National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Technology

This exemplar supports assessment against:

Achievement Standard 91620

Implement complex procedures to integrate parts using resistant materials to make a specified product

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to efficiently implement complex procedures to integrate parts using resistant materials to make a specified product. This involves undertaking procedures in a manner that economises time, effort, and materials. This student has made a charcoal powered barbeque with rotisserie. The product requires precise iteration of two or more pre-prepared parts. The teacher's observational comments support the student's skilful and efficient implementation of complex procedures (1). The student evidence shows they have carefully considered the plasma cutter settings to minimise wastage (2). The student also economised material by testing complex procedures on waste pieces, and by measuring twice before cutting (not shown in the evidence). The student tested different welding methods to ensure the most efficient use of time when implementing the final complex procedures (3). They also trialled the sprocket and rotisserie fit-up to economise time, and an unnecessary step was removed from the manufacture process (4). For a more secure Excellence, the student could have ensured that all processes were carried out with economised effort. For example, by providing evidence of consistently using a preplanned schedule, therefore ensuring that all tests and trials were relevant and purposeful.

Student 1: Low Excellence

Intended for teacher use only

Teacher Attestation

Standard: 91620: Implement complex procedures to integrate parts using resistant materials to make a specified product

Subject: Industrial Design - Engineering

Project: Manufacture a BBQ / Grill

Teacher:XXXXX

Grade Awarded:

Project Timeline	Teacher Comment
Beginning	Excellent evidence and use of time in initial stages of project. XXXXX has considered and used his time well with minimal teacher input. Time was used outside of class to organise materials, plan production and problem solve. CAD and CAM software used extensively to identify efficient use of materials. No teacher input required. Mock ups of mechanism confirmed function and ensured no material wasted, so parts recycled.
Middle	Practice welds determined best methods –XXXXX made all choices independently. Teacher suggestions to manage warping of plates followed. All tolerances very good.
Completed project	Time utilised very well at all stages. Very independent, only needing technical advice as expected – XXXXX tended to seek advice if he needed it and use it to improve his project. No materials at all where wasted. Project finished to very high standard, functions as intended if not better. Safe work practices observed at all times.

(1)

Cut first section on Plasma

- Using the smaller file of the two to ensure that if something went wrong, I didn't waste a whole sheet of steel.

(2)

Evaluation
Because MIG welding is easy and time efficient, I will be using this method for the majority of my project, using it to weld all the panels and housing together. I have taken my stakeholder feedback into consideration and will use the new back and forth method as my welds will be on the outside of the project and need them to look good.

(3)

Trial sprocket and rotisserie fit up on mock pieces

- This trial was essential as it allowed me to see how the most intricate part of my design would work. I noticed that the sprockets would often catch on the sprocket house where the welds weren't completely flat, because of this, I intend to weld on the sides of my real projects sprocket housing rather than the top to ensure this problem doesn't occur again.
- The grub screws worked well, holding the pieces together while also allowing the rotisseries to be removed when needed.
- I have decided that it is too long and that I don't need the two different diameters, so I will be reducing the size on my real ones by 50% and removing the machined step.

(4)

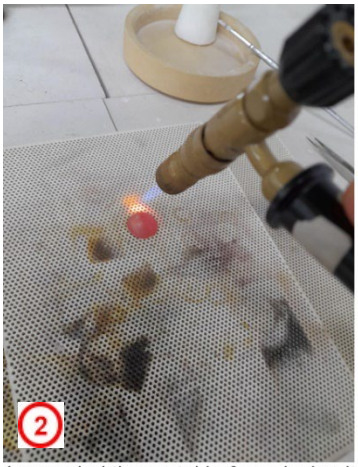
	Grade Boundary: High Merit
2.	For Merit, the student needs to skilfully implement complex procedures to integrate parts using resistant materials to make a specified product. This involves showing independence and accuracy in undertaking procedures. This student has made a neckpiece from a variety of metals. The product requires precise iteration of two or more pre-prepared parts. The teacher's observational comments support the student's skilful and efficient implementation of complex procedures (1). To inform the choice of complex procedures for making the parts, the student undertook extensive trialling (2). They carefully considered the choice and set-up of equipment, resources and the workshop as parts were prepared for integration (3). The student also mocked up the final outcome in an ongoing manner (4), using templates and guidelines to ensure precise integration (5). Preparation and integration of parts were managed by adhering to a work schedule (6). Evidence of testing, trialling and the work schedule itself all demonstrate that the student has worked independently and ensured an accurate outcome (6). To reach Excellence, evidence of how the student undertook procedures in a manner that economised time, effort and materials is required. If assessor comments are used to attest to the efficient implementation of complex procedures, it should be explicit as to how the student has met the criteria for Excellence. Robust evidence of health and safety, measurable product specifications and a record of feedback are all also recommended for higher grades.

