

Logbook

by Jonathan Lloyd-williams

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Log Book Entry

Jonathan Lloyd-Williams - 1805620

Session 1 - Engine Rebuild

2/10/18

13:00-16:00

IQ018

Instructors

- John Kinsella

Session 1 Aims & Learning Outcomes

- Strip down as much of the engine as possible.
- Keep engine components and their respective bolts, nuts and washers organised using a bag and tag system.
- Develop an understanding of the components of a motorcycle engine, with regards to their arrangement, function, disassembly, and assembly.

Observations

- V Twin
- DOHC
- Shaft Driven

Engine:



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-

Health and Safety:

- Steel toe cap boots to be worn at all times in order to minimise the potential risk of heavy items such as the engine itself, or components falling or being dropped and causing injury to the feet.
- As mentioned above, this procedure will involve working with heavy objects. Take care in lifting, lift using the knees whilst keeping a straight back in order to minimise the potential risk of back injury.
- Keeping the workbench clean, and free of clutter can help to reduce the risk of items being knocked off the workbench and causing injury.
- Be aware of potential sharp edges, particularly on the internal engine casing.

- The engine consists of various components, including a selection of moving gears and sprockets. Take care whilst simulating the movements of a running engine, or turning the internal sprockets in any way. These gears and sprockets create “pinch points” in which it is easy to catch the fingers or hands and cause serious injury. In order to minimise this risk, keep hands clear of moving parts whilst simulating engine rotations.
- Be aware that although the engines have been drained of oil; and disassembled prior to task, it is likely some oil will remain. Take care to avoid oil spills on the floor, and take immediate action to properly clean oil from the floor in such an event. Keeping the floor clean of oil reduces the potential risk of injury due to slip hazards.
- When removing certain circlips, there is a risk of these circlips being sprung suddenly and at speed in any number of directions. It is recommended to wear suitable eye protection when attempting to remove or install these circlips, in order to reduce the risk of causing damage to the eyes.

PPE

- Steel Toe Cap Boots
- Suitable Eye Protection

Equipment Required

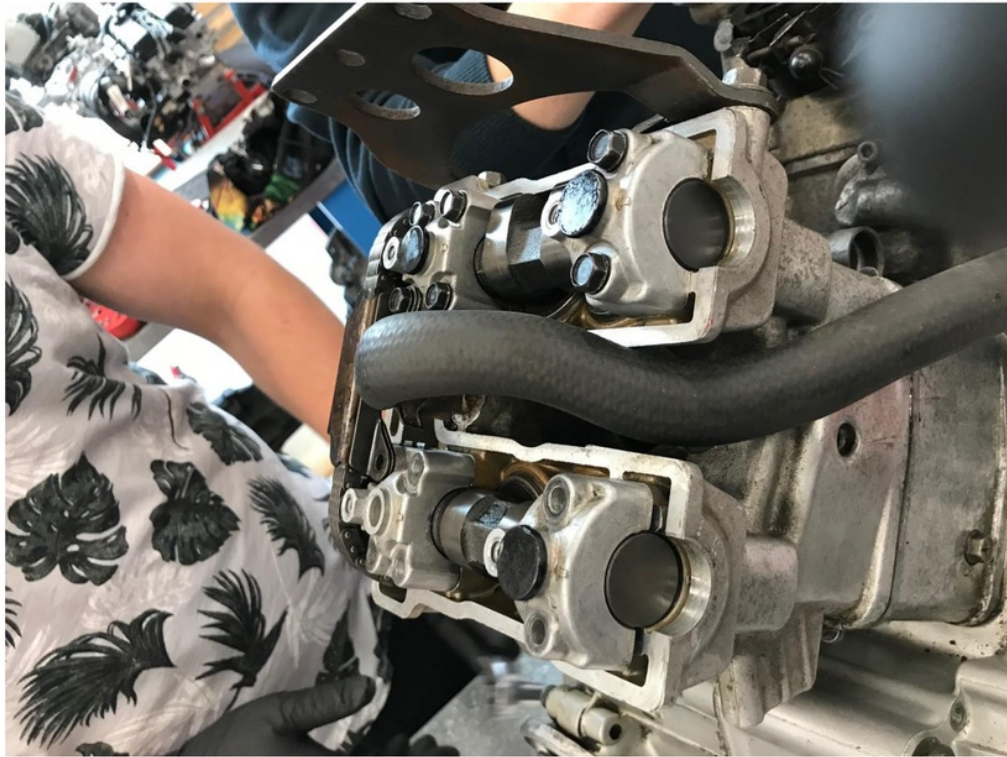
- 3/8 Impact Gun
- 3/8 Sockets: 10mm, 12mm, 13mm, 16mm, 30mm
- Allen Keys/ 3/8Ratchet attachments: 6mm, 8mm
- 3/8 Breaker Bar
- Pry Bar
- 3/8 Ratchet
- Spanners: 2 x 15mm
- Long nosed pliers
- Long nosed pliers (angled)
- Wrap Around pliers
- Flat Head Screwdriver
- #1 Phillips Screwdriver
- Plastic zip tie bags
- Permanent marker
- Hammer
- Mallet
- Cable ties
- Thread Tap
- 16mm Puller

Procedure

1. Whilst carrying out this procedure it is paramount to keep track of components and their respective nuts and bolts, place in zip tie bag and label. We also labelled each bag by number so that we can work backwards during reassembly.
2. Begin by loosening the 2 clamps at the base of the carbs using #1 phillips.
3. Lift off carbs.
4. Remove 8 cylinder head bolts (4 per cylinder), at top of cylinder using 10mm socket and ratchet.

