



Using The New Tabular Crack Growth Rate Data Library

Cordell E. Smith
James A. Harter



LexTech, Inc.
8285 Rhine Way
Centerville, OH 45458



Background



- Initially assigned to create curve fits for twelve materials
- Now have 40 materials available for release



Data Available

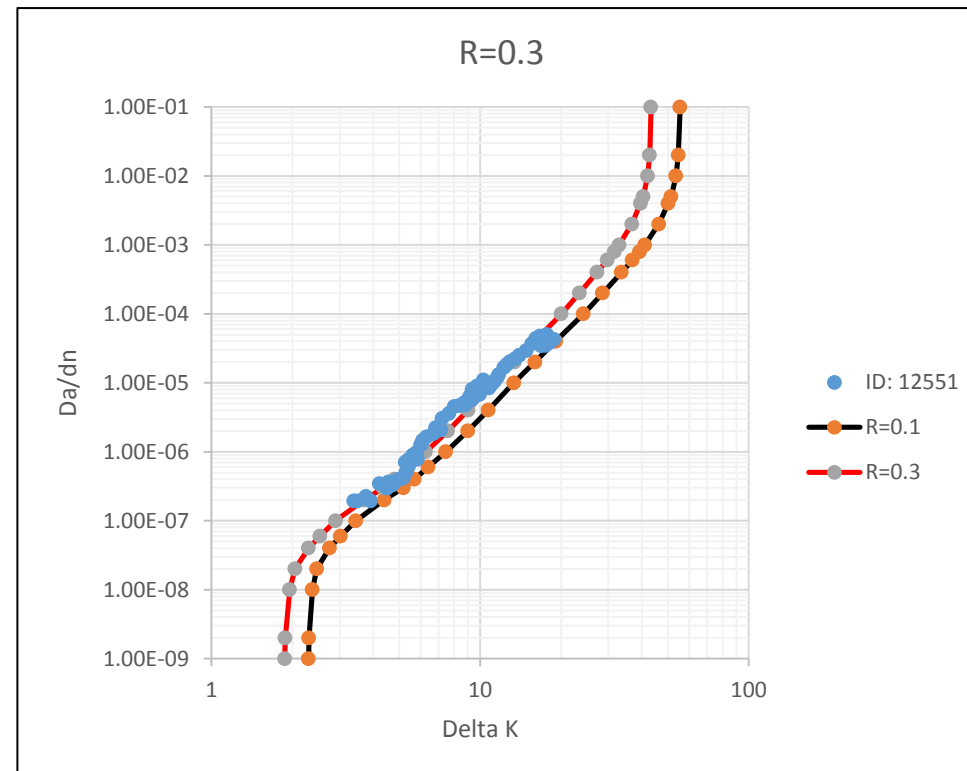
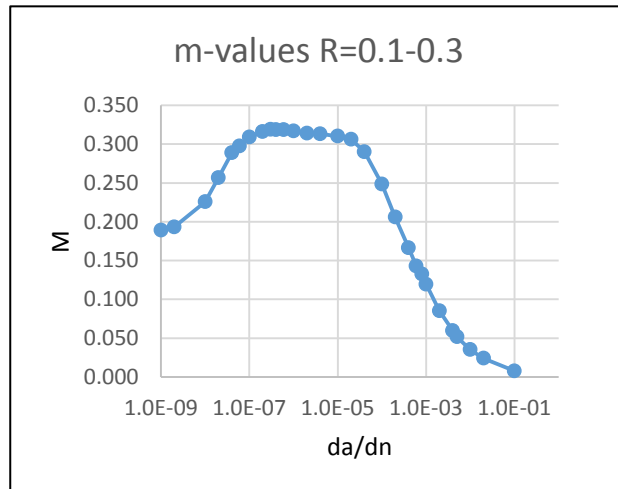
2000 Series	7000 Series	Steel
2024-T3 L-T LAB AIR SHEET	7010-T73651 L-T LAB AIR PLATE	15-5PH H1025
2024-T351 L-T LAB AIR PLATE	7050-T74 L-T LAB AIR FORGING	17-4PH H1025 LAB AIR T-L ROUND BAR
2024-T3511 L-T LAB AIR EXTRUTION	7050-T7451 L-T HHA	300M
2024-T42 L-T LAB AIR PLATE	7050-T73511 L-T HHA EXTRUSION	316L (800)
2024-T851 L-T LAB AIR PLATE	7050-T73651 L-T LAB AIR Plate	4340
2124-T851 L-T LAB AIR PLATE	7050-T74511 L-T LA EXTRUSION	IN100
2219-T87 T-L LAB AIR PLATE	7050-T76511 L-T LAB AIR EXTRUSION	PH13-8Mo-H1000
2324-T39 L-T LA & HHA	7050-T76511 L-T STW	PH13-8Mo-H1050
	7075-T76 L-T LHA SHEET	WASPALLOY
	7075-T651 L-T LAB AIR	
	7075-T7351 L-T LAB AIR PLATE	
	7075-T73511 L-T LAB AIR EXTRUSION	
	7075-T6 L-T LAB AIR SHEET	
	7075-T7651 L-T LHA PLATE	
	7075-T76511 L-T LHA EXTRUSION	
	7150-T7751 LAB AIR PLATE	
	7150-T77511 LAB AIR EXTRUSION	
	7175-T736 L-T HHA FORGING	
	7175-T74 L-T LAB AIR FORGING	
	7178-T6 L-T LAB AIR SHEET	
	7475-T761 L-T LAB AIR	
	7475-T7351 L-T HA PLATE	
	7475-T7651 L-T LAB AIR SHEET	

