

Session 1:

Date: 13/10/2017

Location: MTB04

Time: 13:00 - 15:00

Instructor: Dave

Aim:

The aim for this project was to manufacture a stepped profiles would allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings.

In this first session in particular, the aim was to understand the shape we were going to manufacture, and the process to achieve this, make sure we understand how to use the tools and equipment required and begin manufacturing the part.

Health and Safety:

When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing. Due to the types of machines and tools in this workshop, 3 main pieces of PPE are required.

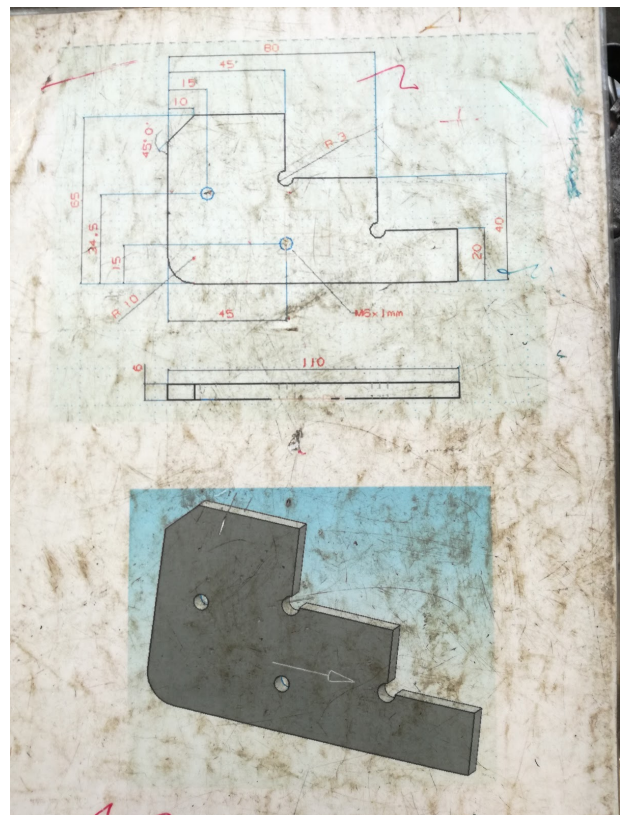
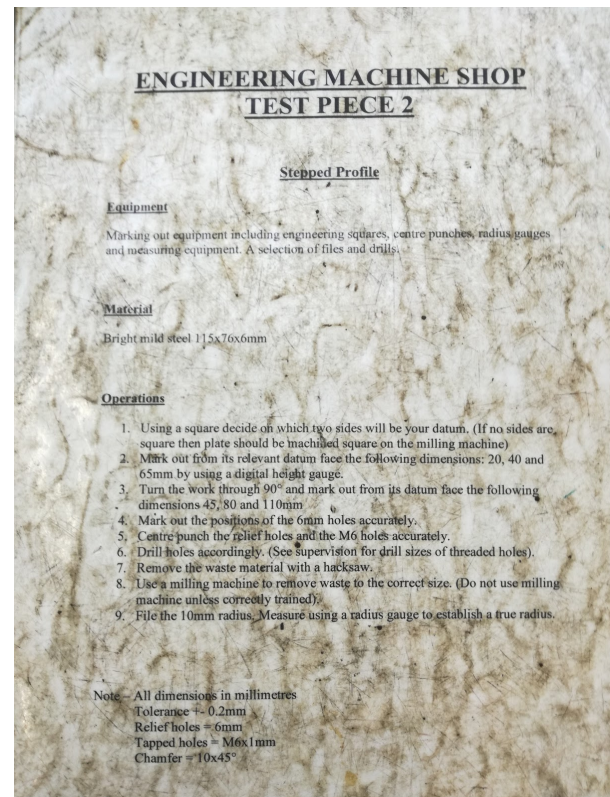
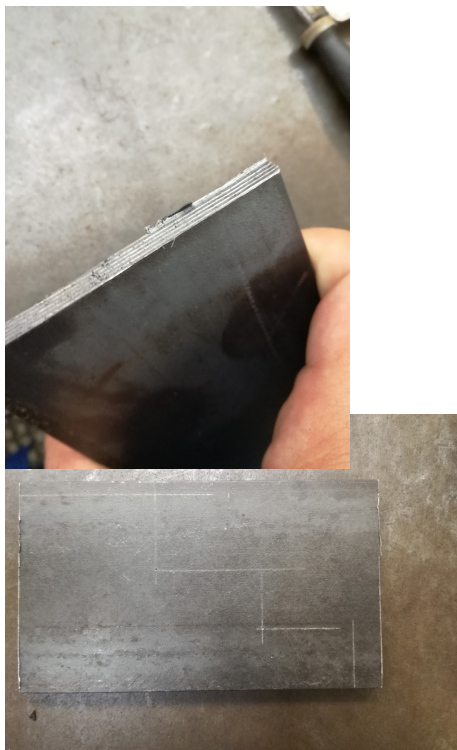
- Eye protective goggles
 - These are required as the mills, lathes and pillar drills cutaway small pieces of metal and can cause them to fly across the workshop. This can cause damage to eyes, so goggles need to be worn at all times in the workshop, if any of these machines are running, even if you are not the person operating the machines.
- Steel capped protective footwear
 - This is required due to the large pieces of metal and the possibility that they might fall from a machine bench or off of a tool.
- Dust coats
 - These are required to protect clothes from dust and chemicals

