In recent years, international markets have adopted certain plant health requirements regarding imported lumber. Such measures are aimed at maintaining forest health by avoiding the introduction of foreign pests and disease. The pine wilt disease epidemic that occurred in Japan in the 70's and 80's is often cited as a primary example of what the regulations are intended to prevent.

The responsibility to inspect exported U.S. agricultural products and certify that they meet such requirements is vested in the U.S. Animal and Plant Health Inspection Service (APHIS). However, inspection of Western lumber products is best made during the production/grading process and the APHIS staff is not large enough to conduct the necessary inspections at producing mills.

Therefore, to ensure the ability of Western mills to meet the demands of foreign markets, Western Wood Products Association and APHIS have entered into agreements which allow WWPA to specify inspection methods and issue certificates and documentation on lumber shipments originating at Association mills and destined for foreign countries. This paper describes the kiln drying/heat treating certification program developed by WWPA and APHIS for the European lumber market.

History of European Restrictions on U.S. Exports

In 1977, European Community (EEC) member countries adopted a code, designated Plant Health Directive 77/93, for the purpose of preventing the importation of animals or plant products which might introduce unwanted insects and diseases into Europe. Included in the code were restrictions on lumber containing bark. On January 1, 1986, the United Kingdom put into effect the requirements of 77/93, which, in the case of lumber imports, made it necessary to certify lumber as bark-free.

In 1986, responding to the UK requirements, WWPA and APHIS developed a program to certify that Western lumber entering some European countries was bark free. In 1990, the program was expanded to include grub hole controls, and is currently known as the Bark Removal and Grub Hole Control Certification Program. The grub hole controls were added to provide additional insurance against the transference of cerambycid longhorn beetles (also known as sawyer beetles) of the genus Monochamus. The Monochamus beetles are known to be the principle vector for the pine wood nematode, Bursaphelenchus xylophilus, a microscopic worm that is widely regarded as being responsible for the Japanese pine wilt epidemic.
[In 1992, a separate documentation program, called the *Kiln Drying Documentation Program*, was created to cover kiln-dried lumber destined for the Middle East and other countries requiring APHIS phytosanitary certificates.]

Subsequent amendments to EEC Directive 77/93 prohibit the importation of all coniferous woods other than cedar from certain countries, including the U.S., unless it has undergone an appropriate heat treatment to achieve a minimum wood core temperature of 56 degrees C for 30 minutes. This time/temperature requirement was arrived at after a review of new and past research conducted in the U.S., Canada, and several EU countries. It was determined that 56 degrees C for 30 minutes was sufficient to kill the pine wood nematode and its vector, Monochamus.

On June 22, 1993, the Commission of the European Communities issued a decision which allows approved US grading agencies to issue heat treating certificates for kiln dried lumber produced under an officially recognized APHIS program. Included in the decision is the following requirement:

"the wood shall be kiln dried over a period of time sufficient to achieve a minimum core temperature of 56 degrees for 30 minutes in a kiln tested and approved for this purpose by an official grading/inspection bureau approved for this purpose by the Animal Plant Health Inspection Service, US Department of Agriculture; in the case of the use of a schedule where the dry-bulb temperature does not reach 56 degrees C, the kiln drying process shall include a condition period at the end of the drying cycle, where the kiln temperature will reach 60 degrees C for at least one hour."

WWPA's *Heat Treating Certification Program* was developed in 1994 to certify that Western lumber destined for countries in the European Union reached a core temperature of 56 degrees C (133 degrees F) for 30 minutes.

**WWPA / APHIS Agreement**

The basis for WWPA's authorization to issue Heat Treatment Certification Using a Kiln Facility documentation is a Memorandum of Understanding between APHIS and WWPA signed July 26, 1993. This agreement provides the framework for WWPA's documentation program. The conditions are as follows:

WWPA and APHIS agree that:

1. The overall direction and control of this program is to be maintained by APHIS. Mill inspection personnel shall remain administratively responsible to WWPA.

2. The basic control requirement for coniferous sawn wood under this system is heat treating using a kiln facility to the extent that the core of the wood has reached a minimum core temperature of 56 degrees C (133 degrees F) for 30 minutes.
WWPA agrees that:

1. Heat treated coniferous sawn wood shipments designated as kiln-dried (KD) shall be inspected be an approved representative of the Association and shall be certified as conforming to the documentation statement imprinted on the Heat Treatment Certification Using a Kiln Facility document. For heat treated (HT) coniferous sawn wood shipments which do not meet the kiln-dried moisture content requirements, kiln records shall be inspected by an approved representative of the Association.

