



Casting Engine Transmission Center

Global Machinery and Equipment Application Notes Document

Machine Run Off and Acceptance Application Notes (MARO)

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***Global GM Manufacturing Engineering
Casting, Engine, & Transmission Center.***

**Document Management Information**

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Revision History			
Published	Version	Section Number	Change Description & Impact
04-MAR-09	G1.0		INITIAL RELEASE
8-JAN-2010	G2.0	ALL	APPROVED FOR GLOBAL RELEASE. CONTENT EDITED TO REFLECT GM REORGANIZED BUSINESS STRUCTURE. NO CHANGES TO SUPPLIER REQUIREMENTS FROM VERSION G1.0.
6-MAY-2013	G3.0	ALL	ADDED NEW CETC LOGO; Configuration of Evaluation for version 3.x in qs-stat V10 and Higher for measurement system; Updated Reports;

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Table of Regional Specific Requirements**TABLE OF REGIONAL SPECIFIC REQUIREMENTS**

All requirements within this specification are common for all GM CETC global plant sites



1.0 INTRODUCTION

1.1 SCOPE OF DOCUMENT

These Application Notes define the configuration of evaluation for the Q-DAS software and the standard reports that are available for the various requirements of **SP-Q MARO** specification.

1.2 LEGAL REQUIREMENTS AND REGULATIONS

The Supplier shall be fully responsible to design, build, and deliver all equipment included within the purchase order agreement in full compliance with governmental laws and regulations applicable to the final destination location for the equipment.

Buyer requirements shall not supersede applicable governmental laws and regulations of the final destination location for the equipment unless a specific exemption has been obtained from the authority having jurisdiction.

1.2.1 ORDER OF PRECEDENCE

Where Buyer requirements, and/or governmental laws and regulations, conflict with one another the manufacturing system design shall adhere to the strictest of these requirements.

1.3 INDUSTRY AND INTERNATIONAL STANDARDS

All machinery and equipment delivered to Buyer, and its' partners adopting these Specifications, by the Supplier shall be designed and built to comply with current industry internationally accepted Standards. GM CETC Specifications may reference various internationally recognized Standards to provide the Supplier with the specific GM interpretation of the Standards requirements that the Supplier shall adhere to and implement in the design of their equipment.

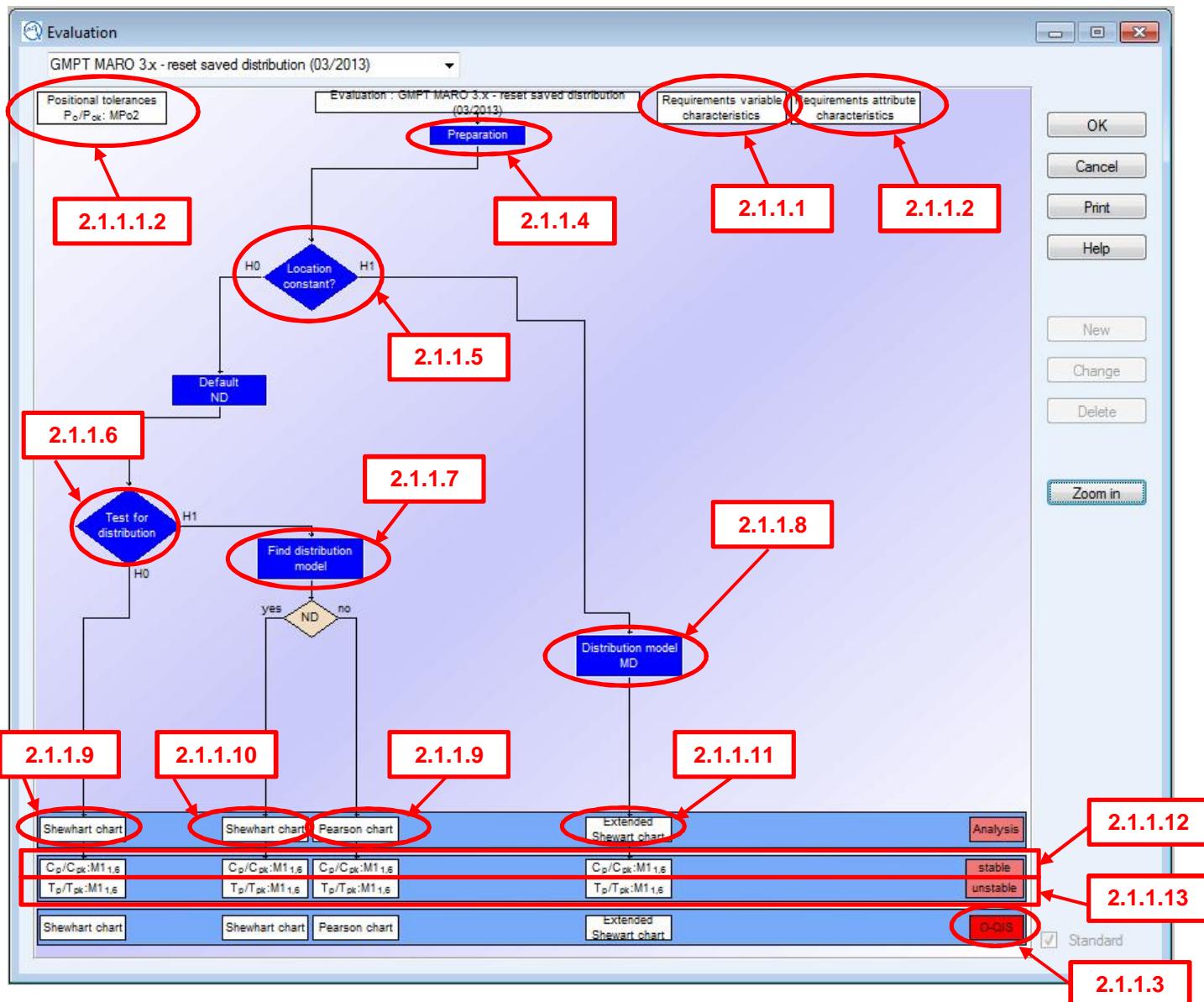
1.4 RESOLUTION OF CONFLICT

Contact the responsible Buyer Manufacturing Engineer in the event of a conflict between the requirements of this document, the references cited herein, or GM CETC Standards and Specifications. The Supplier shall inform the Buyer Manufacturing Engineer responsible for the project of all requirements conflicts. The Buyer Manufacturing Engineer shall direct the Supplier on appropriate action to take in order to resolve the conflict in accordance with Buyer change management procedures.

2.0 CONFIGURATION OF EVALUATIONS FOR Q-DAS V10 AND HIGHER

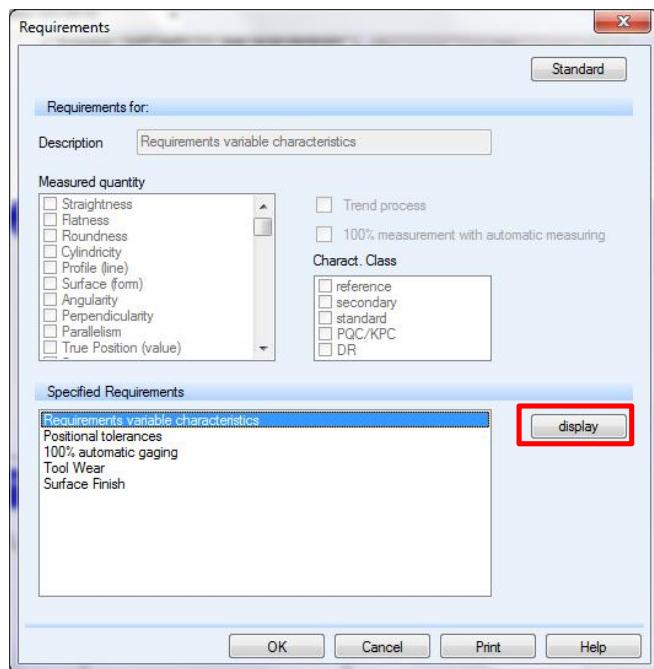
2.1 THE FOLLOWING IS THE CONFIGURATION OF EVALUATION FOR VERSION 3.X IN QS-STAT VERSION V10 AND HIGHER FOR PROCESS CAPABILITY

2.1.1 Capability Studies – Generic method



2.1.1.1 Requirements Variable Characteristics

2.1.1.1.1 Requirements Variable Characteristics



2.1.1.1.1.1 Requirements Variable Characteristics – Requirements

2.1.1.1.1.2 Requirements Variable Characteristics – Target values / QCC stable

Requirements

Target values / QCC stable Target values / QCC unstable AIAG Pp/Cp Requirements Total part evaluation Additional conditions stable Additional conditions unstable

Index valid?

Normally distributed characteristics:		Min. values	250	Min. subgroups		50		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX		0.01	0.01	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX		0.01	0.01	1.32	1.32	1.32	C	pk
Intrinsic capability index		1.66	1.66	1.66	1.66	1.66	C	pi

Not normally distributed characteristics:		Min. values	250	Min. subgroups		50		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX		0.01	0.01	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX		0.01	0.01	1.32	1.32	1.32	C	pk
Intrinsic capability index		1.66	1.66	1.66	1.66	1.66	C	pi

Preliminary capability indices

Index valid?

Normally distributed characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX		0	0	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX		0	0	1.33	1.67	1.33	P	pk
Intrinsic capability index		0	0	1.67	1.67	1.67	P	pi

Not normally distributed characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX		0	0	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX		0	0	1.33	1.67	1.33	P	pk
Intrinsic capability index		0	0	1.67	1.67	1.67	P	pi

Procedure with few values

Automatic adaptation of target values Limit 50 not depending on Cp and Cpk Raise Cp to Cpk Reduce Cpk to Cp

Warning limit for insufficient values Limit 15

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.1.1.1.1.3 Requirements Variable Characteristics – Target values / QCC unstable

Requirements

Target values / QCC stable Target values / QCC unstable AIAG Pp/Cp Requirements Total part evaluation Additional conditions stable Additional conditions unstable

Performance indices

Index valid?

Normally distributed characteristics:		Min. values	250	Min. subgroups		50		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX		0.01	0.01	1.66	1.99	1.99	T	p
CRITICAL PERFORMANCE INDEX		0.01	0.01	1.32	1.66	1.66	T	pk
Intrinsic performance index		1.66	1.66	1.66	1.66	1.66	C	pi

Not normally distributed characteristics:		Min. values	250	Min. subgroups		50		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX		0.01	0.01	1.32	1.66	1.66	T	p
CRITICAL PERFORMANCE INDEX		0.01	0.01	1.32	1.66	1.66	T	pk
Intrinsic performance index		1.66	1.66	1.66	1.66	1.66	C	pi

Preliminary Performance indices

Index valid?

Normally distributed characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX		0	0	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX		0	0	1.33	1.67	1.33	T	pk
Intrinsic performance index		0	0	1.67	1.67	1.67	P	pi

Not normally distributed characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX		0	0	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX		0	0	1.33	1.67	1.33	T	pk
Intrinsic performance index		0	0	1.67	1.67	1.67	P	pi

Procedure with few values

Automatic adaptation of target values Limit: 50 not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit: 15

Confidence interval for capability indices: 95 % Confidence interval for target value adaptation: 99 %

2.1.1.1.4 Requirements Variable Characteristics – AIAG Pp/Cp (not used)

Requirements

Target values / QCC stable | Target values / QCC unstable | AIAG Pp/Cp | Requirements | Total part evaluation | Additional conditions stable | Additional cor

AIAG_Cp_Pp

output AIAG_Cp_Pp

all characteristics:		Min. values	50	Min. subgroups		10		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG		2	2	2	2	2		
smallest process capability index AIAG		2	2	2	2	2		
AIAG Pp/Cp		0.8	0.8	0.8	0.8	0.8		

prel. AIAG_Cp_Pp

output prel. AIAG_Cp_Pp

all characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG		2	2	2	2	2		
smallest process capability index AIAG		2	2	2	2	2		
AIAG Pp/Cp		0.8	0.8	0.8	0.8	0.8		

OK **Cancel** **Print** **Help**

2.1.1.1.5 Requirements Variable Characteristics – Total part evaluation (not used)

Requirements

Target values / QCC stable | Target values / QCC unstable | AIAG Pp/Cp | Requirements | Total part evaluation | Additional conditions stable | Additional cor

Settings for part evaluation

Execute part type grading based on characteristics results

Execute part grading for individuals

Part weights

Grade code

Grade code			
	capable	conditionally capable	not capable
Grade	1	0	0

Characteristic class weights

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Weighting	0	0	0	0	0

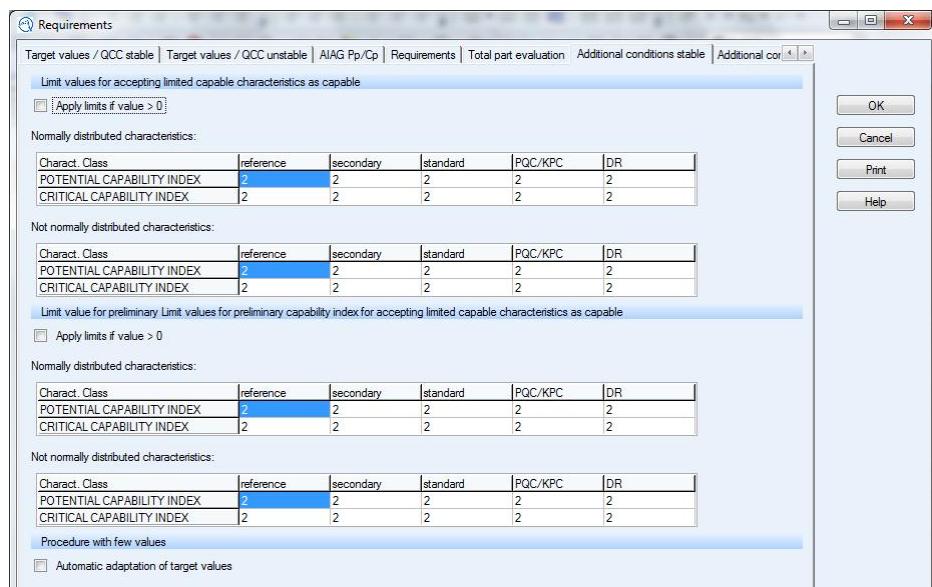
Grade limits for total evaluation

Observe capable limits capable from total grade: 0

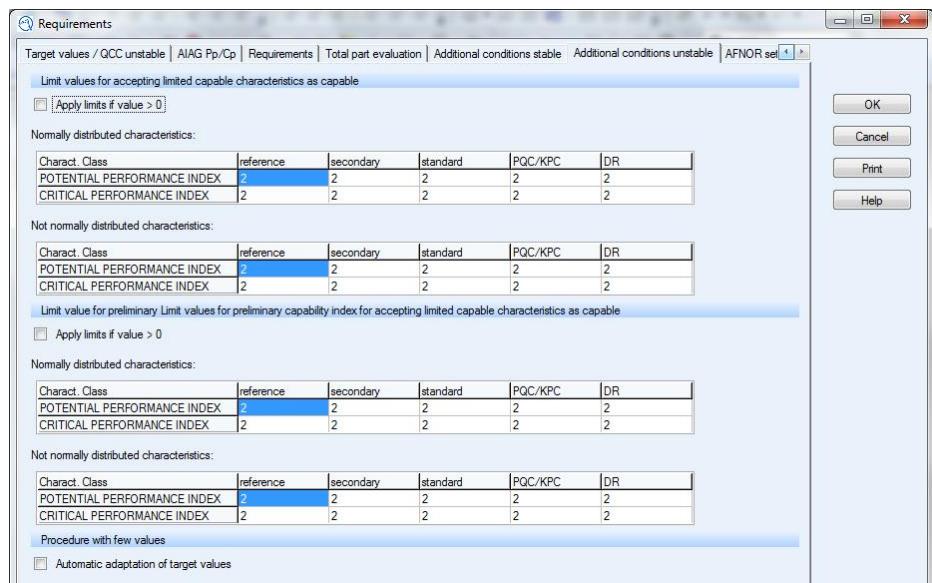
Observe limited capable limits limited capable from total grade: 0

OK **Cancel** **Print** **Help**

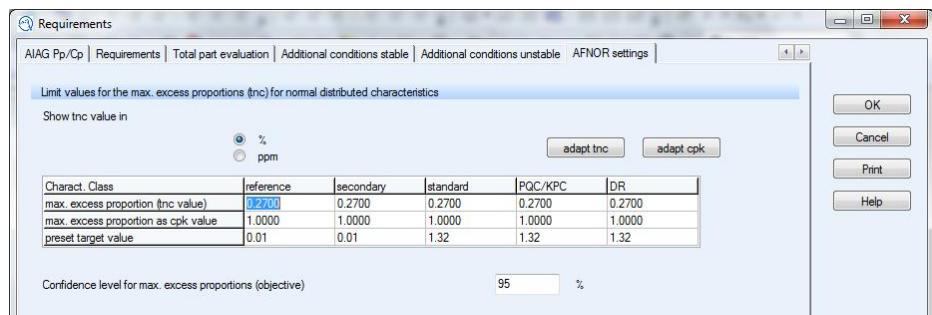
2.1.1.1.6 Requirements Variable Characteristics – Additional conditions stable (not used)



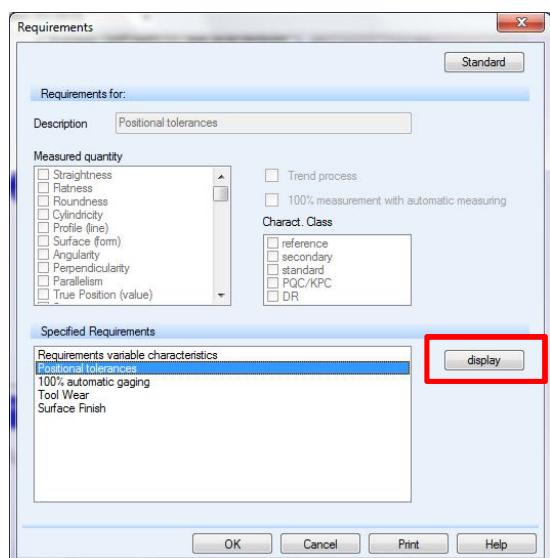
2.1.1.1.7 Requirements Variable Characteristics – Additional conditions unstable (not used)



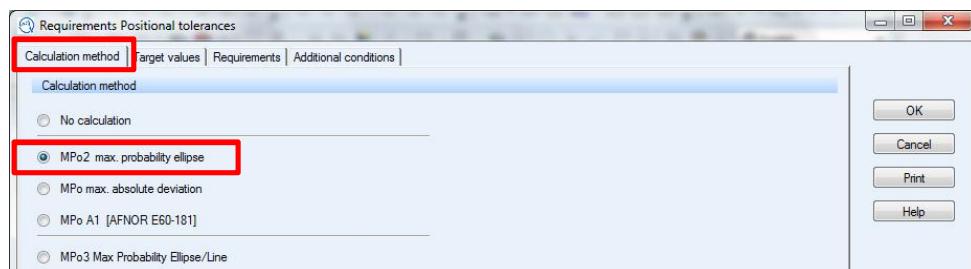
2.1.1.1.8 Requirements Variable Characteristics – AFNOR settings (not used)



