TWENTY FIRST CENTURY CLOCKMAKERS CERTIFICATE AND CERTIFICATION PROGRAMS AND INFORMATION

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AWCI 21st CENTURY CERTIFICATES AND CERTIFICATIONS REQUIREMENTS

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Introduction to AWCI's 21st Century Clock Education Programs

To assess the accomplishments of those professionals who have mastered the Standards and Practices for Clockmakers and to ensure the future of our profession, the following programs have been developed to help those who wish to test themselves against other clockmakers who have already demonstrated these competencies.

In short, with the agreement and support of its expert members, in concert with business and industry, AWCI' Clock Education and Standards Committee has developed the following set of assessments based on the 21st Century Standards and Practices.

The Board of Clock Examiners and the Clock Education and Standards Committee urge every clockmaker to familiarize themselves with the AWCI Standards and Practices and become certified to demonstrate their skills to themselves, their peers and their clients.

AWCI Standards of Excellence

The standard of performance expressed in this document represent the agreed upon knowledge, skills, performances, and dispositions required of the 21st Century clockmaker. In order to attain AWCI certification status these requirements are imperative.

"KNOWLEDGE" - refers to the content or body of information pertinent to the modern practice of horology. What should a modern clockmaker know.

"SKILL" - refers to the demonstration of the knowledge through various types of performances. This referring to what a clockmaker must be able to DO with his or her knowledge.

"PERFORMANCES" - what is expected of a professional clockmaker. For example, but not limited to, replacing a pivot, resetting a depthing using a bushing, cutting a custom bushing on the lathe, researching information for a historical restoration.

"DISPOSITIONS" - exhibiting a professional attitude. Topics such as ethics, quality of service, and cleanliness of the workplace.

As an organization that professes to bear the highest standards for watchmaking education, assessment, certification, and ongoing practice, it is imperative that AWCI, through the agreement of its expert members, in concert with business and industry, set forth these standards, and demand that its membership abide by them proudly.

Code of Ethics

AWCI's Code of Ethics asks that all members of the Institute conduct themselves as professional horologists in ways which will reflect well upon themselves, the organization, and profession.

This is a simple statement, certainly, but it can be seen more clearly what is meant by the code when one reads the "dispositions" expected of each level of AWCI certification. A careful examination of all dispositions should be made by any member who wishes to possess an official AWCI certification, for neither performance nor amount of knowledge can be meaningfully attached to those who would not also adhere to the dispositions expressed.

Summary of AWCI 21st Clockmaker Certificates and Certifications

The following programs and their assessments were designed to test the candidate's knowledge, skills and dispositions as set out in the AWCI Standards and Practices for 21st Century Clockmakers. It is recommended that the candidates familiarize themselves with the S&P document, practice each of the required skill sets until they have mastered them and then take the assessment. This peer reviewed program is the best way to build your skill sets, gain professional respect for your efforts and the recognition of your accomplishments.

Certification Categories:

- Clock Associate (CA21)
- Certified Clockmaker (CC21)
- Certified Master Clockmaker (CMC21)
- Certified Master of the Institute (CMI21)

Certification Descriptions:

Clock Associate (CA21) (This certification is currently in production.)

This certification is designed for the person who is interested in joining the world of clock repair. Wether it be as a counter person or assistant to a Certified Clockmaker or Certified Master Clockmaker, this is a stepping-stone to begin the study of clockmaking with the goal of achieving Certified Clockmaker status. This program will acquaint the participant with the general working of clocks and their parts.

Certified Clockmaker (CC21)

This certification is awarded to the person who has demonstrated the necessary skills to repair and restore the most common mechanical clock types that are prevalent in the United States including mantel, wall, and floor clocks. The holder of this certification is urged to progress and continue their studies and to qualify for the CMC21 which encompasses even more technical skills needed for the restoration and conservation of all types of clocks.

Certified Master Clockmaker (CMC21) (This program is in development)

This certificate is awarded to the person who has demonstrated the necessary skills to repair any type of clock, modern or archaic, pendulum or balance wheel. These skills include those demonstrated by the CC21 plus those necessary to perform services to carriage clocks, ships bell clocks and other timepieces that use balance wheels as their rate controllers. Certificate holders must also show the needed skills to fabricate any required part(s) for any clock. Such skills include but are not limited to the following: gear/pinion cutting, lever and cam fabrication, escapement construction, etc. CMC21's should also be familiar with general construction and repairs to clock cases.

Certified Master of the Institute (CMI21) (This award is currently on hold.)

The Certified Master of the Institute is a special award bestowed upon those who are recognized by the AWCI Board of Directors as possessing the professional knowledge to service a wide range of timepieces: e.g. complicated watches, chronographs, vintage pieces, clocks of all types. In short, this individual holds both the CMW and the CMC certificates (either AWI or AWCI 21st century certificates). He/She needs to be able to design spare parts and manufacture them. He/She has advanced communication and interaction skills for the purpose of training watch/clockmakers in preparing for either the CC21 or CW21 exams. He/She must model AWCI's code of ethics in all of his/her dealings. The Certified Master of the Institute is a "Steward" of the science and art of horology, and is dedicated to the highest ideals of the profession and to the care and perpetuation of the American Watchmakers – Clockmakers Institute.

Essential Knowledge, Performances, and Dispositions

Clock Associate (CA21) General Commentary (This certificate is currently in production)

Essential Knowledge and Performance

This is an Introduction to Clocks, Their Repair and Restoration.

The candidate will be able to:

1) Label and identify typical clock styles, their period of popularity, and country of origin from the 1800's to the present.

2) Identify and label the basic components of a variety of clock movement types, including:
   - Time only with simple, compound and torsion pendulums.
   - Time and strike movements—both rack and snail and count wheel/lock plates.
   - Chiming movements.

