PCCAS Asphalt Rubber Binder Round Robin Phase II

September 2015

Samples

		% Wt. of AR Binder			
	SAMPLE A		SAMPLE B		SAMPLE C	
Asphalt[a]	PG 70-10	76	PG 64-16	77	PG 64-22	80
Extender Oil[b]	Supplier A	2	Supplier A	2	Supplier A	2
CRM Scrap Tire[c]	Supplier A	17	Supplier A	15.75	Supplier B	13.5
CRM High Nat[c]	Supplier A	5	Supplier A	5.25	Supplier B	4.4
Binder/Rubber[d]	Ratio	78/22	Ratio	70/21	Ratio	82/18

[a] asphalt from 3 different suppliers

[b] Extender oil from same supplier for the three samples

[c] CRM source from two suppliers

[d] Each sample (A,B,C)field produced by a different supplier in California

The three materials were field produced by different suppliers, all according to Caltrans Section 39-3.02 for Asphalt Rubber Binder for Rubber Hot Mix Asphalt.

Current Specifications

Test Performed	45 Minute Rx Time			Specification	
	SAMPLE A	SAMPLE B	SAMPLE C		
Cone Penetration, 77F, dmm, (D217)	N/A	57	32	25-70	
Resilience at 77F, %, (D5329)	N/A	32	50	18 min.	
Softening Point, degF (D6)	N/A	146	158	125-165	
Viscosity, Haake at 375F, cP, (LP-11)	N/A	2900	2200	1500-4000	

Protocol

- Written procedures were given out
- An excel spread sheet was provided for entering data
- All samples were tested in triplicate
- Model and software was asked about each equipment
- Notes section was added
- Samples are all field samples, which were mixed together then poured up

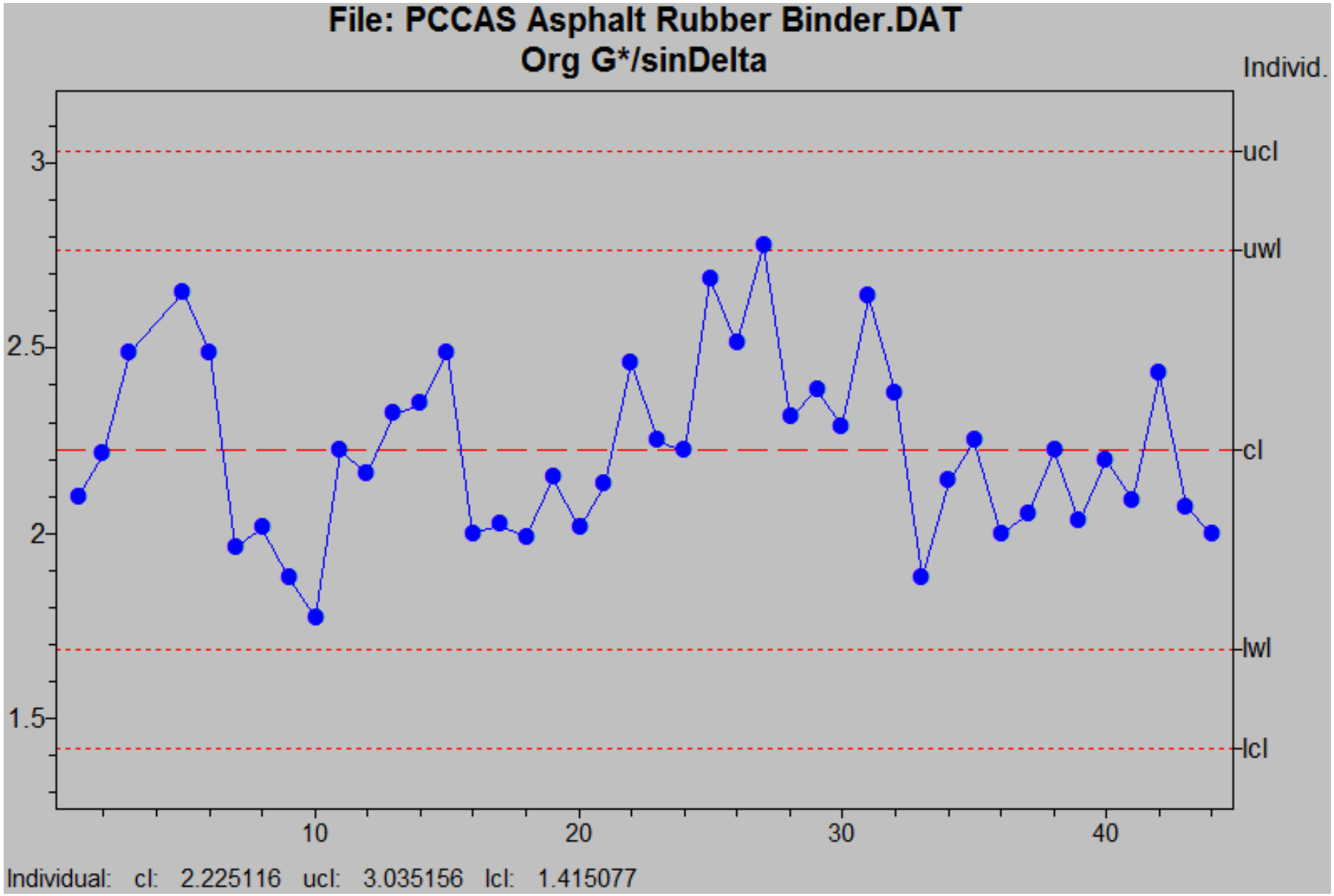
Observations

- DSR looks more reproducible as the binder ages
- AASHTO reproducibility were placed on the graphs and show that most of the data would fall within published ranges.
- ASTM was used for Elastic Recovery and results don't look very good, maybe method needs to be modified for better results
- BBR m value don't look bad
- BBR stiffness does not look good but the numbers are very low, maybe the reproducibility is not as good when the numbers are low. Most of the studies looked at so far have number ranging from 100 to 280.

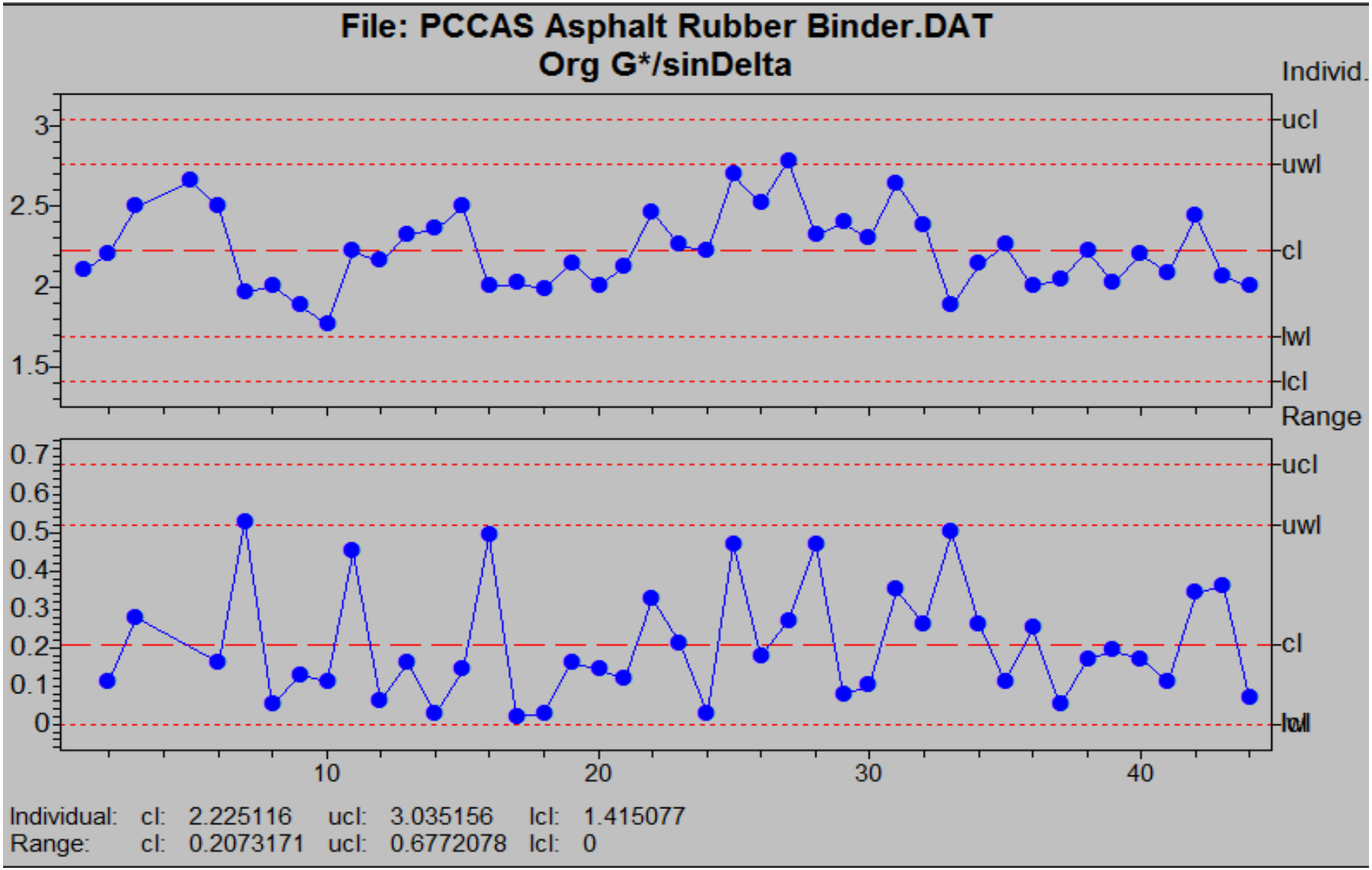
Data

- Northwest Analytical is the software package used
- Some of the data was considered to be outliners and marked in the program as such
- The Mass Change is included but should not be used as many people did not remove the data. I don't have the raw data so I am not sure if the sample came out of the bottles during the RTFO or they just did not do it
- There are some other methods to get mass change and PAV testing, which are not included in this initial report.
- The material did separate slightly during the PAV

Sample A Org. G*/sinDelta



Sample A ORG. G*/sinDelta



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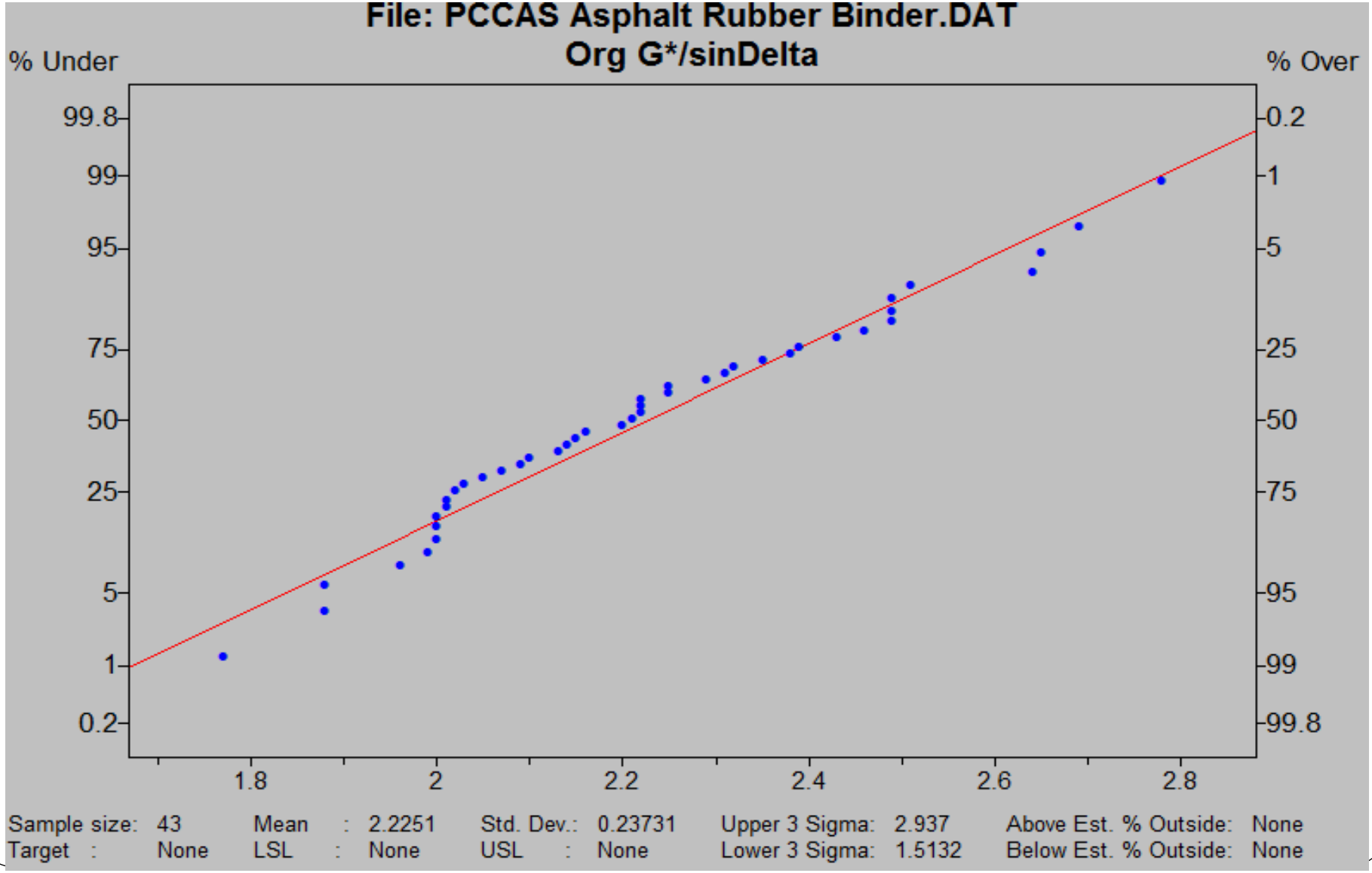

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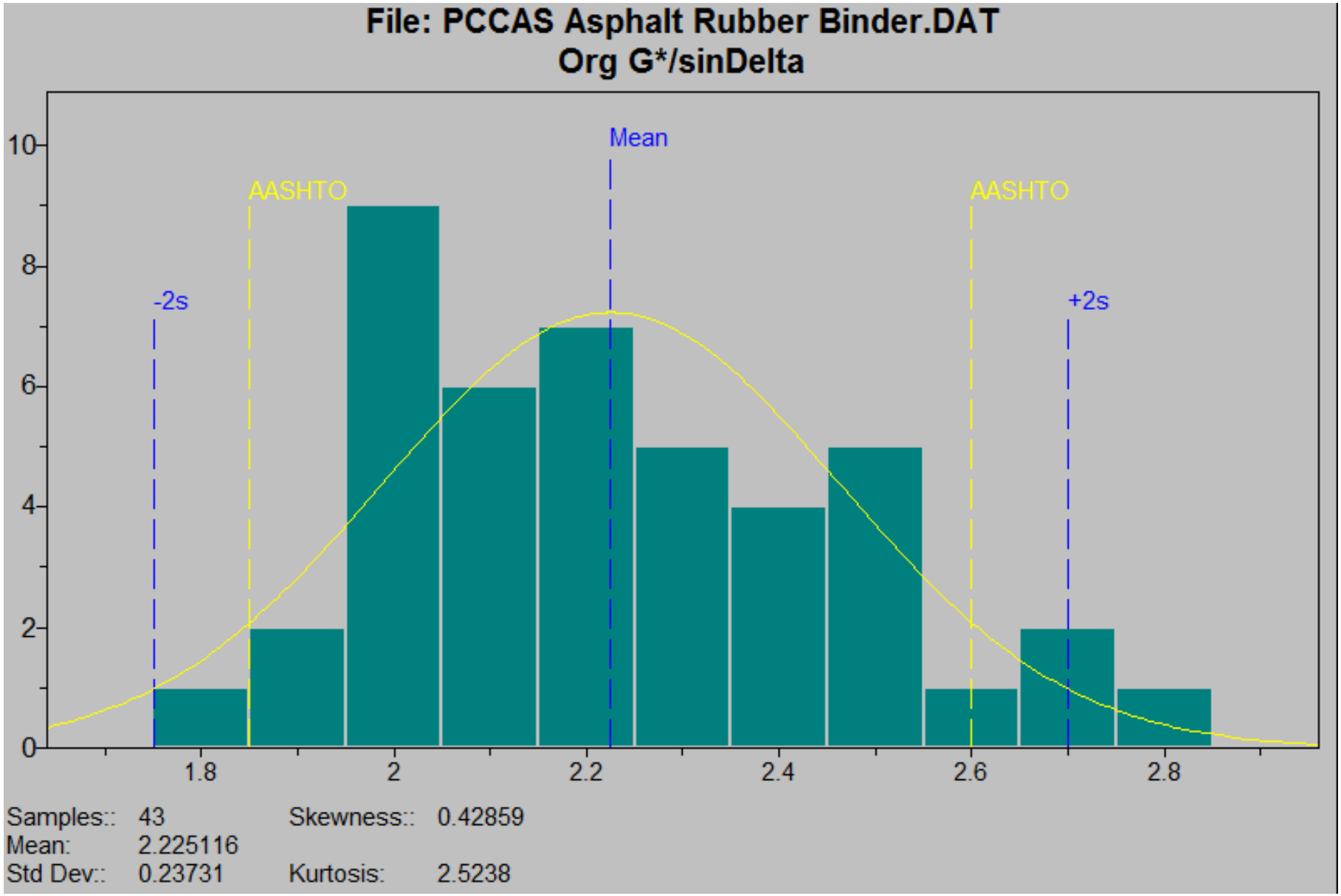
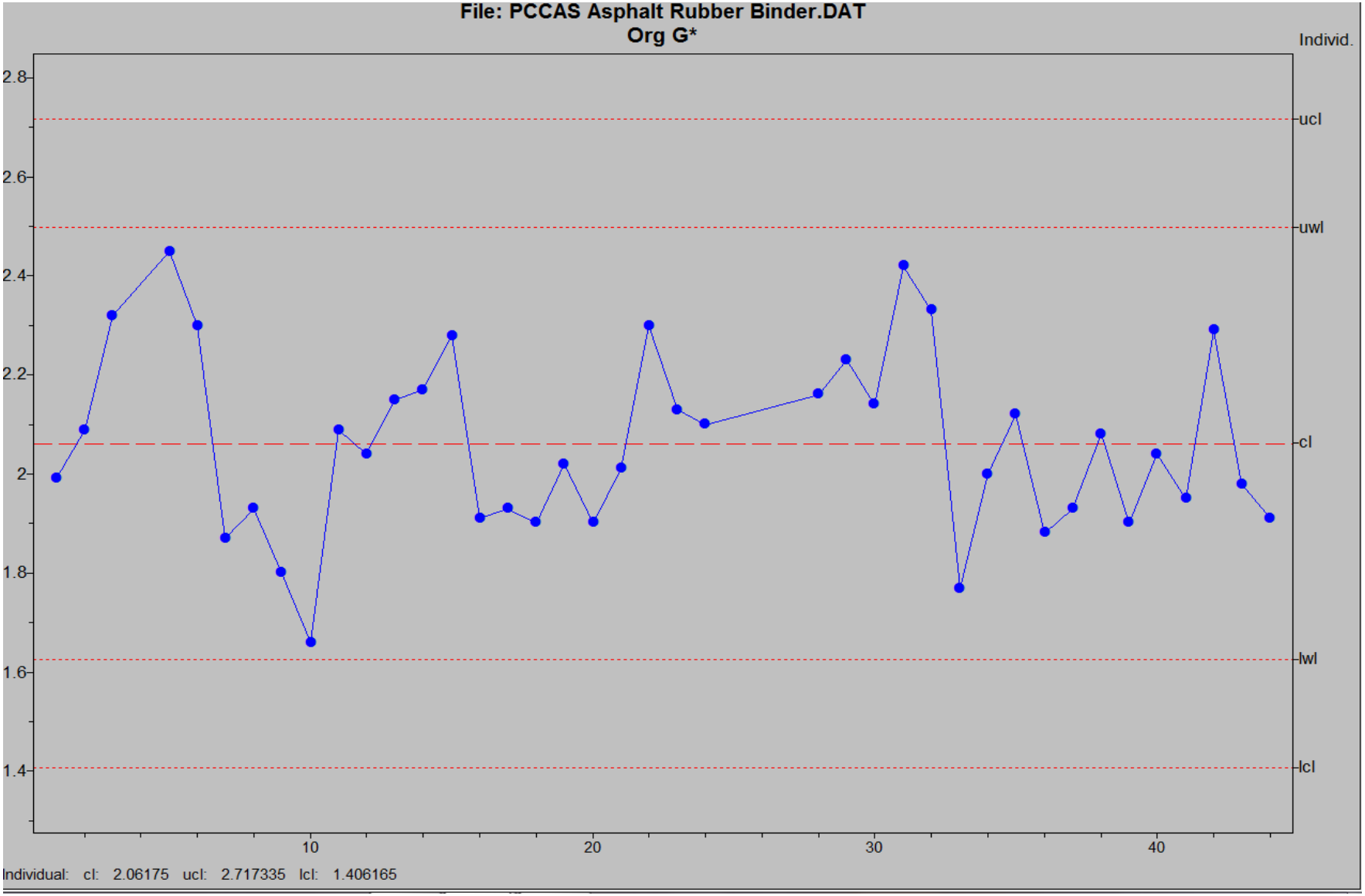


Sample A Org. G*



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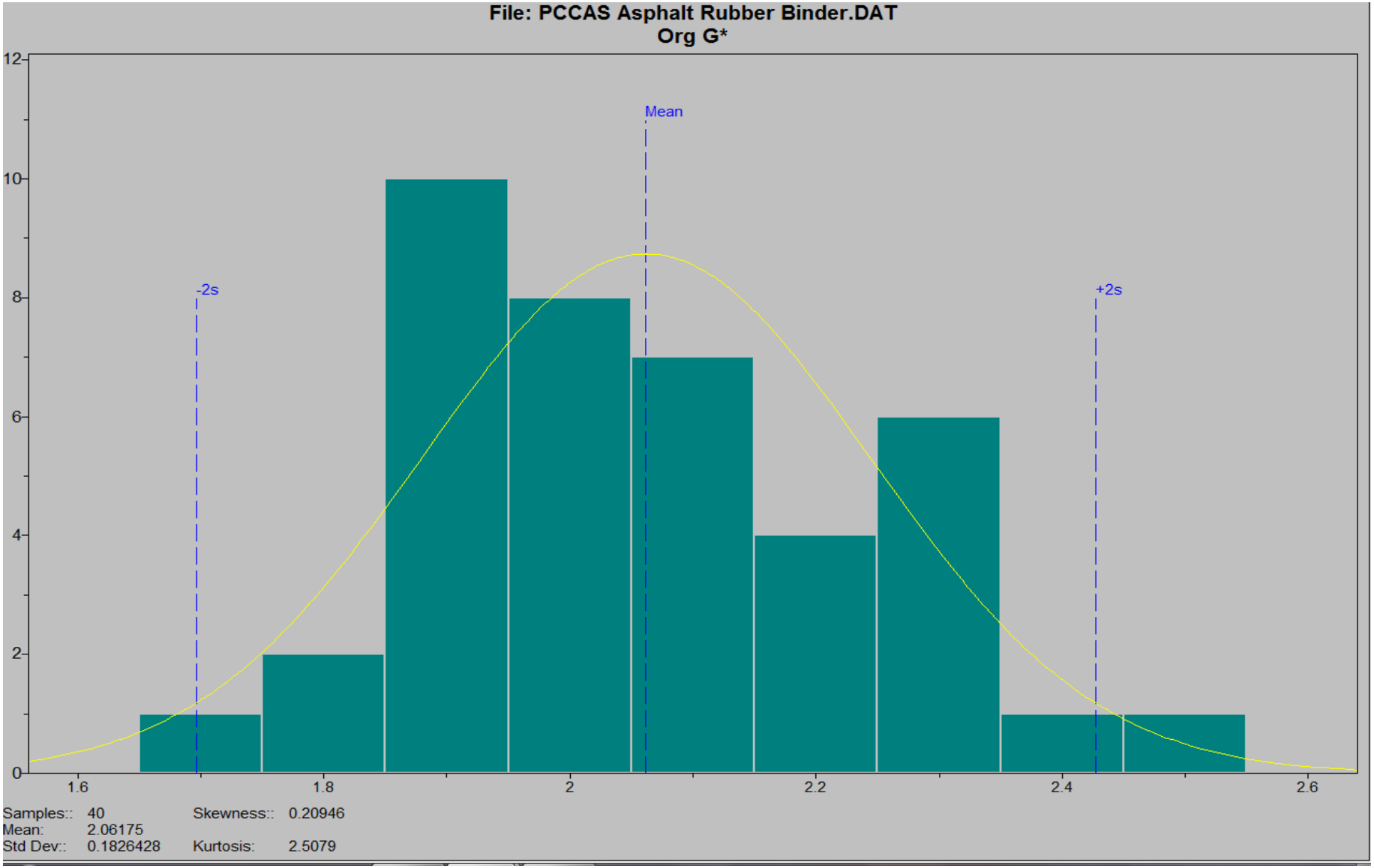
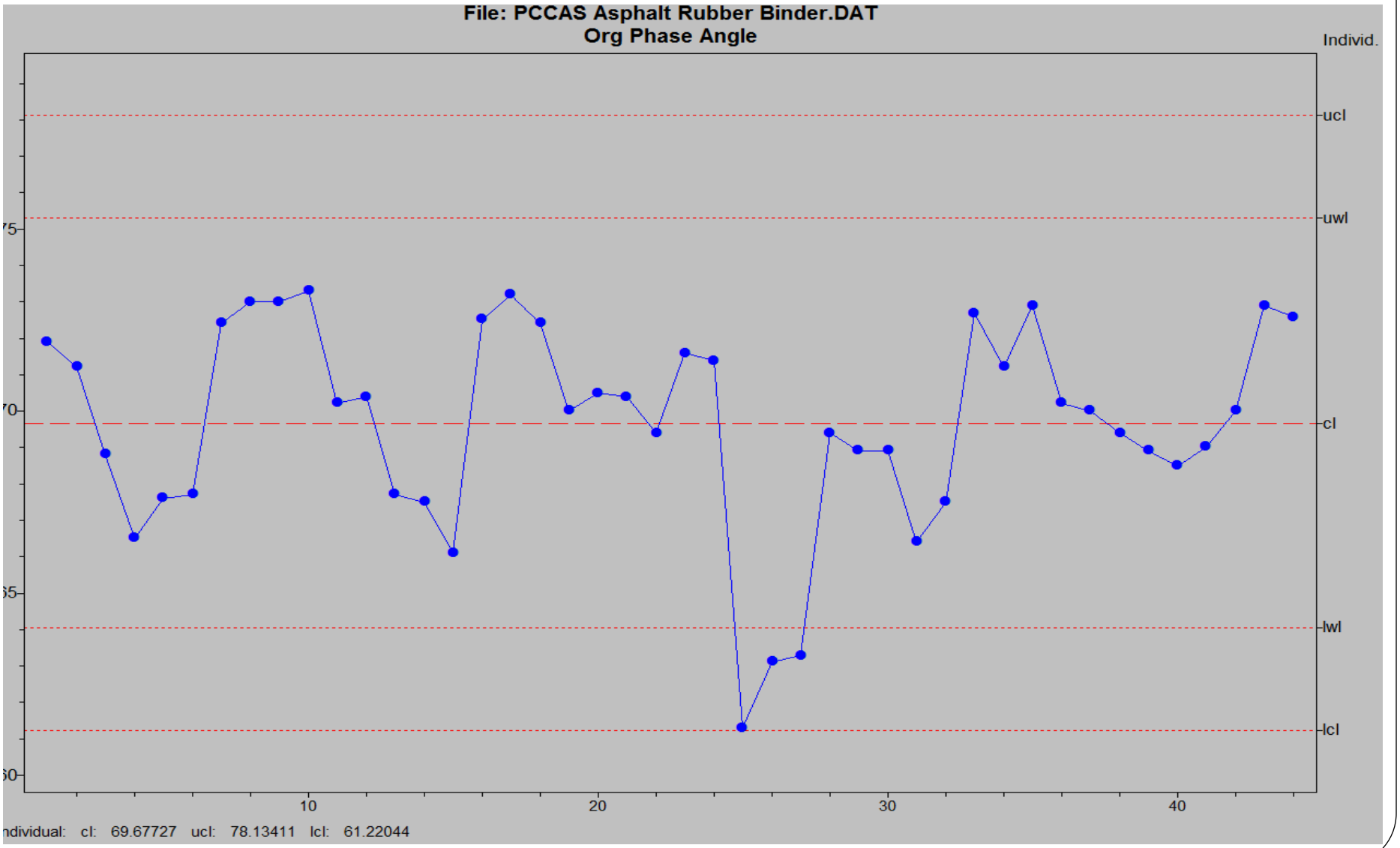


Sample A Org. Phase Angle



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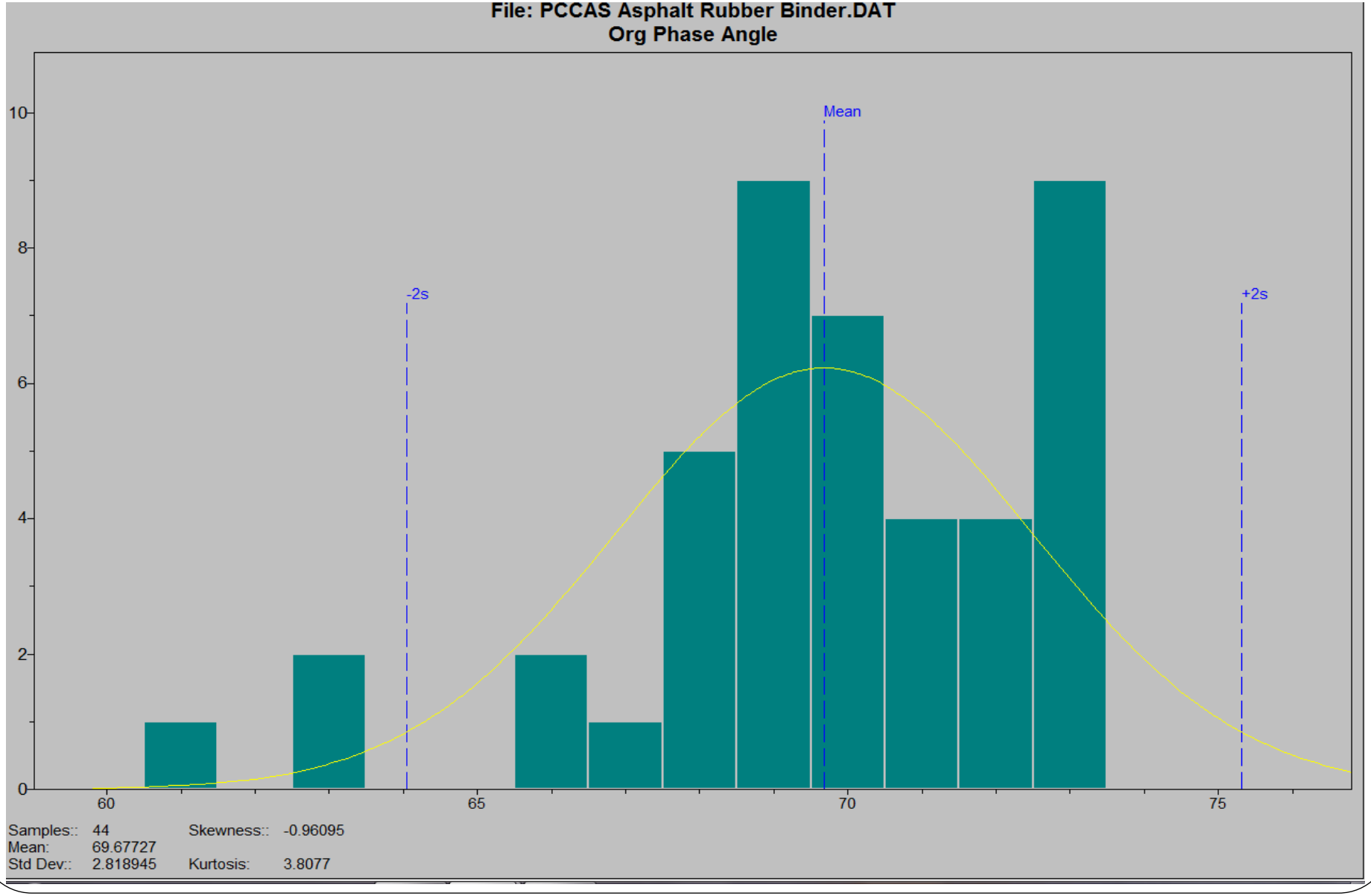

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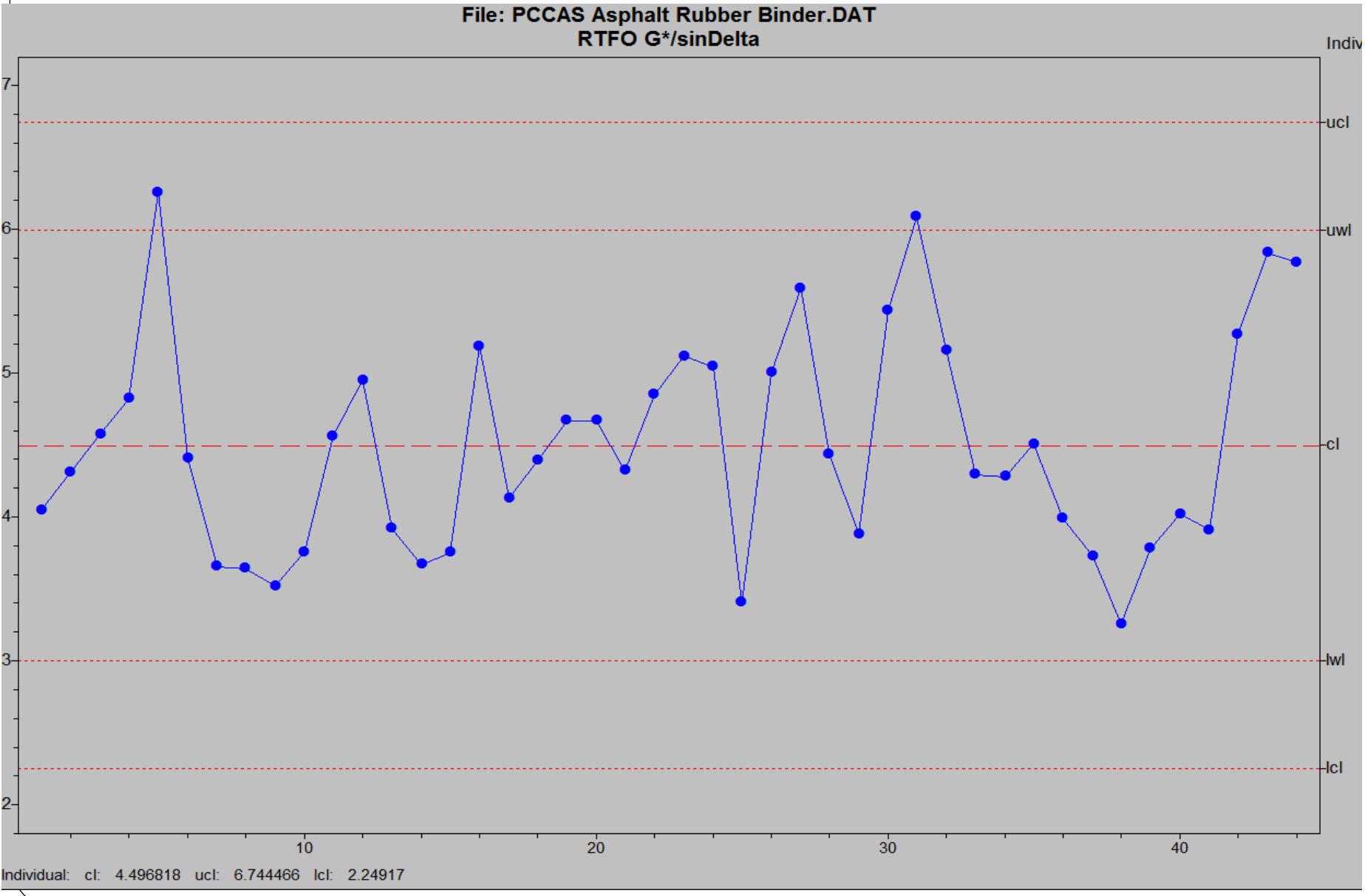
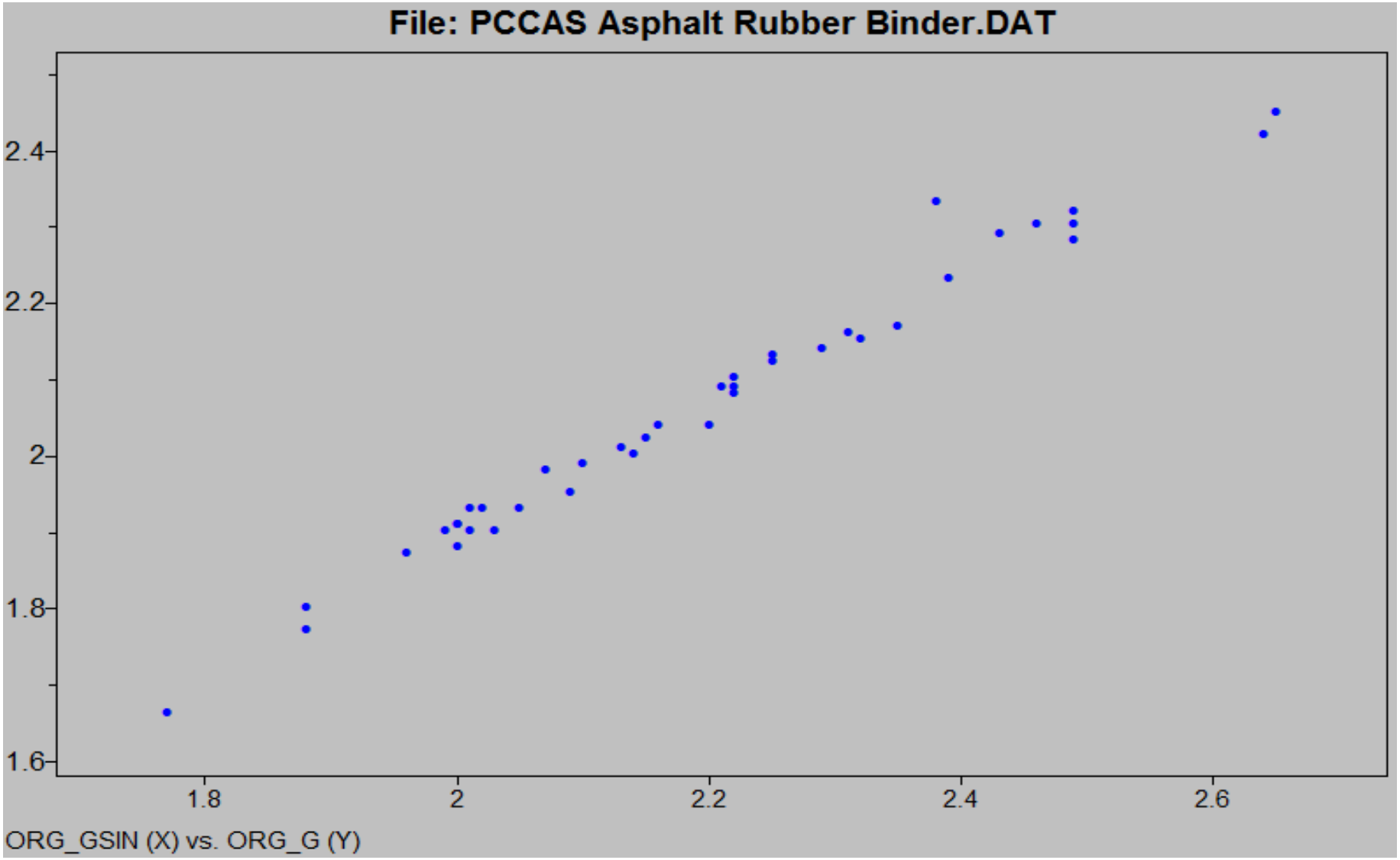


