

# **TWENTY FIRST CENTURY CLOCKMAKERS**



# **CLOCKMAKERS STANDARDS AND PRACTICES**

Version 9AC

# Table of Contents

## INTRODUCTION

1	Forward, Preface and Acknowledgements	3-4
2	AWCI's Standards of Excellence	6

## AWCI STANDARDS AND PRACTICES FOR ALL CLOCKMAKERS

3	Essential Performances for All Clockmakers <b>General Movement Servicing (GMS)</b>	7-12
4	Essential Standards for In-Home/Out of Home Service	13-16
5	Standards and Practices for Specific Clock Type	16-19
6	Shop Practice Dispositions	19

## Forward

### A note about the uses and value of this document.

Any document such as the Standards and Practices requires periodic updating as times change. Even though the original (2010) version was solid and useful, this version has been readjusted and brought up to date to make it easier to use.

This document serves as a reference and guide to be used as the default minimum quality to be reached every time a product is serviced. It was developed to help apprentices grow their skill sets, bench professionals to become masters, and to encourage seasoned clockmakers to include watch work in their skill sets. It is the goal of AWCI to continue its mission to help all horologists grow their skill sets to help maintain the history and operational quality of the clocks on which they work. The Institute encourages all bench professionals to strive to master all these skills, then apply them to AWCI's 21<sup>st</sup> Century Clock Examination Program to demonstrate to their clients not only their qualifications but also their practical achievements by certifying through peer reviewed testing. You are urged to review the 21<sup>st</sup> Century Clock Certification programs by contacting the Clock Director at AWCI (1.866.367.2924 or [clocks@awci.com](mailto:clocks@awci.com)).

## Preface

Putting together a set of standards and practices is not an easy task. I applaud the work done here by the Education Committee.

Establishing a set of standards is important in any field, perhaps even more so in clock repairing. Much of our work revolves around timepieces for which there are no factory guidelines to follow, no factory schematics or oiling charts, no field service manuals with the proper steps and procedures recommended for a particular product. Our only previous reference was the knowledge and materials left behind by our past expert members and the little bits of information that have been found from manufacturers now gone.

By developing a set of well documented Standards, we have a measure for judging our methods today and in the future. We can use these to appraise ourselves. Am I using the best methods the correct way? Where might I need additional training? As doctors are sworn to do, so should we first, do no harm? We are stewards of the products that we work with. We must see to it that what we do is best for both the client **and** the clock. Some methods may be faster, but are harmful for the long-term survival of the clock causing more expense to the client and more work for future repairmen.

For the individual, these standards give one an indication of what level of skill they need to do quality work, and also what they need to do to improve themselves. For AWCI, these standards give us guidance in what types of courses we need to provide for our members to insure that needed skill information and technology are always available. As the premier professional organization for Clock and Watchmakers, our goal is to help all of our members reach the highest level they are capable of and thus be more productive and more financially secure! For the amateur (one who does it for the love of it and not the money) reaching for these levels is personally rewarding. Even if you only repair your own clocks, you want them to be repaired properly.

AWCI hopes that all members will aspire to grow and develop their skills, whatever their level, and strive to become the future experts that help our organization continue on its mission.

Jim Door, **President, AWCI**

**August, 2010**

## **Acknowledgments for August 2010**

Setting standards is perhaps the most difficult challenge that a skilled craft can do for itself. It involves the efforts of many who have the tenacity to work through this type of chore and see it through to the end. In its mission statement, AWCI has dedicated itself “to preserving and promoting the highest standards of workmanship in the horological crafts. It is the role of AWCI to set the standard of excellence to be applied to the quality of instruction for both the repair and restoration practices that are taught worldwide to watch and clockmakers.” It is through perseverance, commitment, patience and cooperation that this document has arrived at its current form. As the craft and the organization evolve, so will this document. We entrust the safekeeping of these standards to the AWCI membership and its Board of Directors to maintain it. I wish to acknowledge the following, however, for their help in bringing the document to this level today. It is through their sacrifice that this document stands for the quality that is the hallmark of our organization.

### **Education Committee:**

Jerry Faier, CMC/AWI, Chairman; Michael Gainey, CC/AWI, Clock Section; Chair, Brien K. Dews, CC/AWI; John Bryant, CC/AWI; Mark Baker, CMW/AWI; Wes Cutter; CC/AWCI.

We also want to thank others that have helped us with suggestions and considerable knowledge.

Mark Butterworth, Butterworth Clocks; Peter Lickl, Black Forest Imports; Jim DeRosier, Empire Clock; JK Nicholas, Chelsea Clock Company; Robert Macomber, CMC/AWI; Jim Riggs, CC/AWI; The Howard Miller Clock Company; Helmut Mangold, Hermle Clocks; Paul Hoffman, Ridgeway Clocks.

## **Acknowledgements for August 2021**

### **BOCE members:**

Jerry Faier, CMC21/AWCI (FAWCI) Chief Examiner; Michael Gainey, BOCE member and CC21/AWCI; Brad Wellmann, BOCE member and CC21/AWCI; and Mike Carpenter, CC21/AWCI--Clock Director.

### **Clock Education Committee:**

Nicholas Butt, Chairman; David Lindow; Ken DeLucca, David LaBounty, CMC/AWCI, FBHI; David Morrow, CC21/AWCI; John Bryant, CC21/AWCI.

**Also, the dozens of others who took their time  
to help us complete our mission!**

# AWCI's Standards of Excellence

The standards of performance expressed in this document represent the knowledge, skills, performances, and dispositions required of the clockmaker of the 21<sup>st</sup> century.

