The above percentages must be added to the chemically dry weight, obtained by drying at 212 deg. F., for several hours.

For example: Suppose a quantity of cotton yarn weighs 1,000 grains, and after thoroughly drying is found to weigh only 880 grains, the amount of excess moisture is found by adding 8% per cent of 880, and deducting the sum from 1,000. The percentage being then obtained in the usual way.

\[
\begin{align*}
880 + 8\% &= 954.8 \text{ grains}, \\
1,000 - 954.8 &= 45.2 \text{ grains excess}, \\
1,000 : 45.2 &= 100 : 4.92\%. 
\end{align*}
\]

Accurate weighing is a great desideratum in all moisture tests, and to obtain this a chemical balance is almost essential. Next there is the condition of the yarn after being dried. If it is allowed to cool in the ordinary atmosphere it will quickly absorb a certain quantity of moisture, the amount depending upon the state of the atmosphere, and this would reduce the value of the test. To guard against this, the material should be placed in some receptacle from which the atmosphere is excluded, and all weighed together, and having deducted the weight of the bottle, proceed to ascertain the moisture in the manner indicated above.

**CONDITIONING OVEN.**

To carry out such a test as this, the material may be dried in a copper drying oven, having a cavity all round, containing the water to be kept at boiling point for from 2 to 5 hours, by means of a Bunsen burner.

In addition to this plan there are many others, some being a combination of a drying chamber and a balance; such a one is shown at Fig. 85. A is the outer casing of the apparatus; B shows the cavity in which the water is contained and kept heated by gas admitted through the pipe D; E is a thermometer, and near it is shown a pipe which acts as an outlet for evaporated moisture; C is the outlet for steam and the inlet for water. The cage shown in dotted lines contains the material to be tested, and is suitably suspended from one end of the balance F, the other end or pan containing the weights. The reduction in weight is carefully watched until there is no further loss, when the percentage is obtained in the manner stated. One of the faults of this and similar machines is that some portion of the condensed steam settles upon the wire, which must extend into the drying chamber, and to this extent the weighing is incorrect.

For testing silk much more elaborate machines are employed; but for cotton, wool, and linen the one shown is sufficiently accurate for all practical purposes.

The apparatus used by testing houses, as well as large silk, etc., mills, who make conditioning an object of their routine work for obtaining absolute dryness, consists of an oven of cylindrical shape constructed with an inner and outer case, about 40 inches high and 30 inches in diameter (outside measurement). A space of \(\frac{1}{3}\) inches is allowed between the two cases to permit the heated air to circulate freely around the inner hot-air chamber. A pair of scales, sensitive to 0.1 gram, is firmly fixed to the oven in such a position that a reel or cage suspended from one arm is directly in the centre of the oven. Both reel and cage are of equal weight, the former being employed for tops or yarns and the latter for loose materials or in the form of cope, and each one corresponds in weight with the pan and chains at the other end of the beam. The heat is obtained from a Bunsen gas burner, the lighted jets being arranged in a circle underneath the inner oven. A thermometer ranging from 40 to 120 deg. C. or higher, is placed so that the bulb reaches half way down the oven, to register the temperature within.

Conditioning Ovens are also built to be heated by electricity instead of by gas. In this instance two (sometimes three) electric heaters are employed. Each heater is controlled from a separate switch, so as to facilitate the regulation of the temperature. This system is less liable to fire, and as there are no flames discharged it is less injurious to the person in charge.

Fig. 86 shows the Baer "Standard Conditioning Oven" heated by electricity, equipped with a Fore-heater attachment by which the waste of hot air is made to partly dry another sample while one test is made, i.e., to build an apparatus in which the material to be dried out could be thoroughly dried in as short a time as possible, at the right temperature and without chances of overheating or scorching the material.

In the old type oven it was relied upon that the warm air being lighter than the cold, would travel of its own accord up through the material and in this way it took a long time before the warm air really penetrated through the material.

