The following report is prepared and published by:

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of

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ABC Company

Temple, Pennsylvania USA

SCORPION® PROFILING SERVICE REPORT
Line 4

October 15 2012

SAMPLE REPORT

The following report is prepared for:

John Smith, Plant Engineer
123 Industrial Boulevard
Temple, PA. 19560
610-929-1234

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PROFILE SUMMARY

Overview

At the request of ABC Company, Reading Thermal conducted an inspection and thermodynamic analysis of the oven baking the Mini-chocolate Cake product at the Temple, Pennsylvania plant. The test was conducted on October 15, 2012. ABC is considering increasing the production output by 20-25% and will use the oven data collected to help determine how to meet that goal.

The evaluating team collected profiles of air temperature, band temperature, heat flux, air velocity, product core temperature, and humidity on the Mini-chocolate Cake oven over the course of the day. The oven was profiled twice (as needed) with the same instrument to ensure the data collected was accurate. Data was collected at increments of approximately 4 centimeters of travel throughout the length of the oven. For the 1 meter wide Temperature and Air Velocity bars, a total of 9 sensors spanned the width of the conveyor with each sensor approximately 11cm apart. For the Humidity and Heat Flux sensor data was collected down the center of the oven. This report contains benchmark profiles of the oven and the process parameters under which these profiles were recorded. It is important to interpret these results as only applicable to the specific product that was being produced when the profiles were collected.

No problems with the oven were reported to Reading Thermal and the oven operated continuously throughout the profiling under full product load. The product being produced by the oven was packaged for distribution with no reported deficiencies. The data from these tests suggest that the oven is functioning within normal operating conditions for a typical convection oven. No significant oven problems were identified by Reading Thermal during the visit.

The profiling team consisted of:

Reading Thermal	Richard Starke, Director Email: richard.starke@readingthermal.com
	Josh Dennis, Thermal Process Engineer Email: josh.dennis@readingthermal.com
ABC Company	John Smith, Plant Engineer Email: john.smith@abctemple.com

PROFILE SUMMARY

Observations

The oven and associated equipment appeared to be well-maintained and functioning properly. For additional comments refer to data specific charts within this report.

- **Oven Band Temperature:**
  With the exception of large side-to-side variation in zone 1 of the oven, and a warm spot near the center of the band in zone 1, the oven band temperature is very even.

- **Oven Upper Air Temperature:**
  The upper air temperature has significant variation in zone 1, improves in zone 2, and becomes very even in zone 3 with the exception of the penthouse area. This is known as the penthouse effect and is very common on this type of oven.

- **Air Velocity:**
  The airflow balance for this oven would be considered poor to fair. Several areas exist where the side to side air velocity difference exceeds +/- 0.6 meters/second. Along the left edge of the oven band the airflow is greatest.

- **Heat Flux:**
  The total heat applied to the product is overwhelmingly convective versus radiant. This is what would be expected from an oven of this type. Each product has its own unique heat flux profile which serves to define a products characteristics.

- **Humidity:**
  As the cake batter travels through the oven moisture is released from the product. The humidity level present within the oven begins to rise in zones 1 & 2, then is allowed to build-up and remain elevated in zone 3. The amount of moisture in the oven air throughout the process will affect the final product moisture content.
  Additionally, water droplets were placed on the oven band directly underneath each baking cup. This additional water added to the process that is not naturally present in the cake batter contributes to the quick rise of moisture in zone 1.

- **Product Core Temperature:**
  The product core temperature slowly increases through zone 1 and zone 2 reaching 100^{o}C as it enters zone 3. The cooling section located outside of the oven exit was included in the profiling to demonstrate the effectiveness of the cooling section on the product core. It appears the product core remains warm throughout most of the cooling section but the exterior of the product is cooled enough to immediately package the product.

PROFILE SUMMARY

Recommendations

The profiling service was performed to provide benchmark data for the oven and process as-is, and not to solve any adverse issues with oven production as no problems were reported to Reading Thermal. The recommendations are based on the oven profiles collected and ABC's desire to increase production output.

- Examine the physical condition of the lower plenum in zone 1. This may explain the large temperature variation in this zone. Keep in mind that this variation may not be having a negative effect on finished product because it is the shortest of the 3 zones. The product spends only 2.47 min out of 9.92 min (25%) in this zone. 75% of the bake time is in zone 2 & 3.
- Upper air temperature variation should be reduced if it is affecting finished product quality. The temperature variation is directly related to the airflow variation. It will be difficult to reduce the airflow variation seen in zone 1 & 2 because of the Air Distribution settings in these zones. Low Top Air Distribution settings cause low pressure in the upper plenum which leads to increased airflow variation.
- Increasing production capacity will require several steps:
    1) The 10 minute process will need to be reduced by 2 minutes for a 20% increase in product output. Experience shows that this needs to be done in small increments, perhaps 30 seconds at a time.
    2) Each time the throughput is increased the Heat Flux profile should be checked. While temperature is important, it is energy transfer that defines finished product characteristics. The Total Heat and % mix between convection / radiation must be maintained to produce identical product. As the conveyor speed is increased the Total Heat experienced by the product will decrease. In order to increase Total Heat the temperature will need to be increased. This will affect the % mix between radiation / convection forcing an adjustment to the Air Distribution settings.
    3) Each step will require more energy due to increased product load on the oven. The two parameters available to increase energy are temperature and airflow. Increasing temperature should not be a problem because the Burner Firing Rates are currently only 20% - 30%. Increasing airflow could be an issue because the Circulation Blower Speeds are fixed ON. Larger circulation blowers may be needed. If this is done a variable speed blowers should be considered for increased control.
    4) Each time the throughput is increased the Humidity profile should be checked. The moisture profile is critical to the products baking profile affecting: chemical reactions of ingredients, product development, surface color, and surface texture. Increased product load will increase moisture in the oven chamber forcing an adjustment to exhaust settings. Current settings show that there is room for adjustment in zones 1 & 3 but zone 2 is Full Open. This suggests that zone 2 will need increased exhaust possibly by replacing the Exhaust Blower with a larger blower. If this is done a variable speed blower should be considered for increased control.

5) As throughput increases the amount of time @ temperature for the product decreases. This can have a negative effect on finished product flavor and texture because these characteristics depend on chemical reactions that require a certain amount of time @ a certain temperature. In addition to the oven environment temperature the product core temperature comes into play. Each time the throughput is increased the product core temperature and product samples should be checked by the product manager for flavor and texture acceptability.

- The SCORPION® 2 R&D Profiling Kit would be the ideal tool for aiding the implementation of the steps required to increase production capacity. Full conveyor width Temperature and Air Velocity Arrays could be added in the future if side-to-side variation is found to be an issue.

PROFILE LOG LINE # 4

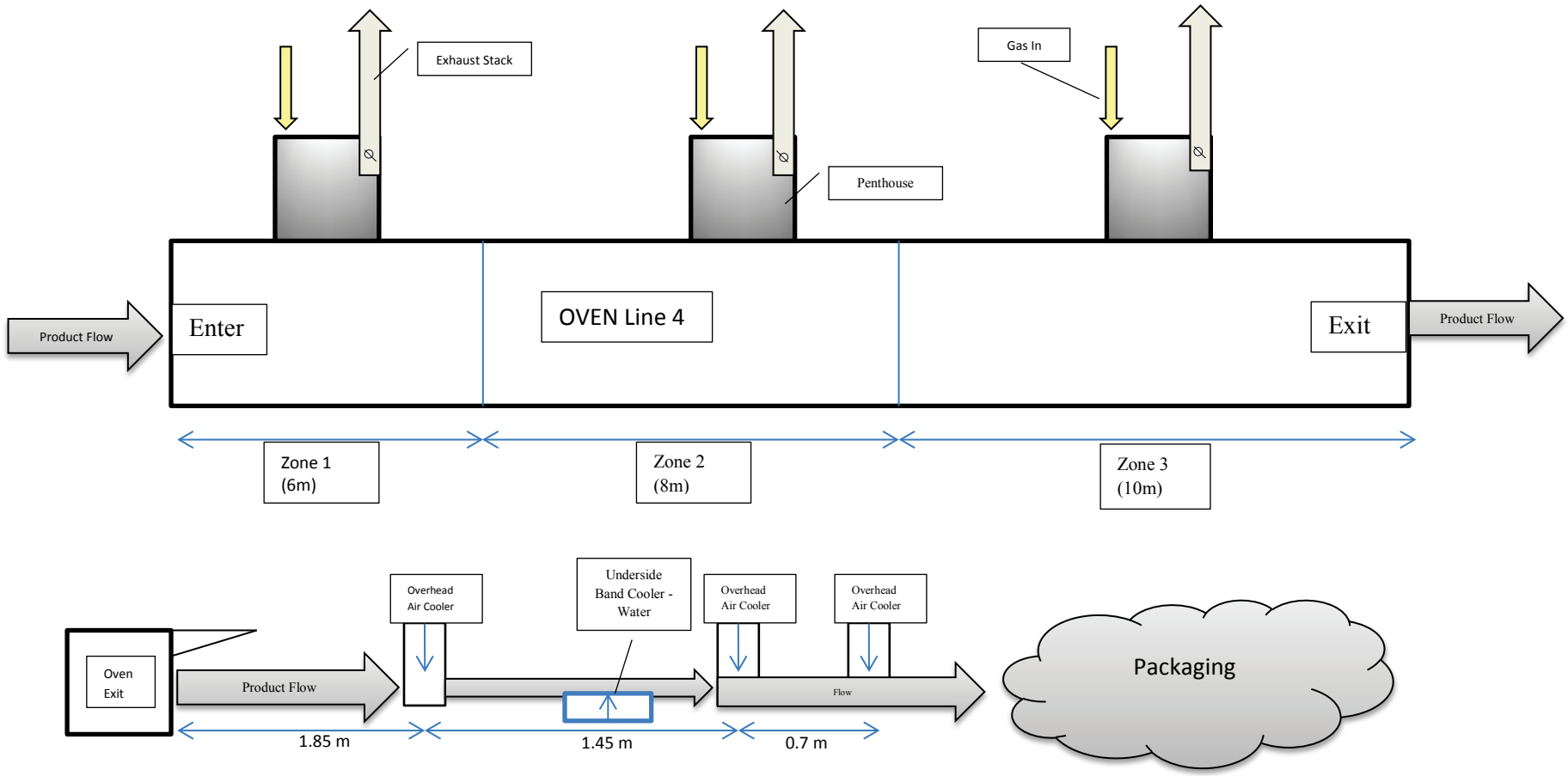
Overview

Oven Profiled			
Oven Line ID	Line 4	**Oven Manufacturer**	XYZ Food Equipment
Oven Type	Convection	**Serial #**	101101 2003
Oven Length	24 m	**Conveyor Width**	1m
# of Oven Zones	3	**Conveyor Type**	Solid Steel Band
Zone Lengths	Z1 = 6m Z2= 8m Z3=10m	**Belt Return**	Exposed (under oven)
		# of Gas Trains	3
		Altitude	166 m

