

# Digital Calipers - A Comparative Review

It's fair to say that, although a proportion of readers will still use mechanical vernier calipers on a regular basis, and an even larger proportion will have one sitting at the back of a drawer, the vast majority will rely on one or more pairs of digital calipers for most of their accurate measuring tasks. Digital callipers are so handy and easy to use that they even get used for the majority of jobs where a micrometer would be ideal. Even a relatively worn or cheap digital vernier will allow you to work to better tolerances than some past model engineers who had to make do with no more than a pair of simple, non-measuring,



The Mitutoyo caliper is very well packaged and comes with a sheaf of paperwork.

1



The storage case is inside a bright orange slip case.

2

looking rather tatty as the silver paint has scratched off.

One quick aside, because of their general resemblance to mechanical vernier calipers, these devices are often referred to as 'digital verniers'. It's possible to come up with a complex justification for such

a name, but if you want to stay out of meaningless arguments, I suggest you call them 'digital calipers'.

## Mitutoyo Absolute Digimatic

This is a professional measuring instrument and is the only one of the calipers that came with a test certificate – that matches the serial number on the back of the caliper body, figure 1. It comes in a nice quality blown plastic box with a spare SR44 (silver oxide) battery clipped to an impressive sheaf of paperwork, the caliper itself is sealed in a plastic bag with a sheet of VCI (rust inhibiting) paper and a slip of the same between its jaws, **photos 1 & 2**. The main instruction leaflet folds out to almost A2 size with many language sections. It is not particularly user friendly, but does include a proper explanation of the digital communications protocol of the calipers – this is different from that used by most inexpensive calipers and digital scales.

The digimatic works in a slightly different way from the other calipers; when you first switch on you are prompted to zero it and use a special button (that needs to be depressed well home and held there) to set

the origin, it also will never miscount because of moving the slider too fast. This is the 'Absolute' aspect of the calipers as no matter what you do they will always remember where they were and show an accurate reading – this is what really sets them apart from cheaper calipers. Unlike my old calipers which I always zero before use, over a couple of weeks with the digimatic it hasn't needed the origin resetting and reliably shows zero every time it is closed, aside from when I took the battery out.

As mentioned it used a silver oxide battery and the expected service life is 18,000 hours or 3.5 years per battery. The caliper has a true absolute/incremental mode

calipers and a skilled sense of touch.

That said, the merits of various calipers from cheap and cheerful to the top of the range have been debated on the Model Engineer forum and elsewhere many times. From fundamental accuracy to battery life it's clear that not all calipers are equal, but just how big are the differences and what issues should you bear in mind when choosing a pair? For this test three brand new calipers, supplied by Machine DRO, [www.machine-dro.co.uk](http://www.machine-dro.co.uk), were put through their paces for this test, at each of three price points as well as some older budget calipers. These were:

**Machine-DRO - ME-CAL-TOL-150** price is £12.76 inc vat, their own-brand entry-level caliper.

**Moore & Wright - MEB-MW110-15DBL** price is £23.70 inc vat (list price is £47.40 inc) from their Value Line series.

**Mitutoyo - 500-196-30** price is £80.00 inc vat (list £118.80 inc) popularly known as one of the 'Absolute Digimatic' calipers.

I also tested the two of my varied collection of 'budget' calipers:

Proops branded, a rather old pair.

Aldi 'Workzone' nowhere near as old, but



The reading head design is subtly different from the usual appearance.

3



The Moore and Wright caliper has distinctive styling.

so you can directly measure the difference between two sizes without having to change the zero point.

Although from a distance they look much like most digital calipers the detail design is subtly different, **photo 3**. Instead of the otherwise obligatory 'threading chart' on the back of other calipers, it has an assortment of code, serial and model numbers and reminders of how to set the origin and move between absolute and incremental mode.

As you would expect from a high-end instrument, the finish of the Digimatic is excellent; it has a virtually mirror finish to the surfaces of the rail and the corners of the rail are finished so as to be comfortable to hold. The jaws are well finished but have a sharper corners, presumably to ensure measuring accuracy.