3) Explain the reasons for the following operational problems and demonstrate/show what corrective actions are most typically taken for:
   - Bearing/pivotal wear (depthing)
   - Beat errors
   - Power supply problems (mainspring/weight)
   - Lever actions

4) Demonstrate, adjust, describe and/or make drawings of the following processes:
   - Beat setting and self-setting beat mechanism.
   - Determine whether hands can be moved backwards or forwards without
   - difficulty.
   - Correct the synchronization of time and strike and time/strike/chime clocks.
   - Show proper winding procedures for both spring and weight clocks.
   - Make speed adjustments, knowing the differences for long and short
   - pendulums.
   - Set the hammers of a chime clock correctly.

5) Demonstrate the ability to place hands correctly and adjust them correctly to get releases at the quarter hours and enable correct synchronization release at the hour.

6) Demonstrate a written knowledge of the features of a modern grandfather movement including each of the following:
   - Moon dial principles
   - Chime selection and rules for moving selector
   - Hand setting

- Beat adjustment
- Night silence feature
- Handling brass parts
- Winding
- Time regulation

7) Identify and describe the proper quality and/or design of the following tools:
   - Screw and nut drivers—what the shape should be to properly fit screw slots and nuts.
   - Pliers - for pin work, adjusting, and shaping, etc.
   - Files, buff sticks, and burnishers
   - Tweezers—designs for specific tasks
   - Jewelers saw
   - Wire bending/adjusting tools
   - Broaches— cutting and smoothing
   - Let-down keys
   - Staking tools, punches, blocks and stumps
   - Bushing reamers and two common systems—Bergeon and KWM
   - Pegwood and pithwood and their uses

Certified Clockmaker (CC21)

Essential Knowledge and Proficiency

The holder of this certification must have the knowledge and dispositions listed under the requirements of the CA21and must be proficient with a working knowledge of the construction and adjustment in the areas listed here:

- History and types of clocks
- Striking and Chiming set up and adjustments
- Movements Servicing
- Proper oiling procedures
- Clock escapements, their construction and adjustments (ie. resetting the drops, locks and lifts):
  - The deadbeat escapement including solid, adjustable and strap type anchors.
  - The half-deadbeat escapement, both solid and strap type anchors.
  - The recoil escapement, both solid and strap type anchors.
  - The Brocot style escapement.
  - The pin-wheel type of escapement.
  - Burnishing and replacement of damaged pivots

- Servicing, repair and Replacement of wheel teeth
- Removing, installing, repairing (re-ending) and cleaning mainsprings
- Cleaning and repairing of mainspring barrels
- Servicing, reparing, rebuilding lantern pinions
- Re-bushing, re-depthing, polishing, and burnishing of pivot holes
- Level adjusting/repair
- Hammer adjusting/synchronizing
- Warning set-up
- Suspension/crutch problems
- Hand strike point adjusting
- Gathering, warning, rack and snail problems
- Servicing of music boxes
- Techniques for Cleaning parts
- Governor adjustments
- Comb adjustments and dampening
- Action/dancer sequencing
- Suspension wire replacing, adjusting
- Bellow servicing, repairing, restoring
- Lift wire adjusting
- Proper unpacking and packing of clocks, clock movements and parts

To be awarded a CC21 certification a candidate must successfully pass an examination consisting of following performances:

Note: The first performances will be completed by an On Site Administrator (OSA). Performances 2, 3 and 4 will be monitored by the OSA.

1) On Site Review of the Work Area
2) A written examination
3) The replacement of a damaged pivot on a clock wheel
4) The replacement of several teeth on a clock wheel
5) The cleaning and servicing of a spring barrel and mainspring and the re-ending of a section of a mainspring
6) The rebuilding of a lantern pinion
7) The General Maintenance Service (GMS) of a floor clock movement
8) GMS of a Cuckoo clock with music
9) 400 day clock movement with suspension unit completing an question sheet
10) An American type strap movement needing some part(s) remade along with a question sheet.

Location where the examination is performed:

The CC21 examination will be performed in a location approved by the Education Coordinator and the Clock Director. The preferred location is in the candidate's own shop. In an effort to support clock schools, clock apprenticeship programs and candidates who do not have their own shops, upon approval, AWCI will allow candidates to take the CC21 assessment program at the school, place of their apprenticeship or an approved location upon completion of their curricula.

(EXPLANATORY NOTE: It was the original intent of the first performance of the CC21 program to review the work environment in which the assessment was to take place in order to ensure a safe and secure workplace, free of strong odors and/or accident hazards for BOTH the OSA and the customer's products which will be serviced there. This performance was established after legal review by AWCI's attorney at the time the original Clock S&P was approved due to the issue that the OSA may not be bound by any AWCI rules/policies even though they had the right to stop the entire assessment if they felt unsafe.)

CC21 Variance Option and Requirements For Students and Apprentices From Horological Schools or Programs or who Do Not Have Their Own Workshop

Several points, however, must be met to be eligible for this option.

1) Once this acceptance has been given, the candidate *must* apply for a variance through the Clock Director, from the BOCE, so that a substitute form of Performance #1 can be supplied.

2) The candidate is responsible for finding an OSA (On-Site-Administrator, see page 21) who must be someone NOT associated with (or on staff of) the school or the training shop and is willing to conform to the requirements stated in the Clockmakers S&P (see page 19) for OSA's. The candidate must get the OSA approved by the Clock Director and the Education Coordinator before the assessment begins. Once the OSA is approved, it is expected that the candidate will pay all CC21 fees as required and meet all deadlines.

3) The candidate must still complete ALL 10 Performances with a score of 70% or higher (a rubric of 4.9 or higher) to be awarded the CC21.

How the Exam is administered:

The exam performances are grouped into three boxes.

BOX 1
Consists of performances 1 through 4 which will be monitored by an On Site Administrator (OSA).