OVEN DESCRIPTION:

- Batter enters in cups, 16 cups across width of band and cupcakes are baked directly on solid steel band in cup
- Water droplet deposited on band under each cup, water on band at oven entrance
- Each cup approximately 5 cm diameter.
- Belt returns under oven exposed to room air
- Each zone has penthouse with exhaust stack and gas line in feed
- A single Air Distribution Damper controls the balance between upper / lower plenum pressures for each zone
- Cooling section located immediately after oven exit with cooling fans and underside belt water cooling
- Exhaust stack over oven exit hood
- Fuel: Natural Gas, Inlet Pressure: 5 psi, Max input rating: 3x 546,000 BTUh, Manifold Press: 4.3” WC

Oven Line 4 Layout Sketch



PROFILE LOG LINE # 4

Process Description

Oven Production Settings			
Process Time	10.2 min	**Belt Speed**	0.04 m/s
Band Coverage (%)	Full width (16 cups across)	**Product (name/type)**	Mini Choco cake (Recipe X)

Process Parameters

Parameter	Zone 1		Zone 2		Zone 3		Zone		Zone	
Temperature (°C):										
	SP	**PV**	**SP**	**PV**	**SP**	**PV**	**SP**	**PV**	**SP**	**PV**
Top	180	180	195	184	210	210	X	X	X	X
	Oven Entrance					**Oven Exit**				
Conveyor	28					162				
Burner Firing Rate (%)										
Top	30		20		30		X		X	
Air Distribution (Scale of 1-10, 10 = full open, 1 = full closed)										
Top	3		3		10		X		X	
Bottom	6		7		1		X		X	
Circulation Blower Speed (impingement blowers – fixed setting)										
	ON		ON		ON		X		X	
Exhaust Blower										
Speed	ON		ON		ON		X		X	
Exhaust Damper Position (%)										
Open	Closed		Full Open		¼ open		X		X	
Exhaust Stack Temperature (°C) 18" above oven at first duct seam										
	63		61		61		X		X	

SCORPION® 2 Profiles

Scan Rate (sec): 1

Distance between Displayed Sample Points = (X mps x 100) x Scan Rate = 3.9 centimeters

RUN #	File Name Root: LINE 4 Extension	Day & Date: Monday 10/15/2012 T_{start}	T_{finish}	T_{total}	Profile Type & Notes
1	Minichoco - 01	35 sec	10:30	9:55	Temp Sensor Array (T)
2	" " - 02	24	10:19	9:55	Air Velocity Sensor Array (AV)
3	" " - 03	23	10:18	9:55	Heat Flux Sensor (HF)
4	" " - 04	24	10:19	9:55	Humidity Sensor (HU)
5	" " - 05	39	10:37	9:58	Product Probe(PP) x2 R&D Sensor, timed PP's
5	" " - 05 continued	10:37	12:04	11:25	Additional travel through cooling section
6	" " - 06	1:20	11:16	9:56	Temp Array + 1 PP(left side channel 1)
7	" " - 07	34	10:29	9:55	Air Velocity (data verification)

SCORPION® 2 Equipment Used

Name	Serial #	# Sensor Pairs	Bar Length (in/m)
Data Logger	10119		
Temperature Sensor Array	5218	9 Type A	1 meter
Air Velocity Sensor Array	5053	9	1 meter
Heat Flux Sensor	From R&D SS		
Humidity Sensor	5217		
Product Probe Interface	From R&D SS		
R&D Smart Sensor	5215		

*Type **A** Sensor Pair: Upper Air & Lower Band Temperature*
*Type **B** Sensor Pair: Upper Air & Lower Air Temperature*

PROFILE CHARTS TABLE OF CONTENTS LINE # 4

ABC Company, Temple, PA, Line #4, October 15, 2012

Temperature Sensor Array

Band Temperature – 2D Line Chart 12
Band Temperature Variation – 2D Chart 13
Band Temperature Variation – 3D Chart 14

Upper Air Temperature – 2D Line Chart 15
Upper Air Temperature Variation – 2D Chart 16
Upper Air Temperature Variation – 3D Chart 17

Air Velocity Sensor Array

Air Velocity Average Left, Center, Right – 2D Line Chart 18
Air Velocity – 2D Line Chart 19
Air Velocity Variation – 2D Chart 20
Air Velocity Variation – 3D Chart 21