The neat adjustment button and general silky-smooth action of the Mitutoyo make it a pleasure to use.

### Moore and Wright Digitronic Value Line Series

Sitting between the budget end of the market and the full professional instruments, Moore and Wright's value line is aimed at the serious hobbyist or production environments rather than the toolroom. These Moore and Wright calipers are the most distinctive of all the pairs I have seen. The body is blue, rather than black, with an oval window and distinctive heavily ribbed thumb-rest, **photo 4**. It comes in a blown plastic case that strongly resembles, but is not identical to, the Mitutoyo one together with a less daunting set of paperwork, a spare battery and the caliper itself inside a ziplock bag with a slip of VCI paper, **photos 5 & 6**.

Like the Mitutoyo it keeps its zero very well, but it doesn't have the same 'protected' zero-button. It also shares the absolute mode, something I haven't seen on cheap calipers yet a very useful feature. It is well finished

and pleasant to handle, but not quite to the 'silky'ness' of the Mitutoyo standard. I should mention that, as the name suggests, more expensive calipers are



Less paperwork, but still a slip of VCI and an internal bag from M&W.

available from M&W which are directly comparable to the Mitutoyo. The M&W caliper doesn't have a socket for remote reading.

It uses a CR2032 lithium battery, a spare is supplied, which is covered by an internal seal. I am not sure of the purpose of this seal as the external cover seems perfectly



Still nicely presented and with excellent instructions, the Machine DRO own-brand caliper

adequate and in common with the other calipers this isn't a sealed unit. I have a suspicion that if you left the seal out you could use a thicker CR2045 battery. The expected battery life is a year.

They don't come with a test certificate but the instruction leaflet does state that they certify it has been inspected and meets the standards set out in their catalogue. The leaflet itself is clear and gives guidance on use.

### Machine DRO Calipers

These are marketed as a



A subtler slipcase from M&W

budget caliper, but I understand they are at the better quality end of the 'generic Chinese caliper' and sold at a low mark up to achieve a competitive price. Like many of these entry level calipers the box is a robust plastic one with a high density foam insert, **photo 7**. A nice touch is a bit of extra soft foam in the lid to stop the calipers rattling.

In the box is a spare LR44 battery and a silica gel sachet, together with Machine DRO's own instruction leaflet which is, to be honest, the most attractive and readable of the three. There are different versions available with tolerance, preset or ABS modes and the use of these is clearly explained on the leaflet.

This version was the tolerance type, and you can easily set high and low limits, handy when doing a repetition job. It has a standard 'sino' interface, as also used on digital scales, hidden behind a removable cover, **photo 8**.

As you might expect, this budget caliper doesn't feel as smooth or well finished as the M&W and Mitutoyo instruments, however, it is better than some other budget calipers that need the sharp corners of the beam breaking in order to make them pleasant to handle. It has a smaller display size than the other two new calipers.

### Comparative Tests

I carried out a series of comparative tests across the three new calipers, as well as a 'Proops' branded unit that is about sixteen years old and a 'Workzone' (Aldi) caliper. The Proops unit has lost its fine adjustment wheel, but is not unpleasant to use, perhaps



The read head of the M-DRO caliper



From the top, M-DRO, M&W then Mitutoyo at the bottom, if this prints well, you will be able to see how the finish improves as you go down the pile.



The three calipers all have reasonably sized gib screws, making adjustment easier.

because it is well worn in, I would say it is comparable to the Machine-DRO unit to use – it was probably made before large numbers of very cheap calipers appeared on the market. The Workzone caliper is the roughest feeling of the five and has a large, angular silver-coloured body. These both use LR44 cells and, interestingly, both have larger digits than the Mitutoyo and M&W calipers. The Proops caliper has a 'sino' interface but the Aldi one does not. I also did incomplete tests on my very first set of calipers, a glass-filled nylon pair reading only to 0.1mm or 0.01 inch; with a small display, awful feel and high battery consumption, they stopped working during the tests. But don't condemn all plastic calipers - polycarbonate ones under Moore and Wright's Baty brand name are used for measuring delicate objects such as collectables and antiques, although they probably aren't the best choice for a metalworking workshop.

