BHS-A Beehive scales

User Manual

Ver. 1.1A

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Contents

1. The purpose of the device

BHS-A Beehive Scales provide a tool for monitoring the status of a hive. Monitoring the beehives in this way is almost completely invisible and non-disruptive to the bees. Yet it gives the beekeeper all sorts of useful information, such as hive production and [??].

A benefit of BHS-A Beehive Scales is that they allow monitoring the hive's status without the need to open the hive. It is well known that opening the hive is stressful for bees and lowers hive resistance to diseases and parasites. Additionally, as bees do no protect the back of the hive, where the scales are operated, there is usually no need to wear protective clothing.

The scales can be used in a number of ways:

- If you weigh a hive periodically (eg. weekly), changes of honey stores can be detected, i.e. whether bees increase or consume their honey stock.
- If you weigh a hive before harvesting and then after, you can note when the hive has regained its previous weight and may be ready for the next harvest.
- If you have a number of hives, you can identify hives which gain weight slower or lose weight faster than the majority, thus identifying the weaker ones that require your attention.
- If you detect a drop in weight around the time of good nectar availability, this indicates that the hive may have swarmed.
- If you monitor hive weight before and during winter, you can detect the hives that may have insufficient stores and should receive additional feeding.

NOTE: The scales have been designed as a beekeeper's tool. **THEY ARE NOT SUITABLE FOR TAKING WEIGHT MEASUREMENTS THAT WILL BE USED FOR TRADE OR COMMERCE.**

2. How the scales work

Beehives are generally uniform in their distribution of mass, i.e. the combs inside the hive have their weight evenly dispersed and not skewed towards the front or back. Therefore, the design of the scales is based on an assumption that the hive centre of weight is in its geometrical centre. This is true for all hives, except those with very serious problems such as a disease or a die-out.

BHS-A Beehive Scales give the beekeeper an indication of the weight of their hives. This is represented numerically on the display unit (the '*displayed weight*'). You can set the display to show kilograms, jin (Chinese weight unit, 1 kg = 2 jin), pounds or ounces.

However remember, the displayed weight is not the true weight of the hive (the '*actual weight*'). The displayed weight is approximately one quarter (or 25%) of the actual weight. Therefore, to obtain the actual weight, multiply the displayed weight by four. For example, if the displayed weight is 30 kg, the actual weight is about 120 kg.

The actual weight is accurate to within +/-5%. It is possible to calibrate the scales to obtain much higher accuracy. You can find detailed instructions for calibrating the scales in section 7.

BHS-A Beehive Scales are made of two separate parts – a **hive platform** and a **measuring frame** with a **display unit**. The assembly, installation and use of these to measure your hives are outlined in this manual.

The beekeeper needs to install a hive platform under each hive. The measuring frame can then be taken from hive to hive in order to weigh them. A hive platform with measuring frame attached can be seen in Figure 1. A beekeeper needs only one measuring frame regardless of the number of hives.

Figure 1. A hive with BHS-A Beehive Scale attached

3. Assembling the hive platform

You need one **hive platform** for *each* hive. Each platform is made of two rectangular frames – bottom frame and top frame - connected by two hinges, see Figure 2. The platform has been designed to be inexpensive and easy to make by a beekeeper with basic tools and elementary carpentry skills.

Figure 2. Assembled hive platform

The design of the platform differs slightly depending on the *width* of the hive. These instructions are for hives up to 380 mm (15”) in width. A typical Langstroth 8-frame hive, which is 356 mm (14”) wide, meets these requirements.

Note that the length of a hive can be variable. ‘L’ in these assembly instructions refers to the length of the hive. Measure the length of your hive before you continue. The design is suitable for hives of any length.

Larger hives, ex. 10-frame Langstroth ones, may require some modifications to increase the platform width. These modifications are not covered in this manual. However, if you do need to modify the design, ensure that the construction is able to carry the maximum expected hive weight and that this weight will not overload the display unit (maximum displayed weight = 40 kg). Also ensure that the fixed areas for attachment plates on the lower part of the platform are left unobstructed by the upper part of the platform. Such modifications should result in a platform that is sufficiently strong and does not obstruct access to the attachment plates.

