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The School STEM Technician

Contents

Supporting the professional development of the school technician community in Scotland

The School STEM Technician bulletin is published by SSERC 1-3 Pitreavie Court South Pitreavie Business Park Dunfermline KY11 8UU Managing Editor: Alastair MacGregor Telephone 01383 626070 enquiries@sserc.scot www.sserc.scot

CEO Introduction
Alastair MacGregor, CEO, SSERC

Professional development is any activity, formal or informal, that helps you develop skills and knowledge to help you professionally and personally throughout the course of your career. It has always been my belief, and that of SSERC, that good quality professional learning and development for school technicians is vitally important. This professional learning and development can be accessed and delivered in many ways, including:

- training courses and workshops
- studying for a qualification
- online courses/webinars/podcasts
- observation (as either observer or person being observed)
- shadowing a colleague
- visiting other schools/colleges
- attending exhibitions and conferences
- self-reflection, personal reading or research.

At SSERC, we have partnered with STAC to support professional development activities for the school technician community in Scotland. Looking ahead, we will be further supporting school technicians' professional learning:

- Continued twilight technician SSERC Meets (online live sessions). You can view our previous Technician SSERC Meets at **Tech_meets - YouTube**. We are always looking for suggestions for themes or topics.
- Technician conference to be held at SSERC in Spring 2023; details to follow.
- Use of Techné to support informal professional development and encourage professional discussion and debate (see page 7 for more information).
- Continued publication of The School STEM Technician facilitating the acquisition of new knowledge and an opportunity to contribute an article. We are always looking for a school or college technician to write a suitable article for one of the forthcoming issues.
- The addition of new professional learning courses to assist the acquisition of new skills and knowledge and, importantly, support mandatory aspects of health and safety.
- Opening up opportunities for SSERC Accredited Centres to offer a broader range of SSERC professional learning activities

SSERC and STAC applied for funding via the Education Scotland Enhancing Professional Learning in STEM Grants Programme to support the development of a Technician Leadership Professional Learning Course. This was rejected by Education Scotland, and we wait with interest to ascertain the official reasons why. However, I believe it may be based on a perception that the proposed course may have limited uptake given the lack of career progression opportunities within the technician profession in Scotland. I think we can all spot the irony here! If this is the case, then it simply reinforces the need to further promote the critical role that school technicians play in supporting the school curriculum and, as evidenced by the articles in the

Technicians' Corner of this issue, the role technicians play in the wider aspects of school life. As a consequence, SSERC is entering into dialogue with other partner organisations to facilitate the development of a Technician Leadership professional learning course; where others cannot or will not, we will. Details to follow.

SSERC is aware of the important role that school and college technicians have in relation to health and safety and, as such, offers a range of professional learning courses that support mandatory health and safety requirements. Our Safe Use of Fixed Workshop Machinery is one such course that is very popular and, indeed, continually oversubscribed, despite also being offered by a number of our SSERC Accredited Centres[1] To complement this course, we are currently developing a new professional learning course with the provisional title 'Safe Operation Training for Bandsaw, Pillar drill and Bandfacer', and which will focus on:

1. Health and safety awareness
2. Bandsaw
3. Pillar drill
4. Bandfacer
5. Extraction

It is anticipated that this 2-day course will be SCQF Credit and Levelled. More details, including timescales, are to follow.

Moving forward, SSERC and STAC will continue to look at opportunities for partnership working with other bodies and organisations that share our vision *to raise the professional status of school technicians and promote the role they play in the education community in Scotland.*[2] The school technician profession in Scotland (and beyond) continues to face challenges and obstacles, but within the challenges and obstacles lies the potential and it is from that potential that progress can truly be made.

Alastair MacGregor
Chief Executive Officer, SSERC

[1] https://www.sserc.org.uk/about/sserc-accredited-centre-programme/
[2] https://www.sserc.org.uk/mission-vision-values/

Chair of STAC update

STAC
Scottish Technicians' Advisory Council

We said farewell to Sam McFarlane at the STAC meeting held on Friday 7th, October 2022, following his retirement from his post as Technician Support Service, Service Manager with Glasgow City Council. Sam served as a highly effective Chair of STAC (and the predecessor body STAG) and was always able to recall many events from the past that were used to illustrate, in a positive way, how current situations and issues could be resolved. We wish Sam all the best in his retirement, and we look forward to working with whoever is nominated to take on the role of the next Chair of STAC.

At the meeting on the 7th of October 2022, and in compliance with the terms of reference for STAC, members commenced identifying a new Chair. This process will be completed by the end of November 2022, and we look forward to providing a profile of the new Chair in the next issue of The School STEM Technician.