Sample A ORG. G*/sinDelta vs G*



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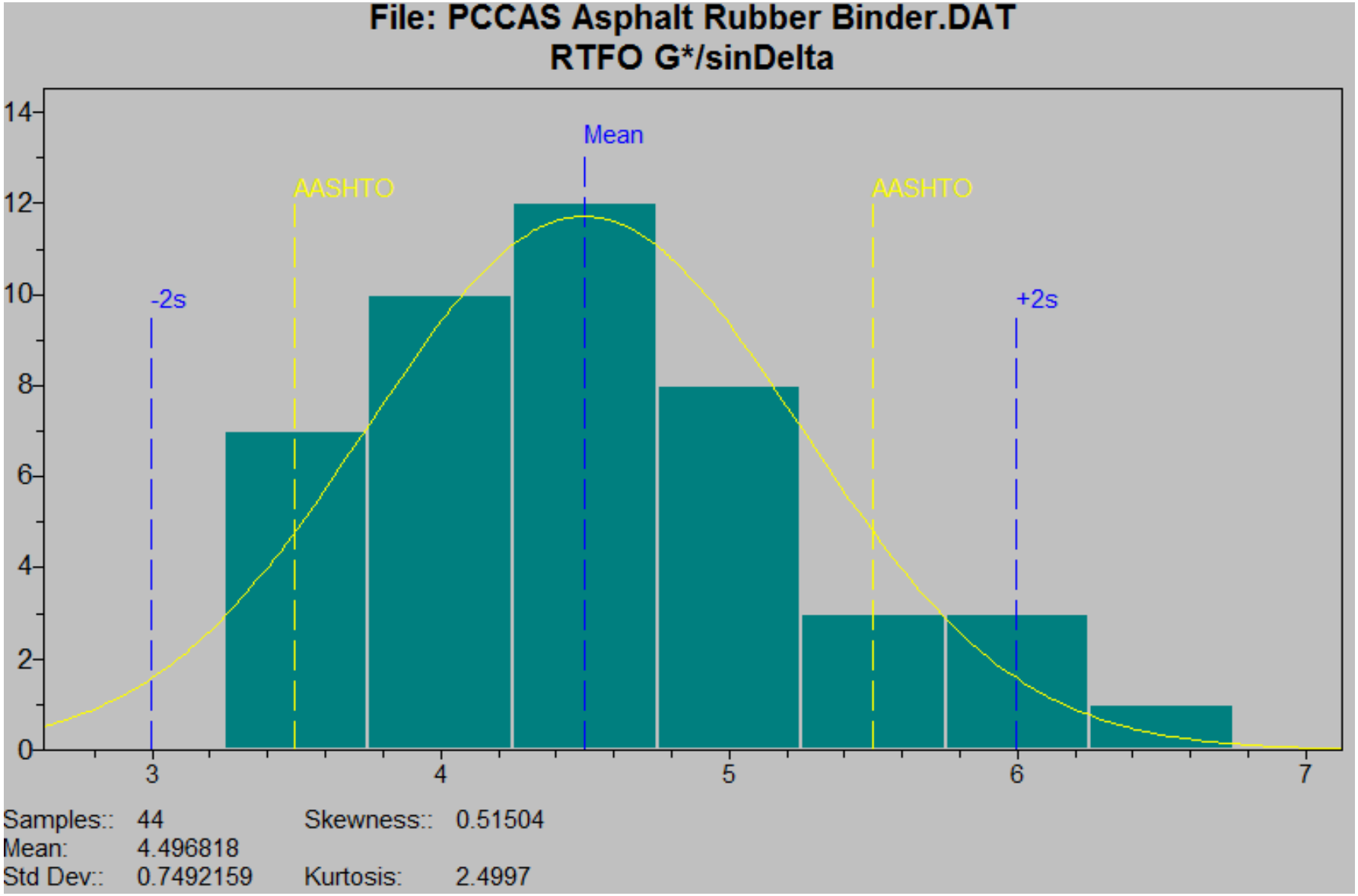

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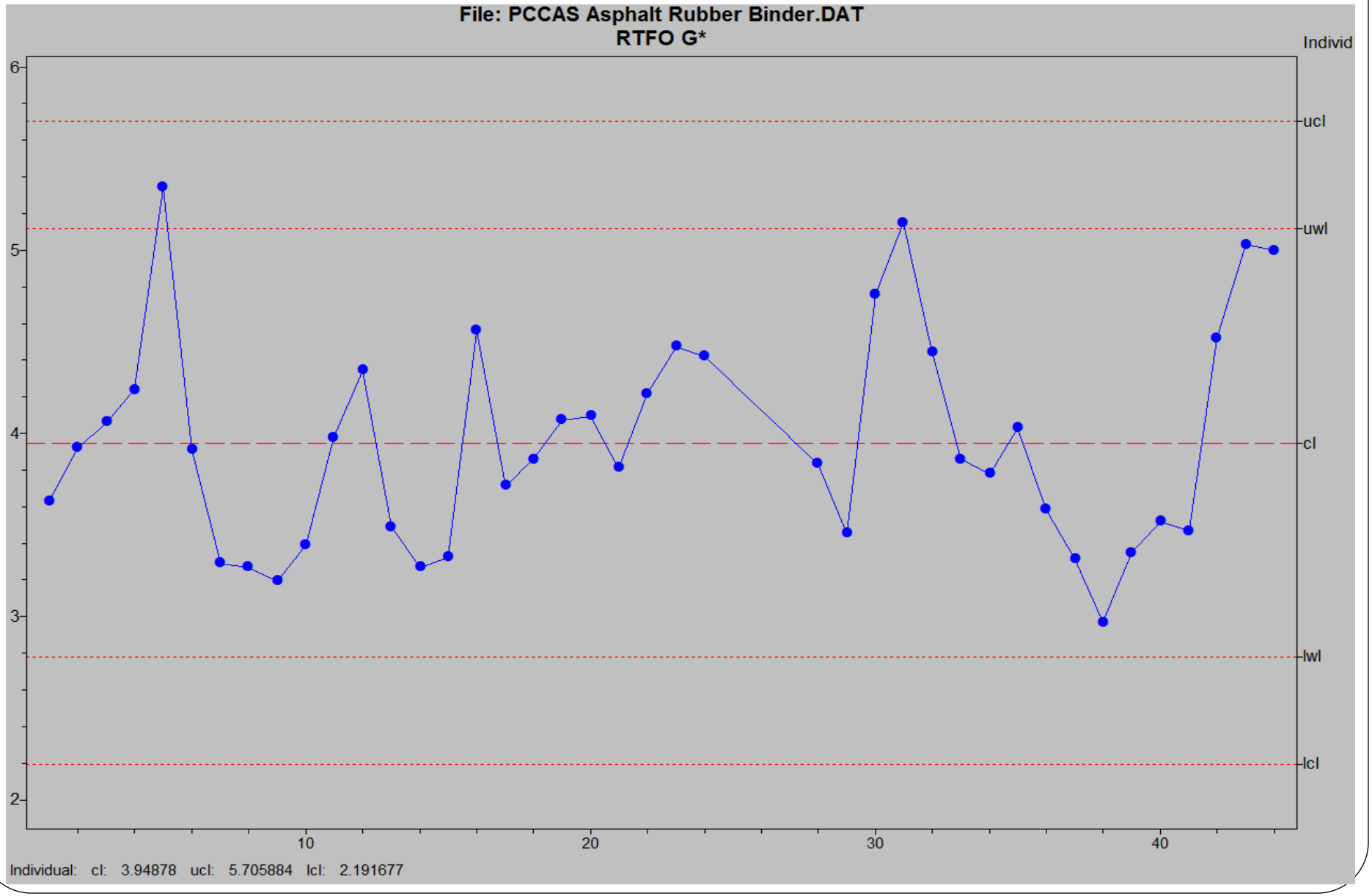

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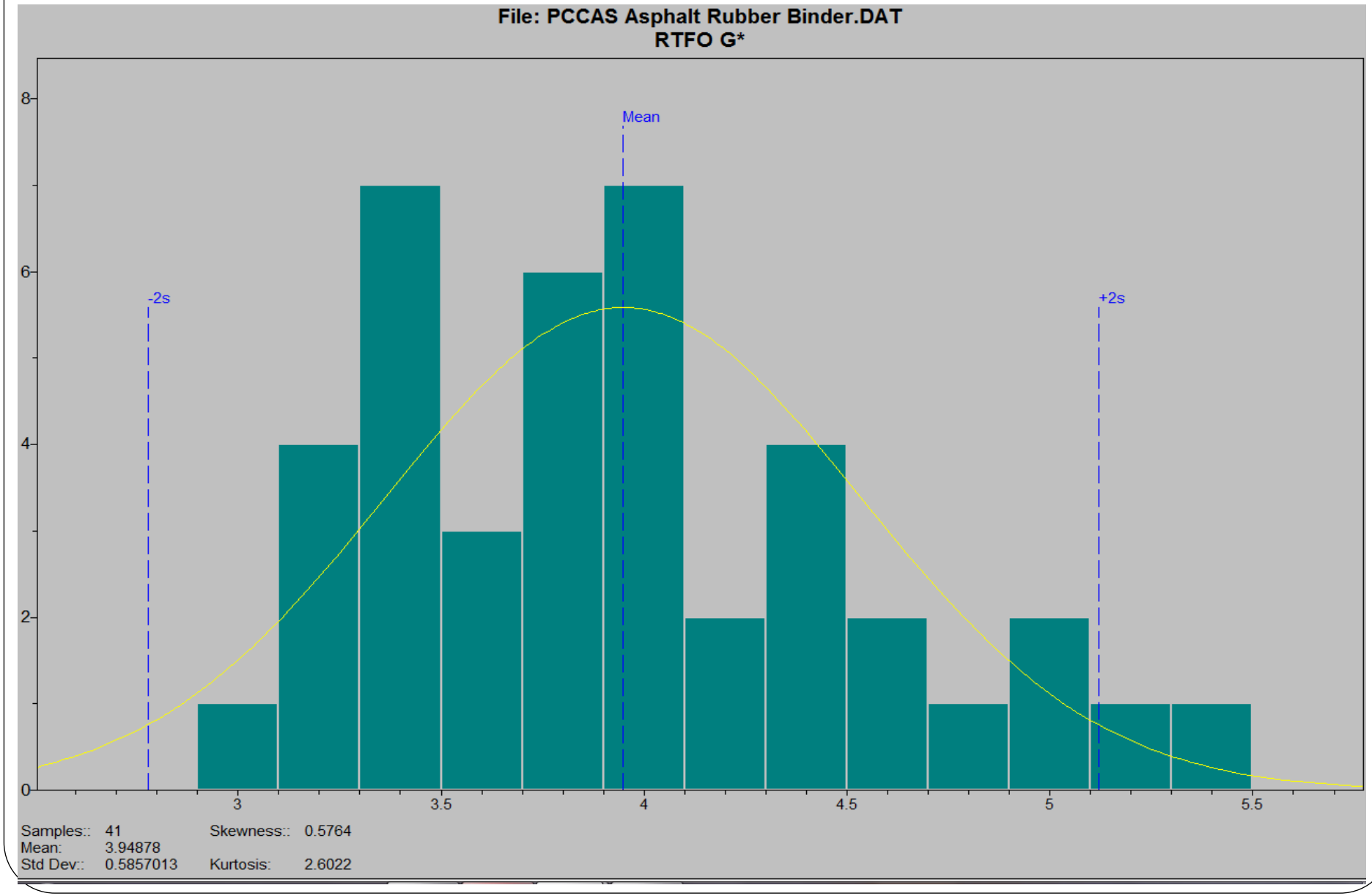

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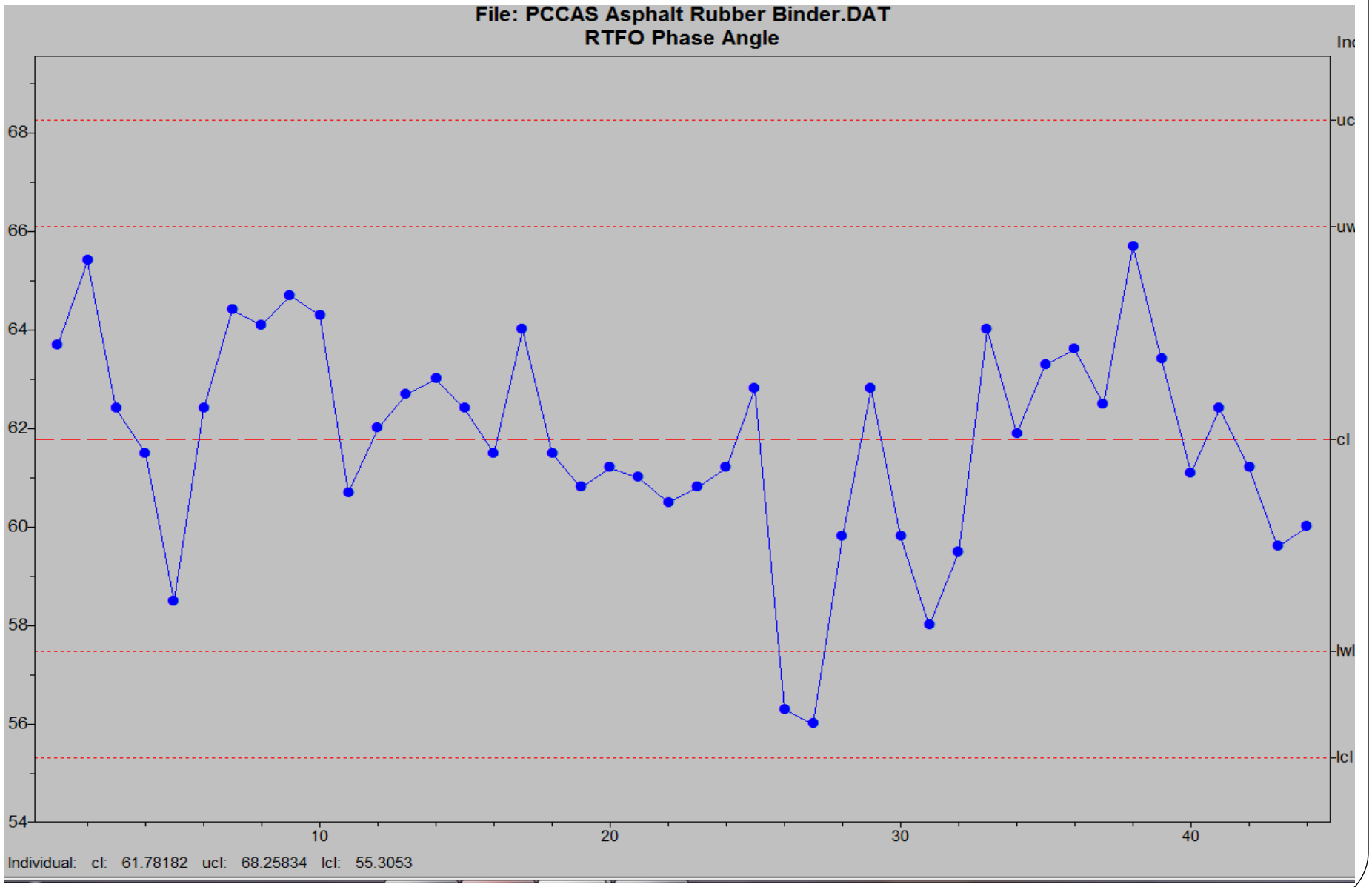
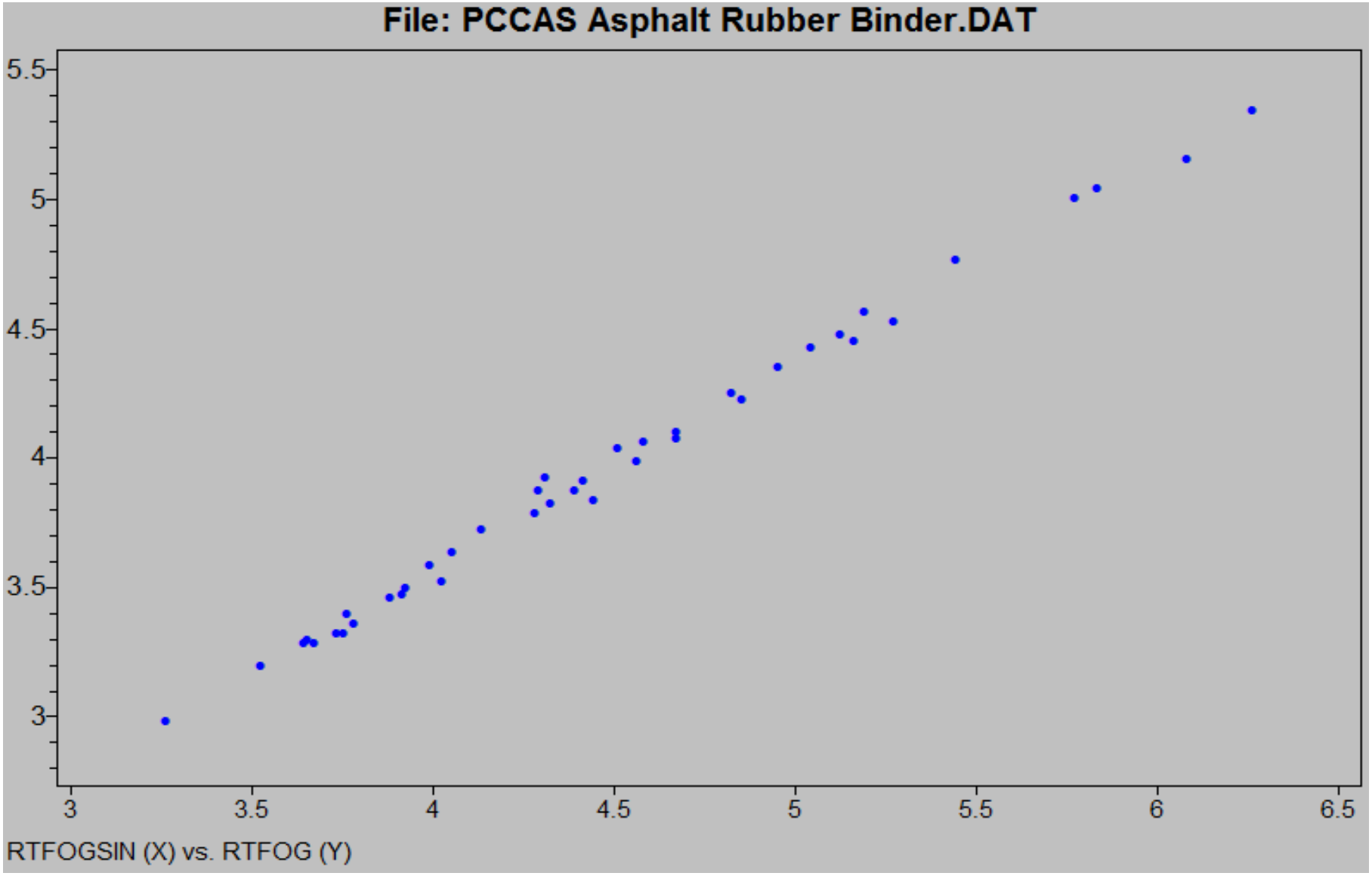


Sample A RTFO G*/sinDelta vs G*



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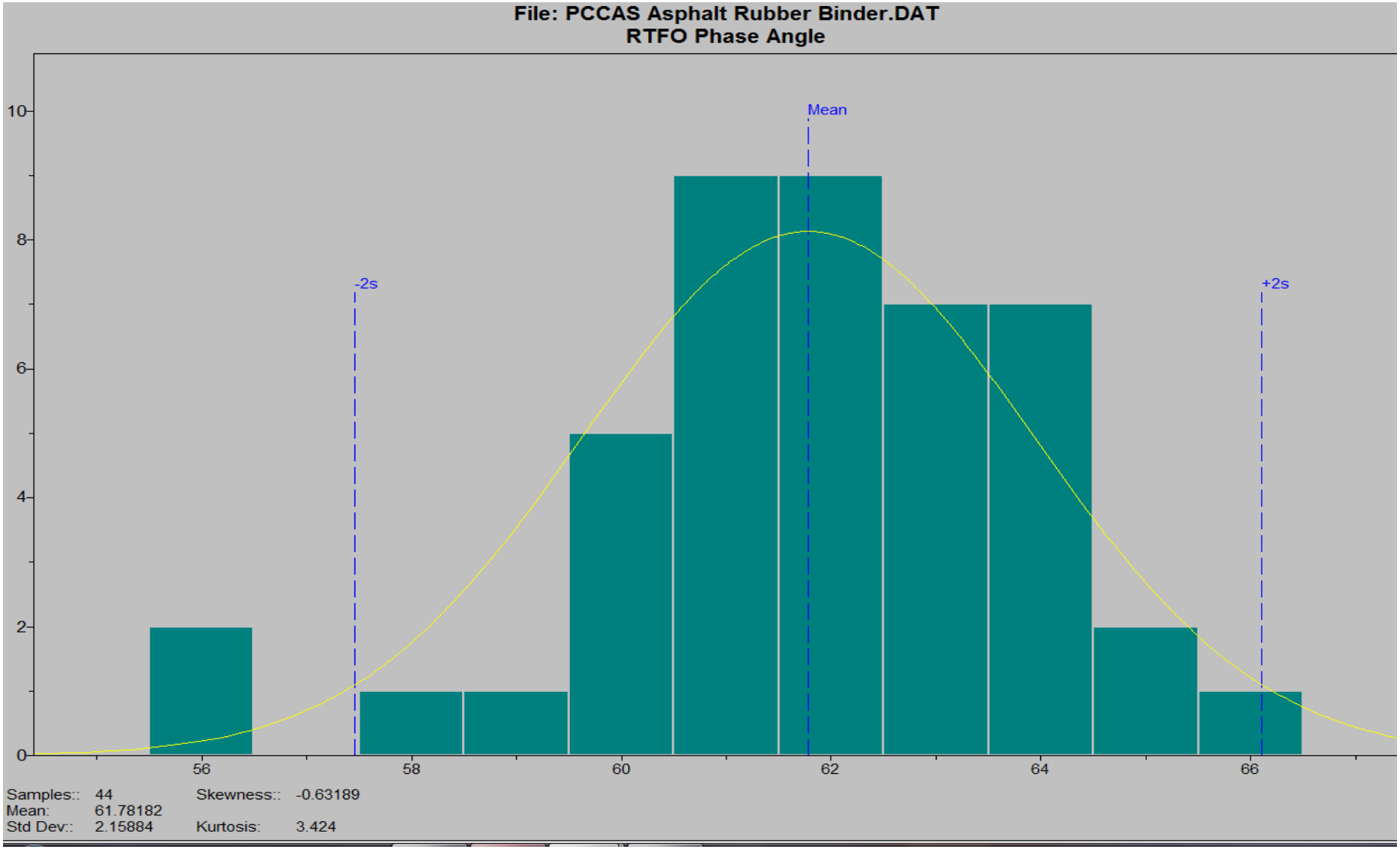
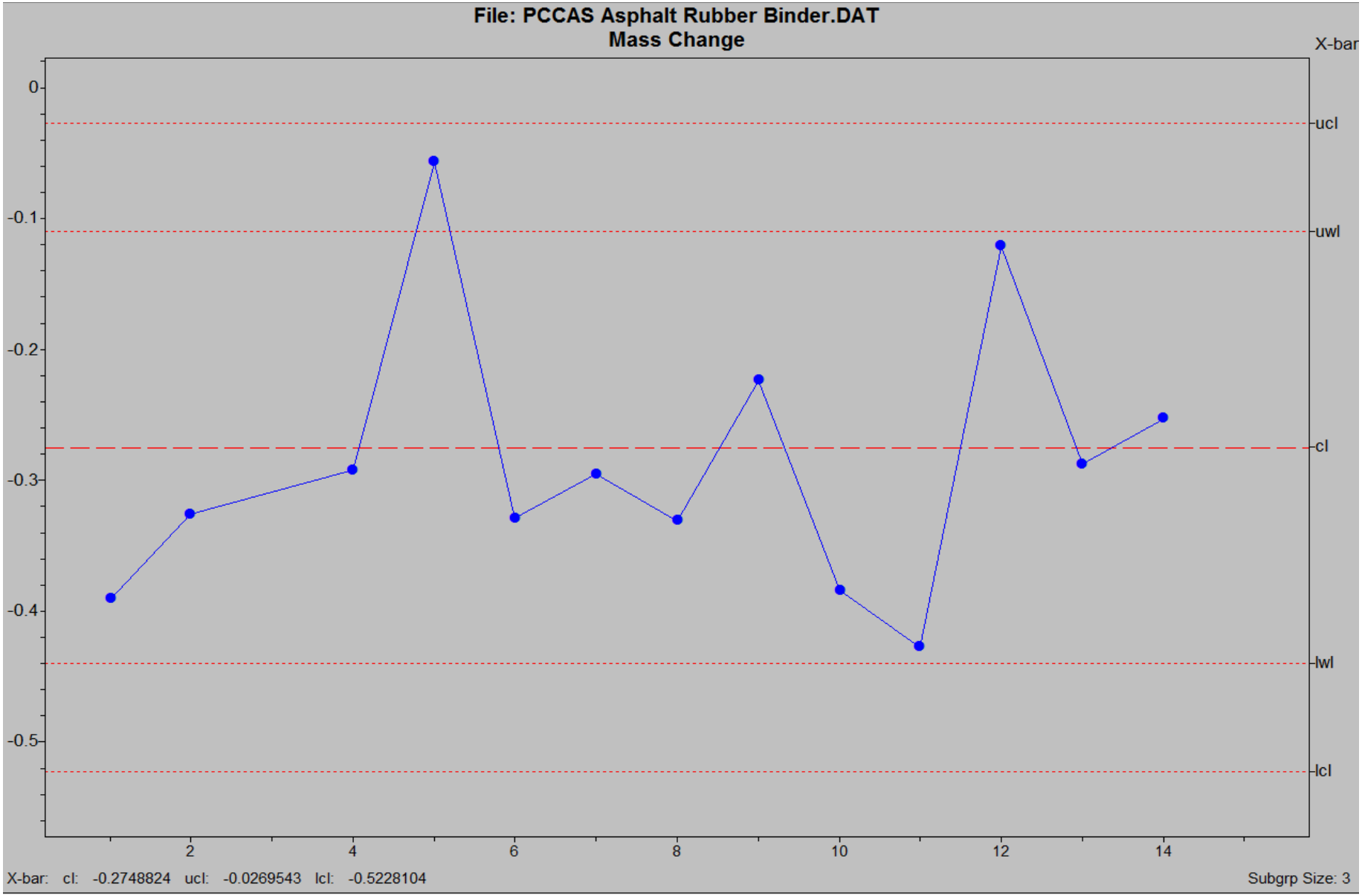


Sample A Mass Change



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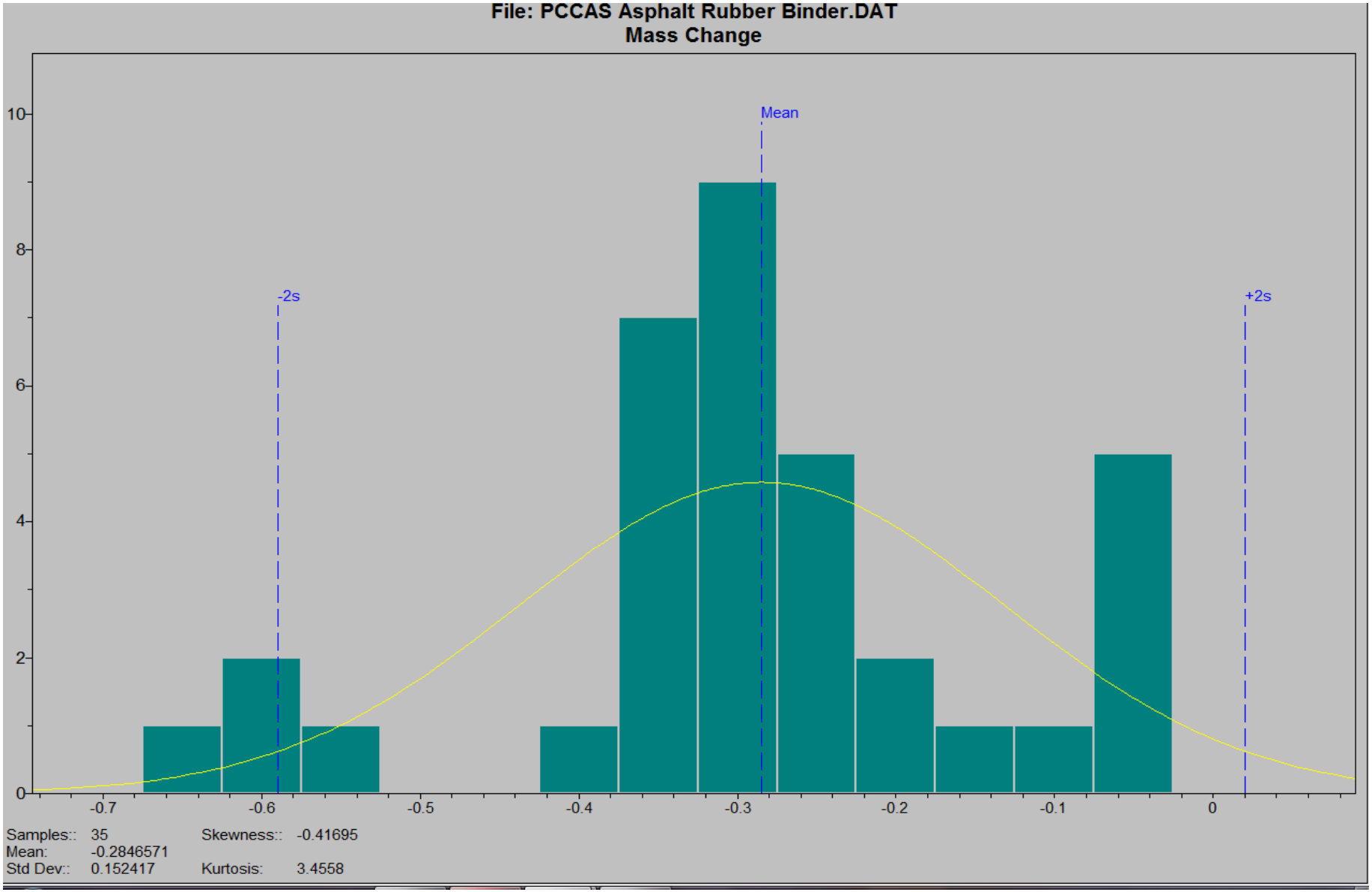
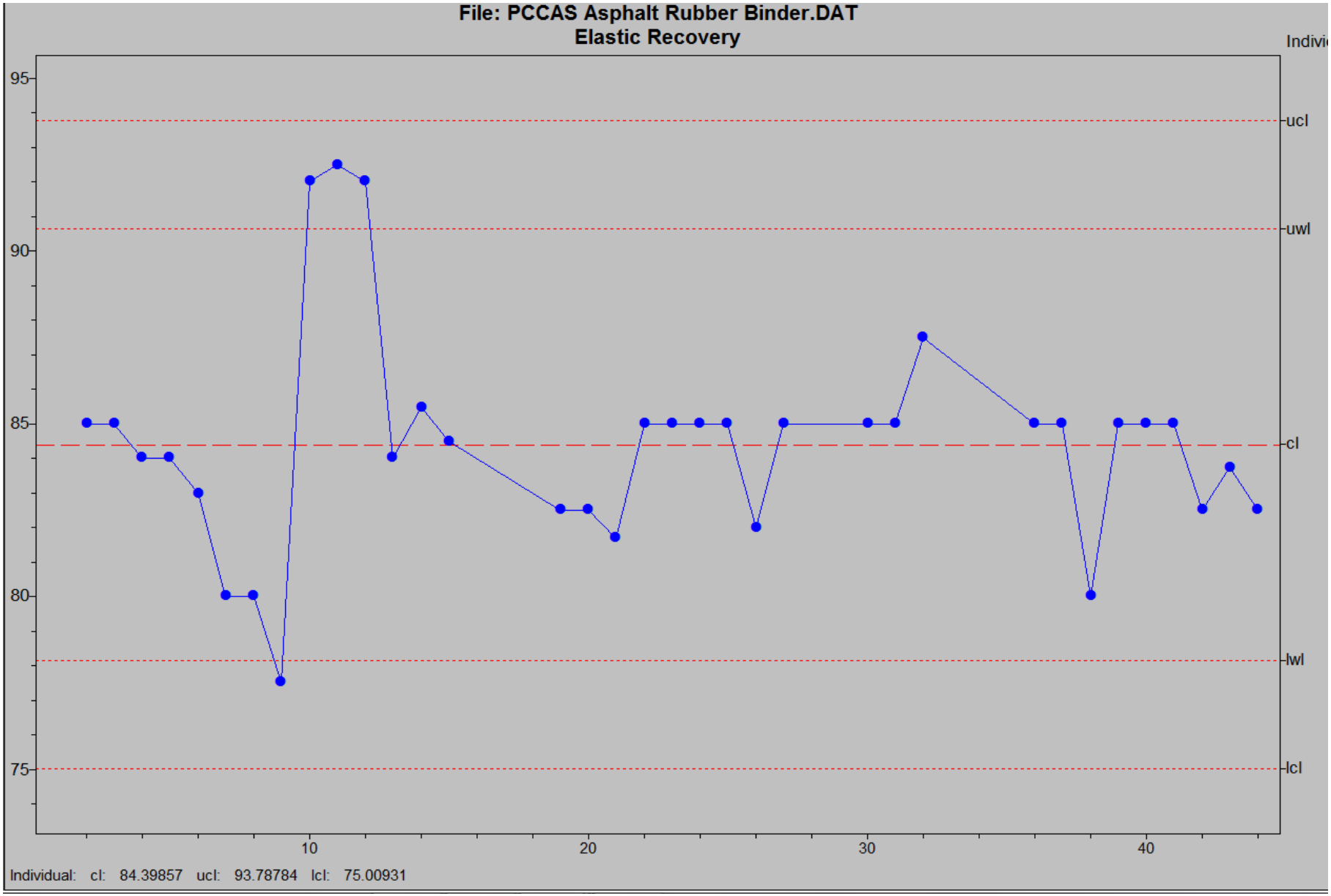


Sample A Elastic Recovery



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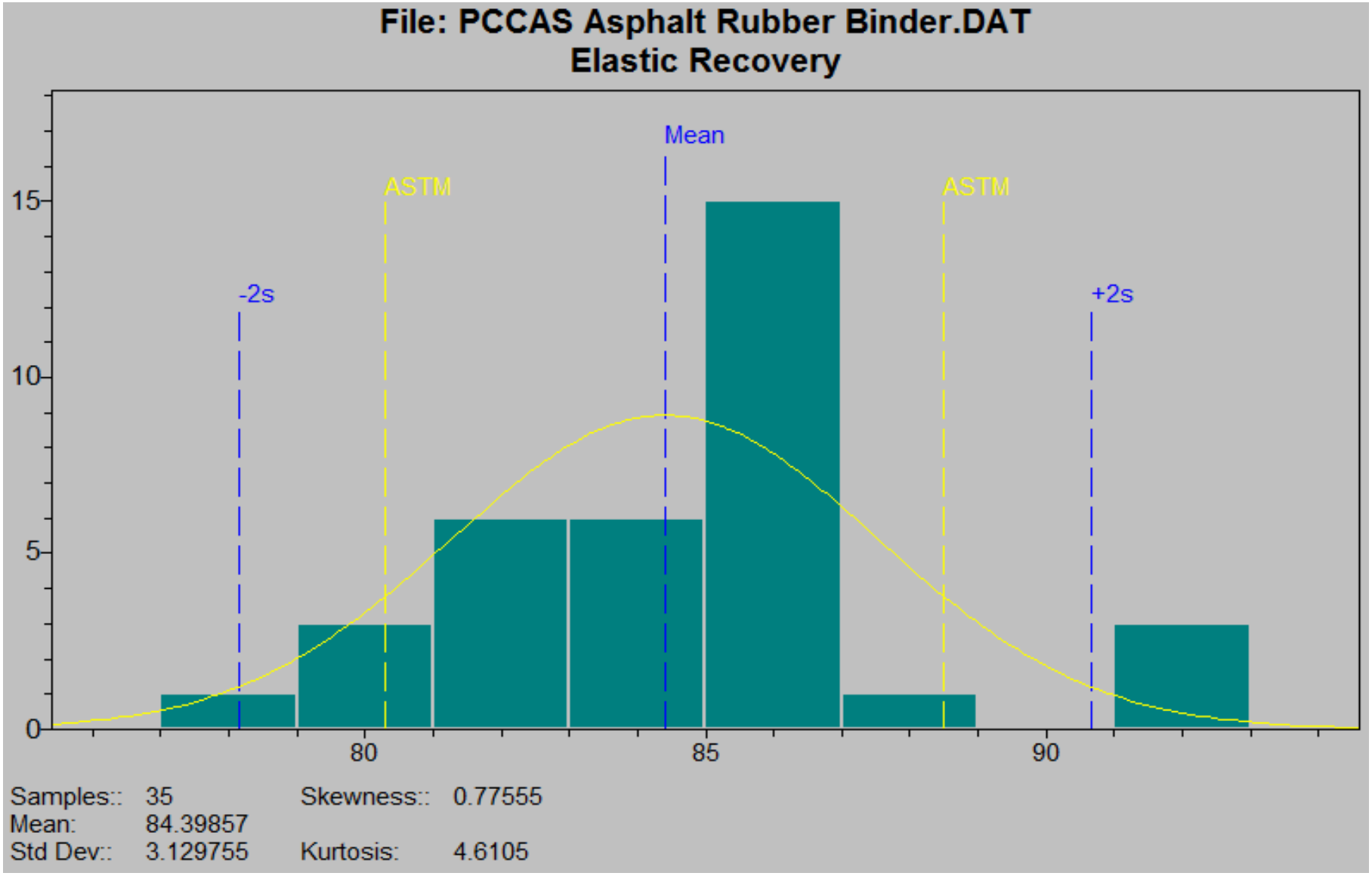
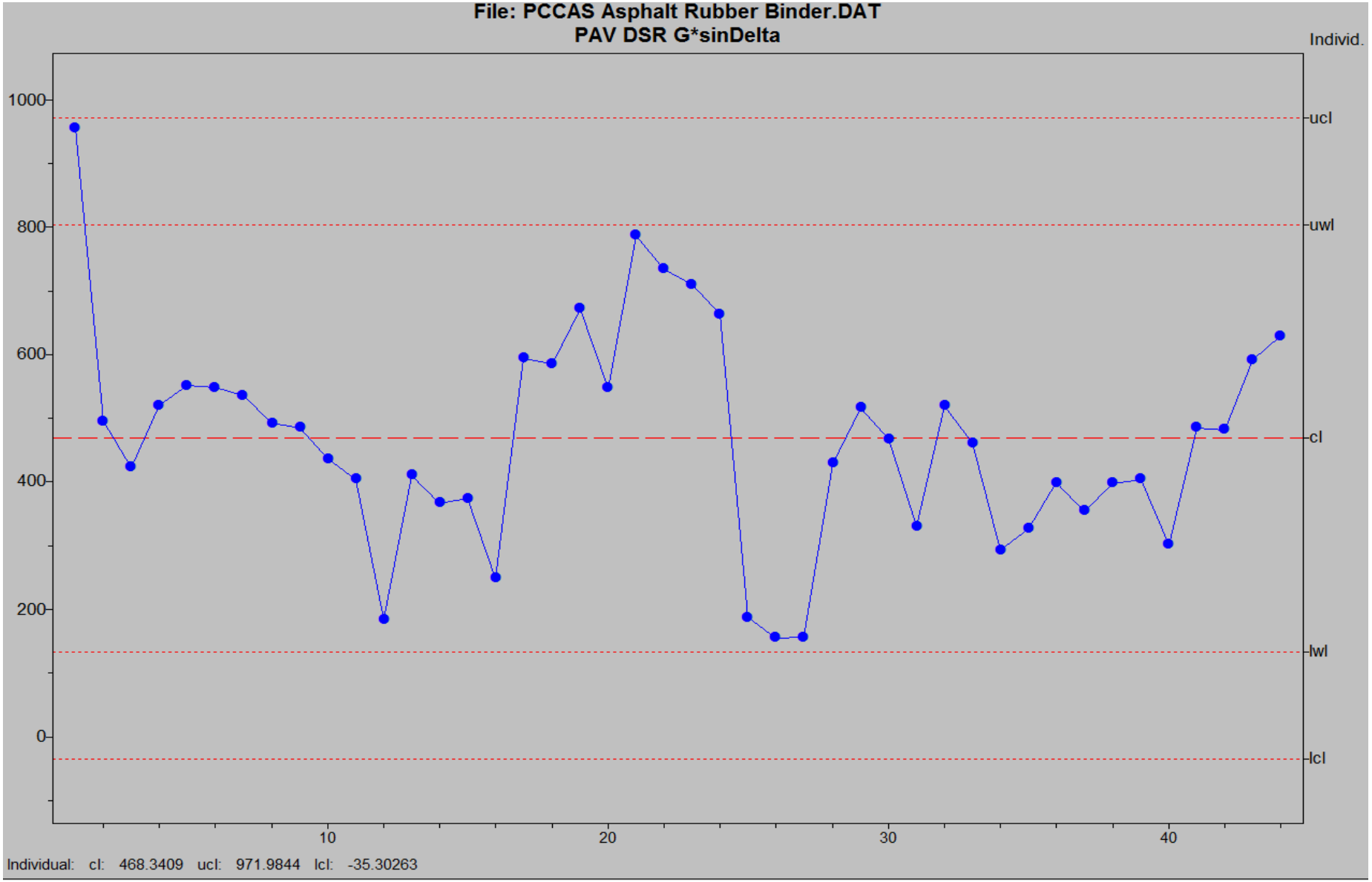


