Sample portfolio: Level 2 Pass

NCFE Level 1/2 Technical Award in Engineering

QN: 603/2963/4

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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.

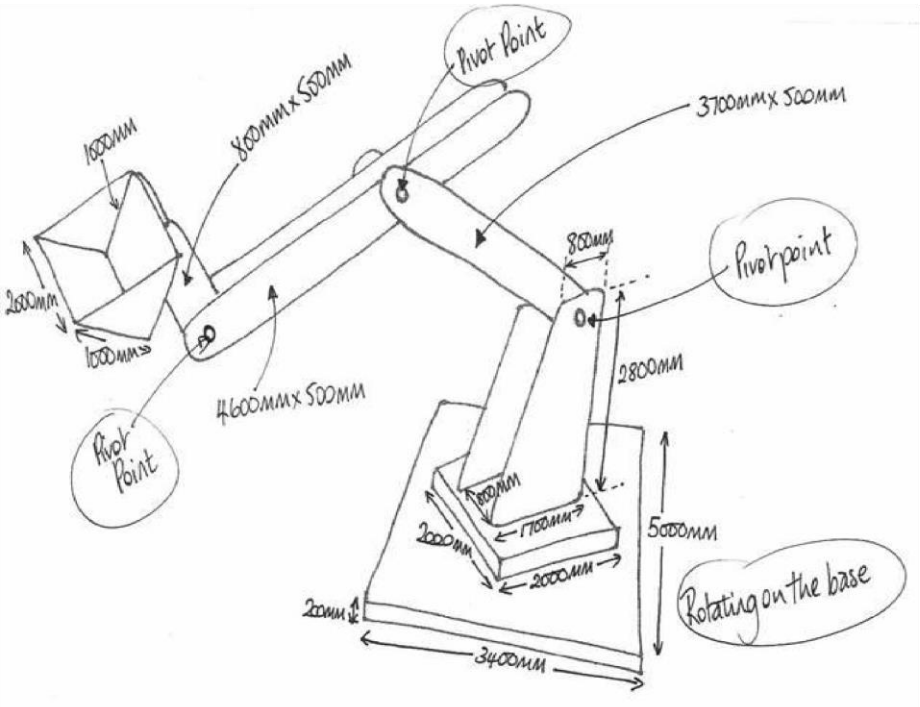
The portfolio should include:

- 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).

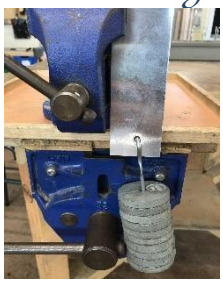
During the project, you will need to refer to the 'Project Brief' to obtain information.

