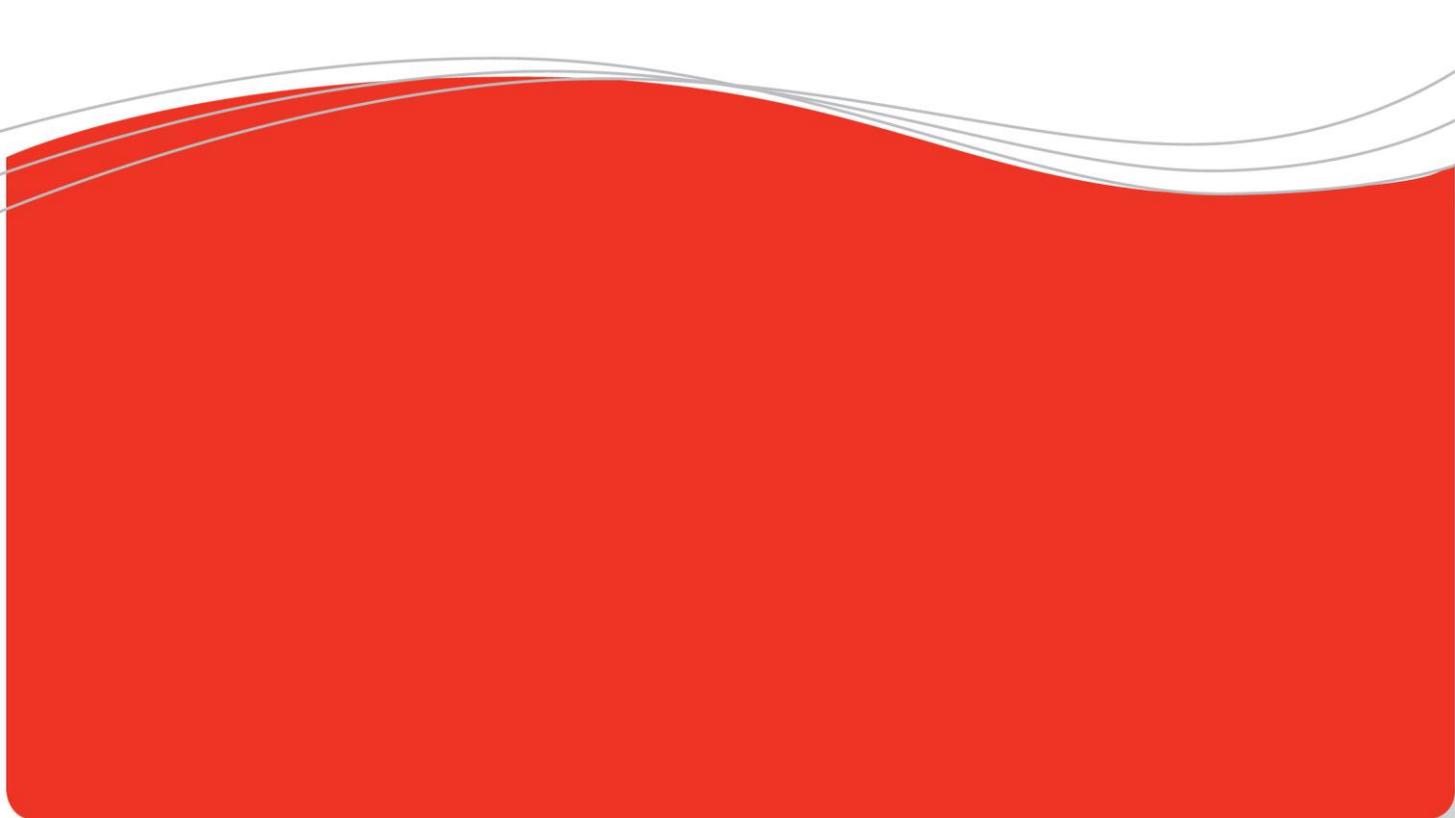




Integrated APQP: Drawing - Ballooning – CMM - Control Plan - SPC

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 for example the Infra Convert software.

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

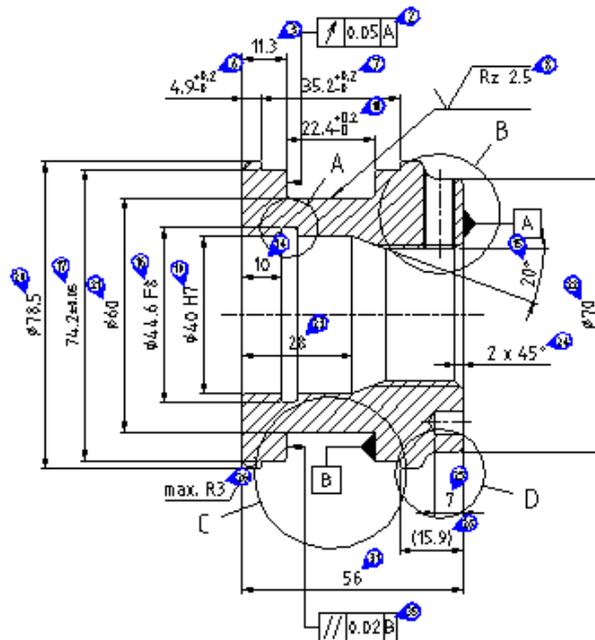


Figure 1: Example dwg drawing with balloons



The example above is from Infra Convert software but there are many ballooning software modules available like SolidWorks, Discuss, InspectionXpert etc.