“KNOWLEDGE” refers to the content or body of information pertinent to the modern practice of horology. In other words, what should a modern clockmaker know?

“SKILLS” refers to the demonstration of the knowledge through various types of performances. Whether we speak of replacing a pivot, resetting a depth using a bushing, cutting a custom bushing on the lathe, researching information for a historical restoration, or tempering steel, we are referring to what a clockmaker must be able to do with this knowledge.

“DISPOSITIONS” refers to the exhibition of a behavior of professionalism, and addresses such topics as ethics, attitudes toward quality of service, cleanliness of workplace, and attitudes consistent with a high degree of professionalism.

In this document, the term “PROFICIENCY” is used quite often. This is a general term used to itemize or “detail” (break into smaller components) a specific standard, and frequently will involve the combining of knowledge, dispositions, and skill demonstrations in a single statement. One might think of the proficiency statements here as expressions of what a clockmaker should “know and be able to do in a skillful and competent manner.”

As an organization that professes to bear the highest standards for clockmaking 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.

# **Essential Performances for All Clockmakers**

The Education Committee recognizes that there may be several scenarios that can be used to define what procedure may be the correct one to follow in a given situation. As such, the clockmaker's dispositions and skills are what create these options. It is the goal of the Standards and Practices to set the "default" guideline in any situation where another option is not a clear or precise choice.

## **On the issue of replacement:**

When it is determined that to implement a "successful" repair, a replacement movement is the best course of action (given customer needs, historic considerations, structural changes needed, and/or costs), it is AWCI's expectation that a movement of like kind and configuration will be the product used. It is considered inappropriate to replace most clock movements which were manufactured before 1970, after which the aggressive use of plated, leaded steels became common. It must be remembered that AWCI members holding certificates are "stewards" of horology and horological history. As such, they are obligated to strive to maintain the integrity of the original manufacturer's intent.

## **General Movement Service (GMS):**

"General movement service" refers to the complete disassembly and servicing of each component of a timepiece by the Clockmaker. This was once referred to as "putting a clock in good running order (GRO)," or "performing an overhaul." Clockmakers of the 21st Century are aware that during this new age we must make a differentiation among "repair," "restoration," and "preservation/ conservation."

"Repair" services to clocks succeed in making the piece function effectively. This is done in an ethical and workmanlike manner. However, "repair" may NOT refer to the concept of "restoration" which implies returning a timepiece COMPLETELY to its original, as new, condition (save the use of bushings, new pivotal material, and other additions/replacements as needed to return the design to its original intent). To the extent possible, 21st Century Clockmakers endeavor to accomplish restoration to "original specifications" in their repairs, but with the caveat that complete knowledge of all the history of the original design and materials may not be known or completely determinable. It is, however, incumbent on the repairer to avail him/herself to study and learn as much of this history as possible!

**The critical function of performing true restoration and preservation/conservation of timepieces of all types is the ultimate responsibility of horologists AWCI has certified as Certified Master Clockmakers, (CMC21), and to Certified Masters of the Institute (CMI). These must be the individuals to whom the stewardship of horological knowledge, skills and practices, must fall. It is hoped that all clockmakers will aspire to these levels of professional attainment.**

AWCI members holding certificates are "stewards" of horology and horological history. As such, they are obligated to strive to maintain the integrity of the original manufacturer's intent; when repairs are complete, perform items in Section 1.) A-D above (page 12).

# General Movement Servicing

It is important for all clockmakers to recognize that all clocks in need of repair do not require a full GMS as described below. However, when a clock movement becomes excessively dirty or is worn to a point where a GMS is needed to return the clock to a state of reliability it is the recommendation of the AWCI Clock Education Committee that all Clockmakers adhere to the following list of practices as set forth by expert horologists in concert with members of industry and business. It is these standards which are used in education, assessments, certifications, and ongoing bench practices.

## **General Movement Service (GMS) consists of:**

- 1.) The full disassembly of the movement before cleaning, removing all levers, cams, etc. for proper service work to be completed on each piece is imperative. Any marking that should be deemed necessary should be as unobtrusive as possible.
- 2.) All parts should be cleaned before work is begun to expedite inspection and review of needed repairs. The use of technologically appropriate techniques and equipment in light of conservation or manufacturing recommendations is preferred. Care should be taken to maintain the quality and integrity of original lacquer coatings when present. (Simple procedures – such as “spray” or “dip” for removal of surface contamination are **not** considered acceptable on their own as a **GMS** for assembled movements.)
- 3.) All shafts should be reviewed for truth in reference to their pivots and straightened as needed. Care should be taken to prevent surface marring during the straightening process.
- 4.) All pivots should be returned to their proper original shape, free of any rutting and gall marks, and burnished brightly. A properly burnished pivot will have a square shoulder, uniformly cylindrical shape (except for such examples as the old Black Forest Cuckoos—see page 16) and a mirror like finish with no scratches visible to the naked eye and almost imperceptible under a 3X loupe. Burnishing is the process of using an oiled, hard polisher that renders the finish bright **without** the use of polishing media. In cases where the pivots are hardened, bright polish is acceptable. Polishing a hardened pivot assumes the use of various abrasive media. Extra care must be taken to ensure that **none** of these media get back into the movement bearings and destroy the entire movement. Shafts with pivots worn beyond acceptable tolerance (beyond structurally safe limits), or broken, should be re-pivoted to the character of their original construction, design and material quality. Care must be taken to maintain the original shaft length. This is a measurement from shoulder to opposing shoulder or the length of the shaft not including the length of the pivots (i.e. distance between the plates minus the needed end shake).
- 5.) All pivot holes must be checked to ensure they are both round and smooth and to determine that they maintain the correct depth with the wheels that turn in them. If the holes do not conform to these requirements, friction bushings are the product recommended for repair. Ideally, bushings should be of the same material and hardness as the original plate stock. Where exact heights are not available, the bush should be cut down so that the pivot clears the bushing hole at both extremes of endshake. (Due to the limited availability of bushings of differing brass composition and hardness, brass bushings should be used in

brass plates and bronze bushings when replacing bronze bushings.) When pivot material is of poor quality (i.e., leaded, nitrided, plated or soft steel), bronze bushings may be the best choice for repairs. All pivot holes should be burnished to brightness with an oiled smoothing broach.

