Lee Precision Lead Alloy Hardness Tester.

I had been putting off buying a lead alloy hardness tester for far too long. The bottom line was that traditionally such units have always been very expensive pieces of kit. Saeco had the market cornered for many years producing the only tester available to handloaders and whilst it was reputed to be a fabulous piece of equipment the exchange conversion from US dollars to our "own bottom of world Paso" was responsible for more than my own reloading budget going into spasm. At a guess I would say that the vast majority of bullet casters went either without, scrounged a wealthy mate's Saeco, guessed or were oblivious to whole business. What we all needed was a reliable unit that was straight forward to use and would not break the bank or lead to the divorce courts.

Enter Lee Precision.

It would be safe to say that most if not all handloaders are familiar with Lee Precision of the US. Lee has been manufacturing reloading and bullet casting equipment since 1958. Every product of the Lee company must pass the following set of three questions:

1. Does it fill a real need or is it better than any other product available?
2. Can it be produced at an affordable price?
3. Would I buy one?

Not a bad philosophy in my books and though Lee is often criticized for a budget product they stand behind EVERY piece with an *"unconditionally guaranteed for a full two years and a conditional lifetime guarantee".* On the basis of this when Lee entered the lead alloy hardness tester market long suffering bullet casters from far and wide embraced the new tool with gusto. I wanted one too! Of course before I made a leap of faith I did some research by asking questions on the various bullet casting forums on the Internet I subscribe to in order to gauge the degree of satisfaction owners of the units were experiencing. Without fail they all reported bountiful happiness. OK, I was convinced.

Ohh, Ohh, the postie has been!

In good time the unit I ordered from a business contact arrived and in a move quite out of character for me I read the instructions FIRST. Right, got that out of the way now let me at it.

The hardness tester consists of three items (see fig. 1).

They are:

> Indenter – At first glance looks like a regular seating or reloading die. The body of the indenter is threaded 7/8 X 14 in order for it to screw directly into all standard reloading presses. The indenter is itself made up of 4 major components being 1) the threaded body, 2) hollow retainer cap, 3) plunger with 5/32 (4mm) harden ball indenter and 4) the calibrated spring.

> V block – This is the component the bullet for testing rests in and is made to fit into the shell holder receptacle on the press ram.

> Magnifier – A 20 power magnifier with an etched lense carrying an imperial scale from 0 to 0.1 inches is 0.002 inch increments.

Accompanying the aforesaid mentioned pieces is the sheet of instructions on the back of which is a reference chart for matching the size of the indent in the alloy on a scale to determine the Brinell hardness. This is a very clever initiative by the good folk at Lee as printing the reference chart on the instructions prevents the user from throwing the instructions away which of course is what most men would do…….COME ON…..be honest. Also on the chart Lee listed the maximum strength and pressure yields for each graduation. More on this later.

NOTE: The Brinell (often mispelt with two N's) scale was named after Johan August Brinell in 1900 and is used to measure hardness across a range of materials. The formula for you mathematical types is:

$$\mathrm{BHN} = \frac{2P}{\pi D(D - \sqrt{(D^2 - d^2)})}$$

Where:

P = applied force (kgf)
D = diameter of indenter (mm)
d = diameter of indentation (mm

Courtesy of Wikipedia.