Shop Review-Performance #1
At the location where the exam is to be performed the shop must be clean, organized, safe, and secure from accidental damage to customer products as well as from fire risks. The On Site Administrator reserves the right to stop an assessment if he/she feels that unacceptable odors or physical safety risks are present.

Written Assessment-Performance #2
This assessment section asks about your knowledge of 6 major areas of clock work. It is recommended that you consult several of the texts listed in the Bibliography at the end of this document. There are other texts as well that are not listed but if you are unsure of what is "the better way", check out later parts of this document, several others in the Bibliography to give you a broader perspective, or contact AWCI. We are assessing the breadth of knowledge that you have acquired. This section is *open book* and you may have any and all texts you deem necessary out and available to you as you complete the questions.

The sections:

1) History of clocks (5%)—is able to identify case styles, makers and historical points as to when certain general styles, makers and when historical firsts occur, etc.
2) General Mechanics (30%)—calculation of beat rates and pendulum lengths, gearing, horological electricity, anatomy of depthings, effects of wear, etc..
3) Escapements (30%)—master the terms drop, lock, and lift (and be able to discuss them), wear scenarios, correction of wear problems, self-beat correctors, etc.
4) Striking and Chiming (25%)—issues of stop, release, and warning, wear scenarios and their corrections, self correction scenarios, hammer actions/sequences, etc.
5) Metallurgy (5%)—as it effects horological products, knowledge of the materials and the conditions we subject them to, etc.
6) Springing (5%)—calculations, thickness/width/length issues, and replacement issues, etc.

Pivot Exercise-Performance #3

The Candidate will be given a wheel that has 1 pivot end that is badly scored. That end must be replaced with a new pivot that matches the pivot on the opposite end of the same shaft exactly - in ALL dimensions. The new pivot will be scored on its dimensional

accuracy as well as the maintenance of the original arbor length, finish quality, security and temper.

Wheel Exercise-Performance #4

You will be given a wheel on which 1-3 teeth have been removed. It is your challenge to replace those missing teeth as exactly as possible to the original ones. You will be scored on dimensional accuracy to the other wheel teeth, as well as plug fit, surface finish and damage to surrounding teeth.

Box 2

Barrel and Mainspring Exercise-Performance #5

1) The candidate must safely remove, clean, lubricate and reinstall a barreled mainspring. The barrel, its cap and arbor must be cleaned and serviced as required. The mainspring must be thoroughly cleaned, lubricated and safely reinstalled in the barrel. This process can be done with a mainspring winder or by hand. Safe handling (and protection of the examinee) must be part of the process. Your work will be scored on the cleanliness of all teeth, arbor pivots, and their pivot holes (Even though you are asked not to do any bushing work, here, we are looking for cleanliness and finish.). Winding smoothness will be examined as well as the freedom of the arbor, security of the barrel cap (as well as the flatness of the cap) and spring flatness within the barrel (re-flatten if necessary). The candidate is NOT to replace the mainspring, the barrel, or the arbor. He/she is to service what is given and return it to the proper qualities required.
   NOTE: Examinee will not be required to bush the barrel in this exercise.

2) Re-construct the end of a strip of mainspring stock by installing a proper hole like those seen in commercial mainsprings. You will be evaluated on annealing qualities; hole centricity, size, shape, and quality; outside end shape; shape of the end for barrel attachment and ease of installation (as if it were a full length mainspring). Your spring end should match the character of modern products.

Lantern Pinion Exercise-Performance #6

Demonstrate your ability to properly rewire a lantern pinion. Your work will be assessed on how well you maintain the original design specifications and locations, so be very careful to maintain all specifications. You will be evaluated on collar positions and security, wire size and length, security of wires and method for doing so, as well as overall handling quality.

Floor Clock Movement-Performance #7

Total GMS (General Movement Servicing) of a modern floor clock (grandfather clock) movement is to be performed by the candidate. Performance tasks will include general

movement servicing and *may* include any or all of the following: Pivoting, pivot burnishing, tooth work (straightening/retoothing), bushing/redepthing, pivot hole polishing, lever adjusting/repair, escapement adjusting, hammer synchronization/ adjustment, warning set-up, hand release position, suspension/crutch problems, and stop-work alignment, etc.. (See items 1-26 in the GMS section of this S&P.)

Time allowed for completion of Box 2
14 calendar days will be allowed to complete the tasks assigned by the BOCE (from the Standards) for the Box 2 series. The completed projects are to be returned to the person on the enclosed return shipping label, postmarked or shipping marked, showing the work completion and shipping no later than 14 calendar days after initial receipt by the examinee. (See page 13 above for further information.)

Box 3

Modern Cuckoo Clock with Music-Performance #8

Performance tasks may include: All "General Movement Servicing" processes, skills and knowledge may be components of this task including strike, gathering, warning, rack and snail problems. Candidates may be asked to adjust operation levers, music levers, make governor adjustments, comb adjustments and insure proper dampening, adjust striking levers, door control levers and bird levers. Also included may be action/dancer sequences, escapement adjustment, suspension wire problems, bellow repairs, lift wire adjustments, and hand/strike point adjustments. The movements may require cleaning but no bushing work will be needed.

400-Day Clock-Performance #9

Performance tasks may include: suspension spring service, escapement resetting, beat setting, hand tension and alignment, and pendulum action. Even though candidates will not be asked to do general cleaning, mainspring servicing, or rebushing of these clocks, other skill or task demonstration as outlined in "General Movement Servicing" may be required. There will be some additional written questions provided for the candidate to answer as well. The candidate is expected to answer these questions completely and return along with the clock materials. You will also be given a suspension unit to rebuild to spec and return for scoring (i.e. new suspension spring and placement of all parts correctly according to Terwilliger's 400 day clock book—see bibliography).