Data Release

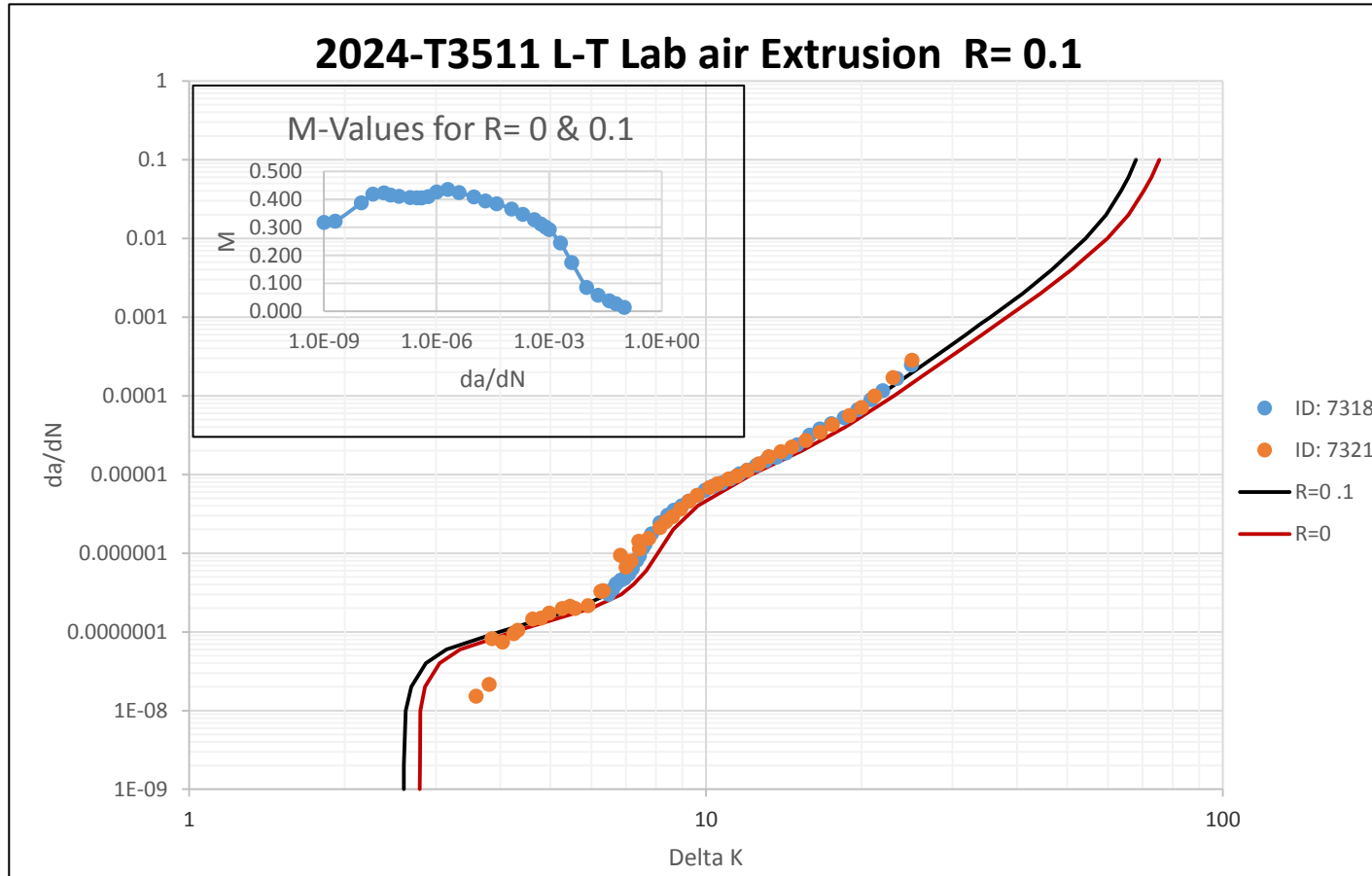
- The new tabular crack growth rate data will be released in two formats, PDF and Tabular look-up
- The PDF format will consist of m -plots and comparison plots of the material data and curve fits
- The look-up files will contain the curve fits and material properties

PDF Format

- The user can:
 - View how the data compares to the fit
 - View the amount of data available
 - View m-plots

