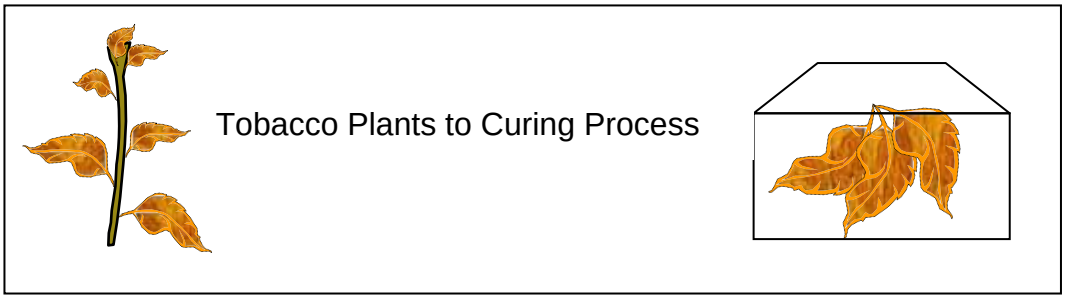
Tobacco Industry Guide

INTRODUCTION

This is an overview of tobacco processing and a guide to the application of Infrared Engineering products. Although the details of tobacco processing are complex, the application of our product range is quite straightforward. The main areas of application are in green leaf threshing and primary manufacturing however there are opportunities elsewhere which should not be ignored. The tight moisture specification demanded during the manufacture of cigarettes is used as the main example in this guide, although the processing of tobacco for other tobacco products (e.g. cigars or RYO **-** roll your own) is very similar, especially in terms of the application of online gauging. This guide takes us from the tobacco plant through the various processes to the final tobacco product:

THE PLANT, LEAF AND STEM



Tobacco is grown in many countries around the world as a highly valued cash crop. The seasonal variation in climate dictates the growing and harvesting seasons which in turn determines the timing of the initial processing stages such as curing and threshing. Threshed tobacco consists of stem and lamina (or leaf). As with most crops there are different plant types (mainly Virginia, Burley and Oriental) and the subsequent processing introduces further variations giving a wide variety of grades. Essentially there are two curing processes, which respectively produce **air-cured** and **flue-cured** tobaccos. Also the natural variations caused by geography and crop year result in classifiable differences. After threshing, the different grades are aged over a period of 18-24 months and then are blended by manufacturers in the production of tobacco products such as cigarettes, cigars, roll-your-own (also known as fine cut tobacco) and snuff.

THE NEED FOR MOISTURE MEASUREMENT

The prime consideration in any cigarette factory is to achieve the correct moisture content of the final blend prior to it being used in the **secondary** process for cigarette making. Correct moisture content in the final blend is *absolutely* essential for efficiency of making machines. These run up to speeds in excess of 14,000 cigarettes per minute and if the tobacco is too wet then machine blockage will occur and cause downtime, thus affecting production efficiency. If it is too dry, the tobacco is brittle and will be damaged in the making process causing strand length reduction, called **shorts**, and dust. Both shorts and dust are undesirable due to loss in filling power. Also wet tobacco causes **spotting**, yellow or brown marks on the cigarette paper after packing, and ultimately, mould growth if it is very wet. Moisture variation will affect the smoking quality of a cigarette and since consistency tends to be equated with high quality it is important to achieve consistency in the final product. Final blend moisture

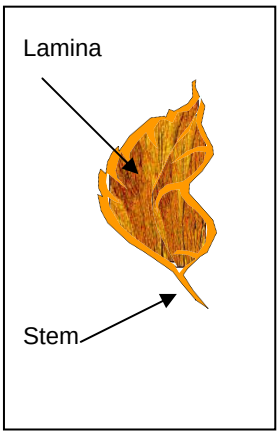
content can be influenced or controlled to some extent by the final dryers on each line and this is why most tobacco factories use a measurement at the exit of the final dryers.

