming tools are scanned in using a barcode to open the correct drawer and bin, eliminating stocking errors. The Matrix is almost infinitely expandable and can cover many locations. The cabinets, drawer and bin configurations can be customised to suit the size of the tools, from tiny tooling inserts to the largest items. Almost 1,800 items are currently managed by the Matrix at Buckley Systems, which has expanded to not only cover tools but regularly consumed spare parts and also control our expansive range of precision measuring equipment. The Matrix software and inbuilt analytics provide real-time feedback, generating reports on stock levels, usage, tool life and stock value. These reports can be compared to historical values and KPIs to optimize efficiency and stock management.

By leveraging advanced technology and continuously investing in smart systems like Matrix, Buckley Systems ensures that our tooling management is as smooth and efficient as possible.

NEUTRON THERAPEUTICS ACCELERATOR IN USE AT UNIVERSITY OF BIRMINGHAM

The University of Birmingham has had their Neutron Therapeutics, accelerator-based neutron source, running and successfully conducting experiments since early 2024. Programmes undertaken so far have included: neutron radiation-induced attenuation in optical fibres for fusion magnet protection; assessing the neutronic shielding performance of materials for nuclear fusion; impact of radiation damage on deuterium retention of CVD diamond; direct activation measurements of the Co-60m metastable state; the production of novel medical isotopes; and radiobiological effects of BPA (Boronophenylalanine) and other novel boron-containing drugs to optimise the response of head and neck cancer to BNCT.

Feedback on the device has been extremely positive. Technical Manager, Ben Phoenix says, "On the operations side my experiences are overwhelmingly positive. It could basically be summed up as "It just works". There is enormous value in having a system where we can decide we want to run, fire it up and within 15 minutes we can have very intense neutron fluxes."

Neutron Therapeutics is partly owned by Buckley Systems' founder Bill Buckley and Buckley Systems manufactured the proton beamline, rotating lithium target, electrostatic alternators, vacuum parts and much of the mechanical componentry. For BNCT inquiries, contact Neutron Therapeutics. For manufacturing magnets and beamline components, contact Buckley Systems.

D-PACE TRANSITIONS TO INDEPENDENT CANADIAN OWNERSHIP AND ANNOUNCES SEARCH FOR NEW CEO

D-Pace and Buckley Systems are excited to announce a major transition in D-Pace's ownership structure. After a decade of successful joint ownership with Buckley Systems, D-Pace will now evolve into its own independent Canadian ownership group. D-Pace and Buckley Systems intend to continue their longstanding collaborative relationship.

In 2014 Buckley Systems invested in D-Pace (50% ownership), and as a result D-Pace had the resources to develop and commercialize new products for the particle accelerator market. During this time, Buckley Systems also established its own product offering, and the collaboration provided excellent technical expertise to both organizations. Over the past 10 years, this collaboration has fueled innovation, development, and growth, positioning D-Pace as a leader in the particle accelerator market. The achievements realized through this joint ownership have established a robust foundation for D-Pace's future growth.

"Our vision and strategic focus remain steadfast," said Kent Dehnel, current President of D-Pace, "The past decade of joint ownership with Buckley Systems has been immensely rewarding. As we transition to an independent Canadian ownership structure, we are excited about the new opportunities that lie ahead."

In addition to this ownership transition, D-Pace is announcing a search for a new CEO to lead the organization into its next phase of growth and innovation. Kent Dehnel, who has served as President, will remain on the executive leadership team as Chief Financial Officer (CFO) and will continue to serve as President until a new CEO is announced, ensuring a smooth transition.

"This is an exciting time for D-Pace" said Arron Sands CEO at Buckley Systems. "Our decade-long partnership has been built on shared goals and mutual respect. We are confident that D-Pace's independent ownership and our continuing, collaborative relationship with D-Pace will drive further success for both organizations."

D-Pace's commitment to delivering exceptional products and services to its clients remains unwavering. The organization is dedicated to maintaining its core values of innovation, quality, and customer service, while exploring new opportunities for growth and expansion.

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