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Quick and easy way to characterize Low voltage (80-125 kV) EB Accelerators using Fast Check Strips

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Agenda

- Low Voltage EB Applications & Markets
- What is Dosimetry?
- Limitations of Dosimetry Used Today
- Fast Check Strips
- Reading & Calibration
- Comparison of Data and Repeatability
- Conclusions & Recommendations
- Acknowledgements



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Development of Low Voltage EB Equipment in the 80 – 125 kV Range

- Speeds of 450 mpm @ 30 kGy (High Speed Industrial Applications)
- Smaller and Less Expensive
- Lower Voltage to minimize substrate issues



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Applications of Low Voltage EB Equipment EZCure Series

- **Curing of Coatings for Laminate Replacement for Packaging Applications**
 - Conventional solvent & water based Gravure inks
 - Conventional solvent & water based Flexo inks
- **Curing of EB Inks**
 - Web Offset Gravure
 - CI-Flexo
 - EB Gravure Inks (Latest Development)
- **Cross-linking of High Barrier Shrink Films**
- **Curing of Coatings on Furniture Foils & coatings for direct metallization for cigarette packaging**
- **Curing of Laminating Adhesives**





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**Market need to Quickly & Easily
Characterize EB Processors To
Ensure Reliable Performance.
For High Speed High Volume
24/7 Industrial Applications**



Why Dosimetry is Important?

- **Ensures Consistent Electron Output During Various Stages of Development**
 - Lab Scale
 - Pilot Scale
 - Commercial
 - Validation of EB equipment at manufacturers site to meet specification
 - Validation of EB equipment at customers site to meet specification
- **Ensures Consistent Electron Output During Ongoing Production**

Electron Beam Processing is the only technology that offers such precise measurement. Very important for food packaging purposes to be in compliance with food law



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What is Dosimetry?

A Dosimeter is anything that undergoes an observable and consistent Physical Change that can be co-related with the dose of radiation it has received.

Radiochromic Nylon Dye Dosimeters Commonly used for Low Voltage EB Equipment Characterization

Types of Dosimeters Commonly Used For Low Voltage EB Processing

- B3 Dosimeter Film supplied by GEX Corporation
- FWT nylon Dosimeter Films supplied by Far West Technology
 - 2 – Types
 - 50 Micron Thick for 150-300kV (Acc. \pm 5%)
 - 10 Micron Thick for 80-125kV (Acc. \pm 8%)

Note: At ESI We use FWT Nylon Dosimeter Films



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EB Processor Characterization