2. Shipments of coniferous sawn wood moving into export channels that have been heat treated according to the requirements of this system shall have each bundle of coniferous wood in the shipment marked at the preparing mill with the appropriate standardized mark which bears the WWPA logo, as shown in Figure 1. The mark shall be located in the upper right hand quarter of one side of the bundle. For kiln-dried lumber, the standardized mark will include the KD symbol. For heat treated lumber not meeting the kiln-dried moisture content requirement, the standardized mark will include the HT symbol.

3. The Association will maintain signed agreements with participating mills, a register of participating mills, including names of representatives approved to issue Heat Treatment Certification Using a Kiln Facility documents; and copies of all documentation issued.

4. The Association will provide mill inspector training to all participating mills. Monthly review of the individual mill certification program shall be made through regular quality control checks by the WWPA.

APHIS agrees to:

1. Monitor the certification system for conformance by conducting inspections at participating mills and points of export and by reviewing WWPA files and records.

2. Refuse to issue federal phytosanitary certificates for any consignment found by physical inspection to be in non-compliance.

Heat Treated (HT) vs. Kiln Dried (KD)

Defining the Difference

Compliance with the European directive requires that all lumber in a shipment be "heat treated" to a minimum core temperature of 56 degrees C (133 degrees F) for 30 minutes. However, the Europeans recognize, and WWPA certifies, lumber in two distinct categories: Heat Treated (HT) or Kiln Dried (KD). The difference between the two lies in the final moisture content of the lumber after treatment and in the documentation required.
FIGURE 1. WWPA standardized marks for Kiln Dried (KD) and Heat Treated (HT) lumber.
While both HT and KD are considered heat treated as far as lumber pasteurization goes, in order for a shipment to be documented as kiln dried and marked KD, the final moisture content of the wood must be less than 20 percent. The Heat Treatment Certification Using a Kiln Facility document must also contain the added statement: "The lumber described is certified to have been kiln dried to a moisture content less than 20 percent". For lumber shipments designated as KD, the Heat Treatment Certification Using a Kiln Facility document serves as the officially recognized document and no phytosanitary certificate is required.

If the lumber is not dried below 20 percent, but it has met the core temperature requirements, it is documented as Heat Treated and marked HT. Thus, it is possible to heat treat lumber and still end up shipping green material. This happens often, especially with lower grades which will not recover the cost of complete kiln drying. The often heard rumor that you can't ship green lumber into Europe anymore is simply not true, it just needs to reach the minimum core temperature requirements and be marked HT. In the case of lumber designated as HT, the Heat Treatment Certification Using a Kiln Facility document is sent to APHIS, who then issues a phytosanitary certificate. The phytosanitary certificate must accompany the shipment, the EU does not recognize HT designated lumber from the U.S. without a phyto.

Economic Considerations

The decision to use a KD or HT treatment is usually an economic one. A typical recommendation for lumber that is 4" and thinner is: if the lumber is going to be used dry, it KD is probably the route to go. This means that almost all upper grades going to Europe would be best served by being KD. On the other hand common grades of 4" and thinner material, such as Belgian merch., are likely to be treated to HT specifications (and consequently get shipped green). It is highly unlikely that the cost of drying such grades would be recovered, so there is no incentive to provide a value added product. The name of the game in this case is to provide heat treating as cheaply as possible, and the HT treatment is much less expensive than the KD treatment. In fact, it costs the exporter about twice as much to heat treat lumber under the KD provisions as it does under the HT provisions, according to one custom drying operation. This added cost for KD can be passed on to the buyer in the case of upper grades, but the market wont support it for the common grades.

Lumber thicker than 4" is almost always going to be treated to the HT standard. It simply takes too long and is too expensive to KD lumber of this dimension. Is there an upper limit in terms of the size of lumber that can be certified HT? Theoretically, no. In fact, the HT process is ideal for thick material as it provides the only practical means of heat treating lumber to meet the EU requirements. As long as the kiln can be kept fully charged with steam (WWPA recommends no more than a three degree wet bulb depression, zero if possible, with all vents closed), the longer kiln times can be accommodated with little or no degrade to the lumber. WWPA has certified HT schedules for 6" and 12" thick material. Try drying that economically!
Time considerations may also enter into the decision. A typical HT schedule for 4" lumber takes 24 hours or less, compared to a KD schedule of one month.

