



# **Diploma in Clock and Watch Servicing**

Syllabus and Specimen Papers

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## 1 Introduction

The Diploma in Clock and Watch Servicing is a qualification accredited at Level 3 within the Qualifications and Credit Framework.

As a result of government changes to qualifications, the British Horological Institute, working in conjunction with the awarding body EAL, (Ema Awards Ltd), has developed the units which are required for the award the Diploma in Clock and Watch Servicing. The Institute is responsible for the administration for the award and registers candidates on the EAL database. EAL awards certificates to candidates when the qualification is completed. Interim certificates showing the units gained at each examination session are issued by the British Horological Institute.

## 2 Objectives

The Diploma in Clock and Watch Servicing has been designed to fulfil the following objectives:

- to provide a national qualification, with accredited national standards, recognisable to centres, students and employers within the horological industry in the UK
- to prepare for employment as a technician servicing clocks and / or quartz watches
- to enable progression to a two year specialist course in Clock or Watch Repair, Restoration and Conservation leading to the proposed awards:
  - Diploma in the Servicing and Repair of Clocks / Watches (Level 4)
  - Diploma in the Repair, Restoration and Conservation of Clocks / Watches (Level 5)

## 3 Examination design and structure

The Diploma in Clock and Watch Servicing is a Qualifications and Credit Framework qualification at Level 3. It was developed by the British Horological Institute to provide a qualification, which meets the needs of the horological industry; the development process included consultation with the training facilities present in the United Kingdom. Candidates who gain the award will have to satisfy the British Horological Institute Examinations Board in two mandatory units and one optional unit. Each unit is separately examined and certificated; no time limit is placed on the completion of the Diploma in Clock and Watch Servicing.

**Mandatory Units** (candidates must complete both of these units):

The Theory of Clock and Watch Servicing (Level 4)

Making Clock Components (Level 3)

**Optional Units** (candidates select one of the following):

Servicing a Single train Clock Movement (Level 3)

Servicing a Quartz Watch (Level 3)

**Examination design and structure, continued:**

Each unit is assessed externally by examination. The British Horological Institute's Examinations Board is responsible for the external assessment and monitors the invigilation of examinations.

Information for each unit, details of the syllabus, learning outcomes and assessment procedure, is given within the section allocated for each unit.

The following grades of pass are awarded for each unit:

- Pass - 50%
- Pass with Merit - 75%

A candidate will be awarded a Pass for the Diploma in Clock and Watch Servicing when a Pass has been gained for each of the two mandatory units and one optional unit. A Pass with Merit will be awarded for the qualification if a Pass with Merit has been awarded for each unit.

**Candidates should note that the Qualifications and Credit Framework provides the facility for awards to be accredited from a wide range of units within the framework. For horology, one benefit of this approach is that some units contribute to more than one qualification:**

- **the theory unit for the Diploma in the Servicing of Clocks and Watches contributes to both the proposed Diploma in the Servicing and Repair of Clocks / Watches and the Diploma in the Repair, Restoration and Conservation of Clocks / Watches.**
- **the units, Servicing and Correcting Faults in a Single Train Clock and Servicing and Correcting Faults in a Quartz Watch contribute to the clock / watch pathways in the proposed Diploma in the Servicing and Repair of Clocks / Watches.**

## 4 Other horological qualifications

The **Certificate in the Repair, Restoration and Conservation of Clocks / Watches** was accredited to the National Vocational Framework on 1<sup>st</sup> October 2002. The last date for registrations is 31<sup>st</sup> December 2011. Candidates who have already commenced the qualification will be able to gain units to complete the award until 31<sup>st</sup> December 2015.

EAL working in conjunction with the Institute is in the process of accrediting two awards to replace the Certificate in the Repair, Restoration and Conservation of Clocks / Watches. It is envisaged that these new qualifications will be available for the Examinations in May 2012.

**Diploma in the Servicing and Repair of Clocks / Watches (Level 4)****Diploma in the Repair, Restoration and Conservation of Clocks / Watches (Level 5)**

An overview of the Diploma in Clock and Watch Servicing and the two further proposed awards is given on Page 42.

## 5 Conditions for examination entry

Examinations are arranged to take place during May / June each year. An advertisement in the January Horological Journal informs members of the actual dates and reminds prospective candidates that entry forms for the examination are available from Upton Hall. Entries are accepted until early March but late entries can be processed after this date on payment of an additional fee.

### Examination entry is accepted on the following terms:

1. Entries received at Upton Hall after the closing date will be subject to an additional fee.
2. Whenever possible, entries will be accepted up to one week prior to the date of the examination for the unit concerned.
3. No refund of fees can be made in the event of cancellation or a candidate not being present for the examination.
4. Candidates who are not students attending a course at an Examination Centre are expected to provide their own workshop facilities for making the Practical Test Piece.
5. Every effort will be made to consider applications from candidates requiring Special Provision but there is no guarantee that the Institute will be able make arrangements if applications are late or not accompanied by the specified supportive information.
6. "Special consideration" can be requested if it is felt that, due to illness or injury, the candidate may have underachieved during an examination. Any such request must be submitted within seven days from the date of the examination in the instance of Theory or the Practical Servicing Tests. In the case of the practical examination requiring a "practical test piece" to be constructed, the request should be made at the onset of the difficulty. Supporting evidence such as Medical Certificate will be required.
7. Any request for the Institute to re-assess a candidate's work (an "Appeal") must be accompanied by the Appeal fee together with any information relevant to the request.
8. An appeal can only be accepted if received at Upton Hall before the closing date for Appeals given at the time when examination results are received, normally 31st August.
9. In the event of an appeal, the Institute's Chief Examiner is responsible for the re-assessment of the standard of the candidate's work and, with two members of the Examinations Board, will consider whether, or not, the outcome of the initial assessment was correct. (the "Appeal Process")
10. The fee for the Appeal will be returned if it is found that, as a result of the Appeal Process, the outcome of the examination is changed. (i.e. Result revised from Fail to Pass or Pass to Pass with Merit)
11. The Institute, having followed the Appeal Process, will have fulfilled its duty to any candidate who has requested that their work is re-assessed and no further appeal will be considered.

**Conditions for examination entry, continued:**

12. Information regarding Special Provision, Special Consideration, Special Assessment Needs and the Appeal Process is contained in this booklet "Diploma in Clock and Watch Servicing, Syllabus and Specimen Papers"
13. The examination papers giving details of the Practical Test Piece for candidates who are students at an Examination Centre will be sent to the centre for distribution by the Examination Centre to the candidates.
14. If you are not a student at the Examination Centre, the examination paper for your Practical Test Piece will be sent by email to the address given on your application form on the day of commencement of the examination. Special instructions such as a request for first class post or delivery to an alternative address must be clearly indicated at the time of entry for the examination.
15. The Institute cannot accept any responsibility for delay in receipt of examination papers, material kits or items such as watch movements.
16. Practical pieces must arrive at Upton Hall on or before 1.00 pm on the closing date specified for the receipt of the Practical Test Piece. The date is clearly stated on the letter informing candidates of examination arrangements and on the examination paper. Any Practical Test Piece arriving late will not be accepted.
17. The Institute will issue interim certificates for units which candidates gain each year; when a candidate has completed a qualification, a certificate will be issued by EMTA Awards Ltd.
18. The details for issuing certificates, name and initials, will be as given on the entry form for the examination. If certificates have been issued by EMTA Awards Ltd previously, the same format will be used for future EAL certificates.

## 6 Special Assessment Needs

The Institute consider requests from candidates who may require Special Provision to enable participation in the examination process:

1. Special Provision: agreed before the examination. e.g. extra time or amanuensis because of a specific learning difficulty such as dyslexia.
2. Special Consideration: agreed during or after the examination. e.g. allowance for temporary illness, injury or indisposition at the time of the examination. In the case of a practical examination requiring the making of a Practical Test Piece, the Examinations Secretary should be informed at the onset of the difficulty.

## 6.1 Special Provision

If a candidate is seeking Special Provision, information concerning the condition should be submitted to the Examinations Secretary with the candidate's application form. This information must include a specialist's report describing the candidate's condition with recommendations for suitable provision.

Examples of the type of information required:-

1. Educational psychologist's report with a recommendation for extra provision.
2. Summary of the situation by an educational psychologist with a recommendation for extra provision.
3. Report from a qualified specialist teacher for dyslexia recommending extra provision.
4. For a medical condition, a doctor's certificate accompanied by a recommendation for extra provision.

Requests for Special Provision are carefully considered; the decision will be based on national guidelines and forwarded to the Examination Centre and the candidate at least one week prior to the examination.

If the information supporting a request for Special Provision is incomplete, or submitted after the closing date for entries, it may not be possible to ensure arrangements are completed in time for the Examination.

## 6.2 Special Consideration

A request for Special Consideration can be made in the event of illness or injury causing a candidate to underachieve during an examination. Any request for Special Consideration should be submitted, together with appropriate evidence, to the Examinations Secretary. In the case of the Theory Examination or a Practical Servicing Examination, the request must be received within seven days of the examination. For the Practical Examination, the Examinations Secretary should be informed at the onset of the difficulty. The Examinations Board will determine the Special Consideration to be granted and will inform the candidate accordingly.

## 7 Overseas candidates

For many years, the BHI / EAL awards have been available to candidates from overseas.

Some travel to an Examination Centre in the United Kingdom in order to sit the examinations but many units can also be examined in the candidate's country of residence. The main difference is the use of Examination Centres and the approach to invigilation.

Overseas candidates usually follow a course of study using the Distance Learning Course and decide to enter the examinations.

**Overseas candidates, continued:**

When applying to enter the examination, the candidate is required to provide the name and address of a suitable invigilator:

- A Justice of the Peace
- A Member / Fellow of the British Horological Institute
- A Principal / Head teacher / Teacher of a recognised educational establishment.

The examination papers for Theory Examinations together with information about the conduct of the examinations will normally be sent by email to the invigilator on the morning of the examination. Examination papers together with the clocks / watches for the Practical Servicing Examination will be posted to the invigilator. A refundable deposit will be required for the clocks / watches. The invigilator will sign a declaration that the examination has been conducted in accordance with the BHI / EAL regulations.

Examination papers for the practical examinations are normally emailed directly to candidates on the morning of the commencement of the examination.

**Certificate in Clock and Watch Servicing:**

All units can be taken in the candidate's country of residence.

**Diploma in Clock and Watch Servicing:**

All units can be taken in the candidate's country of residence.

**Certificate in the Repair, Restoration and Conservation of Clocks / Watches:****Final Grade Part I (first year):**

All units can be taken in the candidate's country of residence.

**Final Grade Part II (second year)**

Two units can be completed in the candidate's country of residence but, because there is a requirement for the Institute to monitor invigilation, the following units must be sat at an Examination Centre in the United Kingdom. The examinations are arranged on consecutive days; the headquarters of the British Horological Institute at Upton Hall, near Newark, Nottinghamshire, is an Examination Centre and can arrange overnight accommodation.

**Clock Pathway:-**

Unit 3 – The Theory of Clocks and Watches and their Repair

Unit 5 – The Practical Repair of Clocks

Unit 6 – The Theory of Clocks and Clock Restoration and Conservation

**Watch Pathway:-**

Unit 3 – The Theory of Clocks and Watches and their Repair

Unit 10 – The Practical Repair of Watches

Unit 11 – The Theory of Watches and Watch Restoration and Conservation

**Overseas candidates, continued:**

It is anticipated that similar arrangements will apply for the proposed awards.

**Record of Repairs / Portfolios:-**

Each of the items that comprise a Record of Repairs or a Portfolio has to be checked by a qualified member of the Institute (MBHI / FBHI). This may prove difficult or impossible in some countries – the Institute maintains a flexible approach to meet the needs of candidates wherever possible. In the first instance, the candidate should contact the Examinations Secretary:

- The Institute will try to provide a qualified member of the Institute (MBHI, FBHI) to check your work.
- If the Institute is unable to locate a suitable person please suggest a suitably qualified clock / watchmaker. It is important to provide details giving the name, address, qualification and experience at an early stage so that the Examinations Board can decide whether the person meets the requirements.
- If the above approaches cannot be followed, please inform the Examinations Secretary so that alternative approaches can be suggested.

## 8 How your work is assessed

Examiners are trained and provided with detailed marking schemes for each of the various units.

Every Theory script, Practical Servicing Test and Practical Test Piece is independently assessed by two Examiners.

The assessment process is monitored by a Senior Examiner in order to prevent any errors. Candidate assessment material can be checked against archived examples to ensure constancy of standards over time. Borderline Pass / Fail and borderline Pass / Pass with Merit are carefully reviewed.

