Sample portfolio: Level 2 Distinction

NCFE Level 1/2 Technical Award in Engineering
QN: 603/2963/4

Contents

Introduction

The material within this portfolio relates to:

Unit 02 – Skills and techniques in engineering (K/616/8969)

This portfolio is designed to demonstrate an example of the evidence that could be produced for Unit 02 of the Level 1/2 Technical Award in Engineering. It's designed to provide guidance on how a portfolio could look, rather than being prescriptive.

In this example there are written accounts and visual evidence, but the evidence could also be presented in an audio/video format. Where the learner has provided visual evidence (for example screen grabs, copies of research), this has been clearly annotated to give context as to why it has been included. Each piece of evidence has been presented with the assessment criteria number shown at the top of the page.

This portfolio contains manufactured learner evidence and assessor feedback produced by NCFE. External Quality Assurer guidance has also been provided for each piece of evidence relating to an assessment criterion. The guidance comments on how the evidence meets the assessment criterion and what could be improved to obtain a higher grade.

Synoptic Project Tasks

Project Brief

You work for a mechanical engineering company who manufacture hydraulic equipment for the construction industry.

You have been asked to design a new model of hydraulic excavator and are required to produce a **working scaled model** of the machine to present to the board of directors.

You have been provided with a basic drawing of a hydraulic excavator with all relevant parts labelled. Use this sketch where required throughout the project.

You are required to produce a **portfolio of evidence** to accompany your model of a hydraulic excavator.

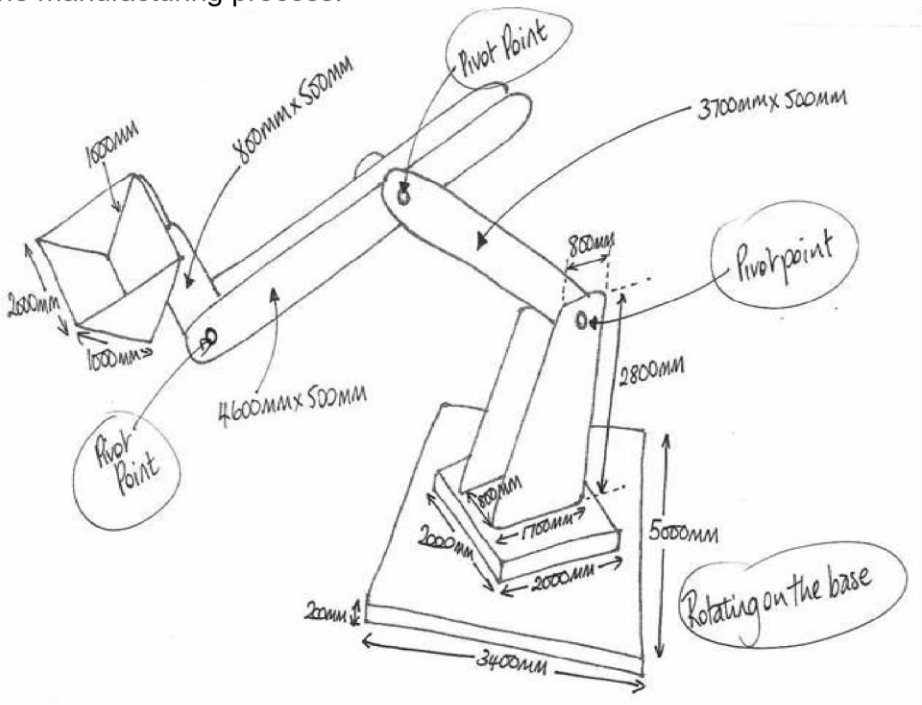
The portfolio should include:

- CAD **and** hand-drafted engineering drawings of your hydraulic excavator using the given information in the sketch
- evidence of materials, tools and machinery testing
- a production plan
- an evaluation of the project, making reference to your learner log where appropriate.

Using your **engineering drawings** and **production plan**, manufacture your hydraulic excavator to an appropriate scale of choice, selecting and using the most appropriate materials, tools and techniques.

During the manufacturing process, you should:

- demonstrate that you are able to carry out manufacturing techniques
- evidence how you demonstrated safe and correct use of a variety of tools and/or machinery throughout the manufacturing process.



Learner log and project evaluation

As you work through the project, you are **required** to keep a learner log to record your approach. You should include:

- how you prepared what resources you used
- how you managed your time.

You **must** use your completed learner log to carry out an evaluation of the project.

Evidence

You are required to submit the following for assessment:

- your portfolio of evidence
- your model of the hydraulic excavator
- your learner log, including your evaluation.

Types of evidence

Below is a list of suggested types of evidence that you could include:

- written/word-processed documents
- presentations
- diagrams
- annotated evidence to include photographs, image and diagrams
- technical drawings
- video/audio evidence
- witness statements (as supporting evidence)
- learner observation records (as supporting evidence).

During the project, you will need to refer to the 'Project Brief' to obtain information.

Learner Evidence

MATERIALS TESTING

PROPERTY	*TEST*
Tensile Strength	*I will fit one end of the sample piece into a vice, projecting 150mm down, then I will hang weights on the other end. I can use this test to measure the amount of weight added until the part begins to stretch or break. I will score out or ten the tensile strength.*
Hardness	*I will use a 200mm length of clear acrylic tube 31.8mm inner diameter, with a tape measure. I will drop a 1 inch diameter grade 100 hardened chrome steel ball bearing into the tube whilst it is held upright on the materials surface and measure the height of the bounce of the ball bearing. The higher the bounce the harder the material.*
Elasticity	*I will fit one end of the sample piece into a vice, projecting 200mm out, then I will hang weights on the other end. A fixed weight is hung from the end by a piece of string. When the string is cut, the material should springs back. I will measure the amount of deflection*
Ductility	*I will use a sample piece of 20mm x 200mm and fit one end of the sample piece into a vice, projecting 150mm out. I will then use a length of tube, placed over a piece of material and used as a lever to fold the material to 90 degrees. I will inspect the cracks / damage on the outside of the bend, representing ductility.*
Malleability	*I will use a sample piece of 20mm x 200mm and fit one end of the sample piece into a vice, projecting 150mm out. I will then use a length of tube, placed over a piece of material and used as a lever to fold the material to 90 degrees. I will inspect the cracks / damage on the inside of the bend representing the malleability.*

MATERIALS PROPERTIES TESTING RESULTS

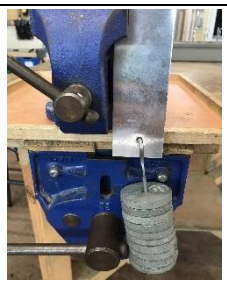
	Tensile Strength	*Hardness*	*Elasticity*	*Ductility*	*Malleability*
 *2mm Mild Steel*	*Weight added before breaking 1000 grams = 1kg - no changes seen* *Score 10/10*	*Height of ball bounce 1400mm* *Score 4/10*	*Amount of deflection 0mm* *Score 0/10*	*Cracks / damage on outside of bend* *None* *10/10*	*Cracks / damage on inside of bend /10* *None* *10/10*
2mm  *Aluminium*	*Weight added before breaking 1000 grams = 1kg - no changes seen* *Score 10/10*	*Height of ball bounce 1200mm* *Score 2/10*	*Amount of deflection 10mm* *Score 1/10*	*Cracks / damage on outside of bend* *None* *9/10*	*Cracks / damage on inside of bend /10* *None* *9/10*

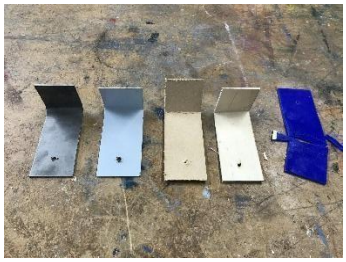
 3mm Acrylic	Weight added before breaking 1000 grams = 1kg - no changes seen Score 10/10	Height of ball bounce 1300mm Score 3/10	Amount of deflection 20mm Score 2/10	Cracks / damage on outside of bend Shattered - would bend if heated and softened with line bender 0/10	Cracks / damage on inside of bend /10 Shattered - would bend if heated and softened with line bender 0/10

3mm Plywood 	Weight added before breaking 1000 grams = 1kg - no changes seen Score 10/10	Height of ball bounce 1200mm Score 2/10	Amount of deflection 60mm Score 6/10	Cracks / damage on outside of bend Wood split and splintered 2/10	Cracks / damage on inside of bend /10 Wood split and splintered 2/10

 3mm MDF	Weight added before breaking 1000 grams = 1kg - no changes seen Score 10/10	Height of ball bounce 1800mm Score 8/10	Amount of deflection 70mm Score 7/10	Cracks / damage on outside of bend Wood split and tore 3/10	Cracks / damage on inside of bend /10 Wood split and tore 3/10