Learner Evidence

MATERIALS TESTING

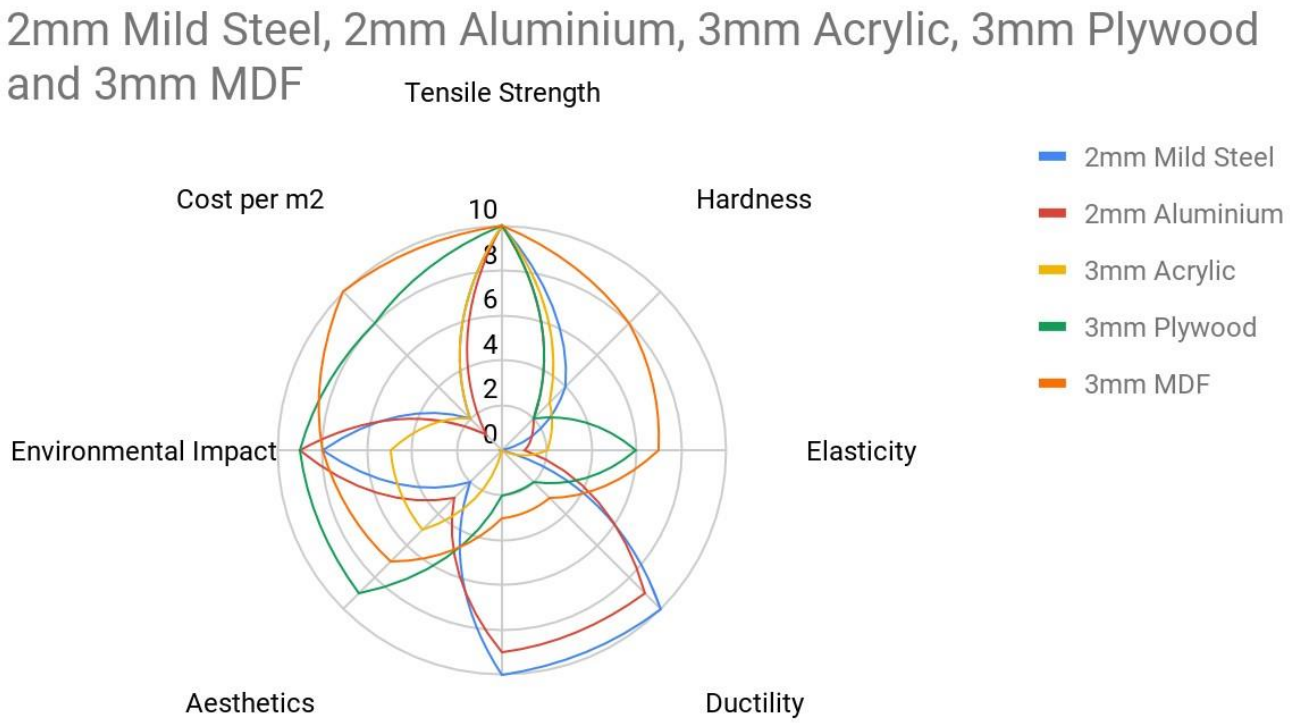
PROPERTY	*DESCRIPTION*
Tensile Strength	*Withstanding force when stretched* *Measured by fitting into a vice, and hang weights off the other end*
Hardness	*Resistance to scratching, cutting, denting and wear* *Measured by dropping a 1 inch diameter ball bearing down a tube onto material and measuring the height of its bounce*
Elasticity	*The ability to regain its original shape after it have been deformed* *Measured by fitting into a vice, and hang weights from a piece of string off the other end, then cut the string and measure the spring back.*
Ductility	*The ability to be stretched and permanently deformed without breaking* *Measured by fitting into a vice, and use a lever to fold the material to 90 degrees inspecting the outside*
Malleability	*The ability to be easily pressed, spread and hammered into shapes* *Measured by fitting into a vice, and use a lever to fold the material to 90 degrees inspecting the inside*

MATERIALS PROPERTIES TESTING RESULTS

PROPERTY	2mm Mild Steel 	2mm Aluminium 	3mm Acrylic 	3mm Plywood 	3mm MDF 
Tensile Strength 	no change Score 10/10	no change Score 10/10	no change Score 10/10	no change Score 10/10	no change Score 10/10
Hardness 	Height of bounce 140cm Score 4/10	Height of bounce 120cm Score 2/10	Height of bounce 130cm Score 3/10	Height of bounce 120cm Score 2/10	Height of bounce 180cm Score 8/10

Elasticity 	Score 0/10	Score 1/10	Score 2/10	Score 6/10	Score 7/10
Ductility 	Cracks / damage None 10/10	Cracks / damage None 9/10	Cracks / damage Shattered 0/10	Cracks / damage split and splintered 2/10	Cracks / split and tore 3/10
Malleability 	Cracks / damage None 10/10	Cracks / damage None 9/10	Cracks / damage Shattered 0/10	Cracks / damage split and splintered 2/10	Cracks / damage split and tore 3/10
CHARACTERS	2mm Mild Steel	2mm Aluminium	3mm Acrylic	3mm Plywood	3mm MDF