Heat Flux Sensor

Heat Flux 2D Line Chart 22
Total Heat Chart 23

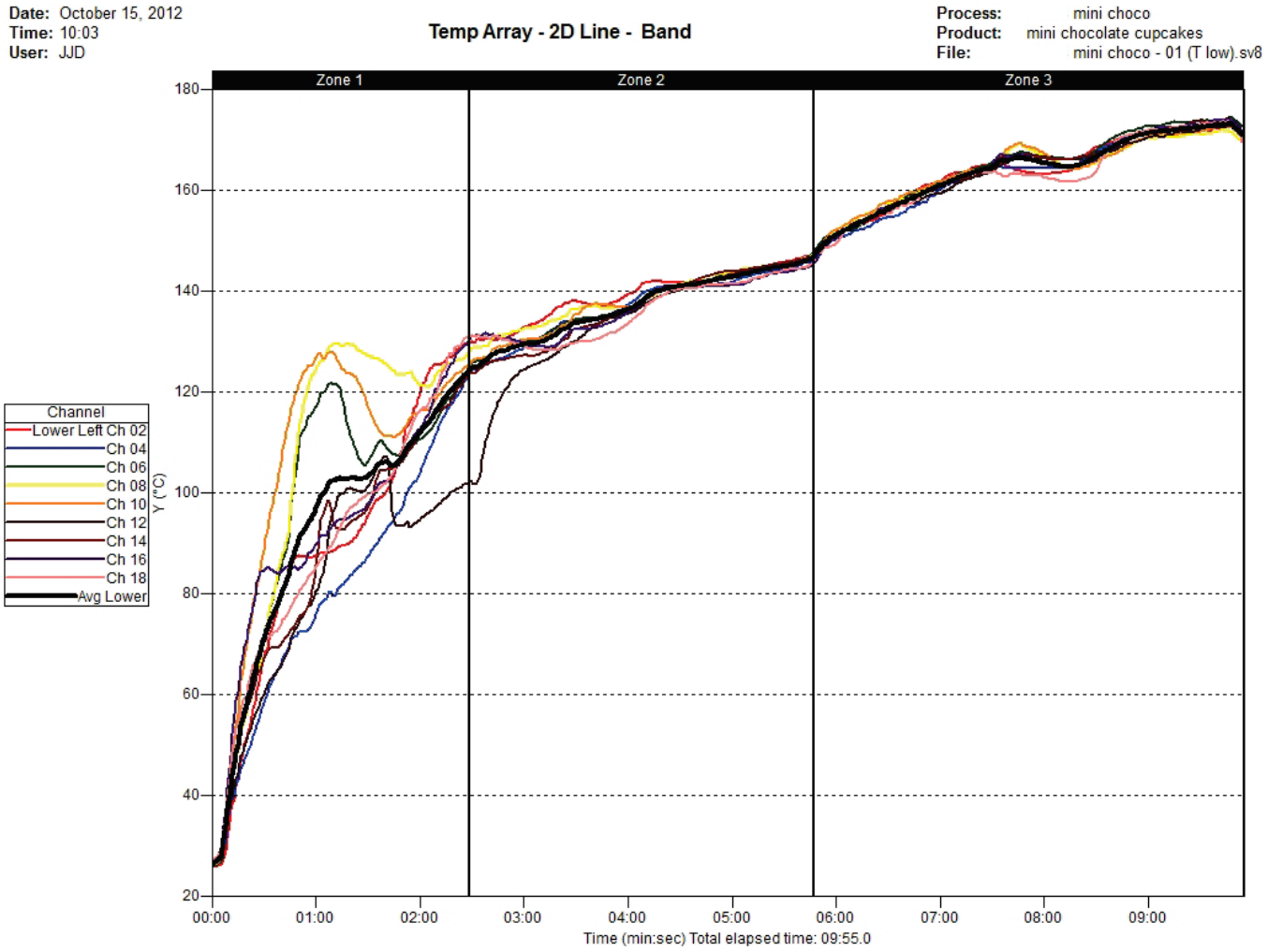
Humidity Sensor

Humidity 2D Line Chart 24

Product Probe

Product Core Temperature 2D Line Chart 25

Band Temperature – 2D Line Chart Line # 4



BLACK = Average of all 9 sensors

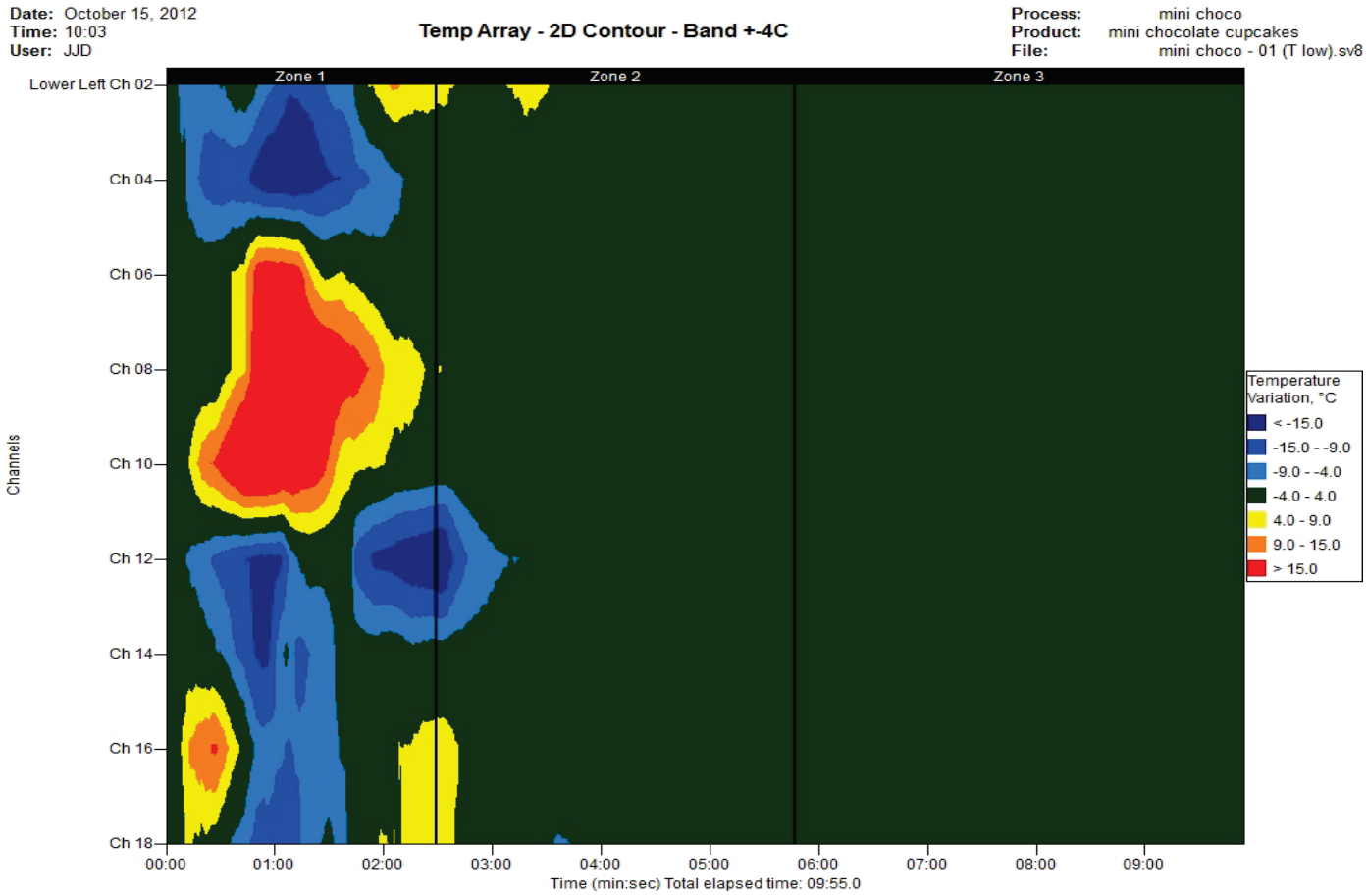
RED = Sensor #2; Left Side

PINK = Sensor #18; Right Side

This chart displays the band temperature measured across the width of the oven. The desired distribution would be a tight pattern of lines correlating to an even distribution of temperature across the width of the band.

The band enters the oven at room temperature and is cooled down rapidly after exiting the oven by the use of cooling fans and a water cooler. The belt temperature was measured on the surface of the belt with an Infrared heat gun. The temperatures collected by the IR gun match those collected by the SCORPION® equipment at the oven entrance and exit. Both zones 2 & 3 of the oven appear to have an even temperature distribution across the width of the band indicating even heat distribution. Deviations in temperature occur in zone 1 with the center left portion of the band warming up faster than the rest of the belt. The spike in band temperature could be due to air circulation issues beneath the band.

Band Temperature Variation – 2D Contour Line # 4



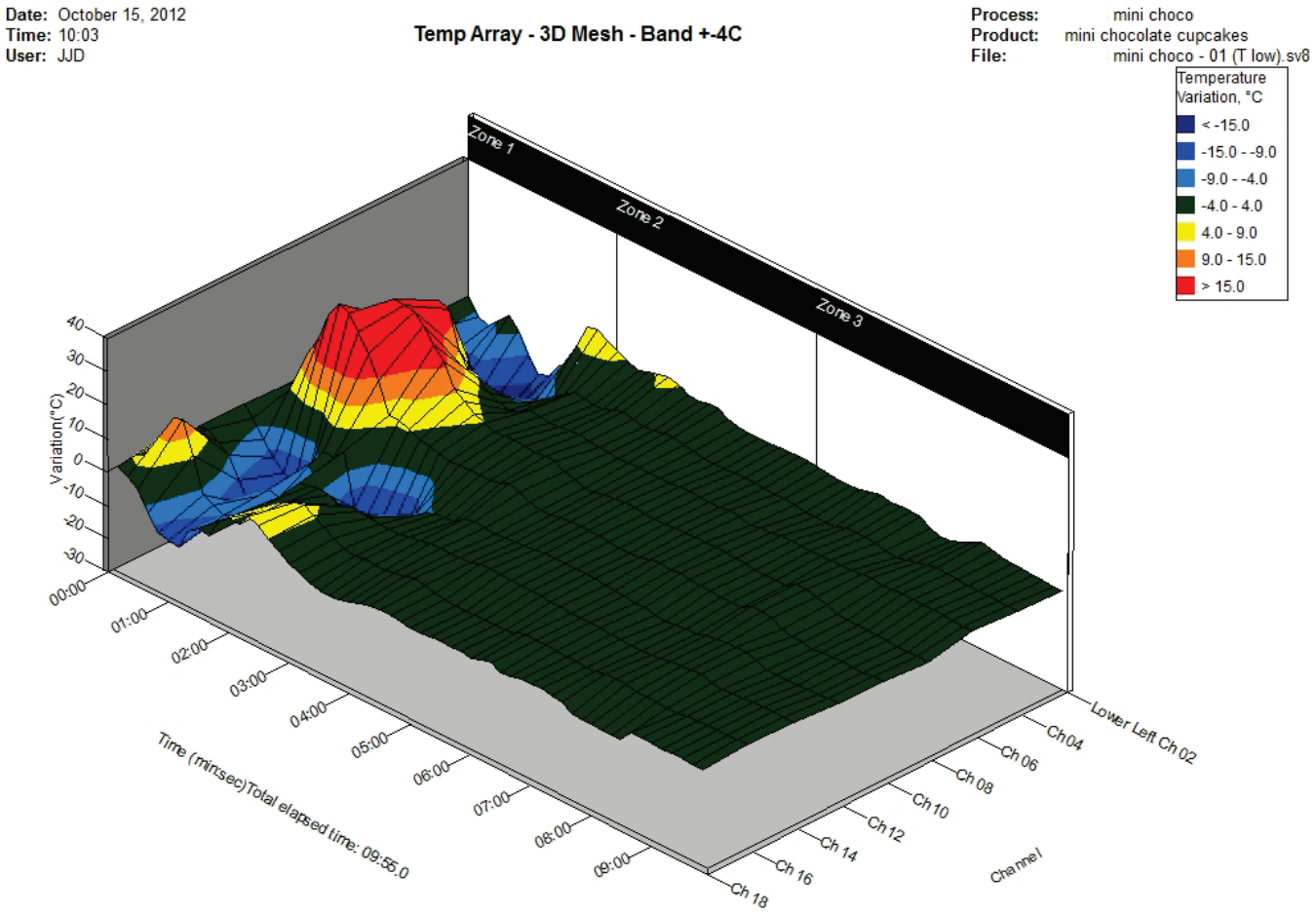
80% -	100%	Green	**= Excellent oven profile; very even heat**
60% -	80%	Green	**= Good oven profile; no adjustments necessary**
40% -	60%	Green	**= Fair oven profile; oven tuning may be necessary**
20% -	40%	Green	**= Poor oven profile; bake will be visibly uneven**

		Color	Min °F	Max °F	Min °C	Max °C
Channel 2	**= Left Side**	Dk Blue	<	-25	<	-15
Channel 18	**= Right Side**	Blue	-25	-15	-15	-9
The color differences in the chart represent temperature variation from the average temperature at each sample point in time.		Lt Blue	-15	-7	-9	-4
		Green	-7	7	-4	4
		Yellow	7	15	4	9
		Orange	15	25	9	15
		Red	25	<	15	<

This chart displays the band temperature variation experienced by the product across the width of the oven. Throughout the profile, an average value of all individual sensors on the SCORPION® array is calculated for each position along the length of the oven. Each individual sensor is assigned a positive or negative value with respect to the calculated average at that position and a color is assigned per the table shown above.

The chart is close to 80% green in color which indicates a good to excellent oven profile for the oven band in this oven. Overall the band temperature indicates very even heat for the oven with the exception of variations in zone 1. Because the large temperature variation only appears in zone 1 (the shortest zone) it may be difficult to discern any effect on the finished product.