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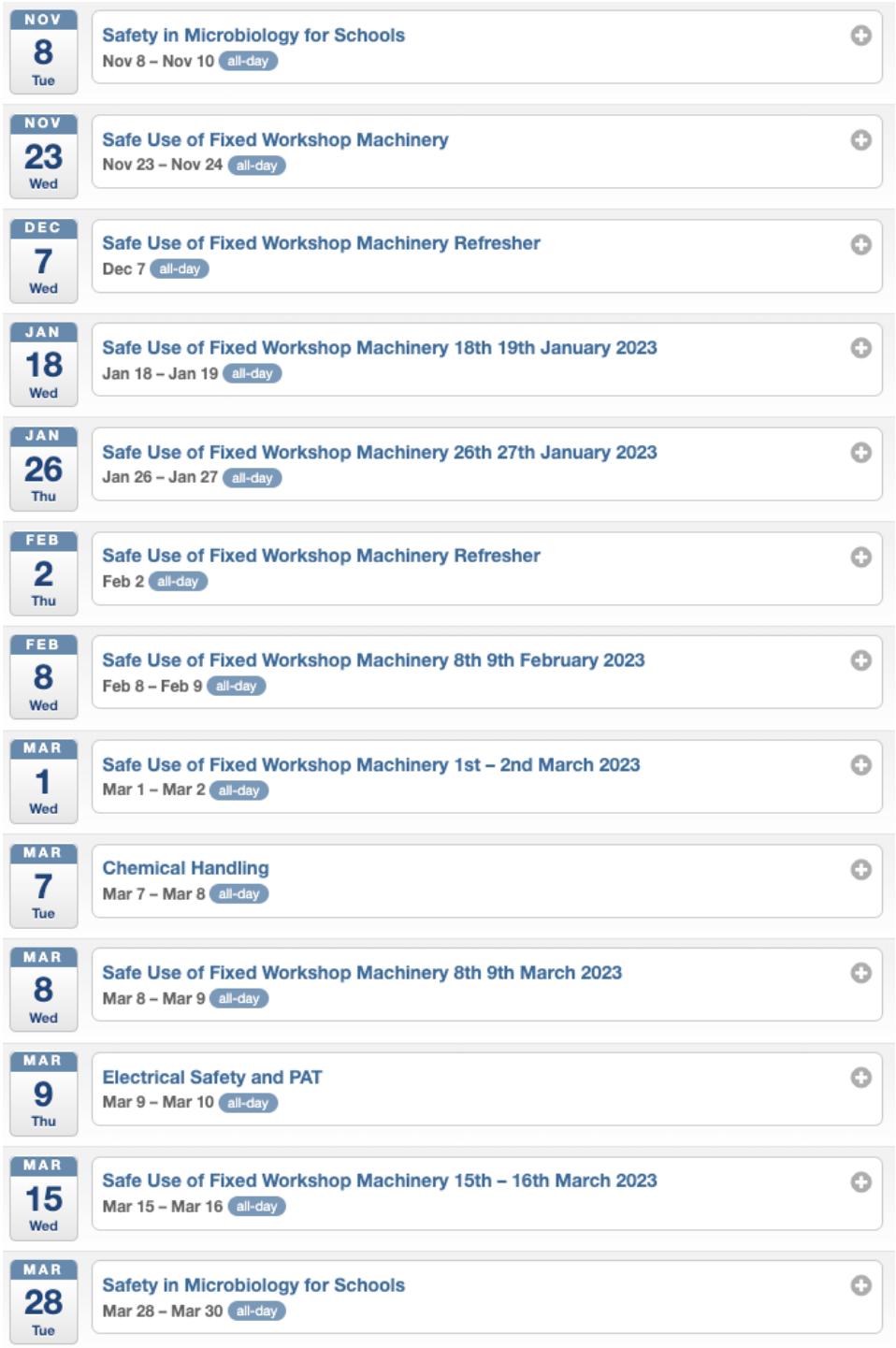
If your Local Authority does not have a representative on the STAC group and you would like to join, please send an email to alan.purves@sserc.scot with your contact details and a note of the LA you would like to represent.

Professional Learning

Technician Professional Learning

November 2022 – March 2023



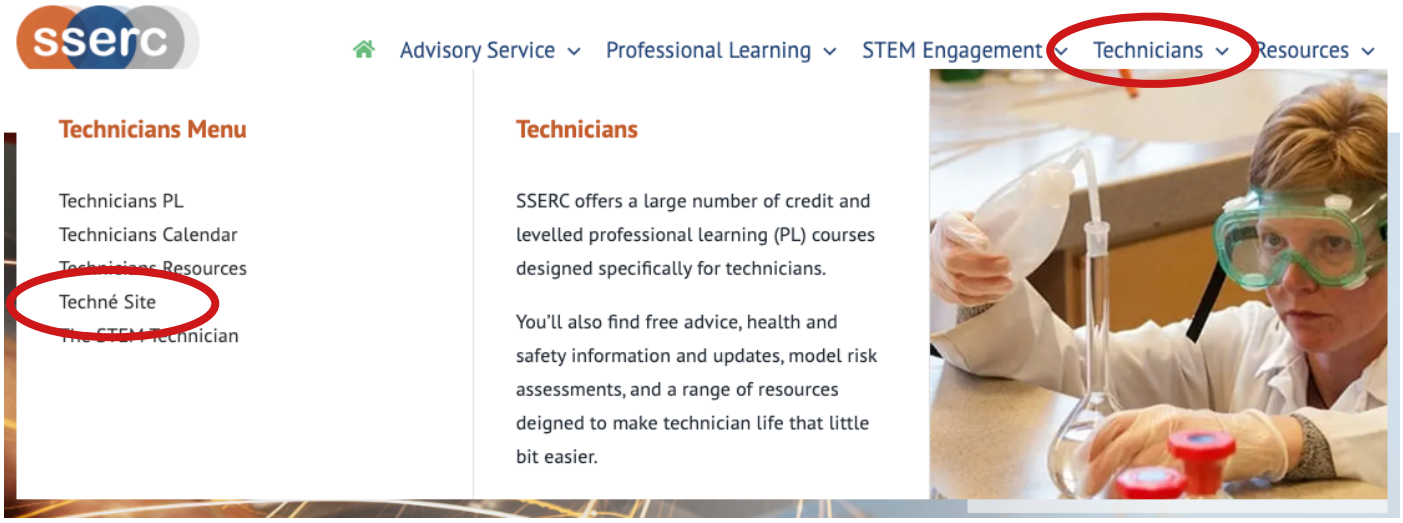
We have added an additional 4 Safe Use of Fixed Workshop Machinery Courses in February and March.

If you missed any of our Tech_Meets you can find them **here**.

