CMH-17
COMPOSITE MATERIALS HANDBOOK

CMH-17 Joint Statistics Meeting

Fall 2024 Virtual Coordination Meetings

Wednesday, November 13, 2024

1:00 – 3:00 pm EST

CALL TO ORDER AND INTRODUCTIONS

REVIEW OF MINUTES FROM SCOTTSDALE MEETING

Vol 7 (Additive Manufacturing) Statistics Content

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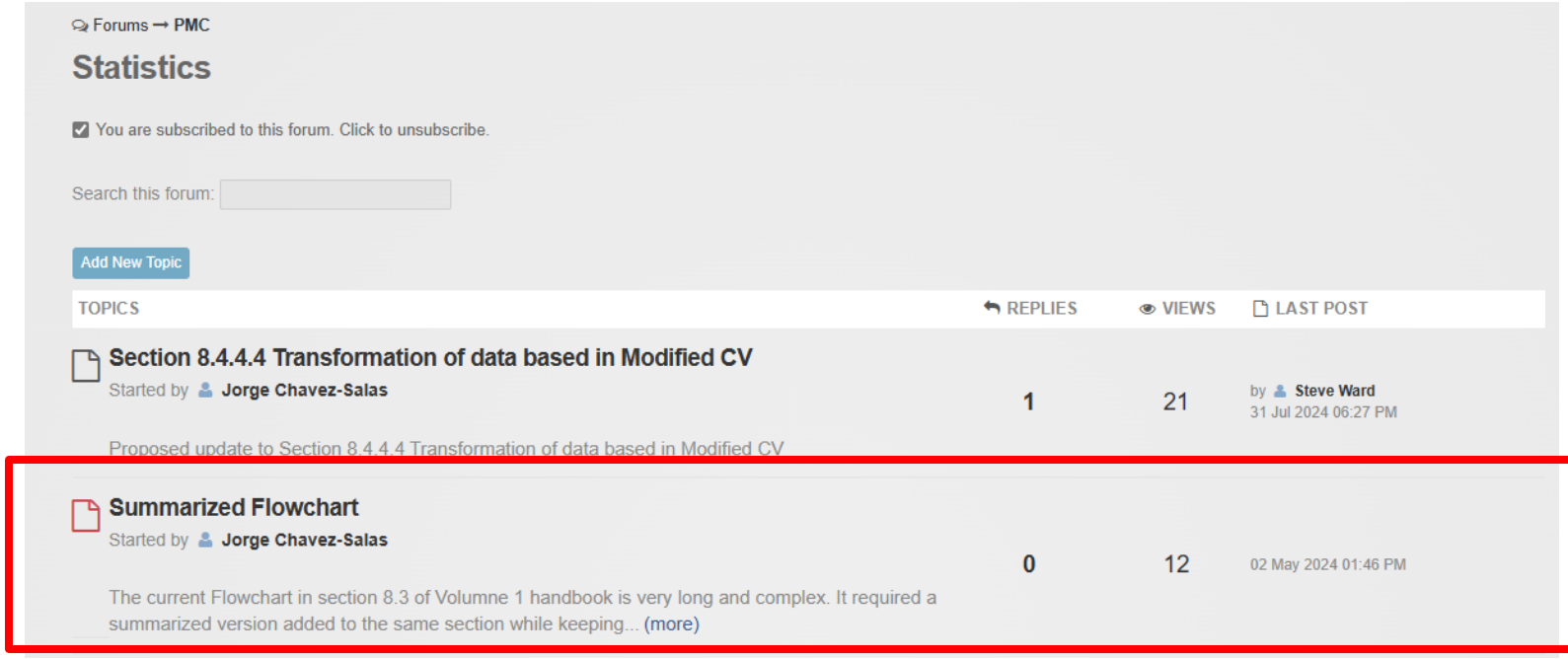
		Spring 2023 YP2	Spring 2023 YP3	Fall 2023 YP1	Fall 2023 YP 2	Spring 2024 YP 1	Spring 2024 YP 2
8.1	Introduction	Resolved Negative					
8.1.1	Overview of Methods for Calculating Statistically-based Properties	Resolved Negative					
8.1.2	Computer software	Resolved Negative					
8.1.3	Symbols	Resolved Negative					
8.1.4	Statistical Terms	Resolved Negative					
8.2	Background	Affirmative					
8.2.1	Analysis of Material Properties	Negative			In Resolution (LJ)		
8.2.2	Descriptive Statistics	Negative			In Resolution (LJ)		
8.2.3	Statistical Graphing		Negative	Negative	In Resolution (LJ)		
8.2.4	Sources of Variation	Negative			In Resolution (LJ)		
8.2.5	Structured vs. Unstructured Data	Negative					Affirmative
8.2.6	Statistically-based Material Allowables	Negative					Negative
8.2.7	Modified CV	Negative					Negative
8.2.8	Equivalence and Acceptance	Resolved Comment					
8.2.9	Comparison between traditional and generic approach			Negative	In Resolution (SK)		
8.3	Calculation of Statistically-Based Material Allowables		Negative				
8.3.1	Traditional		Negative		In Resolution (SK)		
8.3.1.8	Examples						
8.3.2	General Linear Statistical Models		Negative	Negative			
8.3.2.2	ULTEM™ 9085 Example Analysis			Negative	Affirmative		
8.3.3	Generic Approach to Computing Design Values		Negative				
8.4	Statistical Methods for Material Equivalence and Acceptance						
8.4.1	Traditional		Negative		Negative	Resolved Negative	
8.4.2	Generic Approach to Equivalence		Negative				
8.5	Statistical Process Control						
8.6	Other Statistical Methods						
8.6.1	Average stress-strain curves and bearing load-deformation curves			Affirmative – Comments to Address			

