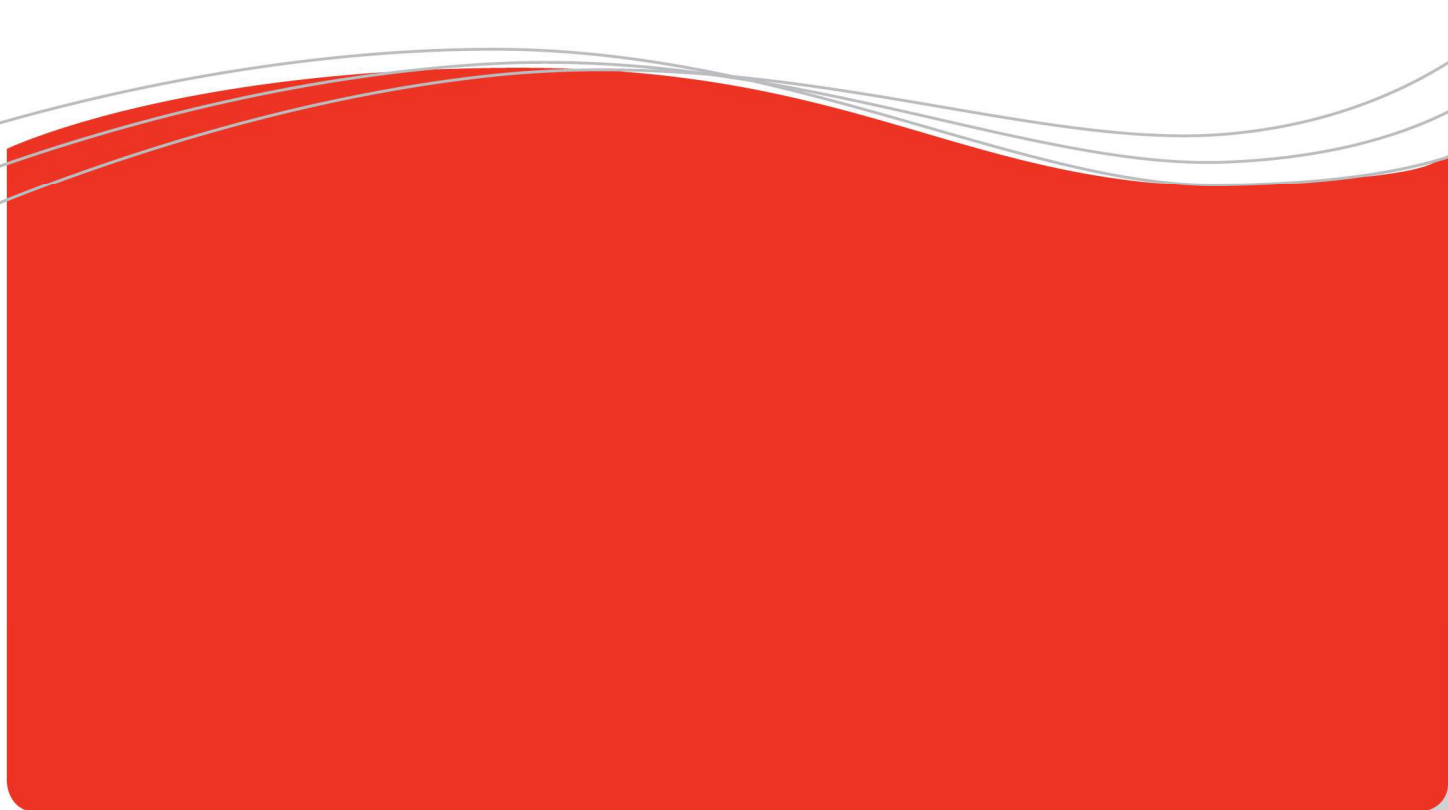




Integrated APQP: Ballooning – Control Plan - SPC

By Marc Schaeffers





Integrated APQP: Ballooning , Control Plan, SPC

INTRODUCTION

During APQP, critical characteristics are established in the control plan. These characteristics are measured on a CMM (e.g. during First Article Inspection) and during production (e.g. during regular SPC checks).

