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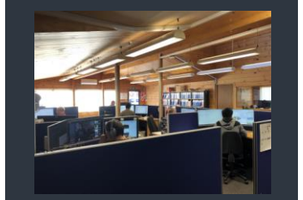
Buckley Systems Technical Bulletin

Design team moves office

The Design and Physics departments have recently moved into refurbished premises attached to our #8 Bowden Rd workshop. The new Design department office has more space to enable us to house our expanding team. The high ceiling and wood panelled walls give it a pleasant atmosphere and, unlike the old office, it is well insulated from noise from the factory.

Our Physicists plus Chief Technical Officer, Chris Philpott, have also moved into an office adjacent to the Design department. This will help facilitate collaboration on our increasing number of design and build projects. Included in the main office building is a meeting space and an AV centre for international tele-conferences allowing our design team to communicate directly with our overseas customers.



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Conferences and Events

With the current Covid-19 pandemic and limited world travel, Buckley Systems and D-Pace do not anticipate that any travel to conferences will take place in 2021. In the meantime, we are more than happy to meet customers via phone or video conference to discuss any current or future projects.

COVID-19

While the Covid-19 pandemic is sweeping the world, New Zealand's isolation and strict border controls has meant that the country has been able to control the community spread of the virus with very little disruption to our business.

We are confident that our practices and protocols will allow our staff to continue to work safely in the event of another community outbreak.

Most of our suppliers have been relatively unaffected and we are working hard to ensure our supply chains remain intact.

With a vaccination program underway for our population of five million, it is hoped that we can avoid any future disruptions and will hopefully, soon be able to host our important international customers again.

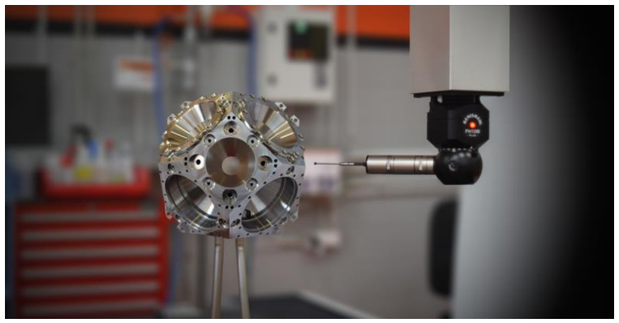
High precision measurement

In a perfect world, components designed on a computer and made on a computer-controlled machine should all be identical. However, factors such as machine repeatability, tool wear, heat expansion, surface deformation and stress relief can all affect the final size and shape of a component. Experienced operators can optimise results with careful tool selection and by taking fine finishing cuts, but to make sure everything meets the specified tolerance, the finished product must be accurately measured.

Our quality assurance team has access to a wide range of calibrated, high-precision equipment to check components. Coordinate measuring machines (CMM) use a calibrated probe mounted on precision guides to accurately map the critical features of a part. We have two motorised, bridge type CMMs mounted on granite tables plus a portable arm CMM which can be used for large components that cannot fit on the bench. To eliminate measurement errors from thermal expansion, our quality assurance area is temperature controlled.

The quality control department holds a wide range of micrometers, digital callipers, pin gauges, thread gauges, slip gauges (Johansson blocks) and other precision measuring devices. All instruments are maintained and calibrated for use throughout our other departments.

For regularly manufactured parts, we have the ability to make our own go/no-go gauges. These allow an operator or QC inspector to instantly check a part is within tolerance without reading an instrument. For high precision parts these types of gauges can be used, not for a final judgement but as a way to sort out parts that are close to the tolerance limit for more precise inspection.



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If you would like to subscribe to an email edition, please contact us at: info@buckleysystems.com

Green Energy

As part of our ongoing commitment to environmental responsibility, Buckley Systems has signed an electricity supply contract with Meridian Energy, a company that generates power only from renewable sources.

Meridian Energy is able under the New Zealand Certified Energy System to issue certification to verify that our annual power consumption is matched against annual energy produced by Meridian's hydro stations and wind farms. This is the equivalent of the EPA Scope 2 GHG emission requirements for our electricity consumption and allows us to use the 100% certified renewable energy logo.

