CLIENT PROGRESS REPORT
EVALUATION OF "NEW" TABLE GRAPE PACKING BOXES

30 October 1992

SUBMITTED TO: International Paper
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San Jose, CA 95133-1696

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EVALUATION OF "NEW" TABLE GRAPE PACKING BOXES

BOX CONFIGURATION AND COMMENTS:

Both the TKV and Clip boxes were stacked on the pallets in a 2X3 configuration, ten layers high. The metric box was arranged in a 3X3 configuration, eight layers high.

Because two sides of the metric box configuration hung slightly over the edge of the pallet, a special pallet had to be made for this box design. The cut cardboard notches on the top of the metric box tend to separate and get caught when one is trying to stack these boxes.

FUMIGATION CHAMBER CALIBRATION:

Method: Kitagawa detector tubes (pump-type gas samplers) 0.1-3.0% were used to determine the SO_2 flow throughout the chamber. Adjustments to the placement of fans and air speed were evaluated by the kitagawa readings. A total of six room calibrations were completed. Results from the final room calibration are shown in Table 2.

Results:

FUMIGATION CHAMBER CALIBRATION TRIAL VI October 7, 1992

TABLE 1: SENSIDYNE TUBE CALIBRATION

Box Type	Placement of Sensidyne Tube	Tube reading SO_2 ppm X Hour
TKV	Middle North Box	120
Metric	Middle North Box	110
Clip	Middle North Box	off scale

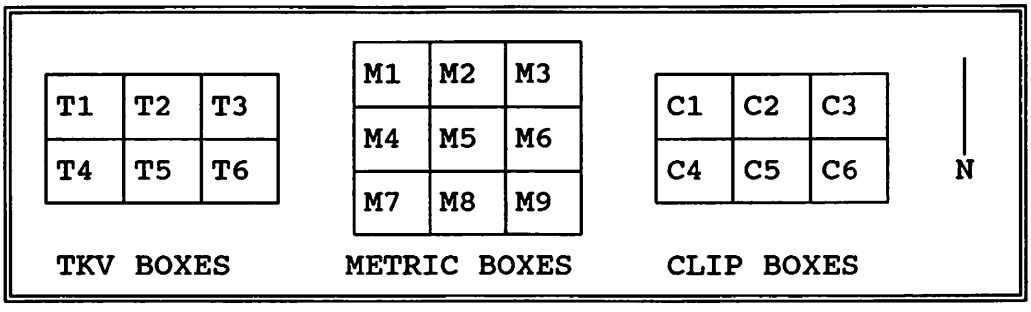
TABLE 2: KITAGAWA TUBE CALIBRATION OF CHAMBER

Pump Position	Time	Kitagawa reading (with 10 draws)
Metric North	10:43	0.35%
Metric South	10:57	0.30%
TKV North	11:02	0.275%
Clip North	11:13	0.25%
Clip South-A	11:24	0.225%
Clip South-B	11:35	0.225%
TKV South	11:47	0.20%

Note decrease with time for sequential kitagawa tube readings. This reflects the natural decrease in SO_2 as it is adsorbed by fruit, boxes and room surfaces. From these readings it appears that the SO_2 is being relatively well mixed in the room atmosphere.

BOX EVALUATION (CIRCULATING-AIR FUMIGATION) TRIALS

FIGURE 1: MAP OF GRAPE BOX PLACEMENT IN CHAMBER



Method: Gastec-Sensidyne Dosimeter Tubes provide a measurement of the mean value of sulfur dioxide in the air by the principle of diffusion sampling. In these trials, the air inside the packing box is sampled. In our trials to date, all Sensidyne tubes have been placed in the 7th layer from the bottom of the TKV and Clip boxes and the 6th layer from the bottom of the Metric boxes. These layers are approximately equal in height from the floor.

Dosimeter tube values are measured in concentration of SO_2 multiplied by time units (SO_2 CT's = SO_2 ppm X Hour). The grape box position within each pallet corresponds with the map (Figure 1). The recorded CT values for six Box Evaluation Trials are shown in Figure 2. All dosimeter tubes were off scale in Trial I. Since we were targeting relative SO_2 measurements and SO_2 penetration through the pallets and into the boxes, we wished to stay below the standard SO_2 fumigation level of 100 CT's. Trials III & IV were dosed at approximately one-third the SO_2 level of Trial II. Trials V & VI were dosed at approximately two-thirds the SO_2 level of Trial II. During each trial six box measurements were made within each pallet. Each measurement was taken at the same box levels used in the calibration trials. The sixth measurement in the Metric pallet was rotated between the four middle-side boxes that have only one side to the outside air.

BOX EVALUATION (CIRCULATING-AIR FUMIGATION) TRIALS

Results:

FIGURE 2: SO_2 CT's FOR SIX TRIALS FOR BOX EVALUATION

- CT 100 CT 15 CT 14 CT 26 CT 22 CT	- CT 75 CT 15 CT 16 CT 18 CT 20 CT	- CT 150 CT 22 CT 28 CT 40 CT 60 CT
- CT 75 CT 17 CT 18 CT 30 CT 30 CT	- CT 100 CT 12 CT 16 CT 22 CT 32 CT	- CT 150 CT 28 CT 30 CT 24 CT 32 CT

TKV BOXES

- CT 175 CT 50 CT 50 CT 80 CT 78 CT	42 CT	- CT 110 CT 35 CT 32 CT 44 CT 36 CT
17 CT	- CT 100 CT 18 CT 22 CT 26 CT 36 CT	70 CT 36 CT
- CT 100 CT 27 CT 12 CT 24 CT 28 CT	26 CT	- CT 80 CT 12 CT 8 CT 20 CT 18 CT

METRIC BOXES
(rotated a single box reading on each trial)

- CT 150 CT 44 CT 36 CT 72 CT 70 CT	- CT 150 CT 32 CT 28 CT 56 CT 60 CT	- CT 150 CT 40 CT 35 CT 70 CT 66 CT
- CT 120 CT 30 CT 35 CT 60 CT 60 CT	- CT 175 CT 42 CT 38 CT 64 CT 40 CT	- CT 130 CT 33 CT 32 CT 64 CT 72 CT

CLIP BOXES

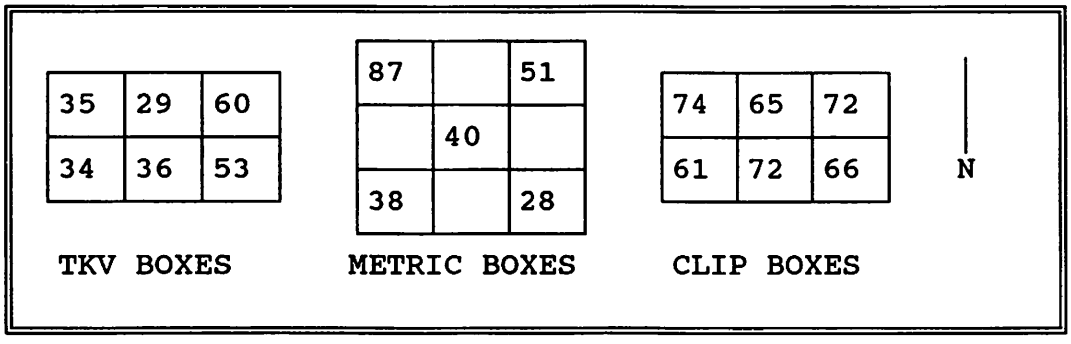
BOX EVALUATION (CIRCULATING-AIR FUMIGATION) TRIALS

TABLE 3: AVERAGE SO_2 CT VALUES FOR EACH FUMIGATION TRIAL.

	Trial II	Trial III	Trial IV	Trial V	Trial VI
TKV	108[a]	18[a]	20[a]	27[a]	33[a]
Metric	106[a]	31[a]	24[a]	37[b]	39[a]
Clip	146[b]	37[b]	34[b]	64[c]	61[b]
Significance of F	.10	.05	.10	.10	05

Means followed by same letter not significantly different.
DNMRT P<.05

FIGURE 3: AVERAGE SO_2 CT VALUES PER GRAPE BOX.



Conclusions: Statistical analysis (Table 3) indicates that the metric boxes exhibited similar response as the TKV boxes to fumigation. SO_2 levels were significantly higher in the clip boxes in all trials compared to the other box types. Average (grand means) SO_2 levels (Figure 3) were similar among box location. Concentration as affected by box location (Figure 3) is similar with the exception of some corner boxes exhibiting higher levels.

Future Work Proposed: Acquire temperature profile data during initial cool down. Evaluate relative penetration of SO_2 into pallet middle boxes by configuring all containers in a 3X3 set-up.

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4 December 1992

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Methods:

COOL DOWN TRIAL I

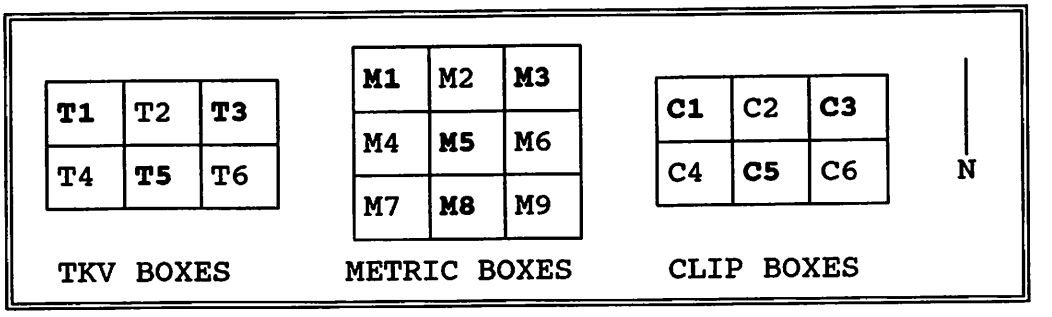
Both the TKV and Clip boxes were stacked on pallets in a 2 X 3 configuration, ten layers high. The Metric box was arranged in a 3 X 3 configuration, eight layers high. Three thermocouples and one relative humidity sensor were placed inside each of the pallets. All sensors were placed in the 7th layer from the bottom of the TKV and Clip boxes and the 6th layer from the bottom of the Metric boxes. These layers are approximately equal in height from the floor. See Figure 1A for the placing of the sensors within the layers. The boxes were warmed until the thermocouple readings were approximately 65° F. At this time the refrigeration was turned on.

COOL DOWN TRIAL II

The TKV and Clip pallets were restacked to a 3 X 3 configuration. Extra empty boxes were used for the bottom layers in this new configuration. A 3 X 3 configuration has been used throughout all experiments for the Metric boxes; this pallet was not restacked. All sensors were placed in the 7th layer from the bottom of the TKV and Clip boxes and the 6th layer from the bottom of the Metric boxes. See Figure 1B for the placing of the sensors within the layers. The boxes were warmed to approximately 75° F. At this time the refrigeration was turned on.

FIGURE 1: MAP OF GRAPE BOX PLACEMENT IN CHAMBER FOR COOL DOWN

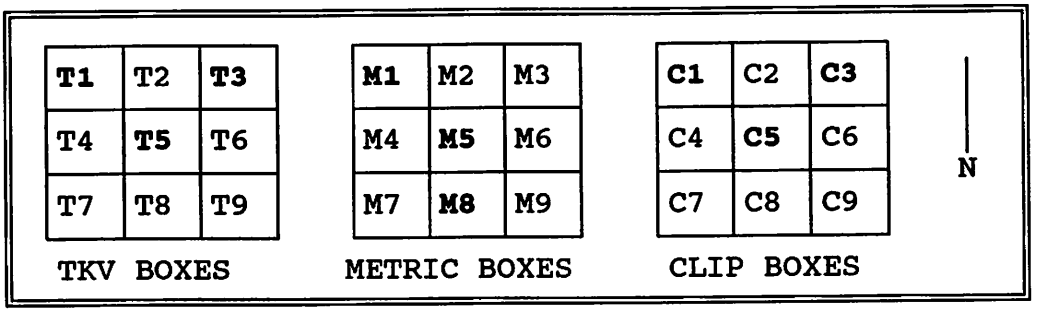
A. Trial I - Boxes in 2X3 (TKV and Clip) or 3X3 (Metric) stacking pattern



PLACEMENT OF SENSORS:

Box type	Temperature	Temperature and Relative humidity
TKV	T1, T3, T5	T3
METRIC	M1, M3, M5	M8
CLIP	C1, C3, C5	C5

B. Trial II - All boxes in 3X3 stacking pattern



PLACEMENT OF SENSORS:

Box type	Temperature	Temperature and Relative humidity
TKV	T1, T3, T5	T5
METRIC	M1, M5	M5, M8
CLIP	C1, C3, C5	C5

Results:

Overall

In Figures 2 and 3 we show average cool down rates for each of the three pallets. In Trial I (Figure 2) the pallets were stacked as 2x3 (TKV and Clip) or 3x3 (Metric). In Trial II (Figure 3) all three pallets were stacked as 3x3. While there is some slight differences in the cool down rate of the Clip vs Metric and TKV (Figure 2) in the first trial, all three types of boxes cooled down fairly rapidly. In Trial II it is obvious that there is no significant difference in the average rate of cool down of the three pallets of 3x3 boxes.

In Figures 4 - 6 individual temperature sensors are graphed for each type of box. In Figure 4 (Metric 3x3 configuration) there is a slight difference in the initial cool down rates of the center and edge boxes vs the corner boxes. This is to be expected, as the corner boxes have two edges exposed to air flow, the edge box has only one edge exposed, and the center box depends on flow through one other box on each side. There are essentially no significant differences in individual box cool down rates for the other two pallets (TKV and Clip 2x3).

In Figures 7 - 9 individual temperature sensors are again graphed for each box in the respective pallets (all stacked 3x3). In Figures 7 and 9 (Metric and TKV boxes) there is one temperature sensor reading significantly different than the others in the pallet. In one instance this reading represents a edge box (Metric Figure 7) and in the other a center box (TKV Figure 9). We believe that these thermocouples were buried in the grape clusters and were measuring fruit temperatures, as opposed to the other thermocouples that were measuring cold air flow into the box. Other than these two temperature profiles, there are no major differences in the temperature profiles of the other boxes in all three pallets.

Conclusions:

The conclusions to be derived from these trials are that there are no major differences in the flow of cold air into any of the three types of boxes when stacked in the 3x3 design. There is a slower rate of cool down for the fruit in these boxes, but that is to be expected.

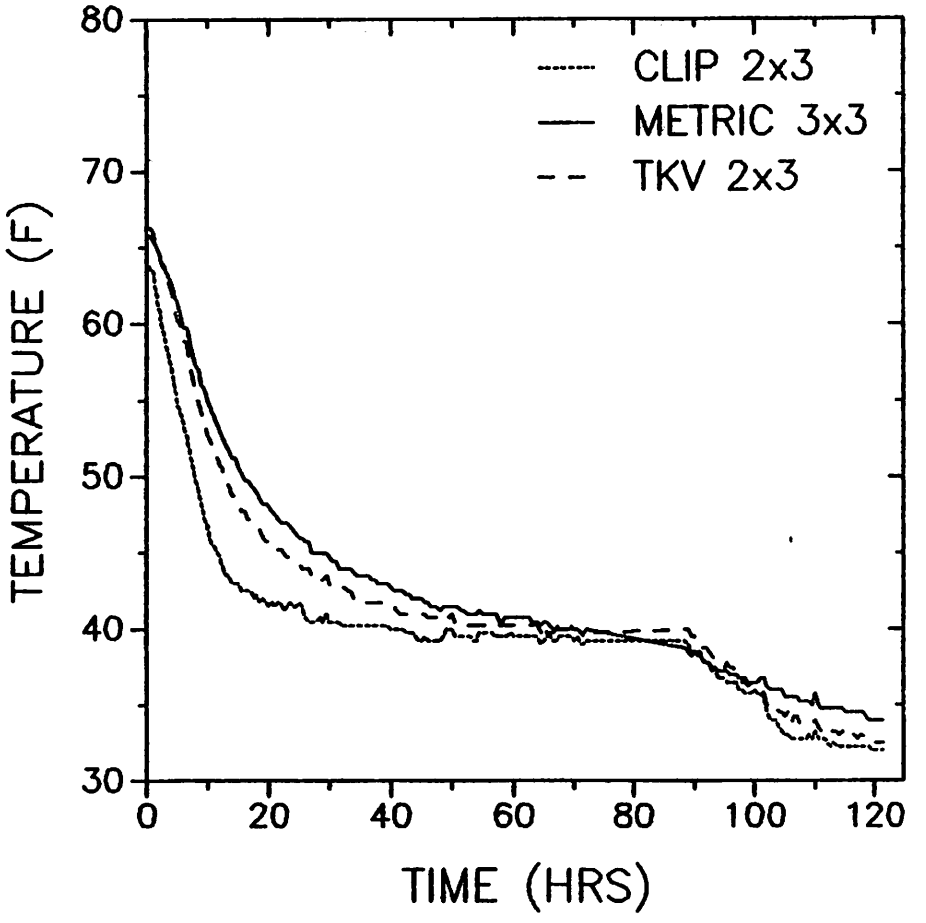


Figure 2 - Average Cooldown Profile by Container Type - Test I
Metric 3x3 / Clip 2x3 / TKV 2x3 Stacks

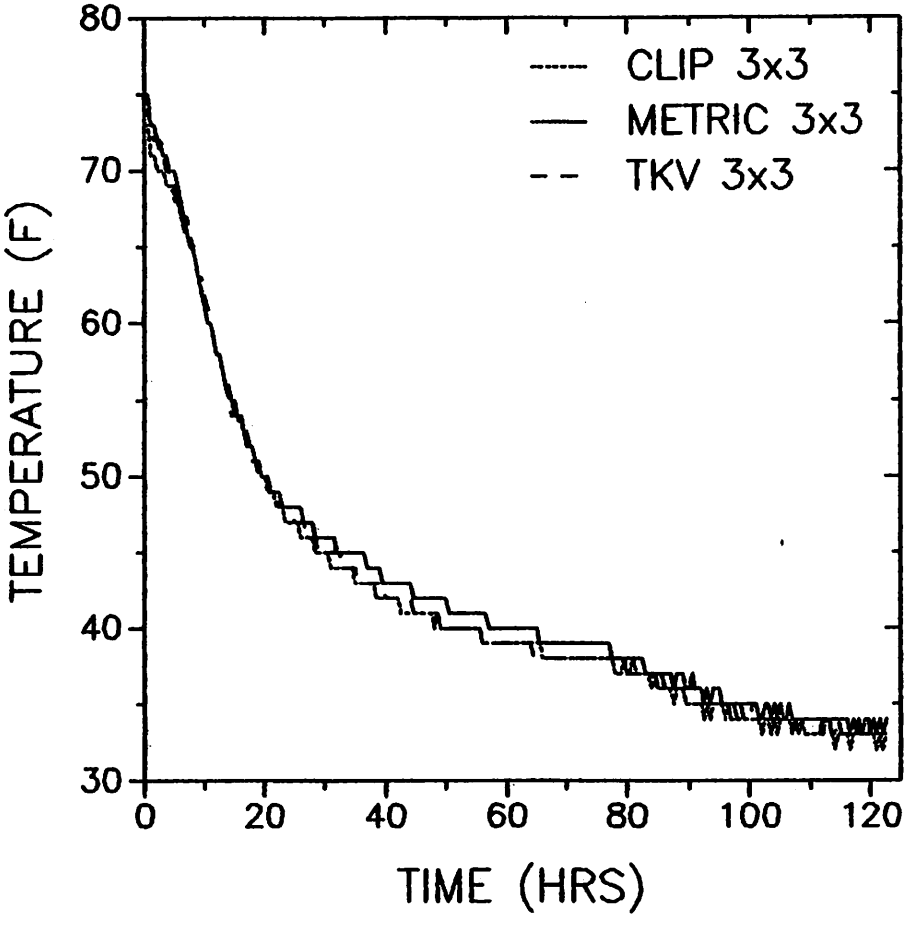


Figure 3 - Average Cooldown Profile by Container Type - Test II
Metric 3x3 / Clip 3x3 / TKV 3x3 Stacks

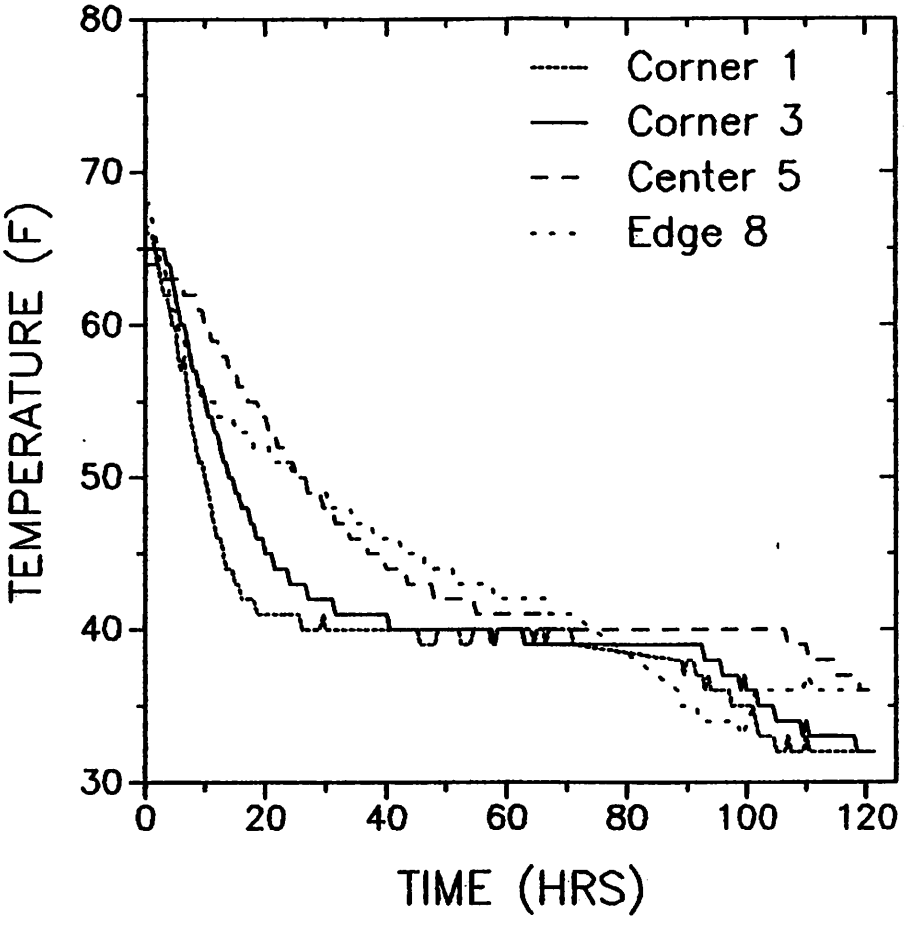


Figure 4 - Cooldown Profile of Individual Containers
Test I - Metric Containers (3x3 stack)

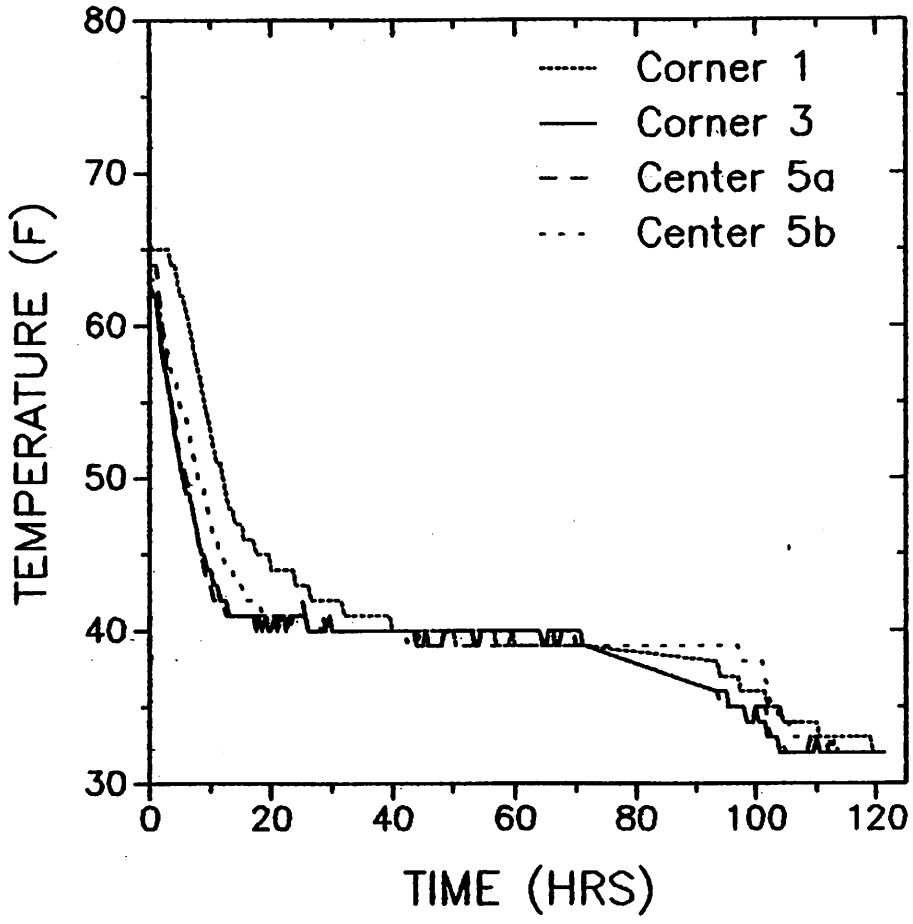


Figure 5 - Cooldown Profile of Individual Containers
Test I - Clip Corner Containers (2x3 stack)

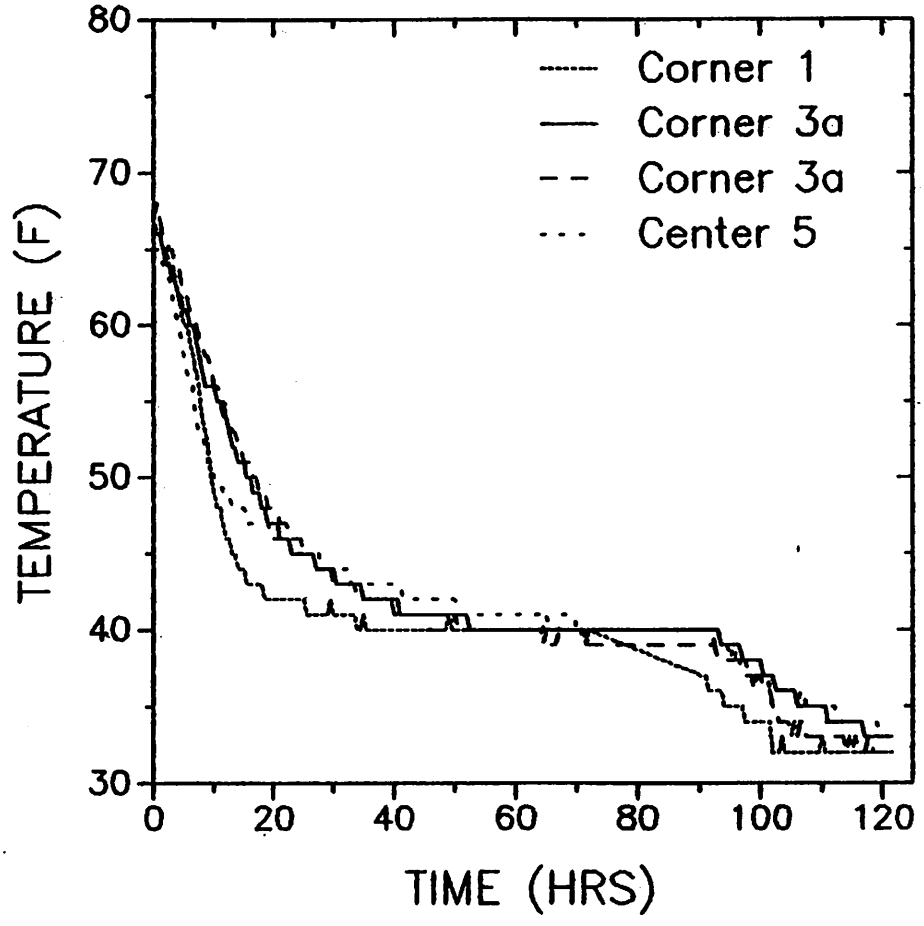


Figure 6 - Cooldown Profile of Individual Containers
Test I - TKV Containers (2x3 stack)