Further to these pieces of clothing, it is important to take care of your hands, by using barrier cream before starting work in the workshop, and by cleaning them thoroughly once you have finished. This will prevent long term damage.

Finally it is important to always be aware of what is going on in the workshop. This means that if you are tired, or for any other reason unable to concentrate and perform correctly, you should not be in the workshop. Other common sensible precautions, such as situational awareness, no running and no consuming of food or drink are also required.

Procedure:

- As this was our first time using this workshop, we were given instructions on how to use each tool before starting, including the pillar drills, hack saws, mills and measuring equipment.
- I began by familiarising myself with the technical drawing and the instructions given, on how to manufacture this part.
- Using a file I began by deburring the material to be used.
- Using the flat and level worktop, and a ritangle, I found the two sides of the material that are closest to being at right angles to each other. There corner joining these two sides was marked, making it easy to identify in future.
- Using the identified corner as a starting point, I began marking the surface of the material. I marked the dimensions for the stepped profile, the locations of the holes and the location of the 3mm radii. The engineering drawing supplied the required dimensions. I used a vernier height gauge to measure and mark these dimensions and locations.



Feedback:

Once I started working, I realised that importance of familiarising yourself with all the equipment and tools required prior to starting the task. This allows you to get into a better workflow, that does not need to be continuously interrupted so that you can be instructed in how to use a piece of equipment.

It is important to make sure that all the measuring is done as accurately as possible, and that all the marks are easy to find again later. Having lots of incorrect marks on the material makes the correct marks difficult to identify later on, and if one or more of the measurements are incorrect it can make some of the steps later on, very confusing.

Session 2:

Date: 20/10/2017

Location: MTB04

Time: 13:00 - 15:00

Instructor: Dave

Aim:

The aim for this project was to manufacture a stepped profiles would allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings.

In this session in particular, I cut the threads and cut the holes identified on the drawing, and cut the rough shape of the profile.

Health and Safety:

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- Eye protective goggles
 - These are required as the mills, lathes and pillar drills cutaway small pieces of metal and can cause them to fly across the workshop. This can cause damage to eyes, so goggles need to be worn at all times in the workshop, if any of these machines are running, even if you are not the person operating the machines.
- Steel capped protective footwear
 - This is required due to the large pieces of metal and the possibility that they might fall from a machine bench or off of a tool.
- Dust coats
 - These are required to protect clothes from dust and chemicals

Further to these pieces of clothing, it is important to take care of your hands, by using barrier cream before starting work in the workshop, and by cleaning them thoroughly once you have finished. This will prevent long term damage.

Finally it is important to always be aware of what is going on in the workshop. This means that if you are tired, or for any other reason unable to concentrate and perform correctly, you should not be in the workshop. Other common sense precautions, such as situational awareness, no running and no consuming of food or drink are also required.

