MASTER

STREAK CAMERA TIME FIDUCIAL

G. R. Avara

QUALITY DIVISION

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Normal Process Development
Endeavor No. 231

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ABSTRACT

Short duration, single pulse, light sources are used to generate time fiducial marks on streak camera records. Previously, a light pulse was transmitted directly to the streak camera slit plate by a fiber optic cable whose emitting end was attached flush to the slit plate. Time resolution on the streak record was improved by positioning the emitting end of the cable back from the slit plate and collimating the light with a small diameter lens.

DISCUSSION

Two Abtonics short duration (~ 1 ns) single pulse light source systems are used to generate time fiducial marks on the streak camera records of the MC-2058 and the MC-1989 test fire assemblies. Each light source presents a single pulse of light to a slit which is imaged on the streak camera film plane. These pulses are time delayed to each other and to the firing signal for the test fire assembly. This yields a time reference between optical and electronic records as well as a measurement of the camera writing rate during the streak.

Previously, a light pulse was transmitted directly to the slit plate by a fiber optic cable whose emitting end was attached flush to the slit plate. Since the slit is imaged onto the film plane, the distribution of irradiance (power/area) at the film is identical to that at the emitting end of the fiber optic cable. This irradiance was greatest at the center of the image and decreased radially from the center. The result was that the film was more exposed in the center than at the edges of the image. Also, since the optical power output of the light source does not repeat exactly for each pulse, identical exposures for equipment testing and for the final streak record cannot be depended upon. Therefore, the emitted light could not be filtered down to the optimum exposure during equipment testing since the final streak could then be underexposed due to a lower amplitude light pulse. The resulting records which were overexposed appeared blurred in the center and the leading edge (first in time) of the streak was rounded instead of straight. This presents a problem in the choice of where the streak really started on the film.

Small diameter, short focal length lenses were placed one focal length away from the emitting ends of the fiber optic cables. The emitted light was then a collimated bundle with approximately constant light intensity for short distances from the lens. The slightly diverging beam of light was then aligned to the slit plate by an aluminum ring fixture designed to fit the camera barrel. A sketch of the ring fixture is shown in Fig. 1. The lenses were positioned approximately 50 millimeters from the slit plate for more uniform irradiance.

Comparisons of the fiducial streak records for the previous method and for the present method of coupling are shown in Figs. 2 and 3, respectively.

Fig. 1. Ring Fixture for Aligning the Light Beam to the Slit Plate

Fig. 2. Streak Record of Time Fiducial Mark With Fiber Cable Attached Flush to the Slit Plate

Fig. 3. Streak Record of Time Fiducial Mark With Fiber Cable Light Collimated

The major concern for uncertainty is the time from point 1 to point 2, as indicated in Fig. 2, which is about 30 ns for this record. Comparisons of repeatability for reading the leading edge (point 1 for Fig. 2) for records obtained with and without the collimating method showed no significant difference. The standard deviation from 30 readings was 1.9 ns without collimation and 1.4 ns with collimation. More quantitative data are being obtained to diagnose this and other WR test schemes for time resolution limitations imposed by optical parameters.

CONCLUSIONS

The collimating device presented more uniform irradiance at the slit resulting in a more constant exposure along the leading edge of the streak. This produced a relatively straight leading edge instead of the usual rounded one. Since the light beam from the cable has been expanded to a larger effective diameter, any variation of the light power output from the original source has a reduced effect on the image irradiance. This allows one to filter the light to a more optimum and more repeatable exposure.