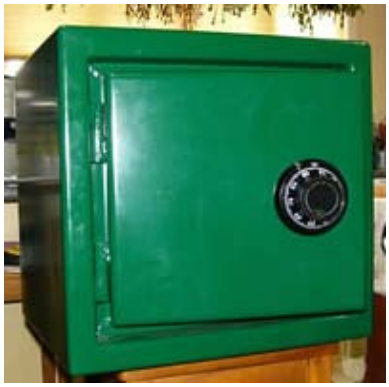
Security safe

Kelly West
Stratford High School
Year 13 Metal Technology
Full-year project
Teacher: Arnold Cox



Stratford High School student Kelly West used unconventional approaches, determination and extensive lateral thinking to produce a unique outcome for Year 13 Technology project – a custom-made security safe for her father.

Kelly's father needed a single secure point to store the keys to his many sheds and lockable closets, so Kelly decided to make her father a custom-made combination safe that would eliminate the need for yet another key that could be potentially lost. Realising that constructing the safe would be a huge learning curve, Kelly put time management as her top priority to give herself plenty of room for research, testing and overcoming potential problems.

Kelly began research on the internet into the types of safes available, then emailed security companies and locksmiths to get information on aspects such as materials, construction methods, and the pros and cons of digital or manual locks.
Kelly eventually sourced a combination lock that would give a range of one million combinations for a price within her budget. This was a much cheaper option than a digital device, which also required a small battery to operate.

Kelly next looked into the construction of the metal box for the safe. From her research, she knew that the majority of safes are constructed with 10 millimetre thick metal for the walls with a layer of concrete in between. Kelly decided that this method would be unnecessary for her small safe's purposes and would be too expensive and difficult for her limited resources. Also, as very few safes are made in New Zealand, she realised that the likelihood of finding someone in her area with the expertise to help construct a safe in this method was extremely slim.

"The concrete would also reduce the amount of space available inside, and I wanted to limit any wasted space so that there was more room to place other objects my client may want in there," she says.

These limitations encouraged Kelly to take a new approach to safe construction, first changing the thickness of the safe walls from 10mm to 5mm steel, which while not as strong, opened up other options.

Kelly talked to Ken Martin at Fineline, a profile cutting service, who assured her that using the thinner metal would make it considerably easier to bend a single piece of metal into three sides of the boxes shape. This single piece folding compactly into itself would be far more structurally sound than having welded edges. Reducing the amount of welding required would also be an advantage to Kelly whose skills in this area were limited.

Kelly tested this idea with a mock-up box to ensure that the 5mm plate could be bent without cracking. The large metal piece would be folded twice to create the sides of the box and the top and bottom pieces would be welded into place afterward.

Kelly decided to take advantage of the folding technique by adding an extra security feature, an internally folding lip at the border of the door hinge that would make levering the safe open far more difficult. This added intricate folds to the metal, which had to be planned carefully in a series of design drawings. This also affected the fit of the lock on the interior.

"Originally the lock was going to bolt into a block that would be welded to the inner side of the safe, but with the new design the security lip was in the way. We solved this by raising the locking mechanism up on a block so that it was out past the lip and constructed a small piece of bent metal that the bolt would lock into," explains Kelly.

The first attempts at folding the piece into shape proved problematic as small

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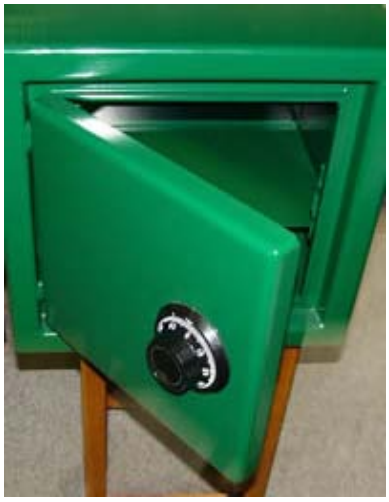
miscalculations in measurements compromised its security or impeded the opening and closing of the front door hinge. Kelly re-measured the pieces, and after some trial-and-error, they were ready to be welded together.

Kelly then took the completed components to Hinton Contracting to first join the parts of the box together temporarily with bolts before starting on the most difficult section, the door and lock. For extra security, Kelly used a 10mm thick piece of steel for the door, which she drilled and taped holes into to fit the locking mechanism.



"Once we were sure it was evenly aligned, we screwed it in properly so we could mark out the centre of the locking mechanism, where the spindle enters. This had to be perfectly straight and centred or the spindle would be at an angle and the dial would not sit flat against the door. To make sure it was correct we used a centre-locating tool. Then we secured it and used the drill machine to drill the hole so it would be perfectly straight," explains Kelly.

Kelly then spent several hours with a technician, fine-tuning the fit of the door with its exterior hinges so that it fell smoothly into place.

Kelly made sure that one side of the box was left until last for the addition of an internal shelf. Kelly's original plan had been to weld this into place, but decided to use bolts instead as she was advised that the heat generated might warp the sides of the safe and compromise its structural strength.

Kelly then employed a technician to do precision arc welding on several points of the safe so that the pressure created by the weld would be spread evenly throughout the safe so there were no weak points.

With the box complete, Kelly then ground the edges of the welds smooth for a clean finish, being careful not to grind too far into the safe and weaken it.

She then took the safe to Taranaki Powder Coating Enterprises who sandblasted it to remove welding residue so that the powder coating adhered to the surface. Once the safe was painted and dried, Kelly then secured the locking mechanism into place.

Kelly's completed outcome is a unique custom safe that has exceeded her client's requirements and impressed all of the technicians involved.

"Due to the help, skill and knowledge of each of the technologists, I was able to create an extremely well-crafted and fully functional project and I am really pleased with the outcome of my safe. It has turned out to be of such high-quality that the boss at Fineline would like his company to make one for him," says Kelly.

While she admits she couldn't have done it without help, it was Kelly's overall direction, vision and strong technological practice that brought these different disciplines together to create a truly successful technological outcome.

Kelly achieved NCEA Level 3 with Excellence for this project and is now realising a personal dream – to study to be an armourer in the New Zealand Air Force's engineering programme.

Teacher Comment

This project was always going to be difficult for Kelly as I didn't have the equipment within the workshop to complete many of the safe's parts. The challenge then was for her to work with industry for the different operations required so she emailed, and travelled to, several different factories in the region to complete the separate parts. Kelly was always responsive to work with and willing to try out new ideas and never let problems and setbacks upset her. Kelly has been in my metal tech classes from Year 10 to 13 and has always worked extremely hard on everything she makes.