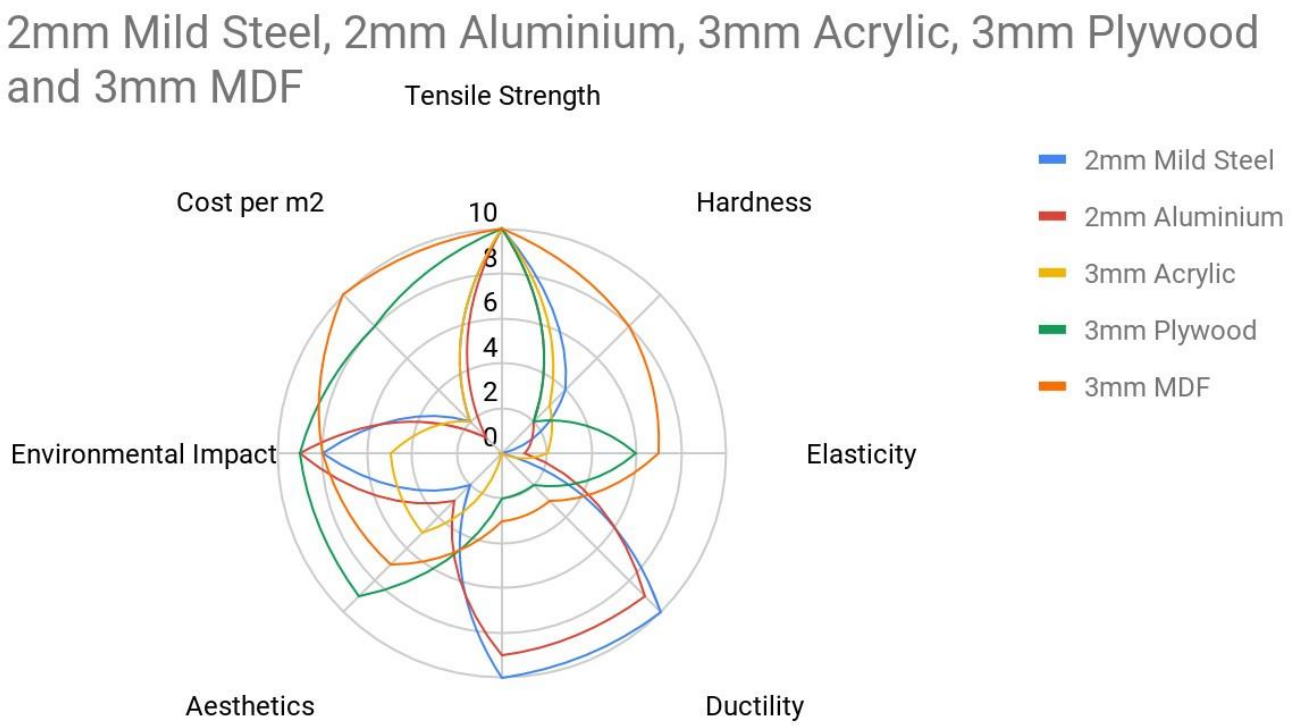
IMAGES OF TESTING

Tensile Strength	 
Hardness	 

Elasticity	 
Malleability	
Ductility	

MATERIALS CHARACTERISTICS TESTING RESULTS

	Aesthetics	*Environmental Impact*	*Cost per m2*
2mm Mild Steel	*Colour - darker blue/grey Surface texture smooth finish effect - matt, can be treated 2/10*	*Sustainability once it is made it can be used, as steel, for ever. Steel is infinitely recycled 8/10*	*£32.47 2/10*
2mm Aluminium	*colour - silver Surface texture – smooth finish effect - shiny, but scratched. 3/10*	*Sustainability Aluminium is the most sustainable building material in the world and is also highly recyclable 9/10*	*£38.73 1/10*
3mm Acrylic	*colour - any surface texture - smooth finish effect - reflective, some scratches 5/10*	*Sustainability horrible on the environment to make in terms of the chemicals that are put into the air but it is amazingly sustainable once it is produced. Acrylic is 100% recyclable and has a very long lifespan 5/10*	*£32.95 2/10*
3mm Plywood	*colour - pale wood surface texture - wood grained finish effect - matt, can be given multiple finishes, does look nice when untreated 9/10*	*Sustainability FSC certified and local wood types. Eco plywood is available, using glues with lower VOC and formaldehyde emissions. 9/10*	*£6.40 8/10*
3mm MDF	*colour - mid brown surface texture - fibrous finish effect - matt, can be given multiple finishes, unattractive when untreated 7/10*	*Sustainability MDF isn't yet fully sustainable. If you remove the glue from the equation, especially the formaldehyde, then it would be a very sustainable 8/10*	*£4.12 10/10*



COMPARISON OF MATERIALS TESTING RESULTS

From the star profile I can conclude the best materials for the model would be 3mm MDF, which could be painted for aesthetic appeal or 3mm plywood for a more aesthetic and professional finish.

