

Examinations of Timing Mechanisms

1 Introduction

Watches, appliance timers and similar devices are encountered in a wide variety of criminal circumstances. 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.

2 Scope

This document applies to caseworking personnel who perform metallurgy analyses. There are a large variety of watches or 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. Principles of various aspects of materials science may be required to evaluate material and component behavior depending on the determination(s) requested.

3 Principle

Watches, appliance timers and similar devices are encountered in a wide variety of circumstances in criminal matters. Commonly, the timers are relatively simple mechanical or electro-mechanical devices. Careful inspection of the device permits a number of characteristics to be determined. These include the manufacturer (and/or brand) of the item, the time and date 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 if the mechanism has been altered. Moreover, it is often possible to deduce the reasons such alterations may have been made.

4 Specimens

This procedure is designed for the examination of time and interval indicating devices (e.g., alarm clocks, analog wristwatches, electrical timers) and the components comprising such mechanisms.

5 Equipment/Materials/Reagents

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. When an instrument marked with an asterisk is used, see the appropriate Chemistry Unit (CU) Metallurgy standard operating procedure (SOP) (see section 15 References) for additional equipment/materials/reagents.

- a. Nikon D200 digital camera and/or Nikon DXM1200 digital camera (or equivalent)
- b. Stereomicroscope having a fiber optic light source and a magnification of at least four (4) diameters
- c. Faxitron CS-100 or NSI 5000 radiography unit (or equivalent)*
- d. Fluke digital multimeter (or equivalent)
- e. Long (~365 nm) and short (~254 nm) wavelength ultraviolet (UV) light source(s)
- f. Alternative light source with filters and goggles
- g. Miscellaneous hand tools
- h. Battery

6 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. Any instrument used in this procedure will employ such standards as are required under its specific SOP (see 15 References). Exemplars for evidentiary items will be obtained as needed.

7 Sampling

Not applicable.

8 Procedure

- a. Conduct a preliminary evaluation of specimen condition to 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 a fair and accurate representation of characteristics deemed to be significant to the determination requested.
- c. If deemed appropriate, perform x-ray radiography of the mechanism to 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.
- d. 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.
- e. Examine the timer for, and note any damage consistent with, impulsive loading if appropriate. These examinations are conducted using multiple lighting conditions. First examine the timer under ambient light to look for any characteristics associated with hand/dial interaction caused by forced contact. Next, examine the relevant timer surfaces with fiber optic lighting using as many incident angles as possible (particularly low angle) looking for indications of hand/dial interaction by forced contact to determine the time displayed by the mechanism when impulsively loaded. 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.
- f. Note the presence and nature of corrosion products, if any.
- g. Perform radiographic examination of the internal components of the device.
- h. 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.
- i. If appropriate, remove timer power source and measure the source's terminal (no load) voltage.
- j. 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.
- k. Prepare findings after evaluation of all data determined to be of value.

9 Instrumental Conditions

- a. The instrumental conditions of imaging systems are generally adjusted by the operator to achieve sufficient resolution for analysis. See section 15 References for the CU Metallurgy SOP that contains additional recommendations of instrumental conditions for digital radiography.
- 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. Micron markers that are automatically generated by camera or microscope software are to be considered approximate and also will not be used to measure image features unless the marker is verified against a calibrated scale.

10 Decision Criteria

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. Conclusions will be expressed in reports and testimony according to current Laboratory requirements (see section 15 References).

11 Calculations

Not applicable.

12 Measurement Uncertainty

Not applicable.

13 Limitations

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

14 Safety

- a. 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 SOPs and pertinent material Safety Data Sheets (SDS) prior to conducting examinations. If additional guidance is required, contact the Laboratory Health and Safety Group.

15 References

Penman, L., *The Clock Repairer's Handbook*, Skyhorse Publishing 2010

Wiles, M. W., *Maintaining and Repairing Mechanical Watches: A Practical Guide*, The Crowood Press 2016

Scatler, N., *Mechanisms and Mechanical Devices Sourcebook*, McGraw-Hill 2011

Parmley, R. O., *Machine Devices and Components Illustrated Sourcebook*, McGraw-Hill 2004

Chemistry Unit Quality Assurance and Operations Manual, Federal Bureau of Investigation, Laboratory Division, latest revision

FBI Laboratory Operations Manual, Federal Bureau of Investigation, Laboratory Division, latest revision

FBI Laboratory Quality Assurance Manual, Federal Bureau of Investigation, Laboratory Division, latest revision

Methodology for Report Writing in the Metallurgy Discipline, Metallurgy Manual Metal 900, Chemistry Unit, latest revision

Chemistry Unit (CU) FBI-Approved Standards for Scientific Testimony and Report Language for the Metallurgy Discipline, Metallurgy Manual Metal 901, Chemistry Unit, latest revision

Department of Justice Uniform Language for Testimony and Reports for the Forensic Metallurgy Discipline, latest revision

Digital Radiography, Metallurgy Manual Metal 303, Chemistry Unit, latest revision

Rev. #	Issue Date	History
3	03/02/2018	Renumbered Metallurgy SOP Manual documents. This document was formerly Metal 3 and is now designated Metal 202. Added personnel to section 2. Made minor editorial corrections throughout document. Deleted obsolete equipment in section 5. Added exemplar statement to section 6. Deleted section 7 and renumbered subsequent sections. Updated safety requirements in section 14. Added references to section 15.
4	12/21/2018	Added paragraph regarding equipment use to section 5. Added reference to instrument SOPs in sections 5, 6 and 9. Augmented section 9 to include specific instrument procedures. Added statement regarding conclusions to section 10. Added SOP references to section 15.

Redacted - Signatures on File

Approval

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Date: 12/20/2018

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Date: 12/20/2018

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