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Guidelines for Temperature, Humidity, and Airflow Control in Tobacco Curing

Paul E. Sumner and John S. Cundiff

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Introduction

The curing of tobacco is a controlled drying process. When a mature tobacco leaf is taken from the plant, it normally contains 80 to 90% moisture and 10 to 20% solids by weight. Of the solids content about 25% is starch. The remaining 75% is made up of numerous biochemical compounds, pigments, minerals, cell tissue, etc. Research and grower experience have established the rate of moisture removal required to achieve the color, and thus the leaf chemistry, desired for bright-leaf (type 14) tobacco.

The temperature and humidity of the air passing through the tobacco can vary over a certain range, depending on the conditions of the tobacco. Such factors as maturity of tobacco, stalk position of the leaf, the use of ripening agents, and weather conditions during the growing and harvest season, will affect the temperature and humidity required for a successful cure. Tobacco harvested from different fields on the same farm may cure differently when exposed to the same curing environment. In addition, the characteristics of the barn also have an effect on the curing process. An older barn which has developed some structural cracks, or with doors that no longer seal tightly, will not subject the tobacco to the same environment as it did when it was new.

This bulletin discusses a temperature-humidity schedule for curing tobacco. Also discussed are airflow requirements, air-exchange rates, moisture-removal rates, solid losses, and energy consumption using the curing schedule. This is done with full knowledge that each individual cure is different and that tobacco can be cured successfully with a temperature-humidity schedule that deviates significantly from the general schedule.

Paul E. Sumner, a former research assistant in the Department of Agricultural Engineering, is now an extension engineer with the Extension Engineering Department, University of Georgia. John S. Cundiff, formerly in the Department of Agricultural Engineering, University of Georgia, is now an agricultural engineer in the Engineering Department, Virginia Polytechnic Institute. The research presented here was supported by the University of Georgia College of Agriculture Experiment Stations.

Temperature Schedule

Leaf coloring, leaf drying, and stem drying are three phases that tobacco undergoes to achieve a suitable cured leaf. The leaf-coloring/transition phase is defined as the period when the dry-bulb temperature in the delivery plenum (air supply) is below 115°F (46°C). The leaf-drying phase is defined as the period when the temperature in the delivery plenum is between 115°F (46°C) and 140°F (60°C), and the stem-drying phase is that part of the cure occuring when the temperature in the delivery plenum is greater than 140°F (60°C).

Humidity during the curing process is determined by wet-bulb temperature measurements. The wet-bulb temperature is essentially the temperature of the undried tobacco leaf at that point in the cure.

A general curing schedule for dry-bulb and wet-bulb temperatures of the air entering the tobacco during a six-day cure is given in figure 1. For comparison, the corresponding relative humidity is shown as a dotted line on the figure. The thermostat settings for this dry-bulb temperature schedule are given in table 1.

Table 1. Thermostat Settings for a Typical Six-Day Cure

Hour	Cure Phase	Thermostat Setting (°F)[1]	Adjustment
0		95	--
	Leaf Coloring		
24		95	--
	Leaf Coloring		
48		95	Automatic advance
	Transition		at 1°F/hr to 115°
72		115	Automatic advance
	Leaf Drying		at 1°F/hr to 130°
96		130	Automatic advance
	Leaf Drying		at 1°F/hr to 140°
120		140	Automatic advance
	Stem Drying		at 3°F/hr to 165°
144		165	

1. To obtain °C, subtract 32.0 and divide by 1.8.

Studies were conducted on a tobacco grower's farm in Tift County, Georgia (Cundiff 1978). This grower was noted for the quality of his tobacco, and the cure management was entirely under his control. The dry-bulb temperature in the delivery plenum was recorded for six cures in 1977 and seven cures in 1978, in four different 126-bulk-rack curing barns. The

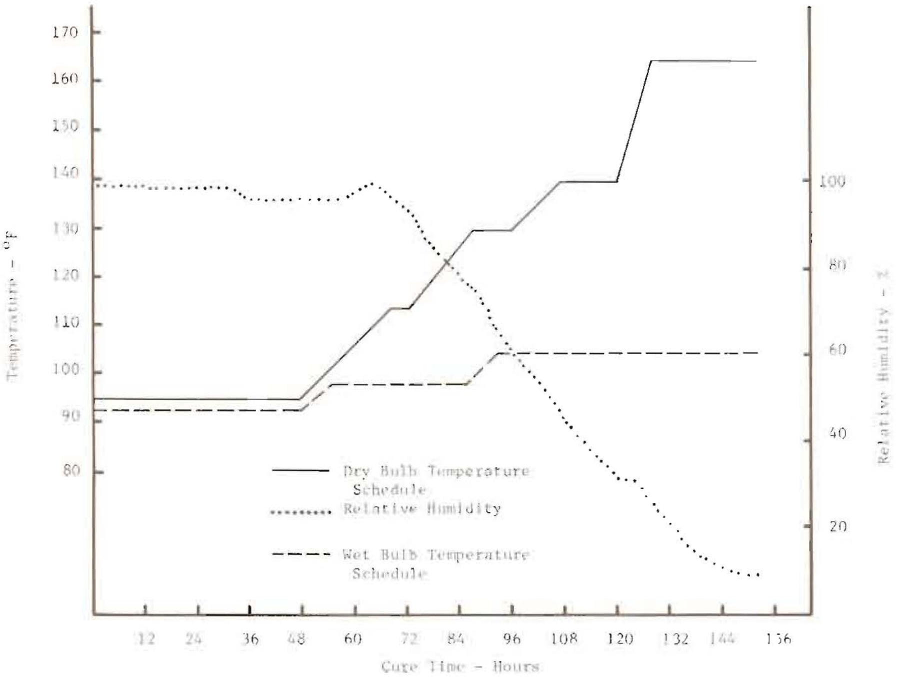

Figure 1. A general wet-bulb and dry-bulb temperature schedule for a six-day cure with relative humidity shown for comparison