Techné Update

As said in the editorial, we want to promote the Use of Techné to support informal professional development and encourage professional discussion and debate.

There were issues with people accessing it through Google Sites, and as such we have moved it to the SSERC website. You can access the Techné Homepage from the technician's section of the website.



We would love technicians to read and contribute to the Techné site with anything you think would help others. Have you been keeping a secret recipe or method for efficient science prep, a handy hint for the technical department or are you and AV/IT wiz, with a vast array of knowledge, then drop off your ideas and share your knowledge with the wider technician community.

Woodturning - part 1

The art of woodturning is a process which has had a place in both the commercial and hobbyist market for a great many years. It has also been a key topic covered within the Technology curriculum whether it be at SQA qualification level or within the broad general education levels.

Woodturning is used in various forms in making furniture and furniture parts, building trim, tool parts, toys, athletics apparatus, and many other useful and beautiful articles in common use.

To assist in the knowledge of basic woodturning techniques, we have been working at SSERC to put in place a 2-day woodturning course for teachers and technicians. Over the last year, the Technology team have created a new workshop area, refurbished and installed 5 woodturning lathes complete with extraction and new tooling. We will be running this new course in June, for further information and to apply for a space, check out our website under the Technology PL link. In the meantime, we have put together a series of short articles as a guide covering the equipment, safety, tools, and processes used in woodturning. We will look at each area in turn over the next few bulletins.

Woodturning lathe

A woodturning lathe is a machine that holds and rotates timber against handheld cutting tools to produce cylindrical or moulded shapes. The main parts of the lathe can be found in Figure 1 with an outline description below. The size of any lathe is specified by the two main factors that determine its capability; the maximum distance between the centres and the height of the spindle centre above the lathe bed.

Figure 1

Bed

The bed of the lathe is made from cast iron and it supports the headstock, tailstock, tool rest and various accessories. The bed is accurately machined on its top and side surfaces and bolted to the headstock and stand.

Headstock

The headstock, made from cast iron, contains the motor, switching, speed pulleys and driving mandrel to which faceplates or other attachments can be screwed or morse taper attachments housed. On older style lathes such as in figure one, the speed of the mandrel is determined through a pulley setup. In this case a set of pulleys, which allow four different spindle speeds of 425, 800, 1400 and 2300 (rev/min). In newer machines now found in some schools, the speed is controlled via a Variable Frequency Inverter. This does give a few benefits to the user such as more incremental control of speed and soft starting and stopping. Generally, the larger the diameter of wood being turned, the slower the speed required. For example, up to 50 mm diameter use 1400-2300 rev/min; 50 to 100 mm diameter use 800-1400 rev/min.

Tailstock

The tailstock is made from cast iron and is machined to fit the bed of the lathe. It serves two functions (1) to support the material being turned via a cone shaped centre and (2) to allow drilling holes in material either using a tapered shanked drill fitted to into the spindle or using a hollow centre to allow a drill to be passed through.

The tailstock is designed to move along the length of the bed and locked into any position. The handwheel allows for final adjustment with a locking screw to retain in position.

Tool rest

The tool rest is made up of two parts, the main body which goes across the bed of the lathe and the tee rests which fit into the main body. These 2 component parts when assembled allow for adjustment in four directions. It can be moved along the length of the bed and locked in any position, the height can be adjusted up or down and at any angle to suit the various cutting tools being used.

Types of woodturning

Face plate

Articles such as bowls, circular bread boards, bases for lamp stands etc. are turned using face plates. The material being turned is attached to a face plate and the face plate is then attached to the headstock via the threaded end of the spindle. There are numerous types of face plates available and ways to mount the material being turned on the headstock spindle. More details of this will be given in future articles. Please see Figure 2.

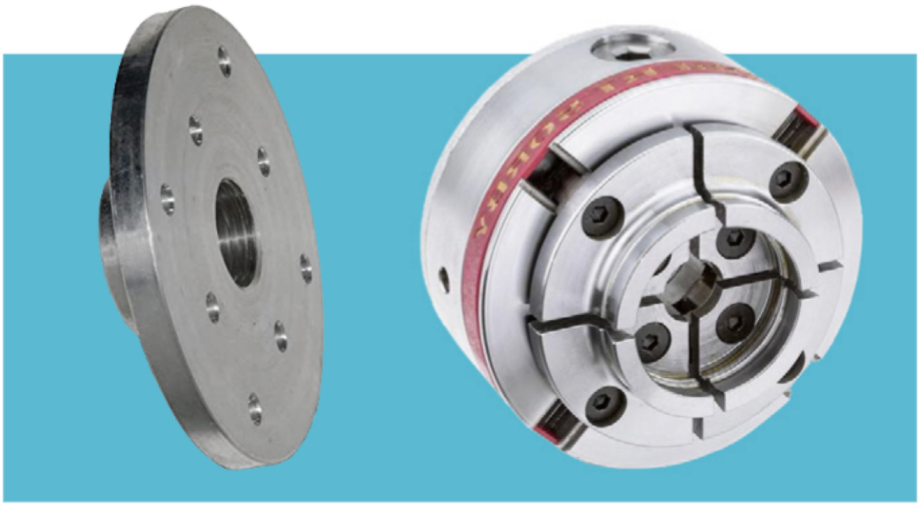


Figure 2 - Typical face plate and lathe chuck.

Turning between centres

Turning between centres, or spindle turning, is almost self-explanatory. The work to be turned (often called the stock) is fitted between the headstock and the tailstock. Table lampstands, rolling pins, stool and table legs are some examples of turning between centres. Most of these turned shapes are formed by the paring action of turning gouges and chisels. Figure 3 show the basic stages in preparing a piece of material for turning between centres.