Procedure:

- The first machining process I used was drilling to create the holes which would later become the three quarter circles on the inside corners. The first step in this sub-process is to punch the material using a centre punch. The location for these holes I had marked out previously using the vernier height gauge. I had marked them

with a cross. Using a centre punch and a hammer, I lightly marked the location to drill.



- Next under a microscope I checked the punch I had created was located directly on the centre of the x I had marked out. If the mark was located correctly, using the centre punch again you can create a bigger indentation in the same location. This makes it big enough to use to locate the drill.
- The next step was to drill a small pilot hole.
- These steps were repeated to mark out the location of the holes that would later have a thread cut into them.
- Once that was done on all 4 holes, they can be drilled to the correct size using a 5mm (for the threaded holes) or 6mm diameter drill bit.



➤ Once all the holes were drilled, the two M6x1 threads can be cut. This is done using a tap to cut the thread in the pre drilled 5mm holes.

➤ At this point I decided to de-bur all the holes. To do this I gently tapped a spinning drill bit, much larger than the holes against the surface, using the pillar drill.

➤ Next using a hack-saw I started cutting out the rough shape of the stepped profile, by removing waste material.



Feedback:

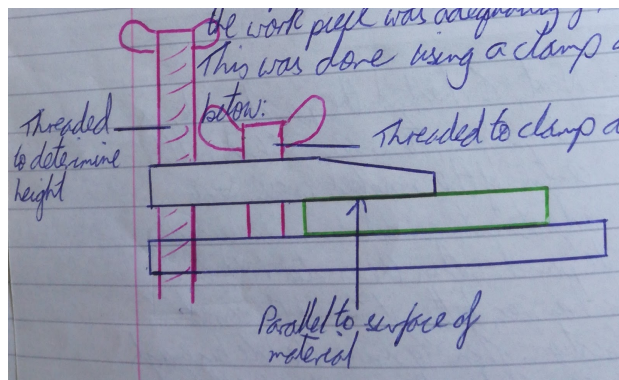
When marking the spot to start drilling using a centre punch it is important to first only use a gentle tap. This mark can now be checked under a microscope, and the centre punch can be easily relocated into the indentation created. However by angling the centre punch in the indentation

and using gentle taps with the hammer, it is still possible to correct the location of the hole if necessary.

The indentation with the centre punch is required to locate the drill. Even in a pillar drill, the drill bit can wander slightly across the surface of your material. Without the indentation created by the centre punch, it is not possible to drill directly on the x marked out previously.

Drilling a pilot hole allows the drill bit to cut using the cutting surface as opposed to the blunt tip.

When using a pillar drill it is important to make sure that the work piece is adequately clamped down. In this situation this was done using a clamp as shown below.



During the process of cutting thread, it is important to make sure the material is clamped down, so that it does not move and so that the tap is vertical. Especially whilst starting off, it is important to make sure that the tap is orientated correctly, to prevent the thread being cut at an angle. It is advisable to use cutting oil to make the quality of the thread better, and to make it easier to cut.

Ideally to de-bur the holes I would use a countersinking tool, however the method I mentioned above works quite well, when a countersinking tool is not available.

As using a hacksaw can be quite inaccurate, I aimed to leave a 2mm excess. The mill will give me the final shape in the correct dimensions. Once you have finished cutting with the hacksaw, it is advisable to deburr the edges to make sure you don't cut yourself, when handling the material.

Session 3:

Date: 27/10/2017

Location: MTB04

Time: 13:00 - 15:00

Instructor: Dave

Aim:

The aim for this project was to manufacture a stepped profiles would allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings.

In this session I wanted to mill all the horizontal surfaces and the outline of the shape.