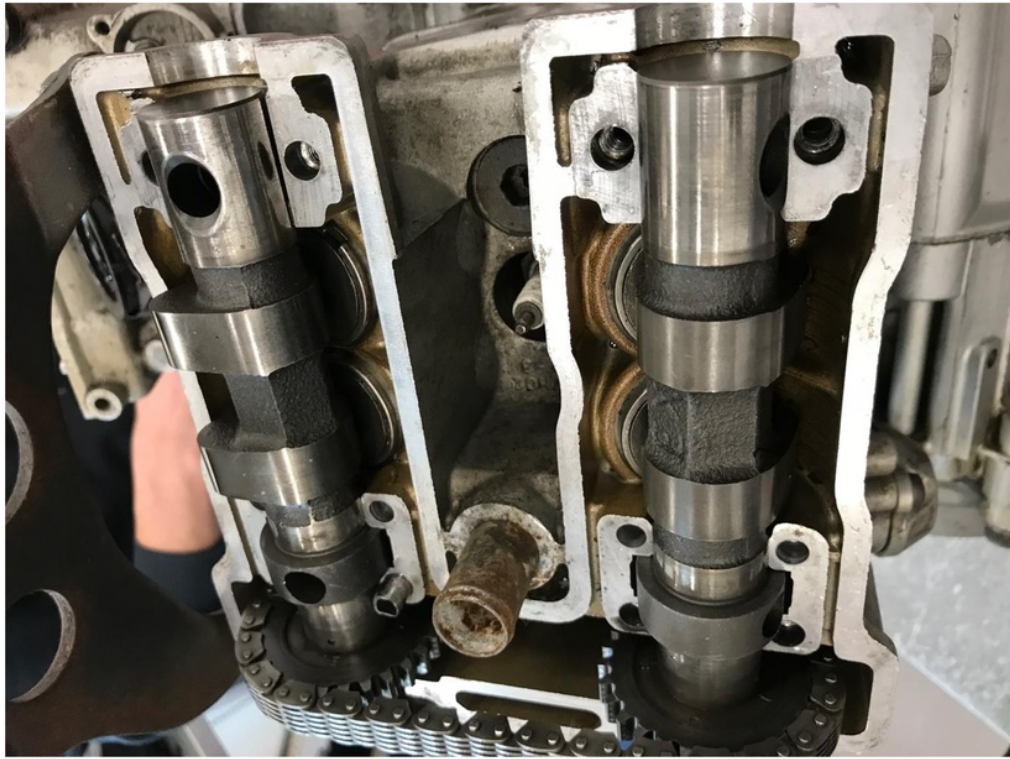


5. Lift off rocker covers.

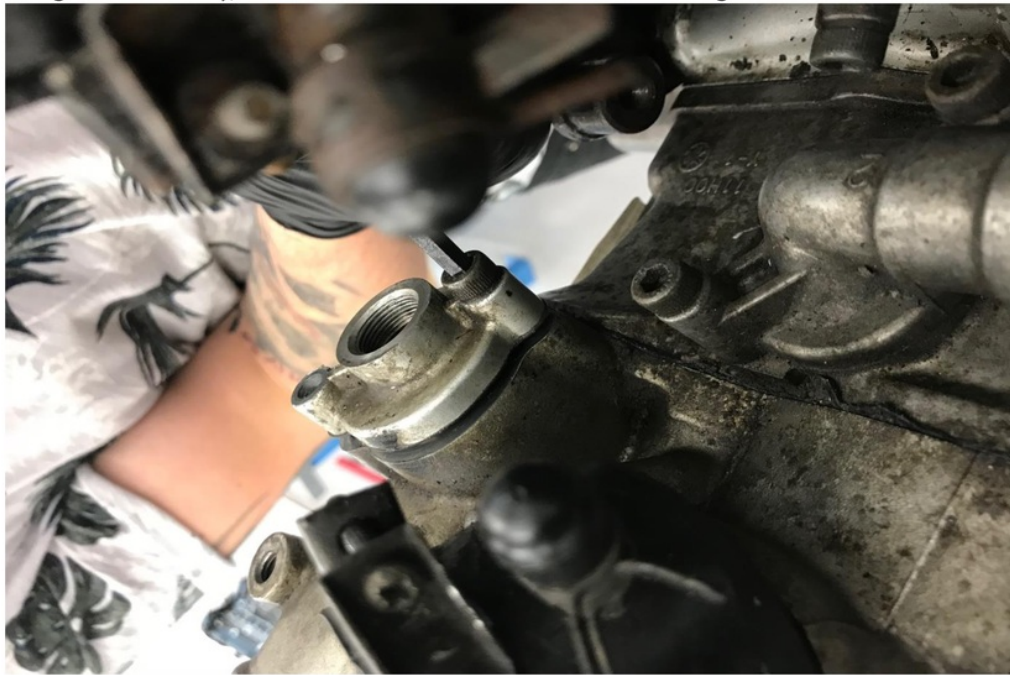


6. Remove hosing using long nosed pliers to loosen clip.
7. Use a 10 mm socket to remove the 12 bolts at the top of the engine. These bolts are mounting the camshafts and brackets. Remove brackets & top cam covers.





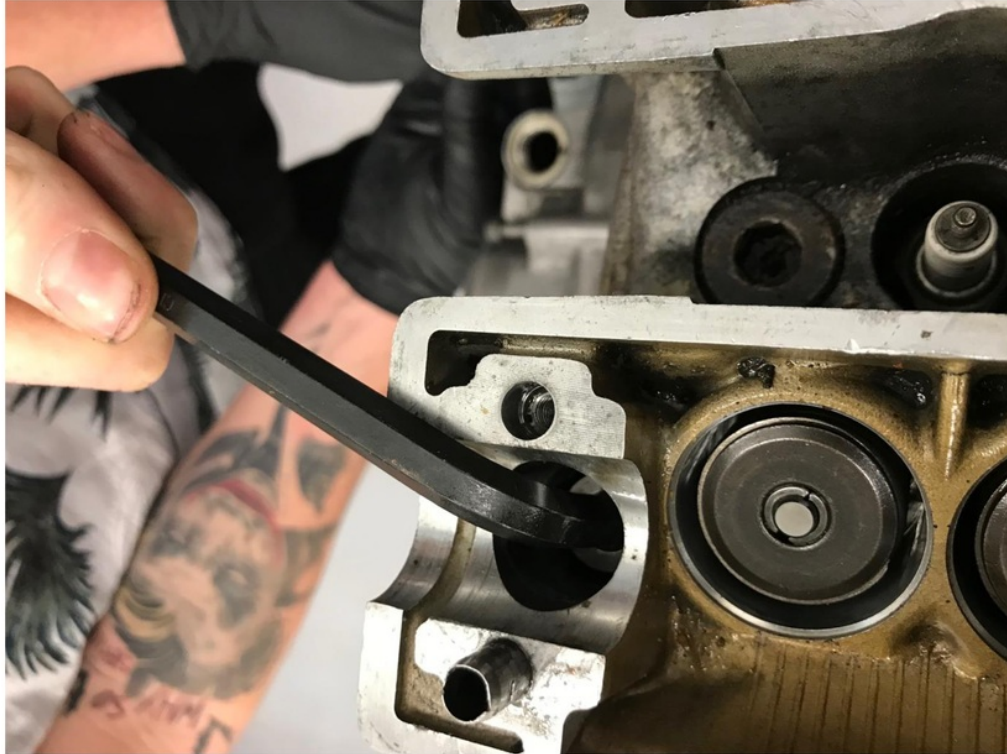
8. Use 12mm to remove cam tensioner spring, be aware there is a spring pressed inside that will pop out during removal. Remove slowly.
9. Using 6mm allen key, remove cam chain tensioner from the casing.



10. Adjust the slack on the drive chain. Slide out camshafts and remove the bucket and shims.



11. Using a 6mm allen key, remove the 8 bolts below where the cams were sat.

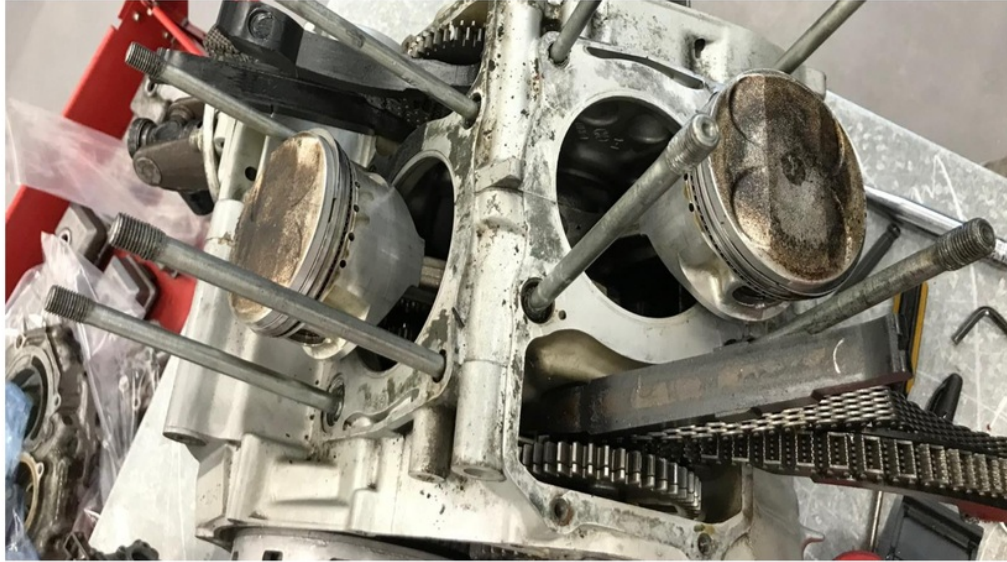


12. Use 6mm allen key to remove outermost exterior bolts on each side (2x2) and carefully lift the cylinder head off. We had trouble on these as the heads of the bolts were rounded, so we used a hammer to drive the socket attachment into the bolts head and removed the bolt taking care not to cause more damage to the head.



13. With the cylinder head removed, remove the valve collets and valve spring compressor.

14. Remove the valve hats.
15. Remove the valve springs and the valves.
16. Remove the valve spring seats and the valve stem oil seals.
17. Remove the remaining bolts holding the cylinder barrel in place and lift off the barrels.



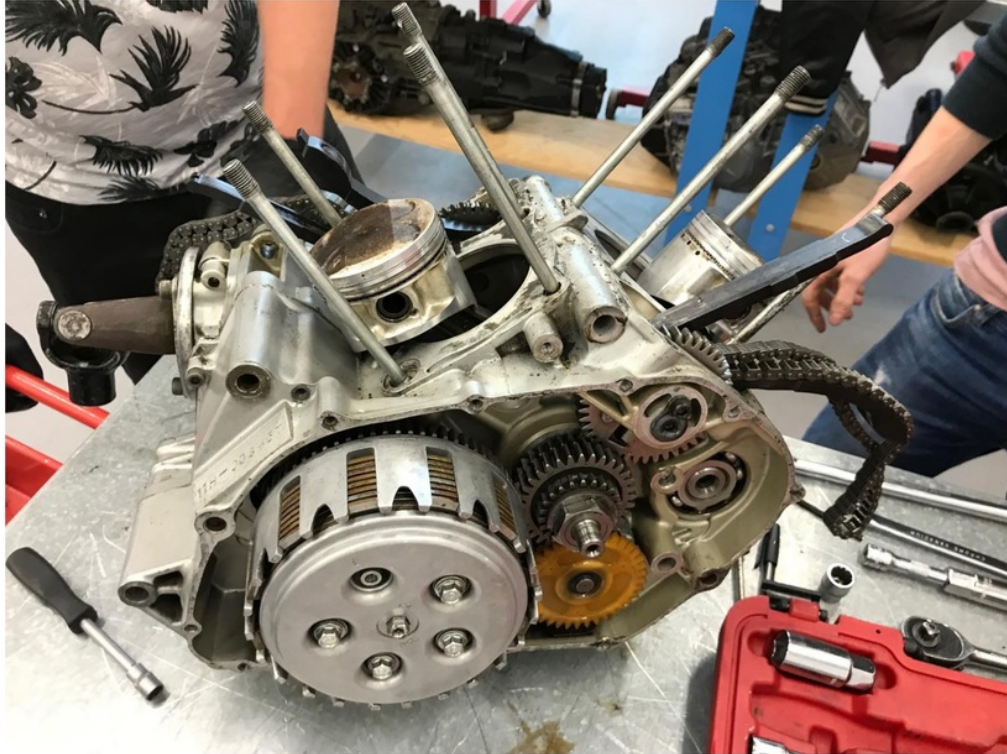
18. Use 6mm allen key to remove 8 bolts from left side casing, slide off.



