

HOW TO IMPROVE HAY QUALITY

Everything You Need to
Know About Moisture Meters



DELMHORST
EUROPE
WHEN ACCURACY IS THE POINT.™

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WHEN ACCURACY IS THE POINT.™

Introduction

For many in the farming industry, hay is an incredibly important crop. Farmers who raise livestock such as pigs, cows or chicken rely on forage to keep their animals fed, and hay is a prime source of forage for months where the weather is too dry or too cold to allow forage plants to grow.

Types of Hay

Because hay is so integral to the raising of healthy livestock, it could be considered one of the most important crops in the entire farming industry. However, hay is not like most crops. Unlike standard crops, where there is usually a single family of plants that are referenced when their name is mentioned (corn, soybeans, wheat, etc.), the term hay covers a variety of forage plants that can be used to feed livestock animals.

For example, hay can consist of:

- Grasses. In particular, fescue and orchardgrass are used for hay because of their superior nutritive value compared to other grasses.
- Legumes. Bean plants such as alfalfa are popular for use as hay since their nutritional value is much higher than grass.
- Wheat, oats, and barley. Less commonly used for hay than for straw, these plants can still be made into hay to feed to certain animals.

Almost any herbaceous plant (plants with leaves and stems which die at the end of their growing season while lacking a wooden trunk) can be used as a base for hay, assuming it is not toxic to the animal that the hay will be fed to.

Types of Bales

Once a forage plant has been harvested for hay, there are generally three ways that the hay can be baled:

1. Round Bales.
2. Small Square Bales.
3. Large Square Bales.

Small square bales are becoming less common, as farmers are embracing newer baling machines with higher hay capacities. However, for farmers with smaller numbers of livestock, the small square bale remains popular. With smaller bales, if a contaminant works its way into a bale (such as mold, excess moisture, or even the carcasses of small rodents), there is less waste when the bale is thrown out.

The larger hay bales, both round and square, are preferred by farmers who have larger livestock herds. By using baling machines with a higher capacity, these farmers can produce more hay in less time than they could with older, lower-capacity balers.

Large square bales are particularly well-suited for transportation to other areas since they can stack easily on a flatbed or in a shipping container. Round bales, on the other hand, are more difficult to transport, but are very tightly packed, making them more resistant to moisture intrusion.

Yes, moisture is one of the largest concerns facing farmers who rely on hay as a supplement for their livestock's diet. Hay can be very sensitive to moisture, a lack of it can ruin nutritional value, while too much can lead to spoilage.

How can farmers quickly and reliably monitor the moisture content of their hay? By using moisture meters, of course.

Read on to learn more about how you can maximize the quality of your hay.



Oven Drying Tests

As we mentioned earlier, hay is a very important part of the farming industry. It serves as a means of providing forage to livestock when grazing is rendered impossible because of adverse weather or even a total lack of plants for animals to graze on.

To raise the best livestock, however, farmers need to ensure that the food the livestock eats is of the highest possible quality. Animals may refuse to eat hay that is poor quality, or even worse, eat bad hay and get sick.

The question is, how can farmers like you make sure that their hay is as nutritional and appealing to animals as possible?

Producing the Best Hay

When it comes to making the best possible quality of hay, it is important to consider a number of factors, including:

1. The Species of Plant That the Hay Comes from:

As we mentioned before, hay can be made from any herbaceous plant, and different herbs have different inherent nutritional values as a base for hay. While grass, particularly fescue and orchardgrass, are frequently used for hay, certain legumes (bean plants) such as alfalfa are more nutritious and desirable.

Using healthier, nutrient-rich plants for hay helps to ensure that the hay produced is of the best quality possible.

2. Timing of the Harvest

Cutting the plants just prior to the seeds of the plants becoming ripe often results in better quality hay. At this point, the plant's nutritional value is at its highest, and any leafy portions of the plant are at their most robust.

If cut too soon or too late, the finished hay won't have as much nutritional value. With the harvesting of hay, timing is of the essence.