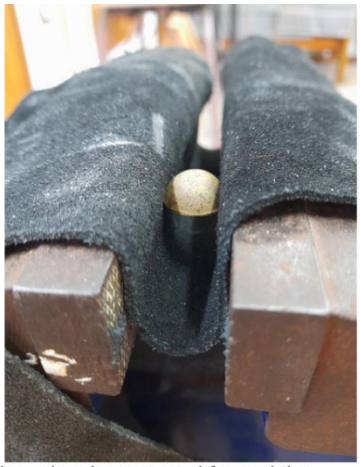
Student 2: High Merit

Intended for teacher use only

Your outcome is very well made.
All steps were completed accurately -
this is particularly impressive given the amount of pieces you had to integrate piece. There was quite a lot you needed to figure out yourself. I was able to let you get on with certain steps with minimal support from me.
You were impressive throughout the construction of your outcome.

(1)





(2)

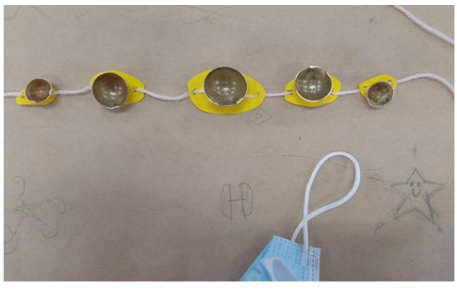
I annealed the metal before placing it in a vice. In my tests i formed the ellipse shape with firm tweezers which while I heated it up, it became soft and squished. I found that using a vice was easier to control and gave me a more consistent repeatable product as I didn't have to leave it up to chance, I could take it slower and adjust when necessary to keep it symmetrical.

I did a practice test for the ribbon to make sure that my method is repeatable. I decided to use plate silver which is stronger than fine silver so it wouldn't break when integrated into a chain. I found that it was hard to work with thick plate and it gave a clunky form so it would be easier and better to use thinner plate. I also found it would be much easier to work with a longer piece over a shorter one, so I cut my pieces longer than needed and could cut them back to size. This also reduced uncertainties as it was hard to accurately measure the curved forms, so it was more reliable to be safer at the cost of some extra silver. I also need to pad the pliers with tape so that they wouldn't munt the silver as it was worked.
Another benefit of the test is that I could work out a consistent formula with steps to streamline the process and to make sure they are all consistent, which is important when integrating as I want it to be symmetrical and for the ends to align around the domes. Also creating a production line of steps increases efficiency when doing anything in multiples

(2)

(3)

Preparing the brass for working. I measured out the sizes a few millimeters larger than needed to account for error, and cut them into a single square which would waste the least material. I cut it out with bench shear in the corner so i could get it against the edge which would tessellate better. Before rolling out, I cleaned the rollers from iron rust which would dirty the piece and could react in the pickle to form a pink metal layer. Before rolling I needed to aneel it to make it more malleable which would decrease the amount of rolling I would have to do. I rolled out so that I could get more out of the material to save cost and make it thinner which would look nicer/ be less clunky, would be easier to work and dome using the doming tool.