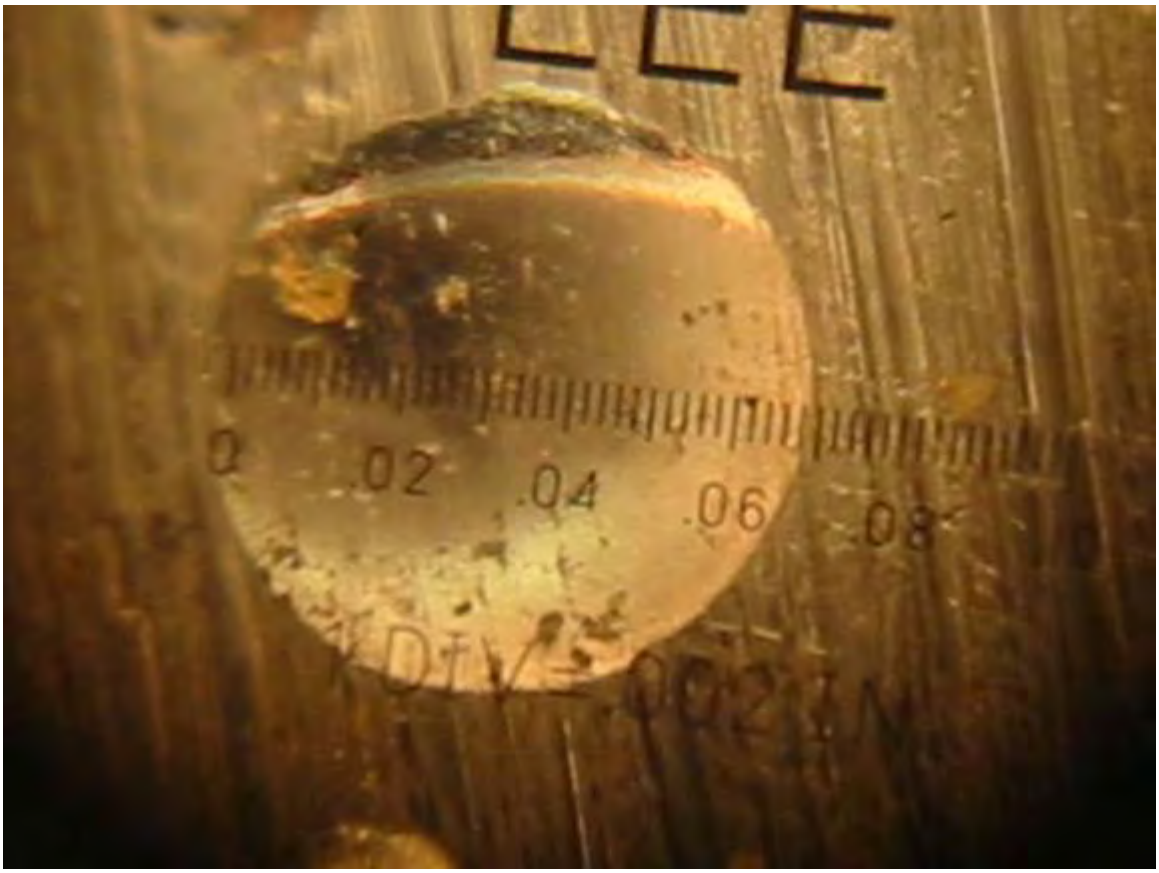
<u>So how does it work?</u>

Dead simple actually. The instructions said (I know because I read them) to screw the indenter in the loading press and install the V block in the press ram. File a small flat section on the bullet to be tested and lay it in the V block (Fig 2.). By filing a flat spot on the round bullet the user creates a 'virgin' platform for the indenter from which to take an accurate reading. Run the ram up so the V block forces the bullet onto the 5/32 inch hardened indenter ball (Fig 3.). The retainer cap is hollow and the internal plunger rises through this as the ram is raised. The press ram should be raised until the internal plunger, via the retainer top cap, is flush with the top of the cap (Fig 4.). A small amount of time playing with the set up will allow the operator to screw the indenter housing up or down in the press so as to match the maximum extent of the ram with the optimum position of the plunger After a period of 30 seconds has elapsed the ram should be withdrawn an the bullet removed so that indentation in the alloy can be measured. Softer alloy allows the creation of a large indentation and vice versa for harder. Fig. 6 shows two Lyman 311008 bullets; left cast in wheel weight, right cast in linotype. Note the difference in indent size.

The calibrated spring has been tailored to apply 60 pounds (27kg) of force at the interface of the alloy and the 5/32 inch ball indenter GIVEN that the internal plunger is flush with the top surface of the retaining cap per Fig. 4. Lee advises that should the plunger pass higher than 1/64 inch (0.40mm) above flush the bullet should be discarded and the process repeated. Presumably this is because a

force of greater than 60 pounds may have been applied thus putting the test beyond the parameters of the data chart. It is worth mentioning here that the leverage available with a loading press makes 60 pounds feel significantly less. Child's play.

Enter the 20 X magnifier. This is where things get interesting. Be advised that if you can not back a trailer you are most likely not going to find using this little gem very enjoyable. Due of the arrangement of the 4 lenses in the magnifier all movements are in reverse. If I had actually listened to my 6th and 7th form physics teacher I would be able to explain this and put you to sleep instantly so from that point of view my inattentiveness is your gain. My scholastic achievements aside, when looking down the magnifier at the indentation in the bullet left is right and up is down. This really does your head in but of course so does reversing a trailer. Ultimately the idea is to straddle the indentation with the scale on the magnifier lense in order to accurately measure the width. By some miracle I was able to capture an image of this in Fig. 5 albeit slightly off centre. Fig. 5 shows an indentation with a width of between 0.070 and 0.072 (70 and 72 thou) we shall call 0.071 inch. Matching this to the chart supplied with the kit gives a Brinell hardness of 10.1 with maximum alloy strength of 14327PSI maximum chamber pressure 12895PSI.