Sample A PAV DSR G*sinDelta



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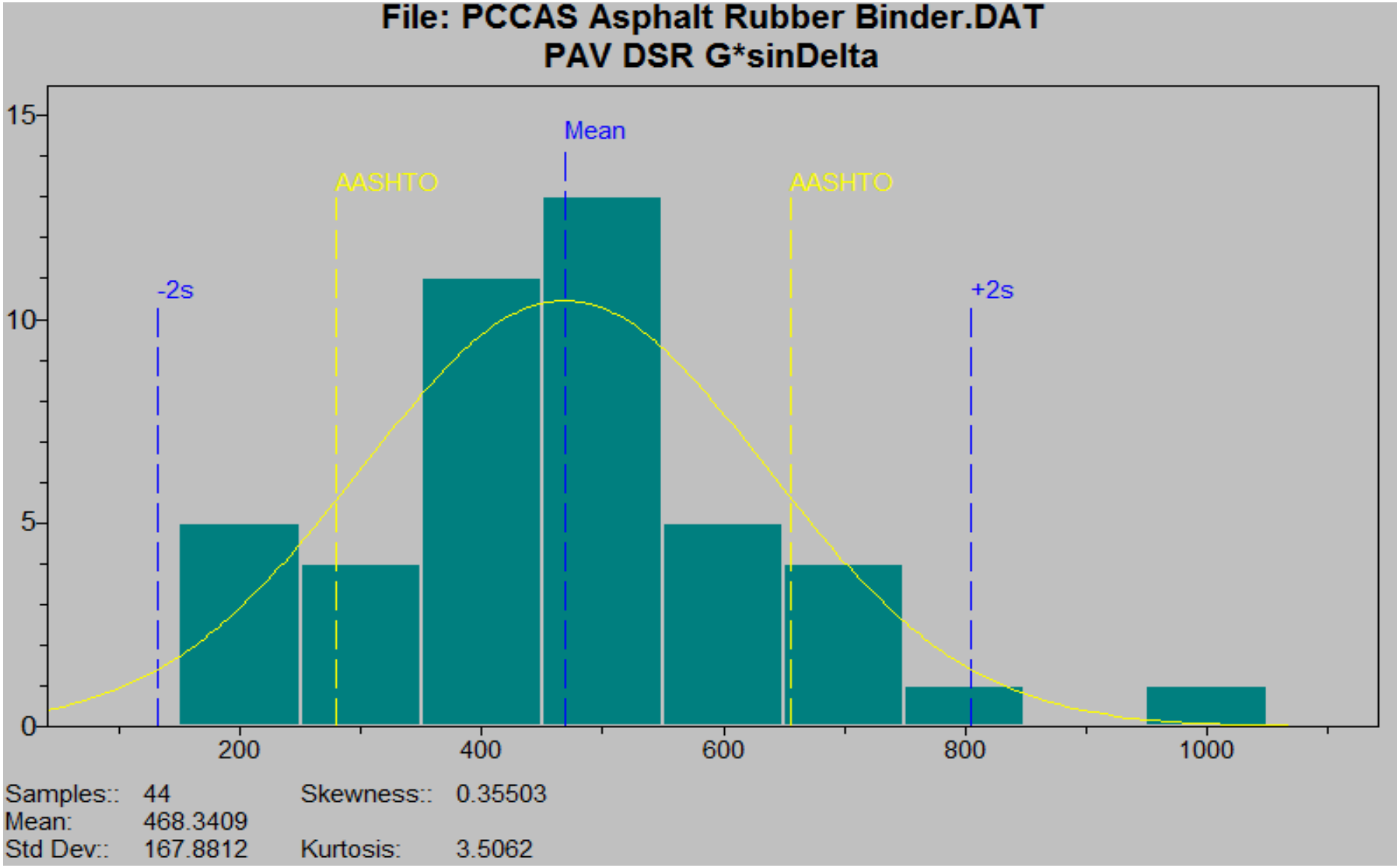

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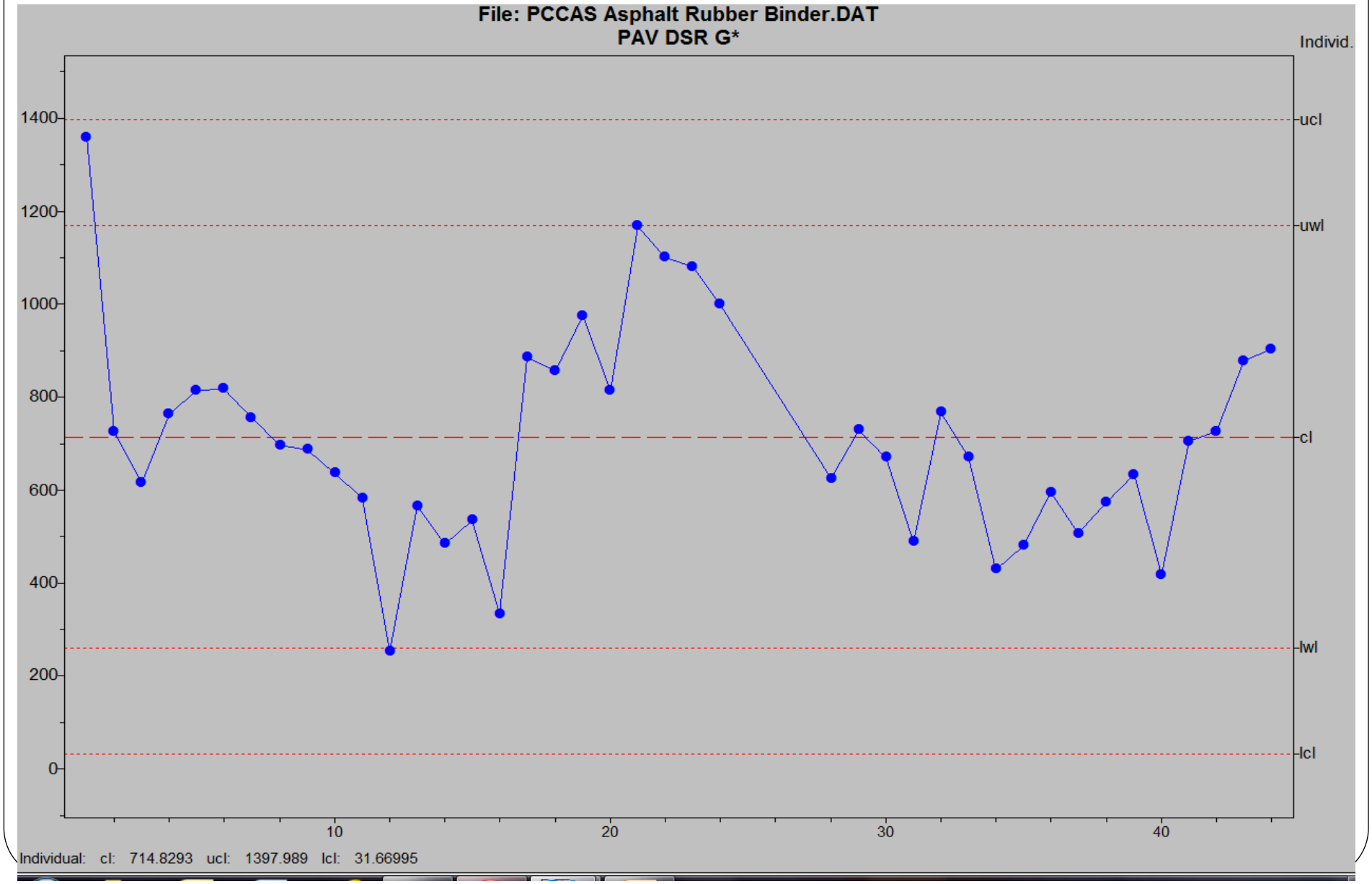

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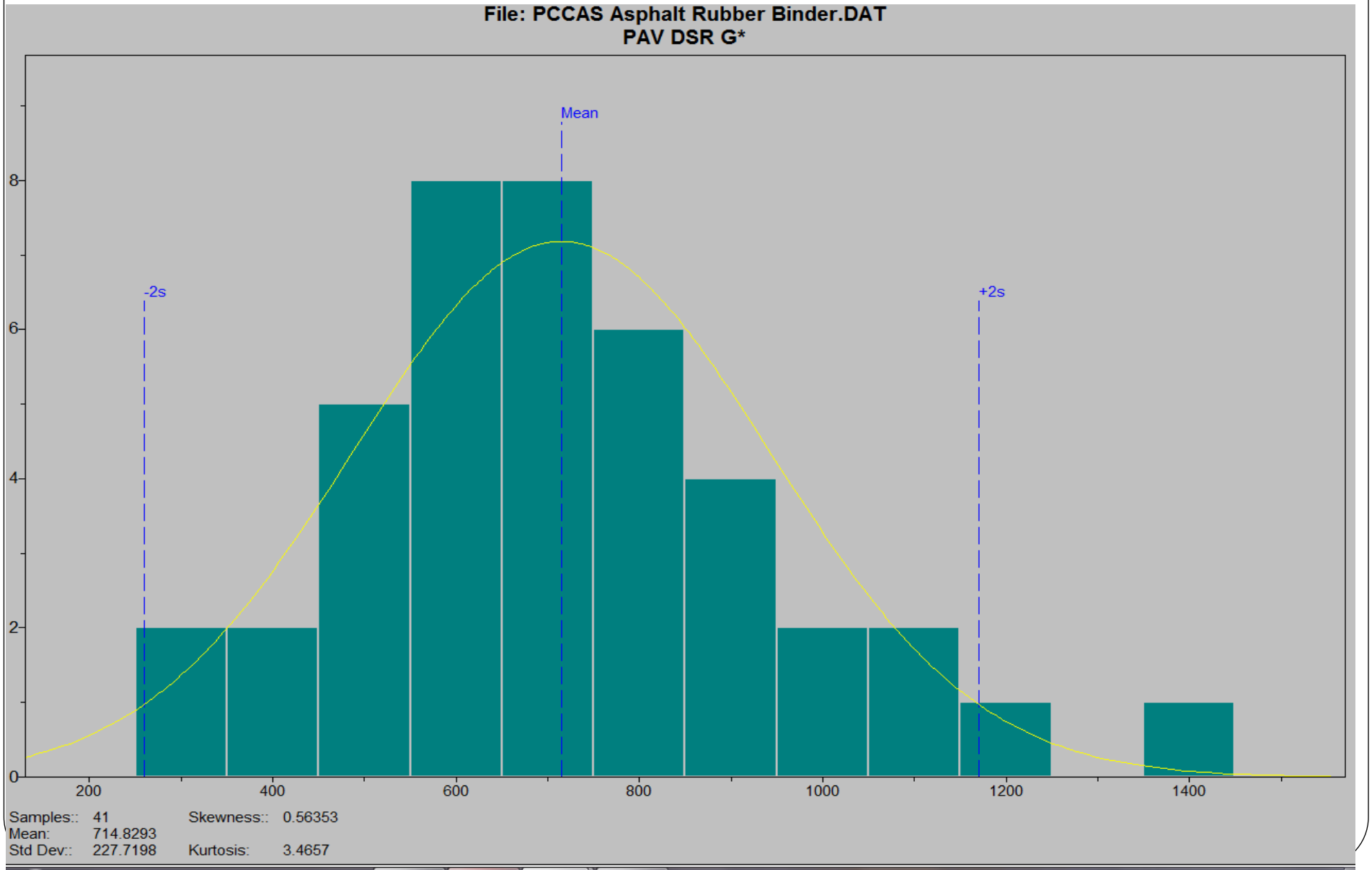
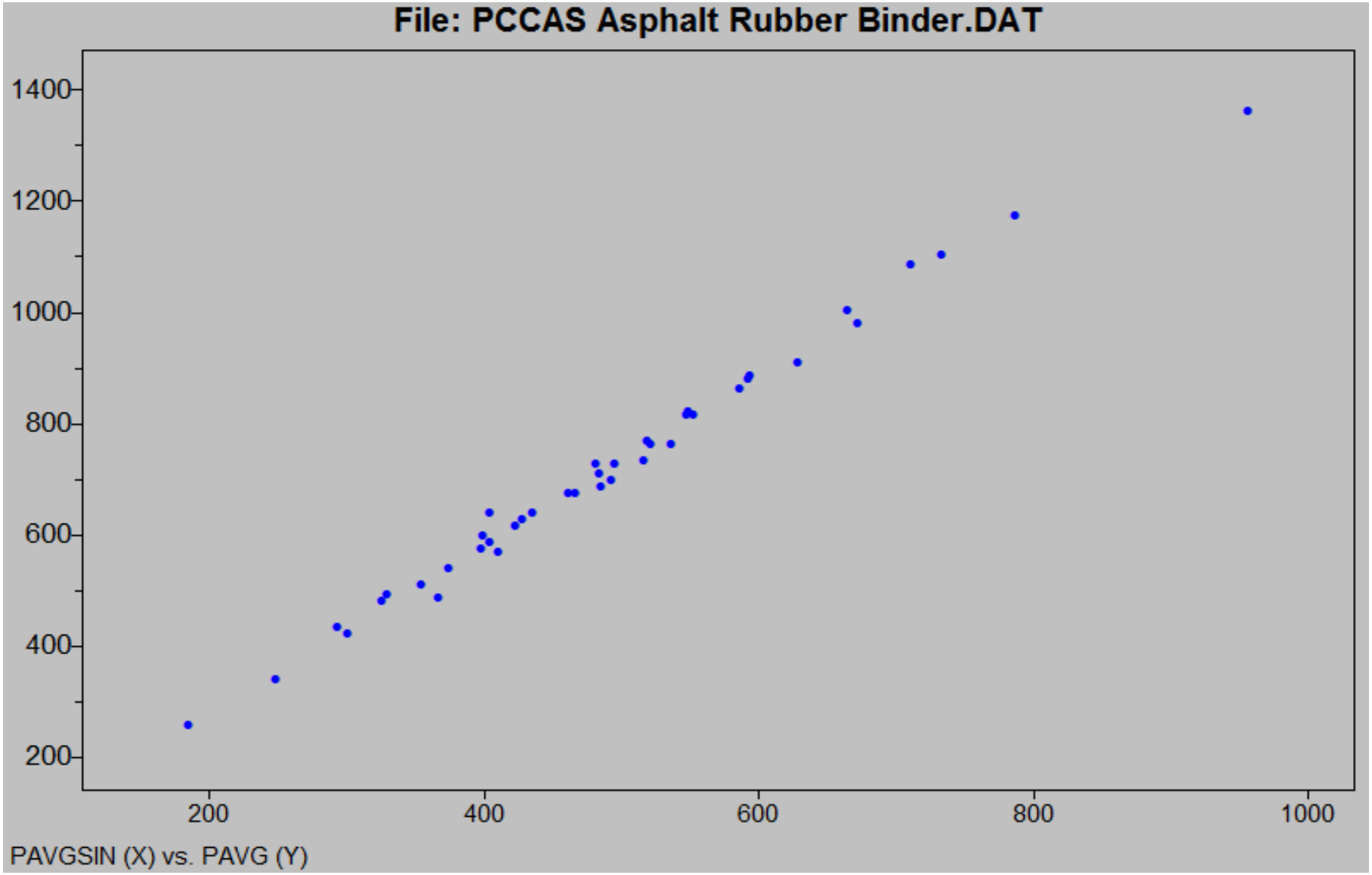
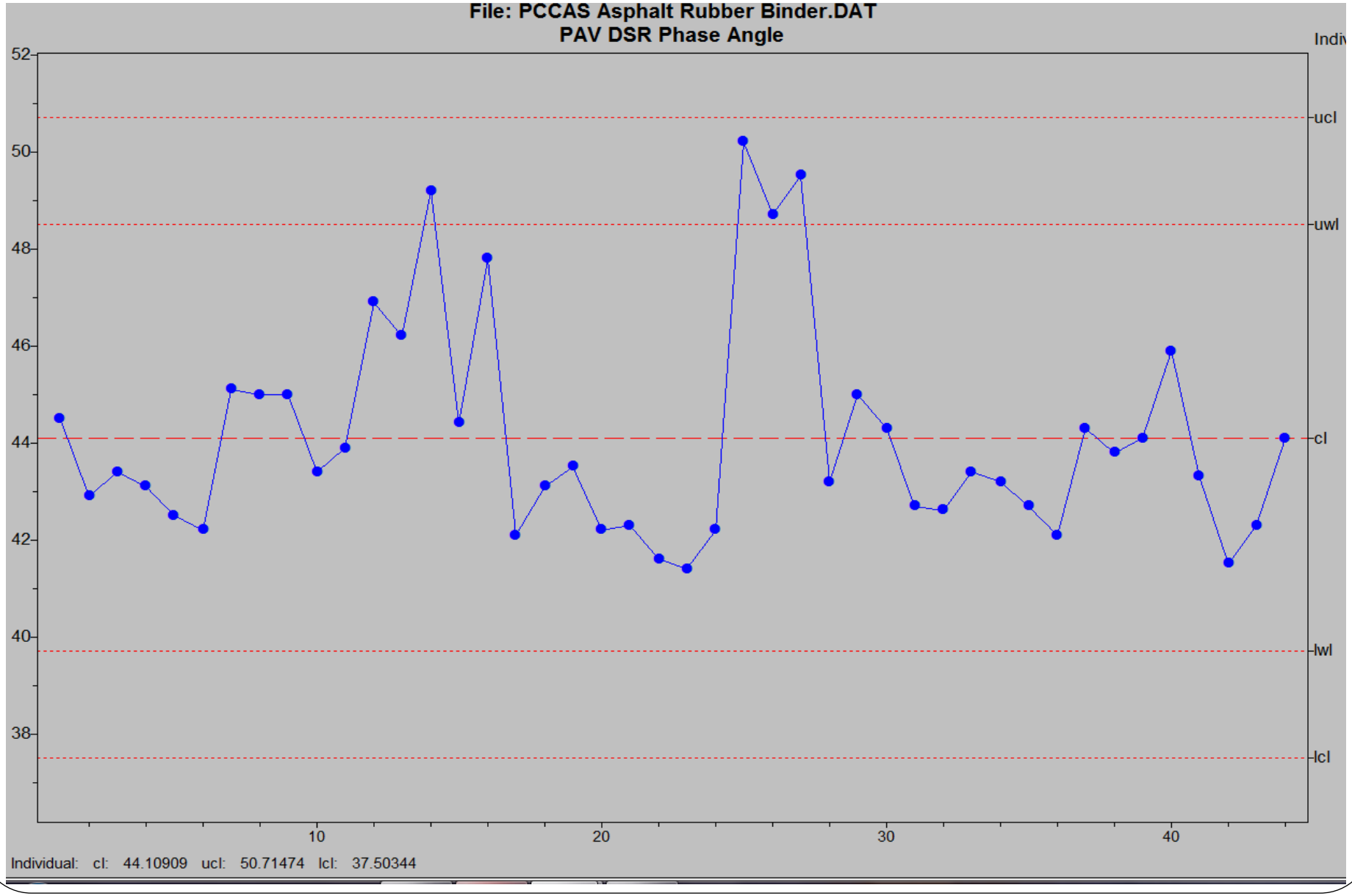


Sample A PAV DSR G*sinDelta vs G*



Sample A PAV DSR Phase Angle



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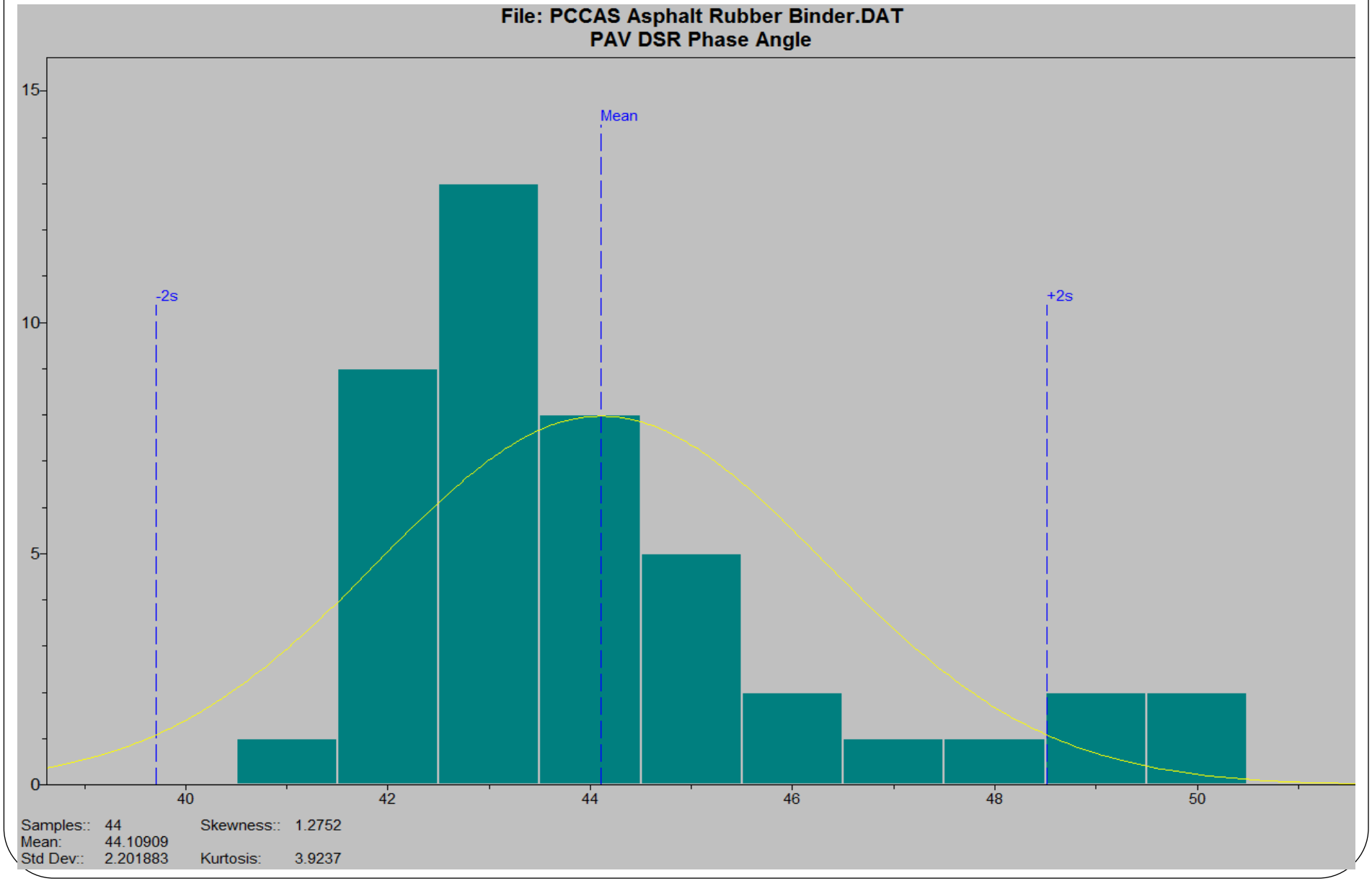
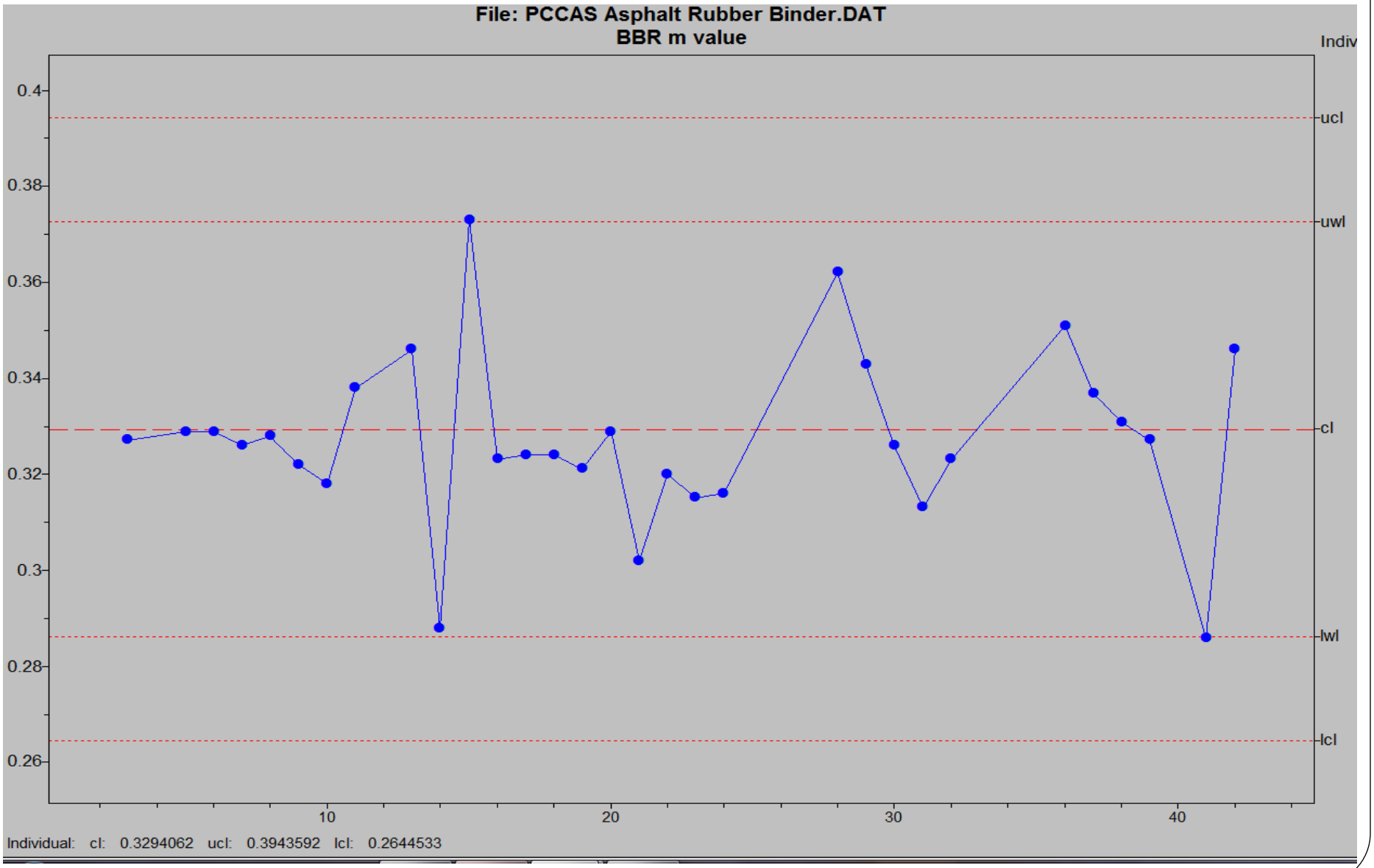


Sample A BBR m value



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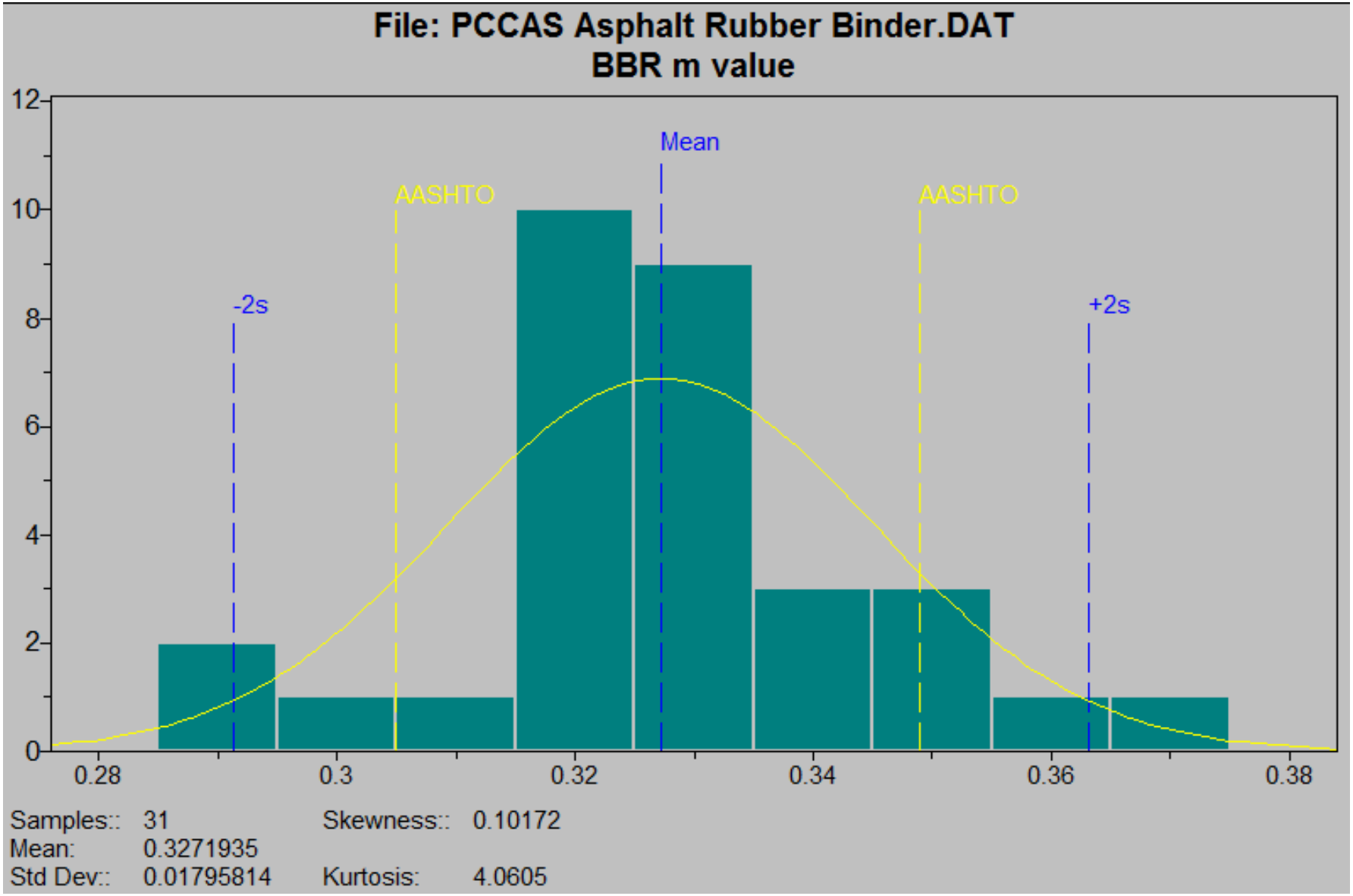
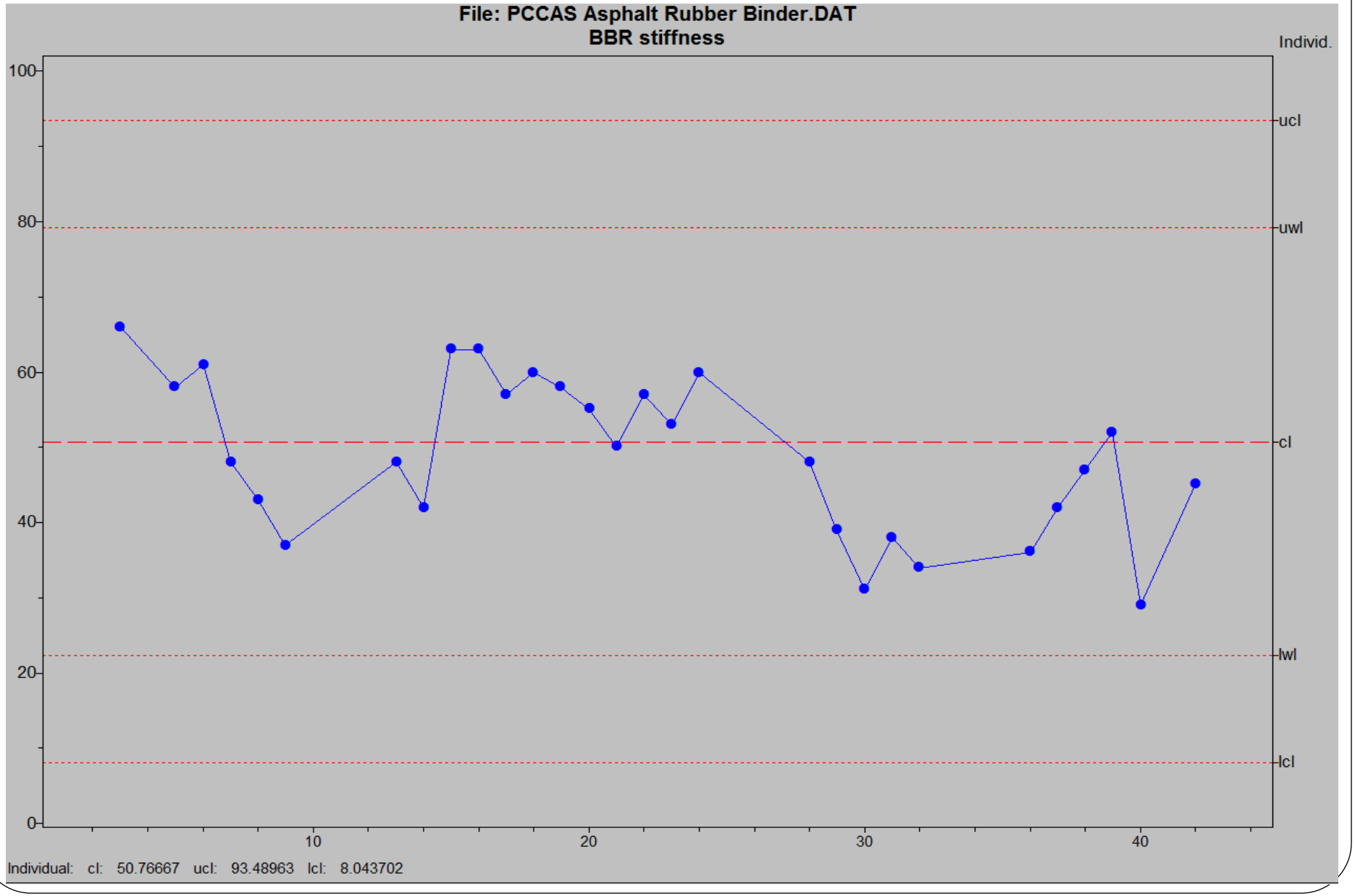