Health and Safety:

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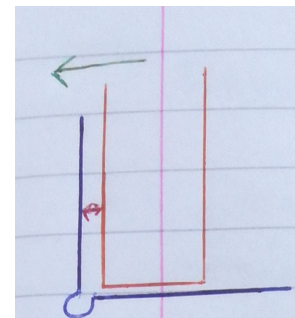
- Eye protective goggles
 - These are required as the mills, lathes and pillar drills cutaway small pieces of metal and can cause them to fly across the workshop. This can cause damage to eyes, so goggles need to be worn at all times in the workshop, if any of these machines are running, even if you are not the person operating the machines.
- Steel capped protective footwear
 - This is required due to the large pieces of metal and the possibility that they might fall from a machine bench or off of a tool.
- Dust coats
 - These are required to protect clothes from dust and chemicals

Further to these pieces of clothing, it is important to take care of your hands, by using barrier cream before starting work in the workshop, and by cleaning them thoroughly once you have finished. This will prevent long term damage.

Finally it is important to always be aware of what is going on in the workshop. This means that if you are tired, or for any other reason unable to concentrate and perform correctly, you should not be in the workshop. Other common sense precautions, such as situational awareness, no running and no consuming of food or drink are also required.

Procedure:

- Using the mill I created a level and plane surface across at least half of the first surface I wanted to mill. In this case, this was the outermost (highest) horizontal surface. In order to do this I brought the mill (whilst rotating) into contact with the highest point on the surface. From there I cut away 0.2mm increments, until at least half the surface had been cut.



- Next using the vernier height gauge I measured the amount of material that needed removing before returning the piece to the mill clamp. Cutting in 0.2mm increments from left to right I cut down to the correct dimensions before deburring with a hand file.
- To cut the other two steps to the correct dimensions, this needs to be repeated - creating a flat and planar surface, measuring and cutting to the correct dimensions. It is however important not to get too close to the vertical surface.

Feedback:

When using the mill it is important that the tool is rotating at the appropriate speed for the material being cut.

The speed of the feed of the tool (how quickly it moves horizontally) is also important, as a fast feed will result in a rougher finish and will cause the tool to overheat, whilst a slow feed means cutting takes longer.

Session 4:

Date: 03/11/2017

Location: MTB04

Time: 13:00 - 15:00

Instructor: Dave

Aim:

The aim for this project was to manufacture a stepped profiles would allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings.

In this session in particular the aim was to mill the vertical surfaces, file the radius corner and create the chamfer.

Health and Safety:

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- Eye protective goggles
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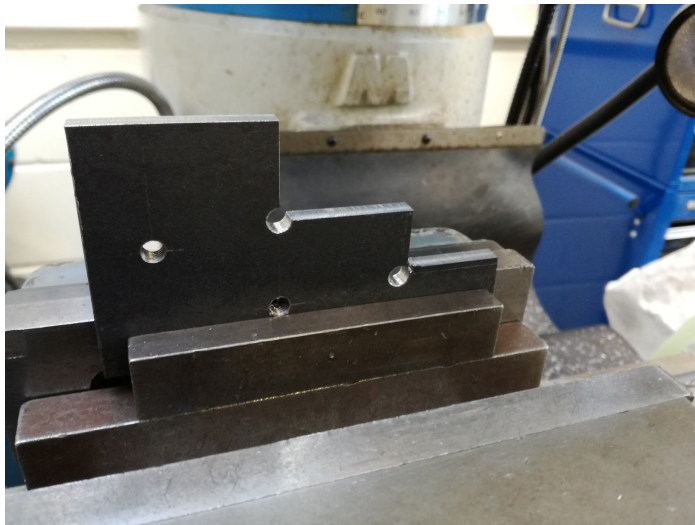
Finally it is important to always be aware of what is going on in the workshop. This means that if you are tired, or for any other reason unable to concentrate and perform correctly, you should not be in the workshop. Other common sense precautions, such as situational awareness, no running and no consuming of food or drink are also required.

Procedure:

- In order to cut the vertical surfaces we used a different procedure than for the horizontal ones. This time moving horizontally and keeping the tool on the height of the top half of the surface, I made contact with the material. Without altering the height or horizontal position, I moved the tool forwards and backwards. Then without changing the horizontal alignment, I moved the tool down until it was 1 mm off the

horizontal surface and again moved the tool forwards and back. This process was repeated to create the flat surface for measuring and to cut to the correct dimensions.