(4)

Final construction plan:

1. Preparation of domes:
   - Cut out sheet
   - Roll sheets
   - Cut sheets
   - Dome sheets
   - Trim
   - Squash

2. Preparation of ribbons:
   - Production line
   - Cut
   - Shape
   - refine

3. Solder together
   - Clean up edges/clean
   - Solder together ribbons
   - Solder onto domes

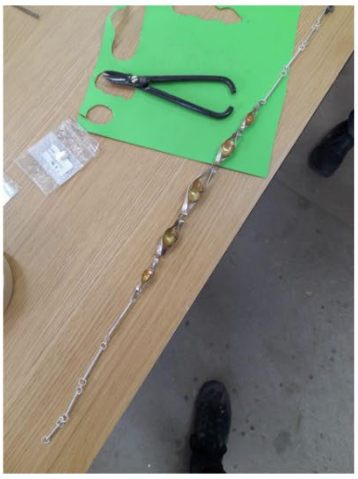
4. Create chain:
   - Cut rods
   - Cut jump rings
   - Create clasp
   - Solder rings to rods

5. Integrate pieces
   - Cut more rings
   - Create clasp
   - Solder rings linking domes together
   - Solder rings linking domes and chain
   - Soldier clasp to chain

6. Resin:
   - Prepare mould
   - Prepare space
   - Place mould in domes
   - Fill with resin

3

Making sure the pieces were snug before soldering. I spent a lot of time filing and adjusting the edges of the ribbons so that they fit and will make a good solder connection while constantly comparing to my reference model. I decided to solder the ribbons together first and then the dome as it would be easier to integrate together and make them aligned and flush, rather than going directly into the dome which is much more permanent and difficult to align.



3

Before I could do the resin, I had to make sure that the rest of my piece would was fully integrated and finished. I found that using a wire brush gave me a finish that I liked that was a good compromise between it being completely unrefined and while not being over the top which goes with the themes of decay. I did want the insides of the dome to be as polished as possible so that they would capture more light and light up the mould encased and allow it to pop.

6

	Grade Boundary: Low Merit
3.	For Merit, the student needs to skilfully implement complex procedures to integrate parts using resistant materials to make a specified product. This involves showing independence and accuracy in undertaking procedures. This student has made a workbench with a wooden base, steel frame and stainless steel top. The product requires precise iteration of two or more pre-prepared parts. Evidence of independence is also shown, as the student followed a personalised work schedule that outlines key construction tasks and the required techniques (1). The student undertook trialling (2) to inform the choice of complex procedures. This allowed them to work as independently as possible during the manufacture. The student scheduled corresponding tests for accuracy to be undertaken prior to the completion of each key task (3). Their final specifications confirm how the product was within requirements, which is a measure of accuracy (4). For a more secure Merit, the teacher's observational comments should attest that the student was supported by the assessor only when required. To reach Excellence, the student could have undertaken procedures in a manner that economises time, effort and materials.

Student 3: Low Merit

Intended for teacher use only

1

Task	Techniques	Tests
First cut the radiata clears 75x50, 3.6 m into 900cm 4 times,	I will use a hand saw to make the initial cut, it will cut it 5mm too long then XXXXX will cut with the drop saw to make it accurate.	measuring against the other compontest guiding me have them all the same length
I will then cut the frame the 42x42 cm and all the supports	I will use a hand saw to make the initial cut, it will cut it 5mm to long then XXXXX will cut with the drop saw to make it accurate.	measuring against the other compontest guiding me have them all the same length
Then use the doweling machine to drill perfect holes for the dowels.	I will set up the machine to fit the length of the dowel holes.	By using a scrap piece of wood I can drill in wholes and use it as a pre set to set the height of the doweling machine
Then I will add layers of varnish	I will use a paint brush to apply the varnish then wait till the varnish is dry by seeing if the wood is still wet after I touch it with my hand then I will and the next coat	I will make sure that the varish will get spread around evenly by applying the right amount and making sure that I do not have any runs of varnish dripping off my wood, I will aslo place some paper down so i will not get the varnish on the floor.
Then I will cut my 50x50 angle iron two pieces 1255mm and two pieces of the same 50x50 to 950mm with the saw machine	I will over cut the angled Iron by 5mm so it gives me room for error, by using the tape measure.	I will use the other piece and make sure that the lengths are identical.
Then I will cut a 45 degree in all four pieces of angle iron so it can be welded	I will use the triangle ruler to make sure that my cuts are 45 degrees, I will also use a flat piece of metal that I can use the cutting disk across.	I will make sure that the 45 degree cuts are identical by comparing it with other spare angle iron that have been cut at a 45 degree angle.
Then tack weld all four corners and make sure it fits on my workbench.	I will tac the corners together, and have a 1mm gap that I will measure with a ruler.	After it has been tacked I will place it onto my table making sure it is a snug fit.
Then I will weld all four corners of the angle iron	I will weld the angle iron and wait till the weld cools down before I move to the next corner, to prevent the metal from twisting or bending through heat.	I will test the welder on the same thickness metal and make changes to the settings if needed. 3