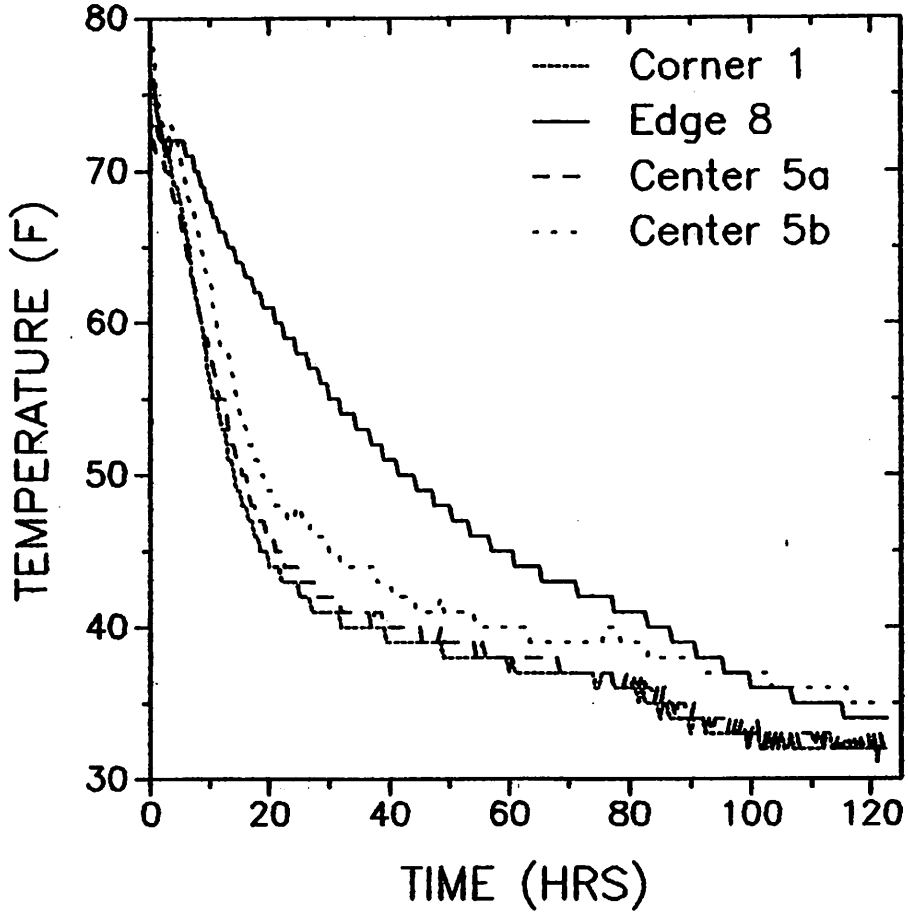


Figure 7 - Cooldown Profile of Individual Containers
Test II - Metric Containers (3x3 stack)

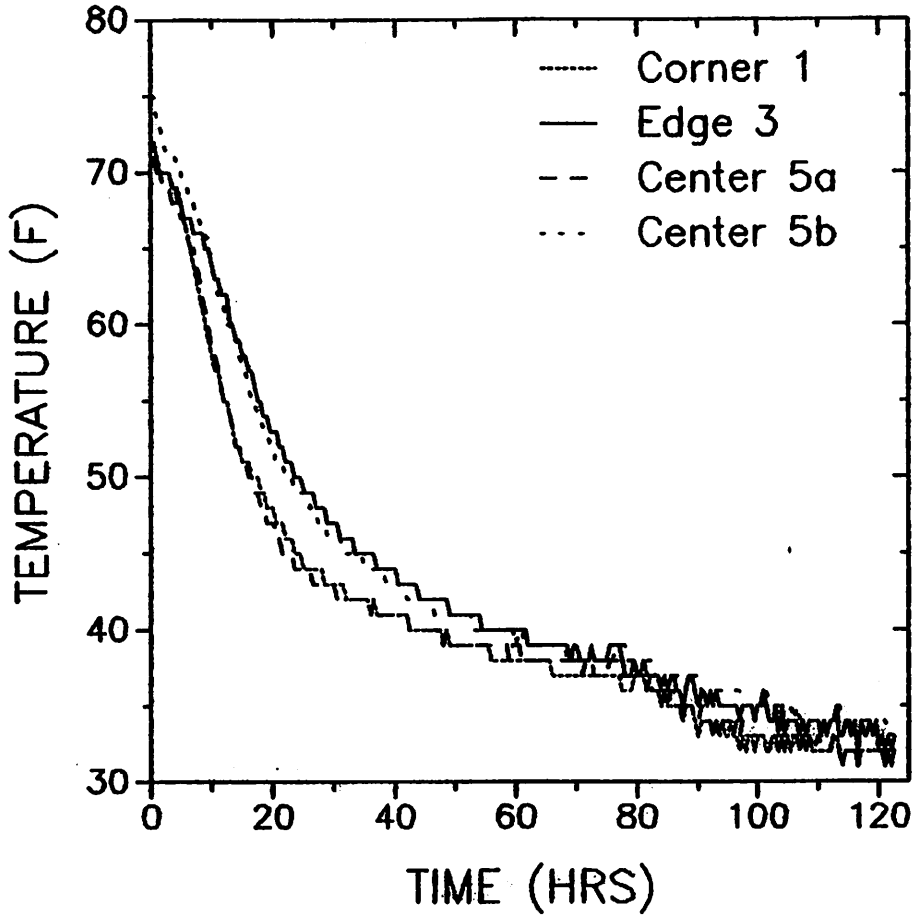


Figure 8 - Cooldown Profile of Individual Containers
Test II - Clip Corner Containers (3x3 stack)

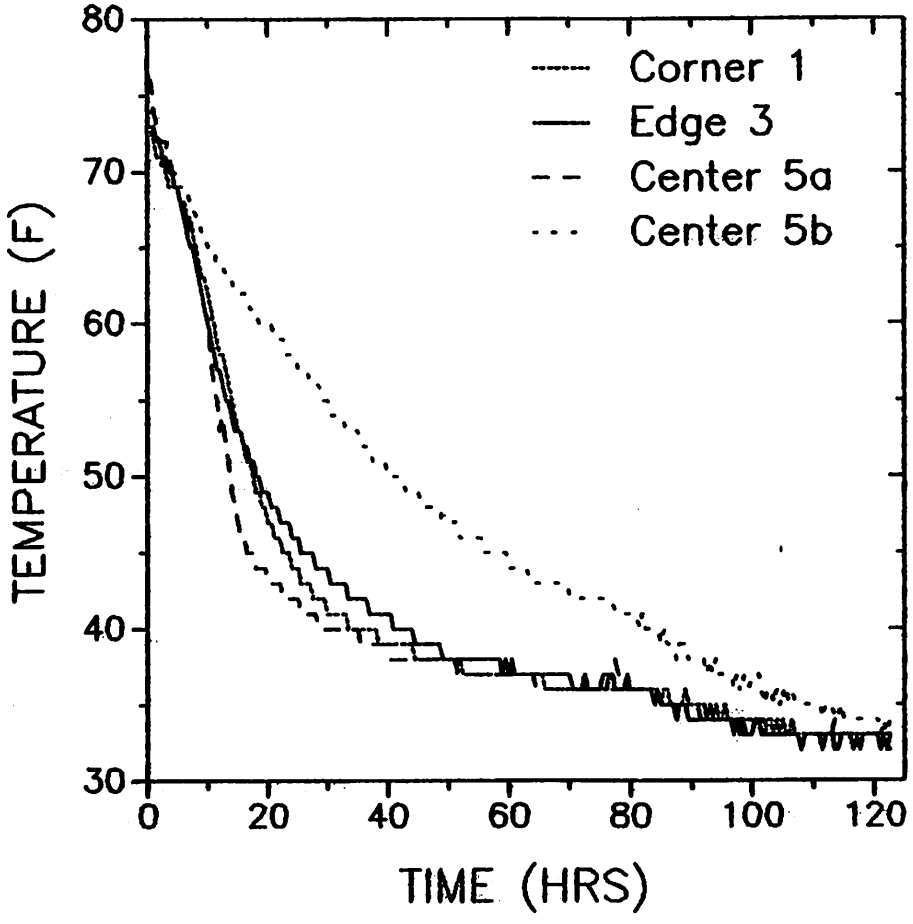


Figure 9 - Cooldown Profile of Individual Containers
Test II - TKV Containers (3x3 stack)

EVALUATION OF A NEW TABLE GRAPE PACKING BOX

FINAL REPORT
March 4, 1993

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INTRODUCTION

1.Project Summary.

This report summarizes the results of experiments conducted during the 1992 harvest season. These research activities included a comparative evaluation of TKV, "Metric" and "Clip Corner" table grape boxes with respect to relative permeation of sulfur dioxide fumigant within the boxes, and the temperature profile of the three type of boxes during cool down. The results of this evaluation are: (1) box type did not have an effect on the permeation characteristics of sulfur dioxide, and (2) the temperature profile of fruit during cool down was not influenced by box type.

2. Background.

Table grapes are held in cold storage using packing boxes. These boxes must permit circulation of air and SO_2 to penetrate and sterilize the fruit packed within them. Boxes stacked on pallets are subjected to initial cooling to remove field heat by reducing fruit temperatures to a storage temperature of 31-32^{0}F. The fruit also undergoes an initial fumigation with SO_2 in order to kill *Botrytis cinerea* (grey mold) spores on the surface of the berries. During subsequent cold storage, weekly fumigations with SO_2 maintain the fruit in a mold free condition.

Initial SO_2 fumigations can be applied using forced or circulating air to facilitate permeation the gas throughout the boxes. Successful application of SO_2 to the fruit requires that each storage chamber and box combination be evaluated for uniformity of application throughout the room and effectiveness of penetration into the box. These "calibrations" are accomplished through the use of several SO_2 measuring devices, placed into the boxes themselves, and positioned throughout a pallet. Devices include gas permeation tubes called Dosimeter Tubes used within a box to directly measure "CT" values, and flow-through Kitagawa Detector tubes used around a pallet to measure uniformity of air distribution.

It requires a certain amount of SO_2 to maintain a mold free condition in a box of grapes. Currently a level of 100 ppm-hours (referred to as 100 CT's - or a Concentration multiplied by Time product) is being recommended by the California Table Grape Commission's Research Task Force. It has been found that storage chamber air circulation characteristics, as well as the presence of any wrapping materials have a significant effect on determining how much SO_2 must be used in initial and subsequent storage fumigations.

Container configuration may also have an effect on the performance of storage facitlies including cooldown characteristics and penetration of fumigant. The purpose of this study has been to evaluate three types of packing boxes for relative performance in table grape storage.

PROCEDURES

1. Experimental Design and Field Observations.

Ruby Seedless grapes were harvested September 18, 1992 from the California State University vineyard and packed into three types of storage containers. Observations were made as to the handling characteristics of each type of container during field packing, as well as ease of stacking the boxes on the pallets. The packed containers were transported to cold storage.

The three containers evaluated in the study included the TKV box incorporating wood end pieces, and packages fabricated from corrugated paperboard into a "Metric" and "Clip Corner" box. Drawings of the configuration of each box are shown in Figures 1 - 3.

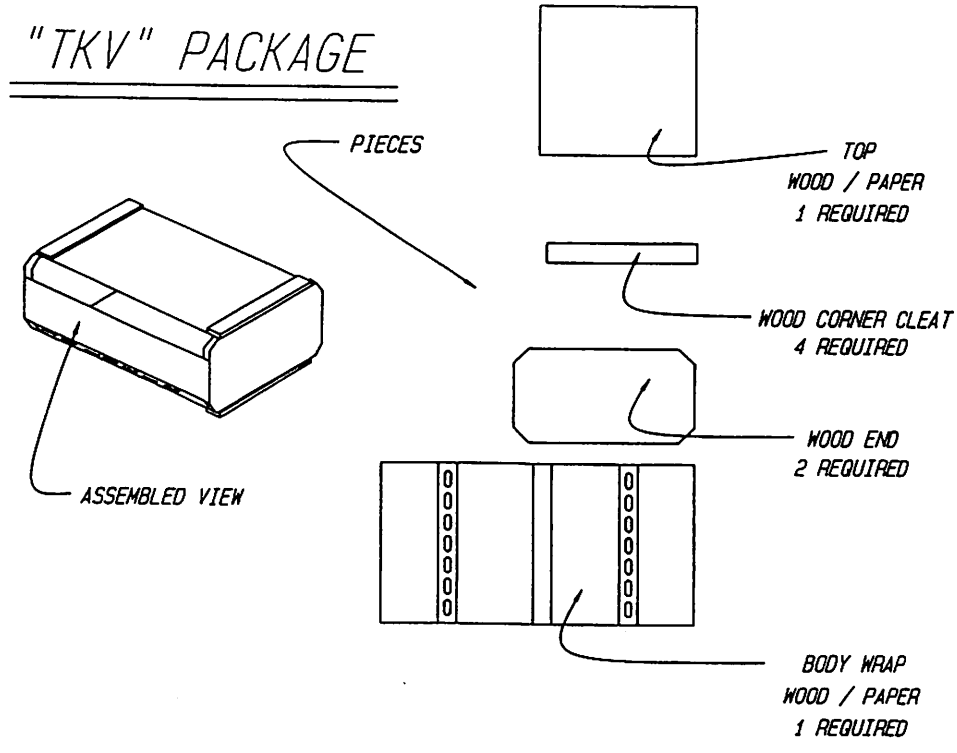

Figure 1. Configuration of a TKV Box.

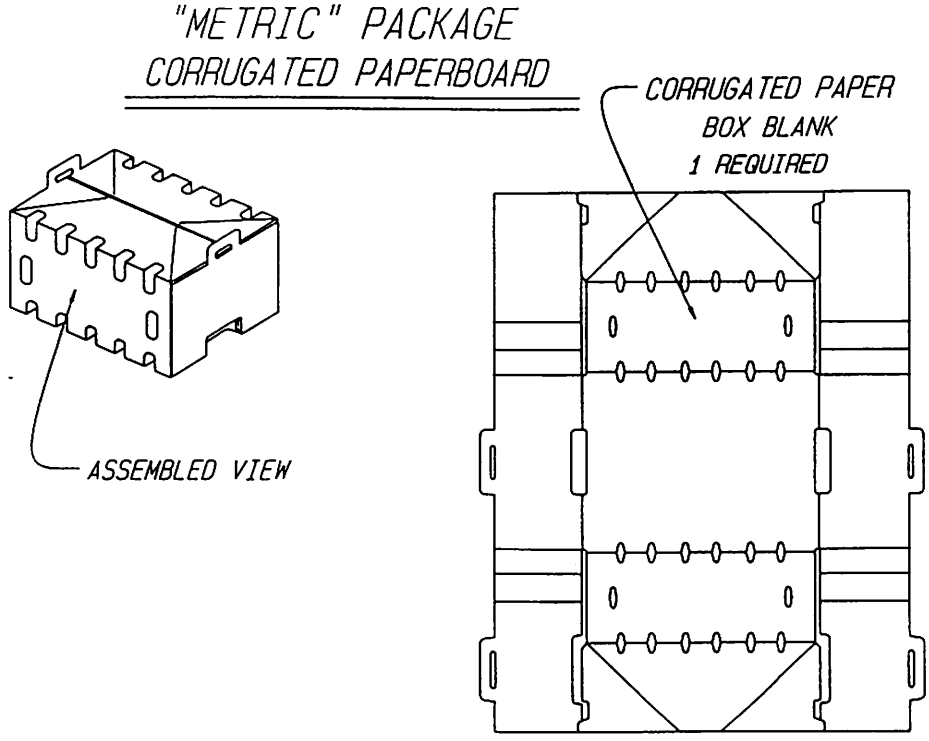

Figure 2. Configuration of a Corrugated Paper Board Metric Box.

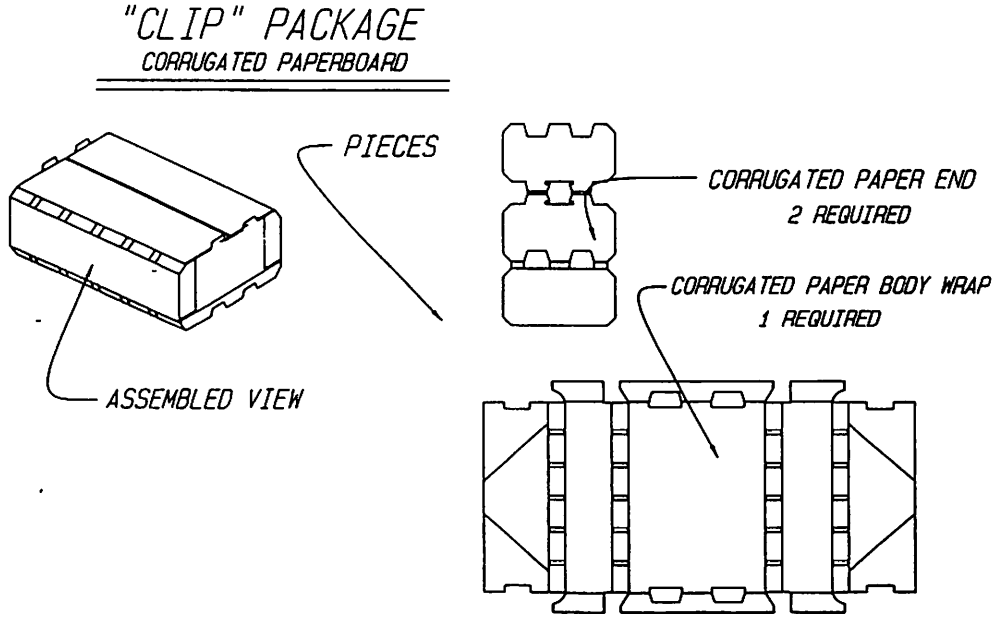

Figure 3. Configuration of Corrugated Paperboard Clip Box.

Two pallet configuration tests were conducted in this study. In Test 1, the TKV and Clip Corner boxes were stacked on the pallets in a 2X3 configuration, ten layers high. The Metric boxes were arranged in a 3X3 configuration, eight layers high (Figure 4). The metric boxes protruded slightly over the edge of the pallet so a special pallet had to made for this box. The boxes in these pallet configurations were used for the traditional fumigation trials in which the storage chamber was vented following the SO_2 dose.

In Test 2, all pallets were stacked in a 3X3 configuration (Figure 5) for the total utilization trials, and cool down profile. A dimensional diagram of the three types of boxes arranged in a 3X3 pallet configuration is shown in Appendix A. The pallets were placed in a cold storage unit equipped with an overhead refrigeration evaporator and circulating fans placed throughout the room. The unit was set to operate at $32^{0}F$.

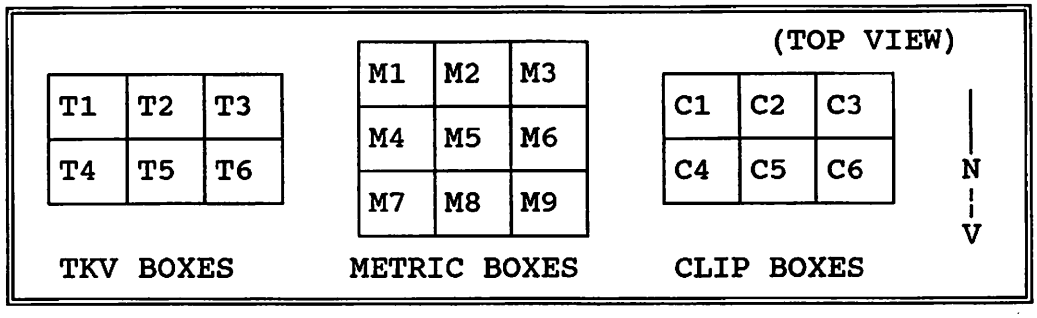

Figure 4. Configuration of Boxes on Each Pallet - Trial I.

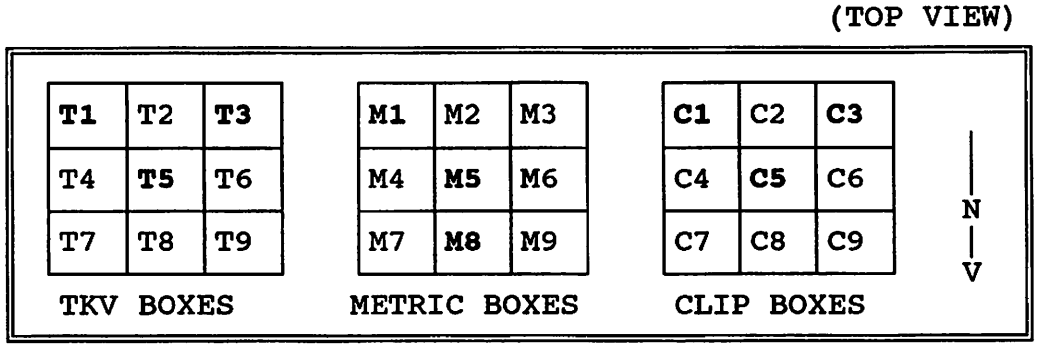

Figure 5. Configuration of Boxes on Each Pallet - Trial II.

2. Fumigation Chamber Calibration.

The Kitagawa detector system consists of a pump-type gas sampler and tubes which read in the range of 0.1-3.0% SO_2 concentration. These tubes were used to confirm the SO_2 dissipation throughout the cold storage chamber. Each pallet was fitted with two pumps and tubes to collect ambient SO_2 adjacent to the pallet during fumigation. The gas sample was pumped through the tubes to the outside of the cold storage chamber where the SO_2 gas concentration was measured. The Kitagawa gas sampler readings permitted adjustments in the placement and air speed of the circulating fans in the chamber. A total of six room calibrations were completed before traditional fumigations commenced.

3. Traditional Fumigations Using SO_2.

Gastec-Sensidyne Dosimeter tubes provide a measurement of the mean value of SO_2 in a box by the principle of diffusion sampling. The Dosimeter tubes read on a scale of 0 - 100 CT units. In these trials, the interiors of selected packing boxes were sampled. All Sensidyne tubes were placed in the 7th layer from the bottom of the TKV and Clip Corner boxes and the 6th layer from the bottom of the Metric boxes. These layers are approximately equal in height from the floor. In pallet configuration Test 1, both the TKV and Clip Corner boxes were stacked on the pallets in a 2X3 configuration, ten layers high, and the Metric box was arranged in a 3X3 configuration, eight layers high. The chamber was fumigated at appropriate levels of SO_2 for 30 minutes and then vented. The tubes were removed from the sample boxes and the CT values recorded.

4. Total Utilization Procedure for SO_2 Fumigation.

In these trials, Sensidyne Dosimeter tubes were placed in the layout described for traditional fumigation with tubes placed in the 7th layer from the bottom of the TKV and Clip boxes and the 6th layer from the bottom of the Metric boxes. As mentioned, these layers are approximately equal in height from the floor. However, in the total utilization trials, all pallet configurations were 3X3. The chamber was fumigated at appropriate SO_2 levels, **not vented,** and the Dosimeter tubes allowed to register gas concentration over a period of days.

SO_2 was applied in order to obtain relative or comparison readings from the Dosimeter tubes within each type of box. The tubes were left in the boxes for the periods of time shown in Table 1 before they were removed and the values read.

Table 1. Dosimeter Tube Residence Time by Trial - Total Utilization Non-vented Experiment

Trial I:	2 days
Trial II:	2 days
Trial III:	3 days
Trial IV:	7 days
Trial V:	3 days
Trial VI:	4 days

5. Cool Down Profiles.

Another important performance factor is the response of fruit within each box type to cooling. Cool down profiles were completed in both pallet configurations (2X3 and 3X3). For the purpose of this report, cool down profiles within the 3X3 pallet configurations will be evaluated and presented. This configuration was assumed to be the most difficult to cool because the boxes in the center of each pallet have no direct air exchange with the cold storage environment and may require extended time to cool.

Boxes from the test layer from each pallet were heated to 120°F in a dehydrator to simulate extreme field heat conditions. The boxes were then replaced in the test layer of each pallet and all pallets were restored to the original 3X3 configuration. Prior to restacking the boxes, two thermocouples were placed into grape berries located in two corner, two center and two edge boxes in the test layer of each pallet (Figure 6). Temperature logging was initiated and the cool down begun. The temperature data were averaged for each location and box type, and plotted to present relative cool down profiles for each box type.

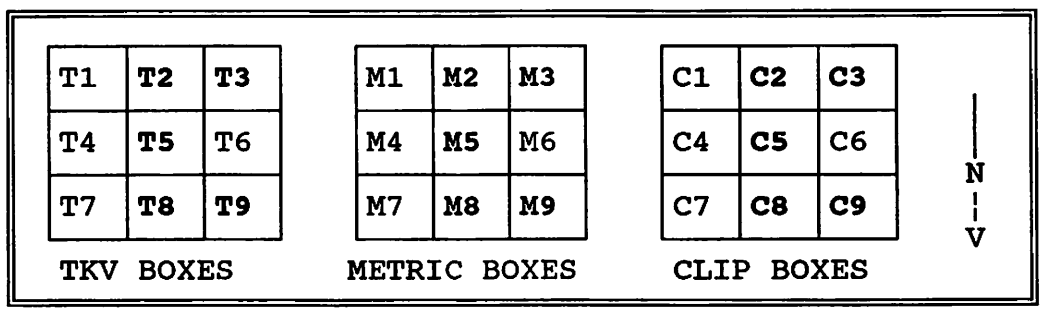

Figure 6. Placement of Thermocouple for Temperature Cool down Profile.

6. Sulfur Dioxide Analysis

Grape berry samples were collected from boxes in the test layer of each pallet for determination of sulfur content. This information was intended to provide cumulative sulfur content of grapes packed in each type of box to indicate the relative permeability of each box type to the SO_2 fumigations. This information would augment the results of the Dosimeter tube data. The grape samples collected were identified and frozen for analysis using the Modified Monier-Williams Procedure for Sulfites in Food (Official Methods of Analysis, 14th Edition. 20:123-20:125. Association of Official Analytical Chemists).

RESULTS AND DISCUSSION

1. Harvest.

Harvesting and field packing of the three box types was completed without major complications. It was noted that the Metric box did not fit into the field packing frames, however this is remedied easily by adding an additional support to the frame. The folding lids of the Metric and Clip Corner boxes presented a slightly different condition to the field worker who did not have to deal with a lid on the TKV until the box was filled. This presented a situation to the field worker that was "different" from existing practices and therefore met with some resistance. While loading the pallets, it was observed that the cut cardboard notches on the top of the Metric box tend to separate and get caught when one is trying to stack these boxes. Although not as pronounced, the tabs on the Clip Corner boxes exhibited a similar characteristic. It is important to note that the boxes in this study were moved and stacked repeatedly.

2. Fumigation Chamber Calibration.

The Kitagawa gas readings shown in Figure 7 are within an acceptable range from one pallet to the next. Variation in these readings reflects the natural decrease in SO_2 as it is adsorbed by fruit, boxes and room surfaces. From these readings, it appeared that the SO_2 was being relatively well mixed in the room atmosphere.

The results from the last of six cold storage chamber calibrations for fumigation are shown in Figure 8. At fumigation rates sufficient to obtain relative readings from the Kitagawa tubes in this calibration, all the Dosimeter tube readings exceeded the 0 - 100 CT unit scale. Nevertheless, the readings beyond the scale were estimated and compared with reading from previous calibrations, and the circulating fans were adjusted accordingly.

Pump Position	Time	Kitagawa reading (with 10 draws)
Metric North	10:43	0.35%
Metric South	10:57	0.30%
TKV North	11:02	0.28%
Clip North	11:13	0.25%
Clip South-A	11:24	0.22%
Clip South-B	11:35	0.22%
TKV South	11:47	0.20%

Figure 7. Storage Chamber SO_2 Concentrations Determined by Kitagawa Sample Tubes.