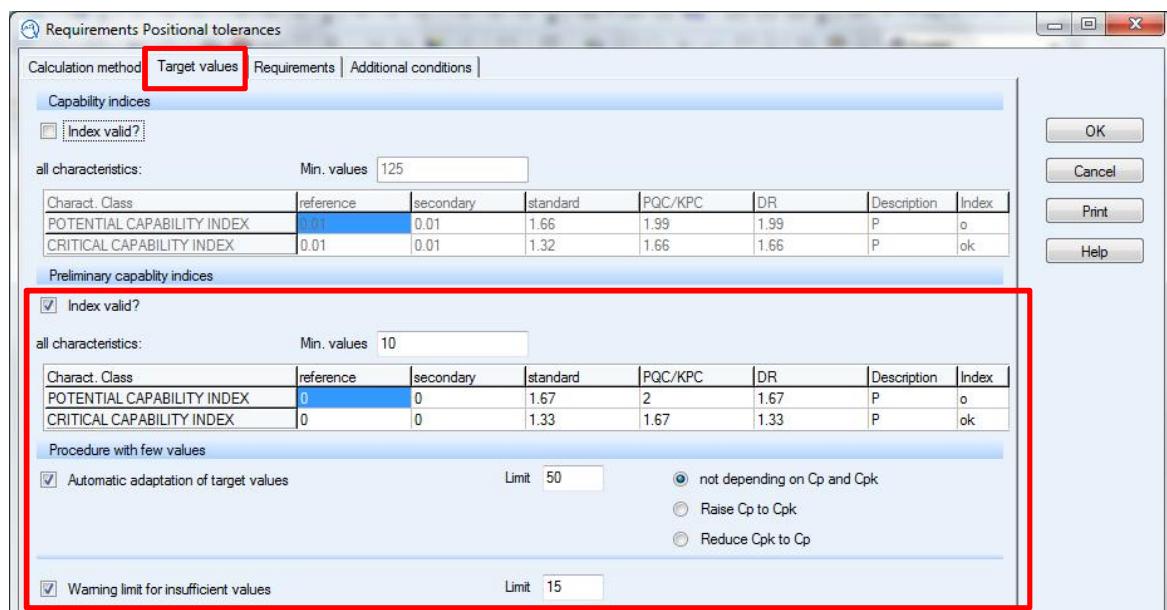
2.1.1.1.2 Requirements Positional Tolerances



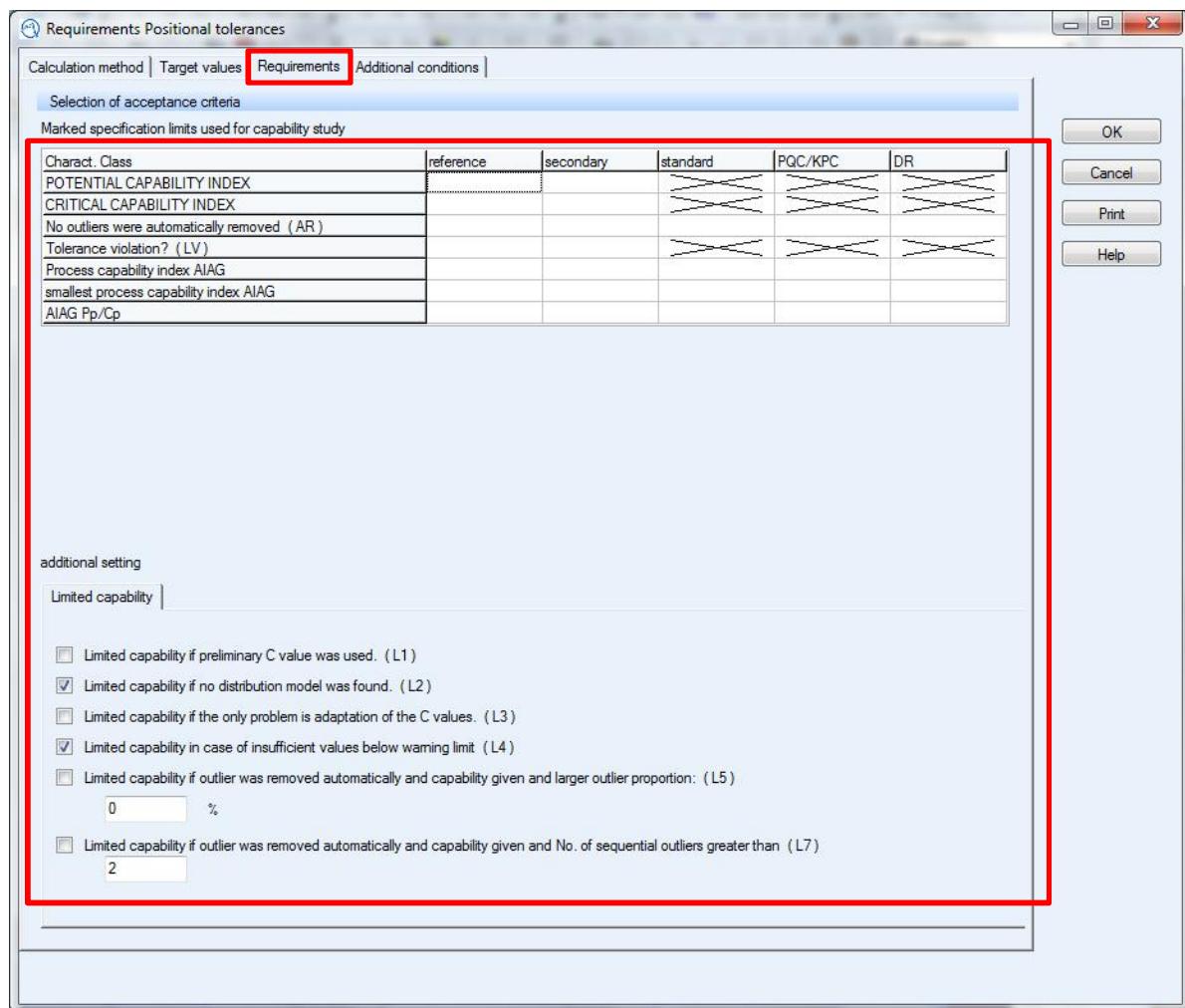
2.1.1.1.2.1 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Calculation Method



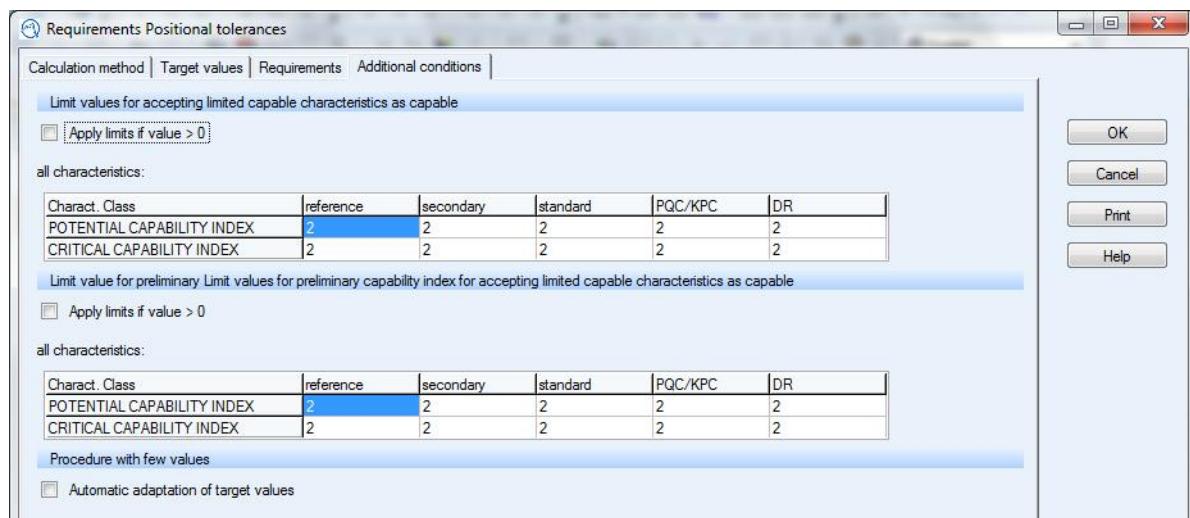
2.1.1.1.2.2 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Target Values



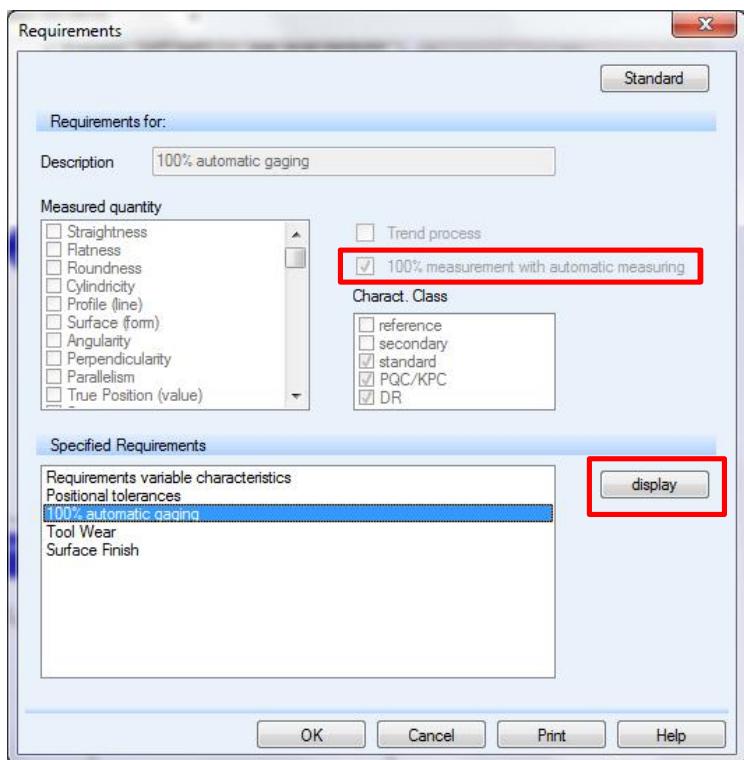
2.1.1.1.2.3 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Requirements



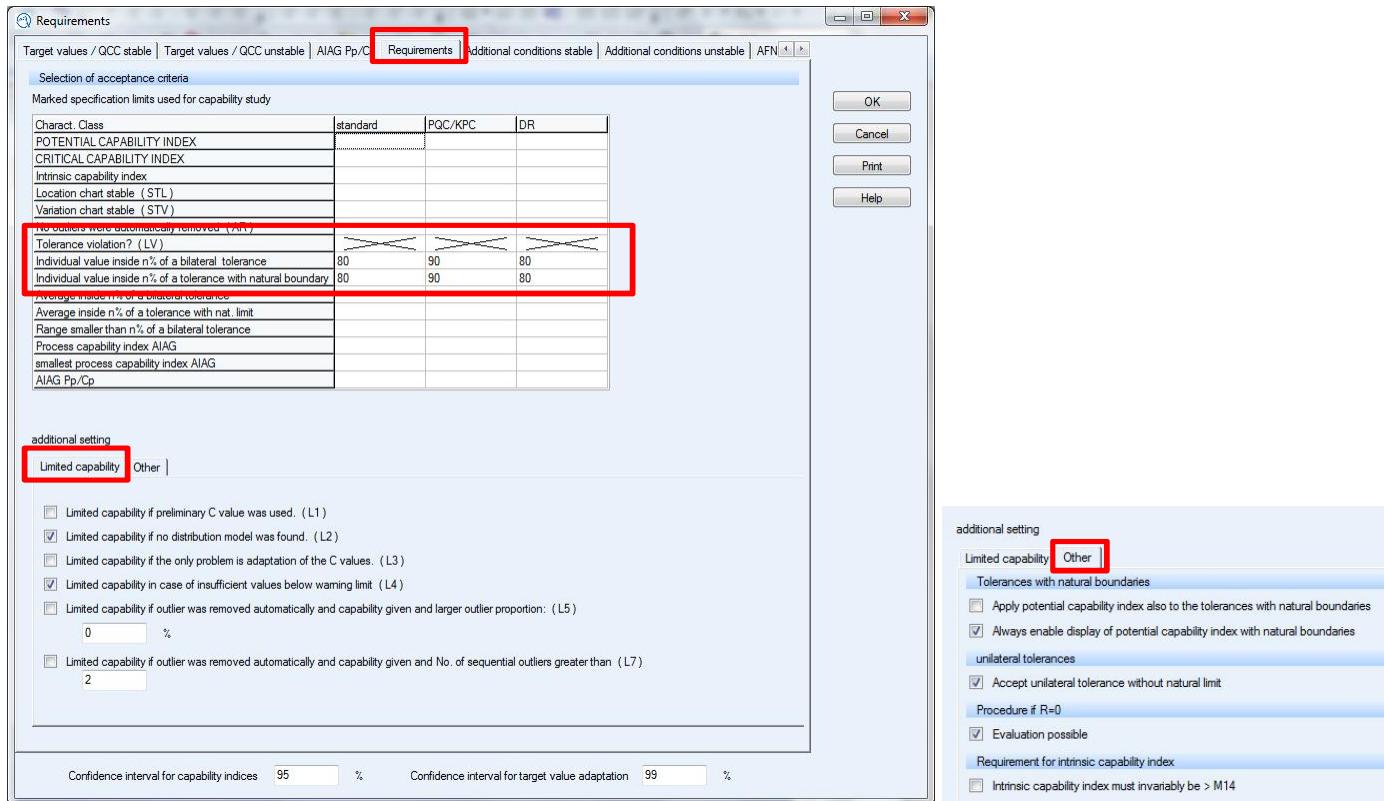
2.1.1.1.2.4 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Additional conditions (not used)



2.1.1.1.3 Requirements 100% automatic gaging



2.1.1.1.3.1 Requirements 100% automatic gaging – Requirements



2.1.1.1.3.2 Requirements 100% automatic gaging – Target Values / QCC stable (not used)

Requirements

Target values / QCC stable **Target values / QCC unstable** **AIAG Pp/Cp** **Requirements** **Additional conditions stable** **Additional conditions unstable** **AFN** **OK** **Cancel** **Print** **Help**

Capability indices

Index valid?

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	C	pi

Normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	C	pi

Not normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	C	pi

Preliminary capability indices

Index valid?

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX	1.33	1.67	1.33	P	pk
Intrinsic capability index	1.67	1.67	1.67	P	pi

Normally distributed characteristics: Min. values 10 Min. subgroups 3

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX	1.33	1.67	1.33	P	pk
Intrinsic capability index	1.67	1.67	1.67	P	pi

Not normally distributed characteristics: Min. values 10 Min. subgroups 3

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX	1.33	1.67	1.33	P	pk
Intrinsic capability index	1.67	1.67	1.67	P	pi

Procedure with few values

Automatic adaptation of target values Limit 50 not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit 15

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.1.1.1.3.3 Requirements 100% automatic gaging – Target Values / QCC unstable (not used)

Requirements

Target values / QCC stable Target values / QCC unstable AIAG Pp/Cp | Requirements | Additional conditions stable | Additional conditions unstable | AFN

Index valid?

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.66	1.99	1.99	T	p
CRITICAL PERFORMANCE INDEX	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	C	pi

Normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.32	1.66	1.66	T	p
CRITICAL PERFORMANCE INDEX	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	C	pi

Not normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.32	1.66	1.66	T	p
CRITICAL PERFORMANCE INDEX	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	C	pi

Preliminary Performance indices

Index valid?

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX	1.33	1.67	1.33	T	pk
Intrinsic performance index	1.67	1.67	1.67	P	pi

Normally distributed characteristics: Min. values 10 Min. subgroups 3

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX	1.33	1.67	1.33	T	pk
Intrinsic performance index	1.67	1.67	1.67	P	pi

Not normally distributed characteristics: Min. values 10 Min. subgroups 3

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX	1.33	1.67	1.33	T	pk
Intrinsic performance index	1.67	1.67	1.67	P	pi

Procedure with few values

Automatic adaptation of target values Limit 50 not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit 15

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.1.1.1.3.4 Requirements 100% automatic gaging – AIAG Pp/Cp (not used)

Requirements

Target values / QCC stable | Target values / QCC unstable | AIAG Pp/Cp | Requirements | Total part evaluation | Additional conditions stable | Additional cor

AIAG_Cp_Pp

output AIAG_Cp_Pp

all characteristics:		Min. values	50	Min. subgroups		10		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG		2	2	2	2	2		
smallest process capability index AIAG		2	2	2	2	2		
AIAG Pp/Cp		0.8	0.8	0.8	0.8	0.8		

prel. AIAG_Cp_Pp

output prel. AIAG_Cp_Pp

all characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG		2	2	2	2	2		
smallest process capability index AIAG		2	2	2	2	2		
AIAG Pp/Cp		0.8	0.8	0.8	0.8	0.8		

2.1.1.1.3.5 Requirements 100% automatic gaging – Total part evaluation (not used)

Requirements

Target values / QCC stable | Target values / QCC unstable | AIAG Pp/Cp | Requirements | Total part evaluation | Additional conditions stable | Additional cor

Settings for part evaluation

Execute part type grading based on characteristics results

Execute part grading for individuals

Grade code

Grade	capable	conditionally capable	not capable
Grade	1	0	0

Characteristic class weights

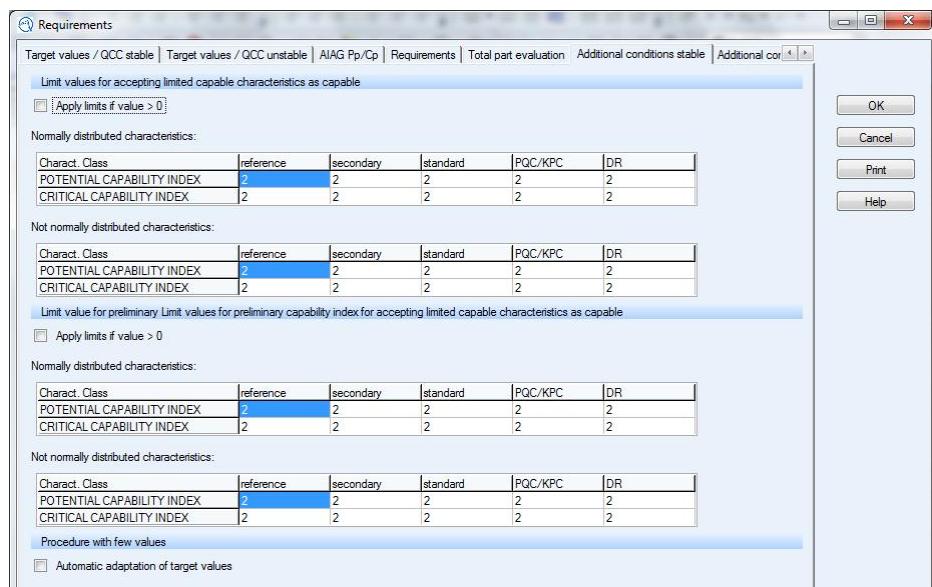
Charact. Class	reference	secondary	standard	PQC/KPC	DR
Weighting	0	0	0	0	0