Band Temperature Variation – 3D Chart Line # 4

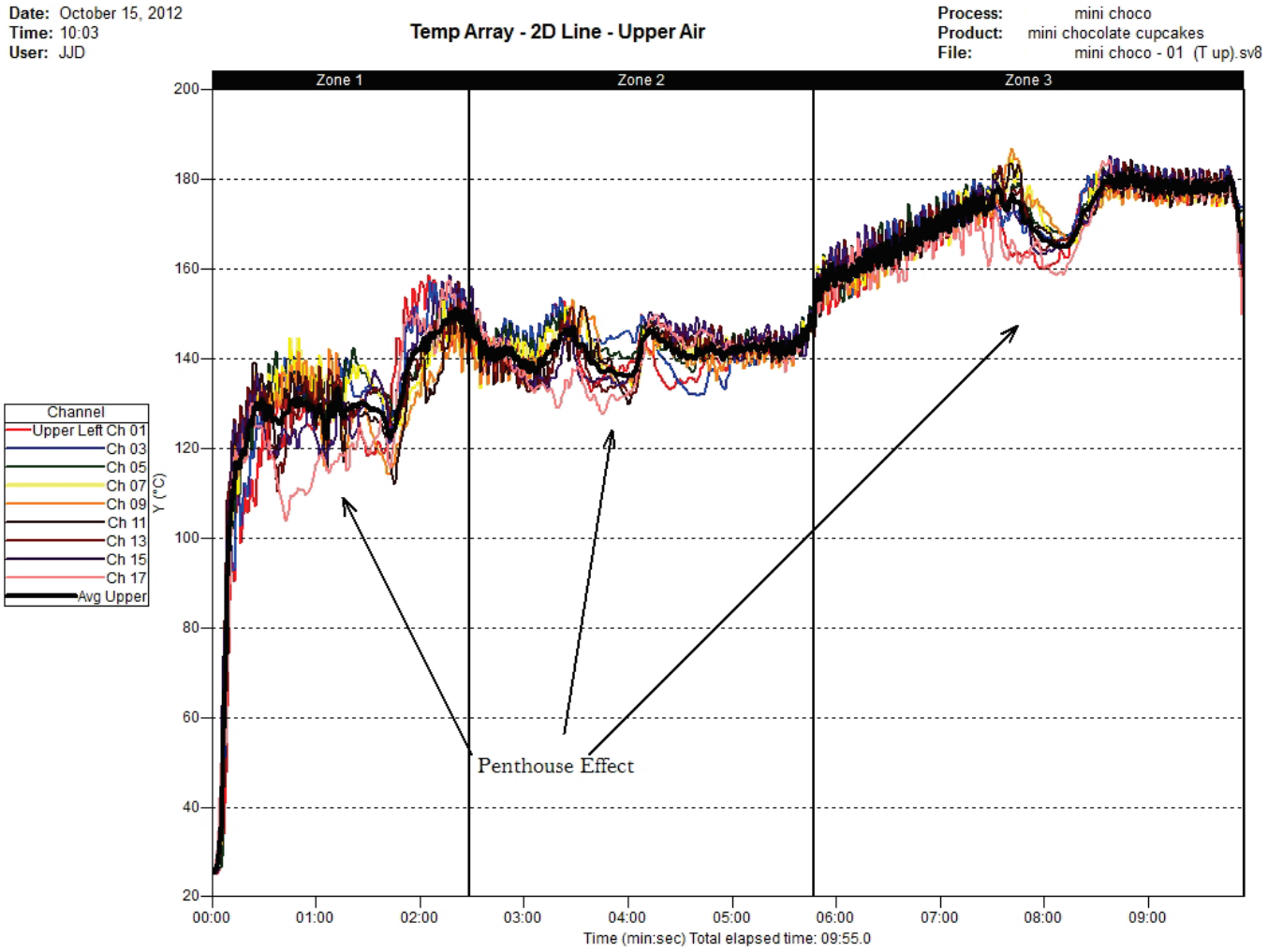


80% -	100%	Green	**= Excellent oven profile; very even heat**
60% -	80%	Green	**= Good oven profile; no adjustments necessary**
40% -	60%	Green	**= Fair oven profile; oven tuning may be necessary**
20% -	40%	Green	**= Poor oven profile; bake will be visibly uneven**

		Color	Min °F	Max °F	Min °C	Max °C
Channel 2	**= Left Side**	Dk Blue	<	-25	<	-15
Channel 18	**= Right Side**	Blue	-25	-15	-15	-9
The color differences in the chart represent temperature variation from the average temperature at each sample point in time.		Lt Blue	-15	-7	-9	-4
		Green	-7	7	-4	4
		Yellow	7	15	4	9
		Orange	15	25	9	15
		Red	25	<	15	<

This chart displays a 3-Dimensional representation of the previous 2-D Contour chart. Some operators view this representation as a quick way to identify the problem spots inside an oven and consequently make adjustments to the oven.

Upper Air Temperature – 2D Line Chart Line # 4



BLACK = Average of all 9 sensors

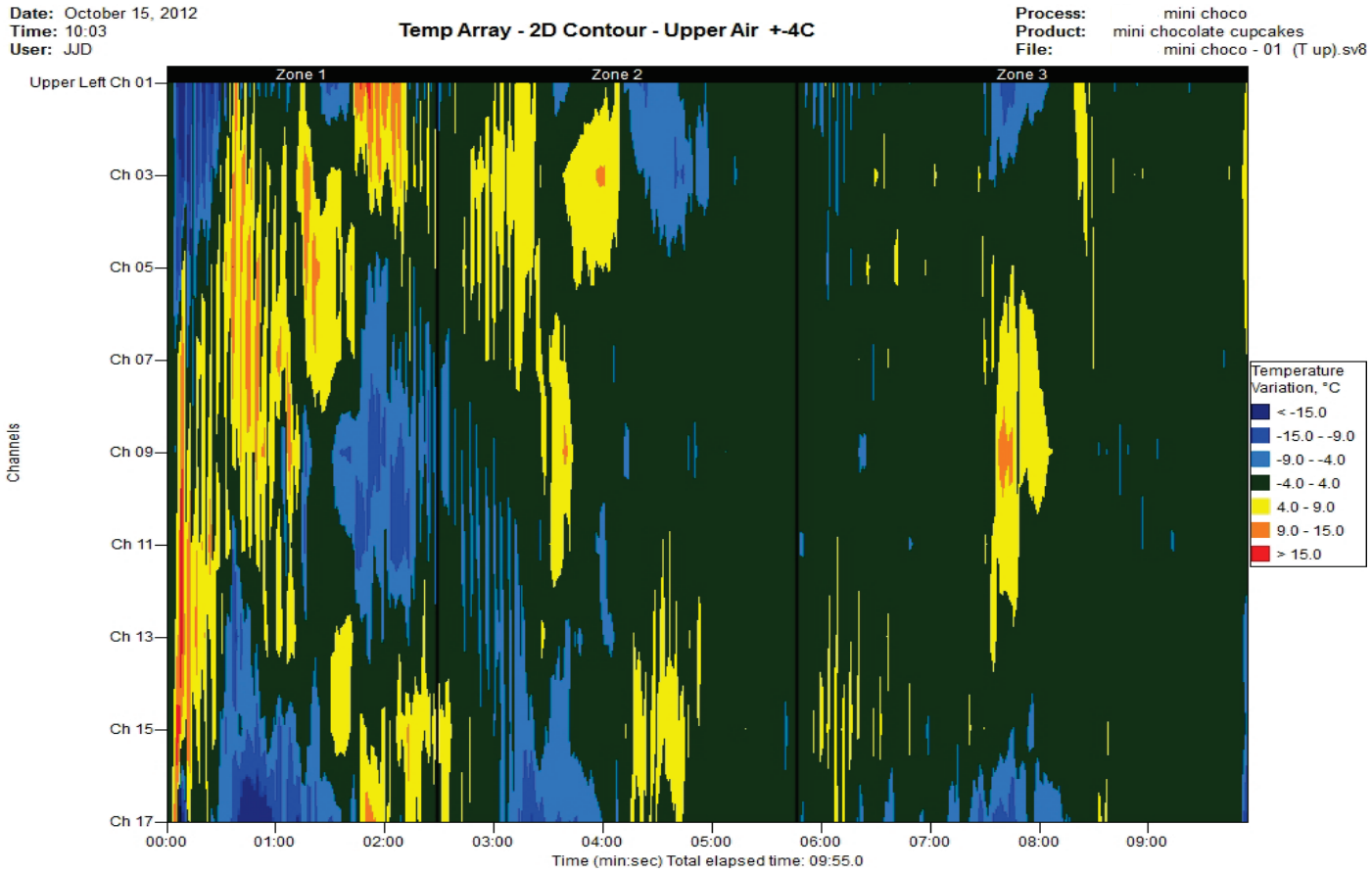
RED = Sensor #1; Left Side

PINK = Sensor #17; Right Side

This chart displays the air temperature measured above the conveyor band across the width of the oven. The desired distribution would be a tight pattern of lines correlating to an even distribution of temperature across the width of the band.

Overall the upper air temperature distribution appears even throughout the oven. There appears to be good temperature control/isolation between zones, as indicated by the temperature transitions at each zone. The temperatures are lower than the oven set points for the process; however, the temperature measurements are collected from a height of approximately 2 inches above the oven band where the product would normally be.

Upper Air Temperature Variation – 2D Contour Line # 4



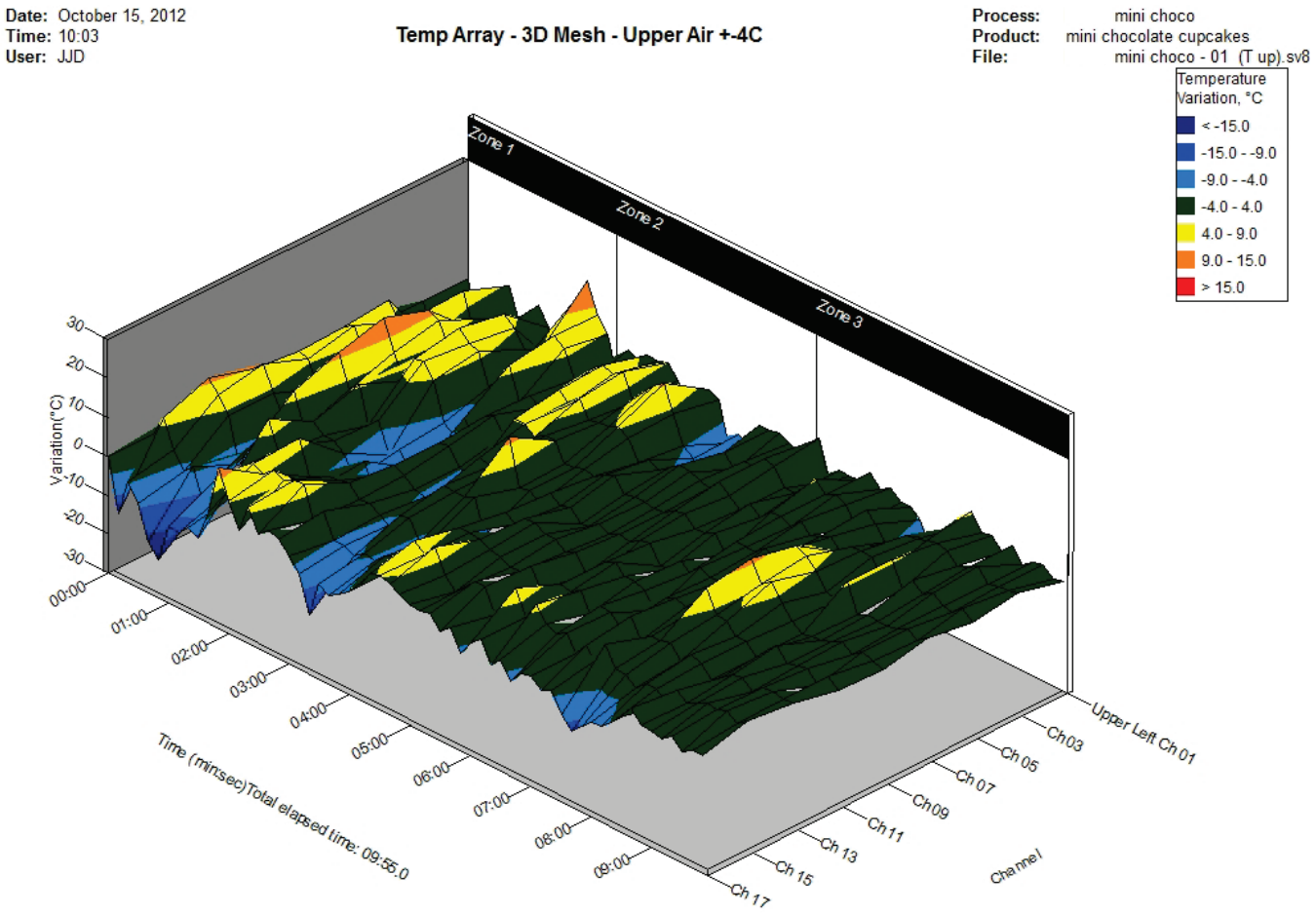
80% -	100%	Green	**= Excellent oven profile; very even heat**
60% -	80%	Green	**= Good oven profile; no adjustments necessary**
40% -	60%	Green	**= Fair oven profile; oven tuning may be necessary**
20% -	40%	Green	**= Poor oven profile; bake will be visibly uneven**