19. Use 6mm allen key to remove 3 x bolts over oil filter casing cover. Remove cover and oil filter.

20. Use 6mm to remove 8 bolts from right side casing. Slide off casing. Remove outer clutch housing using an 8mm socket to remove the 5 bolts. Be aware there are springs beneath the bolts. Use 30mm socket on the impact gun to remove nut on the

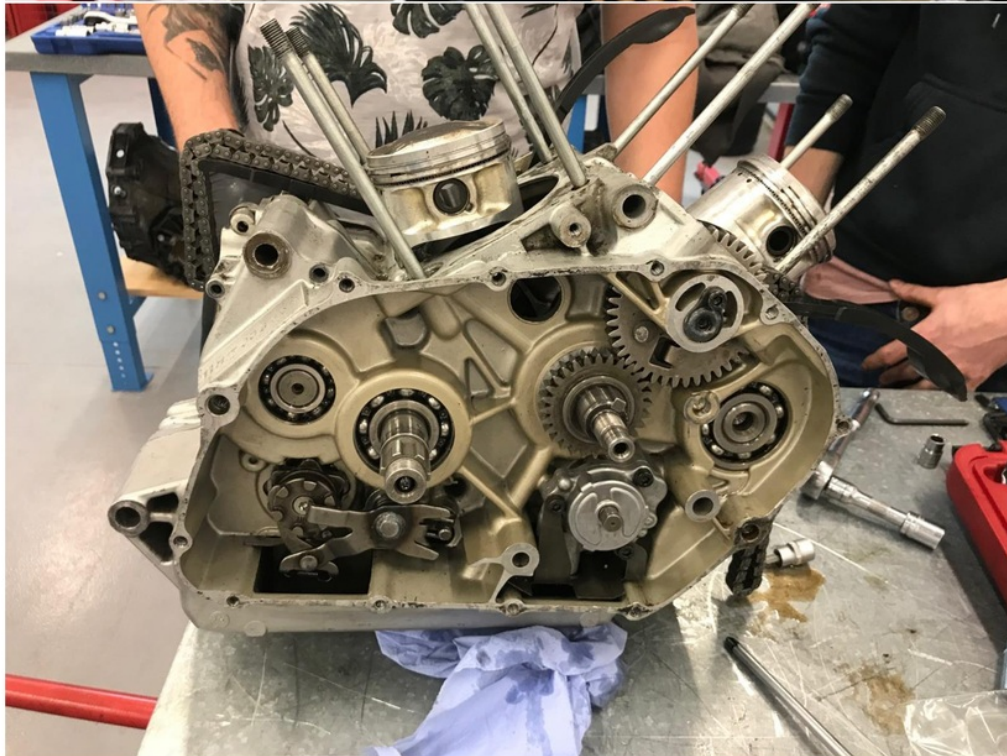
shaft. Slide off clutch discs. Slide off clutch housing assembly.







21. Use 30mm impact gun attachment to remove nuts on the clutch basket and the adjacent gears. Use 2x 15mm spanners on each side to pry off gears. Keep gears together and in order by cable tying them together. You will also need to remove the clip holding the plastic yellow cog in place, and remove the cog.



22. Disconnect the gear selector, and remove the shaft.

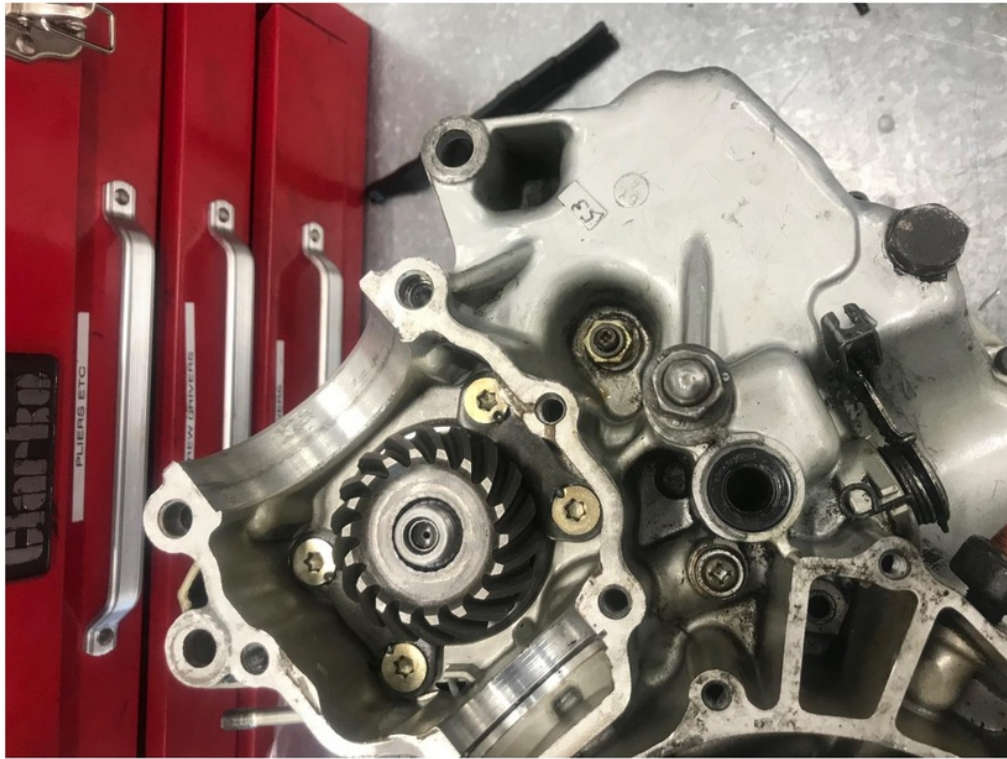


23. Use long nosed pliers to remove the gudgeon pin circlips from inside piston. Slide out piston shaft. Remove piston.



24. Use 6mm allen key to remove 2 bolts connecting starter motor to casing and gently tap out the starter motor.
25. Remove 6 bolts from the front of drive shaft assembly housing and 3 from the rear side using 6mm allen key. Remove housing. Remove driveshaft gears. Use 30mm impact gun to remove the nut holding the final gear in place.





26. Use a 10mm socket and ratchet to remove the outer bolt holding the flywheel. Remove flywheel with puller. We encountered issues as holes had been cross threaded, so we re-tapped the threads and were subsequently able to attempt with the puller. Attempt didn't work as puller wrong size. End of session.



End of Session Notes

- On this occasion there was no generator present within the engine.
- Flywheel has seized to the shaft, flywheel puller available to hand unsuitable for the job. John has advised we try again at the beginning of the next session, using another puller, or to split the cases with the flywheel still attached.

Log Book Entry

Jonathan Lloyd-Williams - 1805620

Session 2 - Engine Rebuild

9/10/18

13:00-16:00

IQ018

Instructors

- John Kinsella

Session 2 Aims & Learning Outcomes

- Strip down as much of the engine as possible.
- Keep engine components and their respective bolts, nuts and washers organised using a bag and tag system.
- Develop an understanding of the components of a motorcycle engine, with regards to their arrangement, function, disassembly, and assembly.

Engine:



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Health and Safety:

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- Keeping the workbench clean, and free of clutter can help to reduce the risk of items being knocked off the workbench and causing injury.
- Be aware of potential sharp edges, particularly on the internal engine casing.
- The engine consists of various components, including a selection of moving gears and sprockets. Take care whilst simulating the movements of a running engine, or turning the internal sprockets in any way. These gears and sprockets create “pinch points” in which it is easy to catch the fingers or hands and cause serious injury. In order to minimise this risk, keep hands clear of moving parts whilst simulating engine rotations.
- Be aware that although the engines have been drained of oil; and disassembled prior to task, it is likely some oil will remain. Take care to avoid oil spills on the floor, and take immediate action to properly clean oil from the floor in such an event. Keeping the floor clean of oil reduces the potential risk of injury due to slip hazards.
- When removing certain circlips, there is a risk of these circlips being sprung suddenly and at speed in any number of directions. It is recommended to wear suitable eye protection when attempting to remove or install these circlips, in order to reduce the risk of causing damage to the eyes.

PPE

- Steel Toe Cap Boots
- Suitable Eye Protection

Equipment Required

- 3/8 Impact Gun
- 3/8 Sockets: 10mm, 12mm, 13mm, 16mm, 30mm
- Allen Keys/ 3/8 Ratchet attachments: 6mm, 8mm
- 3/8 Breaker Bar
- Pry Bar
- 3/8 Ratchet
- Spanners: 2 x 15mm
- Long nosed pliers
- Long nosed pliers (angled)
- Wrap Around pliers
- Flat Head Screwdriver

- #1 Phillips Screwdriver
- Plastic zip tie bags
- Permanent marker
- Hammer
- Mallet
- Cable ties

Notes following previous session

- Flywheel puller incapable of removing seized flywheel, after some further attempts at the beginning of this session to remove the flywheel, John advised we continue without removing it, and split the cases with it in place.