Box Type	Placement of Sensidyne Tube	Tube reading SO_2 ppm X Hour
TKV	Middle North Box	120
Metric	Middle North Box	110
Clip	Middle North Box	off scale

Figure 8. Results of Sensidyne Dosimeter Tube Readings Chamber Calibration.

3. Traditional Fumigation Using SO_2 - Vented.

As mentioned, the Sensidyne Dosimeter tube values represent the product of SO_2 concentration measured in ppm and the time of exposure (ppm X Hours). Therefore, a tube exposed to 100 ppm SO_2 for one hour and another tube exposed to 1000 ppm for $1/10^{th}$ of an hour would give the same reading of 100 CT's. This measurement provides a good evaluation of the relative overall permeation of SO_2 into each container type.

A summary of relative CT values for six traditional fumigation experiments is shown in Appendix B. As mentioned earlier, these SO_2 application methodology involved a dosed exposure followed by 30 minutes of venting of the chamber. All pallets had six measurements each taken at the same box levels used in the calibration trials. The sixth measurement in the Metric pallet was rotated in each trial among the four boxes with only one side exposed the outside air. Each square shown in Appendix B within a pallet represents the position of a test box within each pallet and corresponds to the map discussed in Figure 4. Therefore, a row of values in one pallet map corresponds to the same rows in adjacent pallets. Since all Dosimeter tubes were

off scale in Trial I, only a dash is shown in the first row of the pallet map.

It is important to note that the intent of these trials was to determine an overall dosage of SO_2 that would provide sufficient exposure to obtain relative reading on each Dosimeter tube between all boxes tested. In other words, we were targeting relative SO_2 measurements and not the standard SO_2 fumigation level of 100 CT's. Trials III & IV were dosed at approximately one-third the SO_2 level of Trial II. Trials V & VI were dosed at approximately two-thirds the SO_2 level of Trial II.

An Analysis of Variance of the CT levels observed in each trial is shown in Table 2. With the exception of Trial V, there was no significant difference between average CT levels observed in the TKV and the Metric Boxes. In all trials, the Clip Corner box exhibited significantly higher CT levels. In Trial V, while the Clip Corner box still had the highest CT level, there was a significant difference in the CT values in the Metric and TKV boxes. The lowest level of CT was observed in the TKV box. The conclusion is that statistically, the Metric box performed about the same as the TKV in traditional low level vented fumigations. In all cases, the Clip Corner box proved to be more permeable to SO_2 penetration in traditional vented fumigation.

The conclusion drawn from the traditional vented fumigation trials is that all box types responded well to fumigation. However, the Clip Corner box did allow better permeation of fumigant. Mapping of the average CT levels among all the trials is shown in Figure 9.

Table 2. Analysis of Variance of SO_2 CT Values for Traditional Vented Fumigation Trials 2 - 6.

Trial:	II	III	IV	V	VI
TKV	108a	18a	20a	27a	33a
Metric	106a	31a	24a	37b	39a
Clip	146b	37b	34b	64c	61b
Significance of F:	.10	.05	.10	.10	.05

Means followed by different letters in the same column are significantly different (Duncan's New Multiple Range Test).

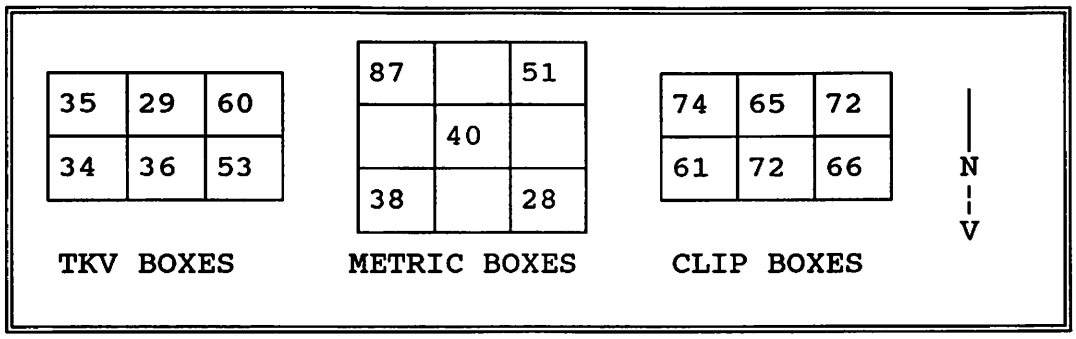

Figure 9. Average SO_2 CT Values for Each Test Box. Traditional Vented Fumigation.

4. Results from the Total Utilization Procedures for SO_2 Fumigation - Non-Vented.

As in the traditional fumigation trials, a summary of relative CT values for the total utilization procedure is shown in Appendix C. The chamber was not vented in these applications. This allowed the fumigant to be absorbed into the fruit and other parts of the storage chamber so that relative levels of CT for each box type could be obtained.

With the exception of Trial IV, no significant differences in CT values were observed indicating that in five out of the six non-vented fumigation trials, there was no difference in the permeation of SO_2 among the three box types. In Trial IV, the Clip Corner box exhibited the highest CT level followed by the TKV and the Metric box (Table 3).

The conclusion of the total utilization non-vented fumigation trials is that all box types exhibit good permeation of fumigant throughout the boxes sampled. Mapping of the average CT levels among all the trials is shown in Figure 10.

Table 3. Analysis of Variance of SO_2 CT Values for Full Utilization Non-vented Fumigation Trials.

Trial:	I	II	III	IV	V	VI
TKV	19	17	34	47b	24	13
Metric	17	18	29	43a	27	13
Clip	26	20	35	53c	35	14
Significance of F:	ns*	ns	ns	0.1	ns	ns

*ns = No Significant Difference in Means
Means followed by different letters in the same column are significantly different (Duncan's New Multiple Range Test).

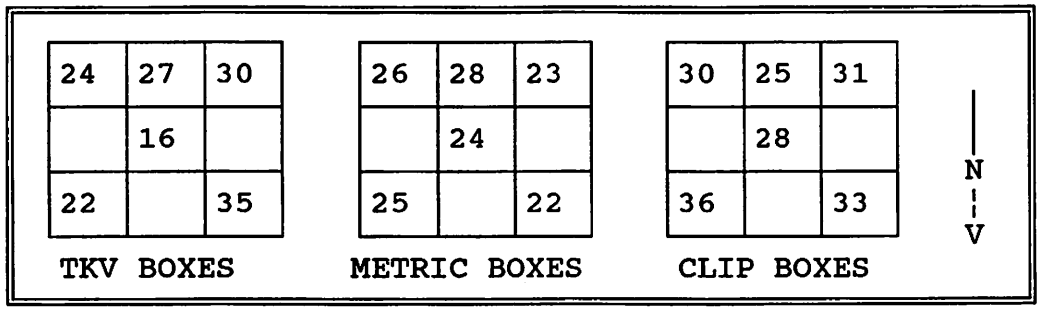

Figure 10. Average SO_2 CT Values for Each Test Box. Total Utilization Non-vented Fumigation.

5. Cool Down Profile.

Temperatures measured in each box type and box location were summarized and plotted as a total average for each pallet (Figure 11), and an average for center, edge and corner containers (Figures 12 - 14). The cool down times in this profile study were extended to emphasis any difference among box type. Normally, forced air pre-cooling requires much less time. Differences in the cool down profiles of each pallet were negligible. The fruit temperature in all the pallets reached 33°F in the same time period. Cooling was not noticeably different between box locations in the pallet as well.

The conclusion of the cool down test is that all box types performed equally well in cooling.

6. Sulfur Dioxide Analyses.

Preliminary results from sulfite level testing in grapes from each box type as indicated by the Modified Monier-Williams Procedure were all below 1 ppm. This would indicate that the grapes used in these extended fumigation trials did not accumulate sulfite residues beyond those expected during normal cold storage operations. Generally, this procedure is not reliable at sulfite levels below 10 ppm. As a result, it is not possible to use any differences in sulfite residue levels between boxes to conclude that any box type permits accumulation of residues above those normally experienced in routine operations.

The SO_2 doses applied in these experiments were kept low and limited to amounts that permitted us to obtain readings from the Dosimeter tubes and therefore the doses used did not leave a residue of sulfites that would provide a comparison among grapes stored in each box type. Although doses of SO_2 applications were relatively low in these experiments, mold was slight to moderate at the conclusion of the experiment in late January, 1993.

CONCLUSIONS

1. All box types responded well in traditional fumigations in which the storage chamber is dosed with SO_2 for 30 minutes and vented. The Clip Corner box exhibited better permeation of fumigant.

2. In a total utilization fumigation program in which the storage chamber is not vented following the SO_2 dose, all box types exhibited good permeation of fumigant throughout the boxes sampled.

3. Cool down testing indicated that all box types performed equally well in cooling.

4. SO_2 doses applied produced very low residues of sulfites on the grapes. This precluded making any comparison between box type in terms of sulfite residue accumulation.

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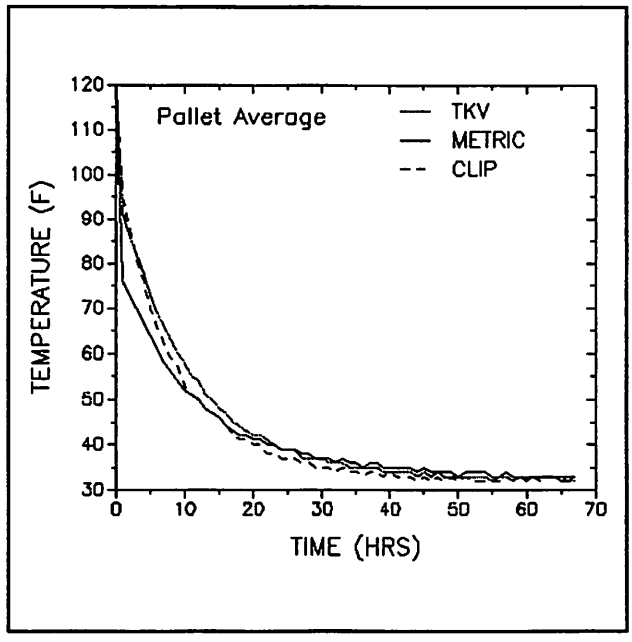


Figure 11. Cool Down Profile - Average for Each Pallet.

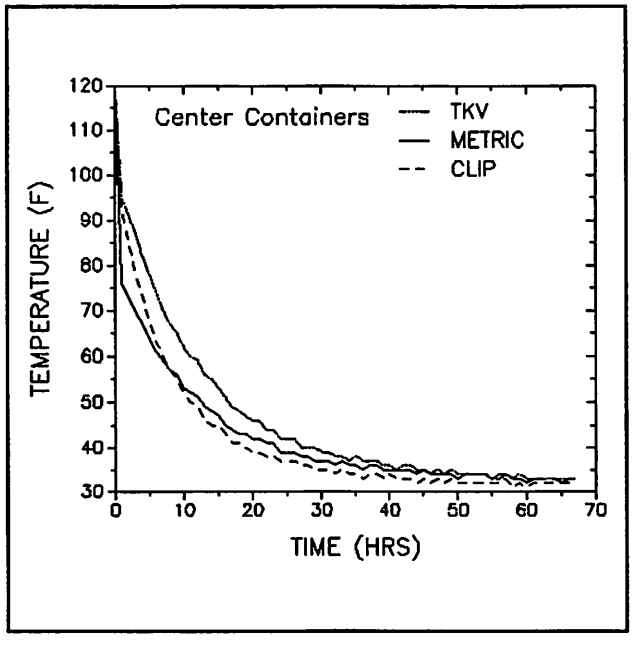


Figure 12. Cool Down Profile - Center Boxes by Box Type.

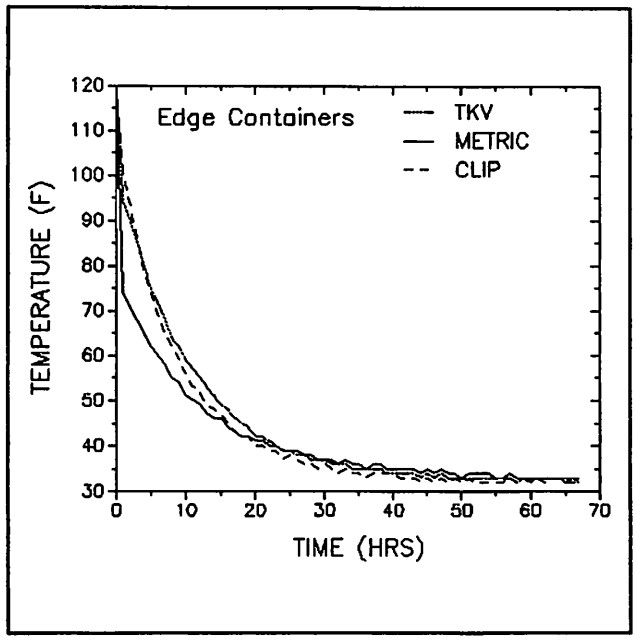


Figure 13. Cool Down Profile - Edge Boxes by Box Type.

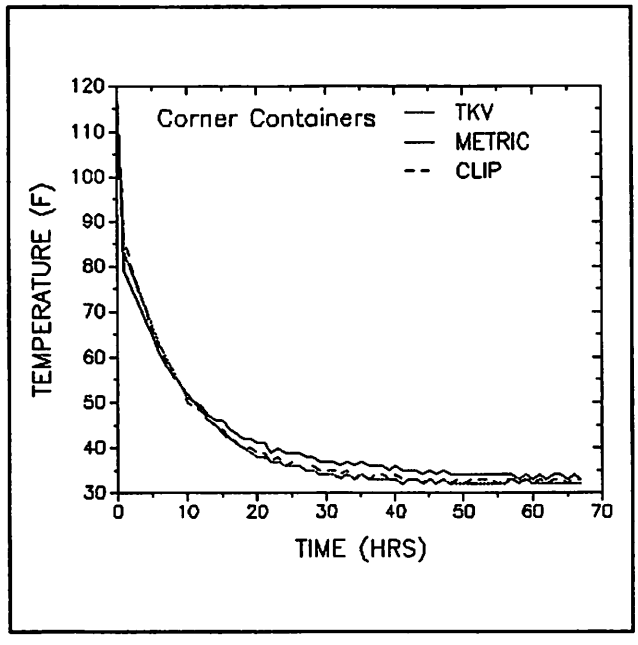
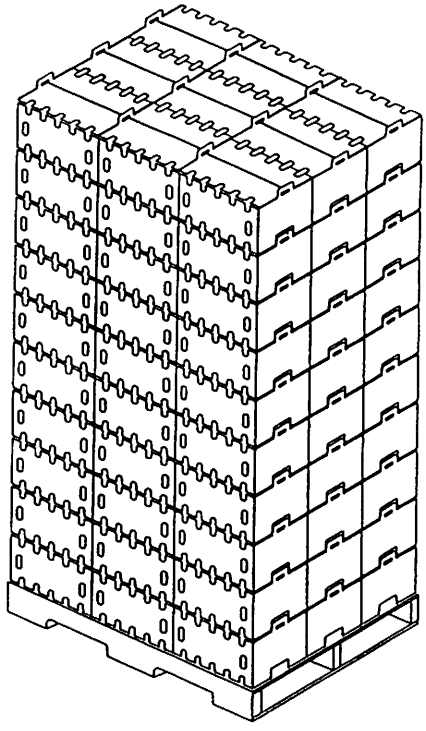
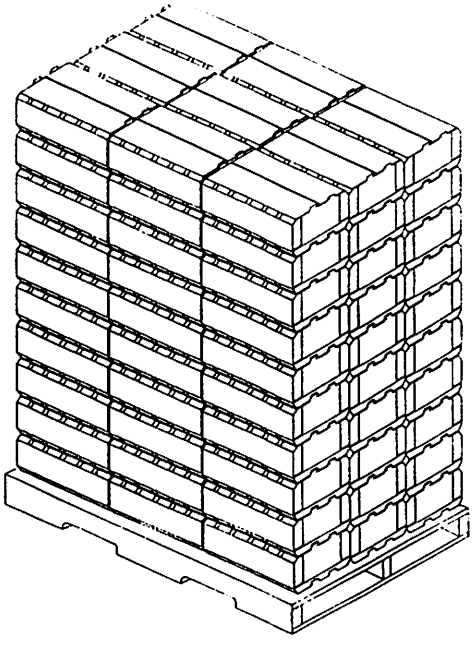


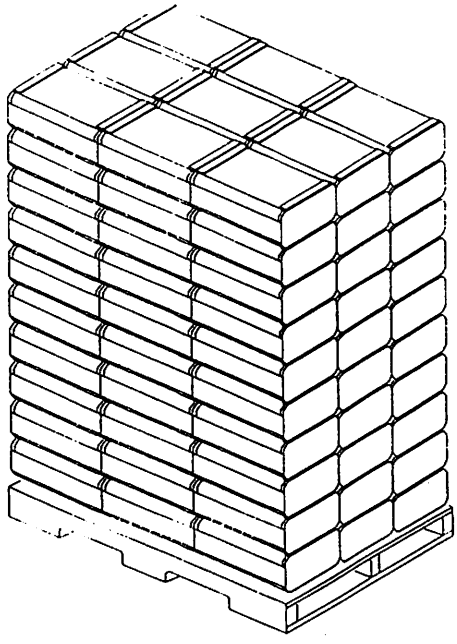
Figure 14. Cool Down Profile - Corner Boxes by Box Type.

APPENDIX A

BOX TYPES ARRANGED IN A 3X3 PALLET CONFIGURATION







APPENDIX A. Box Types Arranged in a 3X3 Pallet Configuration.

APPENDIX B

CT VALUES FOR TRADITIONAL FUMIGATION AND VENTING - SIX TRIALS

- CT 100 CT 15 CT 14 CT 26 CT 22 CT	- CT 75 CT 15 CT 16 CT 18 CT 20 CT	- CT 150 CT 22 CT 28 CT 40 CT 60 CT
- CT 75 CT 17 CT 18 CT 30 CT 30 CT	- CT 100 CT 12 CT 16 CT 22 CT 32 CT	- CT 150 CT 28 CT 30 CT 24 CT 32 CT

TKV BOXES

- CT 175 CT 50 CT 50 CT 80 CT 78 CT	42 CT	- CT 110 CT 35 CT 32 CT 44 CT 36 CT
17 CT	- CT 100 CT 18 CT 22 CT 26 CT 36 CT	70 CT 36 CT
- CT 100 CT 27 CT 12 CT 24 CT 28 CT	26 CT	- CT 80 CT 12 CT 8 CT 20 CT 18 CT

METRIC BOXES
(rotated one box reading on each trial)

- CT 150 CT 44 CT 36 CT 72 CT 70 CT	- CT 150 CT 32 CT 28 CT 56 CT 60 CT	- CT 150 CT 40 CT 35 CT 70 CT 66 CT
- CT 120 CT 30 CT 35 CT 60 CT 60 CT	- CT 175 CT 42 CT 38 CT 64 CT 40 CT	- CT 130 CT 33 CT 32 CT 64 CT 72 CT

CLIP BOXES

APPENDIX B. Measured SO_2 CT's for Six Traditional Fumigation Trials. See text for details of procedure used.

APPENDIX C

RESULTS OF TOTAL UTILIZATION PROCEDURE FOR SO_2 FUMIGATION - NON-VENTED.

15 CT 15 CT 30 CT 50 CT 25 CT 10 CT	15 CT 15 CT 40 CT 50 CT 30 CT 10 CT	22 CT 18 CT 40 CT 50 CT 30 CT 20 CT
	7 CT 12 CT 15 CT 40 CT 15 CT 10 CT	
20 CT 12 CT 30 CT 40 CT 15 CT 15 CT		35 CT 32 CT 50 CT 50 CT 30 CT 12 CT

TKV BOXES

18 CT 30 CT 25 CT 35 CT 35 CT 10 CT	22 CT 18 CT 35 CT 40 CT 40 CT 15 CT	20 CT 15 CT 30 CT 50 CT 15 CT 10 CT
	15 CT 12 CT 30 CT 35 CT 35 CT 15 CT	
18 CT 20 CT 30 CT 50 CT 20 CT 10 CT		10 CT 12 CT 25 CT 50 CT 15 CT 18 CT

METRIC BOXES

25 CT 20 CT 30 CT 55 CT 35 CT 15 CT	15 CT 10 CT 20 CT 60 CT 30 CT 15 CT	32 CT 20 CT 30 CT 60 CT 30 CT 15 CT
	25 CT 25 CT 32 CT 40 CT 35 CT 10 CT	
32 CT 22 CT 45 CT 45 CT 50 CT 20 CT		25 CT 20 CT 55 CT 60 CT 30 CT 10 CT

CLIP BOXES

APPENDIX C. Measured CT Values Obtained from Six Trials of the Total Utilization Procedure for SO_2 Fumigation. See text for details of procedure used.


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Table Grapes
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Table Grapes
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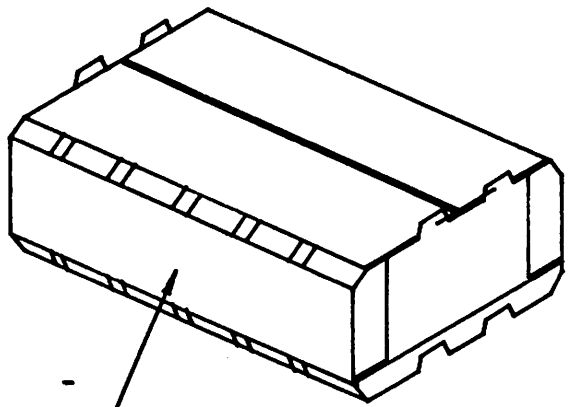
Table Grapes

