

Toilet Paper Strength Testing

Introduction

It is common knowledge, gained through everyday experience, that various properties of toilet paper differ from brand to brand. It is probably not common knowledge that toilet paper manufacturers and high volume sellers (think Costco as an example) have a high enough economic stake in toilet paper sales that they conduct their own technical testing of toilet paper, in some cases using very simple qualitative tests that require little or no instrumentation, and in other cases using specialized engineering test instruments.

The following short (1:59) MSNBC video about toilet paper at Costco illustrates the introductory comments above.

<https://www.youtube.com/watch?v=GZcyb24Vaj8>

Testing (Part 1)

Using materials provided (see list below), devise, carry out, and describe a test method that will compare the strength of two or more brands of toilet paper.

Initially this will be an "Apollo 13" experience, where you will have to create your test from the materials available. There are no instructions and no definitions. The meaning of the term "strength" at this point is left to you.

Following your initial testing, we will share methods and results, hopefully do a second iteration (depending on time), and look briefly at the larger issue of standards, specifications and testing in an industrial society and economy.

Materials

Toilet paper (two different brands)
Craft sticks, regular (6)
Binder clips medium (2)
Binder clips, small (4)
Binder clips, mini (6)
Steel washers, 1/2-inch, ~14 g each (~1000 g total)
Paper clips, jumbo (6)
Paper clips, regular (6)
Paper cup, 9 oz
Paper cup, 5 oz
Plastic dropper pipette
Marbles (20)
Rubber bands, ~3 in, (5)
String (2 ft)



Testing (Part 2)

Shown below are a Consumer Reports description of criteria for testing toilet paper along with an accompanying photo, and an ad for Tinius Olsen, a well known maker of engineering test equipment.



Consumer Reports Ratings for Best Toilet Paper

Which toilet paper performed best in our tests?

We tested 25 toilet papers to determine the best-performing models. Our expert lab technicians tested each toilet paper based on the following criteria:

- Strength:** resistance to puncturing. ←
- Disintegration:** amount of time needed for a sheet to break up in swirling water.
- Softness:** judgment of trained panelists
- Tearing ease:** separation of sheets at their perforation ←



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Paper - Typical Calculations

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- Compression ←
- Puncture ←
- Tensile ←
- Peel ←
- Tear ←
- Friction ←

Which Machine Do I Need?

Paper

- Tear strength of envelopes
- Tensile strength of paper
- Wet strength of paper
- Folding endurance of paper and cardboard
- [Tear strength of tissue paper \(pdf\)](#)
- [Puncture strength of tissue paper \(pdf\)](#)
- Tear strength of toilet paper
- Tensile strength of cigarette paper
- Tear strength of newspaper
- Peel strength of labels

Notice the items marked with arrows:

- *Strength: resistance to puncturing*
- *Tearing ease: separation of sheets at their perforation;*
- *Tear*
- *Puncture*
- *Wet strength of paper*
- *Puncture strength of tissue paper*
- *Tear strength of toilet paper;*

Based on your own and others' initial test designs and the items noted above, redesign and carry out a second iteration of a test procedure for strength of toilet paper.

Going Further

The following short (1:39) video shows actual toilet paper testing used by Consumer Reports:
<https://www.youtube.com/watch?v=VOghvssyQf4>

Industrial Standards, Specifications and Testing

ASTM. SAE. USS. ANSI. UL. TAPPI. ISO. IEC. Are you familiar with these acronyms? (Full versions of the acronyms are given at the bottom of the page in small type.) If so, you're likely in the minority. Each, along with



many others too numerous to list here, is associated in some way with industrial standards, specifications and testing. It's probably safe to say that for the general public, and for middle and high school science students, this area is something of a blank. Yet these very things are extremely important to the successful functioning of industrial/technological societies like ours that are intimately related to science and engineering.



From the faulty bolts in the new Bay Bridge to an ad for a vacuum cleaner to the viscosity of motor oil, to buying a 10-24 machine screw you will find industrial standards and test methods involved. The vacuum cleaner ad shown is from the New York Times, Sunday, July 21, 2013. The text at the bottom of the ad (enlarged in the two paragraphs immediately below) says that the claim of superior suction is based on **ASTM F558**. The official title of this standard is **Standard Test Method for Measuring Air Performance Characteristics of Vacuum Cleaners**. Also cited is **IEC 60312-1**, the title of which is **Vacuum cleaners for household use - Part1: Dry vacuum cleaners - Methods for measuring the performance**.

Suction power is measured in Air Watts and, as you can see, DC41 has twice as much suction of the cleaner head than any other vacuum.* Its cleaner head self-adjusts to seal in that suction across carpets and hard floors. And, its Dyson cyclone technology captures more microscopic dust than any other.

*** Machine representation relative to Air Watts. Suction tested against upright market to ASTM F558 at cleaner head, dust loaded as per IEC 60312-1.**

Full versions of Acronyms at top of page:

American Society for Testing Materials (now known as ASTM International)

Society of Automotive Engineers

United States Standard

American National Standards Institute

Underwriters Laboratory

The American Paper Products Institute

International Standards Organization

International Electronics Committee

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More on Test Methods

Consumer Reports Tests

The following item describes two tests that Consumer Reports uses to determine the strength of toilet paper.

How Consumer Reports tests toilet paper

Finding the perfect combination of strong and soft

Published: September 08, 2015 11:30 AM

You think you're picky about toilet paper? Consumer Reports uses machines and specially trained sensory panelists to determine which rolls combine softness, convenience, and strength.

How strong?

We stack and insert eight sheets of each toilet paper into an Instron, a device also used to test sturdier materials like fabric and plastic. It slowly pushes a steel ball through the sheets. The force required to punch through the paper is measured and recorded. Stronger paper can withstand three times as much pressure as the weakest ones before ripping. The Instron also determines how hard you need to pull to rip two sheets along their perforation, or the "tearing ease."

Two Unofficial Test Designs

Shown below are simple physical setups for testing tear strength and puncture strength of toilet paper. Specifications for procedures are not shown, and these are necessary to ensure meaningful standardized testing.



Tear Strength (at perforation)



Puncture Strength (wet)

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