CLAIMS

What is claimed is:

1. A method of manufacturing showerheads for a substrate processing system, the method comprising:

arranging one or more of the showerheads on a tool including a cutting attachment;

selecting first selected features of a plurality of features to be machined within a first tolerance range of a specified dimension for the plurality of features;

selecting second selected features of the plurality of features, that are located at least a predetermined distance apart, to be machined within a second tolerance range of the specified dimension for the plurality of features;

machining, using the cutting attachment, the first selected features of the plurality of features within the first tolerance range; and

when a parameter associated with the tool causing variation in dimension of the first selected features reaches a predetermined threshold, machining, using the cutting attachment, the second selected features of the plurality of features within the second tolerance range,

wherein the first tolerance range is smaller than the second tolerance range.

2. The method of claim 1 wherein the parameter includes wear on the cutting attachment, temperature of the cutting attachment, temperature of the tool, or temperature of the one or more of the showerheads being machined.

3. The method of claim 1 wherein the parameter includes wear on the cutting attachment, the method further comprising estimating the wear on the cutting attachment based on at least one of a machining time for which the cutting attachment is used on the tool, a number of features cut using the cutting attachment, and a sensed wear on the cutting attachment.

4. The method of claim 1 wherein the first selected features and the second selected features are located on one of the showerheads or on a plurality of the showerheads.

5. The method of claim 1 wherein the parameter includes wear on the cutting attachment, the method further comprising changing the cutting attachment of the tool when the cutting attachment reaches a second predetermined threshold greater than the predetermined threshold.

6. The method of claim 1 further comprising changing the cutting attachment of the tool after machining a predetermined number of the showerheads using the cutting attachment.

7. The method of claim 1 further comprising:

selecting third selected features of a second plurality of features to be machined within a third tolerance range of a second specified dimension for the second plurality of features;

selecting fourth selected features of the second plurality of features, that are located at least a second predetermined distance apart, to be machined within a fourth tolerance range of the second specified dimension;

machining, using the cutting attachment, the third selected features within the third tolerance range; and

when the parameter reaches a second predetermined threshold, machining, using the cutting attachment, the fourth selected features within the fourth tolerance range,

wherein the third tolerance range is smaller than the fourth tolerance range.

8. The method of claim 7 wherein:

the third and fourth selected features are different than the first and second selected features;

the second specified dimension is different than the specified dimension;

the third and fourth tolerance ranges are different than the first and second tolerance ranges; and

the second predetermined distance is different than the predetermined distance.

9. The method of claim 7 wherein the first, second, third, and fourth selected features are located on one of the showerheads.

10. The method of claim 7 wherein the first, second, third, and fourth selected features are located on a plurality of the showerheads.

11. The method of claim 7 further comprising machining the third selected features after machining the first selected features and before machining the second selected features.

12. The method of claim 7 wherein the third and fourth selected features modify the first and second selected features.

13. The method of claim 7 further comprising machining the third and fourth selected features after machining the first selected features and before machining the second selected features.

14. The method of claim 7 further comprising machining the third and fourth selected features after machining the second selected features.

15. A method of manufacturing showerheads for a substrate processing system, the method comprising:

arranging one or more of the showerheads on a tool including a cutting attachment;

selecting first selected features of a plurality of features to be machined within a predetermined tolerance range of a specified dimension for the plurality of features;

selecting second selected features of the plurality of features, that are interspersed with the first selected features, to be machined within the predetermined tolerance range of the specified dimension for the plurality of features;

machining, using the cutting attachment, the first selected features within the predetermined tolerance range; and

when a parameter associated with the tool causing variation in dimension of the first selected features reaches a predetermined threshold, machining, using the cutting attachment, the second selected features within the predetermined tolerance range;

wherein:

a mean value of dimensions of the first and second selected features is less than or equal to a predetermined mean deviation from the specified dimension; and

a standard deviation of the dimensions of the first and second selected features is less than or equal to a predetermined standard deviation.

16. The method of claim 15 wherein the parameter includes wear on the cutting attachment, temperature of the cutting attachment, temperature of the tool, or temperature of the one or more of the showerheads being machined.

17. The method of claim 15 wherein the parameter includes wear on the cutting attachment, the method further comprising estimating the wear on the cutting attachment based on at least one of a machining time for which the cutting attachment is used on the tool, a number of features cut using the cutting attachment, and a sensed wear on the cutting attachment.

18. The method of claim 15 wherein the first selected features and the second selected features are located on one of the showerheads or on a plurality of the showerheads.

19. The method of claim 15 wherein the parameter includes wear on the cutting attachment, the method further comprising changing the cutting attachment of the tool when the cutting attachment reaches a second predetermined threshold greater than the predetermined threshold.

20. The method of claim 15 further comprising changing the cutting attachment of the tool after machining a predetermined number of the showerheads using the cutting attachment.