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Standard Test Method for Jaw Crusher Gouging Abrasion Test[1]

This standard is issued under the fixed designation G81; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers a laboratory procedure to determine the relative gouging abrasion resistance of materials. Materials homogeneous in structure and properties are the most appropriate test materials; however, surface-treated and composite materials can also be tested. The test involves a small laboratory jaw crusher that crushes presized hard rock materials, such as a hard morainal gravel, or some other crushable substance.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* (See 8.1 on Safety Precautions.)

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A128/A128M Specification for Steel Castings, Austenitic Manganese

A514/A514M Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

A517/A517M Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered

E10 Test Method for Brinell Hardness of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron (Withdrawn 1995)[3]

E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

G40 Terminology Relating to Wear and Erosion

3. Terminology

3.1 *Definitions:*

3.1.1 *gouging abrasion*—severe form of *abrasive wear* in which the force between an abrading body and the wearing surface is sufficiently large that a macroscopic gouge, groove, deep scratch, or indentation can be produced in a single contact.

3.1.2 The definitions of some other related terms may be found in Terminology G40.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cheek plates*—wear liners that protect the sides of the crusher adjacent to the movable and stationary jaws.

3.2.2 *movable jaw*—part of the crusher that moves against the material being crushed.

3.2.3 *reference plate*—jaw plate made of a material uniform in microstructure and hardness and not varying significantly from one piece to another; such a plate will give highly reproducible results, to which other materials to be tested may be compared.

3.2.4 *stationary jaw*—part of the crusher that does not articulate, but is directly opposite the movable jaw and is in direct crushing contact.

3.2.5 *test plate*—jaw plate made of a material for which the gouging abrasion resistance is to be measured.

3.2.6 *toggle plate*—plate that holds the bottom edge of the movable jaw relative to the stationary jaw.

4. Summary of Test Method

4.1 A small laboratory jaw crusher with a feed opening of about 100 by 150 mm (4 by 6 in.) is modified to accept an easily machined identical pair of reference wear plates and a pair of similar test wear plates. One test plate and one reference plate are attached to the stationary jaw frame of the crusher,

[1] This test method is under the jurisdiction of ASTM Committee G02 on Wear and Erosion and is the direct responsibility of Subcommittee G02.30 on Abrasive Wear.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