Procedure

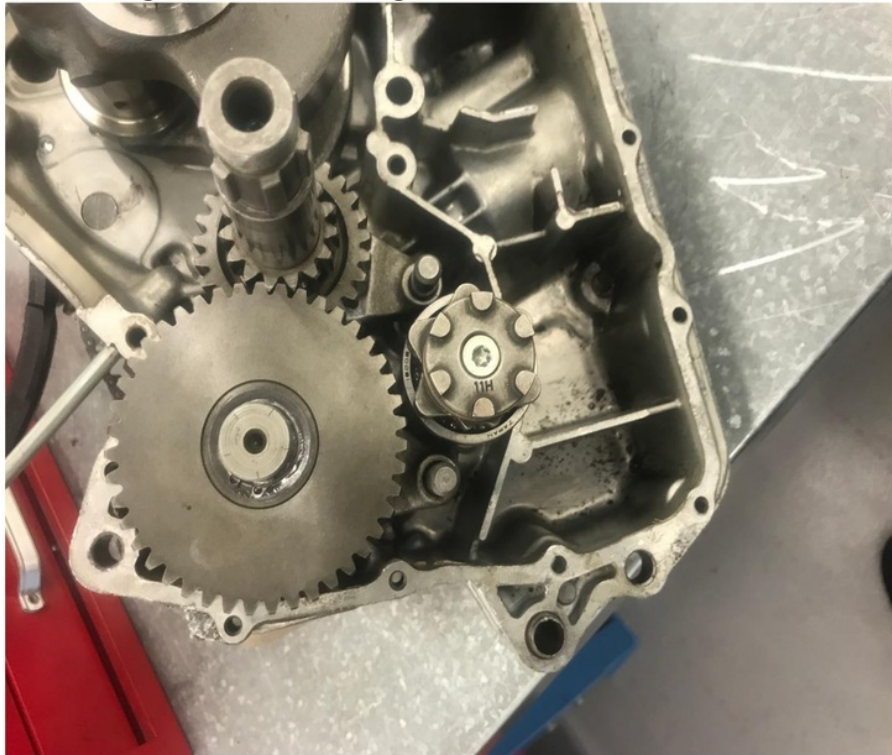
1. Remove the gear and cover located behind the flywheel.



2. Ensure that there are no more bolts connecting the two remaining cases, and begin to split the cases using the rubber mallet.



3. Remove the gearbox from the casing.



End of engine strip exercise.

Notes for next session

- Assembly is in the reverse of disassembly. Refer to logbook in reverse order, and make progress through the numbered parts in order from highest to lowest.
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Log Book Entry

Session 1 - Machine workshop

13/11/18

13:00-16:00

IQ018

Instructors

- Gareth Staddon and Dave Cooper

Session 1 Aims & Learning Outcomes

- Develop an understanding of the importance of accurate measurement, and learn the correct procedure for using and reading a micrometer and digital height gauge.
- Develop an understanding of how a lathe works, what it is used for and the procedures to safely operate the machine.
- Manufacture an accurately made part within the tolerances specified in the given design specification.

Health and Safety

- Steel toe cap boots to be worn at all times in order to minimise the potential risk of heavy items such as the engine itself, or components falling or being dropped and causing injury to the feet.
- Barrier cream to be applied to both hands at the start of each session. There is a second barrier cream that should be used as a top up approximately half way through the session, and a further cleansing cream to be used at the end. This is to avoid contact with cutting fluids and oils that may cause irritation. Gloves do not tend to be worn as they pose a risk of getting caught in the rotating parts of the machine and pulling the fingers or hand in.
- No jewellery should be worn whilst operating the machinery.
- Safety Glasses are to be worn at all times to protect from small metal shavings that are discharged from the lathe during operation.
- The lathe has built in safety features such as a safety screen that must be in the correct position for the machine to be operational.

PPE

- Steel toe cap boots
- Safety glasses
- Overalls

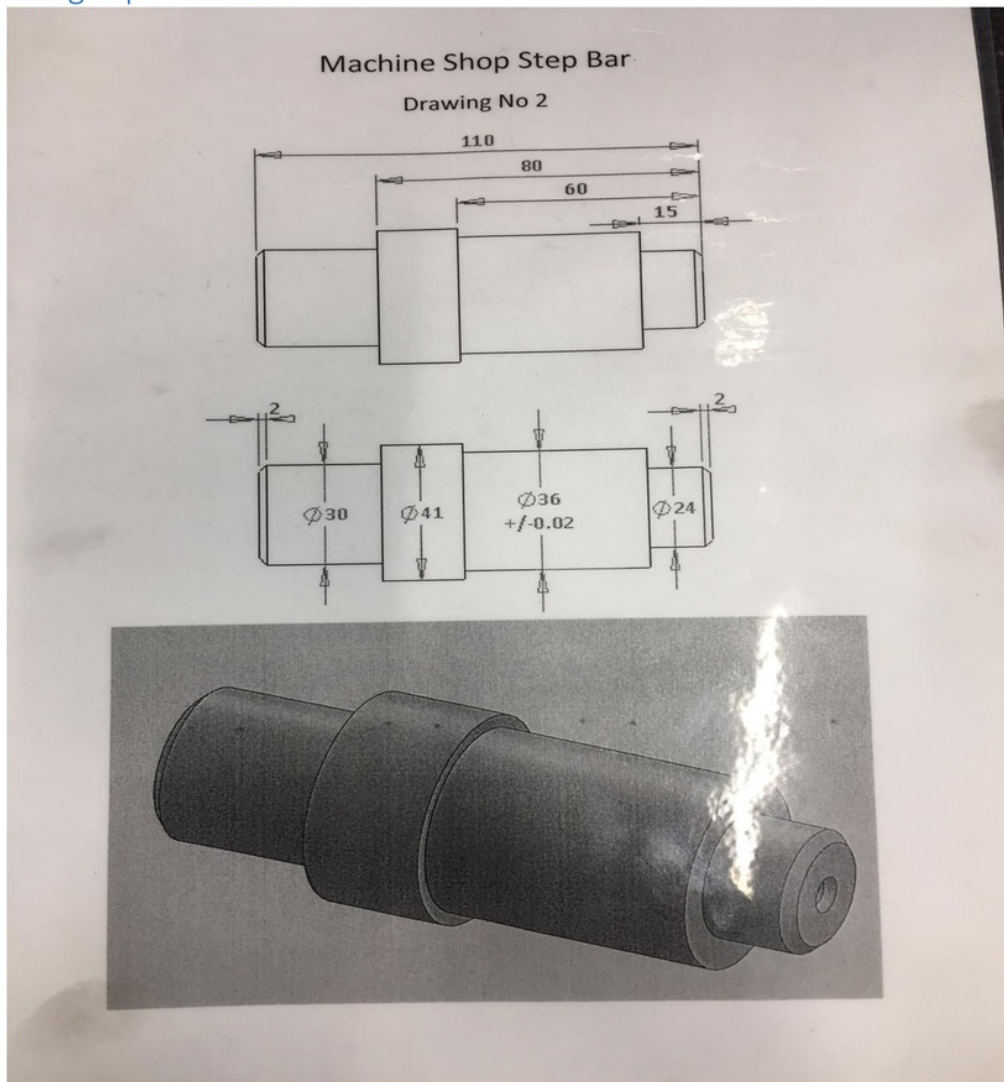
Materials

- Mild steel round bar

Equipment

- Micrometer
- Digital height gauge

Design specification



Procedures

1. Begin by placing the bar inside the three jaw chuck, tighten using the chuck key and ensure to remove the chuck key and position the safety screen before beginning operation.



2. In order to start or stop the lathe, press down on the foot bar.
3. Use the control levers to control the workbench's movement along three axis. The rotating handles may be engaged and rotated manually to provide a slow controlled pace along the axis, whilst the automatic system can be controlled using the lever.





4. Face off both ends of the material to produce a flat uniform edge for accurate measurement. Gareth demonstrated this with my material.
5. Remove the material from the chuck and use the digital height gauge to obtain an accurate measurement. In order to ensure an accurate measurement is obtained, ensure the workbench and material are properly cleaned, also take multiple measurements at various points around the material to ensure that a flat face has been produced at each end. Make a note of the measurement.



6. Place the material back inside the lathe chuck, and replace the attachment for the centre drill. Centre drill the material ensuring the hole is large enough to fit the stabilising attachment.



7. Once the material has been properly centre drilled, turn the material around in the chuck.
8. In order to ensure the correct distance is measured along the X axis, it is important to adjust the lathes measurement instruments (D.R.O) (See picture). To do this, start the lathe spinning, and touch the tip of the cutting tool to the outermost tip of the part. No material should be removed but a light scraping should be heard. Once this is in place, zero the Y and Z axis, and input the measurement taken for the height of

the part in stage 4 for the X axis.



9. Begin removing material by moving the cutting tool in increments of 0.5mm along the Z axis and along the X axis 30.00mm until the part of the bar being cut reaches a diameter and length of 30mm. When approaching the correct amount of material having been removed use the micrometer to accurately measure the diameter of the part and the digital height gauge to ensure the correct amount of material is being removed along the X axis. Do this regularly to ensure too much material is not removed. On the final cut, ensure to bring the cutting tool back through the z axis whilst the lathe is still spinning, this will ensure a flat surface is made on the newly cut edge. Make a note of the height of newly cut face from the worktop this should be 80.00mm +/- 0.02mm, this will be used for the X axis in step 13. Adjust the D.R.O accordingly for the z axis.