range for these 52 cures is shown by the shaded region in figure 2 and illustrates the selection range a grower will use as he responds to differences in the tobacco. For comparison, the general dry-bulb temperature schedule from figure 1 is shown as a heavy solid line.

A research study was conducted during the 1979 curing season using three 30-bulk-rack curing units at the Coastal Plain Experiment Station in Tifton, Georgia (Cundiff 1981a). These were one-fifth the size of commercial 150-rack barns and could accommodate 10 racks on each of three tiers. Two six-day cures and two five-day cures were completed in each of the three units. The dry-bulb temperature range for the five-day cures is given in figure 3a and the corresponding wet-bulb temperature range is given in figure 3b.

The schedule used for the cures in the 30-rack units differed from the grower's schedule primarily in the leaf-drying phase. The grower used only one day to elevate the temperature from 115°F (46°C) to 140°F (60°C) and then used two days in the stem-drying phase. This procedure is a carry-over from stick-curing days. The only means for getting airflow through the tobacco in a stick barn for rapid leaf drying is to run the temperature up to

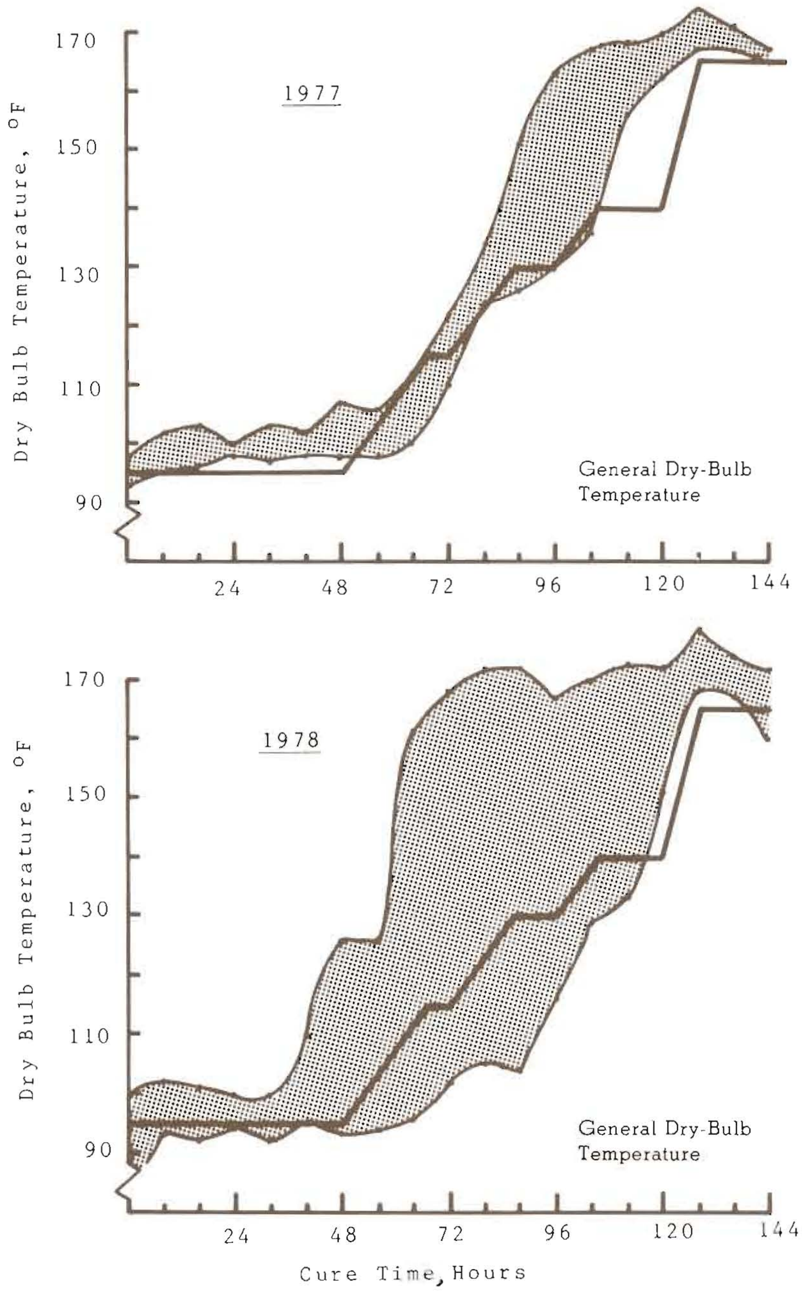

Figure 2. Dry-bulb temperature range for six cures in 1977 and seven cures in 1978 on the tobacco-grower's farm, Tifton, Georgia