The hole that is reamed to receive the bushing should be chamfered on both sides of the plate to reduce the presence of flashing which can throw the bushing off center or tilt it. The bushing should be pressed or tapped into place, maintaining the plate's appearance, without damaging either the bush or the surrounding plate finish. Once the pivot hole is broached to size, the hole should be burnished with an oiled smooth broach (like the other holes) and a proper oil sink cut to match other oil sinks on the plate. **Soldering, prick punching, add-ons, or screw-in technologies are *not* acceptable practices for the resizing or repositioning of any bearing hole.**

6.) Hole Closing:

This is a practice with a long history in clock repair. Using special punches or a sharp pointed punch to close a worn pivot hole is an unacceptable practice. It is also a practice, which has led to severe and frequent abuse of precious timepieces by unskilled or unknowledgeable repair persons. **As such, AWCI does not endorse this technique.**

- 7.) All wheels must be inspected for proper tooth spacing (i.e., all teeth are straight and have equal spacing), flatness, and shape, and corrected as required. Fit of the wheel to its hub or shaft should be tested for security. Should there be a need to replace one or more teeth, the replacement piece(s) must be of similar material, shape and character as the original. There should be no scarring of adjacent teeth to the repair, and the repair should be as invisible as possible to the finish of the rest of the wheel. Large visible gaps filled with solder are not acceptable! The use of solder to lock in a close fitting replacement is acceptable. If a wheel/pinion needs to be remade for any reason and it is sent out for the work, it is recommended that the tooth count, outside diameter, root depth, tooth width and general ogive shape (tooth addendum) be recorded.
- 8.) Pinions must be clean and true, and their leaves straight. In the case of lantern pinions, all collars should be tight to the arbor. Lantern pinion leaves, worn beyond acceptable tolerances, should be replaced with new stock of similar quality and hardness to the original. In most cases hardened steel wire is not used as it may cause excessive teeth wear. All wires replaced must be corralled in their collars (i.e. can't be pulled through) and wire holes should be preferably staked rather than held with bonding agents or solder. Care should be taken to maintain the original collar placement and security. If loose, resetting to the shaft by knurling is the preferred technique.
- 9.) Escapements should be set to their original design. When pallets are worn or rutted it is preferable to recondition them rather than repositioning them. The least amount of material should be removed and then return the proper drop, lock and lift angles taking into account case width, pendulum mass, and original manufacturer's design. The pallets (specifically their lock and lift faces) should be finished to a mirror bright polish.
- 10.) Mainsprings should be removed, cleaned, scrubbed thoroughly as needed, and examined for any visible defects or modifications that would require their replacement or re-ending. If the spring is acceptable, then it should be properly lubricated and reinstalled using appropriate and safe methods. The mainspring should be the correct length, width and thickness for a given movement design. All the coils of a spring should be flat and in



the same plane. Returning a “telescoped” mainspring back into service is not acceptable. Barrel pivots and pivot holes are to be treated as #4 and 5 (above). Arbor endshakes must also be maintained. Barrel and arbor hooks should be checked to be sure they are in a sound and secure condition. If not, they must be retightened securely before the serviced spring is reinserted. The barrel cap fit to the barrel sleeve must also be carefully checked and corrected/tightened if it can be pushed out easily with hand pressure against the arbor. If the inside spring hook hole is torn it is recommended that the spring be replaced.

- 11.) The entire ratchet assembly must be examined for proper operation. Loose, weak or cracked click springs must be repaired or replaced. Loose click rivets or screws must be corrected by proper staking or replacement. The working faces of the click and ratchet teeth must be free of ruts and burrs, and resurfaced or replaced as needed for proper fit and alignment with the click wheel. Winding squares should be dimensionally uniform. Where multiple arbors are present, their squares should be examined for similar shape and size so that a single key or crank will fit them all properly. If a significant difference is observed, squares should be dressed to an equal size and shape and a new key/crank issued to the customer. When the square becomes too small for structural safety, a new arbor should be made.
- 12.) Levers and pins should have all rutting/roughness removed from their work faces, and readjusted to proper, safe design and action levels. It is recommended that surfaces that slide over other levers or pins be burnished for smoothest operation. When return springs (thin wires, coil wires, or pin springs) are present or required, they should be of the lightest gauge and tension to ensure the proper operation of the levers.
- 13.) Any replacement components should be constructed of materials and finished to match the character of all other movement pieces as close as possible. The original intent of the manufacturer and considerations of safety for the movement are key points to keep in mind when replacing or remaking any part.
- 14.) All parts should be re-rinsed, prior to reassembly, to insure cleanliness and the removal of any surface contaminants resulting from restoration operations.
- 15.) All pivot holes in plates and collars should be “pegged out” (or suitably cleaned) and carefully blown out to insure the removal of any residue from the service work and cleaning solutions.
- 16.) After movement reassembly, no new finger or tool marks should be visible. Any pre-existing coloration or tool marks may be left as found. Any use of date codes or identification markings should be made as unobtrusive as possible.
- 17.) Appropriate types and amount of horological quality lubrication should be applied to all wheel and anchor pivot points, hammer arbor pivots (where the hammers are pivoted through the plates—**NOT** on a single arbor with multiple hammers), pallet faces, and hammer tails only. Cam faces where lever arms rest and the points of interaction where levers, pins etc. slide against each other should also be lightly lubricated. Lever arbors should in NO case be oiled. When dealing with new products, consult the manufacturer’s recommendations.
- 18.) In striking or chiming movements, the stop, start, and warning actions should be set to the correct position and lever action adjusted as needed to insure the best conservation of power. In count wheel/lock plate movements, there should be sufficient clearance (~0.010” or 0.03mm) between the stop pin and the stop lever when the count arm is on