Documentation Procedures

Any mill with kiln facilities using WWPA grading services may apply for authorization to issue WWPA Heat Treatment Certification Using a Kiln Facility documents. WWPA will authorize the following personnel to inspect lumber and issue Heat Treatment Certification Using a Kiln Facility documentation:

- Lumber graders assigned to inspect shipments destined for countries that require heat treating documentation who can personally attest that the shipment meets the kiln drying/heat treating requirements cited above.

- Supervisory personnel with direct responsibility for the inspection of such lumber who can personally attest that the shipment meets the kiln drying/heat treating requirements cited above.

Once approved by WWPA, the authorized personnel act as agents of the Association. These individuals have direct responsibility and contractual obligation to WWPA and the shipping mill to assure that the documented shipments have been properly inspected. The authorization to issue documentation can be revoked if shipments do not meet kiln drying/heat treating requirements.

Mill Agreements

Each mill planning to issue Heat Treatment Certification Using a Kiln Facility documentation must first enter into an agreement with WWPA. The agreement specifies the conditions for authorizing mill personnel to issue documentation. It also details responsibilities of WWPA and the mill.

Should lumber shipments not meet the kiln drying/heat treating requirements, customs officials at the port of entry can impound the shipment for fumigation or for other corrective measures. Any costs of fumigation and any other corrective measures are the responsibility of the shipping mill shown on the documentation. Failure of a mill to satisfactorily resolve claims for corrective measures can result in revocation of the authorization to issue documentation.

Certification & Monitoring

Upon notification by a mill to become certified under the Heat Treatment Certification Program, WWPA provides the mill with the certification requirements and performs an evaluation of the facility according to the procedures outlined below.
For certification to apply the KD symbol, VVVVPA reviews and approves the drying schedule and verifies that the requirements for kiln drying/heat treating will be reached. Existing data shows that drying schedules used in the Western U.S. for 2" to 4" thick lumber result in core temperatures well in excess of 56 degrees C. As a result, testing is not conducted for KD certification. For non-standard drying schedules, such as those used with dehumidification kilns or other low drying schedules, additional steps may be required to insure the proper temperature is achieved.

For certification to apply the HT symbol, WWPA establishes and approves a heat treating schedule for each kiln that will be used in the heat treating process. Heat treating schedules will be determined on full kiln charges operating under normal conditions. The schedule for each kiln is based on the following conditions:

1. WWPA inspectors place temperature sensors (thermocouples) into the core of selected pieces of lumber which are distributed at approximate equal distances along the length and height of the kiln. The kiln is divided into 12 zones of approximately equal area, three zones along the length, two zones in height and two zones in width, as shown in Figure 2. One sensor is placed into the core of a sample piece which is located in the interior of the bundle near the center of each zone.

2. The kiln is heated according to a schedule specified by the mill. The following schedule applies to kilns operating under normal conditions:

   - Sensors are monitored at least every hour.
   - The heat treating schedule determines the temperatures used for the heat treating process, including the entry air or exiting air temperature, as measured by the existing kiln temperature sensors (thermocouples). The lowest of the temperatures determined by the sensors at selected locations is used for each sensor location.
   - The heat treatment time is the maximum time required for the last sensor to reach the lumber core temperature of 56 degrees C and maintain it for 30 minutes. The lowest of the air temperatures (either the entry or exiting air) determines the temperature used for the heat treatment schedule.

3. The heat treating schedule established at certification may be used for thinner lumber of the same species. However, separate schedules are required for stock thicker than that tested.

4. The schedules apply to kilns operating under normal conditions. Should the normal operating conditions of the kiln change due to changes in equipment or interruptions in the heating schedule, further action may be required. For example, new equipment could require recertification. Additional steps may be required for non-standard drying schedules, such as those used with dehumidification kilns or other low drying schedules. As a result, testing is not conducted for KD certification.
FIGURE 2. Division on Dry Kiln Zones for thermocouple placement during certification.
Should the kiln not be loaded to capacity, a) bundles should be staggered lengthwise from row to row and piled so as to avoid a continuous hole in the direction of air flow or b) temporary baffles should be used to block any holes.