If you purchase the beehive platform as a ready to be assembled kit, measure your hive and check that it suits your hive. Then assemble the platform as per instructions.

If you make the platform yourself, you will need timber, two hinges and a bag of BHS-A Beehive Scale custom fittings, which should be purchased separately. You will need one bag of custom fittings per platform. BHS-A Beehive Scale custom fittings kit for beehive platform assembly is shown in Figure 3.

Note that the kit *does not* include hinges and screws to fit the hinges. Any reasonably strong hinges for outdoor use (stainless steel, brass or galvanized) are suitable.

Figure 3. BHS-A Beehive Scale beehive platform custom stainless steel fittings. These represent fittings for one beehive platform.

The timber you choose to make the beehive platform from should be both strong and durable for outdoor conditions. Quality hardwood decking, typically 19 mm (3⁄4") thick and at least 90 mm (3 1⁄2") wide is an excellent material, but other sizes can also be used.

Remember: the assembly instructions that follow are applicable to hives **up to** 380 mm (15") wide.

To build a typical Langstroth 8-frame beehive platform, which has a footprint of 508 mm (20") x 356 mm (14"), you would cut:

- 3 x pieces hive width **W** long, in this case 356 mm (14"),
- 1 x piece 450 mm (17 3⁄4") long (the same length for any hives up to 380 mm wide),
- 4 x pieces 533 mm long (hive length **L** plus 25 mm/1 inch).

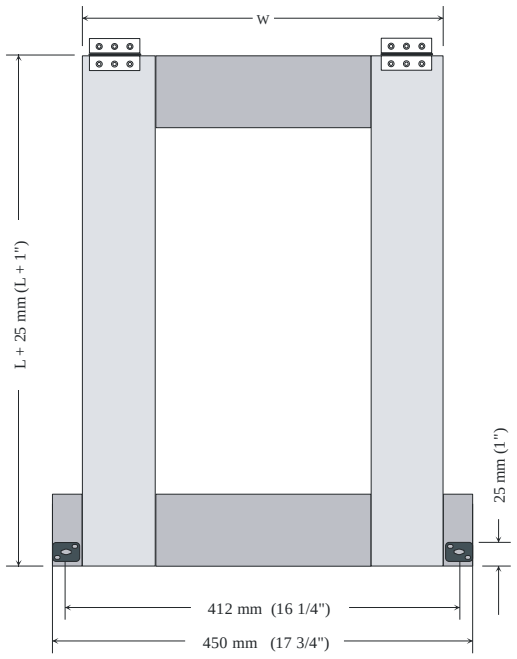
To assemble the lower frame, take 1 x 450mm piece, 2 x 533mm pieces and 1 x 356 mm piece and lay out as per Figure 4. Use carpenter's square to assemble the pieces.

Make sure that 450 mm (17 3⁄4") piece is centered evenly. Use at least two timber screws for each corner.

Attach the hinges at the top parts of the bottom frame using only one screw for each hinge; leave the remaining screws until later. Place the hinges as wide as possible and ensure that they are the same distance from the back of the platform.

If your hive sits on a strong, sufficiently wide timber base, you can use it instead of the bottom frame – attach all the bottom frame fixings directly to your base.

Figure 4. Lower frame as viewed from above.



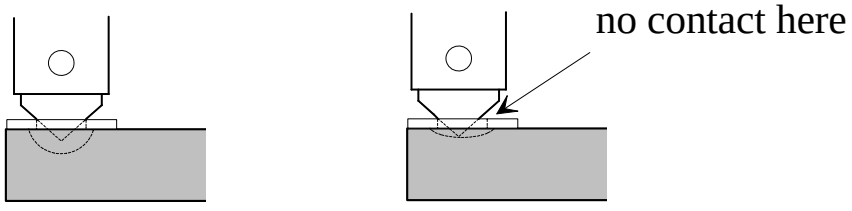
Determine the location for the attachment plates included in the bag of BHS-A custom fittings. The plates should be placed as in Figure 4 – centres 412 mm (16 ¼") apart, both at the same distance to the hinges. Mark the centres of each plate using the tips of the measuring frame as a marking tool.

