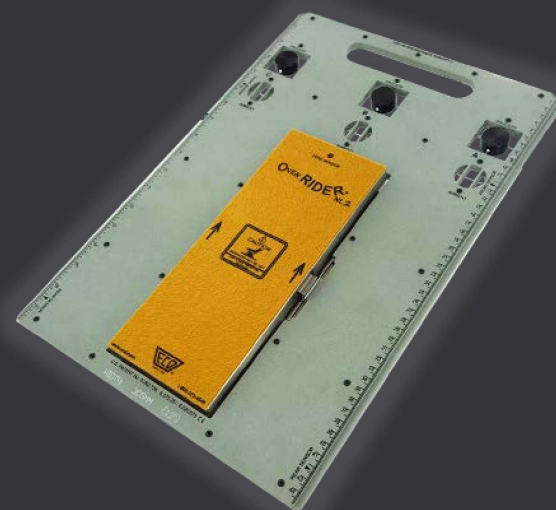


OVENRIDER[®] NL2⁺



ECO[®]
Home of THE
MOLE[®]
Thermal Profiler

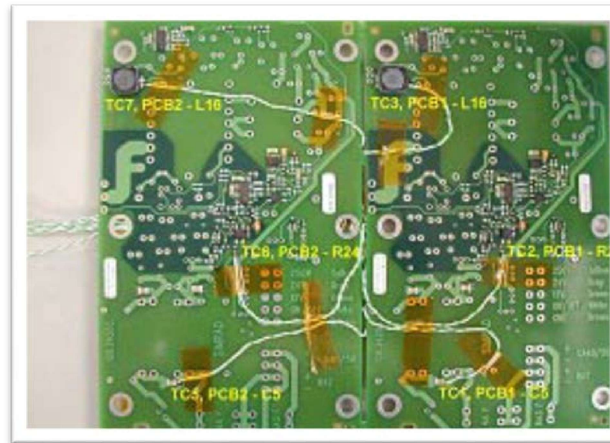
Excellence in Measurement Solutions Worldwide



The OvenRIDER® NL 2+

is a self contained Machine Quality Management Tool allowing the user to analyze machine/oven heating capabilities and process consistency over time.

It can replace/eliminate frequent profiling and expose machine deficiencies before they may effect quality of the products



- *OvenRIDER® NL 2+*
 - *Available as 6.6"-176mm/12"-305mm/ 18"-458 mm widths*
 - *Custom widths available - larger than 6.6"-167 mm*
 - *Height – 0.81" (20.6 mm) – above the conveyor*
 - *Length 17.73in (453 mm)*
 - *3.6 Volt, ½ AA Lithium battery*



All Process Sensors are built right into the rugged pallet

External Features

1) Barrier Box

This is the thermal protective barrier for the M.O.L.E.®. This barrier also is equipped with external insulation on the top and bottom, which provides the extra thermal protection needed for Lead-Free processes. This barrier is lowered 0.685" [17.40mm] into the plane of the pallet for extra oven clearance.

2) Barrier Locking Latch

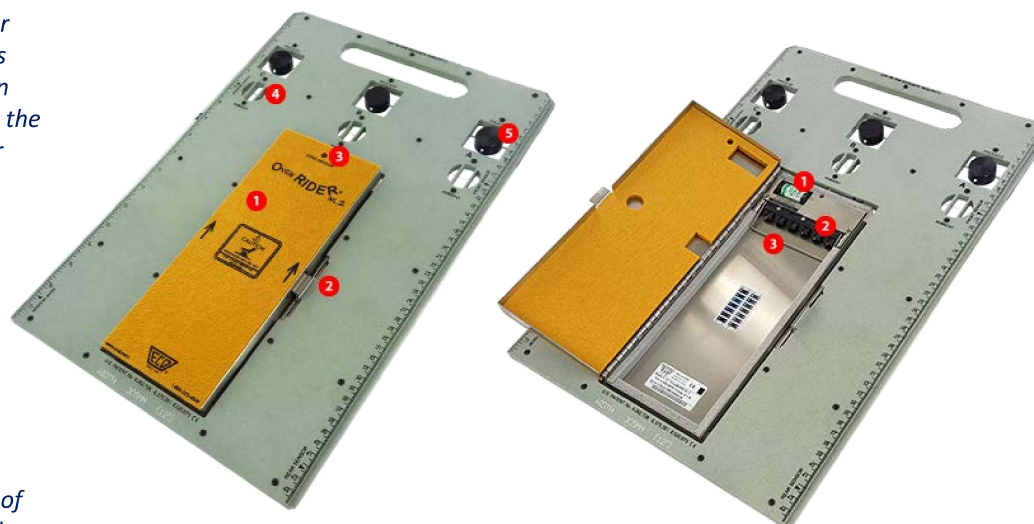
This latch secures the cover of the barrier to prevent it from opening.

3) Zone Sensor Light

There is an LED porthole on the top of the barrier cover that illuminates when the OvenRIDER® NL 2+ detects zone boundary

4 & 5) Process & Ambient Sensors

These are 6 sensors that are used to collect data.



Internal Features

1) Zone Sensor Battery

This is the power source for the zone sensor LED.

2) Connector Bridge

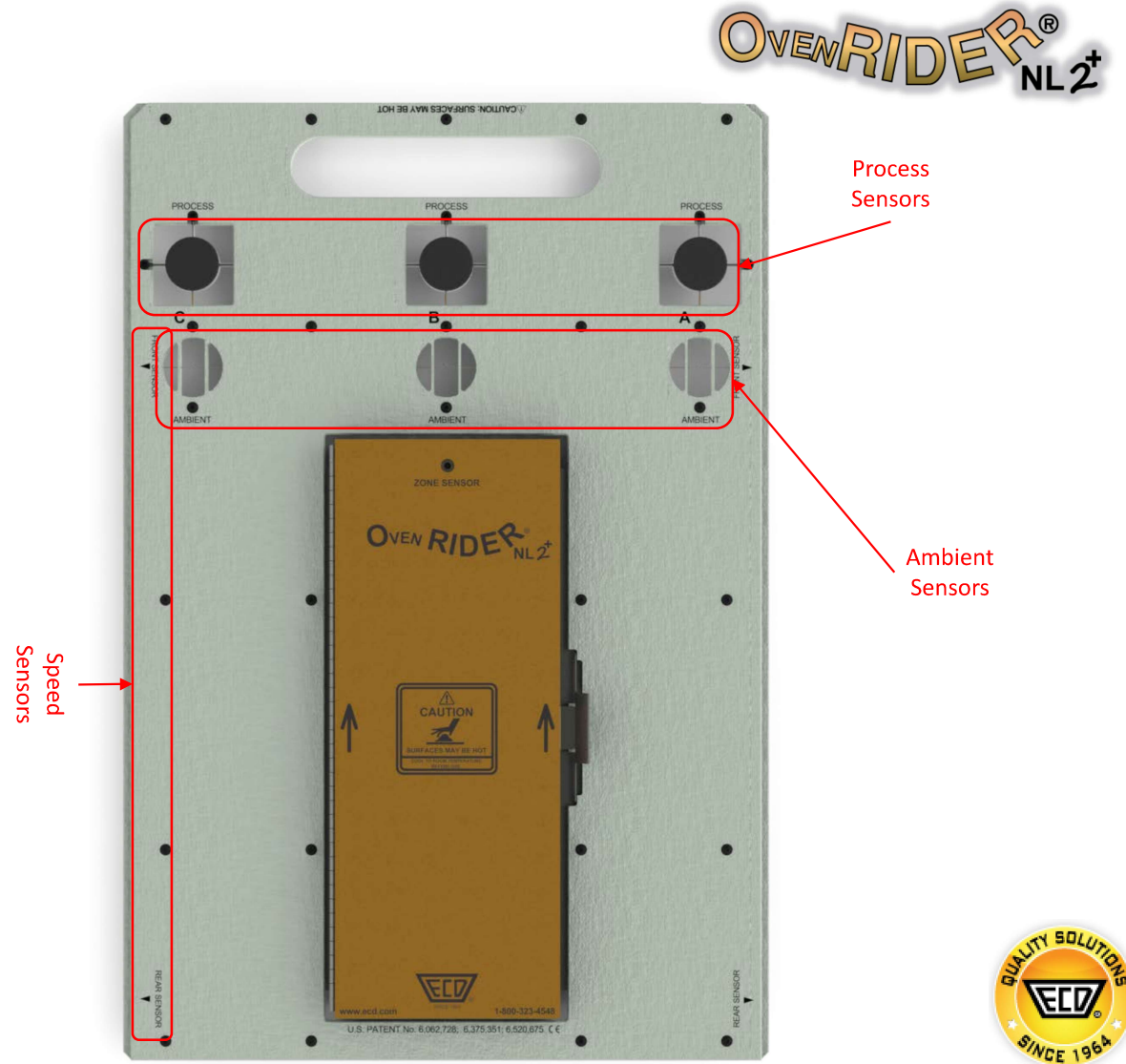
This is where the M.O.L.E.® plugs into the OvenRIDER® NL 2+ for data transfer from the process and ambient sensors.