2

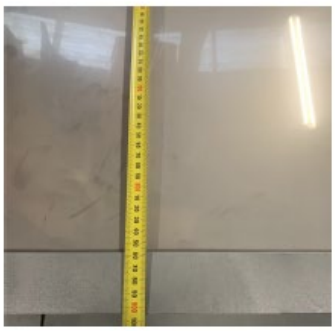
Here I tested for the look of the dowels, I also used this to practice on the dowel machine before I used it.

Accuracy of my final product 4

This is my short rail measurement as you can see it is around 707mm giving me my -3 tolerance.

As you can see this is my long rail it is around 1148mm long fitting in my 3mm tolerance by a -1 of a mm

This was my height of my table and it is around 903mm



This is my width of my table as you can see it is around 904 giving me a +4 in my +/- 10 tolerance

This is the length of my tabletop it is around 1255mm giving a +5 in my +/- 10 tolerance

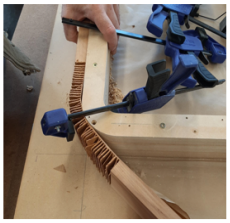
	Grade Boundary: High Achieved
4.	For Achieved, the student needs to implement complex procedures to integrate parts using resistant materials to make a specified product. This involves: • trialling and using feedback to inform the selection of complex procedures to make the product • scheduling techniques and tests for precise preparation and integration of parts • preparation of parts for integration • preparation of the integration environment • integrating parts to ensure product meets specifications • ongoing testing against reference points to reduce error in the integration of parts undertaking preparation, integration and testing to comply with relevant health and safety regulations. This student has made a set of drawers. The product requires precise iteration of two or more pre-prepared parts. The student has used feedback, testing and trialling to inform the selection of complex procedures required to make a carcass (1). They have also prepared the parts of the carcass for integration by manufacturing the individual components (2). Preparation of the integration environment has been confirmed (3), and reference points have been used to check dimensions and test the integration of components (4). Parts of the set of drawers have been integrated to make a bespoke piece of furniture that meets specifications (5). The assessor has confirmed that the student followed health and safety guidelines (6) and that this is supported by folio evidence (not shown in student evidence). To reach Merit, an image of the final product (a functioning integrated set of drawers) is required, along with evidence of how the student demonstrated working with independence and accuracy.

Student 4: High Achieved

Intended for teacher use only

Curve development / construction

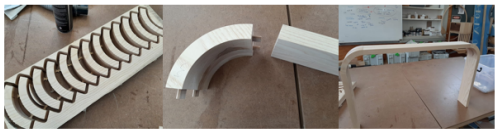


1.Using the thicknesser, I made the rimu only a couple mm thick. This thinned the wood and allowed it to bend. But as seen in the photo, the rimu was far too stiff to bend without breaking. This method would also not work due it making the material too thin and weak.

2.Using the handsaw, I cut small slits adjacent to each other along the wood. This allowed it to bend around the jig I had set up. But due to being both too sharp of a bend and the material being too thin, it snapped.

Both of these methods involved thinning the wood, and would both need extra support underneath them in order to work and hold its shape.



3. FB: (Teacher) "Why don't you take inspiration from XXXXX's project and use a cnc method" (1)

This method involves using a template that is cut on the cnc. These desired curves are then biscuited and glued to the extended sides.

First trial


My first attempt didn't work, as my Vcare files had the incorrect measurements and and this resulted in the drill piece snapping. I then changed the mistake and successfully cut the correct shapes. Yet when I used the domino the height wasn't quite the right measurement. This was also a simple fix. I did trials and tests in order to find the best technique for my design.

Taking inspiration from my feedback, I drew up the 101.3° and 78.7° angles I needed on illustrator and then transferred it to Vcarve. Once cut on the cnc I used the jigsaw to cut the tabs and routed the edges. I then made up a gluing jig, this was to keep all the edges alined. The decision to make a jig was due to looking at others that used the same technique.