3. Weather Conditions

For all farmers, local weather patterns can be either a great boon or a huge obstacle. When conditions are just right, crops are robust, healthy and easy to harvest.

However, Mother Nature rarely feels like being cooperative 100% of the time. If the weather is too



dry, nutrients will be lost and stems will be stiff and coarse, reducing the quality of the hay. If the weather is too wet, not only can leaves be lost, the hay might spoil in the field.

4. Where the Hay is Stored

The storage conditions of the hay also go a long way towards making sure that hay is top-quality. When placed in a dry, cool area that is protected from the effects of adverse weather, hay can last throughout the seasons when farmers need it most.

Stored outside, hay is subject to the fickle nature of the weather, where alternating periods of intense sunshine and rain can ruin the nutritional value of the hay. Even when stored in a silo, barn, or other protective enclosure, hay can still become ruined if the structure holding the hay is compromised with excess moisture.

5. Moisture Content of the Hay

Typically, hay is allowed to sit in the sun for a while before being baled. This gives the hay a chance to lose excess moisture before it is collected into bales. If there is too much moisture in hay, it can spoil in the field before it has a chance to be used.

However, it isn't always readily apparent that hay is too wet when it is getting baled. Obviously, no farmer would bale hay in monsoon-strength rain, but what about after a day or two of drying? Is that hay good to go yet? Left in the field too long, and that hay will be rendered useless anyway, so it has to be baled right away.

Measuring Moisture in Hay

Before a hay bale can be ensiled or otherwise stored for later use, it needs to have the right moisture content. Too wet, and the hay may develop mold or even combust in the silo. Too dry, and the hay loses much of its nutritive value as feed for farm animals. For this reason, it is important to be able to accurately assess the amount of moisture in a hay bale when getting ready to store it.

The question is, how can farmers measure the moisture content of their hay bales before putting them into the silo?

There are actually three different ways that farmers can test the moisture content of their hay. Each moisture testing method has its own benefits and drawbacks, which we'll discuss here.

Method #1: By Hand

This is by far the oldest method by which farmers have assessed the moisture content and quality of their produce. This method has been around for longer than any other mostly because it doesn't require any special tools beyond your own senses.

In this method, a farmer simply takes a bundle of hay out of the bale and twists or squeezes it in his or her hands. The farmer then releases the hay and sees how it reacts. The farmer estimates how much water came out of the bundle and whether the hay holds its new shape, unfolds normally, or breaks.

There are a lot of problems with this method, including that:

- ❑ It takes years of experience in handling hay to be able to make even a rough assessment of the bale's moisture content based on feel alone.
- ❑ Even with experience, a single, fist-sized sample of the hay bale may not be representative of the moisture content of the overall hay bale. This is especially true since such samples are typically taken from near the surface of the bale, where the hay will be more significantly affected by the weather.

However, for a rough guess of the moisture content of a bale when no other tools are available, this method might suffice for an extremely experienced farmer. It is not, however, generally recommended as a primary method for moisture testing.

Method #2: Oven Drying Tests

There are several different kinds of oven dry tests, each one assuming a different kind of oven/heating element. For example, there are variations of the oven dry test for convection ovens, microwave ovens, and even in-field testing apparatuses.

No matter which kind of oven that is used in the test, the process for determining the moisture content of the hay remains largely the same:

1. Measure the weight of the hay sample before drying.
2. Dry the hay (this can take 20-40 minutes, depending on drying method and overall moisture of the hay). In some cases, it may be necessary to repeat the drying process until the weight of the hay sample stops changing.
3. Weigh the dry hay to determine the "dry weight."
4. Divide the dry weight by the wet weight, and convert to a percent number. Subtract this number from 100 to get your moisture content percentage.



An example of the dry/wet equation if you had hay that weighed 200 grams before drying and 150 grams after drying would be: $150 \div 200 = .75$, or 75% dry weight, which means that the %MC of the hay is 25%.

This method can perhaps be considered one of the most accurate methods of determining the exact moisture content.