Before affixing the attachment plates, use a large diameter drill bit (10 mm - 3⁄8" or more) to drill under the centre of each plate to the depth of at least 7 mm (1⁄4"). This will ensure that when you insert the measuring frame tips, the tips contact the attachment plates and not the timber underneath, see Figure 5. Attach the plate, two screws for each, but do not tighten the screws yet.

Again use the tips of the measuring frame to finally position the attachment plates to ensure the measuring frame connects to the attachment plates evenly at four points as shown in Figure 5. Screw holes are elongated to allow you to slightly move the plates sideways. The drawing on the left shows the tip contacting the attachment plate evenly on both sides – this is correct. The drawing on the right shows the tip making contact on the left side only. This can be due to improper alignment of the attachment plates or the drilled hole being too shallow and the tip hitting the timber.

Tighten the screws of the attachment plates and finally verify that the measuring frame indeed contacts the attachment plates evenly at four points and the tips do not rest on the timber.

Figure 5. Alignment of frame tips and attachment points.



Assemble the top half of the hive platform, starting with the cross supports at the front (hinge) side – mount the hinges with one screw each. Open and close the hinges a few times – this will set both hinges precisely in line. Now tighten the hinge screws that are already in place and install the remaining ones. Verify that the hinges work smoothly. Attach the remaining pieces of the top half, again using carpenter's square. Ensure that the top half is aligned with the lower half. See Figure 2 for a picture of a fully assembled hive platform for reference.

Drill a 6 mm (1/4") hole for the eye bolt in the rear cross support (i.e. the non-hinge side) of the top half of the platform. Find the middle point between the two attachment plates and drill the hole there. When marking the location for the eyebolt, ensure that the centre of the hole is approximately 2 - 3 mm (0.1") closer to the edge of the platform than the centres of the attachment points. Install the eye bolt with one normal nut at the top, then a washer, platform timber, another washer and the nylock nut underneath.

Note that if you have only one hive, the height of the eye bolt is not critical. However, if you have more than one hive it is highly recommended that all the eye bolts be at the same height to give you the same lift for each hive.

In order to test that you have assembled your hive platform correctly, attach the measuring frame as in Figure 6 and load the platform, ex. stand on it. Figure 6 shows a hive with the frame in place, handle down. If the platform has been assembled correctly, an unsupported frame with the handle down stays upright, vertical or leaning slightly away from the hive. If it leans in the direction of the hive, drill another hole for the eye bolt, closer to the edge of the platform. If the frame leans excessively away from the hive, drill another hole at greater distance from the edge. Note that the eye bolt holes do not have to be exactly in the middle, they can be up to 12 mm (1/2") to the left or to the right. This allows you to drill alternative holes for the eve bolt to the left or right of the initial one.

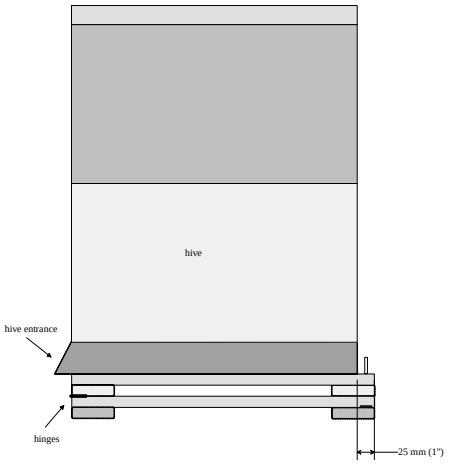
Figure 6. A hive with BHS-A Beehive Scale attached

4. Installing a beehive platform

Installing a beehive platform is straightforward and it has to be done once only for each hive. Once a platform has been installed, leave it there. Platforms are intended to be installed permanently under the hive.

As shown in Figure 7, the hinges of the platform are placed on the entrance side of the hive. On the other side of the platform, at the back of the hive, are the components to attach the measuring frame. The two attachment plates should be on the lower part of the platform. The eyebolt should be on the top part of the platform.