Task P24-073: Improved computational flowchart

- Jorge Chavez-Salas has developed a proposed clarification to the flowchart in Volume 1 Chapter 8
- Please review proposed updates on Forum. Comments, corrections, suggestions are welcome!



P24-074: Improved clarity of Mod CV transform for diagnostic tests

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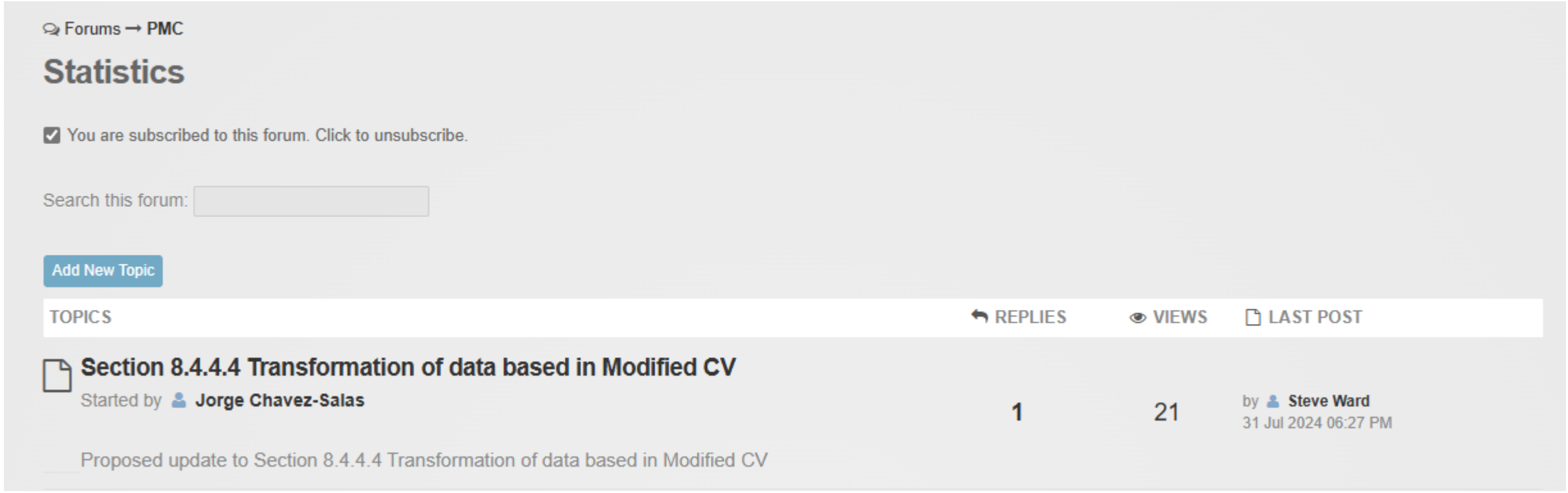
- Jorge Chavez-Salas has proposed an update to Section 8.4.4.4
- Please review proposed updates on Forum. Comments, corrections, suggestions are welcome!



