HB Pencil with Eraser

Technical Description

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1. General Description of an HB Pencil with Eraser

An HB pencil with eraser is a small tube-shaped writing implement with a bit of exposed graphite on one end and a cylindrical rubber on the other. The pencil's graphite, commonly known as lead, leaves marks on paper that are erasable by the rubber, which is ideal for correcting mistakes on the fly.

While many types of pencils exist, the most common wooden pencil with eraser is called #2 in the US and HB elsewhere. It has a usual length of 19 cm out of the box and a diameter of 7 mm that peters out about 2 cm before ending on a point at the lead tip (see Fig. 1).

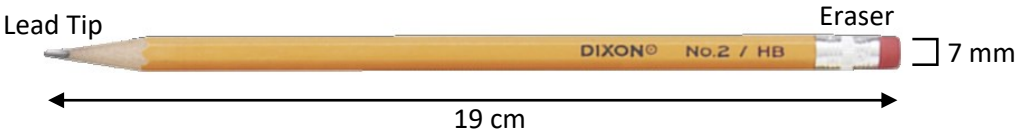

Figure 1: An HB wooden pencil with eraser made by Dixon®.

There are two primary uses for HB pencils: writing down notes and drawing sketches. This makes them a fixture of offices, art studios, and classrooms. The pencil's lead also makes marks on wood, cardboard, fabric, and drywall, so HBs are a mainstay of workshops and construction sites as well.

HBs also last a long time and can write tens of thousands of words, which translates to a month or two of assiduous use—or much longer in the case of sporadic writers [1]. In fact, HBs are so cheap and convenient that they can be found in most homes, workplaces, and schools, resisting the increasing takeover of computers and smartphones [2].

However, pencils are not always appropriate. They do not work on glass, ceramic, or plastic. Likewise, pencils are not suitable for situations that require permanent written marks, like signatures on legal documents, because the erasable pencil marks tend to fade over time.

2. Part-by-Part Breakdown of an HB Pencil with Eraser

An HB pencil with eraser is comprised of two major parts: (1) the body and (2) the eraser.

2.1 Body

The body is the part of the pencil users grasp with their fingers and push against a surface to write or draw something. It typically weighs no more than 7 g and measures 17.5 cm out of the box, so it is extremely lightweight and portable. The body is comprised of three parts: (1) the graphite core (lead), (2) the barrel, and (3) the point (see Fig. 2).

Figure 2: The body of an HB pencil (without an eraser) by Faber-Castell AG.

2.1.1 Graphite Core (Lead)

The graphite core or lead is a thin cylinder of soft carbon material located within the pencil's body (see Fig. 3). The lead is as long as the pencil housing it and can have a thickness that ranges between 0.3-6 mm in diameter, though the lead in HB pencils is only 0.7 mm thick.

Figure 3: A 3 mm-thick pencil lead; the lead in HB pencils is much thinner (0.7 mm).

The softness of the graphite material is key to understanding how pencils work and how they need to be manipulated. On one hand, the lead can shatter inside the pencil's body if the pencil is handled roughly, and since a pencil with shattered lead cannot write, it can only be discarded. On the other hand, the lead's softness is what enables pencils to write in the first place: the pressure created by pushing the pencil against a surface gradually cracks its tip into tiny bits of graphite that stay on the surface. In other words, a pencil writes by impressing paper with lead residue.

The colour of pencil marks ranges from light gray to deep black, depending on the pressure applied and the lead's thickness and hardness. A pencil's hardness defines how much residue stays on the writing surface and how intense the marks are. Softer leads leave darker and more diffuse marks, while harder leads are better for making lighter and thinner lines.

Hardness is determined by the lead grade, a code comprised of three letters—H for "hard," F for "firm," and B for "black"—and a number that quantifies how hard or soft it is [3]. Figs. 4-6 below show 16 common lead grades, emphasizing HB's placement in the middle of the scale:

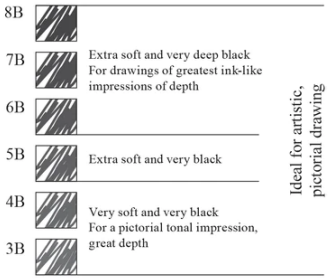

Figure 4: Soft lead grades [3].

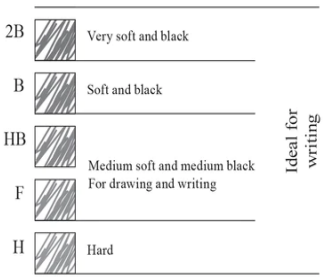

Figure 5: Medium lead grades [3].

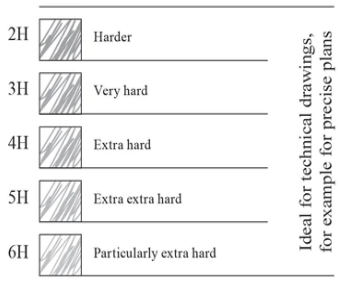

Figure 6: Hard lead grades [3].

