T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Engineering, Manufacturing, Processing and Control (8730-13)

8730-034 Employer-Set Project Exemplar – E Grade

Summer 2023

City & Guilds | eal

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Introduction

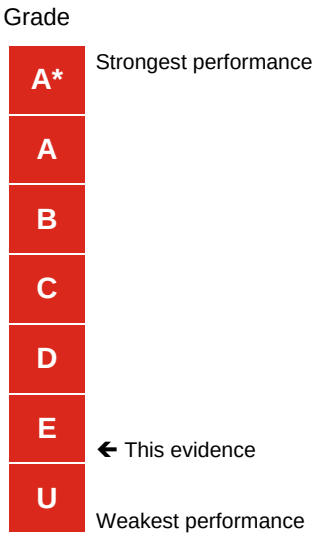
Summer 2023 Results

This document is aimed at providers and learners to help understand the standard that was required in the summer 2023 assessment series to achieve an E grade for the 8730-034 Engineering, Manufacturing, Processing and Control Employer-Set Project (ESP).

Providers and learners may wish to use it to benchmark the performance in formative assessment against this to help understand a potential grade that may be achieved if a learner was to attempt the next summative assessment series.

The Employer-Set Project is graded A* to E and Unclassified.

The exemplar evidence provided for the E grade displays the holistic standard required across the tasks to achieve **two marks above** the E grade boundary for the summer 2023 series. A slightly weaker performance would have resulted in an Unclassified (U) result being issued.



The Employer-Set Project brief and tasks can be downloaded from here.

Important things to note:

- We discussed the approach to standard setting/maintaining with Ofqual and the other awarding organisations before awarding this year. We have agreed to take account of the newness of qualifications in how we award this year to recognise that students and teachers are less familiar with the assessments (Vocational and technical qualifications grading in 2023 – Ofqual blog), whilst also recognising the standards required for these qualifications.

- The exemplar evidence presented, as a whole, was sufficient to achieve the E grade. However, performance across the tasks may vary (i.e. some tasks completed to a higher/lower standard than an E grade).

Marking of this Employer-Set Project is by task and Assessment Objective, below is a summary of these along with the mark achieved by the evidence presented and the maximum mark available for each aspect.

Task	Assessment Objectives	Mark achieved	Max mark available
Task 1 Research	- AO1 Plan their approach to meeting the project brief - AO2a Apply core knowledge - AO3 Select relevant techniques and resources to meet the brief	2	9
	- AO2b Application of core skills	2	6
Task 2 Report	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	3	6
	- AO2a Apply core knowledge	3	6
	- AO2b Application of core skills	3	6
Task 3 Design	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	2	6
	- AO2a Apply core knowledge	2	6
	- AO2b Application of core skills	3	6
	- AO5a Realise a project outcome – was the right outcome achieved - AO5b Review how well the outcome meets the brief, how well the brief was met, the quality of the outcome in relation to the brief	2	6
Task 4 Present	- AO1 Plan their approach to meeting the project brief - AO3 Select relevant techniques and resources to meet the brief	2	6

	- AO2a Apply core knowledge	2	6
	- AO2b Application of core skills	1	6
	- AO5a Realise a project outcome – was the right outcome achieved - AO5b Review how well the outcome meets the brief, how well the brief was met, the quality of the outcome in relation to the brief	1	6
Maths	- AO4a Use of Maths skills	1	3
English	- AO4b Use of English skills	2	3
Digital skills	- AO4c Use of digital skills	1	3

What evidence was being assessed for the maths, English and digital skills:

Maths:

- Volume calculations and initial design sketches (Task 1 & 2)
- Assembly drawings – dimensions and scaling (Task 3)
- Design calculations (Task 3)

English:

- Research notes (Task 1)
- Report (Task 2)
- Assembly drawings and supporting notes (Task 3)
- Presentation delivery (orally) and materials to support presentation (e.g. slides etc) (Task 4)

Digital:

- Types of sources used for Research (Task 1)
- Assembly drawings (Task 3)
- Presentation materials (slides, handouts, notes etc) (Task 4)

Task 1 Research

Assessment number (eg 1234-033)	8730-034
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	1
Evidence title / description	**Evidence expected for marking:** Research notes (typically 1500 words) List of references/sources **Evidence submitted for marking:** Research notes (typically 1500 words)
Date submitted by candidate	DD/MM/YY

Project

The Employer

RYZ Engineering; a medium sized manufacturer of machined and fabricated tooling assemblies on a ‘build to print’ basis. They either manufacture single or batches of components that are then shipped to the client. Their work often requires specific or complex heat treatment, carrying out processes such as hardening, tempering and case hardening. Currently RYZ Engineering can only carry out basic heat treatment processes, and products need to be quenched on a regular basis to fix the material grain structure. But RYZ Engineering currently only have the ability to quench workpieces in water held in a metal bucket.