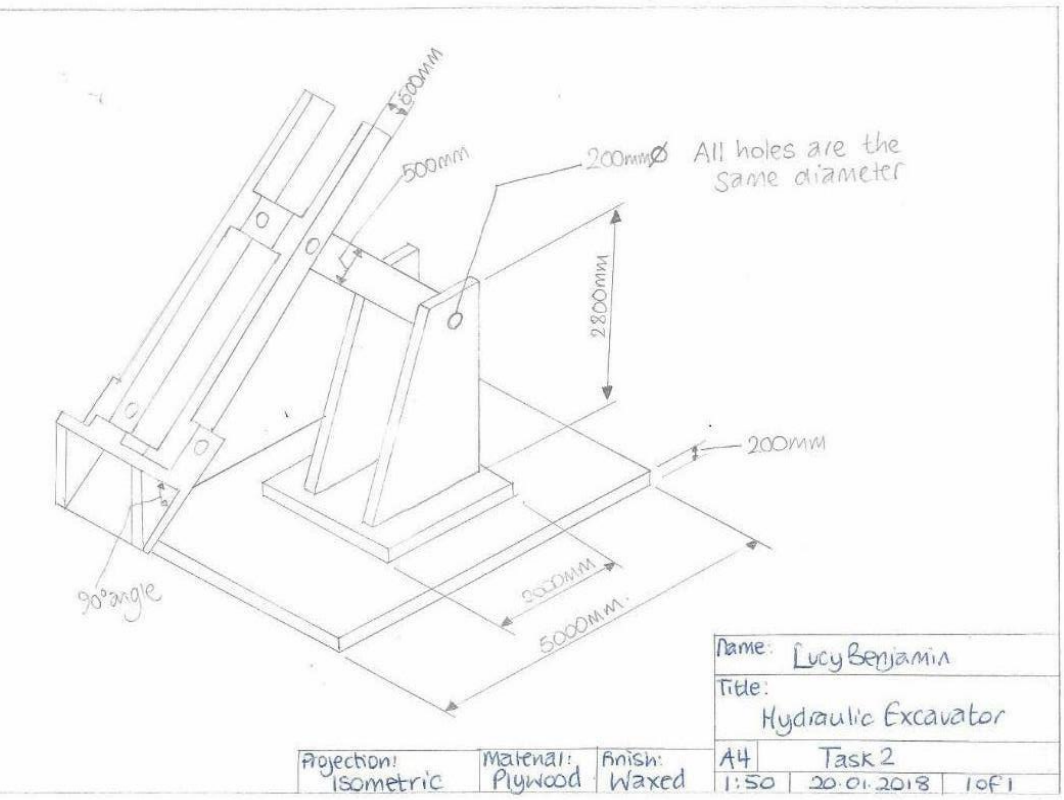
SELECTED MATERIALS, COMPONENTS AND TOOLS WITH JUSTIFICATION

MATERIAL	TOOL & MACHINERY	JUSTIFICATION FOR USE

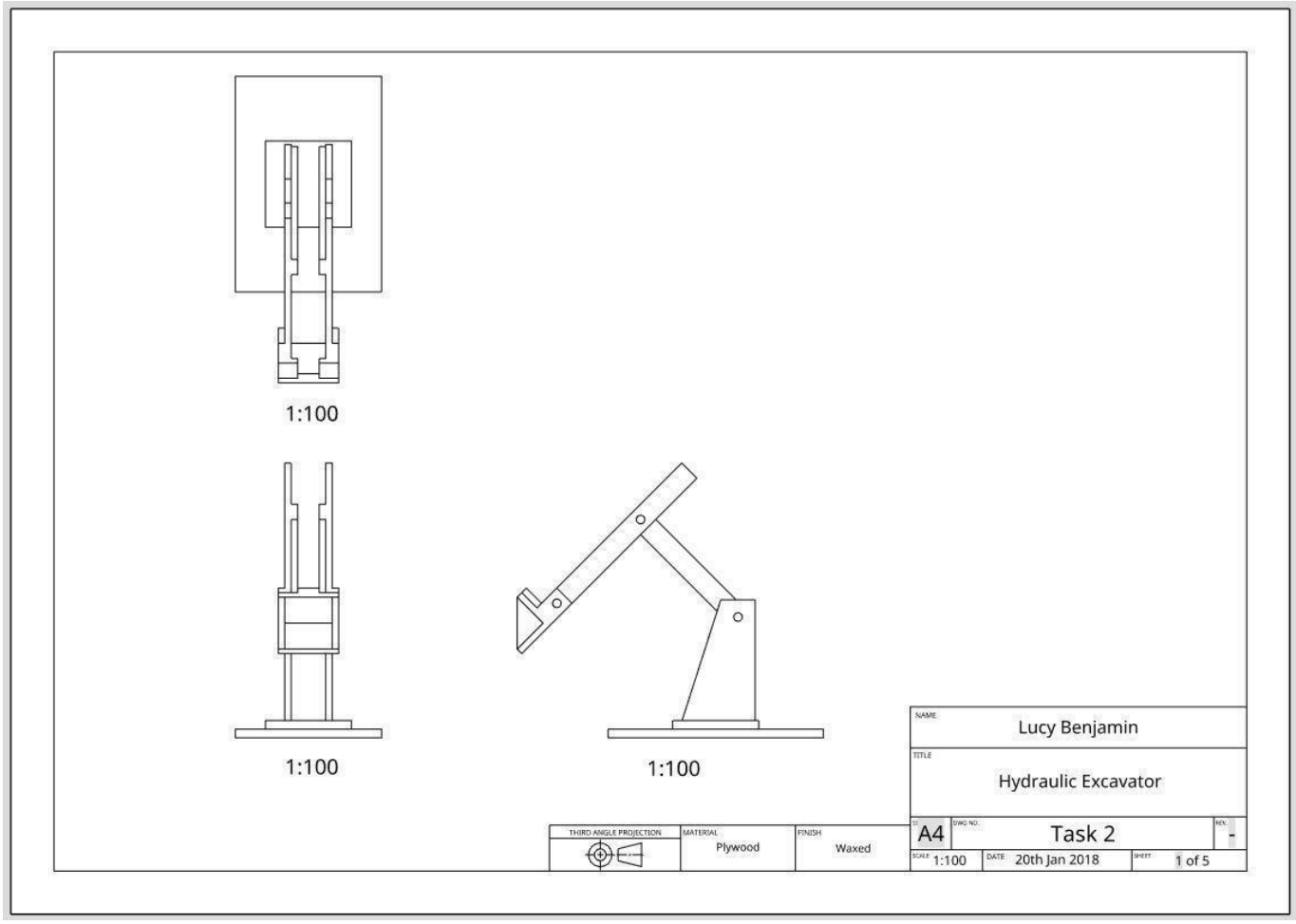
Model pieces will be made from Plywood	*Hand Tools* • *Engineers trisquare* • *Marking gauge* • *Tenon saw* • *Coping saw* *Power Tools* • *Cordless drill* • *Glue Gun* • *Hand Sander* • *Cordless drill* *Fixed machines* • *Pillar drill* • *Scroll saw* • *Disc sander* *CAM* • *Laser Cutter*	*The material I have chosen to use is 3mm plywood. This material is very strong, made up of layers of timber which are glued with the grains at 90˚ to each other. Different grades are available, I have tested and selected an interior grade, as it is only being used for a model.* *From my testing I can see that plywood is low cost when compared to the other materials (except MDF). It got the best aesthetics score which would be good for a model which is to be professionally presented.* *Plywood did not score well for malleability, ductility or hardness, however given the purpose of its use I do not see this as being as much of an issue when compared to the areas where plywood scored well.* *Plywood is also a sustainable materials which when sourced with the FSC mark means the wood that comes from FSC certified forests or from postconsumer waste. There are three types of FSC label; 100%, FSC Mix or FSC Recycled.* *I intend to mark out some of the larger pieces by hand using and engineers tri-square and marking gauge. I will cut these with a tenon saw, coping saw and scroll saw and finish these with the disc sander. Any holes will be marked out and drilled with a pillar drill or cordless drill. Some of the smaller more intricate parts I will cut on the laser to ensure they are accurate. Some fixed parts will be glued together using a glue gun for speed and some moving parts will be held together with aluminium components.*

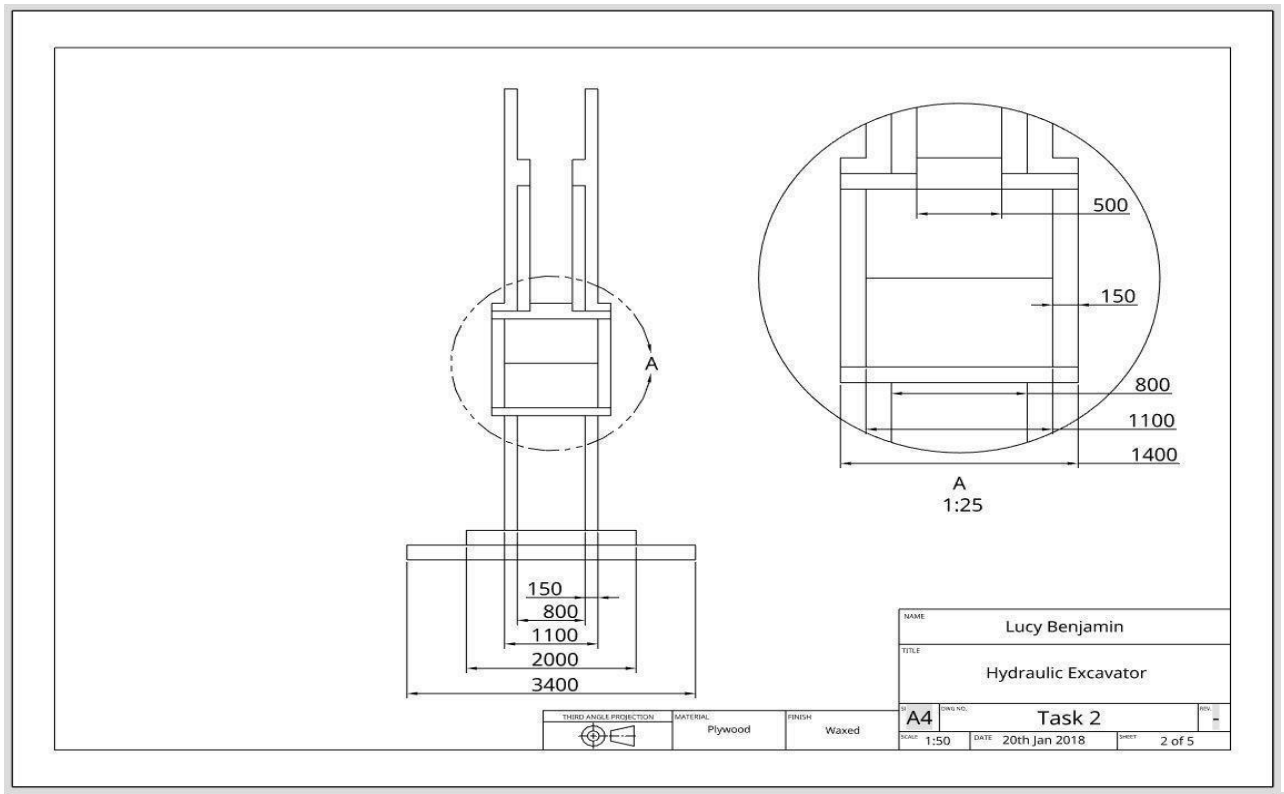
Components - aluminium thread rod and nuts	Hand Tools • Scriber • Hacksaw • File • Spanner	The material I have chosen to use for the component parts is aluminium. This material is light grey and can be polished to give a mirror- like finish, it is lighter in weight than steel which marks it more aesthetically pleasing for the model and a more suitable weight when used with plywood for it purpose. I will use a ruler and scriber to mark off the lengths and a hacksaw to cut the pieces. I will use a file to finish the ends to ensure they are safe from sharp edge and assemble using spanners.
Components - Nylon cable ties	Hand Tools Wire cutters	I will be using nylon cable ties to connect the syringes to the aluminium thread rod. Cable ties can be pulled nice a tight to guarantee a good fit and be robust enough to ensure the mechanism will work properly. Nylon is a hard material which has good wear and tear resistance, which means it will be good for using in the mechanism. I will trim the spare ends of the cable ties with wire cutters as these will be effective at snipping through the nylon and small enough to fit into the smaller spaces of the model.
Components - polypropylene syringes - filled with coloured water	Power Tools Cordless Drill	I will use polypropylene syringes to act as the hydraulic mechanics for the model. This is the most cost effective option to show fluid transference. The plunger of the syringe will need to be drilled. Due to the awkward shape of the syringe and the moving parts I will use a cordless drill for more control.
Components - pvc tube	Power Tools Glue Gun	I will be using pvc tube to connect the syringes to the model to those on the control panel. PVC is commonly used for air and water pipes and it ideal for this purpose, whilst remaining low cost.