**Theory Papers:**

The examination paper indicates the maximum mark which can be allocated to the separate sections of each “essay type” question; the total for each question is twenty marks. The assessment reflects the extent to which the candidate is familiar with the relevant content of the course. The technical content of the answer is assessed; theory papers must be legible but marks are not awarded or deducted in respect of the accuracy of spelling or grammar.

The instructions for the paper state that mathematical questions should be laid out in a clear and logical manner, the use of calculators is permitted but the approach must be clearly shown. A correct answer, without adequate working, is not awarded the full marks allocated to that section of the question. A clearly laid out answer, but with an incorrect result due to mathematical error, may receive a high proportion of the allocated marks.

For short questions, the Examiners award one mark for each wholly correct answer; a partially correct answer can be awarded a half mark.

**How your work is assessed, continued:****Practical Servicing Test:**

It is expected that the clock movement / watch will be fully assembled and in good working condition on completion of the examination.

Each clock movement or watch is assessed using a detailed marking scheme which considers many aspects of the servicing process; particular attention is directed towards the function of the clock movement or the watch. Candidates must achieve a minimum standard in each:

- Where appropriate, the Examiner tests the movement. e.g. the range of tests for quartz movements, water resistance testing, testing for rate.
- The candidate's ability to identify and correct the introduced faults.
- The lubrication of pivots, keyless work, escapement, etc.
- The cleanliness, freedom from fingerprints on the movement, dial, glass.
- Where necessary movements are dismantled / partially dismantled to determine the correction of faults and correct assembly.
- Candidates lose marks for any damage caused to the movement or if components are replaced when they are in good condition.

**Practical Test Piece:**

Each Practical Test Piece is assessed against three broad criteria, Accuracy, Quality of Workmanship and Quality of Finish. Candidates must achieve a minimum standard in each:

**1. Accuracy:**

A number of key dimensions / fits / aspects of operation are checked for accuracy. For dimensions, if the size is within the tolerance stated on the drawing five marks are awarded; if within a broader tolerance, three marks are awarded. If the measurement is less accurate, a zero mark is awarded.

**2. Quality of workmanship:**

Various aspects of the examination piece are identified to test whether, or not, the candidate has demonstrated the ability to achieve a high standard of workmanship. Marks are awarded for each; a maximum of five marks if the aspect concerned shows a high standard of achievement.

For example:

- Are pivots parallel with correct end radius, square cornered root, square shoulder and correct chamfer?
- Are working clearances and fits correct?
- Have parts (where required) been hardened and tempered?

**3. Quality of finish:**

Various aspects of surface finish are identified, each being allocated a maximum of three marks.

For example:

- sharpness of corners
- absence of file and machining marks
- quality of bluing
- quality of polishing on flat surfaces.

## 9 Receiving your results

The results are generally despatched from Upton Hall early August. Candidates who have entered an examination will receive a statement showing the units they have gained, including any units which have been awarded in previous examinations.

If the required units for a qualification have been passed, the statement will include details of the award, Pass or Pass with Merit.

Every candidate receives with their results a copy of the relevant Examiner's Report.

If you feel that there is an error in your results you can ask for your paper to be re-assessed (an Appeal). A request for an Appeal must be received on or before 31<sup>st</sup> August and should be accompanied with the charge payable at the time.

In the event of an appeal, the Institute's Chief Examiner is responsible for the re-assessment of the candidate's work and, with two members of the Examinations Board, will consider whether, or not, the outcome of the initial assessment was correct (the "Appeal Process"):

- The total mark will be checked against the sum of marks awarded for the separate criteria by each Examiner.
- Your Theory Paper / Practical Servicing Test / Practical Test Piece will be reassessed.
- The Chief Examiner will prepare a report informing you of the various details considered and the decision of the Appeals Panel.

The fee for the Appeal will be returned if it is found that as a result of the Appeal Process the outcome of the examination is changed. (i.e. Result revised from Fail to Pass or Pass to Pass with Merit).

The Institute, having followed the Appeal Process, will have fulfilled its duty to any candidate who has requested that their work is re-assessed and no further appeal will be considered.

## 10 Customer service statement

The British Horological Institute works closely with the Awarding Body EMTA Awards Ltd to ensure the provision of quality examinations for clock and watchmaking. The Institute is committed to providing at all times a service, which is open and informative, efficient, courteous and cost effective:

1. The Institute will respond to correspondence concerning examinations within ten working days of receipt.
2. Complaints concerning examinations will be acknowledged within five working days and, wherever possible, a response despatched within ten working days of receipt.

**Customer service statement, continued:**

3. Information about the fee structure for the examinations is available on the Institute website; all candidates are notified of entry fees at the time of registration.
4. Candidates will be informed of their examination results in early August.
5. Candidates will receive a copy of the Examiner's Report for the examination with their results.
6. Candidates who believe that a mistake has occurred in the marking of a paper, practical test piece, portfolio or drawing can request a reassessment (an Appeal). The charge for re-marking is provided on the application form. The fee must accompany any such request which should be received before 31<sup>st</sup> August. The Appeal Process will be completed within fifteen working days from the closing date for appeals; you will be informed of the outcome. The appeal fee is refundable if it is found that there has been an error in the original result – the outcome revised from Fail to Pass or Pass to Pass with Merit.
7. Candidates at the May / June Examination will receive their certificates during Awards Day at Upton Hall (October) or, if the candidate cannot attend will be posted during the following three weeks.

**Contacting us:**

If you require general help or advice on the Institute's examinations please email or telephone the Examinations Secretary at Upton Hall:

[examinationssecretary@bhi.co.uk](mailto:examinationssecretary@bhi.co.uk) 01636 817604

We should like to know if you are in any way dissatisfied with the level of service you receive. An awareness of any difficulties enables us to cater more effectively for our candidates.

Please write to:

The Examinations Secretary,  
British Horological Institute  
Upton Hall  
Upton  
Newark  
Notts.  
NG23 5TE

Telephone: 01636 817 604

Fax: 01636 812 258

email: [examinationssecretary@bhi.co.uk](mailto:examinationssecretary@bhi.co.uk)

## 11 Syllabus - The Theory of Clock and Watch Servicing

This unit provides a theoretical background of the history, construction and functioning of basic clocks and watches. It includes the essential underpinning knowledge for the practical units which require candidates to make an assembly of clock components, and service a single train clock or a quartz watch.

The unit, Theory of Clock and Watch Servicing, is also a requirement for the proposed Diploma in the Servicing and Repair of Clocks / Watches and the proposed Diploma in the Repair, Restoration and Conservation of Clocks / Watches.

Page references are provided to relate the syllabus to the Distance Learning Course, Practical Clock and Watch Servicing. These are not intended to be exhaustive but to provide a guide to relevant sections of the Distance Learning Course; there may be instances where other sections in the Distance Learning Course are used for examination purposes.

### Learning objectives which can be assessed in the theory examination:

#### 1.0 Understand the historical background and identification of different types of clocks and watches

1.1 Differentiate between different types of clocks (L1 P5-22)

1.2 Explain the historical background for common types of clocks (L1 P5-22)

For example, based on the Distance Learning Course, Practical Clock and Watch Servicing:

- a carriage
- b lantern
- c longcase
- d Vienna regulator
- e bracket
- f dial
- g American wall
- h French with drum movement
- i 20<sup>th</sup> century striking
- j 20<sup>th</sup> century chiming
- k with a floating balance
- l anniversary clock

1.3 Differentiate between different types of watches (L1 P22-27)

1.4 Explain the historical background for common types of watches (L1 P22-27)

For example, based on the Distance Learning Course, Practical Clock and Watch Servicing:

- a English lever pocket watch
- b American railroad pocket watch
- c Mechanical wristwatch
- d Quartz analogue wristwatch
- e Quartz LED watch
- f Quartz LCD watch

**2.0 Understand the construction, function and operation of the various components which form a clock movement**

2.1 An overview of the parts of a clock movement (L1 P28-33)

2.2 Explain the function of the main parts of a clock movement:

- a frame (L1 P32-33, P44-46):
  - i pillars
  - ii plates
  - iii bridges
  - iv cocks
- b motive force (L1 P31):
  - i weight driven
  - ii going barrel
  - iii fusee
- c winding mechanism (L1 P31, P38-39; L2 P20-21):
  - i ratchet wheel
  - ii click
  - iii click spring
- d going train (L1 P31, P39-42):
  - i wheels
  - ii pinions
  - iii train layout
- e motion work (L1 P32, P34-35):
  - i cannon pinion
  - ii minute wheel pinion
  - iii hour wheel
- f hand setting, types of friction drive (L1 P32, P43-44; L2 P49-51)
- g escapement (L1 P32, P37-38, P42):
  - i escape wheel
  - ii pallets
  - iii crutch assembly
- h oscillator (L1 P28-29, P32):
  - i pendulum
  - ii balance and spring

2.3 Explain the principles and construction of the motive force for different types of clocks:

- a weight driven clocks (L2 P5-8):
  - i the great wheel, barrel and click work assembly
  - ii pulley arrangements
  - iii line materials
- b portable timekeepers:
  - i the properties of springs (L2 P9-10)
  - ii Hooke's law (L2 P9)
  - iii how to distinguish between good and "set" springs (L2 P15-16)
  - iv rules affecting the strength of mainsprings (L2 P13):
    - length
    - width
    - height
  - v barrel and arbor (L2 P9-18)
  - vi mainspring hooking (L2 P16-17)
  - vii going barrel
  - viii fusee (L12 P5-9)
  - ix detachable barrel (L2 P19)

- 2.0 Understand the construction, function and operation of the various components which form a clock movement, continued**
- 2.4 Critically compare the properties of different types of motive force
- 2.5 Explain the construction and operation of different types of clock trains:
- a types of trains (L1 P34-35, P39-42; L2 P34-37; P46-47):
    - i going train
    - ii striking train
    - iii motion work:
      - single stage
      - two stage
  - b diagrammatic clock trains (L2 P38-45)
  - c the contrate wheel (L2 P43-44)
- 2.6 Complete train calculations to determine:
- a train counts for going train (L2 P26-35)
  - b train counts for motion work (L2 P46-47)
  - c vibrations per hour (L2 P33-35)
  - d pendulum length (L3 P23-25)
    - i using formula
    - ii comparing time with one seconds pendulum
  - e duration (L2 P53-55)
- 2.7 Explain the construction of different types of pivots and bearings for clocks:
- a pivots (L3 P5-7):
    - i parallel
    - ii conical
    - iii cone pivots and their bearings
  - b materials for pivot holes (L3 P8-9)
  - c side and end shake in pivot holes (L3 P9)
  - d size and strength of pivots (L3 P8)
- 2.8 Critically compare the properties of different types of pivots and bearings for clocks
- 2.9 Explain the principles, construction and timekeeping properties of the pendulum and its application to clocks.
- a definition of the pendulum (L3 P15)
  - b pendulum theory (L3 P16-19)
  - c isochronism (L3 P20-22)
  - d pendulum formulae (L3 P23)
  - e calculations (L3 P23-25)
  - f pendulum suspensions (L3 P25-29)
  - g beat setting devices (L3 P31)
- 2.10 Explain the principle, construction and timekeeping properties of the balance and spring and its application to clocks and watches:
- a types of balance (L8 P5-7):
    - i plain
    - ii compensated
  - b types of balance springs (L8 P7):
    - i carbon steel
    - ii elinvar
- 2.11 Critically compare the use of the pendulum and the balance as oscillators for clocks
- 2.12 Critically compare the properties of different types of balance spring

- 2.0 Understand the construction, function and operation of the various components which form a clock movement, continued**
- 2.13 Explain the principle and construction of different types of striking mechanisms:
- a the principles used in count wheel striking clocks (L9 P27-38):
    - i description and action of mechanism
    - ii half hour striking
  - b the principles used in rack striking clocks (L9 P5-26):
    - i description and action of mechanism
    - ii half hour striking
  - c the “modern” variations which may be present (L11 P31-43)
- 2.14 Critically compare the properties of different types of striking mechanism.
- 3.0 Understand the function, construction and operation of the escapements commonly used in clocks and watches**
- 3.1 Explain the functions of the escapement in clocks and watches (L3 P32)
- 3.2 Distinguish between the different categories and types of escapement used in clocks and watches:
- a recoil (L3 P32):
    - i verge
    - ii anchor recoil
  - b frictional rest (L8 P39):
    - i dead beat
    - ii cylinder
  - c detached (L8 P34-38):
    - i Swiss lever
    - ii ratchet toothed lever
    - iii pin lever
- 3.3 Critically compare the qualities of different types of escapements
- 3.4 Explain the construction, operation and adjustment of recoil escapements commonly used for pendulum clocks:
- a introduction to escapement action (L3 P32-37)
  - b general description and construction (L1 P37-8, P42; L3 P38, 42)
  - c action (L3 P39):
    - i impulse
    - ii drop
    - iii locking
    - iv recoil
  - d escaping angle (L3 P40)
  - e supplementary arc /angle (L3 P40)
  - f impulse angle (L3 P40)
  - g drop (L3 P41):
    - i reason for drop
    - ii amount of drop required
  - h advantages of the recoil escapement
  - i variations of the recoil anchor escapement (L3 P43):
    - i bent strip pallets
    - ii French style pallets