American or American Style Time and Strike Movement-Performance #10

This movement will NOT receive General Movement Servicing. There are *NO* errors introduced to pivots, pivot holes or mainsprings. The mainsprings have been serviced enough to allow the Assessors to evaluate the necessary problems without further work.

There *will* be a need to do adjustments, fabricate a missing lever, adjust the escapement and get the clock to run *and* strike properly. This product is expected to run (pendulum motion is important—it should meet the properties of this type of escapement) but timing *will not* be evaluated. The clock should strike properly, keeping up with the time indicated by the hands and strike (plus or minus a minute or so of the correct time) at the proper points. Hands will be provided to ensure consistency of results. When returned, the mainsprings must be let down again into the "C" clip or "keepers" provided. The Assessor will wind the movement, set it on a test stand, attach a pendulum, set the clock in beat and watch its operation and do the evaluations from that point. It will be evaluated for pendulum action, strike action and smoothness (as well as strike point) and the whole for ease of operation. There are a series of written questions that are also included as part of this exercise. The candidate is expected to answer these questions completely and return along with the clock materials.

Time allowed for completion of Box 3
Same as for Box 2 above. (See page 13 above for more information.)

Assessment standards
The examinee must meet minimum performance standards on *each* portion of the examination in order to receive certification. Scaling will be adjusted so that the "cut" (passing score) rests at 70% (or a rubric of 4.9). If retesting is requested, it may be allowed (at the discretion of the BOCE) if no more than three sections of the entire assessment are below this percentage. To receive the 21st Century Certified Clockmaker Certificate, the candidate MUST pass *all* 10 sections with at least minimum passing scores. Scores will NOT be added together and averaged. Any disputes of scores obtained may be submitted to the BOCE by following the "Rules of the AWCI Certification Appeals Process." (See pg.49) Failure on any 4 or more performances will result in the examinee being required to retake the entire examination at his/her own expense, depending on the outcome or any appeals to the BOCE.

NOTE:
If retesting for any section of Box 1 is granted, the retest must be observed by the OSA (the expenses of which may be borne by the candidate), unless otherwise approved by the BOCE. If retesting of any of the other items is allowed, additional costs will be applied as determined at the time the request is granted by the BOCE.

Certified Master Clockmaker

Clock Certificate: Certified Master Clockmaker (CMC21) (This certification is under development.)

Description:
The holder of this certificate must be able to demonstrate the skills, knowledge, and dispositions of the Certified Clockmaker, plus have the ability to fabricate parts for any clock of any age, and design, both pendulum and balance wheel types. They must also demonstrate the ability to service a pocket watch movement, doing general adjustments to timing and balance action.

There are several ways to demonstrate the qualities needed to be awarded this certificate. They include: (See Pathways section for further details.)

- Standard test examination and skill demonstration as described below;
- Submission of an alternative program with needed documentation to the BOCE for its approval (See Pathways section for further details);
- Submission of plans, procedures and skill lists of techniques used to fabricate a clock movement and case. A BOCE approved On-Site Administrator will need to verify the authenticity of work completed.

Procedures:
Since the options vary with this certificate, situation specific procedures will result from the program selected and the directions of the BOCE. In the case of special programs, all steps and results must be documented, photographed and presented to the BOCE as specified.

Escapement Knowledge for the CMC21 and the CMI:
Both the CMC21 and the CMI21 must be able to demonstrate the escapement knowledge of the CC21 (as above) as well as the following:

1) The lever escapement (including the platforms on which they also appear) including Swiss, British and American styles.
2) The cylinder escapement (including the platforms on which they also appear).
3) The pin-pallet—"Roskopf style" escapement (including the platforms on which they appear). Also, "floating" balance type escapements.
4) The chronometer/detent style escapement.
5) The gravity escapement.
6) The barrel or "Lux-Keebler" escapement.
7) The "grasshopper" escapement.
8) Others as determined by the candidate and the BOCE.

Certified Master of the Institute (CMI) (This award is currently under review)

Requirements

The Certified Master of the Institute possesses the professional knowledge to service a wide range of timepieces (e.g. complicated watches, vintage pieces, whether watches or clocks). This individual will hold both the CMW and the CMC certificates (either AWI or AWCI). He/She needs to be able to design spare parts and manufacture them. He/She has advanced communication and interaction skills for the purpose of training watchmakers and/or clockmakers in preparing for either the CC or CW exam. He/She must model AWCI's Code of Ethics. The Certified Master of the Institute is a "Steward" of the science and art of horology, and is dedicated to the highest ideals of the profession and to the care and perpetuation of the American Watchmakers – Clockmakers Institute.

Prerequisites

Candidates must hold both the CMW and the CMC status for three years and have demonstrated skills in the restoration of vintage and complicated watches *and* clocks. Candidates must understand the use of lathe and milling machinery and demonstrate their use in the restoration and/or preservation of timepieces, both modern, and historic.

Procedures

The CMI may only be achieved by recommendation of the Board of Assessors and approved by the Board of Directors of AWCI. The CMI candidate must submit an application and resume to the BOCE showing the following:

1) Photocopies of his/her CMW and CMC certificates from AWI/AWCI.
2) A work resume in horology including any publication materials.
3) Photographs of watch and clock restoration projects with a description of the work performed.
4) Photographs of the work shop area with general equipment used.
5) Mentored review of the work in progress by a representative of the BOCE.

CMI Roles and Responsibilities

The Certified Master of the Institute is:

1) Dedicated to the preservation of horological knowledge.
2) Dedicated to horological education and willing to share his/her knowledge with others.
3) Dedicated to the Standards and Practices of the AWCI, and to the continual growth and improvement of the Institute and its practices.

Certification Process and Procedures

Requirements
The candidate must complete written/practical tasks as required and submit them to AWCI for review.

Assessment
All scoring of assessments will be "pass/fail" with explanations on failures provided. Candidates will be given the opportunity to retest a failed section until passed.