Carcass construction trials

The first trial I dry fitted the carcass lying on the concrete floor and used tie downs to secure the unit. But as seen in the photo this did not form the symmetrical shape that I needed. (1)

For my next trial I moved the carcass to the table and sat it upside down. This was to have the max amount of surface area that provided support. I then screwed a 735 mm ply into the top and base of the unit, this was to insure the desired height was achieved. This trail also did not give the symmetrical shape, due to the weight of the sides pushing down on the curves. (1)

Third trial involved me cutting 78.7° angles on long ply. In theory this was to be pushed against the sides and lift the unit into shape. But there was simply too much human error for the angles to cooperate.

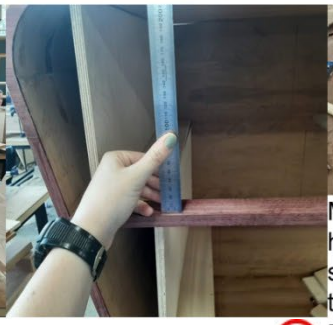
Final carcass construction



Using techniques from both trial 1 and 3, along with feedback from my teacher "using a square jig and tie downs, we should be able to get a symmetrical shape." the carcass was able to be put together. For this unit gorilla glue that expanded was the best option, due to the curved design there are small gaps that the glue could fill easily compared to other wood glues. Once glued and put into place, paper was used to protect the tie downs that got wrapped around the carcass as extra support. A wooden frame was then used to push the sides evenly towards each other. I then used an electric protractor to get the sides an close as possible. While in the process, gaps opened between the curves and flat base, this was fixed by placing think strips of wood into the gaps while the glue was still wet. I then double checked the eagles and height before leaving the glue to set for 3 hours.

2

Internal drawer frame

My four drawers are made of 12mm plywood and have a 3mm MDF bottoms. These have been screwed together and not glued, incase of an damage to the bottom, they can be removed easily

Due to the unique shape of the carcass the drawer fronts need to be made to fit. To create the cured sides (top,bottom) I trialled first on a scap bit of wood, then transferred the shape onto the final material.

My final internal drawer frame created a step like design Throughout the process I continued to measure and check the height of the support beams. This was critical to keep the lines parallel, as any differences would be very noticeable and would create challenges when making the drawers fit later on.

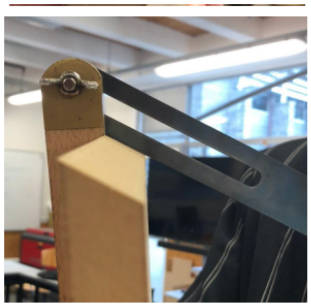
• Health and safety, students working safely within their integration environment	Y	Followed all rules at all times, had many a conversation, and listed in plan and pics

	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to implement complex procedures to integrate parts using resistant materials to make a specified product. This involves: • trialling and using feedback to inform the selection of complex procedures to make the product • scheduling techniques and tests for precise preparation and integration of parts • preparation of parts for integration • preparation of the integration environment • integrating parts to ensure product meets specifications • ongoing testing against reference points to reduce error in the integration of parts undertaking preparation, integration and testing to comply with relevant health and safety regulations. This student has made a triangular wall storage unit with two shelves and a French cleat. The product requires precise iteration of two or more pre-prepared parts. This student has used trialling and feedback to inform the selection of complex procedures for making the shelves and triangular case (1). They have scheduled techniques and tests for precise preparation and integration, e.g. by dry assembling the shelves (2). Evidence shows the preparation and manufacturing of individual components prior to their integration (3). The student has broadly tested against reference points to reduce error, e.g. by using prepared edges and a protractor to regularly check angles. Preparation of the integration environment has been confirmed (4), and the student has integrated the shelves to meet specifications (5). The assessor has confirmed that the student followed health and safety guidelines (6). For a more secure Achieved, explicit evidence of feedback and the scheduling of tests for precise integration is required.

Student 5: Low Achieved

Intended for teacher use only

Trial 1. Here is a photo of my trialling hand-cut shelf to go into the housing joint. As we can see this cut was actually really good for a hand-cut and is almost square. We can see how when hand cutting the wood it puts a weird texture and doesn't look as clean as I want it. (1)



Trial 2. Here we have a photo of my angle that has been cut perfectly . This cut is square and is now going to fit into my housing joint perfectly and flush. Cutting it with the table saw was more precise and also gets rid of the weird texture that a hand-cut makes.
Mr XXXXXX agrees this was a much better technqiue.