**3.0 Understand the function, construction and operation of the escapements commonly used in clocks and watches, continued**

- 3.5 Explain the construction, operation and adjustment of escapements commonly used with a balance and spring in clocks and watches:
- a general description and construction (L8 P16-23)
  - b impulse action (L8 P24-29):
    - i unlocking
    - ii impulse
    - iii drop
    - iv locking
    - v draw
    - vi run to the banking
  - c safety action (L8 P30-32):
    - i safety roller
    - ii guard pin
    - iii banking pins
    - iv horns
    - v reason for draw
  - d overbanking (L8 P30)
  - e balance and spring (L8 P6-8)
  - f jewellery (L8 P9-15)

**4.0 Understand the main approaches for cleaning clocks and watches**

- 4.1 Explain the procedures for cleaning clocks, mechanical watches and quartz watches:
- a general (L7 P63-72; L8 P90; L12 P31-32)
  - b manual (L7 P68-72; L11 P 72-73)
  - c rotary action (L8 P86-90; L11 P70-71)
  - d ultrasonic (L7 P65-67)
  - e vibrasonic (L8 P86)
  - f quartz watch components (L8 P89-90)
- 4.2 Critically compare cleaning methods for clocks, mechanical watches and quartz watches
- 4.3 Explain the properties of cleaning fluids for clocks, mechanical watches and quartz watches:
- a ammoniated (L7 P63-64)
  - b non ammoniated (L7 P63-64)
  - c water based (L7 P64-65)
  - d spirit based (L7 P64-65)
- 4.4 Critically compare cleaning fluids for clocks, mechanical watches and quartz watches
- 4.5 Explain the procedure for the disposal of used cleaning fluids in accordance with current good practice and legislation (L7 P67)

**5.0 Understand the procedures for servicing and the identification and correction of faults in clock movements**

- 5.1 Customer care (L3 P65-68)
- 5.2 Overview of fault finding principles (L3 P53-57; L4 P25-31)
- 5.3 Explain the procedures for dismantling clock movements:
- a weight driven (L2 P6-8)
  - b going barrel (L2 P24; L4 P36-41)
  - c fusee L12 P21)

**5.0 Understand the procedures for servicing and the identification and correction of faults in clock movements, continued**

- 5.4 Explain the approaches for diagnosing faults prior to and during the dismantling of clocks:
- a train (L3 P9-13; L4 P33-35)
    - i pivots
    - ii pivot holes
  - b suspensions (L3 P30; L4 P30)
  - c motive force (L4 P34, 48-49):
    - i mainsprings
      - distorted
      - permanent set
      - broken
    - ii. barrel
      - end shake
      - side shake
  - d winding mechanism (L2 P24)
  - e striking mechanism (L10 P41-46; L11 P32-43):
    - i “setting up”
      - locking
      - run to warning
    - ii hammer lifting pins
      - bent
      - worn
    - iii fly spring tension
    - iv hammer spring tension
- 5.5 Explain the procedures for the correction of faults in clock movements:
- a Cleaning (refer to syllabus section 4.0)
  - b train (L5 P45-54; L6 P55-68):
    - i pivots:
      - refinishing
      - burnishing
    - ii pivot holes:
      - bushing
      - broaching – tapered broach and smooth broach
    - iii wheels:
      - straightening bent teeth
  - c clock suspensions (L3 P25-30)
  - d motive force (L4 P41-42, P48-52; L6 P69-75):
    - i mainspring
      - determine replacement mainsprings
      - form a new eye in a mainspring
    - ii barrel
      - adjust barrel end shake
      - correct barrel side shake
  - e striking mechanism (L9 P7-8; L10 P41-46):
    - i “set up” correctly
      - locking
      - run to warning
    - ii adjust
      - adjust fly spring
      - adjust hammer spring

**5.0 Understand the procedures for servicing and the identification and correction of faults in clock movements, continued**

- 5.6 Explain the procedures for the re-assembly of clock movements
- a testing during assembly (L7 P75-77)
  - b weight driven (L2 P6-8)
  - c going barrel (L4 P43-48)
  - d fusee (L12 P22-30)
  - e count wheel striking clocks (L10 P41-46)
  - f rack striking clocks (L11 P31-43)
  - g testing and regulation (L7 P79-80)
- 5.7 Critically compare procedures for servicing and the identification and correction of faults in clock movements

**6.0 Understand the procedures for servicing and the identification and correction of basic faults in the escapements commonly used in clocks and watches**

- 6.1 Explain the procedures for servicing the escapements commonly used in clocks and watches:
- a recoil escapement (L3 P30, 44-52; L4 P34):
    - i pallets:
      - wear
      - excessive drop
      - unequal drop
      - incorrect centre distance
    - ii escape wheel:
      - worn escape wheel teeth
      - bent escape wheel teeth
  - b action of lever escapement: Swiss lever, pin pallet (L8 P67-69; L12 P 66-67):
    - i basic tests:
      - locking
      - draw
      - impulse
    - ii. advanced tests
      - horn shake
      - guard pin shake
      - locking
      - run to banking
  - c balance and spring (L8 P7; L9 P52-54, P56, L12 P72-78, P81-83):
    - i observations:
      - spring out of flat
      - spring not central
      - curb pin clearance – too big / too small
      - rate
      - beat
    - ii magnetism, identifying

**6.0 Understand the procedures for servicing and the identification and correction of basic faults in the escapements commonly used in clocks and watches, continued**

- 6.2 Explain the procedures for the servicing and correction of basic faults in escapements commonly used in clocks and watches:
- a recoil escapement (L3 P44-52):
    - i pallets:
      - reface pallets
    - ii escape wheel:
      - straighten bent teeth
      - top worn teeth
    - iii adjust / correct centre distance
  - b lever escapement: Swiss lever, pin pallet (L8 P70-82; L9 P45-61):
    - i cleaning
    - ii replacement
      - platform escapement
      - components
  - c balance and spring (L9 P52-54, P56, P62-68; L12 P72-78, P81-83):
    - i removal of balance spring
    - ii adjust balance spring to correct:
      - spring out of flat
      - spring not central
      - curve for index
    - iii adjust curb pin clearance
    - iv adjust for rate
    - v adjust for beat
    - vi de-magnetise
- 6.3 Critically compare procedures for servicing and the identification and correction of basic faults in the escapements commonly used in clocks and watches

**7.0 Understand the principles and practice for the lubrication of clocks and watches**

- 7.1 Explain the procedures for lubricating clocks and watches:
- a cleanliness
  - b the application of oils to clock / watch (L7 P72-75, P78-79; L9 P45-47; L12 P 33-37, P 39, P41-42, P68-69):
    - i. train pivots
    - ii. barrel pivots
    - iii. mainspring
    - iv. pivots with end stones
    - v. striking clocks
    - vi. recoil escapements
    - vii. lever escapements (L8 P33)
- 7.2 Explain the properties of lubricants for clocks and watches:
- a oil retention (L3 P5, P8)
  - b range of lubricant available (L7 P72)
  - c use of manufacturer's Technical Information (L8 P91-92)
- 7.3 Critically compare procedures for lubricating clocks and watches and the lubricants for clocks and watches

**8.0 Understand the use of timing machines for the adjustment of clocks and watches**

- 8.1 Explain the principles of operation of different types of timing machines for the adjustment of clocks and watches:
- general (L11 P 5-8, P19)
  - Vibrograph (L11 P 9-10)
  - Witschi (L11 P11)
  - Microset for watches (L11 P11-13)
  - Microset for clocks L11 P20-22)
- 8.2 Critically compare the applications of different types of timing machines for mechanical clocks and watches
- 8.3 Explain the application of timing machines for the diagnosis of faults and the adjustment of mechanical clocks and watches:
- amplitude (L11 P15-16)
  - rate (L11 P9-14)
  - beat (L11 P16-17)
  - poise (L11 P18)
  - escapement faults (L11 P17)
  - train faults (L11 P17)
- 8.4 Explain the application of testing machines for the diagnosis of faults and adjustment of quartz watches:
- overall testing of quartz watches (L9 P74-86)
  - battery voltage (L7 P49-50, P86-88; L9 P78-79, P84)
  - drive pulses (L7 P50, P84, P89; L9 P79))
  - consumption (L7 P50-51, P90; L8 P105-106; L9 P81)
  - lower working voltage limit (L7 P51; P53; P89; L9 P81-82)
  - grounding switch (L7 P51, P91)
  - coil resistance (L7 P52; L9 P80)
  - coil insulation (L7 P52; L9 P80)
  - end of life operation (L7 P51, P91; L8 P106; L9 P81-82)
  - rate (L7 P54)

**9.0 Understand the construction and servicing of modern watch cases**

- 9.1 Explain the constructional features of modern watch case:
- snap on back and bezel (L4 P6)
  - screw on back and bezel (L4 P7)
  - two piece case (L4 P9)
  - three piece case (L4 P8)
  - water resistant cases (L5 P5-11):
    - terminology for water resistance
    - water resistant cases
    - testing methods
    - divers' watches
  - sizes (L4 P10-11)
  - case materials (L4 P11-15):
    - gold
    - gold plated
    - stainless steel
    - others
  - straps, bands, bracelets (L4 P15-17)
- 9.2 Explain the procedures for opening and re-sealing modern watch cases (L4 P18; L5 P55-61; L10 P50)

**9.0 Understand the construction and servicing of modern watch cases, continued**

- 9.3 Explain the procedures for the replacement / refurbishment of case parts for modern watch cases (L4 P53-62):
- replacing different types of watch glasses
  - shortening bracelets (L4 P59-62)
  - pushers (L5 P65-66)
- 9.4 Explain the different approaches for the water resistance testing of modern watch cases:
- wet or immersion test (L5 P10; L6 P77-82)
  - dry test (L5 P10-11)
  - vacuum test (L5 P11)
- 9.5 Critically compare procedures for water resistance testing

**10.0 Understand the construction, function and operation of the various components which form a quartz watch**

- 10.1 Explain the function of the main components for quartz watch movements:
- overview (L7 P22)
  - the watch train (L7 P23-26)
  - motion work (L7 P27-29)
  - stop lever (L7 P33-34, 43)
  - dial and hands (L5 P12-13)
  - keyless work (L7 P29-43)
  - friction drive to the cannon pinion (L7 P27-28)
  - simple calendar work (L5 P13; L7 P44-45)
  - integrated circuit (L7 P20)
  - battery (L7 P14-19)
  - grounding switch (L7 P21)
  - coil (L7 P52)
  - stepping motor (L7 P8-11)
  - quartz oscillator (L7 P12-13)
  - trimmer (L7 P22)
  - inhibition (L7 P22)
  - liquid crystal display (L7 P46-48)
- 10.2 Explain the construction and selection of watch batteries:
- different types of battery (L7 P14-15)
  - storage of batteries (L7 P17)
  - use of capacitors (L7 P15)
- 10.3 Explain the principles of electricity and magnetism used in quartz watches:
- units (L7 P6-7)
  - piezo electricity (L7 P12-13)
  - operation of stepping motor (L7 P8-11)
  - end of life operation (L7 P19-20)
- 10.4 Explain the principles, construction and operation of the train of a quartz watch movement:
- name and function of components (L7 P23-26)
  - operation of components (L7 P23-26)

**10.0 Understand the construction, function and operation of the various components which form a quartz watch, continued**

- 10.5 Explain the principles, construction and operation of the motion work and calendar of a quartz watch movement:
- a name and function of components (L7 P27-29; P44-45)
  - b operation of components (L7 P27-29; P44-45)
- 10.6 Explain the principles, construction and operation of the keyless work of a quartz watch movement:
- a name and function of components (L7 P29-43)
  - b operation for adjusting hands (L7 P38-39, P42)
  - c operation for adjusting calendar (L7 P37-38, P41)

**11.0 Understand the procedures for servicing and the identification and correction of faults in quartz watch movements**