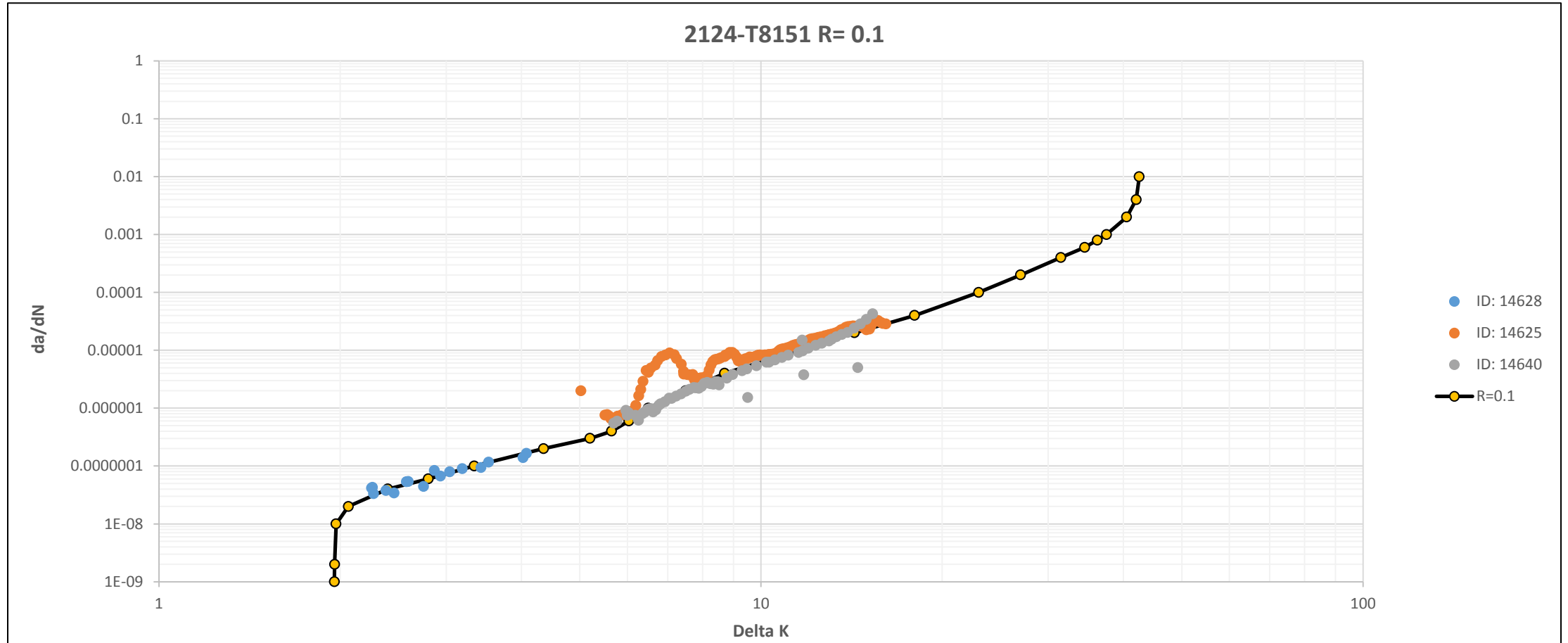


PDF Layout

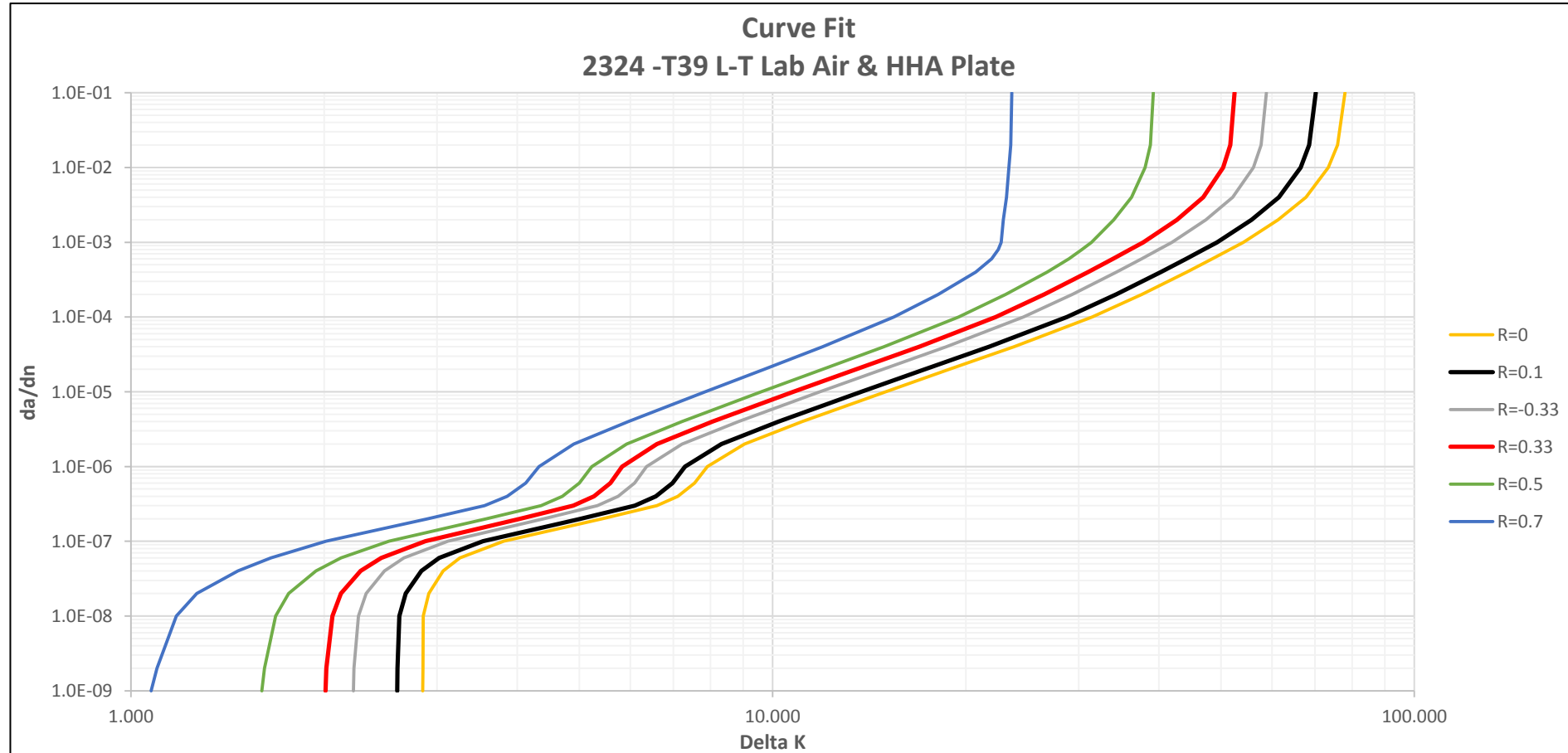


- Individual plots for each stress ratio available for the material
- M plots and neighboring R curve will also be plotted with the data

PDF Layout (Fit Compared to data)



PDF Layout (Curve Fit Plot)



Tabular Look-up

Tabular LOOKUP Data

Input values of Delta_K for da/dN values and up to 10 different R(stress ratio) values.
Matrix must have at least two R values and two da/dN values.
Input Delta_K for R >= 0, input Kmax for R < 0.0

Number of da/dn Sets: 28 Number of R Sets: 4

		R[1]	R[2]	R[3]	R[4]
		0.1	0.3	0.5	0.65
da/dN[1]	1.00e-009	2.73	2.16646	1.65519	1.46636
da/dN[2]	2.00e-009	2.7301	2.16708	1.65622	1.46728
da/dN[3]	1.00e-008	2.74	2.17713	1.66446	1.47413
da/dN[4]	2.00e-008	2.795	2.22921	1.708	1.51333
da/dN[5]	1.00e-008	2.92	2.35836	1.81397	1.60703