Having to purchase green energy certicates provides a strong incentive for us to reduce the total power consumption of our entire business. Where practicable, we have installed LED lighting in our factory and the new extension built to house our latest machining equipment, has lighting that senses the ambient light and adjusts output accordingly.

100% CERTIFIED RENEWABLE ENERGY

This issue

Our ISTF is on the move

The Buckley Systems / D-Pace Ion Source Test Facility (ISTF) will be moving from Buckley Systems' premises in Auckland, New Zealand to the newly founded D-Pace Ion Source Centre (DISC) in Nelson, BC, Canada. The ISTF project started as a joint venture initiated after Buckley Systems purchased a 50% stake in D-Pace in 2014. The ISTF project has been a great success and helped develop strong connections between the two companies with Buckley Systems providing engineering design advice and manufacturing while D-Pace performed the physics design and also designed the electrical control systems. The source produced first-beam in November 2015. Since then, it has been instrumental in developing and validating many of D-Pace's current range of products. Prior to the ISTF, D-Pace had one product, and now with Buckley Systems' investment and the use of the ISTF, D-Pace has over 40 products.

The ISTF had been crucial in validating two types of ion sources: A Volume-Cusp Source for negative ions (primarily H^- and D^-) based on licences from TRIUMF and the University of Jyväskylä and a Penning Ion Source developed by D-Pace for H^-, D^-, He^{++}**.** Current uses for the sources have been in the fields of radio-pharmacology, molecular imaging, radio-immunotherapy and Boron Neutron Capture Therapy (BNCT). Research is being undertaken on 4+ and higher charge states that are of interest to the semiconductor industry. Other products developed and tested using the ISTF over the years have been beam diagnostic equipment such as emittance scanners, beam profilers, Faraday cups, mass spectrometers and other specialised magnets.

The ISTF has also been used by PhD students from the University of British Columbia and University of Auckland as well as hosting scientists from around the world. However, with D-Pace's new manufacturing and research premises in Nelson where they are building an experimental Bernas ion source and also have a proposal for an ECR ion source under consideration, it made sense to bring the New Zealand based ISTF into the centre.

While Buckley Systems will be sorry to see the ISTF go, it will free up valuable manufacturing space and allow us to focus on some other commercially sensitive projects that are currently under development.

Looking to the future

2020 was a highly disruptive year for the world in general. We expect the effects of COVID-19 will continue well into 2021 and probably beyond. Being based in New Zealand, Buckley Systems has avoided much of the disruption experienced elsewhere in the world. Our geographical isolation and a Government that moved quickly to eliminate community transmission of the disease, meant that production was able to continue almost without disruption. Turnover in 2020 set a new record for our company.

It appears that our major customers have been able to continue with their business and orders continue to flow. We have also picked up several important research projects involving extensive design work. More production machinery is arriving soon and we continue to upgrade our premises to make more efficient use of our factory space.

Powered by Mazak

Buckley Systems has always had a close relationship with Japanese machine-tool manufacturer Mazak. Renowned as a market leader in CNC machining and manufacturing technology with an enviable reputation for accuracy and reliability, we currently operate 25 of their CNC machines and have placed orders for more.

In 2018 Bill Buckley formed the company New Zealand Machine Tools (NZMT) and acquired the New Zealand sales and service agency for Mazak. While NZMT is run as a stand-alone business, the close relationship between the two companies gives Buckley Systems access to the latest technology and highly trained service technicians while NZMT uses Buckley Systems as a working machinery showcase.

Mazak PALLETECH System

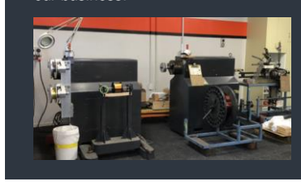
Mazak

Wire winding moves

With the Design department moving to a new location, the factory floor space it took up, has been converted into a new wire coil winding area.

Separated from the main factory floor by a screened doorway, the area is temperature controlled and kept free from potential contamination.