Sample A BBR stiffness



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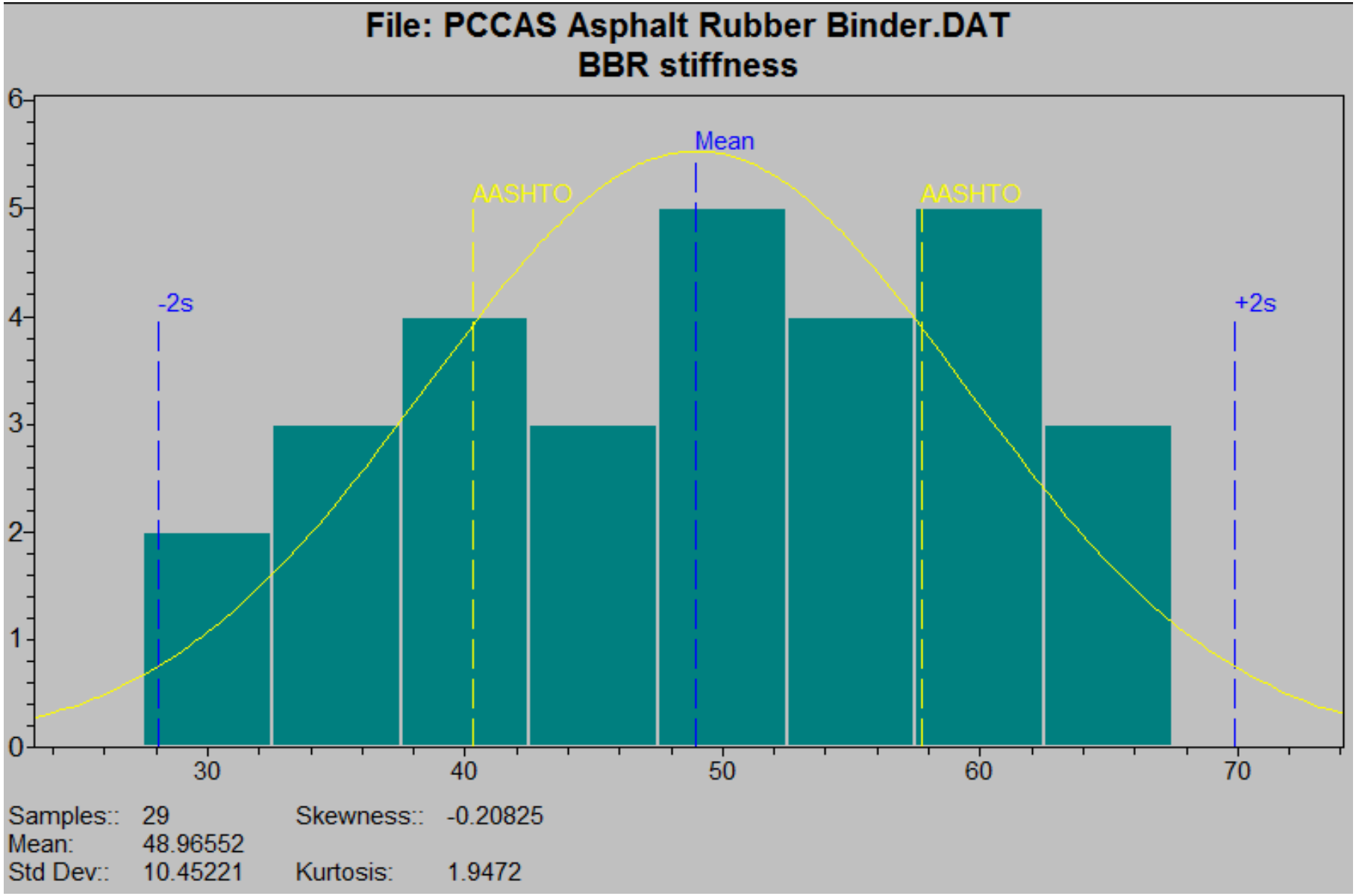
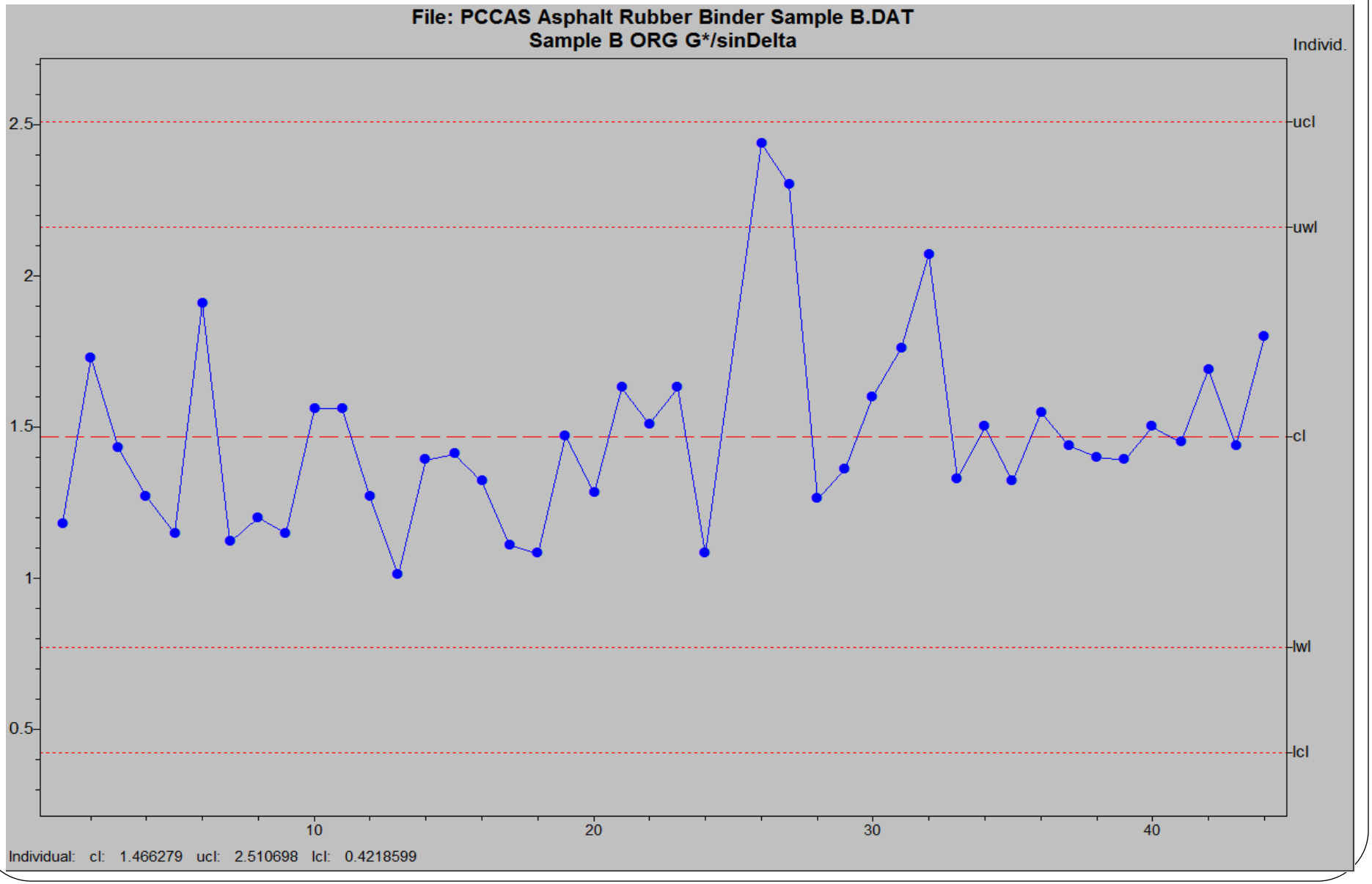


Sample B ORG G*/sinDelta



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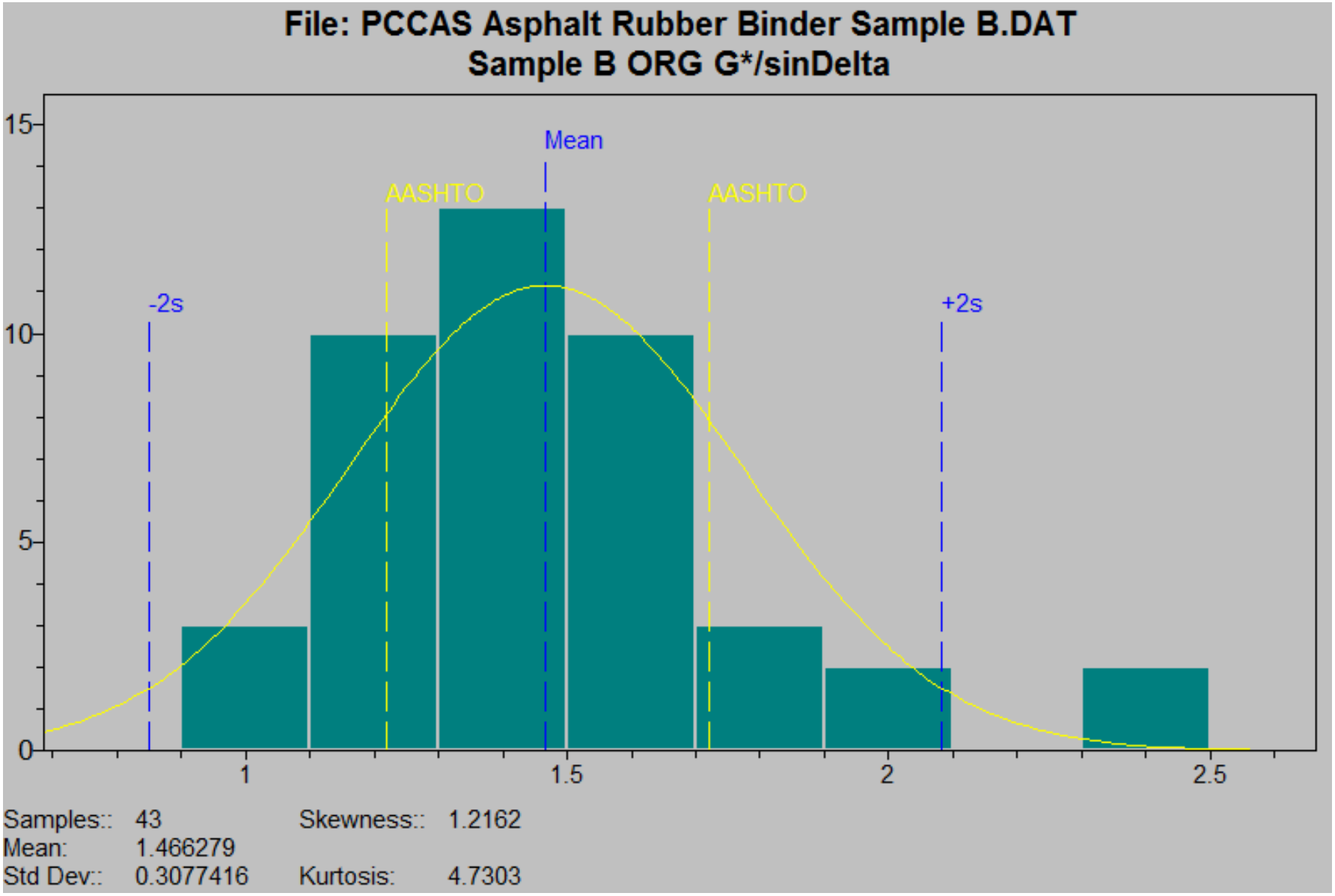
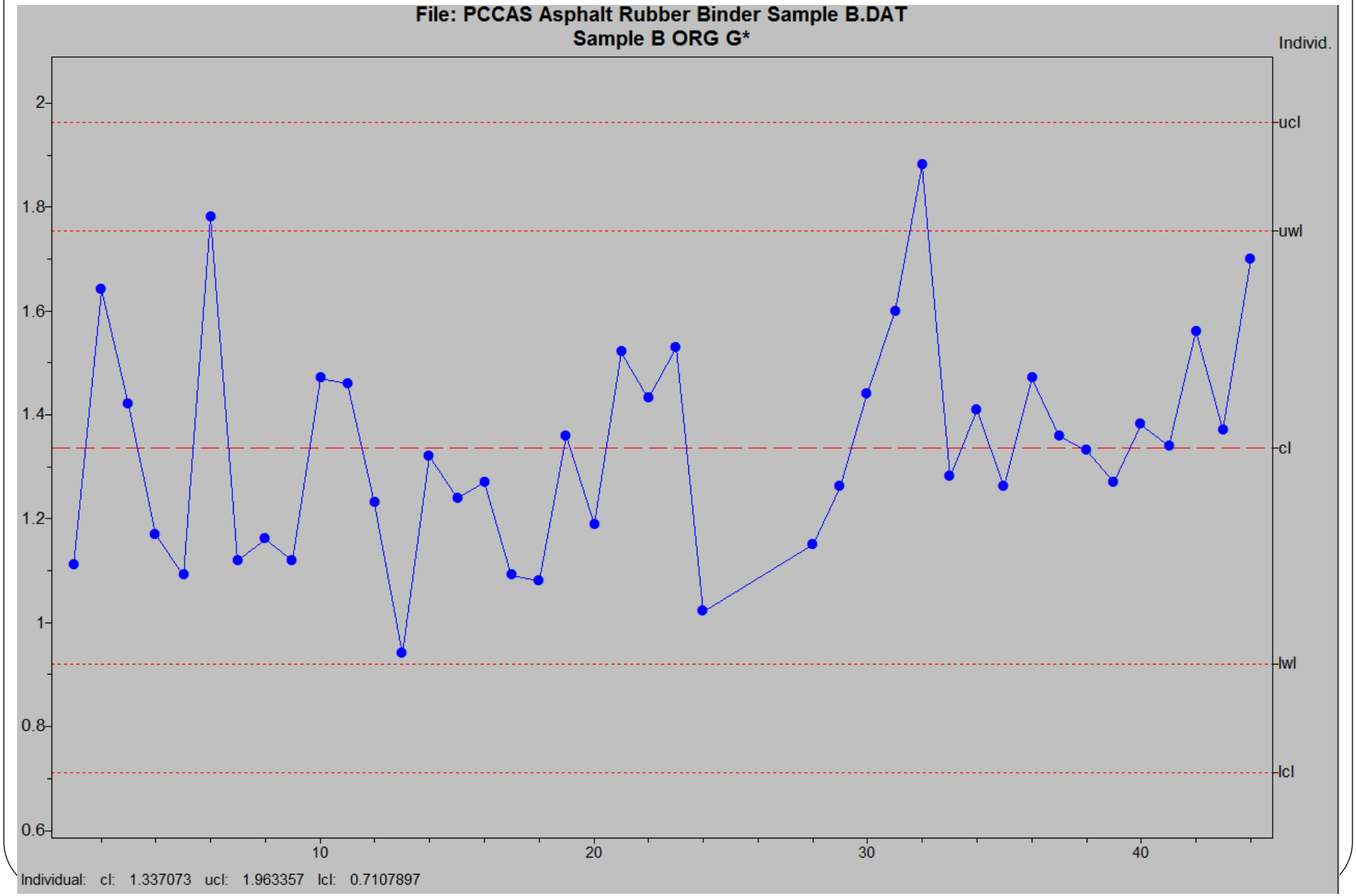


Sample B ORG G*



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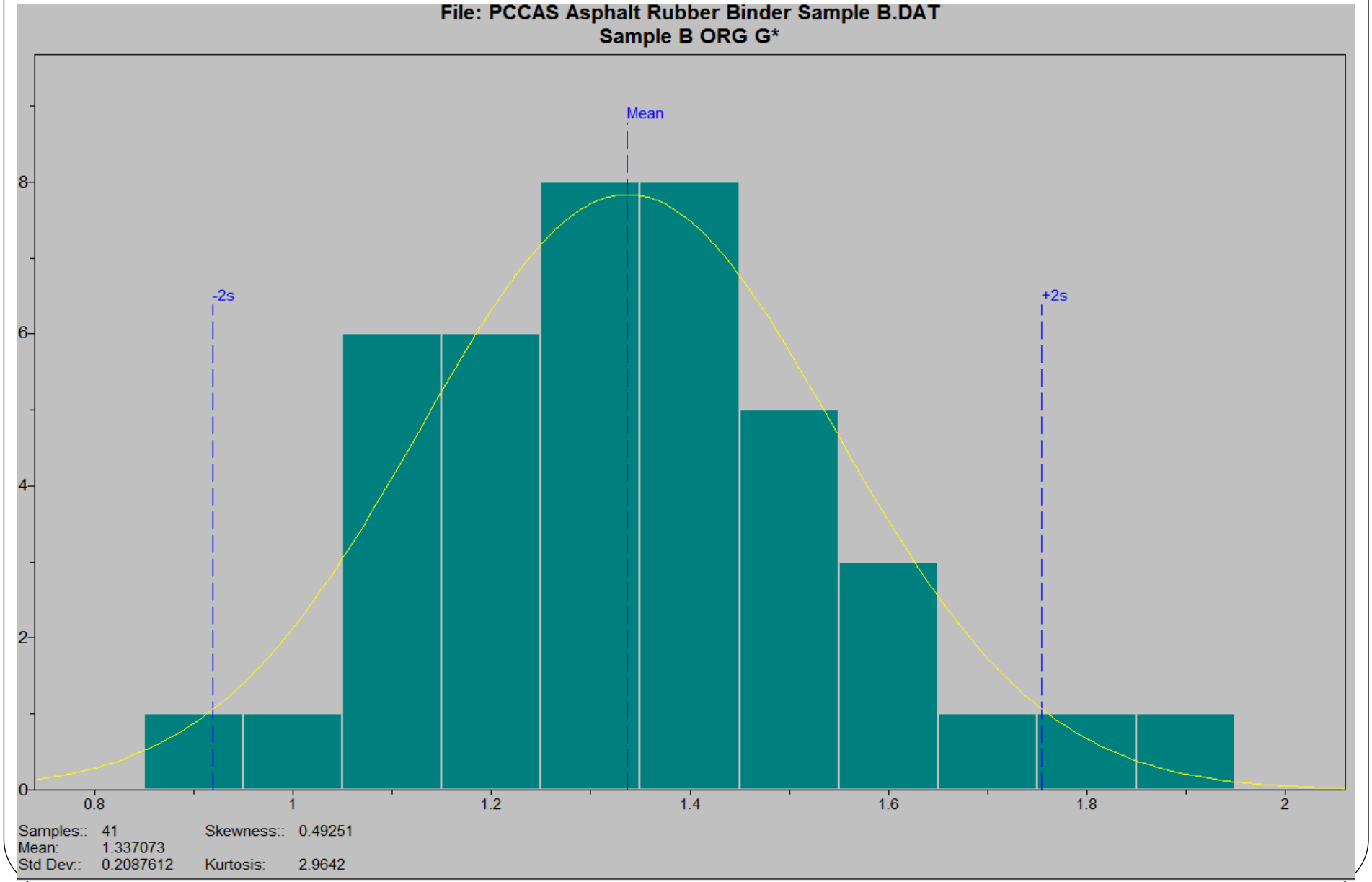
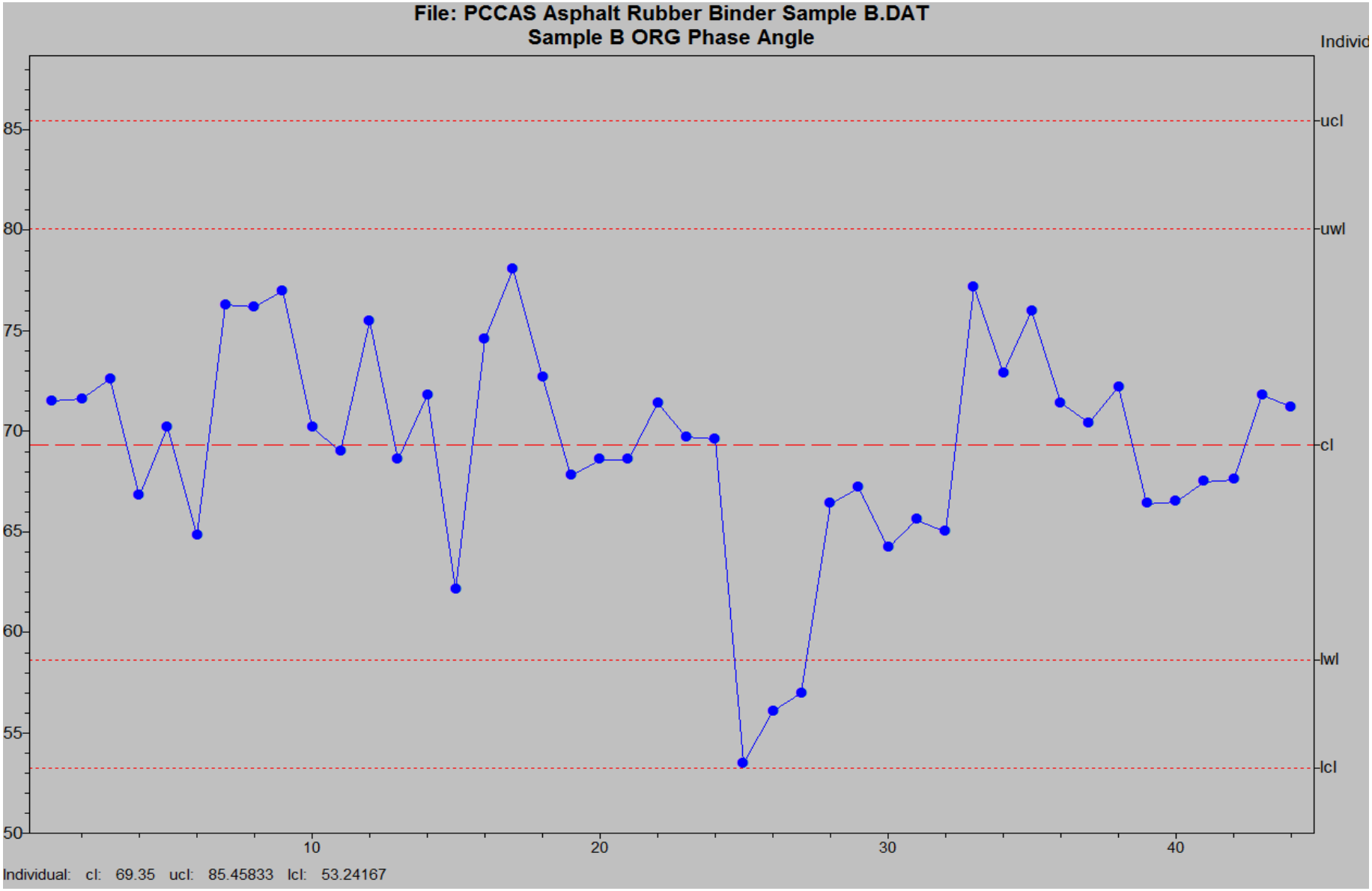


Sample B ORG Phase Angle



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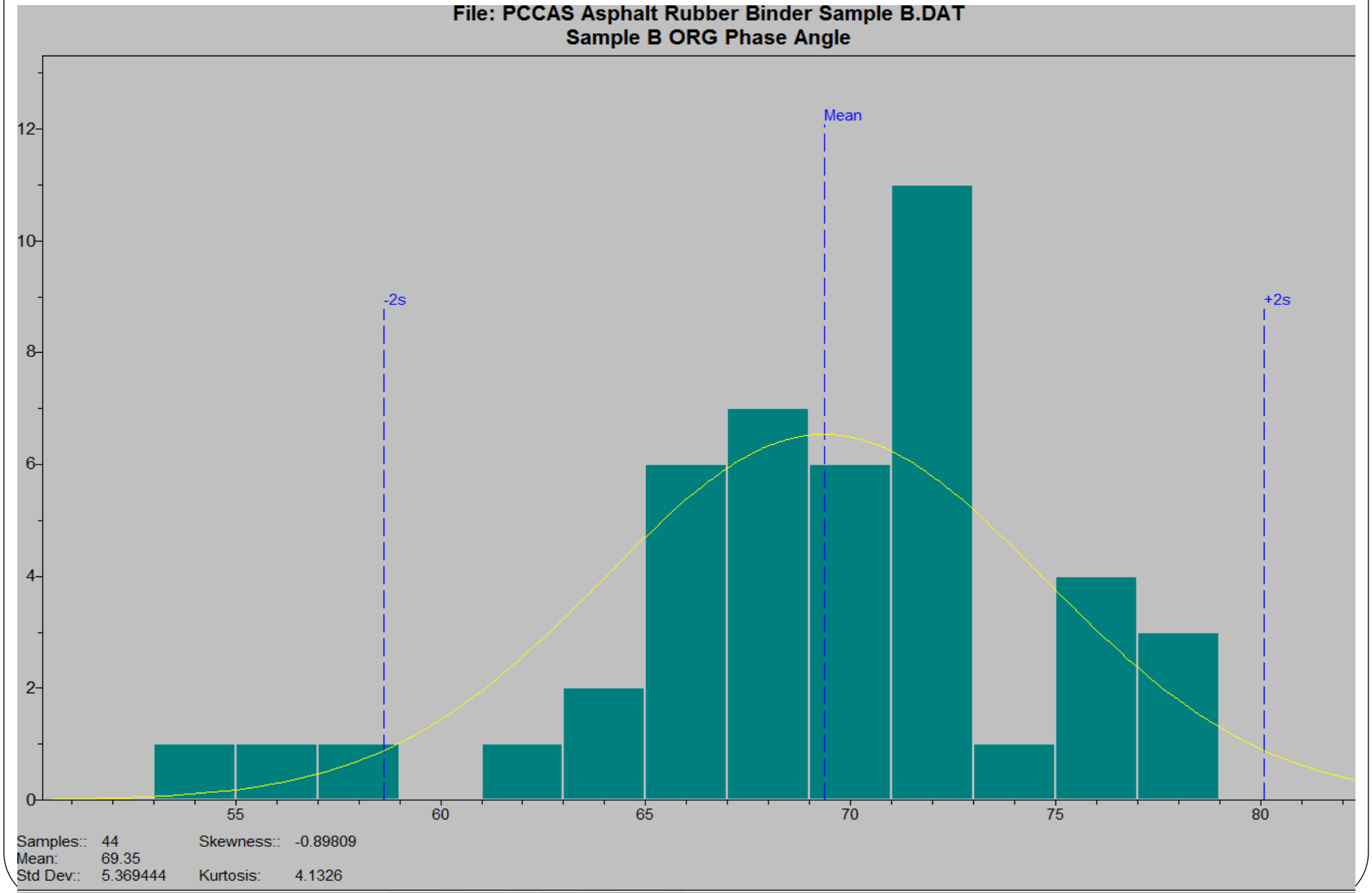
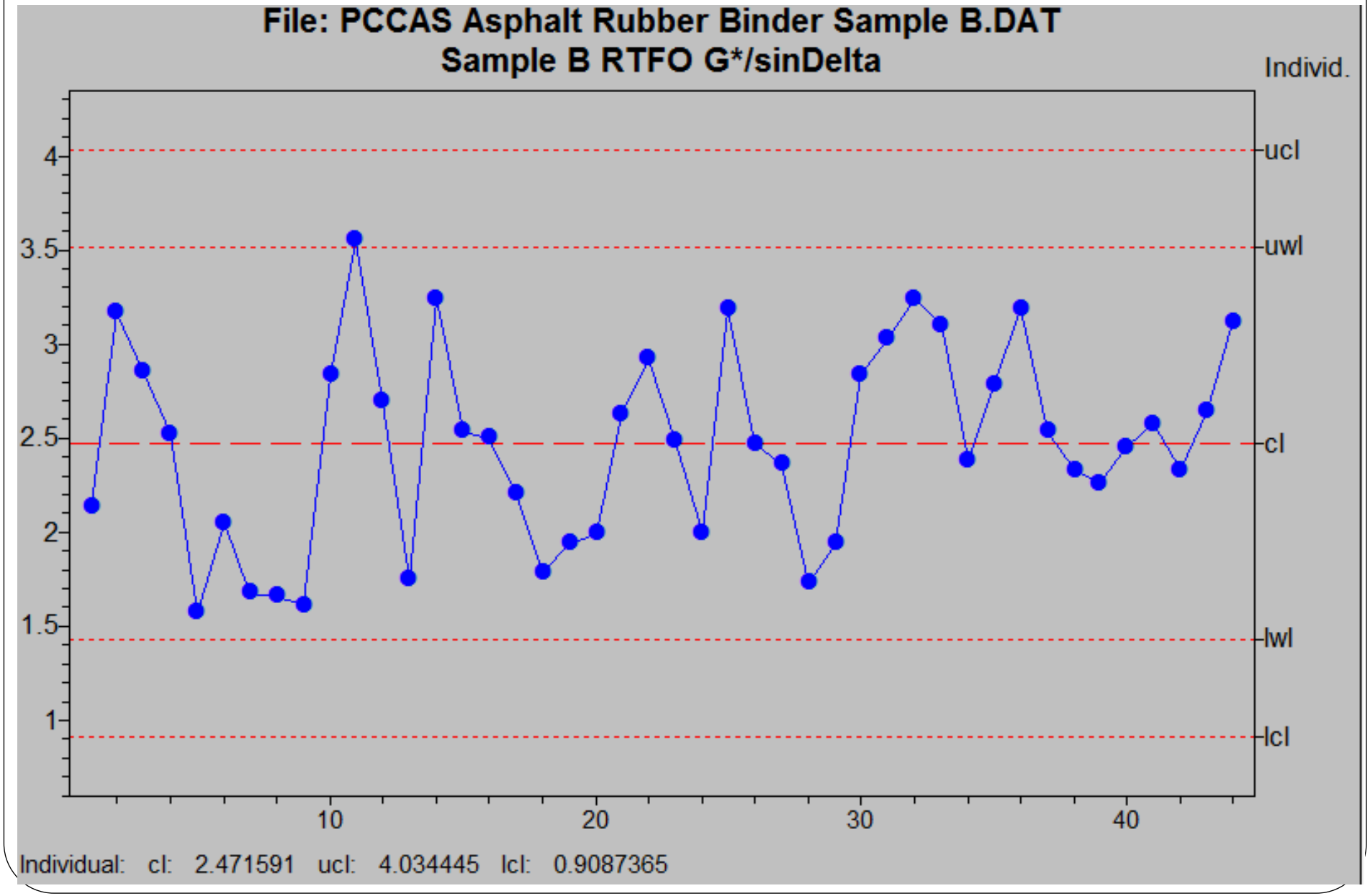


Sample B RTFO G*/sinDelta



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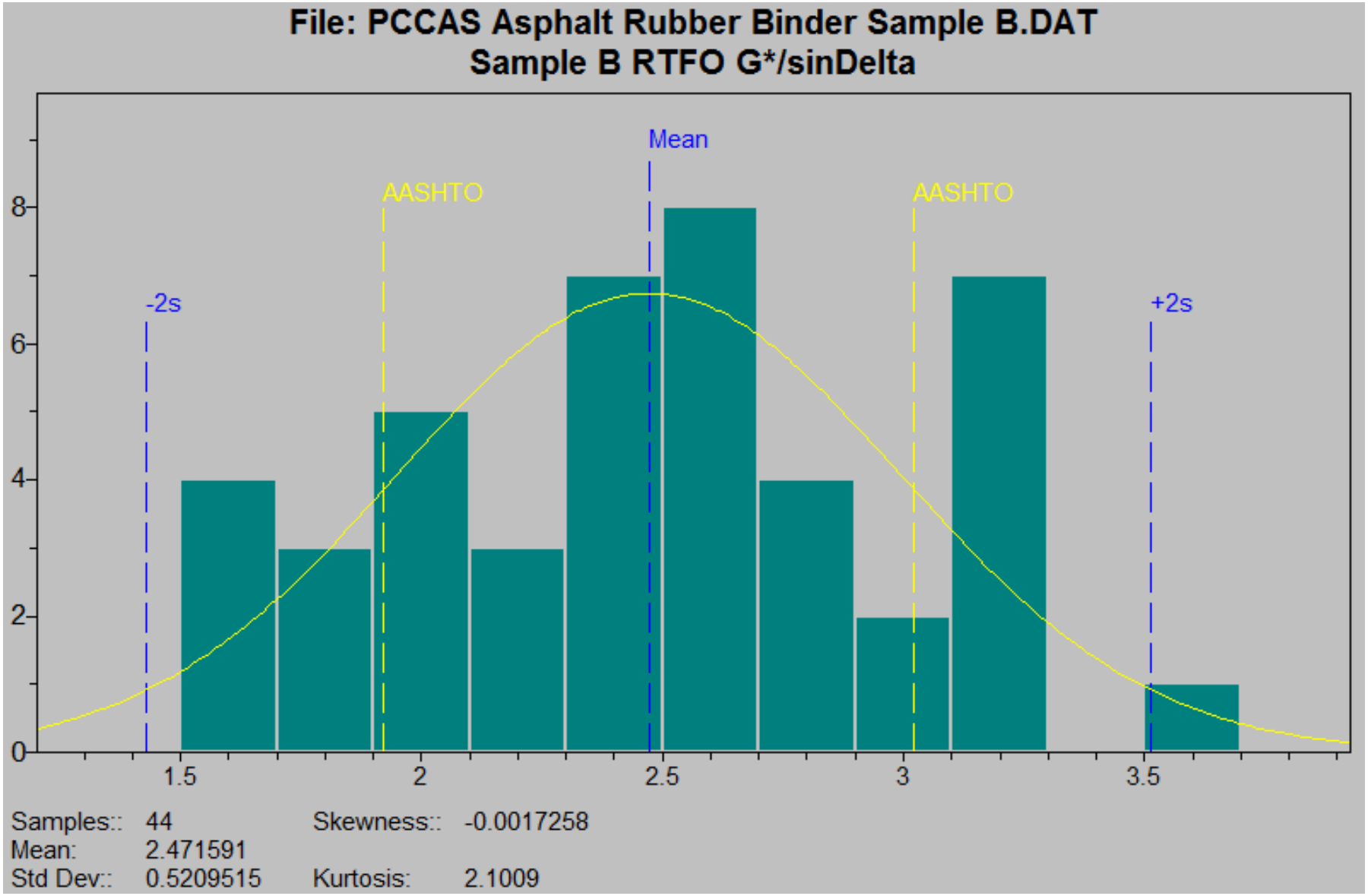
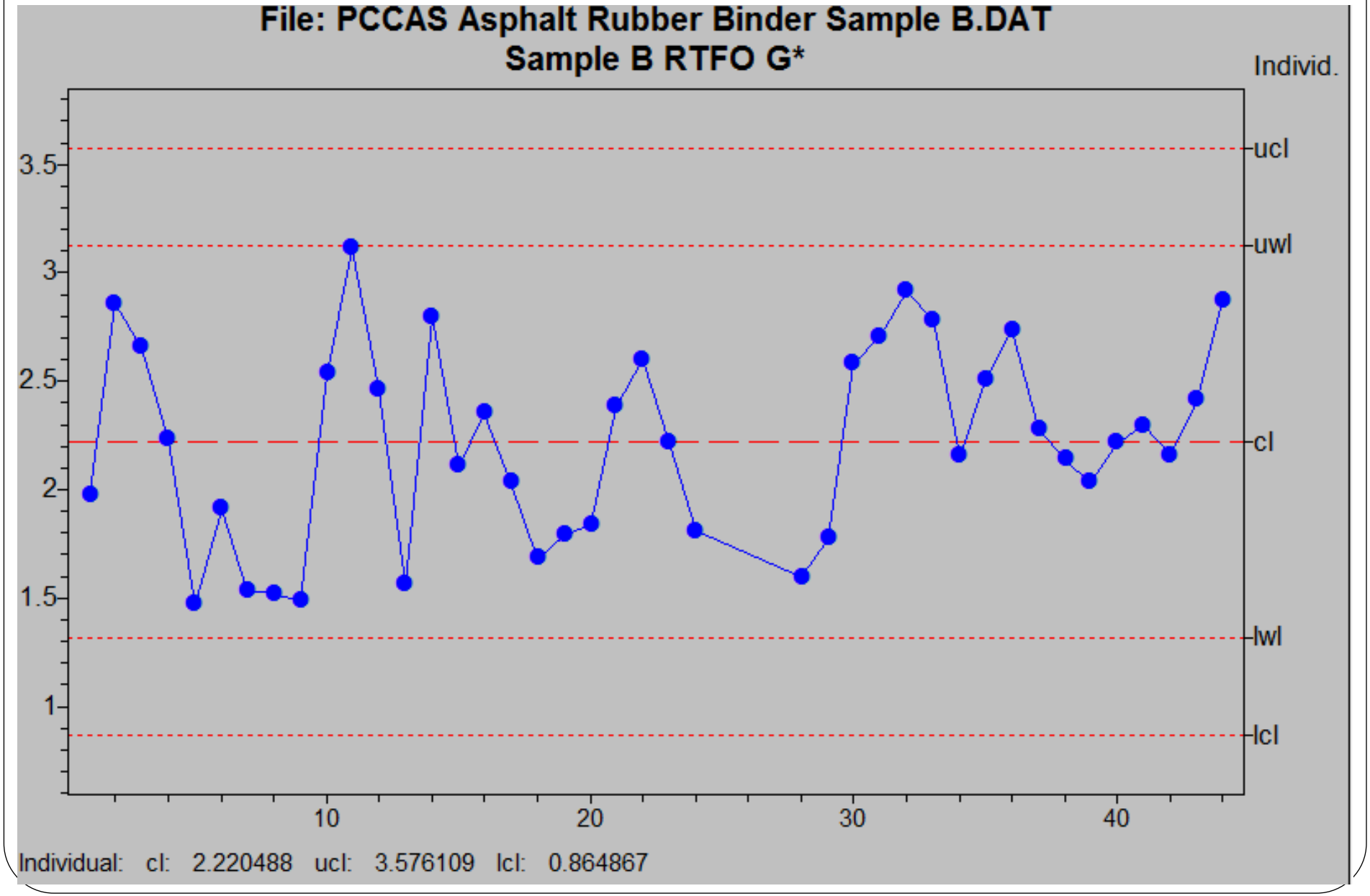