Personally I see little value in the strength and chamber pressure data. How many reloaders and cast bullet shooters have the ability to accurately measure the chamber measure of any given load? It could be argued that the figures on the Lee chart can be matched to those in the likes of the Lyman Cast Bullet Handbook however like all ammunition loading, every piece of book data is nominal only IE: in the TEST firearm, with 'X' lot of powder, 'Y' lot of primer and 'Z' batch of cases a load produced a "nominal" 21546PSI on a given day. In reality, for the handloader, this figure could be 10% in either direction under different circumstances IE: your rifle and load. As such I tend to look at the pressure "advice" we shall call it, as interesting but not necessarily of any great value to me. Sort of like the flared body work on our Isuzu 4X4 which is of significantly greater value to my wife's eyes than mine when up to our axles in mud.

To the 'nay sayers'.

When conducting my research into lead alloy hardness testers and asking other shooters worldwide for their input there was a reasonable amount of discussion on the ability of 'X' model to accurately measure the true Brinnell hardness of a sample. People have their own biases for whatever reason and while some folk claimed the Lee tester was a great device others spoke of how they considered its ability to provide accurate data inferior to the likes of the Saeco or LBT tester from Veral Smith of Lead Bullet Technologies.

Here is my take on it. Numbers mean different things to different people. Three quarters of the people in the world make up 75%. Well duh! An example of numbers that mean NOTHING.

Does the Lee, or for that matter, any of the lead alloy hardness testers give a true Brinell reading? Who knows and for that matter who cares? What I have found with my Lee tester is it gives CONSISTANT readings of the same alloy over several tests. This is the most important factor to me. Whether the reading is true to 'book' values is of little consequence really. Take for example my last batch of wheel weight produced an average of less than 10 Brinell. Wheel weights are quoted as having a Brinell of between 11 and 13 depending on who you believe and to complicate this further there is now NO set formula for wheel weight in the world anymore which throws all of this right out of the window anyway. What shooters need for continuity is a base line from which to work and this is what the Lee tester allows for.

HYPOTHETICAL EXAMPLE: 'X' load shoots 2MOA with cast bullets measuring 10.1 on the Lee tester. The next batch of alloy measured 10.5 and the load shot 3 MOA. The only change was the alloy which indicates a variance in alloy hardness was the cause of the loss of accuracy. Comprende?

Another criticism of the Lee unit is it does not measure below 8 on the Brinell scale. The issue here is that 'pure' lead is quoted at 5 Brinell so a hardness tester should measure to this level. Lee belief that softer than 8 is almost pure lead and as such readings below this level are without real value.

Pros and cons.

The Lee hardness tester is, in my opinion a functional and well built unit. No, I am not being paid to say this and certain Lee products I would not cross the road for – the lead pot and ladle spring to mind. In stark contrast my Lee collet dies will be pried from my cold, dead hands. The tester does have pros and cons and as I see them they are:

PROS:	CONS:
Competitively priced.	Requires bullets to be files to create flat spot.
Consistent over all lead alloy tested.	Magnifier takes a bit of getting used to.
Compact and easy to store.	Must be used in a press.
Compatible with standard 7/8 X 14 presses.	Chart must be used to interpret reading to Brinell.
With practice, easy to use.	Does not measure below 8 Brinell.

Lee sum up the benefits in a few simple sentences:

"No more wasted components shooting too soft or too hard lead. Cast and load with confidence knowing your alloy is up to the job. Quickly and precisely check hardness of your lead alloy. Exclusive conversion chart tells the maximum operating pressure of any lead alloy."

This is a very valuable and true statement. Most cast bullet shooters use alloy much harder than is really necessary. A friend of mine uses straight linotype in .45ACP handgun loads. Pure lead would suffice and most likely shoot better than valuable lino metal. Example: Today I shot an 8 Brinell bullet in my .38/303 at 1700fps with very good accuracy.

All in all I found the unit comparatively straight forward to use. I tested from very soft, almost pure lead reading 8 on the scale to oven heat treated wheel weights reading 33. My unit has proved its worth so far as it has reassured me that my heat treating is generating VERY hard alloy well beyond the ability of the finger nail test. Yes, the magnifier is a bit of a handful to operate to begin with but if I can manage to take a photo down it then the design can't be all bad.

I give the Lee hardness tester 8.5 bullets out of 10.