		Color	Min °F	Max °F	Min °C	Max °C
Channel 1	**= Left Side**	Dk Blue	<	-25	<	-15
Channel 17	**= Right Side**	Blue	-25	-15	-15	-9
The color differences in the chart represent temperature variation from the average temperature at each sample point in time.		Lt Blue	-15	-7	-9	-4
		Green	-7	7	-4	4
		Yellow	7	15	4	9
		Orange	15	25	9	15
		Red	25	<	15	<

This chart displays the upper air temperature variation experienced by the product across the width of the oven. Throughout the profile, an average value of all individual sensors on the SCORPION® array is calculated for each position along the length of the oven. Each individual sensor is assigned a positive or negative value with respect to the calculated average at that position and a color is assigned per the table shown above.

From the amount of green in the chart it would appear the overall temperature distribution is fair. There are very few areas where the side-to-side temperature differs dramatically. The zone that contains the most even temperature profile is zone 3 where the top air distribution damper was set to 10. In zones 1&2 the top air distribution damper was set to 3.

Upper Air Temperature Variation – 3D Chart Line # 4

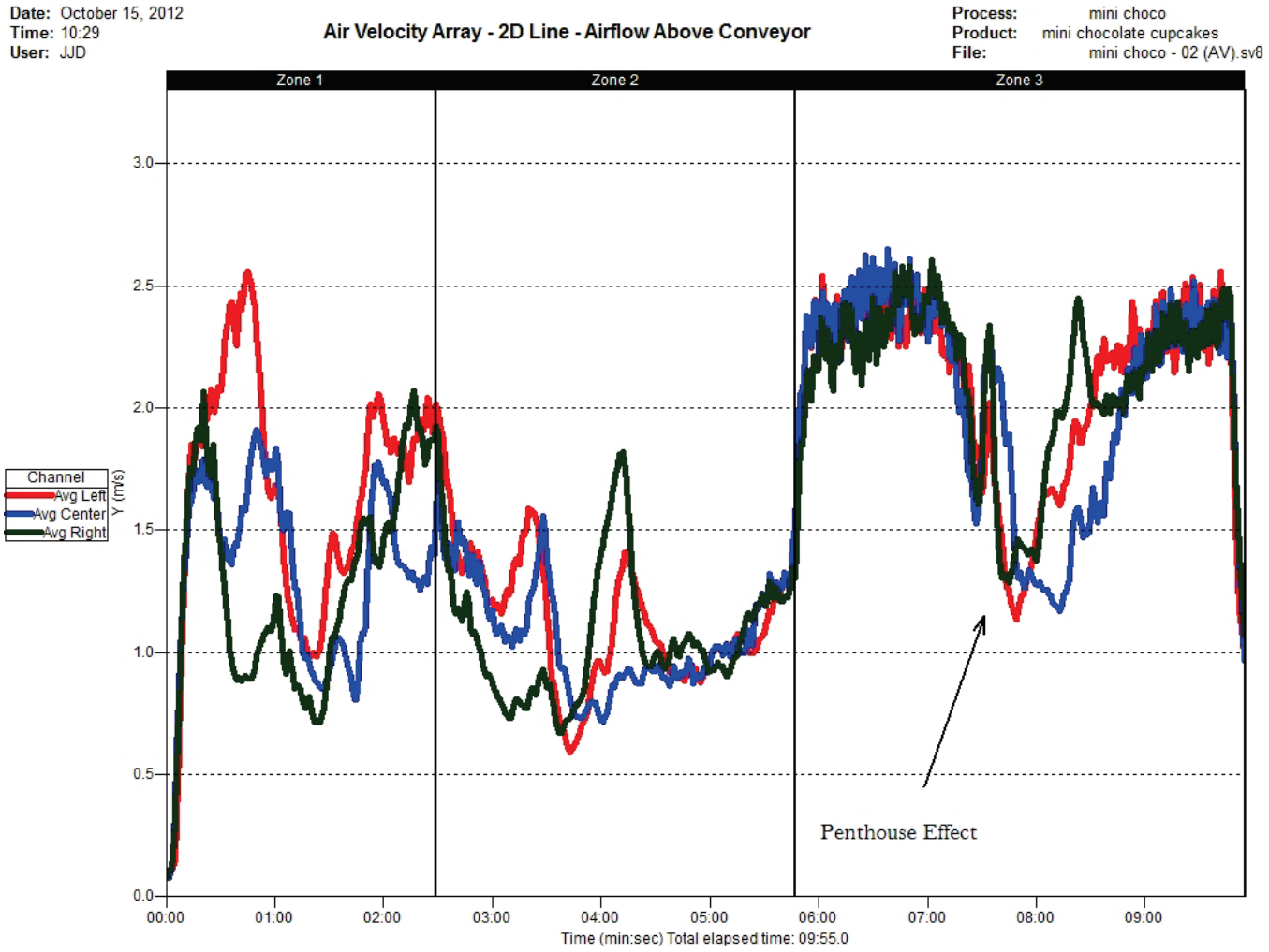


80% -	100%	Green	**= Excellent oven profile; very even heat**
60% -	80%	Green	**= Good oven profile; no adjustments necessary**
40% -	60%	Green	**= Fair oven profile; oven tuning may be necessary**
20% -	40%	Green	**= Poor oven profile; bake will be visibly uneven**

Channel 1	**= Left Side**	Color	Min °F	Max °F	Min °C	Max °C
Channel 17	**= Right Side**	Dk Blue	<	-25	<	-15
The color differences in the chart represent temperature variation from the average temperature at each sample point in time.		Blue	-25	-15	-15	-9
		Lt Blue	-15	-7	-9	-4
		Green	-7	7	-4	4
		Yellow	7	15	4	9
		Orange	15	25	9	15
		Red	25	<	15	<

This chart displays a 3-Dimensional representation of the previous 2-D Contour chart. It may be easier to conceptualize the upper chamber air temperatures with this illustration. Specifically, the location of air distribution points may correspond to the peaks and valleys of this chart.

Air Velocity Average Left, Center, Right – 2D Line Chart Line # 4



RED = Average Left Side

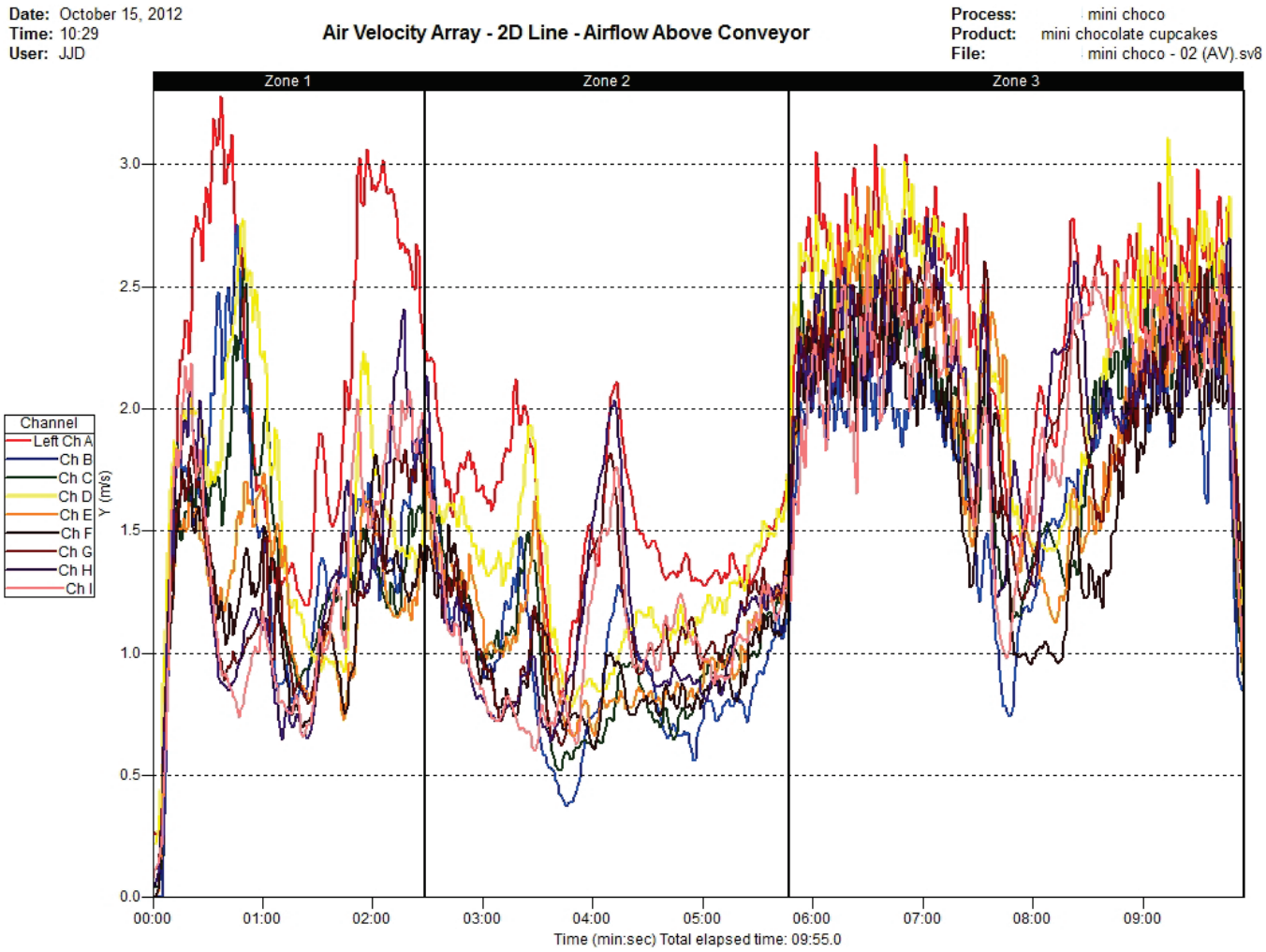
BLUE = Average Center

DARK GREEN = Average Right

This chart displays the average air velocities measured above the conveyor band across the width of the oven. The desired distribution would be a tight pattern of lines correlating to an even distribution of temperature across the width of the band.