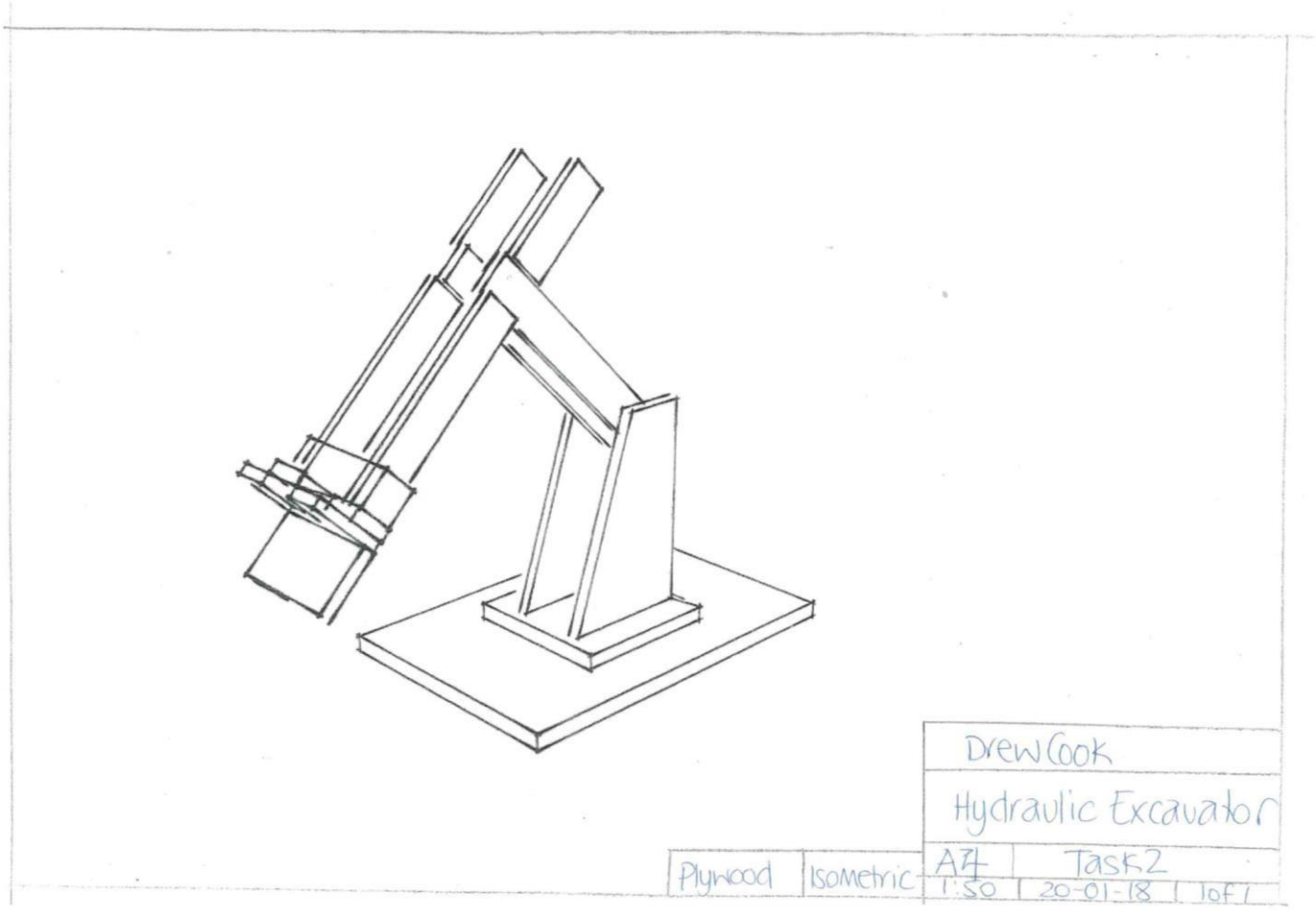
Aesthetics	*grey smooth matt* *2/10*	*silver smooth shiny* *3/10*	*blue smooth shiny, some scratches* *5/10*	*light wood woody matt* *9/10*	*brown smooth matt* *7/10*
Environmental Impact	*Sustainable and recyclable* *8/10*	*Sustainable and recyclable* *9/10*	*Not sustainable but is recyclable* *5/10*	*Sustainable and recyclable* *9/10*	*Sustainable wood but not the glue* *8/10*
Cost per m2	*£32.47* *2/10*	*£38.73* *1/10*	*£32.95* *2/10*	*£6.40* *8/10*	*£4.12* *10/10*