The problem? It can take hours or even days for moisture testing to complete in some cases. For example, the convection oven drying method has you drying out the sample for 24 hours at a temperature of 74 °C. With hay that is already baled, time might not be a huge factor, unless it rains while you're waiting for the results, in which case your previous measurements become worthless.



Also, in order to get a sample size large enough to be considered a reliable measure of the moisture of your hay bales, you would have to take several samples from each bale, which may be impractical when you're making hundreds of hay bales in a day.

Method #3: Moisture Probes for Hay

If measuring moisture by hand is too inaccurate to be useful, and using the oven-dry test takes too long, what is the best way to get a fast, reliable moisture measurement in hay bales? Is there a testing method that provides a reasonable balance between accuracy and immediacy?

Actually, there is a method that provides both a fast measurement speed (even faster than hand measurements) and a reasonable degree of accuracy: hay moisture probes.

These rugged and reliable devices come in many varieties, from baler-mounted units that can measure moisture as the hay is being baled to portable units that farmers can carry with them to double-check moisture in hay bales before storing them.

Simply stick the probe in the hay bale, turn it on, and it will start testing the hay for you.

With the speed at which a moisture meter can test a hay bale, verifying your initial results is the work of a few moments, not hours. This allows moisture meters to be a valid way to measure moisture when preparing the hay for baling as well, since there are often only a few hours in which hay will be at the ideal moisture content for baling.

Overall, moisture meters possess the best combination of accuracy and speed, making them an indispensable tool for farmers who are harvesting hay.

Of course, not just any moisture meter will do. Read the next section to discover how to choose the right moisture meter for hay...

Getting the Right Moisture Meter for Hay

Before you start shopping for a moisture meter to use in your hay harvesting, it is important to know:

How a Moisture Meter Works in Hay

First, and foremost, getting an accurate reading of a pile or bale of hay requires getting measurements of the moisture of said pile or bale at more than one depth. For large piles or bales of hay, this means using an extended-length probe (usually between 25cm and 45cm long).

As for the actual process by which a probe-type meter gets a reading of hay's moisture content, it is quite similar to the way in which a pin-type meter takes a measurement in wood or another solid object. The major differences are in the size of the measuring element and the density of the object being measured.

Just like with a pin-type meter, a farmer taking a moisture measurement in hay takes the electrodes attached to his or her moisture meter and inserts them into the material to be tested. Upon reaching the desired depth, the person taking the measurement activates the meter, sending an electrical current running through one probe. The other probe receives the current, and the meter calculates the moisture content of the material based on how much electrical resistance there is to the current.

The drier the hay, the more resistance there will be to the electrical current, resulting in a lower moisture content reading. The more damp the hay is, the less electrical resistance there will be, resulting in a higher moisture content reading.

With a probe-type meter using 25-45cm long probes, you can quickly and easily gauge if your hay is ready to bale. Simply take a few measurements in the hay, average the results, and you'll know if the hay is too wet or too dry to bale.

Choosing a Moisture Meter

Now that we know the basic operation of a moisture probe, it is important to know that there are actually two primary types of moisture meters used by farmers: portable meters and baler-mounted units.

While the specific features of moisture meters in both the portable and baler-mounted categories will naturally vary by manufacturer, there are a few broad statements about each that hold true when it comes to their pros and cons.

With this in mind, here are a few things to keep in mind about both portable and baler-mounted moisture meters:

Moisture Meter Solutions

Pros of Baler-Mounted Moisture Meters

What could possibly be more convenient than knowing the moisture content of hay as it's getting baled? Baler-mounted moisture meters have several advantages, such as:

- ❑ The ability to draw power from your tractor. In the vast majority of cases, a baler-mounted unit has a power adaptor to allow it to get electricity from the tractor itself, meaning it won't run out of power as long as your tractor is still running.
- ❑ Real time information as you harvest. When using a baler-mounted moisture meter, you are getting up-to-the-second information about the moisture content of the hay being baled. As soon as the hay you're baling falls out of the optimal moisture level for harvesting, you'll know.