- Next, using a spirit level, I clamped the piece into the mill so that surface of the chamfer was vertical with the bed of the mill. Continuing in 0.2mm increments I cut down the corner to create the chamfer.
- With a file, using a rotating motion I filed the radius on the bottom left hand corner.
- Finally I deburred all the edges.



Feedback:

To make cutting the vertical surfaces easier and so that less clamping and unclamping is needed, at each stage, both the vertical and adjoining horizontal surfaces could have been cut and measured in one go, horizontal surface first.

When filling the radius corner a radius gauge can be used to find high and low spots, and to even the radius out.

Session 5:

Date: 10/11/2017

Location: MTB04

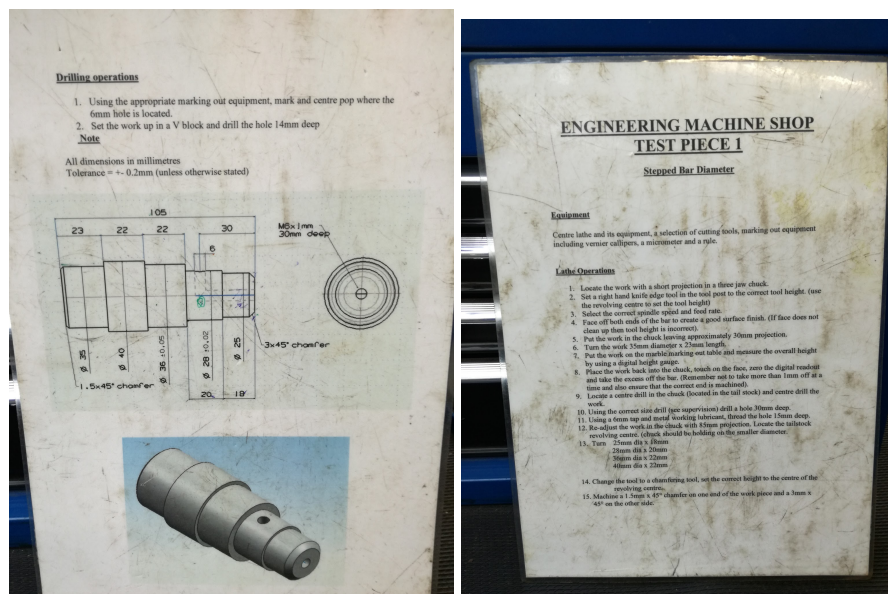
Time: 13:00 - 15:00

Instructor: Gareth

Aim:

The aim for this project was to manufacture a stepped profiles containing rotational symmetry and to allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings and how to use the lathe.

During this session in particular, the aim was to familiarise ourselves with new equipment (the lathe), the engineering drawing and the steps required to complete the project. We would also start manufacturing the part.



Health and Safety:

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any of these machines are running, even if you are not the person operating the machines.

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Procedure:

- To create this part, first the rounded profile was placed into the lathe. The end was then cut down to create a flat and level surface.
- The part was then turned around in the lathe and the other end cut down to create a flat and level surface.
- After removing the part from the lathe the overall height of the material needs to be measured using the vernier height gauge.
- Now, cutting in 0.2mm steps the part is cut down to the overall length on the lathe.
- Then putting the part into the lathe so that half the length sticks out, the outside diameter of the part can be cut down across the entire exposed surface of the profile in 0.2mm increments.
- Next using the digital gauge on the lathe to measure from the exposed end of the piece, the next diameter can be cut in 0.2mm increments.

Feedback:

Whilst using the lathe, it is important not to solely rely on the digital measuring equipment attached to the lathe. Due to parts of the mechanism slipping, the tool blunting and general inaccuracies in the equipment, you should frequently re-calibrate the measuring equipment, using vernier calipers as a referencing point. This is especially important when making the final few passes as cutting away too much material cannot be undone.

Session 6:

Date: 17/11/2017

Location: MTB04

Time: 13:00 - 15:00

Instructor: Gareth

Aim:

The aim for this project was to manufacture a stepped profiles containing rotational symmetry and to allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings and how to use the lathe.