10. Once the first step of the part has been created, turn the material around, placing the smallest end inside the jaws, with a slight gap between the newly cut face and the jaws. Place the centre spinner attachment in the centre hole in order to stabilise the part.



11. Begin removing material from the work piece again at increments of 0.5mm along the Z axis. From this point we will be producing the part from left to right according to the design specification, in other words shaping the largest diameter faces first.
12. Begin by removing material from the entirety of the exposed surface along the X axis at increments of 0.5mm along the Z axis. Take particular care not to run the cutting tool into the rotating chuck, it is recommended to use the automatic system for about 90% of the cut, and to finish the last 10% manually. Do this until the diameter is 41mm across the entirety of the exposed material when measured with a micrometer.



13. Once the diameter is 41mm across the entirety of the exposed material, loosen the chuck and push the part in until the first section is completely enclosed, i.e the vertically cut face is against the jaws. Retighten the chuck. Adjust the centre spinner and the X axis measurement to the measurement taken for the X axis in step 9.

14. Continue cutting in increments of 0.5mm along the Z axis and 60mm along the X axis until the newly cut material has a diameter of 36mm when measured with a micrometer. As before take regular measurements using the digital height gauge to check the X axis and the micrometer to check the Z axis cuts. Do the final 10% of each cut along the X axis manually. On the final cut move the cutting tool back along the Z axis to provide another flat edge.



Feedback

Began by taking cuts of 0.2mm and as such was making slow progress. Gareth suggested taking larger cuts of 0.5mm in order to increase the speed of completing the task.

Log Book Entry

Session 2 - Machine workshop

20/11/18

13:00-16:00

IQ018

Instructors

- Gareth Staddon and Dave Cooper

Session 2 Aims & Learning Outcomes

- Develop an understanding of the importance of accurate measurement, and learn the correct procedure for using and reading a micrometer and digital height gauge.
- Develop an understanding of how a lathe works, what it is used for and the procedures to safely operate the machine.
- Manufacture an accurately made part within the tolerances specified in the given design specification.

Health and Safety

- Steel toe cap boots to be worn at all times in order to minimise the potential risk of heavy items such as the engine itself, or components falling or being dropped and causing injury to the feet.
- Barrier cream to be applied to both hands at the start of each session. There is a second barrier cream that should be used as a top up approximately half way through the session, and a further cleansing cream to be used at the end. This is to avoid contact with cutting fluids and oils that may cause irritation. Gloves do not tend to be worn as they pose a risk of getting caught in the rotating parts of the machine and pulling the fingers or hand in.
- No jewellery should be worn whilst operating the machinery.
- Safety Glasses are to be worn at all times to protect from shall metal shavings that are discharged from the lathe during operation.
- The lathe has built in safety features such as a safety screen that must be in the correct position for the machine to be operational.

PPE

- Steel toe cap boots
- Safety glasses
- Overalls

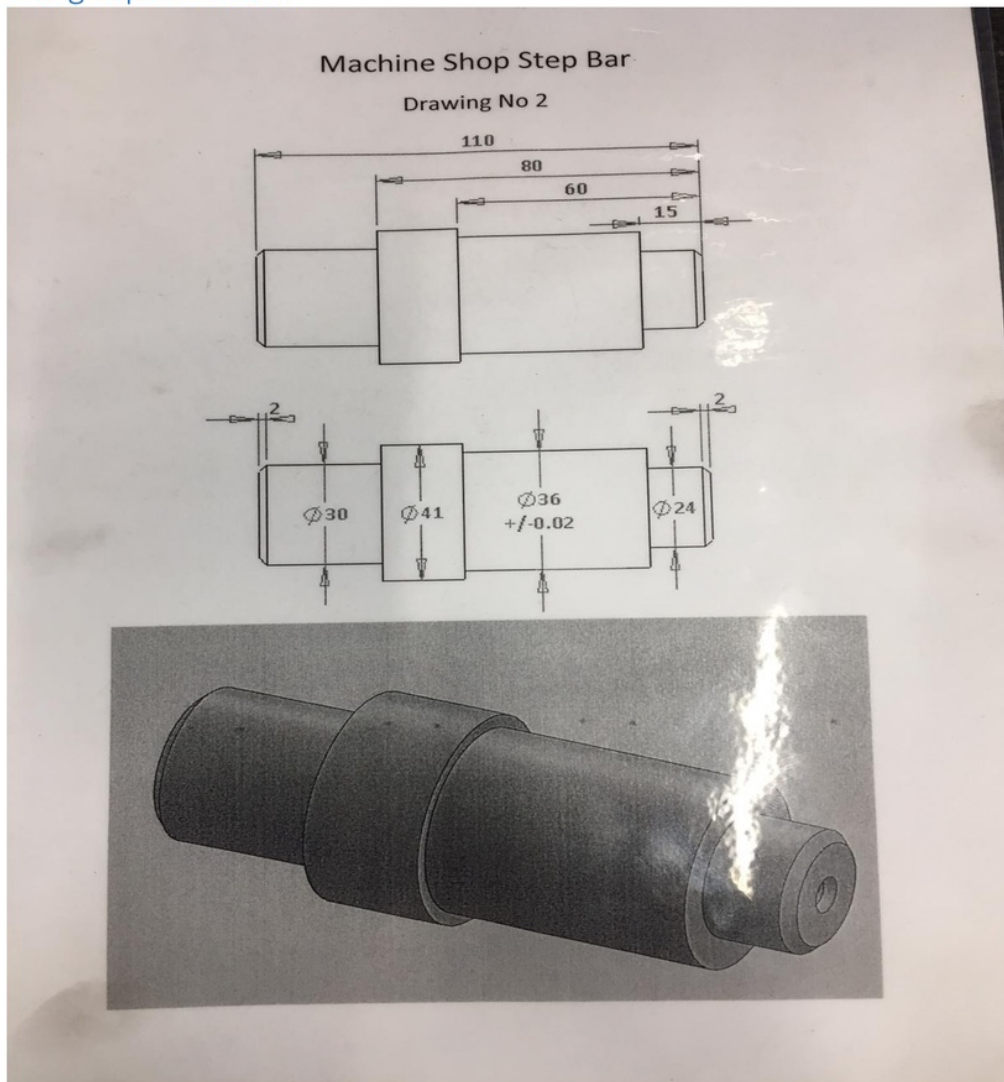
Materials

- Mild steel round bar

Equipment

- Micrometer
- Digital height gauge

Design specification



Procedures

1. Begin by taking accurate measurements using the digital height gauge and micrometer.
2. Place the part back in the lathe's chuck, and adjust the D.R.O accordingly
3. To start shaping the final section begin making cuts at increments of 0.5mm along the Z axis and 15mm along the X axis, doing the final 10% of the cut manually to ensure accurate cutting. Take regular measurements.



4. Once the diameters and sizes of each section of the piece are correct and measured accurately, we must then add the chamfered edges. To do this, adjust the tool piece to a 45° angle. Set the depth to 2mm and with the lathe spinning, use the manual Z handle to move the cutting tool slowly back and forth along the path of the part,

thus cutting the chamfer.



5. Turn the part around and complete another chamfer.

Learning Outcomes

The previous two sessions have taught me the importance of accurate measurements, as well as valuable practical skills and provided an insight into machining processes. I am happy with the outcome of the created part. It is made accurately to the according to the design specification, and I look forward to more machine workshops.

Feedback

Produced an accurate part according to the design specification. Good use of measurement apparatus and the lathe.

Log Book Entry

Session 3 - Machine workshop

04/12/18

13:00-16:00

IQ018

Instructors

- Gareth Staddon and Dave Cooper

Session 3 Aims & Learning Outcomes

- Develop an understanding of the importance of accurate measurement.
- Develop an understanding of how a milling machine works, what it is used for and the procedures to safely operate the machine.
- Manufacture an accurately made part within the tolerances specified in the given design specification.

Health and Safety

- Steel toe cap boots to be worn at all times in order to minimise the potential risk of heavy items such as the engine itself, or components falling or being dropped and causing injury to the feet.
- Barrier cream to be applied to both hands at the start of each session. There is a second barrier cream that should be used as a top up approximately half way through the session, and a further cleansing cream to be used at the end. This is to avoid contact with cutting fluids and oils that may cause irritation. Gloves do not tend to be worn as they pose a risk of getting caught in the rotating parts of the machine and pulling the fingers or hand in.
- No jewellery should be worn whilst operating the machinery.
- Safety Glasses are to be worn at all times to protect from small metal shavings that are discharged from the lathe during operation.
- The lathe has built in safety features such as a safety screen that must be in the correct position for the machine to be operational.

