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NEW IMPACT TESTER FOR REFLECTOR BUTTONS

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In order to improve the accuracy and reproducibility of tests for impact resistance of reflector buttons, the original apparatus used for this test has been completely redesigned and rebuilt. The impact test was originally devised in conjunction with Michigan State Highway Department specifications for Plastic Reflector Buttons issued in April of 1949. These specifications contain a description of the method of test and an illustration of the apparatus used at that time. The new apparatus employs a magnetic release of the steel ball which allows it to fall in a reproducible path to the test specimen without the use of restraining walls or guides of any kind. Steel balls of two or more different weights may be used so that optimum height of drop for maximum accuracy may be secured for several different size ranges of reflector buttons. The method of test to be used with the new apparatus is given in an appendix to this report.

The new impact tester is shown in the accompanying photographs. The base is of hot rolled steel with a circular insert of hardened steel under the impact area. Overall base dimensions are 7/8 by 7-1/2 by 7-1/2 in. Attached to this is a vertical stanchion 1 by 1 by 28 in. To this stanchion an electromagnet is secured which holds the steel ball bearing prior to dropping. The height of the magnet is adjustable from 0 to 55 cm. A model railroad power supply containing a selenium rectifier is used to supply direct current for the magnet. The rheostat is permanently set and a pilot lamp and snap action switch on the primary of the rectifier added to give instantaneous release of the ball. The power supply is in a separate housing.

The base has a flush mounted leveling bubble near the left side with two leveling screws in the back corners and one in the center front. Proper leveling is essential to maintain the same point of impact throughout the test. The sample being tested is placed

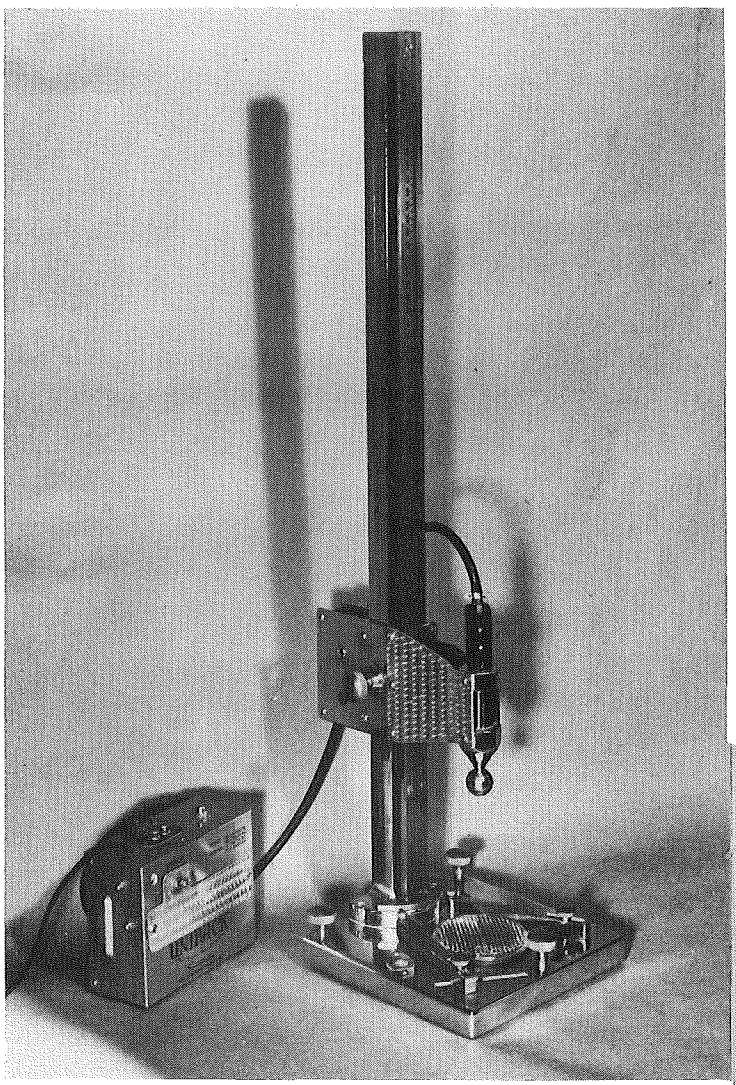

Figure 1. General View of Impact Tester.