Procedure
The candidate for this certificate must request materials, one section (of seven) at a time, fill out the proper forms from the AWCI office and pay all fees. To complete this certificate, the candidate must then complete all seven sections, scoring a "pass" to be issued a certificate of completion.

Disclaimer
The candidate must clearly understand this is a program to develop general knowledge and skills and is not an authorization to begin the practice of clock repair. (A waiver will be included in the initial enrollment packet for candidate signature and testifying to this understanding.)

Time
There is no time limit to any particular assessment section BUT if a candidate does not complete the program within one year, without filing a legitimate reason for a time extension (which must be approved by the Board of Clock Examiners-BOCE), certification procedures must be reinitiated.

Application Procedures and Timetables for Completion of CC21

The interaction of the On-Site Administrator (OSA, See page 11) and the candidate is critical to the success of the CC21 program. To insure that the candidate moves forward consistently and directly, the following policy is to be followed by the On-Site Administrator and the candidate in signing up for and moving forward through the assessment processes.

1) Once AWCI receives and processes the CC21 candidate's registration, the Education Coordinator (EC): 1.866.367.2924, the Clock Director (CD): 1.865.584.2570, and the candidate will work together to identify and assign an OSA. It is expected that this Administrator will be mutually acceptable to both the candidate and AWCI.

2) After all sign-up materials and monies are received by AWCI, the OSA, once selected, will contact the candidate and together, identify the date to start for the examination. The start date must be *at least* 4 weeks from the date the sign-up materials and monies were received at AWCI. This would allow AWCI time to assemble and package all the exam materials and arrange for the first 2 Boxes to be sent to the OSA. (Please note: There are 3 Boxes for the CC21 assessment program that the candidate must complete.)

3) Once all the sign up materials are processed at AWCI, the EC will notify the CD that all materials have been received and the start date set. The CD will then ship out the first 2 Boxes to the OSA to arrive at least one (1) week before the start date. Should there be any need to extend or change this date (with the exception discussed in #4 and #5 below), the candidate must immediately apply to the BOCE (Board of Clock Examiners) for a variance. (See the Clock S&P for the form to be submitted.) Failure to do so will result in their exam materials not being sent and/or scored and the candidate may possibly forfeit his/her monies.

4) To allow for some flexibility, if some conflict with the original start date should develop, the candidate, in agreement with the OSA can start the exam within 2 weeks after the original start date without filing for a variance. In any case, the OSA must contact the CD with the new date to start the exam. It is expected that the **OSA** will see to it that the program begins on the original date or within two weeks following that date (see above). If the program cannot be started at that time, the **OSA** MUST *immediately* apply for a variance from the BOCE as stated in #3 above.

5) Handling the Boxes from the CD: Upon receiving the first 2 boxes, the OSA is to inspect the condition of the outside of the boxes for any visible damage. He/she should then open and check **ONLY** Box 1 materials to ensure everything is ready for the start date. If there is any damage, or if errors are found when checked against the enclosed packing list, the OSA is to immediately contact the CD to resolve the problems. The boxes are to remain in the possession of the OSA until the start of testing. Box 2 MUST remain sealed until AFTER all Box 1 materials are completed, reboxed and ready for return for assessment. The Candidate is **NOT** allowed to review **ANY** materials until the actual start of the examination at their shop. After Box 1 is completed and ready for return, the candidate is then to be given the sealed Box 2. The candidate is then to open and examine the contents of Box 2 in front of the OSA. If there is any damage, or if errors are found when checked against the packing list, the **OSA** is to *immediately* contact the CD to resolve the problems. If none found, then the candidate has 14 calendar days to complete all the work in Box 2, rebox it and return it to the CD for distribution to the assessor.

6) Box 3 (the final 3 performances) will not be shipped to the candidate until all of Box 2 materials have been received by the CD for distribution to the assessor. Once the candidate receives Box 3, he/she has 14 calendar days to complete the work and return it for assessment.

7) **NOTE**: These timetables were set by the BOCE to determine if the candidate can complete work within a reasonable period of time. Time efficiency **is** part of this assessment process. Therefore, it is expected that the candidate will budget their time accordingly.

Cancellation Policy:

Any request for cancellation must be tendered to AWCI not less than 20 business days BEFORE the examination is to begin or no refund will be given.

The Board of Clock Examiners

Function:

The purpose of the Board of Clock Examiners (BOCE) is the oversight of all clock certification and assessment processes, including construction, administration, and scoring of candidate assessments.

Membership

- The Board of Clock Examiners (BOCE) consists of individuals appointed by the AWCI Board of Directors. It is the responsibility of the AWCI Education and Certification Committee to recommend candidate(s) for the BOCE.

- The BOCE will consist of between 2 and 5 members with one individual designated as Chief Examiner (who will be retained for his/her services by AWCI). The remaining Examiners will consist of assessment/content specialists in clockmaking.
- Members of the BOCE must be members in good standing of AWCI, and have a minimum of 8 years of bench experience as horologists/educators and hold at least one of the following: CC, CMC, CC21, CMC21.
- The BOCE along with the Clock Education and Certification Committee will help select, approve and train On-Site Administrators (OSA's) to aid in the administration of clock exams.

Duties

- The Board (BOCE) will meet at least twice a year to construct and/or review all examinations and any needed changes to these Standards.
- The BOCE will be responsible for training Certified Clock Assessors who will, in turn, help conduct examinations according to the AWCI Clock S&P.
- Examinations will reflect appropriate 21st Century content, skills and proficiencies.
- Examinations will be tested for reliability and validity by the Chief Examiner, or a qualified agent of the Chief Examiner.
- The BOCE will approve examinations for use for each testing year, which will coincide with AWCI's fiscal year.
- The BOCE will supervise the preparation of examinations, and provide oversight to the

exams as they are conducted.
- The Board will also select and train On-Site Administrators. These individuals will observe and record the Examinee's (candidate's) required activities that are part of the Certifying examination as required by the BOCE.