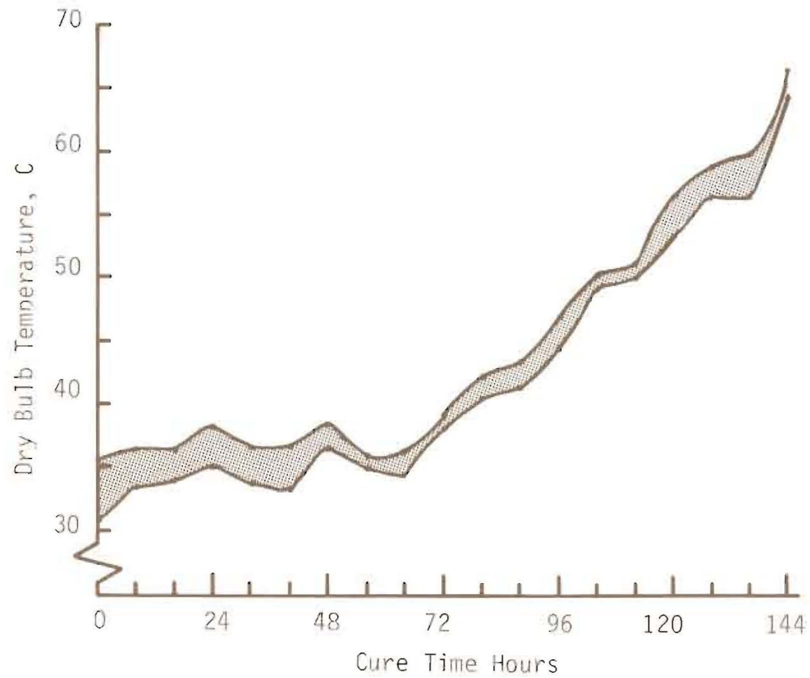

Figure 3A. Dry-bulb temperature range for six six-day cures in the 30-rack barns at the Coastal Plain Experiment Station, Tifton, Georgia

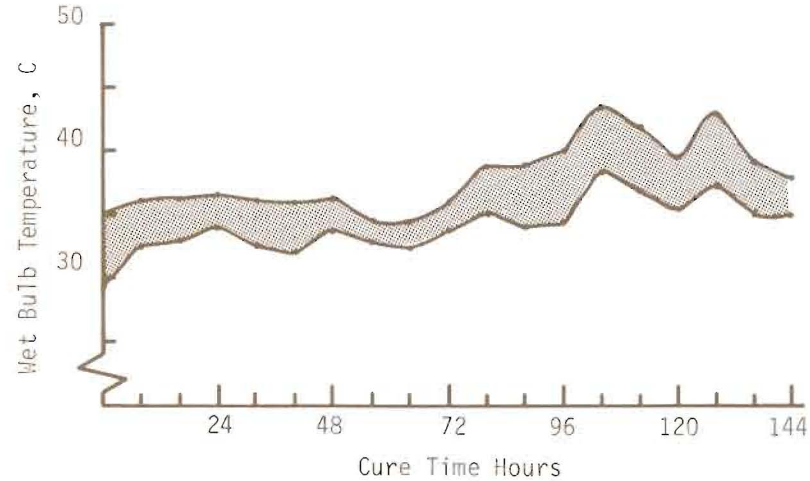

Figure 3B. Wet-bulb temperature range for six six-day cures in the 30-rack barns at the Coastal Plain Experiment Station, Tifton, Georgia increase natural convection. The forced airflow in a bulk-curing barn gives much better control over the curing environment; consequently, it is not necessary to advance the temperature so rapidly.

Automatic Damper Controllers

The accuracy of an automatic damper control is dependent on the accuracy of the wet-bulb temperature measurement. It is very difficult to measure this temperature accurately in a bulk-curing barn. During the study at the Coastal Plain Experiment Station, wet-bulb temperature was recorded at the automatic damper-control sensor and compared with measurements made with a hand-held probe. The sensor was located in the center of the return plenum (above the tobacco) at the furnace room wall. The sensor wick was kept moist with a capillary moisture movement from a reservoir like that used in many conventional barns. The float in the reservoir was adjusted so that 10 drops per minute dripped from the wick at the beginning of the cure.

The probe measurement, plotted as a dotted curve in figure 4, is taken as the actual wet-bulb temperature. The solid curve in figure 4 is the wet-bulb temperature measured at the automatic damper-control sensor. Note that there is good agreement until the temperature is advanced for stem drying. During this phase, the humidity is so low that the wick is drying faster than it can be rewetted by capillary action from the reservoir.

In general, wet-bulb controllers of this particular design do a good job during the first four days of the cure. They will overventilate the barn during the final two days if the wick dries out. It is good procedure to learn the characteristics of an individual barn and set the inlet damper by hand during the final two days. In all cases, the wick should be changed for each cure and the reservoir adjusted to achieve an adequate flow over the wick.

Airflow Requirements

Early research on bulk curing established that an airflow velocity of 30 ft/min (0.15 m/s) across the surface of the leaf will dry it in an acceptable manner (Johnson et al 1960). This velocity is a design minimum for field conditions. Slightly higher air velocity will give better control of the curing conditions and make the system less susceptible to small mistakes in temperature advance and exchanged-air control. It is desirable to have an airflow 10 to 50% greater than the design minimum.