The ability to get instant feedback about the moisture content of your hay bales is what makes baler-mounted meters such a great tool for harvesting hay. With that information, you are able to avoid accidentally continuing to bale hay that is too dry and losing the leafy portions of herbaceous hay plants that are so vital to the nutritive value of your hay.

Cons of Baler-Mounted Moisture Meters

"What are the disadvantages of meters that are attached to the baler," you ask?

Well, to begin, the biggest disadvantage to using a baler-mounted meter is that you have to already be harvesting hay before it can start taking moisture measurements. If the hay's moisture content was not in the right range to begin with, you won't know until you've already started making bales.

With a baler-mounted unit, you cannot take measurements in a windrow before the baling process begins to make sure that it is ready in the first place. In fact, the normal process is to check the moisture content of hay in the windrow first, then begin baling. For this reason, a baler-only unit may not be enough.

Pros of Portable Moisture Meters



Now that you've seen some of the pros and cons of baler-mounted moisture meters, what about the portable units that you can carry with you into the field? Here are a few benefits of using a portable moisture meter:

- ❑ With a portable moisture meter, you're able to take readings of the hay before the harvesting process begins. By taking measurement of the hay before baling, you can avoid harvesting hay that isn't ready, avoiding many moisture-related problems before they begin.
- ❑ Also, with a portable moisture probe, you can take readings in finished bales to double-check them before storage in case it begins to rain while you're busy baling. A last minute drizzle could either be nothing to worry about, or it could cause stored hay to explode. Water absorbs heat, and when stored in a closed environment, such as a silo, wet hay can undergo a chemical reaction that causes explosions. Knowing if the hay is within acceptable moisture levels right before storage can be very valuable info.
- ❑ Portable moisture meters often have the ability to swap out probe types, allowing them to be useful for many different types of hay bales. For example, you can use both 25cm and 45cm length probes for reaching the center of larger hay piles and bales.

Beyond the above benefits, portable meters are light, easy-to-use and adaptable.

Cons of Portable Meters

Unlike baler-mounted units, portable moisture meters cannot give you a real-time measurement of your hay's moisture content as you're baling it. This means that while you're baling, if the moisture content of the hay changes significantly (which will happen as the day goes on), you won't know it unless you stop to recheck the windrow periodically.

Having to stop to take measurements repeatedly slows down the collection process, which can mean a smaller yield for that day than what would be possible with a baler-mounted unit.

Also, portable units have to use their own power supply (typically a 9-volt battery), meaning that they can run out of power during standard use. Better-made portable moisture meters will often have a battery status warning to let you know if you're running low, however.

Meters are Not Mutually Exclusive

Of course, if you want to enjoy all of the benefits of portable and baler-mounted moisture meters, you can get both. By using both types of meters, you'll have the most complete picture of your hay's moisture content from start to finish.

In fact, there are moisture meters with both baler-mounted and portable modes, giving you the best of both worlds in a single device. Read moisture in



the field in the portable mode, then attach it to the baler mount for your tractor and get up-to-date readings while on the go!

What to Look for in a Moisture Meter

Now that we know the basics of how a moisture meter works in hay, as well as the pros and cons of the two primary types of moisture meters, what are the things you should look for in your moisture meter, regardless of whether it is portable, baler-mounted, or both?

Here are four things that you'll want to check for when shopping for your next hay moisture probe:

#1: Useful Life

A moisture meter is an investment in maximizing the quality of your hay. So, naturally, you'll want to make sure that such a tool will continue to be useful to you for a long time. While proper care is a big part of ensuring that a moisture meter will last, it is also important to get a moisture meter that is built to last in the first place.

When looking for moisture meters, consider the construction of the unit. Is it solid? Are the materials high-quality? Are there replacement probes for when the older ones wear out? Can the probes even be replaced?

Top quality meters have rugged construction and are designed so that probes can be easily replaced. This way, they can take the occasional drop or other impact, and if the probes do wear out, you can simply switch out the probes instead of having to buy a whole new meter.