- **Yield Measurements**
- **Beam Uniformity**
- **Penetration Performance**

Yield Measurements

Usually Three at Various Speeds and Beam Currents

$$K = \frac{\text{Dose}(D) \times \text{Speed}(S)}{\text{Beam Current}(I)}$$

D = Mrads OR kGY

S = FPM OR MPM

I = mA

K = Mrads\fpm\mA OR kGy\mpm\mA

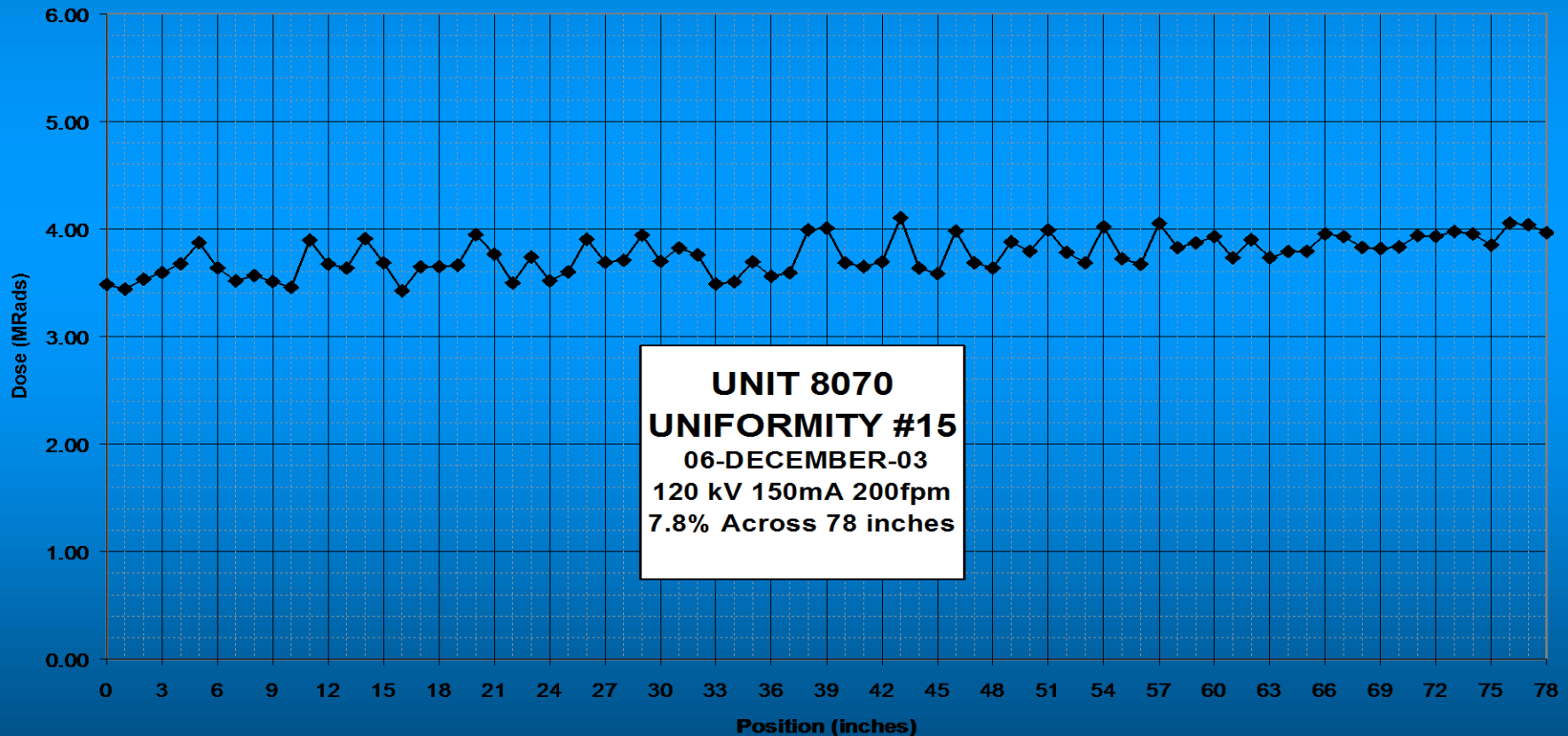


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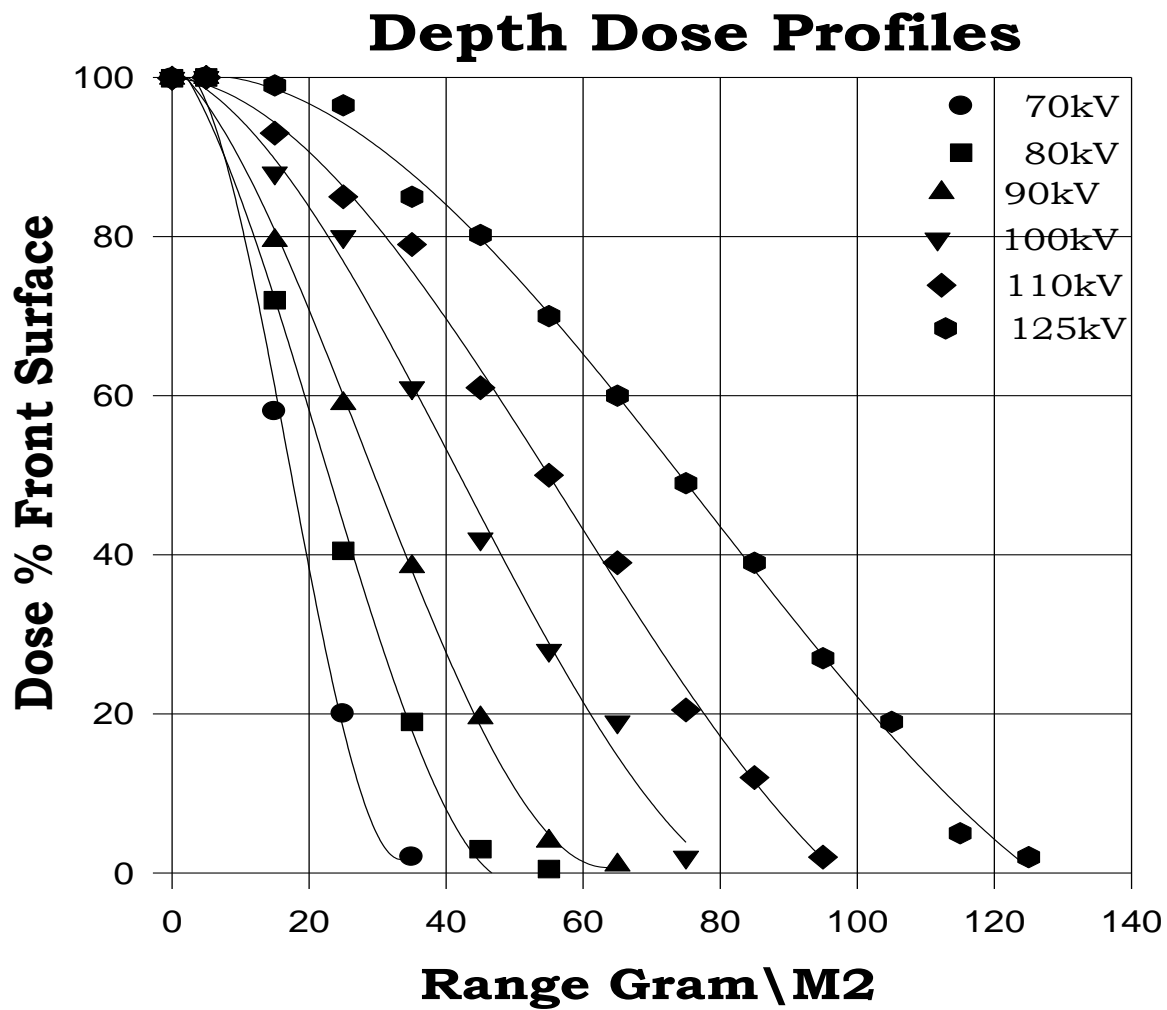
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Beam Uniformity