Project brief:

I have been tasked by the Chief Engineer of RYZ Engineering a medium sized manufacturer to design a quenching tank for small ADHOC (projects that aren’t planned) heat treatment work that requires the process of quenching. This is because it has been seen as not safe to fill up a bucket of oil and use that instead, due to considering it from toxicological, fire or slip hazard points. Meaning that I need to design and manufacture a custom quenching tank to sit closely to the workshop forge so that hot workpieces that easily be placed into the oil to cool. There are specific requirements that I need to ensure that I include when design and manufacturing this product, to meet all of the customers’ requirements, maximise success and ensure safety.

Customer requirements

When I designing and manufacturing RYZ Engineering quenching tank I have certain requirements that need to be taken in to consideration to meet the job role, suit their business and how and where it will be used.

These requirements are:

- The quenching tank must be able to hold a minimum of 20 litres of oil and up to a maximum of 50 litres of oil in the quenching tank without leakage.
- It must have a tolerance of 1 litre of oil to allow for the volume of components to be inserted and to stop it from boiling over and spillages.
- The tank must accommodate a wire mesh basket that has already been commercially purchased that can either have a handle or wire hook that an be used to lift the wire basket out of the tank.
- The tank must be fitted a with a lid that completely covers the tank to stop any water and debris entering the tank, it also must be fitted with a seal to prevent access to air and so that any fire can be extinguished by the lid. The must

have a handle so that the lid can it can easily be lifted off the top of the quenching tank.
- Located at the at the side of the quenching tank near the bottom should be a drainage to plug to easily usable and accessible. This should be oil tight so that the it be can routinely drained and cleaned to remove any debris or components sitting at the bottom of the quenching tank so that oil can be replaced.

General issues

The Chief Engineering of RZY made some general considerations that should be taken into when designing, constructing and using the quenching tank. For example

- Health and safety risks and issues, this will be largely taken into consideration as the product can be dangerous if the regulations aren't followed.
- Basket insertion/extraction
- Checks required to ensure that it is function how it should do correctly (routine maintenance)

Task 1 research

Item being created

What is a quenching tank?

A quenching tank is a device that is capable of cooling moulded pieces just before they are sheared or sent to the process of recovery.

Project plan

I plan to design and manufacture a stainless-steel quenching tank that is simple and easy to use by all, it can also be easily used and with the correct maintaining and care it will be long lasting and hard wearing. It will also be mobile so that it can be moved around the work shop with ease. I hope to design it to be as simple and easy to use, but at the same time safe follow the relevant HSE guidelines to storing oil and using heated objects.

Materials

When thinking about materials for a project like this I believe that is should meet the following criteria to maximise usage these are:

- What is the strength and integrity of the materials?
- Is it permeable?
- Is it hard wearing?
- What is the specific heat capacity?

- Is the material easy to work with? i.e can it be bent, cut, reshaped
- How does the material cost?

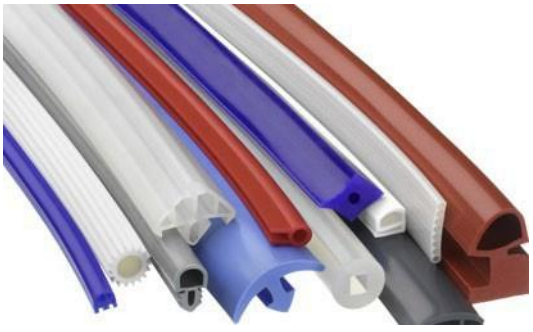
Stainless steel

After researching different materials, I made the decision that stainless steel to be the main material that is used to construct the quenching tank. This is because it is primarily made from iron and carbon meaning that it is corrosion resistant. Along with this it is also a highly durable metal meaning that it can withstand harsh conditions of wear and tear. For example, it is scratch resistant and has an invisible layer of chromium meaning that it prevents oxidation, it also has a specific heat capacity of 468 joules per kilogram per degree Celsius and a melting point of 1400-1455 degrees Celsius. Meaning that it would be able to withstand the heat of the hot oil.

Stainless steel is also easy to work with meaning that it can easily bend, cut and welded into different shapes. The disadvantage of using stainless steel is that it is a very expensive to buy.