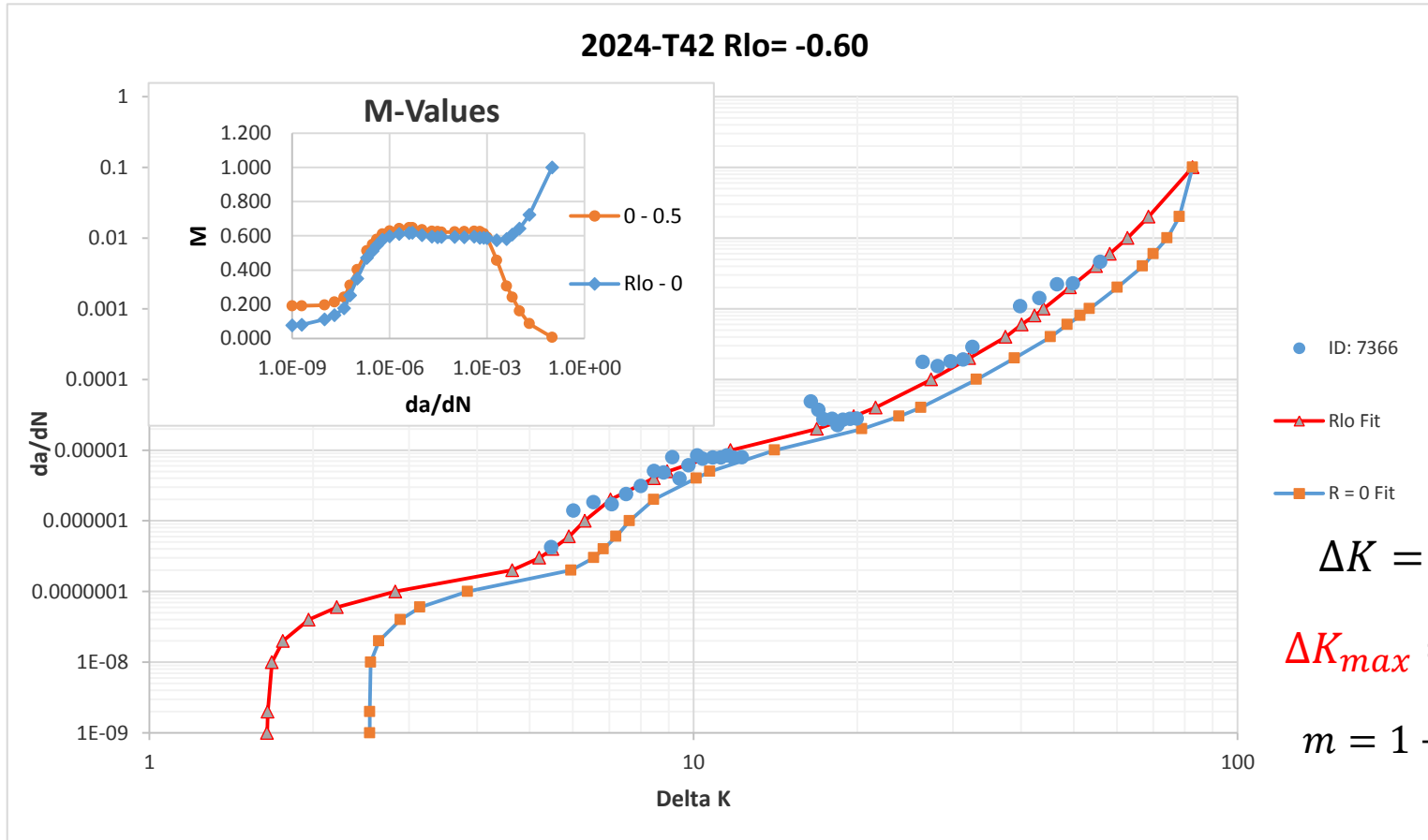
Material name: 7010-T73651 L-T Plt Lab Air

Ultimate Strength: 72 Young's Modulus: 10000
 Coefficient of Thermal Expansion: 1.31e-005 Poisson's Ratio: 0.33
 Upper limit on da/dN, DADNHI: 0.01 Lower limit on da/dN, DADNLO: 1e-009
 Plane Stress Fracture Toughness, KC: 62 Yield Strength, YLD: 62.7
 Plane Strain Fracture Toughness, KIC: 34 Lower limit on R shift (Max: 0): -0.33
 Delta K threshold value @R=0: 3.01 Upper limit on R shift (0, 1): 0.75

OK Cancel Save Read Apply

- All files have material properties specific to the material.
- To load curve fits, select the read button in the bottom of the look-up dialog and choose the file's location.