Documentation

WWPA provides Heat Treatment Certification Using a Kiln Facility forms to certified mills (see Figure 3). These documentation may be issued by mills only after the lumber has been inspected by authorized personnel. Documentation may not be issued subsequent to shipping.

After the Heat Treatment Certification Using a Kiln Facility document has been filled out, it is mailed to the WWPA Quality Standards Department for approval and validation by the Quality Standards Department. Documents are then returned immediately to the mill or, upon request, forwarded according to the mill's instructions.

WWPA maintains a file of documentation forms by mill and by number. Should documentation be lost in transit, WWPA can issue a copy and attest to its authenticity. WWPA keeps copies of each documentation form on file for three years.

Inspection Review

Lumber shipments documented as heat treated are subject to periodic inspections by WWPA and APHIS personnel to assure the integrity of the documentation program. Kiln records are subject to periodic inspection in the case of heat treated lumber shipments bearing the HT symbol. In addition, mill files of documentation may also be inspected.

Field Observations

WWPA has certified dry kilns for several different size categories under the Heat Treatment Certification program, including 3" and thinner, 3" to 6" thick and 6" to 12" thick lumber. Observations from these certifications have provided us with practical information on the process. We have noticed very little degrade in the lumber due to the heat treating process, even in the thickest sizes. The main reason for this is that HT schedules are run with the minimum wet bulb depression possible. Initially a wet bulb depression of no more than 5 degrees was recommended, however, some mills actually set the wet bulb temperature higher than the dry bulb to insure continuous live steam in the kiln throughout the process. This approach has been particularly helpful for the thicker material which require longer schedules. In addition, all vents are closed during the schedule to keep the kiln environment as humid as possible (fan reversals still occur to maintain uniform temperatures). These two factors combined prevent the lumber from drying and minimize drying defects.
The lumber described below is certified to have undergone an appropriate heat treatment to achieve a minimum wood core temperature of 56 degrees C for 30 minutes.

**DESCRIPTION OF CONSIGNMENT**

| INDICATE SPECIES, GRADE MARKS, OR OTHER IDENTIFYING MARKS. ALSO, INDICATE NUMBER OF PACKAGES AND BOARD FEET/CUBIC METERS BY LOT (LOT NUMBER AND VOLUME ARE REQUIRED) |
| Mill Order No.: | Number of Bundles: |
| Invoice No.: | Marks on Bundles: |
| Customer No.: | Vessel: |

This document is issued under a program officially approved by the Animal and Plant Health Inspection Service, U.S. Department of Agriculture. The products covered by this document are subject to preshipment inspection by that agency. No financial liability shall be attached to the U.S. Department of Agriculture or to any officer or representative of the Department with respect to this certificate.

**AUTHORIZED PERSON RESPONSIBLE FOR CERTIFICATION**

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**AGENCY VALIDATION**

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HT schedules have varied significantly, depending on the kiln set up. For example, one single track kiln has been certified to heat treat 3" thick Douglas fir in approximately 12 hours (this includes a 7 hour "preheat" phase which occurs overnight). Another kiln, a double track, has been certified to heat treat the same material in approximately 24 hours, or twice as long. One main difference is that the double track kiln was certified with one track empty, so air flow through the sticker openings was poor resulting in considerably longer heating times. Schedule times for different size categories are not as different as initially expected. For example, the previously mentioned 12 hour schedule for 3" thick lumber can be contrasted with a schedule of approximately 26 hours for 12" thick lumber. Even considering the fact that the 3" schedule could likely be shortened to 8 hours or less, it came as a surprise that 12" thick material would heat in such a relatively short period of time. Again, the application of live steam throughout the schedule probably played a major role.

So far, all HT schedules developed have started at a lower temperature (around 125 degrees F) and built up to the final temperature (between 145 and 160 degrees F). Starting and ending temperatures have varied depending on the size of the material and the kiln set up.