Sample B RTFO G*



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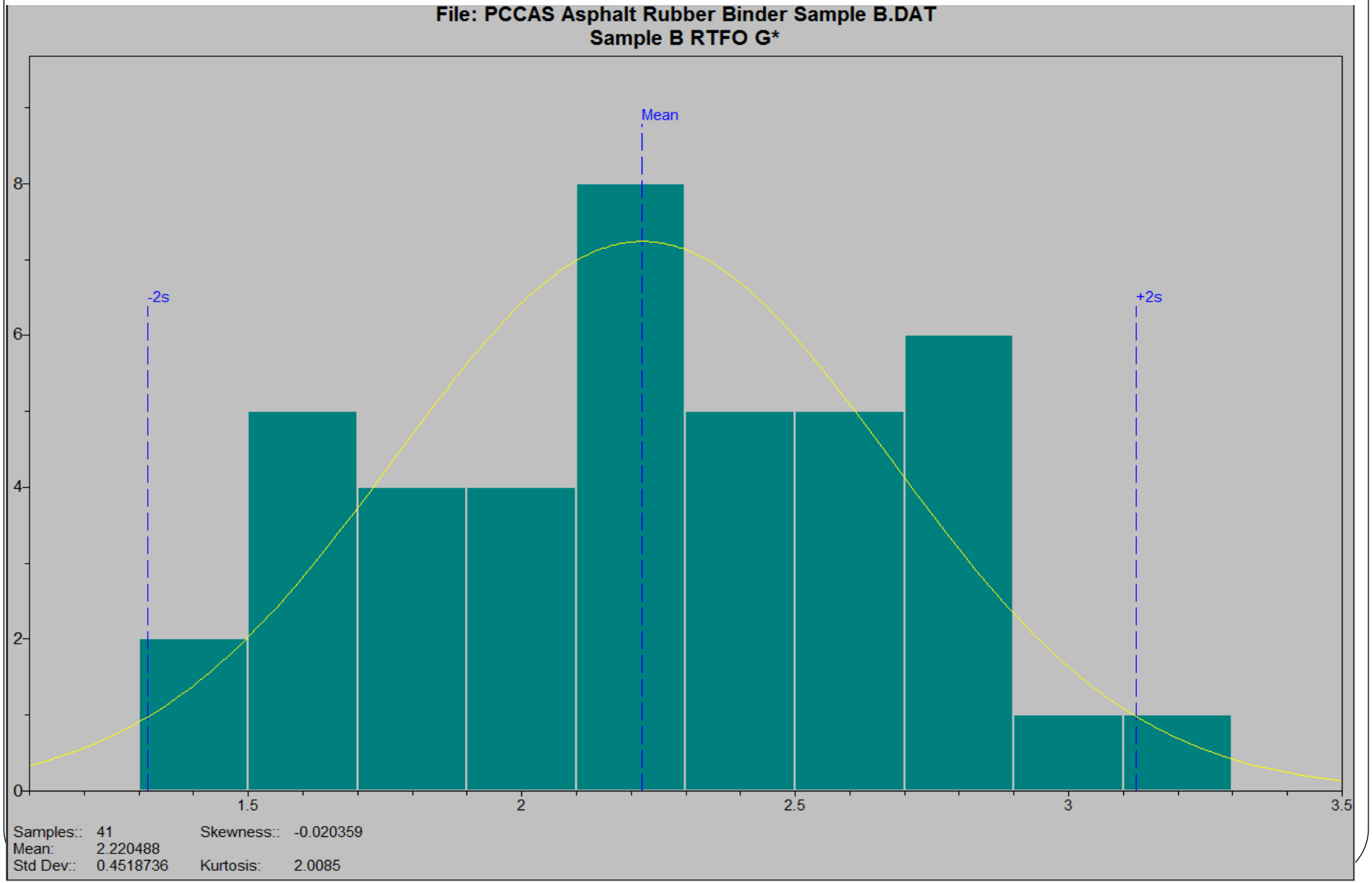
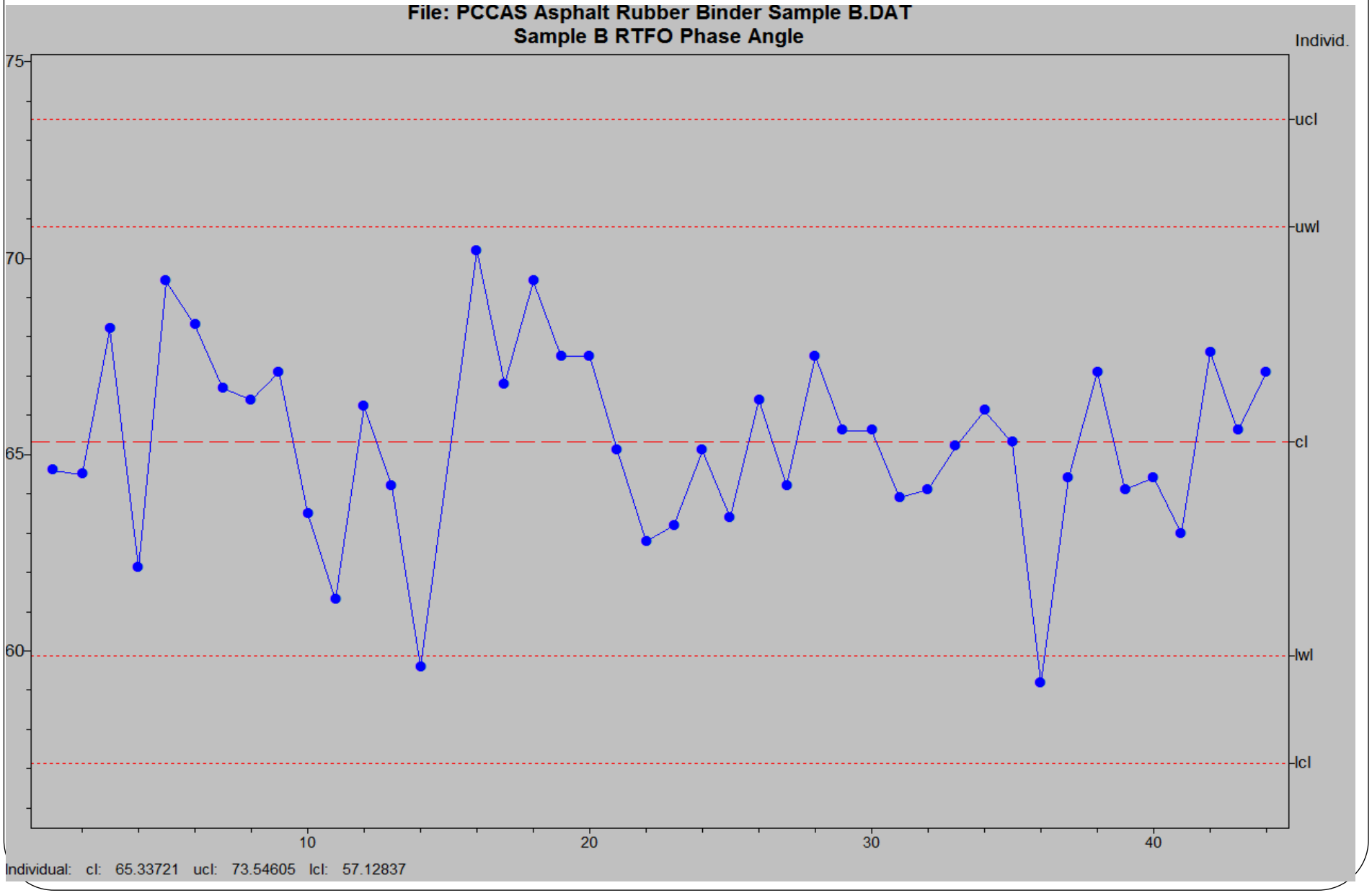


Sample B RTFO Phase Angle



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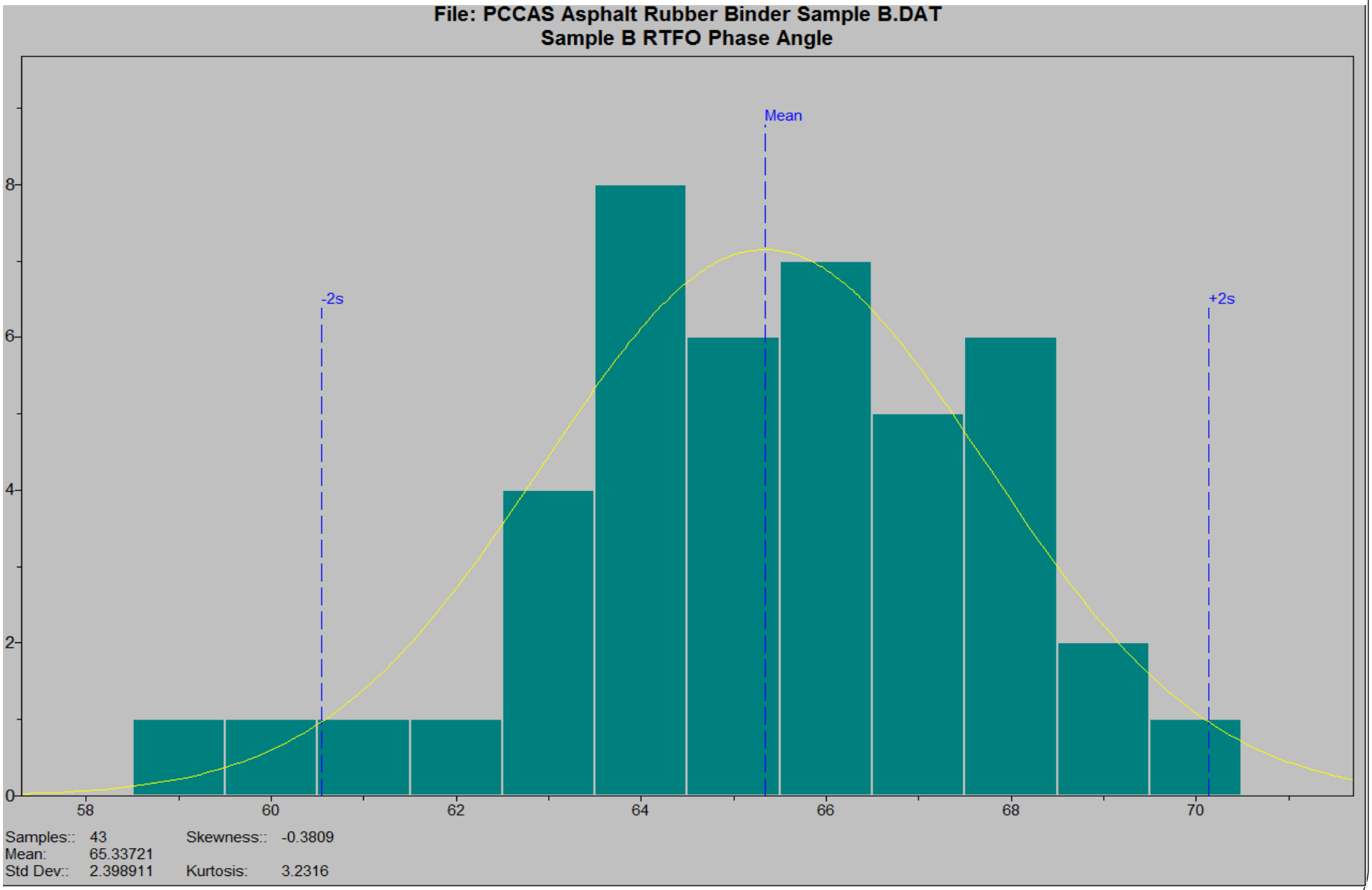
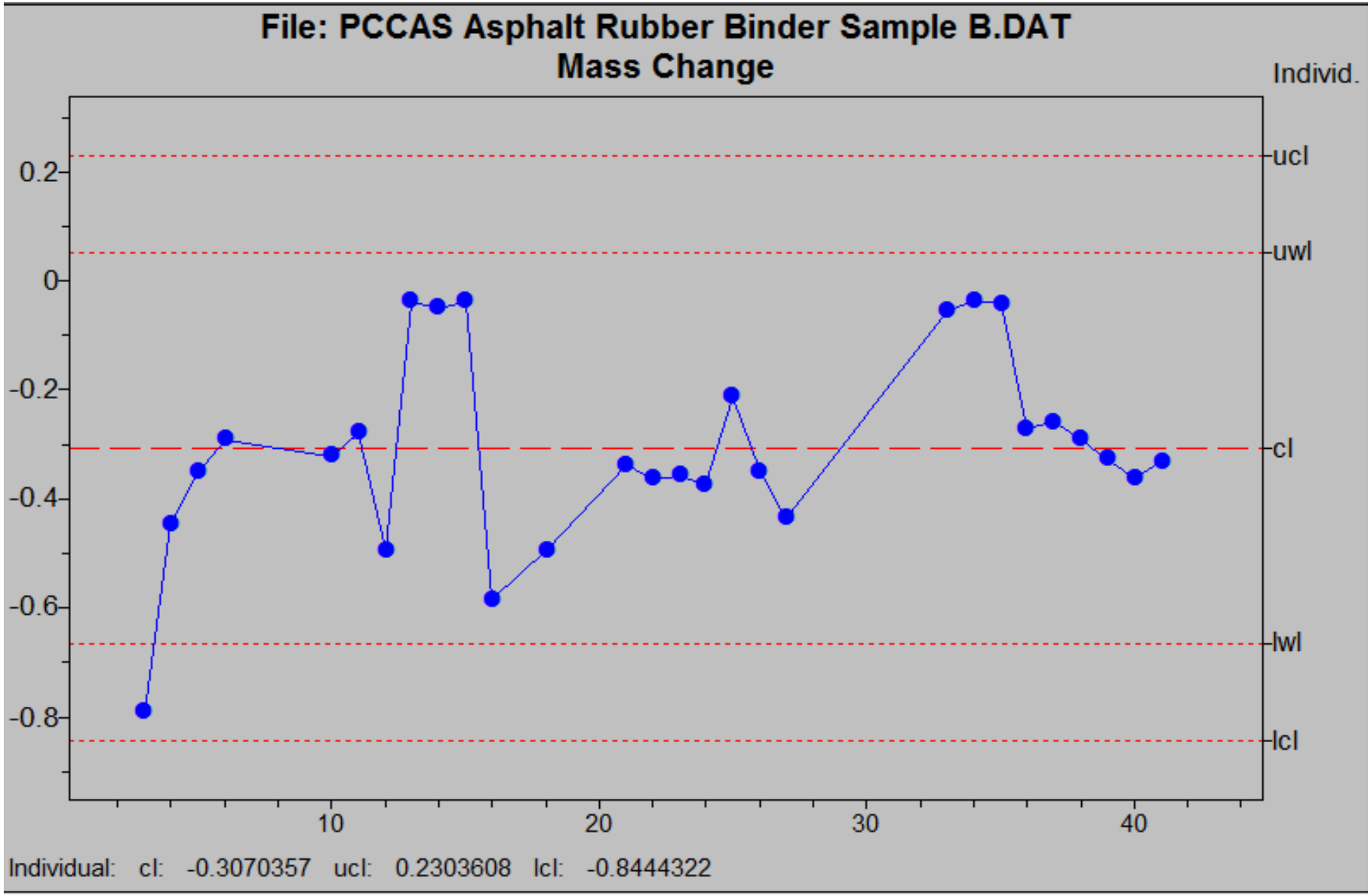
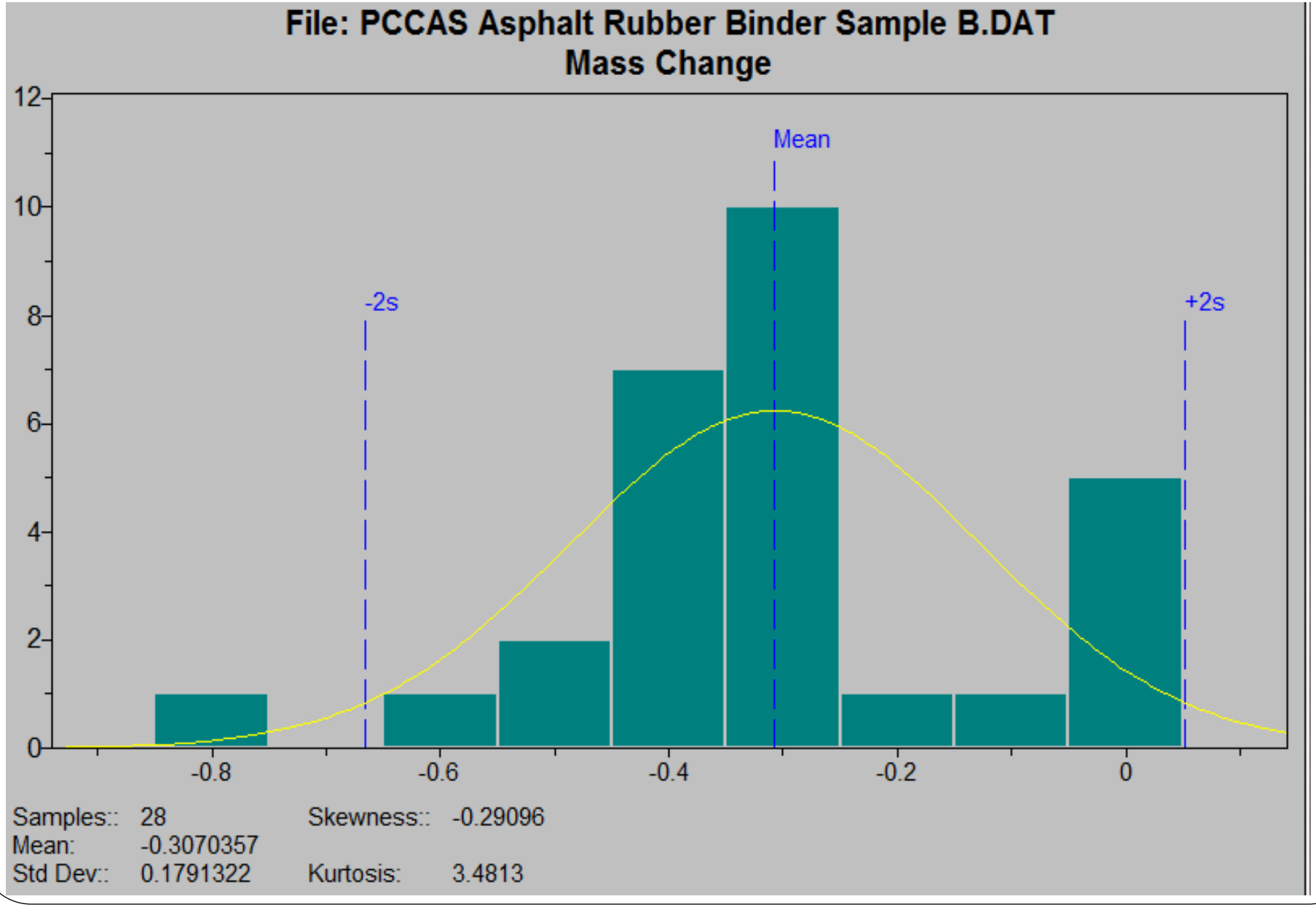


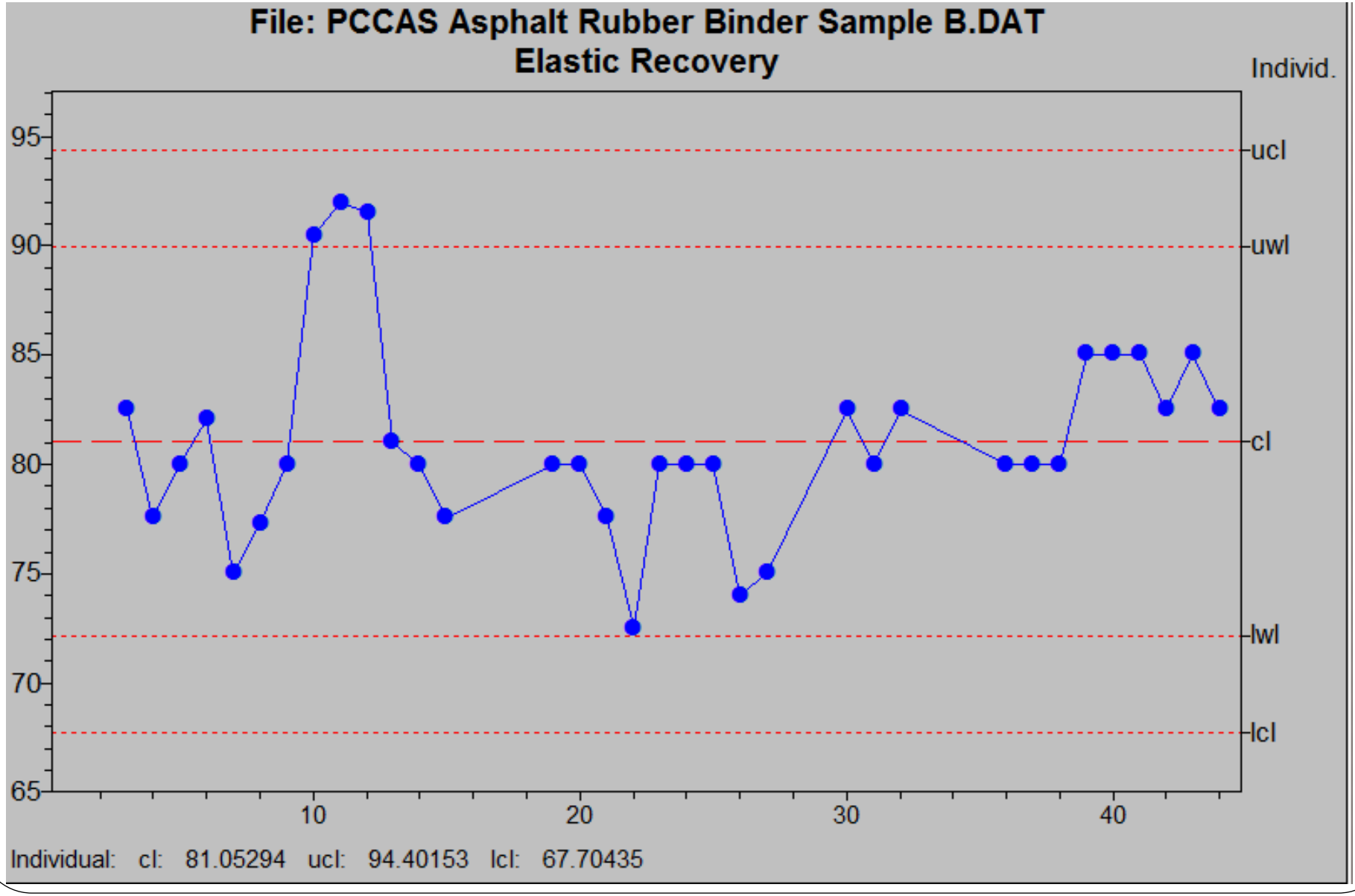
Sample B Mass Change



Sample B Mass Change



Sample B Elastic Recovery



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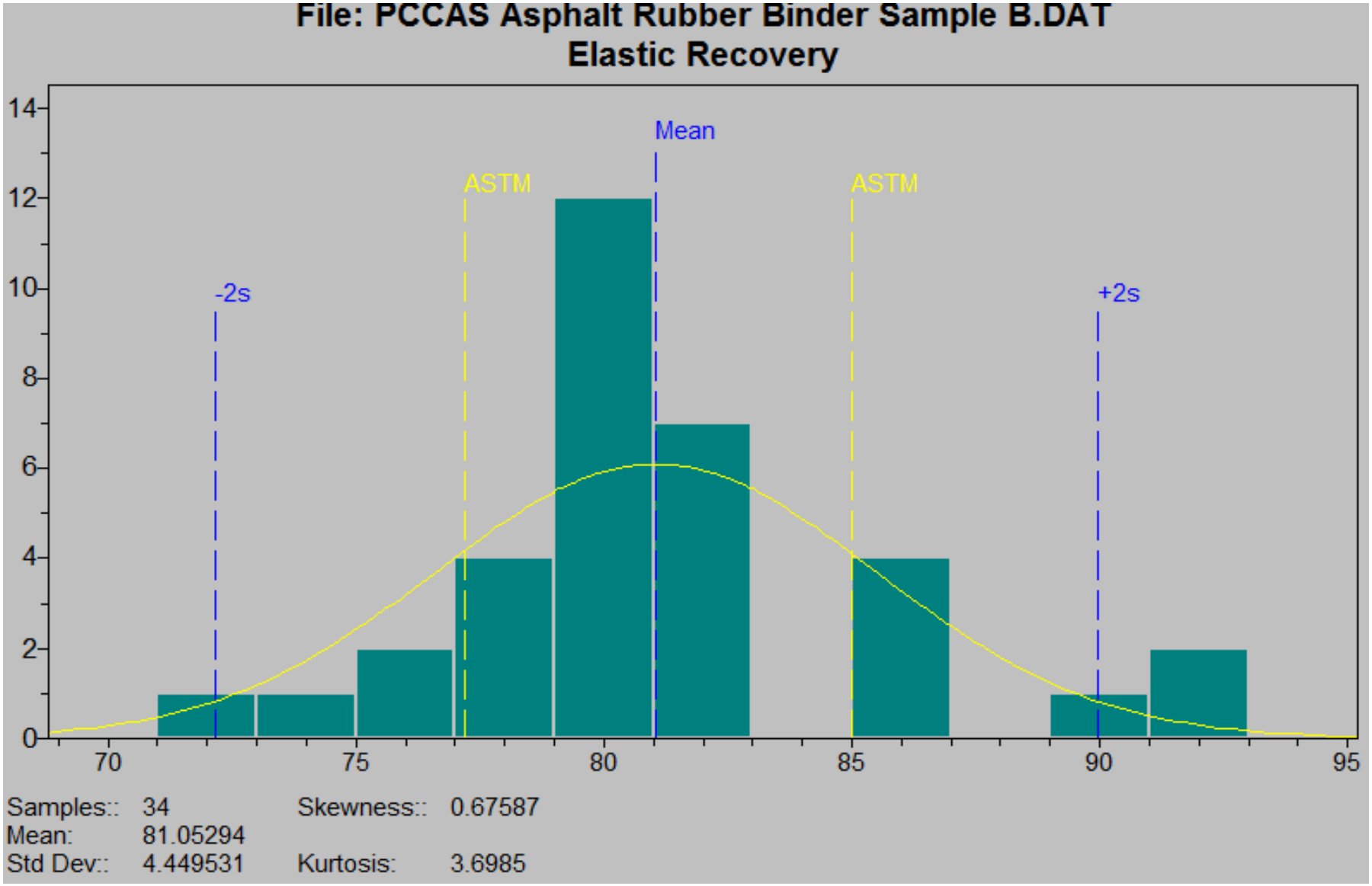
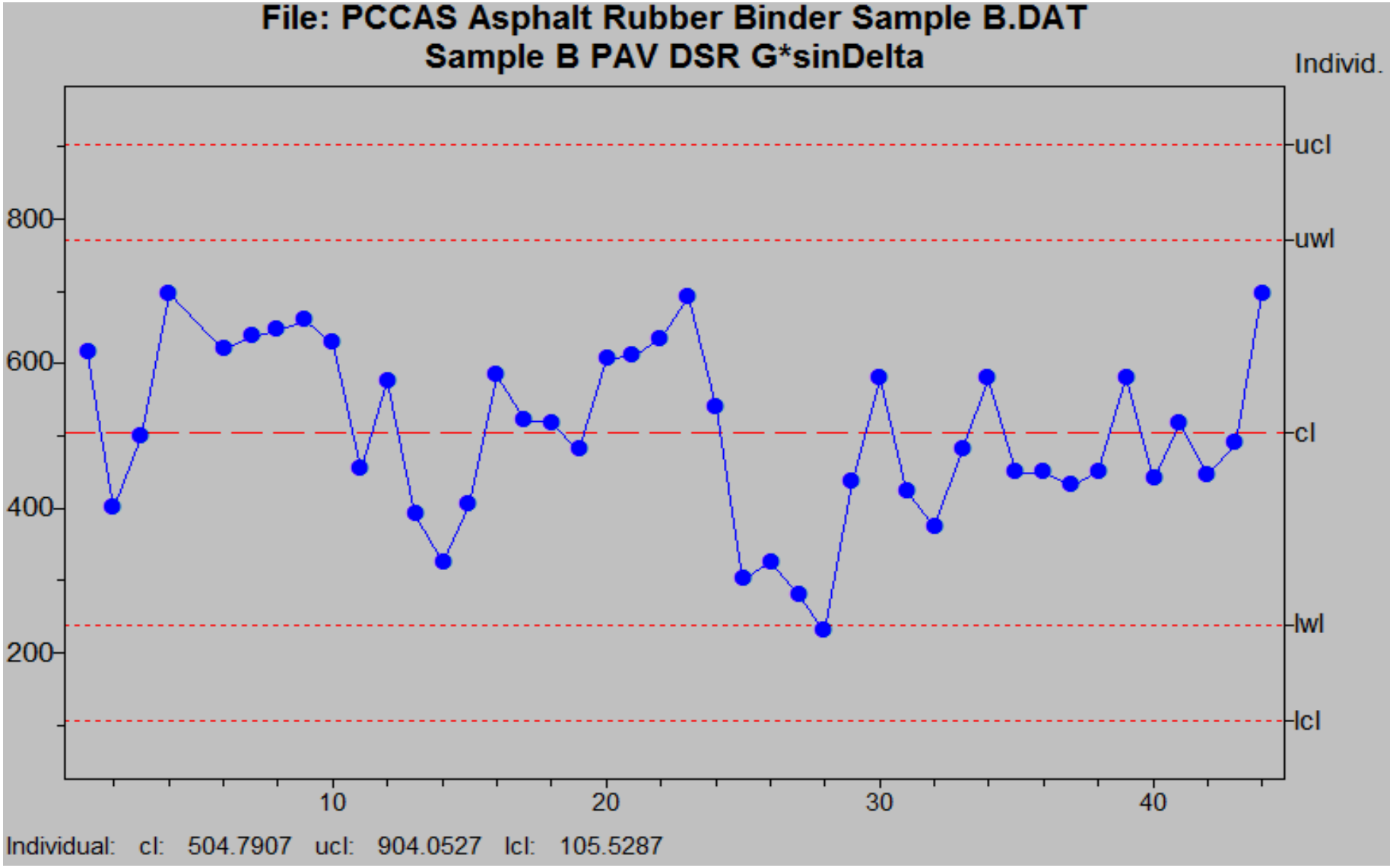


Sample B PAV DSR G*sinDelta



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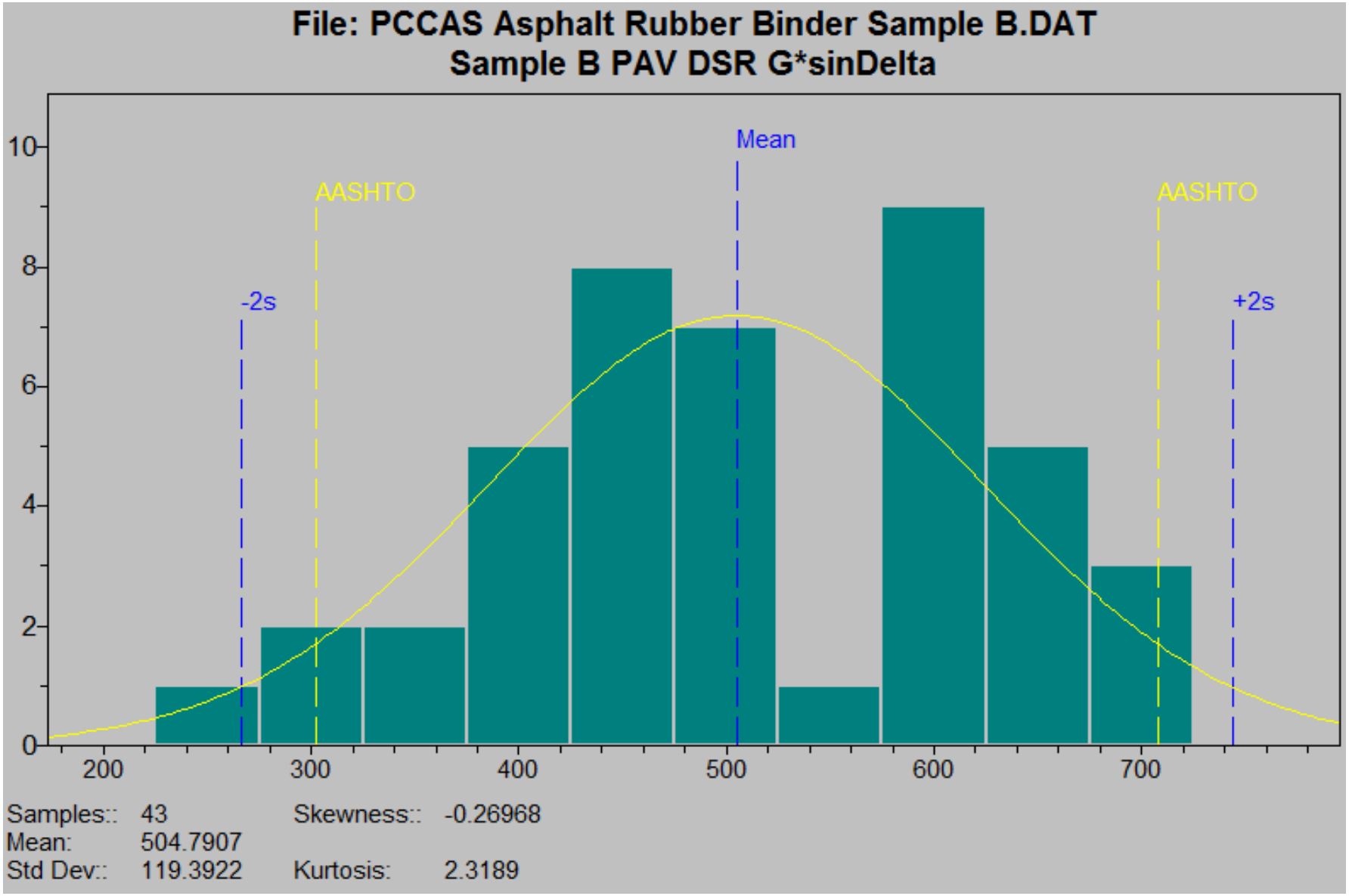

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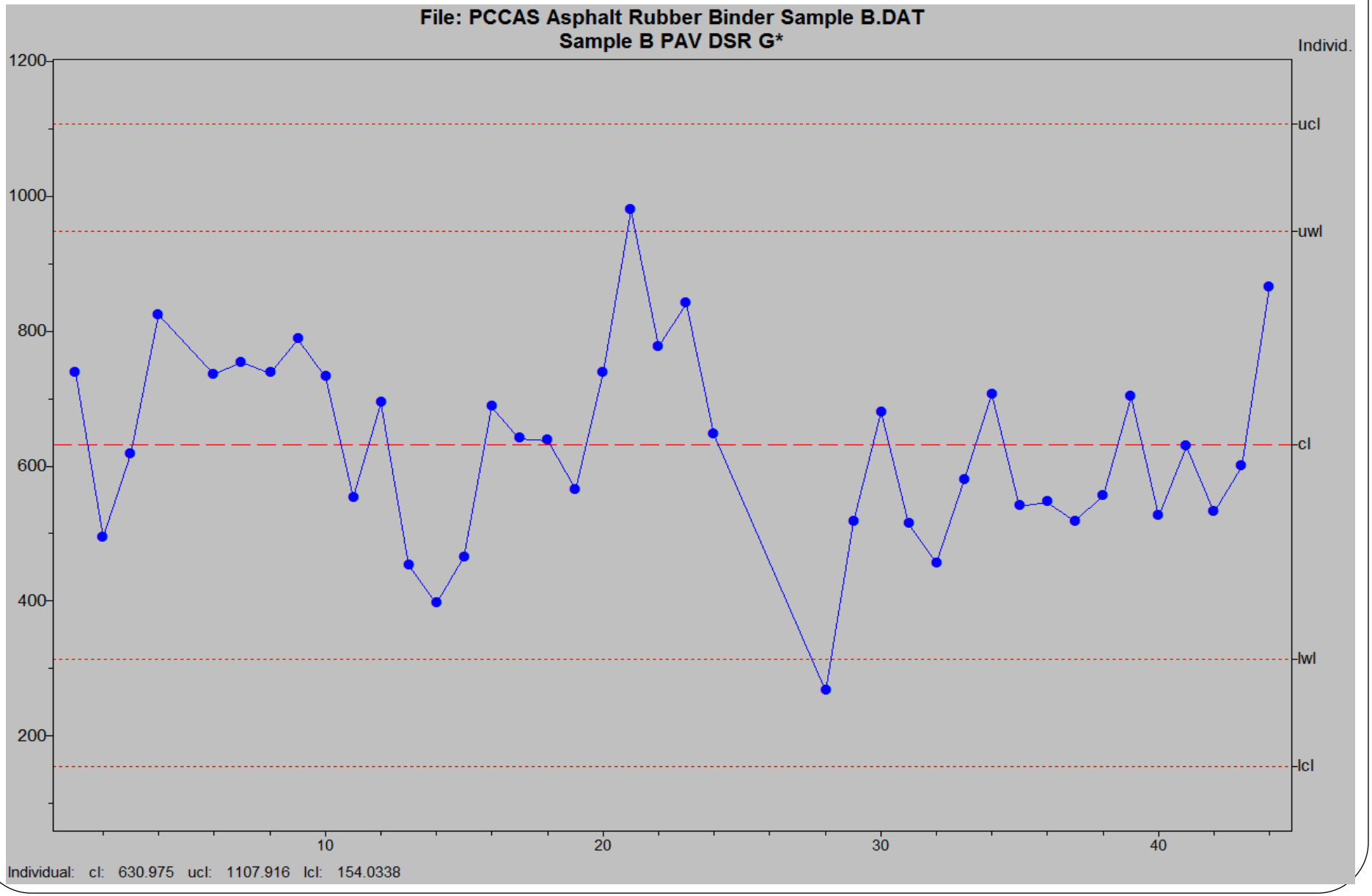