Typically, the static pressure in the delivery plenum of a three-tier bulk-rack barn will be 0.8 to 1.0 inches of water column (in. WC) (200 to

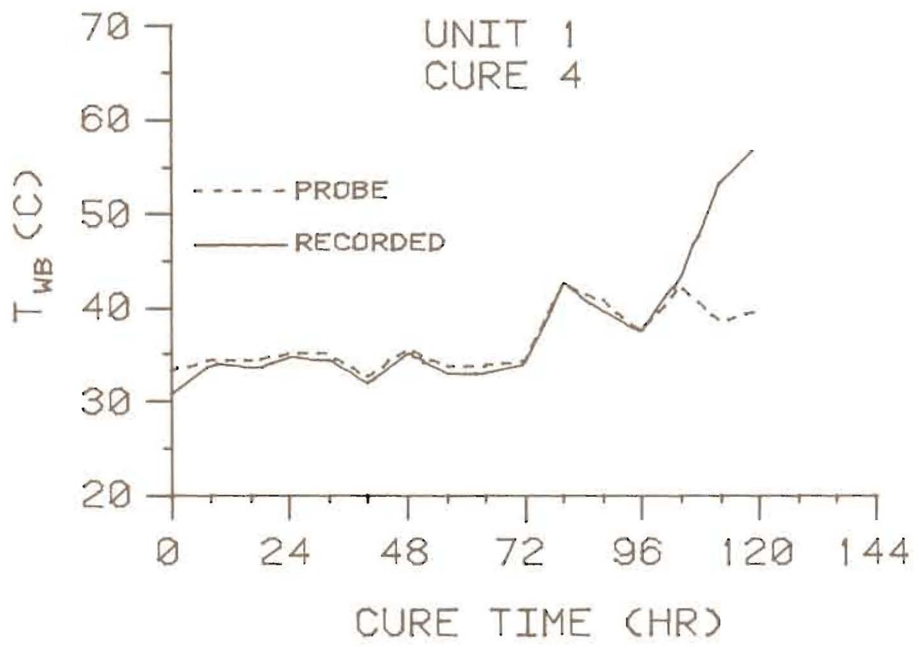

Figure 4. Comparison of wet-bulb temperature recorded at the vent control sensor (solid line) and the actual wet-bulb temperature (dotted line) during cures 3 and 4 in barn 1 at the Coastal Plain Experiment Station, Tifton, Georgia

250 Pa) at the beginning of the cure and 0.1 to 0.3 in. WC (25 to 75 Pa) at the end. As the tobacco dries, resistance decreases and airflow increases. Airflow through the tobacco can be determined by measuring the static pressure drop across the tobacco and then reading the corresponding flow from the fan performance curve. A curve developed from data taken with the fan in place in the barn must be used. The barn structure and placement of the fan in the barn affect the performance; consequently, a performance curve based on data taken on a laboratory test stand is not appropriate. Airflow parameters for a representative cure in the 30-rack barns are given in table 2 to illustrate the change in circulated air during a six-day cure in a three-tier unit.

It is difficult for a grower to determine the airflow in his barn. Fortunately, the commercial equipment available appears to provide adequate airflow for successful curing. The manufacturer's loading recommendations should be followed. If a barn is not uniformly loaded, then airflow problems can result. Specifically, the air will channel through the loosely packed area and bypass the tightly packed area. As a frame of reference for loading

Table 2. Static Pressure in the Delivery Plenum, Velocity of Air Through the Tobacco, and Percentage of Total Circulated Air Exhausted During Cure 2 in Barn 3 (30-Rack) at the Coastal Plain Experiment Station, Tifton, Georgia

Hour	Static Pressure (in. WC)[1]	Airflow (ft/min)[2]	Exchanged-Air Percentage
0	0.92	39	4
24	0.81	46	10
48	0.74	49	10
72	0.64	50	11
96	0.39	52	6
120	0.31	53	3
144	0.21	56	

1. To convert to Pa, multiply by 250.
2. To convert to m/s, multiply by 0.0051.

bulk racks, the range for the cures in the 30-rack barns was 107 to 123 lb (48 to 56 kg) green leaf per rack. Some growers load the first priming tobacco at this rate and increase the loading for the upper stalk tobacco.

Exchanged-Air Rate

The information collected on the 12 cures at the Coastal Plain Experiment Station was used to define the exchanged-air rates. These rates were presented as air changes per hour. One air change per hour means that the air in the curing compartment is replaced each hour. Sixty air changes per hour means that the air in the curing compartment is replaced each minute.

The curing compartment is the space within the barn that is filled with tobacco. The volume of the curing compartment is defined as the area of the drying floor multiplied by the depth of tobacco. For updraft and downdraft barns with boxes, the distance through the tobacco is taken to be the height of the curing containers. For bulk racks, it is taken to be the distance from the drying floor to a point 6 in. (15 cm) above the top tier rail for an updraft barn, and for a downdraft barn, it is the distance from the ceiling to a point 24 in. (60 cm) below the bottom tier rail.

The range of exchanged-air rates and the average for each day of the six six-day cures are given in table 3. Similar data for the five-day cures are given in table 4. The range of exchanged-air rates shown in tables 3 and 4 represents the range that a grower might use as he controls the venting, and thus the drying rate, based on the way a given barn of tobacco responds to the curing environment.

