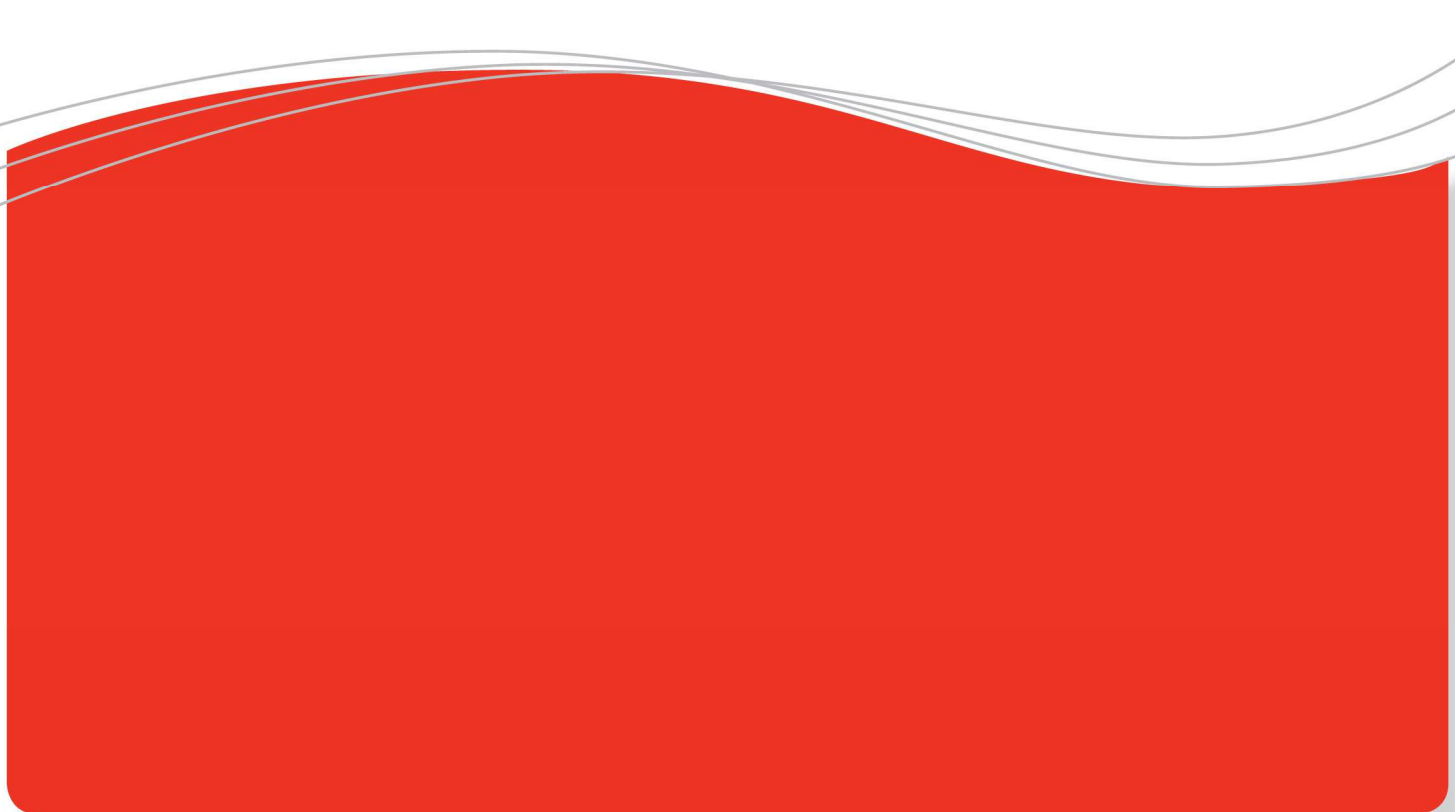




## **Integrated APQP: Drawing - Ballooning – CMM - Control Plan - SPC**

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.