Safety in woodturning

Safety, as with all activities undertaken in the workshop is paramount. As outlined in BS 4163, the following must be followed specifically to woodturning;

- The main controls for setting the machine on and off should be via a starter switch that has both overload protection and have a no volt release feature.
- The machine should be provided with a means of electrical isolation using a fused isolating switch which should be in the 'off' position before setting up the lathe. The main controls for setting the machine on and off should be via a starter switch that has both overload protection and have a no volt release feature.
- An emergency stop switch should be positioned so that it is readily accessible. Any guarding to the motor, pulley, spindle shafts and electrics should be locked and any access allowable with the use of a tool. Interlocking switches are also advisable.
- There should be enough clear space around the lathe to prevent the user being accidentally pushed by passers-by.
- The floor surface should not be slippery and should be kept free of loose items and wood shavings.
- Only one person at a time should operate the machine.
- Suitable eye protection must be used while operating the machine. Substantial footwear should be worn.

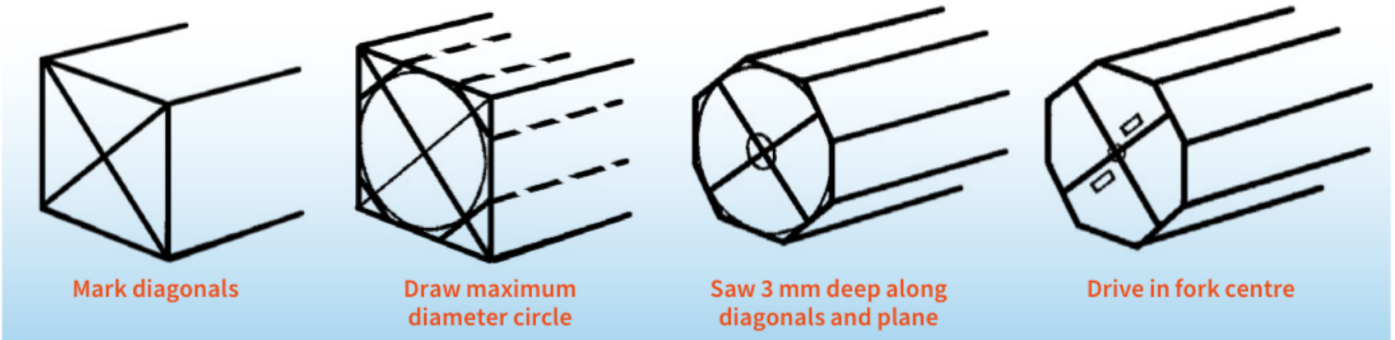


Figure 3

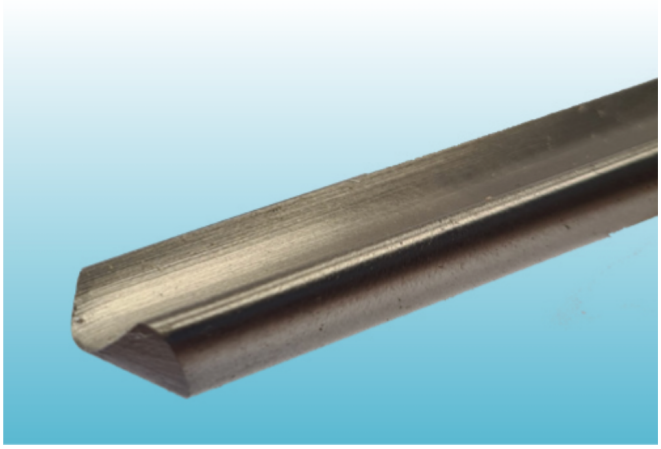


Figure 4 - Roughing gouge.

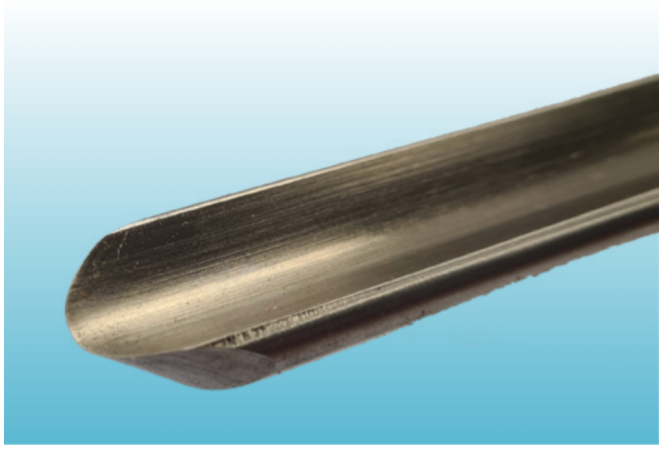


Figure 5 - Bowl gouge.

- Long hair, loose clothing and jewellery should be secured/ removed to prevent it from coming into contact with moving parts
- Gloves should not be worn while operating the lathe due to the high risk of potential entrapping of fingers.
- Timber should be inspected carefully to ensure it is free from any defects and it should be prepared in a roughly circular or octagonal shape before commencing machining operations. Segmented material should not be turned. If jointed material is used (e.g. in pattern making), it should be turned under close supervision.
- Work mounted to a faceplate, a chuck or between centres should be properly secured and balanced to prevent excessive vibration.
- Ensure that the tool rest is locked and is as close as possible and parallel to material being turned. ie. stock must not foul the tool rest.
- Only one side of the headstock should be used at one time with the other end protected.
- The lathe should be isolated before speeds are changed. A safe turning speed is important and should be appropriate for the type, diameter and condition of material.
- Woodturning tools must be held securely, at the correct cutting angle, stored safely and kept in good order. Under no circumstances should improvised tools be made or used.
- All measuring, gauging or adjustments must be made with the machine stopped.
- Dust must be controlled or prevented – When effective LEV is not in place, a dust mask conforming to BS EN 149:2001+A1:2009 class FFP3 must be used.

