PHOTOGRAPHIC INSTRUMENTATION FOR THE SKID TEST

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DEVELOPMENT DIVISION

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Normal Process Development
Endeavor No. 216

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ABSTRACT

An attempt to improve the quality of the Fastax camera records was undertaken. The films are used to provide a check on the coefficient of restitution and on the final rotational velocity of the billet as obtained from the accelerometer records. Other information obtained from the film record is much more qualitative being the determination of the reaction level and the proper impact of the target by the skid test sample. Procedures defined to improve the Fastax camera film records are outlined.

DISCUSSION

Fastax camera film records are obtained on each skid test. The film records are used to: (1) provide an indication of the reaction level obtained, (2) provide an indication of whether the skid test sample (billet) impacted the target properly, (3) provide the final velocity of rotation of the billet after the impact and (4) provide the coefficient of restitution of the billet after the impact. Items 1 and 2 provide only qualitative data. The reliability of the data obtained in items 3 and 4 is directly a function of the quality of the Fastax film record.

Previously the Fastax film records were usually either underexposed or exhibited poor contrast. Underexposure or poor contrast do not usually affect the determinations of reaction level and accuracy of the impact to the extent that they affect the measurement of the final rotational velocity and the coefficient of restitution. The underexposure can be compensated for somewhat by utilizing a "push-processing" technique to increase the apparent speed of the film (at the cost of increasing the graininess of the resultant film). The coefficient of restitution and the final rotational velocity measurements are not improved by using a "push-processed" film since the resolution of the film is decreased as much or more than the apparent exposure is increased by the process.

The exposure of the films is understandable when considering the conditions under which the films are produced. The Fastax film is produced at a framing rate of 4000 frames/sec using a 150 mm lens at its maximum aperture of $f/4.5$. The camera also had to view the skid test area from within the protective bunker through three thicknesses of 32 mm thick plate glass. Because of the placement of the port windows relative to the skid test area, the camera was not able to view parallel to the normal to the glass surface. A drawing of the placement of the camera during testing is given in Fig. 1. The port which the camera must utilize is governed by the firing pad. The top of the firing pad is approximately 40 cm above ground level. To be able to see the skid target at the 0.24 and 0.79 radian position, ports 2 and 3, respectively, have to be used. Depending upon the conditions under which a skid test was conducted, the angle of the camera to the normal to the port glass was between 0.25 and 0.35 radians. The oblique view through the port window also makes the alignment of the camera rather critical. The port window is basically a tunnel with a diameter of 100 mm and a length of about 150 mm. The oblique view cuts the usable diameter considerably.

Because of the difficulty in viewing through the port windows, the placement of the camera was changed. An unused 150 mm diameter cable conduit is now used to view through when it is desired to conduct skid tests at a 0.79 radians impact angle. A hole was cut in the door of a small utility closet on the side of the bunker to view skid tests at an impact angle of 0.24 radians. When not in use these ports can be sealed with a pipe cap to protect against inclement weather. Fig. 2 shows the placement of the camera and the turning mirror at both viewing positions.

In order to evaluate any differences in film contrast and exposure, films were exposed both by shooting through the port glass and through the unobstructed conduit. The films were made within several minutes of each other so that the ambient lighting conditions would be as nearly identical as possible. The film made through the unobstructed conduit showed a greater extent of exposure as well as an increased level of contrast, or resolution over that of the film shot through the port window. Photometric tests were made to see how much light was actually lost when viewing through the three port glasses and when using a turning mirror and the unobstructed cable conduit. It was found that almost two f/stops are lost when viewing through the port glasses and less than one-half f/stop was lost when using the mirrored image.

Occasionally, it is necessary to employ auxillary lighting when ambient lighting is not sufficient. At one time, flood flash lamps type FF-33 manufactured by Sylvania Electric Products, Inc., were used to provide auxillary lighting. Eight bulbs fired simultaneously were used. The use of these flashlamps presented some problems. Aiming the bulbs was difficult, timing between the activation of the bulb and the time when impact of the skid piece was to occur was uncertain, and since the bulbs were usable but once, cost was of consideration. A low cost, high intensity sealed beam lamp was selected to replace the flash lamps. This lamp is a PAR-46 bulb, manufactured by General Electric Company, and is primarily used in aviation applications. Two lamps per test are used. Since the lamps are usable more than once aiming is easily accomplished by turning on the light and pointing it wherever desired. Timing between the light and skid impact is facilitated by turning on the lamp prior to the test and turning off the lamp when the test is complete. The cost of the lamps is amortized over the number of tests done before the lamp burns out or is damaged as a result of a reactive skid event being obtained.

COMMENTS, CONCLUSIONS

By viewing the skid test area through other than the port windows, an improvement in exposure and resolution of the film records has been obtained. Several aspects of using auxillary lighting have been simplified by using a different type lamp.

Fig. 1. Placement of Fastax Camera Relative to Skid Pad Position for 0.24 and 0.79 Radian Impact Angles Using Port Windows

Fig. 2. Placement of Fastax Camera Relative to Skid Pad Position for 0.24 and 0.79 Radian Impact Angles Using Turning Mirrors