P24-077: Improved accuracy of Normal A- and B-Basis factors

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- Improved computational power in the past several decades allows for improved accuracy of kA and kB factors.
- Differences typically in the 3rd decimal place

N = 2 - 137							
n	k_B	n	k_B	n	k_B	n	k_B
2	20.581	36	1.725	70	1.582	104	1.522
3	6.157	37	1.718	71	1.579	105	1.521
4	4.163	38	1.711	72	1.577	106	1.519
5	3.408	39	1.704	73	1.575	107	1.518
6	3.007	40	1.698	74	1.572	108	1.517
7	2.756	41	1.692	75	1.570	109	1.516
8	2.583	42	1.686	76	1.568	110	1.515
9	2.454	43	1.680	77	1.566	111	1.513
10	2.355	44	1.675	78	1.564	112	1.512
11	2.276	45	1.669	79	1.562	113	1.511
12	2.211	46	1.664	80	1.560	114	1.510
13	2.156	47	1.660	81	1.558	115	1.509
14	2.109	48	1.655	82	1.556	116	1.508
15	2.069	49	1.650	83	1.554	117	1.507
16	2.034	50	1.646	84	1.552	118	1.506
17	2.002	51	1.642	85	1.551	119	1.505
18	1.974	52	1.638	86	1.549	120	1.504
19	1.949	53	1.634	87	1.547	121	1.503
20	1.927	54	1.630	88	1.545	122	1.502
21	1.906	55	1.626	89	1.544	123	1.501
22	1.887	56	1.623	90	1.542	124	1.500
23	1.870	57	1.619	91	1.540	125	1.499
24	1.854	58	1.616	92	1.539	126	1.498
25	1.839	59	1.613	93	1.537	127	1.497
26	1.825	60	1.609	94	1.536	128	1.496
27	1.812	61	1.606	95	1.534	129	1.495
28	1.800	62	1.603	96	1.533	130	1.494
29	1.789	63	1.600	97	1.531	131	1.493
30	1.778	64	1.597	98	1.530	132	1.492
31	1.768	65	1.595	99	1.529	133	1.492
32	1.758	66	1.592	100	1.527	134	1.491
33	1.749	67	1.589	101	1.526	135	1.490
34	1.741	68	1.587	102	1.525	136	1.489
35	1.733	69	1.584	103	1.523	137	1.488

SPC Task Group (new)

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- Brice Langston has volunteered to chair the new SPC TG
- Call for TG Co-Chair
- To join, please contact info@cmh17.org or use the chat

SPC Task Group

By Brice Langston

CMH17 , Fall 2024

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Objectives

Volume 1

8.4.5

- Modernize Graphs & Update Content
- Add additional application examples to demonstrate practices