HAND DRAWINGS - Isometric Projection


600mm
500mm
200mmØ
All holes are the same diameter
2800mm
200mm
90° angle
3000mm
5000mm
Name: Lucy Benjamin
Title: Hydraulic Excavator
Projection: Isometric
Material: Plywood
Finish: Waxed
A4
Task 2
1:50
20.01.2018
1 of 1

CAD DRAWINGS - Third Angle Orthographic projection

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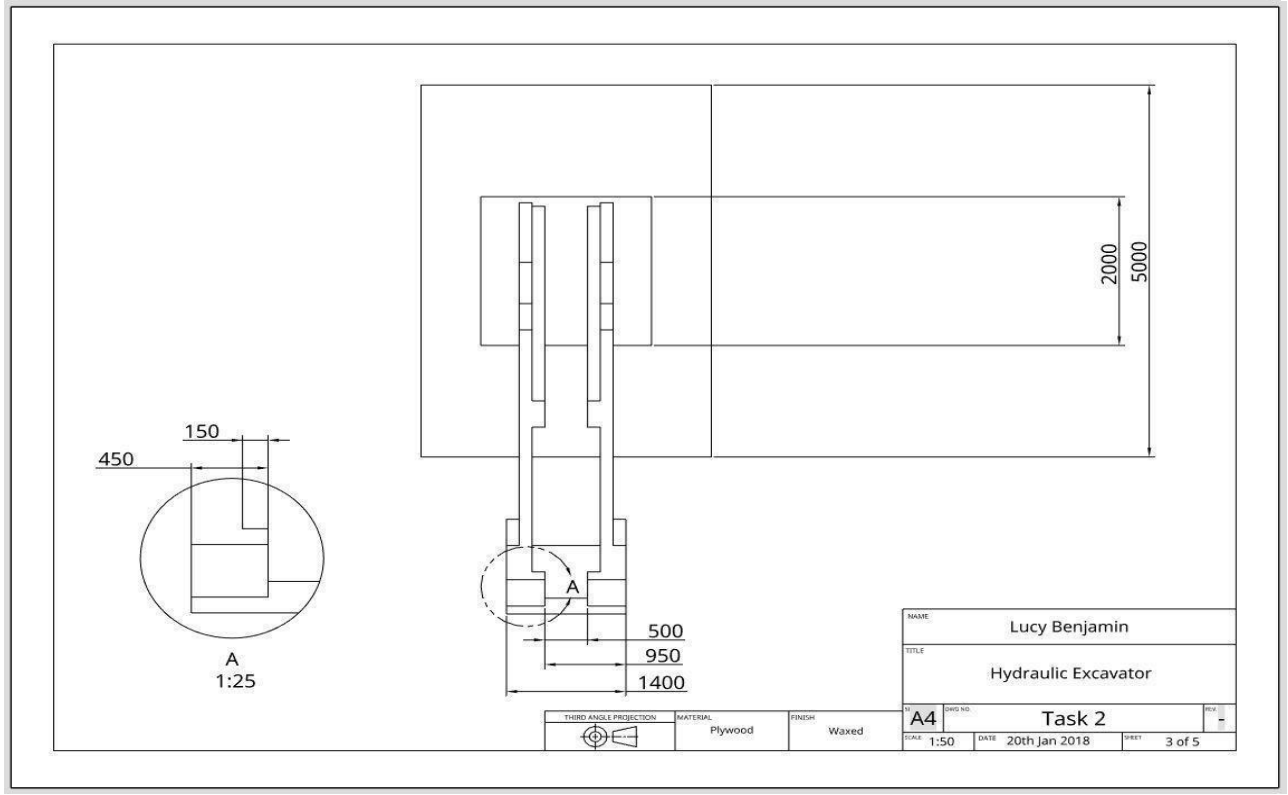
2000
3400
NAME
Lucy Benjamin
TITLE
Hydraulic Excavator
THIRD ANGLE PROJECTION
MATERIAL
Plywood
FINISH
Waxed
A4
DWG NO.
Task 2
REV.
-
SCALE
1:50
DATE
20th Jan 2018
SHEET
2 of 5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NAME
Lucy Benjamin
TITLE
Hydraulic Excavator
THIRD ANGLE PROJECTION
MATERIAL
Plywood
FINISH
Waxed
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DWG NO.
Task 2
REV.
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SCALE
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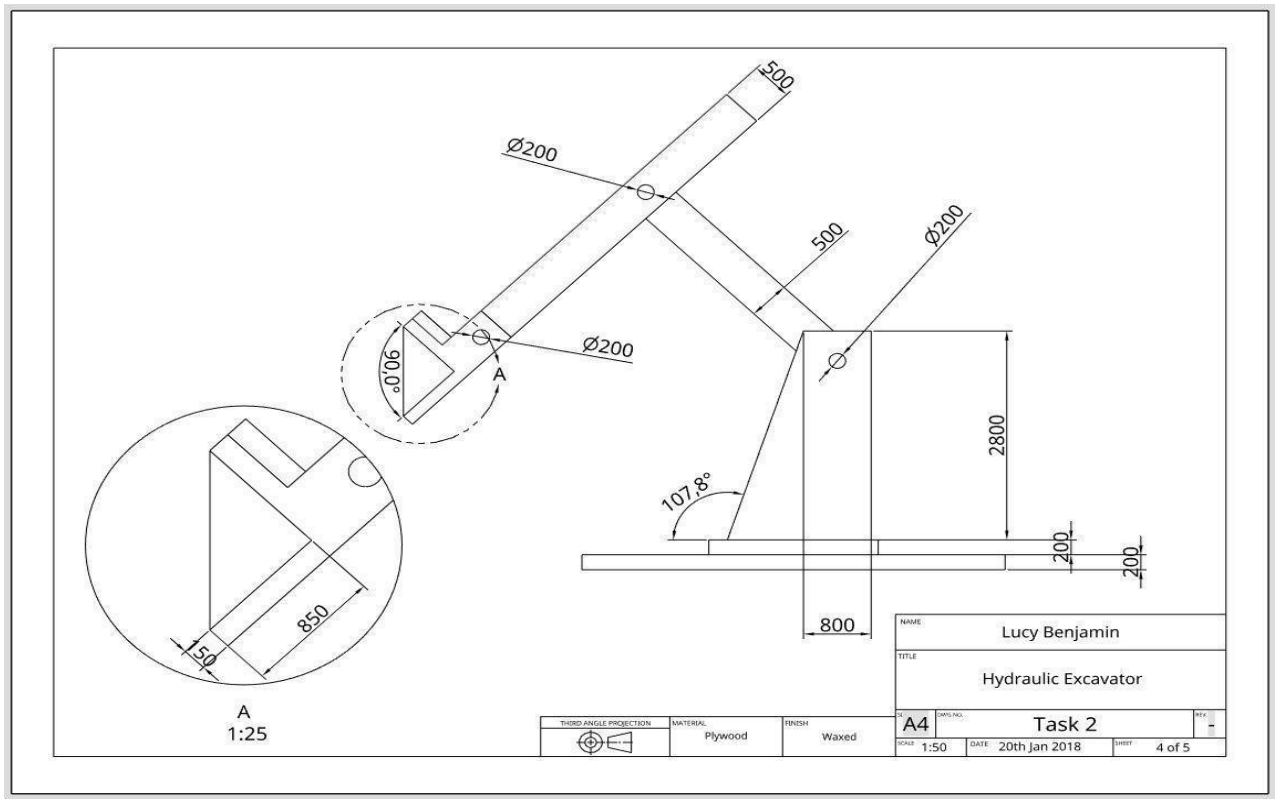
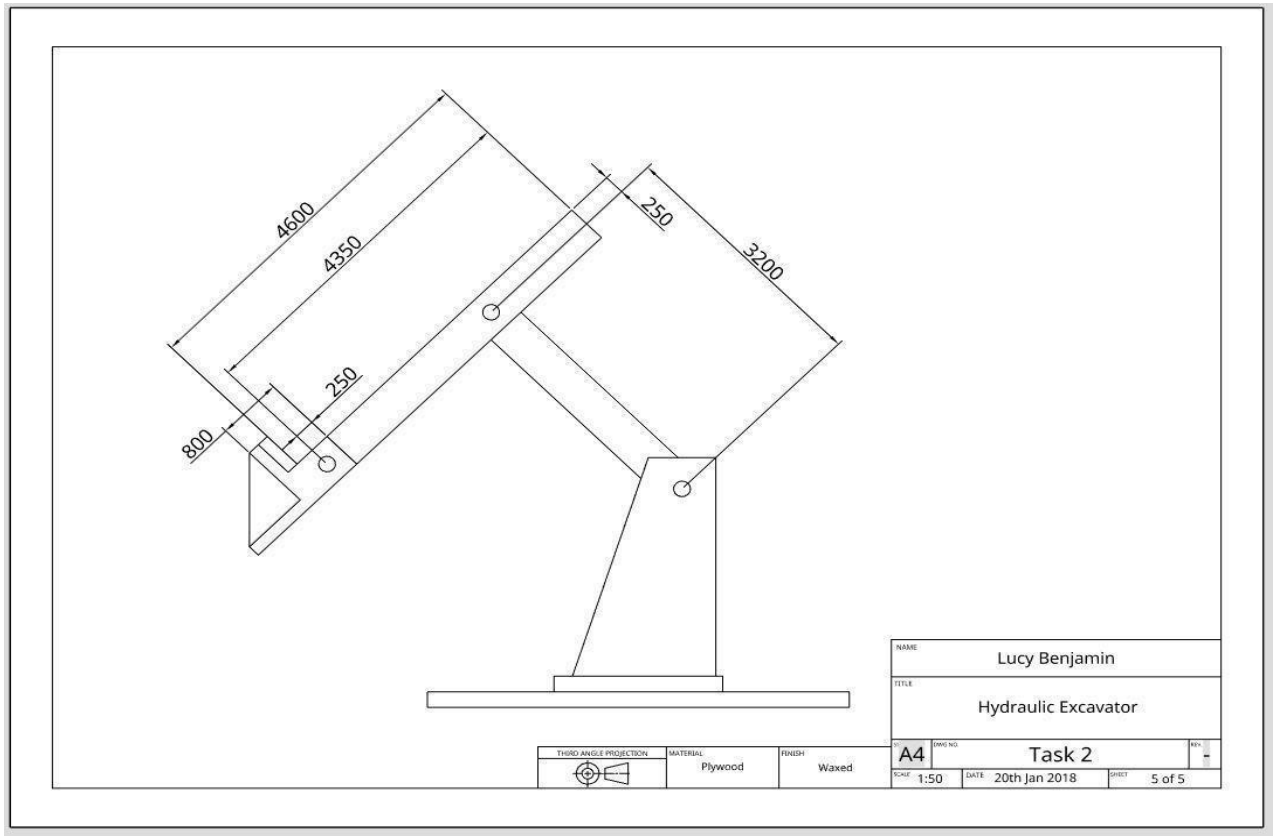
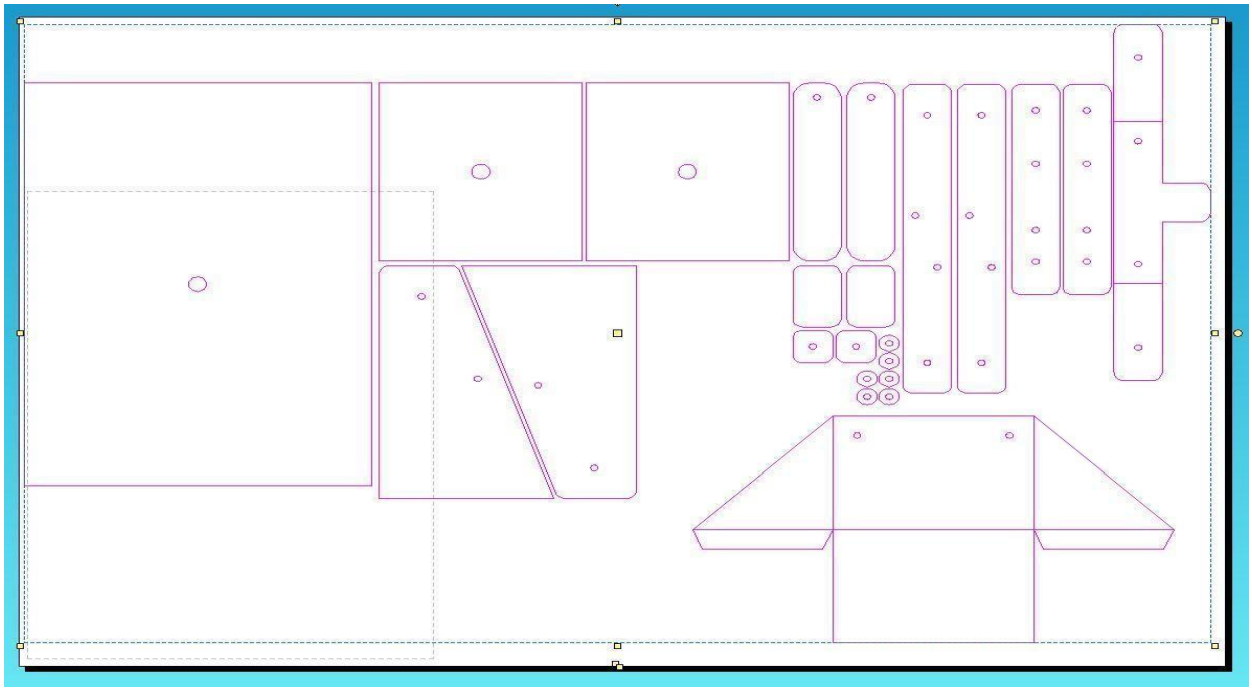
DATE
20th Jan 2018
SHEET
3 of 5