Length of Term
- Membership on the Board of Clock Examiners will be for five years, with terms to overlap, to guarantee continuity and knowledge transmission.
- The Chief Examiner will serve an indefinite term, as determined by the AWCI Board of Directors, who may conduct a performance or personnel evaluations every two years.
- The person to fill the Chief Examiner position will be recommended to the AWCI Board of Directors for their approval by the Chair of the Education Committee with a majority approval by the Education Committee membership.

Certified Examiners (Assessors)
These individuals will act as agents of the Board of Clock Examiners and represent AWCI in the formal assessment process. They will be trained and empowered to administer various assessments developed by AWCI as these are developed and revised. They may or may not participate in the actual development of these assessments, and also the scoring of candidate performance.

Individuals who may qualify for an Examiner (Assessor) position:
- AWCI Certified members
- Industry representatives
- REC School instructors
- Other professionals as approved in advance by the BOCE

Certified Examiners (Assessors) will be appointed by the Board of Clock Examiners, pending completion of training and recommendation by the Executive Director and/or the AWCI Board of Directors.

Duties of the On-Site Administrator
- The role of the AWCI OSA is to verify that all work submitted is done in accordance with the AWCI Clock Standards and Practices.
- His/Her role is to administer the exam materials but NOT to score them, discuss or divulge any information to the examination candidates or anyone else.
- He/She will observe the candidates work environment using systematic procedures. These will include evaluating equipment, work processes, and the kind/quality of tools and measuring instruments.
- OSAs are responsible to see that time limits are met for each examination section in Box 1 and that at the close of the day, these materials are collected and returned to AWCI for scoring.
- OSAs may come from a pool of members, certified members of AWCI (regardless of

certification date), and others approved by the BOCE. They may come from either the Watch section *or* the Clock section, but in either case must be familiar with horological concepts, and professional and traditional shop practices, and in the OSA procedure.

BOCE requirements for overseeing the assessment of a candidate

CA21: Minimum of one AWCI Approved Assessor.
CC21: A panel of 1, 2, or 3 Certified Assessors will assess the performance tasks.
CMC21: A panel of 2 or 3 Certified Assessors of which two are CMC's will assess candidate performance.

Scoring Procedures and Logistics

Assessors employ "Scoring Rubrics" (the rules applied to performances that reflect AWCI Standards) as determined by the Board of Clock Examiners (a sample of the scoring sheet employed for the CC21 exam is included with this document).
In short, trained Assessors rate work performed by candidates. This will be done on a 7 point scale (rubric). The scale will be determined by the type of task-- performance or written.

Sample Rubric

For example, on a performance task, a candidate's work will fall into one of these categories (remember that a 4.9 is a minimum passing score for the CC21 and 5.3 for the CMC21):

- Totally unsatisfactory or incomplete.
- Work partially completed but unsatisfactory.
- Work completed but unsatisfactory.
- Work completed and marginally functional.
- Work completed and satisfactory.
- Work completed with a high degree of skill and knowledge evident.
- Exemplary work of the highest quality

Shop Review Performance

The scoring of this review is strictly based on the items listed in the Clock S&P. No scoring will be done on personal traits or behaviors. All points are based on Yes or No responses.

Written Performances

Written performances will be scored with an answer key that uses key identification words where a short answer is required. Optional answers are given in the key to allow partial credit for other solutions. Where mathematical solutions are required, partial credit (1/2) is given, when the answer is not correct, but the method employed is correct and the candidate did show the math work.

Below is a sample score sheet used by the Assessors to score your work. To use this sheet properly, you must have proper Assessor training. However, it is provided to you, to help you understand the detail that we are examining as your work is scored. For example, the <u>diameter accuracy (D.A.)</u> requires that your work fall within a rubric range as follows (remember that 7 is the highest quality and 1 is unsatisfactory): This is correct for D.A., only!

7 = ±0.0005" or 0.013mm
6 = ±0.001" or 0.025mm
5 = ±0.0015" or 0.038mm
4 = ±0.002" or 0.051mm
3 = ±0.0025" or 0.064mm
2 = ±0.003" or 0.076mm
1 = >±0.003"

Performance 3: Repivoting Project

Section 1

Project completion Yes No Comments

1) The arbor has been repivoted…….

2) Arbor not cracked or swollen near insertion…….

3) Pivot in line with shaft w/o magnification……..

If all answers above are "yes," the project is considered operational for scoring.

If any answer above is "no," the project is considered non-operational and therefore <u>not</u> scoreable.

Grades are Yes=1, No=0

Section 2

Pivot Specifications-(Use rubric charts) weight x grade= score Comments

1) Diameter accuracy……..5

2) Length accuracy……. 5

3) Maintenance of original arbor length…….5

Total:

Section 3

Finish quality weight x grade= score Comments

1) Shoulder quality.

a. Shoulder face polished……..…1

b. Shoulder edge shape, beveled…… .1

2) Pivot tip quality.

a. Pivot edge at tip-smoothed over… ..1

b. Pivot tip-rounded/finished…….1

3) Pivot finish quality. Use gauge (Grade 1-7)…..5

Total:

Section 4

Miscellaneous weight x grade= score Comments

1) Temper of pivot-use #6 file. Grade 3, 5, or 7……2

2) Pivot anchorage pullout test…….1

Total:

Scoring

Score from Section 2

Score from Section 3

Score from Section 4

Sheet total:

Total ÷ factor 22.714285 = Final rubric score:

As you can see, diameter, length, maintenance of arbor length and pivot finish are considered crucial elements to any pivot work.

