

CLEANING OF OPTICAL ELEMENTS

Supersedes Issue 1, dated 20 Sep 45

INTRODUCTION

1. This instruction details the equipment and materials to be used and the technique to be followed when cleaning the optical elements of instruments.
2. These elements must be cleaned with great care to prolong the life of the instruments and maintain their efficiency.
3. Soap or detergent solutions will not be used for the final cleaning of optics. Although such solutions will produce a pleasing lustre after polishing, the residual surface film will cause fogging.
4. Atmospheric conditions and dust control are extremely important factors to be considered when cleaning optical elements. The conditions under which cleaning should be done are described in Instruments A 278.

EQUIPMENT AND MATERIALS

5. The following is a list of equipment and material needed to clean optical elements.

Equipment

Bottles, dropping, clear glass, 60 ml	6H-HF10337
Brush, camel-hair, flat, 1/2-in wide	1F-12800
Brush, water colour, red sable, No. 1	P&S 3024
Brush, water colour, red sable, No. 4	P&S 3027
Blower, watchmaker's, metal	1F-9970
Desiccator, plain, knob cover, inside dia 250 mm	6H-306947
Magnifier, eyeglass, 2 1/2-in focus	1F-55550
Plate, desiccator, porcelain, 230 mm dia	6H-306946
Shield, cello-metal, cylindrical, 3 1/2-in high x 5-in dia	6H-300005

Materials

Acetone, industrial	1H-50
Ethyl alcohol-methyl alcohol mixture	6810-21-103-7647
Cotton, absorbent	2H-8750
Cloth, polishing, linen, 12-in x 9-in	8K-313224
Paper, lens, 8-in x 6-in, 100 sheets, book	6V-504352
Pegwood	1H-32200

### CLEANING MATERIALS

6. Ethyl alcohol will be used as the cleaning fluid for optical elements. Methylated spirits, grade 1, may have a high water content and should not be used except in an emergency.

7. The cleaning fluid for use on workbenches should be kept in the small dropping bottles (60 ml capacity) for ease of use and for cleanliness. The dropping bottles have ground glass stoppers which are grooved to allow the fluid to be dispensed by drops as needed. Cleaning fluid which shows signs of contamination by dirt or grease should be discarded and used for less important cleaning operations.

8. The materials to be used with the cleaning fluid are pure linen cloths, optical tissue paper, and absorbent cotton. Materials such as selvyts, chamois leather, and silk are unsuitable and will not be used as they have a tendency to gather grit and dust which may scratch the soft glass surfaces. They also collect spore which may be deposited on the glass surface, and they become contaminated with skin acids after use.

9. The pure linen cloths should be of a soft, fine weave material with a minimum of knots, and approximately 12-in x 9-in in size. The linen must be kept perfectly clean by frequent washing and this should be done as detailed in para 27 and 28.

10. The optical tissue paper should be a soft, non-shredding type, with low absorption qualities. The tissue is usually in sheets approximately 8-in x 6-in in size and packaged in booklet form from which it may be removed as needed. The sheets should be cut into small rectangles approximately 2-in x 3-in to simplify handling when preparing cleaning swabs.

### CLEANING EQUIPMENT

11. Clean camel-hair brushes will be used to remove particles of dust, dirt, fluff, and fibres from glass surfaces. Brushes must be cleaned frequently in alcohol and kept in clean containers when not in use, and the hair must not be touched with the fingers.

12. A watchmaker's blower, fitted with a fibre- or brass-tipped nozzle is suitable for removing loose specks of dust or lint from previously cleaned glass surfaces. Immediately before use the blower should be pumped while the nozzle is held over the end of a spirit lamp flame. This burns all the particles of dust contained in the air drawn in by the blower and also dries out any moisture.

13. A vacuum system, with a suction hose and nozzle attachment at each workbench, is ideal for removing dust and lint from optical elements. Small paper cones of lens tissue paper should be placed over the nozzle to prevent it touching the polished glass surface.