Rubber seals

I chose to silicone would be the best rubber to use for the seals on the lid of the quenching tank as they have a high resistance to heat with temperatures up to 305 degrees Celsius meaning that they wouldn’t melt and keep the tank air tight.



Health and safety

The quenching tank in the wrong hand can be a very dangerous piece of equipment if the user has not received the correct training and doesn't know how to correctly operate it. This means there would have to be safety regulations put place and routine maintenance log book to state when it was last serviced and cleaned. Along with this RZY would be informed of what PPE would be required for them to wear following the Health and Safety Executive guidelines to keep workers safe by law.

Size of product

Listed in the project task it was said that the quenching tank must hold a minimum of 20 litres of oil and a maximum of 50 litres of oil without leaking and must allow enough space to allow the volume of the components that will be placed inside, this would be a maximum of 1 litre.

I would make mine hold a maximum of 52 litres to allow for the volume of the components and wire basket.

20 litres=20000 cubic centimetres

50litres=50000 cubic centimetres

Risks and quality standards

Risks:

There is a

Standards:

Throughout the project I plan to make sure that my product is of a high standard and then to ensure success to test and evaluate the part and phases of the project life cycle.

Scope and budget

For this project the employer hasn't made a set budget for this project but there must thought when coming to choosing things like materials so that the price isn't outrageous. Through the project I plan to keep track of the items and materials that have been purchased, through the designing and manufacturing phases storing all the information in a log book.

Previous products

Quenching tanks have

Task 2 Report

Assessment number (eg 1234-033)	8730-034
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	2
Evidence title / description	**Evidence expected for marking:** Written report (typically 2000 words) **Evidence submitted for marking:** Written report (typically 2000 words)
Date submitted by candidate	DD/MM/YY

Task 2- report

Looking back at my project brief I was tasked in the Chief Engineer of RYZ engineering to design and manufacture a quenching tank for heat treatment work. I have concluded that this project is achievable and I believe I can design and manufacture this product meeting all of their needs and desires. In the project brief I mentioned why this product needed to be manufactured for this engineering business due to previous unsafe method the company previously used, it also to allow RYZ Engineering to manufacture more high-quality items for their business. I

continued to outline in the project brief what that I need to make sure I cover when carrying out this project for example the customers requirements.

Materials and components

As part of my research I had to find a suitable material that could be used for the quenching tank, I thought the best decision would be to make it out of metal due to the physical properties that some metals portray. I then found that stainless steel meet all of the requirements that the quenching tank needed for example the material needed to be strong, have a high durability and withstand temperatures up too 1400 degrees Celsius. Which is all of the qualities that stainless steel showed. It is also an easy material to work with as it is easy to cut, bend and weld into different shapes and sizes.

But there was a large disadvantage compared to other materials, this was because an average 1000mm, 500mm, 1m sheet of stainless-steel retails at an average price of £230.

I started to question if the material was worth it. But after doing further research on other materials I concluded that I needed to turn my focus more to the quality of the item that I am producing then focusing purely on the budget.

To manufacture the quenching tank, I plan to purchase large sheets of stainless steel for the main body of the tank, I would also require the steel to be at least be 5mm thick, this is to ensure structural integrity and durability. The tank would also be welded on all sides of the tank to prevent leaking and it from falling apart.

The other material that I considered for the quenching tank was aluminium, but it had both advantages and disadvantages, meaning that its properties weren't better than steel. The advantages of using aluminium were: it has a high level of resistance to corrosion making it very durable, it is also very lightweight if I had chosen aluminium this would have been a really good property too have had as I plan to make the quenching tank mobile. It is also nonmagnetic and non-sparking what is a good property to have when working in this environment. But it did also have some disadvantages, these were; it has a high thermal conductivity, what isn't a good property to have when working with hot oil. It can also coast as much as steel or sometimes even more. Inconclusion it was a possible material that could have been used but didn't have the exact properties that were needed for it to be a success.

I plan to produce multiple rough sketches in 3rd angle projection using manual drafting, after coming up with a final design of what I want my quenching tank will look like. From there I will produce a final detailed drawing on google SketchUp.

The lid

Listed in the customers' requirements, it states that the quenching tank would also require a lid. This was to put a stop to any water or debris entering the tank, that must be fitted with a seal to prevent access to air and so that any fires can be extinguished with the lid. After searching the internet, I wasn't successful finding a pre-made lid that could be purchased and put on the quenching tank. This means that the lid will have to be made from scratch from stainless steel, it must also include to handles coming away from the main body of the lid. This decision was made with health and safety in mind, the user will still be wearing PPE to remove to remove the lid but so that the risk of the user burning their selves on the handles is massively decreased.