While the impressive large magnets we make are usually hollow-core or strip-wound, small wire wound coils still comprise a very important part of our business.



Tony Misa

Group Manager - Operations

Tony started his working life at Buckley Systems in November 2003, straight from Waiuku College where he played 1st XV rugby and competed in BMX at National level.

He was part of an intake of six pre-apprentices at Buckleys' who were given the chance to apply for the three apprenticeships on offer. After being selected, he managed to fast-track his CNC Machining qualification, alternating his studies at Manukau Institute of Technology three days a week with working at Buckley Systems. By working extra evenings and weekends, his apprenticeship was completed in a record time of just over two and a half years. The main reason for the rush was that he had been offered a four-month rugby contract in the UK and he wanted to complete his qualification before leaving. However, on returning to New Zealand in 2007, the global financial crisis had hit and there was not enough work at Buckley Systems to re-employ him.

Tony quickly found another job operating the laser and plasma cutting machines at Sandvik New Zealand, where he worked for two years until lured back to Buckley Systems in 2009.

By 2015 Buckley Systems was undergoing a rapid expansion so Tony took on the newly created role of Machine Shop Planner, becoming Machine Shop Manager in 2017. In his current role as Group Manager Operations, which was created in 2020, he now oversees the machine shop, fabrication, laser, O-ring, plating & planning teams involving over 110 staff.

Having worked his way up through the company, Tony is a great mentor for his team and is always exploring ways to do things better. He enjoys the challenges of troubleshooting the large, small and fine tolerance work that is involved in the manufacture of high precision electromagnets and associated components.

Tony is married with three young daughters. In his free time, after helping his children with their sports and activities, he keeps in shape with CrossFit training.

Technology topics

BNCT for Japan

In April, a BNCT machine designed by Neutron Therapeutics will be shipped to Japan. Buckley Systems manufactured the beamline magnets and most of the mechanical parts including sixteen high frequency alternators, support structures and bismuth shields.

Largest magnet so far

As part of a magnet set destined for a laboratory, Buckley Systems will be building its largest magnet to date.

Weighing in at 54 tons, a 60°/119°switching dipole has been designed by our Physics and Engineering teams for a Canadian client and will be built in-house by our skilled Manufacturing team.

Being given a free hand to design the magnet, enabled us to make efficient use of readily available material sizes, keeping costs down. With the magnet needing to be disassembled for shipping, design features were also included to make handling and assembling the components as easy and safe as possible.

The 54-ton magnet will be accompanied by 10 other magnets and shipped to the end-user in Italy.

PhD thesis based on ISTF research project submitted to UOA

Anand George, PhD student at the University of Auckland, has just submitted his thesis "*A Study on the Extraction of Negative Ions from a Multi-cusp Ion Source*". His experiments were performed on the Ion Source Test Facility at Buckley Systems.

D-Pace is currently applying together with TRIUMF for a MITACS Post-Doctoral fellowship for Anand. This will enable him to move to Canada to help set up the ISTF at the newly founded D-Pace Ion Source Centre (DISC). Once commissioned he will continue experiments and developments primarily in the area of RF-powered volume-cusp source technology for negative ions.

Well-travelled magnet

A recent project for a Lambertson magnet involved manufacturing a 680mm long laminated core with a wire-cut, high-precision central beam path through it. The part-finished assembly was sent to America where a vacuum chamber and vacuum ports were welded around the outside of it. The magnet was then returned to us for the coil to be installed and the finished assembly tested. While we can perform vacuum tight welding, our customer wanted to use a supplier known to them but use us for the steel and coil work. By the time the magnet is installed, it will have crossed the Pacific Ocean three times by sea freight.

The D-Pace team celebrating 25 years

D-Pace celebrates 25th anniversary

When one thinks of Nelson, British Columbia, Canada they might think of the vast wilderness surrounding the small Canadian mountain town or the laid back, artistic vibe. They may think of adventures like world class mountain biking and powder skiing at Whitewater Ski Resort. What they may not know is that there is a company in the heart of Nelson that supplies products and services to the international commercial accelerator industry that's been operating since 1995.

