Examinations of Timing Mechanisms

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1 INTRODUCTION

Watches, appliance timers and similar devices are encountered in a wide variety of forensic contexts. For example, altered watches are commonly used as timers in explosive devices. Similarly, appliance timers are frequently encountered in arson investigations. Careful examination of such a device can reveal a variety of useful information regarding the timer and its possible alteration.

There are a large variety of watches and other timing mechanisms. These are subject to a myriad of conditions of environmental exposure, types of damage (for example, impact, corrosion, and/or compression damage), and applications (wristwatches, kitchen timers, appliance timers, etc.). Combinations of all of these variables are considered in these examinations.

Characteristics of timing devices that may be able to be determined include the manufacturer (and/or brand) of the item, the time and date indicated when the mechanism ceased functioning, the cause of mechanism cessation, and the identity of jeweler's or owner's markings. Comparison of the device with exemplars also makes it possible to determine whether the mechanism has been altered.

2 SCOPE

This document applies to caseworking personnel who perform metallurgy analyses on watches or other timing mechanisms and the components that comprise them. It supplements METAL-210, METAL-220, and METAL-221 by detailing inspection techniques that can be advantageously applied to timing mechanisms.

3 EQUIPMENT

A list of items commonly used in this examination follows. Not every item is used for every investigation. The instrumentation and equipment used will depend on the configuration of the timing mechanism to be examined.

- Macro camera
- Stereomicroscope having a fiber optic light source and a magnification of at least four (4) diameters with camera
- Digital X-ray radiography system*
- Digital multimeter
- Long (~365 nm) and short (~254 nm) wavelength ultraviolet (UV) light source(s)
- Alternative light source with filters and goggles
- Miscellaneous hand tools
- Battery

* When an instrument marked with an asterisk is used, see the appropriate Chemistry Unit (CU) Metallurgy technical procedure for additional equipment/materials/reagents.

4 STANDARDS AND CONTROLS

The standards and control samples to be used in this procedure will depend on the specific analytic methods employed and the nature of the items under analysis. Exemplars for evidentiary items will be obtained as needed and available.

5 PROCEDURE

A. Conduct a preliminary evaluation of specimen condition per METAL-210 and METAL-220. Assess the condition of crystal and face, the time displayed by mechanism immediately upon receipt, and any apparent shipping damage or material transfer due to shipping and handling. Also, note if mechanism is functioning or attempting to function.

B. Photograph the specimen(s) in the "as-received condition" (ARC). Photodocumentation should depict the characteristics deemed to be significant to the determination requested.

C. Conduct stereomicroscopic examinations of the specimen(s) in ARC to evaluate any damage present, the mechanism type, any identification markings, any exogenous deposits, as well as any other information deemed of value for the determinations requested.

D. Examine the timer for, and note any damage consistent with, impulsive loading if appropriate. These examinations are conducted using multiple lighting conditions.

    1. First examine the timer under ambient light to look for any characteristics associated with hand/dial interaction caused by forced contact.
    2. Next, examine the relevant timer surfaces with fiber optic lighting using several incident angles (particularly low angle) and directions looking for indications of hand/dial interaction by forced contact to determine the time displayed by the mechanism when forced contact occurred.
    3. Then repeat the surface examinations in a darkened room using long and short wavelength UV lighting looking for characteristics of hand/dial interaction by forced contact, including luminous or phosphorescent material transfer between the surfaces.

E. Note the presence and nature of corrosion products, if any.

F. Perform X-ray radiography of the internal components of the device. (See METAL-330.) Evaluate the movement type, the component positions, any internal damage, the power source, as well as any other information deemed to be of value for the determinations requested.

G. Conduct an internal visual examination of the movement and cavity noting any jeweler's markings, movement plate markings, and the condition of the mainspring or the internal power source. Note any calendar (day/date) position(s) as well as any component damage, blockage and/or misalignment.

H. If appropriate, remove timer power source and measure the source's terminal (no load) voltage.

I. Loss of power due to winding down of the mechanism or an exhausted battery can be ascertained by replacing the battery or winding the mechanism as appropriate, per METAL-221.

J. Summarize findings based on evaluation of all gathered data.

6 INSTRUMENT CONDITIONS

A. The instrumental conditions of optical and radiographic imaging systems are generally adjusted by the operator to achieve sufficient resolution for analysis.

B. Macro- and micro-photographs will contain a reference scale whenever feasible, however these are included for general reference, and measurements will not be made from the images.

7 ACCEPTANCE CRITERIA

7.1 Instrument Performance

Adequate function of any test or inspection equipment used will be demonstrated and recorded in the case notes.

7.2 Evaluation of Time/Timer Indicator Position

A conclusion that a damaged timer stopped at a particular time can often be read directly from the device if it remains intact. In other cases, damage to the timer from fire, explosion, corrosion, or other effects will leave physical marks on the mechanism that allow the hand positions to be inferred from the observed characteristics.

8 LIMITATIONS

Time and date determinations on non-functioning timepieces are typically limited to those having analog-type displays.

9 SAFETY

A. Wear an X-ray film badge or dosimeter when operating instruments that generate X-rays. Wear an x-ray film badge or dosimeter when operating instruments that generate x-rays. The instruments have protective enclosures and internal safety interlocks to prevent inadvertent x-ray radiation exposure. Never bypass or disable safety interlocks on instruments.

B. Wear personal protective gear and use engineering controls that are appropriate for the task being performed (e.g., safety glasses when cutting and chemical fume hood when etching). Electrical or mechanical hazards may require special precautions (e.g., grounding to prevent electric shock or wearing a face guard to prevent impact from flying debris.) Review instrument technical procedures and pertinent material Safety Data Sheets (SDS) prior to conducting examinations.

10 REFERENCES

- METAL-210, Examinations for Association or Origin, Chemistry Unit, latest revision
- METAL-220, Analysis for Failure, Damage, and Fracture, Chemistry Unit, latest revision
- METAL-221, Functionality Examinations, Chemistry Unit, latest revision
- METAl-330, Digital Radiography, Chemistry Unit, latest revision

11 REVISION HISTORY

Revision	Issued	Changes
05	09/15/2022	Revised to comply with new formatting requirements. Expanded description of acceptance criteria.
06	11/15/2024	Relocated descriptive information from Principle section to Introduction. Removed Specimen section. Removed instructional references to retain as training materials. Added references to relevant metallurgy technical documents.