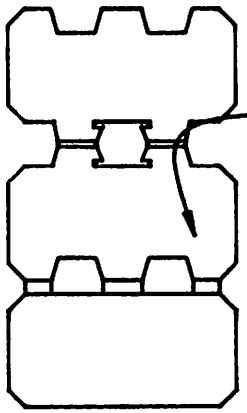
"CLIP" PACKAGE

CORRUGATED PAPERBOARD



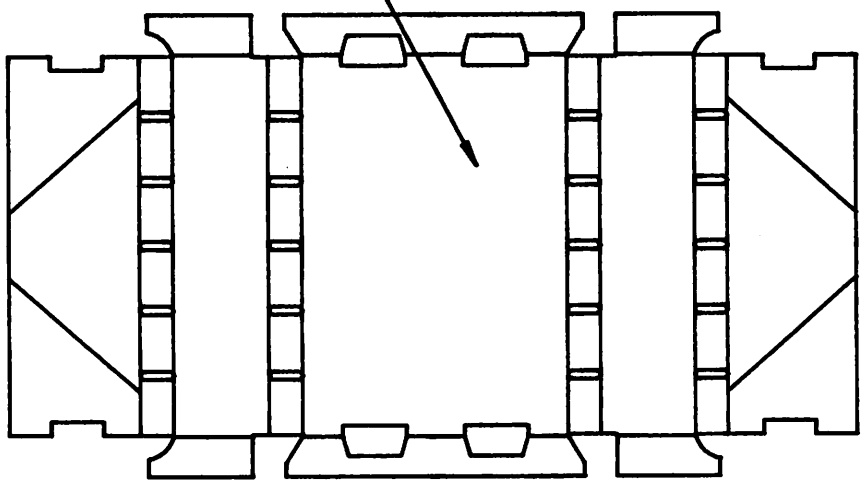
ASSEMBLED VIEW

PIECES

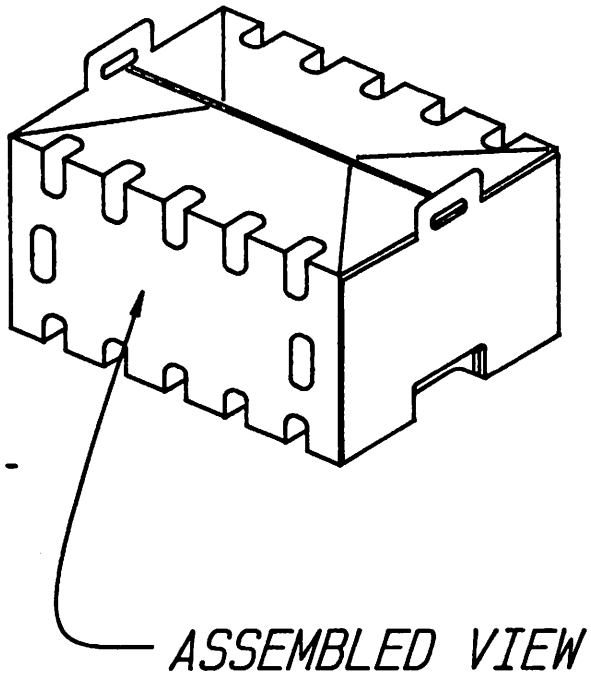


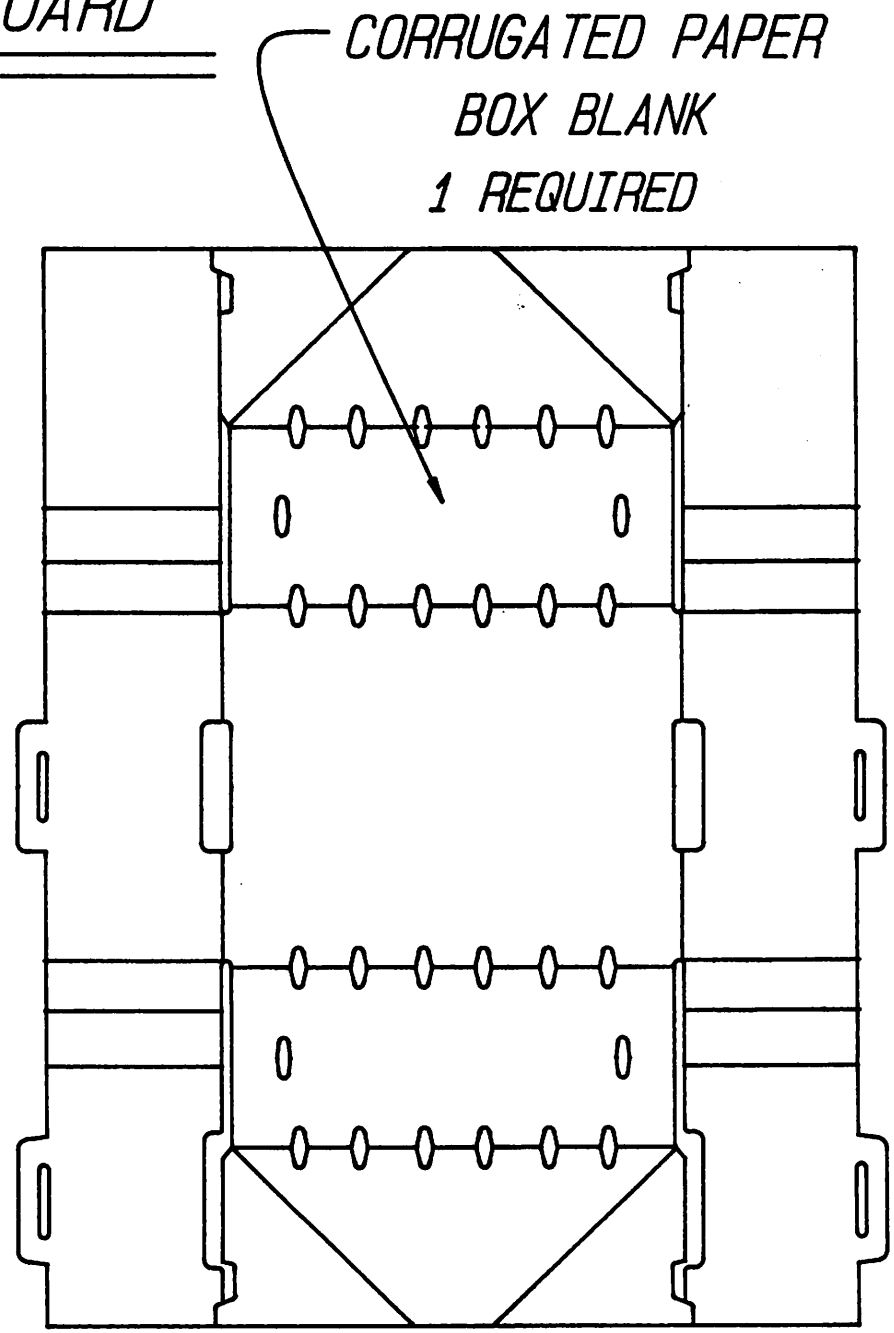
CORRUGATED PAPER END
2 REQUIRED

CORRUGATED PAPER BODY WRAP
1 REQUIRED

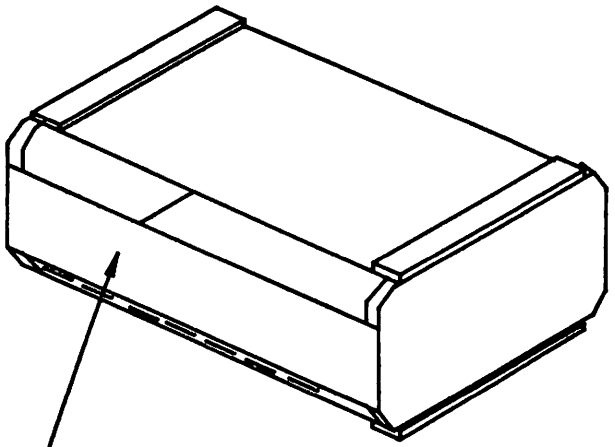


"METRIC" PACKAGE
CORRUGATED PAPERBOARD



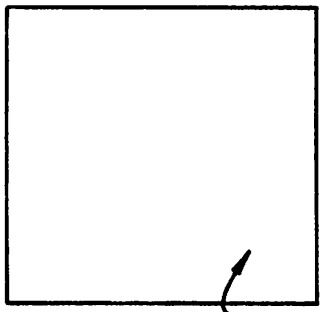


"TKV" PACKAGE

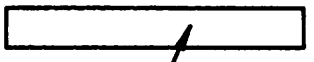


ASSEMBLED VIEW

PIECES

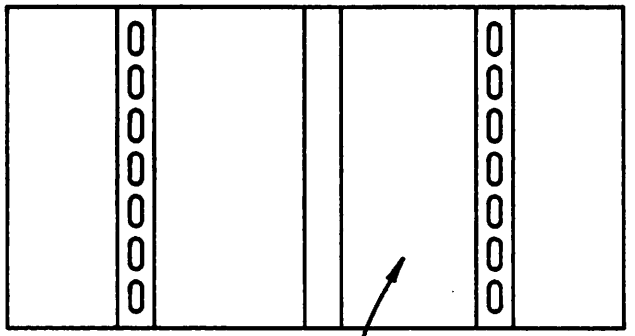


TOP
WOOD / PAPER
1 REQUIRED

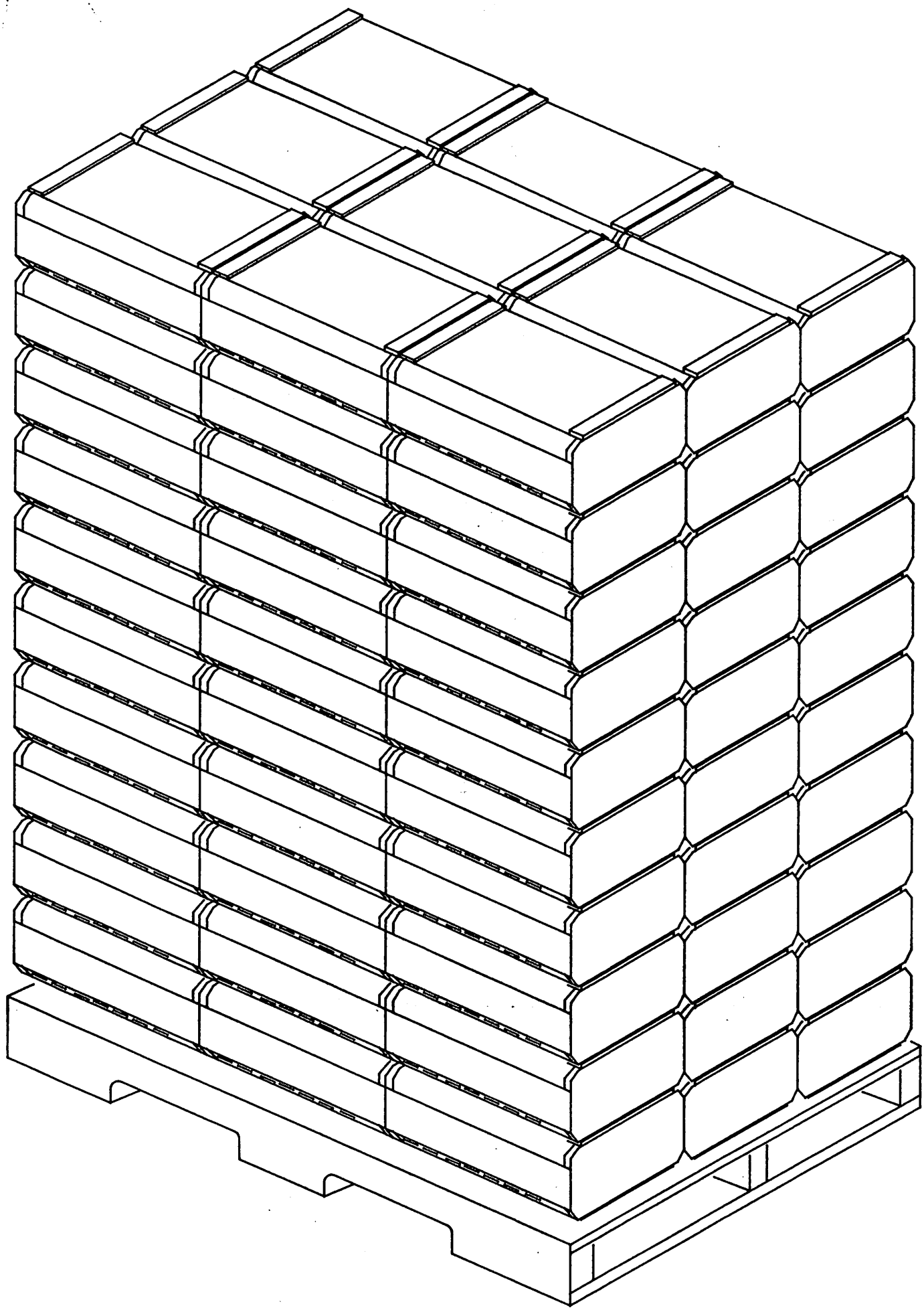


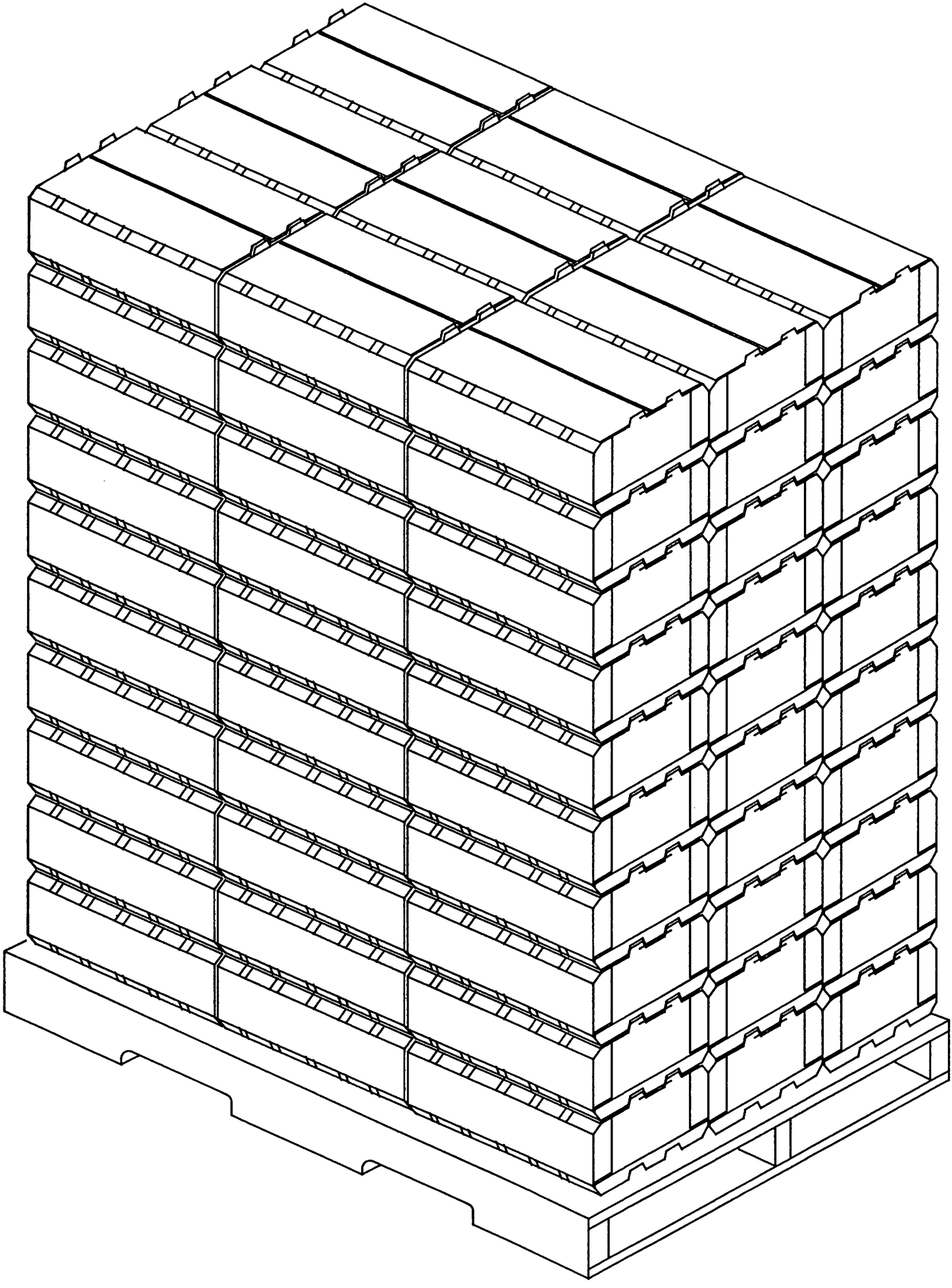
WOOD CORNER CLEAT
4 REQUIRED

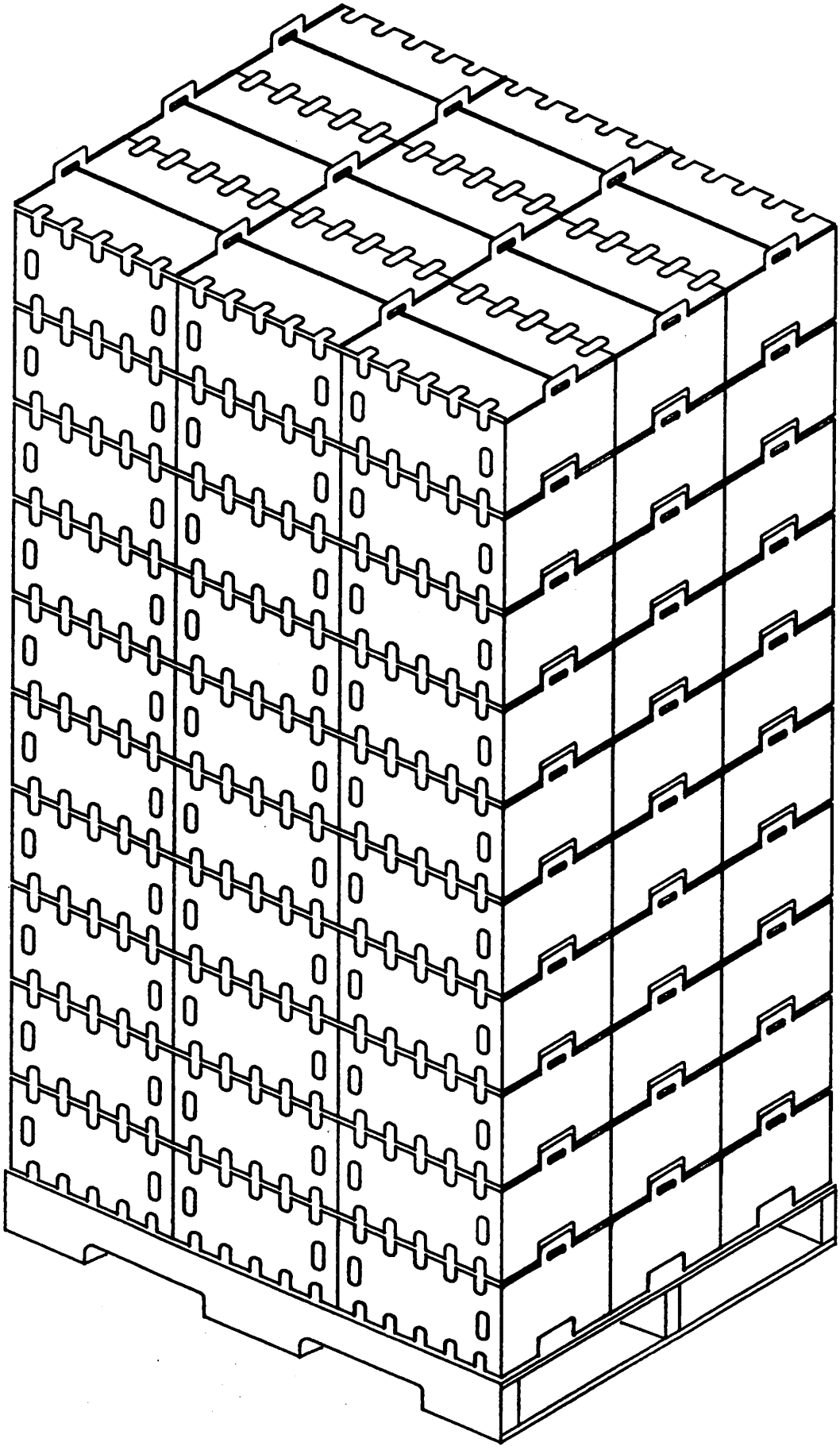
WOOD END
2 REQUIRED

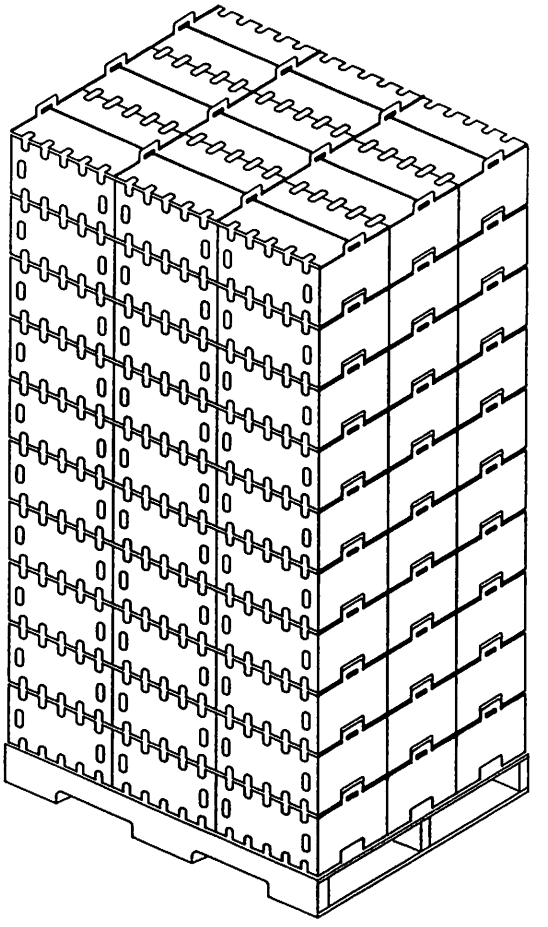


BODY WRAP
WOOD / PAPER
1 REQUIRED









Container configuration may also have an effect on the performance of storage facitlies including cooldown characteristics and penetration of fumigant. The purpose of this study has been to evaluate three types of packing boxes for relative performance in table grape storage.

PROCEDURES

1. Experimental Design and Field Observations.

Ruby Seedless grapes were harvested September 18, 1992 from the California State University vineyard and packed into three types of storage containers. Observations were made as to the handling characteristics of each type of container during field packing, as well as ease of stacking the boxes on the pallets. The packed containers were transported to cold storage.

The three containers evaluated in the study included the TKV box incorporating wood end pieces, and packages fabricated from corrugated paperboard into a "Metric" and "Clip Corner" box. Drawings of the configuration of each box are shown in Figures 1 - 3.

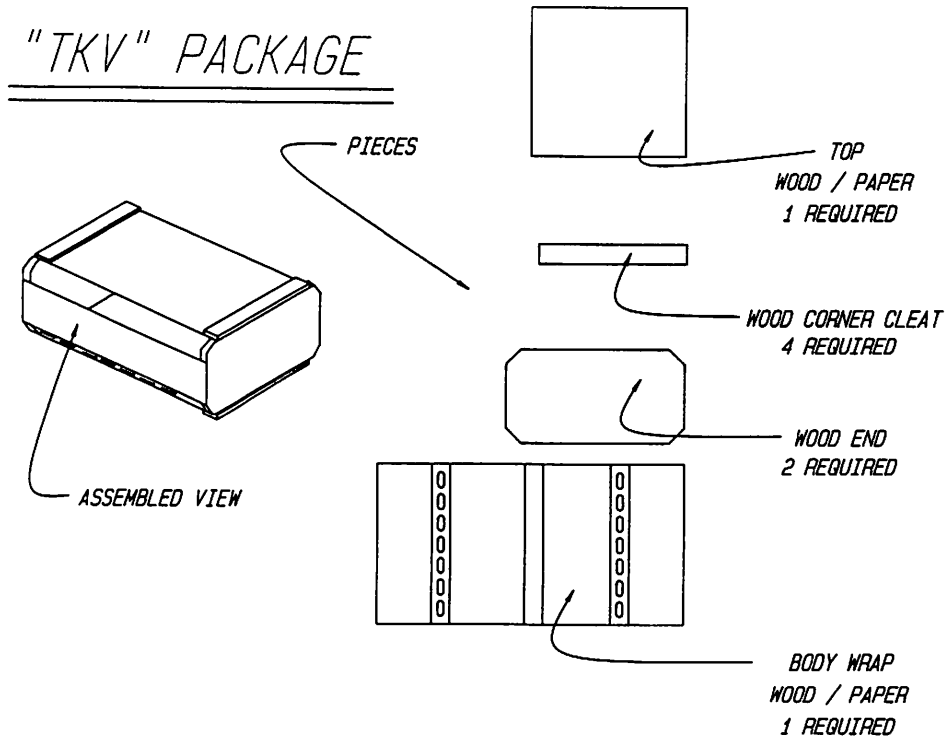


Figure 1. Configuration of a TKV Box.

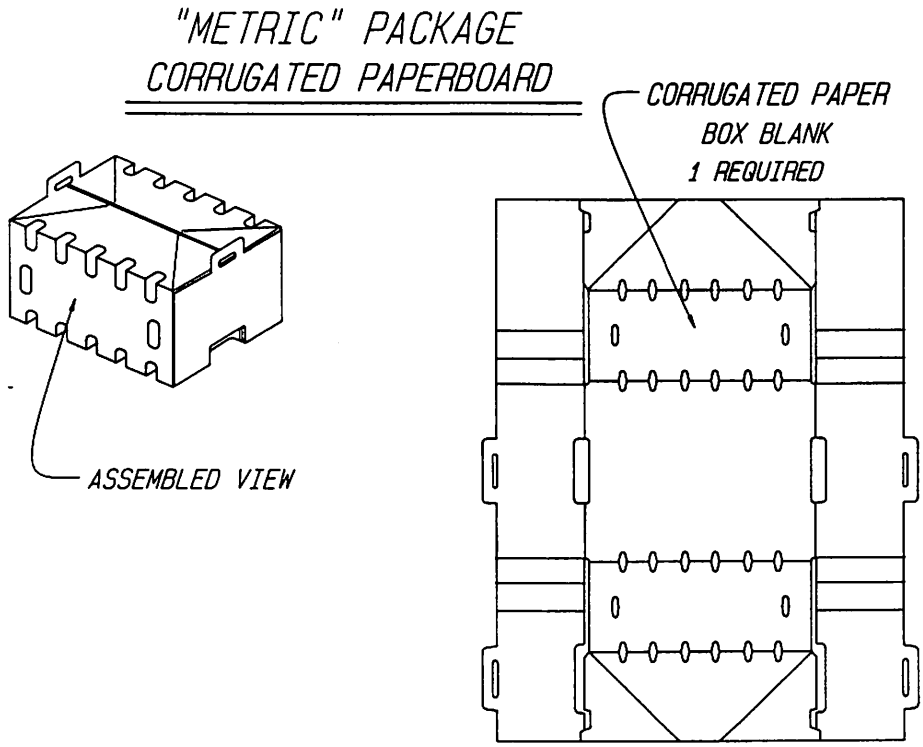


Figure 2. Configuration of a Corrugated Paper Board Metric Box.

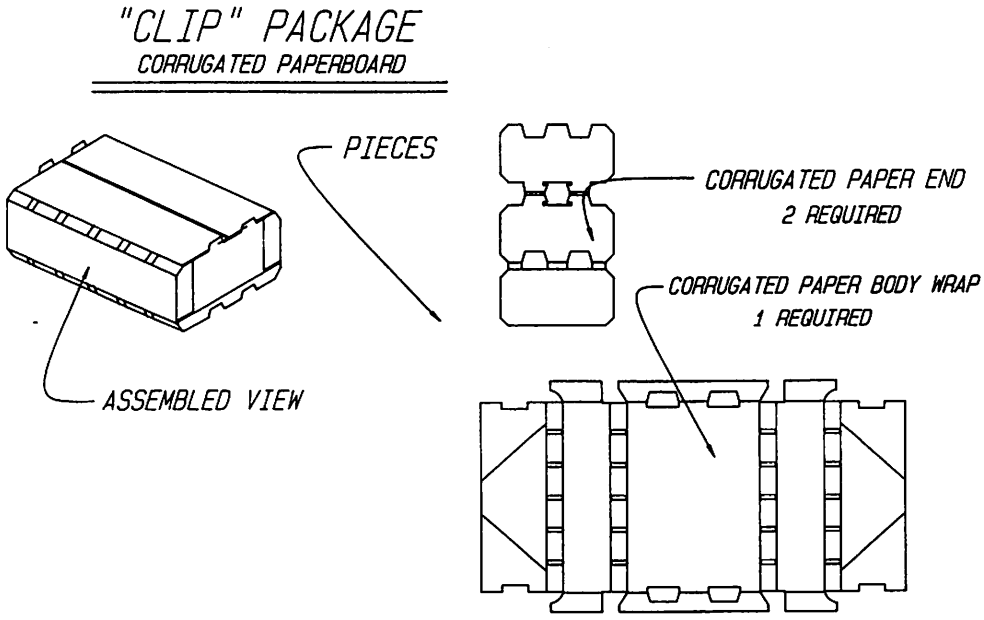
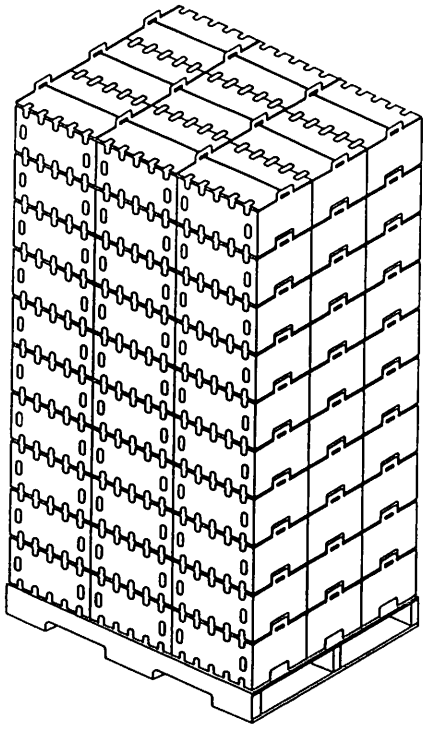
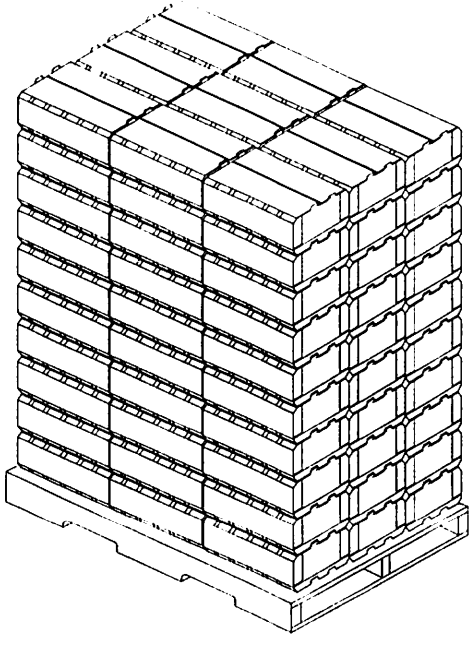
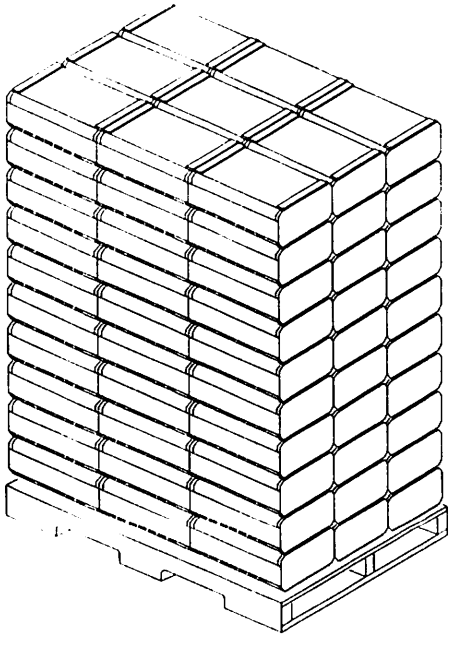


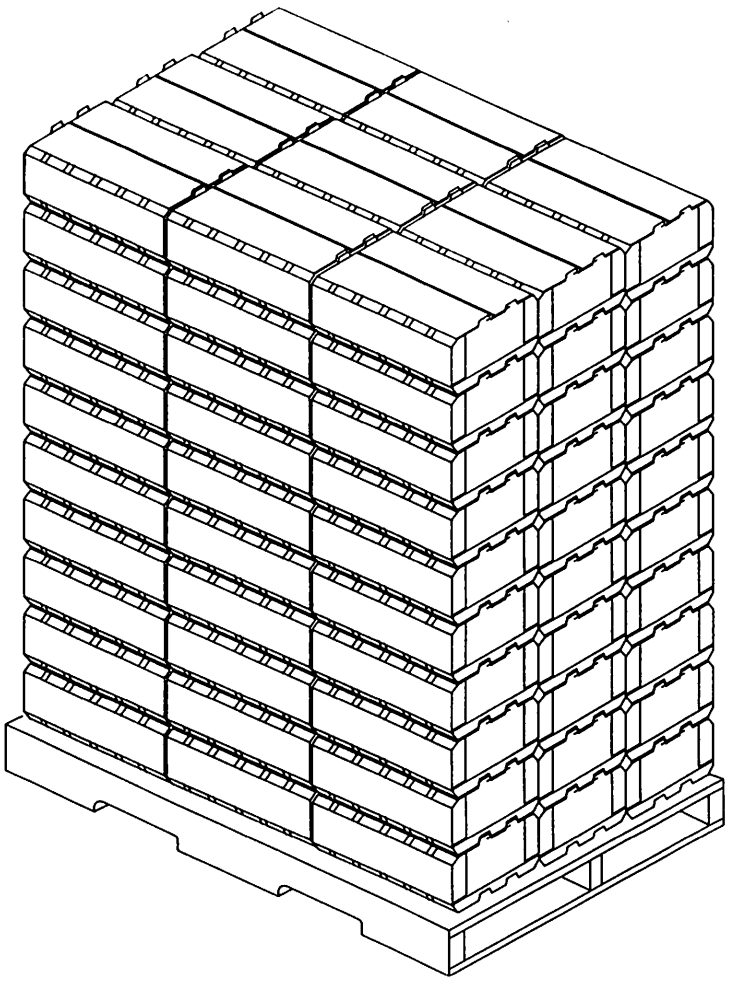
Figure 3. Configuration of Corrugated Paperboard Clip Box.