RULES FOR AWCI CERTIFICATION APPEALS PROCESS

These Certification Appeal Rules (the "Rules") shall govern the process for any individual wishing to appeal a non-qualifying score (lower than a rubric of 5 or 70%) on any part of an AWCI Certification Exam. All individuals taking AWCI Certification Exams have previously agreed, as a condition of taking the exam, that this appeals process is the exclusive means by which to seek review of a failing grade. Moreover, all individuals have agreed that this appeals process shall be final and binding upon the individual and AWCI.

1) **Notice of Appeal**

Any individual wishing to appeal a failing grade on any part of the AWCI Certification Exam must file a written Notice of Appeal with the AWCI Executive Director within thirty (30) days of receipt of his or her Certification Exam result. The form of the Notice of Appeal is available at AWCI's headquarter office by calling: 866-367-2924 or (513) 367-9800. The Notice of Appeal must be filled out, signed and received at AWCI's headquarters within thirty (30) days of notification of a non-qualifying score in order to be effective.

2) **Board of Clock Examiners Review**

Upon receipt of the Notice of Appeal, the Executive Director, Education Coordinator or Clock Director shall submit an appeals packet to the Board of Clock Examiners (the "BOCE") for review. The package shall contain the Certification Exam section in question, but shall not disclose the identity of the individual seeking appeal. Within ninety (90) days of the receipt of the Notice of Appeal by AWCI, the BOCE shall review the Certification Exam section(s) and vote on whether to uphold or overturn the failing grade. All votes shall be by the majority vote of the Board of Clock Examiners. If a BOCE member participated at any point in the candidate's assessment, that BOCE member shall not participate in the voting. Candidates will be promptly notified of the results of the Board's vote by the Chief Clock Examiner through the Clock Director.

3) **Executive Committee Review**

If any member of the BOCE dissents with the Boards decision to uphold a non-qualifying score, then the individual appealing that score shall be granted a further right to appeal the decision to the AWCI Executive Board. The notice from AWCI informing the individual of the Board of Clock Examiner's vote in upholding/overturning the non-qualifying score shall also notify the individual if he or she has the right to appeal that decision to the AWCI Executive Committee. If the individual is given that right, he or she must exercise it by sending a written notice to the AWCI Executive Director requesting the appeal to the Executive Committee within 30 days of notification. The Executive Committee shall consider the appeal within ninety (90) days of its receipt. The Executive Committee can uphold/overturn the non-qualifying score by majority vote. The individual appealing the non-qualifying score shall be promptly notified of the Executive Committee's action once it is taken, by the Executive Director.

4) **Binding Decision**

Except as noted in Section 3 above, all decisions of the BOCE in upholding or overturning a non-qualifying score shall be final and binding upon AWCI and the individual appealing the decision. In the event that the individual appealing the non-qualifying score is given a right to appeal to the Executive Committee, then the action of the Executive Committee in upholding or overturning the score shall be final and binding upon AWCI and the individual appealing it.

If you would like a form for an Appeal, please contact the Education coordinator at AWCI Central.

Recommended Tooling List For Clockmaker Examination

- WW style lathe or small bench lathe and appropriate chuck/collet set, tooling (gravers) and burnishers
- Measuring devices (with both inch and metric)—calipers is essential, micrometer is optional
- Number drill set
- Assorted files, buff sticks and abrasives
- Torch/alcohol lamp with solders and fluxes
- Jewelers saw and blades
- Bench pin
- Let-down keys
- Mainspring clamps
- Bushing system tools, either hand or machine and bushings (KWM, American or Bergeon)
- Cutting and smoothing broach sets and handles
- Assorted hand tools—pliers, screwdrivers, nut drivers, hammers, etc.
- Staking tool set or punch set and bench blocks
- Lubricants, oils and applicators
- Cleaning and drying system—that is safe!
- Bench vise
- Assorted tweezers
- Pegwood, etc. for cleaning pivot holes, etc.
- Safety goggles or glasses
- Leather gloves and work protection gloves
- Brass and steel stock appropriate for horological products
- Loupes or optics
- A variety of movement test stands
- Pin vices in a variety of sizes

Optional Tooling Recommendations

- Drill press
- Bench mill
- Dental burrs or jewelers burrs and slotting saws
- Mainspring winder
- Electronic movement timer
- Ultrasonic cleaner(s)
- Bushing tool
- Larger lathe (6” and up with necessary tooling)
- Step chucks, bezel chucks and drill chucks (even for the WW lathe)

Sample Examination Questions

Please note that the % next to the category is the percent that this section will count on the total. Question style will vary but the answers will be in the styles requested here. If an incorrect answer is given to a calculation question, partial credit may be given for work that is shown if the Examiner can follow the math logic given. (See sample rubric above.)

Proficiency: History (5%)

1. The clock style (below) with the latest 30 hour brass movement opened the sales market in the mid-1800's for clocks.

   a.) Give an approximate range of years over which this clock was sold.
   b.) Who was credited with the development of this case style *and* who received the credit for the development of the movement?
   c.) Name 5 other companies that sold this style of product.
   d.) What was this style called?

2. The concept of a "cottage industry" has been with us for centuries. In Europe, two countries, in particular, have left us clock products that are very common in ou (USA) marketplace.
   a.) Name the countries.
   b.) One style of clock from this industry was a floor clock (there are, however, wall clock examples) and the other country made, and is still making, a large variety of wall clocks. Name these 2 styles of clocks.
   c.) Each of these clock styles has a unique striking arrangement. Explain how each of these clock styles strikes the hours.

3. From the late 1600's, the British started and continue through today a very strong clockmaker's organization.
   a.) Name this historic Guild.
   b.) Many famous members came from this group after they became "free men" of the guild. Name two of these men who are credited with inventing clock escapements

that are still in use today and give the name of the escapement.

Proficiency: General Mechanics (30%)

Given that the length of a "Royal" pendulum at Harrison, OH of 39.12" or 99.36 cm.

