From: "Johnson, Kenneth" <Kenneth.Johnson@msfc.nasa.gov>
To: "Hodge, Andrew" <Andrew.Hodge@msfc.nasa.gov>,
"Rogers, Patrick" <Patrick.Rogers@msfc.nasa.gov>,
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"Ledbetter, Frank" <Frank.E.Ledbetter@msfc.nasa.gov>,
"Holmes, Steven G" <Steven.G.Holmes@msfc.nasa.gov>,
"Rainwater, Adrienne" <Adrienne.L.Rainwater@msfc.nasa.gov>,
"Kaul, Raj" <Raj.K.Kaul@msfc.nasa.gov>,
"'Robert.W.Biggs@maf.nasa.gov'" <Robert.W.Biggs@maf.nasa.gov>
Cc: "Rogers, Jim" <Jim.H.Rogers@msfc.nasa.gov>
Subject: RE: CNC Stress Assessment
Date: Tue, 23 Apr 2002 16:24:07 -0500

Andy and cc's:

I have several points here. I'd like to discuss this in a tag-up; there is a lot to follow for me as well as for you all.

First, be extremely careful of the way MIL-HDBK-17-1E calculates specifications. I can't underline enough that if specifications come from a production process, it is possible to fail a finished part, even though the part passed the spec. Every time specifications are widened without heed to requirements in the finished part, a greater chance of end use failure gets introduced.

If a specification is set properly using a known requirement of the end use, you have the most robust specification you can muster. If a specification is set not considering this requirement, a failure could result.

If anyone is not convinced, consider this scenario: A tire company manufactures tires that meet a tread separation specification set at 150 degrees F 99.9997% of the time. An SUV manufacturer buys the tires, knowing that these tires meet the spec reliably. Unfortunately, the tires see 165 degrees F in actual use, and some tires separate in the field.

In summary, anyone can set acceptance criteria as wide as they would like. However, specifications set this way may not avoid failure.

Other comments:

1. Remember that calculations in MIL-HDBK-17-1E SS 8 assume normality or Weibullness. The data I have examined so far all varies from this. This will affect results, but again, I don't know the extent of the effect. It could be significant.

2. 17-1E SS 8.4.2 and related gives you an acceptance chart, not a control chart. As either type of chart, it is very unresponsive. That is OK, if you don't want to be alerted when something extraordinary happens in your process, but only if something completely crazy happens. Take a look at the following charts, taken from data marked "Tag Comp".

First, look at "Tag Comp std x-bar.jpg". This is a plain vanilla X-bar chart; an acceptance chart, though constructed differently, would carry the same analysis. Note that the limits are not calculated correctly because it shows the process to be out of control (the process must be in control, or nearly so, by this chart to calculate good limits). However, subgroup 10 (circled) is clearly different from other batches, there is a downward trend over the first ten batches, and something different started happening at about batch 13. That's the information you want from a control or acceptance chart.

Now look at the control chart constructed using 17-1E. The data, first of all, is obscured by a calculation; the points on the graph don't have any intuitive relationship to the base data. That's OK if you can pull out useful information anyway; many times, data needs to be transformed before it can be analyzed. However, the trends and key spikes shown in the simpler graph don't show up here. Is this because we don't need to be concerned with those data points? I think we do. Note that while I had another engineer check my results, we could have misinterpreted or miskeyed these fairly complex formulas. If someone else sees something different, please let me know.

It is possible that the chart is meant as an acceptance chart, not a control chart. The top paragraph on page 8-71 states: "if the absolute value of V(k+1) exceeds t . . . the batch is not accepted." Again, however, note batch 10. If the batch had been produced below a specification based on requirements, there would be no way to tell using the ANOVA-based X-bar chart from 17-1E.

The difference between process control charts and acceptance charts:
- Acceptance charts compare process output to specification (the chart you have been using to monitor batches is this type)
- Process control charts compare process output to previous process output, not specification

Note that acceptance charts do not tell you when a process is doing something out of the ordinary. A process could be very unpredictable and still produce in-spec parts. Process control charts do not compare process output to specification. A process could be humming along completely predictably, but not be producing parts that anyone can use.

Incidentally, we really need more information to use this chart effectively. One of the required tests is a time-based calculation intended to weed out trends; we should really use production dates here. This does not affect my observations.

3. Since the process is not predictable and not normal or Weibull, be careful about talking about in- and out-of-family. This could lead to confusion when calculations based on this assumption come up with unexpected answers, as we found in RSRM.