Table 3. Exchanged-Air Rates for Six Six-Day Cures in 30-Rack Barns at the Coastal Plain Experiment Station, Tifton, Georgia

	Air Changes Per Hour[1]	
Day	Range	Average
1	14-39	23
2	33-66	41
3	34-65	49
4	46-70	62
5	26-41	36
6	14-25	21

1. Based on curing compartment volume

Table 4. Exchanged-Air Rates for Six Five-Day Cures in 30-Rack Barns at the Coastal Plain Experiment Station, Tifton, Georgia

	Air Changes Per Hour[1]	
Day	Range	Average
1	13-37	30
2	25-37	32
3	34-63	48
4	25-55	39
5	20-34	25

1. Based on curing compartment volume

The exchanged-air percentages given in table 2 can be compared with the exchanged-air schedule presented as air changes per hour in table 3. A relatively small percentage of total circulated air is exhausted during the cure. Tobacco curing is a controlled drying process over a five- to six-day period. If the tobacco is dried too slowly, it goes through the yellow or golden leaf color and begins to brown. If it is dried too quickly, the lamina at the butt of the leaf and around the main veins doesn't have time to finish coloring.

As previously mentioned, the average loading density for the 12 cures in the three 30-rack barns ranged from 107 to 123 lb (48 to 56 kg) green leaf per rack. This corresponds to a loading density, based on the curing compartment volume, of 7 to 8 lb green leaf per cubic foot (112 to 128 kg/cu m). If a greater loading density is used, then the air changes per hour must be increased proportionally to maintain the desired moisture-removal rate. For example, if tobacco is packed into boxes at a 12 lb/cu ft (192 kg/cu m) loading density, then the exchanged-air rate must be at least 50% greater than the rates shown in tables 3 and 4. Research has shown that a 15 lb/cu ft (240 kg/cu m) loading density requires an exchanged-air rate up to 230 air changes per hour (Cundiff and Dodd 1980).

Moisture Removal

As stated previously, 80 to 90% of the total weight of green leaf loaded into a tobacco barn is water. The moisture content of the green tobacco cured in the 30-rack curing units during 1979 was measured and found to range from 80.4 to 84.1%. This measurement was used to calculate the total water removed during the cure. The percentage of this water that was removed each day of the cure is given in table 5 for the six-day and five-day cures.

Table 5. Daily Water-Removal Percentages for Cures in 30-Rack Barns at the Coastal Plain Experiment Station, Tifton, Georgia

1979 -- Six Six-Day Cures		
Range (%)	Average (%)	Cure Phase
41-55	48	Leaf Coloring/Transition (Average 77 hr)
37-46	42	Leaf Drying (Average 41 hr)
6-13	10	Stem Drying (Average 26 hr)
1979 -- Six Five-Day Cures		
Range (%)	Average (%)	Cure Phase
36-51	47	Leaf Coloring/Transition (Average 65 hr)
27-32	30	Leaf Drying (Average 24 hr)
19-34	23	Stem Drying (Average 31 hr)

On the average, 48% was removed during the leaf-coloring/transition phase (days 1-3), 42% during the leaf-drying phase (days 4-5), and 10% during the stem-drying phase (day 6) for the six-day cures. For the five-day cures, 47% was removed during the leaf-coloring/transition phase (days 1-3), 30% during the leaf-drying phase (day 4) and 23% during the stem-drying phase (day 5).

For comparison, the corresponding water-removal percentages in a 126-rack barn on the grower's farm are given in table 6. These percentages were calculated for six cures during the 1977 season and eight cures during the 1978 season. The moisture content of the green tobacco for the 1977 season cures ranged from 72.5 to 87.9% and for 1978 ranged from 79.7 to 87.5%.

Table 6. Water-Removal Percentages for Cures in 126-Rack Barn on the Talley Farm, Tift County, Georgia

1977 Season (Six Cures)		
Range (%)	Average (%)	Cure Phase
15-29	19	Leaf Coloring/Transition (Average 72 hr)
38-60	48	Leaf Drying (Average 25 hr)
22-39	33	Stem Drying (Average 40 hr)
1978 Season (Eight Cures)		
Range (%)	Average (%)	Cure Phase
13-25	18	Leaf Coloring/Transition (Average 64 hr)
31-43	40	Leaf Drying (Average 24 hr)
32-52	42	Stem Drying (Average 61 hr)

Energy Balance

The energy balance for the tobacco-curing process is simply stated as

energy input = energy output

Energy Input

When tobacco is cured, there are two energy inputs: (1) petroleum fuel, the primary source, and (2) heat energy that is released by the tobacco itself. Tobacco, like most organic matter, goes through a ripening process where respiration takes place. Heat is generated and spoilage results if the crop is not properly ventilated. Heat given off by the tobacco as a result of respiration and as a by-product of the complex reactions that take place during curing, equals *11%* of the total heat energy required (Cundiff 1981b). The other *89%* is supplied by petroleum fuel.