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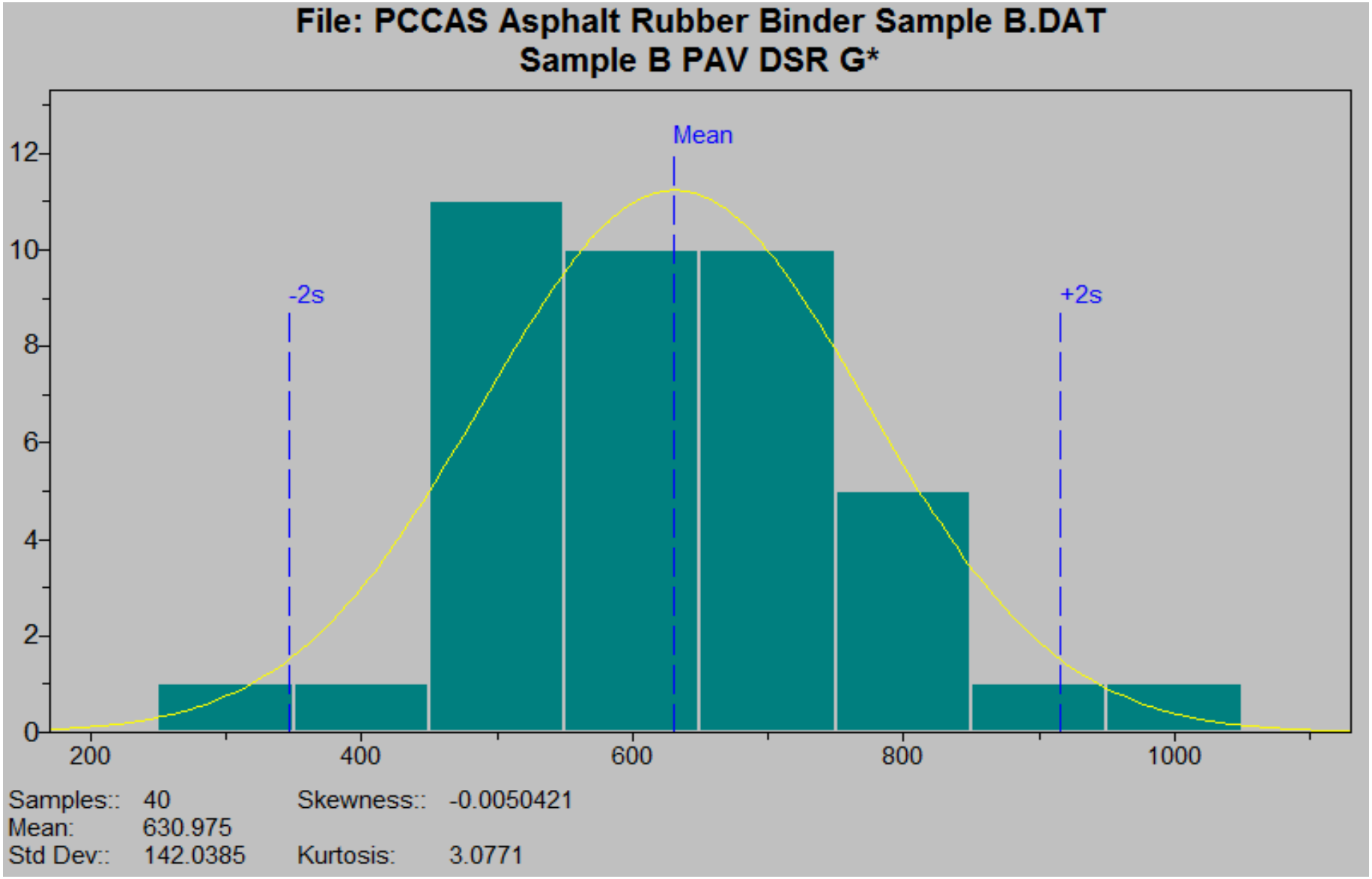
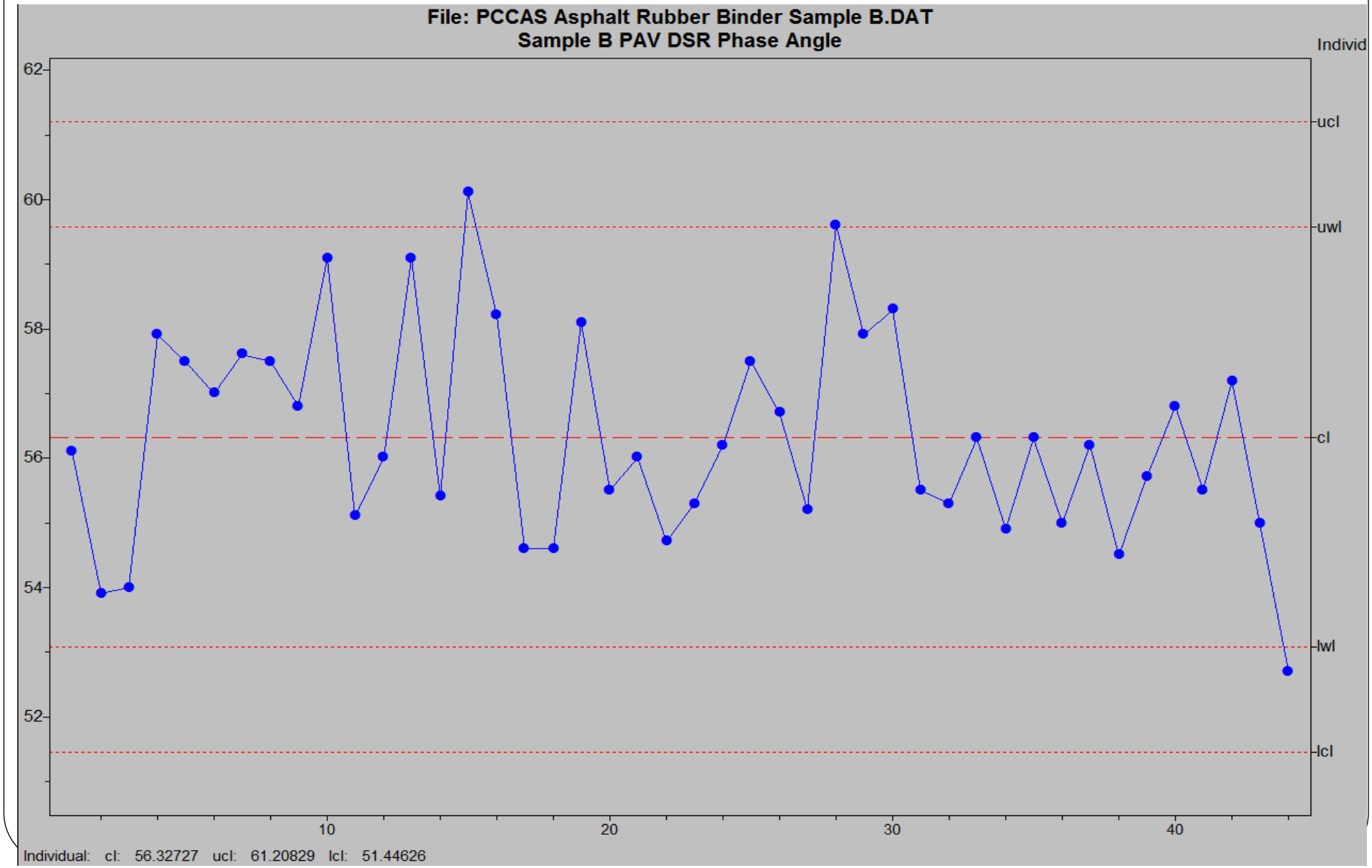
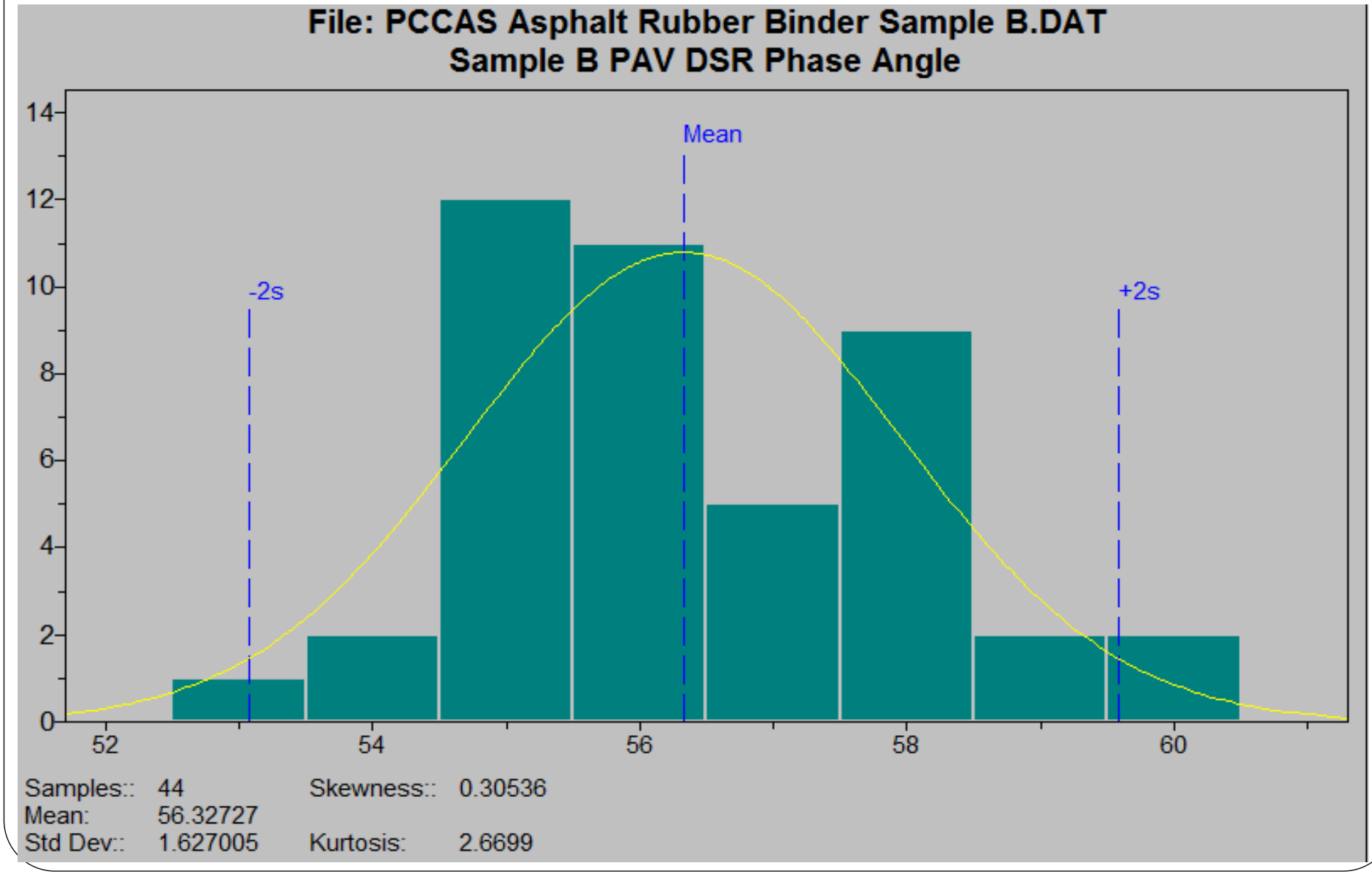


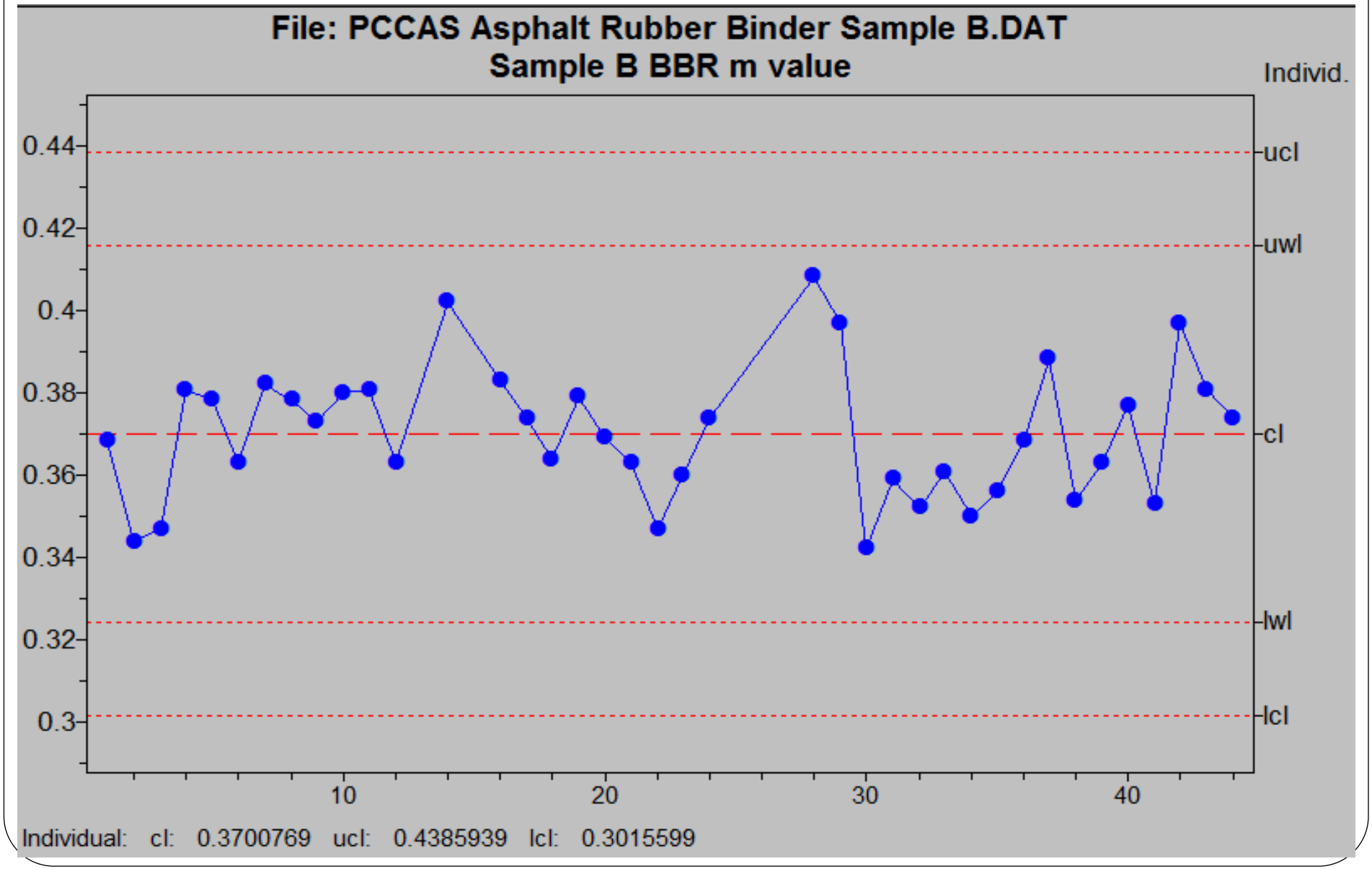
Sample B PAV DSR Phase Angle



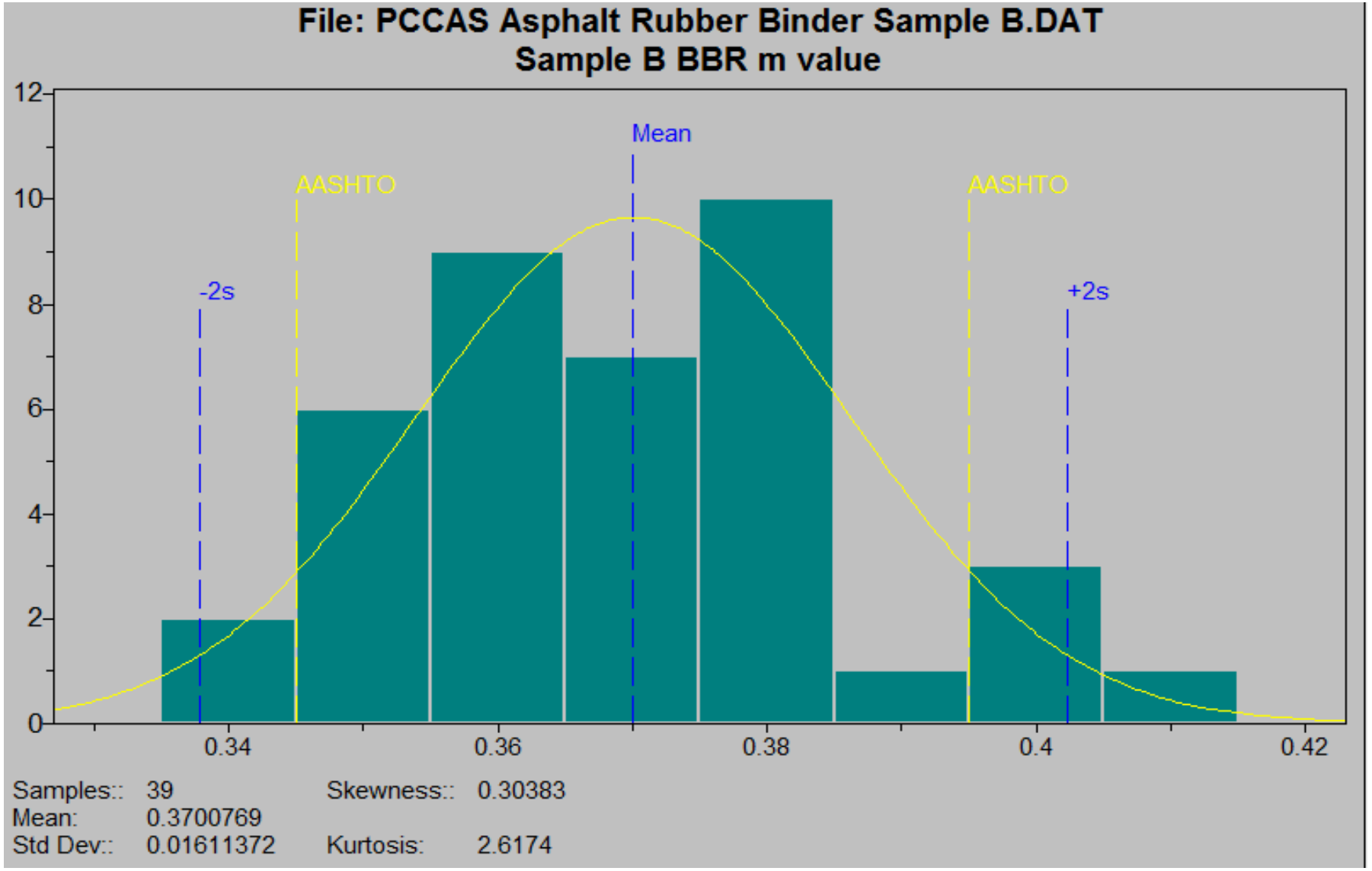
Sample B PAV DSR Phase Angle



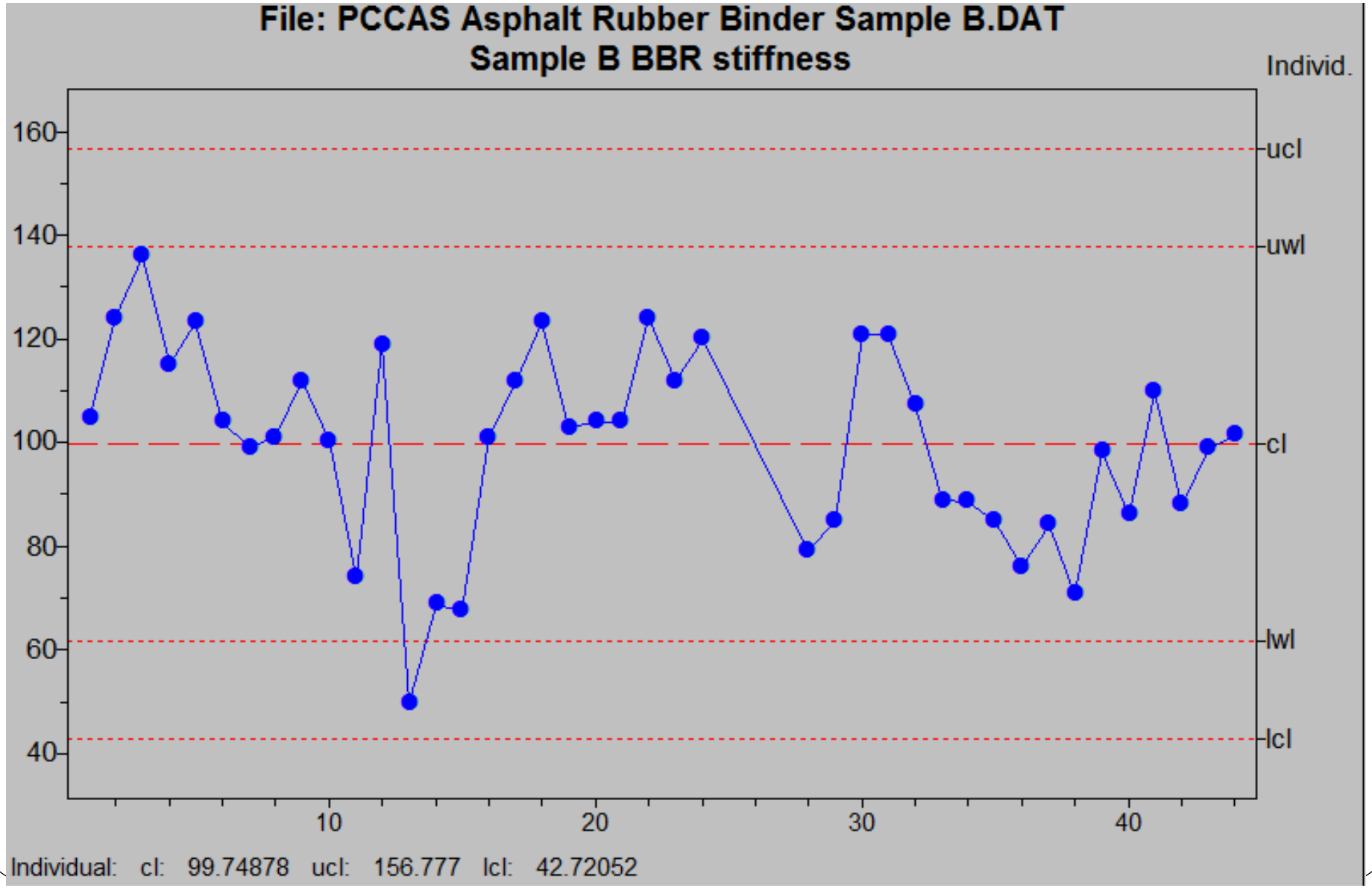
Sample B BBR m value



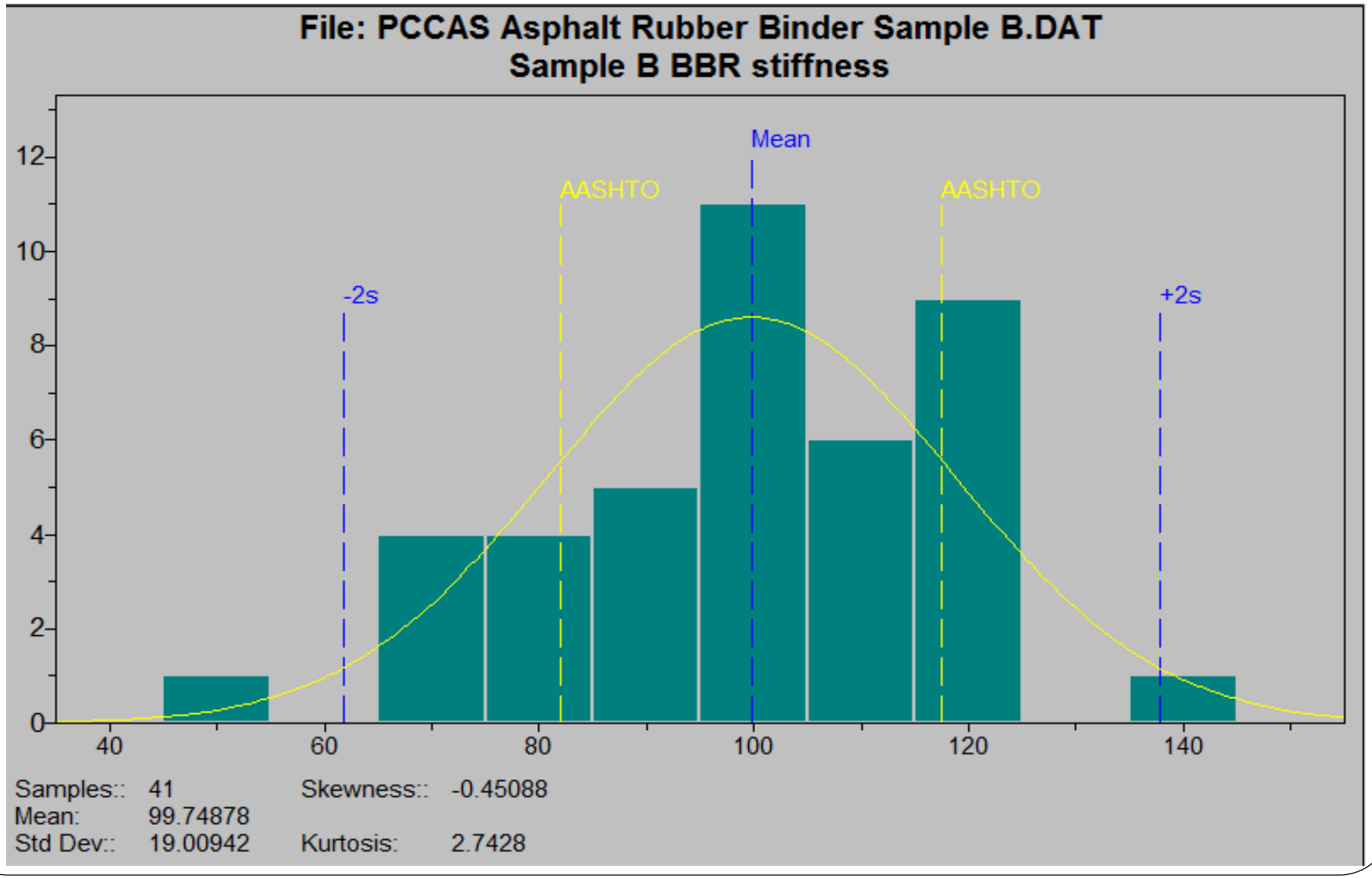
Sample B BBR m value



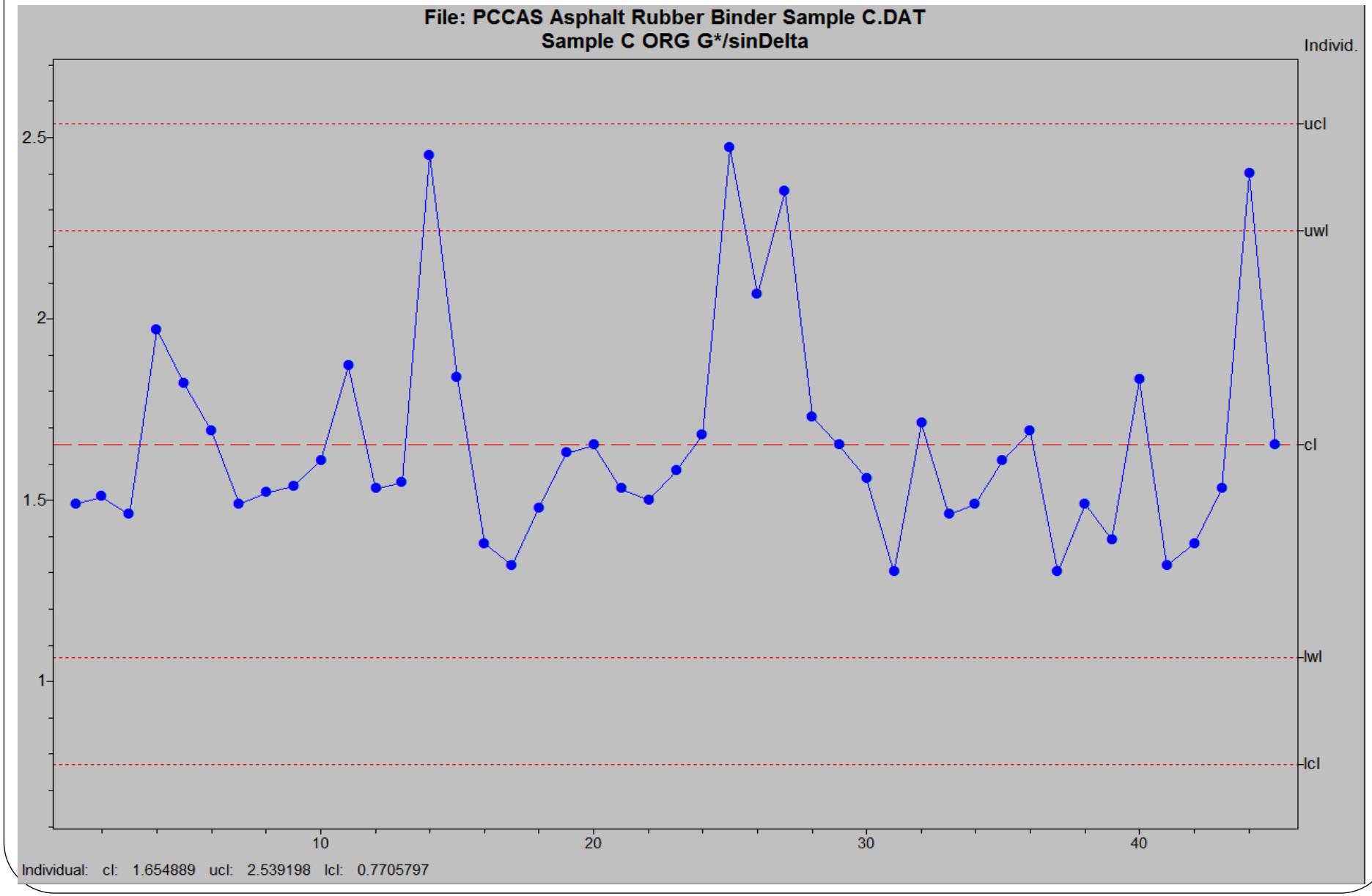
Sample B BBR Stiffness



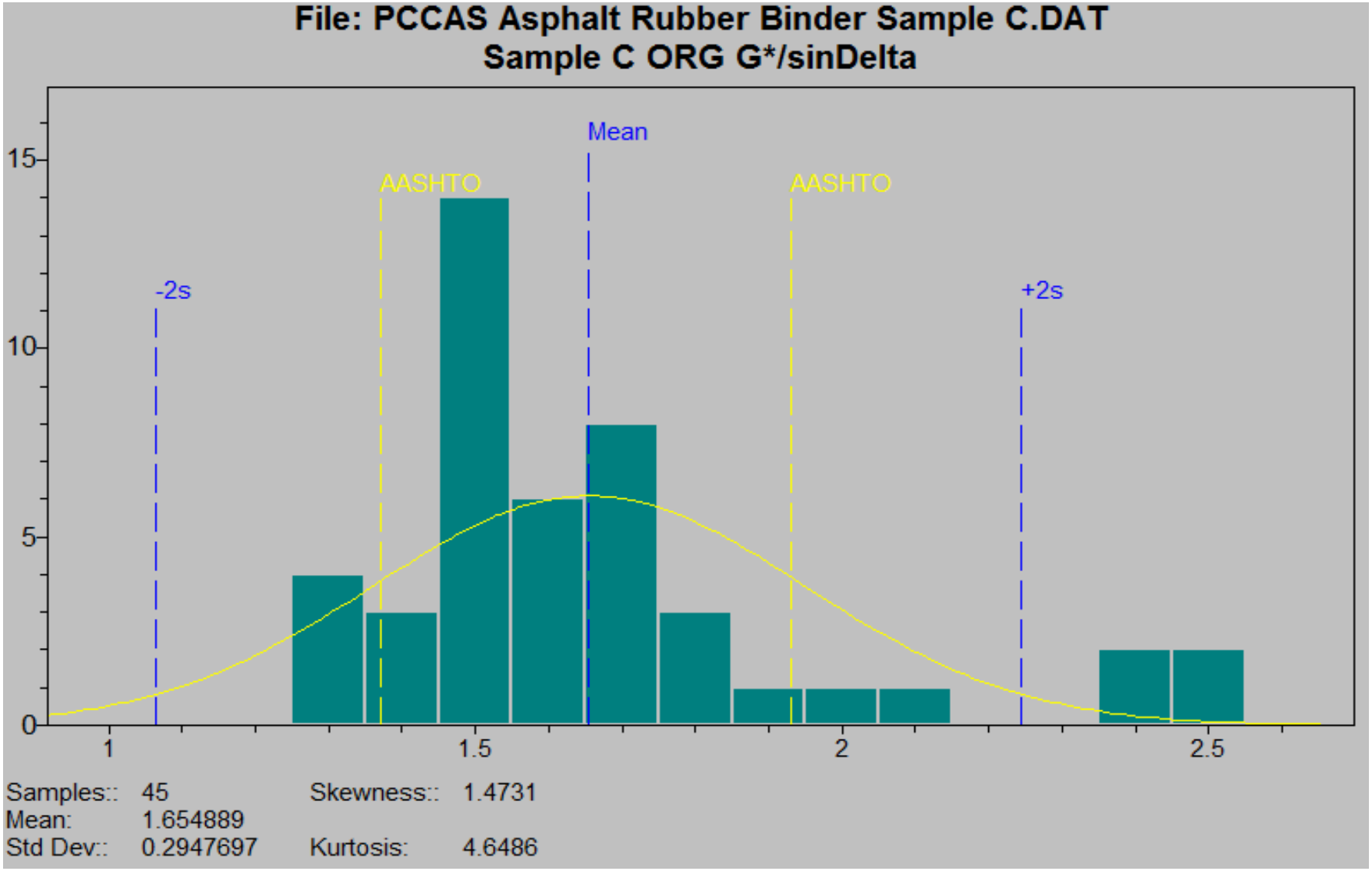
Sample B BBR Stiffness



Sample C ORG. G*/sinDelta



Sample C ORG. G*/sinDelta



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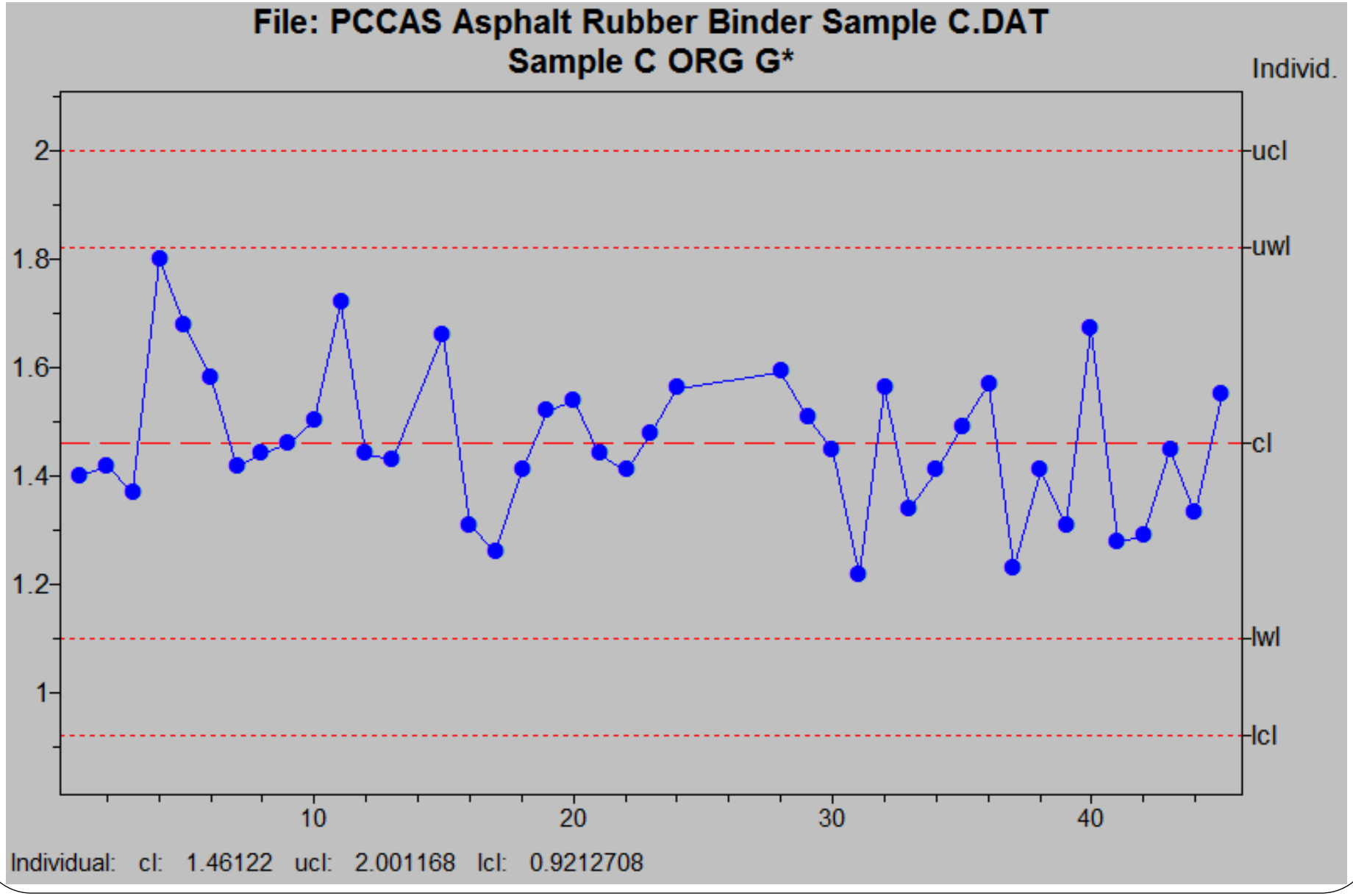