In particular for this session, the aim was to cut the remaining stepped diameters.

Health and Safety:

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Procedure:

- The procedure moving forward was very similar to the previous session.
- The part was clamped into the lathe the other way round to previously, so that the end that would eventually have a threaded hole, was now exposed.
- The remaining three diameter steps were cut, starting with the largest and working down to the smallest diameter.

Feedback:

When long pieces of material are hanging out of the clamp in the lathe it is important to use a stock. This stops the piece from moving away from the cutting tool when pressure is applied.

Session 7:

Date: 24/11/2017

Location: MTB04

Time: 13:00 - 15:00

Instructor: Gareth

Aim:

The aim for this project was to manufacture a stepped profiles containing rotational symmetry and to allow us to familiarise ourselves with the the workshop and the wide range of tools it contains. We would also start learning to read engineering drawings and how to use the lathe.

In this session in particular, the holes needed to be drilled and the chamfers cut into the ends.

Health and Safety:

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Procedure:

- To drill the hole into the centre of the piece, the part was placed into the lathe, so that this end was exposed.
- Using a pilot bit clamped into the stock, a pilot hole was first drilled to help position the drill bit.
- Then the final hole was cut using an ordinary drill bit in the stock.
- Next I cut the chamfer on the same end. This is done by rotating the same cutting tool that I have been using to cut the diameter, to the angle on the chamfer. Instead of moving the cutting tool from right to left, or from forwards to backwards, it is moved parallel to the chamfer surface.
- Next by turning the part around in the clamp, I cut the chamfer on the other end, using the same method as before.
- To cut the thread into the hole, I clamped it into an ordinary table clamp and used a tap. It is important to use cutting oil to make a clean cut thread. At regular intervals I took the piece out of the clamp to get out the cuttings using compressed air. Leaving this in could damage the cutting tool, and generally makes cutting the thread more difficult. Once the thread was cut, I cleaned it out again.
- Next I marked out the position for the hole that is cut into the side of the piece, using the vernier height gauge.
- Then using the pillar drill I drilled first a pilot hole, and then the actual hole into the material.
- I deburred this hole, and the threaded hole by gently tapping an oversized drill bit against the hole, using the pillar drill.
- Finally I deburred all the edges using sand paper.

Feedback:

Drilling using a lathe is very similar to with a pillar drill, however in this situation, the part being cut moves, whilst the tool remains still.

Session 8:

Date: 26/01/2018

Location: MTB05

Time: 15:00 - 17:00

Instructor: Barry

Aim:

The aim of this session was to familiarise ourselves with a new workshop, and to learn about all the health and safety risks in this workshop.

Health and Safety:

When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing.

As there are heavy parts being handled, it is important to wear protective footwear.

To protect our skin from the aggressive chemicals used within lubricants it is important to use barrier cream and it is advisable to use gloves.

The area should be well ventilated so prevent issues caused by emission gasses, or harmful substances contained within cleaning products.

Procedure:

- We began by looking at the entrances and exits to the workshop.
- Next we looked at the different areas within the workshop and what risks are present in each one.
- We discussed emergency procedures in different scenarios.

Session 9:

Date: 02/02/2018

Location: MTB05

Time: 15:00 - 17:00

Instructor: Barry

Aim:

The aim of this project was to familiarise ourselves with the way in which a modern internal combustion engine functions by disassembling and reassembling it.

In this session in particular we disassembled the majority of the engine.

Health and Safety:

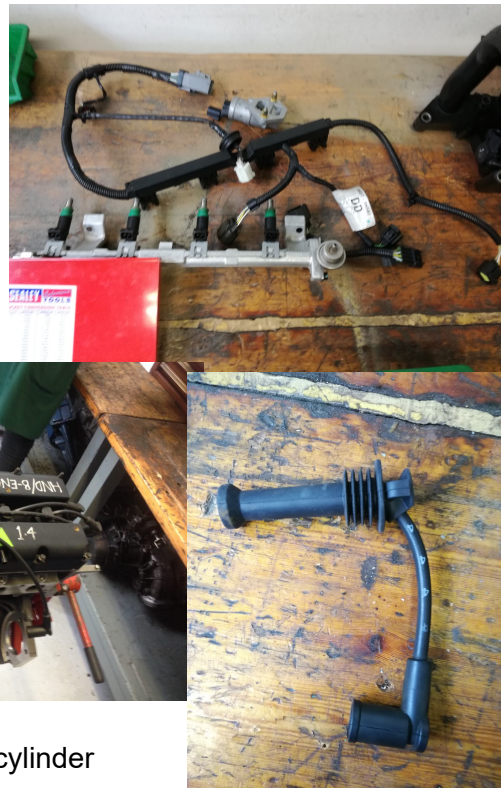
When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing.