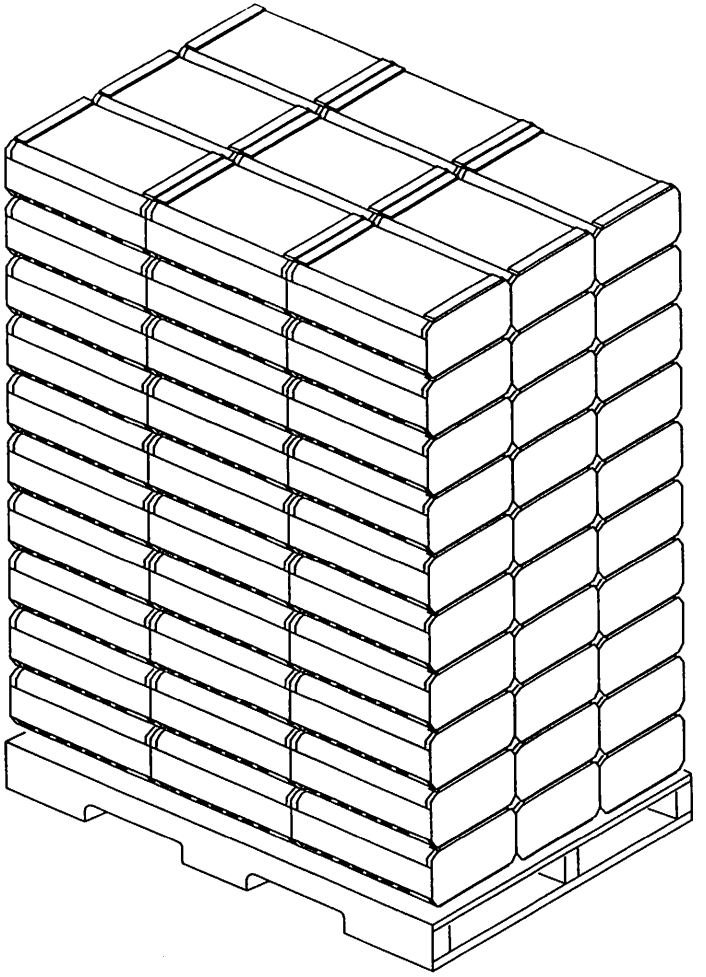


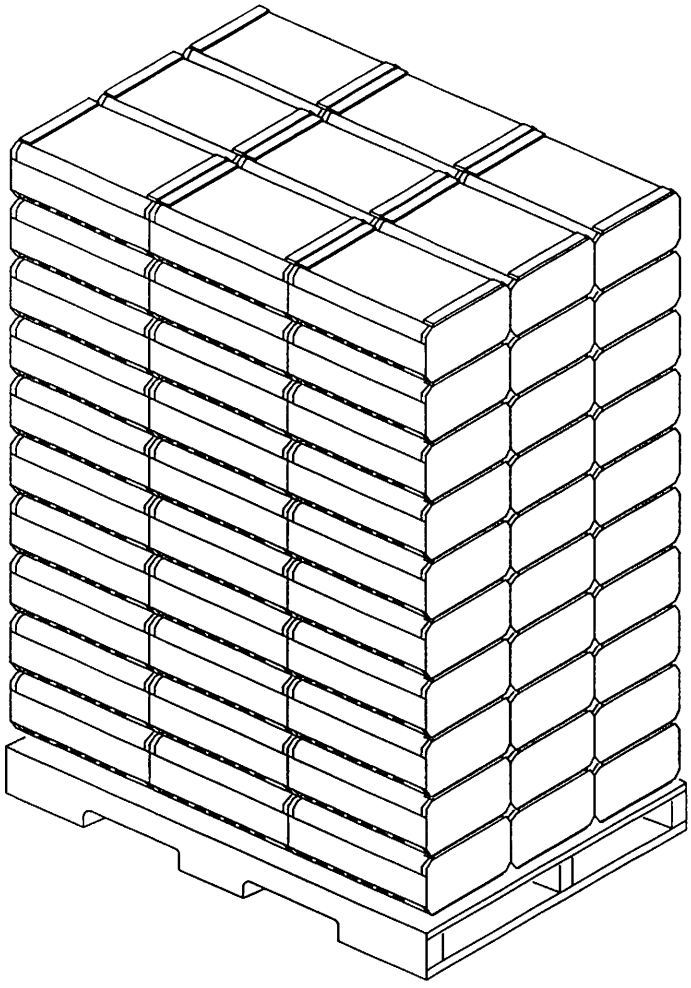


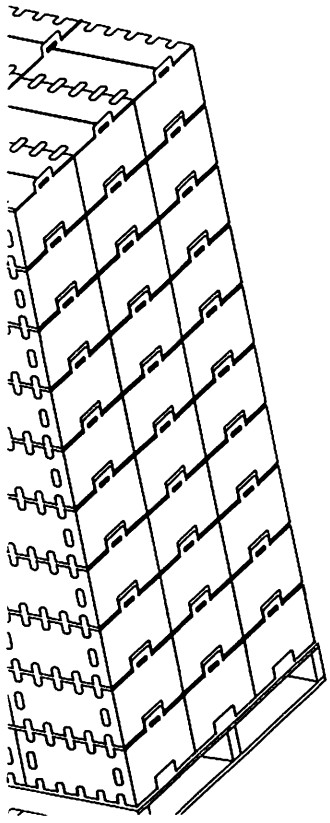


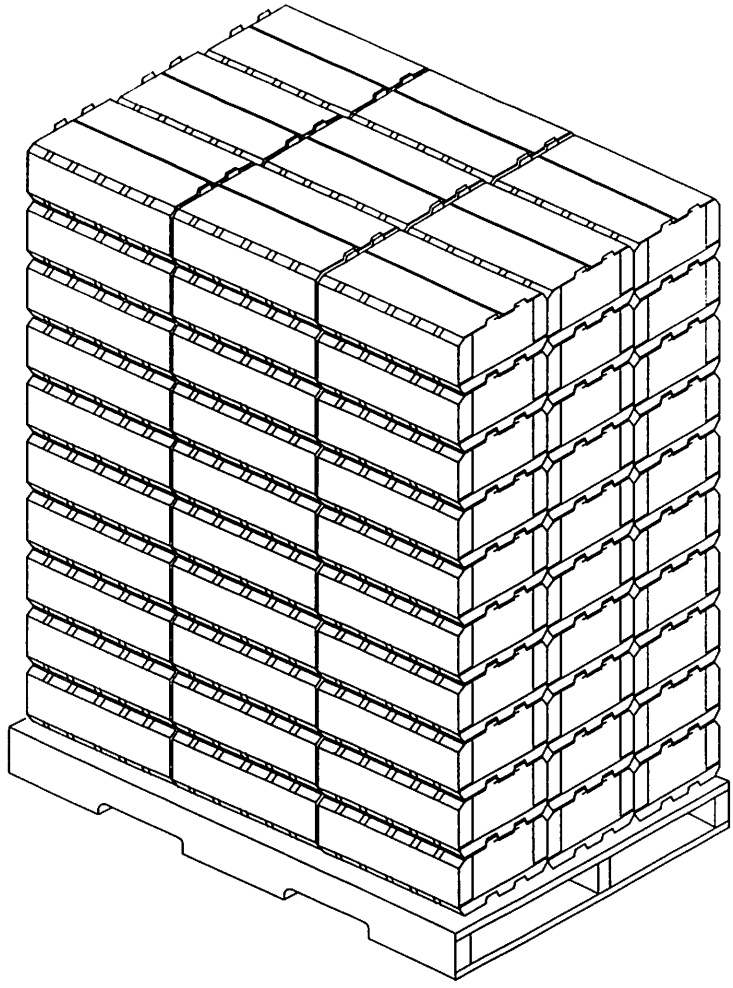
APPENDIX A. Box Types Arranged in a 3X3 Pallet Configuration.











Trials focus on table grape box design and penetration

Researchers at the Viticulture & Enology Research Center (VERC) have been evaluating new table grape box designs. The research team included Barry Gump, a California State University, Fresno chemistry professor, and Carter Clary and Katie Haight, two of the Center's research associates, and student research assistant, Dean Dionesotes. According to Gump, "We set up a model fumigation chamber in the VERC facilities to evaluate three types of table grape boxes on pallets". Following SO_2 fumigations penetration efficiencies, humidity, temperature cool down rates, and sulfite residue levels were measured in the different types of grape boxes. "This project was a natural extension of a number of years research on table grape fumigations and fumigation chamber wall materials carried out by researchers at VERC", Gump stated.

Table grapes are held in cold storage using packing boxes. These boxes must permit circulation of air and SO_2 to penetrate and sterilize the fruit packed within them. Boxes stacked on pallets are subjected to initial cooling to remove field heat and therefore chilling the fruit to a storage temperature of 31-32^0 F. The fruit also undergoes an initial fumigation with SO_2 in order to kill *Botrytis cinerea* (grey mold) spores on the surface of the berries. During cold storage, weekly fumigations with SO_2 maintain the fruit in a mold-free condition.

Initial SO_2 fumigations can be applied using forced or circulating air to facilitate permeation of the gas throughout the

boxes. Successful application of SO_2 to the fruit requires that each storage chamber and box combination be evaluated for uniformity of application throughout the room and effectiveness of penetration into the box. These "calibrations" can be accomplished through the use of several types of SO_2 measuring devices, placed into the boxes themselves, and/or positioned throughout a pallet. Devices include gas permeation tubes called Dosimeter Tubes used to measure SO_2 levels in the box, and flow-through Kitagawa Detector tubes used around a pallet to measure uniformity of SO_2 distribution.

It requires a certain amount of SO_2 to maintain a mold-free condition in a box of grapes. Currently a level of 100 ppm-hours (referred to as 100 CT's - or a Concentration multiplied by Time product) is being recommended in the California Table Grape Commission's Research Task Force Report, Gump explained. It has been found that storage chamber air circulation characteristics, as well as the presence of any wrapping materials have a significant effect on determining how much SO_2 must be used in initial and subsequent storage fumigations.

Container configuration may also have an effect on the performance of storage facilities including cool down characteristics and penetration of fumigant. The purpose of this study was to evaluate three types of packing boxes for International Paper in terms of their relative performance in table grape storage.

Ruby Seedless grapes were harvested September 18, 1992 from the California State University, Fresno vineyard and packed into a sufficient number of three types of boxes to yield a pallet of each type for cold storage. These containers included the traditional TKV box incorporating wood end pieces, and a removable lid. The prototype packages are fabricated entirely from corrugated paperboard into a "Metric" or "Clip Corner" box configuration. The corrugated paper board clip corner box resembles the TKV from the standpoint of shape, however it uses a folding lid. The metric box is designed with square corners and is of a slightly different dimension.

Two pallet configuration tests were conducted in this study. In Test 1, the TKV and Clip Corner boxes were stacked on the pallets in a 2X3 configuration, ten layers high. The Metric boxes were arranged in a 3X3 configuration, eight layers high. The boxes in these pallet configurations were used for the traditional fumigation trials in which the storage chamber was vented following the SO_2 dose. In Test 2, all pallets were stacked in a 3X3 configuration for the total utilization trials. In these trials the chamber was not vented after fumigation. "The conclusion of both tests is that all box types exhibit good permeation of fumigant throughout the boxes sampled", Haight says.

Another important performance factor is the response of fruit within each box type to cooling. Cool down profiles were completed in both pallet configurations (2X3 and 3X3). The 3X3 configuration was the most difficult to cool because the boxes in the center of

each pallet have no direct air exchange with the cold storage environment and may require extended time to cool. "Differences in the cool down profiles of each pallet were negligible", Clary stated. The fruit temperature in all the pallets reached 33° F in the same time period. Clary's conclusion of the cool down test was that all box types performed equally well in cooling.

The researchers have reported back to the company producing these prototype grape boxes that no significant differences were proven in relationship to penetration of SO_2 or cool down of fruit when compared to the traditional TKV boxes.

4 March 1993

COPY

Mr. Walter Tindell
Office Manager
Cal Pine Containers
P.O. Box 2796
Fresno, CA 93745

Dear Walt:

Please find enclosed a copy of our final report, "Evaluation of a New Table Grape Packing Box", dated 4 March 1993. When you and your colleges have a chance to review this report, we would be happy to meet with you and discuss it.

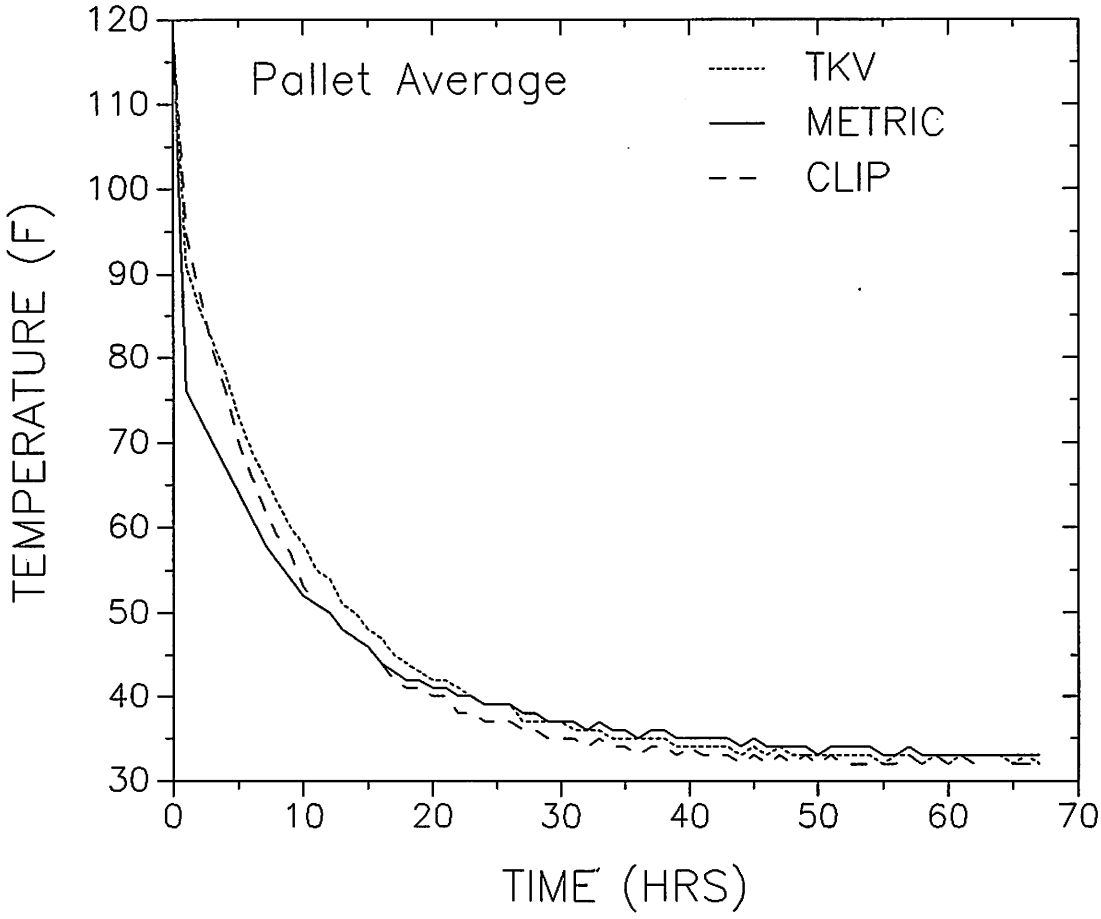
If you have any questions, or suggestions, please feel free to call us at the Viticulture & Enology Research Center.

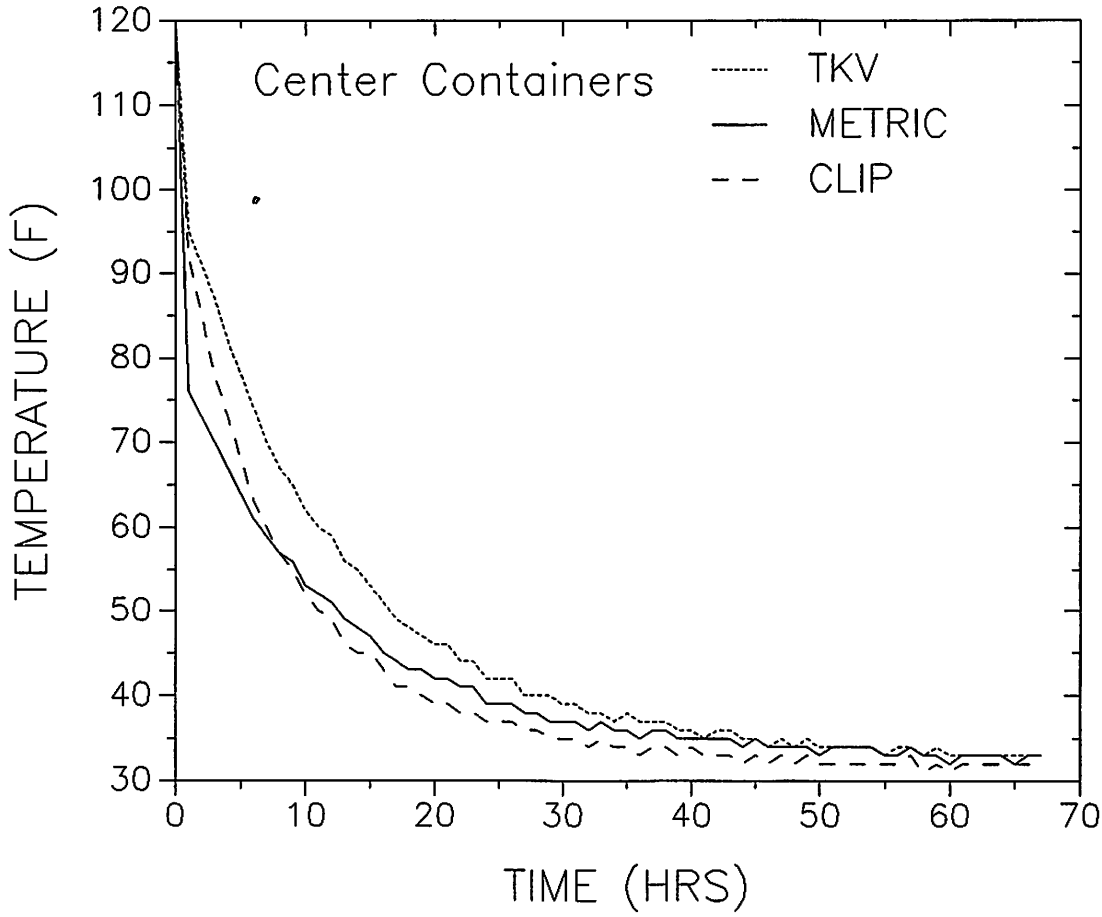
Sincerely,

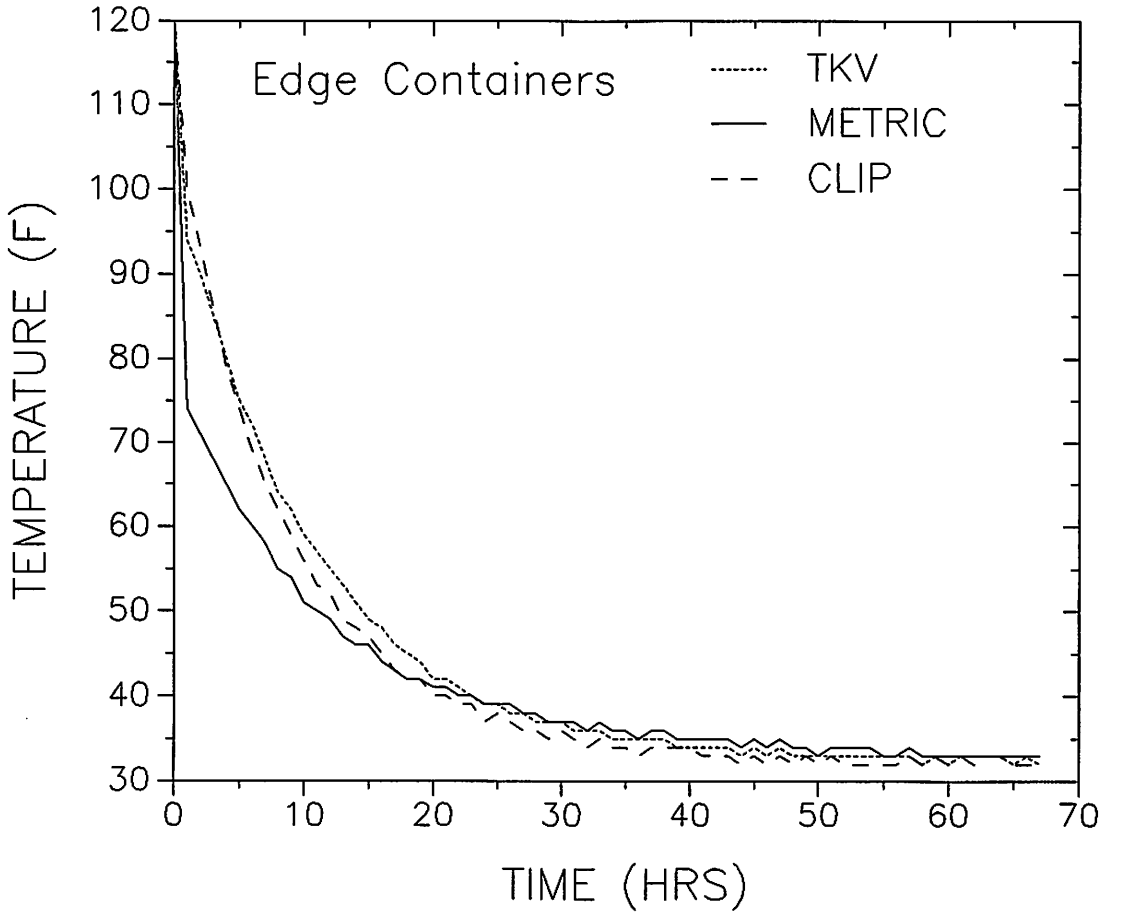
Katie G. Haight
Research Associate

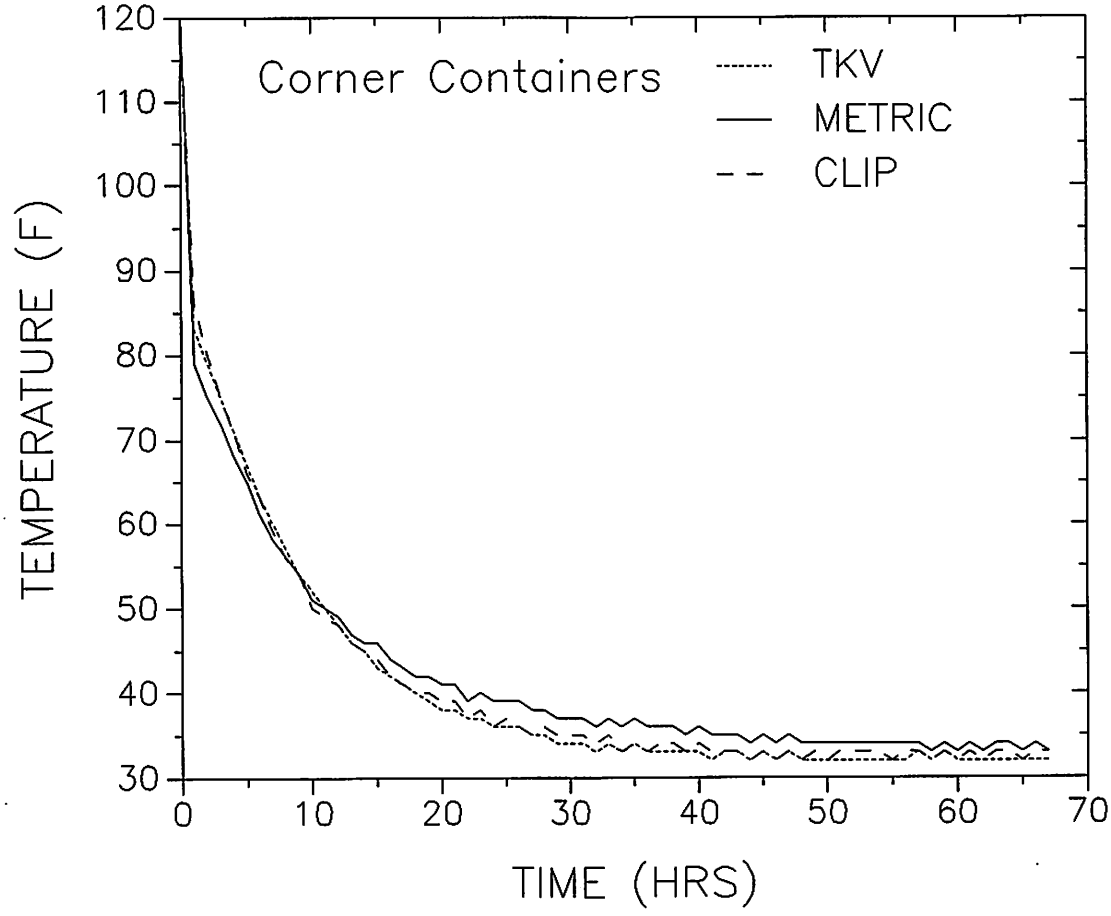
Enclosure

cc: B. Gump
C. Clary ✓


Pallet Average
TKV
METRIC
CLIP
TEMPERATURE (F)
120
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70
TIME (HRS)


Center Containers
TKV
METRIC
CLIP
TEMPERATURE (F)
120
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70
TIME (HRS)


Edge Containers
TKV
METRIC
CLIP
TEMPERATURE (F)
TIME (HRS)
120
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70


Corner Containers
TKV
METRIC
CLIP
TEMPERATURE (F)
120
110
100
90
80
70
60
50
40
30
0
10
20
30
40
50
60
70
TIME (HRS)

	TRU	METRIC	CLIP
EDGE	C3TE	C3ME	C3CE.PRN
CORNER	C3TC	C3MC	C3CC
(MIDDLE) CENTER	C3TM	C3MM	C3CM
(AVE) TOTAL	C3TA	C3MA	C3CA

PLOT, FILENAME, 1, SAVE WP5.1

=> SDF -> EDGE.SPF — EDGE.PLT
" CORNER.SPF
" CENTER.SPF
MEAN.SPF — MEAN.PLT

SEE LAST PAGE FOR REGRESS.