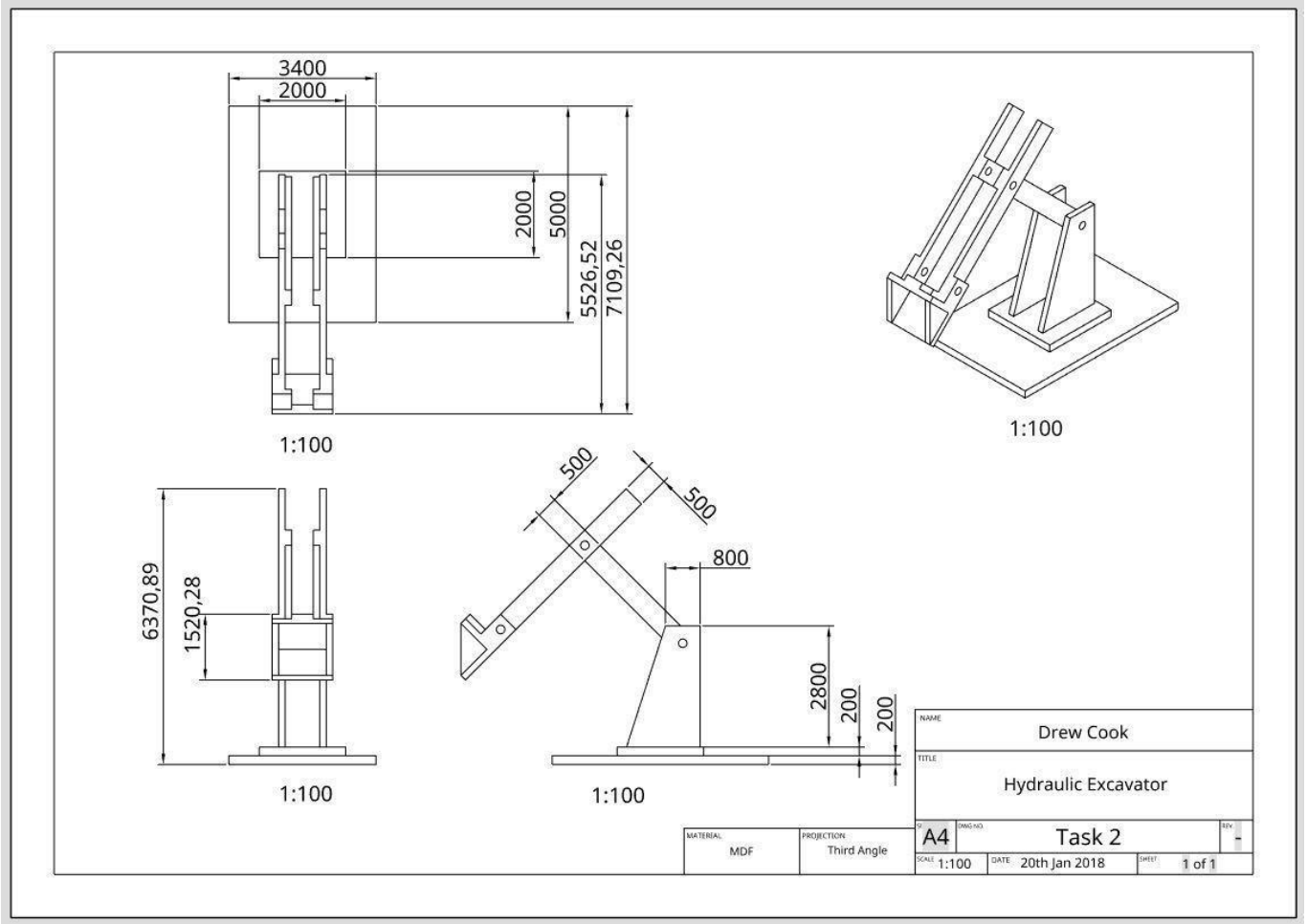
SELECTED MATERIALS, COMPONENTS AND TOOLS WITH JUSTIFICATION

MATERIAL	*TOOL & MACHINERY*	*JUSTIFICATION FOR USE*
Model pieces will be made from MDF	*Hand Tools* • *Engineers trisquare* • *Marking gauge* • *Tenon saw* *Power Tools* • *Cordless drill* • *Glue Gun* • *Hand Sander* • *Cordless drill* *Fixed machines* • *Pillar drill* • *Disc sander* *CAM* • *Laser Cutter*	*I have chosen to use is 3mm MDF.* *From my testing I can see that MDF is low cost when compared to the other materials. It got a good aesthetics score. MDF is also a sustainable materials* *I will 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 and finish these with the disc sander. Any holes will be marked out and drilled with a pillar drill or cordless drill. The smaller parts will be cut on the laser so they are accurate. Some fixed parts will be glued together using a glue gun for speed and moving parts will be jointed with 3mm dowel*
Components - 3mm dowel rod	*Hand Tools* • *Coping saw* • *Wire cutters* • *Sand paper* • *Power Tools* • *Glue Gun*	*The material I have chosen to use for joints is dowel rods. These are cheaper than nuts and bolts and can be attached quickly with a glue guidance n.*
Components - Nylon cable ties	*Hand Tools* • *Wire cutters*	*I will be using nylon cable ties to connect the syringes to the dowel 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.*
Components – plastic syringes - filled with coloured water	*Power Tools* • *Cordless Drill*	*I will use plastic syringes to act as the hydraulic mechanics for the model. This is the most cost effective option to show Pascal's principle*
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.*