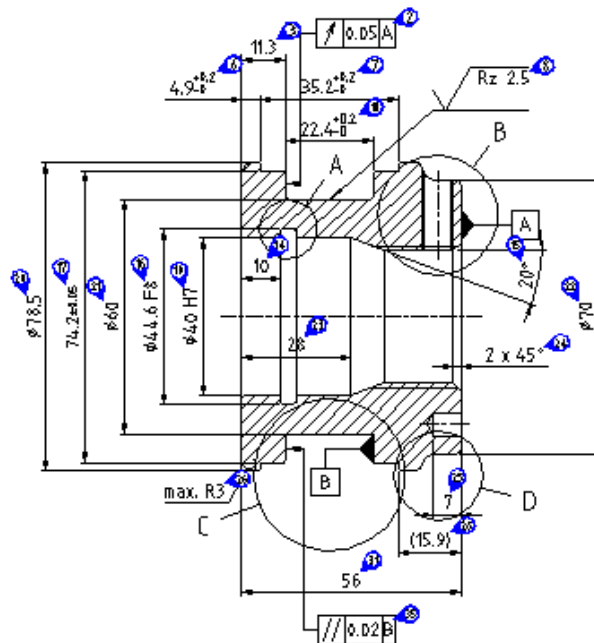


Figure 1: Example dwg drawing with balloons



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

Nr	Order	Code	Characteristic	Value	Min	Max	Unit	Class	Standard	GT
1	0	38	Thread M8	M8				1		
9	1	16	Radial run-out	0,05	0,000	+0,050	0,000	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				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	+0,025	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
15	1	2	Diameter ø60	ø60	60,000	+0,600	-0,600		21	DIN-1687-4-Table-2
25	1	2	Diameter ø70	ø70	70,000	+0,600	-0,600		22	DIN-1687-4-Table-2
18	1	0	Linear 28	28	28,000	+0,400	-0,400		23	DIN-1687-4-Table-2
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
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
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
36	1	0	Linear 7	7	7,000	+0,350	-0,350		36	DIN-1687-4-Table-2
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 Calypso 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.

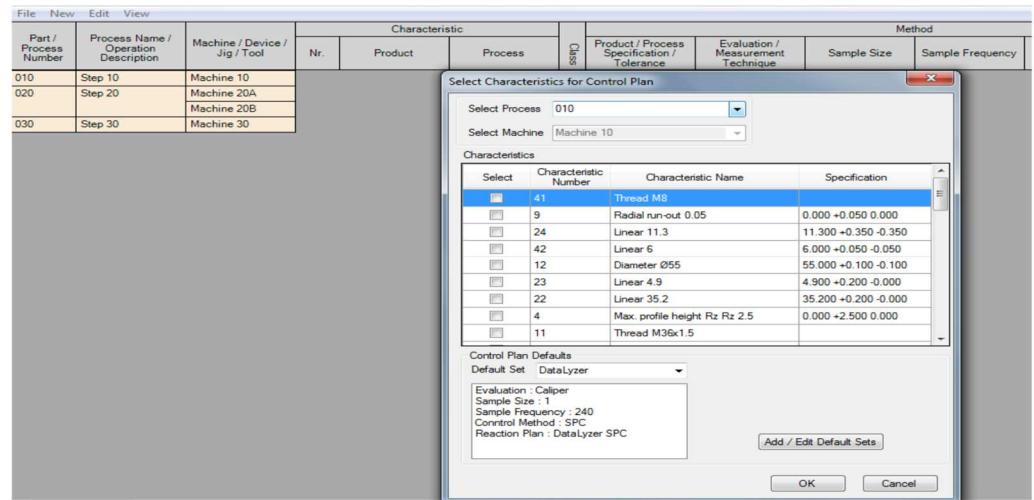


Figure 4: Import table to assign characteristics to process steps

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	Class	Product / Process Specification / Tolerance	Evaluation / Measurement Technique	Sample Size	Sample Frequency	Control Method	Reaction Plan
010	Step 10	Machine 10	41	Thread M8								
			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
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.

### Control Plan - 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.

### CMM – SPC

Part of the data might be measured using a CMM. In that case it will be helpful that data is automatically imported from the CMM. DataLyzer offers a solution that the setup of characteristics will be done automatically when importing CMM data. A special import service monitors the CMM data and imports it into the control charts. When a control chart is not existing it will automatically create the chart based on the data in the CMM file.

Below you see an example how Zeiss Calypso is integrated with DataLyzer SPC and data is imported automatically for 8 CMM machines in production



Datalyzer Import Services (Version 0.4.101C)

Main | Channels In Sequence |

SelectChannel	ChannelName	ChannelFileName	Adaptor	Import Tj	NextFire	Status	Sch.Type
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS01....	Calypso	SPC	2017-...	ACTIVE	Cron
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS02....	Calypso	SPC	2017-...	ACTIVE	Cron
<input checked="" type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS03....	Calypso	SPC	2017-...	RUN	Cron
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS04....	Calypso	SPC	NA	INAC...	Cron
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS07....	Calypso	SPC	2017-...	ACTIVE	Cron
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS08....	Calypso	SPC	NA	INAC...	Cron
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS09....	Calypso	SPC	2017-...	RUN	Cron
<input type="checkbox"/>	Calypso_0.3_...	C:\DatalyzerImportServices\Calypso_0.3_PCZEISS10....	Calypso	SPC	2017-...	ACTIVE	Cron

