A simple method to determine handle strength of bags

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A simple method to evaluate the handle strength of the bag is proposed. This fills the gap in the existing bag testing procedures in any international standards. The procedure determines the bag handle strength in terms of impact strength and velocity of lift.

Keywords: Bags, Handle strength, Impact strength, Jerk, Velocity of lift

Bags made from jute, woven plastics, cloth, etc. are used to store and carry materials from one place to another. Whenever a filled bag is suddenly lifted up from the rest position, the handle is more likely to receive impact loads, intensity of which depends on the density of the filled material. Such impact loads also vary considerably in manual handling because of differing individual styles. The strength of the bag depends on many factors such as bearing area (width of the handle), type of stitching and the thread used, method of joint, distance between the two joints of each handle, position of the handle, construction material of bag and handle, etc. In its span, a bag will be handled many times during transit and correspondingly the handle would be subjected to repeated impact loads. Hence, it becomes necessary to consider the handle strength as a design criterion. Although the standard test procedures are available for the evaluation of fabric strength and seam strength of a bag, no separate test has so far been proposed for the evaluation of the handle strength, which can be arrived at in terms of impact strength and velocity of lift. A simple procedure containing these factors is proposed here to determine the handle strength. This fills the void in general test procedures for bags.

A filled bag is bodily lifted up, free of any lateral or longitudinal movements, manually by a wooden lifter and then released to hang full length from the handle in a jerk.

In the actual test, a filled bag of known weight \( W \) is mounted by handle on a fixture which is shown in Fig.

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A—Rectangular wooden span  \( w \)—Width of the arc
B—End supports  \( l \)—Length of the arc
C—Side supports to prevent movements of the handle  \( r \)—Radius of the arc
h—Height of the side supports

The radius, width and length of the arc of the wooden span A are chosen in such a way that these dimensions should represent the dimensions of the lifter (hand or conveyor) used. In most of the cases the bag is usually lifted by means of hand. A wooden span with this configuration simulates the lifter in practice. The height of the end supports B depends upon the length of the bag under test. This can be made adjustable by using telescopic tubes or by some suitable alternate arrangement. The height of the side supports C should be slightly more than the lifting height of the handle. Before starting the test care should be taken to isolate the equipment from distortion during lifting and releasing of the bag.

After suspending the bag on the arc of the rectangular wooden span by its handle, a wooden plank is kept at the bottom of the bag such that they are just in contact with each other. The width of the wooden plank should preferably be more than half of the bag width to have a wider bearing area. The bag should be completely free of any sideward movements. Now the bag is lifted to height \( h \) manually by this plank either by a single person or more depending upon the load in the bag. The plank is then withdrawn quickly allowing the bag to fall freely to its original position. By doing so, the whole weight of the bag is dynamically applied to the handle. The bag lifting and releasing operation can be mechanized.
The potential energy absorbed by the handle is equal to potential energy due to the free fall.

The energy absorbed by each joint
\[ E = W \times \frac{H}{N} \text{ kg.cm} \]
Where \( W \) is the load in the bag in kg; \( H \), the lifting height in cm; and \( N \), the number of joints.

In normal practice, the lifting height is usually around 16 cm (handle length + head space left in the bag) and number of joints is 4. Therefore, the equation reduces to
\[ E = 16 \times \frac{W}{4} = 4W \text{ kg.cm} \]

The same procedure is repeated till the handle fails. The observation in each drop is recorded. The number of drops from a constant height sustained by the bag before the failure can be taken as the handle strength.

For a perfect bag, i.e. if the material of the bag is isotropic and symmetrical construction and the load in the bag is acting centrally, both the handles should fail at one end. The bag handle strength can be compared by the number of drops sustained before failure.

The velocity of jerk \( V \) can be calculated from the equation \( V = \sqrt{2gh} \), where \( h \) is the height of the drop. The velocity at which the handle fails is the critical velocity.

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References