3) M.O.L.E.® Extractor Handle

This handle assists in the removal of the M.O.L.E.®.

Pallet Sensors

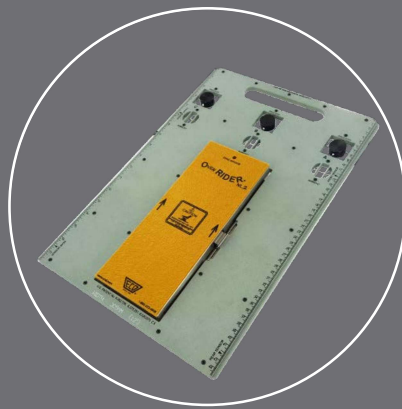
- **Process Sensors:** Mass pucks (3) measure the effect of convection to drive heat evenly into a product. The center 70% in each oven zone reports a Process Delta to verify convection consistency for SPC. Detects a failed fan, clogged vent or wrong oven setting.
- **Ambient Sensors:** Exposed thermocouples (3) have fast response to Oven Air Temperatures. Averages reported per zone to verify consistency (SPC). Detects a failing heater or wrong oven setting.
- **Speed Sensors:** Front & Rear Speed Sensors define process origin and conveyor speed with rail-mounted 'Start' magnet. Belt speed verified for consistency (SPC). Detects the wrong oven setting or maintenance requirement.



The OvenRIDER® NL 2+ works with the SuperM.O.L.E.® Gold and SuperM.O.L.E.® Gold/2



SuperM.O.L.E.® Gold



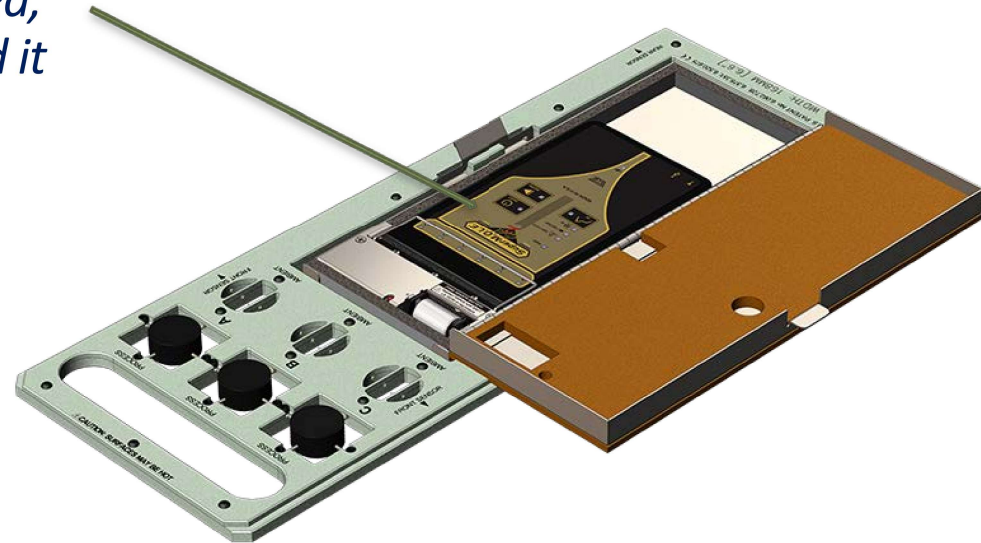
OvenRIDER® NL 2+



SuperM.O.L.E.® Gold 2



*SuperM.O.L.E.® Gold/2 Profiler
requires only insertion into OR Pallet.
No other configuration is required,
the profiler will recognize OR and it
will be set-up automatically.*



Operation:

- 1) Set OvenRIDER® NL 2+ on the conveyor, Press the ON Button then Record.
- 2) Confirm the SuperM.O.L.E.® Gold 2 is properly docked - indicated by the Channel and Rider Mode LED's.
- 3) Lock the barrier closed and let the conveyor pull it through for a 1st Article pass.

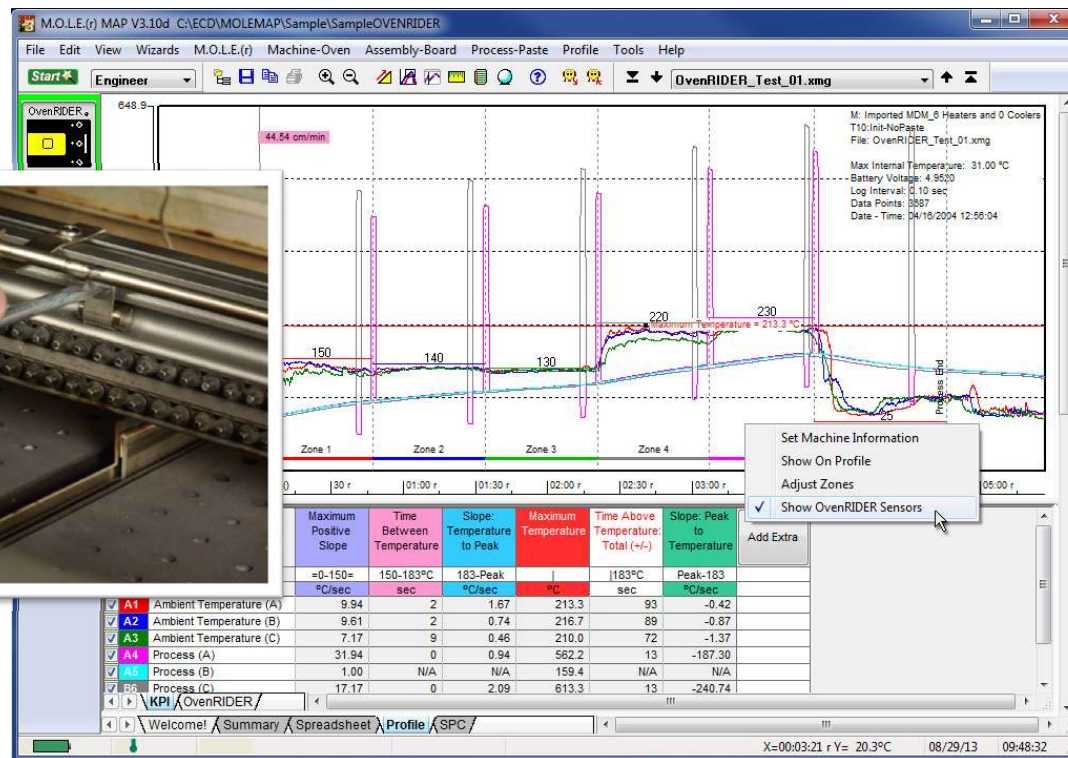
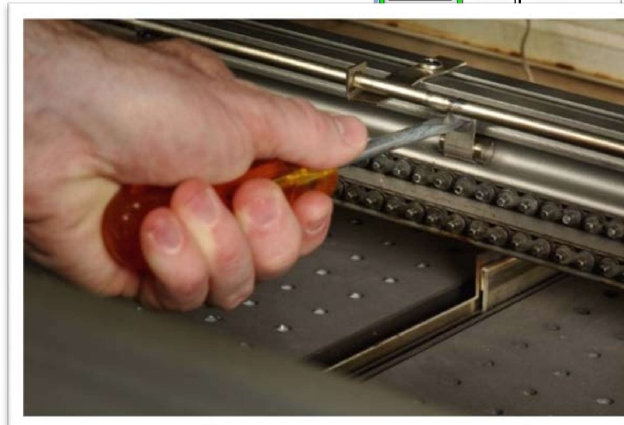


The OvenRIDER® NL 2+ Kit

- *OvenRIDER® NL 2+ Pallet*
- *Start/Zones Magnet Kit [P&C]*
- *M.O.L.E.® MAP Software*
- *Quick Reference Guide*
- *Carrying Box*