one of the shallow notches. The same clearance amounts also hold true for rack and snail warnings. At the stop, the pin/cam controlling that motion should safely lock the train's action while allowing easy release to warning without causing the train to back up. All hammers should be in a *rested state* when the gear train is in warning or stopped position. Hammer leathers, pads and inserts should be free of perforations and deterioration, and replaced as necessary with similar materials as original.

- 19.) As assembly is continued, recheck escapement drop, lock and lift and adjust as needed.

**NOTE 1:** Platform escapements require special handling. The entire mechanism should be disassembled, any cap jewels removed, the balance and hairspring removed from the balance cock, and all pieces treated as above—i.e. cleaned with appropriate technologies, pivots polished, jewel holes carefully pegged clean and cap jewels scrubbed and examined for pitting. Any pitted or worn cap jewels should be either replaced or reground and polished to return the working surface to its original quality. Worn or cracked hole jewels should be replaced, taking care to determine the proper hole size after polishing the pivot that rides in it. All parts should then be re-rinsed, dried, reassembled, oiled and adjusted to run and rate properly. High quality watch oil is the preferred lubricant to use on jeweled bearings. Care should be taken to see that the correct amount of oil is introduced onto the escapement as well as into those pivot jewels with caps before the caps are reinstalled.

**NOTE 2:** Since the platform escapement is in essence the escapement of a watch, special education for this type of device is essential! It is incumbent on the clockmaker who does not possess the necessary skills and knowledge to service these types of pieces to refer them to someone who does. For example, an AWCI Certified Watchmaker, Certified Master Watchmaker or Certified Master Clockmaker as well as the 21stCentury CMC who is required to show all the knowledge and skills necessary to successfully deal with these types of devices.

- 20.) Suspension parts should be true and appropriate for the type of movement.  
Suspension springs must be unbent and properly fit. Suspension loops should be free of ruts and well polished or remade/replaced. If regulating chops are present, they should be adjusted to fit the suspension spring properly for best action and timing adjustment. Suspension posts should be secure and square to the plates and fit the suspension spring closely but not tight.

- 21.) The casement is to be stable and solid. It must be free from any motion or articulation, and dust free inside and out. Gongs, bells and chime rods should be securely fastened to the case and tightened as needed to obtain the best sound. Hinges should also be checked for security and proper door/bezel alignment, and adjusted as necessary. Glass/tablets should be carefully cleaned and checked for security. Extra care should be taken **not** to remove chipped decals, gold leaf or painted designs from the glass or case.

- 22.) The movement must be securely fastened to the case. Where screws have been stripped in their holes or refuse to grab securely, the holes should be filled with glued plugs of the same type of wood as the case back. Then, the correct size screws reinserted rather than using larger screws. If screws have been or must be replaced, they should be of the same type and size as the original, and appropriate to the age of the clock. When taper-pins are used anywhere in the clock, their ends should be dressed for the safety of the customer and future clockmakers.

- 23.) All movements must be test run and be able to be adjusted to a minimum accuracy  $\pm 60$  seconds/day for 30-hour products;  $\pm 2$  minutes/week for general mass production 8-day products including mantel, wall and floor clocks;  $\pm 15$ -20 seconds/month for Atmos clocks and  $\pm 15$ -30 seconds/week for better quality regulators. When a clock is regulated for accuracy, the rating assembly should **not** be set to either extreme of its travel but as close to center of adjustment as possible.
- 24.) Dials should be gently cleaned of dust/debris. Although there are special sealants to stabilize a flaking dial or tablet, it is recommended that this work be referred to a dial specialist.
- 25.) The hands must be properly formed and parallel to both each other and the dial. Release of the strike/chime should occur on or slightly before the center of the 12 o'clock mark. When recoloring is needed, it should be done in a technique to match the original character and color of the original product.
- 26.) As part of the final return process of the product to the client, it is the clockmaker's responsibility to instruct the customer on the manipulation of all the movement's features, and the need for further servicing to maintain the work performed. Client education should include at least the following information:
- A. Not transporting clocks, even for short distances, with the pendulum attached or unlocked unless the movement provides for this action.
  - B. The importance of level and secure placement of the clock to maintain proper beat. Explain the 'beat' concept and how they are to achieve it with their product.
  - C. Moving the hands to set the time. I.e. can they be turned backwards without damage?
  - D. The synchronizing of the strike/chime sequence(s) to the hand position; any correction mechanisms; night silence; chime selection levers; etc. that are built into their movement.
  - E. Adjusting hammer position to achieve the desired sound the customer prefers.
  - F. Regulation of the timekeeping and what level of performance to expect.
  - G. Case care and cleaning instructions as well as care of printed/stenciled glasses.
  - H. Any accessory features: Moon Dials, Calendar, Alarm setting, etc.
  - I. Proper winding to help the customer avoid the 'spring snapping' syndrome and damage to ratchets and clicks, etc.
  - J. Conditions of the warranty including what is and is not covered.
  - K. Specific problems inherent to the client's product, i.e. air motion with exposed pendulums, hand 'turn-back' features, etc. which could create problems for the clocks operation or disturb the strike/chime sequence and how to correct it.