Canadian Approach: Some Differences

In 1994, approximately 240 million board feet of softwood lumber was exported from the U.S. to Europe. By contrast, Canadian based Council of Forest Industries (COFI) records indicate Canadian mills shipped approximately 420 million board feet during the same period. Needless to say, the European regulations affect the Canadian export lumber industry even more significantly than the U.S. export lumber industry. Consequently, the Canadians have taken the lead in many areas of research and regulation negotiations involving the KD/HT process and the European regulations. Agriculture Canada publishes the Agriculture Canada Program for Producers of Heat Treated Lumber: Participant Requirements and Procedures which provides the specifications for heat treated lumber and gives the qualification and ongoing monitoring requirements for the Canadian heat treating program.

Overall, the Canadian and U.S. programs are similar, however, there are some differences in the certification process which will be briefly outlined here. Under the Canadian certification program, the first step in certification is to identify the "cold spot" of the heat treating chamber (a heat treating chamber is, for all intents and purposes, a dry kiln, but it could be a chamber specially designed for heat treating only). The cold spot is established by dividing the kiln into 5m long x 1.5m high zones which extend the width of the chamber. Thermocouples are placed in the sticker opening near the center of each zone and in the core of at least two pieces. The chamber is heated until both core thermocouples reach 56 degrees C. Whichever spot consistently shows the lowest temperature throughout the schedule is defined as the "cold spot". Next, thermocouples are inserted into the core of at least 20 pieces of a unit, which is then placed in the cold spot. The chamber is heated for a second time until the last core thermocouple reaches 56 degrees C for 30 minutes. The heat treating schedule
is determined through a statistical calculation, which is a function of the standard deviation and the number of pieces monitored.

There are other differences between the two countries programs, but in terms of monitoring, record keeping, and administration, they work essentially the same.

What Lies Ahead?

As we move more and more into a "new world order" in terms of economies and trade and the globe continues to shrink, what changes can we expect which will affect the export (and import) of lumber from (and to) our country? One thing is almost certain. Plant health issues, like those which are at the foundation of the European HT/KD regulations, will become more common as additional countries move into the international lumber trading scene. One example of this is the recent new KD regulations for all pine lumber being exported to Korea. The regulations were adopted in 1994 and require that all pine be heat treated to 56 degrees for 30 minutes and be dried to a moisture content of 20 percent or less. Manufacturers shipping to Korea must be certified under the program and must obtain a Heat Treating Certification Using a Kiln Facility document from the recognized grading agency. This document is used, in turn, to obtain a phytosanitary certificate from APHIS.

Another recent development is the push in Great Britain towards kiln dried lumber. If such a move is adopted, and there is serious talk of it, all lumber from North America will have to be heat treated and dried to a moisture content of 20 percent or less. In other words, it will have to carry the KD designation under the heat treating program. This type of move will have a significant impact on the grades and sizes of lumber sent to the UK and could affect plant health decisions in other countries as well.

Finally, our own APHIS is preparing a new import document which will specify the requirements for importing foreign lumber into the U.S. The document, scheduled to be printed in the Federal Register within the next few months, will outline heat treating requirements which are stiffer than those being imposed by Europe and Korea. All foreign lumber and logs will have to be heat treated to 71.1 degrees C for 75 minutes before being admitted into the country. It is said that APHIS is requiring the tougher limits in order to protect U.S. forests from all pests, whereas the European and Korean regulations are targeted to more specific pest threats, such as the pinewood nematode. When the US adopts the new plant health import regulations, look for other countries to consider tightening their current requirements to match the U.S. This would mean higher core temperatures and longer kiln times for US manufacturers, resulting in increased costs and threatening our competitiveness in the international market.

In short, current trends would indicate that if lumber is going to travel over international boarders in the future, it will be heat treated to some degree. Which leads to the general conclusion that the future will bring a worldwide increase in
the demand for kiln space. Certainly in this country, if you're going to be in the overseas export business, you're going to need access to a kiln.

Summary

Growing international awareness and concern for forest health has created a need for certification and monitoring of exported wood products which is aimed at preventing the spread of forest pests. Throughout the last ten years, the European Union countries have required such certification programs to be in place for all lumber exported from North America. The current program involves heat treating lumber to a core temperature of 56 degrees C (133 degrees F) for 30 minutes. A heat treating certification program is available through several U.S. and Canadian agencies. The program allows for certification under two options, Kiln Dried (KD) or Heat Treated (HT). The decision as to whether to provide KD or HT material is typically an economic one based on the grade and value of the lumber being exported. In the future, we are likely to see more countries (including the U.S.) adopting similar requirements and an increase in the demand for kiln space for exported lumber.