As there are heavy engine parts being handled, it is important to wear protective footwear.

To protect our skin from the aggressive chemicals used within lubricants it is important to use barrier cream and it is advisable to use gloves.

Procedure:

- When we started stripping the engine, it was already on an engine mount.
- We began by removing the the cables and hoses that were still attached to the engine. This included the fuel lines, fuel injection, injector rail and the coil packs.
- Next we removed all the plastic, protective covers.
- Then we removed, the cam cover, spark plugs, and the camshaft.
- After turning over the engine, we removed the oil sump, and the oil dispersal components within.
- After turning the engine back we removed the cylinder head and took the valves out of the head.



Feedback:

Engine mounts are very helpful when stripping an engine, as the engine has to be accessed from both the top and the bottom. The engine mount allows you to turn the engine over, making access easier.

To avoid making a mess you should make sure all the fluids are completely drained before starting.

When removing engine parts it is important to make the orientation and order in which each component is placed in the engine.



Session 10:

Date: 09/02/2018

Location: MTB05

Time: 15:00 - 17:00

Instructor: Barry

Aim:

The aim of this project was to familiarise ourselves with the way in which a modern internal combustion engine functions by disassembling and reassembling it.

In this session in particular we disassembled the remainder of the engine and to take a few measurements from the engine.

Health and Safety:

When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing.

As there are heavy engine parts being handled, it is important to wear protective footwear.

To protect our skin from the aggressive chemicals used within lubricants it is important to use barrier cream and it is advisable to use gloves.

Procedure:

- First we removed the crankshaft, by unscrewing the conrods, and dropping the pistons out of the cylinder.
- Next we removed the crankshaft
- For the rest of the session, we took a number of measurements from a number of the engines components.
 - Big end bearings - 2.96mm
 - Cylinder bore - 75.33mm
 - Piston face diameter - 74.97mm
 - Valve diameter - 28.02mm
 - Valve length - 99.37mm
 - Valve spring length - 47.69mm



Feedback:

When measuring diameters of round components it is important to take at least three measurements, and to rotate the part in between each measurement. This means that if a component is slightly oval, the average diameter can be obtained.

Session 11:

Date: 02/03/2018

Location: MTB05

Time: 15:00 - 17:00

Instructor: Barry

Aim:

The aim of this project was to familiarise ourselves with the way in which a modern internal combustion engine functions by disassembling and reassembling it.

In this session in particular we re-assembled the engine.

Health and Safety:

When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing.

As there are heavy engine parts being handled, it is important to wear protective footwear.

To protect our skin from the aggressive chemicals used within lubricants it is important to use barrier cream and it is advisable to use gloves.

Procedure:

- The process of reassembly the engine was the reverse of disassembly.
- When replacing the cam shafts, the crankshaft should be rotated until all the pistons are on the same height, then after lightly screwing in the camshafts, they should be rotated so that the slit on the back of both are parallel to the cylinder head, so that the engineers square can sit in the slits. At this point the belt can be replaced over the cogs and camshaft pulley



Feedback:

On many of the screws it is important to apply the appropriate torque to prevent them from coming undone when the engine runs, and so that there are no leak.

Session 12:

Date: 09/03/2018

Location: MTB05

Time: 15:00 - 17:00

Instructor: Barry

Aim:

The aim of this session was to familiarise ourselves with the different types of transmissions available, and to learn a bit about the types used in the past.

Health and Safety:

When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing.