Woodturning tools

Lathe tools can be classified under three headings; cutting tools, scraping tools and boring tools. Turning tool handles are longer than the bench chisel and gouge handles. They are shaped to give a comfortable grip and give sufficient leverage to counteract the action of the revolving timber on the tool. Here, we will look at some of the common tools used in turn.

Tools for cutting

Gouges

Gouges of the standard pattern are made in sizes ranging from 6 mm to 25 mm. Gouges are, in the main, used for roughing work, although very fine work can be carried out with the gouge when used correctly. For turning between centres roughly to size, a 25 mm gouge with a cutting edge of 45 degrees ground square across is recommended (see Figure 4).

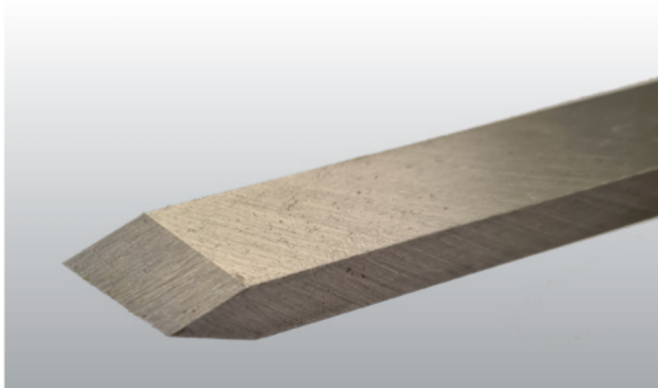


Figure 6 - Skew Chisel.

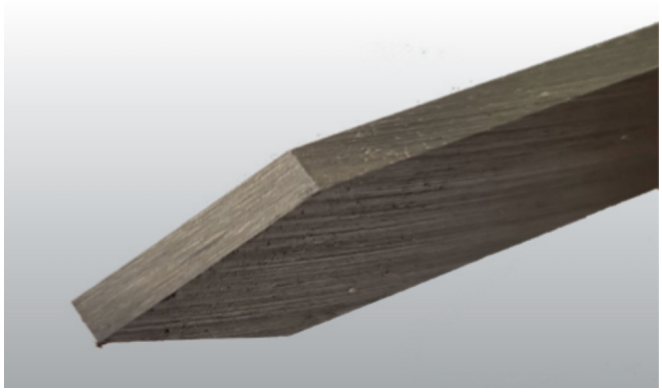


Figure 7 - Parting Chisel.

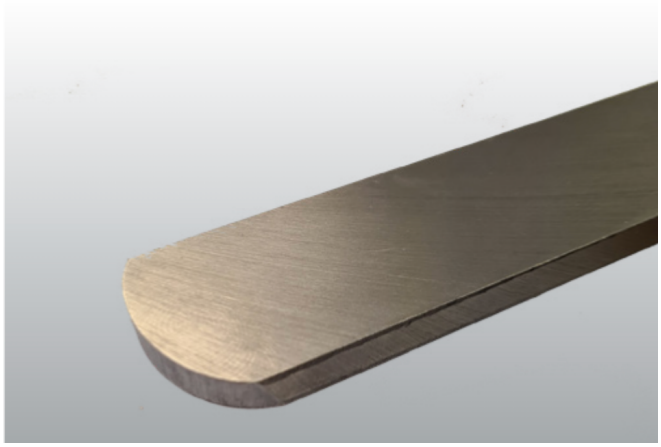


Figure 8 - Round nose scraper.

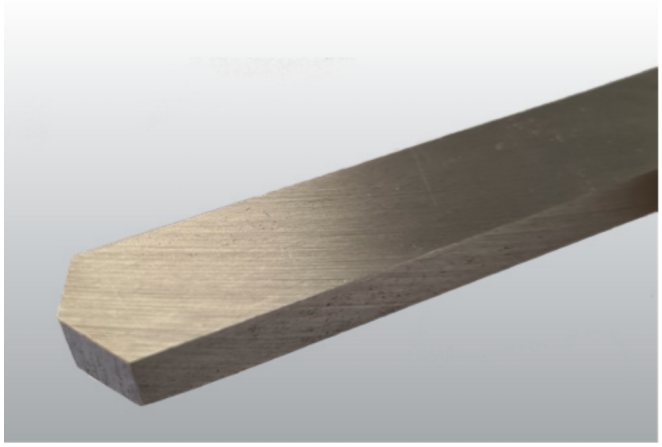


Figure 9 - Diamond point scraper.

For bowl turning, the gouge must be shaped like the end of a finger, i.e. the corners ground well back to an angle of 50-55 degrees. Like the bowl gouge (see Figure 5), the spindle gouge is shaped in the same way though the grinding angles differ – they should be ground to 35 degrees.

Chisels
Chisels are obtainable in sizes ranging from 13 mm to 25 mm and are ground on both sides. The cutting edge itself is either skewed (see Figure 6) or squared. Skew chisels are used for smoothing spindle turnings, for cutting beads and as a cutting tool is most useful for softwood turning where a scraping action would tear out the fibres of the wood. The edge should be ground to 60 degrees. Parting chisels are made in one size only. They are designed for parting off the finished job or for cutting grooves when marking out. The grinding angle for parting tools should be 25 degrees (see Figure 7).