Curve Fits Explained



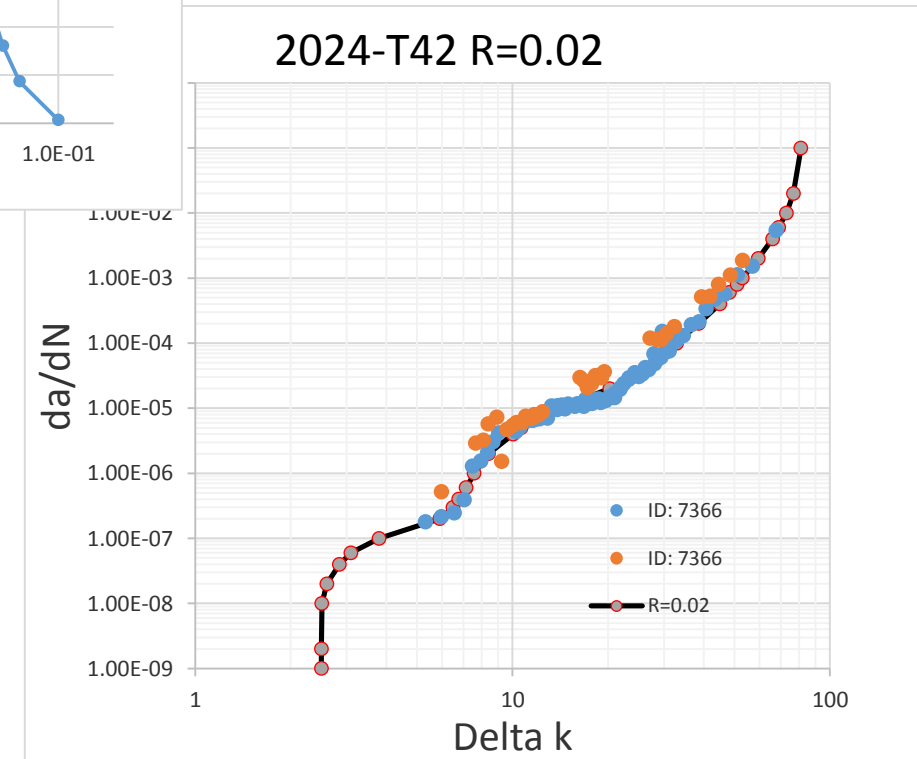
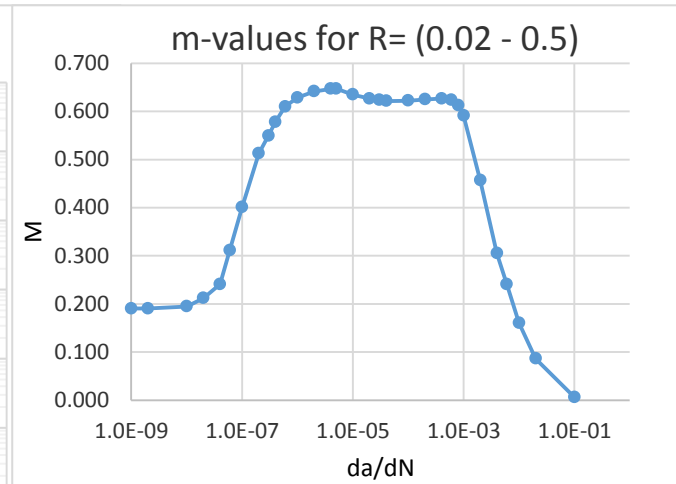
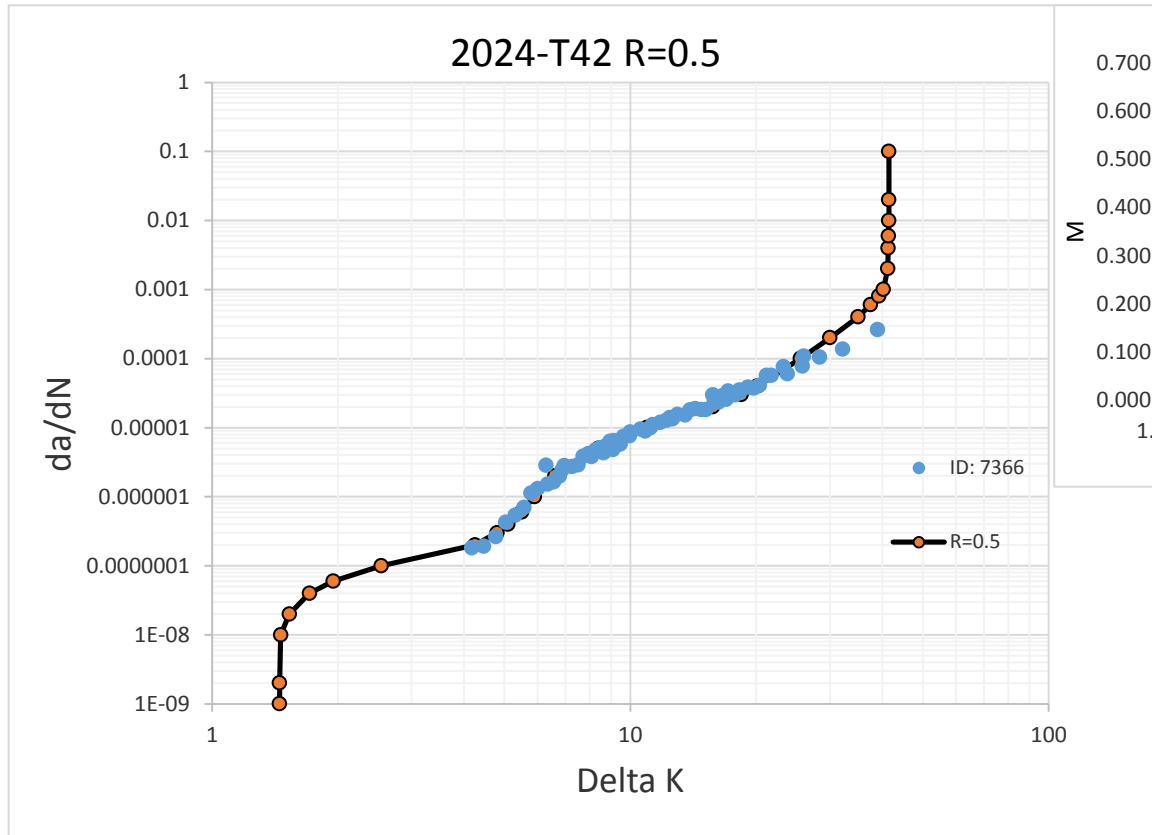
- 2024-T42 had data for R=-1 in AFMAT database
- Determined that Rlo stopped shifting at R=-0.6
- Since negative R curves are plotted with Kmax we made Rlo fail at Kmax at R=0

$$\Delta K = \Delta K_{R=0}(1 - R)^{(1-m)}; \text{ for } R \geq 0$$

$$\Delta K_{max} = \Delta K_{R=0}(1 - R)^{(m-1)}; \text{ for } R < 0$$

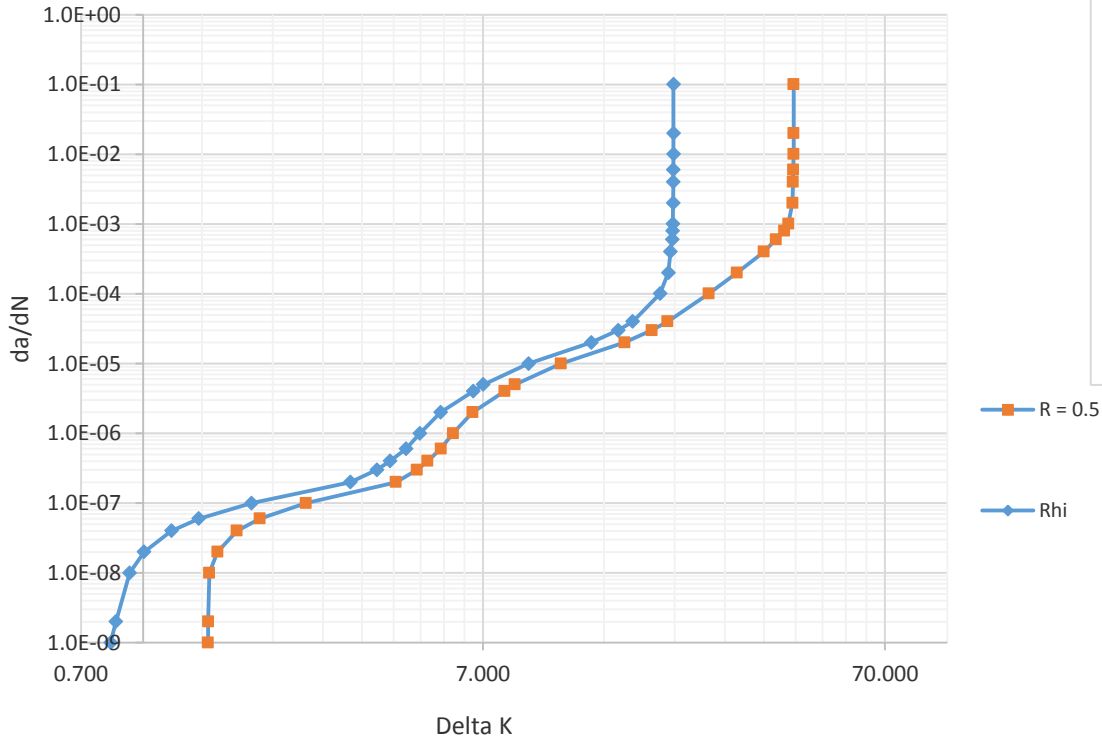
$$m = 1 + \left[\text{Log}_{10} \left(\frac{K_{max}}{\Delta K} \right) / \text{Log}_{10}((1 - R_1)(1 - R_2)) \right]$$