- 11.1 Customer care (L3 P65-68)
- 11.2 Explain the procedures for dismantling quartz watch movements (L7 P81-102; L8 P83-90)
- 11.3 Explain the procedures for the use of calibrated test equipment for the diagnosis of defects:
- a overall testing of quartz watches (L9 P74-86)
  - b battery voltage (L7 P49-50, P86-88; L9 P78-79, P84)
  - c drive pulses (L7 P50, P84, P89; L9 P79)
  - d consumption (L7 P50-51, P90-91; L8 P105-106; L9 P81)
  - e lower working voltage limit (L7 P51, P53; P89; L9 P81-82)
  - f grounding switch (L7 P51, P91)
  - g coil resistance (L7 P52; L9 P80)
  - h coil insulation (L7 P52; L9 P80)
  - i end of life operation (L7 P51, P91; L8 P106; L9 P81-82)
  - j rate (L7 P54)
  - k rate adjustment (L7 P54)
- 11.4 Explain the approaches for diagnosing faults during the dismantling and re-assembly of quartz watch movements:
- a stepping motor (L8 P89)
  - b train (L7 P50-51, P90-91; L8 P105-106; L9 P81)
  - c keyless work (L7 P29-43, P82; L9 P77-78)
  - d calendar (L7 P82)
- 11.5 Explain the procedures for the correction of faults in quartz watch movements:
- a obtain manufacturer's Technical Information (L7 P91)
    - i movement identification
    - ii servicing details
    - iii component identification and replacement
  - b servicing (Quartz Watch Servicing Skills Lessons 7, 8, 9)
  - c movement exchange (L5 P14-17)
- 11.6 Explain the procedures for the re-assembly of quartz watches (L8 P90-104; L9 P69-73)
- 11.7 Critically compare procedures for servicing, identification and correction of faults in quartz watches / movements

**12.0 Understand the construction, function and operation of the various components which form a mechanical watch movement**

12.1 Explain the function and construction of the main components for manual winding mechanical watch movements:

- a frame (L10 P9-10):
  - i pillar plate
  - ii barrel and train bridges
  - iii cocks
- b motive force (L2 P9-17; L10 P14-16):
  - i barrel assembly
- c winding mechanism (L2 P22-23; L10 P19-27):
  - i keyless work
  - ii ratchet wheel
  - iii recoiling click
  - iv click spring
- d going train (L2 P45, 52; L10 P11-13):
  - i wheels
  - ii pinions
  - iii train layout
  - iv centre seconds train
- e motion work (L10 P17):
  - i cannon pinion
  - ii minute wheel pinion
  - iii hour wheel
- f hand setting (L2 P48; L10 P18-19):
  - i types of friction drive
- g escapement (L10 P28):
  - i escape wheel
  - ii pallets
- h oscillator (L8 P5-8):
  - i balance assembly
  - i dial and hands (L5 P12-13)

12.2 Explain the principles for the construction and operation of the motive force for mechanical watch movements:

- a the properties of springs (L2 P9-10)
- b Hooke's law (L2 P9)
- c how to distinguish between good and "set" springs (L2 P15-16)
- d rules affecting the strength of mainsprings (L2 P13):
  - i length
  - ii width
  - iii height
- e barrel and arbor (L2 P9-18; L10 P14-16)
- f mainspring hookings (L2 P16-17)

12.3 Explain the construction and operation of the train for mechanical watch movements:

- a name and function of components (L2 P45; L10 P11-13)
- b centre seconds train with bridge (L2 P52)

**12.0 Understand the construction, function and operation of the various components which form a mechanical watch movement, continued**

- 12.4 Explain the construction of different types of pivots and bearings, for mechanical watch movements and evaluate their properties:
- a pivots (L3 P5-13):
    - i parallel
    - ii conical
    - iii cone pivots and their bearings
  - b materials for pivot holes (L8 P9)
  - c side and end shake in pivot holes (L3 P9)
  - d size and strength of pivots (L3 P8)
  - e shockproof settings (L8 P10-15)
- 12.5 Explain the construction and operation of the motion work for mechanical watch movements
- a name and function of components (L10 P17-19; L12 P84-86)
  - b cannon pinion tension (L2 P48; L10 P18; L12 P84-85)
  - c dial washer (L12 P86)
- 12.6 Explain the construction and operation of the keyless work for mechanical watch movements (L10 P19-27)

**13.0 Understand the procedures for servicing and the identification and correction of faults in manual winding mechanical watch movements**

- 13.1 Customer care (L3 P65-68)
- 13.2 Overview of fault finding principles (L3 P53-57; L10 P30-32, P48-49)
- 13.3 Explain the procedures for dismantling manual winding watch movements (L10 P47-61; L11 P45-69)
- 13.4 Explain the procedures for the use of calibrated test equipment for the diagnosis of defects prior to dismantling mechanical watch movements:
- a amplitude (L11 P15-16)
  - b rate (L11 P9-14)
  - c beat (L11 P16-17)
  - d poise (L11 P18)
  - e escapement faults (L11 P17)
  - f train faults (L11 P17)
- 13.5 Explain the application of approaches for diagnosing faults during the dismantling and re-assembly of manual winding watch movements:
- a Train (L12 P31-33; P63):
    - i pivots
    - ii pivot holes
    - iii jewels
    - iv wheels
    - v pinions
  - b motive force (L2 P15-16; P18; L12 P47):
    - i barrel end shake
    - ii mainsprings
      - distorted
      - broken
      - permanent set
  - c escapement (L11 P47-54)
  - d balance and spring

**13.0 Understand the procedures for servicing and the identification and correction of faults in manual winding mechanical watch movements, continued**

13.6 Explain the procedures for the correction of faults in manual winding watch movements:

- a manufacturer's Technical Information (L10 P48)
  - i movement identification
  - ii servicing details
  - iii component identification and replacement
- b servicing (L10 P47-61; L11 P45-73; L12 P31-92)
- c determining replacement mainsprings (L2 P12-16)
- e adjusting barrel end shake (L12 P47)
- f fitting new stem and crown (L5 P61-65)
- g shock resistant settings (L10 P56-66; L12 P33-37):
  - i servicing
  - ii replacement of shock springs
- h friction jewels (L10 P66-69):
  - i replace
  - ii adjust end shake

13.7 Explain the procedures for the re-assembly of manual winding watch movements (L12 P33-92)

13.8 Critically compare the procedures for servicing and identification and correction of faults in manual winding mechanical watch movements

**14.0 Understand the selection, use and heat treatment of metals used in horology**

14.1 Explain the properties of ferrous and non ferrous metals:

- a iron (L5 P33)
- b steel (L5 P33-36)
- c brass (L5 P36-38)

14.2 Critically compare types of ferrous and non ferrous metals for producing replacement components in horology :

- a Steel (L5 P33-36):
  - i mild steel
  - ii silver steel
  - iii EN8
  - iv pivot steel
- b brass (L5 P36-38):
  - i CZ 120 – “engraving” brass
  - ii CZ 121 or equivalent “machining” brass
  - iii CZ 131
  - iv cast brass
  - v CZ 108 “common” brass for bending

14.3 Critically compare processes for the heat treatment of ferrous and non ferrous metals in horology:

- a hardening (L5 P38 - 40)
- b tempering (L5 P 40- 41)
- c work hardening (L5 P 38)
- d annealing (L5 P 42-43)
- e bluing (L6 P53-54)

**15.0 Understand the principles for the use, operation and maintenance of tools and equipment required to service clocks and watches and make and modify components for the repair of clocks and watches**

- 15.1 Explain the use, care and maintenance of hand and machine tools for modifying and producing components for clocks and watches:
- a marking out tools (L2 P57-58):
    - i scriber
    - ii centre punch
    - iii dot punch
    - iv dividers
  - b measuring tools (L2 P59-64):
    - i rule
    - ii callipers
    - iii micrometer
    - iv digital electronic calliper
  - c hand tools: (L1 P51-67; L4 P19-24; L5 P19, 31-33; L8 P41-66)
    - i screwdrivers
    - ii tweezers
    - iii hacksaw
    - iv hammer
    - v files
    - vi broaches - cutting; smoothing
    - vii reamers
    - viii taps and dies
    - ix hand drill
    - x punches, staking set (L5 P27-29)
  - d abrasives and polishing materials (L1 P67 -70; L7 P57-60)
  - e cleaning materials, pegwood, pith, Rodico (L7 P60)
  - f centre lathe (L6 P30; L6 P5-30):
    - i safety and maintenance
    - ii headstock
    - iii tailstock
    - iv bed
    - v carriage
    - vi compound slide
    - vii cutting speeds
    - viii cutting tools
    - ix three jaw chuck
    - x four jaw chuck
    - xi faceplate
    - xii collets
    - xiii centres
    - xiv carrier and driving plate
    - xv drilling in the lathe
  - g watchmaker's lathe (L6 P31-51):
    - i safety and maintenance
    - ii headstock
    - iii bed
    - iv tailstock
    - v T-rest
    - vi graver, use and maintenance
    - vii collets
    - viii step chucks
    - ix wax chucks
    - x carrier chuck

**15.0 Understand the principles for the use, operation and maintenance of tools and equipment required to service clocks and watches and make and modify components for the repair of clocks and watches, continued**

- g watchmaker's lathe (L6 P31-51; P59-60; P67-68), continued:
    - xi mandrel
    - xii jacot drum
    - xiii lantern runner
    - xiv drilling using a watchmakers lathe
    - xv filing rest, compound slide
  - h drilling machine (L5 P20-27)
    - i drilling machine
    - ii types of drills- twist drills
    - iii countersinks
- 15.2 Critically compare hand and machine processes to mark out, modify and produce clock / watch components
- 15.3 Explain procedures for joining metals:
  - a using screws (L8 P41-66)
  - b using solder (L9 P39-44)
  - c using rivets (L10 P33-36)
  - d adhesives (L10 P38-40)
- 15.4 Explain the procedures for bending metals (L11 P23-29)
- 15.5 Explain the processes for the surface finishing of clock and watch components:
  - a producing a polished surface on brass flat and turned surfaces (L11 P97-99; L12 P11-20)
  - b producing a polished surface on steel flat and turned surfaces (L12 P19)
  - c producing grained flat surfaces(L12 P13)
- 15.6 Critically compare surface finishes for clock and watch components

**Assessment procedure:-**

This unit is externally assessed; a 2½ hour examination paper set by the Examinations Board of the British Horological Institute assesses the candidate's knowledge and understanding of the Theory of Clock and Watch Servicing. Candidates are required to answer one question from each section of the examination paper:

- Section A Clocks and Clock Servicing
- Section B Watches and Watch Servicing
- Section C Escapements
- Section D Workshop Processes
- Section E Contains twenty short questions which sample the syllabus.

The scripts are assessed on the basis of the accuracy and depth of content by Examiners appointed by the Examinations Board; two grades of Pass are awarded Pass (50%) and Pass with Merit (75%).

## 12 Syllabus - Making Clock Components

This unit requires the candidate to develop the skills and knowledge to use hand and machine tools to measure, make and modify simple clock components made from brass and steel.

Working drawings are provided for the student to follow giving the dimensions and tolerance for each of the components which form a small assembly of clock parts.

Distance Learning Course page references are not provided for the unit, **Making Clock Components**. The “Workshop Skills” and “Practical Exercise” sections in each Lesson provide a structured approach to learning many of the hand skills which are required. The theoretical content explaining the selection and heat treatment of metal and the use of tools and equipment will help to provide theoretical background.

The section in the Distance Learning Course, Examination Exercise, is introduced in Lesson 10 and continues in Lessons 11 and 12. The objective is to guide the student through the various stages in making a typical Practical Test Piece.

### Learning Objectives which can be assessed in the practical examination:

#### 1.0 Understand health and safety procedures for the repair, restoration and conservation of clocks / watches

- 1.1 Demonstrate safe working practices during the construction of clock components:
  - a oneself
  - b fellow workers
  - c visitors

#### 2.0 Be able to mark out accurately when producing /modifying, brass and steel components for the servicing of clocks

- 2.1 Interpret working drawings:
  - a orthographic projection:
    - i first angle projection
    - ii third angle projection
  - b pictorial views:
    - i isometric projection
    - ii oblique projection
- 2.2 Mark out small clock components:
  - a read drawings
  - b measure and mark out small interacting components to achieve a tolerance of + or - 0.1 mm using (L3 P59-64):
    - i the master edge
    - ii rule
    - iii scriber
    - iv dividers
    - v centre punch

**3.0 Be able to use hand and machine tools to repair, modify and produce brass and steel components for the servicing of clocks / making an assembly of small interacting clock components**

- 3.1 Determine a suitable approach to produce brass and steel components for the servicing of clocks / making of an assembly of small, interacting clock components
- 3.2 Use hand tools to produce clock components to within a general tolerance of + or - 0.1 mm with required fits and clearances:
  - a hacksaw, piercing saw and files to produce straight; flat; curved; and square surfaces
  - b taps and dies to make inside and outside threads (sizes down to 0.5 mm)
  - c a slotting file for cutting screw slots
  - d rivets and screws to fasten components
  - e hammer / mallet to produce simple bends to brass and steel components
  - f broaches
  - g files and punches to create square holes
- 3.3 Use a drilling machine to drill, countersink and counterbore holes
- 3.4 Use a watchmaker's / centre lathe to turn cylindrical, flat and spherical surfaces to tolerance of + or - 0.1 mm including:
  - a use of collets and chucks
  - b turning between centres
  - c use of compound slide with lathe cutting tools
  - d use of T-rest and graver
  - e sharpening lathe tools and graver
  - f drilling using twist and flat drills
  - g "catching" a centre
  - h turning and burnishing pivots
  - i filing flats using roller filing rest
  - j use of slitting saw for cutting screw slots
- 3.5 Achieve close working clearances between assembled components

**4.0 Be able to apply heat treatment when producing / modifying brass and steel components for the servicing of clocks**

- 4.1 Determine the extent of heat treatment which is required for produced / modified steel and brass components
- 4.2 Conduct heat treatment for steel components:
  - a annealing
  - b hardening
  - c tempering
  - b bluing
- 4.3 Conduct heat treatment for brass components
  - a annealing
- 4.4 Conduct work hardening for brass components

**5.0 Be able to produce a variety of finishes when making and modifying brass and steel components for the servicing of clocks**

- 5.1 Grain and polish flat and curved surfaces on steel components using:
  - a abrasive papers
  - b micro finishing film
  - c aluminium oxide
  - d diamond compound
- 5.2 Polish screw threads
- 5.3 Grain and polish flat and curved surfaces on brass components using:
  - a abrasive papers
  - b micro finishing film
  - c metal polishing compound

**Assessment procedure:-**

This unit is externally assessed; the British Horological Institute provides each candidate with a dimensioned drawing giving full details of an assembly of small clock components; the period of two weeks is allocated for candidates to produce and assemble the components.