THEN convert to WP

INTERNATIONAL PAPER

COOL DOWN PROFILE III
3X3 STACK

A:C3SUM.CAL IP#3

Mo/DayHr/Min	Elapsed Hours	TKV 3x3 STACK T2 EDGE (F)	T3 CORNER (F)	T5A CENTER (F)	T5B CENTER (F)	T8 EDGE (F)	T9 CORNER (F)	TKV MEAN	METRIC 3x3 STACK M2 EDGE (F)	M3 CORNER (F)	M5A CENTER (F)	M5B CENTER (F)	M8 EDGE (F)	M9 CORNER (F)	METRIC MEAN
1 20 18 6	0	120	120	120	120	120	120	120	120	120	120	120	120	120	120
1 20 19 6	1	88	85	92	98	99	81	91	72	88	74	77	76	69	76
1 20 20 6	2	85	82	89	93	94	75	86	68	81	71	75	74	68	73
1 20 21 6	3	81	79	84	89	89	70	82	64	75	67	72	72	68	70
1 20 22 6	4	77	75	80	84	83	66	78	61	69	64	70	69	67	67
1 20 23 6	5	73	71	76	79	77	62	73	58	64	61	67	66	65	64
1 21 0 6	6	70	67	72	75	73	58	69	56	60	58	64	63	62	61
1 21 1 6	7	66	64	69	71	69	55	66	54	56	56	62	61	59	58
1 21 2 6	8	63	61	67	67	65	52	63	51	54	54	60	59	57	56
1 21 3 6	9	61	58	65	65	63	50	60	50	52	53	58	57	56	54
1 21 4 6	10	58	56	62	62	60	48	58	48	49	51	55	54	52	52
1 21 5 6	11	56	53	60	59	57	46	55	47	48	50	54	53	51	51
1 21 6 6	12	54	52	59	58	55	44	54	46	48	49	53	52	50	50
1 21 7 6	13	52	49	56	55	53	42	51	44	46	46	51	50	48	48
1 21 8 6	14	50	48	55	54	51	41	50	43	45	46	49	49	47	47
1 21 9 6	15	48	46	54	52	50	40	48	42	45	45	49	49	46	46
1 21 10 6	16	47	45	52	50	48	39	47	41	43	43	47	47	45	44
1 21 11 23	17	45	43	50	48	47	38	45	40	42	42	45	46	44	43
1 21 12 23	18	44	42	49	47	45	37	44	39	41	41	44	45	43	42
1 21 13 23	19	43	41	48	46	44	37	43	38	41	41	44	45	43	42
1 21 14 23	20	41	40	47	45	43	36	42	38	40	40	43	44	41	41
1 21 15 23	21	41	40	47	45	43	36	42	38	40	41	43	44	42	41
1 21 16 23	22	40	39	45	43	41	35	41	37	38	39	42	42	40	40
1 21 17 23	23	39	39	45	43	41	35	40	37	39	39	42	42	40	40
1 21 18 23	24	38	37	43	41	40	34	39	36	38	38	40	41	39	39
1 21 19 23	25	38	37	43	41	40	34	39	36	38	38	40	41	39	39
1 21 20 23	26	37	37	43	41	39	34	39	36	38	38	40	41	39	39
1 21 21 23	27	37	36	41	39	38	33	37	35	37	37	39	40	38	38
1 21 22 23	28	36	36	41	39	38	33	37	35	37	37	39	40	38	38
1 21 23 23	29	36	35	40	39	37	33	37	35	36	36	38	39	37	37
1 22 0 23	30	36	35	40	38	37	33	37	34	36	36	38	39	38	37
1 22 1 23	31	35	35	40	38	37	33	36	34	36	36	38	39	37	37
1 22 2 23	32	35	34	39	37	36	32	36	34	35	35	37	38	36	36
1 22 3 23	33	35	35	39	37	36	33	36	34	36	36	37	39	37	37
1 22 4 23	34	34	34	38	36	35	32	35	33	35	35	36	38	36	36
1 22 5 23	35	34	34	38	37	36	33	35	34	36	35	37	38	37	36
1 22 6 23	36	34	33	37	36	35	32	35	33	35	34	36	37	36	35
1 22 7 23	37	34	34	37	36	35	32	35	34	35	35	36	38	36	36

1	22	8	23	38	34	34	37	36	35	32	35	34	35	35	36	37	36	36
1	22	9	23	39	33	33	36	35	34	32	34	33	34	34	35	37	35	35
1	22	10	23	40	33	33	37	35	35	32	34	33	35	34	35	37	36	35
1	22	11	23	41	33	33	36	34	34	31	34	33	34	34	35	36	35	35
1	22	12	23	42	33	33	36	35	34	32	34	33	34	34	35	36	35	35
1	22	13	23	43	33	33	36	35	34	32	34	33	34	34	35	36	35	35
1	22	14	23	44	32	32	35	34	33	31	33	32	34	33	34	35	34	34
1	22	15	23	45	33	33	36	34	34	32	34	33	34	34	35	36	35	35
1	22	16	23	46	32	32	34	33	33	31	33	32	33	33	34	35	34	34
1	22	17	23	47	33	33	35	34	34	32	34	33	34	34	34	36	35	34
1	22	18	23	48	32	32	34	33	33	31	33	32	33	33	34	35	34	34
1	22	19	23	49	32	32	35	34	33	32	33	33	34	33	34	35	34	34
1	22	20	23	50	32	32	34	33	33	31	33	32	33	33	33	34	34	33
1	22	21	23	51	32	32	34	34	33	32	33	32	34	33	34	35	34	34
1	22	22	23	52	32	32	34	34	33	32	33	32	34	33	34	35	34	34
1	22	23	23	53	32	32	34	33	33	32	33	32	33	33	34	35	34	34
1	23	0	23	54	32	32	34	33	33	32	33	32	33	33	34	35	34	34
1	23	1	23	55	32	32	33	33	33	31	32	32	33	33	33	34	34	33
1	23	2	23	56	32	32	34	33	33	32	33	32	33	33	33	34	34	33
1	23	3	23	57	32	33	34	34	33	32	33	33	34	34	34	35	34	34
1	23	4	23	58	32	32	33	32	32	31	32	32	33	32	33	33	33	33
1	23	5	23	59	32	33	34	33	33	32	33	32	33	33	33	34	34	33
1	23	6	23	60	32	32	33	32	32	31	32	32	33	32	32	33	33	33
1	23	7	23	61	32	32	33	33	33	32	33	32	33	33	33	34	34	33
1	23	8	23	62	32	32	33	33	33	32	33	32	33	33	33	34	33	33
1	23	9	23	63	32	32	33	33	33	32	33	32	33	33	33	34	34	33
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1	23	11	23	65	32	32	33	32	32	31	32	32	33	32	32	33	33	33
1	23	12	23	66	32	32	33	33	33	32	33	32	33	33	33	34	34	33
1	23	13	23	67	32	32	33	33	32	32	32	32	33	33	33	33	33	33
1	23	14	23	68	32	32	33	32	32	31	32	32	33	32	33	33	33	33
1	23	15	23	69	32	33	33	33	33	32	33	33	33	33	33	34	34	33
1	23	16	23	70	32	32	32	32	32	31	32	32	32	32	32	33	33	32
1	23	17	23	71	32	32	33	33	32	32	32	32	33	33	33	33	33	33
1	23	18	23	72	32	32	32	32	32	31	32	32	32	32	32	33	32	32
1	23	19	23	73	32	32	33	33	32	32	32	32	33	33	33	33	33	33
1	23	20	23	74	32	32	33	33	32	32	32	32	33	33	33	33	33	33
1	23	21	23	75	32	32	33	33	32	32	32	32	33	33	33	33	33	33
1	23	22	23	76	32	32	33	33	32	32	32	32	33	32	33	33	33	33
1	23	23	23	77	32	32	32	32	32	31	32	32	32	32	32	33	33	32
1	24	0	23	78	32	32	33	32	32	32	32	32	33	32	33	33	33	33
1	24	1	23	79	32	32	32	32	32	31	32	32	32	32	32	32	32	32
1	24	2	23	80	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	3	23	81	32	33	33	33	33	32	33	33	33	33	33	34	34	33
1	24	4	23	82	32	32	32	32	32	32	32	32	32	32	32	32	32	32
1	24	5	23	83	32	33	33	33	32	32	33	32	33	33	33	33	33	33
1	24	6	23	84	32	32	32	32	32	32	32	32	32	32	32	32	32	32
1	24	7	23	85	32	32	33	32	32	32	32	32	33	33	32	33	33	33
1	24	8	23	86	32	32	33	33	32	32	32	32	33	32	32	33	33	33

deleted from graph

1	24	9	23	87	32	32	32	32	32	32	32	32	33	33	32	33	33	33
1	24	10	23	88	32	32	33	33	32	32	32	32	33	32	32	33	33	33
1	24	11	23	89	32	32	32	32	32	31	32	32	32	32	32	32	32	32
1	24	12	23	90	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	13	23	91	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	14	23	92	32	32	32	32	32	31	32	32	32	32	32	32	32	32
1	24	15	23	93	32	33	33	33	33	32	33	33	33	33	33	33	33	33
1	24	16	23	94	32	32	32	32	32	31	32	32	32	32	32	32	32	32
1	24	17	23	95	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	18	23	96	32	32	32	32	32	31	32	32	32	32	32	32	32	32
1	24	19	23	97	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	20	23	98	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	21	23	99	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	22	23	100	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	24	23	23	101	32	32	32	32	32	31	32	32	32	32	32	32	32	32
1	25	0	23	102	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	25	1	23	103	32	32	32	31	32	31	32	32	32	32	32	32	32	32
1	25	2	23	104	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	25	3	23	105	32	33	33	33	33	32	33	33	33	33	33	33	33	33
1	25	4	23	106	32	32	32	32	32	32	32	32	32	32	32	32	32	32
1	25	5	23	107	32	33	32	32	32	32	32	32	33	32	32	33	33	33
1	25	6	23	108	32	32	32	32	32	32	32	32	32	32	32	32	32	32
1	25	7	23	109	32	32	32	32	32	32	32	32	33	32	32	33	33	33
1	25	8	23	110	32	32	32	32	32	31	32	32	32	32	32	32	32	32

CLIP 3x3 STACK						
C2 EDGE (F)	C3 CORNER (F)	C5A CENTER (F)	C5B CENTER (F)	C8 EDGE (F)	C9 CORNER (F)	CLIP MEAN
120	120	120	120	120	120	120
106	719	552	92	94	86	95
97	716	549	85	88	80	88
89	714	547	78	82	75	81
82	714	546	73	76	71	76
76	713	546	68	71	66	70
71	714	546	63	67	63	66
67	714	547	60	63	59	62
63	715	548	57	60	56	59
60	717	550	55	58	54	57
57	717	550	52	54	50	53
54	712	545	50	52	49	51
53	714	547	49	51	48	50
50	711	544	46	48	46	48
49	714	547	45	47	45	47
48	713	546	45	46	44	46
45	713	546	43	44	42	44
44	714	546	41	42	41	42
43	711	544	41	41	40	41
42	714	547	40	41	40	41
41	711	544	39	39	39	40
41	714	547	39	39	39	40
39	713	546	38	38	37	38
39	713	546	38	38	38	38
38	712	544	37	36	36	37
38	714	547	37	37	37	37
37	713	546	37	36	36	37
36	713	546	36	35	35	36
36	714	547	36	35	36	36
35	711	544	35	34	35	35
36	714	547	35	35	35	35
35	714	547	35	35	35	35
34	712	544	34	33	34	34
35	715	548	35	34	35	35
34	713	546	34	33	33	34
34	713	546	34	34	34	34
33	712	545	33	33	33	33
34	714	547	34	34	34	34

34	712	545	34	33	34	34
34	714	547	33	33	33	33
34	714	546	34	33	34	34
33	711	544	33	32	33	33
33	714	547	33	33	33	33
33	713	545	33	33	33	33
32	712	545	32	32	32	32
33	715	548	33	33	33	33
32	713	546	32	32	32	32
33	713	546	33	33	33	33
32	713	546	32	32	32	32
33	714	547	33	32	33	33
32	711	544	32	32	32	32
33	714	547	32	32	33	33
32	713	545	32	32	33	32
32	715	547	32	32	33	32
32	714	546	32	32	33	32
32	714	547	32	32	32	32
32	714	547	32	32	33	32
33	716	549	33	33	33	33
32	714	546	31	32	32	32
32	714	547	32	33	33	33
32	712	545	31	32	32	32
32	714	547	32	33	33	33
32	712	545	32	32	32	32
32	715	547	32	33	33	33
32	713	546	32	33	33	33
32	713	546	32	32	32	32
32	714	547	32	32	33	32
32	712	545	32	32	33	32
32	714	547	32	32	32	32
33	715	548	33	33	33	33
32	713	546	31	32	32	32
32	714	547	32	33	33	33
32	712	544	31	32	32	32
32	714	547	32	32	33	32
32	713	545	32	32	33	32
32	715	548	32	32	33	32
32	714	546	32	32	33	32
32	714	547	32	32	32	32
32	714	547	32	32	33	32
31	712	545	31	31	32	31
32	714	547	32	32	32	32
33	717	550	33	33	33	33
32	714	547	31	32	32	32
32	714	546	32	33	33	33
32	712	545	31	32	32	32
32	714	547	32	33	33	33
32	712	545	32	32	33	32

$Y = B_0 + B_1 X + B_2 X^2$

Regrad	B_0	B_1	B_2	r^2
TKU-Contr	89.96	−2.48	.026	91.3
METRIC-Contr	75.[illegible]	−1.91	.02	81.0
CLIP-Contr	80.85	−2.33	.026	82.7

32	715	548	32	33	33	33
32	714	547	32	33	33	33
32	712	545	31	32	32	32
32	714	547	32	32	33	32
32	713	546	32	32	33	32
32	714	546	32	32	32	32
33	715	548	33	33	33	33
32	713	546	31	32	32	32
32	714	547	32	32	33	32
31	712	544	31	31	32	31
32	714	547	32	32	33	32
32	713	546	32	32	33	32
32	715	548	32	32	33	32
32	714	547	32	32	33	32
32	713	546	31	32	32	32
32	714	547	32	32	32	32
31	712	544	31	31	32	31
32	714	547	32	32	32	32
33	717	550	33	33	33	33
31	714	547	31	32	32	32
32	714	546	32	33	33	33
32	713	545	31	32	32	32
32	714	547	32	32	33	32
32	711	544	31	32	32	32

LOCATION: IP LOGGER 1
OPERATOR:
REPORT: 1

SCAN INTERVAL: 10 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

C31-9A.PRN

	TKV2 EDGE (F) INST	TKV3 CORNER (F) INST	TKV5A CENTER1 (F) INST	TKV5B CENTER (F) INST	TKV8 EDGE (F) INST	TKV9 CORNER (F) INST	METRIC2 EDGE (F) INST	METRIC3 CORNER (F) INST	METRIC5 CENTER1 (F) INST
01/20 19:06	88.	85.	92.	98.	99.	81.	72.	88.	74.
01/20 20:06	85.	82.	89.	93.	94.	75.	68.	81.	71.
01/20 21:06	81.	79.	84.	89.	89.	70.	64.	75.	67.
01/20 22:06	77.	75.	80.	84.	83.	66.	61.	69.	64.
01/20 23:06	73.	71.	76.	79.	77.	62.	58.	64.	61.
01/21 00:06	70.	67.	72.	75.	73.	58.	56.	60.	58.
01/21 01:06	66.	64.	69.	71.	69.	55.	54.	56.	56.
01/21 02:06	63.	61.	67.	67.	65.	52.	51.	54.	54.
01/21 03:06	61.	58.	65.	65.	63.	50.	50.	52.	53.
01/21 04:06	58.	56.	62.	62.	60.	48.	48.	49.	51.
01/21 05:06	56.	53.	60.	59.	57.	46.	47.	48.	50.
01/21 06:06	54.	52.	59.	58.	55.	44.	46.	48.	49.
01/21 07:06	52.	49.	56.	55.	53.	42.	44.	46.	46.
01/21 08:06	50.	48.	55.	54.	51.	41.	43.	45.	46.

Enter A Command
LOCATION: IP LOGGER 2
OPERATOR:
REPORT: 1

SCAN INTERVAL: 60 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

C310-18A.PRN

etc

	METRIC5 CENTER (F) INST	METRIC8 EDGE (F) INST	METRIC9 CORNER (F) INST	CLIP2 EDGE (F) INST	CLIP3 CORNER (F) INST	CLIP5A CENTER1 (F) INST	CLIP5B CENTER2 (F) INST	CLIP8 EDGE (F) INST	CLIP9 CORNER (F) INST
01/20 19:08	77.	76.	69.	106.	719.	552.	92.	94.	86.
01/20 20:08	75.	74.	68.	97.	716.	549.	85.	88.	80.
01/20 21:08	72.	72.	68.	89.	714.	547.	78.	82.	75.
01/20 22:08	70.	69.	67.	82.	714.	546.	73.	76.	71.
01/20 23:08	67.	66.	65.	76.	713.	546.	68.	71.	66.
01/21 00:08	64.	63.	62.	71.	714.	546.	63.	67.	63.
01/21 01:08	62.	61.	59.	67.	714.	547.	60.	63.	59.
01/21 02:08	60.	59.	57.	63.	715.	548.	57.	60.	56.
01/21 03:08	58.	57.	56.	60.	717.	550.	55.	58.	54.
01/21 04:08	55.	54.	52.	57.	717.	550.	52.	54.	50.
01/21 05:08	54.	53.	51.	54.	712.	545.	50.	52.	49.
01/21 06:08	53.	52.	50.	53.	714.	547.	49.	51.	48.
01/21 07:08	51.	50.	48.	50.	711.	544.	46.	48.	46.
01/21 08:08	49.	49.	47.	49.	714.	547.	45.	47.	45.

Enter A Command
LOCATION: IP LOGGER 1
OPERATOR:
REPORT: 1

SCAN INTERVAL: 10 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

	TKV2 EDGE (F) INST	TKV3 CORNER (F) INST	TKV5A CENTER1 (F) INST	TKV5B CENTER (F) INST	TKV8 EDGE (F) INST	TKV9 CORNER (F) INST	METRIC2 EDGE (F) INST	METRIC3 CORNER (F) INST	METRIC5 CENTER1 (F) INST
01/21 09:06	48.	46.	54.	52.	50.	40.	42.	45.	45.
01/21 10:06	47.	45.	52.	50.	48.	39.	41.	43.	43.

Enter A Command

LOCATION: IP LOGGER 1
OPERATOR:
REPORT: 1

SCAN INTERVAL: 10 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

	TKV2 EDGE (F) INST	TKV3 CORNER (F) INST	TKV5A CENTER1 (F) INST	TKV5B CENTER (F) INST	TKV8 EDGE (F) INST	TKV9 CORNER (F) INST	METRIC2 EDGE (F) INST	METRIC3 CORNER (F) INST	METRIC5 CENTER1 (F) INST
01/21 11:23	45.	43.	50.	48.	47.	38.	40.	42.	42.
01/21 12:23	44.	42.	49.	47.	45.	37.	39.	41.	41.
01/21 13:23	43.	41.	48.	46.	44.	37.	38.	41.	41.
01/21 14:23	41.	40.	47.	45.	43.	36.	38.	40.	40.
01/21 15:23	41.	40.	47.	45.	43.	36.	38.	40.	41.
01/21 16:23	40.	39.	45.	43.	41.	35.	37.	38.	39.
01/21 17:23	39.	39.	45.	43.	41.	35.	37.	39.	39.
01/21 18:23	38.	37.	43.	41.	40.	34.	36.	38.	38.
01/21 19:23	38.	37.	43.	41.	40.	34.	36.	38.	38.
01/21 20:23	37.	37.	43.	41.	39.	34.	36.	38.	38.
01/21 21:23	37.	36.	41.	39.	38.	33.	35.	37.	37.
01/21 22:23	36.	36.	41.	39.	38.	33.	35.	37.	37.
01/21 23:23	36.	35.	40.	39.	37.	33.	35.	36.	36.
01/22 00:23	36.	35.	40.	38.	37.	33.	34.	36.	36.
01/22 01:23	35.	35.	40.	38.	37.	33.	34.	36.	36.
01/22 02:23	35.	34.	39.	37.	36.	32.	34.	35.	35.
01/22 03:23	35.	35.	39.	37.	36.	33.	34.	36.	36.
01/22 04:23	34.	34.	38.	36.	35.	32.	33.	35.	35.
01/22 05:23	34.	34.	38.	37.	36.	33.	34.	36.	35.
01/22 06:23	34.	33.	37.	36.	35.	32.	33.	35.	34.
01/22 07:23	34.	34.	37.	36.	35.	32.	34.	35.	35.
01/22 08:23	34.	34.	37.	36.	35.	32.	34.	35.	35.
01/22 09:23	33.	33.	36.	35.	34.	32.	33.	34.	34.
01/22 10:23	33.	33.	37.	35.	35.	32.	33.	35.	34.
01/22 11:23	33.	33.	36.	34.	34.	31.	33.	34.	34.
01/22 12:23	33.	33.	36.	35.	34.	32.	33.	34.	34.
01/22 13:23	33.	33.	36.	35.	34.	32.	33.	34.	34.
01/22 14:23	32.	32.	35.	34.	33.	31.	32.	34.	33.
01/22 15:23	33.	33.	36.	34.	34.	32.	33.	34.	34.

Enter A Command
LOCATION: IP LOGGER 2
OPERATOR:
REPORT: 1

SCAN INTERVAL: 60 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

	METRIC5 CENTER (F) INST	METRIC8 EDGE (F) INST	METRIC9 CORNER (F) INST	CLIP2 EDGE (F) INST	CLIP3 CORNER (F) INST	CLIP5A CENTER1 (F) INST	CLIP5B CENTER2 (F) INST	CLIP8 EDGE (F) INST	CLIP9 CORNER (F) INST
01/21 09:08	49.	49.	46.	48.	713.	546.	45.	46.	44.
01/21 10:08	47.	47.	45.	45.	713.	546.	43.	44.	42.

Enter A Command
LOCATION: IP LOGGER 2
OPERATOR:
REPORT: 1

SCAN INTERVAL: 60 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

	METRIC5 CENTER (F) INST	METRIC8 EDGE (F) INST	METRIC9 CORNER (F) INST	CLIP2 EDGE (F) INST	CLIP3 CORNER (F) INST	CLIP5A CENTER1 (F) INST	CLIP5B CENTER2 (F) INST	CLIP8 EDGE (F) INST	CLIP9 CORNER (F) INST
01/21 11:21	45.	46.	44.	44.	714.	546.	41.	42.	41.
01/21 12:21	44.	45.	43.	43.	711.	544.	41.	41.	40.

01/21 13:21	44.	45.	43.	42.	714.	547.	40.	41.	40.
01/21 14:21	43.	44.	41.	41.	711.	544.	39.	39.	39.
01/21 15:21	43.	44.	42.	41.	714.	547.	39.	39.	39.
01/21 16:21	42.	42.	40.	39.	713.	546.	38.	38.	37.
01/21 17:21	42.	42.	40.	39.	713.	546.	38.	38.	38.
01/21 18:21	40.	41.	39.	38.	712.	544.	37.	36.	36.
01/21 19:21	40.	41.	39.	38.	714.	547.	37.	37.	37.
01/21 20:21	40.	41.	39.	37.	713.	546.	37.	36.	36.
01/21 21:21	39.	40.	38.	36.	713.	546.	36.	35.	35.
01/21 22:21	39.	40.	38.	36.	714.	547.	36.	35.	36.
01/21 23:21	38.	39.	37.	35.	711.	544.	35.	34.	35.
01/22 00:21	38.	39.	38.	36.	714.	547.	35.	35.	35.
01/22 01:21	38.	39.	37.	35.	714.	547.	35.	35.	35.
01/22 02:21	37.	38.	36.	34.	712.	544.	34.	33.	34.
01/22 03:21	37.	39.	37.	35.	715.	548.	35.	34.	35.
01/22 04:21	36.	38.	36.	34.	713.	546.	34.	33.	33.
01/22 05:21	37.	38.	37.	34.	713.	546.	34.	34.	34.
01/22 06:21	36.	37.	36.	33.	712.	545.	33.	33.	33.
01/22 07:21	36.	38.	36.	34.	714.	547.	34.	34.	34.
01/22 08:21	36.	37.	36.	34.	712.	545.	34.	33.	34.
01/22 09:21	35.	37.	35.	34.	714.	547.	33.	33.	33.
01/22 10:21	35.	37.	36.	34.	714.	546.	34.	33.	34.
01/22 11:21	35.	36.	35.	33.	711.	544.	33.	32.	33.
01/22 12:21	35.	36.	35.	33.	714.	547.	33.	33.	33.
01/22 13:21	35.	36.	35.	33.	713.	545.	33.	33.	33.
01/22 14:21	34.	35.	34.	32.	712.	545.	32.	32.	32.
01/22 15:21	35.	36.	35.	33.	715.	548.	33.	33.	33.

Enter A Command

LOCATION: IP LOGGER 1 SCAN INTERVAL: 10 MINUTES
OPERATOR: REPORT INTERVAL: 60 MINUTES
REPORT: 1 START WHEN?:
STOP WHEN?:

	TKV2 EDGE (F) INST	TKV3 CORNER (F) INST	TKV5A CENTER1 (F) INST	TKV5B CENTER (F) INST	TKV8 EDGE (F) INST	TKV9 CORNER (F) INST	METRIC2 EDGE (F) INST	METRIC3 CORNER (F) INST	METRIC5 CENTER1 (F) INST
01/22 16:23	32.	32.	34.	33.	33.	31.	32.	33.	33.
01/22 17:23	33.	33.	35.	34.	34.	32.	33.	34.	34.
01/22 18:23	32.	32.	34.	33.	33.	31.	32.	33.	33.
01/22 19:23	32.	32.	35.	34.	33.	32.	33.	34.	33.
01/22 20:23	32.	32.	34.	33.	33.	31.	32.	33.	33.
01/22 21:23	32.	32.	34.	34.	33.	32.	32.	34.	33.
01/22 22:23	32.	32.	34.	34.	33.	32.	32.	34.	33.
01/22 23:23	32.	32.	34.	33.	33.	32.	32.	33.	33.
01/23 00:23	32.	32.	34.	33.	33.	32.	32.	33.	33.
01/23 01:23	32.	32.	33.	33.	33.	31.	32.	33.	33.
01/23 02:23	32.	32.	34.	33.	33.	32.	32.	33.	33.
01/23 03:23	32.	33.	34.	34.	33.	32.	33.	34.	34.
01/23 04:23	32.	32.	33.	32.	32.	31.	32.	33.	32.
01/23 05:23	32.	33.	34.	33.	33.	32.	32.	33.	33.
01/23 06:23	32.	32.	33.	32.	32.	31.	32.	33.	32.
01/23 07:23	32.	32.	33.	33.	33.	32.	32.	33.	33.
01/23 08:23	32.	32.	33.	33.	33.	32.	32.	33.	33.
01/23 09:23	32.	32.	33.	33.	33.	32.	32.	33.	33.
01/23 10:23	32.	32.	33.	33.	33.	32.	32.	33.	33.
01/23 11:23	32.	32.	33.	32.	32.	31.	32.	33.	32.
01/23 12:23	32.	32.	33.	33.	33.	32.	32.	33.	33.
01/23 13:23	32.	32.	33.	33.	32.	32.	32.	33.	33.
01/23 14:23	32.	32.	33.	32.	32.	31.	32.	33.	32.
01/23 15:23	32.	33.	33.	33.	33.	32.	33.	33.	33.
01/23 16:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/23 17:23	32.	32.	33.	33.	32.	32.	32.	33.	33.
01/23 18:23	32.	32.	32.	32.	32.	31.	32.	32.	32.

01/23 19:23	32.	32.	33.	33.	32.	32.	32.	33.	33.
01/23 20:23	32.	32.	33.	33.	32.	32.	32.	33.	33.
01/23 21:23	32.	32.	33.	33.	32.	32.	32.	33.	33.
01/23 22:23	32.	32.	33.	33.	32.	32.	32.	33.	32.
01/23 23:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/24 00:23	32.	32.	33.	32.	32.	32.	32.	33.	32.
01/24 01:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/24 02:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 03:23	32.	33.	33.	33.	33.	32.	33.	33.	33.
01/24 04:23	32.	32.	32.	32.	32.	32.	32.	32.	32.
01/24 05:23	32.	33.	33.	33.	32.	32.	32.	33.	33.
01/24 06:23	32.	32.	32.	32.	32.	32.	32.	32.	32.
01/24 07:23	32.	32.	33.	32.	32.	32.	32.	33.	33.
01/24 08:23	32.	32.	33.	33.	32.	32.	32.	33.	32.
01/24 09:23	32.	32.	32.	32.	32.	32.	32.	33.	33.
01/24 10:23	32.	32.	33.	33.	32.	32.	32.	33.	32.
01/24 11:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/24 12:23	32.	32.	32.	32.	32.	32.	32.	33.	32.