2.1.2 Barrel

The barrel encases and protects the brittle graphite core and allows people to safely grasp the pencil with their fingers. The barrel ends where the point begins, so the bodies of unsharpened HB pencils are all barrel and lead (see Fig. 7).

Figure 7: Unsharpened HB pencils by Charles Leonard Inc., which are pencil bodies with barrels but no points.

Barrels come in two shapes: “round” with totally cylindrical barrels (see Fig. 7), and the ergonomic “hex” with barrels shaped like a hexagonal prism (see Fig. 2). In either case, barrels are smooth to the touch, usually dyed—yellow is a common colour for HBs in North America (see Fig. 1)—and sport the pencil’s brand and lead grade in debossed lettering.

2.1.3 Point

The point is the pencil’s writing end. It has a conic shape and spans the final 2 cm of the body. The point is comprised of two parts: (1) the graphite or lead tip and (2) the collar (see Fig. 8).

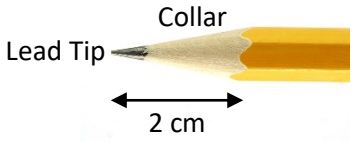

Figure 8: The point of an HB pencil, with a collar and a lead tip.

2.1.3.1 Graphite Tip (Lead Tip)

The graphite or lead tip is the exposed sharp end of the pencil’s graphite core. It measures only 2-3 mm, a little over 1% of a new pencil’s total length (see Fig. 9), but it is the pencil’s most critical part because it is the one that produces the marks. Even when other parts of the pencil have issues, e.g. the barrel has bite marks or the eraser is depleted, if the lead tip is in good condition, then the pencil can still do its main job: writing.

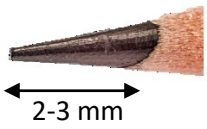

Figure 9: The lead tip of an HB pencil.

The lead tip is more fragile than the lead inside the barrel. It gets dull easily. It breaks if it receives too much pressure. A person who wants their pencil to perform well must handle the lead tip with care and sharpen it frequently.

2.1.3.2 Collar

The collar is the area of the point around the lead tip where the barrel has been shaved away with a pencil sharpener to reveal and shape the inner lead. The collar is rougher to the touch than the barrel and has no dye. A point with a broken-off tip is all collar (see Fig. 10).

Figure 10: The collar of an HB pencil with a broken tip.

2.2 Eraser

The eraser sits on the opposite end of the pencil’s writing tip and rubs out pencil marks from paper. It allows people to correct their mistakes by simply flipping the pencil around and

scrubbing the wrong marks out. Erasers are generally 2 cm long and consist of two parts: (1) the eraser proper and (2) the ferrule (see Fig. 11).

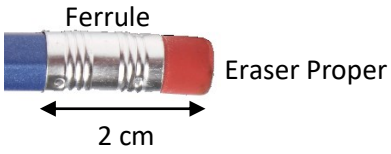

Figure 11: HB pencil erasers consist of a rubber (usually red, as shown) connected to the pencil's body by a ferrule.

Pencil-mounted erasers are convenient, but they are not an essential part of pencils. Many HB pencils have erasers, but not all do. Likewise, harder and softer pencils do not have mounted erasers as often as HBs do because they tend to require larger and more specialized erasers.

2.2.1 Eraser Proper

The eraser proper is a small cylindrical rubber that removes pencil marks from surfaces by breaking and scraping the lead residue out of them. As part of this process, the rubber also breaks itself down gradually.

A rubber on a new HB pencil with eraser has the same diameter as the pencil and is 1 cm long, though only 5 mm are visible and usable, which translates to an expendable volume of about 190 mm^3. This means the eraser has a much shorter lifespan than the pencil itself. The rubber's other 5 mm stay inside the ferrule to anchor the eraser proper to the body of the pencil (see Fig. 12).

Figure 12: A typical HB pencil rubber, detached from the eraser. This rubber's vertical grooves were created by the ferrule's stakes when the rubber was pulled apart from it.

The rubber is perfectly apt for erasing occasional mistakes, but because of its minute size, it does not perform well when extensive erasing is required. Erasing expends the rubber, making it increasingly less effective as it becomes wobblier and looser in the ferrule until it is too small to use. So, people who anticipate needing to erase a lot of pencil marks will do better with separate and larger erasers.

2.2.2 Ferrule

The ferrule is a tube-shaped aluminum sleeve that secures the connection between the rubber and the body of the pencil. It is 13 mm long—half of it covering the pencil, and the other half the rubber—and its diameter is just a fraction of a millimeter wider than the body of the pencil to allow for a snug fit (see Fig. 13).

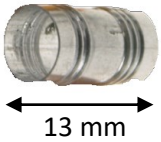

Figure 13: A rubber-less and unattached HB pencil ferrule.