A declaration signed by the candidate and, where appropriate, the college tutor provides confirmation that the piece is the candidate's own work; 10% of candidates will be contacted by an Examiner to verify the declaration.

Examiners appointed by the Examinations Board assess the Practical Test Pieces by considering accuracy, quality of workmanship and finish. Two grades of pass are awarded, Pass (50%) and Pass with the Merit (75%).

## 13 Syllabus - Servicing and Correcting Faults in a Single Train Clock Movement

This unit requires the candidate to develop the skills and knowledge to diagnose and correct faults and service a single train clock movement.

The unit, Servicing and Correcting Faults in a Single Train Clock Movement, is also a requirement for the Diploma in the Servicing and Repair of Clocks/ Watches.

Distance Learning Course page references are not provided for the unit, **Servicing and Correcting Faults in a Single Train Clock Movement**. The *Clock Servicing Skills* sections in Lessons 3 – 12, together with relevant sections in the *Knowledge and Understanding* section, provide the skills and background knowledge required to prepare the student for this practical examination.

It is not anticipated that every fault listed will be present in each candidate's clock movement; a small number of faults will be introduced by the Examiners into each movement.

### Learning Objectives which can be assessed in the single train clock practical servicing examination:

#### 1.0 Understand health and safety procedures in the repair of clocks

- 1.1 Demonstrate safe working practices during clock servicing (L1 P49-50):
- a oneself
  - b fellow workers
  - c visitors

#### 2.0 Be able to evaluate the overall condition of a single train clock movement

- 2.1 Assess the visual condition of the dial and hands of a single train clock:
- a condition of hands
  - b hand clearance
  - c security of hands
  - d finish of hands
  - e condition of dial
  - f security of dial
- 2.2 Assess the general functioning of a single train clock:
- a rate
  - b beat
  - c amplitude of oscillator
  - d friction drive to hands
  - e motive force:
    - i click work
    - ii mainspring

**3.0 Be able to identify faults in a single train clock prior to dismantling**

3.1 Remove hands and dial

3.2 Release mainspring power

3.3 Assess the condition and function of movement components prior to dismantling:

a train assemblies:

i pivots / pivot holes:

- length of pivots
- side shake for pivots
- end shake for arbors

ii wheels:

- wear
- damage
- true in the flat
- true in the round

iii pinions:

- wear
- damage

b motion work and friction drive

c motive force:

i broken / damaged mainspring

ii click

iii click spring

iv mainspring

d recoil anchor escapement:

i drop:

- inside drop equal to outside drop
- $1^\circ$  drop ( $\frac{1}{2}^\circ$  tooth tip thickness +  $\frac{1}{2}^\circ$  actual clearance)

ii impulse:  $4^\circ$  movement of pallets

iii recoil for each pallet

iv escape wheel teeth:

- spacing
- condition

v escape arbor pivot holes:

- side shake
- end shake

vi pallet arbor pivot holes:

- side shake
- end shake

vii depthing between escape wheel and pallets

viii remove back cock and pallet arbor to determine condition of pallets

ix escape wheel – true in the flat

x escape wheel – true in the round

e platform escapement: Swiss lever, pin pallet, as appropriate:

i balance spring:

- flatness at centre
- flatness at cock
- concentricity at collet
- concentricity at cock
- concentricity with curb pins
- curb pin clearance

**3.0 Be able to identify faults in a single train clock prior to dismantling, continued.**

- e platform escapement: Swiss lever, pin pallet, as appropriate, continued:
  - ii locking (after removing balance)
    - safe locking
  - iii run to the banking and draw
    - draw causes lever to move back to the banking pin
  - vi depthing of escape pinion with contrate wheel  
contrate arbor end shake

**4.0 Be able to dismantle a single train clock movement**

- 4.1 Determine appropriate procedure for the safe dismantling of a single train clock movement:
  - a spring driven single train clocks with a pendulum
  - b spring driven single train clocks with a platform escapement
- 4.2 Dismantle a single train clock movement in accordance with good practice, for example:
  - a confirm release of mainspring power
  - b remove platform escapement
  - c remove motion work
  - d separate plates
  - e remove train
  - f dismantle barrel assembly
  - g dismantle platform escapement

**5.0 Be able to identify faulty components in a single train clock movement**

- 5.1 Assess visually the condition of movement components:
  - a arbors:
    - i worn / damaged pivots
    - ii bent pivots
    - iii bent wheel teeth
  - b motive force:
    - i broken / distorted mainspring
    - ii set mainspring
    - iii worn, damaged barrel arbor
    - iv incorrect endshake
  - c clickwork:
    - i insecure shoulder screw
    - ii damaged ratchet wheel
    - iii incorrect click spring action
  - d escapement, recoil anchor:
    - i worn / damaged escape wheel teeth
    - ii worn / damaged pallets
    - iii incorrect depthing
  - e platform escapement: Swiss lever, pin pallet:
    - i dirt and congealed oil
    - ii incorrect impulse / safety action
    - iii balance accuracy: concentricity, flatness
    - iv balance spring faults
  - f motion work and friction drive:
    - i bent wheel teeth
    - ii incorrect adjustment for friction

**6.0 Be able to correct defects in a single train clock movement**

- 6.1 Specify replacement components
- 6.2 Determine appropriate techniques for correcting component defects
- 6.3 Use hand and machine tools to correct component defects:
  - a train assemblies:
    - i straighten bent arbors
    - ii refinish and burnish worn / damaged pivots
    - iii straighten bent pivots
    - iv straighten bent wheel teeth
  - b pivot holes:
    - i bush worn train pivot holes
    - ii bush worn barrel pivot holes
  - c motion work and friction drive:
    - i straighten bent wheel teeth
    - ii adjust friction drive
  - d motive force:
    - i replace distorted / broken mainspring
    - ii form new mainspring eye
    - iii adjust end shakes
  - e clickwork:
    - i insecure shoulder screw
    - ii damaged ratchet wheel
    - iii incorrect click spring action
  - f recoil anchor escapement:
    - i reface pallets to correct, as applicable:
      - excessive drop
      - incorrect impulse
  - g platform escapement: Swiss lever, pin pallet:
    - i adjust balance spring at stud to:
      - ensure balance spring is flat
      - ensure balance spring is central
    - ii ensure correct curb pin clearance
    - iii ensure the balance is in beat

**7.0 Be able to clean single train clock movement components**

- 7.1 Determine an appropriate technique for cleaning movement components:
  - a clock components
  - b platform escapements
- 7.2 Clean clock movement components using suitable equipment and fluids:
  - a fluids
    - i ammoniated / non-ammoniated fluids
    - ii water based / spirit based
    - iii appropriate rinsing solution
  - b manual / ultrasonic / non ultrasonic
  - c dry movement parts
  - d clean pivot holes with pegwood

**7.0 Be able to clean single train clock movement components, continued**

- 7.3 Clean platform escapement components using suitable equipment and fluids:
- a fluids
    - i ammoniated / non-ammoniated fluids
    - ii water based / sprit based
    - iii appropriate rinsing solution
  - b manual / ultrasonic / non ultrasonic / vibrasonic
  - c dry movement parts
  - d clean with pegwood:
    - i pivot holes
    - ii notch
    - iii banking pins

**8.0 Be able to re-assemble and lubricate the components of a single train clock movement**

- 8.1 Verify that that all components are in a suitable condition for replacement
- 8.2 Re-assemble and lubricate a single train clock movement according to approved practice:
- a spring driven single train clocks with a pendulum
  - b spring driven single train clocks with a platform escapement

**9.0 Be able to ensure a single train clock movement meets operational requirements**

- 9.1 Set up single train clock movement for testing:
- a spring driven single train clock movement with a pendulum
  - b spring driven single train clock movement with a platform escapement
- 9.2 Check and adjust escapement:
- a amplitude
  - b beat
  - c rate
- 9.3 Verify functioning of a single train clock movement:
- a security of components
  - b alignment of hands
- 9.4 Make any adjustment to components to ensure correct operation

This unit is externally assessed; the candidate attends an Examination Centre. The British Horological Institute provides each candidate with a single train clock movement with either a pendulum or a platform escapement. Faults have been introduced into the movement.

The candidate is allocated eight hours to analyse the faults, dismantle, correct the faults, re-assemble, lubricate and test the single train movement.

Examiners appointed by the Examinations Board use a marking scheme to assess the diagnosis and correction of faults and standard of servicing of the movement.

Two grades of pass are awarded, Pass (50%) and Pass with Merit (75%).

## 14 Syllabus - Servicing and Correcting Faults in a Quartz Watch

This unit requires the candidate to develop the skills and knowledge to diagnose and correct faults and service an analogue quartz watch.

The unit, Servicing and Correcting Faults in a Quartz Watch, is also a requirement for the Diploma in the Servicing and Repair of Clocks/ Watches.

There are no Distance Learning Course page references provided for the unit, **Servicing and Correcting Faults in a Quartz Watch**. The *Watch Servicing Skills* sections in Lessons 3 – 12, together with relevant sections in the *Knowledge and Understanding* section, provide the skills and background knowledge required to prepare the student for this practical examination. The candidate is particularly advised to study the use of watch test equipment to determine faults in a quartz watch movement and the step by step dismantling and re-assembly of a quartz movement in Lessons 7, 8 and 9.

It is not anticipated that every fault listed will be present in each candidate's watch; a small number of faults will be introduced by the Examiners into each watch movement.

### Learning Objectives which can be assessed in the quartz watch practical servicing examination:

- 1.0 Understand health and safety procedures in the servicing of quartz analogue watches**
  - 1.1 Demonstrate safe working practices during watch servicing:
    - a oneself
    - b fellow workers
    - c visitors
  
- 2.0 Be able to assess the condition of a quartz analogue watch prior to removing and dismantling the movement**
  - 2.1 Assess visually the condition of the case, dial, hands and strap / bracelet of a quartz analogue watch:
    - a external damage
    - b glass
    - c strap / bracelet
    - d security of strap / bracelet
    - e dial and hands
    - f crown
  - 2.2 Assess the general functioning of a quartz analogue watch:
    - a operation of stepping motor
    - b operation of keyless work for adjusting hands
    - c operation of keyless work for date correction
    - d operation of calendar, if applicable
    - e alignment and movement of hands

**3.0 Be able to open quartz watch cases**

- 3.1 Determine type of watch case and method of opening:
  - a two piece
  - b three piece
  - c snap back
  - d screw down back
  - e back secured with screws
- 3.2 Use tools and equipment to open watch case:
  - a snap back
  - b screw down back
  - c back secured with screws

**4.0 Be able to fit a replacement stem and crown to a quartz analogue watch**

- 4.1 Identify movement calibre number and case / model number to specify replacement
- 4.2 Determine approximate length with movement fitted to case
- 4.3 Cut the watch stem to approximately the correct length
- 4.4 Fit the watch crown to the watch stem
- 4.5 Adjust length of watch stem to ensure correct clearance between crown and watch case
- 4.6 Secure the watch crown to the watch stem

**5.0 Be able to identify faults in quartz analogue watch movements using test equipment**

- 5.1 Identify movement calibre
- 5.2 Obtain manufacturer's technical information
- 5.3 Remove battery and use calibrated diagnostic quartz movement test equipment to assess the functioning of movement components
  - a battery voltage under load
  - b coil resistance
  - c movement consumption using external supply
  - d consumption:
    - i stem pushed in
    - ii stem pulled out
  - e lower working voltage limit
  - f rate
  - g end of life operation
- 5.4 Analyse test information to determine defects