Twenty-five years ago, Dr Morgan Dehnel returned to the West Kootenays of British Columbia from Vancouver, where he had been completing his Ph.D. in Accelerator Physics from TRIUMF/UBC. The internet was just good enough at that time that Dr Dehnel could work remotely from Nelson as an independent consultant, while his wife worked for the City of Nelson as a city planner. That same year, the couple created Dehnel Consulting Ltd., providing engineering services to accelerator-based clients. In 1998, the first employees were hired, bringing drafting and design to the table.

Over the next few years, the company survived a tech slump, licensed technology through TRIUMF in 2001, and changed its name to reflect the addition of hardware development, manufacture, and sales. Dehnel – Particle Accelerator Components & Engineering, Inc. (D-Pace) was launched in 2004 and was able to make its first ion source within a year, with financial support from the Canadian government.

By 2010, D-Pace was expanding to international markets; Dr Dehnel had lived in France, working on projects with THALES, and D-Pace had made its first ion source sale. 2014 marked a milestone for D-Pace, when Buckley Systems bought a 50% ownership, allowing D-Pace to develop and build an Ion Source Test Facility (ISTF) at Buckleys' headquarters in New Zealand. The buy in and ISTF gave D-Pace the resources and platform to develop dozens of new products for the particle accelerator market.

In the summer of 2019, D-Pace had around 15 employees and officially outgrew the existing office space. Signing a five-year lease with Selkirk College, D-Pace opened the D-Pace Ion Source Centre (DISC) on campus. The 4500 square foot space allowed D-Pace to assemble large million-dollar systems as well as smaller assemblies. The Ion Source Test Facility will move to DISC this year, allowing D-Pace to develop Bernas, Volume-cusp, ECR, and Penning ion source systems.

Dr Dehnel has always been motivated by interesting, challenging R&D projects in the accelerator field. When asked about his visions for the future, Dr Dehnel says of course profit is important, but it has never been the driver of the company. "It's been about satisfying intellectual curiosity, which has resulted in a vibrant, healthy company that is diverse with staff having multi-layered capabilities. It's about interesting work. We are interested in the educational aspect and in a number of cases, students remain as staff. University education is subsidized in Canada and it's a way to pay back our country for funding education and being such a good place to live when we contribute royalties back to national laboratories".

Dr Dehnel still hopes to see an innovative institute in Canada where ion source technology could be developed, and students could study for their Masters or Ph.D. while being linked to vocational students who could provide hardware and assemblies for the graduate student projects. He envisions D-Pace as instrumentally connected to the institute, working with Selkirk College, UBCO, TRIUMF and other collaborators, to create a Canadian institute of ion source sciences. As for D-Pace, "we are about 20 people, becoming a self-sustaining company that can stand on its own two feet and we've been successful so far, with good management and ownership."

D-Pace is very thankful for Canadian, British Columbian, and local Kootenay support through programs such as CRA-SRED, NRC-IRAP, NSERC (Scholarships & IUSRA), Callaghan (NZ), MITACS, CanExport, First Job in Science and Technology, SICEAI, WEDC, BDC, EDC, CBT, KAST, Selkirk College, UBCO, and the City of Nelson. A special thank you to Buckley Systems for its collaboration, investment and support of D-Pace over the years.

Implementation of new ERP system

Buckley Systems is investing in new ERP software to help cope with the growth of the business. Our existing software has coped with our rapid expansion over the past few years but had reached its limits with both the size of the company and keeping up with the growing requirements of international regulations. The new software will bring more transparency to our processes, produce quotations faster, help with resource planning plus give real-time progress of jobs through the manufacturing process. Electronic forms will allow us to reduce paper documents plus give us the ability to capture data straight from the workbench. Embedded fields will make compliance with RoHS and REACH legislation easier.

Though much of the improvement will be behind the scenes, the changes our customers will see will be faster turnaround on quotations, accurate, just-in-time delivery schedules and the ability of our customer services team to present delivery time scenarios for different product mixes.

It is hoped that the system will be ready to go live late 2021.

EPICOR