PPE

- Steel toe cap boots
- Safety glasses
- Overalls

Materials

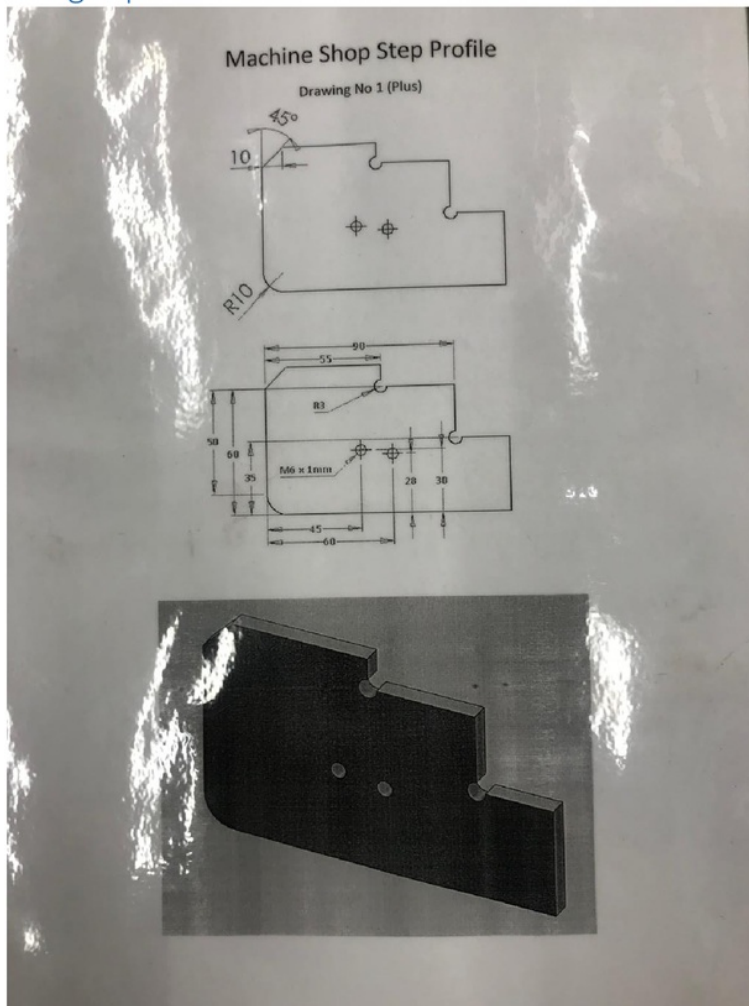
- Mild steel flat bar



Equipment

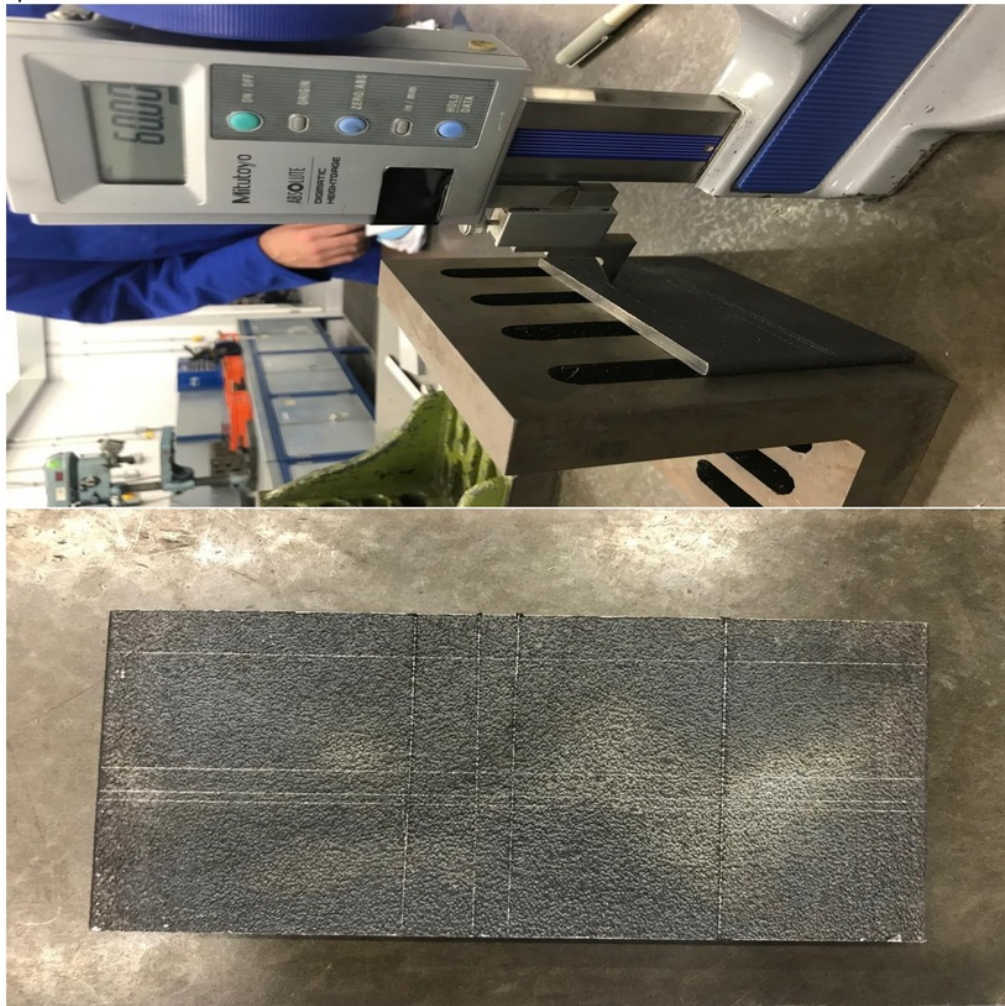
- Digital height gauge
- Centre punch
- Hammer
- Metal files
- Hack Saw
- Pillar drill
- Centre drill 4mm
- 5mm drill bit
- Copper hammer
- Milling machine
- Tap and die set
- 90° engineering block
- Vice grip

Design specification

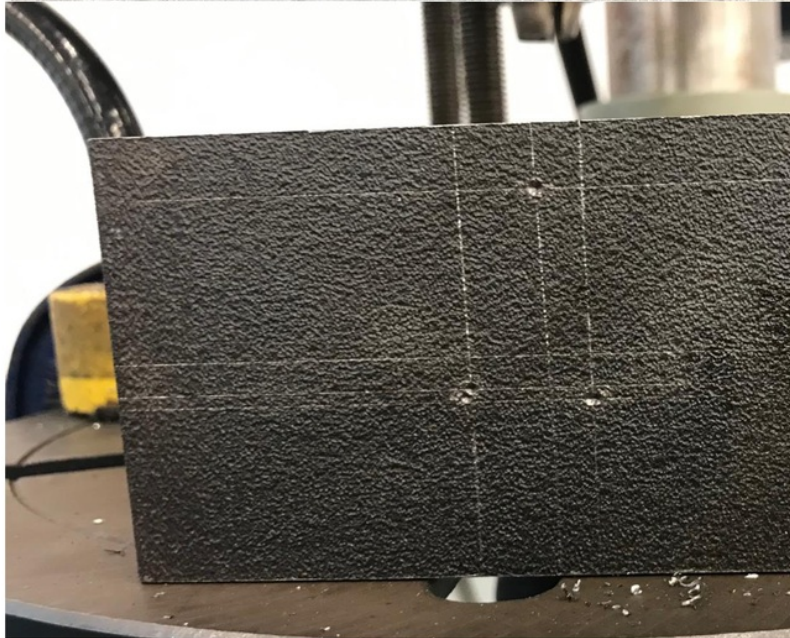


Procedures

1. As the part has been cut using a band saw, the edges are particularly rough and will need to be lightly filed flat to remove any excess material along the cut. This is best done by moving the file in one direction and keeping it flat against the edge. Find the flattest edge using 90° engineering block.
2. Using the hardened carbide tip of the digital height gauge to accurately mark out the appropriate reference lines on the work piece with respect to the design specification.



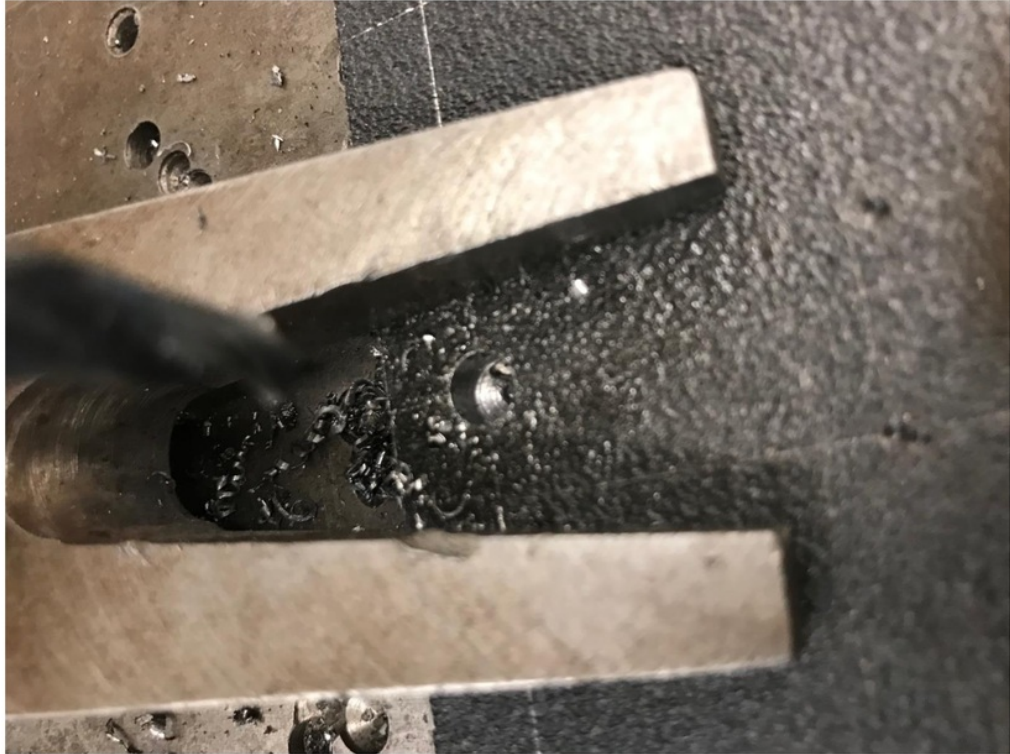
3. Use the centre punch and hammer to accurately mark out clearly where the holes will need to be drilled.