Tools for scraping

This group of tools are those which have a scraping action. These tools are generally used for turning very hard woods. Though they produce very satisfactory results in turning hardwood generally, they are particularly suitable for use within the school workshop as they require less skill than cutting tools. They are ground on one side only and available in round nose and diamond point shapes, standard widths include 13, 19 and 25 mm (see Figure 8 and 9). Scrapers are ground to an angle of 80 degrees, with a tiny burr being raised on its top face.

Tools for boring

General purpose drilling can be done on the lathe using normal twist drills (held in a suitable chuck) or using taper shank drills fitted straight into the tailstock spindle. For boring larger holes, a Forstner bit is ideal.

It can produce a clean hole with a smooth base. These are available in many sizes ranging from 6 mm to 50+ mm. To bore long holes, down the length of a spindle such as when turning table and standard lamps a Shell Auger can be used conjunction with a hollow centre fitted the tailstock (see Figure 10).

In part 2, we will look at attachments for the lathe such as centres, face plates and chucks, as well as techniques how to use some of the common tools.

Figure 10 - Selection of boring tools.

Technicians' Corner

Paul Watson:
A real driving force in the technician profession

When institutions like Siemens, Ford, IET, and Solid Edge recognise the value of a project enough to become an official partner, then you know you are onto something special, and that's the case with The Greenpower Challenge[1], which is organised by the Greenpower Education Trust. The trust is a UK-based charity with an outstanding record of inspiring students in Science, Technology, Engineering and Mathematics (STEM) related subjects through motorsport. The challenge, where students design and build an electric car to race, has become an acknowledged success on a number of levels for Eyemouth High School (EYHS) thanks to the vision and efforts of their technical technician – Paul Watson.

Paul began his technician career on the Youth Training Scheme (YTS) in the late 1980s. The training on this apprenticeship covered both technical and IT disciplines. His commitment and efforts during his apprenticeship years led him to be rewarded with the offer of the first technical technician post at EYHS in the Scottish Borders, where he is still based to this day.

As well as covering technical and IT needs within the school, Paul has always helped to run extra-curricular clubs, initially becoming involved with the Duke of Edinburgh award by running a Woodworking Skills unit for pupil participants. From this initial start, Paul's extra-curricular efforts grew over the years, further supporting links with college courses and feeder primary schools with STEM-related activities and events.

A fortuitous visit by Borders College to Eyemouth in 2018 introduced Paul to the world of Greenpower and the challenge of building and racing electric kit cars. Paul was hooked on the idea from the offset, envisaging how this could be used to encourage and stimulate pupils' interests in engineering and the technical disciplines. When Paul presented this idea to the Senior Leadership Team of EYHS, they could also see the merits and benefits of the Greenpower initiative for the school.

However, as always, there was the question of funding, but this did not deter Paul. He was determined and successfully raised funds in order to allow EYHS to purchase their first electric kit car. Seeking help from Tesco via their community grant scheme and perhaps taking the lead from Formula One, sponsorship packages were created. These packages gave businesses the opportunity to have advertising space on the car, with a welcome pack including a team-signed and framed image of the car, invitations to functions at the school and regular updates.

From the initial beginnings, and thanks to the efforts of Paul and the ongoing support of EYHS, the project continues apace; EYHS now have two cars in different racing categories. But Paul will always say the success is due to the pupils' efforts and sees himself very much in a supporting role. Rarely will you actually see a photo of him with the team!

[1] https://www.greenpower.co.uk/schools

To him, success is not just about technical proficiency but also about the life skills of teamwork, communication, planning etc., that the pupils learn along the way.

Like many engineering heroes, Paul is a most unassuming individual, preferring to let students and their work take centre stage. But his enthusiasm and pro-activeness have not gone unrecognised, and he has been acknowledged with awards, both in the workplace, #YourPartAwards and externally within the community as the Rotary Eyemouth and District Community Champion for Special Service.

When you speak to Robin Chapman, the Head Teacher of EYHS, about Paul, words and phrases such as 'an amazing contribution', 'much valued' and 'brings real quality' come into the conversation repeatedly, and the senior management team at EYHS have fully supported and enabled Paul in his career.

The impact of the cars does not stop at this stage. The cars are not just kept and utilised for technical or other STEM subjects. Paul's desire to leverage the maximum benefit for the school and its pupils has meant that these cars have been used in other departments, for example, art for design aspects and music for background tracks in social media videos. So, this is not just a technical success story but one owned by the entire school community.

But it has to be said that trophies are nice, and the team added to their already extensive trophy collection with a "home" victory, winning the Jim Clark Trust EV Trophy at Thirlestane Castle; at the Sir Jackie Stewart Classic in June 2022 and future plans see further racing in September. Furthermore, it is hoped to organise visits to primary schools to further promote this STEM-related area in the near future.

A final word on Paul's achievement. Thomas Edison is reported to have once stated that "there is no substitute for hard work", and this is certainly the case here. Paul's commitment, expertise, and time underpin this success. Be it driving to events, updating social media, running workshops, and supervising builds; Paul regularly goes 'above and beyond. He sees this as a down payment on those unsung heroes that he encountered during his education, who imparted to him their expertise and life skills. We are fortunate that many people in our society, like Paul believe in trying to give something back to the community where they live and work. This is something we should all be grateful for, and it is nice to be able to say a simple thank you to one such hero!

The article was written by Caroline Butler

Case study: Technicians going that bit further

The landscape has changed over the years for those providing technical support. Broader job descriptions, more bureaucracy, and procurement challenges mean there may be fewer opportunities for technicians to make tangible contributions. But these opportunities do arise.

Such an occasion arose at the Douglas Ewart High School (DEHS), Newton Stewart. In 2016 we received a laser cutter. This was primarily to educate the students in automated fabrication, but we quickly realised there was potential for other applications.