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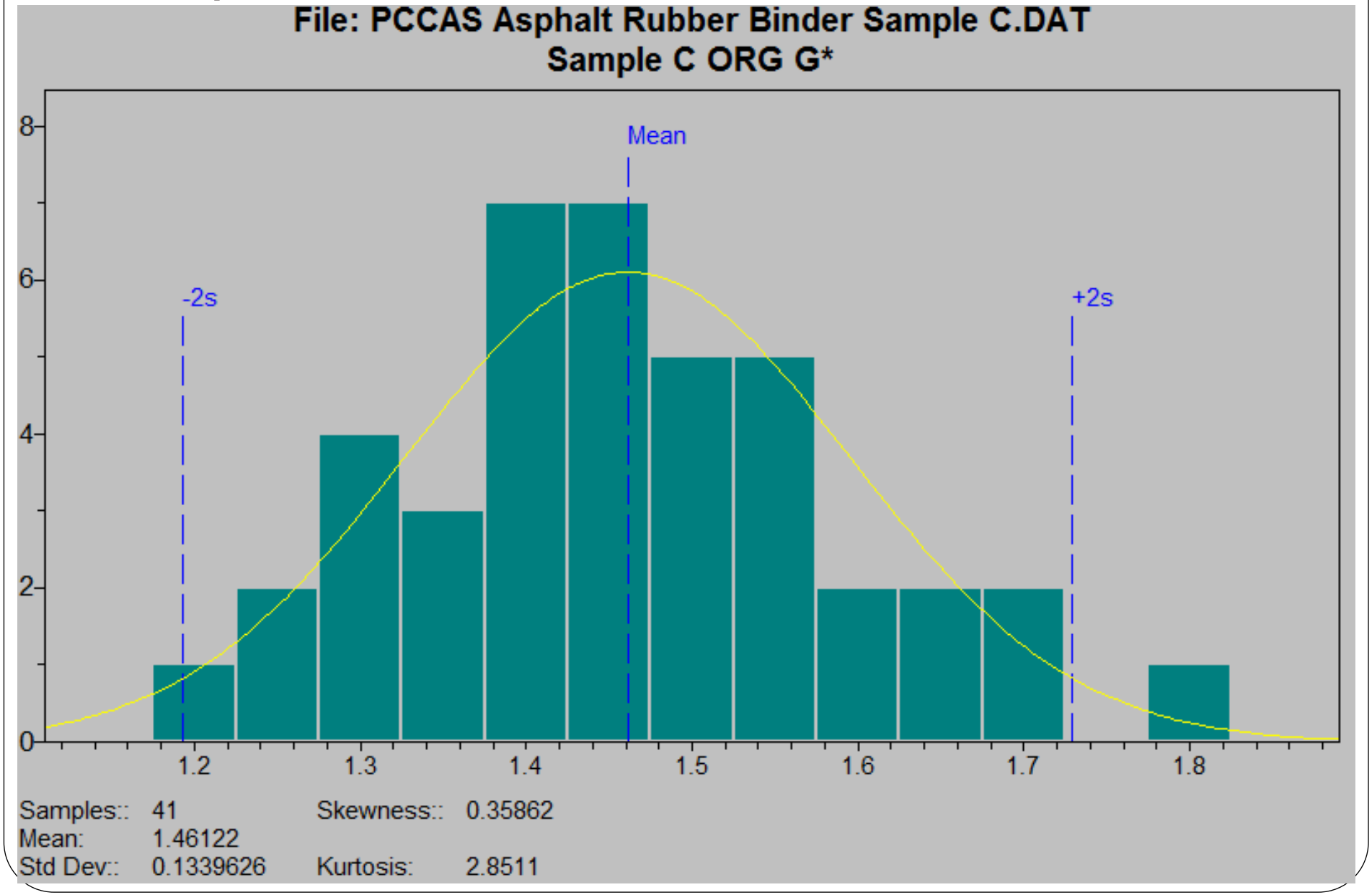
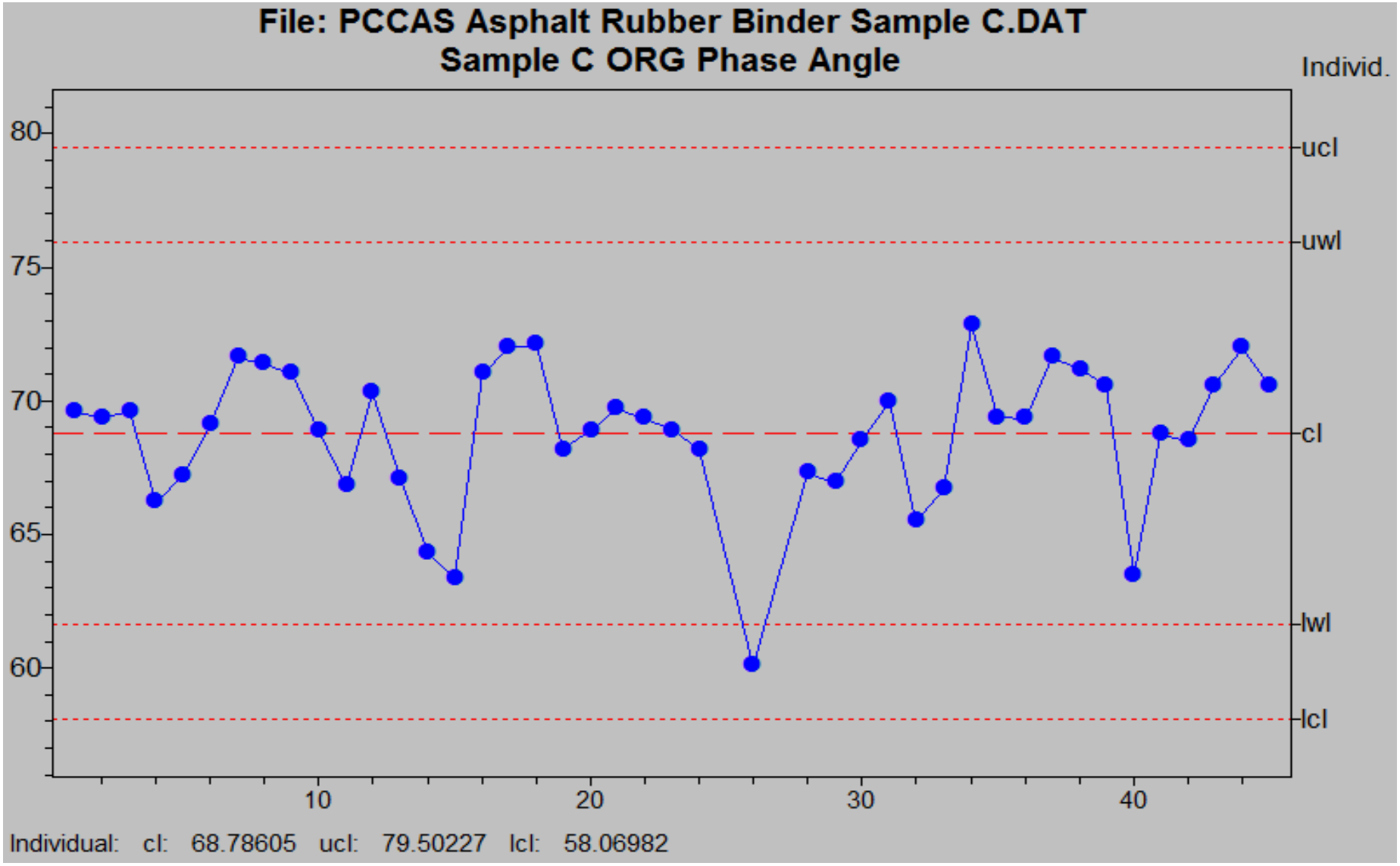
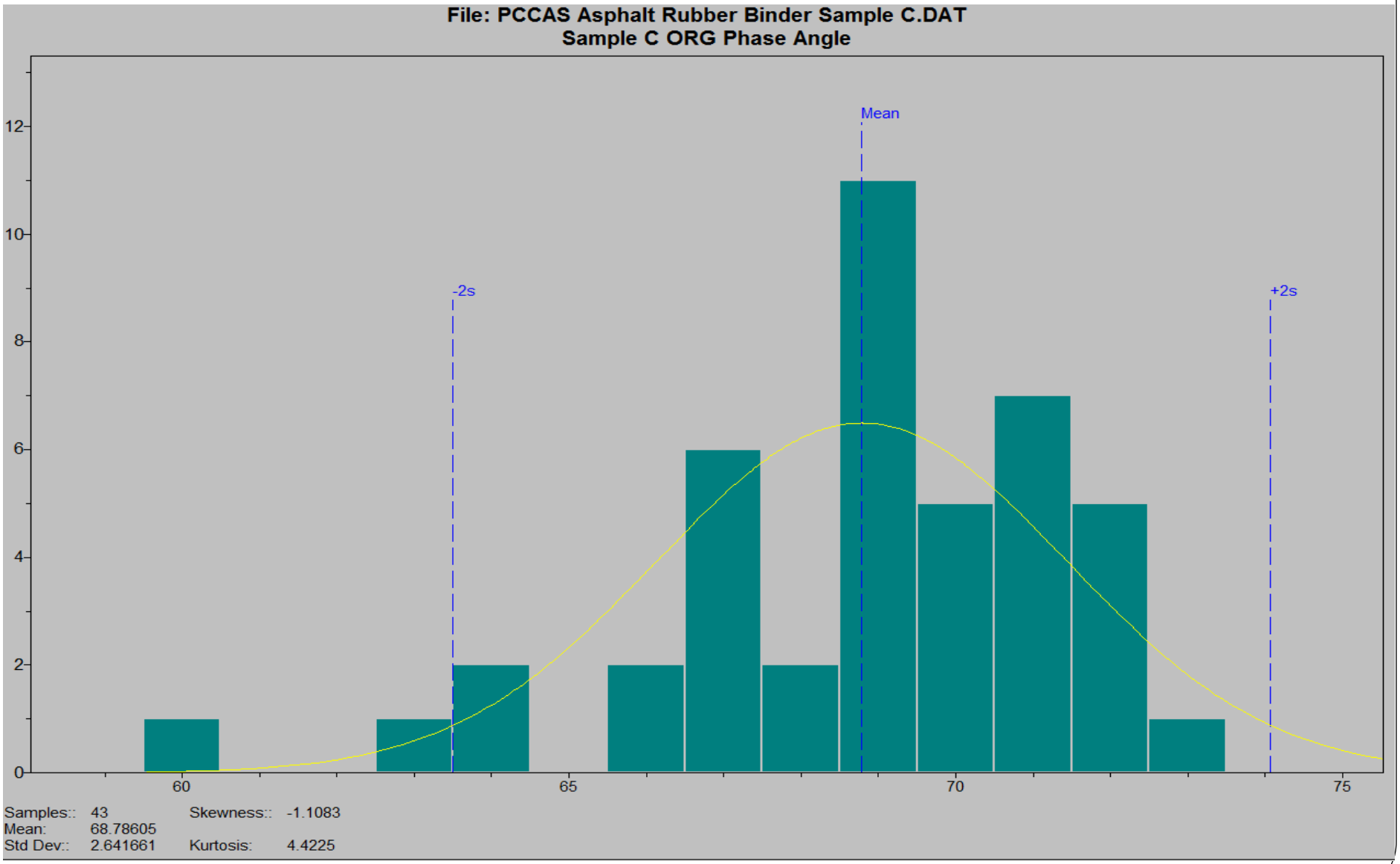


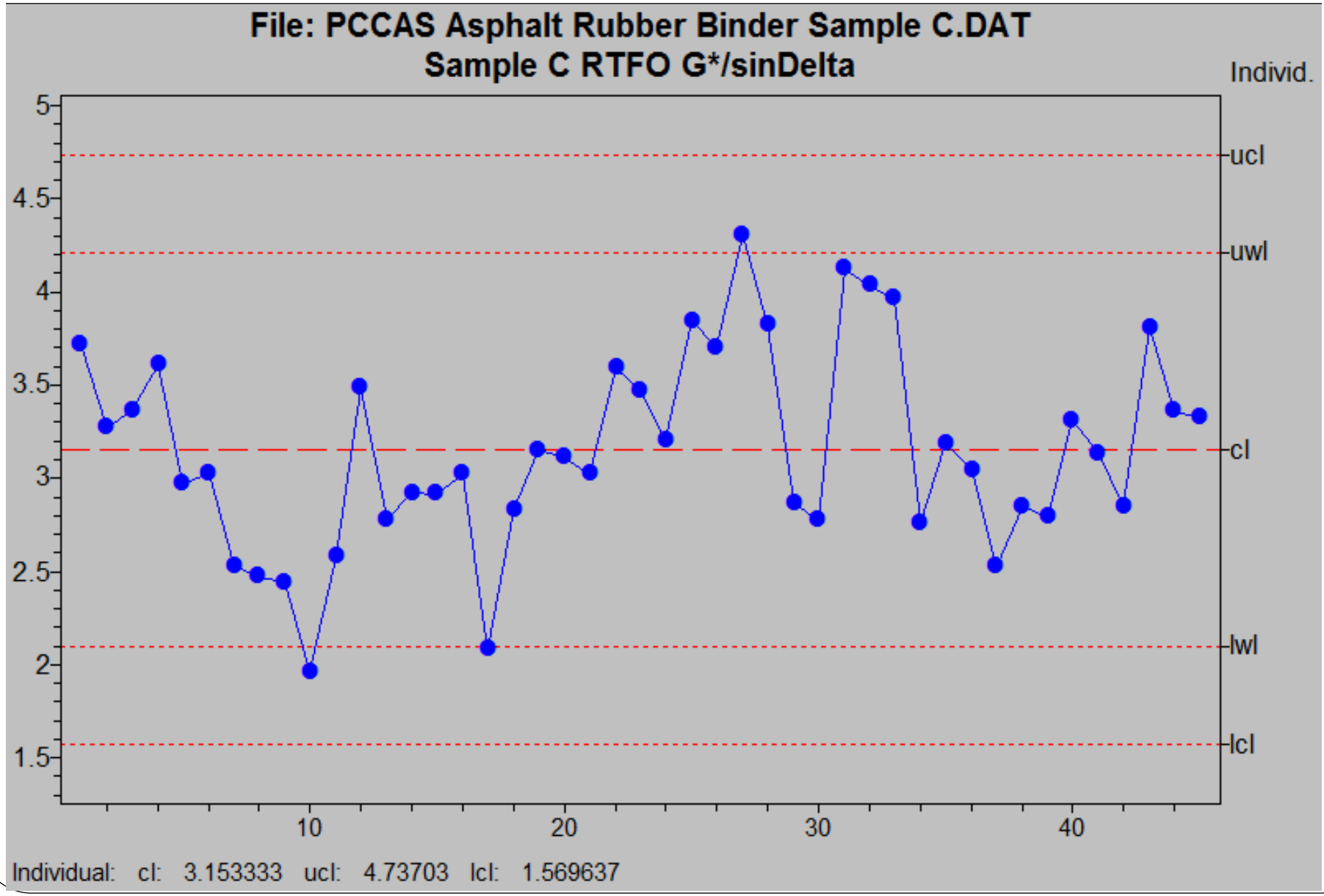
Sample C ORG. Phase Angle



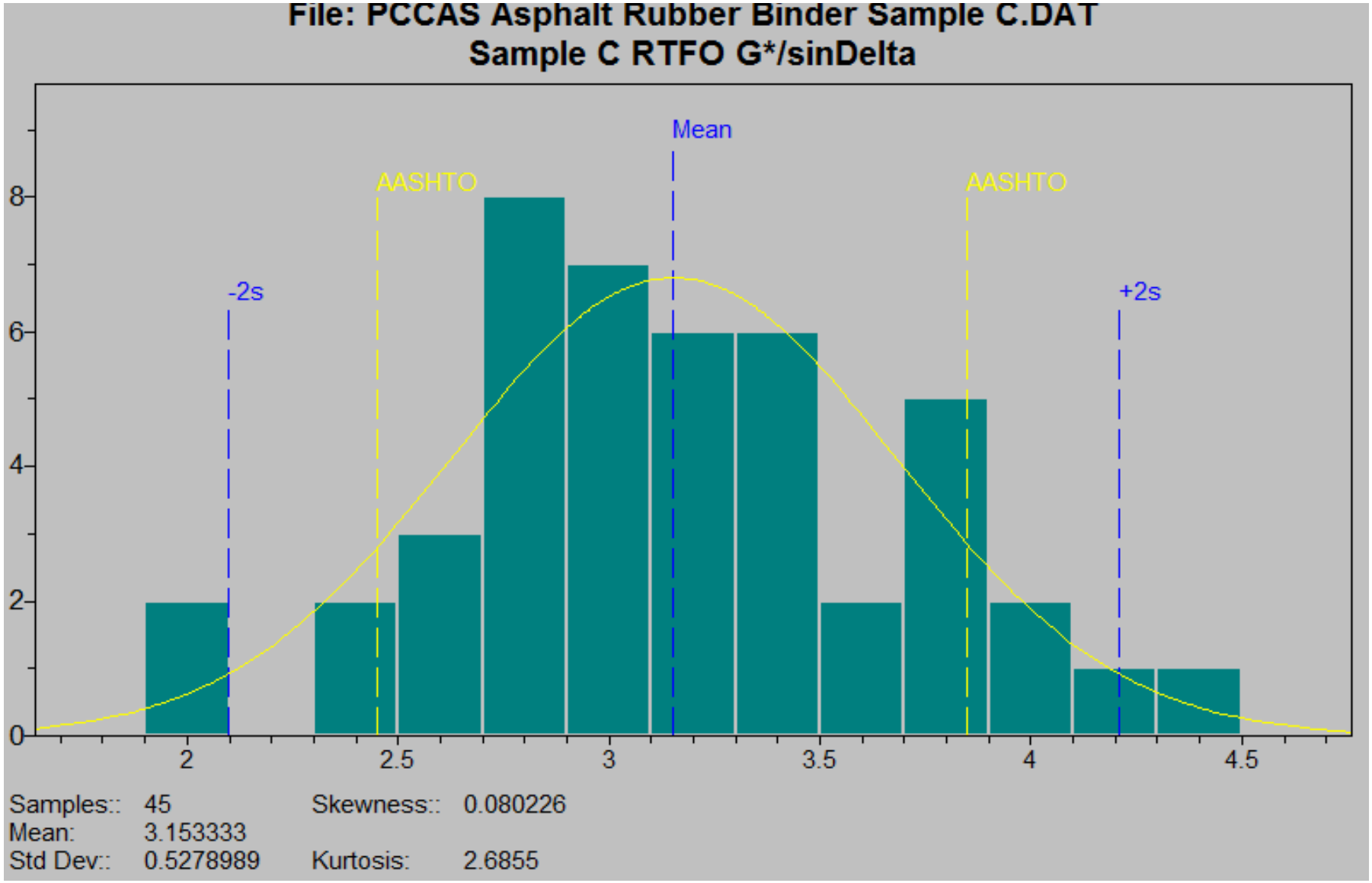
Sample C ORG. Phase Angle



Sample C RTFO G*/sinDelta



Sample C RTFO G*/sinDelta



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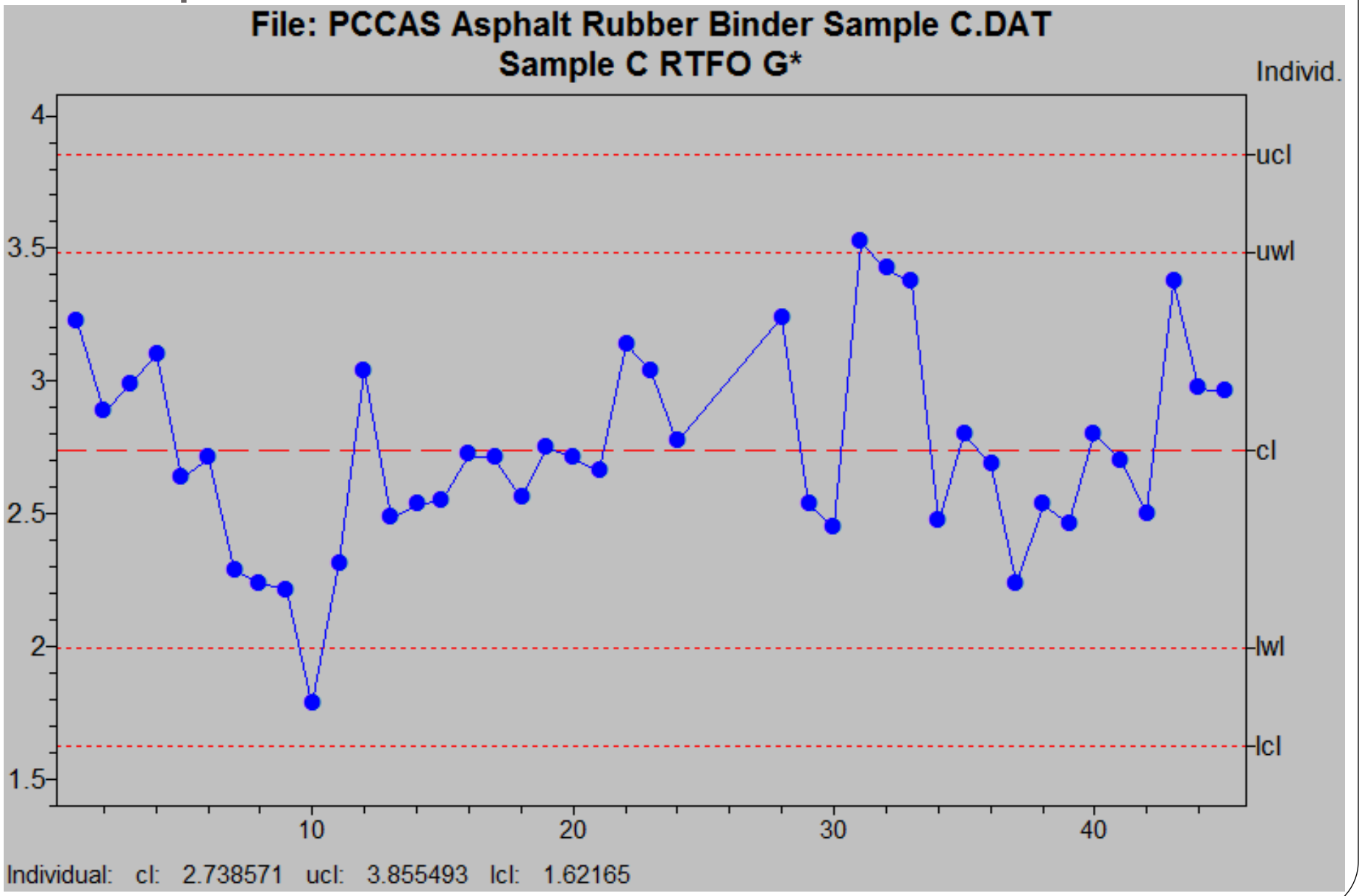

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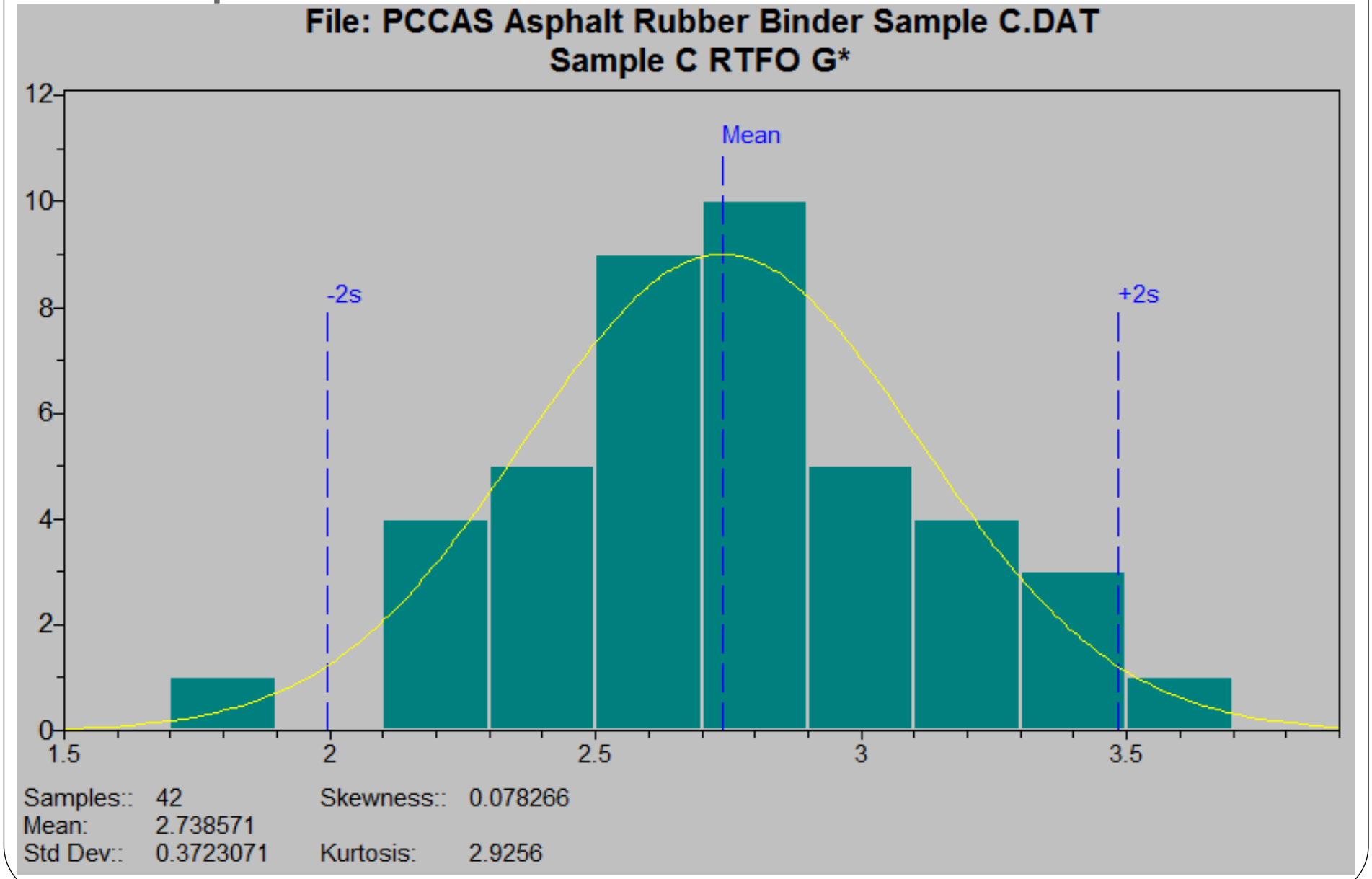
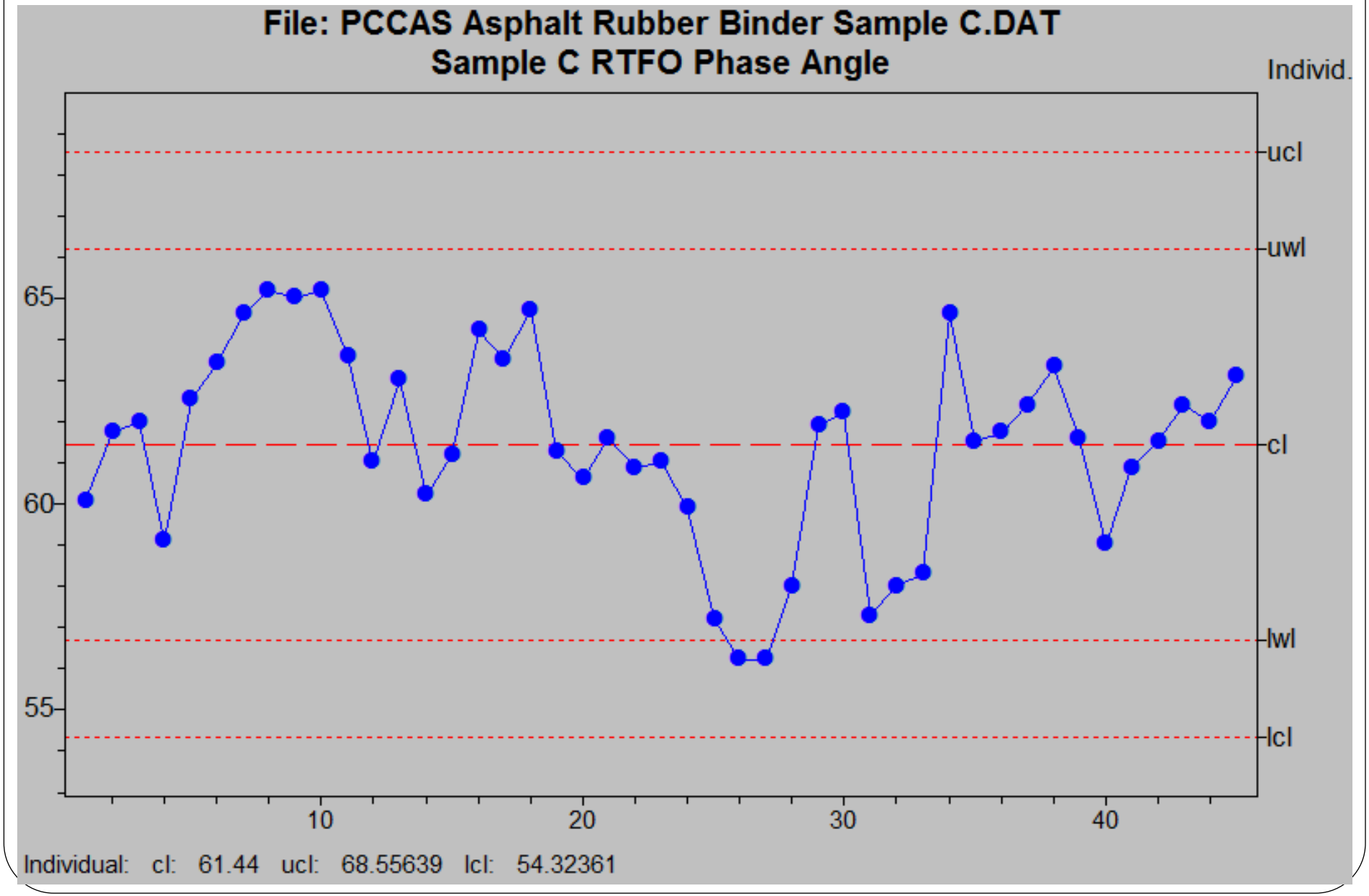
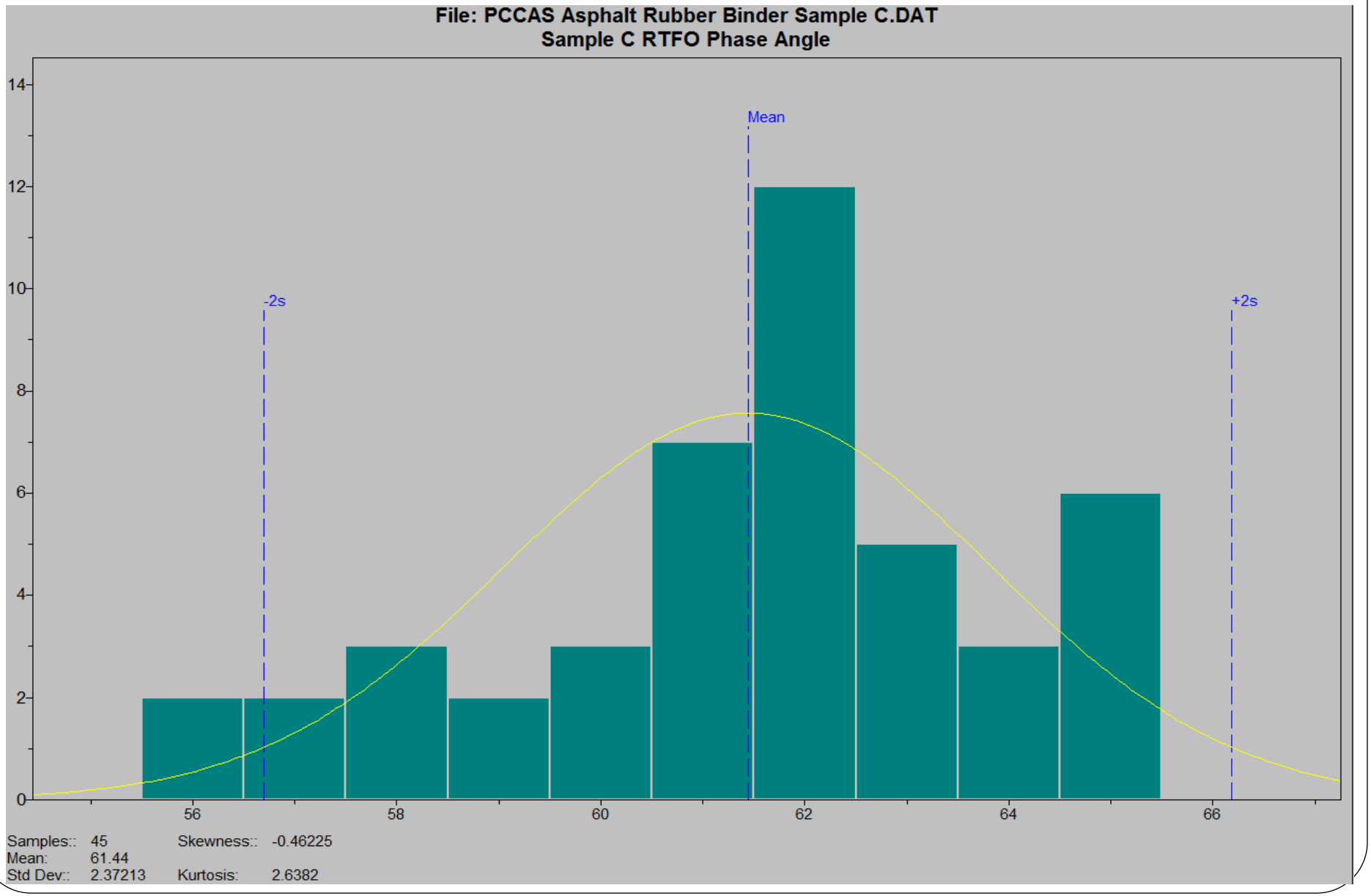