## Specific Standards of Practice for all Clockmakers in the performance of In-Home Servicing of Clocks:

- A. Review with the client the current operational symptoms of his/her timepiece.
- B. Examine the clock to gain additional information.
- C. Discuss service options with the client.

### I. In-Home Service Options:

#### 1.) Set up, Adjustment:

- A.) The case should be stabilized solidly and shimmed (or adjusted with levelers if present) as needed to insure that when movement is running or wound, the case will **NOT** move. It is recommended that the case be stabilized against a wall or wedged in a corner of a room if at all possible. If necessary to aid in avoiding interaction of the pendulum, chime rods or tubes, use wood strips taped to the clock back to push it upright. Due to top heaviness of the clock cases, any motion of the case can lead to the liability of the clock tipping over, or at the least, poor performance or stoppages due to sympathetic vibration (i.e. power going to the case rather than the pendulum). When a situation is encountered that renders total stability not possible, it is the clockmaker's responsibility to ask the client to release him/her from any liability due to the unstable circumstance in which the clock exists, or decline the job. Remember, safety is **your** responsibility!
- B.) Once the case is stabilized, the rest of the clock is to be assembled as required and checked out completely to be sure that all functions are operating as designed. The dial, moon dial, movement and suspension are to be checked out for proper functions and alignment. The chime and strike hammers are to be adjusted to the best quality sound the clock can produce, making minor adjustments to accommodate the desires of the client. The Clockmaker must also check the operation of all levers to be sure that the action of the movement is at its best.
- C.) Adjustments to be reviewed with the client may include:  
Hammer adjustment, beat adjustment, suspension spring replacement, moon dial index spring adjustment (if present), hand adjustment for release of the chimes at or slightly before 12, setting the time, manual synchronization as well as how the clock synchronizes itself, winding and how far to wind the clock (including stop-works if present), chime selection (as well as night shut-off and total silencing of the chimes) and when to move the selector without detriment, fast/slow rating adjustments, and general care of the clock's exterior and glass. Lastly, further maintenance procedures and intervals should also be discussed with the client as well as any warranty information provided by the Clockmaker and/or the manufacturer.
- D.) The client **should** be educated about all the features of their floor clock and the management of all non-warranted adjustments before the Clockmaker leaves the job.

#### 2.) Minor Repair and Adjustment:

Minor repairs or adjustments are those that can be safely made in the client's home without disassembly of the movement or cabinet. When repairs are complete, perform

items in section 1.) A-D above (page 12).

3.) **Oil and Adjustment:** Procedures should include the following:

- A.) Remove the hands, dial, and etc. from the movement and the movement from the case. Any residue from the old oil should be pegged/picked out and wiped off as completely as possible from inside (with artist type brushes) and outside the movement, including both plates, wheels and pinions. The pivots should be re-oiled with lubricants that are similar to the original manufacturers or that are the current recommendations of the manufacturer. This type of procedure is based on industry recommendations for movements that are within 10-12 years of original manufacture and show very little build-up of residue. (It may not be appropriate for vintage or antique clocks or clocks which show a large build-up of residue or debris. In these situations, general movement servicing (GMS) would be the preferred choice.)
  - B.) Check the operation of all levers and cams to be sure that the action of the movement is at its best, given its age and wear. The moon dial (if present) should be checked and serviced as needed to insure the smoothest and easiest operation as possible of the gears, lift levers or cams. It may be necessary to adjust the tension and/or the position of the moon dial index spring so that the gathering pin engages the flank of the moon gear tooth, and the dial advances easily with little resistance. **NO OIL IS TO BE USED ANYWHERE ON ANY MOON DIAL.**
  - C.) Reinstall the movement and other items that were removed. When repairs are complete, perform items in section 1.) A-D above (page 12).
- 4.) **Rinse/Peg out, Oil, Adjustment:** When the build-up of unwanted debris is evident in pinions and against pivot shoulders and oil sinks, the use of small amounts of rinse solvent along with aggressive brush and peg-out techniques can be used to improve the environment for the new oils. The use of artist brushes to brush off old materials from pivot shoulders and oil sinks is very useful. It is important that careful consideration be given to the need for GMS of the movement if the debris is hard or difficult to remove. If so, it is better to inform the client that “**General Movement Servicing**” is a more appropriate choice (See pp7-11). It is not recommended that movements be submerged in solvents or cleaners in a client’s home. Clockmakers, who follow the above procedure while using careful application of ANY cleaning materials, must insure that these materials are dried out of the movement before any oiling is undertaken. When repairs are complete, perform items in section 1.) A-D above (page 12).

**Warning: AWCI highly recommends that on ALL in-house calls where solvents are used, the clockmaker should incorporate a close review of the above techniques, especially safety concerns, such as fume and odor risk to the client, and related issues.**

5.) **Packing for a move:** In general the following procedures should be followed before moving a clock any distance.

- A.) Remove the weights and secure the pulleys with Styrofoam pulley supports in an effort to keep the cable from tangling/coiling over itself on the cable drum, or coming unhooked during shipping and scratching the case. Chains should be tied together with binding wire, bagged and taped to the seatboard to keep them from falling off the sprockets or scratching the case. Chains may also be wired together near the

sprockets and the ends secured with rubber bands to an “L” hook in the base of the case for shipping. Wrap and pack weights, separating them from each other to protect them from denting, scratching or tarnishing. Never touch brass with bare hands! Be sure to check to determine if the weight slugs are loose in the shell. If so, packing material should be used to keep the slugs from moving back and forth in the shell during shipment and denting or distorting the shells.