#2: Accuracy

There wouldn't be much point to buying a moisture meter to test your hay's moisture content if you couldn't rely on it to be accurate.

In general, cheaply-made moisture meters are less reliable than top-of-the-line models. With less sophisticated measuring devices, cheap meters often have a much larger margin of error than ones that are well-made.

When a bale of hay is right on the borderline between being okay for use and needing to be dried or even thrown out, a difference in accuracy of plus or minus two percent can mean the difference between correctly assessing the hay as being moisture-compromised or thinking that it is okay for use.

Also, in lower-quality meters, the low range for moisture readings tends to be very inaccurate. For hay bales that are meant to be shipped elsewhere, it is very important to have an accurate measurement when moisture content is low because hay being shipped long distances needs to be drier.

#3: Special Functionality

It can pay off to have a moisture meter for hay that has specific extra functions. For example, a moisture meter that can automatically average up to 100 stored readings for you can make the task of finding out the overall moisture content of a hay bale much quicker, as it saves you from having to punch in the numbers into a calculator or doing the math in your head.

So, when looking at moisture meters for hay, read the complete list of features the meter possesses. You never know when you might see a feature that will be incredibly useful to you.

At a minimum, though, whatever meter you purchase should have 25cm or 45cm probes included.



#4: The Warranty

Before finalizing your moisture meter order, take a moment to read the warranty for that piece of equipment. Manufacturers with superior products usually back them up with a stronger warranty. In the grand scheme of things, a simple 90 day workmanship warranty is nothing. Once that warranty is out, you'll have to buy a new moisture meter all over again when the cheap unit stops working correctly.

Getting a high-quality moisture meter from a manufacturer with a one-year warranty can be much more convenient in the long run than getting a store-bought meter with a simple 30 to 90-day warranty. Knowing that you can get a free warranty repair/replacement if your meter stops working correctly within the next year can be incredibly comforting to know.

Also, see if the warranty covers things such as accidental damage or damage from normal use. Keep in mind that with the vast majority of moisture meters (and indeed most products), the warranty will not cover abuse, so it is important to take care of your moisture meter once you get it.

Get a Great Moisture Meter for Your Needs

Whatever moisture meter you ultimately decide to purchase, it's important to make sure that it is the right one for your needs. Taking into account all of your needs when making your moisture meter purchase is key to getting the perfect device for your hay monitoring needs.

Now you know how moisture meters for hay work, and how to find the right one for your needs. However, how do you get the most out of your moisture meter for hay-making?

Tips for Using Moisture Meters for Hay

In this part of the guide, we've assembled a list of things that you can do to make sure that you not only get accurate readings from your hay bales, but that you can keep your moisture meter working for a long time to come:

Best Practice #1: Take Multiple Readings!

Why would you want to take more than one measurement of the moisture content of hay? Because, as you may know, hay is a loosely-packed material before it is baled. Even tightly baled, hay is not a singular, dense object. After all, hay is typically meant to be fed to livestock, and they can't eat a solid brick.

Because a pile or bale of hay is not a solid, singular object, there can be any number of pockets of empty space inside of it. While baled hay may have fewer empty spaces compared to a hay pile, the chances of hitting one and having it throw off your readings are still high enough to warrant at least a second reading.

The first benefit of taking multiple readings is that more readings mean that your moisture content information is more reliable. A single high or low moisture reading could be a fluke; six readings that agree with one another is proof of whether or not the hay's moisture content is within acceptable levels.

Other benefits of taking multiple readings in hay include:

- The ability to take an average of your readings.
- Being more likely to find a hidden moisture pocket.
- Having proof that your hay was checked thoroughly if you record your reading results (or use a meter that can store readings).
- Getting a more complete picture of the moisture content of your hay.
- Avoiding putting spoiled hay with healthy hay bales.
- Improved safety and health for animals that feed on hay.

When you average a large number of measurements, you are getting a much more reliable assessment of the overall condition of your hay than you could with any single measurement. Not only that, but by taking multiple reading measurements at different depths and from different angles, you are more likely to find a hidden moisture pocket than you would be with a single reading.