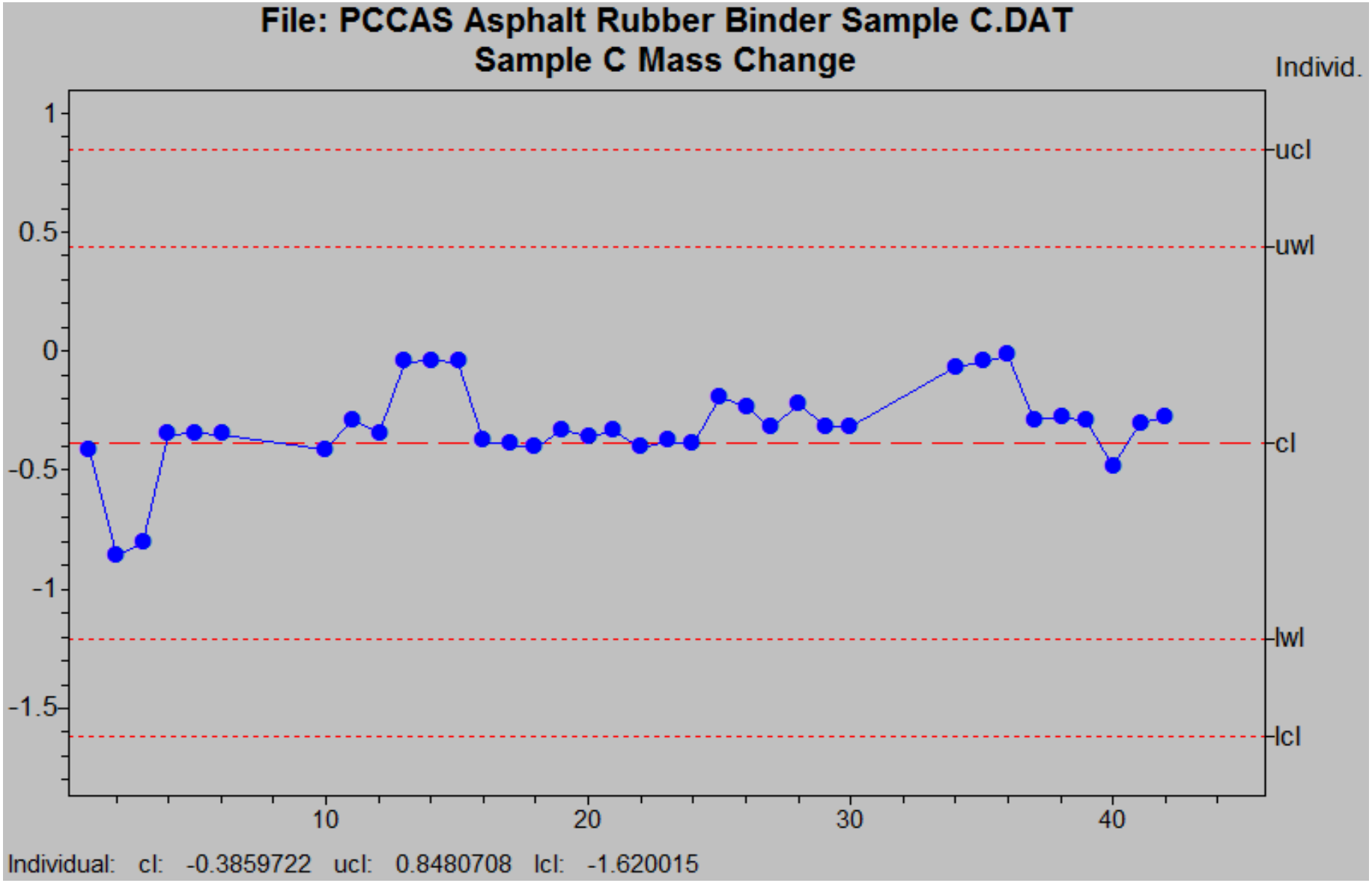
Sample C RTFO Phase Angle



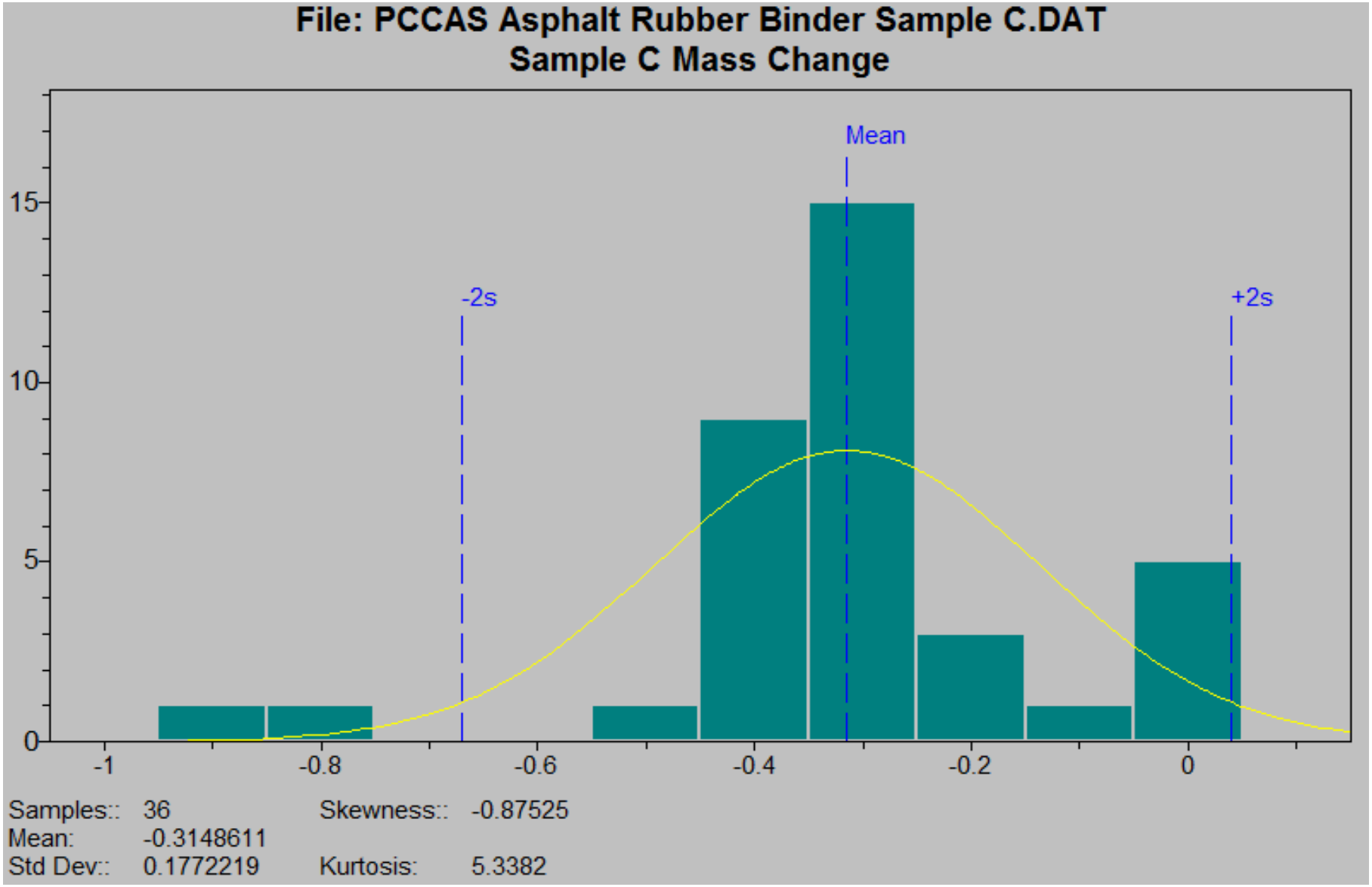
Sample C RTFO Phase Angle



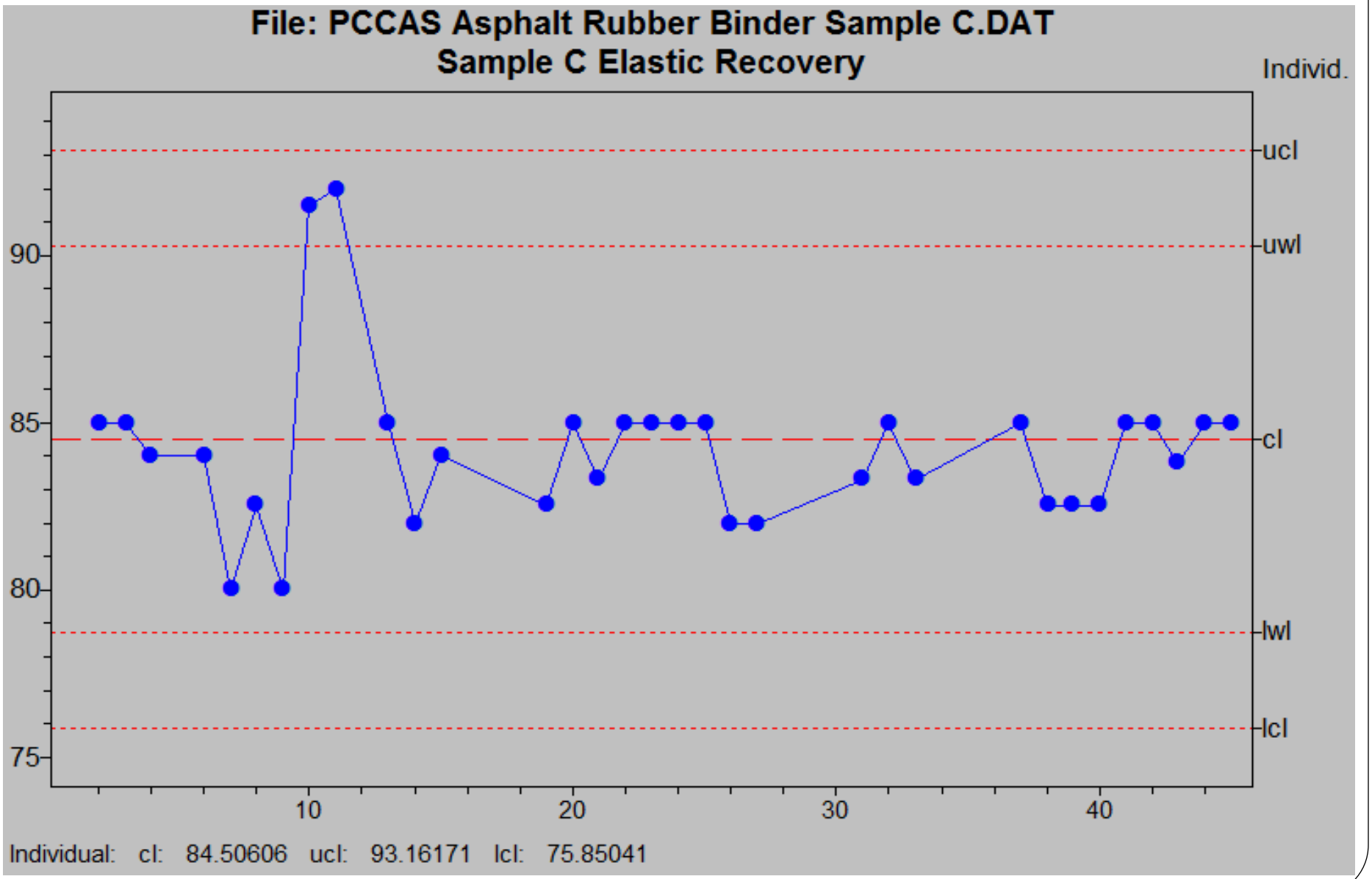
Sample C Mass Change



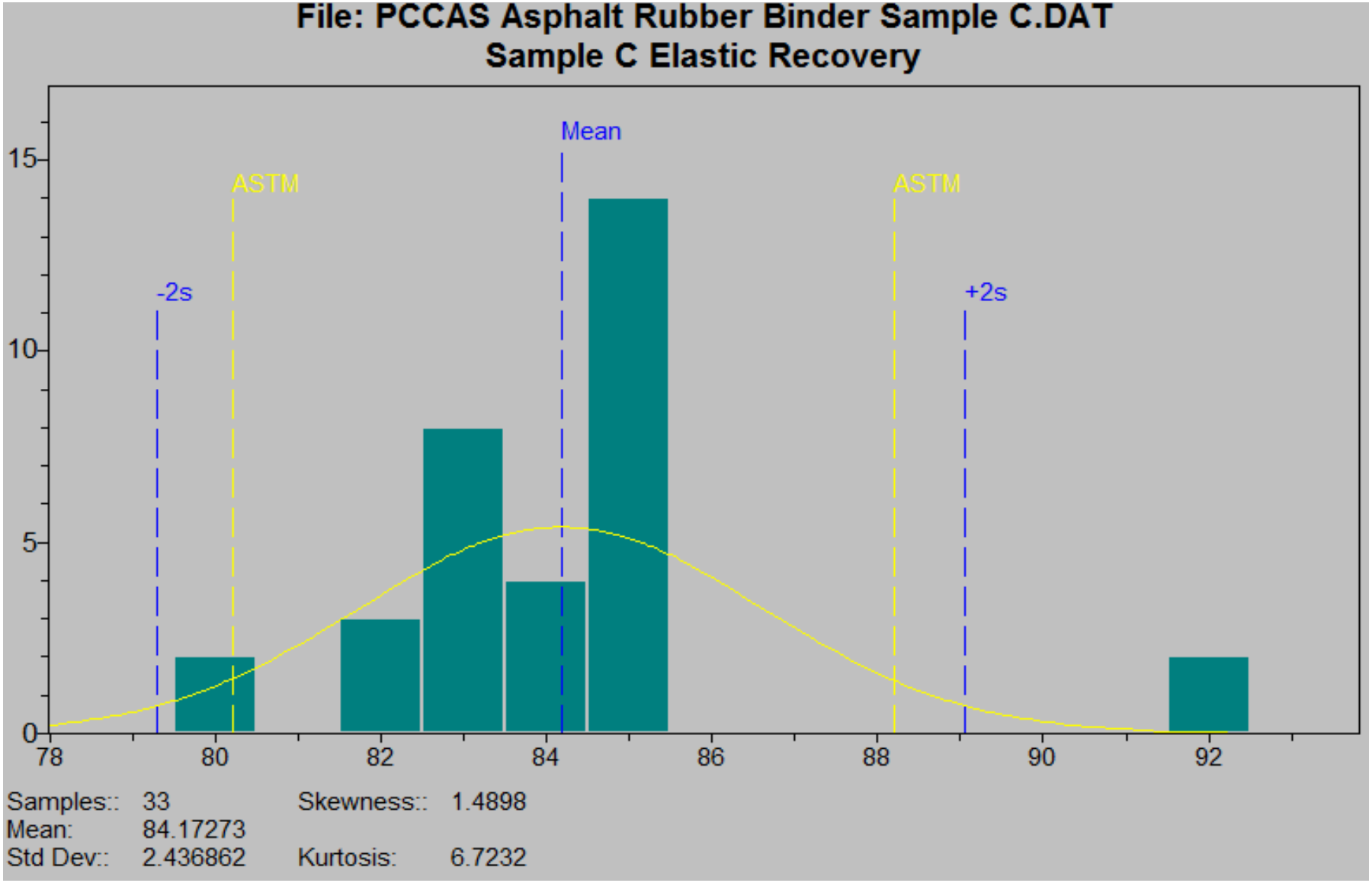
Sample C Mass Change



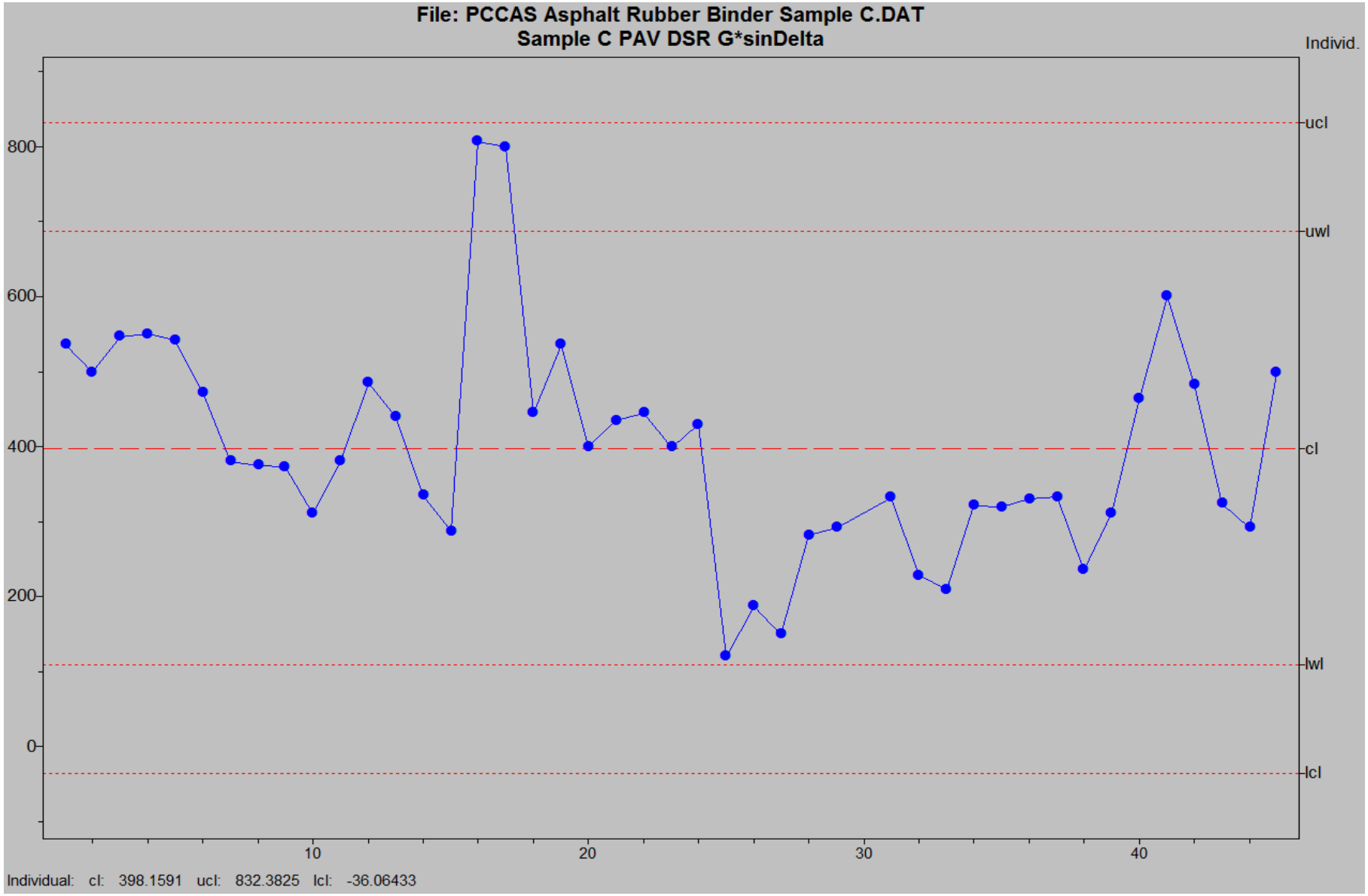
Sample A Elastic Recovery



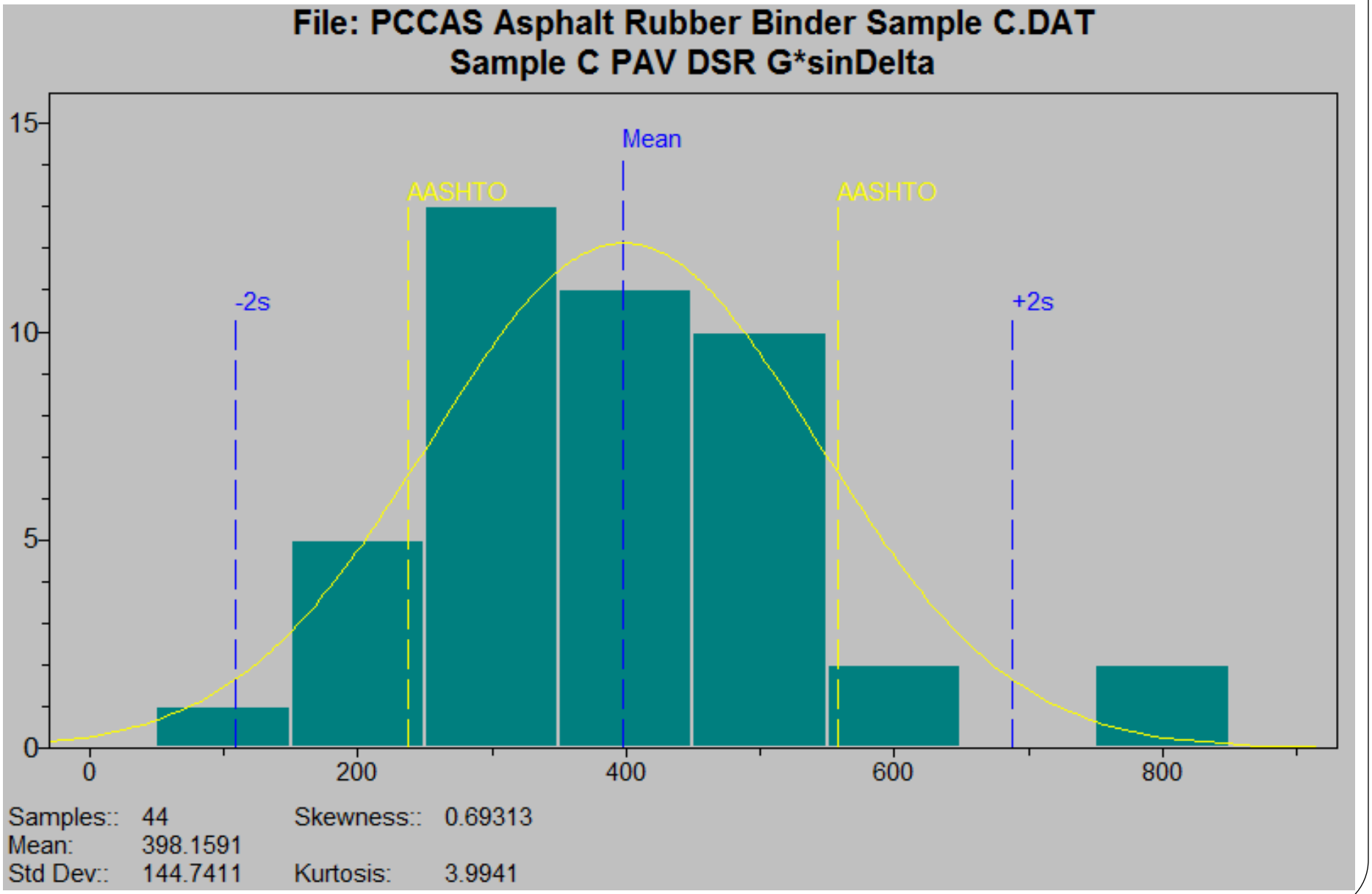
Sample C Elastic Recovery



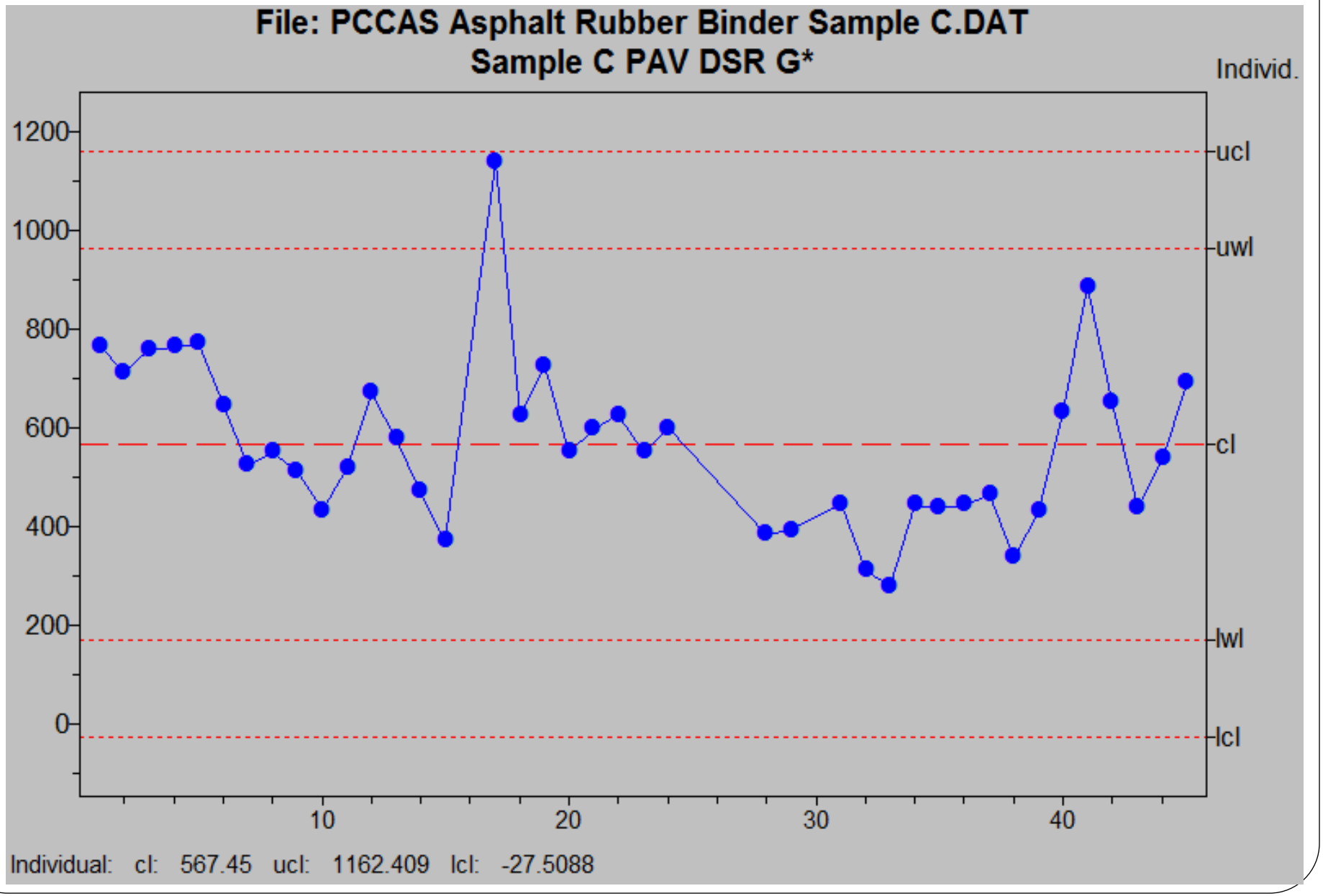
Sample C PAV DSR G*sinDelta



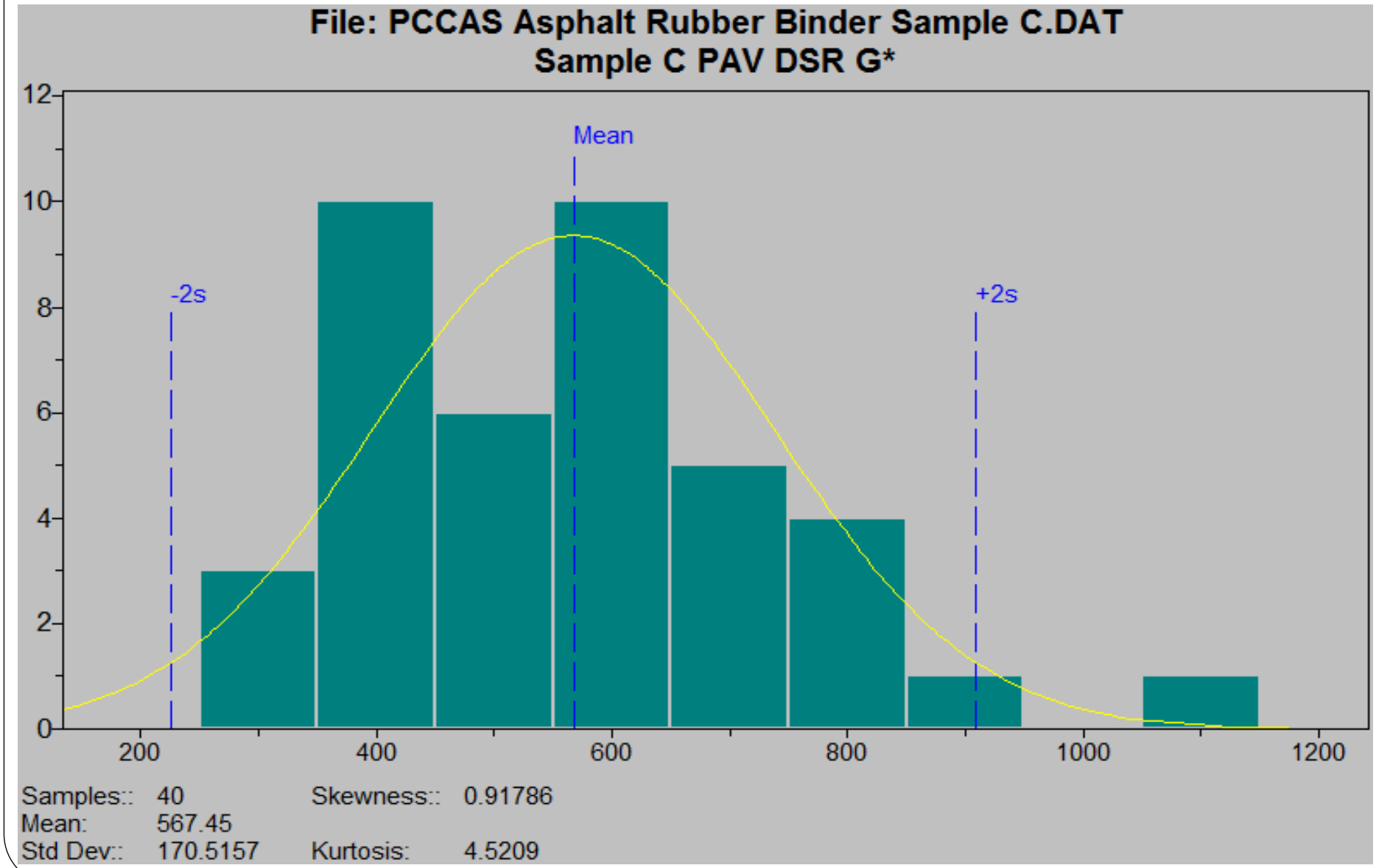
Sample C PAV DSR G*sinDelta



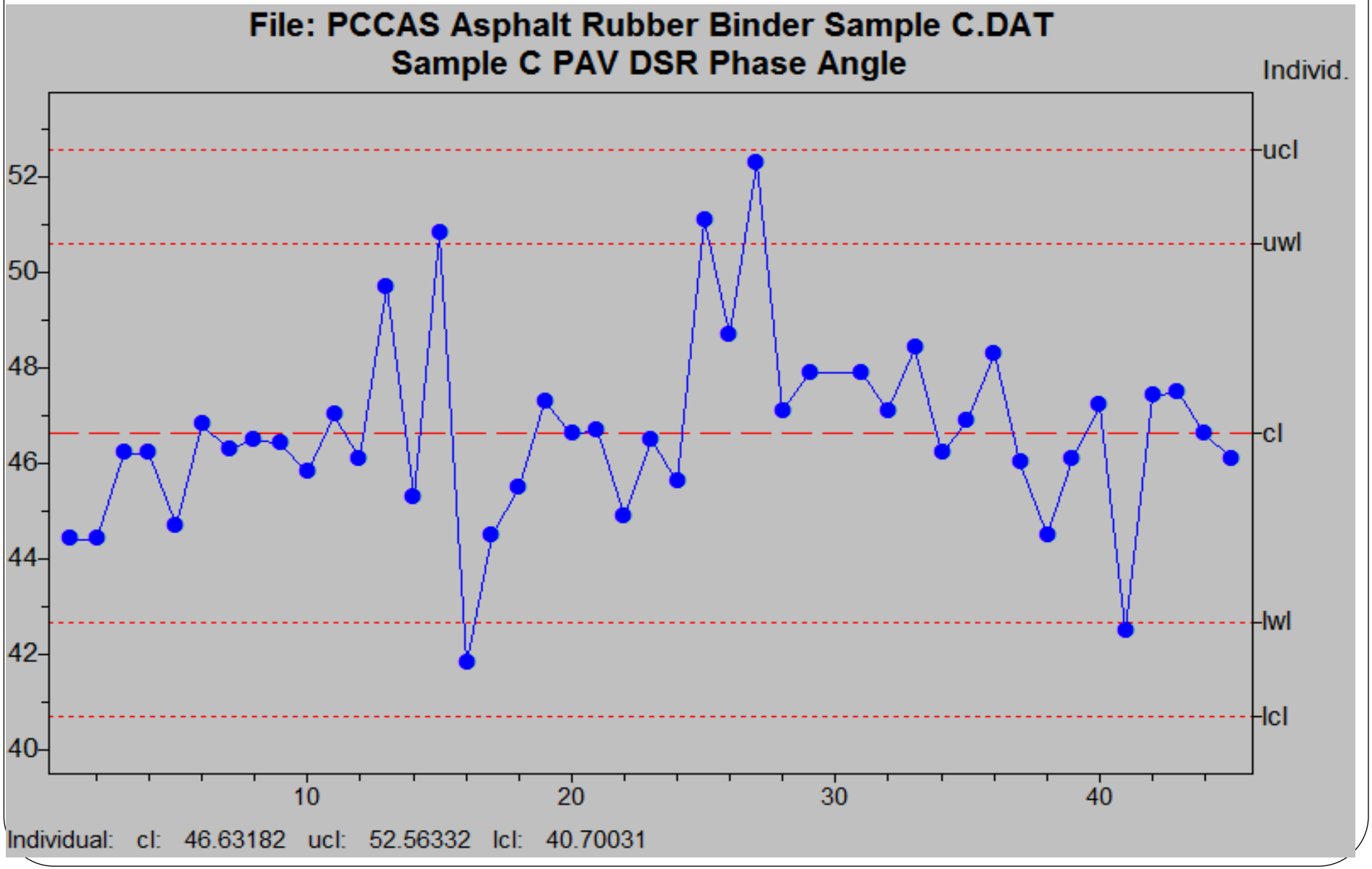
Sample C PAV DSR G*



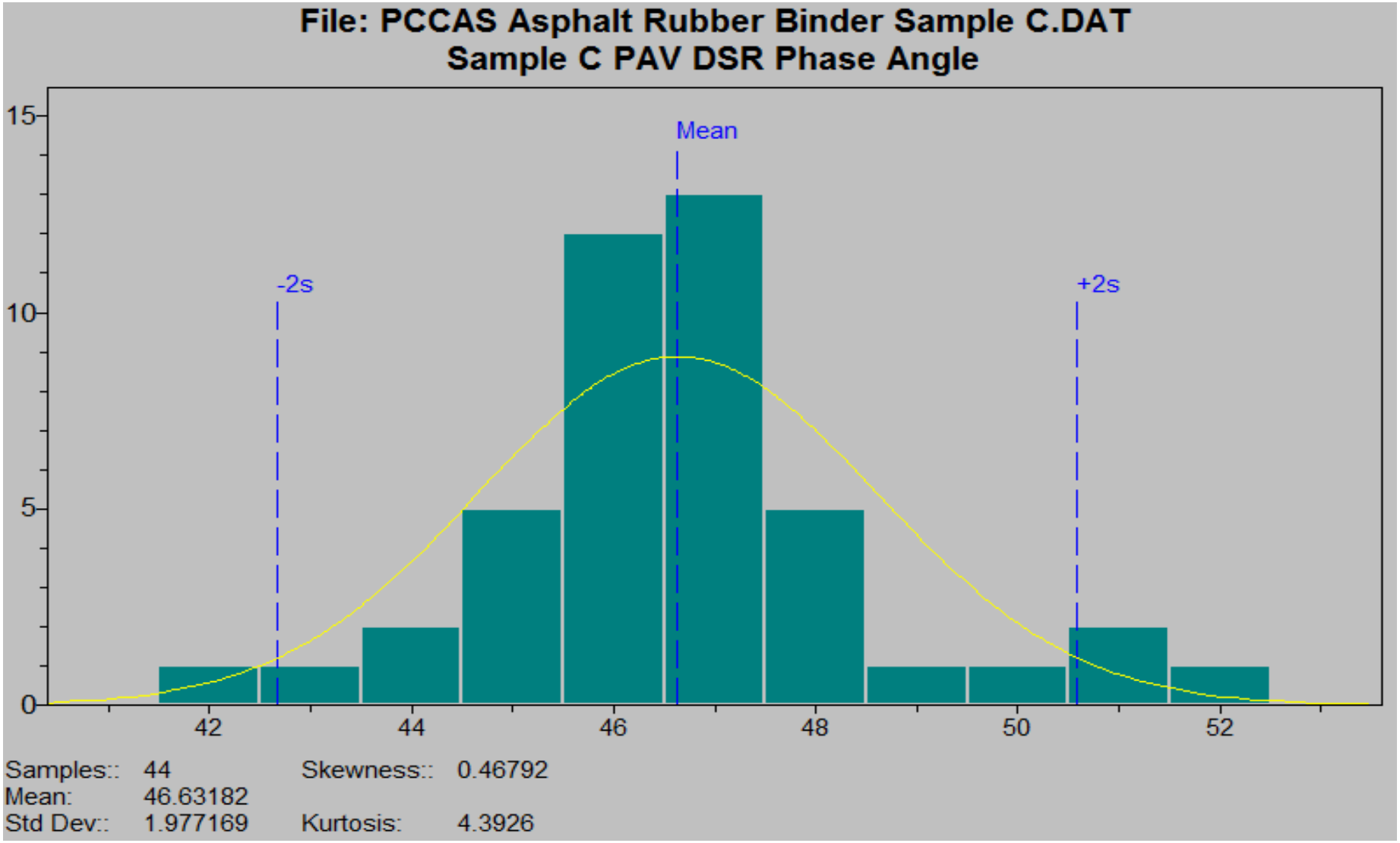
Sample C PAV DSR G*



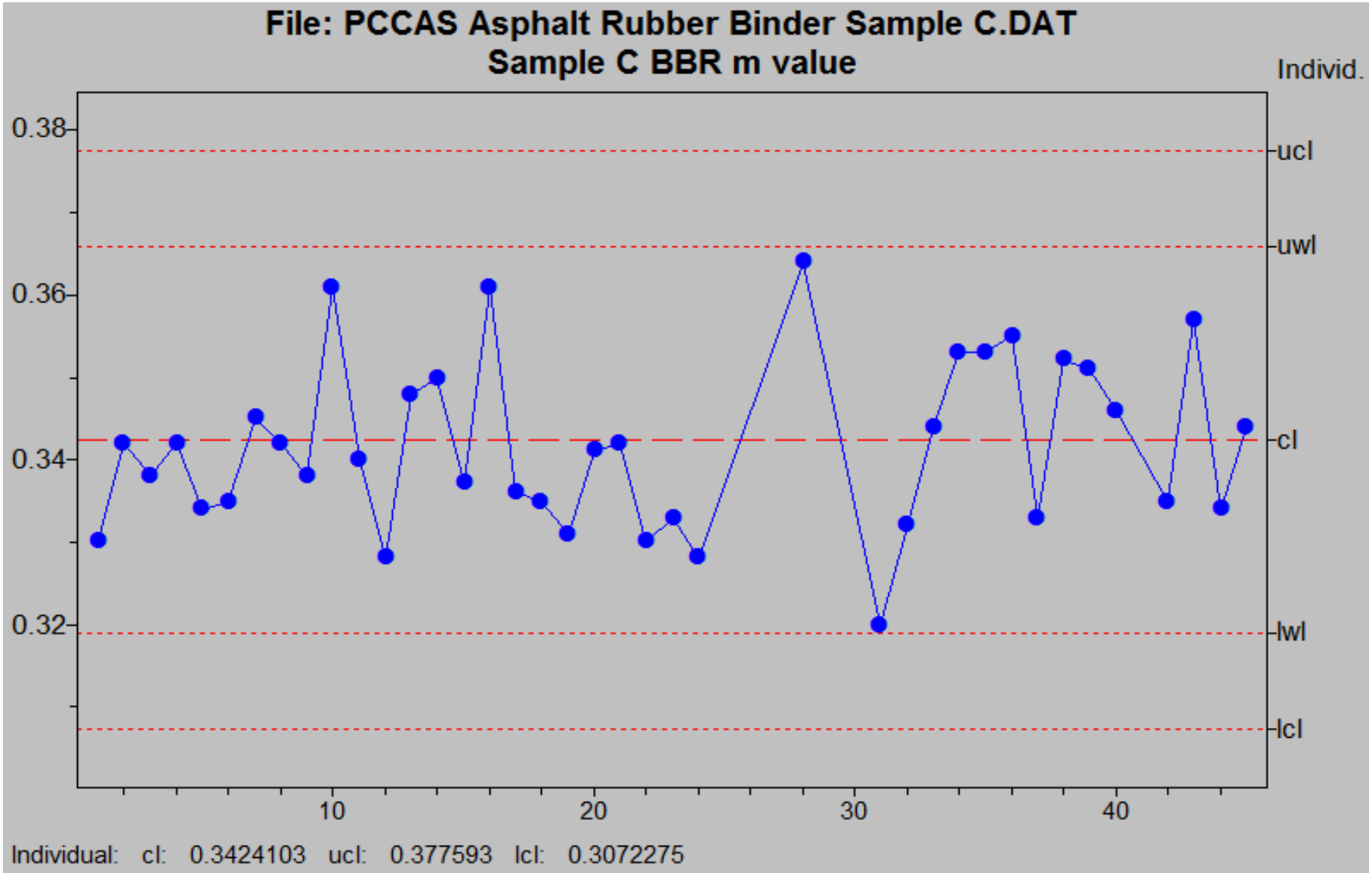
Sample C PAV DSR Phase Angle



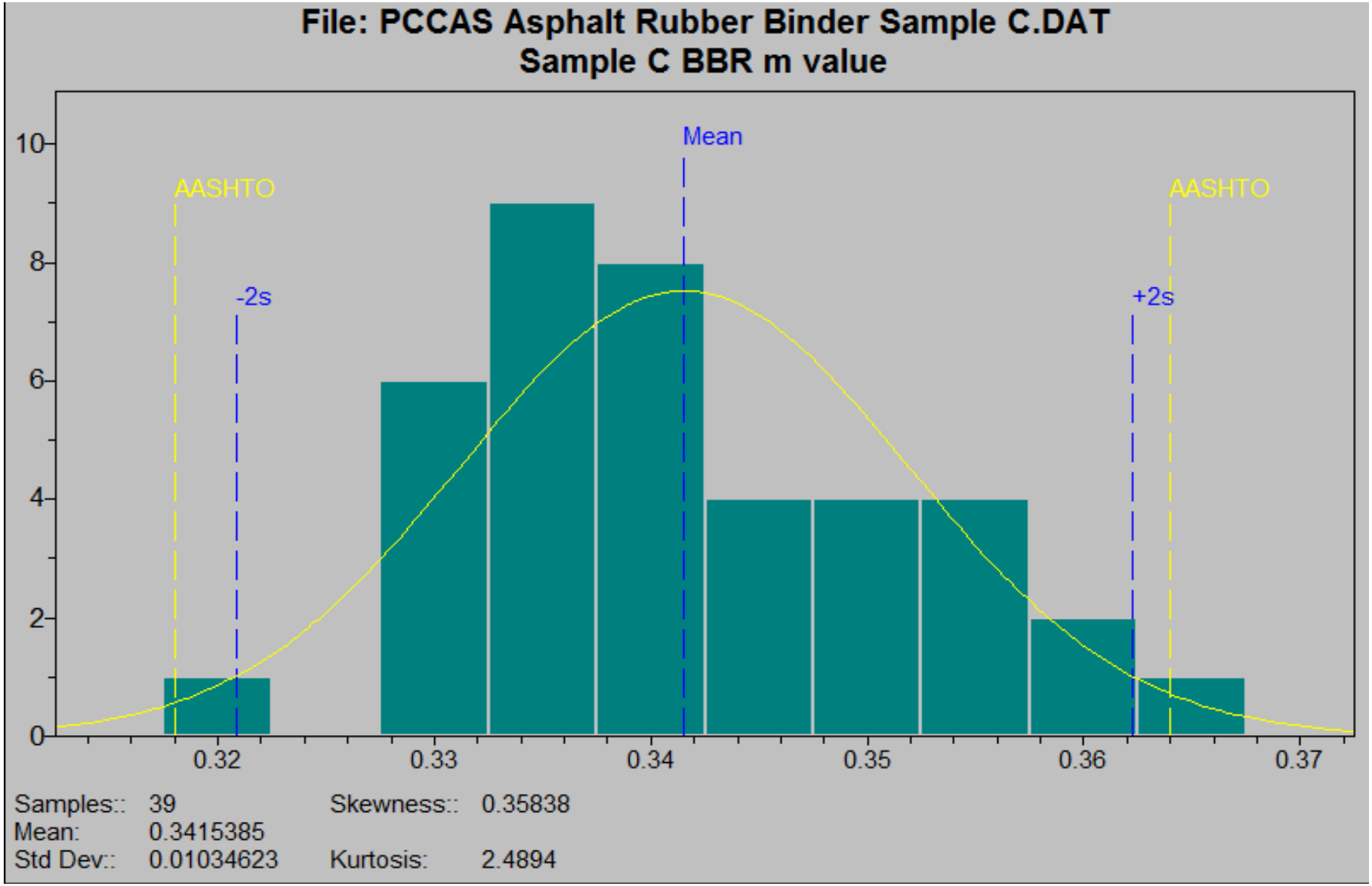
Sample C PAV DSR Phase Angle



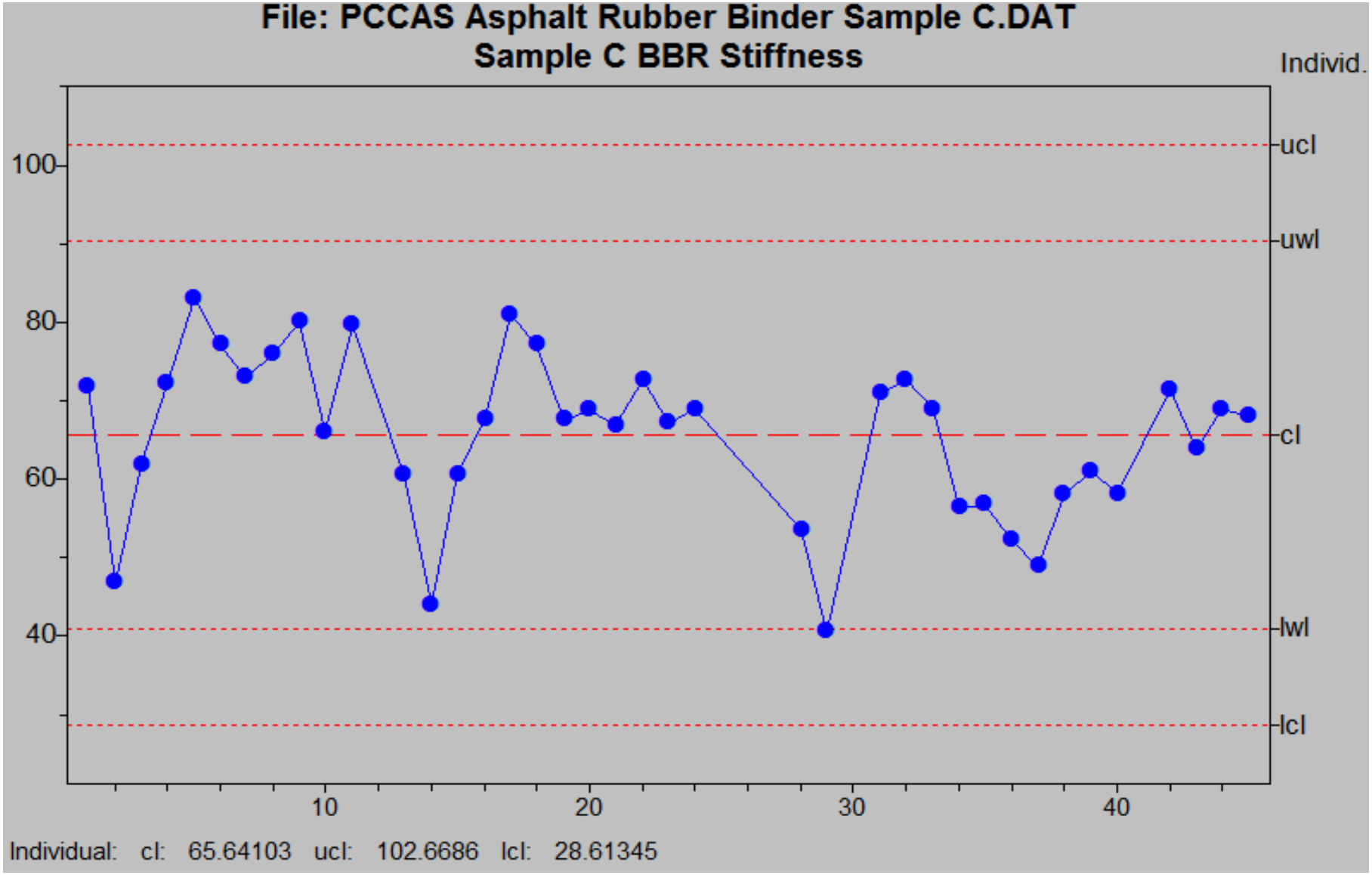
Sample C BBR m value



Sample C BBR m value



Sample C BBR Stiffness



Sample C BBR Stiffness