Silicone lid seal

In the customers' requirements I mentioned that there were other materials that needed to be included for example a rubber seal that was resistant to heat, that

needed to be placed around the top of the lid. This was to stop air entering to the quenching tank and to put a stop to any fires that had broken out by cutting off the oxygen supply to the fire. And the best material to use was a silicone seal cover the inside of the lid due it being able to withstand temperatures of 305 degrees Celsius. An advantage of using these is they can easily brought from a hardware store for a cheap price.

Small wheels

After looking at previous products that had been made in the past I wanted my quenching tank to have wheels on the bottom so that it could be easily moved around the workshop when it was in use. I searched for these and found that easily fixable, heavy duty wheels can be brought from various different hard where stores. A key requirements of the project so for the quenching tank to easily house a wire mesh basket so that components could be easily placed inside and removed by lifting the basket out.

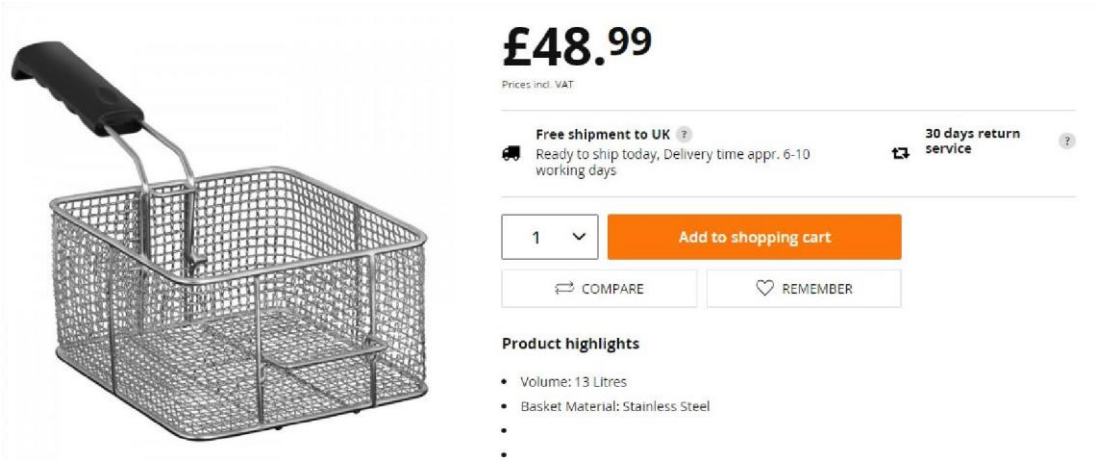
These could be purchased for a small price of £8.99 on Amazon.

Oil tap

For the product to meet RYZ requirements it would also needed to be fitted with a tap that could be used to easily empty all of the oil out of the quenching tank and

replaced. For this I have chosen to purchase a metal tap to be placed at the side of the tank. Retailing at £32.64 at the ‘choppershop.com’.

Wire mesh basket



After searching for a commercial basket to hold the components in the oil I came to the decision that a deep fat fryer basket is the best for the job as they are made from high grade steel. They are also designed to withstand high temperatures in the oil. There were no other baskets commercially available, that were right this role this was because they were made from different types of metal, these types of metal were not suitable to withstand the temperatures that they would be exposed too. Another reason for choosing this basket was to that it would easily inside the quenching tank, it could also be removed from the tank with ease.

The dimensions are:

35cm x 21cm x 12cm

I have also decided it would be best to remove the handle and the basket to be removed by wire hooks, this is so that the basket can fit better into the quenching tank.

Sizing of quenching tank

Part of the design specification, it was said that RYZ Engineering needed the quenching tank hold a minimum of 20 litres of oil and an maximum of 50 litres of oil.

The quenching it also needed to allow for volume of components being placed inside this would be maximum of 1 litre. But I found that if I was to make the quenching tank hold a maximum of 51 litres of oil, it would be filled to the top making their be a large chance of spillages. Meaning that the tank would have to have a marking showing the user the maximum amount of oil that it can store.

I decided to make my quenching tank in the shape of a square and have straight edges, I think this so that I would be easier to manufacture and less time consuming than if I was to round the edges of the tank.

The dimensions of my quenching tank would be:

40cm x 40cm x 40cm= 64000cm cubed

Length x width x height = volume

64000cm cubed = 64 litres

I have calculated that this is best size for the quenching tank as it would meet the Chief Engineers requirements of holding a minimum 20 litres and 50 litres maximum, it would also allow the displacement of one litre along with this it then allows a tolerance of 13 litres for the oil to boil and not over fill.