LOCATION: IP LOGGER 1
OPERATOR:
REPORT: 1

SCAN INTERVAL: 10 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

	TKV2 EDGE (F) INST	TKV3 CORNER (F) INST	TKV5A CENTER1 (F) INST	TKV5B CENTER (F) INST	TKV8 EDGE (F) INST	TKV9 CORNER (F) INST	METRIC2 EDGE (F) INST	METRIC3 CORNER (F) INST	METRIC5 CENTER1 (F) INST
01/24 13:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 14:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/24 15:23	32.	33.	33.	33.	33.	32.	33.	33.	33.
01/24 16:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/24 17:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 18:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/24 19:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 20:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 21:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 22:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/24 23:23	32.	32.	32.	32.	32.	31.	32.	32.	32.
01/25 00:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/25 01:23	32.	32.	32.	31.	32.	31.	32.	32.	32.
01/25 02:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/25 03:23	32.	33.	33.	33.	33.	32.	33.	33.	33.
01/25 04:23	32.	32.	32.	32.	32.	32.	32.	32.	32.
01/25 05:23	32.	33.	32.	32.	32.	32.	32.	33.	32.
01/25 06:23	32.	32.	32.	32.	32.	32.	32.	32.	32.
01/25 07:23	32.	32.	32.	32.	32.	32.	32.	33.	32.
01/25 08:23	32.	32.	32.	32.	32.	31.	32.	32.	32.

Enter A Command
LOCATION: IP LOGGER 2
OPERATOR:
REPORT: 1

SCAN INTERVAL: 60 MINUTES
REPORT INTERVAL: 60 MINUTES
START WHEN?:
STOP WHEN?:

	METRIC5 CENTER (F) INST	METRIC8 EDGE (F) INST	METRIC9 CORNER (F) INST	CLIP2 EDGE (F) INST	CLIP3 CORNER (F) INST	CLIP5A CENTER1 (F) INST	CLIP5B CENTER2 (F) INST	CLIP8 EDGE (F) INST	CLIP9 CORNER (F) INST
01/22 16:21	34.	35.	34.	32.	713.	546.	32.	32.	32.
01/22 17:21	34.	36.	35.	33.	713.	546.	33.	33.	33.
01/22 18:21	34.	35.	34.	32.	713.	546.	32.	32.	32.
01/22 19:21	34.	35.	34.	33.	714.	547.	33.	32.	33.
01/22 20:21	33.	34.	34.	32.	711.	544.	32.	32.	32.
01/22 21:21	34.	35.	34.	33.	714.	547.	32.	32.	33.
01/22 22:21	34.	35.	34.	32.	713.	545.	32.	32.	33.
01/22 23:21	34.	35.	34.	32.	715.	547.	32.	32.	33.
01/23 00:21	34.	35.	34.	32.	714.	546.	32.	32.	33.
01/23 01:21	33.	34.	34.	32.	714.	547.	32.	32.	32.
01/23 02:21	33.	34.	34.	32.	714.	547.	32.	32.	33.
01/23 03:21	34.	35.	34.	33.	716.	549.	33.	33.	33.
01/23 04:21	33.	33.	33.	32.	714.	546.	31.	32.	32.
01/23 05:21	33.	34.	34.	32.	714.	547.	32.	33.	33.
01/23 06:21	32.	33.	33.	32.	712.	545.	31.	32.	32.
01/23 07:21	33.	34.	34.	32.	714.	547.	32.	33.	33.
01/23 08:21	33.	34.	33.	32.	712.	545.	32.	32.	32.
01/23 09:21	33.	34.	34.	32.	715.	547.	32.	33.	33.
01/23 10:21	33.	34.	34.	32.	713.	546.	32.	33.	33.
01/23 11:21	32.	33.	33.	32.	713.	546.	32.	32.	32.
01/23 12:21	33.	34.	34.	32.	714.	547.	32.	32.	33.
01/23 13:21	33.	33.	33.	32.	712.	545.	32.	32.	33.
01/23 14:21	33.	33.	33.	32.	714.	547.	32.	32.	32.
01/23 15:21	33.	34.	34.	33.	715.	548.	33.	33.	33.
01/23 16:21	32.	33.	33.	32.	713.	546.	31.	32.	32.

01/23 17:21	33.	33.	33.	32.	714.	547.	32.	33.	33.
01/23 18:21	32.	33.	32.	32.	712.	544.	31.	32.	32.
01/23 19:21	33.	33.	33.	32.	714.	547.	32.	32.	33.
01/23 20:21	33.	33.	33.	32.	713.	545.	32.	32.	33.
01/23 21:21	33.	33.	33.	32.	715.	548.	32.	32.	33.
01/23 22:21	33.	33.	33.	32.	714.	546.	32.	32.	33.
01/23 23:21	32.	33.	33.	32.	714.	547.	32.	32.	32.
01/24 00:21	33.	33.	33.	32.	714.	547.	32.	32.	33.
01/24 01:21	32.	32.	32.	31.	712.	545.	31.	31.	32.
01/24 02:21	32.	33.	33.	32.	714.	547.	32.	32.	32.
01/24 03:21	33.	34.	34.	33.	717.	550.	33.	33.	33.
01/24 04:21	32.	32.	32.	32.	714.	547.	31.	32.	32.
01/24 05:21	33.	33.	33.	32.	714.	546.	32.	33.	33.
01/24 06:21	32.	32.	32.	32.	712.	545.	31.	32.	32.
01/24 07:21	32.	33.	33.	32.	714.	547.	32.	33.	33.
01/24 08:21	32.	33.	33.	32.	712.	545.	32.	32.	33.
01/24 09:21	32.	33.	33.	32.	715.	548.	32.	33.	33.
01/24 10:21	32.	33.	33.	32.	714.	547.	32.	33.	33.
01/24 11:21	32.	32.	32.	32.	712.	545.	31.	32.	32.
01/24 12:21	32.	33.	33.	32.	714.	547.	32.	32.	33.

LOCATION: IP LOGGER 2 SCAN INTERVAL: 60 MINUTES
OPERATOR: REPORT INTERVAL: 60 MINUTES
REPORT: 1 START WHEN?:
STOP WHEN?:

	METRIC5 CENTER (F) INST	METRIC8 EDGE (F) INST	METRIC9 CORNER (F) INST	CLIP2 EDGE (F) INST	CLIP3 CORNER (F) INST	CLIP5A CENTER1 (F) INST	CLIP5B CENTER2 (F) INST	CLIP8 EDGE (F) INST	CLIP9 CORNER (F) INST
01/24 13:21	32.	33.	33.	32.	713.	546.	32.	32.	33.
01/24 14:21	32.	32.	32.	32.	714.	546.	32.	32.	32.
01/24 15:21	33.	33.	33.	33.	715.	548.	33.	33.	33.
01/24 16:21	32.	32.	32.	32.	713.	546.	31.	32.	32.
01/24 17:21	32.	33.	33.	32.	714.	547.	32.	32.	33.
01/24 18:21	32.	32.	32.	31.	712.	544.	31.	31.	32.
01/24 19:21	32.	33.	33.	32.	714.	547.	32.	32.	33.
01/24 20:21	32.	33.	33.	32.	713.	546.	32.	32.	33.
01/24 21:21	32.	33.	33.	32.	715.	548.	32.	32.	33.
01/24 22:21	32.	33.	33.	32.	714.	547.	32.	32.	33.
01/24 23:21	32.	32.	32.	32.	713.	546.	31.	32.	32.
01/25 00:21	32.	33.	33.	32.	714.	547.	32.	32.	32.
01/25 01:21	32.	32.	32.	31.	712.	544.	31.	31.	32.
01/25 02:21	32.	33.	33.	32.	714.	547.	32.	32.	32.
01/25 03:21	33.	33.	33.	33.	717.	550.	33.	33.	33.
01/25 04:21	32.	32.	32.	31.	714.	547.	31.	32.	32.
01/25 05:21	32.	33.	33.	32.	714.	546.	32.	33.	33.
01/25 06:21	32.	32.	32.	32.	713.	545.	31.	32.	32.
01/25 07:21	32.	33.	33.	32.	714.	547.	32.	32.	33.
01/25 08:21	32.	32.	32.	32.	711.	544.	31.	32.	32.

Enter A Command

STATS

Dosimeter tube values (SO_2 CT's = SO_2 ppm X Hour) for six Box Evaluation Trials are listed on ?. The position within each pallet corresponds with the map ?. All dosimeter tubes were off scale in Trial I. We were targeting relative SO_2 measurements and not the standard SO_2 fumigation level of 100 CT's. Trials III & IV were dosed at approximately one-third the SO_2 level of Trial II. Trials V & VI were dosed at approximately two-thirds the SO_2 level of Trial II. All pallets had six measurements each taken at the same box levels used in the calibration trials. The sixth measurement in the Metric pallet was rotated between the four boxes with only on side to the outside air.

FIGURE ?: AVERAGE SO_2 CT VALUES PER GRAPE BOX.

TKV BOXES

35	29	60
34	36	53

METRIC BOXES

87		51
	40	
38		28

CLIP BOXES

74	65	72
61	72	66

N

TRAD

TABLE ?: AVERAGE SO_2 CT VALUES FOR EACH FUMIGATION TRIAL.

	Trial II	Trial III	Trial IV	Trial V	Trial VI
TKV	108[a]	18[a]	20[a]	27[a]	33[a]
Metric	106[a]	31[a]	24[a]	37[b]	39[a]
Clip	146[b]	37[b]	34[b]	64[c]	61[b]
Sign. of F	.10	.05	.10	.10	05

Statistical analysis (Table ?) indicates that the metric boxes exhibited similar response as the TKV boxes to fumigation. Compared to the other box types, SO_2 levels were significantly higher in the clip boxes in all trials. Average (grand means) SO_2 levels were similar among box location (Figure ?). Concentration as affected by box location is similar with the exception of some corner boxes exhibiting higher levels (Figure ?).

Traditional Fumigations for Decay Control

FIGURE ?: SO_2 CT's for Six Taditional Fumigation Experiments

- CT	- CT	- CT
100 CT	75 CT	150 CT
15 CT	15 CT	22 CT
14 CT	16 CT	28 CT
26 CT	18 CT	40 CT
22 CT	20 CT	60 CT
35.7	24	
- CT	- CT	- CT
75 CT	100 CT	150 CT
17 CT	12 CT	28 CT
18 CT	16 CT	30 CT
30 CT	22 CT	24 CT
30 CT	32 CT	32 CT
34		

TKV BOXES

Req. 15/2
.10 - 2.70
.05 - 3.68
.01 - 6.36

ANOVA	F	dfe +	Sig
T2	3.12	15-2	.10
T3	5.87	15-2	.05
T4	confirmed		
T5	This was done		
T6	earlier		
PRN			
IPA3			

- CT		- CT
175 CT		110 CT
50 CT	42 CT	35 CT
50 CT		32 CT
80 CT		44 CT
78 CT		36 CT
	- CT	
	100 CT	70 CT
	18 CT	
17 CT	22 CT	
	26 CT	
	36 CT	36 CT
- CT		- CT
100 CT		80 CT
27 CT		12 CT
12 CT		8 CT
24 CT	26 CT	20 CT
28 CT		18 CT

METRIC BOXES
(rotated one box reading on each trial)

- CT	- CT	- CT
150 CT	150 CT	150 CT
44 CT	32 CT	40 CT
36 CT	28 CT	35 CT
72 CT	56 CT	70 CT
70 CT	60 CT	66 CT
- CT	- CT	- CT
120 CT	175 CT	130 CT
30 CT	42 CT	33 CT
35 CT	38 CT	32 CT
60 CT	64 CT	64 CT
60 CT	40 CT	72 CT

CLIP BOXES

Total Utilization Procedure for Decay Control

FIGURE ?: AVERAGE SO_2 CT VALUES PER GRAPE BOX.

24	27	30
	16	
22		35

TKV BOXES

26	28	23
	24	
25		22

METRIC BOXES

30	25	31
	28	
36		33

CLIP BOXES

N

TOTAL CT.

TABLE ?: AVERAGE SO_2 CT VALUES FOR EACH FUMIGATION TRIAL.

Carter

	I	II	III	IV	V	VI
	Trial ~~II~~	Trial III	Trial IV	Trial V	Trial VI	
TKV	? ~~24~~ 19	~~a~~	~~a~~	~~a~~	~~a~~	
Metric	? ~~24~~ 17	~~a~~	~~a~~	~~a~~	~~a~~	
Clip	? ~~26~~ 26	~~a~~	~~a~~	~~a~~	~~a~~	
Sign. of F	~~.10~~ NS	.05	.10	.10	05	

Results??????????????

	I	II	III	IV	V	VI
T	19	17	34	476	24	13
M	17	18	27	430	27	13
C	26	20	35	530	35	14
Sig	NS	NS	NS	.10	NS	NS

MSE
583
df = 17

583
6
1.00 - 1.05 - 1.09
99.33 46.67 58.33

~~10~~
15

Total Utilization Procedure for Decay Control

FIGURE ?: SO_2 CT's for Six Total Utilization Fumigation Experiments

15 CT 15 CT 30 CT 50 CT 25 CT 10 CT	15 CT 15 CT 40 CT 50 CT 30 CT 10 CT	22 CT 18 CT 40 CT 50 CT 30 CT 20 CT
	7 CT 12 CT 15 CT 40 CT 15 CT 10 CT	
20 CT 12 CT 30 CT 40 CT 15 CT 15 CT		35 CT 32 CT 50 CT 50 CT 30 CT 12 CT

TKV BOXES

dfe/t
15/2
.10 - 2.70
.05 - 3.41
.01 - 6.36

AOV	dfe	fmt	F	Sig
LL1	15 - 2		2.48	NS
LL2			0.17	NS
LL3			0.61	NS
LL4			2.92	.10
LL5			2.40	NS
LL6			[illegible]	NS
PRN				
IPH3				

18 CT 30 CT 25 CT 35 CT 35 CT 10 CT	22 CT 18 CT 35 CT 40 CT 40 CT 15 CT	20 CT 15 CT 30 CT 50 CT 15 CT 10 CT
	15 CT 12 CT 30 CT 35 CT 35 CT 15 CT	
18 CT 20 CT 30 CT 50 CT 20 CT 10 CT		10 CT 12 CT 25 CT 50 CT 15 CT 18 CT

METRIC BOXES

25 CT 20 CT 30 CT 55 CT 35 CT 15 CT	15 CT 10 CT 20 CT 60 CT 30 CT 15 CT	32 CT 20 CT 30 CT 60 CT 30 CT 15 CT
	25 CT 25 CT 32 CT 40 CT 35 CT 10 CT	
32 CT 22 CT 45 CT 45 CT 50 CT 20 CT		25 CT 20 CT 55 CT 60 CT 30 CT 10 CT

CLIP BOXES

INTERNATIONAL PAPER A:INTPAPER1.CAL
Alternative Table Grape Container Study CANTISANO DISK

Temperature Log - Initial Fumigation
5,000ppm -- 1lb SO2 -- 30 Minutes
Cold Storage Off

Mo/	Day	Hr/	Min	----------Not Used-----				Clip	TKV	Room	Metric
9	23	14	43	28	89	48	88	33	35	35	35
9	23	14	44	28	89	48	88	33	35	42	35
9	23	14	45	28	89	48	88	33	37	42	35
9	23	14	46	28	89	49	88	33	35	45	35
9	23	14	47	28	89	49	88	33	35	47	35
9	23	14	48	28	89	49	88	33	36	48	35
9	23	14	49	28	89	48	88	33	36	45	35
9	23	14	50	28	89	49	88	33	36	44	35
9	23	14	51	28	89	49	88	33	36	43	35
9	23	14	52	28	89	49	88	33	35	43	35
9	23	14	53	28	89	49	88	33	35	43	35
9	23	14	54	28	89	50	88	33	35	43	35
9	23	14	55	28	89	49	88	33	35	42	35
9	23	14	56	27	89	48	88	33	35	42	35
9	23	14	57	27	89	48	88	33	35	42	35
9	23	14	58	27	89	47	88	33	35	42	35
9	23	14	59	27	89	47	88	33	35	42	35
9	23	15	0	26	89	45	88	33	35	42	35
9	23	15	1	27	89	46	88	33	35	42	35
9	23	15	2	27	89	46	88	33	35	42	35
9	23	15	3	27	89	46	88	33	35	42	35
9	23	15	4	27	89	47	88	33	35	43	35
9	23	15	5	26	89	46	88	33	36	42	35
9	23	15	6	27	89	47	88	33	36	43	35
9	23	15	7	26	89	46	88	33	36	43	35
9	23	15	8	26	89	46	88	33	36	43	35
9	23	15	9	26	89	46	89	33	36	43	35
9	23	15	10	26	89	46	89	33	36	43	35
9	23	15	11	26	89	45	89	33	36	43	35
9	23	15	12	26	89	45	89	33	36	43	35
9	23	15	13	26	89	45	89	33	36	43	35
9	23	15	14	26	90	45	89	33	36	43	35
9	23	15	15	26	90	45	89	33	36	43	35
9	23	15	16	26	90	45	89	33	36	43	35
9	23	15	17	26	90	46	89	33	36	43	35
9	23	15	18	26	90	46	89	33	36	43	35
9	23	15	19	26	90	46	89	33	36	43	35

IP BOX PROJECT

To: Dean 11/19/92

T	T	T
	T	
T		T

↓ N

T = Sensidyne Tube

11/18 - 5 burets SO_2, normal venting

11/19 - add Sensidyne tubes to same layer as always (7th layer TKV & Clip, 6th layer metric). Use the 6 positions in layer as noted in map. Fumigate with a small amount (1/3 to 1/2 buret) of SO_2. Do NOT vent. Total Utilization Procedure. No condenser covering

11/26 - unstack and read sensidyne tubes.

* Humidifier: fill & run

Katie 11/19

cc: Dr Gump
Carter ✓

M E M O R A N D U M

Date: 11 November 1992

COPY

To: Dean Dionesotes

From: Katie Haight

Subject: Work Plan For This Week

Wednesday and Thursday: Remove thermal couples; no need to restack boxes. Fill and turn-on humidifier in fumigation chamber. Fumigate with five burets of SO_2. Vent normally.

Tear down TKV and Clip pallets, to be restacked in 3X3 configuration. Mark boxes on 7th layer to be put back in same position. Also mark center boxes on 6th layer, and use these boxes for middle-side positions of 7th layer in a 3X3 configuration. Mark and use any box from the 8th layer for middle-middle position of new 7th layer. If confusing, see Katie for a map. Use empty boxes for lower layers of TKV and Clip pallets (boxes and two pallets for 3X3 configuration in MIVAC building).

No dosimeter tubes. Note condition of grapes in lab book. After partial restacking, sample grapes from the same layer as before and freeze. No need to get exactly 100 berries, we will be analyzing 100 gram samples. This should save time. Run thermal couples and set-up data logger.

thermocouple

Get heaters from Carter, warm room.

Tito will help IF he finishes with Mark on Wednesday. Ask him if he can help you Thursday.

Friday: (Check for up-date in plans) Keep going with concentrate samples, 12 more whites to arrive next week.

cc: B. Gump
C. Clary ✓

M E M O R A N D U M

Date: 4 November 1992

To: Dean Dionesotes

From: Katie Haight KGH

Subject: Work Plan For This Week

Wednesday: Remove dosimeter tubes and read results; no need to restack boxes. Get heaters from Carter, warm room. Make sure the heaters are turned off before leaving. Leave fumigation door wide open for the night. Keep going with concentrate samples, 12 more whites to arrive soon.

Carter is NOT in today

Thursday: (Check for up-date in plans) Run thermal couples and set-up data logger. Restack pallets as before. No dosimeter tubes. Fumigate with four burets of SO_2. Vent normally. Fill humidifier in fumigation chamber.

Friday: I will meet you at one o'clock in the Gallo Lab. Bring lab book.

cc: B. Gump
C. Clary

M E M O R A N D U M

Date: 28 October 1992

To: Dean Dionesotes

From: Katie Haight

Subject: Work Plan For This Week

Wednesday: Fumigate table grapes with three burets of SO_2. Do not add dosimeter tubes at this time. Vent normally. After venting tear down pallets; then add dosimeter tubes to the same positions as previously done. Rebuild pallets and leave dosimeter tubes for one week. Read dosimeter tubes next Wednesday. Check temperature readings on data logger and replace cassette if necessary.

Thursday & Friday: Fill humidifier in fumigation chamber. Run Folin-Ciocalteu and color analyses on 24 Oct. samples (15 red, 9 white) from Canandaigua Wine Co. Your list is in winery drawer, plus two (conc A & B). Samples in cool room.

cc: B. Gump
C. Clary

CALIFORNIA STATE UNIVERSITY • FRESNO

SCHOOL OF AGRICULTURAL SCIENCES AND TECHNOLOGY
CALIFORNIA AGRICULTURAL TECHNOLOGY INSTITUTE
Viticulture and Enology Research Center

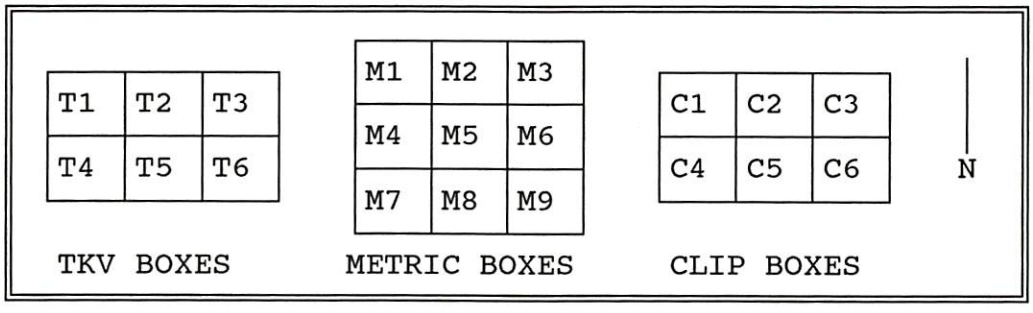
2360 East Barstow Avenue
Fresno, California 93740-0089
(209) 278-2089

INTERNATIONAL PAPER UPDATE
MEETING 6 NOVEMBER 1992

28 October 1992

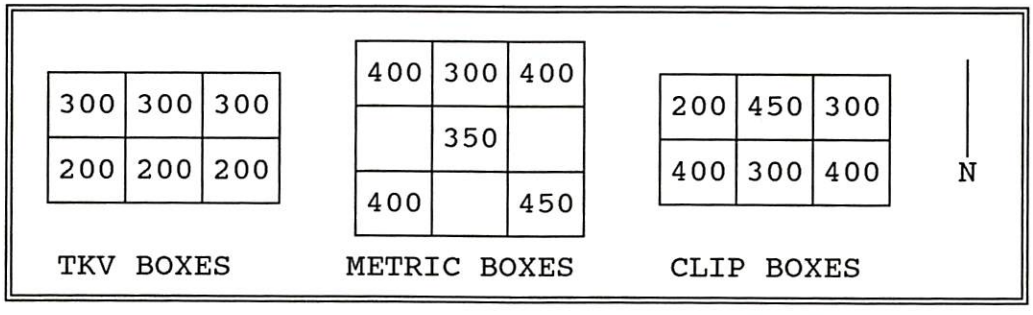
Normal fumigation and venting; the pallets were then taken apart and dosimeter tubes were placed in the same positions as noted in the progress report dated 30 October 1992 (re: the 7th layer from the bottom of the TKV and Clip boxes and the 6th layer from the bottom of the Metric boxes). These layers are approximately equal in height from the floor.

FIGURE 1: MAP OF GRAPE BOX PLACEMENT IN CHAMBER



4 November 1992 (one week later)

FIGURE 2: RELATIVE SENSIDYNE DOSIMETER TUBE VALUES



* NOTE: Following final Dose Test, plant Thermocouples - warm storage - restart - for temp cool down profile

9-21-92

Stacking

I	TKV	14x 17½"	2x3x10	TKV Pallet 35x42
II	Clip	14x 17½	2x3x10	
III	Square	13x 16	3x3x8	40x48

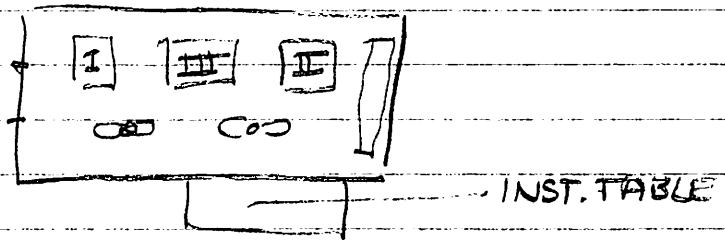
Kevin 800 627 6214

$$\text{lbs } SO_2 = \frac{(1.82)(1190)(5000\text{ ppm})}{10{,}000{,}000}$$

$$= 1.08 \text{ lb}$$

Pallets placed in #4 storage today - (they were picked Friday and held in Post Harvest.

Room calib tomorrow or Wed.
- hang pumps on "front" and "back" of each pallet. Fans adjusted (total 4)



9-22-92

- Walt stopped by
  said that "Square" stack needs a modification to the pallet.
  Add ½ft on each side (minus end board. I'll call it)
  Then it should be okay.
  everything else looks ok

9-24-92

Room calib

1 lb SO_2

logger on

Kitagawa tubes wrong range

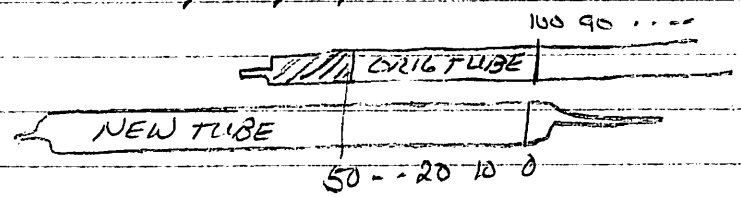
Dosi tubes one taped to each pallet

one placed inside each pallet

Result	INSIDE	OUTSIDE
TKN	150%	>160
Clip	>160%	>160
Metric	135%	>160

↑

measured by laying another tube to use scale



Recommend 0.5 lb fumigation

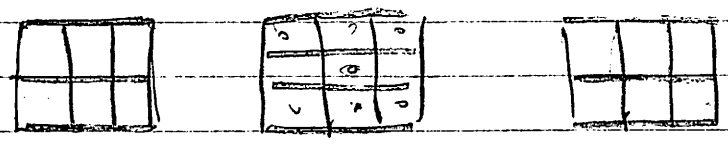
1000 — 30 000 PPM
.1 — 3.0 %

.15000

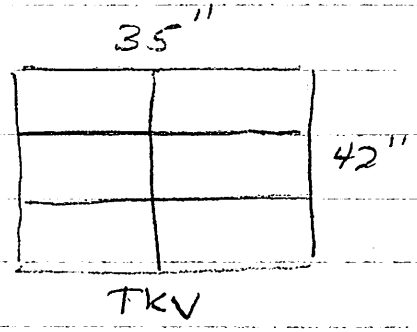
.02 — 3.0 %
200 — 30000 PPM

SO_2 Density at 0°C — 2.9 gms/liter gaseous

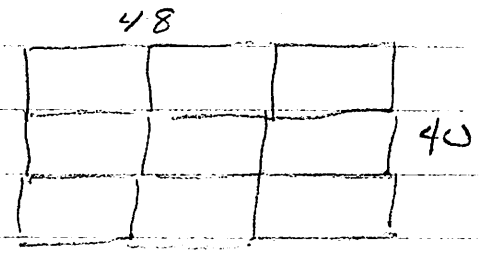
6 reps/pallet



9-21-92



2x3x10 14x17½ TKV
2x3x10 14x17½ clip
3x3x8 16x13 metric



7th Layer

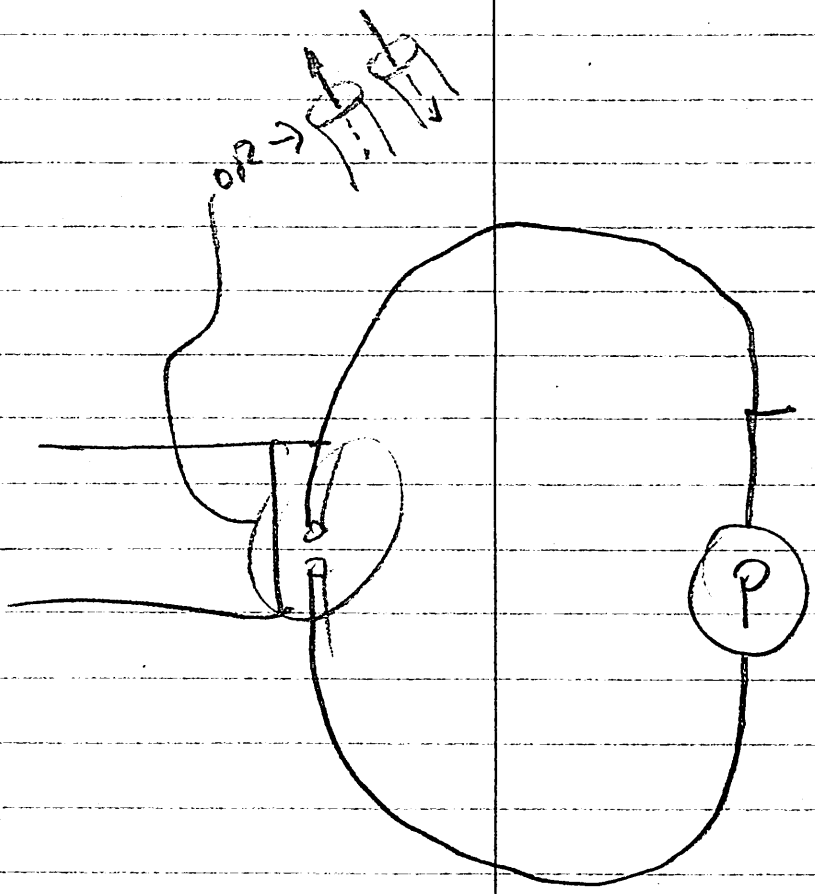
40 x 48
35 x 42 TKV
46 x 52

9.25' x 17.16' x 7.5' = 1190 ft³

111 x 206 x 90'
= 1190 cu ft

$$\text{lbs } SO_2 = \frac{(1.82)(1190)(SO_2 \text{ conc})}{10{,}000{,}000}$$

- 72's are fiber 40x48 ✓
- 60 is TRV 36x36 ?