### Beam Parallelism and Fit

The 'beam' is the part of the caliper along which the read head moves, **photo 9**. The fit of the caliper head to the rail can usually be adjusted with two gib screws on most calipers although many owners don't realise this and use the locking screw instead. If you use the proper gib screws then you will get the most accurate results. The three calipers (Mitutoyo,

M&W and Machine DRO) have large enough screws for them to be relatively easily adjustable, **photo 10**, some cheap units use very small screws that need the use of a tiny jewellers screwdriver.

All three of the new calipers also showed no difference in width between each end of the rail, this meant that once adjusted the head moved freely along its entire length. The Proops and Aldi calipers had 0.01mm difference, which explains why they tend to become a bit tight when fully opened; this may be due to wear, however. I have another cheap pair where the difference was so great I had to work on the rail with a diamond slip as when it was set not to be wobbly at the jaw end, it would not open past half way. I haven't included that pair in the test as I have no idea where it came from, but take it as read that it is a poor performer. The plastic caliper was all over the shop, with errors of varying size up to 0.06mm along the beam.

### Thumb Rollers

The thumb rollers help you get consistent and delicate feel with the calipers. Funnily enough this simple component reflects the comparative qualities of the instruments, that on the Mitutoyo being particularly well finished with a nice crisp knurl. The Proops caliper has had its roller broken off, **photo 11**, and this seems to be a problem with

other cheaper units which seem to have less 'meat' on the hook which holds the roller than the branded items.

### Basic Accuracy

I have an accurate 25.00mm carbide test rod, used for setting my 1-2" micrometer. I used this to test each of the calipers. All three of the new calipers (Mitutoyo, M&W and Machine DRO) read a rock steady 25.00, my elderly Proops read 24.99 which is creditable for an elderly unit. The Aldi one gave readings of 25.03 and 25.02, despite the tatty appearance this one has not had a huge amount of use and I shall not rely on it in future. It is also noticeable that the Mitutoyo and M&W calipers read zero when closed, every single time.

### Temperature Sensitivity

Naturally any caliper will be calibrated at a fixed temperature, typically 20 centigrade (this is quoted on the Mitutoyo test certificate), but in our workshops we regularly see changes in temperature of several degrees over a day. Naturally the beam of the vernier will expand, but as most workshop metals will expand by a similar amount this probably doesn't make a critical difference. What is of more concern is the 'drift' in readings with temperature that I have previously noted. To run this test, I placed the five calipers in the fridge for three hours until they had stabilised at 6°C. I then made sure each one was zeroed and adjusted it to read 100.01 millimetres. It was a fairly warm day and within minutes I could see the displays of the cheaper units flickering. After three hours and stabilising at 22.5°C, **photo 12**, the results were telling. The Mitutoyo and M&W calipers still read 100.01, rock solid despite a 17-degree temperature change, **photo 13**. The Machine DRO caliper's reading had dropped by 0.07mm and the Proops rose by 0.07mm. The Workzone calipers reading had dropped by a full 0.12mm. When closed the M&W and Mitutoyo calipers both read zero, the Machine DRO retained its -0.07mm error and the Workzone went to -0.13, **photo 14**, very little further change. Interestingly, the Proops read 0.12, suggesting that the temperature change had really upset it.



11 *Oops! The venerable Proops caliper lost its thumb roller many years ago, but is still accurate enough to use, if not perfect.*



12 *A max-min thermometer was used for the temperature stability test.*

Now a 17 degree temperature change is extreme, even if we warm up a cold workshop on a frosty day, but these results show that even just a change of a few degrees is enough to make cheap calipers drift out of calibration by enough to cause problems if we are working to fine tolerances. The answer is simple, try not to let them heat or cool down rapidly and always zero them regularly.

