Destructive And Non-Destructive Testing Of Metal Samples

This assignment is about different types of testing such as: Tensile testing; Rockwell Hardness testing and Dye penetrant testing of various metals as: Brass; Mild steel; Aluminium; Stainless Steel and Carbon Steel as well as their results.

What is Destructive Testing and Non-Destructive testing?

With Destructive testing such as (Tensile testing and Rockwell Hardness test) allows us engineers to identify roughly the mechanical properties if its ductile, brittle or malleable and what pressure it over goes if its compression which is a squeezing force; tensile force which is a pulling force; Bending which is the stress in a material just before it yields in a flexure; A shear which is a cutting force or a torsion which is a twisting force. We use this testing to approximate the breaking point/ failure of the material.

Non-Destructive testing such as (dye penetrant testing) allows us engineers to identify the fail points of the material without damaging it. We can use the end result to figure out how to mend the material correctly to get a smooth finish.

Testing materials and components are required as it allows the engineer to find the best material for the product if it’s durable and corrosive resistance and not ductile or brittle. If it is brittle it means, there's no necking which means it'll be hard to see when it will break.

Tensile Testing

Tensile testing is a way of determining how something will react when it is pulled apart the data from the results can be used in many ways such as: determine the batch quality; determine the consistency in manufacture; to aid in the design process and to ensure compliance with international and industrial standards.

Firstly, when setting up we measured out on the materials we got which were Brass; Mild Steel; Aluminium and Stainless Steel the length and marked the middle, we then marked 4x1 cm points on either side of the middle and converted the cm to metres. After we marked up the material we measured the diameter of the bar and calculated the area with the equation CSA=? (d squared)/4. Secondly, once we marked the materials up we then placed them in the machine where we clamped the bottom end and clamped the top end and slowly the machine pulled the material till it snaps on a couple of metals we see it necking where it goes thinner and then

snaps, we can see this through the results and pictures.

Rockwell Hardness Testing

Rockwell hardness test is a method of measuring the hardness of materials by pressing an indenter into the surface of the material with a specific load then measuring how far the indenter was able to penetrate the surface.

The date we tested the materials were on the 18th September 2018 at room temperature 23°c with the test and standard: ISO 6508-1:2015 metallic materials-Rockwell hardness test-part1When setting up the equipment we used the B scare of the Rockwell hardness test which was the ”HRBW” hardness unit, we firstly setup the Rockwell hardness test by inserting the metal plate where the materials go on, then crank it up till the small arrow was on the black dot on the scale, secondly once that was done we loaded the sample which where any of these (Brass; Aluminium and Mild Steel) we tested all these one after each other, Once loaded the sample on the plate we raised the sample to the point where the indenter was slightly touching then pressed the pressurized button to load the testing then pressed it again to do the testing.

The results that we got for Mild Steel was 84HRBW, (Number means Rockwell hardness value; HR means Rockwell hardness; B means Rockwell Scale and W is indicates use of tungsten carbide ball indenter). The results for Aluminium was 26HRBW and the results for Brass was 30HRBW all these results were done in the same test conditions to make it a fair test.

Dye Penetrant Testing

Dye penetrant testing is a widely applied inspection and low cost inspection method used to check surface-breaking defects in all non-porous metals such as: metals, plastics or Ceramics. This allows us engineers determine the faults of the materials without damaging them so that we can correct it to use in there design process.

We carried out this test by firstly, this can range from grinding and wire brushing to merely wiping the part with a rag moistened with the cleaner/ remover. The surface needs to be free of dirt, rust, scale, paint, oil, and grease, and be smooth enough to wipe off the penetrant without leaving residue. Secondly, we applied the penetrant, this is generally done by spraying penetrant from the aerosol can or applying it with a brush. A dwell (soak) time needs to be observed to allow for the penetrant to permeate into cracks and voids. This is typically 5 to 30 minutes but should never be long enough for the penetrant to dry.

Thirdly, we removed the penetrant, all penetrant should be removed with clean, dry, lint-free

rags until thoroughly clean. The part or material should be rubbed vigorously until the penetrant is not visible on the dry rags. Next, cleaner/ remover should be sprayed on another clean, dry, lint-free rag and used to vigorously rub the part again until there is no penetrant visible on the rag. Lastly, we sprayed a thin, light coating of developer should be sprayed on the part being examined. A dwell time needs to be observed to allow time for the dye to exit the flaws and create an indication (flaw) in the developer. The dwell time for developer is typically 10 to 60 minutes. Then the defects should be visible for us engineers to see.

My results could be different to the actual ones through different factors such as; the Rockwell hardness machine we used was old and needed a fixing or replacing with a newer version/model, the surface the Rockwell hardness machine needed to be hard metal surface where ours was on a desk supported by 4 metal stands. The environment would have been better in a workplace with metals rather than doing the test in a class room and with our Rockwell hardness machine being old and needing either a newer version/model the calibration on it might be a bit loose leading to false readings.

Mechanical properties and Application

Aluminium is a silvery-white, lightweight metal. It is soft and malleable. Aluminium is used in a huge variety of products including cans, foils, kitchen utensils, window frames, beer kegs and aeroplane parts. This is because of its particular properties.

Brass is a bright gold like appearance used for decoration because of its corrosion resistance, ductility and strength. It is also used as locks, gears, bearings, doorknobs it is also used for musical instruments such as trumpets, trombone etc. this is because of its mechanical properties. Low Carbon steel is a silvery-greyish white, strong weight metal, it is malleable and ductile. Low carbon steel is used for shipbuilding, wire and vehicle bodies as it is easily change shape and form by heat treatment because of its specific mechanical properties.

Stainless Steel is a shiny-silvery colour, less ductile and high corrosive resistance, used for cutlery and cookware such as non-stick pans, knife blades etc. they use this because of its mechanical properties.

Conclusion

In conclusion, I have written about what destructive and non-destructive testing is and why as engineers need these for testing different materials. I then went on and wrote about the tensile testing and how it was setup and what it was used for and how materials are tested along with a table of results and pictures, I then wrote and explained what the Rockwell Hardness test is,

how it was setup, how we tested the materials and wrote out the results as a report, then the dye penetrant testing an how that was setup and why us engineers use it to test materials along with another set of pictures. I then compared my results and the actual results to the Rockwell hardness test and compared them and explained why the results could be different.

After that I then looked at mechanical properties for Aluminium, Brass, Low carbon Steel and Stainless steel and the applications for then.

Testing materials is important for engineers as it allows them to test the hardness of the material, if the material is brittle, ductile or malleable and were the errors are for them to be mended and processed to determine which material can be used for the design of the product.