It soon becomes apparent that moisture measurement is needed *at other points earlier in the primary process*. Tobacco primaries have separate stem and lamina lines and maybe even an expansion line for lamina expansion. Other lines such as those for reworking tobacco, e.g. 'shorts' - may also be present. All of these components are blended together and for accurate mixing of the right quantities of each it is vital to know the moisture content so that this can be achieved. Moisture also directly influences tobacco filling power, which is important because this affects how much tobacco is used in each cigarette. Further back in the process there is cutting of both stem and lamina and correct moisture here is important to achieve correct tobacco strand length.

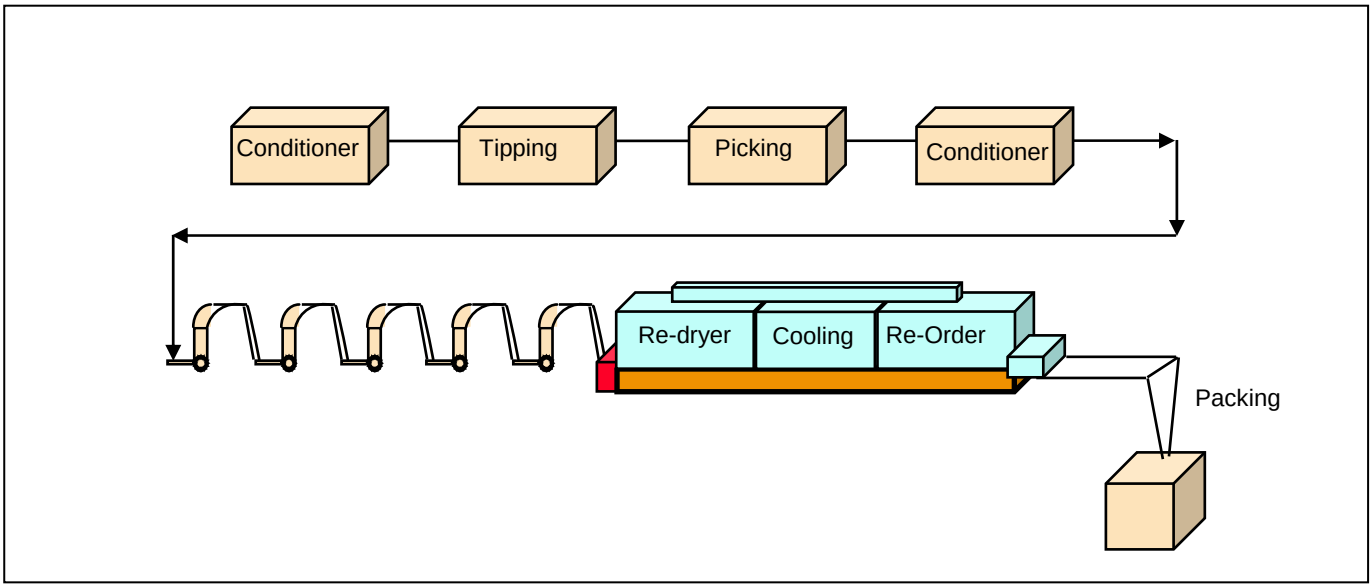
THE THRESHING PROCESS

Cured tobacco is delivered to the GLT plant where it is processed to achieve the following objectives:

1. Separate the hard central stem from each whole leaf and to grade each according to quality, colour, nicotine and sugar levels. The reason for separating stem and lamina is that their physical differences require separate processing operations.
2. Terminate the chemical and biological processes that were initiated in the curing process.
3. Homogenise the moisture content to target values in the 10-12% moisture range, rendering it suitable for storage during the ageing process for up to several years.