Construction Sequence (schedule of techniques and tests)

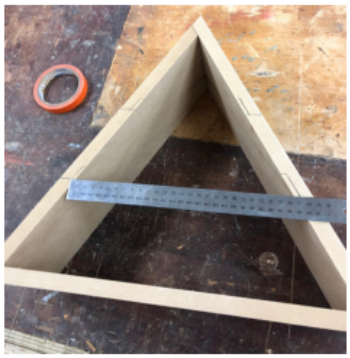
Task	Techniques	Tests
Measure and cut MDF sheet	Use tap measure, use table saw, cut to the correct length and width as above in the cutting list,	Check length twice, stack on top and compare parts,
Cut housing joint into self and right inside shelf	Done on the table saw by Mr leary. I will also need to tilt the saw blade to the required angle	Use protractor with sliding bevel which goes onto the table saw. (2)
Cut components to the required lengths and angles	Done on the table saw by Mr leary. I will first do a ruff cut of a larger size then Mr leary will finish perfecting size.	Double-check measurements with a tape measure,
Dry assemble task	Put all pieces on the floor and assemble without gluing or screwing	Take a photo of the piece and make sure everything is in the correct place, make sure lengths are correct.
Assemble my triangle with screws and glue	Put pieces all together and screw them in with glue for an extra hold	Once the product has finished, check that it can hold similar size and weight objects that are going into the product
Aerosol paint	Spray the aerosol paint on the product not to close up or too far away	Check the nozzle is not blocked and test on scrap first
Primer Coat	Spray paint product in front of the extractor	

In this photo, we can see myself measuring my triangle of where I need to cut the housing joints for my shelves. These shelves were all cut 129mm each on both sides. This gives enough space to put all of the objects my sister is intending on putting inside of the shelf.
My teacher double checked the measurements.

3

In this photo, we can see that we are doing a test cut for the housing joint to make sure that when we do the cut on the correct piece of wood it would be perfect. This took many adjustments to the table saw so that we could get the correct angle for the housing joint. We did end up getting it to the correct angle which was 30 degrees. My teacher helped with this for safety reasons

3



In this photo I am double checking that my housing joint cuts are going to be cut at the correct length. In this photo we can see that it is a 270mm gap for my shelf to go. This was put here because I needed the bottom shelf to be the biggest so that I could fit the biggest objects in. I made clear marks so that I knew where I needed to chisel out the gap for the housing joint.

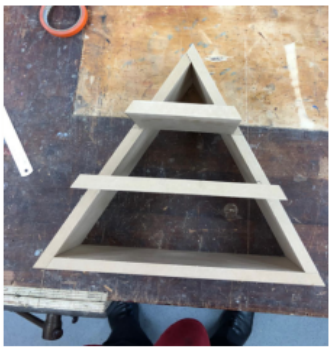
In this photo, we have a birds-eye view of how my piece is going to assemble without any shelves or screws. This gives us an indication if anything needs to be adjusted with my Bottom, Left, and Right bases. We didn't need to adjust the angles as everything would become flush once it was screwed and glued together.

5

2

Here we have a photo of the product without the housing joints or pieces glued together. This shows us a rough idea of how the piece is going to look and that all of the ends of the triangle are going to be flush or perfect and will not need to be re-angled again with the table saw.

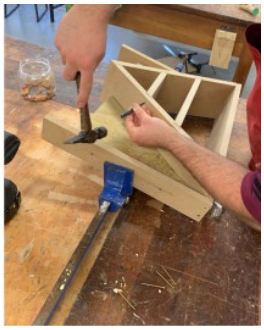
Testing the parts for integration to make sure they will all fit correctly



In workshop	✔ Use of extraction when teacher cut MDF. Vice used to secure parts when drilling.
PPE 6	✔ Apron. Dust mask and gloves in spray booth, Leather shoes worn. Safe handling of all tools witnessed.

In these photos we can see the process of how we glued and screwed the shelves together flush. We can see that I made a jig because it is hard to do this part on the angles it has. We fit the triangle in flush and then using a clamp to tighten it once I out the in the housing joints and bases all lined up and integrated. We can see that I have used small nails to then use the centre punch to push the nail down. I had tested this earlier and had tried screws but it was not suitable.
Further on I can use filler to make the edges flush with the MDF. I screwed small pilot holes in the wood so that the nail wood go in easier without splitting the wood.