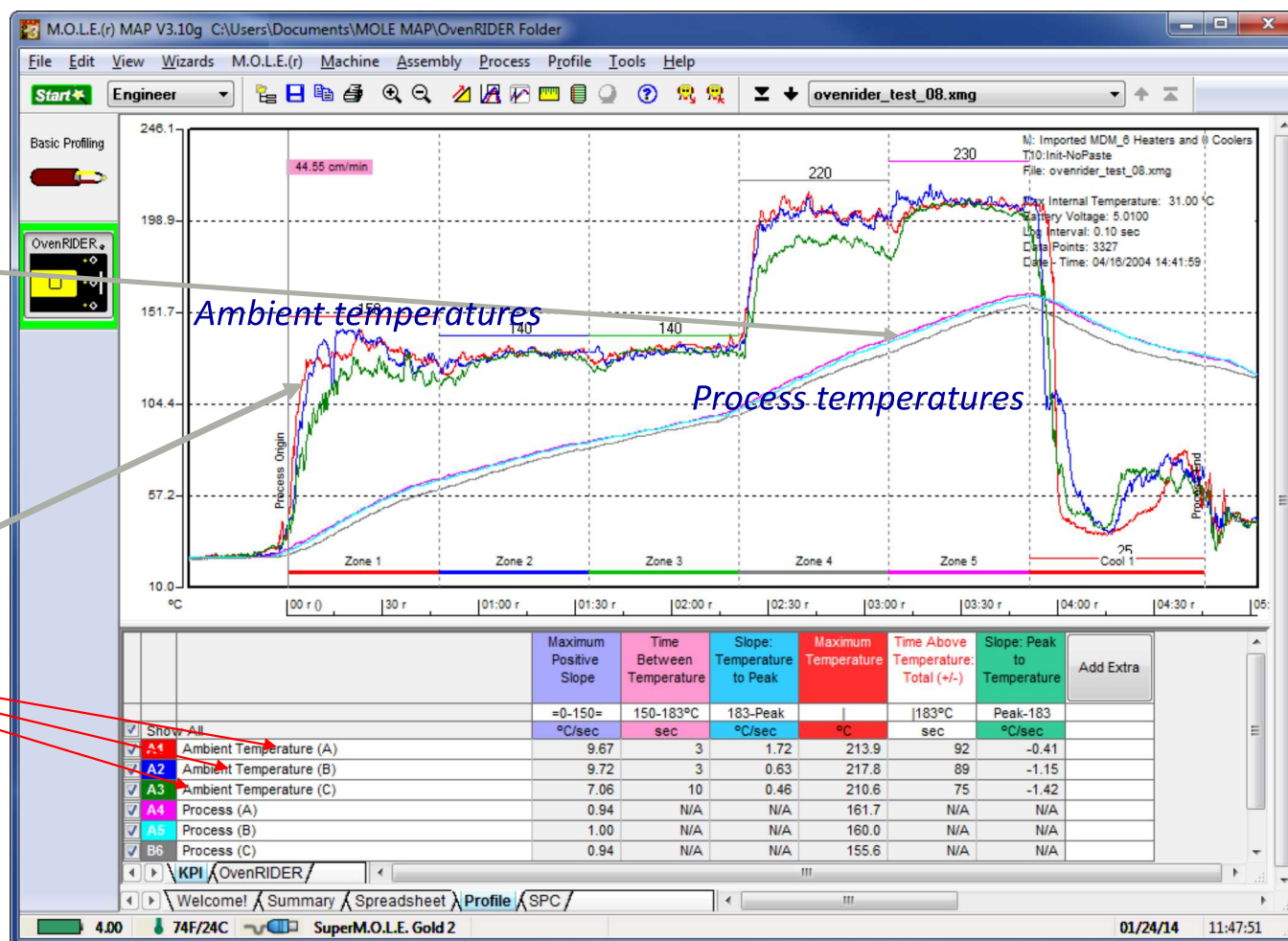
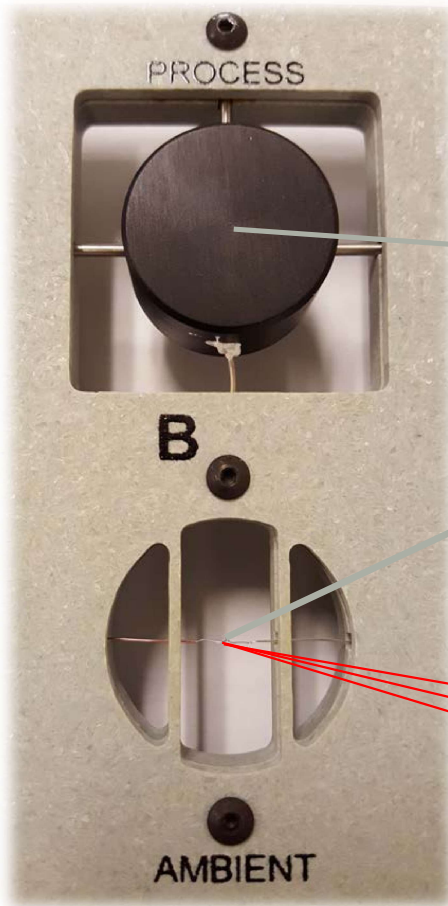


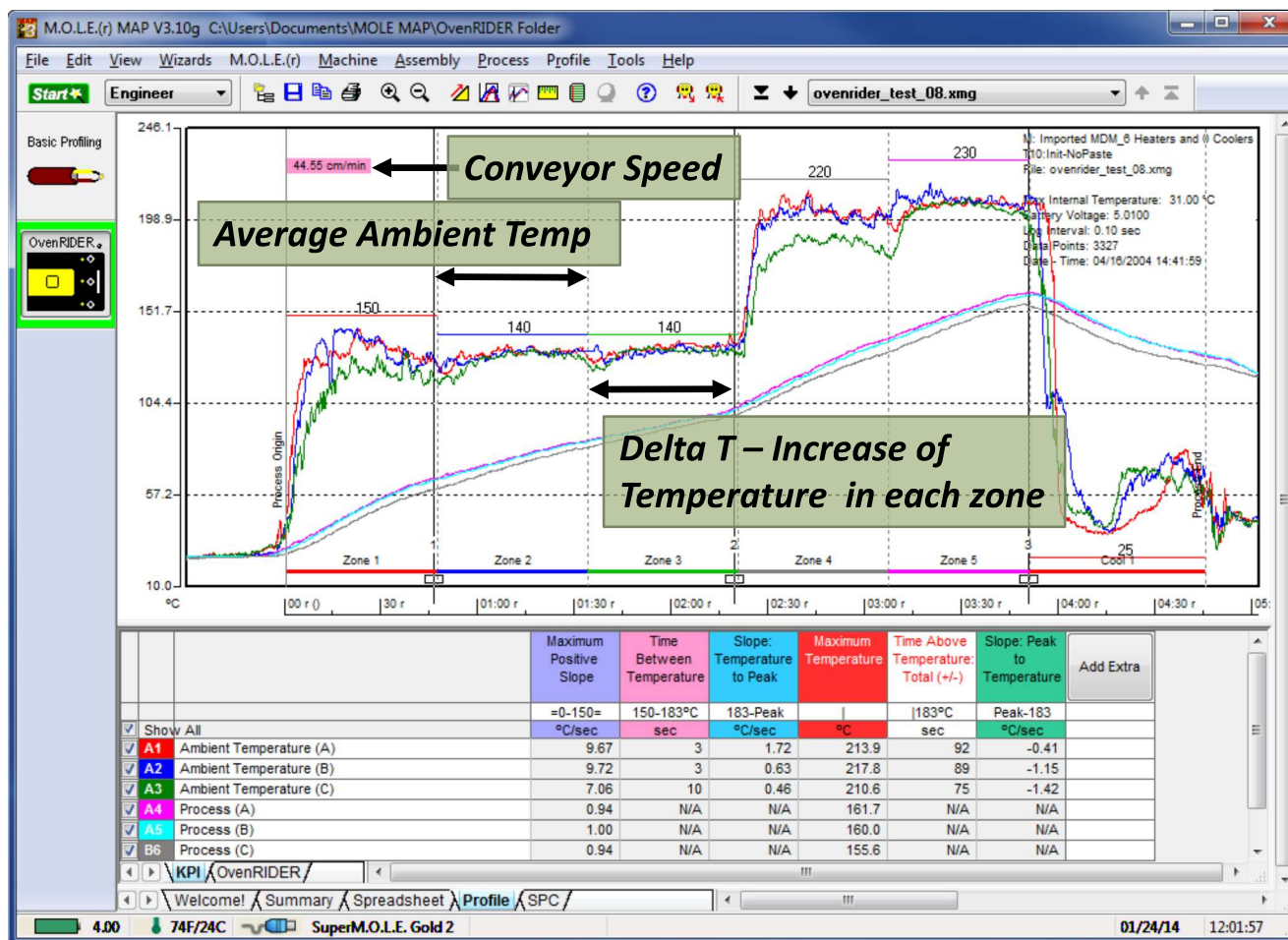
OvenRIDER® NL 2+ uses rail-mounted Magnets to define Oven zone lengths & verify conveyor speed. (A minimum of one Start Magnet is Required).