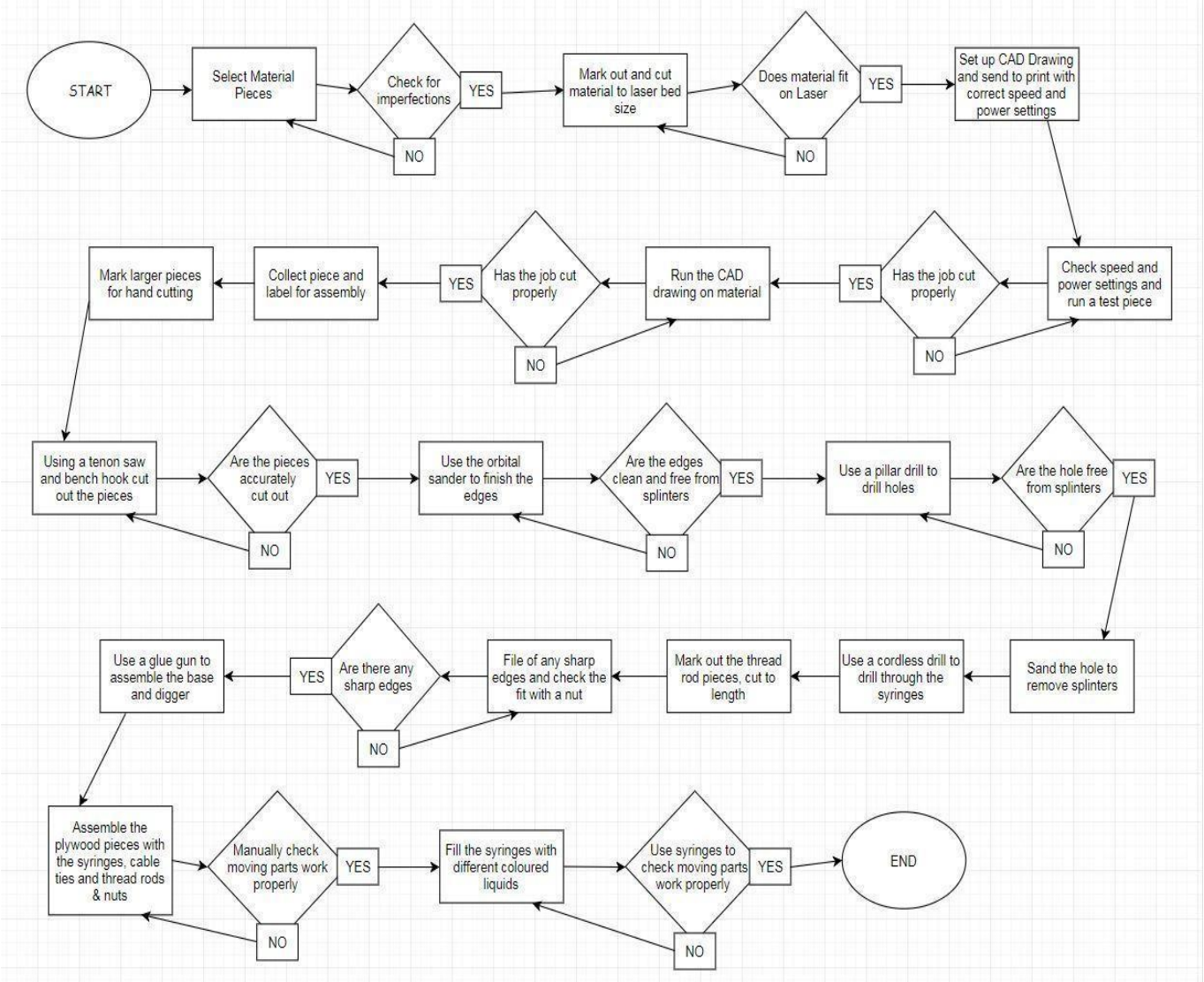




CAD DRAWINGS - 2D DESIGN FOR CAM LASER CUTTER



.PRODUCTION PLAN - FLOW DIAGRAM



PRODUCTION PLAN – RISK ASSESSMENT

HAZARD	*RISK*	*LEVEL OF RISK*	*AT THE MINUTE, WHAT IS THERE TO PROTECT PEOPLE FROM THESE HAZARDS OR STOP THE HAZARD HAPPENING?* *CAN ANYTHING ELSE BE DONE TO FURTHER REDUCE THE RISK OF SOMEONE INJURING THEMSELVES?*

Laser Cutter *Fumes* *Laser beam* *Heat* *Electricity*	*Injuries to eye and skin from laser beam* *Fire* *Exposure to fumes* *Failing electrical equipment and faults*	*Low*	*Fan and access hatches interlocked so that laser is isolated (cuts out) in the event they are opened.* *Students will be supervised by a competent member of staff when using the equipment unless trained by that competent member of staff and signed off* *Equipment must never be left unattended when in use.* *Equipment must not be used by trained students outside of normal school hours, 8.45am – 3.35pm* *Air intake vents must never be obstructed.* *Only suitable materials are to be engineered by the laser cutter.* *CO2 extinguisher available close to equipment and staff will be trained in its use.* *Students should not use extinguishers. Local Exhaust Ventilation (LEV) attached to laser so that all fume is removed.* *Any electrical equipment should be regularly tested for electrical safety. And all isolation buttons should be accessible and in full working order.*