- B.) Check the tightness of seatboard screws and movement mounting bolts/screws.
- C.) Remove the pendulum and secure the leader. The use of any kind of tape to secure a leader is not recommended. The use of a rubber band or spring strap is preferred. Insure coverage of the pendulum disc to protect it from scratching, and pack entire pendulum securely to insure it does not get bent, twisted or dented. Mercurial pendulums require special handling. Contact AWCI Central for the names of experienced professionals who can guide your efforts to pack this type of pendulum. Mercury spills can require hazmat involvement.
- D.) Block up the chime rods securely to eliminate individual rod motion. It is recommended this be done with cardboard or hard Styrofoam which is cut or punched to keep the rods in their *original* alignment. Taping chime rods together is not recommended. If chime tubes are present, they must be removed, individually wrapped, and packed as a bundle, securing the entire bunch, then boxed. A notation of tube order should be given to the customer or left in the box to help with reinstallation. Tubes are always handled with gloved hands.
- E.) Hammers should be secured to eliminate their movement during shipping without the use of tape. Rubber bands (the manufacturer’s choice) will work well for this purpose. The rubber band is caught under the outside hammer heads of one side then pulled over the chime block and attached under the other set of hammer heads on the other side to hold all hammers together. Should the hammers all be on one side, a piece of cardboard or Styrofoam can be slit to hold the hammers as a unit.
- F.) Side panels, when present, should be secured to ensure they do not shake loose or fall out during shipping. Wedging a small piece of Styrofoam sheet between the side panel and its top will keep it in place during shipping. Any interior glass shelving or glass side panels should be removed, individually wrapped, and packed separately (boxed) for careful handling. When side panels are removed, the clock should be appropriately sealed (with consideration to the finish) to keep out dust and/or debris for any long-distance moving or storage. Use of a band made of newspaper to help secure the door(s) from coming open during shipping may be necessary. The band should go around the entire cabinet at the level of the door lock and be secured by wrapping packing tape around the paper band holding the paper and securing the door. Never apply tape directly to the finish on a clock.
- G.) Wrap accessories (crank, door key, finials etc.) separately to protect them from damage, but pack the lot together in their own box and label the outside with the contents. Oftentimes, it is better to tape the door key to the front door glass if there are no other pieces to secure.
- H.) Where door or bonnet security is questionable (or to insure that neither will spontaneously open during a move), it is recommended that a newspaper band be wrapped around the clock body or bonnet as described in “F” above. If the bonnet cannot be secured to the clock body, it is best to pack it separately for the move.
- I.) Where the movement age, weight, or quality dictates, individual packing of the

movement may be necessary. It is recommended that a piece of paper be inserted between the dial and the hands to prevent scratching of the dial. Secure the paper by taping to the back of the dial. The movement, with its seatboard and dial, should be bagged or sealed to prevent the entry of dust and dirt before final packing. Next, the entire dial with the movement is floated in its own box of Styrofoam for protection during shipping.

- J.) Raise any leveler feet, if present, into case to protect them from damage during the move. Be sure to include any other written instructions that may be relevant to their specific clock to facilitate re-setup at its final place.

## II. “Out of Home” Service:

- A.) On the issue of movement replacement (see page 6):

1.) When it is determined that to implement a “successful” repair, a replacement movement is the best course of action (given customer needs, historic considerations, structural changes needed, and/or costs), it is AWCI’s expectation that a new movement with the same quality, size and functions be used if an identical replacement cannot be found. Any new movement must be thoroughly mechanically reviewed, reoiled as needed, and adjusted to be sure that all movement actions are proper, any parts required from the old movement are serviced and reset to the new movement and the clock’s timing is adjusted within specs and is easily adjustable by the customer. In modern manufacturing and shipping of movements, problems can show up (right out of the box) and must be *corrected by the clockmaker* before resetting the movement back in its case. Also, AWCI does not recommend the replacement of clock movements manufactured before 1970, unless there is no suitable alternative. Many German movements after this period used leaded, plated, steel which showed rapid wear of both pivotal materials as well as movement levers once the plating had worn. This circumstance also left plating materials in the bearing holes. If a movement such as this is to undergo GMS, it is recommended that these problems be accounted for and extra care be taken to insure product quality and durability once the work is completed.

2.) If the manufacturer is no longer in business and the movement is after 1970, the movement will need to be put through General Movement Servicing. It is recommended, however, that both pivots of the main wheels through 3<sup>rd</sup> wheels (as well as any other wheels whose pivots have caused excessive bearing hole wear) may need to be repivoted to ensure the durability of the service work performed. Additionally, bronze bushings may also be necessary to give longer wearing bearing surfaces.

3.) When repairs are complete and the movement ready for reinstallation, perform items in section 1.) A-D above (page 12).

- B.) Cabinet Repairs: Protect the movement from dust and debris. When cabinet repairs are complete, perform items in Section 1.) A-D above (page 12).

- C.) Pack, Move and Setup: See section 6 above (a through j) and perform items in Section 1.) A-D above (page 12).

- D.) When work suggestions or estimates *are refused*, refer to number 9 below in “Shop Practices and Dispositions” (page 19).

- E.) Client Education: When performing any type of in-home “set-up” such as listed above, either “in-home” or after shop procedures are completed and subsequent “at-home” client education is needed, refer to and follow GMS section #26, A-K

above for guidelines.