By finding hidden pockets of moisture that would be missed when relying on a single reading, you can identify problematic hay stacks and bales that should not be placed in storage. If one hay bale becomes contaminated with mold because of excessive moisture, that mold can spread spores to other, nearby hay bales in storage, even if they do not have excessive moisture themselves.

Best Practice #2: Take Care of Your Meter's Probes/Electrodes in between Uses

When using extended-length probes that are 25cm to 45cm long, be aware that these probes need to be taken care of. Not even the best-made probes will last for very long if they are not properly stored and maintained in between uses.

If there is excessive debris or moisture collected on the probes, detach them from the meter and gently wipe them clean with a cloth before storing them.



Best Practice #3: Handle Probes with Care when Taking Measurements

In fact, the longer the probe, the more gently it needs to be handled. Extended-length probes are more susceptible to breaking when force is applied to them. If you experience heavy resistance to pushing the probes into a hay bale or a haystack, do not try to force them. Simply remove the probes, and try inserting them again from a different angle.

Sometimes, farmers will drill or core the bale so that they can get the probe in to a point where they only have to push at the very end

Best Practice #4: Don't Forget the Temperature

On extremely hot or cold days, the ambient temperature can influence moisture readings. While most farmers prefer to not bale their hay on days with temperatures in either extreme, once the hay is cut, there's only so much time that it can sit before needing to be baled, so you may not always have a choice. Part of getting the most nutritive value out of hay is in cutting the plants being used for hay just before their seeds ripen, and Mother Nature may not always be kind to your schedule.



So, if you are forced to harvest hay on a day that is either very cold or very hot, be sure to take how the temperature affects your moisture readings into account. Having a [temperature correction chart](#) for this task can be very helpful.

Best Practice #5: Keep Taking Readings throughout the Harvesting Process

Speaking of the temperature on any given day, it is important to keep checking the moisture content of hay throughout the entire harvesting cycle instead of relying on readings that were taken at the start of the morning.

As the day goes on, the heat from the sun will continue to evaporate the moisture in the hay being harvested. Over time, the hay may become too dry to continue baling, and you will have to stop harvesting.

By frequently checking the moisture content of your hay as you bale it, you can know when to stop and avoid creating a bale of substandard hay. Moisture meters that can be mounted on a baler are particularly useful for this, as they can give you a real-time measurement of the moisture content of the hay you're baling.



Best Practice #6: Check Your Meter's Calibration Regularly

No matter how well-made a meter is, it can eventually become less accurate over time. Whether it is because of damage to the probes or even contamination of the PC board, every meter is bound to lose accuracy over time. This is why it is important to check your meter's calibration before any hay harvest.

The specific method for verifying your meter's calibration can change depending on the model of the moisture meter you're using. Some meters use a specialized testing device, while others have a built-in calibration check. Meters with built-in calibration checks are highly convenient because they allow you to test them anytime, anywhere.

By verifying your meter's calibration, you can be confident that your meter is giving you the most accurate readings possible.

Best Practice #7: Read the Owner's Manual

For many moisture meters, the owner's manual that comes with the device is a handy resource that can answer a lot of commonly asked questions. From proper care and maintenance to how to get a reading with the meter, the manual can be of great help.

If you lose your owner's manual, check the manufacturer's website to see if they have a copy of it online. Many top-end manufacturers will post owner's manuals on their website, typically under a "support" tab.

The Value of Moisture Meters for Hay

Overall, a moisture meter for hay is an invaluable tool for farmers to use. With these devices, it is possible to quickly and accurately measure the moisture content of hay to prevent problems such as spoilage, combustion, and even the loss of nutritive value as feed.

Make sure your hay is the best quality for feeding to livestock by using a moisture meter to track the moisture content of your hay today!



Feel free to give us a call or email for answers to your questions about what kind of meter to use for your project, and where to purchase. And remember, we value our customers and look forward to your feedback.

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