The science department had, for many years, through no fault of its own, taken a rudimentary approach to teaching S1/2 electronics. We could not afford the shiny plastic mounted & labelled components from the catalogues. So unmounted battery holders, crocodile clips, and homemade paperclip switches were the order of the day (see images 2 and 3). However, the laser cutter changed things drastically. We could buy a few sheets of

Image 1: Scott, with his pride and joy

acrylic and some electronic components, and, hey presto, we had something nice to use at a fifth of the cost. All it took was a few days of getting your head around the vector graphics software (I used Serif draw plus X8) and a lot of soldering and sticking (see images 4 and 5).

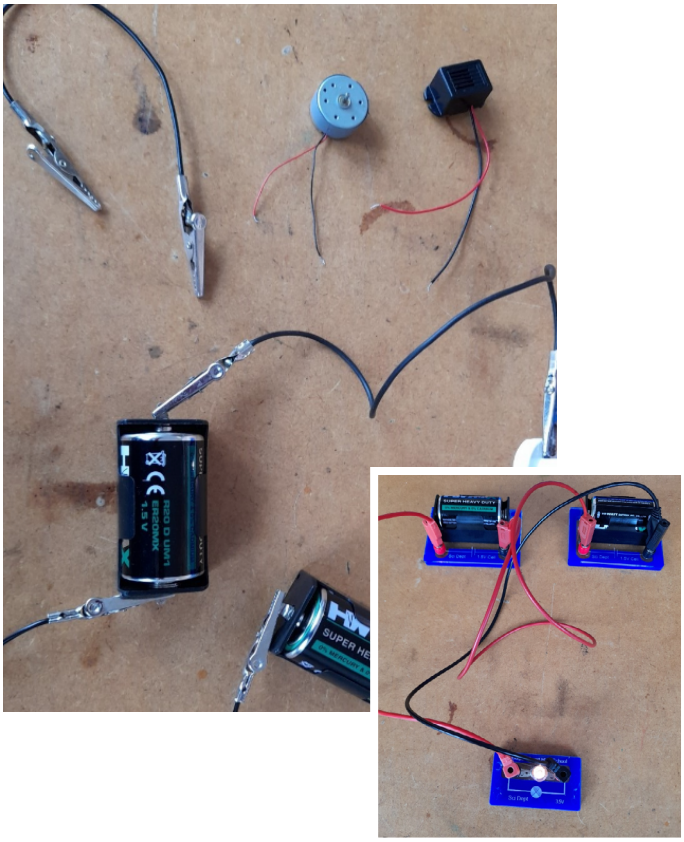
It wasn't long before other projects were requested. The laser cutter came to our aid during Advanced Higher Biology investigations. Two of our students wished to perform animal behaviour experiments. This required making aquatic mazes for goldfish to solve and cages for spiders (see images 6 and 7). These projects would've been significantly more difficult, if not completely impractical, without the laser cutter.

During and post-lockdown, we employed the laser cutter again. We made visors for care staff, vulnerable people, and at-risk workers. We also required some way of protecting science staff in two labs, where it was impossible to maintain a safe distance. The purchased solutions were expensive (£600) and unsuitable. So we made our own safety partitions to prevent Covid transmission. The Laser-cutter, while not replacing certain engineering skills, does give staff the option to be creative in a cost-effective way. Yes, the laser-cutter is very expensive, but for it to be there solely as a curiosity for lower school pupils, & an enabler of upper students would be a waste. Allowing staff the time to get proficient with such equipment will pay back in many ways and will only be limited by imagination.

Obviously, none of this could've been achieved without cross-department support. So there are some acknowledgements to make.

Thank you to the DEHS Tech Department, especially Scott Templeton, who co-worked with the projects and manned the Laser-cutter and Jane Kennedy, Science PT, for understanding & sharing the vision.

Rob Bacon DEHS Science Technician



Images 2 and 3: Pre-laser-cutter electronics kit

Images 4 and 5: What we use now

Image 6: Goldfish maze

Image 7: Spider cage

Working on Your Own – The Advantages

Sole technicians seem to be on the rise in our schools. As staff leave or retire and are not replaced, we are having to consider a new way of working. As with all things of this nature, there are multiple considerations, positives and negatives and health & safety implications. In this article, I will discuss the positives and the benefits of sole working. Yes, there are some!!

Firstly, I must identify what I mean by sole technicians and lone working. Lone working usually is taken to be a person working in a near-empty building. Health and safety is the paramount consideration in this scenario, but not the only one. However, the term sole technician can mean working as the only member of staff in the school who is a technician. You are surrounded by people and pupils daily but do not have peers, and you may not be considered a part of any particular team or department.