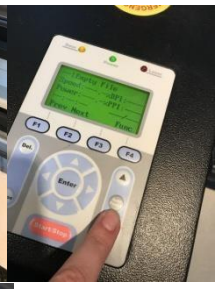
Disc Sander *Debris* *Dust* *Rotating machinery*	*Entanglement* *Flying work piece Exposure to dust Failing electrical equipment and faults*	*Low*	*Long hair must be tied back; jewellery should be removed or covered and loose clothing covered by a secure apron or overall.* *Eye protection should always be worn when using this machine.* *Local Exhaust Ventilation (LEV) attached to sander so that all dust is removed.* *Dust mask may be worn* *Any electrical equipment should be regularly tested for electrical safety. And all isolation buttons should be accessible and in full working order.*

Hand Sander Debris Dust Electricity	*Flying work piece Exposure to dust Failing electrical equipment and faults*	*Low*	*Eye protection should always be worn when using this machine. Exhaust Ventilation attached to sander so that all dust is removed. Dust mask may be worn Any electrical equipment should be regularly tested for electrical safety.*
Pillar Drill Debris (swarf) Dust Rotating machinery	*Flying work piece Trapping Entanglement Exposure to dust and debris (swarf)*	*Medium*	*Correct selection of the bit speed will reduce the risks from flying workpieces but machine vices or clamps should be used where required. Eye protection should always be worn when using this machine. Guards around the chuck and bit will reduce the risk of hand or finger injury but training and experience are essential. The drill chuck guard should be adjusted to cover the whole of the drill bit when the machine is in use. Guards preventing inadvertent contact with belt drives should require a tool to remove them or be interlocked with the power supply to prevent trapping when moving the drive belt. Long hair must be tied back; jewellery should be removed or covered and loose*
			clothing covered by a secure apron or overall. Any electrical equipment should be regularly tested for electrical safety. And all isolation buttons should be accessible and in full working order.

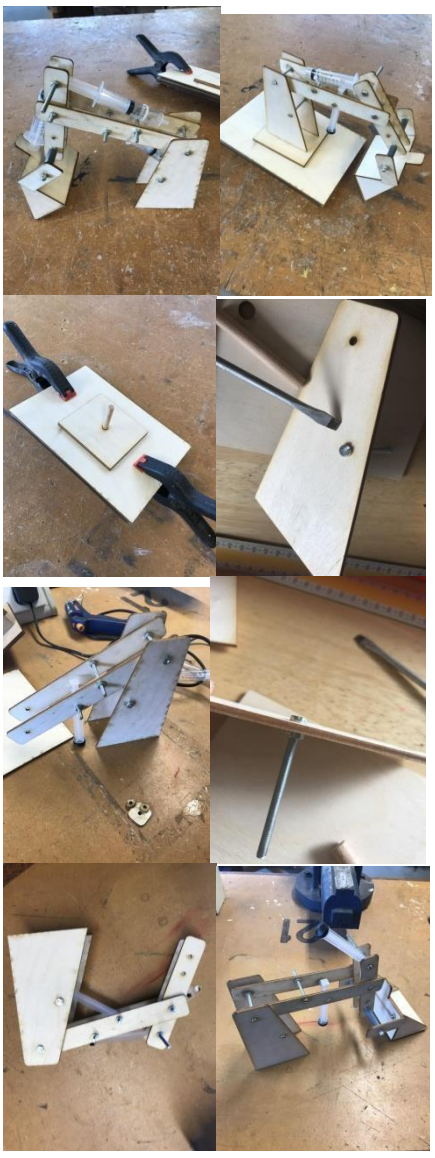
Cordless Drill Debris (swarf) Dust Rotating machinery Electricity	Flying work piece Entanglement Exposure to dust and debris (swarf) Failing electrical equipment and faults	Low	Eye protection should always be worn when using this machine. Long hair must be tied back; jewellery should be removed or covered and loose clothing covered by a secure apron or overall. Eye protection should always be worn when using this machine. Any electrical equipment should be regularly tested for electrical safety.
Glue Gun Heat	Burns Failing electrical equipment and faults	Low	A glue gun stand should be used; equipment should only purchase from a reputable supplier Any electrical equipment should be regularly tested for electrical safety.
Hand tools	Cuts Impact injury,	Low	Walk when transporting tools and hold by side Instruction on how to use tools safely Ensure regularly checked All Equipment to remain in workshop

Practical Progress Log

Stage	Tool or machine Used	Description of progress log entry	Photographic evidence.

1	Laser Cutter (CAM Machine) TriSquare Ruler and Tape Measure Pencil	I selected my piece of material and checked this for imperfections, damage, knots and warping. I measured and marked out using a ruler, trisquare, tape measure and pencil 600mm x 400mm to be cut to fit the laser bed. I requested this cut piece from the technician and checked the material fit on Laser bed and auto-focused. I then set up CAD Drawing from my 2D Design file, making the amendment to the laser and send to print with correct speed and power settings. I ran a test piece to check speed and power settings cut properly, then ran the CAD drawing on material and collected the pieces which I label for assembly later in the manufacturing process.	  
2	Tri Square Ruler and Tape Measure Pencil Bench Hook Tenon saw Disc sander Sand	I measured and marked out using a ruler, trisquare, tape measure and pencil for the larger pieces such as the base. I used a tenon saw with a bench hook cut out the pieces. I used the trisquare to check the pieces were accurately cut out. Once I was happy with all the piece hand cut and from the laser I used the orbital sander and the disc sander to finish the edges to ensure they were clean and free	 

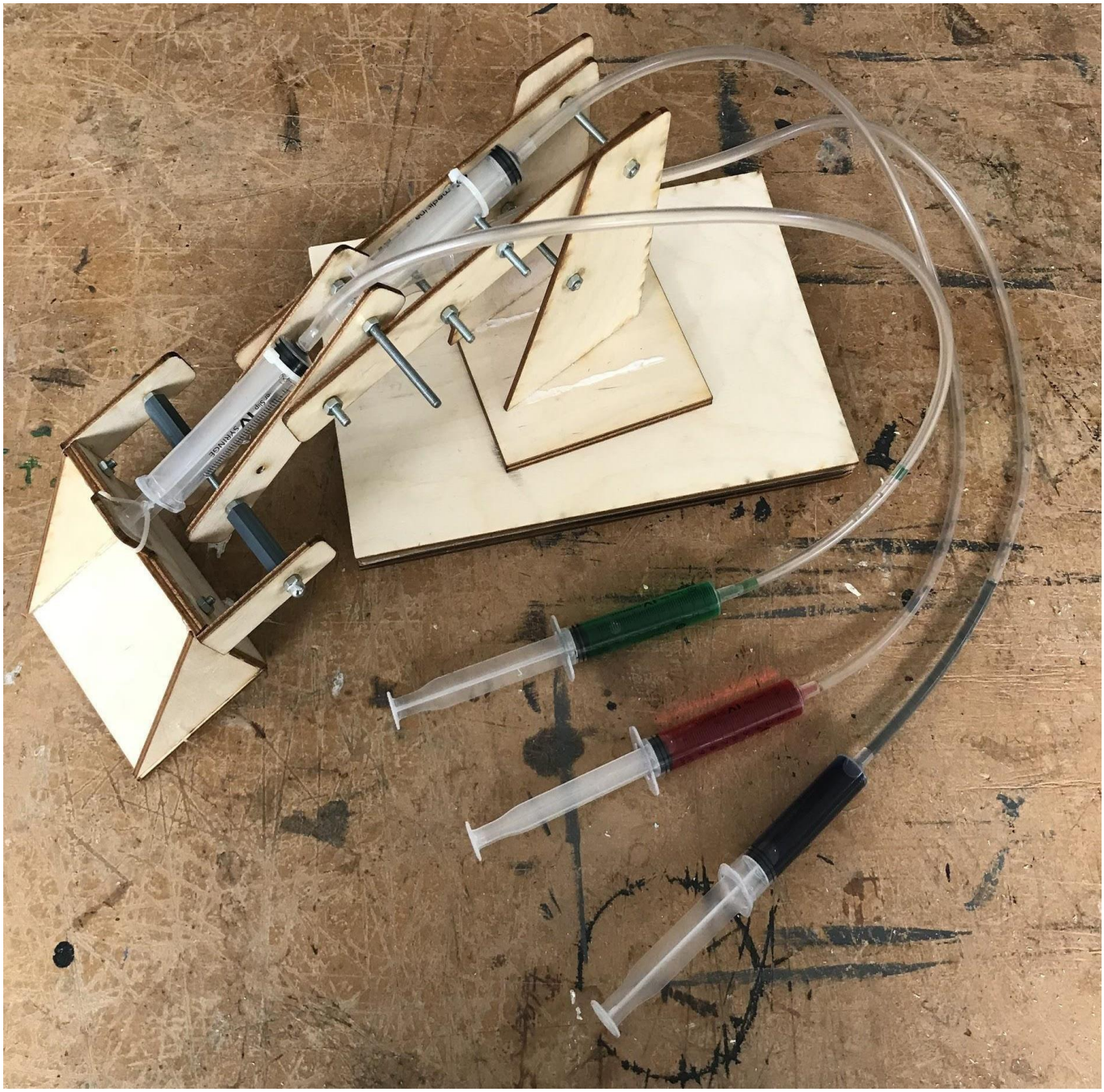
	paper *Pillar drill*	*from splinters.* *I then used a pillar drill to drill all the holes. I checked again to ensure the holes were free from splinters and used sandpaper to sand the hole to remove splinters and smooth over.*	   
3	*Cordless drill*	*Rather than a pillar drill I used a cordless drill to drill through the syringes. As these are very delicate and thin, I thought I would have more control and be able to hold them better in the vice if I used a cordless drill.*	 