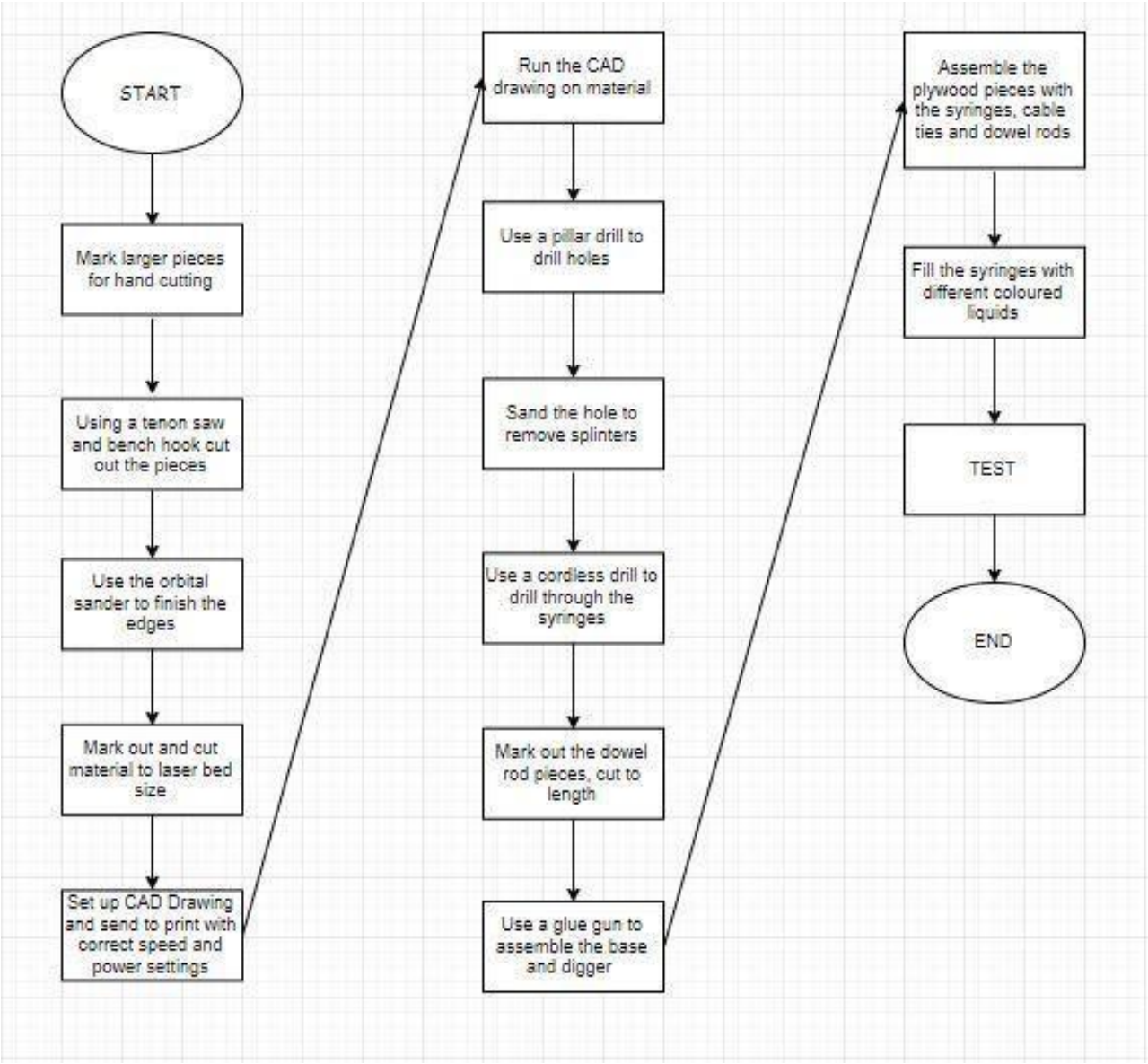
HAND DRAWINGS - Isometric Projection



CAD DRAWINGS - Third Angle Orthographic projection



PRODUCTION PLAN - FLOW DIAGRAM

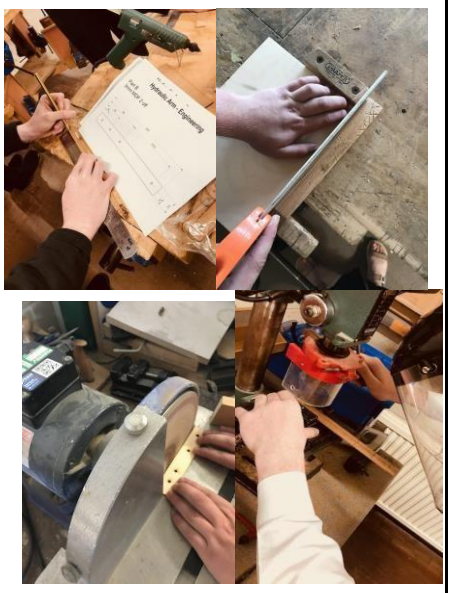


PRODUCTION PLAN – RISK ASSESSMENT FOR A PILLAR DRILL

Hazards	*Built in precautions*	*Risks*	*Additional precautions*

Rotating equipment	When powered if the top of the pillar drills open the power will shut off. There is also a kick plate what will stop all power going to it when kicked and there's an off button at the side.	Can get tangled and possible death and your hair and scalp could get ripped off. If you are not careful you could get a drill bit through your hand what would be very painful.	If you have long hair the best thing you would do is where a hair bobble to stop it going too far. You could also wear a hairnet what stop all your hair from dangling down
Not clamping materials	There will be clamps on the pillar drill what will be used to keep your work in place what means your hands will be free.	If u do not clamp down your materials it could get caught in the drill bit and start spinning and possibly come flying off at someone.	Wearing your gloves to protect your hands eye protection what can protect you if your works isn't clamped down.
Electric shock	On the pillar drill there will be a cut of switch what will stop all power going to the machine.	The risk could be minor shock to a big electrical incident what could cause fibrillation to the heart.	You could wear rubber soles on your feet what should stop a major electrical incident.
Violent ejection	There's a guard on the machine to stop it from happening so you need to make sure that you keep it down on the pillar drill.	The risk of the drill bit coming / flying off is that it could go straight through your body serious injury or even death.	You could clamp your work down so your hands will be free you can also you use the guard what should protect you from the drill bit.

Practical Progress Log

	Tool or machine Used	*Description of progress log entry*	*Photographic evidence.*
1	• *Laser Cutter (CAM Machine)* • *TriSquare* • *Ruler and Tape Measure* • *Pencil*	*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 then set up CAD Drawing from my 2D Design file, making the amendment to the laser and send to cut.*	