The process of registering all characteristics can be very time consuming. Characteristics are established during the design process and then they need to be entered in the CMM program, the control plan and the SPC program. A time consuming step for suppliers is that they often need to balloon the drawing from the customer as well.

This document describes how this can be done efficiently.

BALLOONING

When the drawing is in dwg, dxf, igs or pdf format the ballooning can be done with the Infra Convert software.

When the ballooning is activated the balloons are added to the drawing and the list of characteristics is also available.

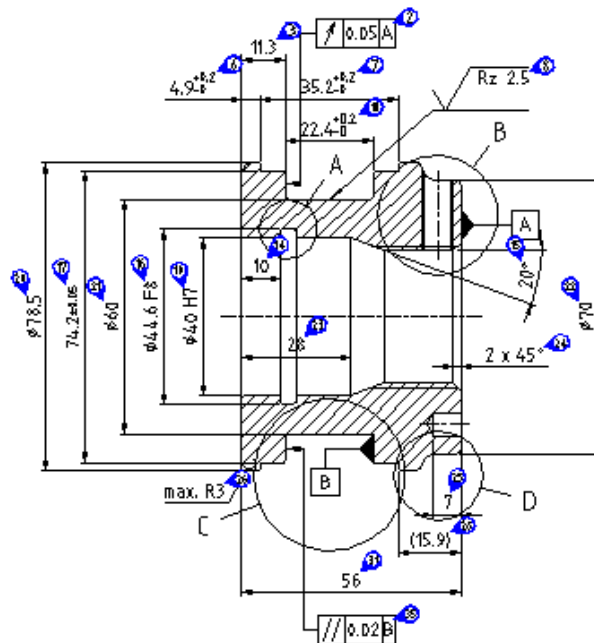


Figure 1: Example dwg drawing with balloons



In addition to the balloons the full list of characteristics can be exported to a prf file.

Ln	Id	Qnt	Char	Val	Min	Max	Unit	Class	Spec	GT
9	1	38	Thread M8	M8				1		
10	1	16	Radial run-out	0,05	0,00	+0,05	0,00	2	A	
24	1	0	Linear 11,3	11,3	11,300	+0,350	-0,350	3	DIN-1687-4-Table-2	GT
42	1	0	Linear 6	6	6,000	+0,050	-0,050	4		
12	1	2	Diameter ø55	ø55	55,000	+0,100	-0,100	5		
23	1	0	Linear 4,9	4,9	4,900	+0,200	-0,000	6		
22	1	0	Linear 35,2	35,2	35,200	+0,200	-0,000	7		
4	1	23	Max. profile height	Rz 2,5	Rz 2,5	0,000	+2,500	8		
11	0	38	Thread M36x1,5	M36x1,5				9		
21	1	0	Linear 22,4	22,4	22,400	+0,200	-0,000	10		
40	1	1	Radius R0,5	R0,5	0,500			11		
39	1	1	Radius R0,5	R0,5	0,500			12		
31	1	0	Linear 3,9	3,9	3,900	+0,200	-0,000	13		
19	1	0	Linear 10	10	10,000	+0,350	-0,350	14	DIN-1687-4-Table-2	GT
6	1	3	Angle 20,000°	20,000°	20,000			15		
14	1	2	Diameter ø44,6 F8	ø44,6 F8	44,600	+0,064	+0,025	F8	16	DIN-ISO-286-2
7	1	0	Linear 74,2	74,2	74,200	+0,050	-0,050	17		
10	1	3	Angle 135,000°	135,000°	135,000			18		
20	1	2	Diameter ø40 H7	ø40 H7	40,000	+0,000	0,000	H7	19	DIN-ISO-286-2 H7
8	1	2	Diameter ø78,5	ø78,5	78,500	+0,600	-0,600	20	DIN-1687-4-Table-2	GT
15	1	2	Diameter ø60	ø60	60,000	+0,600	-0,600	21	DIN-1687-4-Table-2	GT
25	1	2	Diameter ø70	ø70	70,000	+0,600	-0,600	22	DIN-1687-4-Table-2	GT
18	1	0	Linear 28	28	28,000	+0,400	-0,400	23	DIN-1687-4-Table-2	GT
5	1	33	Chamfer 2 x 45°	2 x 45°	2,000			24		
2	1	0	Linear 7	7	7,000	+0,350	-0,350	25	DIN-1687-4-Table-2	GT
16	1	1	Radius R3	R3	3,000			26		
13	1	2	Diameter ø6 H7	ø6 H7	6,000	+0,012	0,000	H7	27	DIN-ISO-286-2 H7
3	1	0	Linear (15,9)	(15,9)	15,900			28		
35	1	1	Radius R1,5	R1,5	1,500			29		
34	1	1	Radius R3	R3	3,000			30		
1	1	0	Linear 56	56	56,000	+0,600	-0,600	31	DIN-1687-4-Table-2	GT
33	1	1	Radius R1,5	R1,5	1,500			32		
27	1	1	Radius R0,8	R0,8	0,800			33		
28	1	1	Radius R0,8	R0,8	0,800			34		
17	1	13	Parallelism 0,02	0,02	0,000	+0,020	0,000	35	B	DIN-1687-4-Table-2
36	1	0	Linear 7	7	7,000	+0,350	-0,350	36		
30	1	1	Radius R0,5	R0,5	0,500			37		
29	1	1	Radius R0,5	R0,5	0,500			38		