4	Metal working vice Hacksaw File Scriber Ruler	I marked out the thread rod pieces to assembly the excavator, each piece was marked using a scriber then held in a metal working vice to be cut to length using a hacksaw. I then filed of any sharp edges with a flat file and checked the fit through the plywood and syringes and with a nut.	
5	Glue gun Wire cutters Screwdriver Pliers	I used a glue gun to assemble the base of the excavator to an 8mm piece of dowel for stability. I also used the glue gun to assemble the digger sections of the excavator. I assembled the plywood pieces with the syringes, cable Ties and thread rods & nuts and manually checked each mechanism as I went along to ensure all moving parts worked properly.	

			
6		*I filled the syringes with different coloured liquids to show which cable connected to which part. Then using the syringes I checked all the moving parts worked properly*	

H&S	*PPE* *Goggles* *Face Shield* *Apron*	*PPE is equipment that will protect the user against health or safety risks at work. Even where engineering controls and safe systems of work have been applied, some hazards might still remain. The risk of injury to me in this project included:* • *the eyes, from flying particles, dust and swarf* • *the body, from heat of the glue gun and the risk of entanglement* *PPE is needed in these cases to reduce the risk.* *The PPE I used was, face shield, goggle and apron.*	

FINAL MODEL AT SCALE OF 1:20



Learner Observation

Record of Learner Observation

Qualification	V.cert L1 / 2 Engineering	**Learner Name**	Lucy Benjamin
Date & Time of observation	11th - 31st January 2018 (3 weeks @ 2 lessons per week - total 6 lessons)	**Assessor Name**	Laura Mulligan
Description of the learner's activity.		Assessment Criteria Met	

People present
Laura Mulligan (LM- Engineering Teacher)
Linda Rodgers (LR - Supporting TA - DT LSA Link)
Roy Michael (RM - DT Technician - DT and H&S qualified)
Dawn Maskell (DM - Head of DT Department).

What was observed
Hydraulic Arm Manufacture

What the learner did

- Marked out plywood using tri-square, pencil or laser cutter (RM) according to their engineering drawings. (LM & LR)
- A tenon saw with a bench hook and vice and a coping saw with a vice to cut along the marked lines by hand and a laser cutting machine to cut the more detailed pieces. (LM & LR)
- Orbital sander and a disc sander to clean up the edges of hand cut pieces (LM)
- Pillar drill with a 4mm drill bit to create the holes for connecting the parts. (LM & RM)
- Engineers vice, scriber, steel rule and hacksaw were used to mark out the thread rod and a flat file was used to remove any rough edges (LM)
- Assembled hydraulic mechanism using glue gun for plywood to plywood, spanner and nuts for the thread rod to plywood and cable ties to connect the syringes to the thread rod, trimmed off with wire cutters. (LM & DM)

Learn is clearly working at Band 3 for AO4 having met all the assessment criteria to a high standard whilst maintaining a good standard of safe working practice throughout.

You have skillfully performed operations with hand tools, power tools, fixed equipment, and CAM for your hydraulic excavator.

You have demonstrated a safe working environment throughout

You have accurately applied your knowledge and understanding of maths, science and engineering theory, which is relevant to the context and situation - Band 3

Task 2

Manufacture your functioning prototype of the hydraulic excavator to an appropriate scale of choice

Demonstrate that you are able to carry out manufacturing techniques

Set up and use a minimum of one Computer Aided Machine, one fixed machine, one power tool, one hand tool to manufacture your hydraulic excavator

Evidence how you demonstrated safe and correct use of tools and/machinery throughout the manufacturing process.

Assessor Signature		**Date**	31st January 2018
Learner Signature		**Date**	31st January 2018

Peer Observation

Witness Testimony

Learner Name:	Lucy Benjamin
Assessor Name:	Mrs Mulligan
Witness Name:	Drew Cook
Role of Witness:	Learner - Peer Assessor
Qualification:	V.cert Engineering Level 1 / 2
Location:	T3 Workshop

Briefly describe the relationship between the witness and the learner
Peer (buddy group A)

Describe what you witnessed the learner doing	**Assessment criteria**
I was working in the same buddy group as Lucy, sharing a work bench and hand tools. Lucy made her hydraulic with no help from the teachers and made a really good job of her work.	Demonstrate that you are able to carry out manufacturing techniques
I saw lucy use the Laser cutting machine, a pillar drill, a glue gun, a hacksaw, a file and a spanner.	Set up and use a minimum of one Computer Aided Machine,one fixed machine, one power tool, one hand tool to manufacture your hydraulic excavator
I have seen Lucy wearing the correct PPE at all times and she knows how to safely use machines such as a the pillar drill. Lucy does not mess above in lessons and is careful with the equipment.	Evidence how you demonstrated safe and correct use of tools and/machinery throughout the manufacturing process.

Witness Signature		**Date**	19/01/2018
Assessor Signature		**Date**	19/01/2018

Learner Interview

Record of Professional Discussion

Qualification	V.cert L2 Engineering	**Learner Name**	Lucy Benjamin
Date and Time of discussion	02/02/2018	**Assessor Name**	Laura Mulligan

Record of the Professional Discussion.	**Assessment criteria met**
People present Laura Mulligan & Dawn Maskell **Q&A** 1. How have you demonstrated that you are able to carry out manufacturing techniques? 2. How did you set up and use a Computer Aided Machine to manufacture your hydraulic excavator? 3. How did you set up and use a fixed machine to manufacture your hydraulic excavator? 4. How did you set up and use a power tool to manufacture your hydraulic excavator? 5. How did you set up and use a hand tool to manufacture your hydraulic excavator? 6. How have you evidenced how you demonstrated safe and correct use of tools and machinery throughout the manufacturing process. **What the learner did - learner response:** 1. I have created a 2D design template for the hydraulic excavator to provide me with a template to work from. I used knowledge from physics lessons about Pascal's Principle to use syringes to transfer liquid to move the parts of the mechanism. I have researched and used a range of tools and equipment and i tested the materials for suitability before starting. 2. I used the laser cutting machine. I loaded my 2D design drawing onto the laser cutter. Switched on the laser and extractor, placed my material in the machine and levelled it. then I set the cut speed and power and allowed ht machine to cut my template. 3. I used the pillar drill. I cleaner the area first and used a vice and clamps to secure my work. I then moved the table to the correct position and used a chuck key to insert and tighten the correct drill bit. I wore a face shield and apron with my hair tied up. 4. I used an orbital sander to clean up the edges and surfaces of the plywood. I checked the grade of sandpaper on the sander and plugged it in. I practiced first on a test piece to gain confidence. I wore a dust mask, goggles and an apron. 5. I used two spanners working in opposite directions to tighten the nuts to the plywood on the thread rod. 6. I know the location of the power cut off buttons. I wore the correct PPE and used the machine or tool safety feature where applicable. I checked machine and tools for damage before and after use and stored tools and equipment back safely after I used them.	Demonstrate that you are able to carry out manufacturing techniques Set up and use a minimum of one Computer Aided Machine,one fixed machine, one power tool, one hand tool to manufacture your hydraulic excavator Evidence how you demonstrated safe and correct use of tools and/machinery throughout the manufacturing process.
Feedback to Learner	
You have clearly demonstrated the ability to explain the manufacturing processes you have undertaken. Your knowledge is of a high level which was evident through observation of practical application	

Assessor Signature		**Date**	02/02/2018
Learner Signature		**Date**	02/02/2018

Evaluation of the project.