In zones 1&2 the air velocities vary across the width of the oven. In zone 3, the airflows appear mostly even. The drop in airflow in the center of a zone is the result of no air distribution under the combustion penthouse. This "penthouse effect", as we call it, is inherent with this type of oven design and is seen on most all oven manufacturers' equipment of this type. The zone with the most even air velocity, zone 3, had the top air distribution set to 10. Zones 1&2 had the top air distribution set to 3. The low setting of the top air distribution may lead to uneven air velocities in the oven.

Air Velocity All Sensors – 2D Line Chart Line # 4



RED = Sensor A; Left Side

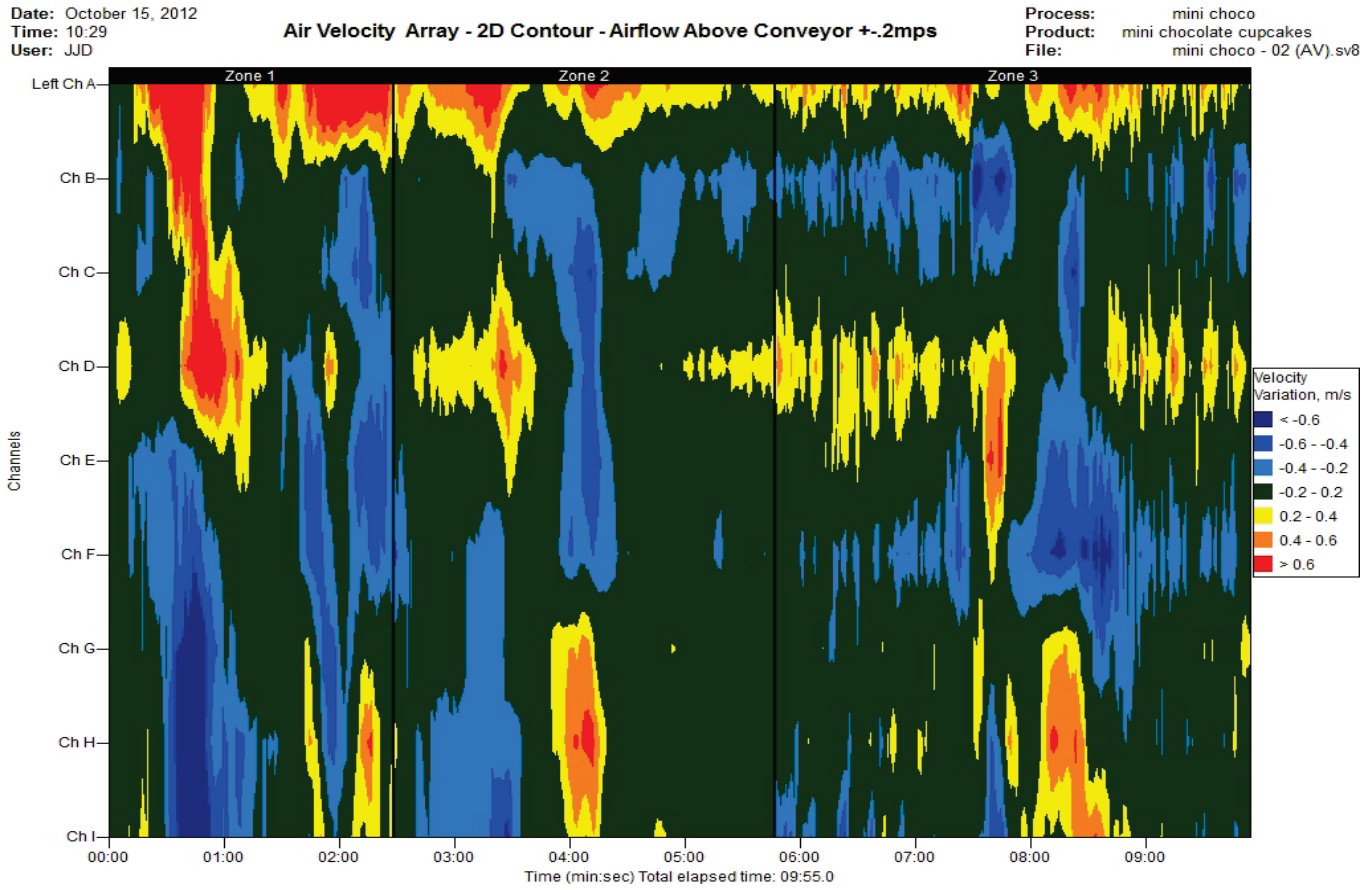
ORANGE = Sensor E; Center

PINK= Sensor I; Right Side

This chart displays the air velocity measured above the conveyor band across the width of the oven at all sensor locations. The desired distribution would be a tight pattern of lines correlating to an even distribution of airflow across the width of the oven.

For example, note that the red line (far left sensor) and the blue line (second from far left) follow roughly the same pattern but with noticeably different air velocities. The arrangement of air distribution ports may be causing these differences along with the top air distribution settings. Additional airflow around the sides of the band to the oven exhaust could also be contributing to the higher airflow on the left side of the oven. We were unable to determine what path air travels to exhaust from the oven.

Air Velocity Variation – 2D Contour Line # 4



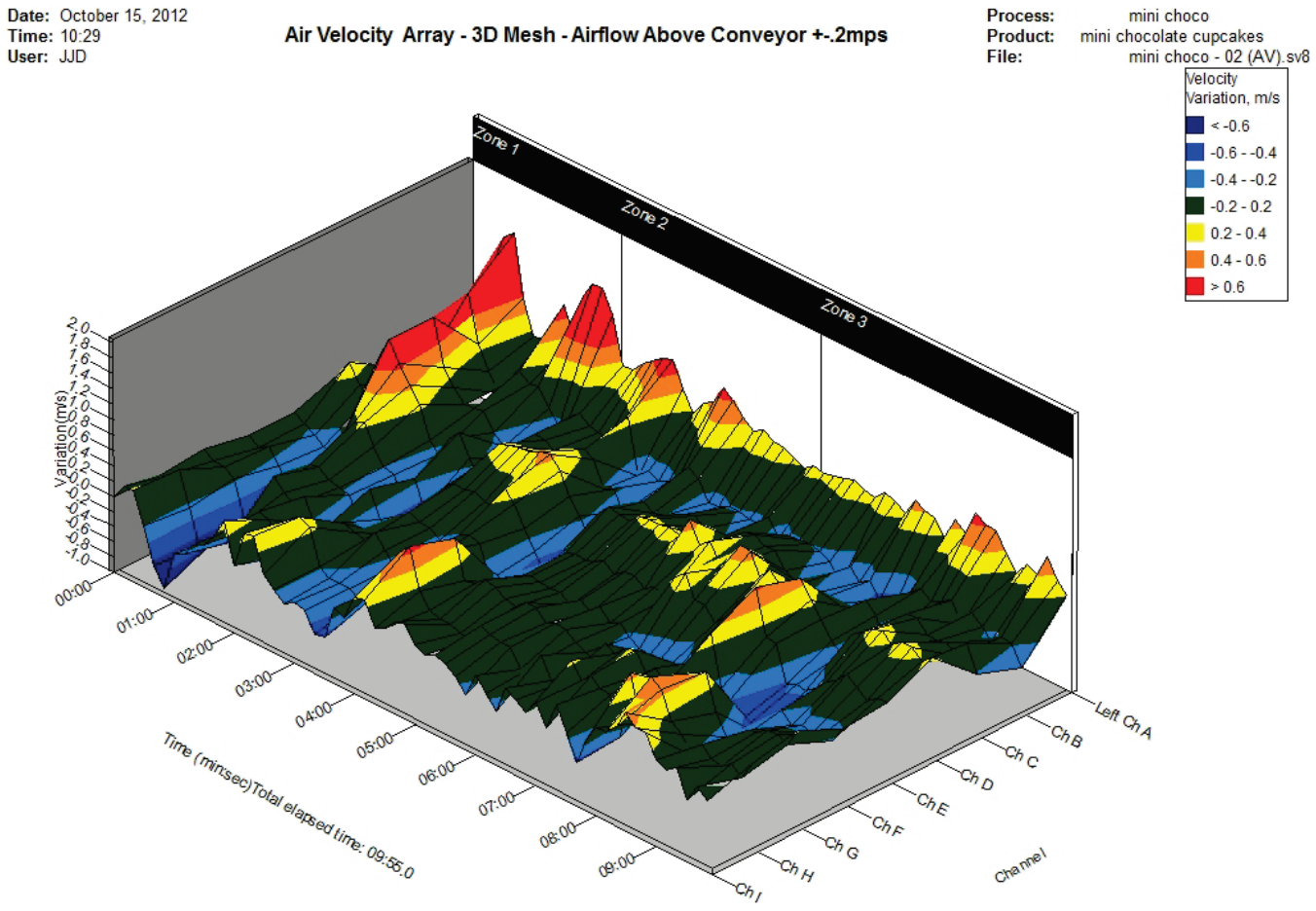
80% -	100%	Green	**= Excellent oven profile; very even heat**
60% -	80%	Green	**= Good oven profile; no adjustments necessary**
40% -	60%	Green	**= Fair oven profile; oven tuning may be necessary**
20% -	40%	Green	**= Poor oven profile; bake will be visibly uneven**

Channel A = LEFT SIDE **Channel I = RIGHT SIDE**	Color	Min fpm	Max fpm	Min mps	Max mps
	Dk Blue	<	-100	<	-0.6
The color differences in the chart represent airflow variation from the average airflow at each sample point in time	Blue	-100	-75	-0.6	-0.4
	Lt Blue	-75	-50	-0.4	-0.2
	Green	-50	50	-0.2	0.2
	Yellow	50	75	0.2	0.4
	Orange	75	100	0.4	0.6
	Red	100	<	0.6	<

This chart displays the air velocity variation experienced by the product across the width of the oven. Throughout the profile, an average value of all individual sensors on the SCORPION® array is calculated for each position along the length of the oven. Each individual sensor is assigned a positive or negative value with respect to the calculated average at that position and a color is assigned per the table shown above.