Threshing separates the stem from the leaf for grading and ease of subsequent processing. It involves increasing the moisture of the cured, dried leaf to a uniform level to give it



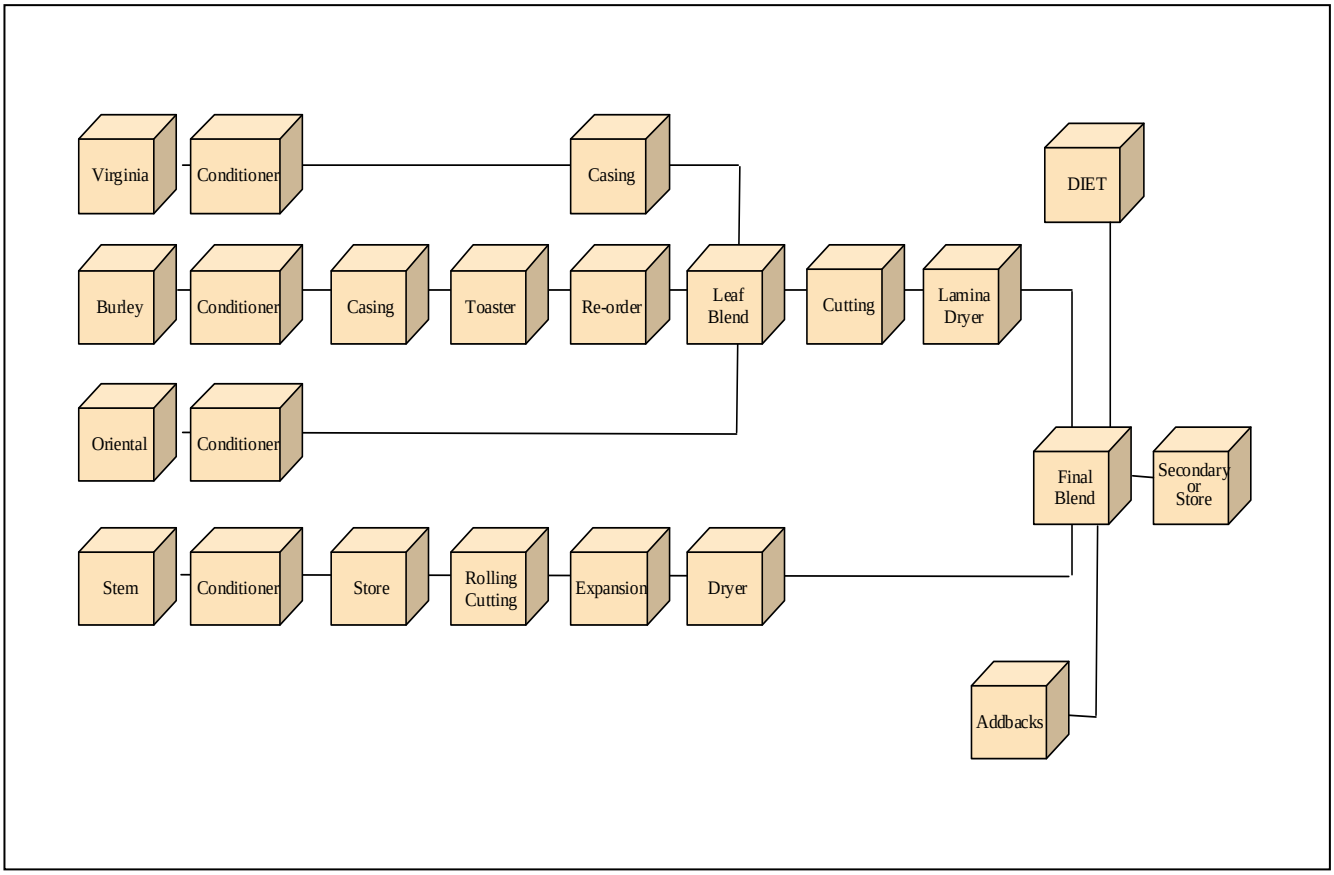
consistent mechanical characteristics. The tobacco is then pliable and the threshing machines can remove the stem with the minimum damage to the lamina. The lamina is then re-dried which prevents

further biological activity associated with curing. The re-dryers consist of belts several metres wide and tens of metres long, split into two main sections - drying and cooling. **GLT** (Green Leaf Threshing factories are known as **stemmeries** in some countries) operation is seasonal and for long periods of time large volumes of single grades are processed. The most critical measurement location is at the exit of the re-ordering section of each re-dryer where the moisture must be correct before the tobacco is pressed into cases and placed in storage. Tobacco is purchased on a dry weight basis (there is a very wide range as supplied by farmers). Correct moisture prior to threshing is also important as this can affect the efficiency of the threshing lines.