Figure 2: Example prf file

The list is also available in a format that can be automatically imported (for example into the Calypro CMM software).

The next step in the process is to create the control plan to establish what needs to be measured during the different APQP stages.

CONTROL PLAN

The control plan will be created based on the FMEA. It contains the steps defined by the FMEA.

Part / Process Number	Process Name / Operation Description	Machine / Device / Jig / Tool	Characteristic			Class	Product / Process Specification / Tolerance	Evaluation / Measurement Technique
			Nr.	Product	Process			
010	Step 10	Machine 10						
020	Step 20	Machine 20A						
		Machine 20B						
030	Step 30	Machine 30						

Figure 3: Example Control Plan



When importing characteristics from the prf file, you will need to add the characteristics to the appropriate machine/device/jig/tool field. When possible, you also need to add the contents of the other fields that are not available in the prf file into the control plan.

You can accomplish this by first importing the prf file into an internal table.

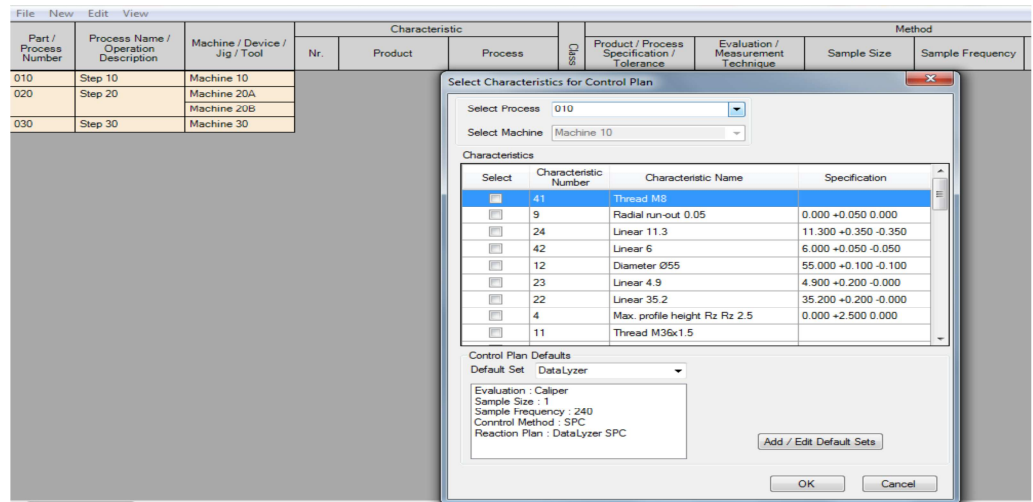


Figure 4: Import table to assign characteristics to process steps

When the prf file is imported into the table, the data is converted so it will fit in the control plan format. The table also offers the option to select a default set for the additional fields. For example, a fixed subgroup size is often used for all characteristics. That information can be added in a default set. Another example is if you want to refer to a standard out of control action plan (OCAP) for this product, then you can add this entry as a default for the reaction plan field.