Figure 7. Placement of an assembled beehive platform under the hive.



5. The display unit

See figure 8 for a picture of the display unit.

Figure 8. BHS-A Beehive Scales display unit.

You can switch the display unit ON by pushing the POWER button once. The same button switches the display unit OFF. In some cases, to switch the display unit OFF you need to push the POWER button more than once.

Immediately after you switch the display unit ON, the LED goes ON and the display unit enters SELF-CALIBRATION mode to determine the zero level. Make sure that while the display unit is self-calibrating, no load is applied to it. Upon completion of self-calibration the LED goes OFF.

Measurement process differs depending on whether DISPLAY LOCK feature is active or not. The frames are being shipped with the DISPLAY LOCK active.

If DISPLAY LOCK is active, once load has been applied to the unit the LED starts flashing. It stops flashing after a stable readout has been detected. This readout will remain on the display unit until the POWER button is pushed again. When you push the POWER button again, the display unit will start to take another weight measurement.

If DISPLAY LOCK is not active, the LED stays OFF after self-calibration and the display continuously shows the weight it detects.

DISPLAY LOCK can be activated and deactivated by pushing the TARE button for a few seconds. The display will then show L_ON (DISPLAY LOCK ON) and L_OF (DISPLAY LOCK OFF).

The UNIT button allows the user to switch between kilograms, jin, pounds or ounces. Pushing the button changes the unit. The display shows the current unit.

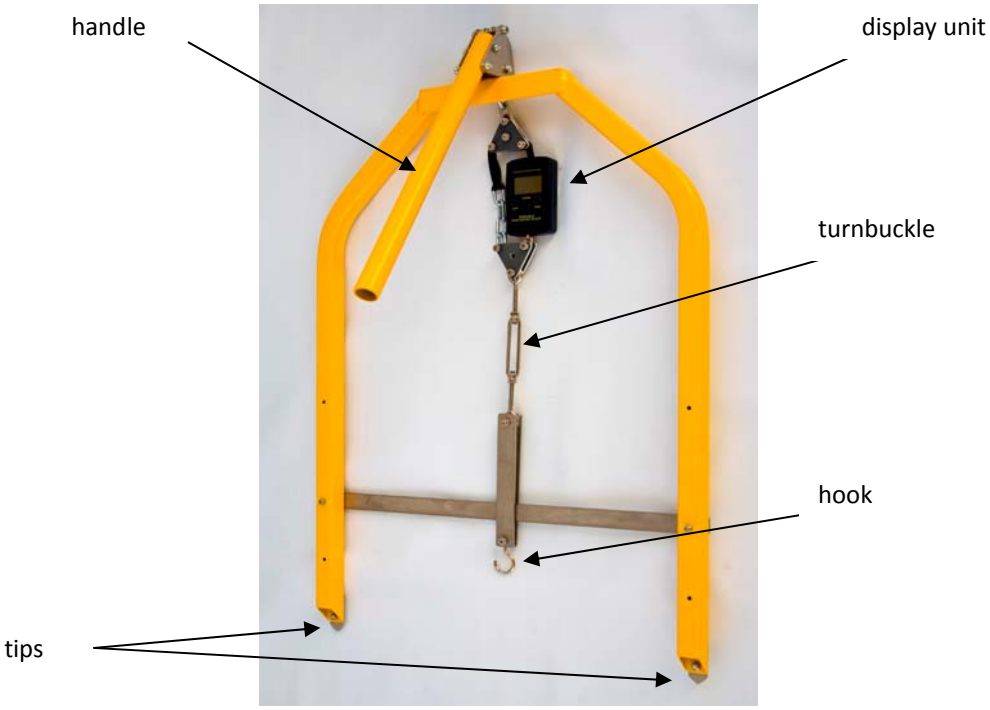
Any settings of the display unit will be retained if you switch the power OFF or replace the batteries. On shipment the display unit is set to kg, DISPLAY LOCK on.