	OUTCOME EVALUATION *(WWW - What went well) & (EBI - Even better if)*
Materials Testing - Tensile Strength	*All the results for this test were the same. Although knowing the tensile strength is important for this project I feel the test results were of little benefit to me and another test of material strength could have been more beneficial.*
Materials Testing - Hardness	*Although the different materials did provide different data, I do not think hardness was such an important test for the end purpose. As the model will not come under great stresses in theory. I think this test would be more applicable in the development of a full scale excavator, where the use is much more demanding.*
Materials Testing - Elasticity	*The results from the elasticity testing did influence how the material could be affected when the hydraulic mechanisms are in use. I did want the material to have some elasticity to make the assembly and construction a little easier, but snot so much it would be unstable. This test did help me in selecting the material*
Materials Testing - Ductility	*These two tests were very valuable to the selection of material and the manufacturing process and tools needed. I have initially through I might be able to bend the material into shape around the digger, but from the test this was clearly not an option and I had to rethink my initial ideas for manufacture into making separate parts which could be glued together.*
Materials Testing - Malleability	
Materials Testing - Aesthetics	*I think the plywood looked really nice with its light grain when I initially was looking at materials, even the edges have a nice sandwiched look about them. I am glad I went with this material as the finished product is light in colour and has a nice self-finish, even without being waxed, which was my initial plan.*

Materials Testing - Sustainability	*I think in the current age sustainability is very important especially for business and their reputations. A good business wants to be seen as doing the best for the environment and not contributing the environmental problems. It might only be a small model, but a larger business might want to build several of these to promote themselves and being able to say the materials are FSC would only look good for them.*
Materials Testing - Cost p/m2	*This had a huge influence over the model, as a business would need the model to be cost effective and not blow the budget. I also found the cheaper materials were the easier ones to tool and the tools themselves would also be cheaper, especially when compared to the steel.*
Technical Drawings CAD Drawings	*I enjoyed producing these CAD drawings and found I learned a lot more about the programme as I was using it, such as how to do the to show areas in more detail and making it easier to dimension. I found this to be a much faster way of working then hand drawing and errors could be rectified easily. If I tried to draw something which was incorrect the computer would warn me, whereas with hand drawn you would have to rub out or start again. I also thought the CAD drawings looked much more professional and was happier with how they looked with when printed out.*
Production Plan	*I decided to do the production plan as a flow diagram to make each stage of the process clear, but also to factor in quality control to provide quality assurances. This also helped me to make a clear plan of how to manufacture the model and give me a rough guide to how long this might take. By things through each stage it also made me consider through which I had not previously through about or considered. I thought my plan was quite accurate and I did follow this in the manufacturing stages, although I'm not sure I was as meticulous with the quality control as I had intended.*

Risk Assessment	*I think the risk assessment was a valuable exercise in this process, It was a good refresher on keeping safe and made me re-evaluate my own practice when doing practical. Reading up about the risks and accidents on the HSE website, made me more cautious in how I worked and made me think about how easily an accident could happen and how the simple safety feature make a huge difference.*
Set up & use CAD	*Setting up and using the Laser cutter was one of the most time consuming exercises in the process as I had to get the power and speed setting correct. I had initially put into my production plan to run one test, but I had to do several tests to get this right, as although I followed the instructions in the manual the school laser cutter is old and not as good as it should be! I ran 3 tests in total as not only was I struggling to get the setting correct the plywood was slightly warped so would not sit completely flush on the laser bed, which caused problems in levelling the machine. I did find the process of having to sit whilst the laser was running a waste of time, as I could have been doing something else, but I understand this is for health and safety reasons and was also in my risk assessment*
Set up & use fixed machine	*I set up and used the pillar drill, which was something I was trained on in Y7. I had to clean the area first with a dustpan and brush, as there was a lot of debris from the previous user left behind. I used the chuck key to loosen the chuck and fit the 4mm drill bit, then used the key again to tighten this. I used a vice on the drill table and levelled the table to the right height. I also clamped the vice to the table to stop it from spinning (as I saw this happen to someone else!).*
Set up & use power tool	*I tested both the glue gun and cordless drill prior to use. I replaced the glue in the glue gun. I fitted the drill bit into the cordless drill. I made sure I had the speed setting correct on the cordless drill.*
Set up & use hand tool	*The hand tools I used did not need much setting up, but correct use of them was important to avoid accidents. I also had to report the handle on one of the files was loose to the technician.*

Safe and correct use and practice	*I made sure my hair was always tied up and my tie was tucked into my shirt. I always wore a DT apron and wore goggles for most of the tasks unless a face shield was more appropriate.*

Manufacture	*I used a glue gun to assemble the base of the excavator to an 8mm piece of dowel for stability, but found this left big blobs and when I tried to file them off it made the post loose, I ended up assembling this with PVA and leaving overnight to harden. I also used the glue gun to assemble the digger sections of the excavator, which worked ok, but might have also been better with PVA glue.* *Assembling the plywood pieces with thread rod and nuts was frustrating as it was a much slower process than I had anticipated. I also had to put spaces in where the digger is to provide some stability and reduce wobble.*
Final outcome	*I am really happy with the final outcome I think it looks really good and really professional, I did leave the lengths of the thread rods too long and was planning to cut them down again and file them off, but though this might risk damaging the model and it was better to leave them.* *I also found in testing the syringes the pvc tube kept flying off with the pressure, so once they were filled I used an epoxy resin to glue the pvc tubing to the syringes at either ends to reduce the risk of them flying off. I did have to do this several times as they did keep coming off on the first few tests.*

Assessor Feedback to Learner

Learner Name	Lucy Benjamin	**Qualification Name**	
Assessor Name	Laura Mulligan	**Qualification Number**	

Please list the assessment objectives which were achieved

AO1 Recall knowledge and show understanding – Band - 3
Learners recall and communicate a wide range of accurate and comprehensive engineering knowledge and understanding.
Subject specific terminology is used accurately and consistently throughout the project.

AO2 Apply knowledge and understanding – Band - 3
Learners accurately apply knowledge and understanding of maths, science and engineering theory, which is relevant to the context and situation.

AO3 Analyse and evaluate knowledge and understanding – Band - 3
Learners critically analyse and evaluate engineering information, systematically judging and reaching reasoned and valid conclusions.

AO4 Demonstrate and apply technical skills and processes – Band - 3
Learners demonstrate and apply relevant engineering technical skills effectively, by applying and using appropriate engineering processes, tools and techniques.
Learners demonstrate and apply engineering technical skills to develop a complete and effective solution/outcome.

AO5 Manage and evaluate the project – Band – 3
Learners manage the project, including preparation and planning of a wide range of project stages, time frames and resources.
Learners evaluate a range of their approaches, skills and accomplishments.

Feedback from Assessor to Learner

Well done. You have produced an assessment which meets all of the assessment objectives across all of the tasks. You have worked diligently throughout and your hard work during the theory part of the course has lent itself well to your application in this synoptic assignment.

Comments from Learner

I have enjoyed this synoptic project and have been happy with the level of feedback that I have received throughout.
I have particularly liked how the theoretical knowledge covered can be applied to a wholly vocational scenario – I feel that this has prepared me well for further study or employment.

Any further actions? (Please initial and date once actions have been completed)			
In future assessments, where you use additional sources to help you with your work, you may wish to consider including a bibliography (see me if you want more information) as this will help prepare you for study at Level 3.			
Learner Signature	 Lucy Benjamin	**Date**	28th February 2018
Assessor Signature	 Laura Mulligan	**Date**	28th February 2018

Marking Guide

/\ word missing	sp spelling	p punctuation	gr grammar
ex poor expression	T wrong tense	? meaning unclear	
Cp capital letter	// new paragraph	! not sure what this is—incoherent	

External Quality Assurer Commentary

Grade awarded for this assessment criterion – **Level 2 Distinction**

Justification for the awarded grade:

AO1 - Recall knowledge and show understanding

Band – 3

The learner recalled and communicated **a wide range of accurate** and **comprehensive** engineering knowledge and understanding. This was evident during the learner interview when she was able to recall knowledge, explain her application in undertaking a practical and explain the impact of the application.

Subject specific terminology was used **accurately** and **consistently throughout** the project. Again evident during the interview and through observations, learner could articulate herself well, using correct subject specific terminology.

AO2 - Apply knowledge and understanding

Band – 3

The learner **accurately** applied knowledge and understanding of maths, science and engineering theory, which is **relevant** to the context and situation. Final outcome demonstrated good numeracy skills in measuring and marking out for pieces and in application during CAD processing. Applying physical and engineering principles in materials testing yielded reliable results which could appropriately inform decision making on materials, tools and equipment later in the manufacturing process.

AO3 Analyse and evaluate knowledge and understanding

Band – 3

The learner **critically** analysed and evaluated engineering information, **systematically** judging and reaching **reasoned** and **valid** conclusions. Evidence in portfolio of materials testing and used of data from results to make decisions on materials, tools and equipment.

AO4 Demonstrate and apply technical skills and processes

Band – 3

The learner demonstrated and applied **relevant** engineering technical skills **effectively**, by applying and using **appropriate** engineering processes, tools and techniques. The learner has demonstrated confidence and worked to all safety expectation when undertaking any practical applications.

The learner demonstrated and applied engineering technical skills to develop a **complete** and **effective** solution/outcome. Hydraulic excavator has been completed to a very good standard and is fully working.

AO5 Manage and evaluate the project

Band – 3

The learner managed the project, including preparation and planning of **a wide range of** project stages, time frames and resources. The learner worked diligently in producing both her portfolio and her final model. Setting time plans and quality expectation and observed adhering to these and completing all the work in a timely manner.

The learner evaluated **a range** of their approaches, skills and accomplishments. There is evidence throughout the process that the learners has self-evaluated, using data from test results and reacted to peer feedback when working in buddy groups to question her own practice and make improvement or adjustments where required.