8.#.#

Proposed Process Capability & Performance Indices section

Related Sections

Volume 3

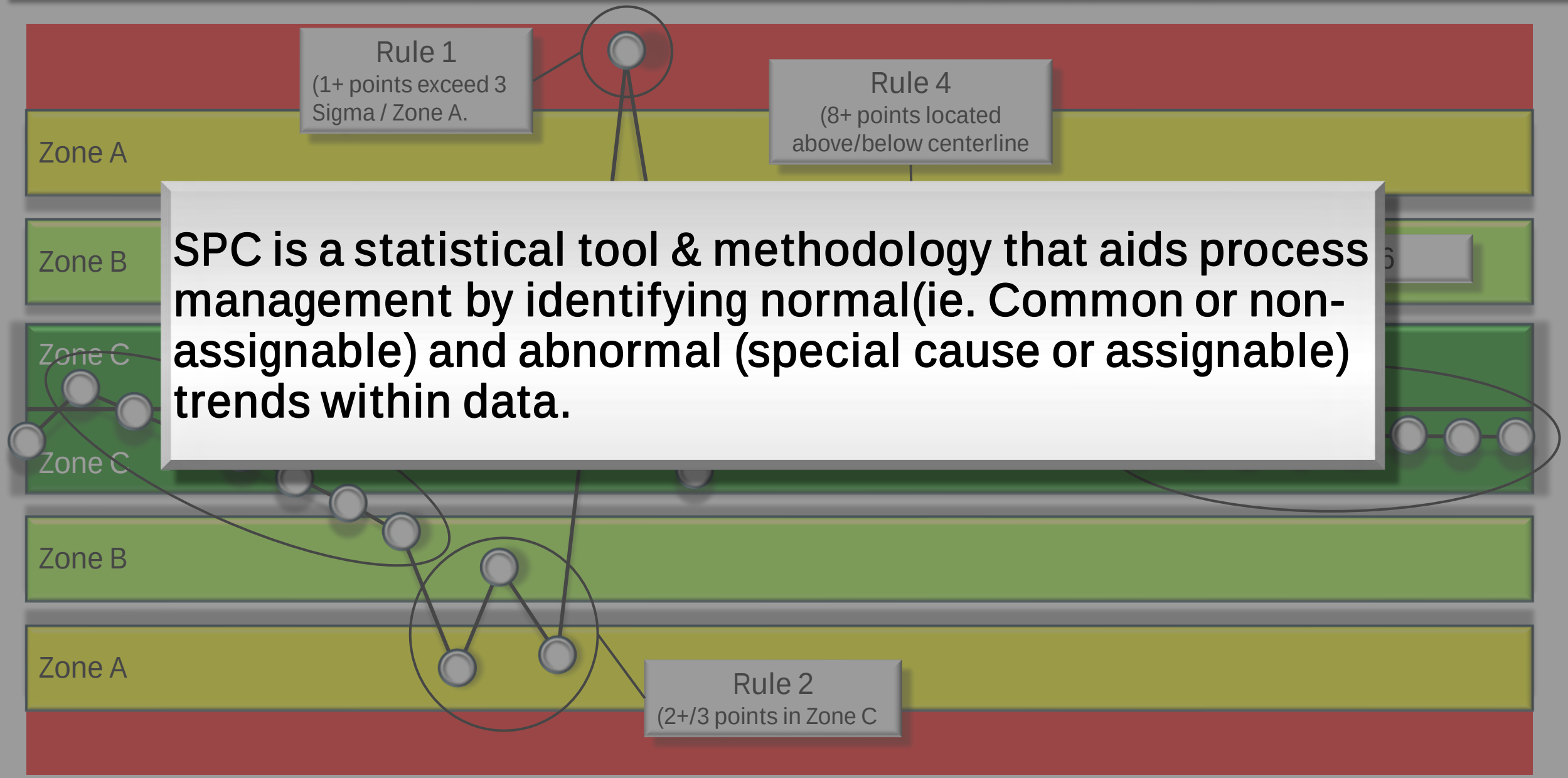
6.2.2.2

- *Citation to capability indices statistics section*

6.5.1

- *Recommend Citation to Volume 1 - 8.4.5*

What is Statistical Process Control (SPC)?



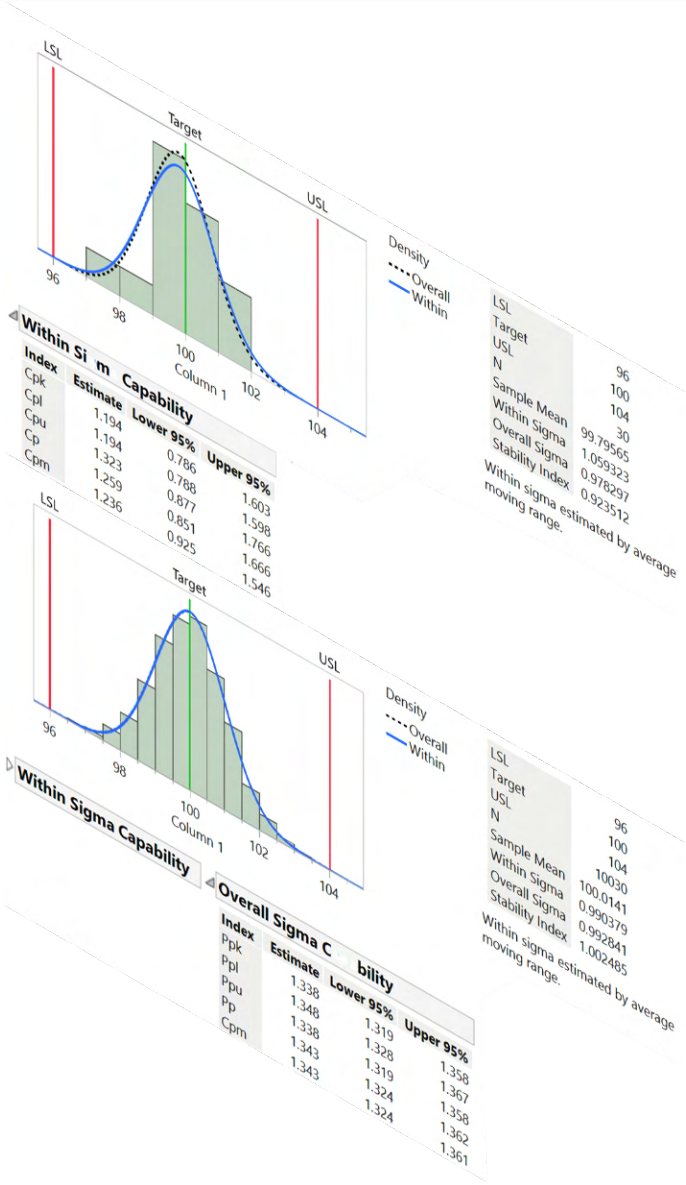
SPC is a statistical tool & methodology that aids process management by identifying normal(ie. Common or non-assignable) and abnormal (special cause or assignable) trends within data.