Energy Output

Heat energy is used during curing in three ways: (1) to increase the moisture-holding capacity of the exchanged air, (2) to elevate and maintain the temperature of the curing structure, and (3) to elevate the temperature of the drying tobacco (Cundiff and Dodd 1980). The energy added to the exchanged air is defined as the energy in the exhaust air minus the energy in the inlet air. The exhaust air contains moisture it has picked up from the tobacco. It takes 1000 to 1200 BTU (1055 to 1266 kJ) to evaporate each pound of water. This energy is known as latent heat. Sensible heat (the heat energy stored in the tobacco) added to the inlet air as it passes through the furnace becomes latent heat in the exhaust air. During a tobacco cure, the exhaust air always has a higher humidity than the inlet air; consequently, it always has a higher latent heat content. The energy in the exchanged air accounts for 80 to 95% of the energy output.

The energy required to elevate and maintain the temperature of the barn during a cure is composed of three parts: (1) conductive heat loss — heat energy lost through the surfaces of the barn, (2) stored heat — heat energy stored in the structural materials in the barn, and (3) radiant exchange — heat gain during the day resulting from the sun shining on the barn, minus the heat loss at night because the barn is warmer than the night air and radiates heat energy into the atmosphere. The energy required to elevate and maintain the temperature of a well-insulated barn accounts for *10-15%* of the total energy output.

The heat energy stored in the tobacco is known as the sensible heat. At the beginning of the cure, the green tobacco is at 95°F (35°C). At the end of the cure, the dry leaf is at 165°F (74°C). Obviously, the leaf is hotter at 165°F (74°) than at 95°F (35°C), but it weighs considerably less. Only 10 to 20% of the intial mass remains at the end of a tobacco cure. For this reason, the total sensible heat is less at the end of the cure than at the beginning, usually accounting for -1% of the total energy output.

Solids Loss During Curing

The energy released by the tobacco during curing is not free. It results primarily from the oxidation or breakdown of the leaf sugar. When sugar breaks down, carbon dioxide gas and water vapor are produced and heat is released. The carbon dioxide and water vapor are removed by the drying air passing through the tobacco. Anyone who has opened a bulk barn during the cure can appreciate that gasses are given off during the curing process. In effect, part of the leaf is "burned up" during curing.

The percentage of solids present at the beginning of the cure, which were not present at the end, is presented in table 7 for the 12 cures in the 30-rack units. Note that the percentages range from 5.3 to 29.6%. If these two extremes are eliminated, then the average solids loss is 19.9%. This means that approximately 20% of the harvested leaf was consumed in these cures. A 10% loss has been measured in laboratory experiments (Mohapatra and Johnson 1980). It is safe to say that the solids loss during a typical tobacco cure is between 10 and 20%. There is a need for further research to evaluate different cure management strategies in terms of energy consumption *and* solids loss.

Table 7. Percentage Solids Loss During the 12 Cures in the 30-Rack Barns at the Coastal Plain Experiment Station, Tifton, Georgia

Cure No.	Barn 1	Barn 2	Barn 3
1	18.2	17.7	5.3
2	17.0	21.1	29.6
3	23.2	20.4	20.4
4	18.8	20.4	21.4
Average	19.6	19.9	19.2

Energy Consumption Versus Stalk Position

It takes more energy to cure lower stalk tobacco than upper stalk tobacco. This is because the first priming tobacco has a higher moisture content. Let us assume that the first priming has a moisture content of 90%. This means that 0.9 lb (0.41 kg) of water must be removed to obtain 0.1 lb (0.05 kg) of dry leaf solids. If we assume that there is a 15% solid loss during the cure and that the leaf is reordered and sold at 20% moisture content, then 0.9 lb (0.41 kg) of water is removed for each 0.106 lb (0.048 kg) of marketed leaf.

The average heat required to evaporate moisture during a tobacco cure is 1113 BTU/lb (2588 kJ/kg). This translates to 0.0139 gal LP gas (GLP) (0.116 LLP gas/kg) per pound of water removed. The fuel consumption, based solely on water removal, is then

0.9(0.0139)/0.106 = 0.12 GLP/lb (1 LLP/kg) marketed leaf

The top leaves or tips typically have a moisture content of 80%. In this case 0.8 lb (0.37 kg) of water is removed to obtain 0.2 lb (0.09 kg) of dry leaf solids, or 0.212 lb (0.096 kg) of marketable leaf. The fuel consumption, based solely on water removal, is then

0.8(0.0139)/0.212 = 0.05 GLP/lb (0.42 LLP/kg) market leaf

It takes more than twice as much energy to remove the moisture from the first priming tobacco as it does the last priming tobacco.

Comparison of 30-Rack and 126-Rack Barns

The manufacturer who built the barns on the Talley farm built the 30-rack barns as scaled-down models of their 126-rack barn. The 30-rack barns and the 126-rack barn both had the same insulation in the side walls, doors, and ceiling of the curing compartment. Both had the same insulation in the furnace room wall of the curing compartment, and both were insulated from the ground with the same insulation. It is valid, then, to compare the energy efficiency of the cures in the 30-rack barns with the cures on the grower's farm in his 126-rack barn. This is done in table 8 on the basis of gallons of LP gas equivalent per pound of marketed leaf (GLP/lb leaf). The total tobacco marketed from the grower's barn in 1977, 1978, and 1979 was divided into the total fuel consumed for those years to obtain the GLP/lb marketed leaf ratios. The same procedure was used to obtain this ratio for the 12 cures (six six-day and six five-day cures) in the 30-rack barns.