Always With 50 Micron Dosimeters 3-inline 1" spacing



Depth Dose












Limitations of the Existing Radiochromic Dosimetry Systems

- Temperature and humidity dependence, requires controlled environmental conditions.
- Requires precise gauge assembly to measure thickness that needs to be equilibrated to room conditions for at least 24 hrs.
- Requires densitometer, or a spectro photometer for reading.
- Requires trained personnel to handle 8-10 μ thick dosimeter, needed for low voltage measurements.
- Requires 24 hrs of development or an oven for annealing.
- Onsite testing of EB processors difficult
- Expensive



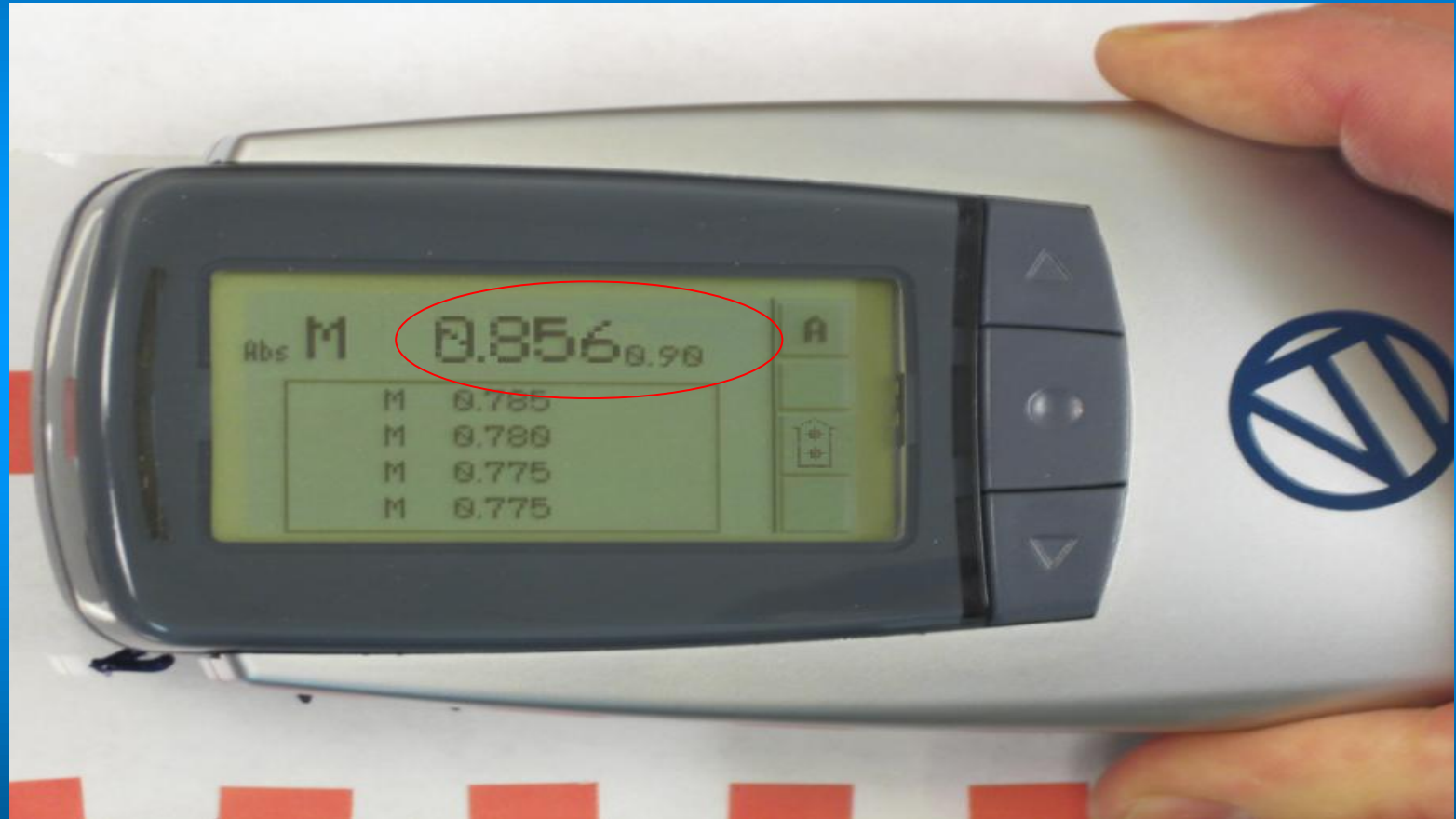
EB Fast check Strips

Dose (kGy)	0	5	10	20	30	40	50	70	100
Color									

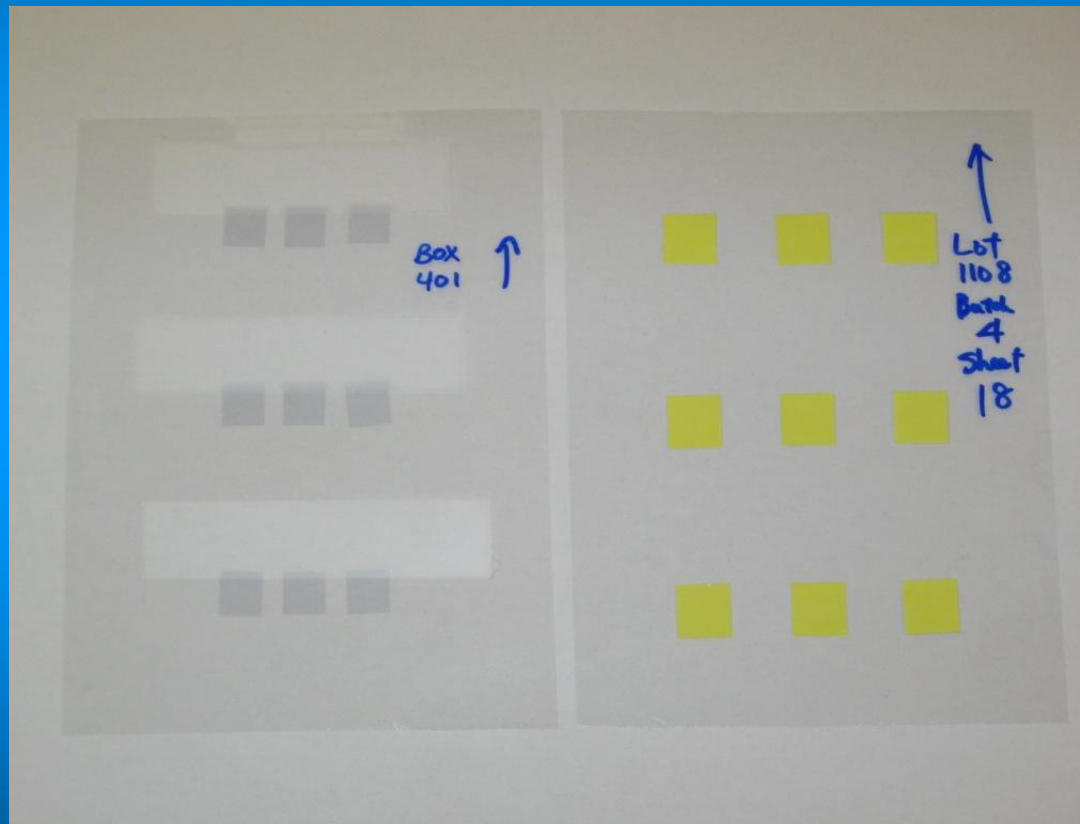
- 150kV, 50fpm



Reading of the Fast Check strips using Color Densitometer (Beta color Reader)



