

A Photographic Recording Technique for Measuring High-Speed Camera Image Unsteadiness

This Recommended Practice originated in the Subcommittee on High-Speed Camera Steadiness on October 9, 1959. The technique has been revised and improved in an attempt (1) to overcome the very serious problem of making several thousand microscope measurements of consecutive reference images on motion-picture film; e.g., at least 16,000 readings per 100 ft of 16mm film and (2) to obtain a permanent data write-out system for lifetime camera evaluation. The improved technique was described in a paper presented at the 90th SMPTE Semiannual Convention on October 3, 1961.¹

It has been the experience of the committee that the achievement of optimum high-speed camera performance depends not only on accuracy in manufacturing tolerances, but also on periodic camera maintenance when and if indicated by the unsteadiness measurement technique. Furthermore, costly repairs may be reduced since serious camera damage is usually preceded by gross image unsteadiness.

Recommendations

1. Scope

- 1.1 *Specification.* This recommendation specifies a photographic method of recording and measuring high-speed motion-picture image unsteadiness.
- 1.2 *Image-Steadiness Methods.* Existing image-steadiness methods are applicable to professional motion-picture cameras showing vertical image-steadiness accuracy within 0.0004 in.^{2,3}
- 1.3 *Application.* The procedure for measuring image unsteadiness, described in this Recommended Practice, is far more practical for high-speed, rotating-prism motion-picture cameras usually showing unsteadiness characteristics greater than 0.0004 in.

2. Measurements Procedure

2.1 Film Exposure

- 2.1.1 *Double Exposure.* Film shall be double exposed to produce overlapped images of the plus sign target.
- 2.1.2 *Target.* The target shall be opaque, except for a plus sign transmitting sufficient light for exposure through lines no wider than 1mm on an 8 by 10 in. field.
- 2.1.3 *Backlighting.* The target shall be backlit.
- 2.1.4 *First Exposure.* The first exposure shall be made in a professional camera known to afford image steadiness within 0.0004 in.
- 2.1.5 *Second Exposure.* The second exposure shall be made in a high-speed motion-picture camera, as shown in Fig. 1.

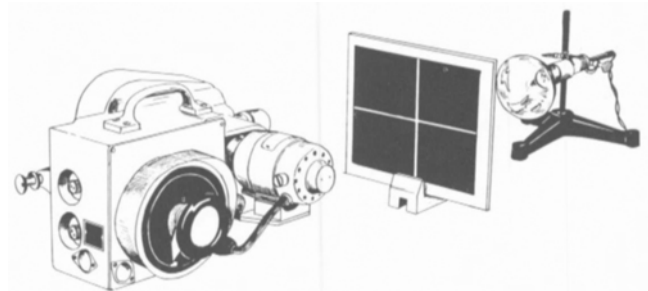


Fig. 1. Typical set-up for second exposure.

- 2.1.6 *Exposure Adjustments.* Exposure shall be adjusted for each camera to produce equal density for both plus sign images.

3. Recording Unsteadiness Data

- 3.1 *Projection.* Processed film shall be projected onto a rotating drum wrapped with recording-type paper (cut 1½ in. by 24 in.), as shown in Fig. 2.

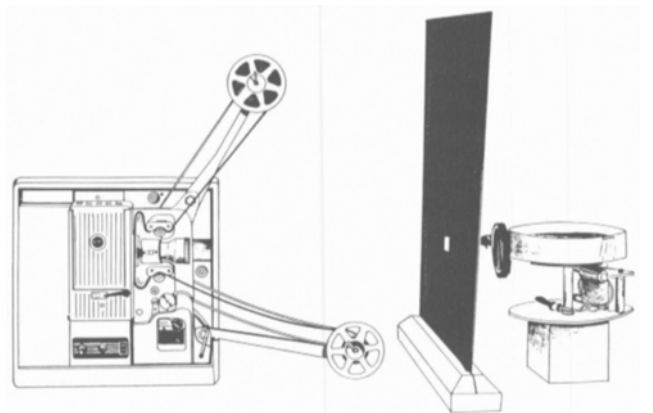


Fig. 2. Projection of test film onto drum wrapped with recording paper.

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¹ A. E. Quinn, "A photographic recording technique for measuring high-speed motion-picture camera image steadiness," presented on October 3, 1961, at the Society's Convention at Lake Placid, N. Y. A manuscript is expected to be available for publication during the latter part of 1964.