**6.0 Be able to complete the dismantling process for a quartz analogue watch**

- 6.1 Remove movement from case
- 6.2 Determine an appropriate procedure and dismantle the movement

**7.0 Be able to identify faulty components in quartz analogue watch movements**

- 7.1 Assess visually the condition of movement components during the dismantling process and after dismantling:
- a plates and bridges
  - b train components
  - c electronic circuit
  - d stepping motor
  - e motion work
  - f friction drive
  - g calendar work

**8.0 Be able to determine and justify the replacement of components for quartz analogue watches**

- 8.1 Determine from manufacturer's technical information the component part numbers and description of required parts
- 8.2 Correct component defects by replacement:
- a train defects
  - b electronic circuit
  - c battery
  - d dial and hands
  - e handsetting and date adjustment

**9.0 Be able to clean quartz analogue movement components**

- 9.1 Select suitable equipment and fluids:
- a fully dismantled / partially dismantled
  - b vibrasonic / ultrasonic
  - c suitable cleaning fluid for quartz movements
  - d suitable rinse
- 9.2 Clean the movement components

**10.0 Be able to re-assemble and lubricate the components of a quartz analogue watch movement**

- 10.1 Verify that that all components are in a suitable condition for replacement
- 10.2 Re-assemble and lubricate a quartz analogue movement according to manufacturer's technical information

**11.0 Be able to carry out final testing of a quartz analogue watch movement and correct any defects / discrepancies with the manufacturer's specification**

- 11.1 Use calibrated test equipment to verify the quartz movement operates to manufacturer's specification:
- a battery voltage under load
  - b coil resistance
  - c movement consumption using external supply
  - d consumption:
    - i. stem pushed in
    - ii. stem pulled out
  - e lower working voltage limit
  - f rate
  - g end of life operation
- 11.2 Conduct a visual examination to determine any outstanding defects
- a check alignment of hands
  - b check date operation
  - c check the security of components
- 11.3 Correct any defects / discrepancies

**12.0 Be able to clean and refinish watch cases and correct case defects**

- 12.1 Clean watch cases using a suitable approach
- 12.2 Correct case defects by replacement / refinishing:
- a external damage
  - b glass
  - c strap / bracelet
  - d security of strap / bracelet
  - e replace seals for stem / tube

**13.0 Be able to refit the movement to the case, reseal and close case**

- 13.1 Check dial and case for cleanliness
- 13.2 Refit movement and stem to case
- 13.3 Replace seal for back
- 13.4 Close case

**14.0 Be able to test for water resistance and correct any defects / discrepancies with the manufacturer's specification**

- 14.1 Select suitable approach to test for water resistance:
- a wet or immersion test
  - b dry test
- 14.2 Test water resistance:
- a wet or immersion test
  - b dry test
- 14.3 Correct any discrepancies with manufacturer's requirements for water resistance
- 14.4 Re- test for water resistance (if required)
- 14.5 Complete documentation

This unit is externally assessed; the candidate attends an Examination Centre. The British Horological Institute provides each candidate with a quartz analogue watch. Faults have been introduced into the movement.

The candidate is allocated six hours to use test equipment to analyse the faults, dismantle, correct faults, clean, re-assemble and lubricate the watch.

Examiners appointed by the Examinations Board use a marking scheme to assess the diagnosis and correction of faults and the standard of servicing of the watch.

Two grades of pass are awarded, Pass (50%) and Pass with Merit (75%).

## 15 An overview of the qualifications

Units	Qualifications					
	Clock Pathways			Watch pathways		
Mandatory Units Clock Pathway Units Watch Pathway Units						
	Diploma in Clock and Watch servicing	Diploma in the Servicing and Repair of Clocks / Watches	Diploma in the Repair, Restoration and Conservation of Clocks / Watches	Diploma in Clock and Watch Servicing	Diploma in the Servicing and Repair of Clocks / Watches	Diploma in the Repair, Restoration and Conservation of Clocks / Watches
<i>Level of Qualification</i>	Level 3 clock	Level 4 clock	Level 5 clock	Level 3 Watch	Level 4 watch	Level 5 watch
Level 3 Units:						
Constructing Clock Components	•			•		
Servicing and Correcting Faults in a Single Train Clock Movement (Servicing Test)	•	○				
Servicing and Correcting Faults in a Quartz Watch (Servicing Test)				•	○	
Level 4: Units						
The Theory of Clock and Watch Servicing	•	○	○	•	○	○
Constructing Clock and Watch Components (Practical Test Piece)		○	○		○	○
Drawing Clock / Watch Escapements		○	○		○	○
The Practical Servicing of Clocks (Record of Repairs)		○	○			
The Recoil Escapement, Design and Construction (Servicing Test)		○	○			
Servicing and Correcting Faults in a Striking Clock Movement (Servicing Test)		○	○			
The Practical Servicing of Watches (Record of Repairs)					○	○
Servicing and Correcting Faults in a Manual Winding Watch (Servicing Test)					○	○
Servicing and Correcting Faults in an Automatic Watch (Servicing Test)					○	○
Level 5: Units						
The Theory of Complex Clocks and their Repair, Restoration and Conservation		○	○			
The Practical Servicing of Complex Clocks (Record of Repairs)		○	○			
The Theory of Complex Watches and their Repair, Restoration and Conservation					○	○
The Practical Servicing of Complex Watches (Record of Repairs)					○	○
Level 6: Units						
The Practical Restoration and Conservation of Clocks (Portfolio)			○			
The Dead Beat Escapement, Design and Construction (Practical Test Piece)			○			
The Practical Restoration and Conservation of Watches (Portfolio)						○
Servicing and Correcting Faults in a Chronograph Movement (Servicing Test)						○
<i>Total Number of units for Awards</i>	3	9	10	3	9	10

## 16 The transition from Certificate in Clock and Watch Servicing to the Diploma in Clock and Watch Servicing

### 16.1 The Certificate in Clock and Watch Servicing

Currently the final date for candidates to register for the Certificate in Clock and Watch Servicing is 31<sup>st</sup> December 2012; candidates must complete the award by 31<sup>st</sup> December 2014.

This means that, any candidate wishing to commence this qualification will have to register for the May 2012 examinations when applications are sought in January 2012. If required, units will be available to complete the award during the May 2012, May 2013 and May 2014 examinations.

The new Diploma in Clock and Watch Servicing was accredited on 1<sup>st</sup> May 2011 to replace the Certificate in Clock and Watch Servicing.

### 16.2 The Diploma in Clock and Watch Servicing

There are differences between the new Diploma in Clock and Watch Servicing and the award which it replaces, the Certificate in Clock and Watch Servicing.

**You must pass both of these Mandatory units:**

Certificate in Clock and Watch Servicing	Diploma in Clock and Watch Servicing	Important Information
Unit Title	“New” Unit Title	
Unit 1 : Theory of Clock and Watch Servicing (Level 2)	Theory of Clock and Watch Servicing (Level 4)	The syllabus for the “new” unit is similar to the previous unit but a more detailed knowledge is required because the “new” unit is accredited at a higher level.  Once gained, this “new” unit also contributes towards the proposed Diploma in the Servicing and Repair of Clocks / Watches and the proposed Diploma in the Repair, Restoration and Conservation of Clocks / Watches.
Unit 2 : Basic Practical Workshop Processes (Level 2)	Constructing Clock Components (Level 3)	The syllabus and examination is unchanged

**You must pass one of these Optional Units:**

Certificate in Clock and Watch Servicing Unit Title	Diploma in Clock and Watch Servicing "New" Unit Title	Important Information
Unit 3 Technical Drawing (Level 2)	No equivalent	
Unit 4 Practical Clock / Watch Servicing (Level 2)	No equivalent	
	Servicing and Correcting Faults in a Single Train Clock Movement (Level 3)	<p>A "new" unit introduced for the Diploma in Clock and Watch Servicing, you will be required to service a single train clock movement at an Examination Centre. Faults will have been introduced which are to be identified and corrected.</p> <p>Once gained, this "new" unit also contributes to the clock pathway in the proposed Diploma in the Servicing and Repair of Clocks / Watches</p>
	Servicing and Correcting Faults in a Quartz Watch (Level 3)	<p>A "new" unit introduced for the Diploma in Clock and Watch Servicing, you will be required to service a quartz analogue watch at an Examination Centre. Faults will have been introduced which are to be identified and corrected.</p> <p>Once gained, this "new" unit also contributes to the watch pathway in the proposed Diploma in the Servicing and Repair of Clocks / Watches</p>

**Examinations for the Diploma in Clock and Watch Servicing will be introduced at the May 2012 examinations; entry forms will become available from Upton Hall in January 2012.**

### 16.3 Frequently asked questions

Whether to enter the new Diploma in Clock and Watch Servicing or the Certificate in Clock and Watch Servicing is a personal decision for the candidate. The following points help to provide an overall picture:

1. Question: Are the qualifications at the same level?

Answer:

*The Diploma in Clock and Watch Servicing is at a higher level than the Certificate in Clock and Watch Servicing. There are different frameworks for determining levels for qualifications in the UK. The Certificate in Clock and Watch Servicing was accredited at Level 2 in the National Qualifications Framework; the Diploma in Clock and Watch Servicing is accredited at Level 3 in the Qualifications and Credit Framework.*

2. Question: I have already commenced the Certificate in Clock and Watch Servicing. Should I finish the award or start the new qualification?

Answer:

*If you have already commenced the Certificate in Clock and Watch Servicing, you should continue and complete the qualification.*

3. Question: How long have I got to complete the “The Certificate in Clock and Watch Servicing”?

Answer:

*The three units must be completed during examinations in May 2012, May 2013 or May 2014. After that it will be too late.*

4. Question: What happens if I do not complete the Certificate in Clock and Watch Servicing in May 2014?

Answer:

*The awarding body assures the Institute that, where units you have gained are equivalent to units in the new qualification, they can contribute to the requirements of the new qualification.*

5. Question: What are the differences in syllabus between the Certificate in Clock and Watch Servicing and the Diploma in Clock and Watch Servicing?

Answer:

*For the theory unit, there are some additions to the syllabus for the new Diploma in Clock and Watch Servicing unit – The Theory of Clock and Watch Servicing. The requirements for the practical unit where the candidate makes a Practical Test Piece are the same. Both of the Practical Servicing units are new for the Diploma in Clock and Watch Servicing.*

**Frequently asked questions, continued:**

6. What are the advantages in gaining the Diploma in Clock and Watch Servicing instead of the Certificate in Clock and Watch Servicing?

Answer:

*The biggest advantage for the Diploma in Clock and Watch Servicing is that some of the units which you are required to pass also contribute to the higher qualifications.*

- *The unit, the Theory of Clock and Watch Servicing contributes to both the proposed Diploma in the Repair and Servicing of Clocks / Watches and the Diploma in the Repair, Restoration and Conservation of Clocks / Watches.*
- *The units, Servicing and Correcting Faults in a Single Train Clock and Servicing and Correcting Faults in a Quartz Watch contribute to the proposed award, the Diploma in the Servicing and Repair of Clocks / Watches*

7. Question: I have purchased the **Preliminary Grade** Distance Learning Course; can I use it for preparing for the new qualification, the Diploma in Clock and Watch Servicing?

Answer:

*There are distinct differences between the old Preliminary Grade Course and the new Technician Grade Course, a few are listed below:*

- *The Clock Servicing Skills and Watch Servicing Skills sections in the new **Technician Grade** course, Practical Clock and Watch Servicing, provide much more detailed guidance to prepare candidates for the Practical Servicing units: Servicing and Correcting Faults in a Single Train Clock Movement and Servicing and Correcting Faults in a Quartz Watch.*
- *There is additional content in the Knowledge and Understanding section in the new **Technician Grade** course, Practical Clock and Watch Servicing but, initially, only the syllabus content common to the “old” Preliminary Grade and the “new” Technician Grade will be used for the preparation of theory examination papers.*
- *The “new” **Technician Grade** course includes additional detailed information in the Examination Exercise section to help prepare candidates for the theory and practical examination.*

8. Question: I am disappointed that Technical Drawing is no longer available as a unit in the Diploma in Clock and Watch Servicing. Is the ability to make drawings no longer required in the examinations?