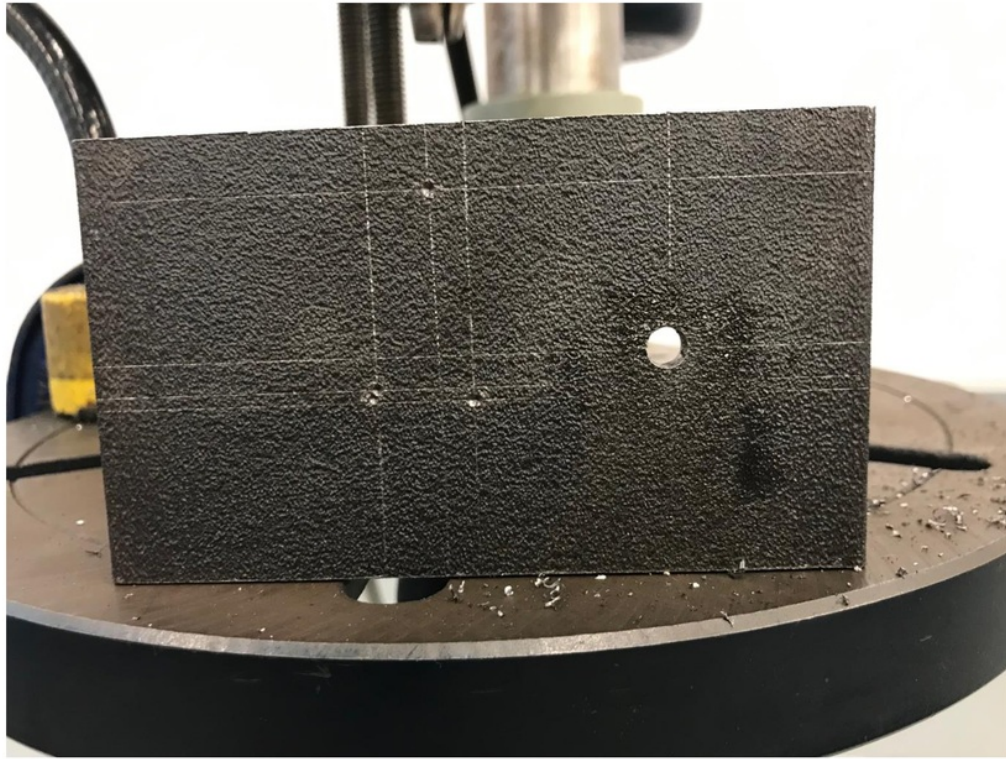


4. Use the centredrill to begin the hole, applying small amounts of Moly slip regularly. Do not complete the drill in one motion, instead remove the drill from the material for a few seconds and wipe shavings clear of the drill area regularly.

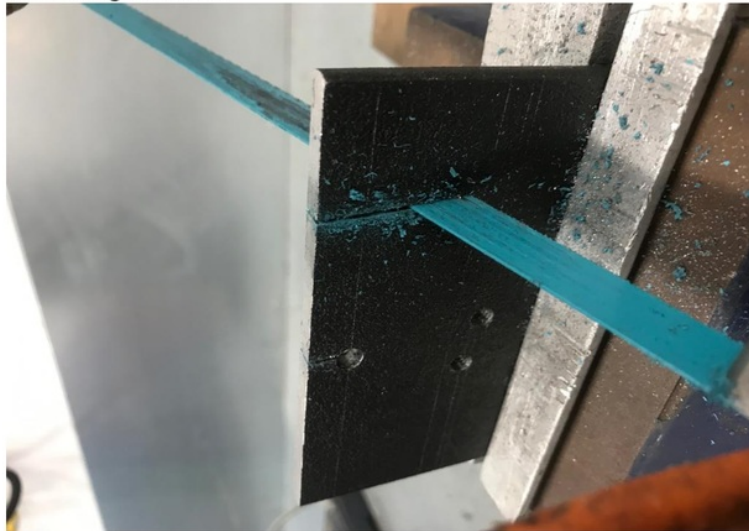


5. Replace the centre drill for the 5mm drill and finish the hole following the same procedure as the step above.

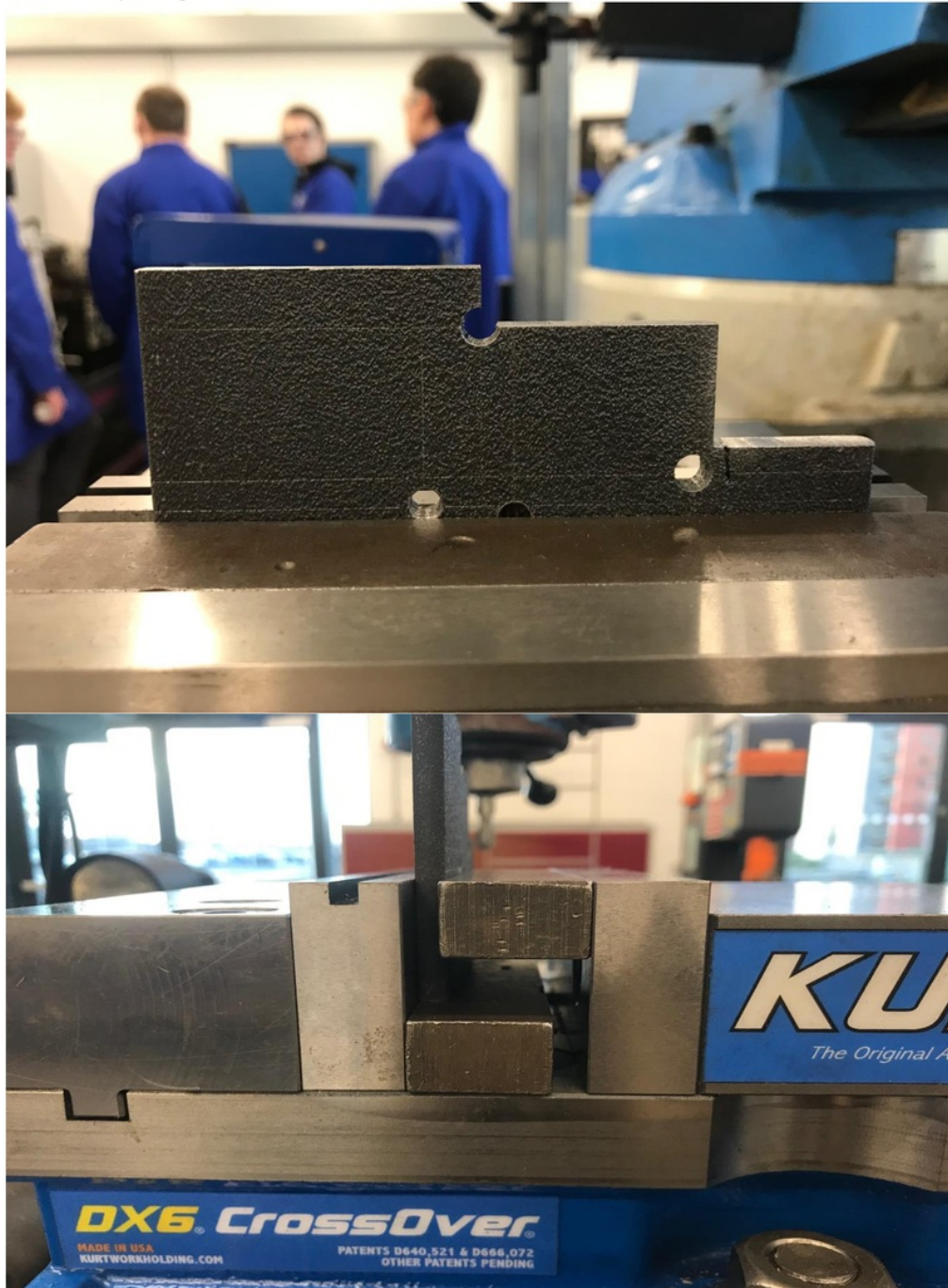




6. Repeat steps 4 & 5 for the remaining 3 holes.
7. Use the tap and die set to tap the two holes that require threading. Ensure the appropriate M6x1mm tap is used. Place the tap into the hole, ensuring that it is facing straight and level out. Turn 360° clockwise, and then back 180°. Continue until the thread has been created through the entire hole.
8. Place the part horizontally in the vice grip, and using the hacksaw, cut along the appropriate reference lines, giving approximately 5mm margin to be finished using the milling machine.