Based on the amount of green evident in the chart it appears the airflow is not balanced. It is clear that the left side of the oven experiences higher airflow than the other portions of the oven.

Air Velocity Variation – 3D Chart Line # 4

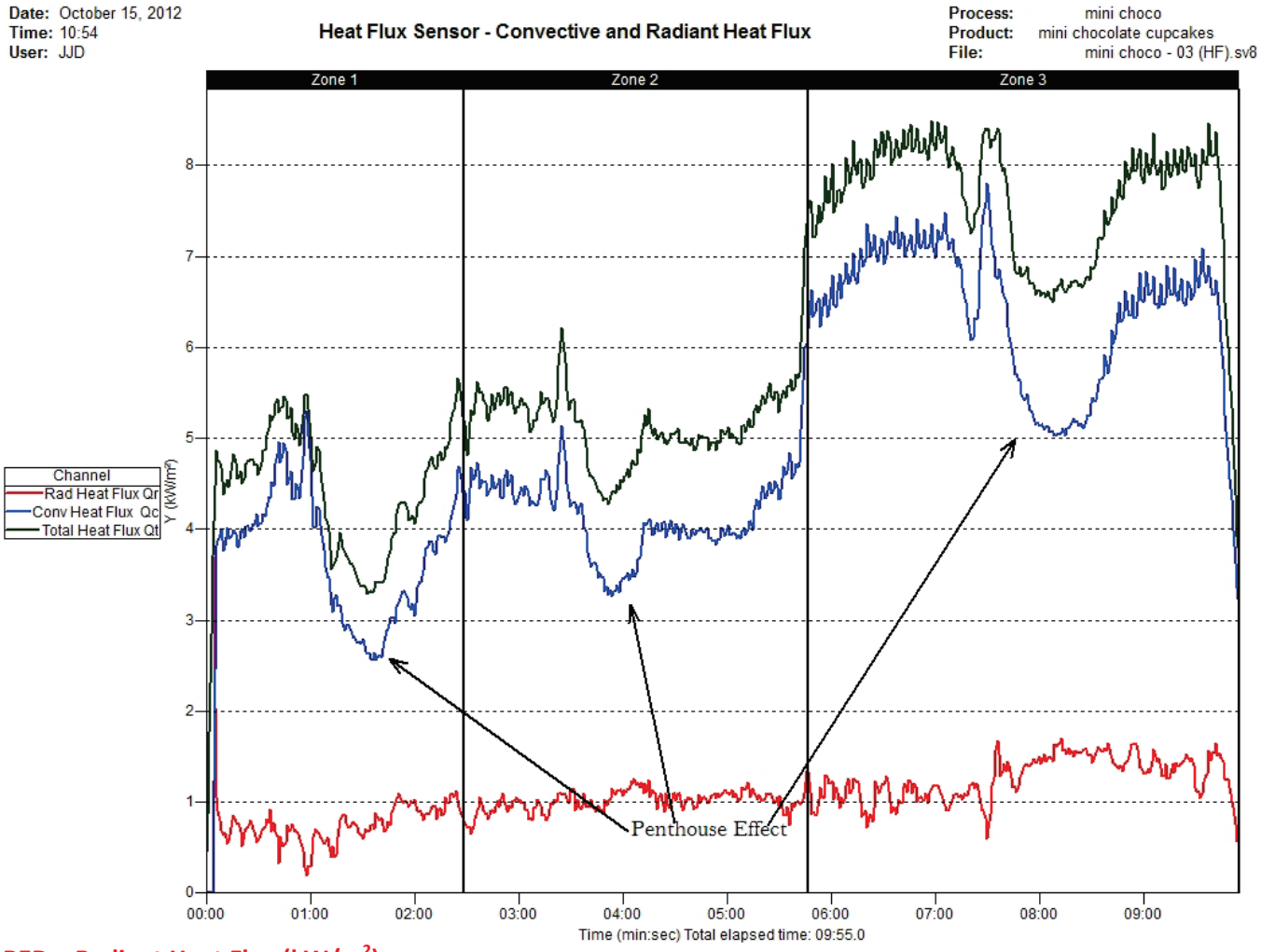


80% -	100%	Green	**= Excellent oven profile; very even heat**
60% -	80%	Green	**= Good oven profile; no adjustments necessary**
40% -	60%	Green	**= Fair oven profile; oven tuning may be necessary**
20% -	40%	Green	**= Poor oven profile; bake will be visibly uneven**

Channel A = LEFT SIDE **Channel I = RIGHT SIDE**	Color	Min fpm	Max fpm	Min mps	Max mps
	Dk Blue	<	-100	<	-0.6
The color differences in the chart represent airflow variation from the average airflow at each sample point in time	**Blue**	-100	-75	-0.6	-0.4
	Lt Blue	-75	-50	-0.4	-0.2
	Green	-50	50	-0.2	0.2
	Yellow	50	75	0.2	0.4
	Orange	75	100	0.4	0.6
	Red	100	<	0.6	<

This chart displays a 3-Dimensional representation of the previous 2-D Contour chart. It is easy to see where the higher airflows (in **Red**) and the lower airflows (in **Blue**) are located.

Heat Flux 2D Line Chart Line # 4



RED = Radiant Heat Flux (kW/m^2)

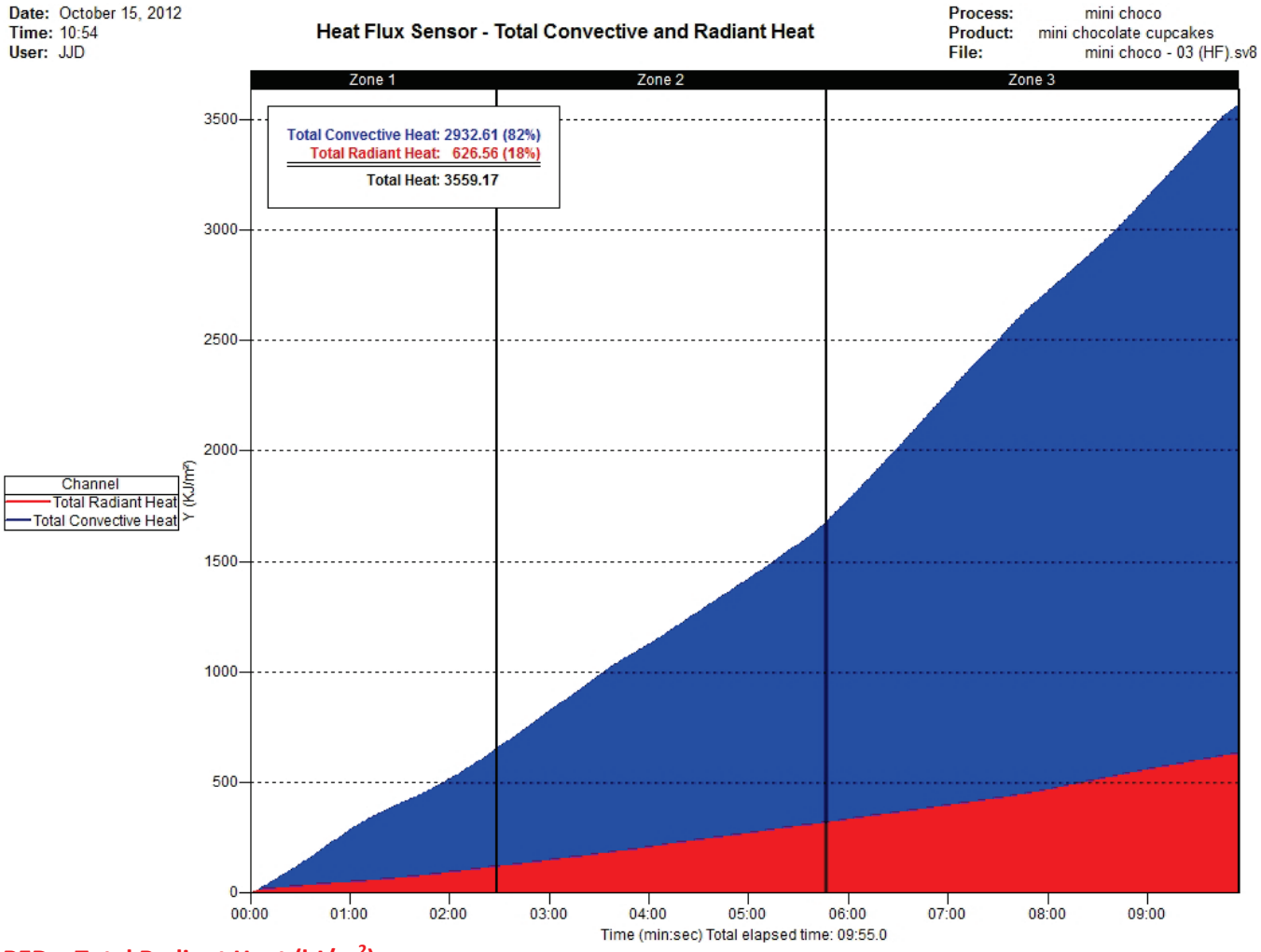
BLUE = Convective Heat Flux (kW/m^2)

GREEN = Total Heat Flux (kW/m^2)

This chart shows the radiant and convective heat flux components within the baking chamber as they change throughout the process.

The oven has no significant source of radiant heat, and nearly all heat transferred to the product is convective from the air flow and conductive from the band. This heat flux is typical of a convection oven as most of the heat flow should be convective. Heat Flux is considered the profile which truly defines a product's characteristics. It is a measurement of the type (convective/radiant) and the amount of heat seen by the product. The increase in heat flux seen in zone 3 matches the Top Air Distribution setting of 10 versus 3 for zones 1&2.