4



	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to implement complex procedures to integrate parts using resistant materials to make a specified product. This involves: • trialling and using feedback to inform the selection of complex procedures to make the product • scheduling techniques and tests for precise preparation and integration of parts • preparation of parts for integration • preparation of the integration environment • integrating parts to ensure product meets specifications • ongoing testing against reference points to reduce error in the integration of parts undertaking preparation, integration and testing to comply with relevant health and safety regulations. This student has made a standing metal cabinet with shelves and a hinged door. The product requires precise integration of two or more pre-prepared parts. The evidence shows that the student used trialling and feedback to inform the selection of cutting and joining methods (1). They also undertook tests for precise integration of parts, e.g. by checking dimensions were correct, and that components were square, parallel and level (2). Evidence of preparing parts for the integration environment is seen throughout the photographs (3), and this complied with relevant health and safety regulations (4). The student prepared the integration environment by testing against reference points to reduce error (5), and the parts were integrated to meet product specifications (6). To reach Achieved, evidence of a schedule of techniques and tests needed to precisely prepare and integrate parts is required, e.g. a production plan prepared prior to manufacture. Evidence of trialling and feedback could also be more in-depth.

Student 6: High Not Achieved

Intended for teacher use only

Decision 1

The first decision I made was about how to cut the metal. At school we didn't have a guillotine bug enough to cut 3mm steel sheet and I tried a hacksaw which was pretty bad and angle grinder was too noisy and not safe at school. I needed to use the plasma cutter. The teacher and I did trials to get the setting and this was by far the easier method.

Decision 2

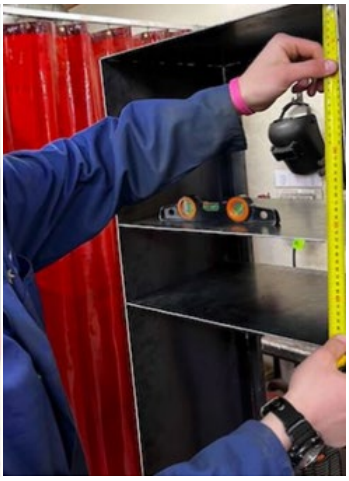
The second decision that I made was around a suitable and accurate way to construct my frame. The way the teacher and I decided was best was to join the 2 pieces of angle iron together before cutting them. This saved time as I had to do fewer measurements and fewer cuts. Another reason for this decision was accuracy doing it this way was far more accurate. This is important for this part of the safe because it is the frame. The rest of the safe is based off this part so if it is not accurate then the whole safe won't be.

1

Decision 3

The third decision I made was about how to join my frame together. After trialling MIG and TIG methods I decided that the best way to do this was to MIG weld it. MIG welding was the best way to join my frame together because it is a full steel project, MIG welding is a strong, easy, and accurate way to join steel together.

2



How did the testing during this stage confirm that my project would continue to meet the specifications in the Brief?

Before welding my frame there were some things that I needed to test. I needed to test that my frame was square and parallel. To test these I used a tape measure. I used a tape measure because it is quick, easy and accurate to use for testing. Another thing that I had to test was that I had the right voltage and wire speed coming from the welder. By testing this I was able to set the welder up to join my 3mm angle section material together.

2

How did the testing during this stage confirm that my project would continue to meet the specifications in the Brief?

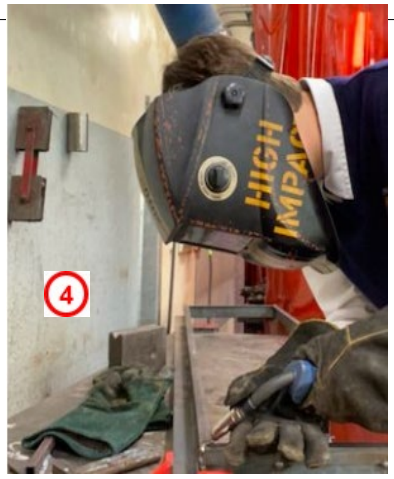
During this stage I had to test that I was going to fit the hinges in a place that the door would hinge smoothly and be held on securely by the hinges. To test this I did some calculations and measurements to work out where the hinges would best be fitted and how far apart they should be. I then measured and marked out where they should be before centre punching and drilling the holes into the door and cabinet frame. To measure/test where the hinges were going to be fitted I used a tape measure.