In addition to the balloons the full list of characteristics can be exported to a file In the example below it is a text file but we can also process JSON files or Excel files.

File	Edit	Format	View	Help
81	0	38	Thread M8	M8
9	1	16	Radial run-out	0.05
24	1	0	Linear	11.3 11.3 11.300 +0.350 -0.350 0.000 1 2 A
42	1	0	Linear	6 6 6.000 +0.050 -0.050 0.000 3 2 DIN-1687-4-Table-2 GT.
12	1	2	Diameter	ø55 55.000 +0.100 -0.100 0.000 4 5
23	1	0	Linear	4.9 4.9 4.900 +0.200 -0.000 0.000 6 6
22	1	0	Linear	35.2 35.2 35.200 +0.200 -0.000 0.000 7 7
4	1	23	Max. profile height	Rz Rz 2.5 Rz 2.5 0.000 +2.500 0.000 8 8
11	0	38	Thread M36x1.5	M36x1.5
21	1	0	Linear	22.4 22.4 22.400 +0.200 -0.000 0.000 10 10
40	1	1	Radius	R0.5 0.500 0.000 11 11
39	1	1	Radius	R0.5 0.500 0.000 12 12
31	1	0	Linear	3.9 3.9 3.900 +0.200 -0.000 0.000 13 13
19	1	0	Linear	10 10 10.000 +0.350 -0.350 0.000 14 14
6	1	3	Angle	20.000° 20.000° 20.000 0.000 15 15
14	1	2	Diameter	ø44.6 F8 44.600 +0.064 +0.025 F8 16 16 DIN-ISO-286-2
7	1	0	Linear	74.2 74.2 74.200 +0.050 -0.050 0.000 17 17
3	1	3	Angle	135.000° 135.000° 135.000 0.000 H7 18 18
20	1	2	Diameter	ø40 H7 40.000 +0.005 0.000 H7 19 19
8	1	2	Diameter	ø78.5 78.500 +0.600 -0.600 0.000 H7 20 20
15	1	2	Diameter	ø60 60.000 +0.600 -0.600 0.000 H7 21 21
25	1	2	Diameter	ø70 70.000 +0.600 -0.600 0.000 H7 22 22
18	1	0	Linear	28 28 28.000 +0.400 -0.400 0.000 23 23
5	1	33	Chamfer	2 x 45° 2 x 45° 2.000 0.000 24 24
2	1	0	Linear	7 7 7.000 +0.350 -0.350 0.000 25 25
16	1	1	Radius	R3 3.000 +0.350 -0.350 0.000 26 26
13	1	2	Diameter	ø6 H7 6.000 +0.012 0.000 H7 27 27 MAX. DIN-ISO-286-2 H7
3	1	0	Linear	(15.9) (15.9) 15.900 +0.005 0.000 H7 28 28
35	1	1	Radius	R1.5 1.500 0.000 29 29
34	1	1	Radius	R3 3.000 0.000 30 30
1	1	0	Linear	56 56 56.000 +0.600 -0.600 0.000 31 31
33	1	1	Radius	R1.5 1.500 0.000 32 32
27	1	1	Radius	R0.8 0.800 0.000 33 33
28	1	1	Radius	R0.8 0.800 0.000 34 34
17	1	13	Parallelism	0.02 0.02 0.000 +0.020 -0.000 0.000 35 35
36	1	0	Linear	7 7 7.000 +0.350 -0.350 0.000 36 36
30	1	1	Radius	R0.5 0.500 0.000 37 37
29	1	1	Radius	R0.5 0.500 0.000 38 38

Figure 2: Example text 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.



Prototype Control Plan - Example CP

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

DataLyzer FMEA offers a very flexible import module where you can define templates for import from almost any ballooning software capable of exporting the information to Excel.

When importing characteristics from any 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 file into the control plan.

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

The screenshot shows the 'Select Characteristics for Control Plan' dialog box. It includes dropdowns for 'Select Process' (010) and 'Select Machine' (Machine 10). A table lists characteristics with checkboxes, numbers, names, and specifications. Below the table are 'Control Plan Defaults' for 'DataLyzer' with fields for Evaluation, Sample Size, Sample Frequency, Control Method, and Reaction Plan.