In order to stay attached, the ferrule has two rows of small holes punched around its circumference. Punching the holes sinks the aluminum into the wood of the pencil and the rubber, creating very little stakes that keep the pencil and eraser together.

3. Conclusion

An HB pencil with eraser makes writing, sketching, and erasing simple and accessible to people of all ages and backgrounds, and is the ideal writing implement for every-day needs at home, work, or in school. HBs can be found for sale in any store that may sell some office supplies, from specialized retail chains to gas stations and bodegas. HB pencils with erasers tend to sell for Can$0.20-1.00, depending on the brand and whether they are bought in bulk.

3.1 Cycle of Operation for an HB Pencil with Eraser

The use of an HB pencil with eraser entails four actions: (1) sharpening, (2) writing/drawing, (3) erasing, and (4) storing.

3.1.1 Sharpening

Before a pencil can be used, it must be sharpened. Some pencils come pre-sharpened out of the box; if this is the case, the pencil can be used immediately. Otherwise, if the lead tip is dull or broken, or if the pencil does not have a point, sharpening is required.

Some people like to whittle the pencil point with a knife, but in most cases pencils are sharpened with a pencil sharpener, a small plastic frame or box with a pencil-wide hole. Inside the hole are sharp blades that come together like a cone.

The pencil is inserted in the blade hole, and then rotated by the person's hand. This action shaves the pencil's point, revealing and shaping the lead (see Fig. 14).

Figure 14: A person sharpening an HB pencil with a sharpener by Sysabe. Photo by WikiHow.

Some people have access to mechanical or electric sharpeners (see Figs. 15-16). They replace the manual rotation of the pencil with crank turning or an electric motor, respectively.

Figure 15: A mechanical pencil sharpener by X-Acto™.

Figure 16: An electric pencil sharpener by X-Acto™.

3.1.2 Writing/Drawing

To write or draw anything, the pencil is grasped by the barrel. Typically, this is done by resting the barrel between the tips of the index and middle fingers while holding it in place with the thumb. There is no right way to do it, however, and some people might prefer involving other

fingers or even the palm of their hands. The main consideration should be holding the pencil in a way that does not force the hand into an uncomfortable position.

Then, the pencil is pressed firmly (but not too firmly) against paper and allowed to gently slide over it. This creates a trail of lead that stays on the paper and that can represent any shape the pencil user has the ability to create, from lines and letters to complex diagrams (see Fig. 17). To stop writing, the pencil is simply lifted from the paper.

Figure 17: A person writing words with an HB pencil. Photo by Britannica.

Care must be taken not to rest one's hand on freshly written marks, as the hand can smear the lead residue and create unintended messiness on the paper and on the hand itself.

3.1.3 Erasing

Invariably, people make mistakes when they write or draw. To erase a pencil mark, the wooden pencil with eraser is grasped like before but flipped upside down in the person's hand, so that the eraser is the end closest to the paper (see Fig. 18). The rubber is then scrubbed against the offending mark until the lead residue is gone and the mark can no longer be seen. Intense marks may require more forceful scrubbing.

Figure 18: A rubber erasing a pencil mark. Photo by Readers Digest Canada.

Erasing pencil marks creates some mess: the scrubbed rubber mixes with the lead and then splinters, releasing dirty shavings. So, after erasing, rubber shavings have to be swept by hand from the paper before it can be written on again. It is also a good practice to sweep the floor around the place where a person has been writing or drawing.

3.1.4 Storing

After use, the wooden pencil with eraser can be stored anywhere it can fit in. Common storage places include pencil cases and desk drawers.

3.2 Value of an HB Pencil with Eraser to the User

HB pencils with eraser are cheap, easy to find, easy to use, and convenient. There are alternatives, but they come with downsides: softer or harder lead grades have more specialized uses than general writing and sketching; mechanical pencils are much more expensive and need to be refilled with lead often; and the ink of pens smears easily and can be impossible to remove. So, HBs remain the ideal handwriting and drawing implements for most people in most situations.

4. References

[1] R. Eastaway, “How long a line can a pencil draw?,” *Plus*, March 31, 2021. Available: https://plus.maths.org/content/how-long-line-can-pencil-draw. Accessed: October 24, 2023.

[2] C. Passy, “Why pencils are still so popular—billions a year are sold,” *Morningstar*, August 26, 2023. Available: https://www.morningstar.com/news/marketwatch/20230826356/why-pencils-are-still-so-popular-billions-a-year-are-sold. Accessed: October 23, 2023.

[3] A. Gluza, “Graphite pencils degrees of hardness explained,” *Faber-Castell* (blog post), April 20, 2021. Available: https://www.fabercastell.com/blogs/creativity-for-life/graphite-pencil-lead-degree-hardness. Accessed: October 24, 2023.