2024-T42 L-T Lab air Plate

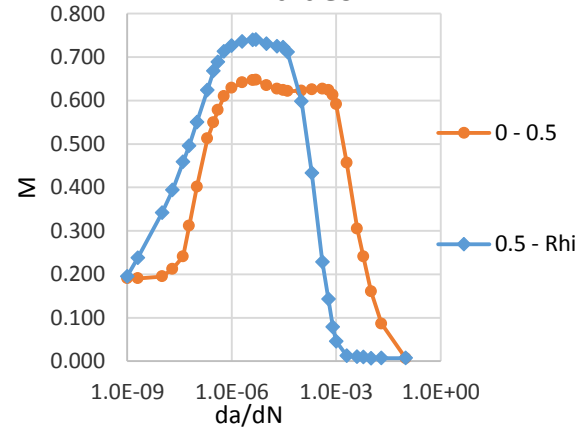


2024-T42 L-T Lab air Plate

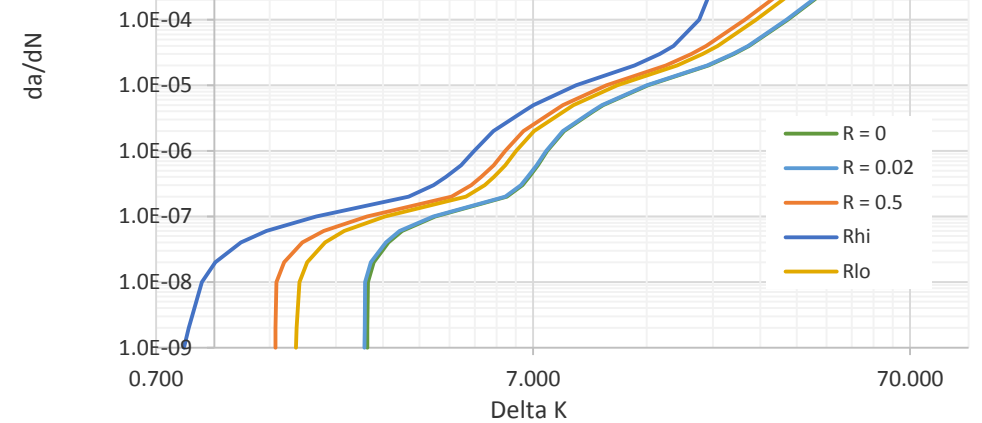
2024-T42 Rhi = 0.75



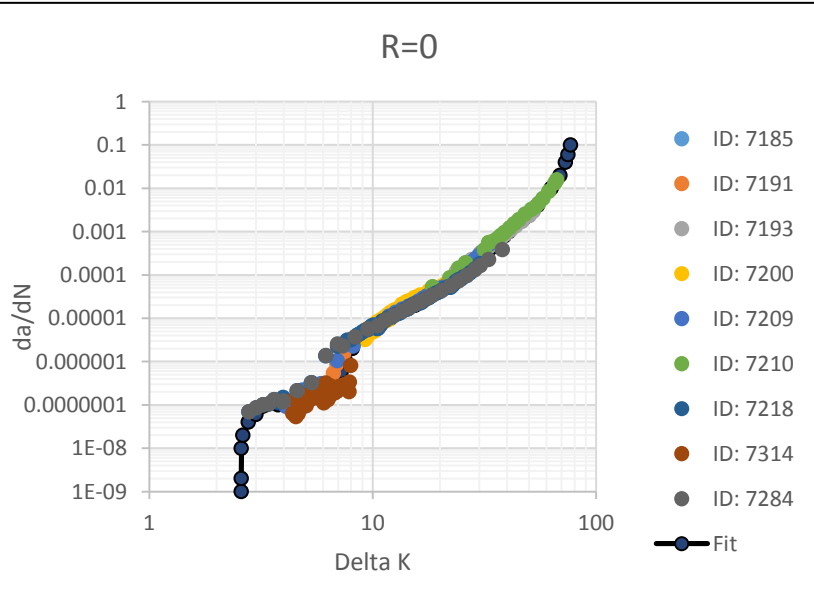
m-values



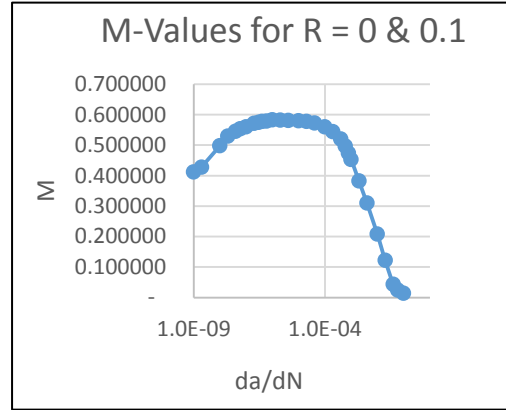