² A. C. Robertson, "A method of measuring the steadiness of motion picture cameras," Jour. SMPTE, 68: 21-25, Jan. 1959.

³ M. G. Townsley, "A method for measuring the steadiness of motion picture cameras," Jour. SMPE, 43: 45-50, July 1944.

- 3.1.1 The projector shall be positioned approximately 24 in. from the drum, with both horizontal lines focused on the recording paper and through a $\frac{1}{32}$ in. vertical slit positioned directly in front of the recording drum.
- 3.1.2 The vertical slit shall transmit very small, dotlike sections of both horizontal lines representing the image characteristics of the reference camera and the high-speed camera.
- 3.1.3 The recorder shall rotate horizontally one revolution per 100 ft of projection (or 6 in. per minute), as shown in Fig. 3.

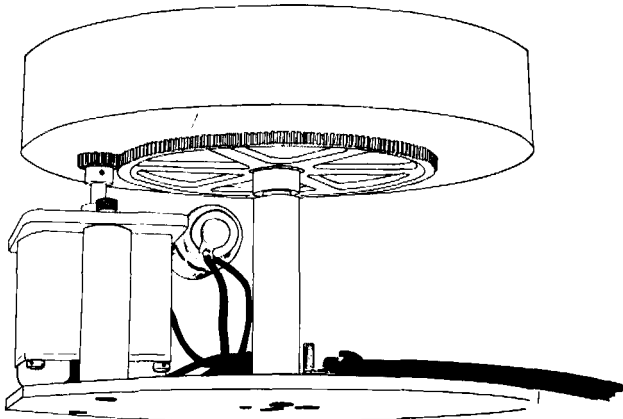


Fig. 3. Driving mechanism of recording drum.

- 3.2 *Vertical Unsteadiness.* The photographic record shall be processed conventionally and the camera evaluated for vertical unsteadiness.
 - 3.3 *Horizontal unsteadiness* shall be recorded in a similar manner by rotating the normally vertical lines 90° optically with a mirror or dove prism, as shown in Fig. 4.
4. *Characteristics of Recording*
- 4.1 Differential in amplitude between the traces indicates relative image unsteadiness of the high-speed camera, since projector unsteadiness is cancelled.

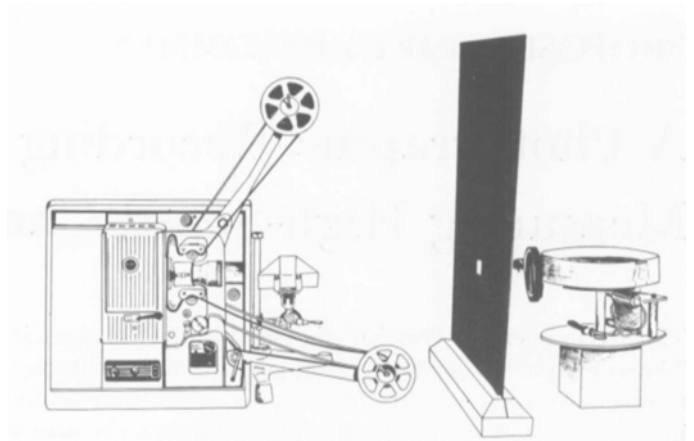


Fig. 4. Position of dove prism for recording horizontal unsteadiness.

- 4.2 *Comparisons.* The permanent recording should be compared with previous recordings to determine the degree of degradation.

5. *Calculation of Image Displacement*

Actual image displacement on the high-speed camera film shall be calculated by determining the magnification factor between the focal plane of the projector and the recording paper. When using a 2-in. projection lens 2 ft from the recording drum, the magnification is approximately 10X. A typical trace is shown in Fig. 5.

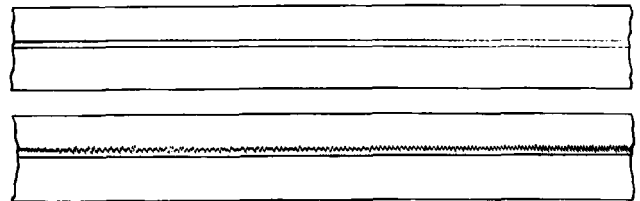


Fig. 5. Typical trace shown on recording paper.