After the default sets are complete select the characteristics per process step/machine field.

When finished the characteristics are added to the specific process step and the list is updated. You can then select the following step and select the appropriate characteristics for that step



Part / Process Number	Process Name / Operation Description	Machine / Device / Jig / Tool	Characteristic			Method						
			Nr.	Product	Process	Product / Process Specification / Tolerance	Evaluation / Measurement Technique	Sample Size	Sample Frequency	Control Method	Reaction Plan	
010	Step 10	Machine 10	41	Thread M8				Caliper	1	240	SPC	DataLyzor SPC
			9	Radial run-out 0.05		0.000 +0.050 - 0.000	Caliper	1	240	SPC	DataLyzor SPC	
			24	Linear 11.3		11.300 +0.350 - 0.350	Caliper	1	240	SPC	DataLyzor SPC	
			42	Linear 6		6.000 +0.050 - 0.050	Caliper	1	240	SPC	DataLyzor SPC	
			12	Diameter Ø55						SPC	DataLyzor SPC	
020	Step 20	Machine 20A										
		Machine 20B										
030	Step 30	Machine 30										

Select	Characteristic Number	Characteristic Name	Specification
<input checked="" type="checkbox"/>	23	Linear 4.9	4.900 +0.200 -0.000
<input type="checkbox"/>	22	Linear 35.2	35.200 +0.200 -0.000
<input type="checkbox"/>	4	Max. profile height R...	0.000 +2.500 0.000
<input type="checkbox"/>	11	Thread M3x1.5	
<input type="checkbox"/>	21	Linear 22.4	22.400 +0.200 -0.000
<input type="checkbox"/>	40	Radius R0.5	0.500
<input type="checkbox"/>	39	Radius R0.5	0.500
<input type="checkbox"/>	31	Linear 3.9	3.900 +0.200 -0.000
<input type="checkbox"/>	19	Linear 10	10.000 +0.350 -0.350

Default Set	DataLyzor
Evaluation	Caliper
Sample Size	1
Sample Frequency	240
Control Method	SPC
Reaction Plan	DataLyzor SPC

Figure 5: Assigning characteristics to steps/machine

The process continues until all relevant characteristics are added to the process step.

SPC

In the next step the characteristics are entered in the DataLyzor Spectrum SPC module.

Like described above, you can derive an internal table and can then add a default set for the remaining fields. Depending on the SPC configuration, different default options can be used.

The control chart setup screen is then automatically filled with the required information.



930-1200-406-V1 : Linear 11.3

File Part Characteristic Options Preferences

Characteristic Description
Plant: _____ Department: _____ Operation: _____

Characteristic: Linear 11.3 Special Field Title: _____
Special Field Contents: _____

Comment: _____

Operator Information
Control Plan Reference: 930-1200406-V1
Measuring Instructions: _____
 Critical Characteristic
Attachments

Frequency: 240 Hide characteristic on network status screens Last characteristic

Specifications
Upper Spec: 11.650
Lower Spec: 10.950
Target: 11.300
Units: _____
Subgroup Size: 1

Natural Limits:
 Upper Spec: _____
 Lower Spec: _____

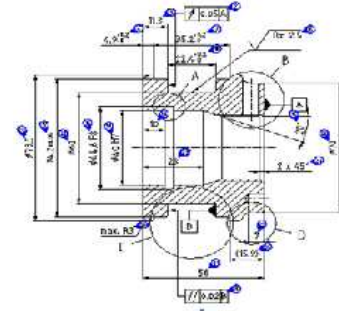
Reasonable Limits
Upper Limit: _____
Lower Limit: _____

Figure 6: SPC Chart setup from the Control Plan screen

The SPC system can be used for regular SPC checks and also for First Article Inspection or importing from the CMM.