2

How did I keep myself safe during this construction stage
What PPE did I use ?
What health and safety procedures did I follow ?

4

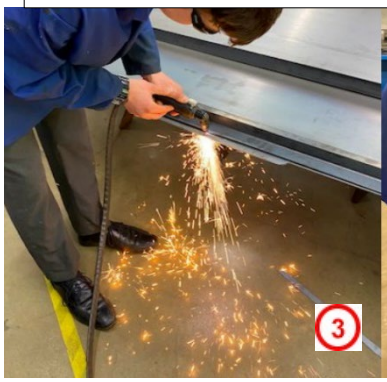
During this stage I had to wear/use PPE to keep myself and others safe. When welding I made sure to wear a welding helmet, welding gloves, a jacket and close the welding curtain. A welding helmet protects my head and eyes from the bright light and sparks off the weld. Welding gloves protect my hands from the heat and sparks off the welder. The welding curtain blocks the light out from the rest of the workshop, keeping others in the workshop safe from the bright light, heat, and sparks of the welder.
After I had finished using the welder I made sure to tidy the welding bay and put all of the equipment back.



How did the testing during this stage confirm that my project would continue to meet the specifications in the Brief?

5

During this stage I tested the position of my shelves in the cabinet. I tested that they were parallel from both the top and bottom of the cabinet. I tested this because the shelves need to be in accurately for the safe to function properly with accurate measurements. To test this I used a tape measure because it was quick, easy, and accurate to use.
I also tested the shelves for level. I needed to test this because the shelves need to be accurate and level for the storage to work well. I tested this using a level. I used a level because it gives a very accurate gauge for me to go by and it is very easy to use.
I also tested that the welder heat and wire speed was set up accurately to weld 3mm steel. I tested/adjusted this using the dial and information on the welder.



Evaluation against specifications and final design

Evaluate each specification in your brief against the final project once it was complete. Explain to what extent the project met each specification.

6

Specifications in my brief:

Height - 1800mm
- This specification met my brief perfectly, my gun safe is 1800mm tall so will fit in its intended location as expected.

Width - 450mm
- My finished safe meets this specification as intended, it is 450mm wide and will have plenty of room to store guns and ammunition.

Depth - 400mm
- The depth of my finished gun safe meets this specification exactly, it is 400mm deep. This allows for maximum storage and a snug fit in its intended location.

3 lockable compartments (one for ammo, one for guns, and one for any other valuables - will be a separate shelf in the ammo compartment and will be accessible by the same door for the ammo compartment)
- The finished safe meets this specification fully. It has 3 storage compartments with 2 lockable doors, this is perfect for what I need and allows for maximum storage space and it meets the NZ police gun storage requirements.

3 locks (one for ammo box, 2 for gun compartment) - will have separate keys for each lock, I like this because it adds extra security.
- My finished safe is complete with 3 locks, one for the ammo compartment and 2 for the gun storage, all of these have separate keys to allow for maximum security.

Hinges - ammo storage door = 2, gun storage door = 3.
- My safe is fitted with a total of 5 hinges. 2 for the ammo box door, and 3 for the gun storage door. This is meets my specifications and is ideal as the doors a securely held on and they are nice and strong so breaking in should not be easy to do.

Made from 3mm sheet steel
- My gun safe is made fully of 3mm sheet steel. This is because the NZ police firearms storage guides state that no metal safe can be built with less than 3mm sheet steel.

Frame made of 40x40x3 mm and 20x20x3 mm angle section.
- This specification is met in my finished project as the cabinet frame is constructed of 40x40x3 mm and 20x20x3 mm angle section. These two combined together make for a perfect surface for the door to close up against.

In conclusion my final completed project meets all of my specifications as well as I'd hoped. Through doing this I have gained a great sense of satisfaction by completing this project. I am really looking forward to getting it home, in its intended location and storing guns and ammo. The final test for this safe will be getting it checked over by the NZ police to make sure it meets their firearm safety requirements.