Grade limits for total evaluation

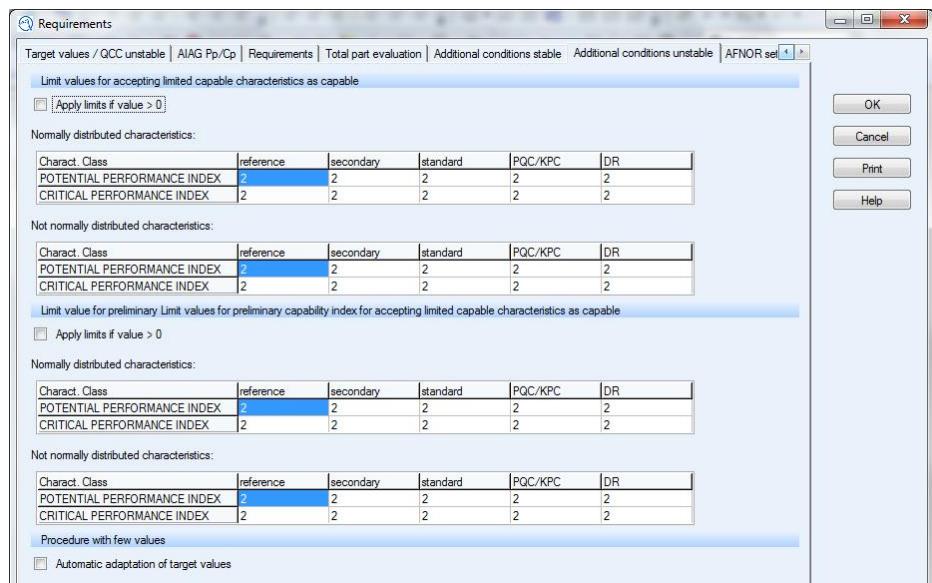
Observe capable limits capable from total grade

Observe limited capable limits limited capable from total grade

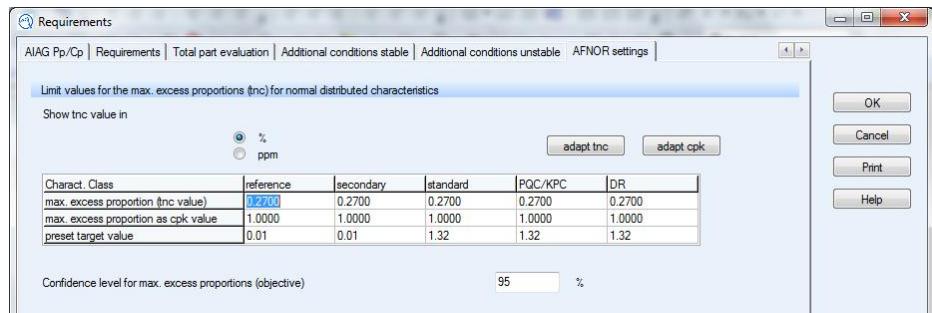
2.1.1.1.3.6 Requirements 100% automatic gaging – Additional conditions stable (not used)



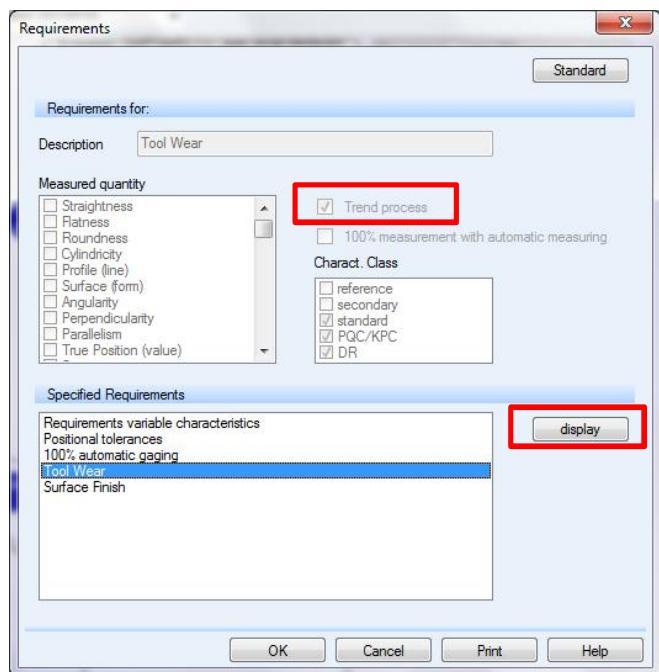
2.1.1.1.3.7 Requirements 100% automatic gaging – Additional conditions unstable (not used)



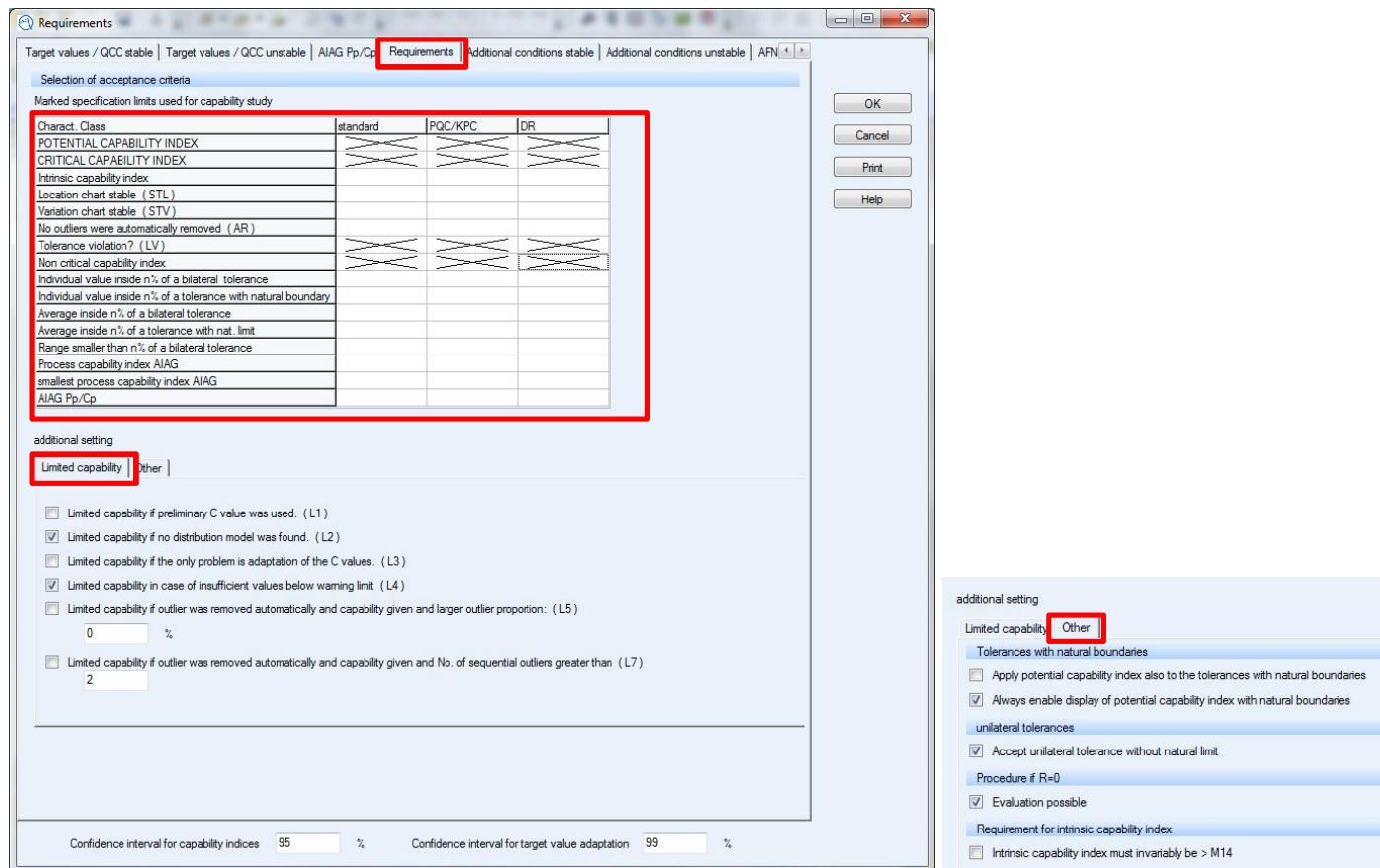
2.1.1.1.3.8 Requirements 100% automatic gaging – AFNOR settings (not used)



2.1.1.1.4 Requirements Tool Wear



2.1.1.1.4.1 Requirements Tool Wear – Requirements



2.1.1.1.4.2 Requirements Tool Wear – Target values / QCC stable

Requirements

Target values / QCC stable Target values / QCC unstable AIAG Pp/Cp Requirements Additional conditions stable Additional conditions unstable AFN

Capability indices
 Index valid?

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	C	pi
Non critical capability index	1.66	1.66	1.66	end	p

Normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	C	pi
Non critical capability index	1.66	1.66	1.66	C	p

Not normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	C	pi
Non critical capability index	1.66	1.66	1.66	C	p

Preliminary capability indices

Index valid?

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX	1.33	1.67	1.33	P	pk
Intrinsic capability index	1.67	1.67	1.67	P	pi
Non critical capability index	1	1	1	TW	pk

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.67	2	1.67	P	p
CRITICAL CAPABILITY INDEX	1.33	1.67	1.33	P	pk
Intrinsic capability index	1.67	1.67	1.67	P	pi
Non critical capability index	1	1.67	1	TW	pk

Procedure with few values

Automatic adaptation of target values Limit 50 not depending on Cp and Cpk Raise Cp to Cpk Reduce Cpk to Cp

Warning limit for insufficient values Limit 15

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.1.1.1.4.3 Requirements Tool Wear – Target values / QCC unstable

Requirements

Target values / QCC stable **Target values / QCC unstable** AIAG Pp/Cp | Requirements | Additional conditions stable | Additional conditions unstable | AFN

Performance indices

Index valid?

Normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.66	1.99	1.99	T	p
CRITICAL PERFORMANCE INDEX	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	C	pi
Non critical performance index	1.66	1.66	1.66	end	p

Not normally distributed characteristics: Min. values 250 Min. subgroups 50

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.32	1.66	1.66	T	p
CRITICAL PERFORMANCE INDEX	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	C	pi
Non critical performance index	1.66	1.66	1.66	C	p

Preliminary Performance indices

Index valid?

Normally distributed characteristics: Min. values 10 Min. subgroups 3

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX	1.33	1.67	1.33	T	pk
Intrinsic performance index	1.67	1.67	1.67	P	pi
Non critical performance index	1	1	1	TW	pk

Not normally distributed characteristics: Min. values 10 Min. subgroups 3

Charact. Class	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	1.67	2	1.67	T	p
CRITICAL PERFORMANCE INDEX	1.33	1.67	1.33	T	pk
Intrinsic performance index	1.67	1.67	1.67	P	pi
Non critical performance index	1	1.67	1	TW	pk

Procedure with few values

Automatic adaptation of target values Limit 50 not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit 15

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.1.1.1.4.4 Requirements Tool Wear – AIAG Pp/Cp (not used)

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG	2	2	2	2	2		
smallest process capability index AIAG	2	2	2	2	2		
AIAG Pp/Cp	0.8	0.8	0.8	0.8	0.8		

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG	2	2	2	2	2		
smallest process capability index AIAG	2	2	2	2	2		
AIAG Pp/Cp	0.8	0.8	0.8	0.8	0.8		

2.1.1.1.4.5 Requirements Tool Wear – Total part evaluation (not used)

Settings for part evaluation

- Execute part type grading based on characteristics results
- Execute part grading for individuals

Part weights

Grade code

Grade	capable	conditionally capable	not capable
Grade	1	0	0

Characteristic class weights

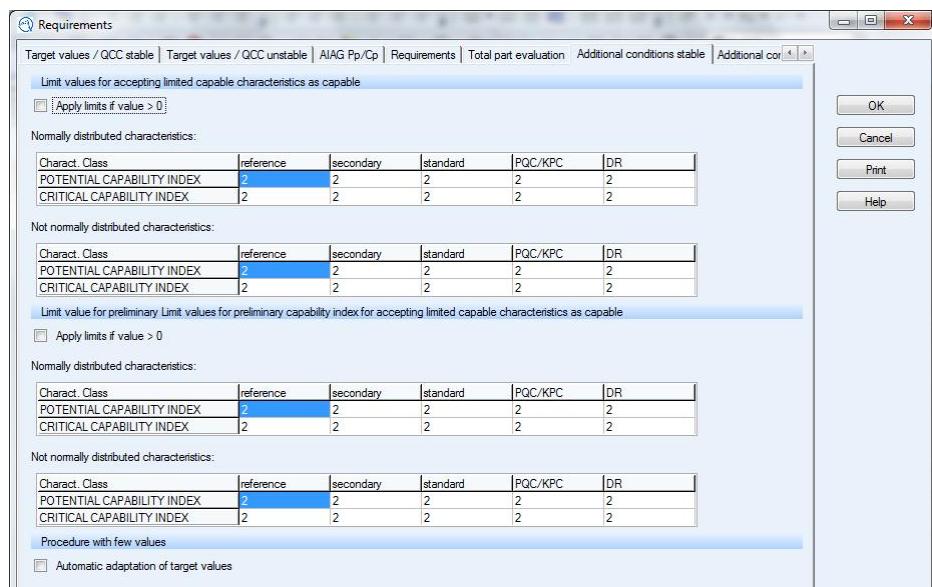
Charact. Class	reference	secondary	standard	PQC/KPC	DR
Weighting	0	0	0	0	0

Grade limits for total evaluation

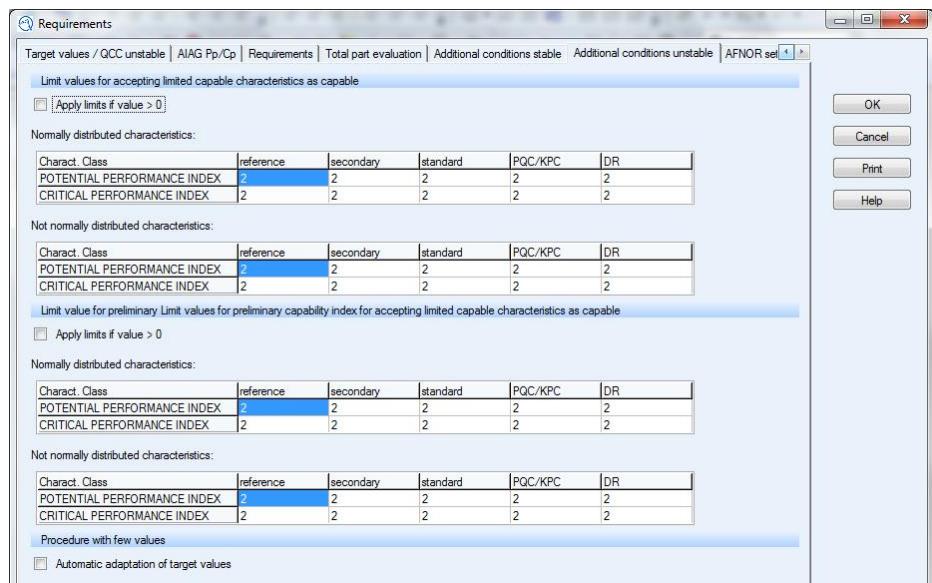
- Observe capable limits
- Observe limited capable limits

capable from total grade	0
limited capable from total grade	0

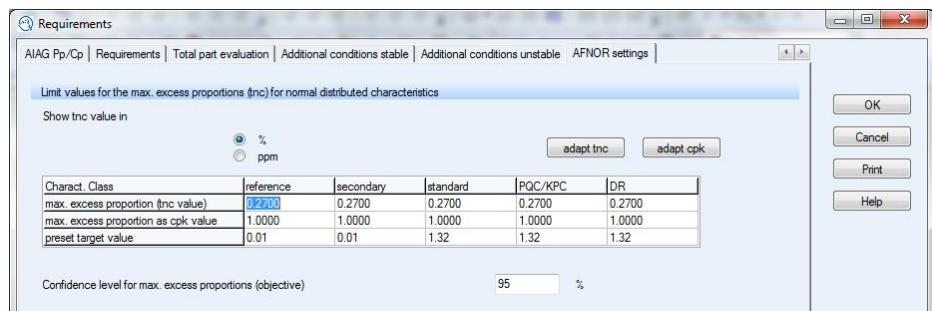
2.1.1.1.4.6 Requirements Tool Wear – Additional conditions stable (not used)



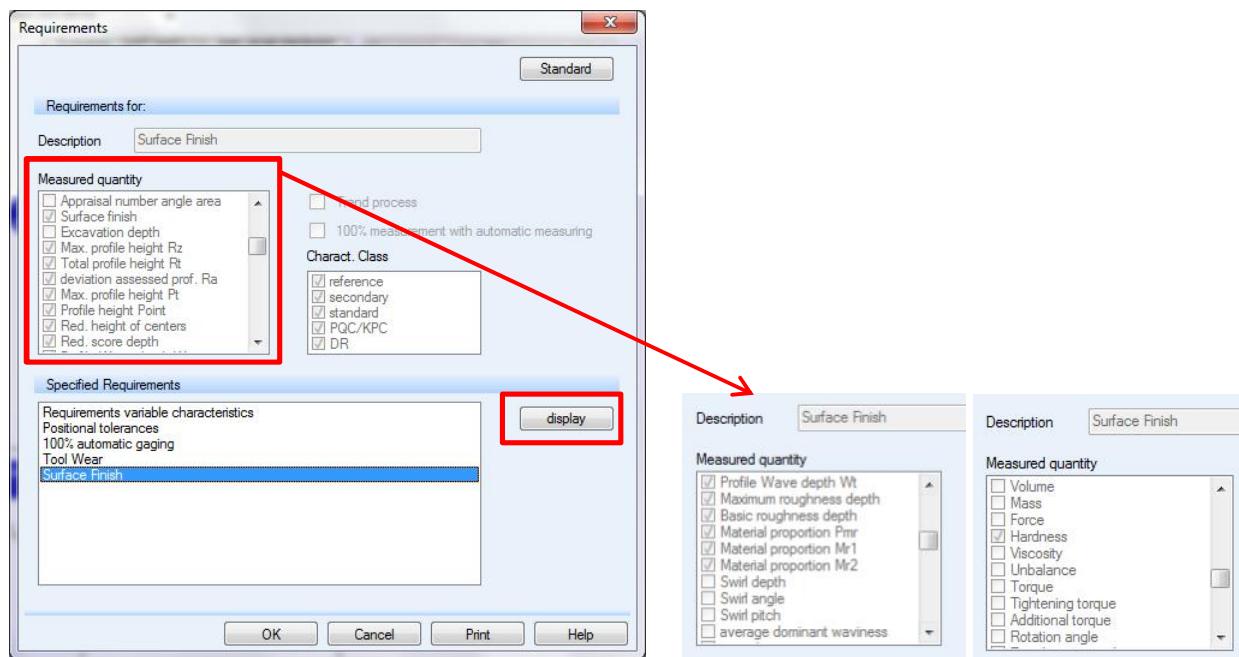
2.1.1.1.4.7 Requirements Tool Wear – Additional conditions unstable (not used)



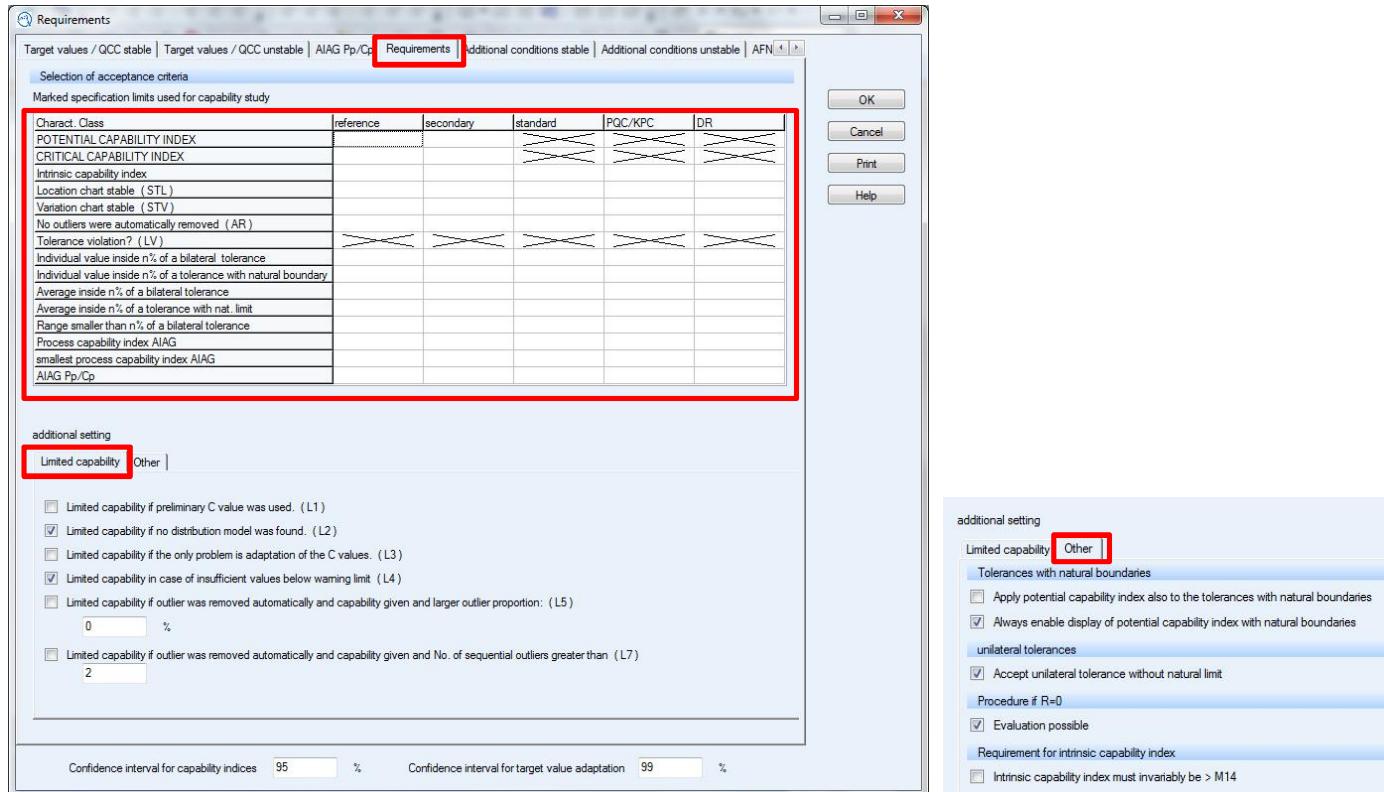
2.1.1.1.4.8 Requirements Tool Wear – AFNOR settings (not used)



2.1.1.1.5 Requirements Surface Finish



2.1.1.1.5.1 Requirements Surface Finish – Requirements



2.1.1.1.5.2 Requirements Surface Finish – Target values / QCC stable

Requirements

Target values / QCC stable [Target values / QCC unstable] [AIAG Pp/Cp] [Requirements] [Additional conditions stable] [Additional conditions unstable] [AFN]

Capability indices

Index valid?

Normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	0.01	0.01	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	0.01	0.01	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	1.66	1.66	C	pi

Not normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	0.01	0.01	1.32	1.32	1.32	C	p
CRITICAL CAPABILITY INDEX	0.01	0.01	1.32	1.32	1.32	C	pk
Intrinsic capability index	1.66	1.66	1.66	1.66	1.66	C	pi

Preliminary capability indices

Index valid?

Normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	0	0	1	1	1	P	p
CRITICAL CAPABILITY INDEX	0	0	1	1	1	P	pk
Intrinsic capability index	0	0	1	1	1	P	pi

Not normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	0	0	1	1	1	P	p
CRITICAL CAPABILITY INDEX	0	0	1	1	1	P	pk
Intrinsic capability index	0	0	1	1	1	P	pi

Procedure with few values

Automatic adaptation of target values Limit

not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit

Confidence interval for capability indices % Confidence interval for target value adaptation %

2.1.1.1.5.3 Requirements Surface Finish – Target values / QCC unstable

Requirements

Target values / QCC stable | **Target values / QCC unstable** | AIAG Pp/Cp | Requirements | Additional conditions stable | Additional conditions unstable | AFN |

Index valid?

Normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	0.01	0.01	1.66	1.99	1.99	T	p
CRITICAL PERFORMANCE INDEX	0.01	0.01	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	1.66	1.66	C	pi

Not normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	0.01	0.01	1.32	1.66	1.66	T	p
CRITICAL PERFORMANCE INDEX	0.01	0.01	1.32	1.66	1.66	T	pk
Intrinsic performance index	1.66	1.66	1.66	1.66	1.66	C	pi

Preliminary Performance indices

Index valid?

Normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	0	0	1	1	1	T	p
CRITICAL PERFORMANCE INDEX	0	0	1	1	1	T	pk
Intrinsic performance index	0	0	1	1	1	P	pi

Not normally distributed characteristics: Min. values Min. subgroups

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL PERFORMANCE INDEX	0	0	1	1	1	T	p
CRITICAL PERFORMANCE INDEX	0	0	1	1	1	T	pk
Intrinsic performance index	0	0	1	1	1	P	pi

Procedure with few values

Automatic adaptation of target values Limit

not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit

Confidence interval for capability indices % Confidence interval for target value adaptation %

2.1.1.1.5.4 Requirements Surface Finish – AIAG Pp/Cp (not used)

Requirements

Target values / QCC stable | Target values / QCC unstable | AIAG Pp/Cp | Requirements | Total part evaluation | Additional conditions stable | Additional cor

AIAG_Cp_Pp

output AIAG_Cp_Pp

all characteristics:		Min. values	50	Min. subgroups		10		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG		2	2	2	2	2		
smallest process capability index AIAG		2	2	2	2	2		
AIAG Pp/Cp		0.8	0.8	0.8	0.8	0.8		

prel. AIAG_Cp_Pp

output prel. AIAG_Cp_Pp

all characteristics:		Min. values	10	Min. subgroups		3		
Charact. Class		reference	secondary	standard	PQC/KPC	DR	Description	Index
Process capability index AIAG		2	2	2	2	2		
smallest process capability index AIAG		2	2	2	2	2		
AIAG Pp/Cp		0.8	0.8	0.8	0.8	0.8		

OK **Cancel** **Print** **Help**

2.1.1.1.5.5 Requirements Surface Finish – Total part evaluation (not used)

Requirements

Target values / QCC stable | Target values / QCC unstable | AIAG Pp/Cp | Requirements | Total part evaluation | Additional conditions stable | Additional cor

Settings for part evaluation

Execute part type grading based on characteristics results

Execute part grading for individuals

Part weights

Grade code

Grade	capable	conditionally capable	not capable
Grade	1	0	0

Characteristic class weights

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Weighting	0	0	0	0	0

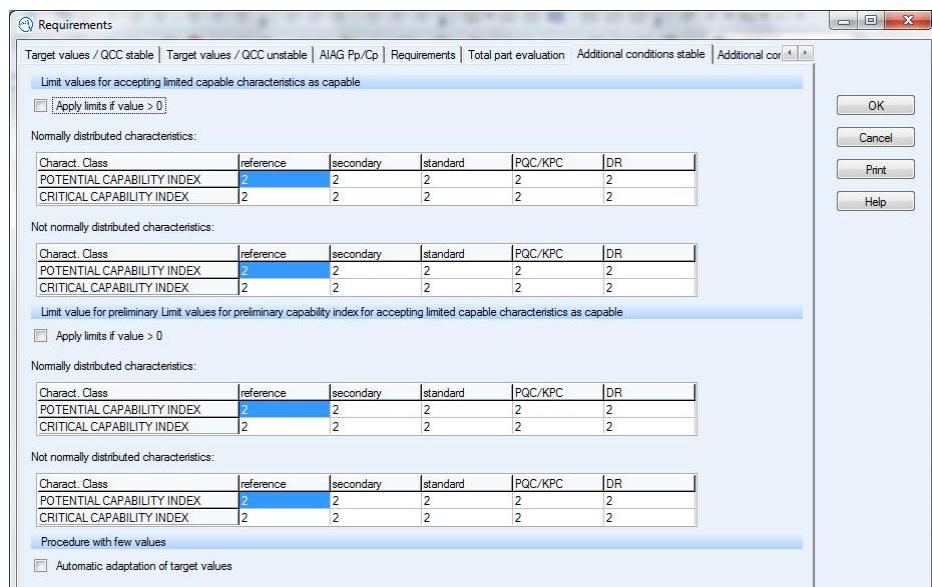
Grade limits for total evaluation

Observe capable limits capable from total grade: 0

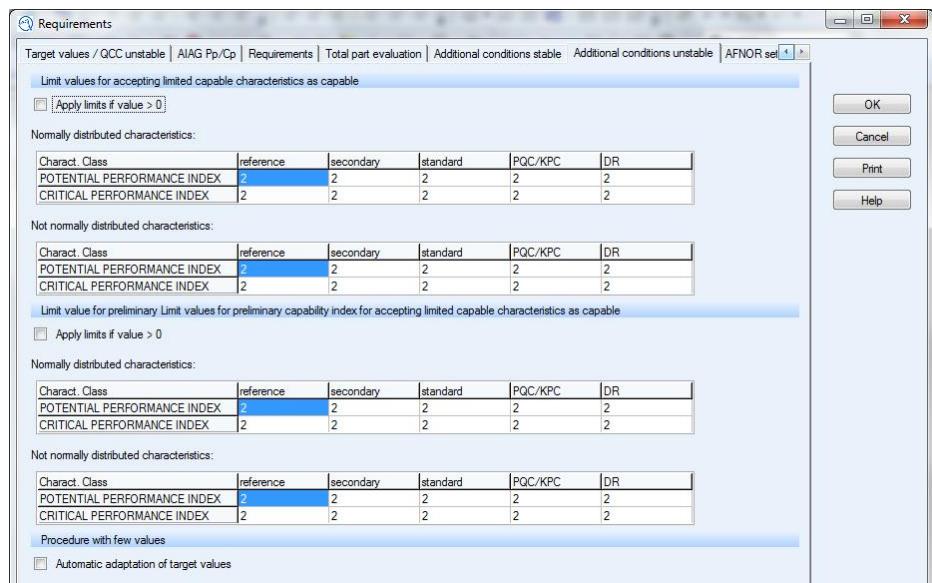
Observe limited capable limits limited capable from total grade: 0

OK **Cancel** **Print** **Help**

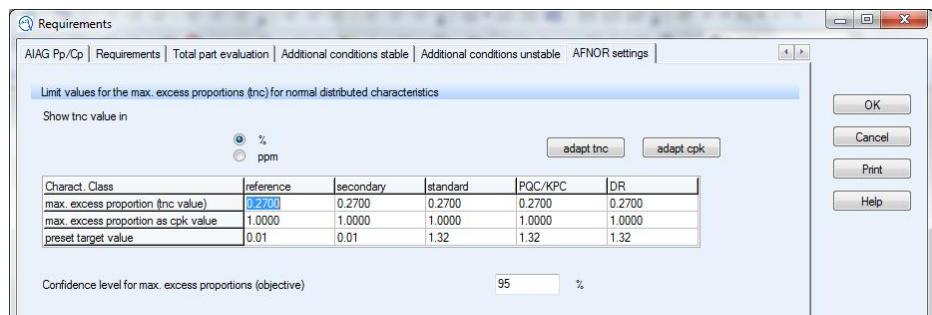
2.1.1.1.5.6 Requirements Surface Finish – Additional conditions stable (not used)



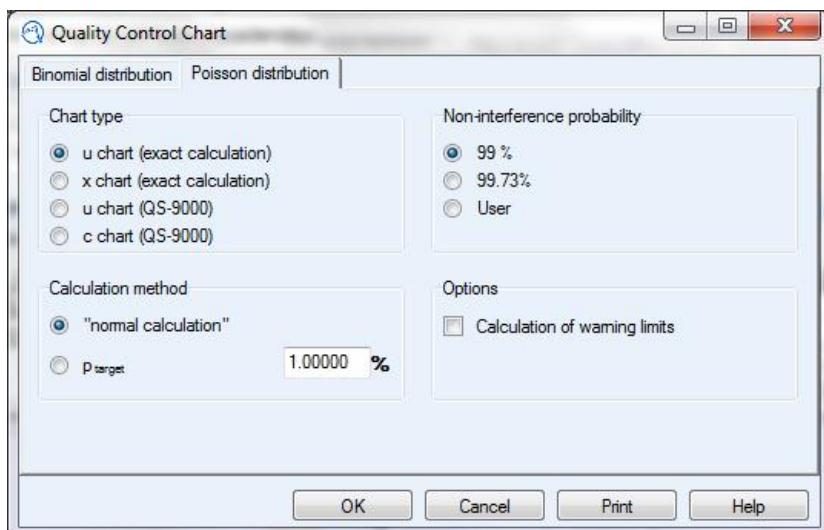
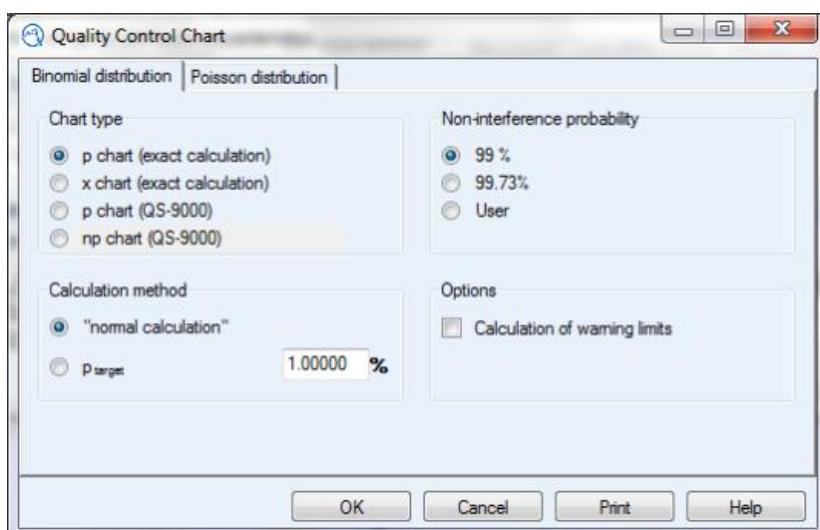
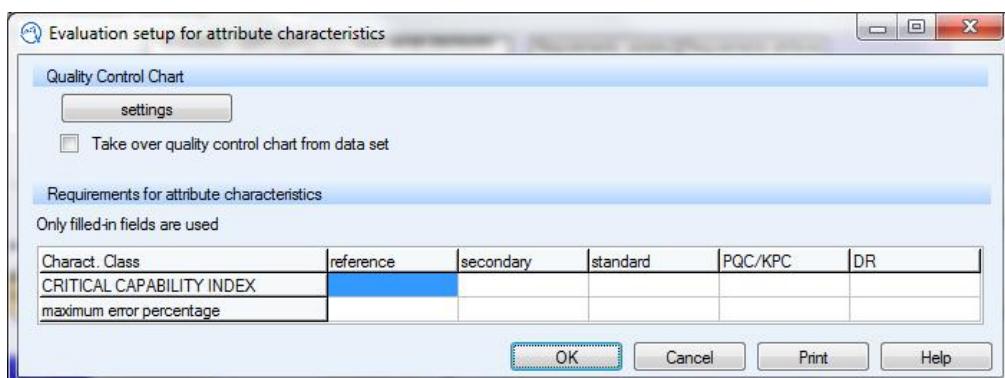
2.1.1.1.5.7 Requirements Surface Finish – Additional conditions unstable (not used)



2.1.1.1.5.8 Requirements Surface Finish – AFNOR settings (not used)

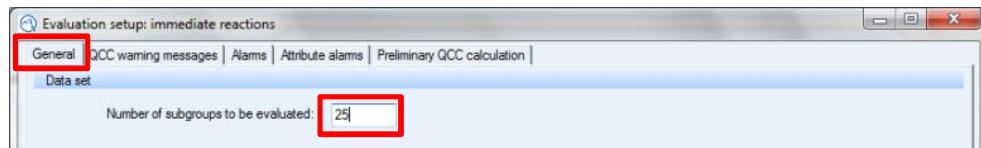


2.1.1.2 Requirements – attribute characteristics (not used)

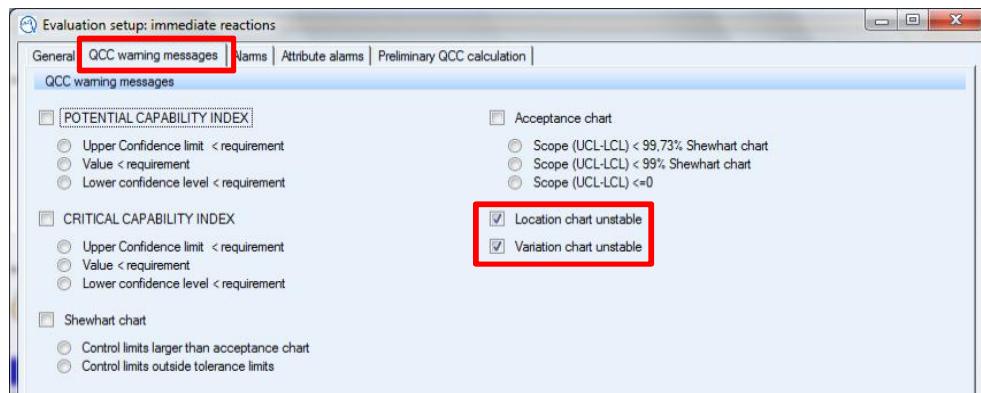


2.1.1.3 O-QIS – Evaluation Setup: Immediate Reactions

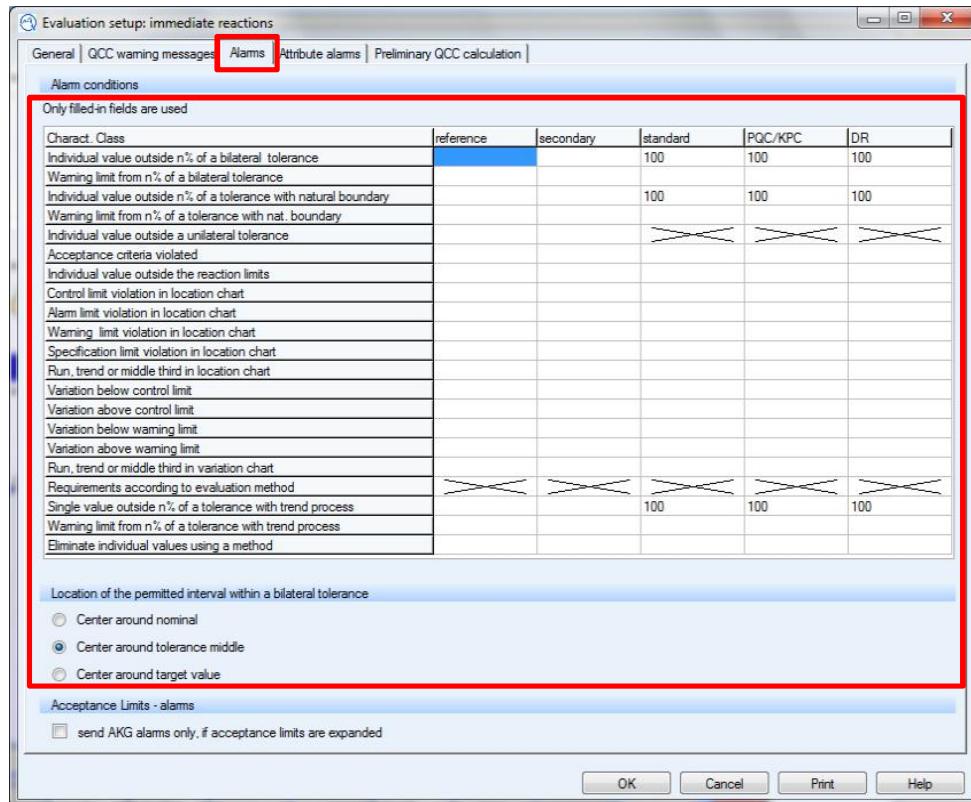
2.1.1.3.1 O-QIS – Evaluation Setup: Immediate Reactions – General