Inside later

60
60
1

H-4 Temp Calif
Alternational Pasture Study

Month	Day	Hour	Minute	RH1	Temp1	RH2	Temp2
9	18	18	6	88	34	92	34
9	18	19	6	85	30	93	30
9	18	20	6	89	33	94	33
9	18	21	6	89	32	95	33
9	18	22	6	86	30	95	29
9	18	23	6	90	32	96	32
9	19	0	6	91	33	96	33
9	19	1	6	91	33	96	33
9	19	2	6	92	33	97	33
9	19	3	6	92	33	97	33
9	19	4	6	92	33	97	33
9	19	5	6	92	33	97	33
9	19	6	6	92	33	98	33
9	19	7	6	92	33	98	33
9	19	8	6	91	31	97	32
9	19	9	6	88	29	98	29
9	19	10	6	90	32	99	31
9	19	11	6	92	33	99	33
9	19	12	6	90	32	99	32
9	19	13	6	89	31	98	30
9	19	14	6	91	34	98	33
9	19	15	6	85	30	97	29
9	19	16	6	91	34	97	34
9	19	17	6	86	30	97	29
9	19	18	6	91	34	98	33
9	19	19	6	86	29	97	29
9	19	20	6	92	33	98	33
9	19	21	6	92	33	98	33
9	19	22	6	85	28	98	28
9	19	23	6	90	31	98	31
9	20	0	6	92	32	98	32
9	20	1	6	92	33	99	33
9	20	2	6	93	33	99	33
9	20	3	6	93	33	100	33
9	20	4	6	93	33	99	33
9	20	5	6	93	33	99	33
9	20	6	6	92	32	99	32
9	20	7	6	91	32	99	32
9	20	8	6	90	30	98	31
9	20	9	6	89	30	98	30
9	20	10	6	90	32	98	32
9	20	11	6	91	33	98	33
9	20	12	6	90	32	98	32
9	20	13	6	89	31	98	31
9	20	14	6	91	34	98	33
9	20	15	6	85	30	97	29
9	20	16	6	91	33	98	33
9	20	17	6	84	29	97	28
9	20	18	6	91	33	98	33
9	20	19	6	84	29	97	28
9	20	20	6	92	33	98	33
9	20	21	6	92	34	99	33
9	20	22	6	88	29	98	30
9	20	23	6	89	30	99	30
9	21	0	6	91	32	99	31
9	21	1	6	92	32	99	32
9	21	2	6	92	32	99	32
9	21	3	6	92	32	99	32

9	21	4	6	92	32	99	32
9	21	5	6	91	32	99	31
9	21	6	6	90	31	99	30
9	21	7	6	88	30	99	29
9	21	8	6	89	30	99	30
Average				90	32	98	32

CALIFORNIA
STATE
UNIVERSITY,
FRESNO

October 1, 1997

Dan Sellers
International Paper
660 Mariposa
Modesto, CA 95352

Dan:

Please find the progress report enclosed for your review. Analysis of the data indicates a clear difference in performance of the boxes used in this test. I will await direction as to further testing.

In addition to the report, I have included an invoice for our expenses. It has been a pleasure being of service to International Paper.

Sincerely,

Carter Clary Ph.D.
Dried Foods Technology Laboratory

Viticulture and Enology Research Center
A unit of the
California Agricultural
Technology Institute

2360 East Barstow Ave. M/S 89
Fresno, CA 93740-8003

209. 278-2089
Fax 209. 278-4795

INVOICE

Research Services

EVALUATION OF NEW TABLE GRAPE PACKING BOXES

October 1, 1997

Dan Sellers
International Paper
660 Mariposa
Modesto, CA 95352

Research Personnel / Laboratory Time $500/day x 2 days	$1000
Supplies	
Hobo loggers 6 @ $49 plus tax & shipping	$ 320
Dosimeter tubes 2 boxes @ $52.50 + tax	$ 105
Indirect Charges	$ 410
TOTAL	**$1835**

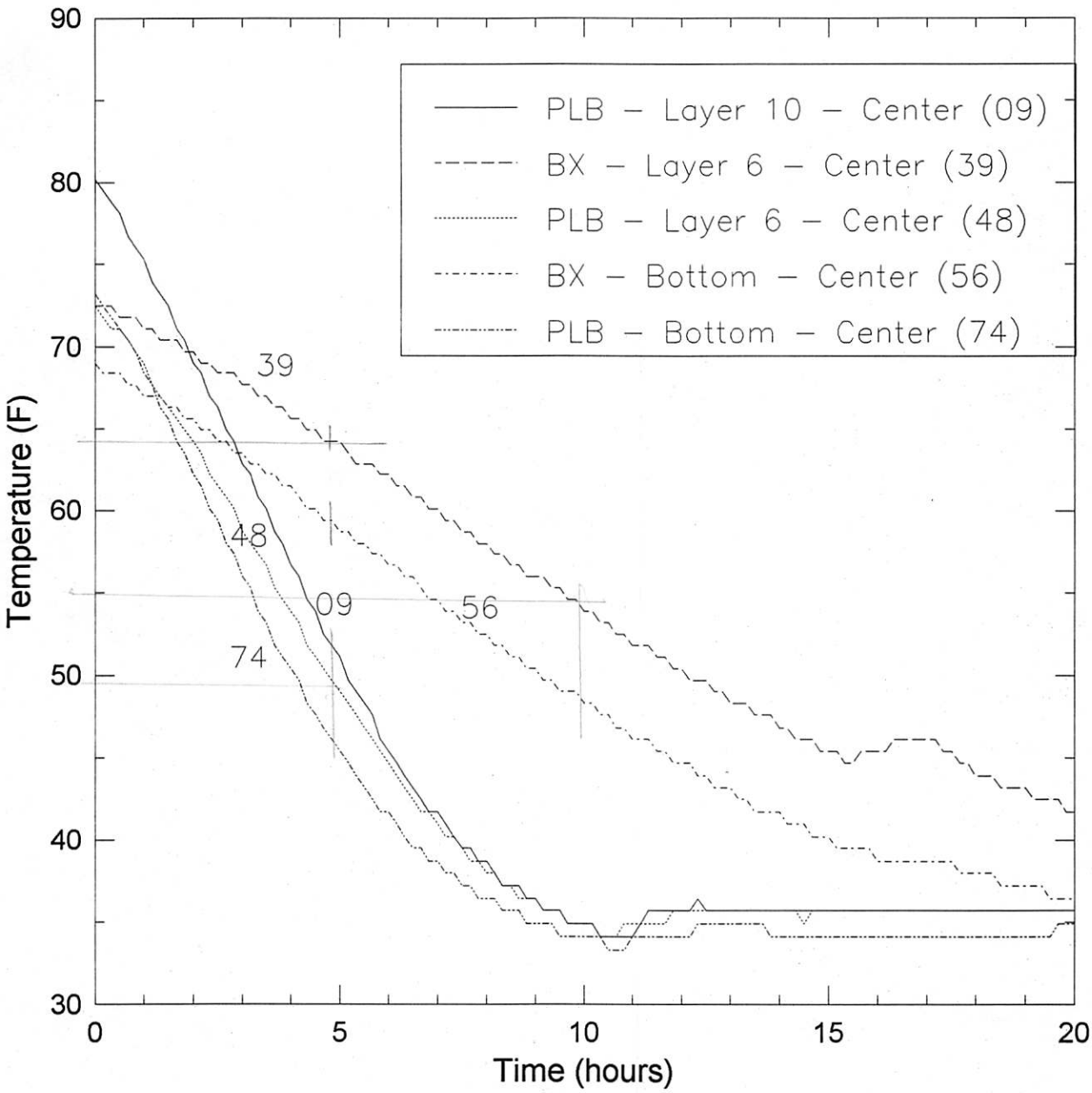
Payable to:

California State University, Fresno Foundation

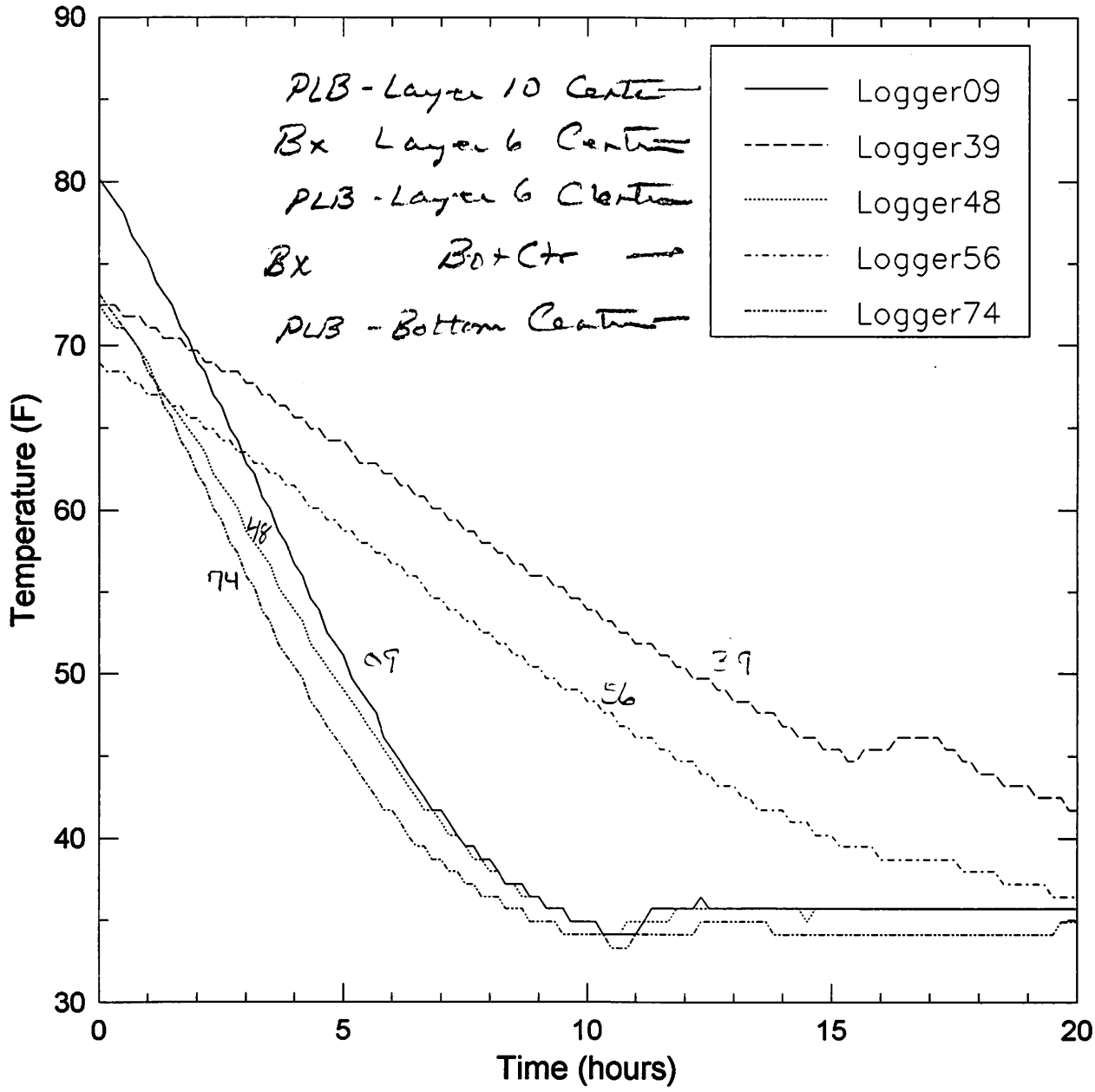
Mail to:

Carter Clary Ph.D.
Dried Foods Technology Laboratory
Viticulture and Enology Research Center
California State University
Fresno, CA 93740-8003

Thank you.



Post-it® Fax Note 7671	Date	# of pages ▶ 1
To DAN SELLERS	From CARTER	
Co./Dept. IP	Co. FRESNO STATE	
Phone #	Phone # 2092786854	
Fax # 2095260557	Fax #	


PLB - Layer 10 Center
Bx Layer 6 Center
PLB - Layer 6 Center
Bx Bo + Ctr
PLB - Bottom Center
Logger09
Logger39
Logger48
Logger56
Logger74
48
74
09
39
56
Temperature (F)
Time (hours)
90
80
70
60
50
40
30
0
5
10
15
20

°F = (_<>; F)

1P Test Box 9-10-97

Loggers 74 - Bottom Ctr
48 - Layer 6 Ctr
09 - Layer 10 Ctr

{ 6 from bottom
Stacked 2 high

Brand X (Maxco corrugated)
56 - Bottom Ctr
39 - Layer 6 Ctr

TKV - " " - missing

10/2/97 They found it on the floor sometime - we'll download + see

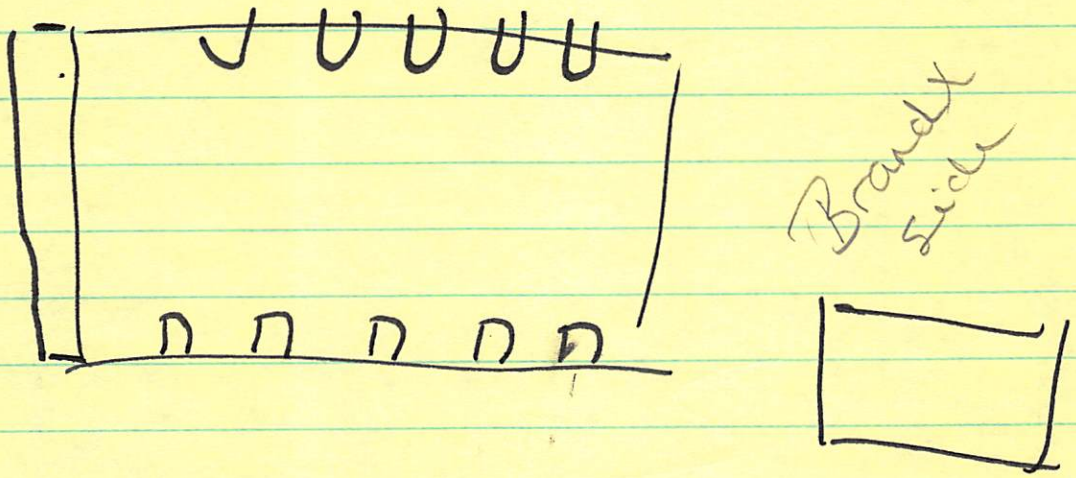
All tubes paired w/ loggers = max'd out

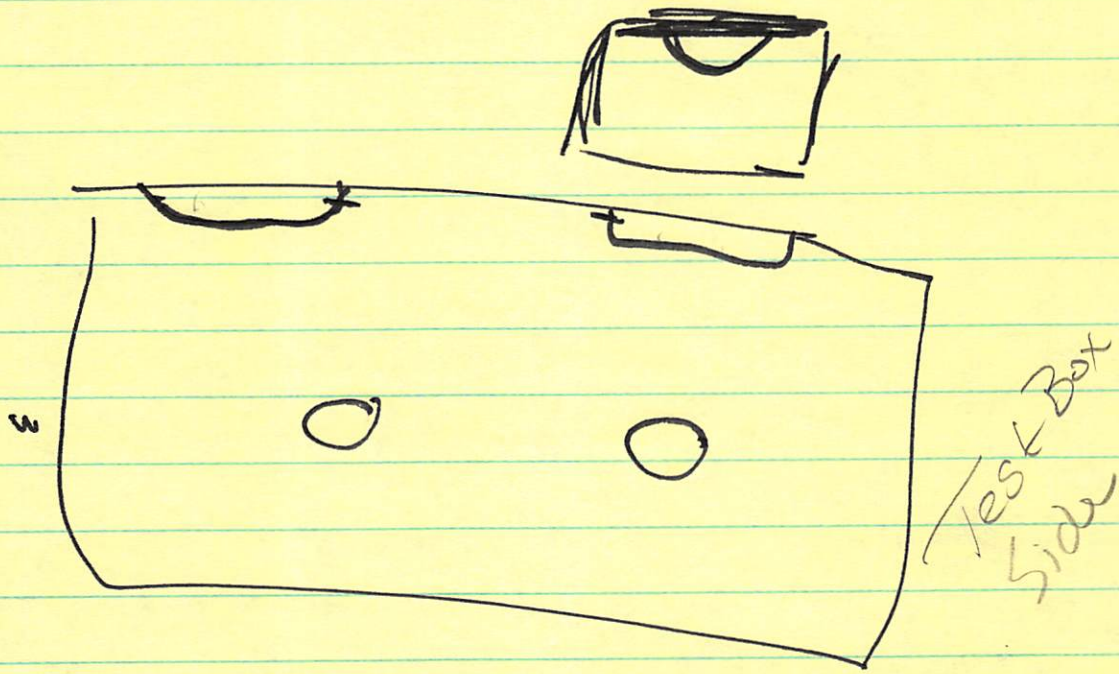
Went in ~2pm Th 9/4 for precooling
SO_2 application simultaneous
Probably moved from precool to CS ~ 8:30 9/5

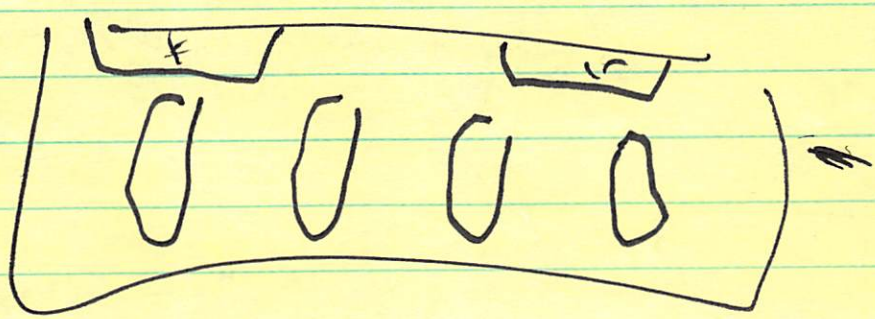
Notes:
Test Box is cooling better (by more than a day)
" " has fewer but larger holes 8%
compared Brand X more/smaller holes

Small temp variation during CS could be
heat load Δ btwn day + nite

Repeat → test.
Report on temp (install by contractor) analysis
and results


Brandt Side


Test Box Side



SEND PROPOSAL TO AGENCY: (X) (N)

atus: Awarded / Pending

VERC M.S. 89 (82089,

P979804

Project Information Form (PIF)

Project Director(s): CARTER CLARY Code: VSP Submission Deadline

Department/Area: VERC MS# 89 Extension FAX 82998 Phone 86854

Project Title: EVALUATION OF NEW TABLE GRAPE PACKING BOXES

RECEIVED AUG 12 1997

Project Description: Cold Storage and Fumigation Experiment

~~Funding Agency~~: Name International Paper Inc.

ew Account / ~~xisting Account~~ / ontract Account

Address 660 Mariposa Acc#36100 MIVAC Processing

Modesto CA 95352 Phone 209 491 3725

To be completed by Project Director (all questions must be answered by checking either "yes" or "no") prior to any signatures.

Yes	No	
☐	☑	Will you need space other than that which is assigned to you to perform the project?
☐	☑	Does this proposal request overload salary for any individual?
☐	☑	Does this proposal request released reimbursed time for any individual?
☐	☑	Is the funding source a governmental agency (Federal, State or Local?) *If "no," a Conflict of Interest form must be signed prior to receipt of funding.*
☐	☑	Will this project involve hiring new faculty?
☐	☑	Is the awarding of academic credit through the Extension Division involved?
☐	☑	Is cost sharing or local match required?
☐	☑	Will this project involve hiring new clerical or technical personnel?
☐	☑	Are humans or animals involved as experimental subjects? *If "yes," appropriate forms must be signed prior to funding.*
☐	☑	Are radiation, biological, or toxic chemicals safety considerations required? *If "yes," appropriate committee must be contacted.*

For all items checked "yes," the appropriate person has been contacted and/or form has been submitted.

C D Clary 8-11-97

Project Director Date

BUDGET INFORMATION

	1st Year	Total
Personnel		$1500
Fringe		
Supplies		$ 425
Travel		
Equipment		
Other VERC		$ 231
Direct Costs		$2156
Indirect		$ 323
TOTAL		$2479

Indirect Rate 15 % (TDC) (SWB)

VERC DIRECTOR ~~Department Chair~~: I have reviewed and recommend the attached proposal.

Keith Stuyle 8/12/97

Date

Joe Bezeno 8/14/97

School Dean: I have reviewed and recommend the attached proposal.

Thomas M. Clark 8/15/97

Date

UNIVERSITY GRANTS & RESEARCH

Office Use Only

Provost and VP of Academic Affairs

Thomas M. Clark 8/20/97

Date

CSUF Foundation Executive Director or Director of Procurement and Administrative Services

Thomas M. Clark 8/20/97

Date

Director of Budget Planning and Internal Audit

Date

UGRO Use Only

Key Words CFDA # PIF reviewed by Date

Title of Grant Program

Comments

Distribution: White: UGRO Green: ~~Foundation~~ Yellow: Project Director Pink: Dean Goldenrod: Budget Planning

Proposal

EVALUATION OF NEW TABLE GRAPE PACKING BOXES

Presented to:

Dan Sellers
International Paper
660 Mariposa
Modesto, CA 95352
209-491-3725 Tel
209-526-0557 Fax

This proposal was reduced in scope to just data analysis

Submitted by:

Carter Clary Ph.D.
Barry Gump Ph.D. Collaborator
Dried Foods Technology Laboratory
Viticulture and Enology Research Center
California State University
2360 E Barstow Ave
Fresno, CA 93740-8003
209-278-6854 Tel
209-278-2998 Fax

August 11, 1997

BACKGROUND

Due to several factors, the materials used in the construction of table grape boxes are continually being evaluated for performance and cost. Work conducted in 1992 by California State University for International Paper indicated the use of a corrugated paperboard based box provided similar if not better performance compared to the TKV box with respect to cool down characteristics and permeation of sulfur dioxide gas.

The purpose of this proposal is to outline testing of another box type. The test protocol will include evaluation of a pallet of test boxes compared to a currently available box type. Specifically, the boxes will be evaluated for cool down characteristics and fumigation.

OBJECTIVES

1. Evaluate two table grape box types for cool down characteristics in cold storage.

2. Compare the sulfur dioxide penetration into the boxes using dosimeter tubes.

PROCEDURES

Table grape boxes stacked for storage and fumigation will be evaluated for cool down profiles and fumigation. One pallet each of two box types will be provided to Fresno State and placed in a cold storage set to 33°F. Cold storage facilities vary in operational characteristics related to air circulation and permeation of sulfur dioxide. The table grape stacks in this study will be subject to the same temperature and air circulation profile to ensure that any differences in performance is due to the box type used.

Temperature. Solid state temperature data loggers will be placed at three locations in the interior of each stack prior to cool down in the cold storage. The loggers will be down loaded after the test to determine the relative cool down profile of each box type.

SO_2 Permeation. Sensidyne SO_2 5 -100 ppm model 5D dosimeter tubes will be placed at various locations throughout each stack prior to cool down in the cold storage. After cool down, the cold storage will be shut down and fumigated with sulfur dioxide. The rate of application will be determined in consultation with International Paper. After the test, the dosimeter tubes will be read for SO_2 concentration.

The dosimeter tube is used to determine the cumulative concentration of sulfur dioxide in the table grape box. A level of 100 ppm-hours is used as a standard for sufficient fumigation. This is also referred to as 100 CT's. The sulfur dioxide application rate in this test will be targeted to achieve less than 100 CT's so that a comparison in SO_2 concentration can be made between box type. If the CT values are too low in the first test, a second dose of SO_2 will be applied.

Data Analysis. Temperature profiles will be evaluated to determine the cool down performance of the two box types. The dosimeter tubes will be removed from the two stacks and read for to CT. A final report will be submitted to International Paper at the conclusion of the test.

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Thank you.

Viticulture and Enology
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A unit of the
California Agricultural
Technology Institute

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Barry:
I can never remember which address is most expedient so I've sent this to both.

In regard to the SO2 table grape trial, we did the initial applications by weight at about 0.20 lbs. Later we used some kind of applicator dispense about 5 to 10 ml of SO2 into the chamber per each "fill" of the dispenser.

It looks like we settled on 6 ml of SO2 to get dosimeter readings of 10 to 50 (within the 100 CT scale).

Sound OK?
Do you know where this applicator is and can we use it?
How much does 6 ml of SO2 weigh in the event we must apply it by weigth (6gms?)? That's going to be tough to measure out of a 30 lb cylinder...

I will look forward to hearing from you (did I send a copy of the proposal to you?)
Carter

CALIFORNIA
STATE
UNIVERSITY,
FRESNO

August 11, 1997

FAX 4 Pages
Original Sent US Mail

Dan Sellers
International Paper
660 Mariposa
Modesto, CA 95352

The scope of this proposal was reduced to data analysis only

Dan:

Please find the draft proposal enclosed for your review. We are ready to proceed on the trial. There are a few things I would like to clarify. First, I would like you to review the protocol particularly with respect to a recommendation for the rate of application of SO_2. As noted in the proposal, we will be using rates lower than commercial rates so that we do not saturate the dosimeter tubes.

Secondly, please let me know a few days notice prior to receiving the grapes at Fresno State. Finally, I would like to point out that there is a chance the grapes may be affected by either too much or not enough sulfur dioxide. I suggest you advise the packing house that the grapes should be considered expendable.

In addition to the proposal, I have included an invoice for our expenses. We look forward to being of service to International Paper.

Sincerely,

Carter

Carter Clary Ph.D.
Dried Foods Technology Laboratory

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Commercial Study

6 - Hobo loggers ← Seal in bags ~~wrapping~~ SO_2

SO_2 ~~Draeger~~ OR 6 - CT Tubes

Tubing

too much trouble go to

2 box types — Sample center in several location 3

Existing fiber is being used

Do a proposal