6. Weighing your hives

The **measuring frame** is shown in Figure 9. Note these important parts:

- the handle
- the display unit
- the adjustment turnbuckle
- two tips for attaching the frame to the hive platform
- the hook for attachment to the eyebolt

Figure 9. Measuring frame with display unit.



When using the frame for the first time, check the adjustment of the turnbuckle. When you place the frame tips in the attachment plates, connect the hook to the eye bolt and push the handle down, the top part of the platform should lift by about 12 mm (1/2"), +/- 3 mm (1/8"). You can adjust the lift using the turnbuckle. When the adjustment has been made, tighten the turnbuckle nuts. If you have multiple hives but the height of the eyebolt is the same on each platform, the adjustment will be correct for all the platforms.

Make sure that the platform top does not lift by more than 15 mm (5/8"). Much higher lift is of no added benefit and in extreme cases may risk tipping the hive. The recommended lift (12 mm +/- 3 mm) results in a tilt of approximately 2.5 degrees. A 1.2 m (3 feet) high hive requires around 12 degrees of tilt to tip.

To measure the weight of a hive, proceed as follows:

- place the frame tips in the platform attachment plates
- make sure the hook is hanging free so there is no load on the hook, then turn the display unit on. The LED on the display unit will go ON – the unit is calibrating itself and determining the zero level. After a few seconds the LED goes OFF and the display shows zero. The device is ready to take measurement.
- make sure that the handle is in the UP position, connect the hook to the eye bolt and push

the handle down all the way. Leave the frame free – the handle will stay in a down position and the frame will stay up. Do not hold or push the frame – this will result in an inaccurate reading. The LED will start flashing as the device takes the measurement.

- when the LED stops flashing, lift the handle, disconnect the frame from the platform and read the display. The display will stay locked so you can read it at your convenience.
- after you have read the weight, push the POWER button twice. After the first push the LED will go OFF, after the second push the device will switch off. If you do not switch it off, this will occur automatically after about 2 minutes.

7. Accuracy and calibration

The displayed weight is accurate to approximately +/-60 gram (2 oz). If all you want to do is to monitor weight trends – the direction of change, the speed of weight change in percentage terms – you can use the displayed weight and you do not need to calibrate the scales to measure the actual weight. Also there is no need to calibrate if you are satisfied with measurement accurate to within +-5% - just multiply the displayed weight by 4.

To get the highly accurate actual weight, you need to multiply the displayed weight by a correction factor, usually somewhere between 3.8 and 4.1. Example – if a correction factor is 3.9 and the displayed weight is 20 kg, the actual weight of the hive is 20 x 3.9 = 78 kg.

Note that the correction factor changes if platform dimensions change or placement of the hive on a hive platform changes.

You can calibrate the scales (measuring frame, hive platform and hive) by following this procedure:

- determine and mark the center of the hive lid
- obtain a reference weight – an item of known weight and regular geometrical proportions. A round bucket or a rectangular can full of water will do a good job. Make sure that it weighs not less than 5% of the expected weight of the hive. Find the center of the reference weight
- weigh the hive, write down the displayed weight
- place the reference weight on top of the hive, make sure that the center of the reference weight is aligned with the center of the hive lid
- weigh the hive again, this time with the reference weight on top
- calculate the increase in displayed weight
- divide the weight of the reference weight by the increase in the displayed weight – this is the correction factor

Example:

- we have a reference weight of 4.5 kg
- displayed weight of the hive without the reference weight – 22.40 kg
- displayed weight of the hive with the reference weight – 23.56 kg
- increase in displayed weight – 1.16 kg
- correction factor – 4.5/1.16 = 3.88
- actual weight of the hive – 22.4 x 3.88 = 86.9 kg

The correction factor will not change for a given frame and platform until you move the hive, so once you have established it you can write it on the hive and use for subsequent measurements.

8. Specifications

Max. displayed weight – 40 kg
Max. actual weight – approximately 160 kg (can be increased to 240 kg if required)
Accuracy of displayed weight – accurate to within 60 g (2 oz)
Batteries – 2 x AAA