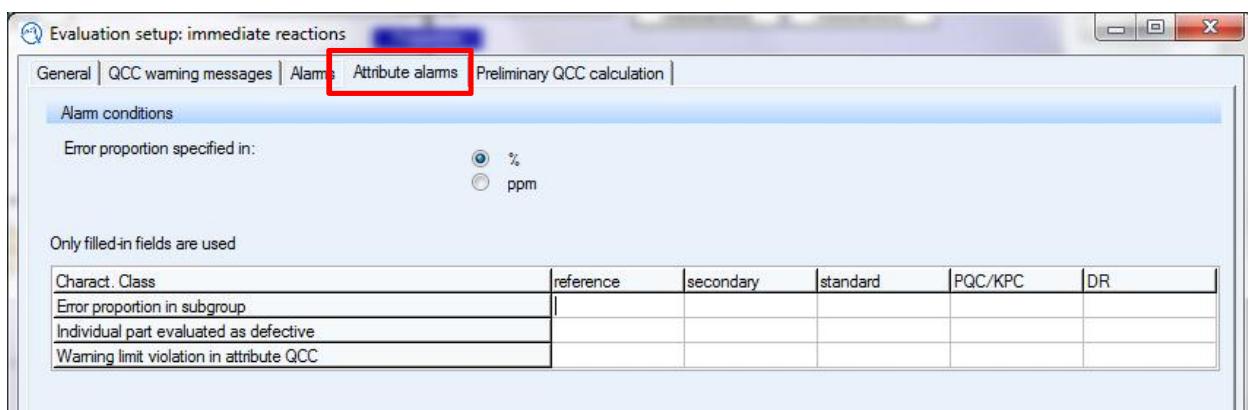
2.1.1.3.2 O-QIS – Evaluation Setup: Immediate Reactions – QCC Warning Messages



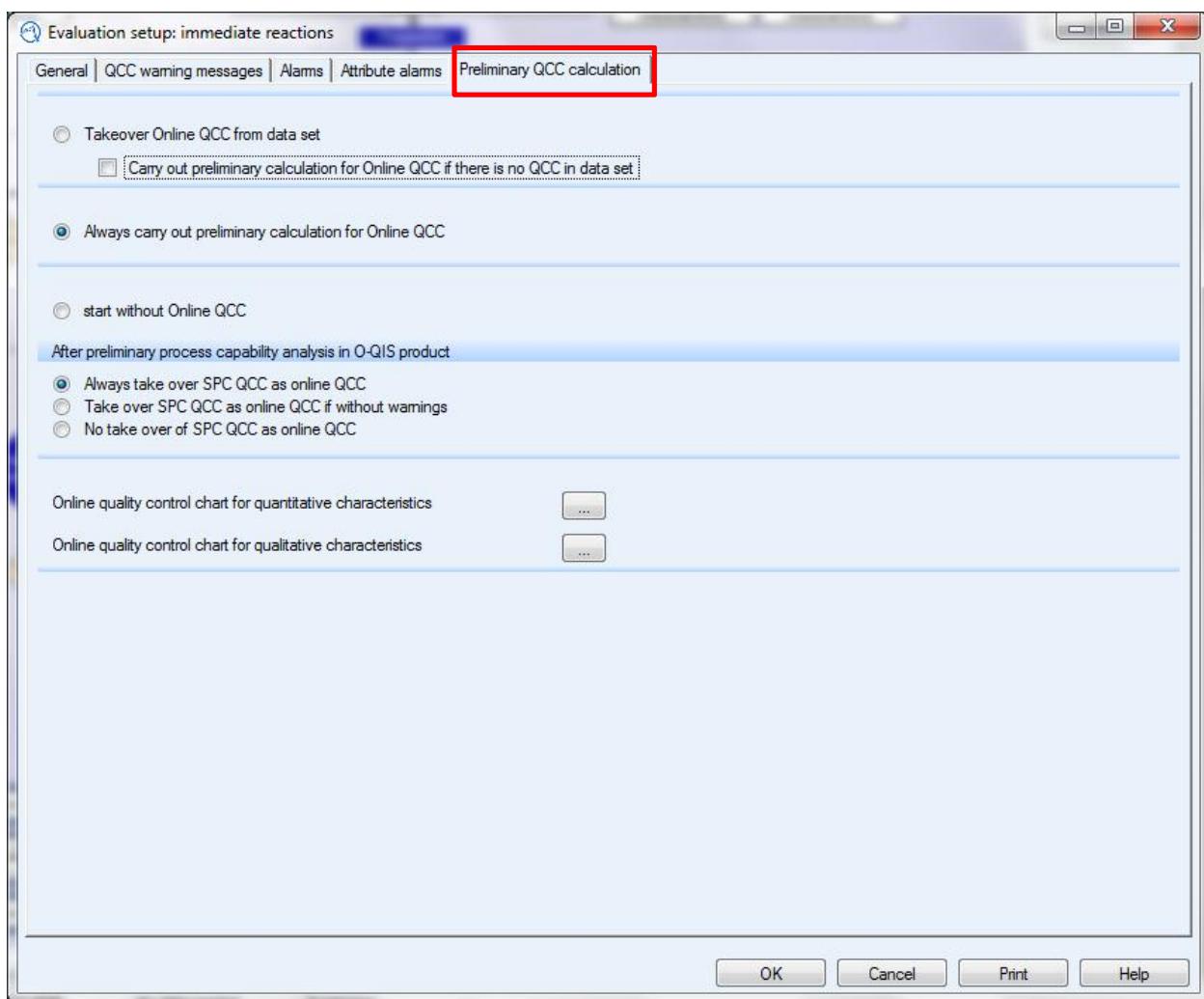
2.1.1.3.3 O-QIS – Evaluation Setup: Immediate Reactions – Alarms



2.1.1.3.4 O-QIS – Evaluation Setup: Immediate Reactions – Attribute Alarms (not used)

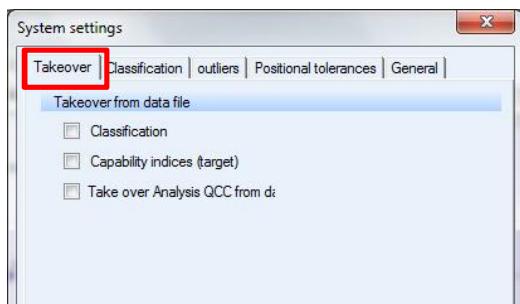


2.1.1.3.5 O-QIS – Evaluation Setup: Immediate Reactions – Preliminary QCC Calculation

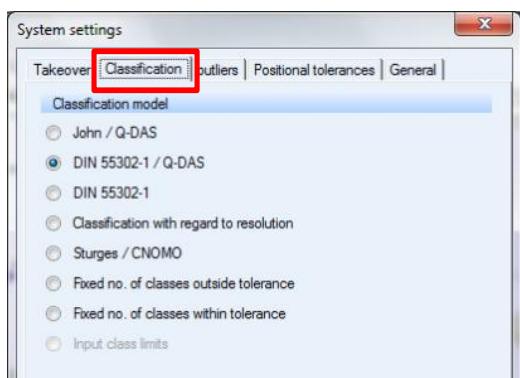


2.1.1.4 Preparation – System Settings

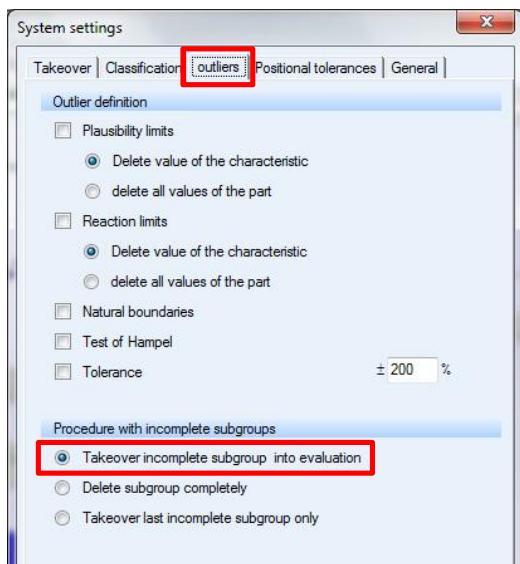
2.1.1.4.1 Preparation – System Settings – Takeover



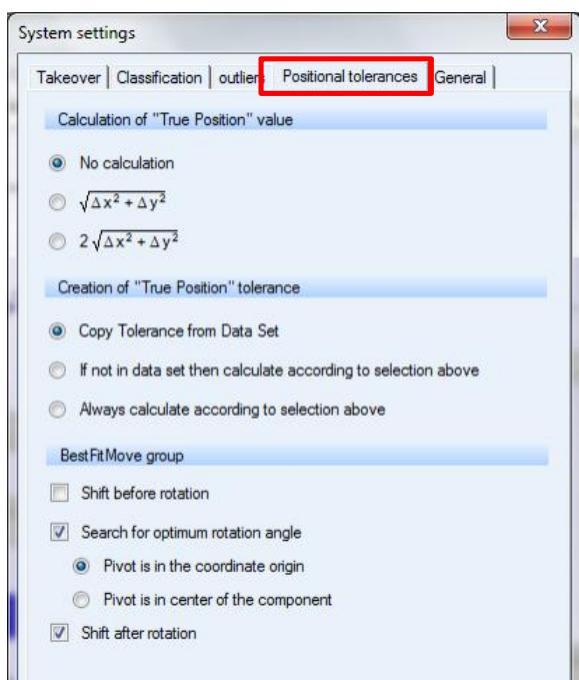
2.1.1.4.2 Preparation – System Settings – Classification



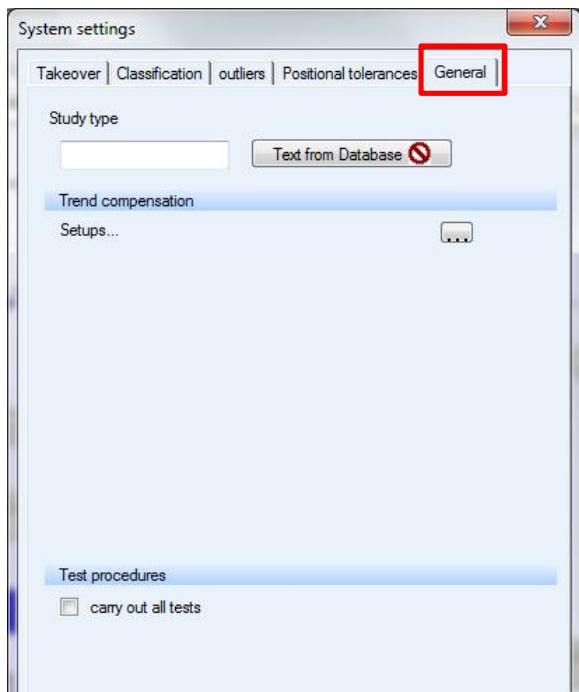
2.1.1.4.3 Preparation – System Settings – Outliers



2.1.1.4.4 Preparation – System Settings – Positional Tolerances

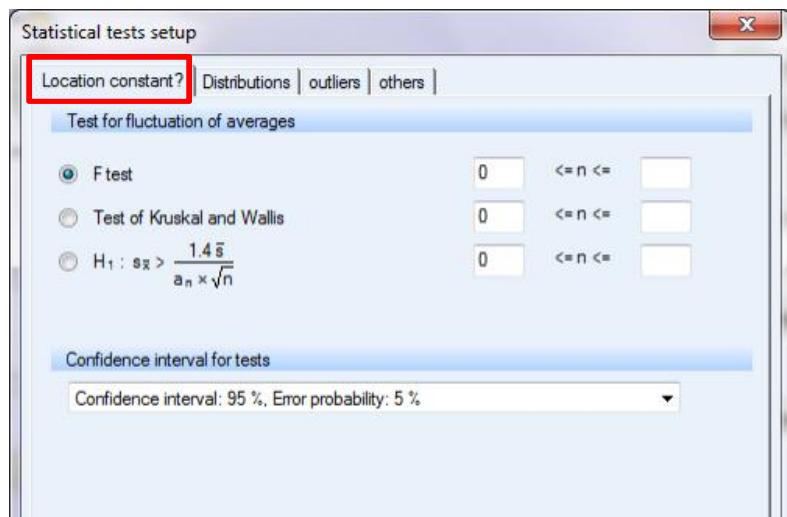


2.1.1.4.5 Preparation – System Settings – General



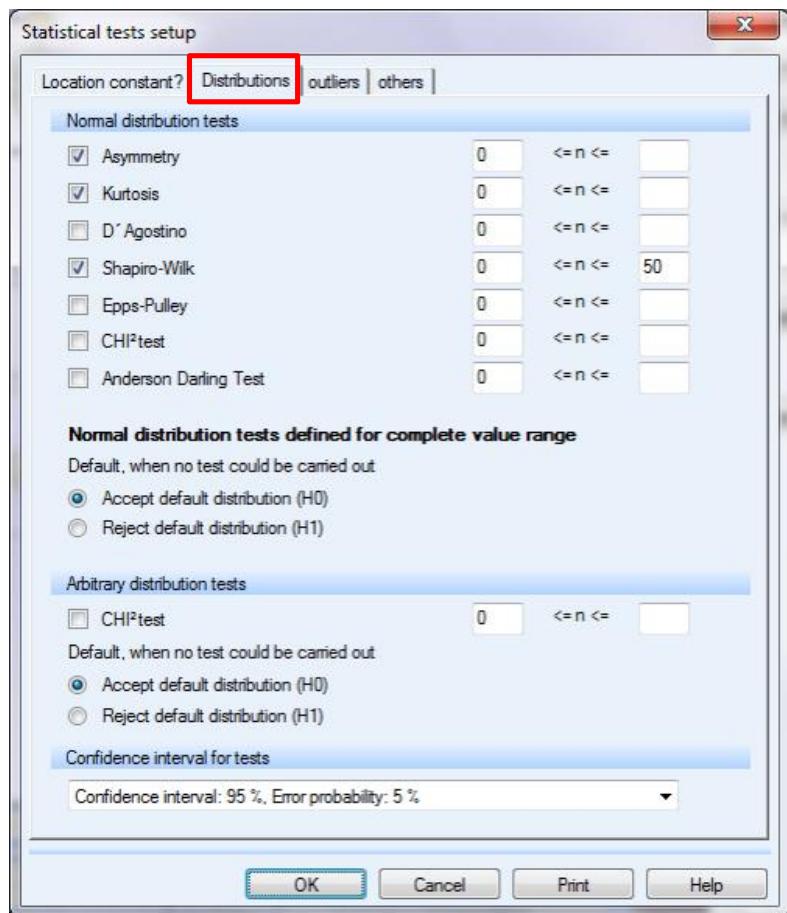
2.1.1.5 Location Constant? – Statistical Tests Setup

2.1.1.5.1 Location Constant? – Statistical Test Setup

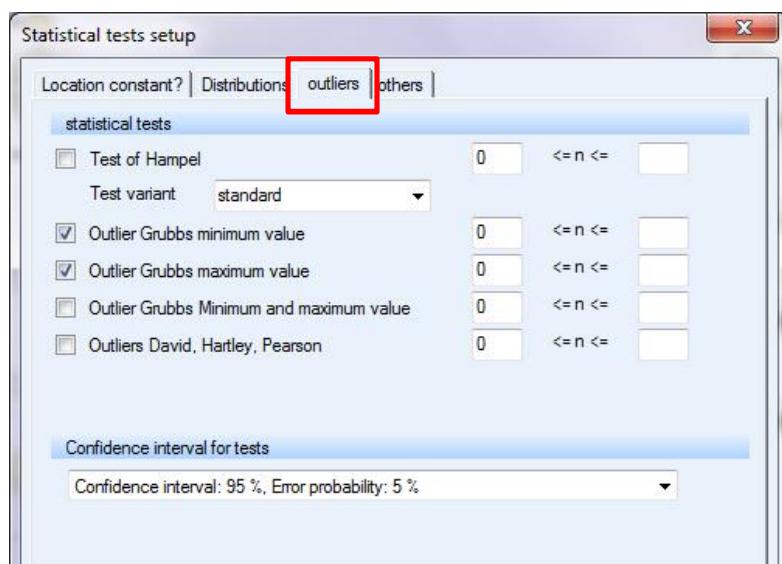


2.1.1.6 Test for Distribution – Statistical Tests Setup

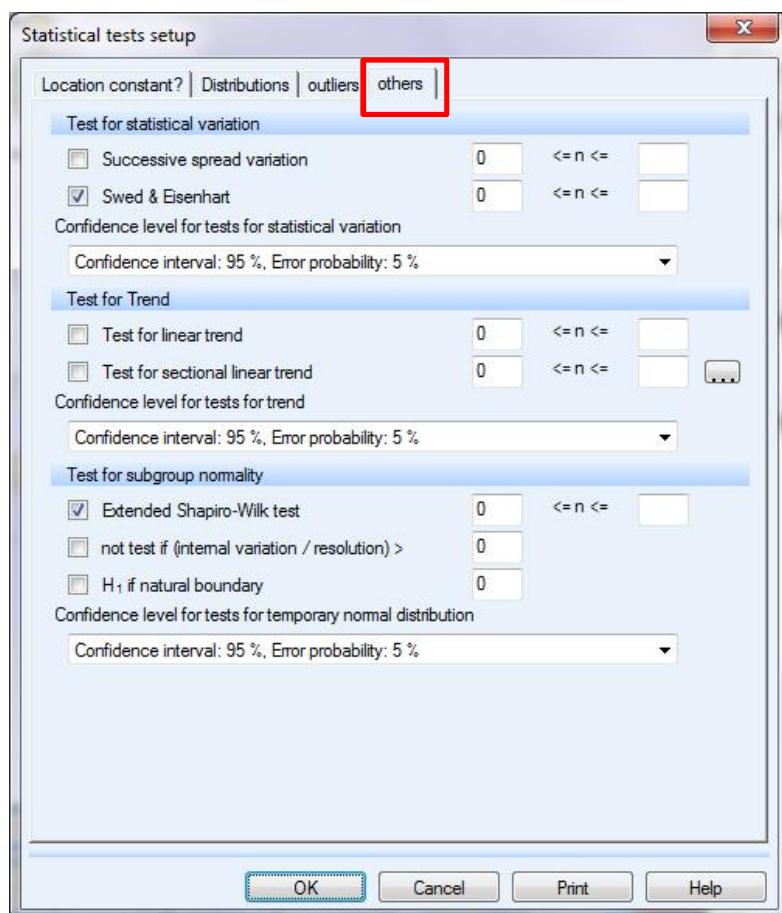
2.1.1.6.1 Test for Distribution – Statistical Tests Setup – Distributions