Answer:

*Technical Drawing will not be examined in the new Diploma in Clock and Watch Servicing. Technical Drawing will be assessed by a unit required for the proposed awards Diploma in the Servicing and Repair of Clocks / Watches and Diploma in the Repair, Restoration and Conservation of Clocks / Watches. The examination will require an understanding of the conventions for Technical Drawing and an ability to draw escapements.*

## 17 Appendix - specimen papers

The following pages provide specimen papers for each of the units required for the Diploma in Clock and Watch Servicing:

### Mandatory Units:

- The Theory of Clock and Watch Servicing
- Making Clock Components

### Optional Units:

- Servicing and Correcting Faults in a Single Train Clock Movement
- Servicing and Correcting Faults in a Quartz watch

**Supplementary notes for guidance follow each specimen paper.**

# The Theory of Clock and Watch Servicing

## Specimen Paper

Time allowed: 2½ HOURS

### Important notes - please read carefully

1. You will be known to your Examiners by your examination number only, please put this number at the top right hand corner of all sheets of paper you use, including Section E.
2. There are four sections, A, B, C, D where each question carries twenty marks. Section E, which is on two separate pages, contains twenty short answer questions, each of which carries one mark.
3. You should attempt questions as follows:
  - A total of four questions, one from each of Sections A, B, C and D.
  - All questions from Section E should be attempted and, as only brief answers are expected, the answers should be written in the spaces provided on the question paper.
4. At the end of the examination period, the pages giving your written answers to Sections A, B, C and D together with Section E, should be numbered in sequence before being collected by the invigilator. All answers should be clearly numbered.
5. Good informative sketches or drawings, with the various components labelled, should accompany all descriptive answers, where appropriate, since they could attract a significant proportion of the total marks awarded.
6. All answers must be written in blue or black ink, using a pen or ball point. Pencil will not be accepted except where appropriate in sketches or drawings.
7. Any calculations required must be shown and laid out in a clear and logical manner. The use of non-programmable calculators is allowed.
8. You may use the following data, if required:

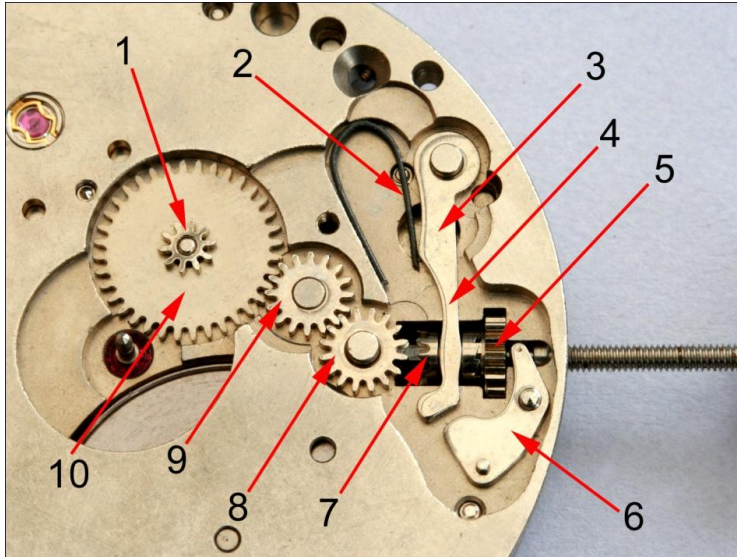
$$\pi = 3.142, \quad g = 9.812 \text{ ms}^{-2}, \quad \text{length of seconds pendulum} = 994.16\text{mm.}$$



## Section B

### Watches and Watch Servicing – answer one question from this section.

3. a. The photograph shows the keyless work from a modern watch in the winding position; one component has been removed.

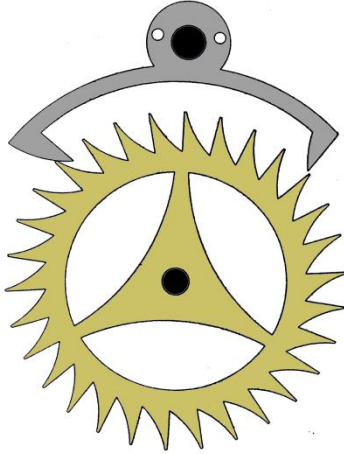


- i. Name the ten components and explain their function. (10 marks)
  - ii. Explain in detail the effect of turning the crown to wind the movement. (3 marks)
  - b. i. Draw the keyless mechanism in the handsetting position with the missing component replaced. (5 marks)
  - ii. Explain the movement of the various components when changing from the handsetting to the winding position. (2 marks)
4. a. Draw the layout of the train for a modern centre seconds mechanical watch; label the components. (6 marks)
- b. A watch train comprises the following wheels and pinions:
- |              | wheel | pinion |
|--------------|-------|--------|
| barrel       | 96    |        |
| centre arbor | 80    | 12     |
| third arbor  | 60    | 10     |
| fourth arbor | 60    | 8      |
| escape arbor | 15    | 6      |
- i. Draw a well proportioned diagram showing the train with the arbors positioned in a straight line and the wheels and pinions engaging correctly. (5 marks)
  - ii. Show the period of rotation for each arbor. (5 marks)
  - iii. Calculate the “train count”. (2 marks)
  - iv. Can this watch be fitted with a seconds hand? Give your reasons. (2 marks)

## Section C

### Escapements – answer one question from this section.

5. a. The recoil anchor escapement is the commonest clock escapement; the diagram shows the escapement at the point where the escape wheel has just locked on the entry pallet.

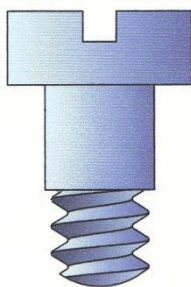


- i. Using diagrams and notes, explain the sequence which follows until a tooth has just locked on the exit pallet. Describe the movement of the wheel, the pallets and the pendulum at each stage. (6 marks)
- ii. Drop comprises two elements; use a sketch and notes to explain. (2 marks)
- iii. Give four reasons why drop is important? (2 marks)
- b. You are inspecting the wheel and pallets of an anchor escapement to discover any defects.
- i. Give four possible problems you might identify (2 marks)
- ii. In each instance, explain in detail how you would correct the defects (8 marks)
6. a. During operation, the Swiss lever escapement includes both **impulse action** and **safety action**. Explain the function of each. (4 marks)
- b. In a Swiss lever escapement, an escape wheel tooth has just locked on the entry pallet. Explain the movement of the wheel, pallets and balance during the sequence which follows until a tooth has just locked on the exit pallet. (8 marks)
- c. When servicing a watch with a Swiss lever escapement, explain the checks you would make to ensure that the escapement and balance and spring are operating correctly (8 marks)

## Section D

### Workshop Processes – answer one question from this section.

7. a. i. Lathe tools require clearance in order to cut. Draw: (6 marks)  
a general purpose cutting tool  
a parting tool  
a tool for boring holes  
Showing the clearance angle in each instance.
- ii. Attachments for the centre lathe and the watchmaker's lathe provide greater versatility. Describe with sketches three attachments not found with a basic lathe and explain their use. (6 marks)
- b. i. Give two types of solder commonly used in horology, explain their differences and give two examples for the use of each type of solder in horology. (6 marks)
- ii. Distinguish between the two kinds of flux and explain the function of flux in the soldering process. (2 marks)
8. a. i. A watchmaker should ensure that screwdrivers are in good condition and fit the slot in the screw head accurately. Show with diagrams and notes how the blade should fit the slot and explain the damage which can occur if the blade is too big or too small. (5 marks)
- ii. Use sketches and notes to show how a screwdriver blade is sharpened. (5 marks)
- b. The drawing shows a hardened and tempered shoulder screw to be used for securing a click.



- Explain step by step the various stages in making the screw commencing with the selection of a suitable material. (10 marks)

# The Theory of Clock and Watch Servicing

## Specimen Paper

### Section E

WRITE YOUR EXAMINATION NUMBER HERE

Write a brief answer in the space provided below each question.

(1 mark is awarded for each question)

1. What is meant by the term 'isochronous'?
2. How is the winding stem normally removed from a mechanical watch?
3. What is the purpose of a dial washer?
4. What are the two main elements of brass?
5. What is a fusee stop iron?
6. What is the purpose of EOL in a quartz watch?

<p><b>7.</b> What device is sometimes used in clocks to equalise the force of the mainspring?</p>
<p><b>8.</b> Why should a mainspring winder be used to remove or insert a mainspring into a barrel?</p>
<p><b>9.</b> What is the purpose of a plug tap?</p>
<p><b>10.</b> In a keyless watch, how is the movement normally secured to the case?</p>
<p><b>11.</b> Give the name of a frictional rest escapement.</p>
<p><b>12.</b> Why does a weight provide a constant force to drive a clock?</p>
<p><b>13.</b> How is the rate of a clock or watch with a jewelled lever escapement adjusted?</p>
<p><b>14.</b> What is the difference between a simple pendulum and a compound pendulum?</p>
<p><b>15.</b> What sort of tweezers would you use to handle a watch battery?</p>
<p><b>16.</b> How is the rate of a quartz watch adjusted?</p>
<p><b>17.</b> What is the benefit of a detachable barrel?</p>
<p><b>18.</b> Give two ways in which the barrel hook can be formed in the going barrel of a clock.</p>
<p><b>19.</b> What is wrong with a quartz analogue watch if the consumption is high?</p>
<p><b>20.</b> What is the relationship between the thickness of a spring and its strength?</p>

Notes concerning the unit – Theory of Clock and Watch Servicing:

1. The learning objectives forming the syllabus for Theory in Clock and Watch Servicing are given earlier in this handbook. Page references are provided to help define the syllabus more precisely and link the syllabus with the Distance Learning Course, Practical Clock and Watch Servicing.

The Distance Learning Course, Practical Clock and Watch Servicing, contains more information than the previous Distance Learning Course, the Preliminary Grade.

When the examinations for the Diploma in Clock and Watch Servicing are introduced, some students may be using the “old” Preliminary Grade Distance Learning Course instead of the “new” Practical Clock and Watch Servicing. The syllabus content which is common to both versions of the Distance Learning Course will form the examinable content for examinations in May 2012 and May 2013.

2. The Theory of Clock and Watch Servicing is accredited at a higher level than Unit 1 : Technician Grade : Theory of Clock and Watch Servicing. Candidates should be aware that a higher level of knowledge and understanding is required to gain a Pass / Pass with Merit.

# Making Clock Components

## Specimen Paper

### Important notes - please read carefully

1. You will be known to your Examiners by your examination number only; your work must be indelibly marked with your Examination Number at the position shown on the drawing. (This aspect is not assessed – scratch number or use fine permanent marker, metal etching pen, etc.) You must also use the tie on label, securely fastened to your work, to give your examination number.

In previous years some unidentified work has been received; please ensure that your time and effort are not wasted in this way.

2. The package containing your work must be clearly marked "Practical Examination" with your Examination Number on the outside of the package.

It should be addressed:-

The Examinations Secretary  
British Horological Institute  
Upton Hall  
Upton  
Newark  
Notts, NG23 5TE, United Kingdom.

The date of arrival of the package will be recorded; the package will be opened by the Examinations Secretary and must **only** contain the test piece, your declaration and the postcard which enables the Institute to inform you when the piece has arrived. The declaration will be retained at Upton Hall and the Practical Piece forwarded to the Examiner for marking.

3. UK candidates: Practical Pieces should be received at Upton Hall on or before (the final date for receipt) 1.00 pm; pieces received late will not be accepted. In order for you to know when your test piece has been received please ensure that the enclosed card is completed and sent with the test piece. The card will be returned to you giving the date of receipt at Upton Hall. In case of loss or delay in transit, it is advisable to request evidence of posting from the Post Office. In the event of any delay arising between the date of dispatch and arrival at Upton Hall please inform the Institute and include your evidence of posting.

4. Overseas candidates: Practical Pieces must be dispatched on (the day before the final date for receipt) at the latest. You should ensure that you receive evidence of posting showing clearly that the package is being sent to Upton Hall. A copy of the certificate of posting should be emailed / posted to Upton Hall to ensure acceptance; your practical piece will clearly arrive after the final date for the receipt of Practical Test Pieces.
5. You must complete and sign the declaration at the bottom of this page and return it with your work. All components, including any screws, taper pins etc., are to be produced by the candidate, unless the Institute indicates otherwise.
6. An Examiner may contact you, either during or after the Examination, to enquire about the various processes you have undertaken when making the Practical Test Piece.
7. Examiners consider the accuracy of a number of dimensions and some elements of workmanship and surface finish. This "sampling" process cannot consider every point of accuracy or quality of construction. If it is evident to the Examiner that a candidate's work includes a **serious error** in the accuracy, workmanship or finish of an aspect **not** being routinely checked five marks will be deducted from the total score.
 

E.g. components fastened with Loctite or Superglue instead of riveting  
soldering to repair component broken during construction  
excessive error in dimension (over 1mm)
8. No electrolytic treatment, such as the plating of components, is permitted.
9. Your practical test piece will be retained by the Institute.