Table 8. Comparisons of Energy Efficiency in 30-Rack Barns with 126-Rack Barn on the Talley Farm, Tift County, Georgia

	Seasonal Average	
Barn	Market Weight GLP/lb	Market Weight LLP/kg
126 Rack		
1977 (7 cures)	0.08	0.66
1978 (8 cures)	0.09	0.74
1979 (6 cures)	0.07	0.62
30 Rack		
1979 (12 cures)	0.08	0.66

The percentage of fuel consumed for the various cure phases during the 1977 and 1978 cures on the Talley farm is given in table 9. A comparison of tables 6 and 9 shows that the grower used, on the average, 20% of the fuel consumption to remove 19% of the moisture during the leaf-coloring/transition phase of the 1977 cures. He used 44% of the fuel to remove 33% of the moisture during stem drying. The percentages for the 1978 cures are similar.

This illustrates an obvious point, one that is appreciated by all involved in tobacco curing. *Moisture removal is by far the dominant factor in energy consumption.* The amount of water removed from the 1977 cures on the Talley farm averaged 1000 gal/cure, and during 1978, the average was 940 gal/cure. The fuel required to evaporate this water, without considering the heat required to elevate and maintain the temperature of the barn, would be 116 GLP/cure for the 1977 cures and 107 GLP/cure for the 1978 cures. For comparison, the measured LP gas consumption averaged 149 gal/cure in 1977 and 158 gal/cure in 1978.

Table 9. Fuel-Consumption Percentages for Cures in 126-Rack Barn on the Talley Farm, Tift County, Georgia

1977 Season (Six Cures)		
Range (%)	Average (%)	Cure Phase
16-28	20	Leaf Coloring/Transition
34-56	44	Leaf Drying
26-39	36	Stem Drying
1978 Season (Eight Cures)		
Range (%)	Average (%)	Cure Phase
13-24	17	Leaf Coloring/Transition
28-45	36	Leaf Drying
36-57	47	Stem Drying

Electrical Energy Consumption

In general, the electrical energy required for tobacco curing in an insulated bulk-curing barn is 10 to 20% of the total energy consumption (Cundiff 1978). The measured electrical energy for the 12 cures in the 30-rack units was 17% of the total. On the grower's farm, the measured electrical energy consumption averaged 499 kwh/cure for the 1977 season (six cures) and this was 12% of the total energy consumption. For the 1978 season (eight cures) the consumption was 656 kwh/cure or 15% of the total.

Comparison of Six-Day and Five-Day Cures

When fully ripe tobacco is harvested, it is often possible to shorten the leaf-coloring phase and finish the cure in five days. The heat energy required for the six five-day cures in the 30-rack units was 7% less than the heat energy required for the six six-day cures. It does not take a great deal of heat energy to maintain the leaf-coloring environment; consequently, the savings realized by shortening this phase is not proportional to the number of hours the curing time is reduced.

It is good management to use only the number of hours in the leaf-coloring phase required to achieve the color uniformity associated with good quality. Electrical energy consumption *is* proportional to fan operating hours; consequently, when 24 hours is subtracted from a 144-hour cure the reduction is 17%. The actual measured electrical energy reduction for the five-day cures in the 30-rack units was 19.6%. The total (electric + heat) energy reduction for the five-day cures in comparison with the six-day cures was approximately 9%.

Typical LP Gas Consumption

Typical daily fuel consumption in an insulated 126-rack barn on an insulated foundation slab is given in table 10. Note that 29% of the fuel is consumed in the leaf-coloring/transition phase (days 1-3). The stem-drying phase (day 6) requires 18% of the fuel. If the barn contains 2800 lb of cured leaf, then the energy-efficiency ratio is

228/2800 = 0.08 GLP/lb marketed leaf

Table 10. Daily LP Gas Consumption in a 126-Rack Insulated Barn on an Insulated Foundation Slab During a Typical Six-Day Cure

Day	GLP	Percent
1	9	4
2	25	11
3	32	14
4	64	28
5	57	25
6	41	18
Total	228	100

Management Objective for Energy Efficiency in Tobacco Curing

Using good management, a grower can obtain a seasonal average (six to eight cures) of 0.10 GLP/lb (0.83 LLP/kg) marketed leaf in a conventional uninsulated barn. This assumes that the furnace is properly adjusted, the barn is well sealed on the foundation slab, and the doors seal properly. If the barn is insulated and installed on an insulated slab, then the seasonal average can be reduced 20% to 0.08 GLP/lb market leaf (0.66 LLP/kg). Further reductions can be achieved with a solar system (Cundiff 1981) or the more sophisticated cross-flow barn with exhaust air heat exchanger.

Summary

Certain guidelines for bulk curing of bright leaf tobacco have emerged over several years of research. These guidelines are presented here, not as a recipe for the curing of any specific sample of tobacco, but to give guidance in the selection of the most important curing parameters.

Temperature. A temperature schedule is selected and then modified as the response of the tobacco to the curing environment is observed. In general, the dry-bulb temperature is maintained at 90°F to 105°F and the relative humidity at 80 to 90% during the leaf-coloring phase. The leaf-drying phase is defined as the period when the temperature in the delivery plenum is between 115°F and 140°F and lasts 24 to 60 hours. Stem drying is defined as the cure time when the delivery plenum temperature is above 140°F and typically ranges 12 to 48 hours.