Typical profile data collection

OVENRIDER® NL2⁺

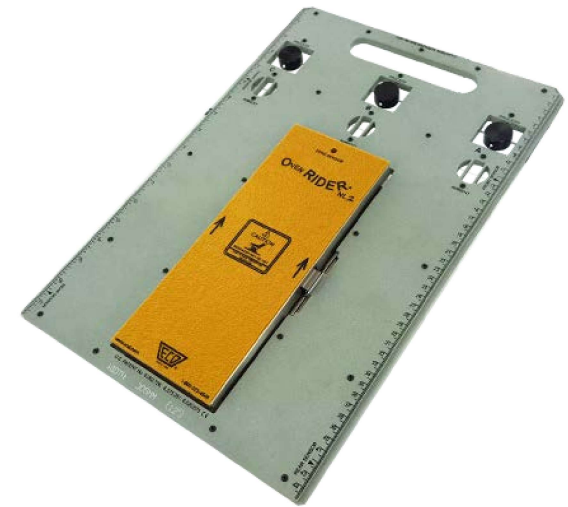




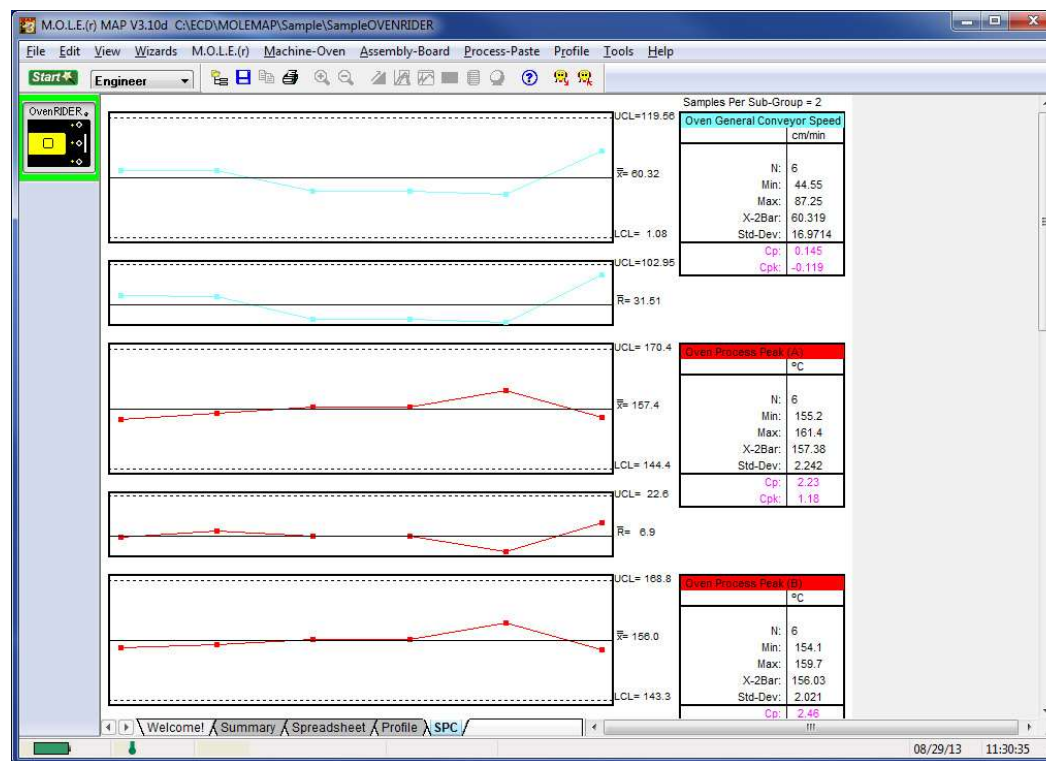
OvenRIDER® NL 2+ Data

OvenRIDER® NL 2+

- *OvenRIDER® NL 2+ collects all critical information of the oven including*
 - *Conveyor speed,*
 - *average ambient temperature in each zone,*
 - *process delta temperatures,*
 - *start, stop temp,*
 - *...and displays in easy to understand form/table*



Each Data Run is automatically saved to the Spreadsheet and oven performance is compared by Parameter against Spec Limits built from a set of baseline standard runs



OvenRIDER(r) Data - ORSample

Company:

File Tag: OR_CMPTRNAME_99999

Date: 04/16/2004

Machine:

Part
Number: Zone 3

Time: 12:56:04

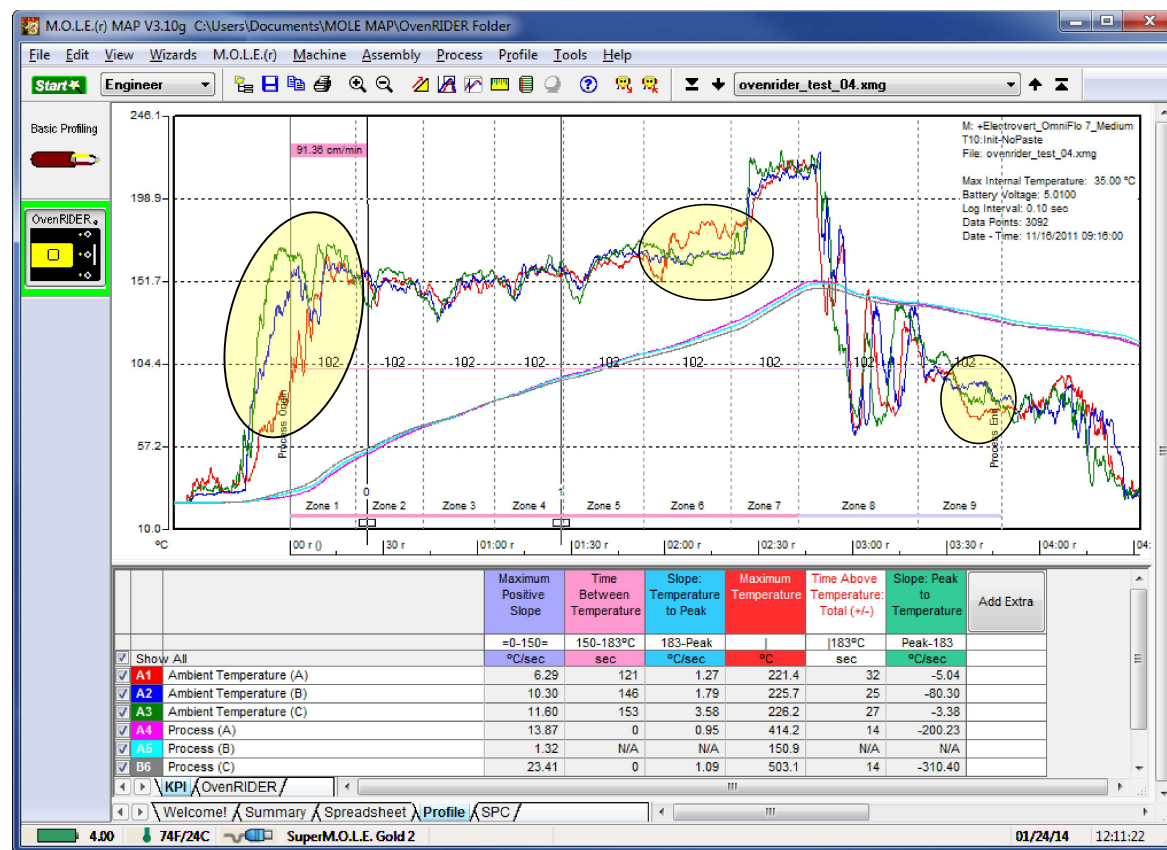
	Oven AMB		Oven Process					Oven		M.O.L.E.(r)
	Start Temp	Peak Avg	Start Temp	Delta	Peak	Time Above	Time Between	Conveyor	Zones	Temp
	C	C	C	C	C	sec	sec	cm/min	-	C
(A)	<u>28.9</u>	207.7	24.4	130.0	161.1	0	0	44.54	6	31.0
(B)	<u>26.1</u>	209.1	24.4	128.9	159.5	0	0			
(C)	<u>26.1</u>	205.5	24.4	126.1	154.5	0	0			