2024-T42 Curve Fit



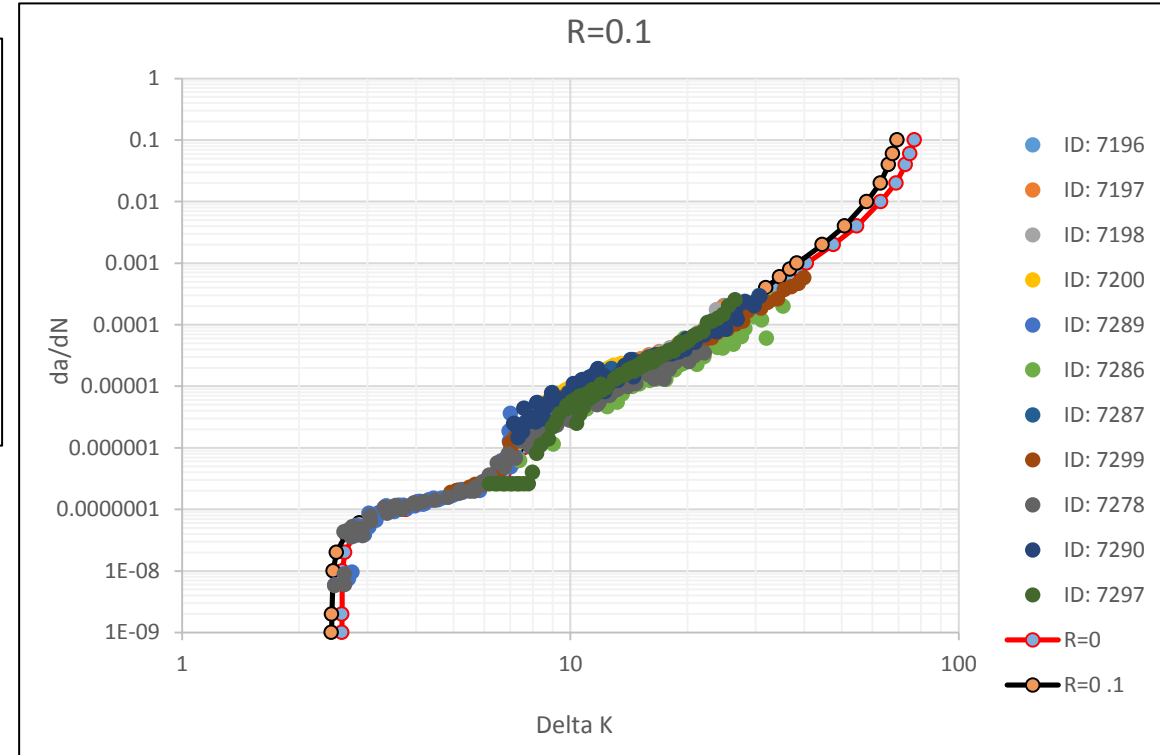
R=0



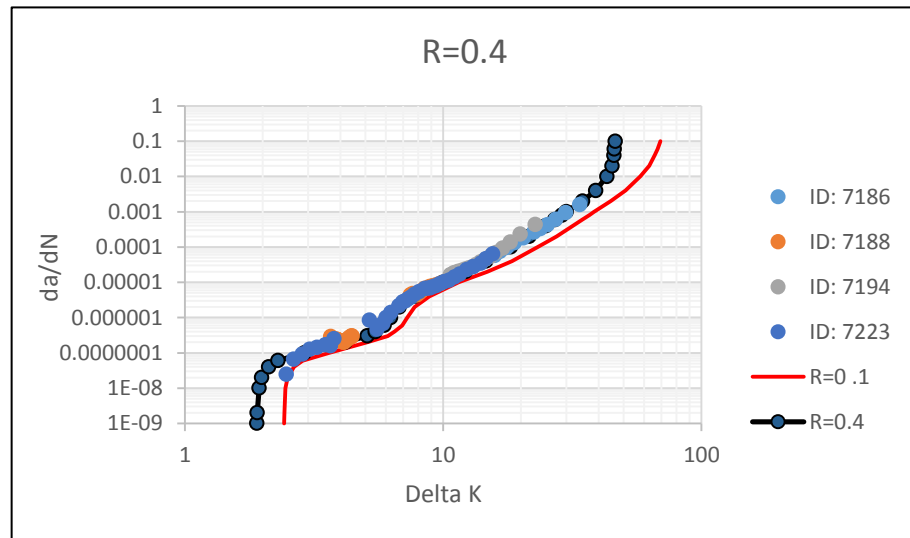
M-Values for R = 0 & 0.1



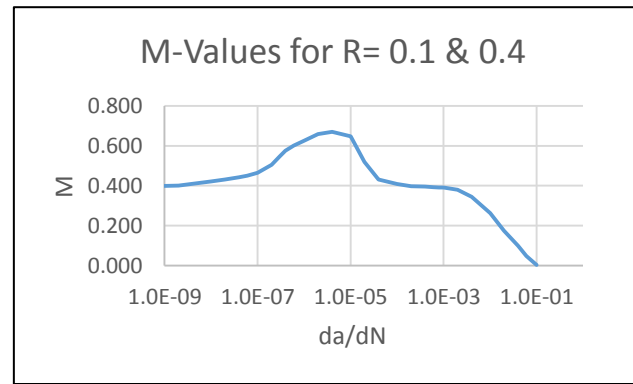
R=0.1



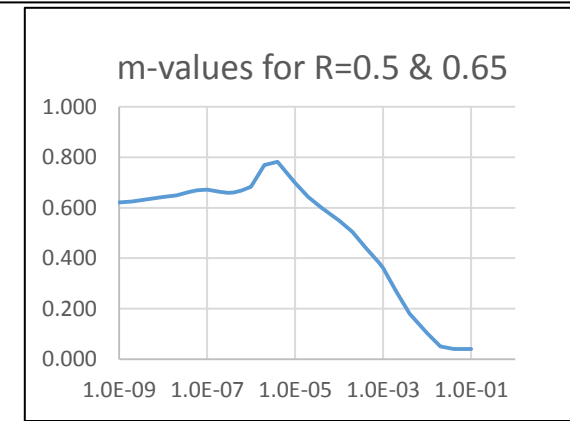