### Current Consumption

I have a sensitive ammeter capable of measuring down to 0.1uA, so partly insulating the batteries with a slip of paper I was able to take current readings for each caliper. I was initially surprised to see the M&W was by far the greediest taking 3.5uA, with the Mitutoyo not far behind with 3.0uA (actually, its reading consistently swapped between 2.8 and 3.3). The Machine -DRO caliper used a tiny 0.3uA, Proops 1.7uA and the Aldi 0.6uA. I should add that the plastic calipers use a whopping 5.7uA!

With this sort of device the active current consumption is very much related to the 'clock rate' or how fast the processor inside is working. I suspect that the two high-end calipers both work rather faster than the cheaper units.

But, the popular wisdom is that inexpensive calipers eat batteries compared to the better units, and what of Mitutoyo's claim of a 3 1/2 year battery life? There had to be more going on so I decided to take a second set of readings with the displays switched off. The difference was immediately apparent. Both the Mitutoyo and M&W calipers gave readings of 0.0uA – in other words their consumption when switched off was less than I could measure. The Machine DRO flickered between 0.0 and 0.1, so I estimate a consumption of a creditable 0.1uA. In contrast, the cheap Proops unit still used 0.4uA when switched off and the Workzone one 0.3uA.

These currents are very low, indeed it suggests the Aldi unit should have a battery life of about five years. In practice, however, most people's experience is that cheap calipers will last up to a year on a new battery, usually failing rapidly in the cold winter.

The measured figures bear out the

observation made elsewhere that high quality calipers do use much less current when switched off.

Another observation is that the Moore and Wright and Workzone calipers both switch off automatically – in fact my only real criticism of the M&W calipers is that they switch off a bit quickly, although they remember their setting. The others don't, or at least don't do so in less than about 20 minutes. Whether you have cheap calipers or high end ones, it IS worth switching off the display to extend battery life.

### Real Budget Calipers

I did a few quick checks on a brand new budget pair for a comparison. It is more poorly finished than any of the ones tested above, with sharp edges to the beam. It took several resettings before it would reliably read zero and on the 25mm standard it reads between 25.01 and 25.02 depending which end of the jaws you use. My verdict on this one is that it might find a use as a drilling machine depth indicator, but you wouldn't want to use it regularly or rely on its accuracy, yet other relatively inexpensive budget calipers clearly perform better than this.

### Conclusions

Its clear from these tests that, as you pay more, you really do get better quality. At the real budget end of the market things can be hit and miss because two apparently similar calipers can be rather different in terms of accuracy, temperature drift or current consumption, for example.

The Mitutoyo Digimatic Absolute calipers are understated but clearly a top-end product. They are a delight to use, and you know you can just pick them up and use them without having to worry they have drifted or lost their origin. If you can afford them and are someone who gets pleasure out of owning and using the best, then these are for you.

The Moore and Wright value range are rather more colourful, and in practice, not far behind the Mitutoyo to use. To be honest, they will probably meet all the practical needs of most model engineers. And at under £24 you don't have to invest



13 *A seventeen-degree temperature change did not affect the Mitutoyo's reading – the M&W caliper was also rock solid.*

a lot to get the quality feel, better battery life and great accuracy, even with changing temperatures, of the M&W calipers.

On the other hand, if you are on very tight budget or you want some 'hack' calipers to live in the swarf tray, then still choose with care. Budget calipers are not all equal, and you could do far worse than the Machine DRO budget pair; at less than £13, it really seems foolish to bother going for anything cheaper as they are both accurate and well finished enough to be comfortable to use. Whatever budget calipers you use, though, zero them frequently and remember to switch off the display when not in use.

Finally, why not visit a reputable supplier like Machine DRO and do a comparison yourself. Of course the danger is you go out planning to buy budget and come home with a Mitutoyo... ■



14 *The Workzone caliper was most affected by changing temperatures, drifting about 0.007mm per degree, enough to cause material errors in the average workshop.*