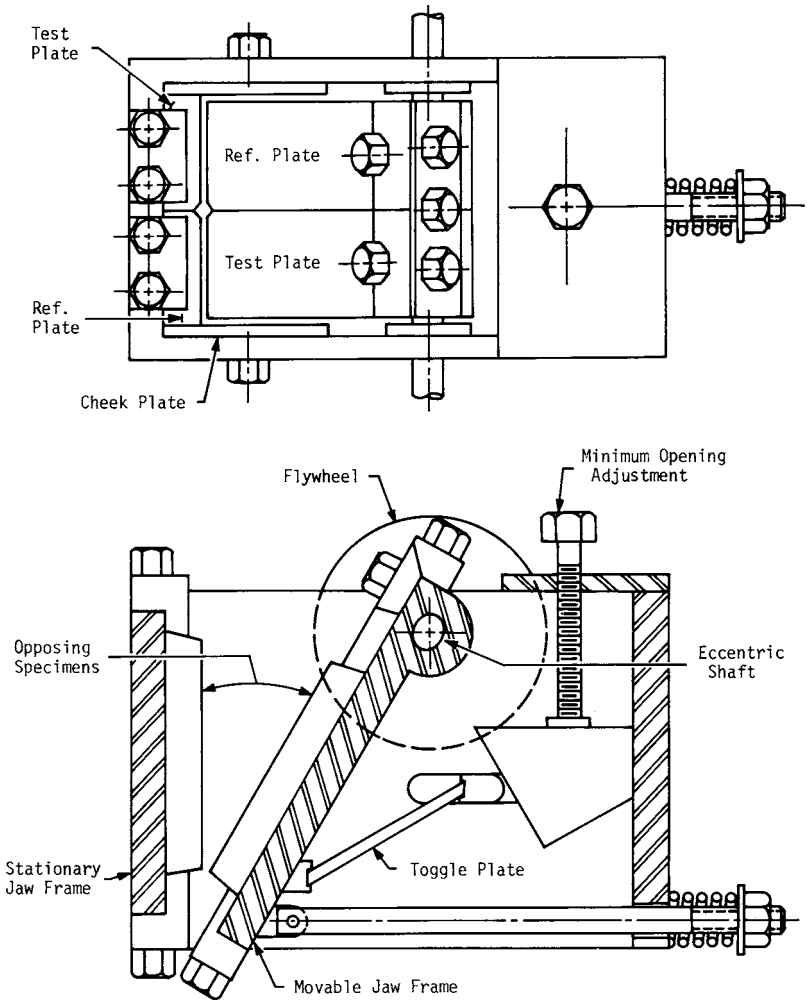

FIG. 1 Typical Jaw Crusher Construction and Layout of the Test Plates

and the other test and reference plate are attached to the movable jaw frame, such that a reference plate and a test plate oppose one another. The minimum jaw opening is set at 3.2 mm (0.125 in.), and a 225-kg (500-lb) load of prescreened material of suitable hardness is run through the crusher. The minimum opening is then reset to 3.2 mm (0.125 in.) and another 225 kg (500 lb) of rock is crushed. This is repeated until a minimum of 900 kg (2000 lb) of rock is crushed. The precleaned and weighed test plates are then recleaned and weighed, and the mass loss (in grams) is recorded. The volume loss may be calculated from the mass loss and the known densities of the test materials, or it may be measured for nonmonolithic materials. A wear ratio is developed by dividing the volume loss of the test plate by the volume loss of the reference plate. This is done separately for the stationary and the movable plates. The two wear ratios are then averaged for a final test wear ratio. The smaller the decimal figure for the wear ratio the better the wear resistance of the test plate compared to the reference plate. When highly wear resistant test and reference plates are used the total amount of rock must be increased to 1800 kg (4000 lb) or more.

5. Significance and Use

5.1 A number of types of jaw crushers have been used for laboratory abrasion tests, see Refs (**1-5**)[4] and a limited amount of data has been published (**6-10**). With emphasis on the crusher described in Section 6, this test method ranks materials and also indicates differences in wear life for that type of abrasion defined as gouging abrasion, as is found in crushing equipment and in many mining and earthmoving applications. This test method is considered useful for research and development purposes, but not to specify universal wear ratios, since the wear ranking and severity of wear may change dramatically with a change of the characteristics (chemistry, shape, angularity, etc.) of the crushed material or type of machinery.

[4] The boldface numbers in parentheses refer to a list of references at the end of this standard.

6. Apparatus

6.1 A jaw crusher with an approximate feed opening of 100 by 150 mm (4 by 6 in.) is used.[5] This should have a single movable jaw and be of very rugged construction (see Fig. 1).

6.2 The jaw crusher should be capable of accepting two identical wear plates on the stationary jaw frame and two wear plates of the same design on the movable jaw frame. Plate locating devices should be attached to hold the plates tightly in position. The plate-bottom locating device shall ensure reproducible positioning of the bottom of each test plate for each test. The crusher shaft bearings should be roller or needle bearings to hold consistent tolerances. Spacers may be affixed to the shaft to prevent the movable head from changing the gap on the sides of the jaws. The toggle plate should be easily removed for rebuilding. The machine should have easily replaceable wear liners for the toggle plate holders.

6.3 A motor of higher power than a standard crusher motor may be necessary, since the flat wear plate design takes more power to crush the rock. A 5.2-kW (7-hp) motor has been found to be satisfactory for this test method.

6.4 *Important Tolerances:*

6.4.1 *Toggle Plate Length,* +0 to −1.5 mm (+0 to −0.062 in.).

6.4.2 *Wear Liners in Toggle Plate Holders,* +0 to −0.75 mm (+0 to −0.031 in.).