As there are heavy transmission parts being handled, it is important to wear protective footwear.

To protect our skin from the aggressive chemicals used within lubricants it is important to use barrier cream and it is advisable to use gloves.

Procedure:

- During this session we looked at different transmissions, including combinations, of front engine, mid engine and rear engine vehicles, with front wheel, rear wheel and all wheel drive drivetrains.
- We also looked at the differences between, manual, automatic and sequential transmissions and motorcycle transmissions.
- Finally we looked at the differences between domestic and competition transmissions.

Feedback:

Different engines are appropriate for different applications so it's important to understand what different types of transmissions can be used for.

It is also important to look at old types of transmissions to understand why certain developments came about and improved modern transmissions.

Session 13:

Date: 16/03/2018

Location: MTB05

Time: 15:00 - 17:00

Instructor: Barry

Aim:

In this session we learned about using test rigs. We also compared the difference in the content of the exhaust gas between a newer and an older engine.

Health and Safety:

When deciding what precautions need to be taken in the workshop, it is important to consider not only what you will be doing, but also what everyone else in the workshop is doing.

As there are heavy parts being handled, it is important to wear protective footwear.

To protect our skin from the aggressive chemicals used within lubricants it is important to use barrier cream and it is advisable to use gloves.

As we would be using the rigs indoors, it was important to make sure that the area was well ventilated, so that any harmful gases produced by the engine would not affect the people in the room. We also carbon monoxide sensor, incase the levels got too high, as this gas can not be noticed without a sensor.

As there were many parts of the engine that get hot and spin quickly, these areas have to be covered to prevent people accidentally touching them.

Procedure:

- After attaching the extractor hose to the engine exhaust of the older engine, we also attached an exhaust content sensor. This allowed us to read the content of the engine when the engine was in different circumstances. These included: cold idle, warm idle, increasing load, and constant load.
- We then repeated this with the newer engine

Feedback:

From this it was easy to realise that newer engines are far better at managing the content of their exhaust gasses. Although the older engine had very similar values once the engine was at a constant state (warm idle or under constant load), when the engine was under load or not at operating temperature, the values spiked.

Personal Development Plan

During this module I learn a wide variety of skills. These will influence my future work to make me a better engineer. This module has also highlighted a variety of skills I still need to improve on in the future.

The aim of the first project was to teach me how to use the mill. This was achieved by manufacturing an example component that required a variety of different milling techniques. This understanding will help me in future when designing my own components, which should be manufactured on a mill. Understanding how to operate the tool helps me understand the limitations in its ability to manufacture a part. This means I won't design parts that can't be manufactured using the process I had intended.

The aim of the second project was to help me understand the process of using a lathe. As before, this was achieved by manufacturing an example component, requiring a variety of different lathing techniques.

Along with teaching me to use a mill and a lathe, these projects also taught me how to use a variety of different tools, such as pillar drills, files and saws. As before, this will help to prevent me from designing parts that can't be manufactured.

Finally these two projects taught me how to read and understand engineering drawings. This will help me in the future when creating my own instructions for others to manufacture my parts. This is important as difficulties in understanding drawings will result in the process taking longer, and potentially resulting in a component with incorrect dimensions.

The third project was different from the first two. The aim of this was far more orientated on understanding what we were working on, rather than the tools being used. On the other hand, being able to use hand tools efficiently to disassemble components and machines will be useful in the future, when looking at understanding how products designed and manufactured by others, work. Disassembling the engine has helped me to understand how internal combustion engines work and the job of each of the components inside. This will be useful in the future when designing my own similar components or even engines.

In the future, there are many practical skills that I still need to work on. Proficiency in all the skills I have learned in this module, will help me in future, however I believe that the engineering drawings require my particular attention. To improve my ability to read these drawings and to help me create my own, I will need to practice when creating components in the future. I also think it will help if I create drawings for components in future projects. I also believe that it will benefit my development if I learn to use CAM tools as these are being used more and more in industry. I will learn to use these through work placements and by taking up the universities offers to learn to use these tools through projects (such as the MCR team) that compliment my course, but are not necessarily a structured part of it.