## **Additional Standards of Practice for Specific Types of Clocks:**

**400 Day and Torsion Clocks:** In these clocks, it is critical that the mainspring, suspension spring and the escapement are carefully set to the original manufacturer's specifications. Escapement action is the key to their timekeeping. For example, the rotation for pendulums of most 400 day clocks should not be less than 270° and there should be NO "flutter" of the escapement as it operates.

**LeCoultre "Atmos"** clocks differ from the "typical" 400 day clock and require that factory specifications be followed **exactly**. (See factory technical booklets: Vacheron & Constantin-LeCoultre Watches, Inc. 1952. "How to Repair the Atmos Clock." Jaeger-LeCoultre. "Repair Notes" for each caliber. Also, Jaeger, G.G. 1992. "Repairing the Jaeger LeCoultre Atmos Clock, Caliber 540. AWCI Horological Times, May-August.)

**Cuckoo Clocks:** These timepieces require efficient conservation of power and ease of action of all movement parts. Lift and release levers should be adjusted for the least power use. In any bent wire system, it is critical for any wires that contact each other to do so at the best mechanical advantage angles with the least power demand. "Jerky" motion is an indication of improper adjustment or wear. Even minor wear in the suspension loop requires the replacement of the loop for best pendulum action. The bird door should not 'flutter or slap' when the cuckoo is activated. The door should open smoothly and stay open for the duration of the cuckoo action and then close sharply. On those movements with count wheels, the count wheel lever also affects the opening of the bird door. This lever must be adjusted to minimize door bounce. In reference to pre-1900's movements (the ones with the heavy cast plates), the outside diameter of the pivots were intentionally made slightly barrel shaped rather than cylindrical. Due to the heavy weights and the movement mounted by its front plate, there is a tendency for the plates to shift slightly during winding and over time. With this shape, the pivot will not bind in its pivot hole.

**With music addition:** In general, music movements should produce minimal extraneous noises (buzzes, clicking, etc.) and show smooth action during play. Attention to the governor's action and smoothness of operation is critical. Gear to pinion depth between the governor and the pin barrel main wheel is critical and must be set for the smoothest operation. The release levers must be set with the best mechanical advantage and with least power demand. Any denting or wear of operation levers should be corrected to insure smoothest action. Comb dampers should be present and properly positioned to insulate the action of the comb tooth before the barrel pin (nub) plucks the tooth. Buzzing and clicking of the music as it operates is *not* acceptable. If this occurs, new dampers should be installed as needed.

**Striking and Chiming Clocks:** In such clocks, it is critical that the warnings be set with the hammer action in mind. No hammer action or motion can occur until after warning is complete and the train is released for action. The balance between hammer action and power use is to be carefully adjusted to give the best sound and performance as possible for a given mechanism.

**Chiming Clocks:** Not all chiming clocks utilize the same hammer arm sequence in chiming. Careful notes must be taken before movement disassembly to insure that the proper sequence is retained when the clock is returned to service. In all cases, the hammers must be



set to make the best hit of the rod/tube/gong that results in a clear sound without muting or rebound (stutter). If the hammer faces are leathered, they should be re-leathered as needed to avoid “metal against metal” and the resulting “metal on metal” sound. All levers require close inspection for ruts and rough spots. These marks must be smoothed out and burnished, then reexamined for proper lift/functioning. Also, like striking systems, no hammer lift should occur until after warning is complete.

**Vienna Style:** Many Viennese and Vienna-style movements (and other movements such as some French carriage clocks) exist without warning mechanisms and require special care. Due to a need for the train to get up to speed before any hammers are raised, it is critical in assembly that attention be paid to the position of the hammer lift tab with regard to the pin/tab that will raise it. Here, the most ‘run’ of the train that is possible before hammer lift is preferred.

**Carriage Clocks:** Many of these are set similarly to Vienna style movements to aid in the efficiency of the striking action. Here too, care must be taken that 1.) The escapement platform is cleaned and serviced as if it were in a watch movement (The platform should be treated as described in Notes 1 and 2 after #19 page 10, in the General Movement Service.) and 2.) The tension springs on all strike levers should be set with the least amount of tension necessary for them to perform their intended operation, with their working surfaces smooth and free of wear/ruts. If there is no warning pin/lever arrangement, then it is critical that the train get up to speed before hammers are lifted.

**Ships Bell Clocks:** Ships clocks have a unique strike sequence and often have a unique method for counting those strikes. Both rack and snail and count wheel types are well known in addition to special locking devices for the count of half-hours. The clockmaker must be familiar with any and all of these actions before any disassembly is started. It is recommended that drawings and notes be made before disassembly is done. Again, familiarity with platform escapements is required here as well. See Notes 1 and 2 after #19 page 10 in General Movement Service for specific points.

**Fusee Clocks of all types:** Extra attention must be given to the chains or cords that are used on the fusee. The chain must be cleaned, oiled and inspected for rusty, stiff, broken link pins or worn links. These defects should all be corrected before the chain is reused and the hooks, their pins, and barrel hook holes inspected and repaired as needed for safety. Cords should be carefully inspected and replaced if any indication of wear or fray is suspected. Also, due to the size of fusee mainsprings, extra care must be used when servicing them to ensure the safety of both the product and the clockmaker.