PRIMARY PROCESSING

The vast majority of product manufacturers have a **primary** department that is dedicated to the blending, cutting and flavouring of tobacco. The resulting **blends** are then delivered to the next and final stage of manufacture. In the manufacture of cigarettes it is the **secondary** department that is responsible for the making and packing of cigarettes.

The schematic below shows the various elements of primary processing.



VIRGINIA/FLUE CURED LAMINA LINE

After de-baling by either vacuum chamber steam conditioning (older method) or DCC (direct cylinder conditioning) tobacco moisture is important at this stage prior to the leaf being fed to the silos because once again if it is too dry the tobacco can be damaged by all the subsequent mechanical handling. Measurement at this point is possible although the large local variation and the stratification of moisture at the exit of the DCC cause difficulties in the interpretation of results. Nowadays, DCC machines often include a 'casing cylinder' on the output of the conditioner these are known as DCCC or DC3. Please refer to the note at the end of this guide for more detailed comments on this application.

BURLEY/AIR CURED LAMINA LINE

The same comments apply as to flue-cured tobaccos but Burley will usually be diverted via a flavouring process (**casing**) where sugars and flavours are sprayed onto the tobacco leaf and then it is toasted on a wide flat bed dryer. Moisture at the exit of this process is also important and recently we have had some interest in the measurement across the width of the dryer to determine the cross-bed drying profile. The tobacco is dry and brittle and therefore needs to be re-moistened in a **re-ordering** cylinder prior to further processing.

STEM LINE

Whole stem has to be conditioned to quite high moistures to allow the material to be rolled to flatten it to a 'leaf' format. After cutting and rolling the tobacco undergoes expansion caused by heating with steam. We can measure moisture before and after expansion and this is important because moisture will have an impact upon the degree of expansion. Measurement of the whole stem is also possible but if the moisture is not fully equilibrated the results will be sensitive to the degree of equilibration.

EXPANDED TOBACCO PROCESS

The increase in leaf and stem prices coupled with the demand for lower '**delivery'** cigarettes (low tar and nicotine) has caused a dramatic increase in the use of expanded tobacco. Expanded tobaccos have lower density, which means they have greater **filling power** i.e. higher yield and lower delivery.

Moisture measurement after the expansion process is important because after expansion tobacco is often very dry (2 or 3%) and extremely brittle. It will then undergo conditioning to increase moisture content so that it becomes pliable again. However it is important that it is not over-wetted as this can cause collapse of the expanded tobacco structure and a reduction in its filling power. Later the expanded tobacco is added back to the other components and at this point measurement is important to ensure correct blending.

A SUMMARY OF THE BENEFITS OF ON-LINE GAUGING

Moisture measurement and control is vital to achieve efficient tobacco primary processing, maximising production throughput and ensuring **optimum making efficiency**. Processed **tobacco yield is affected by low moisture**, especially where there will be significant strand degradation throughout the process due to the intensive mechanical handling of the material. Correct moisture **minimises waste** or the need for re-processing via re-con sheet. Tobacco **smoking quality is affected** adversely by

incorrect moisture, which is a customer perceived problem. **Filling power is affected by moisture** and therefore yield will be affected, which of course relates directly to operational profitability.

A note regarding moisture measurement ex-DCC

The purpose of the DCC process is to take separate grades of stored tobacco (equilibrated at approx. 10% moisture), and to condition the moisture to 19-21%, feeding the resulting tobacco to blending silos where it would be left to re-equilibrate at the higher moisture prior to further processing. During a given DCC operation, bales of different tobacco type are sliced in a particular bale sequence and fed into the conditioning cylinder. In the cylinder, water and steam (and maybe casing) are added. If there is a weigh-conveyor immediately before the cylinder it is then possible to control the mass flow of tobacco. The water, steam and casing flow-rates may also be controlled. In spite of these controls, the tobacco at the exit of this process is highly non-uniform in its moisture distribution. In addition, distribution of moisture is actually dependent upon tobacco type i.e. it is known that Burley absorbs water more slowly than Virginia, which in turn absorbs more slowly than reconstituted sheet. Even under conditions of tightly controlled flow-rates, the surface moisture would be somewhat dependent on tobacco type.