1. What length pendulum is needed to make a clock that shows a beat rate of 180 beats per minute? (Show all your work.)

2. On our sample clock movement there is a "V" shaped release lever. One arm is 2" long and the other arm that contacts the cannon pinion is 1" long. If we move the shorter arm ¼", how much will the longer lever move? (Show all your work.)

3. There are 3 major sources of friction that can occur between a train wheel and its mating pinion. They are pivotal, tooth engaging and tooth disengaging. Explain what a benchman can do to minimize the effects of all 3 of these.

4. Minute wheels often get lost with poor repair handling. Calculate the options for a missing minute wheel and its pinion, given the canon pinion has 16 leaves and the hour wheel has 48 teeth. This is a standard 12 hour dial. (Show all your work.)

5. The average resistance of a 110 AC electric coil is between 500 to 2000 Ohms. If the leads are pulled out of the coil and are repaired by tweezing out the start windings and resoldering new leads, what effect will the loss of the 5-10 windings taken to set the new leads have on the functionality of this coil?

6. Quartz clocks are not usually repaired because of their inexpensive construction and ease of replacement. There are several tests that a clockmaker can use to determine if the movement is useless or just needs the terminals cleaned and a new battery installed. What do the following tests tell us?
   a) Microampere consumption:
   b) Lower or minimum running voltage:
   c) What voltage range will a "AA" battery typically show when it has lost its ability to move a set of hands on a standard quartz clock?

7. Make a diagram of the mating of a gear tooth and a lantern pinion and label the following terms: Addendum, dedendum, tooth, pitch circle, line of centers, pinion trundle, root, and ogive. Also give a definition of epicycloidal gearing.

8. What is the relationship between suspension spring thickness and time keeping on a given pendulum? Also, is this true for both torsion and simple pendulums?

9. Endshake and sideshake are essential for the proper running of any wheel train.
   a) Define these two concepts.
   b) Explain how you determine how much of each is "enough."

10. Pivotal wear is predictable. Explain why pivot holes never wear uniformly round, but only in one direction.

Proficiency: Escapements (30%)

1. Define:
   Drop:_____
   Lock:_____
   Lift:_____

2. On some American and European clocks a "half deadbeat" escapement was used. Explain what is meant by a "half deadbeat" escapement?

3. Given an escape wheel tooth distance of 0.100" (2.54mm), what is the largest, best size of stock to use to make a Brocot pallet for this wheel? (Hint, what is the size of stock to start with, not the finished pallet width.) Show all your work.

4. "Floating Balance" escapements can pose several problems even when "new out of the box." Explain the effect of the following and how these problems are corrected.
   a) The fork is too deep (but not bottomed) onto the impulse pins of the balance wheel:
   b) The outer coil of the hairspring is too close to the next inner coil as it beats:

5. Fluttering is a common problem in 400 day clocks. It most often occurs from 1 or 2 sources—the escapement and/or the fork. Explain the effect of each source and how each is corrected.

6. There are several designs of "self-beat adjusting" clock movements. The principle of their action is similar. How does a clock escapement correct its beat by itself?

7. There are a number of reasons that a clock will go in and out of beat while it is running. Frequently, this problem will not stop the clock. Discuss several reasons for the cause of this problem in various clock movements and how each example you give can be corrected. (Give at least 3 examples.)

8. Explain the relationship between pallet thickness and the drop experienced in an escapement. Be sure to discuss the effects of both a thinner pallet and how thick a pallet can be before it affects the drops causing the clock not to work.

9. When an escape wheel comes in with bent and chipped teeth, it is necessary to straighten the teeth back to their original indexing and then re-round the wheel to insure uniformity of tooth length. If this removes even 0.001"± 0.001" (~ 0.10mm), it will affect the efficiency and possibly the running of the escapement. What does this do to the escapement in terms of drop, lock and lift?

10. Anchors and strap pallets frequently show up with deep ruts in their working faces. What effect does removing these ruts have on the escapement in terms of drop, lock and lift?

Proficiency: Striking and Chiming (25%)

1. Warning is a key concept in clocks.
   a) Explain what is meant by this concept.
   b) Explain the necessary amount of warning for both the chime *and* the strike trains.

2. There are several types of clocks that lack "warning," e.g. Morbiers, Viennese regulators, and some carriage clocks. If "warning" is important, then how do these clocks get around this problem?

3. Define the word "detent" and explain its meaning as used in striking clocks.

4. Explain the differences between the 3 common types of strike counting arrangements seen in clocks: count wheel, lock plate, rack and snail.

5. Explain how to determine which type of striking/chiming clock can have its minute hand turned backwards without any damage and which type cannot.

6. In American strap type time and strike movements, the maintenance arm frequently will have a deeply worn groove where it rides against the maintenance cam. What effect will this have on the action of the strike train as a whole?

7. Explain how a modern Hermle, Kieninger, or Urgos movement is able to synchronize its 4th quarter chime with the minute hand at 12:00, when thrown out of sequence.

8. In a modern floor clock movement, when "things go awry" the clock can chime "on and on and on"….. Explain how this can happen.

Proficiency: Metallurgy (5%)

1. Describe the composition of the following:Brass:_____
   Steel:_____
   Bronze:_____

2. Explain how each of the following is affected by heating to a dull red and plunging into cold water.
   Brass: (e.g. 360 grade):_____
   Low Carbon Steel:(e.g.1020:_____
   High Carbon Steel: (e.g.1090 or 001):_____

Proficiency: Springing (5%)

1. A barrel has an internal diameter of 2.25", an arbor diameter of 0.250," and the old spring thickness is 0.0165". What is the best length of spring to properly fit this barrel?

2. Describe the effect of:
   a.) using a thicker mainspring:

   b.) using a wider mainspring:

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