2	• *Tri Square* • *Ruler and Tape Measure* • *Pencil* • *Bench Hook* • *Tenon saw* • *Disc sander* • *Sand paper* • *Pillar drill*	*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.* • *I used the disc sander to finish the edges to ensure they were smooth* *I then used a pillar drill to drill all the holes and sanded the hole to smooth over.*	
3	• *Cordless drill*	*I used a cordless drill to drill through the syringes.*	

4	• Wire cutters	I marked out the dowel rod pieces to assembly the excavator, each piece was marked using a pencil cut to length using wire cutters.	
5	• Glue gun • Wire cutters	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 MDF pieces with the syringes, cable	
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	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**	Drew Cook
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 2 for AO4 having met the assessment criteria to an acceptable standard whilst maintaining a mostly 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 applied your knowledge and understanding of maths, science and engineering theory, which is mostly accurate and of some relevance to the context and situation - Band 2	**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

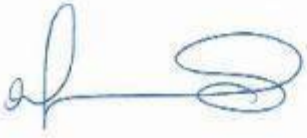
PEER OBSERVATION

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	Drew Cook
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 demonstrated some ability to explain the manufacturing processes you have undertaken. Your knowledge is of a acceptable standard which was evident through observation of practical application	

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

Evaluation of the project.

I thought the materials testing was good, but some of the results did not really help me much. I think the MDf was the best material as it got really good scores on my star profile. I am glad I went with this material as it was easy to work with and looked ok at the end.

Cost was very important as this had to be a reasonable price for a business. 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.

I was not completely happy with my isometric drawing and had to make a few attempts at this before I could get it right, I found drawing on isometric grid paper helped, then I could trace through the final drawing using a light box. I find it harder to visualise something in isometric and can get confused something with where this lines should go.