Calibration of Fast check Strips with FWT nylon dosimeters



Calibration Curve of the EB Fast check Strips

COEFFICIENTS

A = 0.3522

B = 0.1404

BETA READER 0798

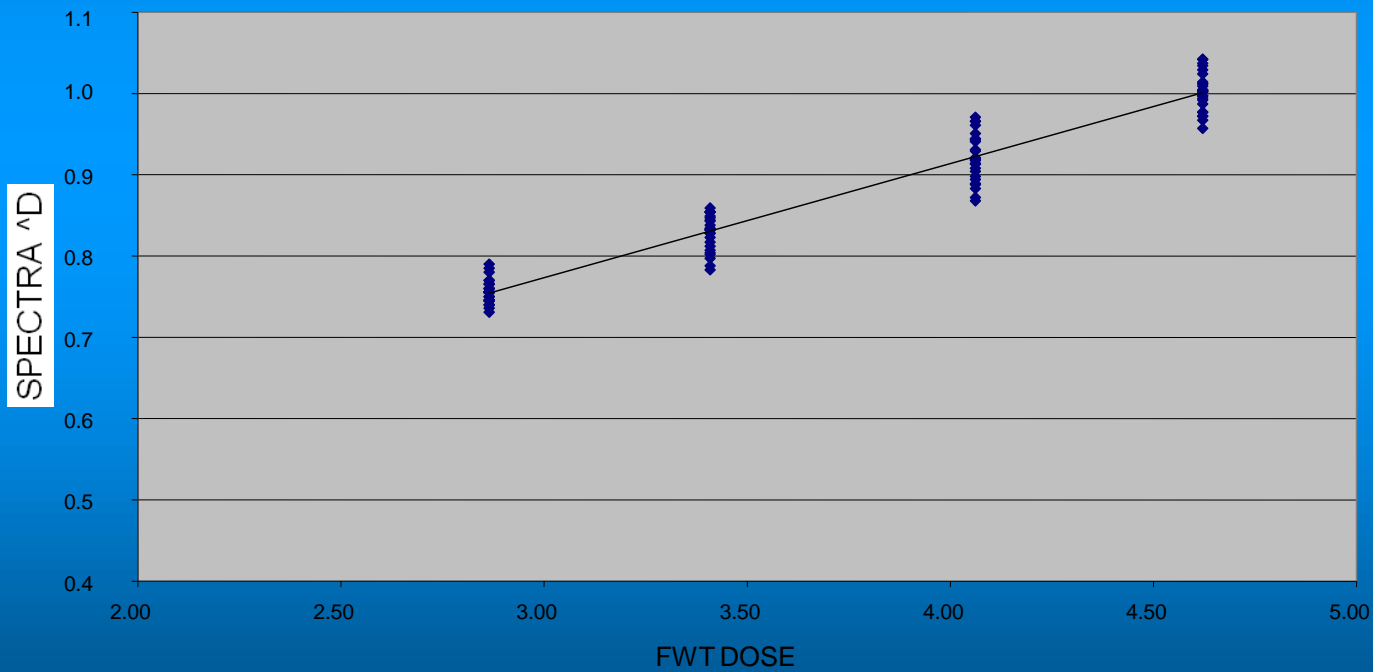
SPECTRA CURVE

SEPTEMBER 2009

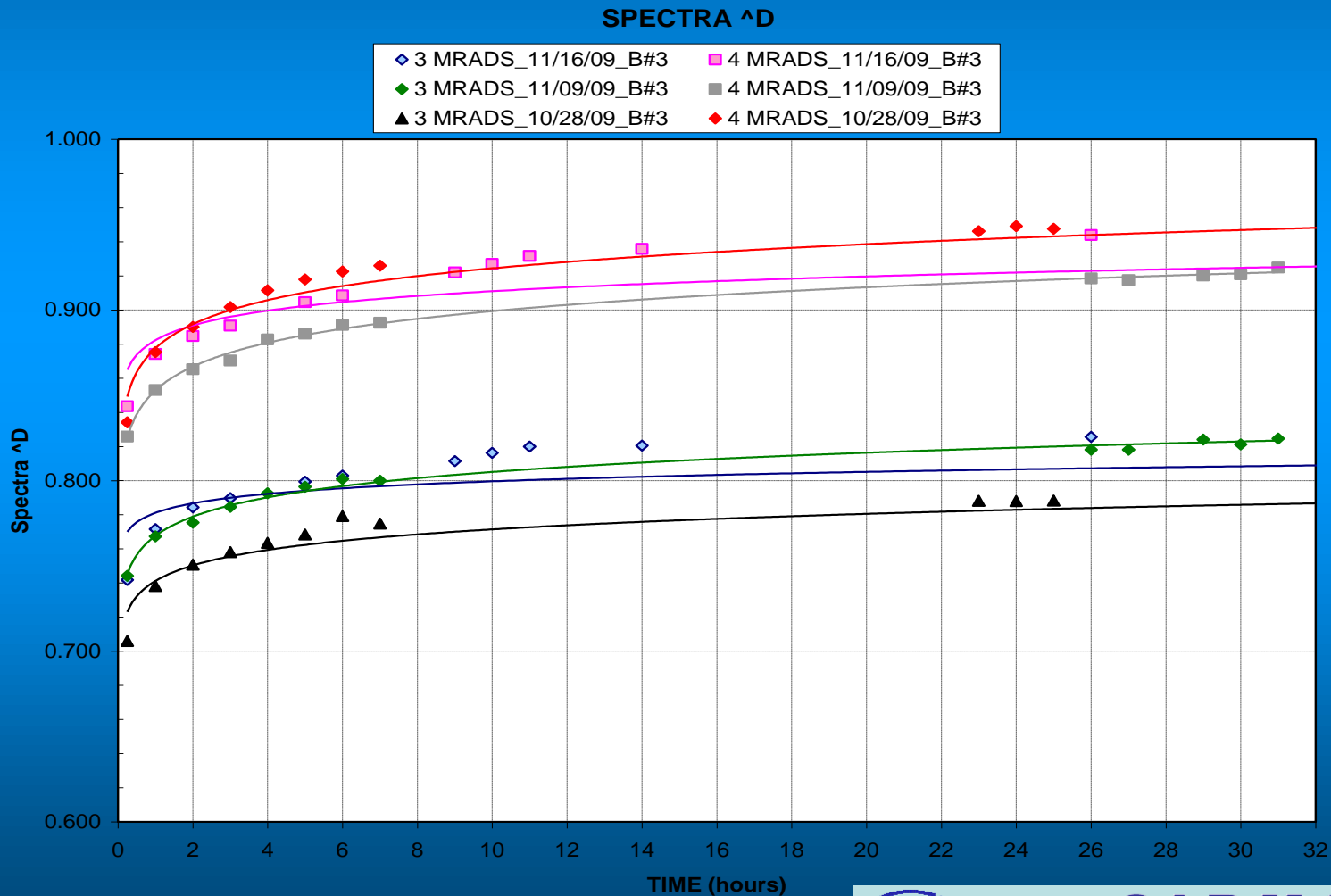
LOT#1108, BATCH#4

DOSE= (Y-0.3522/0.1404)