The Sole Technician

1. Working on your own has the benefit of increasing your productivity and efficiency. There are no team members to allocate jobs to, explain things to or consult. As long as you have everything prepared correctly and at the right time, it is up to you to get there. This allows for working in a way that suits you best. For example, you may prefer to prepare for each lesson separately (I call this a modular approach, and it is the one that suits me best), or you may prefer to work science by science or item by item. Greater concentration and faster job completion should result in fewer errors and happier teachers.
2. Make the job as fresh and challenging as you would like. The sole technician should have a complete overview of their work in each department and therefore be able to spot areas for improvement. Being able to make suggestions, streamline processes and generally make your own and teachers' lives better can be extremely rewarding. For those of us with a creative streak, we can indulge ourselves and make the job our own.
3. Conflict at work is unavoidable, but working without a team can greatly reduce the potential for this. There may be an odd clash with a teacher, but you can generally avoid the misunderstandings, personality conflicts, mismatched work ethics and differing viewpoints that come with teamwork. Smooth sailing is almost impossible, but at least you may not need the seasick tablets!!
4. Working as a sole technician can help to eliminate politics and focus on your job instead. Less need to focus on the personalities involved and hierarchy disputes or 'that isn't my job' conversations.
5. A more relaxed environment is frequently a benefit of being a sole technician. You can work away in your prep room with little interference. Put your favourite music on and enjoy a less formal workday.
6. Job satisfaction has a lot to do with "ownership". This is your 'baby', and you can take complete credit for a well-done job. So the staff around you can recognise your skills and organisational abilities.
7. There is no need to manage staff with all the extra duties involved. No need to allocate jobs, conduct assessments, calm hurt feelings or perform a hundred and one other duties.
8. Your reputation will be enhanced as you are seen as a go-getter, an organiser, and someone who does not have to depend on others for instruction and advice. You become an asset to the departments that you work in and become invaluable.
9. Safety can be enhanced by working alone. The only person in the prep room, your mind can focus completely on your task, and you can develop a system of checks and balances that works well for you.
10. A qualified and experienced technician working alone has the freedom to make important decisions themselves. These will be based on your experience, knowledge of their particular department/ organisation, and frequently increasing the support you give to a higher standard.

The Lone Worker

1. No distractions, greater productivity, fewer errors, and faster progress.
2. Organise your work as you please.
3. Clear access to classrooms to complete jobs that take more time.
4. A relaxed atmosphere so less stress.
5. A good time to undertake the annual stocktake if you have several days.
6. Opportunity to do jobs that have been on the back burner for a while.
7. Health and safety can be at the forefront of your mind as you can concentrate fully on your task.
8. A great feeling of accomplishment as you work through all those in sequence and complete them all.
9. Time and peace to think about better ways to do things and impress teachers (and yourself) with your ideas.
10. Get organised and make your term-time work easier.

Well, that is for the advantages of being a sole technician and/or a lone worker. I hope that this has been informative and given pause for thought. This is by no means a comprehensive list, and I am sure a book could be written about it all!!

Feel free to submit comments, ideas, and opinions.

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References:
Indeed Career Guide, The Benefits of Working Alone, April 2021
Procedures for Lone working, PKC, March 2021
HSE, Lone Working Guide, current.

Health and Safety Update

Mercury Thermometers

We have had a few queries recently about these so thought it worthwhile clarifying the situation.

It has not been legal to sell mercury thermometers in the UK (or most other mercury-containing instruments) since 2009 but there has been no legislation regarding the use of any purchased before then.

So if you have mercury thermometers you are perfectly entitled to use them. They are a little more responsive than other liquid in glass thermometers and can be slightly more accurate but modern digital thermometers are more accurate than either so there is certainly no need to use them.

If you are going to keep your mercury thermometers you should:

- Keep them separate from the other thermometers so they can't be used by mistake
- Only let them be used by competent people, staff or senior pupils.
- Not use them in situations where if they were to break they would release mercury vapour, such as in a melting point apparatus.

Oxygen in the laboratory

Oxygen is one of a small number of gases that is commonly used in schools and thus needs a more regular supply than might otherwise be the case. In this article, we look at some different methods of obtaining oxygen for use in the laboratory.

1. Cylinder/canister

This is the traditional method whereby you have a (usually large and heavy) cylinder of the compressed gas, (see Fig 1) often containing around 2,000 litres of gas, though there are smaller cylinders available. The cylinder is fitted with a regulator that allows the controlled release as required.

There is much to be said for the convenience of this method but there are some disadvantages: the cylinders are heavy and unwieldy and proper procedures need to be followed for safe storage and use[1]. The cylinders are leased rather than bought, though that is probably an advantage, the gas is refilled as required and the regulators need to be replaced every 5 years at a cost of around £80. For a 2,000 litre cylinder, BOC currently quotes rental of ~£30 per month and a refill charge of ~£15.

A variation on this is to use smaller, disposable canisters. These are commonly available for hydrogen but harder to track down for oxygen. The gas is pressurised rather than liquified and they hold 110 litres. The canisters cost ~£120 and usually come with a small but perfectly usable valve. Once empty, they are simply disposed of and replaced. While the cost per litre of gas is significantly higher there are none of the rental costs so this should work out cheaper unless you have very high usage. Our rough calculations suggest canisters become more expensive if you are using more than 5 litres of oxygen per week, every week. This seems unlikely in a school context.

Figure 1: Oxygen Cylinder

2. Chemical generation

Oxygen can easily be generated using manganese dioxide to catalyse the decomposition of hydrogen peroxide. If you prepare your own 5 vol peroxide from 100 vol and can recover the manganese dioxide (straightforward if you use the granular form) then the cost in materials at least is vastly cheaper. However, it is significantly more time consuming and technician time is limited.

An alternative chemical method is to prepare gases in syringes on a microscale. The method is detailed in Bulletin 263[2].

[1] https://www.sserc.org.uk/health-safety/chemistry-health-safety/hazchem_database-2/gas-cylinders-2/
[2] https://sserc2.wpenginepowered.com/wp-content/uploads/Publications/Bulletins/263/SSERC-bulletin-263p8_9.pdf

3. Oxygen Concentrator

We have recently in SSERC been looking at these devices that are widely available on the market for domestic, clinical oxygen supply. They are electrically powered devices that produce a steady supply of oxygen from the air, using molecular sieves to remove the nitrogen. (See Fig 2)

The highest concentration available is 90% oxygen. Not suitable if you need 100% pure oxygen but we are not sure we can think of a situation where that would be essential. Once switched on, it will produce around 1 litre per minute indefinitely.

The devices cost £200 – £300 but other than the cost of electricity (not negligible these days) there is no other running cost so you will soon recoup your investment.

Figure 2: Oxygen Concentrator