2.1.1.6.2 Test for Distribution – Statistical Tests Setup – Outliers

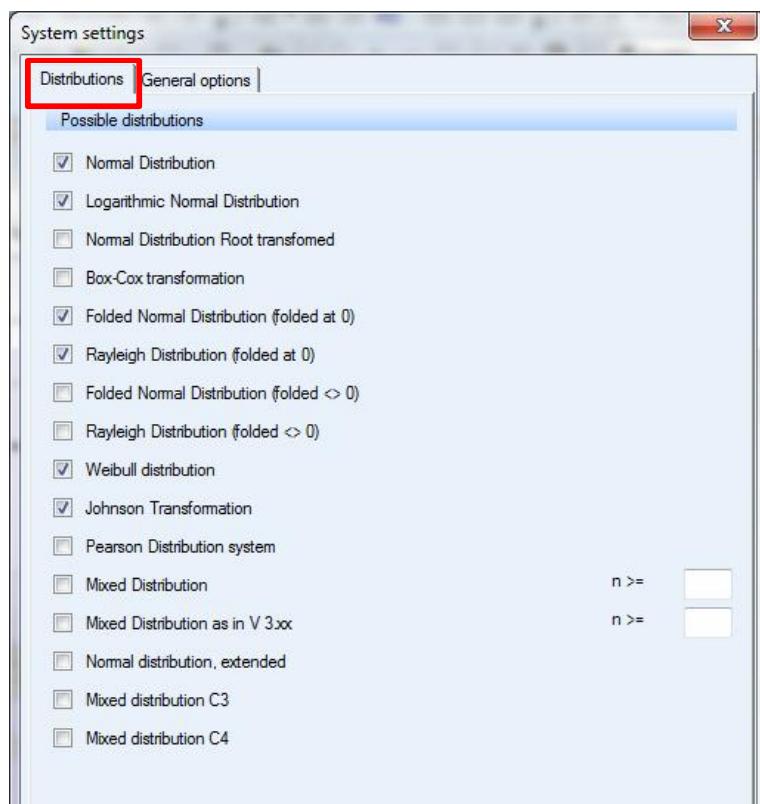


2.1.1.6.3 Test for Distribution – Statistical Tests Setup – Others

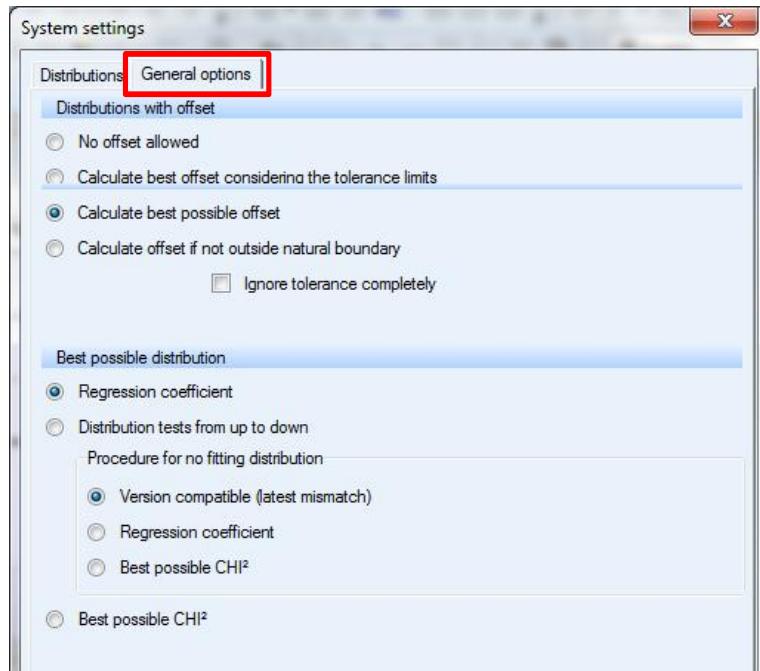


2.1.1.7 Find Distribution Model – System Settings

2.1.1.7.1 Find Distribution Model – System Settings – Distribution

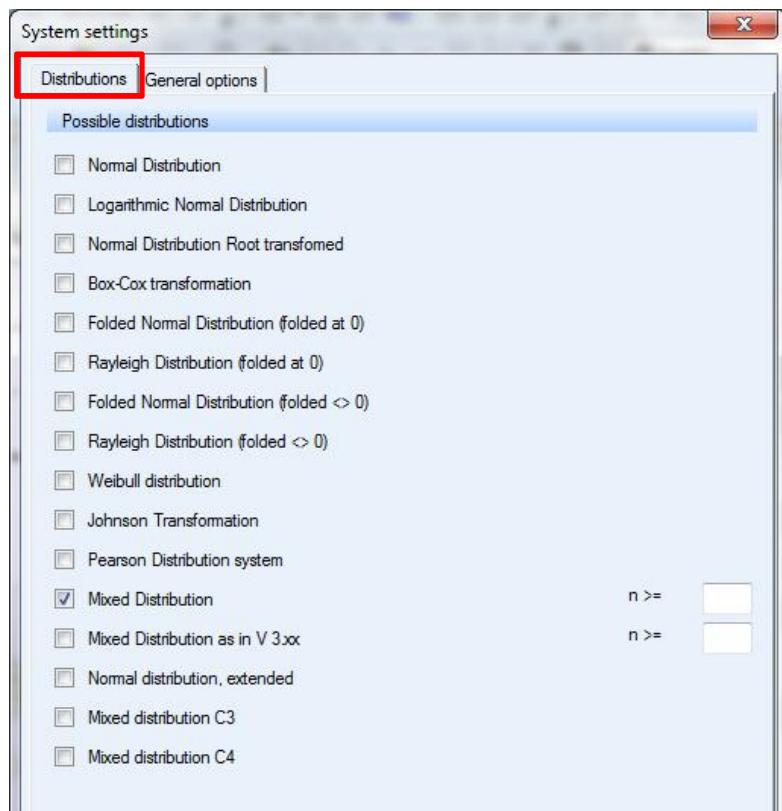


2.1.1.7.2 Find Distribution Model – System Settings – General Options

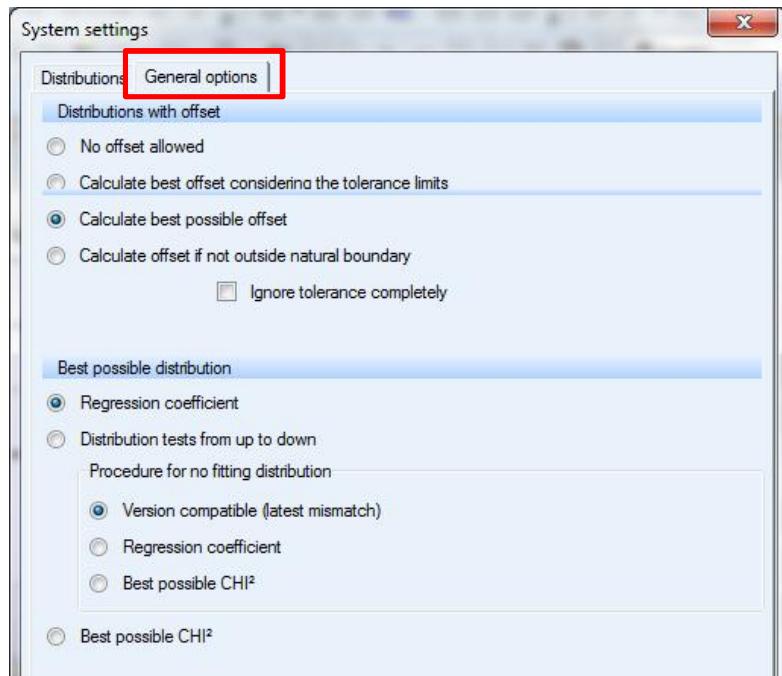


2.1.1.8 Distribution Model MD – System Settings

2.1.1.8.1 Distribution Model MD – System Settings – Distributions

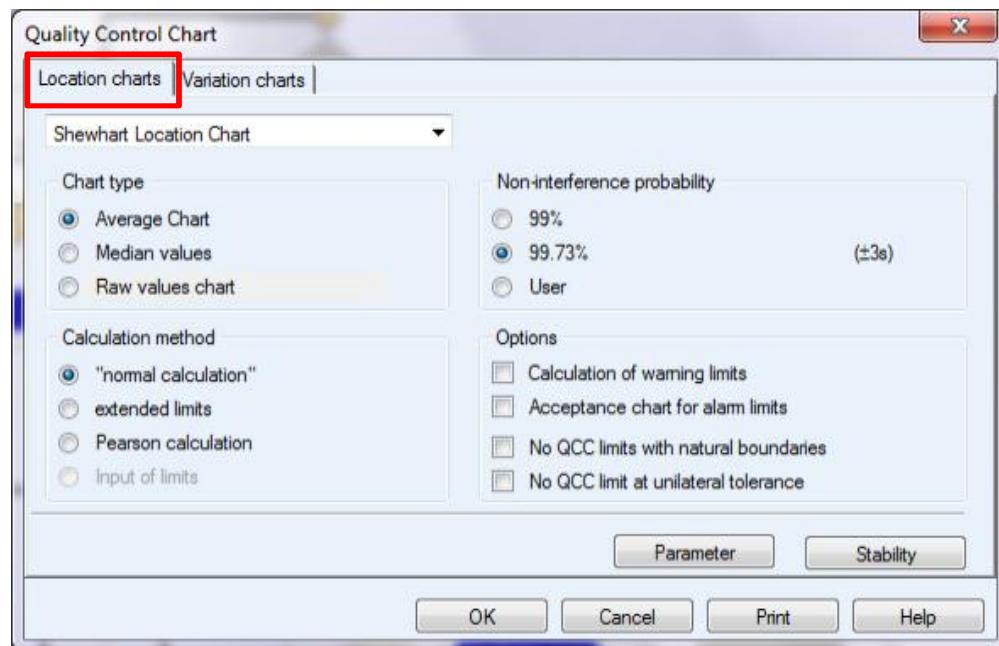


2.1.1.8.2 Distribution Model MD – System Settings – General Options

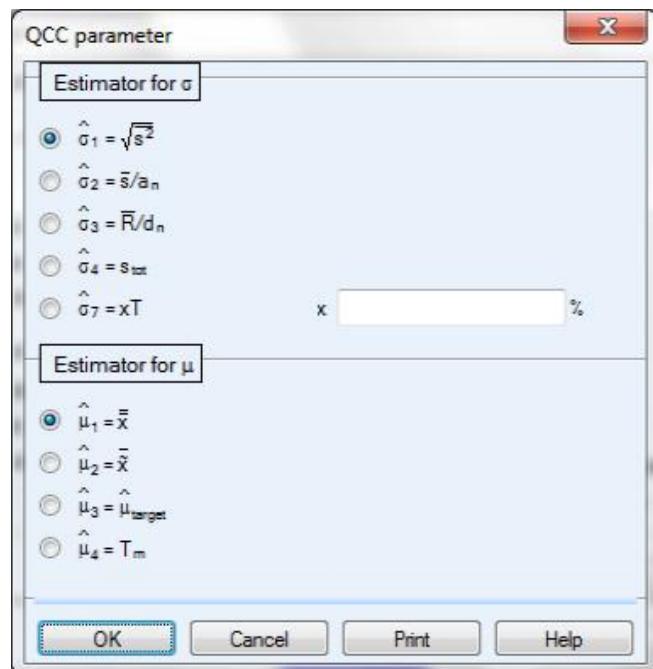


2.1.1.9 Shewhart chart – Quality Control Chart

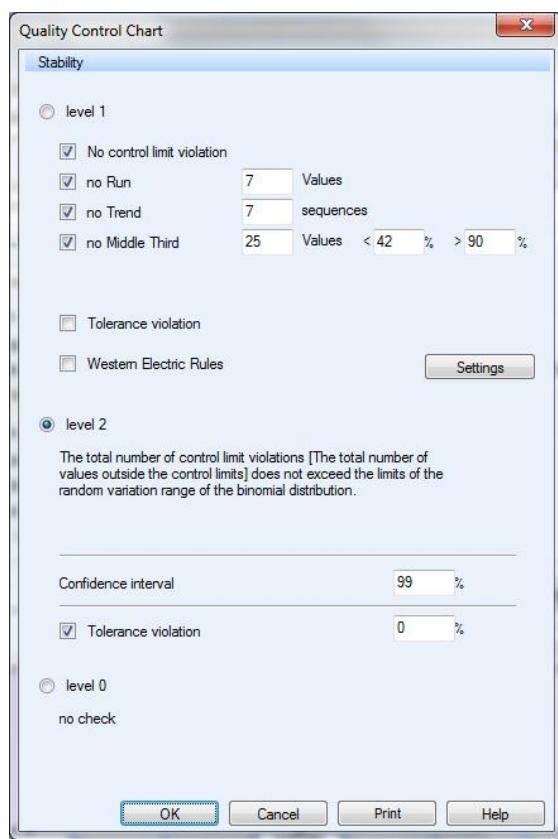
2.1.1.9.1 Shewhart Chart – Quality Control Chart – Location Charts



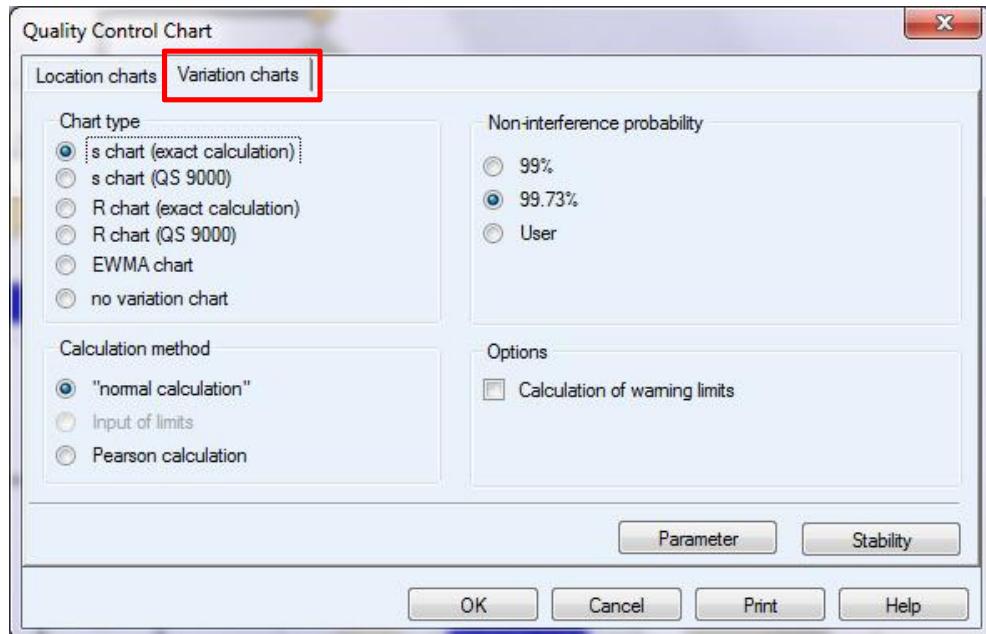
2.1.1.9.1.1 Shewhart Chart – Quality Control Chart – Location Charts – QCC Parameter



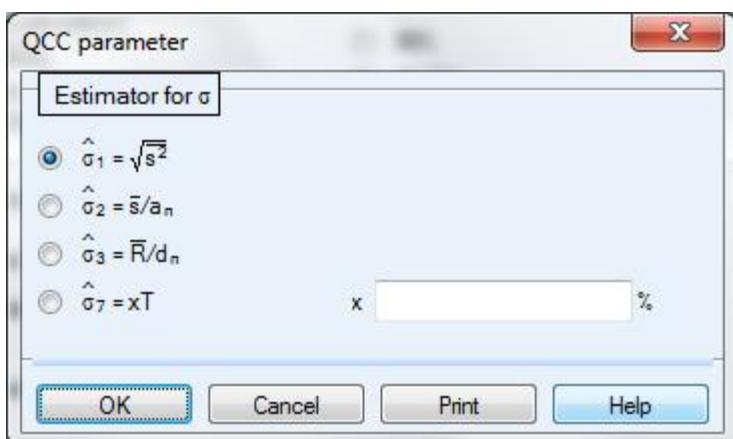
2.1.1.9.1.2 Shewhart Chart – Quality Control Chart – Location Charts – Stability



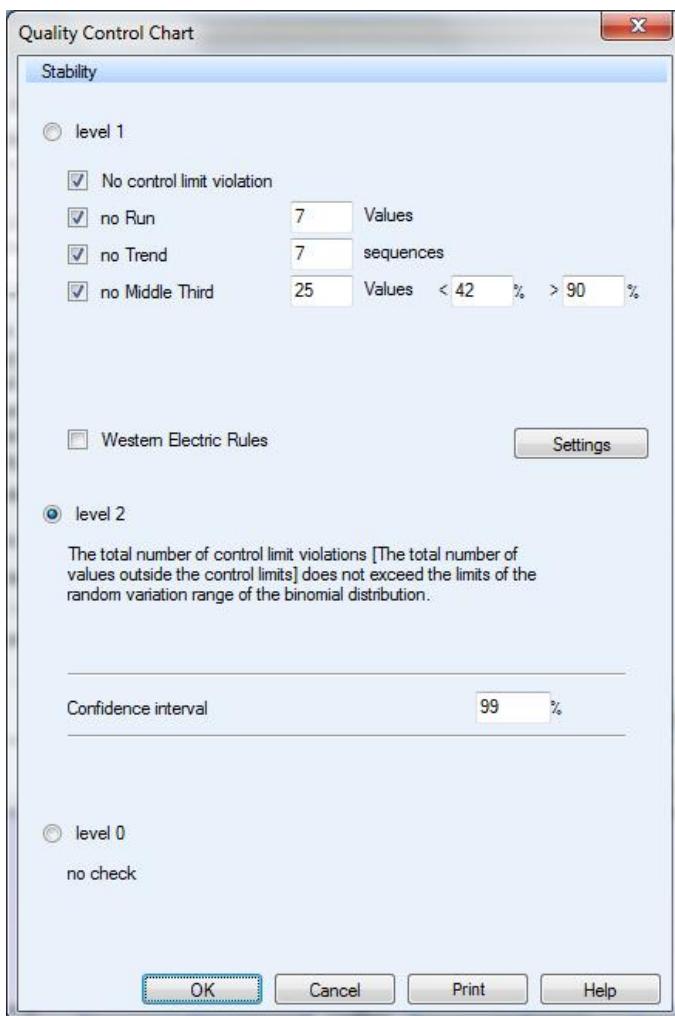
2.1.1.9.2 Shewhart Chart – Quality Control Chart – Variation Charts



2.1.1.9.2.1 Shewhart Chart – Quality Control Chart – Variation Charts – QCC Parameter

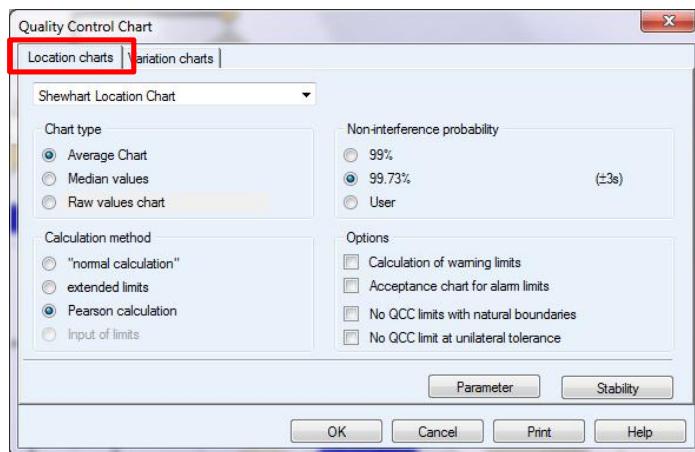


2.1.1.9.2.2 Shewhart Chart – Quality Control Chart – Variation Charts – Stability

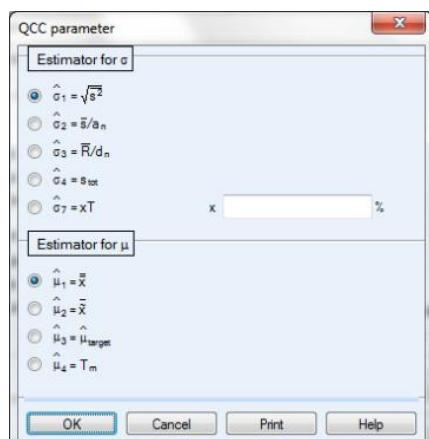


2.1.1.10 Pearson Chart – Quality Control Chart

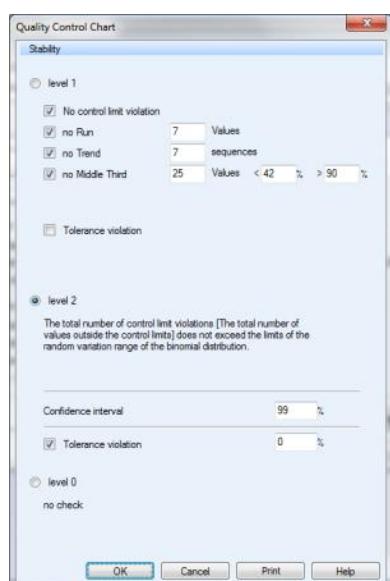
2.1.1.10.1 Pearson Chart – Quality Control Chart – Location Charts