$$y = 0.1404x + 0.3522$$



Development Times of Spectra Dosimeters



Measurements with EB Fast Check Strips

- Yield Measurements “K”
- Longitudinal Beam Uniformity



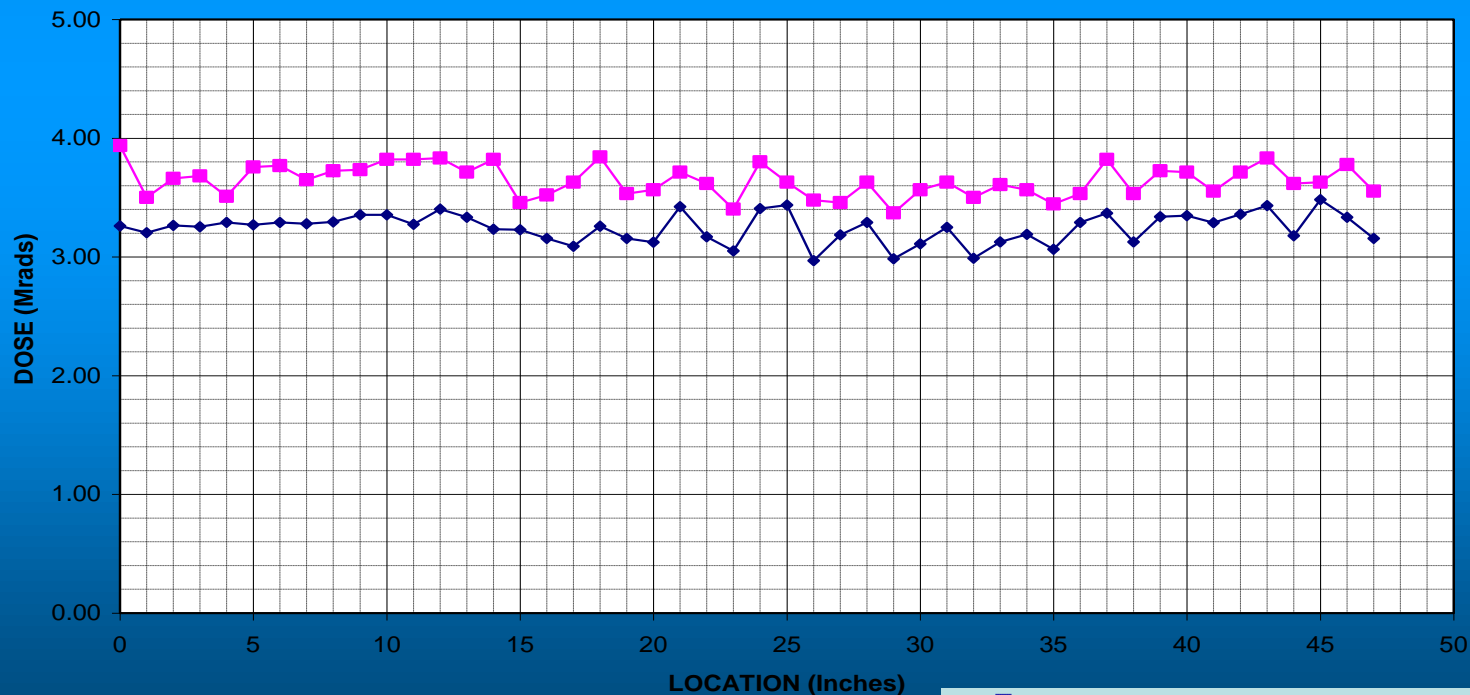
Dose Comparison FWT nylon & EB Fast Check Strips

YIELD COMPARISON					
UNIT 8201 - 125 kV					
Reader #3367					
Far West			Spectra		
Dosimetry			Dosimetry		
	Dose		Dose		% Diff
Run	Mrads	Avg. K	Mrads	Avg. K	K value
Yield#1	3.43	1.86	3.43	1.86	-0.1%
Yield#2	3.41	1.85	3.41	1.86	0.6%
Yield#3	3.48	1.89	3.44	1.87	-1.2%
	Total	1.87	Total	1.86	
	Avg.K		Avg.K		