I also found the CAD drawings hard and had to spend a lot of my time on this however I found this to be a much faster way of working then hand drawing and errors could be rectified easily. I also thought the CAD drawings looked much more professional and was happier with how they looked with when printed out.

I decided to do the production plan as a flow diagram to make each stage of the process clear. I thought my plan was quite accurate and I did follow this in the manufacturing stages, although I could have added more detail.

I had to get some help in setting up and using the Laser cutter get the power and speed setting correct

I set up and used the pillar drill, I was happy using the pillar drill, but did forget to drop the guard on the first use and was reminded by another person. I remembered to do it after then

I made sure my tie was tucked into my shirt, I wore a DT apron and wore goggles

I am happy with the final outcome I think it looks really ok, I think the blobs of glue could have been a bit smaller!

Assessor Feedback to Learner

Learner Name	Drew Cook	**Qualification Name**	
Assessor Name	Laura Mulligan	**Qualification Number**	

Please list the assessment objectives which were achieved

AO1 Recall knowledge and show understanding – Band - 2
Learners recall and communicate a range of appropriate engineering knowledge and understanding, with some accuracy.

Subject specific terminology is used appropriately on occasions.

AO2 Apply knowledge and understanding – Band - 2
Learner's application of knowledge and understanding of maths, science and engineering theory is mostly accurate and has some relevance to the context and situation.

AO3 Analyse and evaluate knowledge and understanding – Band - 2
Learners appropriately analyse and evaluate engineering information, judging and reaching suitable conclusions.

AO4 Demonstrate and apply technical skills and processes – Band - 2
Learners demonstrate and apply mostly relevant engineering technical skills by applying and using mostly appropriate engineering processes, tools and techniques.

Learners demonstrate and apply engineering technical skills to develop a mostly complete and working solution/outcome.

AO5 Manage and evaluate the project – Band – 2
Learners manage the project, including preparation and planning of a range project stages, time frames and resources.
Learners evaluate some of their approaches, skills and accomplishments.

Feedback from Assessor to Learner

Well done. You have produced an assessment which attempts all of the assessment objectives across the tasks which demonstrates some accuracy and relevance with suitable conclusions. You have worked to the best of your ability throughout and evidence of the learning from the theory part of the course can been seen in some parts of this synoptic assignment.

Comments from Learner

Although I have enjoyed doing the synoptic project I have found some parts difficult and would have liked more time to do a better job of my practical model. I think the feedback that I have received have been fair and has helped guide me through.

Any further actions? (Please initial and date once actions have been completed)			
You need to focus more on the planning of the production in future to help prepare you for the practical undertaking. You may also think about where you use additional sources to help you with your work, including a bibliography as this will help prepare you for study at Level 3.			
Learner Signature		**Date**	February 2018
Assessor Signature		**Date**	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 – Band 2

Justification for the awarded grade:

Learners recall and communicate **a range** of **appropriate** engineering knowledge and understanding, with **some accuracy**. This was evident during the learner interview when he was able to recall some knowledge which was mostly accurate
Subject specific terminology is used **appropriately** on **occasions**. Again evident during the interview and through observations, learner could articulate on occasion correct subject specific terminology.
Learner's application of knowledge and understanding of maths, science and engineering theory is **mostly accurate** and has **some relevance** to the context and situation. Final outcome demonstrated numeracy skills in measuring and marking out work pieces, during CAD operations and in collating data. He could apply some relevance to materials testing and achieved some relevant results

Learners **appropriately** analyse and evaluate engineering information, judging and reaching **suitable** conclusions. Evidence in portfolio of materials testing and used of data from results to make suitable decisions about materials, tools and equipment.

Learners demonstrate and apply **mostly relevant** engineering technical skills by applying and using **mostly appropriate** engineering processes, tools and techniques. The learner has demonstrated confidence and safe working practices when undertaking any practical applications.

Learners demonstrate and apply engineering technical skills to develop a **mostly complete** and **working** solution/outcome. Hydraulic excavator has been mostly completed and is operational with some areas for further improvements.

Learners manage the project, including preparation and planning of **a range** project stages, time frames and resources. The learner planned work strategy to produce both a portfolio and a final model. Time plans was adhered to as witnessed in observations

Learners evaluate **some of** their approaches, skills and accomplishments. There is evident of self-evaluated and use of data from test results to evaluate some of his approaches.