9. Place the part horizontally in the milling machine, and face off the edges. In order to face off a vertical edge, ensure the cutting tool is moved back and forth through the Z axis, completing the cut.



10. Use the milling machine to continue removing material from the top down, ensure not to take too deep a cut, or run the cutting tool into a vertical flat edge of the part.

Cut to the reference marks, stopping at regular intervals to take accurate measurements and update the D.R.O.
11. End of session.

Learning outcomes

The previous session has taught me the important of accurate measurements, as well as valuable practical skills and provided an insight into machining processes. I enjoyed using the milling machine and the centre drill, and understanding the different stages involved in producing a part from raw material. I am happy with the outcome of the created part. It is made accurately to the according to the design specification.

Feedback

Produced an accurate part according to the design specification. Good use of apparatus and machinery.

Log Book Entry

Jonathan Lloyd- Williams - 1805620

Session 1 - Guest lecture

05/12/18

11:00

IQ001

Guest Lecturer

- Aston Martin Lagonda

Learning Outcomes

Ex UWTSD graduate gave an interesting presentation regarding his work with the Aston Martin team since graduating. He and his colleague, gave a brief overview of some of the new concepts Aston Martin have in production, and showed a video of their new release. Had a chance to go with the film crew to film the video and gained a great experience through his employment. He provided interesting information regarding the engineering designs that are used in cars, particularly Aston Martin's bodywork, such as the fact that the adhesive they use in assembling their body work is also used in aircraft design. Overall enjoyed the lecture, and found it interesting to gain an insight into car manufacture as my interest has mainly surrounded motorcycles.

Log Book Entry

Jonathan Lloyd- Williams - 1805620

Session 2 - Guest lecture

20/03/19

12:00

IQ001

Guest Lecturers

- Vicki Martinson – Select Automotive
- Will Gray – UWTSD Motorcycle Engineering graduate currently working as a systems engineer for McLaren.

Learning Outcomes

The lecture began with Vicki Martinson from Select Automotive who delivered a talk on contracting as an option after graduation as appose to graduate schemes. Vicki represents a company that handles contractors, in that they act as a recruitment middleman and take their fee from your employers. I was surprised to learn that on a graduate scheme you can be expected to earn up to £40,000pa, whereas a contractor can be expected to earn between £50,000-£100,000pa. As a contractor you must establish your own company and are in a sense outsourcing for the employer.

The talk continued with Will Gray, a former motorcycle engineering student who went on to work for Ford as contractor for two years, before going onto become a contractor for McLaren. He currently earns £350 a day before tax and develops areas of their cooling systems. I found it interesting to see first hand how a motorcycle engineering degree does not limit opportunities simply to motorcycles but opens many other doors within the industry. Will explained some of the details behind becoming a contractor and recommended considering it as appose to graduate schemes. He also mentioned how his work with the raceteam whilst attending university was a great help in getting him to where he is. His employer at McLaren shares a love for VFR400s and Will said that his time on the race team was the main talking point of his interview and arguably what won him the position. Despite providing clear examples of the benefits of working as a contractor, Will mentioned that he is considering taking a permanent position with his current team at McLaren. Although this will mean a reduction in salary for him, he has found a workplace that is right for him and has said he would be willing to take a permanent position based on the outcome of ongoing negotiations.

1805620

27/03/19

IQ001

- Charlotte White – UWTSD Motorsport Management graduate currently working for Oxford Advanced Systems

Learning Outcomes

Charlotte delivered a great talk about her experience in industry since graduating in 2015. Charlotte went on to work for the Motorsport Industry Association (MIA) and made many contacts during her time there. She then went on to work for Rockingham Motor Speedway, organising various events and working closely with both organisers and racers to ensure that events went to plan. Unfortunately Rockingham was forced to close and Charlotte now works for a company that has manufactured a product that removes the need for sanding during certain processes involving bodywork for both cars and aeroplanes. By applying their product, many man hours can be saved in prep work, and as such labour costs reduced. Charlotte is trying to make good use of the contacts made in her time at the MIA by marketing the product in the motorsport industry's direction.

Logbook

GRADEMARK REPORT

FINAL GRADE

93/100

GENERAL COMMENTS

Instructor

Electronic submission only.

Jonathon, this is a very high quality logbook.

The structure and formatting of the entries are not only consistent but also appear very professional.

You have embedded the photos into the logbook well (they perhaps don't need to be so big, therefore using less pages).

The engine workshop is always hard to write up, however you have done a very good job and have remembered to include what tooling should be used at each step as well.

The level of detail is repeated in the machine workshop entries as well.

Health and Safety, including PPE, is discussed in depth for every entry. You have also remembered to reflect on each session as well.

The reviews of the guest lectures are very good as well. (15/15 marks)

Being really picky, I would have like the photos

smaller, labelled or annotated.

Otherwise this is a great logbook and with your permission I would like to use it as an example to next year's first years.

Logbook Mark = 93%

**Overall Module Mark (including CWK1 and CWK2)
= 85%**

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RUBRIC: BACHELOR'S LOGBOOK CRITERIA

K & U SUBJECT**Exceptional
85-100%**

Knowledge and Understanding of Subject. Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.

OUTRIGHT FAIL 0-29%	Major gaps in knowledge and understanding of the basic underlying concepts and principles of the subject matter. Inclusion of irrelevant material. Substantial inaccuracies
UNSATISFACTORY 30-39%	Gaps in knowledge of the basic underlying concepts and principles, with flawed or superficial understanding. Some significant inaccuracies and/or irrelevant material.
SATISFACTORY 40-49%	Limited knowledge and understanding of the basic underlying concepts and principles within the subject area. Some elements may be missing
GOOD 50-59%	Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth.
VERY GOOD 60-69%	Competent knowledge of the basic underlying concepts and principles. Exhibits very good understanding
EXCELLENT 70-84%	Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.
EXCEPTIONAL 85-100%	Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles

C&I SKILLS**Exceptional
85-100%**

(Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.)

OUTRIGHT FAIL 0-29%	Wholly or almost wholly descriptive work. Little or no evaluation of the underlying concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Minimal or no use of evidence to back up views.
UNSATISFACTORY 30-39%	Largely descriptive work, with superficial evaluation of the underlying concepts and principles. Weak interpretation of data, flawed development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory
SATISFACTORY 40-49%	Limited attempt at evaluation of the underlying concepts and principles, tending towards description. Can interpret qualitative and quantitative data but with some errors. Some evidence to support emerging arguments and judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.
GOOD 50-59%	Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to

support the argument. Mostly valid arguments and logical judgements.

VERY GOOD 60-69% Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.

EXCELLENT 70-84% Excellent evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately and with some insight. Excellent ability to devise arguments using evidence and make appropriate and valid judgements

EXCEPTIONAL 85-100% Exceptional evaluation of the underlying concepts and principles based evidence. Outstanding interpretation of qualitative and quantitative data. Exceptional ability to devise arguments using evidence and make wholly appropriate and valid judgements

PRAC SKILLS

**Exceptional
85-100%**

(Different approaches to solving problems in particular contexts.)

OUTRIGHT FAIL 0-29% Limited or no use of taught, basic methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Very weak evidence of different approaches to problem-solving in particular contexts.

UNSATISFACTORY 30-39% Rudimentary application of taught, basic methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak evidence of different approaches to problem-solving in particular contexts.

SATISFACTORY 40-49% An adequate awareness and mostly appropriate application of basic methods, materials, tools and/or techniques. Basic appreciation of the context of the application. Can identify problems in particular contexts and propose basic alternative approaches or solutions though there may be errors.

GOOD 50-59% A good and appropriate application of basic methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Good evidence of different approaches to problem-solving in particular contexts and proposes mostly appropriate solutions.

VERY GOOD 60-69% A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application. Very good evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.

EXCELLENT 70-84% An advanced application of a range of taught, basic methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Excellent evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.

EXCEPTIONAL 85-100% Exceptional levels of application and deployment skills in particular practical contexts. Outstanding identification of problems in particular contexts and formulation of wholly appropriate, thoughtful solutions / different approaches.

(Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.)

OUTRIGHT FAIL 0-29%	Work is poorly structured, disorganised, inaccurate and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Failure to work effectively individual or as part of a group. Little or no evidence of the skills for employment requiring the exercise of some personal responsibility.
UNSATISFACTORY 30-39%	Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to individual or group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of some personal responsibility.
SATISFACTORY 40-49%	Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence and/or accuracy in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of some personal responsibility, with some areas of minor weakness.
GOOD 50-59%	Mostly coherent, organised and accurate work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of some personal responsibility, with some areas of strength and some of minor weakness.
VERY GOOD 60-69%	Work is accurate, coherent, fluent, well-structured and organised. Can work effectively independently and/or as part of a team, with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.
EXCELLENT 70-84%	Work is coherent, very fluent and is presented professionally. Can work effectively independently and/or as part of a team, with an excellent contribution to group activities. Demonstrates excellent skills for employment requiring the exercise of some personal responsibility with an appetite for further development.
EXCEPTIONAL 85-100%	Work is accurate, exceptionally coherent, very fluent and presented well. Can work effectively independently and/or as part of a team, with an exceptional contribution to group activities. Demonstrates exceptional skills for employment requiring the exercise of some personal responsibility with an appetite for further development