In the new Conditioning Oven, the heating-coils are therefore built somewhat stronger and very compact, providing at the same time a fan, driven by an electric motor, which, drawing the air from the outside through a fine wire screen, forces it through the heating unit and from there through the material to be dried. In its passing through the heating
Testing Raw Cotton.

To make a test, samples are collected from different parts of the bulk, and placed as loosely as possible within the oven and then weighed. Next the heat is turned on; and 10 to 15 minutes after a temperature of 220 deg. F. has been attained, weights are placed in the small pan attached to the cage wire, to restore equilibrium. The material is then shaken and turned top to bottom, and again submitted to the heat, and weighed at intervals of 5 to 8 minutes until a constant weight, indicating absolute dryness, is obtained. The weights in the cage pan represent loss or moisture, and the same subtracted from the original weight (which has remained undisturbed throughout the operation) gives the dry weight. The addition of the percentage regain to the latter then gives the correct weight, or weight in the correct condition.

Example: Suppose 2 lbs. of cotton are taken from a 500 lb. bale of cotton, and they are to lose 4 oz. in drying.

The dry weight of these 2 lbs. of cotton is thus 1 lb. 12 oz., or 28 oz.

Adding 8% per cent of permissible moisture to the latter (i.e., 2.38 oz.) we obtain (28 + 2.38 = 30.38 oz) as the correct weight.

From this we obtain the invoice weight of the bale of cotton thus:

\[ 30.38 \times 500 = 1517 \text{ lbs.} \]

\[ 1517 - 474.68 = 2.38 \text{ lbs.} \]

Excess moisture in the bale of cotton under consideration thus is:

\[ 30.38 - 2.38 = 28 \text{ lbs.} \]

Another Example: From a lot of cotton yarn weighing 260 lbs. net, 1½ lbs. of cops are taken for testing.

When absolutely dry, they weigh 1 lb. 5½ oz.

Question: Can any claim be made for excess moisture, and if so what amount, assuming the yarn to cost 22 cents per lb.

Dry weight (1 lb. 5½ oz. =)..............21,2500 oz.
Add 8½ per cent.........................1,80025 oz.
Correct weight.........................23,0525 oz.
Original weight (1½ lbs. =).............24,0000 oz.
Correct weight.........................23,0525 oz.

Excess moisture........................0.94375 oz.

Total excess moisture \[ 0.94375 \times 260 = 10.212 \text{ lbs.} \]

Answer: Claim to be made is 10.22 lbs. @ 22c = $2.25.

Testing Yarns for Moisture.

For testing yarn in a hank a number of hanks are selected and placed on the reel. Provided the yarn to be tested is upon spools, tubes or bobbins it must be wound into hanks, whereas if warp yarn is ball shape, a convenient number of ends are spooled off. When dealing with the testing of loose material, for convenience of simplifying calculations, as a rule a fixed quantity is used, whereas this is not the case when dealing with yarns and when the sample is weighed intact, and the calculation worked out as previously explained, the difference being that we may have to use additional fractions in the calculation.

Testing Fabrics for Moisture.

The percentage of moisture present in fabrics can be largely increased above the normal amount by storing the goods in damp cellars, or by loading the material with certain hypodesmic substances which have a natural affinity for moisture. In former days, and when conditioning was unknown, loading of woolen goods by moisture was then the means of producing by Government contracts some of the old time millionaires textile manufacturers in this country, and when storing goods rejected on account of "below weight" were stored some time in damp cellars, to be in turn found "up to weight" later on by the government. The basement of mills on the Schuykill of the "Fall" furnishing excellent specimens for this work.

To determine the percentage of moisture at present, a given quantity of fabric is weighed and dried in a conditioning oven, and previously examined.

Whether dealing with fabric, yarn or raw materials, provided only small samples are tested, a most delicate balance must be used, one weighing up to the thousandth part of a gram or even finer; the "Treuemmer Balance" being the Standard Balance used by the Government.