The elevated product temperature presents no problem to the 710e measurement; however sampling must be undertaken with extra care. Many studies have been carried out by tobacco manufacturers to understand the measurement at this location. Most of these studies have concluded that the measurement may be a useful indication of average moisture content but that control of water/steam/casing on a bale by bale basis is virtually impossible. In one study, the variability of consecutive samples taken for lab testing was as much over 10 seconds as it was over a whole hour. Suggestions have been made that changes to the bale sequencing would give longer runs on a particular type (to process all Burley, then all Virginia and so on for each operation). However, tobacco manufacturers seem reluctant to do this and the challenge remains for instrument manufacturers and machinery suppliers to solve the problem. NDC Infrared Engineering recommends that the current 710e measurement be used for trending purposes only at the exit of the DCC.

Glossary

Ageing	A process that allows subtle chemical changes to take place, giving the tobacco time to develop flavours.
Air-curing	Fermentation of freshly harvested tobacco in specially designed barns. The process is subject to the natural environmental conditions.
Apron dryer	A type of dryer used in leaf processing and Burley toasting. The tobacco is spread over a wide belt and heated either directly from above (Burley toaster) or from re-circulating air from below.
Blend	A mixture of different tobaccos designed to achieve certain flavour characteristics.
Burley	A type of tobacco typical of American blends.
Casing	Flavours and chemicals added to the tobacco.
Conditioning	A process for increasing moisture content either to make the tobacco more pliable for subsequent mechanical handling or to achieve expansion by rapid conversion of water to steam.
Classifier	A process that separates heavy and light particles. The heavy particles could be foreign matter or just heavier unprocessed tobacco particles (such as pieces of stem that weren't cut and rolled properly).
DCC	Direct conditioning cylinder.
Delivery	Refers to the quantity of nicotine and tar delivered to the smoker.
DIET	**D**ry **I**ce **E**xpanded **T**obacco.
Filling power	How many cubic centimetres can you get from one gram.
Flavouring	Materials like cocoa, chocolate and garlic are applied to the tobacco to give characteristic flavour.
Flue-cured	A shorter harsher curing process where the air temperature and humidity are cycled to speed up the fermentation process.
GLT	Green leaf threshing, sometimes called a stemmery in the USA. This process separates the hard middle part (stem) from the flat part (lamina) of the tobacco leaf.
HTD	High temperature dryer. A vertical airstream dryer using air up to 450°C for very short periods (few seconds) the principle is that the surface dries very rapidly maintaining or even increasing the volume of each tobacco particle to achieve an increase in filling power.
Humectants	Chemicals like Polyethylene glycol are added to tobacco to help retain the desired moisture level.
Lamina	The flat part of the leaf.
Making machine	Makes cigarettes. High speed machines such as the Protos2 from Hauni have

	achieved in excess of 16000 cigarettes per minute.
Oriental	A type of tobacco. It has a small leaf and aromatic qualities.
Primary	The department that prepares tobacco for cigarette making.
Recon	Reconstituted sheet tobacco made from dust and scrap tobacco in a process very similar to papermaking.
Re-ordering	A process for increasing the moisture of tobacco.
RYO	Roll your own.
Secondary	Cigarette making department.
Shorts	Mechanically degraded tobacco.
Spotting	Brown spots that appear on cigarettes if the moisture is too high.
Stem	The hard central part of the tobacco leaf.
STS	Steam treated stem.
Strips	Uncut lamina.
Threshing	Separation of stem from lamina.
Virginia	A common type of tobacco – most often processed by flue curing.