T-LEVELS | Institute for Apprenticeships & Technical Education

T Level Technical Qualification in Engineering, Manufacturing, Processing and Control

Employer-Set Project (8730-034)

Project Brief Summer 2023

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The employer

RZY Engineering is a medium sized manufacturer of machined and fabricated tooling and assemblies on a 'build to print' basis. The company is contracted by a wide variety of clients to manufacture tools, tooling, components and assemblies to either designs provided by the client or internally produced designs. RZY Engineering then manufacture either single items or batches of components, which are subsequently delivered to the client.

Given the variety of work and the often widely differing requirements, specific or complex heat treatment of parts is often contracted out by RZY Engineering to an external specialist heat treatment company. Within the workshops basic heat treatment such as hardening, tempering and case hardening can be undertaken on a small workshop forge, which can be used to heat a workpiece up to 900 ºC. Use of this forge avoids the cost and delay of documenting and dispatching small simple components and tools to be heat treated externally.

The problem with heat treating materials in-house is that a workpiece often needs to be quenched to fix the material grain structure, however, currently RZY Engineering has only been able to quench workpieces in water held in a metal bucket. Whilst water is cheap and efficient, it can produce embrittlement, distortion, and cracking in the workpiece. A potential alternative is quenching in oil. Oil is an effective cooling agent but has a reduced cooling rate, resulting in less embrittlement and cracking.

The project

The RZY Chief Engineer has decided that for small ad hoc heat treatment work that requires quenching, workpieces will be cooled in an oil bath rather than a bucket of water.

Whilst consideration was given to just filling a bucket up with a commercially available quenching oil it was recognized that this was not safe from both a toxicological, fire or slip hazard viewpoint. Therefore, it is necessary to design and manufacture a bespoke quenching tank to sit in close proximity to the workshop forge, so that the very hot workpieces could be placed into the oil to rapidly cool.

The requirement is for a simple oil quenching tank which is capable of holding a minimum of 20 litres of quenching oil. The tank must contain a wire mesh basket similar to a 'chip basket' to allow the components to be lifted out of the oil once cooled, without an operator having to immerse their hands in the oil. It must also have a simple lid to prevent ingress of water and contaminants, egress of significant fumes, and to prevent the oil from setting on fire. A drain plug is required to be fitted to the side of the tank, close to the bottom, to allow safe draining of the oil, so that any sludge can be removed and the tank can be cleaned.

Project tasks

As an Engineering Technician, you are tasked with designing a quenching tank capable of holding a minimum of 20 litres of oil and up to a maximum of 50 litres of oil, without leakage. It must have sufficient space to allow for the volume of components inserted (typically a maximum of 1 litre) and any localised boiling without over spillage.

Specific issues

The RZY Chief Engineer has identified some specific issues which relate to this task:

- the tank must contain a commercially obtained wire mesh basket that fits within the tank but can be lifted out of the tank to extract the quenched components. This does not necessarily need a handle as the basket can be hooked out using a piece of bent wire or similar tool. If a handle is used it must not prevent closure of the tank with a lid or require the operator to insert their hand into the oil

- the tank must have a lid that completely covers the top surface to prevent ingress of water and debris. Whilst it does not have to be a tight fit or have any type of seal, it must be reasonably close fitting such that any fire can be extinguished by covering up the tank and preventing access to air. The lid must also have a handle to allow it to be lifted off

- the tank must be fitted with a drain plug located on the side of the tank close to the bottom. It should be oil tight but allow the internal oil to be periodically drained off to allow oil replacement, cleaning of sludge and debris, and extraction of any lost components.

General issues

The RZY Chief Engineer has also noted the following more general considerations that relate to this project brief:

- health and safety risks and issues i.e., consider mass, and ergonomic issues
- basket insertion/extraction
- checks required to ensure function.

Get in touch

City & Guilds Technicals Quality Team

We are here to answer any queries you may have regarding your T Level Technical Qualification delivery.

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