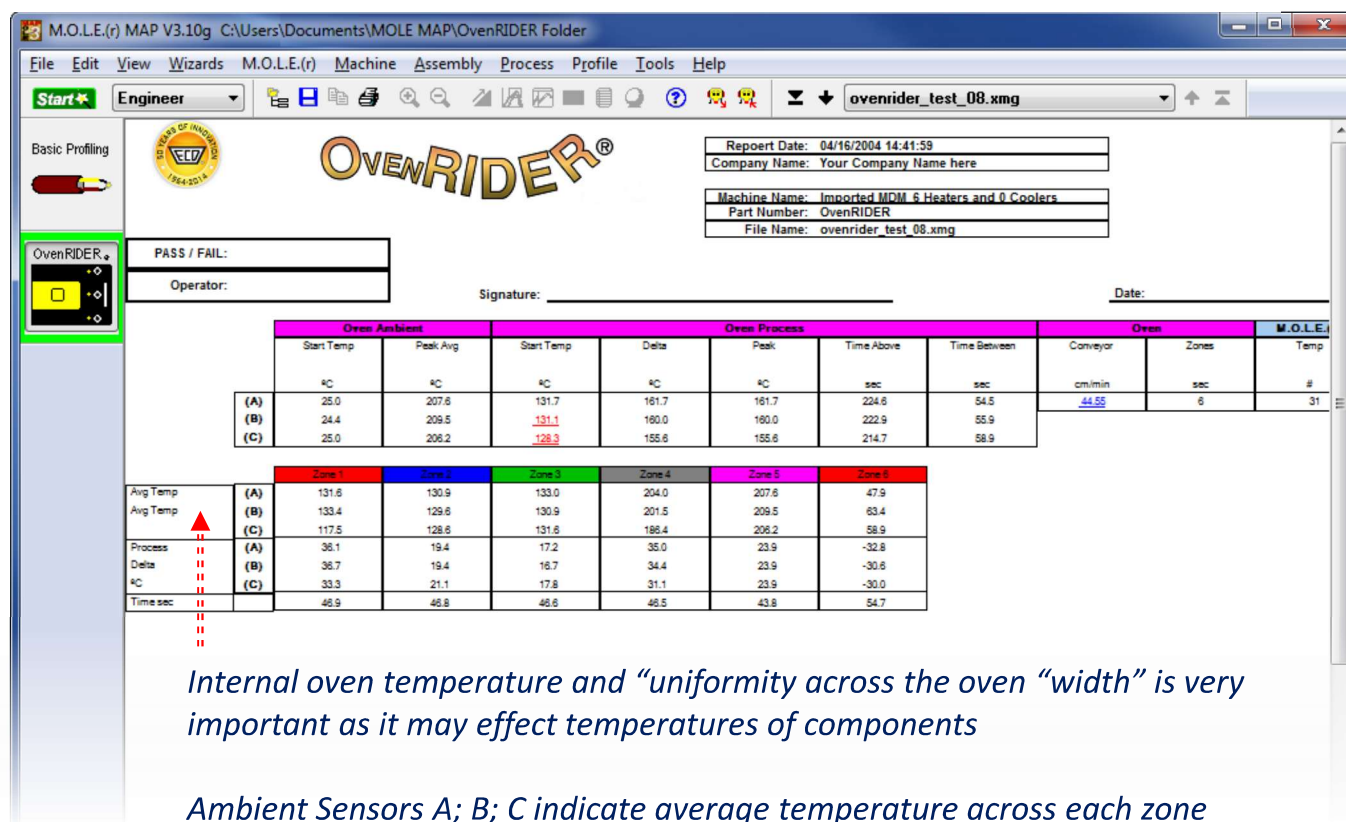
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Avg Temp	(A)	132.0	131.1	127.6	203.7	207.7	47.8
C	(B)	135.0	130.0	124.8	200.5	209.1	61.4
	(C)	118.5	129.0	126.2	184.8	205.5	60.2
Process	(A)	36.1	18.9	<u>16.7</u>	35.0	23.3	-33.3
Delta	(B)	35.6	19.4	<u>15.6</u>	35.0	23.3	-31.1
C	(C)	33.3	20.6	<u>16.7</u>	31.1	23.3	-30.6
Time sec		46.9	46.8	46.6	46.5	43.8	54.7

Visual notification - if recorded data is within limits

Red – above specs **Black** – within specs **Blue** – below specs

Using OvenRIDER® NL 2+ we can quickly show internal oven problems caused by uneven ambient temperatures across oven zones





Internal oven temperature and “uniformity across the oven “width” is very important as it may effect temperatures of components

Ambient Sensors A; B; C indicate average temperature across each zone

Delta T across the oven width should be small 2-3 deg C max

M.O.L.E.(r) MAP V3.10g C:\Users\Documents\MOLE MAP\OvenRIDER Folder

File Edit View Wizards M.O.L.E.(r) Machine Assembly Process Profile

Start★ Engineer

Basic Profiling

OvenRIDER

PASS / FAIL:

Operator:

Signature:

Oven Ambient			
	Start Temp	Peak Avg	Start Temp
	°C	°C	°C
(A)	25.0	207.6	131.7
(B)	24.4	209.5	131.1
(C)	25.0	206.2	128.3

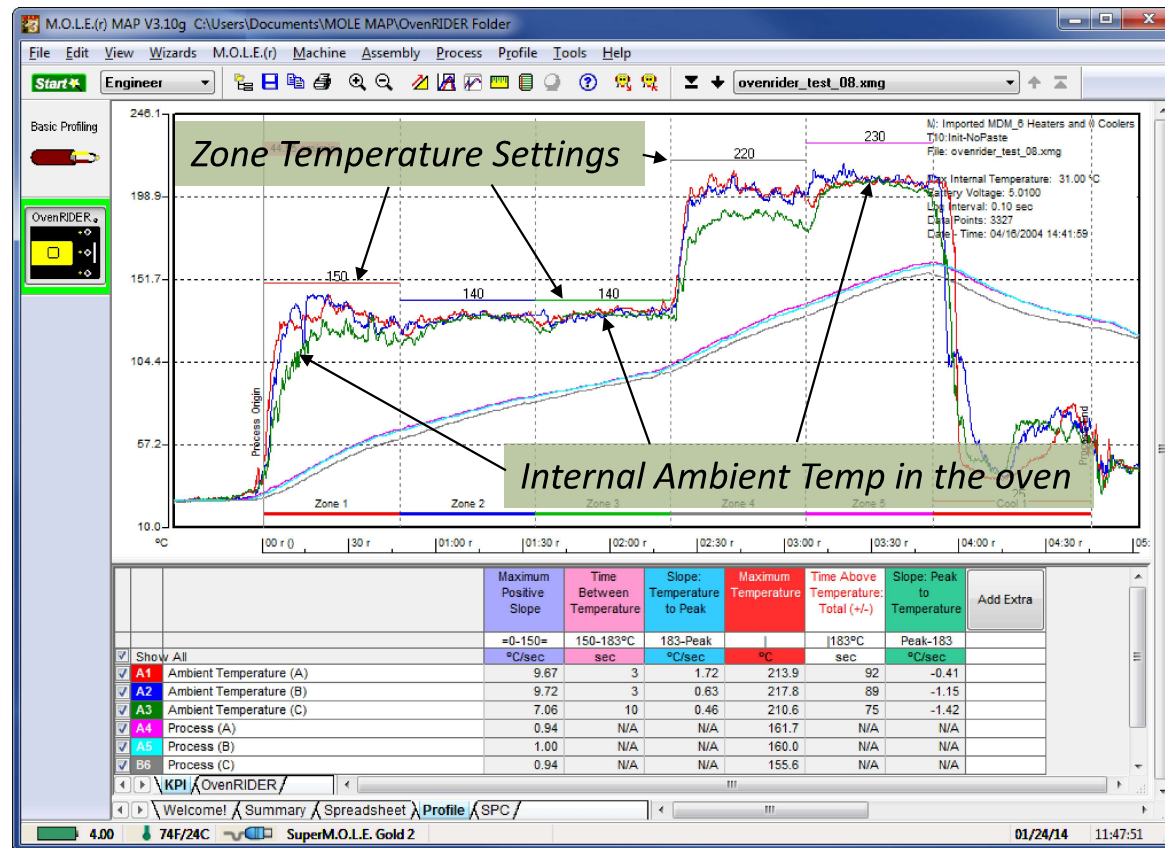
		Zone 1	Zone 2	Zone 3
Avg Temp	(A)	131.6	130.9	133.0
Avg Temp	(B)	133.4	129.6	130.9
	(C)	117.5	128.6	131.6
Process	(A)	36.1	19.4	17.2
Delta	(B)	36.7	19.4	16.7
°C	(C)	33.3	21.1	17.8
Time sec		46.9	46.8	46.6

When the Delta T measured by Ambient Sensors across the oven reaches higher values - this indicates problem - 15.9 deg !!!