Conclusion

Using the integrated Ballooning – Control Plan – SPC solution in combination with import capabilities from the CMM machine saves a lot of time in the setup of all requirements and offers an advanced solution to control your process.



Part / Process Number	Process Name / Operation Description	Machine / Device / Jig / Tool	Nr.	Prod.
010	Step 10	Machine 10		
020	Step 20	Machine 20A		
		Machine 20B		
030	Step 30	Machine 30		

Item	Value	Unit	Target	Deviation	Spec
1	10.000	mm	10.000	0.000	±0.005
2	10.000	mm	10.000	0.000	±0.005
3	10.000	mm	10.000	0.000	±0.005
4	10.000	mm	10.000	0.000	±0.005
5	10.000	mm	10.000	0.000	±0.005
6	10.000	mm	10.000	0.000	±0.005
7	10.000	mm	10.000	0.000	±0.005
8	10.000	mm	10.000	0.000	±0.005
9	10.000	mm	10.000	0.000	±0.005
10	10.000	mm	10.000	0.000	±0.005
11	10.000	mm	10.000	0.000	±0.005
12	10.000	mm	10.000	0.000	±0.005
13	10.000	mm	10.000	0.000	±0.005
14	10.000	mm	10.000	0.000	±0.005
15	10.000	mm	10.000	0.000	±0.005
16	10.000	mm	10.000	0.000	±0.005
17	10.000	mm	10.000	0.000	±0.005
18	10.000	mm	10.000	0.000	±0.005
19	10.000	mm	10.000	0.000	±0.005
20	10.000	mm	10.000	0.000	±0.005
21	10.000	mm	10.000	0.000	±0.005
22	10.000	mm	10.000	0.000	±0.005
23	10.000	mm	10.000	0.000	±0.005
24	10.000	mm	10.000	0.000	±0.005
25	10.000	mm	10.000	0.000	±0.005
26	10.000	mm	10.000	0.000	±0.005
27	10.000	mm	10.000	0.000	±0.005
28	10.000	mm	10.000	0.000	±0.005
29	10.000	mm	10.000	0.000	±0.005
30	10.000	mm	10.000	0.000	±0.005

Select	Characteristics	Characteristics	Characteristics
	Name	Value	Unit
<input type="checkbox"/>	Process 101		
<input type="checkbox"/>	Process 102		
<input type="checkbox"/>	Process 103		
<input type="checkbox"/>	Process 104		
<input type="checkbox"/>	Process 105		
<input type="checkbox"/>	Process 106		
<input type="checkbox"/>	Process 107		
<input type="checkbox"/>	Process 108		
<input type="checkbox"/>	Process 109		
<input type="checkbox"/>	Process 110		
<input type="checkbox"/>	Process 111		
<input type="checkbox"/>	Process 112		
<input type="checkbox"/>	Process 113		
<input type="checkbox"/>	Process 114		
<input type="checkbox"/>	Process 115		
<input type="checkbox"/>	Process 116		
<input type="checkbox"/>	Process 117		
<input type="checkbox"/>	Process 118		
<input type="checkbox"/>	Process 119		
<input type="checkbox"/>	Process 120		



File	View	Step	Machine	Process	Product	Material	Operator	Inspector	Tester	Tester	Tester
010	Step 10	Machine 10	Process 101	Product 101	Material 101	Operator 101	Inspector 101	Tester 101	Tester 101	Tester 101	Tester 101
020	Step 20	Machine 20A	Process 20A	Product 20A	Material 20A	Operator 20A	Inspector 20A	Tester 20A	Tester 20A	Tester 20A	Tester 20A
030	Step 30	Machine 30	Process 30	Product 30	Material 30	Operator 30	Inspector 30	Tester 30	Tester 30	Tester 30	Tester 30

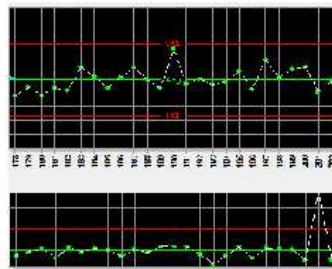


Figure 7: Integrated solution Ballooning – Control Plan – CMM - SPC