Start  
Stop  
ForceStop  
Show Log

Program Settings   Minimize to System Tray   Help   Exit

Status  
The ChannelCalypso\_0.3\_PCZEISS02 has imported successfully  
The ChannelCalypso\_0.3\_PCZEISS01 has imported successfully  
The ChannelCalypso\_0.3\_PCZEISS10 has imported successfully  
The ChannelCalypso\_0.3\_PCZEISS07 has imported successfully

### Datalyzer SPC import service for Zeiss Calypso 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.

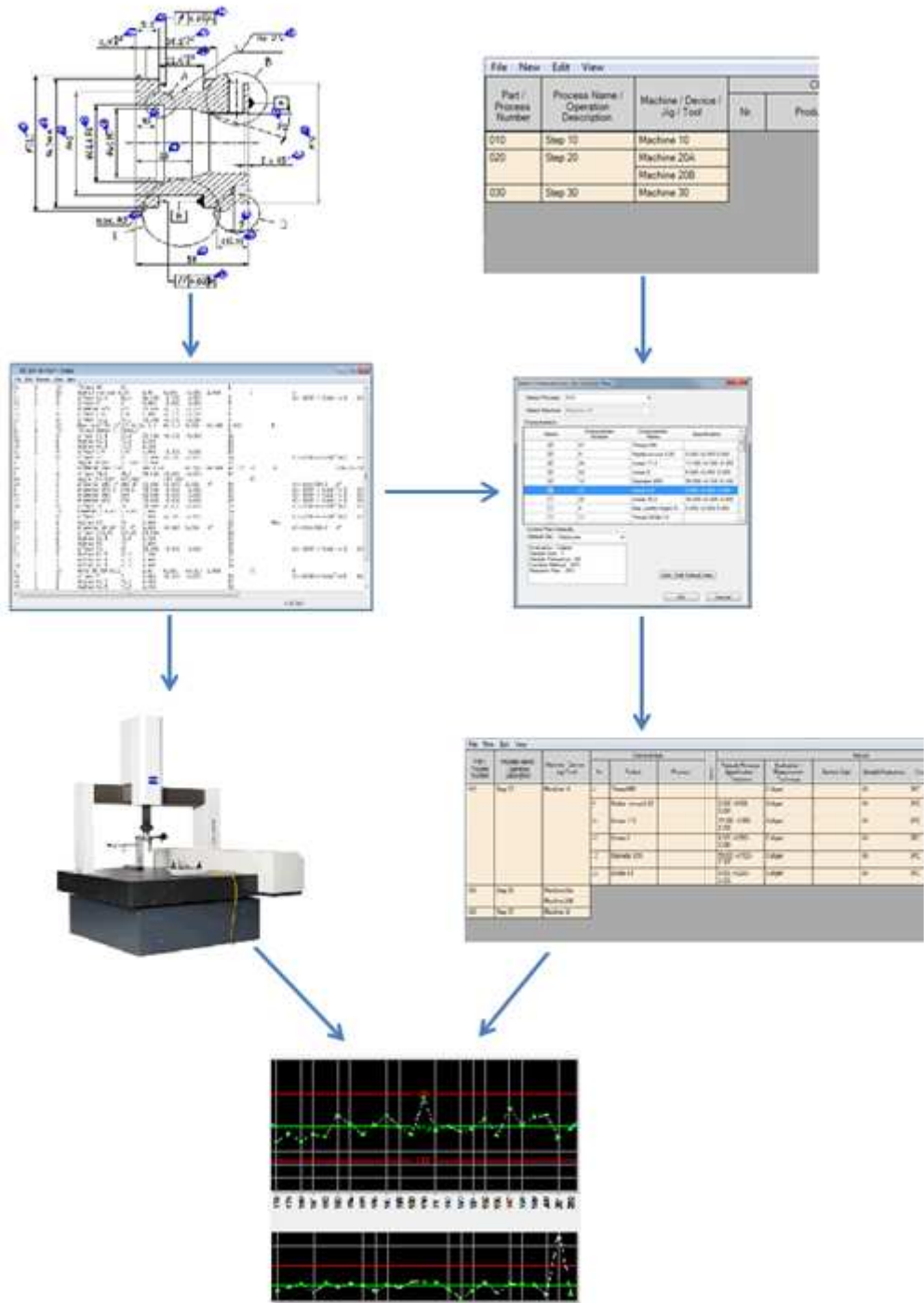


Figure 7: Integrated solution Ballooning – Control Plan – CMM - SPC