✂-----

**Candidate's Declaration:-**

**I declare that the whole of the work in producing this Practical Test Piece is my own work, not aided or advised by any other person. Moreover, my signature is given in the knowledge that if it is found, at any time, that a false declaration has been made, any "Pass" or "Pass with Merit" achieved in this and other Horology Examinations may become null and void.**

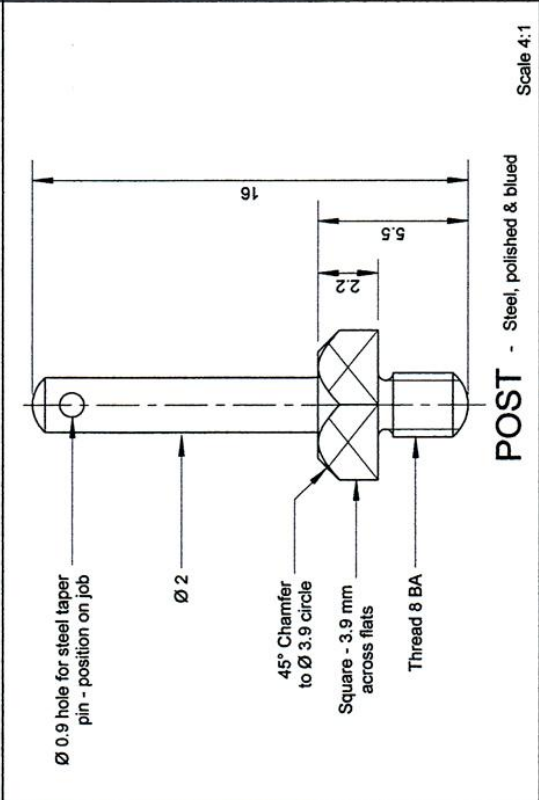
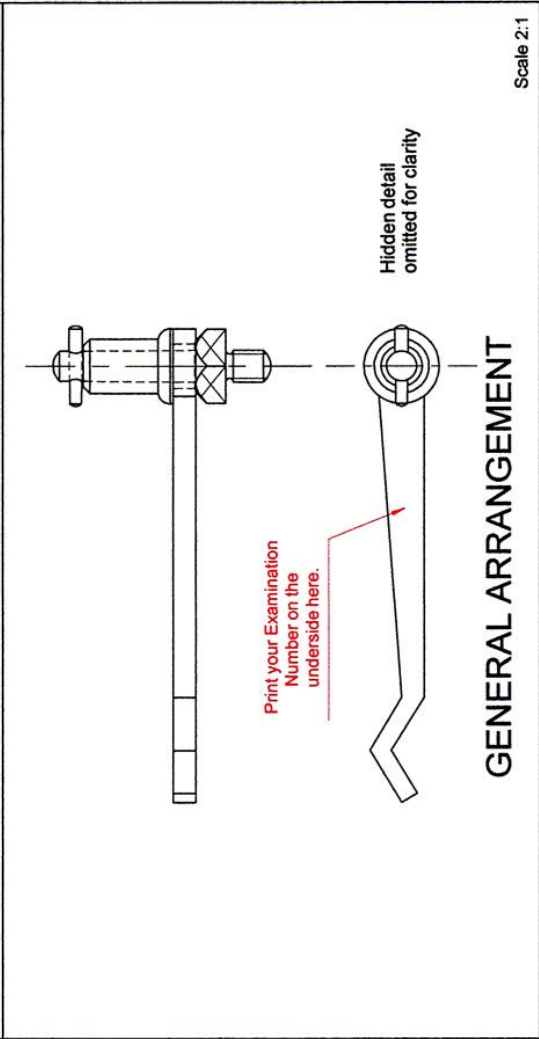
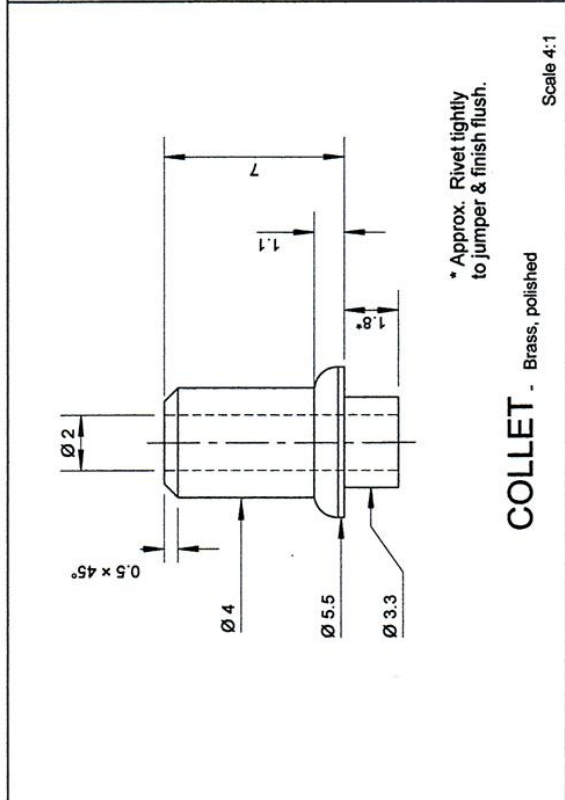
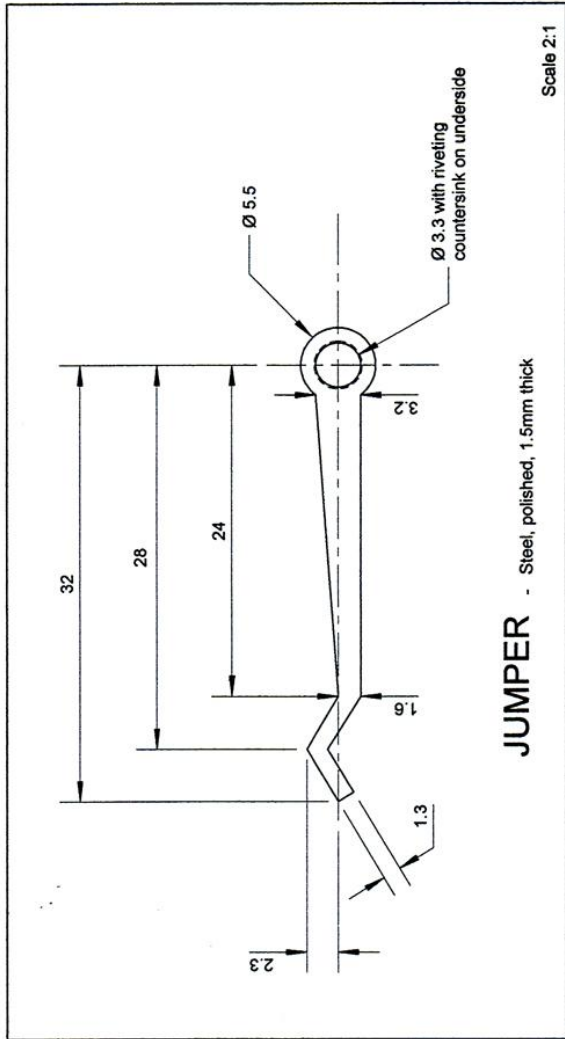
Candidate's Name ..... Examination Number .....

Signed ..... Date.....

Signature of College Lecturer.....

Date.....

**Make sure that your examination number is on the package and your work.**



<p><b>CARRIAGE CLOCK: JUMPER, COLLET &amp; POST ASSEMBLY</b></p> <p>MATERIALS: AS STATED</p> <p>FINISH: AS STATED</p> <p>ALL DIMENSIONS IN mm. (Do not scale)</p> <p>TOLERANCE: ± 0.1mm</p>	 <p>British Horological Institute Founded 1858</p>	<p>UNSTATED DIMENSIONS AND WORKING CLEARANCES ARE LEFT TO THE CANDIDATE'S DISCRETION</p>
		<p>FIRST ANGLE PROJECTION</p> <p>FINISHED COMPONENTS TO BE SUBMITTED TO UPTON HALL BY ?? June 20??</p>
<p>Diploma in Clock and Watch Servicing</p> <p>Making Clock Components</p> <p>Specimen Paper</p>		

# **Servicing and Correcting Faults in a Single Train Clock Specimen Paper**

Time allowed: 8 HOURS

## **Important notes - please read carefully**

1. You will be known to your Examiners by your examination number only; your work must be clearly identified with your Examination Number by means of a tie on label. Please ensure that the label is securely attached.
2. You are required to service the carriage clock movement including the platform escapement; this will necessitate fully dismantling, cleaning, reassembly, lubrication and adjustment:
  - Many components are gold plated and it is important that a suitable cleaning approach is adopted to prevent damage to these parts.
  - The dial is painted and should not be subjected to cleaning fluids.
  - There will be a taper pin missing and some faults have been introduced; these faults will affect the operation of the movement; they are not superficial or relating to dirt or surface damage.
  - **Candidates are advised to follow good practice by carefully checking each component during dismantling and re-assembly.** You should identify these defects prior to commencing / during work and correct them to ensure that the movement is in sound mechanical working order.
  - The faults should be listed in the section on the next page; this form must accompany your work.

**N.B. Replacement “shockproof setting springs”, replacement endstones and jewel holes are not available, you are advised to take considerable care to ensure that you do not lose or damage these components.**



Notes concerning the unit – **Servicing and Correcting Faults in a Single Train Clock Movement:**

1. The Specimen Paper relates to candidates servicing a timepiece carriage clock movement; Candidates may be required to service either a going barrel pendulum clock movement or a carriage clock movement.
2. Introduced faults will be selected from faults such as:
  - a pivots requiring re-finishing
  - b bent pivots
  - c worn pivot holes
  - d damaged mainspring
  - e faulty friction drive
  - f incorrect barrel endshake
  - g incorrect curb pin clearance
  - h faulty click spring
3. Introduced faults will not require:
  - a manipulation of the balance spring at the collet
  - b adjustment of pallet jewels
  - c adjustment of guard pin
4. The serviced clock must meet a good operational standard for a pass to be awarded.

# Servicing and Correcting Faults in a Quartz Watch Specimen Paper

Time allowed: 6 HOURS

## Important notes - please read carefully

1. You will be known to your Examiners by your examination number only; the watch and the movement must be clearly identified with your Examination Number by means of tie on labels and returned in the box provided. Please ensure that the labels are securely attached.
2. You are required to service the quartz watch; a number of faults will have been introduced into the watch; you should identify these prior to commencing / during work and correct them to ensure that the movement is in sound working order. **The introduced faults will not be just superficial or relating to surface damage, dirt or dust except where this could affect the operation of the movement. They will require the replacement of parts or adjustment of components for correction.** Candidates are advised to follow good practice by carefully checking each component for damage and function during dismantling and re-assembly. The faults and the action you have taken to correct the faults should be listed in the section provided on the following page. **This form must accompany your work.** You should conduct the listed tests on the quartz watch prior to commencing work and again after completion of the service.
3. Technical information about the quartz watch is provided for your guidance; you should use appropriate lubricants and follow good practice when servicing the watch.
4. You should complete a water resistance test and, where possible provide printed information about the water resistance of the watch.
5. Each watch is identified by a number and any damage prior to this examination will have been noted.
6. Parts are available from the invigilator to replace any defective components; any parts removed must be returned together with the serviced watch and serviced movement in the box provided. Marks will be lost if components are damaged by the candidate or parts are replaced where it is not necessary.
7. Examiners will consider the quality of your work, the cleanliness of the movement, alignment of the hands and test results, etc.

**Diploma in Clock and Watch Servicing**  
**Servicing and Correcting Faults in a Quartz Watch**

Your examination Number

**Diagnosis of Faults, Calibre Number 955.112**

Complete the following tests before and after servicing:

Test	Specification	Before Repair (candidate)	After Repair (candidate)	BHI use only
Battery voltage under load	1.55 volts			
Coil (resistance)	1.3 – 1.8K Ohms			
Consumption (stem in)	Max 1.3µa			
Consumption (stem out)	Max 0.5µa			
Lower working voltage	1.3v			
Rate of module	No data given or adjustment possible			
Check end of life operation				

List the faults that you identify and the action you take to correct each fault.

Quartz Watch: Operational Faults	Action taken to correct faults
New parts fitted:-	

Notes concerning the unit – Servicing and Correcting Faults in a Quartz Watch:

1. The Specimen Paper relates to candidates servicing an ETA 955.112 movement; various movements can be used.
2. Introduced faults will be selected from faults such as:
  - a. damaged coil
  - b. damaged components
  - c. faulty electronic module
  - d. dirty battery contact
  - e. seconds hand touching the glass
  - f. debris attached to rotor
3. Each watch will have a broken stem and the candidate will be required to cut the replacement stem to the correct length and secure the crown.
4. When servicing the watch, candidates are expected to routinely:
  - a. replace the battery
  - b. replace case seals
  - c. test the watch for water resistance
5. Candidates will be required to complete the standard electrical diagnostic tests for quartz watches both before and after servicing.
6. The serviced watch must meet operational standards for a pass to be awarded.