Total Heat Chart Line # 4



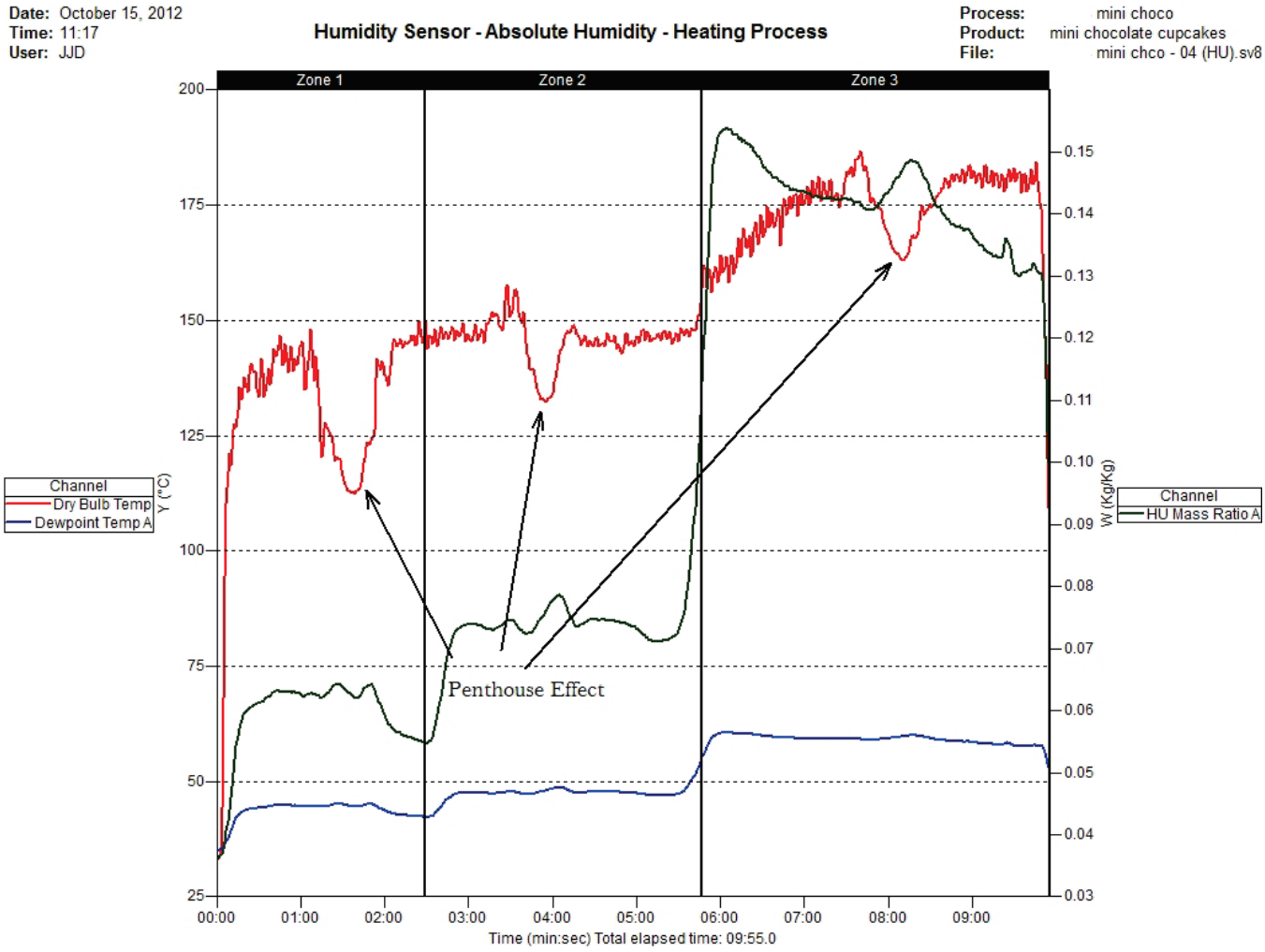
RED = Total Radiant Heat (kJ/m^2)

BLUE = Total Convective Heat (kJ/m^2)

This chart shows the total radiant and convective heat components experienced by the product as they build over time within the baking chamber.

The total heat applied to the product is approximately 3,560 kJ/m^2 and is split 82% convective and 18% radiant. The observed heat flux is typical for this type of oven.

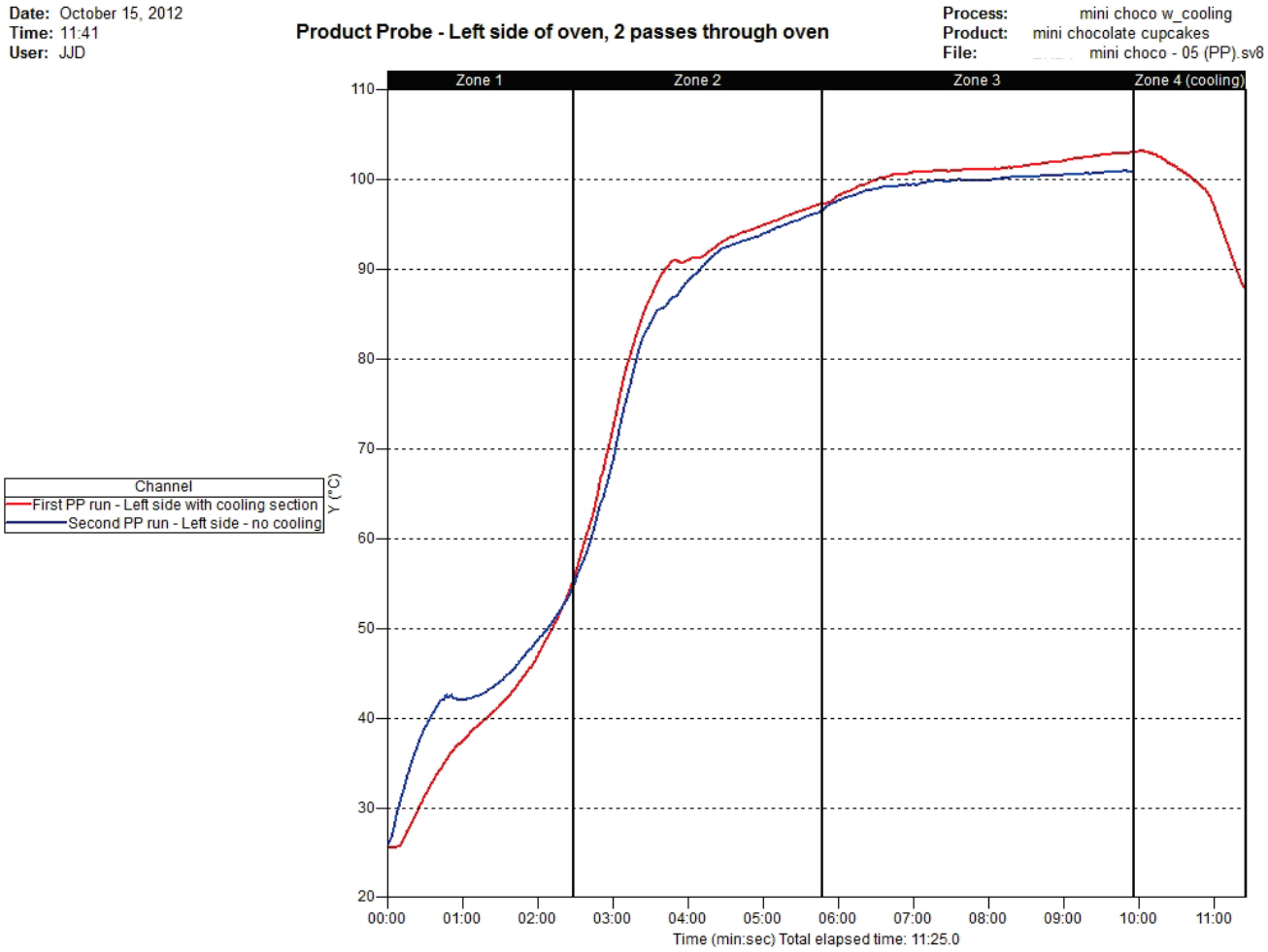
Humidity 2D Line Chart Line # 4



This chart shows humidity mass ratio (kg water / kg air) measured at a single point along the center of the conveyor at product level. The sensor measured the amount of moisture in the chamber air and simultaneously calculated the dew point temperature and dry bulb air temperature.

Moisture is released from the product as it begins to bake and the moisture builds up inside the oven based on exhaust settings. As the product transitions from zone 2 to zone 3, the moisture increases. The exhaust for zone 3 is only ¼ open and allows rapid moisture buildup as the product moves from zone 2 (exhaust full open) to zone 3 (exhaust ¼ open).

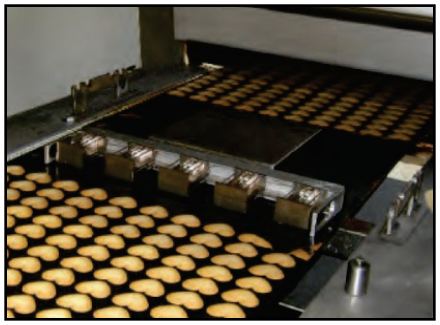
Product Core Temperature 2D Line Chart Line # 4



The product probe was passed through the oven a total of two times in a position left of the center of the band to facilitate easy setup and removal. The first pass (red) included travel through the cooling section located after the exit of the oven. On the chart the cooling section is labeled “Zone 4 (cooling)” and should not be confused with the oven itself. The data for the pass with the cooling section ends just before the product travels below the final cooling fan in the cooling stage. The second pass-through (blue) of the product probe was accomplished to verify the data we had collected with the first run and did not include the cooling section after the oven exit. The product probe was inserted into the cake batter by piercing through the side of a baking cup. The product probe is held in a fixed position by a fixture which held the tip of the product probe in the center of the cupcake to capture the core temperature of the mini-cake throughout the baking process.

APPENDIX

SCORPION® PROFILING SERVICE



The SCORPION® System allows us to measure process conditions with fixed sensors located at product level.

Reading Thermal Technicians collect thermal profiles that completely characterize the oven and product in terms of Temperature, Airflow, Energy Transfer, and Humidity. Interpreting these profiles help determine what changes, if any, need to be made to the thermal environment with respect to product development, improvement, and quality.

The SCORPION® 2 Data Logging Measurement System is used to collect the profile data. SCORPION® 2 Smart Sensors are passed through the process collecting data along the width and length. The SCORPION® 2 equipment travels with the product while the oven is under full production load.

SCORPION® 2 Sensors

Temperature Sensor Array: This sensor array measures air and band temperature at fixed positions across the width of a conveyor.

Air Velocity Sensor Array: This sensor array measure airflow at fixed positions across the width of a conveyor.

Heat Flux Sensor: This sensor measures convective and radiant energy experienced by the product.

Humidity Sensor: This sensor measures dry bulb temperature, dew point temperature, absolute humidity in heating processes and relative humidity in cooling processes.