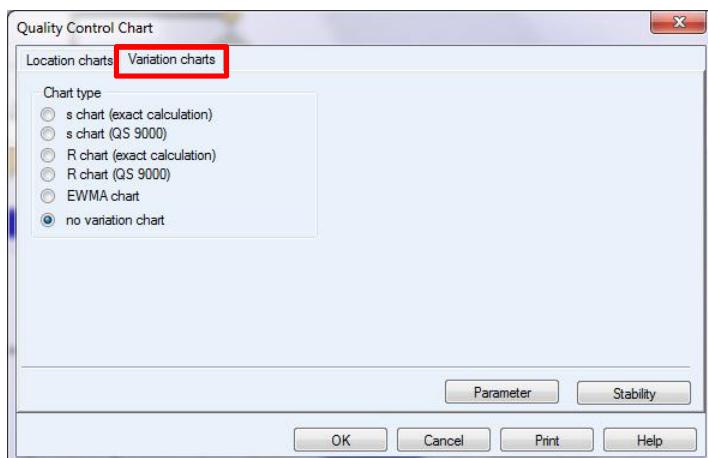
2.1.1.10.1.1 Pearson Chart – Quality Control Chart – Location Charts – Parameter



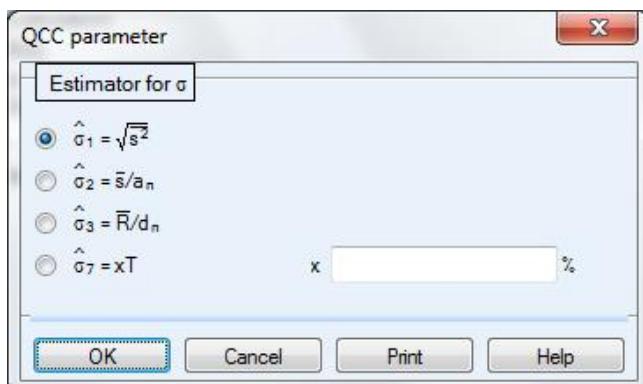
2.1.1.10.1.2 Pearson Chart – Quality Control Chart – Location Charts – Stability



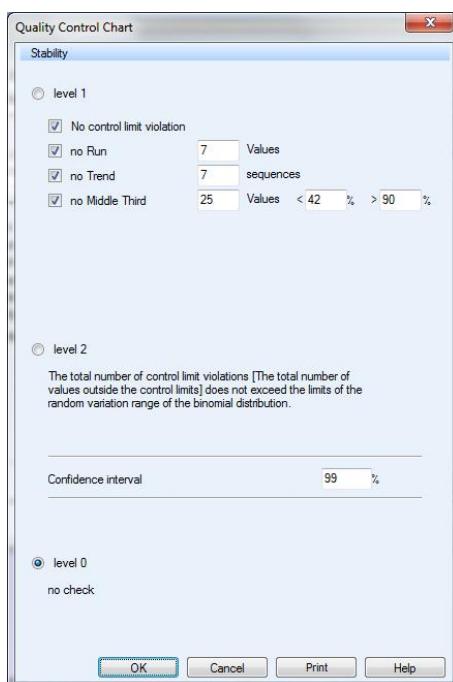
2.1.1.10.2 Pearson Chart – Quality Control Chart – Variation Charts



2.1.1.10.2.1 Pearson Chart – Quality Control Chart – Variation Charts – Parameter

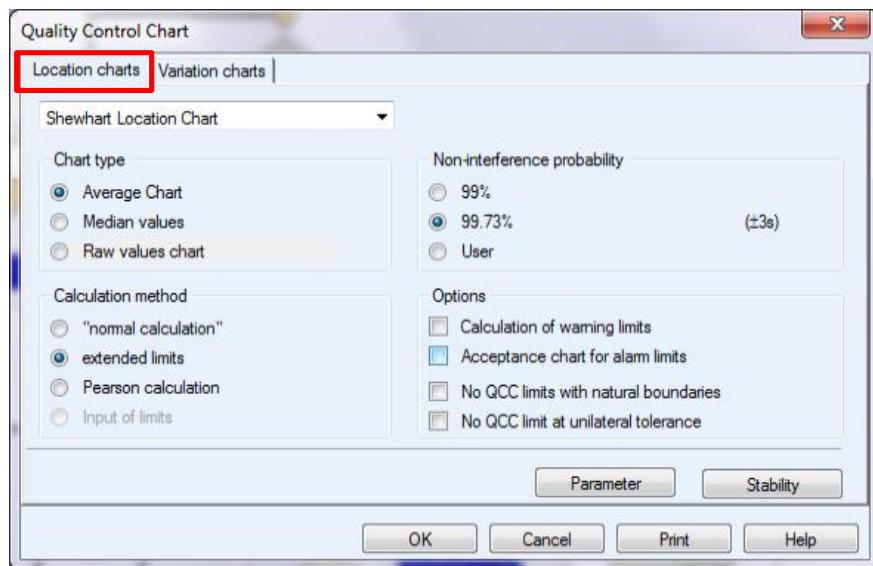


2.1.1.10.2.2 Pearson Chart – Quality Control Chart – Variation Charts – Stability

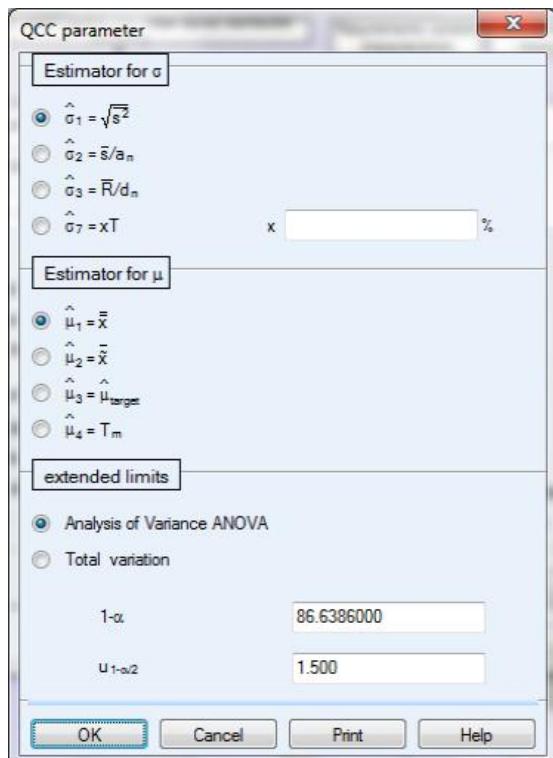


2.1.1.11 Extended Shewhart – Quality Control Chart

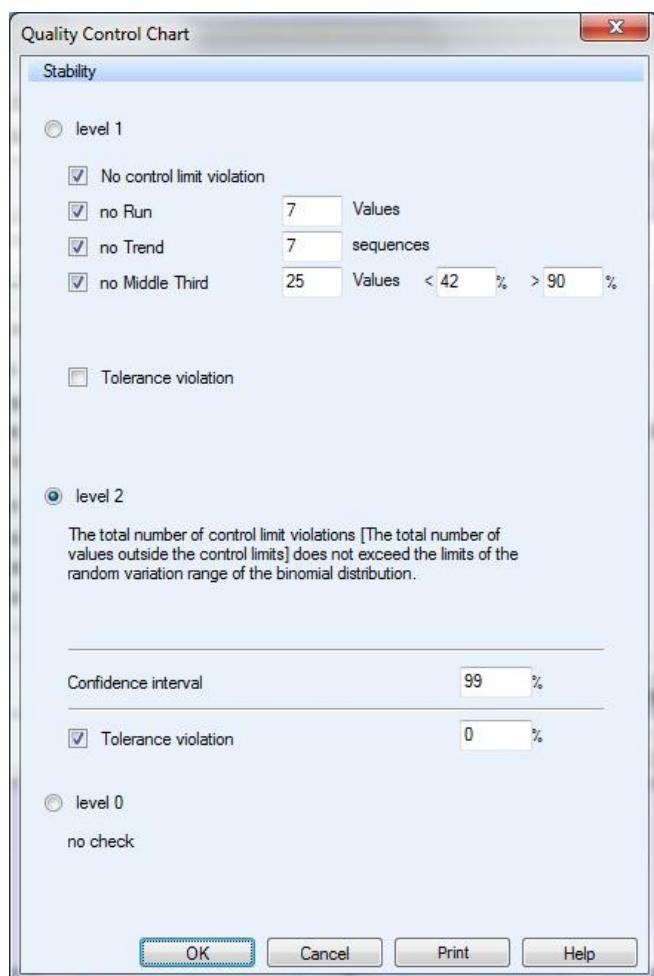
2.1.1.11.1 Extended Shewhart – Quality Control Chart – Location Charts



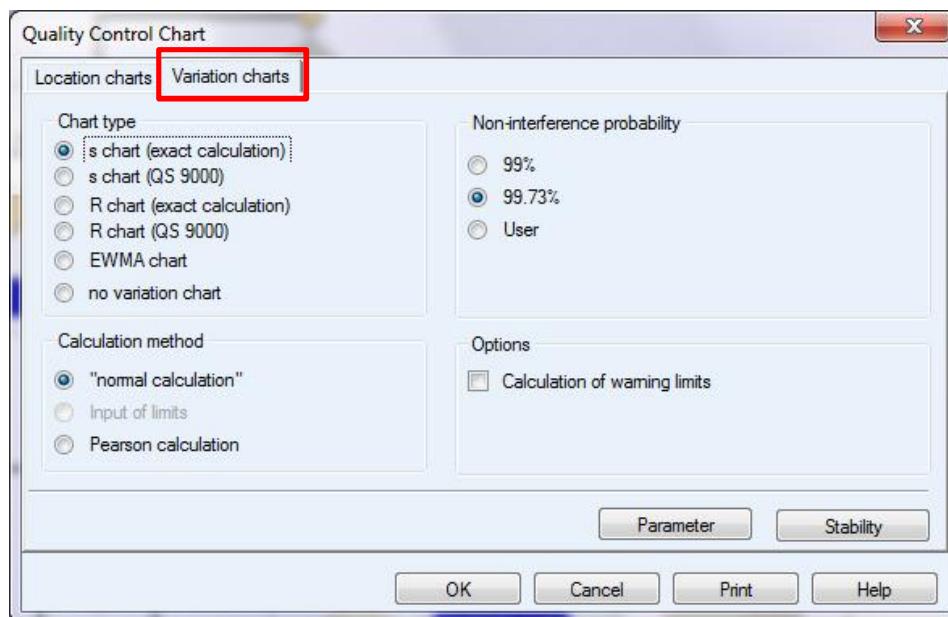
2.1.1.11.1.1 Extended Shewhart Chart – Quality Control Chart – Location Charts –Parameter



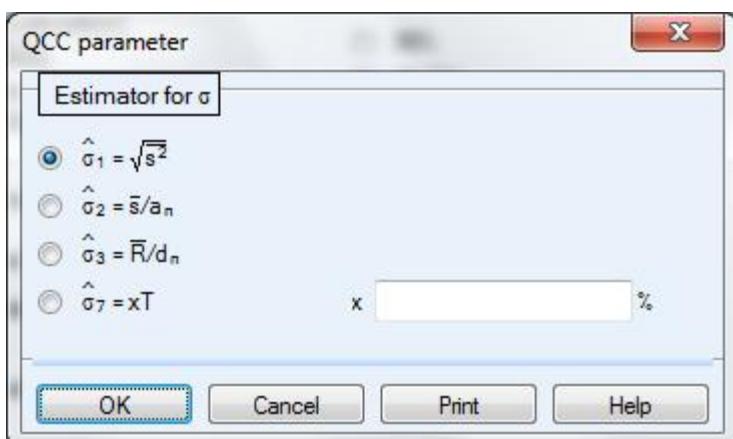
2.1.1.11.1.2 Extended Shewhart Chart – Quality Control Chart – Location Charts –Stability



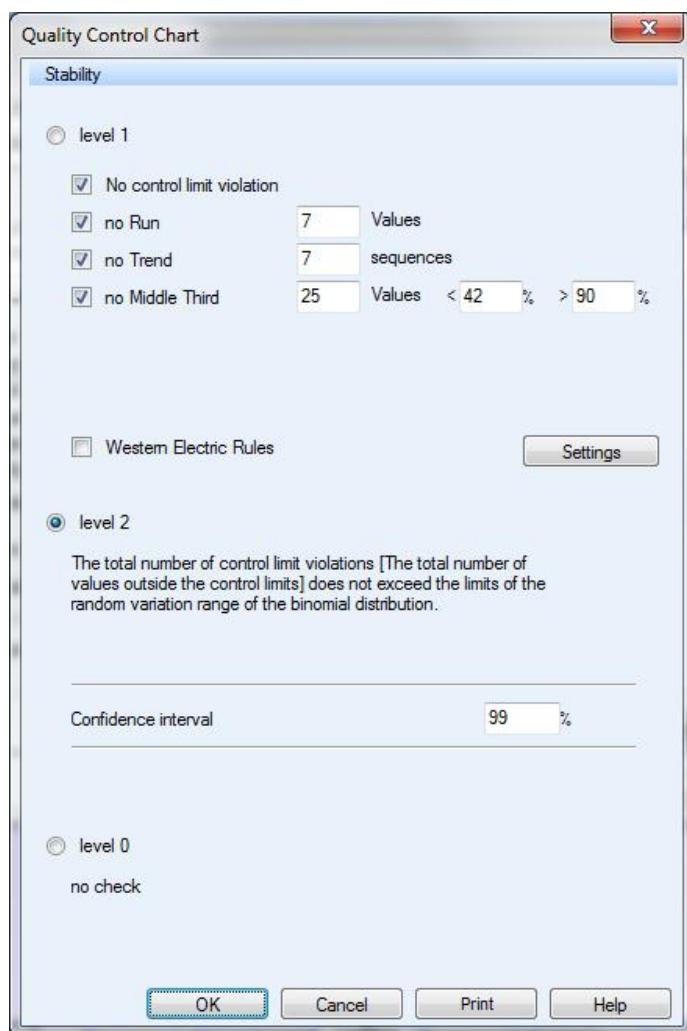
2.1.1.11.2 Extended Shewhart – Quality Control Chart – Variation Charts



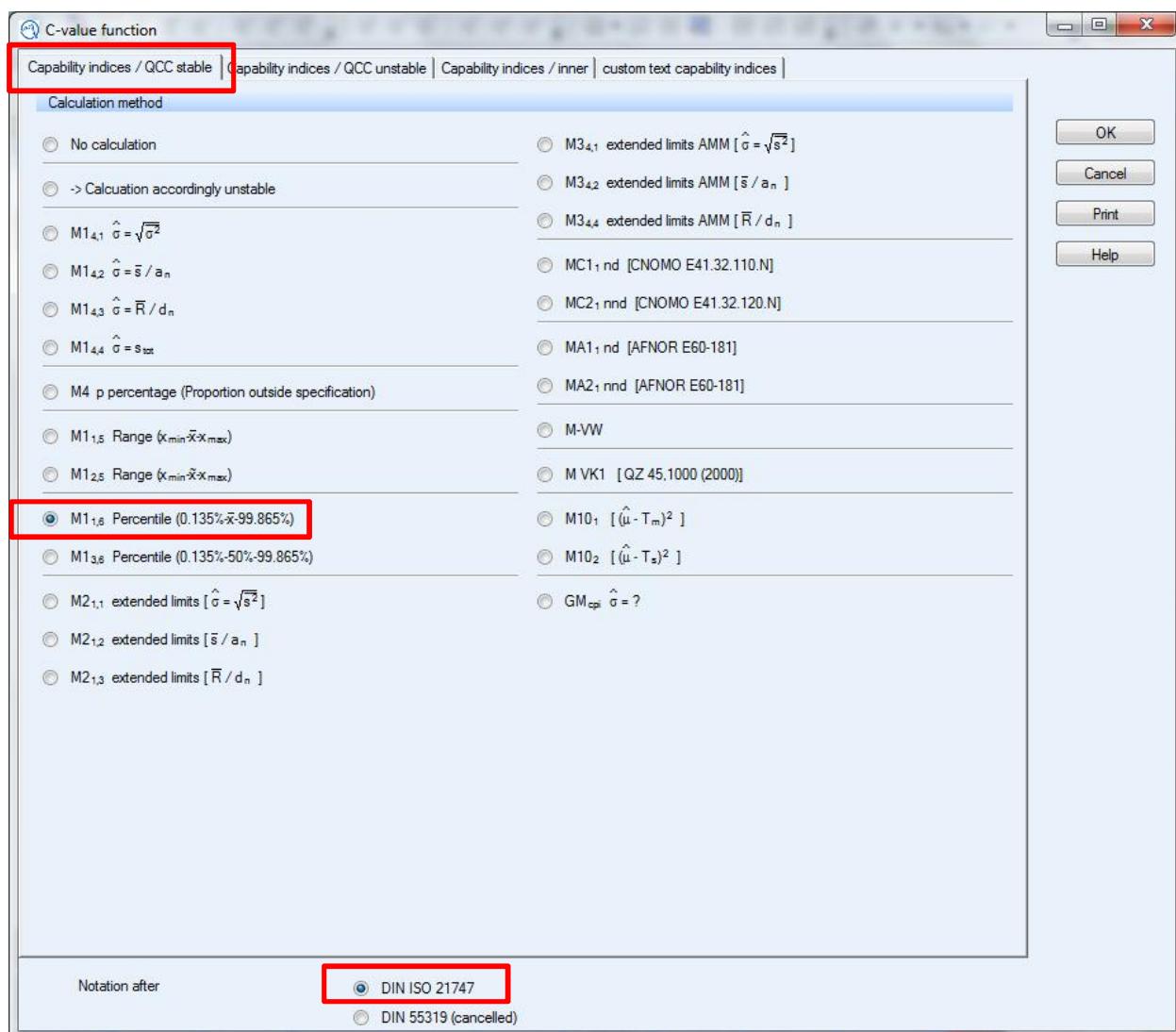
2.1.11.2.1 Extended Shewhart Chart – Quality Control Chart – Variation Charts –Parameter