Oven Performance analyzes

Oven Zone Temperature Set and OvenRIDER® NL 2+ rider data downloaded

OvenRIDER® NL 2+

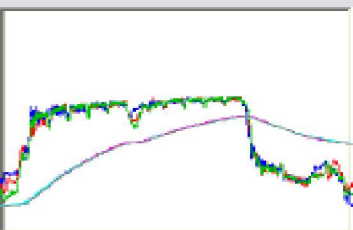


SPG

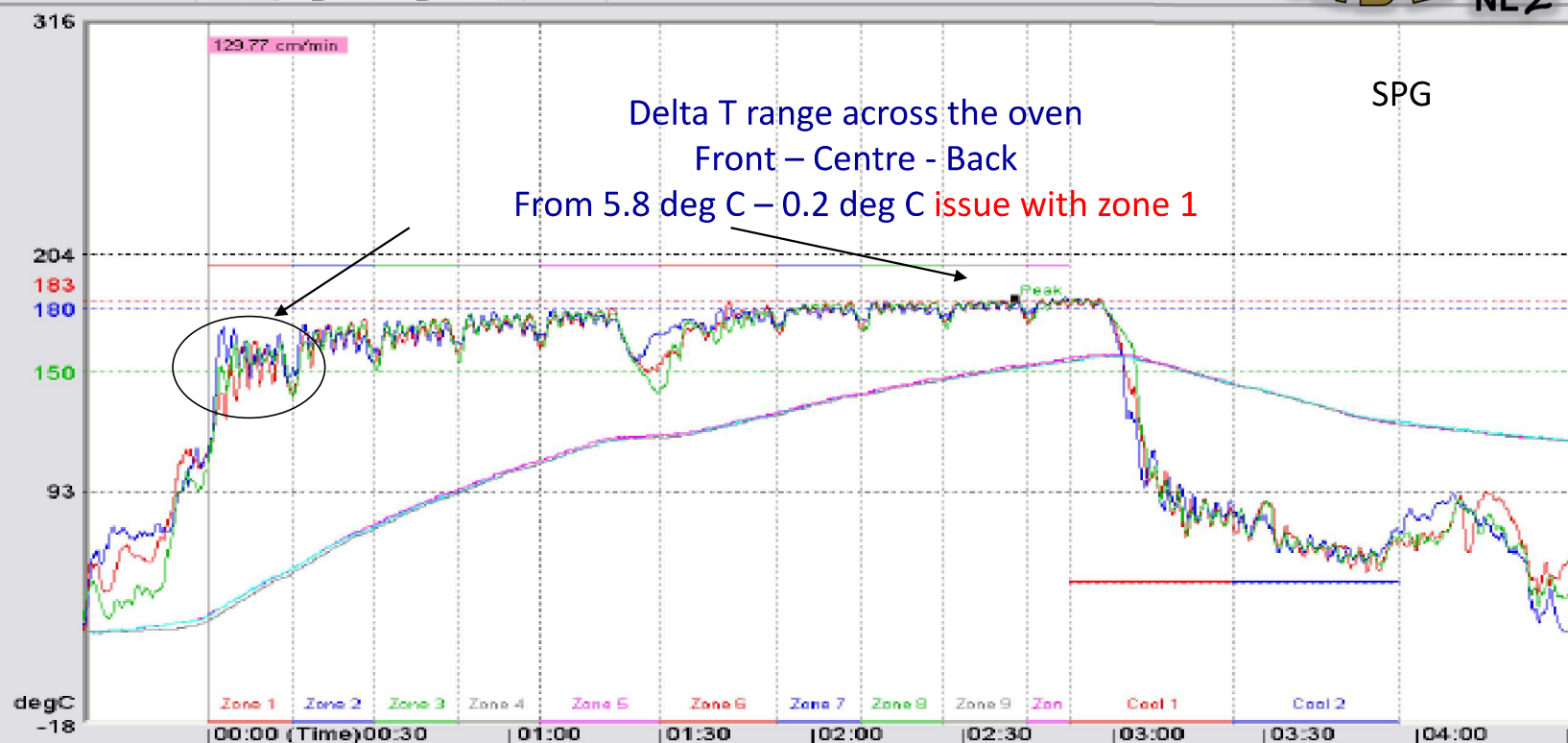
M.O.L.E.(r) STATUS
 Max Internal T: 37C
 Battery: 4.981
 Points: 2967
 Active: 123456
 Interval: 00:00:00.1
 Date: 01/15/06
 Time: 14:12:05 V09.02

Tool status box:

Run 1
 X
 module 3
 cal 200



Show Sensors



Sensor Locations	Peak	Minimum	Max (+)Slope	Max (-)Slope	Time Above 183C	Time 150-180C	183C / Peak	Peak \ 183C
✓ Ambient Temperature (A)	185.0	27.2	8.29	-11.96	9.9	75.8	0.24	-0.13
✓ Ambient Temperature (B)	184.4	26.1	10.92	-12.62	6.7	116.0	0.10	-0.24
✓ Ambient Temperature (C)	183.9	32.2	10.36	-12.52	9.4	113.6	0.23	-0.43
✓ Process (A)	157.8	26.1	1.51	-0.75	0.0	0.0	0.00	0.00
✓ Process (B)	156.1	26.1	1.51	-0.75	0.0	0.0	0.00	0.00
✓ Process (C)	156.7	25.6	1.51	-0.75	0.0	0.0	0.00	0.00

Value Time To Ref T Above Ref Statistics Summary Stats

WELCOME! OvenRIDER(r) Data Spreadsheet Profile Admin Guide SPCA SPCB

X=00:30 Y=101C

02/15/06

17:27:38



M.O.L.E.(r) STATUS

Max Internal T: 37C

Battery: 4.981

Points: 2967

Active: 123456

Interval: 00:00:00.1

Date: 01/15/06

Time: 14:12:05 V09.02

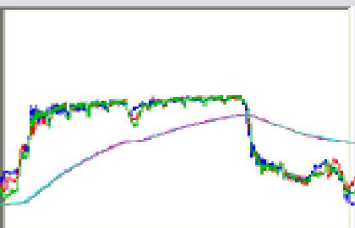
Tool status box:

Run 1

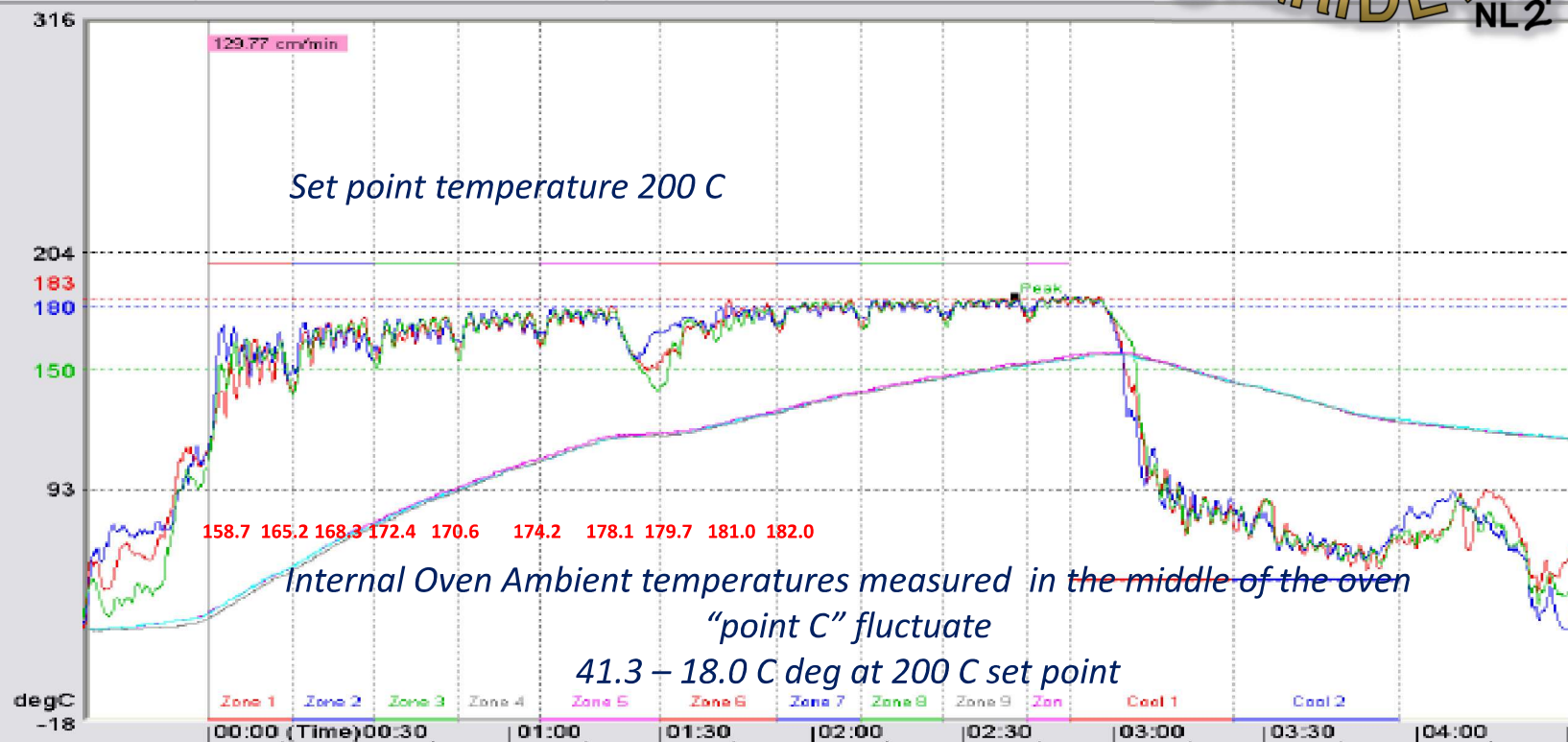
x

module 3

cal 200



Show Sensors



	Sensor Locations	Peak	Minimum	Max (+)Slope	Max (-)Slope	Time Above 183C	Time 150-180C	183C / Peak	Peak \ 183C
☒	Ambient Temperature (A)	185.0	27.2	8.29	-11.96	9.9	75.8	0.24	-0.13
☒	Ambient Temperature (B)	184.4	26.1	10.92	-12.62	6.7	116.0	0.10	-0.24
☒	Ambient Temperature (C)	183.9	32.2	10.36	-12.52	9.4	113.6	0.23	-0.43
☒	Process (A)	157.8	26.1	1.51	-0.75	0.0	0.0	0.00	0.00
☒	Process (B)	156.1	26.1	1.51	-0.75	0.0	0.0	0.00	0.00
☒	Process (C)	156.7	26.6	1.51	-0.75	0.0	0.0	0.00	0.00

Value Time To Ref T Above Ref Statistics Summary Stats

Welcome! OvenRIDER(r) Data Spreadsheet Profile Admin Guide SPCA SPCB

X=00:30 Y=101C

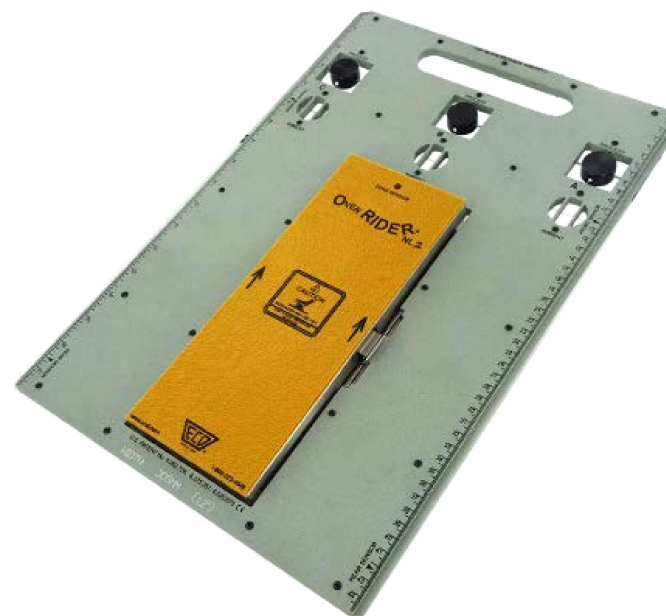
02/15/06 14:27:38



OvenRIDER® NL 2+ collects *Machine* process data

OvenRIDER® NL 2+

- *By a Consistent Method*
 - *Built-In Thermocouples*
- *With a Consistent Vehicle*
 - *Pallet is rated for Thousands of Runs*
- *That is compared statistically over time*
 - *Built-In Statistical Process Control Features*
- *To gauge process conditions remain in spec*
 - *SPC Control Charts & Cp, CpK Process Capability*
- *Such that product *Quality is Managed* proactively*
 - *Process variance trends are tracked to their assignable cause*



Upper/Lower Set point limits
allow to view SPC data
for all oven parameters collected

OVENRIDER® NL2+

The screenshot displays the OVENRIDER(r) SPC V5.20 software interface. The main window is divided into two primary sections: a 'Spreadsheet Parameters' table on the left and a 'SPC Sheets' panel on the right.

Spreadsheet Parameters Table:

	LSL	USL	LCL	UCL
USER 1	-5%	+5%		
USER 2				
USER 3				
USER 4 - Machine				
USER 5 - Part Number				
General -				
General - Date				
General - Time				
General - File Tag				
M.O.L.E (t) - Temp	34.5	30.1		
M.O.L.E (t) - Batt	4.722	5.220		
Oven - Zones	11	13		
Oven - Conveyor	123.26	136.26		
Oven AMB - Start Temp (A)	27.1	29.9		
Oven AMB - Start Temp (B)	27.7	30.7		
Oven AMB - Start Temp (C)	27.9	30.9		
Oven AMB - Peak Avg (A)	172.3	190.5		
Oven AMB - Peak Avg (B)	172.8	191.0		
Oven AMB - Peak Avg (C)	172.2	190.4		
Oven Process - Start Temp (A)	24.5	27.1		
Oven Process - Start Temp (B)	24.3	26.9		
Oven Process - Start Temp (C)	24.3	26.9		
Oven Process - Delta (A)	116.9	129.3		
Oven Process - Delta (B)	116.5	128.7		
Oven Process - Delta (C)	119.1	131.7		
Oven Process - Peak (A)	149.9	165.7		
Oven Process - Peak (B)	148.5	164.1		
Oven Process - Peak (C)	140.9	164.5		
Oven Process - Time Above (A)	0.0	0.0		
Oven Process - Time Above (B)	0.0	0.0		
Oven Process - Time Above (C)	0.0	0.0		
Oven Process - Time Between (A)	0.0	0.0		
Oven Process - Time Between (B)	0.0	0.0		
Oven Process - Time Between (C)	0.0	0.0		
Zone 1 - Temp	15.7	17.3		
Zone 1 - Avg Temp (A)	143.4	158.4		
Zone 1 - Avg Temp (B)	151.0	167.0		
Zone 1 - Avg Temp (C)	147.9	163.5		
Zone 1 - Process Delta (A)	20.4	22.6		
Zone 1 - Process Delta (B)	21.1	23.3		
Zone 1 - Process Delta (C)	21.5	23.7		
Zone 2 - Temp	15.6	17.2		
Zone 2 - Avg Temp (A)	157.1	173.7		
Zone 2 - Avg Temp (B)	156.0	173.4		
Zone 2 - Avg Temp (C)	157.6	174.2		
Zone 2 - Process Delta (A)	20.2	22.4		
Zone 2 - Process Delta (B)	19.0	21.0		

SPC Sheets Panel:

- SPCA:** Zone 1 - Avg Temp (A), Zone 1 - Avg Temp (B), Zone 1 - Avg Temp (C)
- SPCB:** Zone 9 - Avg Temp (A), Zone 9 - Avg Temp (B), Zone 9 - Avg Temp (C)
- SPCC:**
- SPCD:**
- SPCE:**
- SPCF:**
- SPCG:**
- SPCH:**
- SPCI:**

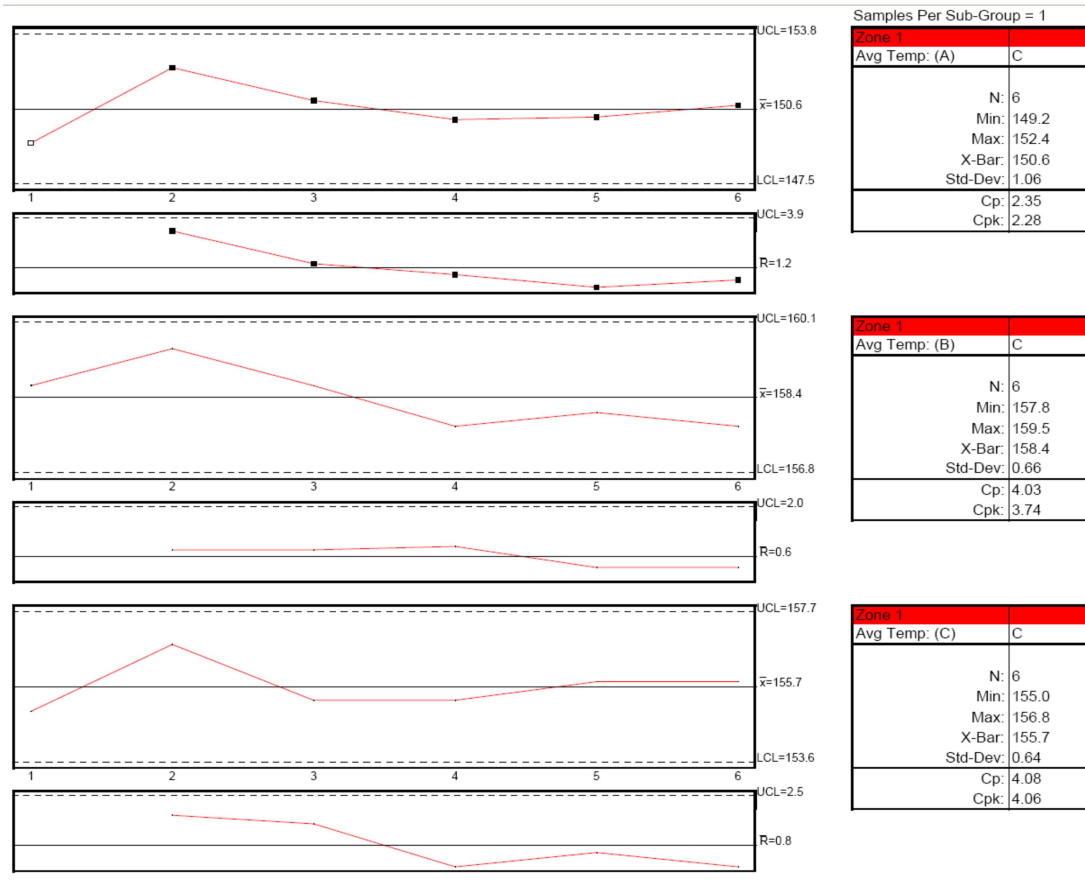
The bottom status bar shows the current view as 'Admin' and the date/time as '02/16/06 18:30:27'.