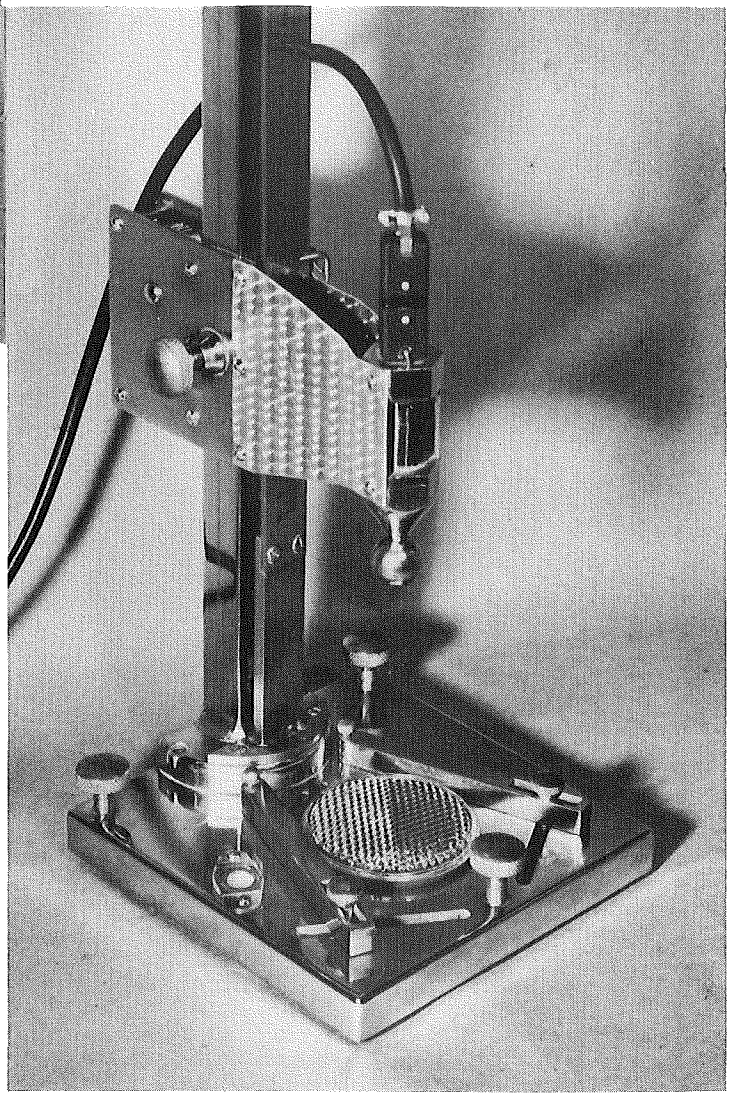

Figure 2. Closeup of Base and Magnetic Holder.

in a "V" formed by two adjustable arms swinging on pins near the stanchion base. The sample is centered directly under the ball.

Along the front of the stanchion is fastened a brass scale to indicate height adjustments. These adjustments are made in one-centimeter increments increasing with each impact to the failure point. A 3/8 inch square gear rack is partially recessed in a groove milled out in the back side of the stanchion. A 2 inch diameter gear is in contact with the rack and a 1 inch diameter gear is in turn in contact with this. The shaft of this smaller gear protrudes through the "U" shaped housing and the wheel used for height adjustments is attached to this shaft. On the left side of the gear housing a clamping device is located. This tightens against the stanchion to hold the ball at the proper height. The pointer, indicating height, can be seen on the right side of the gear housing. This has a small vertical adjustment for "zeroing-out" at the beginning of each test.

The electromagnet is secured to the gear housing by an aluminum plate on each side. The most critical part of the magnet is the shape of the small conical impression at the tip. It is within this cone that the steel ball is retained prior to dropping. Any flaws in either the surface or the roundness of this cone will be greatly amplified at the greater test heights. By fine finish grinding of this surface, it has been possible to repeat the point of impact within 1 millimeter for ten impacts at a height of 55 centimeters.

To extend the test range, balls of two sizes are used; a 44 gram ball for reflectors having diameters of 3 inches or larger, and a 16 gram ball for the smaller units. Experimental tests to determine equivalent impacts of the two steel balls compare favorably with theoretical equivalent impacts.

Impact tests have been run on over 720 reflector buttons of eight sizes, varying from 1/2 inch to 3 inches in diameter, as well as oval units. Resulting impact resistance figures follow approximately a normal distribution curve.

APPENDIX

METHOD OF TEST FOR IMPACT RESISTANCE OF REFLECTOR BUTTONS

Preliminary Adjustment and Mounting of Specimen

Make necessary electrical connections and adjust the apparatus for level, using the leveling legs and bubble. With the electromagnet turned on, place the proper size impact ball on the magnet end. Place the button to be tested on the base plate face up. Then lower the ball, held by the magnet, to the point where it just touches the reflector at its center. Move the "V" guides up against the sides of the button, tighten in place, and set the pointer for height indication at zero. The equipment and specimen are now ready for the test.

Test Procedure

With the magnet on and the impact ball in place, raise the instrument head to one centimeter height. Release the ball by turning off the switch on the power supply, allowing the ball to strike the button only once. Secondary impacts due to bouncing can be prevented by intercepting with a sheet of cardboard or by actually catching the ball.

Inspect the button for fracture. If fracture has occurred, discontinue impacts on the specimen at this point. Otherwise, continue dropping the ball, increasing the distance of drop by increments of 1 centimeter after each successive drop until fracture occurs. Fracture is defined as the appearance of a crack in the face which is equal to or greater in length than the distance between two successive cube corners along the line of a crack. Record impact resistance as the height in centimeters from which the ball was dropped to produce fracture.