Uniformity comparison FWT Nylon & Fast Check Strips

UNIT 8179
UNIFORMITY
125kV, 106mA, 60m/mim

◆ FWT +/- 8.0%
■ SPECTRA +/- 7.8%



Repeatability measurements FWT Nylon & Fast Check Strips

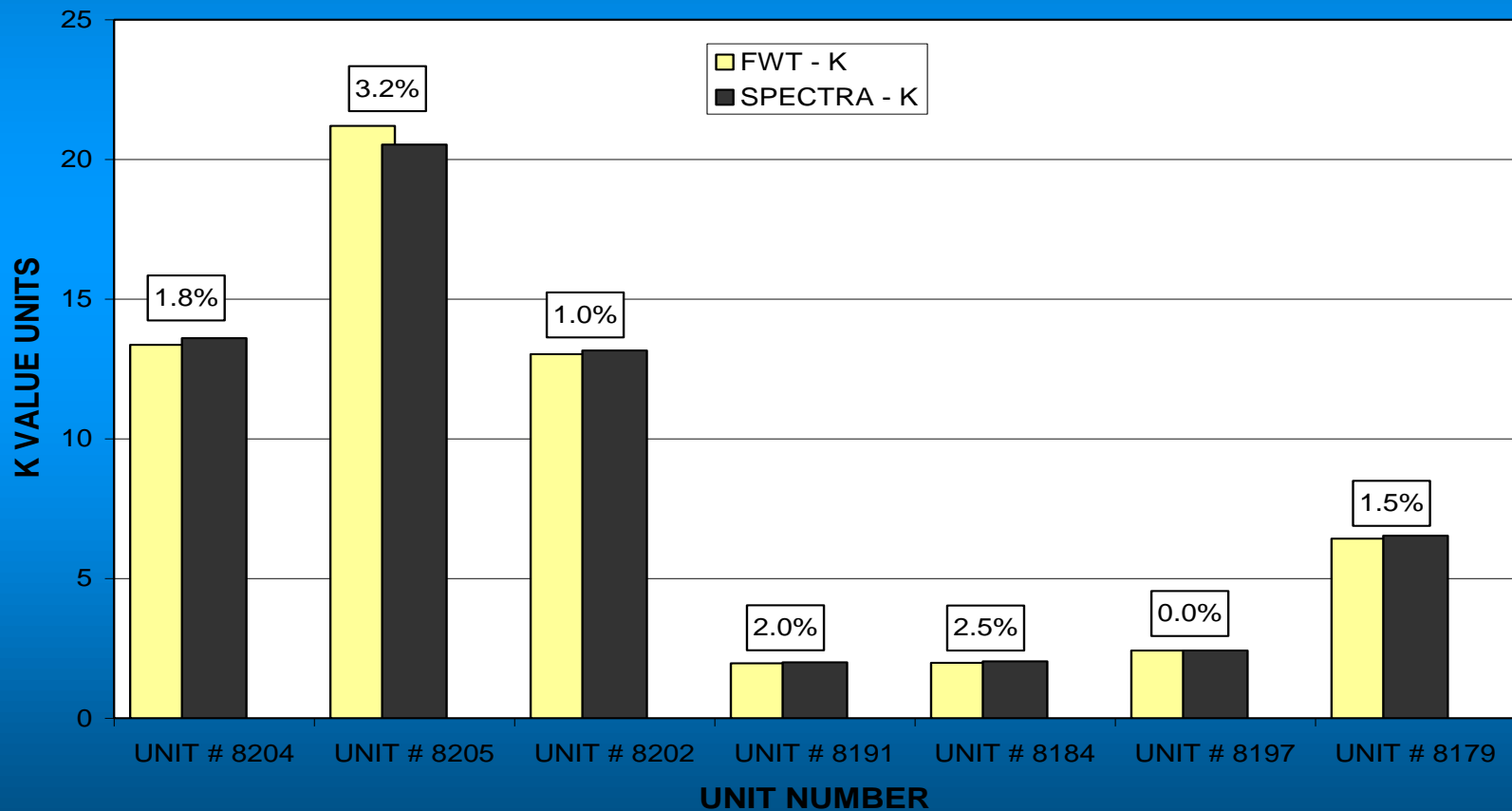
Table 4

SPECTRA - FWT DOSE COMPARISON UNIT EZ95 - 110KV

16-Mar-09	FWT 10MICRON		SPECTRA		%DIFF
	Avg. Dose	Total Std.Dev.	Avg. Dose	Total Std.Dev.	
Yield #1	2.66	0.07	2.64	0.10	-1.1%
3 MRADS		4.9%		7.3%	
Yield #2	4.03	0.07	3.88	0.16	-3.8%
4 MRADS		3.6%		8.2%	
Yield #1	2.66	0.07	2.65	0.09	-0.6%
3 MRADS		4.9%		6.6%	
Yield #2	4.03	0.07	3.88	0.17	-3.8%
4 MRADS		3.6%		8.8%	

Field Testing Results

FWT VS. SPECTRA - FIELD RESULTS
110 KV



Conclusions & Recommendations

- EB Fast Check Strips provides a quick & easier way to measure the performance of the EB accelerators especially at low voltages.
- Batch to batch repeatability results when compared to FWT radiochromic dosimeters is very encouraging.
- It is recommended to use fast check strips to evaluate the performance of EB accelerators on-site after installation. Final acceptance of EB equipment performance will be done using FWT dosimeters.
- It is recommended to use fast check strips by users of EB equipment to periodically evaluate its performance especially after routine maintenance.
- The onsite measuring technique offered by fast check strips will aid the growth of EB accelerators in various high volume applications globally.



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THANK YOU FOR YOUR ATTENTION