Airflow. Guidelines for the control of airflow, and subsequent moisture removal, are

Cure Phase	Air Velocity Through Tobacco (ft/min)	Exchanged-Air Rate (AC/H)	Moisture Removal (%)
Leaf Coloring	33 - 50	25 - 40	15 - 55
Leaf Drying	45 - 60	50 - 70	25 - 60
Stem Drying	50 - 65	20 - 40	20 - 50

The energy required to elevate and maintain the temperature of a well-insulated tobacco-curing barn is 10 to 15% of the total heat energy required for the cure. The remaining 85 to 90% is used for moisture removal.

LP gas consumption in a well-managed cure will average 0.1 gal/lb of marketed leaf. If the curing barn is insulated, this ratio can be reduced by 20% to 0.08 GLP/lb. Typically it requires approximately twice as much fuel per unit of market weight to cure the lower stalk.

Electrical energy consumption is 10 to 20% of the total (electrical and heat) energy. Reducing the curing time from six days to five days reduces the electrical energy consumption by 17% but only reduces the heat energy consumption by 9%.

Tobacco, through respiration and other biochemical activity, supplies approximately 10% of the total heat energy required for the cure. The corresponding solids loss can range 5 to 30%, with 20% being an average loss under field conditions.

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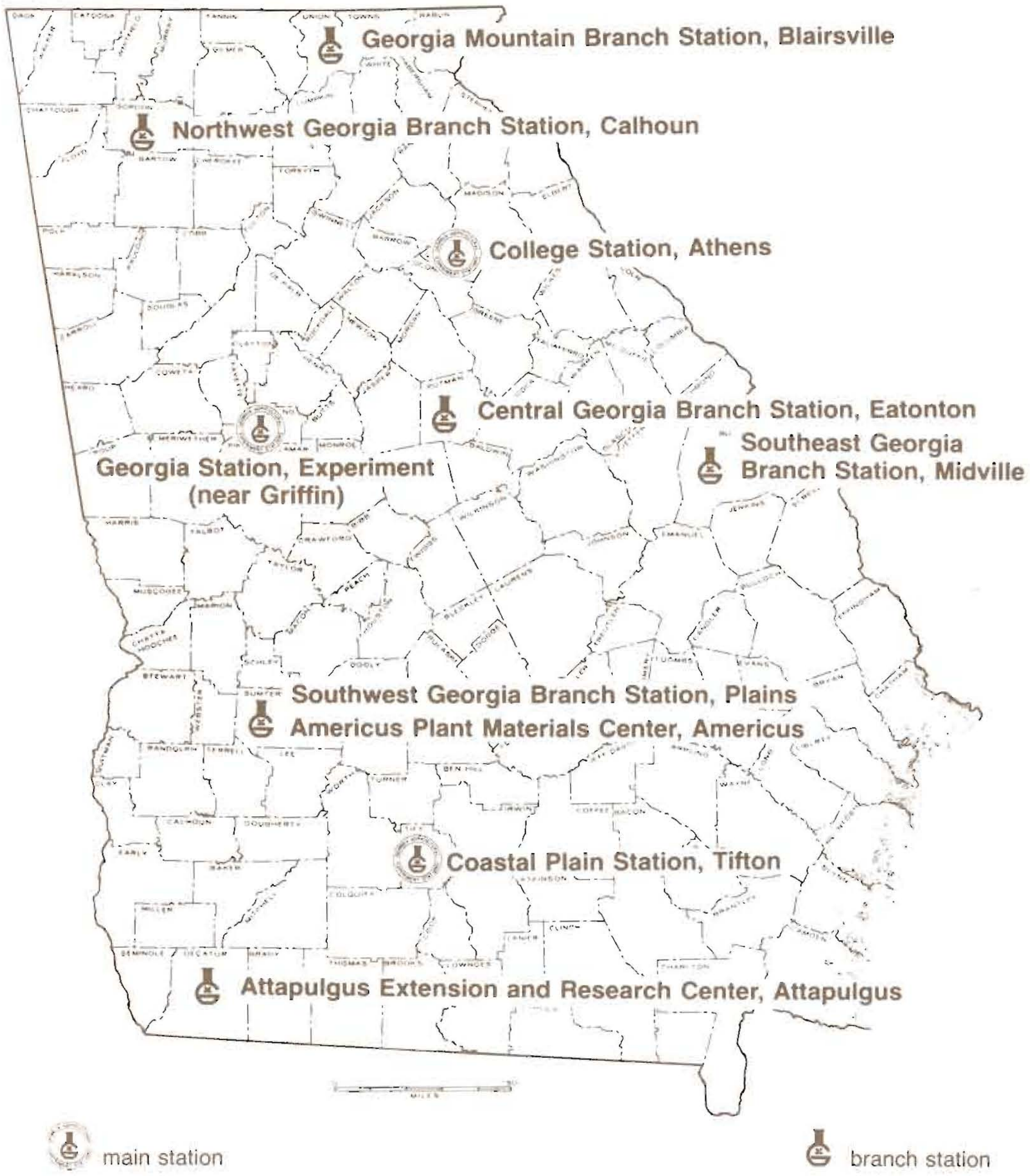

Georgia Mountain Branch Station, Blairsville
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Georgia Station, Experiment (near Griffin)
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Americus Plant Materials Center, Americus
Coastal Plain Station, Tifton
Attapulgus Extension and Research Center, Attapulgus
main station
branch station