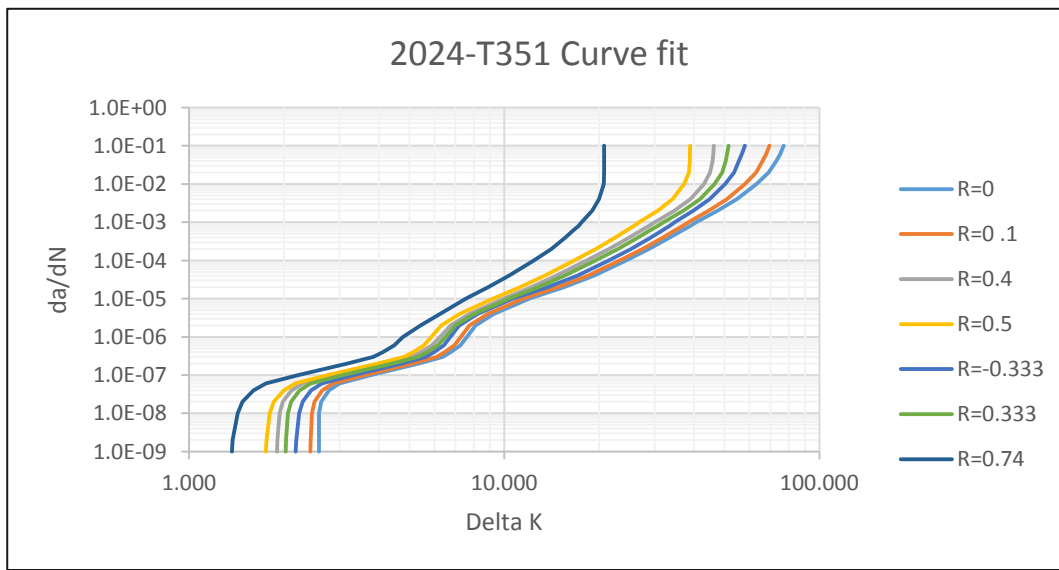
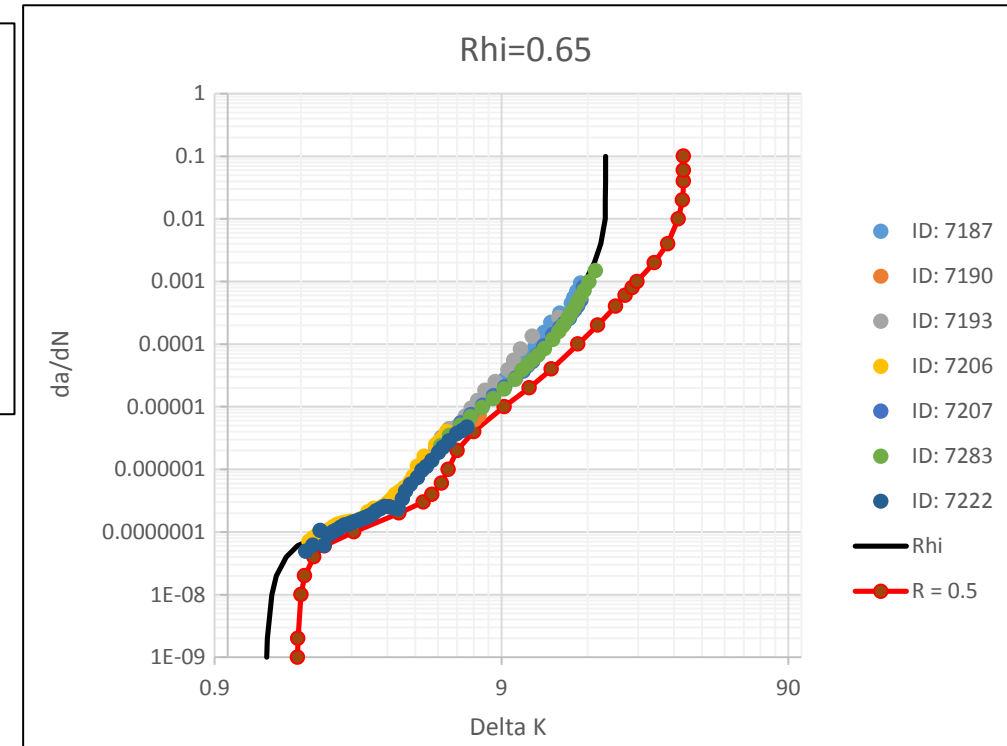
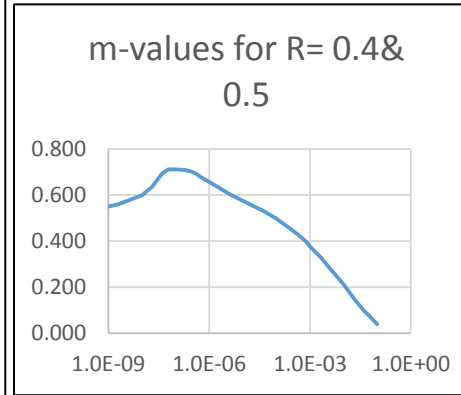
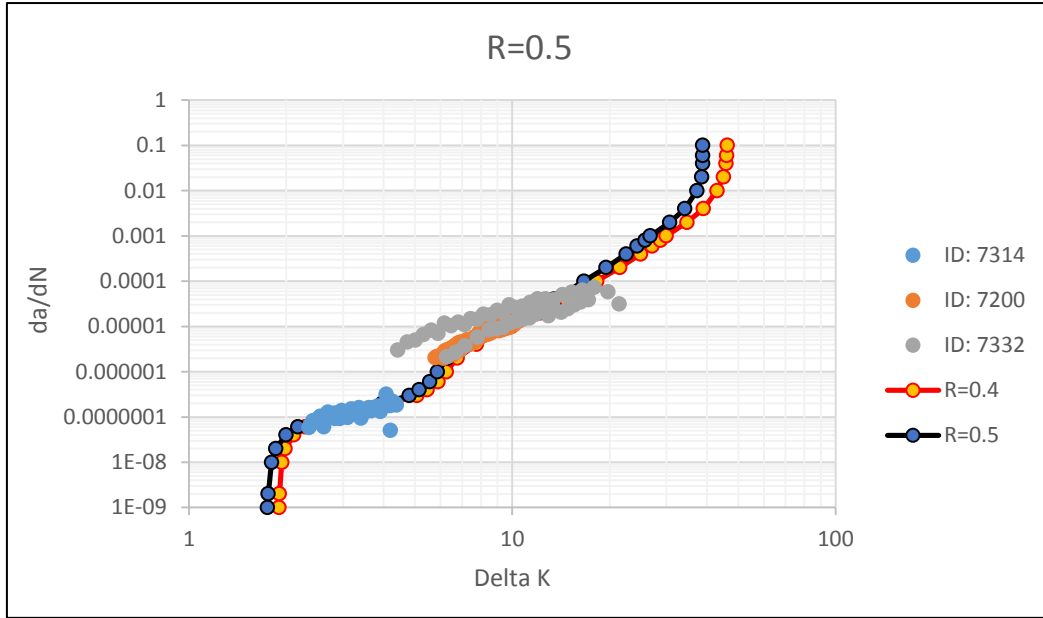
R=0.4



M-Values for R = 0.1 & 0.4



2024- T351 L-T Plate





Questions?