14. Cleaning materials must be protected to prevent their contamination by oils, greases, moisture, dust, or spore. At the workbench optical tissue paper and linen cloths should be kept in glass desiccating jars with silica gel.

#### CLEANING PROCEDURE

15. Optical elements are easiest to clean when removed from their respective cells or mounts but in many cases it is necessary to clean them in their mounts. The procedure outlined is primarily for unmounted elements but will apply to mounted elements with certain variations.

16. Each polished optical surface must be cleaned, and usually each surface must be cleaned separately. The following procedure will be used:

- a. Remove loose particles of dust and dirt using a soft hair brush or the blower.
- b. Remove grease films and stains using a linen cloth moistened with ethyl alcohol and rub lightly with a circular or reciprocating motion. The portion of the linen cloth in contact with the optical surface should be changed frequently to prevent minute particles of grit becoming imbedded in the cloth and scratching the soft glass surface.
- c. Take care when cleaning elements cemented with Canada balsam as the alcohol will dissolve the cement. Test to ensure that the linen cloth is not moistened excessively by trying it on a portion of the polished glass surface. If the alcohol does not dry off immediately the linen is too moist.
- d. Make a swab by wrapping one piece of lens tissue paper around a piece of pegwood or equivalent. Dispense one or two small drops of alcohol on the tip of the swab. Starting at the centre of the polished surface swab with a light downward pressure and circular motion gradually increasing the radius until the entire polished area has been swabbed. When the edge of the element has been reached gently slide the swab past the edge to remove the accumulated lint.
- e. Repeat the operation until no trace of dirt or smears is seen when the surface of the glass is observed under an eyeglass. Smears can be detected by viewing a light source through the element and tilting it so that a shadow covers the optical surface.
- f. The final cleaning operation is the dry polishing of the glass surface after all grease and stains have been removed. Use soft optical tissue paper drawn from a clean container and discard after use.

- g. After polishing, carefully inspect the glass surface from all angles under reflected light using an eyeglass. Minute particles of fluff, dust or lint fibres should be removed with a clean camel-hair brush or suction nozzle.

17. When perfectly clean the optical element should be placed in a clean glass desiccator jar containing silica gel, and remain there until ready for assembly in the instrument. If the optical element is placed on the bench it should rest on a clean piece of tissue paper and be covered with a cello-metal shield.

18. During final cleaning and assembly, elements must not be held in the bare fingers but will be protected with tissue paper or held in suitable holders.

#### Coated Elements

19. A large number of service instruments have coated or 'bloomed' elements. British-made instruments have the letter 'B' as a distinguishing mark, stencilled in oil paint on their bodies. American instruments of early manufacture do not have a distinguishing mark but those of later manufacture have a decal transfer on their bodies. The lettering in gold reads "This instrument has coated optics, clean lenses carefully."

20. A coated element can usually be identified by the bluish-purple colour which may be seen when examined under light reflected obliquely from the polished surface. Elements which have been coated by more recent processes emit only a very slight colour when examined under reflected light, and so are sometimes difficult to detect.

21. Elements which are coated by the more recent methods are quite durable and will usually withstand several normal cleaning operations. However, those coatings applied under earlier processes and which emit a deep bluish-purple colour are fairly soft and will not stand normal cleaning methods. Cleaning must therefore be done in the following manner:

- a. Ensure that no water comes into contact with the coated surface during cleaning. Should condensation or other water deposit occur in an instrument, the coated surfaces must be allowed to dry thoroughly before starting to clean them.
- b. Carefully remove loose particles of dust and dirt with a camel-hair brush or watchmaker's blower. Avoid contaminating the coated surface with grease or perspiration from the fingers.
- c. Test the hardness of the film by first cleaning a small area. Carefully clean the coated surface, using ethyl alcohol and clean absorbent cotton, rubbing gently in one direction. The surface should be frequently examined by a reflected light during the cleaning process to determine whether the film is being scratched or removed.