Approach to designing

After completion of the report phase and starting the design phase I plan to manual draft ideas and different concepts to help me picture how my product could look like. For this to be successful I will produce 10-15 different drawings of what my quenching tank could look like, following up from this phase I would take the best drawing and covert it over to google SketchUp. From there I will produce a full detailed drawing of what my end product will look like including measurements and all of the components.

Health and safety

Whilst researching, I read multiple of the HSE regulations that I have decided will need to be followed, along with the user receiving the appropriate training before it is used. This is so that if an accident was to occur then both the victim, RZY and me would not get into legal implications if RZY are given the right safety information, wear the right PPE and they receive sufficient training so they are protected from an accident.

Risks and quality standards

Standards:

When producing this product I can ensure a RZY high quality item at the end of this project

Scope and budget

In the employers brief a budget was not mentioned for this project, but I have learnt from researching different materials that this project isn't going to be cheap, due to what is needed for this project to be successful. But throughout this project I plan to produce a log book and keep every purchase and expense noted in one place.

Task 3 Design

Assessment number (eg 1234-033)	8730-034
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	3
Evidence title / description	**Evidence expected for marking:** Drawings (typically to A3 drawings) Supporting design calculations and reflection notes (typically two sides of A4) **Evidence submitted for marking:** Drawings (typically to A3 drawings) Supporting design calculations and reflection notes (typically two sides of A4)
Date submitted by candidate	DD/MM/YY