What are Capability and Performance Indices?

Capability/Performance Indices are analysis that are used to compare specification limits to process variability

Volume 3, Section 6.2.2.2

"A fundamental question for a manufacturing process is given the variability present, what percentage of product would meet specification requirements. Numbers representing this concept are termed measures of process capability."



Forming SPC Task Group

- Co-Chair – Looking for a Volunteer
- Looking for volunteers to support the task group

Equivalency Task Group (New)

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- To join, please contact info@cmh17.org or use the chat
- Activities to start after Spring 2025 meeting
- Call for TG Co-Chair(s)

Equivalency/Acceptance Statistical Tests

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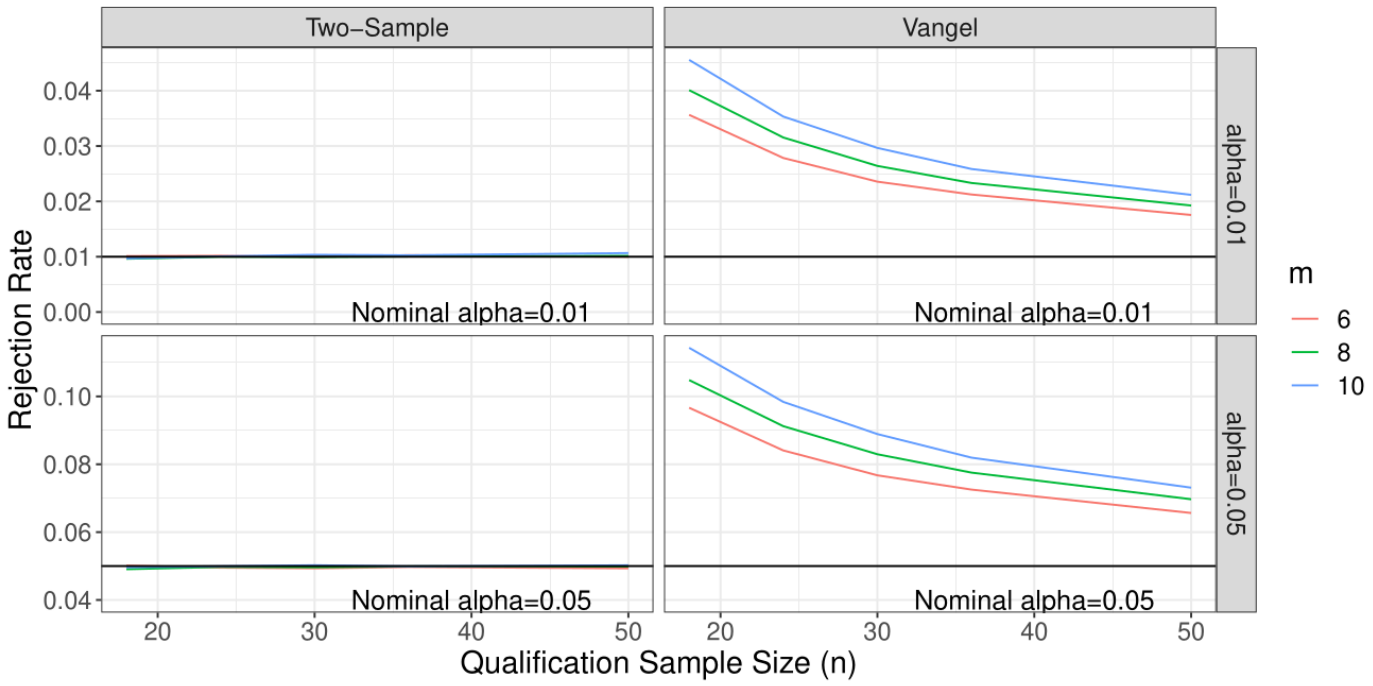
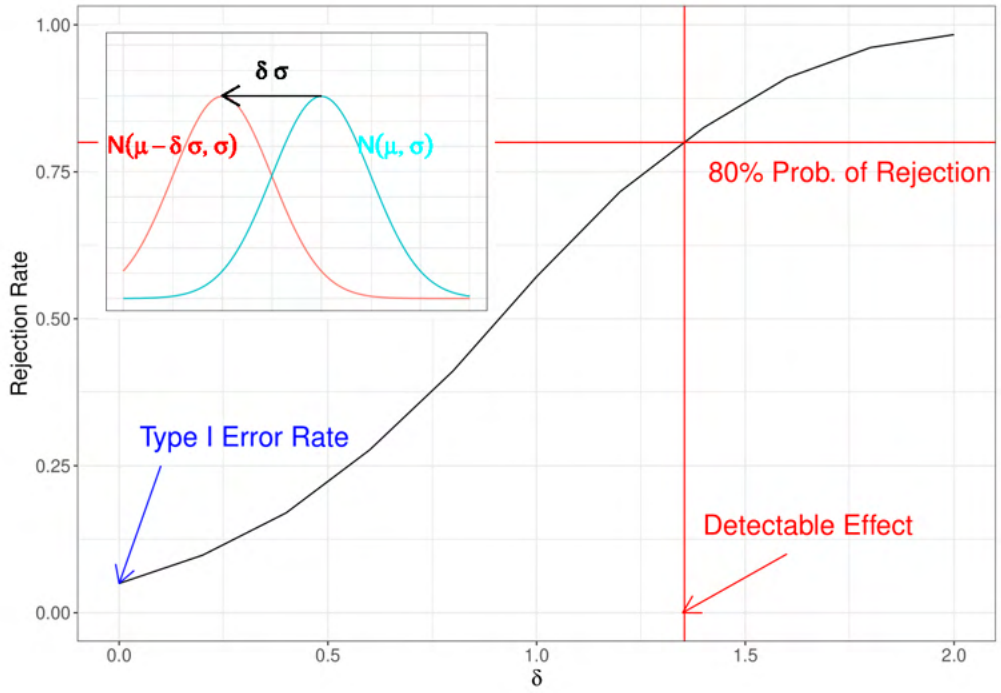
False Rejection Rate (Type 1 Error)



False Acceptance Rate (Type 2 Error)



Equivalency TG Scope

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- Updated guidelines on when equivalency is appropriate
  - The statistical test can be useful to disprove equivalency, but not to prove it
- Add “two-sample” method to Volume 1
  - Corrected Type 1 error rate
- Sample size recommendations
  - Power sampling
- Training?
- Is the assumption of normal distribution appropriate for equivalency?
- Guidelines around engineering judgement
  - Engineering significance of changes
  - When is use of historical non-pedigreed data appropriate
- Possibility of different methods depending on dataset (sample size, # lots, maturity of data, batch/build effects, etc.)
- CMC is dealing with large panel effects and is using different test matricies. How should this affect equivalency?
- How to deal with different sources of variability (possible multiple sources of variability, could be nested or crossed) for different materials or material systems?

BAYESIAN METHODS

LINDSAY JONES

Future of a Joint Statistics WG

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- Additive Manufacturing Statistics WG will remain as-is until Initial Release of Vol 7
- What should a future Joint Statistics WG look like?
- CMC DRWG currently does statistics for Vol 5. Could consider Joint Stats WG taking this on (with agreement from CMC DRWG)
- May want to include PoD methods in Handbook (similar to MIL-HDBK-1823, but for composites).

THANKS FOR ATTENDING!