By the way, I did recalculate some limits for the process based on 17-1E in my original analysis. That was the impetus for my presentation. I believe that 17-1E, applied again, could potentially lead us to trouble.

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-----Original Message-----
From: Hodge, Andrew
Sent: Wednesday, April 17, 2002 3:28 PM
To: Johnson, Kenneth
Subject: FW: CNC Stress Assessment

Ken,
The procedure I mention is in section 8.4.2 page 8-70. I would very much appreciate your input and hope you have the time to evaluate this to make sure I'm not out in left field.
Andy

-----Original Message-----
From: Hodge, Andrew
Sent: Wednesday, April 17, 2002 3:17 PM
To: 'Biggs, Robert W'; Rogers, Patrick
Cc: Sharpe, Jon; Ledbetter, Frank; Holmes, Steven G; Rainwater, Adrienne; Johnson, Kenneth; Kaul, Raj
Subject: RE: CNC Stress Assessment

Bobby,
I have taken a method outlined in the MIL-HDBK-17 to develop a 95% and 99% confidence interval on batch dependant material. The interval is larger than that suggested by standard quality control methods such as that presented by Ken Johnson. The majority of the CTL data is within the 99% confidence interval with only a few failures.

I have also calculated a "Beta acceptance level". Beta is the probability of accepting material you think is good, when it is actually below a minimum value. I calculated the Beta level based on the ANOVA A-basis with Beta = 1.0%. I think we could readjust our acceptance criteria based upon either the Beta level or 99% confidence interval. (Possibly use the higher of the two.) This would assure us the properties are above the A-basis AND within family.

Ideally we could have input from stress analysis that provides the bare minimum stresses that provide zero Margin of Safety. I could then calculate a Beta level that could be used as our new acceptance criteria.

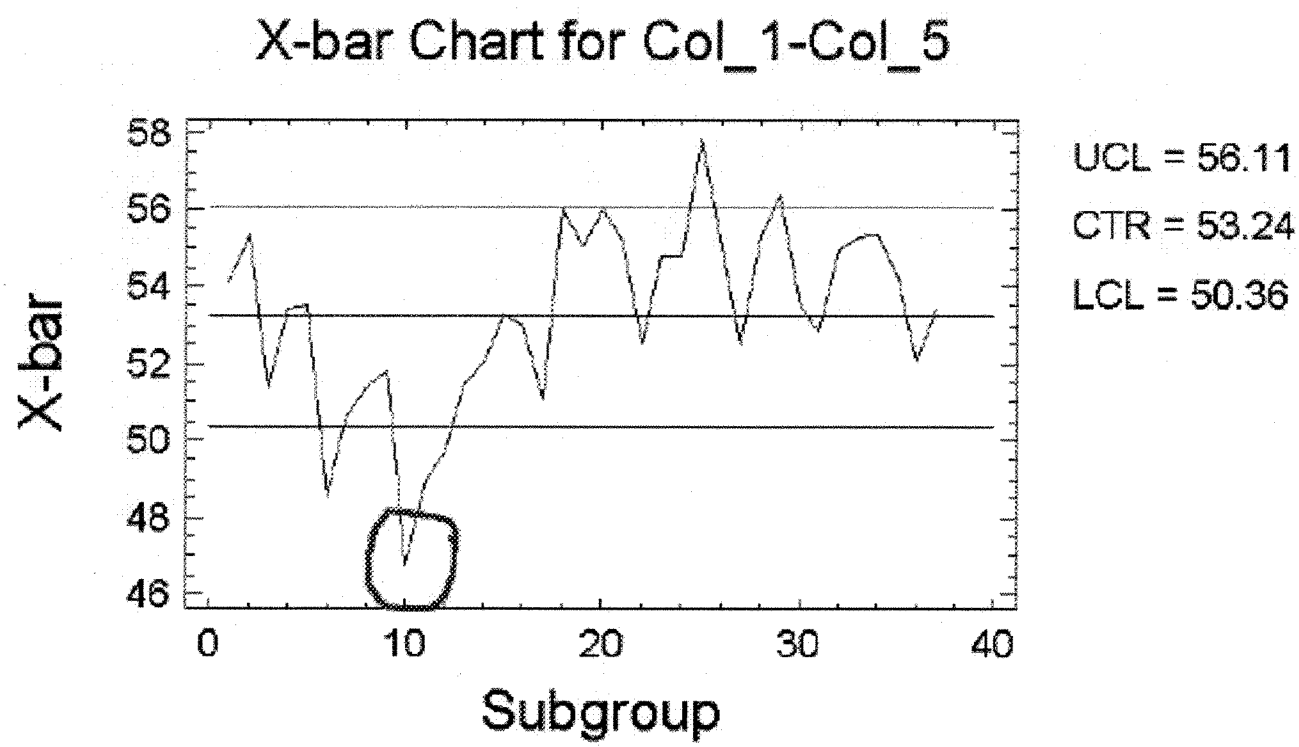
-----Original Message-----

From: Biggs, Robert W [mailto:Robert.W.Biggs@msfc.nasa.gov]
Sent: Tuesday, April 16, 2002 12:02 PM
To: Hodge, Andrew
Subject: CNC Stress Assessment