6.4.3 *Side to Side Movement of Movable Frame,* ±0.75 mm (±0.031 in.).

6.4.4 *Wear Groove in Cheek Plates,* no deeper than 6 mm (0.250 in.).

6.4.5 *Shaft Movement Relative to Crusher Frame,* less than 0.25 mm (0.010 in.).

6.4.6 *Movable Jaw Frame Movement Relative to Shaft,* less than 0.25 mm (0.010 in.).

6.4.7 *Difference in Toe-to-Toe Spacing,* no more than 0.25 mm (0.010 in.) across the width of the crusher exit.

6.5 A frame should be made to support the crusher. The framework must include a hopper above the crusher that will hold a minimum of 225 kg (500 lb) of rock at one time. Below the hopper a lever-actuated control gate and a chute should be attached to deliver the rock into the crusher opening. Below the crusher a removable box may be installed that will hold 225 kg (500 lb) minimum of crushed rock. This box should have a lid with an opening just below the crusher exit.

6.6 An evacuation blower should be installed on the frame to pull dust out of the crushing area and the receiving box and move it to an acceptable collection or dump area. A protective magnetic grate should be installed at the top of the hopper to collect any tramp iron or steel in the rock.

6.7 One or more dump boxes are recommended that will hold 225 kg (500 lb) of rock. This is for weighing the rock and transporting it to the hopper above the crusher.

6.8 A method of weighing 225 kg (500 lb) of rock and the container should be available.

6.9 A balance of sufficient capacity to weigh the test plates is necessary. The sensitivity should be at least ±0.1 g.

7. Materials

7.1 *Reference Plates:*

7.1.1 Reference plates can be made of any readily available material that gives wear behavior consistent with Section 9.

7.1.2 The most common reference wear plate materials are Specification A514/A514M, Grade B steel plate, or Specification A517/A517M, Grade B plate, quenched and tempered. It is suggested that an effort be made to select a plate as close as possible (±8 HB maximum) to 269 HB hardness (see Test Methods E10 or E18 and Hardness Conversion Tables E140). A large plate should be purchased and cut into pieces suitable to machine into individual plates. The direction of rolling should be in the direction of rock flow through the crusher. Each new batch should be compared with the previous batch.

NOTE 1—The exact hardness of the reference wear plate material is not critical, but most published data are based upon experiments utilizing reference wear plates quite close to 269 HB.

7.1.3 Cast manganese steel reference plates can also be used. Specification A128/A128M, Grade A is a consistent cast product and works well as a reference material for testing more wear resistant materials. The plates should be cast oversize and then heat treated. A narrow carbon range of 1.15 % ± 0.02 % is recommended, rather than a specific hardness (see Test Methods E30 and E350).

7.1.4 Any material can be used as a reference material if it provides results consistent with Section 9, and if later batches also reproduce original values. Any secondary reference material can be referenced or calibrated by running it against the primary reference material to find by what percentage the wear differs from the primary reference material.

7.2 *Rock:*

7.2.1 The rock to be crushed should be a hard, tough, precrushed material sized to be between 25 mm (1 in.) and 50 mm (2 in.). A hard morainal rock with the following composition is given as an example (proportions are not critical): 18 % quartz and quartzite, 28 % basalt, 20 % granite and gneiss, and 34 % limestone and shale.

7.2.2 However, the rock composition and hardness are not critical to the test. For example, taconite has been used, leading to a large increase in plate wear rate compared to the morainal rock, but with no more than an 8 % variation in the wear ratio measured on the samples tested.

8. Precautions

8.1 *Safety Precautions:*

8.1.1 All belts and flywheels should have metal guards to meet OSHA standards.

8.1.2 A safe means of manual operation of the machine should be provided.

8.1.3 The on/off switch should have a key-operated lockout.

8.1.4 The fill chute should fit well enough so that all rock is directed to the crushing chamber.

[5] A Massco laboratory jaw crusher from Mine and Smelter, P.O. Box 16067, Denver, CO 80216 has been successfully modified for this test. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.