$= 50,000 cm^3$

30
35 35
$40 \times 40 \times 40$
45 $64000 cm^3$

LxWxH

$2500 \times 1000 \times 500$

$250 \times 10 \times 5$

15×10
$300 \times 15 \times 10$

$50 \times 30 \times 35$

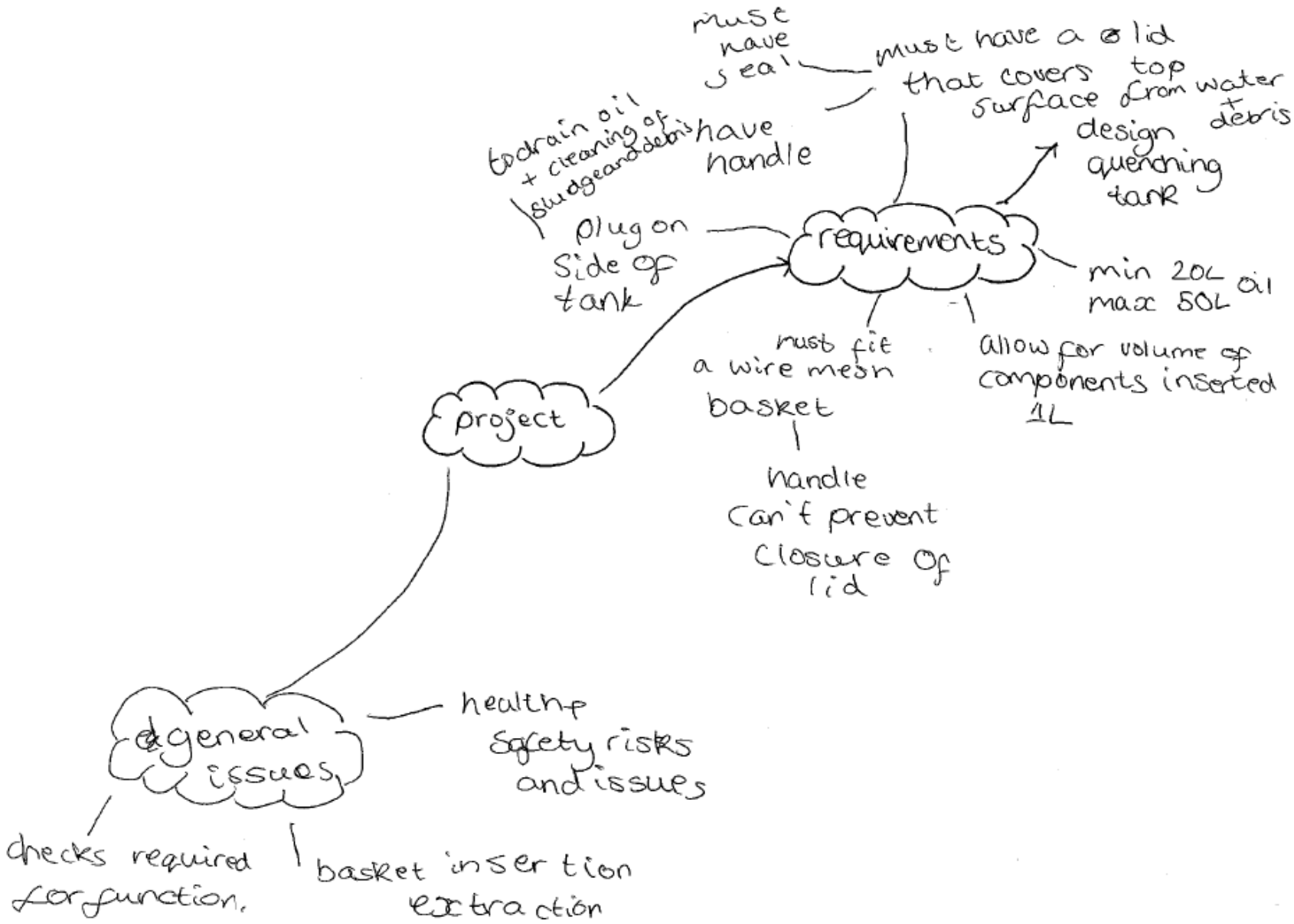
64
51
13

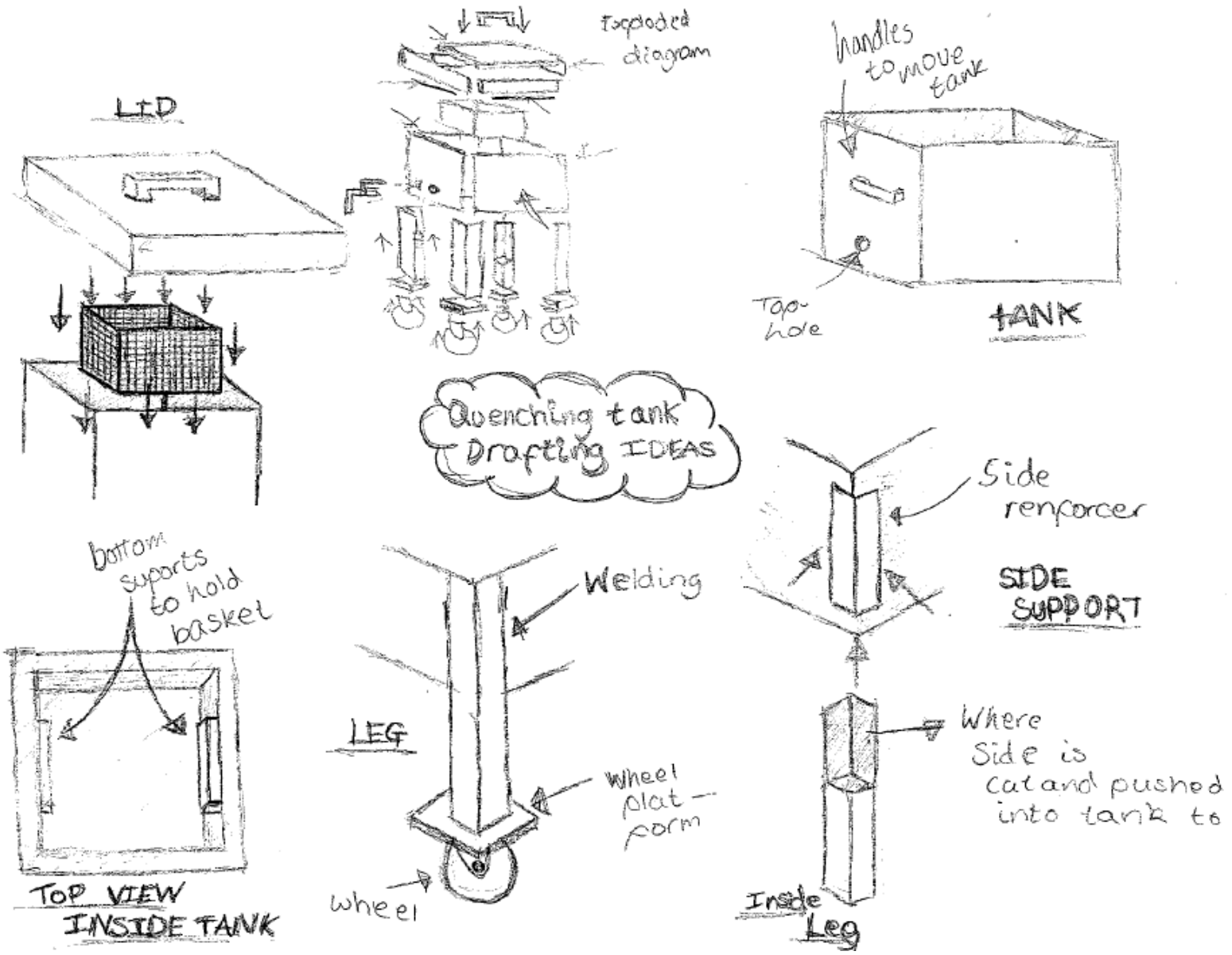
40

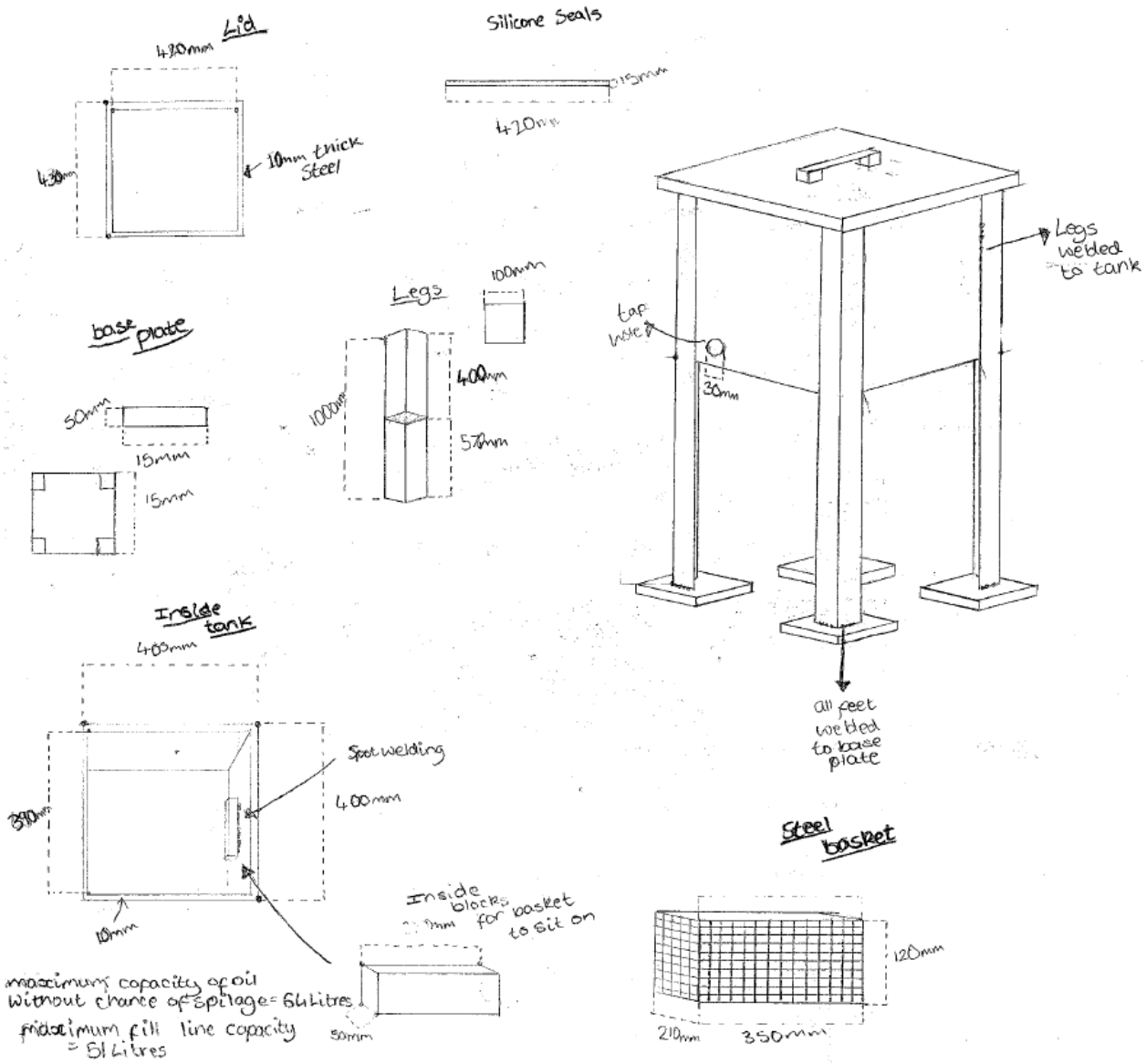
40

40

$35 \times 35 \times 30$


must have seal
must have a lid that covers top surface from water + debris
to drain oil + cleaning of sludge and debris
have handle
design quenching tank
plug on side of tank
requirements
min 20L oil max 50L
must fit a wire mesh basket
allow for volume of components inserted 1L
project
handle can't prevent closure of lid
general issues
health + safety risks and issues
checks required for function.
basket insertion extraction