Min, Max, X-bar, StdDev Cp, Cpk

OVENRIDER®
NL2⁺

SPC A - Calibration 200



From the data collected we can analyze many oven parameters and detect Conveyor Speed, Internal Temperatures and convection changes over time

OvenRIDER(r) Data - Calibration 200

Company: Solelectron P1

File Tag: OR_THOMAS_000117

Date: 01/15/2006

Machine: module 3

Part Number: cal 200

Time: 14:12:05

	Oven AMB		Oven Process					Oven		M.O.L.E.(r)
	Start Temp	Peak Avg	Start Temp	Delta	Peak	Time Above	Time Between	Conveyor	Zones	Temp
	C	C	C	C	C	sec	sec	cm/min	-	C
(A)	27.2	181.5	26.1	123.3	157.8	0	0	129.77	12	37.0
(B)	29.4	182.0	26.1	122.2	156.1	0	0			
(C)	32.2	181.2	26.1	125.0	156.7	0	0			

		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Zone 7	Zone 8	Zone 9	Zone 10
Avg Temp C	(A)	149.2	165.5	167.4	171.3	171.1	171.8	178.6	179.8	181.1	181.5
	(B)	158.7	165.2	168.3	172.4	170.6	174.1	178.1	179.7	181.0	182.0
	(C)	155.0	166.1	169.8	172.8	171.3	170.1	179.7	180.2	181.2	181.0
Process Delta C	(A)	21.7	21.1	16.1	13.9	12.2	10.6	8.9	7.2	6.7	2.8
	(B)	22.2	20.0	16.1	13.3	13.3	10.6	8.3	7.2	6.1	3.3
	(C)	22.8	20.6	16.7	14.4	12.8	10.0	8.9	7.8	6.1	2.8
Time sec		16.5	16.4	16.5	16.4	23.5	23.5	16.5	16.5	16.4	8.6

		Zone 11	Zone 12
Avg Temp C	(A)	119.9	68.3
	(B)	118.0	67.2
	(C)	123.1	67.9
Process Delta C	(A)	-11.7	-19.4
	(B)	-10.6	-18.3
	(C)	-11.1	-18.3
Time sec		32.5	32.9

Conveyor out of limit warning

OvenRIDER(r) Data - ORSample

Company:

File Tag: OR_CMPTRNAME_99999

Date: 04/16/2004

Machine:

Part
Number: Conveyor

Time: 13:36:34

	Oven AMB		Oven Process					Oven		M.O.L.E.(r)
	Start Temp	Peak Avg	Start Temp	Delta	Peak	Time Above	Time Between	Conveyor	Zones	Temp
	C	C	C	C	C	sec	sec	cm/min	-	C
(A)	<u>28.9</u>	206.2	24.4	124.5	154.5	0	0	<u>49.61</u>	6	<u>27.0</u>
(B)	25.6	208.1	24.4	123.9	153.3	0	0			
(C)	<u>33.3</u>	204.7	24.4	<u>121.1</u>	148.3	0	0			

Excessive speed (red)

		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Avg Temp	(A)	130.7	130.1	132.6	202.5	206.2	46.3
C	(B)	132.7	128.7	129.9	199.9	208.1	60.5
	(C)	118.3	127.5	130.6	185.9	204.7	58.5
Process	(A)	<u>33.3</u>	<u>17.8</u>	18.3	<u>32.8</u>	22.2	<u>-29.4</u>
Delta	(B)	<u>32.8</u>	<u>18.3</u>	17.8	<u>32.2</u>	22.8	<u>-27.2</u>
C	(C)	<u>30.0</u>	20.0	17.8	30.6	<u>21.7</u>	<u>-26.1</u>
Time sec		<u>42.1</u>	<u>42.1</u>	<u>41.8</u>	<u>41.7</u>	<u>39.4</u>	<u>49.1</u>

Shorter time in each zone (blue)

Blower failure warning

OvenRIDER(r) Data - ORSample

Company:

File Tag: OR_CMPTRNAME_99999

Date: 04/16/2004

Machine:

Part
Number: Zone 3

Time: 12:56:04

Oven AMB		Oven Process					Oven		M.O.L.E.(r)
Start Temp	Peak Avg	Start Temp	Delta	Peak	Time Above	Time Between	Conveyor	Zones	Temp
C	C	C	C	C	sec	sec	cm/min	-	C
(A) <u>28.9</u>	207.7	24.4	130.0	161.1	0	0	44.54	6	31.0
(B) <u>26.1</u>	209.1	24.4	128.9	159.5	0	0			
(C) <u>26.1</u>	205.5	24.4	126.1	154.5	0	0			

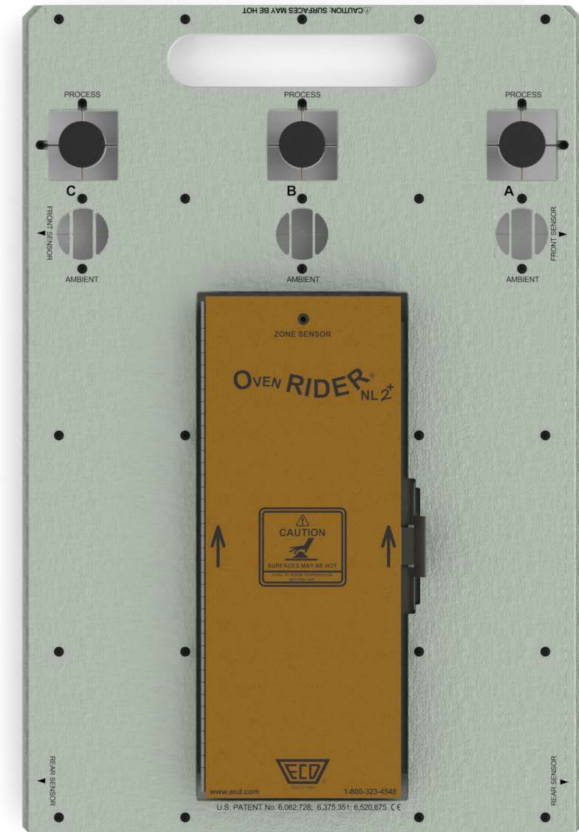
		Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Avg Temp	(A)	132.0	131.1	127.6	203.7	207.7	47.8
C	(B)	135.0	130.0	124.8	200.5	209.1	61.4
	(C)	118.5	129.0	126.2	184.8	205.5	60.2
Process	(A)	36.1	18.9	<u>16.7</u>	35.0	23.3	-33.3
Delta	(B)	35.6	19.4	<u>15.6</u>	35.0	23.3	-31.1
C	(C)	33.3	20.6	<u>16.7</u>	31.1	23.3	-30.6
Time sec		46.9	46.8	46.6	46.5	43.8	54.7

Blower failure indication
as reduced convection

OvenRIDER® NL 2+ collects Machine process data

- *By a Consistent Method*
 - *Built-In Thermocouples*
- *With a Consistent Vehicle*
 - *Pallet is rated for Thousands of Runs*
- *Data is compared statistically over time*
 - *Built-In Statistical Process Control Features*
- *To gauge process conditions remain in spec*
 - *SPC Control Charts & Cp, CpK Process Capability*
- *Such that product Quality is Managed proactively*
 - *Process variance trends are tracked to their assignable cause*
- *Visually displays temperature variances in an oven*

OvenRIDER® NL 2+



OvenRIDER® NL 2⁺

OvenRIDER® NL 2++ ensures the reflow soldering process remains in control.

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