- d. When the alcohol has evaporated, polish the surface very lightly with a clean piece of absorbent cotton.

22. A surface that shows small clear patches caused by partial removal of the coating is not unserviceable. Its optical properties will still be better than an element which is not coated.

#### Reticles

23. Film, scratches, and particles of dirt, dust, or lint on the surface of glass reticles are magnified when inside an instrument, because the reticle is positioned in the image plane, so reticles must be cleaned thoroughly.

24. Take care to avoid removing the filling material from the markings of acid-etched reticles or the surface emulsion from the photographed type of reticle. On some reticles a protective glass cover is cemented over the surface on which the markings are placed so take care that the cleaning alcohol does not run over the edge and penetrate the cement.

25. Examine the fine scales and markings with an eyeglass to see if they are complete and not broken or damaged. Clean by carefully and lightly rubbing with a linen cloth slightly moistened with alcohol. Examine the markings again under an eyeglass to verify that they are still complete and undamaged then continue the cleaning process. Use a camel-hair brush, blower, or suction nozzle to remove specks of dust and lint.

#### Aluminized Mirrors

26. Front surface mirrors consist of a thin reflecting coating of aluminum applied to an optical surface with a protective coating of magnesium fluoride applied over the aluminized coating. Mirrors of this type are difficult to clean because of the danger of scratching the reflecting surface. The best procedure is to use an acetone spray for cleaning these mirrors.

- a. Immerse the mirror in warm distilled water and very lightly brush the surface with clean absorbent cotton. Do not touch the mirror surface with the bare fingers.
- b. Remove the mirror from the water and allow excess water to drain off.
- c. Apply a fine mist spray of acetone to the surface of the mirror by means of an atomizer. The acetone removes the remaining water and will evaporate from the surface without leaving a film. The mirror should be warm to assist the evaporation of the acetone.
- d. Dry off the mirror thoroughly, first by warming and then by placing it in a desiccating jar for a few hours, before reassembling into the instrument.

### CLEANING OPTICAL LINENS

27. Keep soft linen cloths clean by frequent washing. A good method is to work the cloths thoroughly in a solution of one part oleic acid and one hundred parts of distilled water. Add a small quantity of ammonia until the oleic acid is dissolved and the solution begins to smell of ammonia.

28. After washing rinse the cloths in distilled water to which a few drops of ammonia have been added to remove traces of grease, then follow with another rinse in distilled water only. The cloths should be dried in a dust-free place, then kept until needed in a clean covered container, such as a desiccating jar.

### CLEANING METAL COMPONENTS

29. To help preserve the cleanliness of optical elements assembled in an instrument, the internal metal surfaces should be thoroughly cleaned using the following method:

- a. Metal surfaces will be cleaned with authorized cleaning solvent. The solvent must be renewed frequently so that it does not become saturated with dirt and grease:
- b. The most efficient means of cleaning dust and spores from metal parts is by suction. Air blasts tend to charge the atmosphere with dust which will settle on other instrument parts.
- c. Final cleaning may be done by wiping the metal surfaces with a lintless cloth moistened with alcohol.

### PRECAUTIONS

30. The following is a summary of precautions which must be observed to ensure satisfactory cleaning of optical elements.

- a. Cleaning should be done only in a dry, dust-free atmosphere.
- b. Use only the authorized cleaning materials and ensure that they are not contaminated.
- c. Keep linen cleaning cloths and optical tissue paper in a glass desiccating jar when not in use.
- d. Keep camel-hair brushes clean by frequent washing in alcohol. Do not touch brush hairs with the fingers.
- e. Never touch polished optical surfaces with the bare fingers. Use several layers of tissue paper or suitable holders.
- f. Personal cleanliness is important. Hands should be as free as possible from moisture, and kept clean by frequent washing then thoroughly dried with a cloth towel.

END