LID
Exploded diagram
Handles to move tank
Tap-hole
TANK
Quenching tank Drafting IDEAS
Bottom supports to hold basket
TOP VIEW INSIDE TANK
Welding
LEG
Wheel plat-form
Wheel
Side reinforcer
SIDE SUPPORT
Where Side is cut and pushed into tank to
Inside Leg


Lid
420mm
430mm
10mm thick Steel
Silicone Seals
15mm
420mm
base plate
50mm
15mm
15mm
Legs
100mm
1000mm
400mm
570mm
Legs welded to tank
tap hole
30mm
all feet welded to base plate
Inside tank
400mm
390mm
Spot welding
400mm
10mm
Inside blocks for basket to sit on
50mm
maximum capacity of oil without chance of spillage = 64 litres
maximum fill line capacity = 51 Litres
Steel basket
120mm
210mm
350mm

Task 4 Present

Assessment number (eg 1234-033)	8730-034
Assessment title	Employer-Set Project

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234

Provider name	<provider name>
City & Guilds provider No.	999999a

Task(s)	4
Evidence title / description	**Evidence expected for marking:** Presentation materials **Evidence submitted for marking:** Presentation materials
Date submitted by candidate	DD/MM/YY

QUENCHING TANK PROJECT

THE EMPLOYER

A company by the name of RYZ Engineering a medium sized manufacturer of machine and fabricated tooling assemblies on a 'build to print basis'. Where they either manufacture single or batches of components, they are then shipped to the client. Sometimes their work can require specific heat treatment, but the company can only carry out basic heat treatment processes.

This project so far has been broken down into 4 phases, the first being research, then a producing a report, designing by hand what I wanted the project to look like and finally presentation, where I explain my project.

The chief engineer of RYZ engineering, had tasked me with manufacturing a quenching tank for small projects. For those who don't know, quenching is the process where extremely hot metal components are taken and placed into a liquid to receive a nice finish. The chief engineer wanted this tank because of their previous practise of filling a bucket of oil was unsafe. Meaning that I needed to design and manufacture a quenching tank that was easy and sae to use so that the employees can forge hot pieces of metal that can be placed into oil to cool.

PROJECT BRIEF

CUSTOMER REQUIREMENTS

When designing and manufacturing the quenching tank for RYZ engineering I was asked to meet the following requirements to suit them and their business, how and where it will be used.

These requirements are:

-have the ability to hold a minimum of 20 litres of oil and up to 50 litres of oil.

-it must also allow 1 litre of oil to allow for the displacement of the components being placed in the oil and to allow for the oil to boil without it causing spillage.

-the had to accommodate a commercially brought wire mesh basket.

-the tank must be fitted with a lid that covers the whole tank

-located at the side of the tank near to the bottom needs to be a hole where a tap could be fitted.

Employer-Set Project – Presentation Q & A Record (Task 4)

8730-12 T Level Technical Qualification in Maintenance, Installation and Repair for Engineering and Manufacturing

8730-033 Employer-Set Project (Summer 2023)

Candidate name	<first name> <surname>
City & Guilds candidate No.	ABC1234
Date	DD/MM/YY

Provider name	<provider name>
City & Guilds Provider No.	999999a

Record observation notes below to inform external marking. **Notes must be detailed, accurate and differentiating.**

Tutor questions to candidate	Candidate responses
What parts of the brief did you find the most challenging?	Trying to calculate the size fitting min & allowing expansion
What size & shape of basket? Why chosen?	Size of tank to withstand 50L 35X21X12 basket 64L total
What other materials did you consider?	All- light, strong, easy of use. Not withstand the heat. Needed to consider requirements of the brief.
If done again, what would you differently?	Not mobile, incorporate a bench and consider the shape.

Any other comments

Tutor signature	Date
X _____	DD/MM/YY

If completing electronically, double click next to the 'X' to add an electronic signature once the record is **finalised**.

Get in touch

The City & Guilds Quality team are here to answer any queries you may have regarding your T Level Technical Qualification delivery.

Should you require assistance, please contact us using the details below:

Monday - Friday | 08:30 - 17:00 GMT

T: 0300 303 53 52

E: **technicals.quality@cityandguilds.com**

W: **http://www.cityandguilds.com/tlevels**

Web chat available **here**.

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