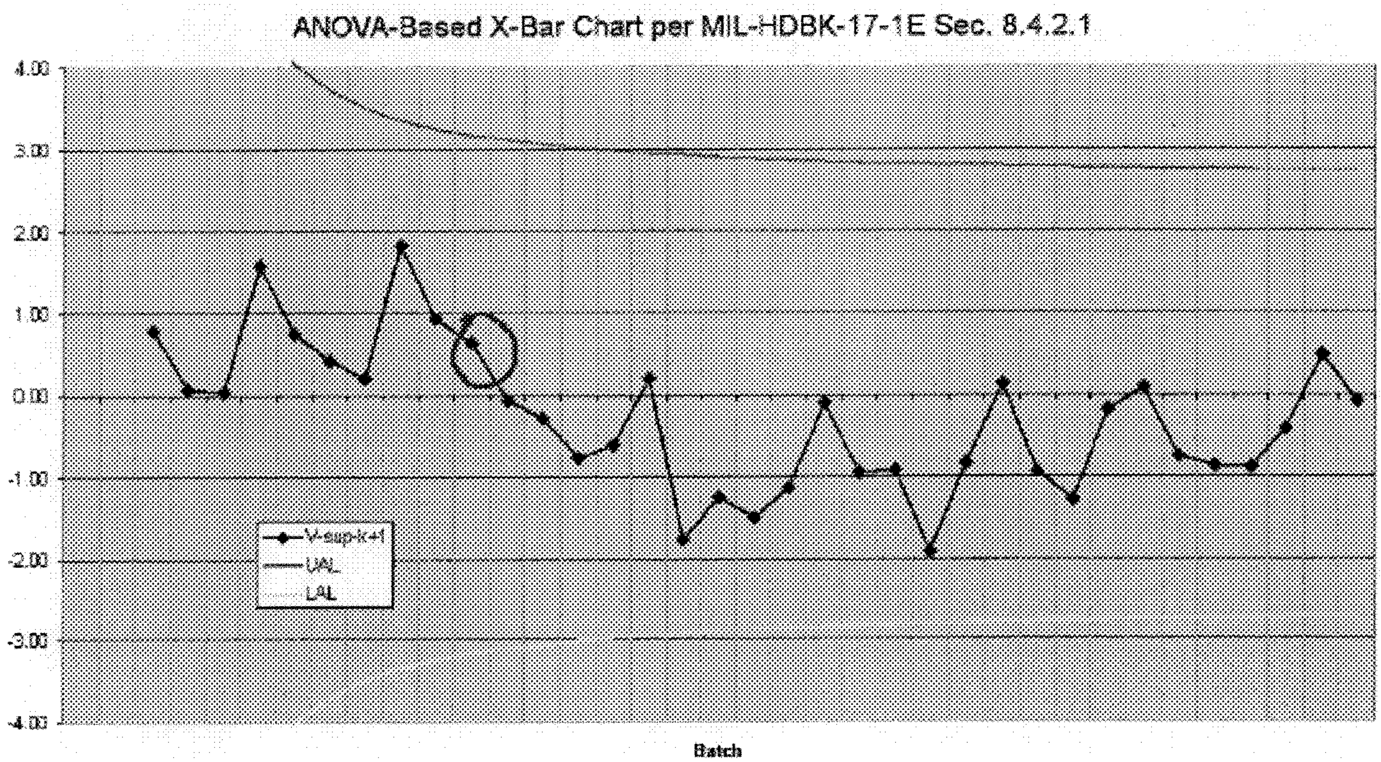
Andy,

I talked to Yeung Lee (our stress lead) about the stress assessment of the proposed allowables. They are still looking at it as well as other combinations of ANOVA and minimums. They also need to more time to coordinate with Pat Rogers. It sounds like they will need the rest of this week, maybe more. I just wanted to give you an update.

Bobby



Tag Comp std x-bar chart 402.jp



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