Select	Characteristic Number	Characteristic Name	Specification
<input checked="" type="checkbox"/>	41	Thread M8	
<input type="checkbox"/>	9	Radial run-out 0.05	0.000 +0.050 0.000
<input type="checkbox"/>	24	Linear 11.3	11.300 +0.350 -0.350
<input type="checkbox"/>	42	Linear 6	6.000 +0.050 -0.050
<input type="checkbox"/>	12	Diameter Ø55	55.000 +0.100 -0.100
<input 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 Rz Rz 2.5	0.000 +2.500 0.000
<input type="checkbox"/>	11	Thread M36x1.5	

Control Plan Defaults
 Default Set: DataLyzer
 Evaluation: Caliper
 Sample Size: 11
 Sample Frequency: 240
 Control Method: SPC
 Reaction Plan: DataLyzer SPC

Figure 4: Import table to assign characteristics to process steps

When the 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	Unit	Product / Process Specification / Tolerance	Evaluation / Measurement Technique	Sample Size	Sample Frequency	Control Method	Reaction Plan
010	Step 10	Machine 10	41	Thread M8					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					1	240	SPC	DataLyzor SPC
020	Step 20	Machine 20A										
		Machine 20B										
030	Step 30	Machine 30										

Select Characteristics for Control Plan

Select Process: 020

Select Machine: Machine 20A

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 M3&x1.5	
<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

Control Plan Defaults

Default Set: DataLyzor

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

Add / Edit Default Sets

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 Typ
<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 sucessfully
The ChannelCalypso_0.3_PCZEISS01 has imported sucessfully
The ChannelCalypso_0.3_PCZEISS10 has imported sucessfully
The ChannelCalypso_0.3_PCZEISS07 has imported sucessfully
```

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.

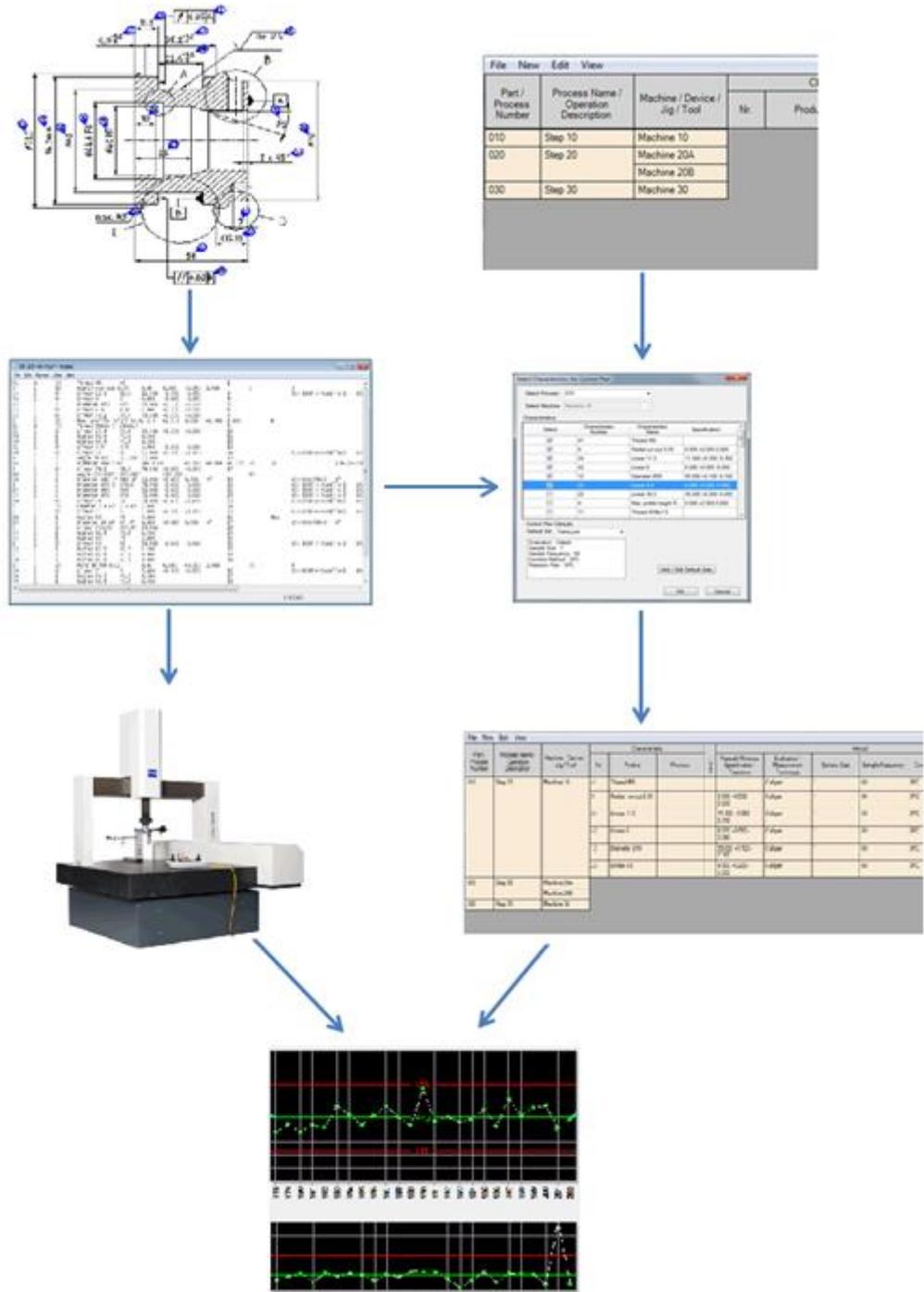


Figure 7: Integrated solution Ballooning – Control Plan – CMM – SPC



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