**Electric Clocks of all types:**

- 1) The goal in the repair of AC voltage clocks should be to reduce all possible stress from the time, strike and chime trains and their levers. Tension springs should be set to a minimum pressure to insure that the actions of these levers perform smoothly. Motors and rotors should be thoroughly cleaned and serviced. Where the clockmaker is not equipped to rebuild a motor or rotor, this should be completed by a specialist whose work will be done according to high standards and who will offer a warranty.
- 2) The repair of DC voltage clocks (not quartz fit-up movements) requires a solid working knowledge of the construction and operation of “flutter motors,” and related “rotor type” winding mechanisms. It also requires knowledge of wear problems associated with the use of contact points in a circuit and how to restore and adjust these points. In such clocks, it is imperative that current consumption be kept as low as possible, consistent with the minimum voltage required of the original design. Increasing the voltage applied is **not** a

recommended or an acceptable method of correcting a circuit or contact problem!

### Wooden Works:

Regardless of the country of origin, wooden works timepieces require special care including, but not limited to, the following:

- 1.) All pivots should be set as true and centric as possible, with regard to the wheel and pinion on the shaft, and burnished as usual.
- 2.) Wheels must be reviewed for roundness as well as tooth spacing and structural soundness. In clocks with wooden wheels, it is not uncommon to encounter wheels with as much as 0.025" to 0.030" variation of diameter along the circumference of a given wheel. The key to successful repair is to be sure that wheel to pinion depthing is safe at all points in the rotation of the wheel. If not, slight rerounding (as much as 0.010") followed by relocation (redepthing) of the pivot hole, may be necessary to restore proper action.
- 3.) In American wooden movements, when bushing of holes is necessary, the material of choice should be doweling which is made from the same kind of material (wood) as the plates of the movement. (Note: In those cases where Ivory bushing material was originally used, either wood doweling similar to the plate material or deer antler, taken from the antler tip, should be the choice for replacement material. These bushings should only be installed in those places in which they were originally used and shaped as the original.) Where a brass strip is used to support a wheel pivot (e.g. the escape wheel bridge), a brass bushing is preferred and that bushing is to be treated as usual. Pivot holes should be burnished with a wooden stick (toothpick or pegwood) after the hole is correctly sized. The use of metal bushing materials in American produced wood plate movements is **not** recommended unless this was the original bushing material as stated on *the clock's original label*. When no label is present, default to the use of material similar to the plates. Due to the tradition of using metal inserts in wood plates in European movements, using similar materials and/or techniques to what is presented will result in less movement damage, rather than total removal and plate rebuilding with similar wood materials. Keeping the repairs similar in character to the original manufacturer's intent is always the preferred choice.
- 4.) Damaged wheel teeth should be replaced with a similar wood material as the original (commonly American Cherry in USA made wooden works). Care should be taken to obtain the new stock with strong grain (preferably quarter sawn). If more than one tooth is to be replaced and it is mated with the main wheel, it may be safer to cut a new pinion instead of repairing the old one. When repairing pinion stock, the replacement piece should be set with the grain in its strongest orientation. Careful judgment must be used when repairing pinions in considering where in the train the pinion is functioning. Since the typical pinion used is a species of Mountain Laurel which now has a limited availability, Dogwood has shown to be an acceptable substitute.
- 5.) No lubrication should be used in wood or ivory bushings or wood pivot holes. This material is self-lubricating. Should the use of a brass strip for a pivot cock be present, that should be treated as usual.
- 6.) The escape wheel should be as true as possible and the anchor should be treated as usual. The escapement should be set as in any other clock. When the eccentric is adjusted, it should be resecured as in its original form (with tiny cut nails) and **not** glued in place.
- 7.) Plate alignment should be checked and stabilized so the movement runs smoothly. Hot hide glue was the original adhesive of choice. However, in its absence, carpenter's casein

resin glue (water soluble/indoor type only) is acceptable for most gluing needs. Where there is a space larger than 0.010 of an inch, a wood shim of the same material as the piece being glued should be used with the glue to add to the stability to the repair.

- 8.) The wooden plates and wheels of the movement should be cleaned using appropriate techniques. (Consult: Barlow, Hans, 1979. The Repair of American Wood Geared Clock Movements, self published.) Under no circumstances should wooden parts be rinsed or submerged in water or water-based cleaning products. It is the experience of the clockmaking professionals who reviewed this section that the use of water and soap to clean wooden plates has lead to more destruction and warpage of these clocks than any other short term repair.
- 9.) Metal cables should **never** be used on wooden winding drums or pulleys. Braided nylon or cotton cords are preferable.

## Shop Practice Dispositions:

Although it is not the intent of AWCI to set shop *policies*, it is the purpose of these Standards and Practices to establish *guidelines* which it believes represent the hallmarks of professional practice and safety.

The Clockmaker, in adherence to AWCI Professional Standards and Practices, should:

1. Adhere to the AWCI Code of Ethics.
2. Maintain a clean and professional work environment. All clockmakers and employees who have contact with the public in that work environment should present a neat and professional appearance.
3. Practice care and safety for environmental concerns and the proper handling and disposal of all toxic solutions and compounds used in the shop. Proper ventilation to remove toxic odors and fumes from the shop area must also be a part of this safe environment.
4. Be committed to systematic shop practices.
5. Be willing to document (including intake client receipts, and a finished summary of work performed) and warrant all professional services.
6. Be committed to the advancement of professional knowledge.
7. Be committed to professional standards and quality horological education.
8. Be committed to stewardship of the client and his/her product(s).
9. Exhibit professional standards and ethics by returning the clock in the same state or better as was originally presented when work suggestions or estimates are refused.
10. Be judicious and careful in the use of adhesives, solders, heat and other chemistries when correcting material defects or damage. It is always recommended that adherence to the original design of a product is the best path to follow.
11. When the work is completed and returned to the customer, use of a comprehensive educational and informational program to help the customer properly care for their products is strongly recommended. See Section 1.) A-D above (page 12).