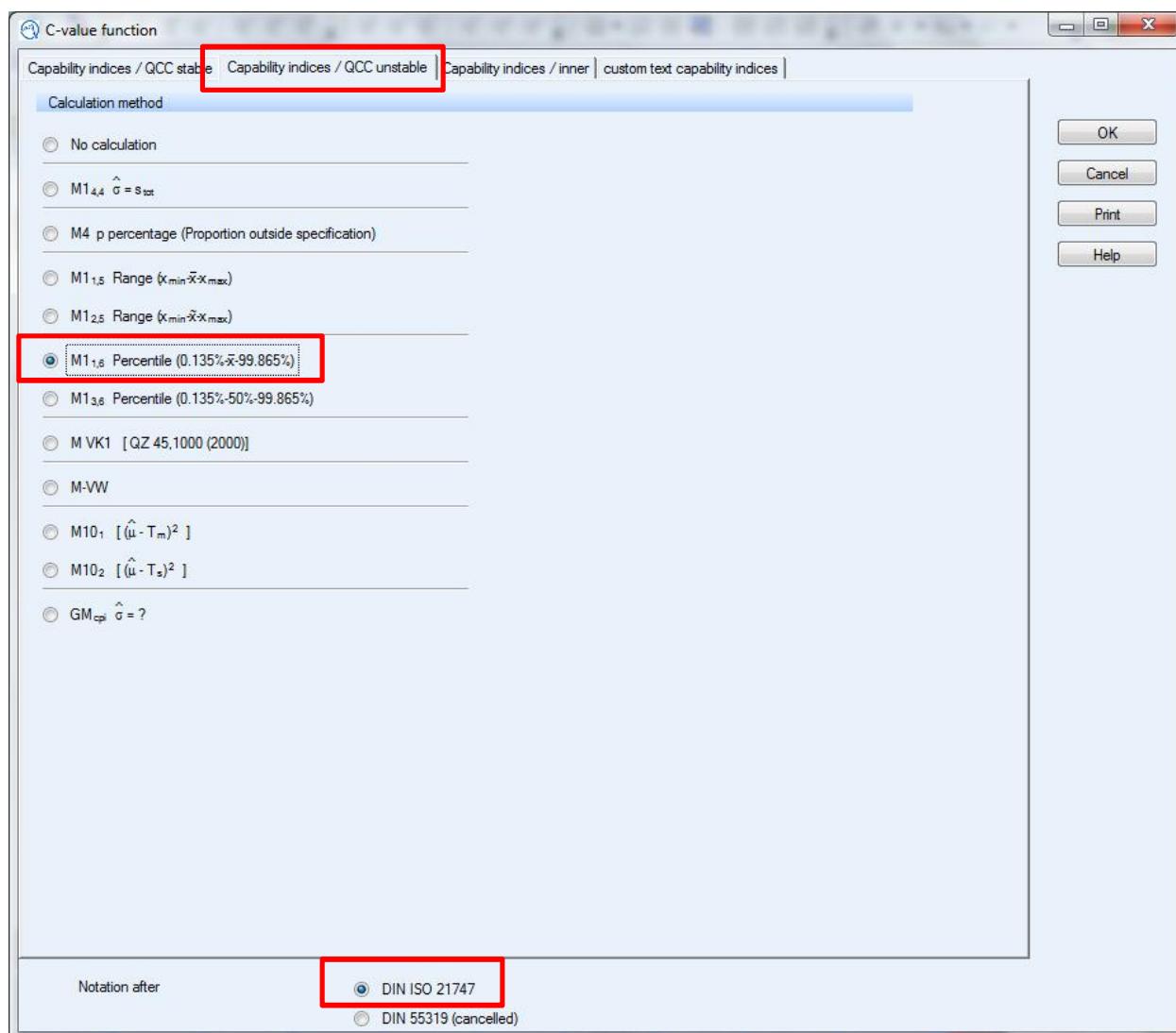
2.1.11.2.2 Extended Shewhart Chart – Quality Control Chart – Variation Charts –Stability



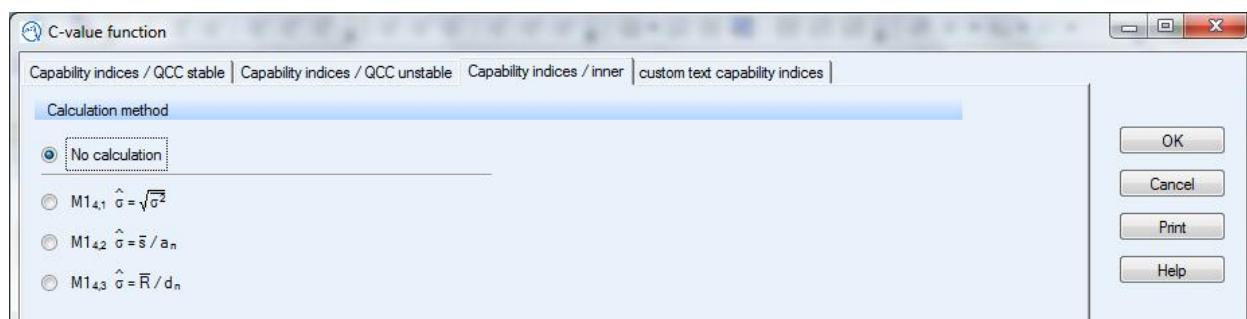
2.1.1.12 C-Value function – Capability indices/QCC stable



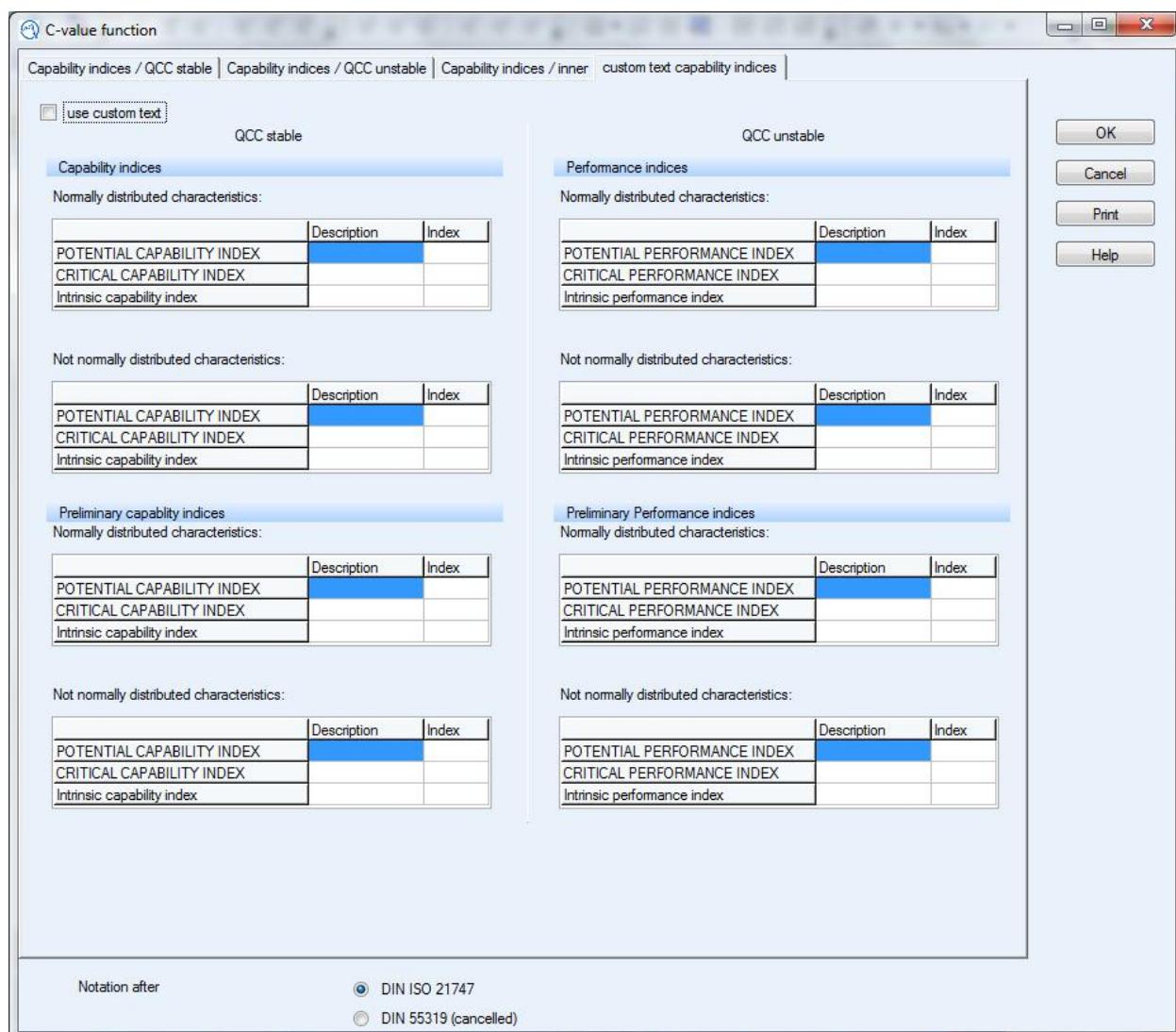
2.1.1.13 C-Value Function – Capability indices/QCC unstable



2.1.1.14 C-Value Function – Capability indices/inner

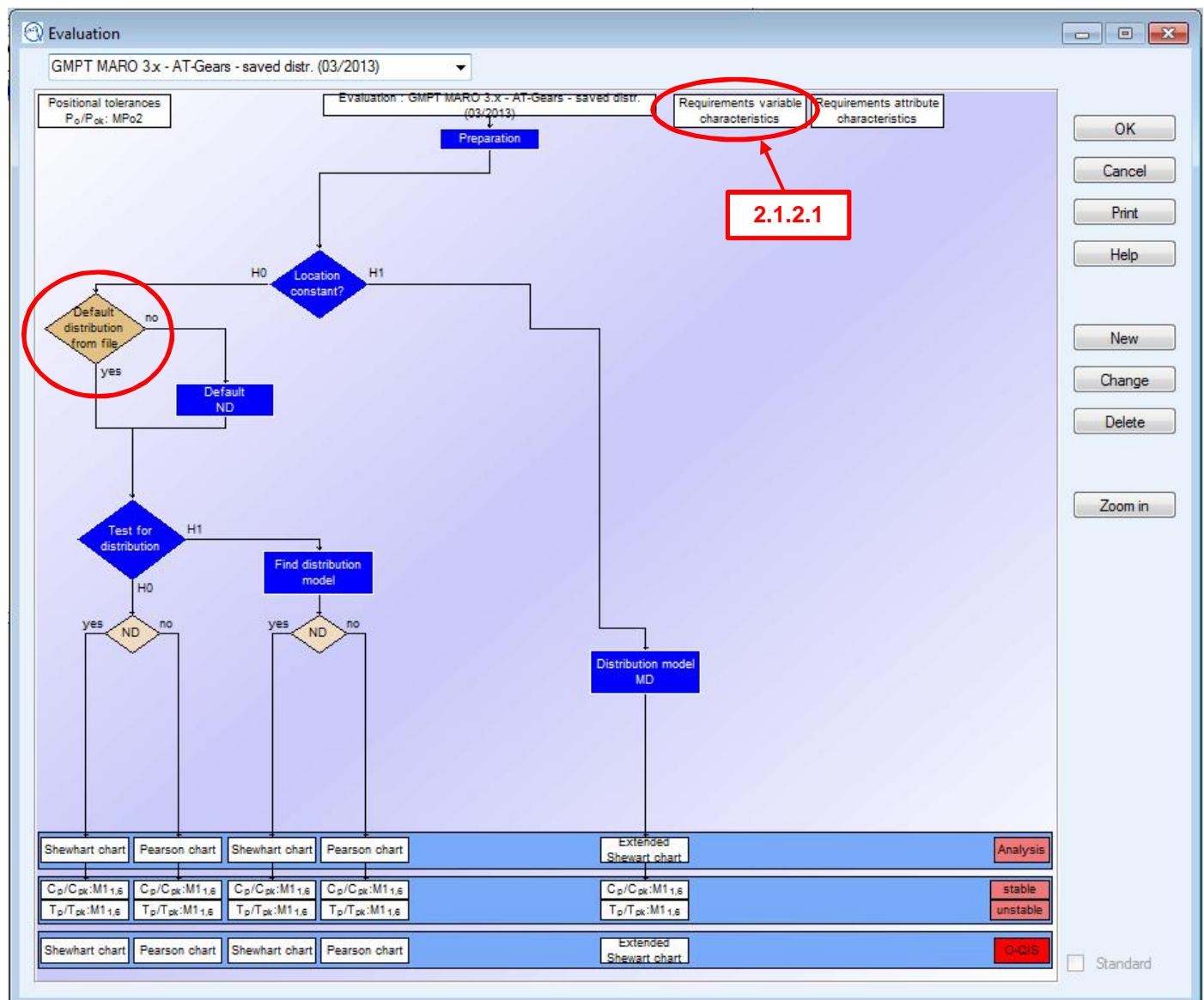


2.1.1.15 C-Value Function – custom text capability indices



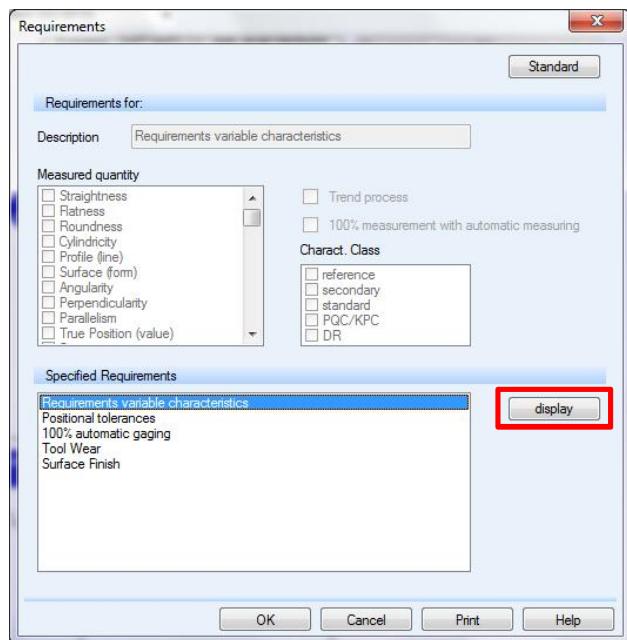
2.1.2 Capability Studies – Automatic Transmission Gears – Differences from generic method only

This chapter shows the differences to the generic evaluation method as shown in chapter 2.1.1 only.

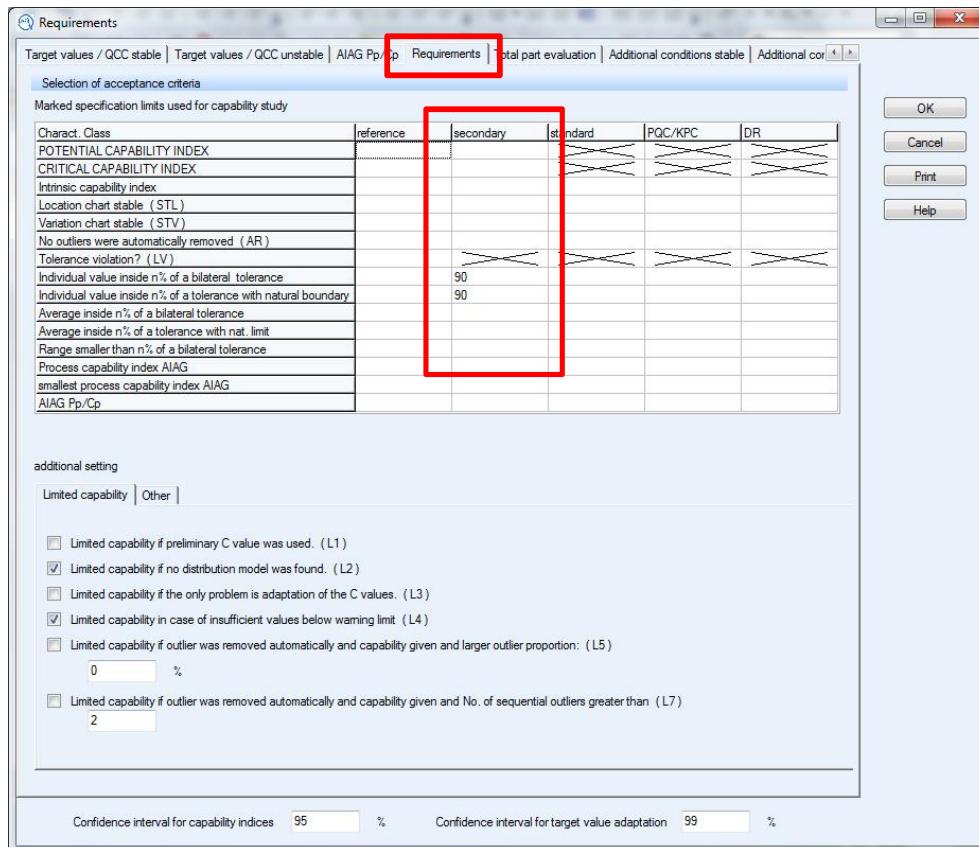


2.1.2.1 Requirements Variable Characteristics– Differences only

2.1.2.1.1 Requirements Variable Characteristics– Differences only

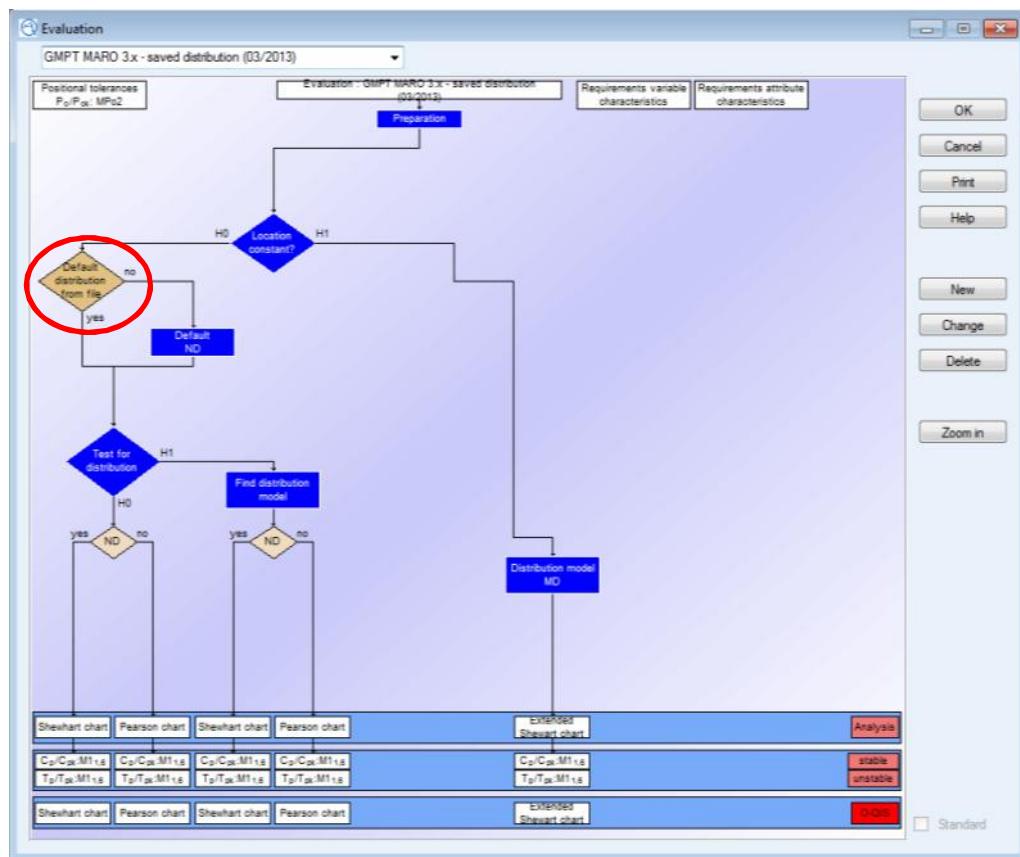


2.1.2.1.1.1 Requirements Variable Characteristics – Requirements – Differences only



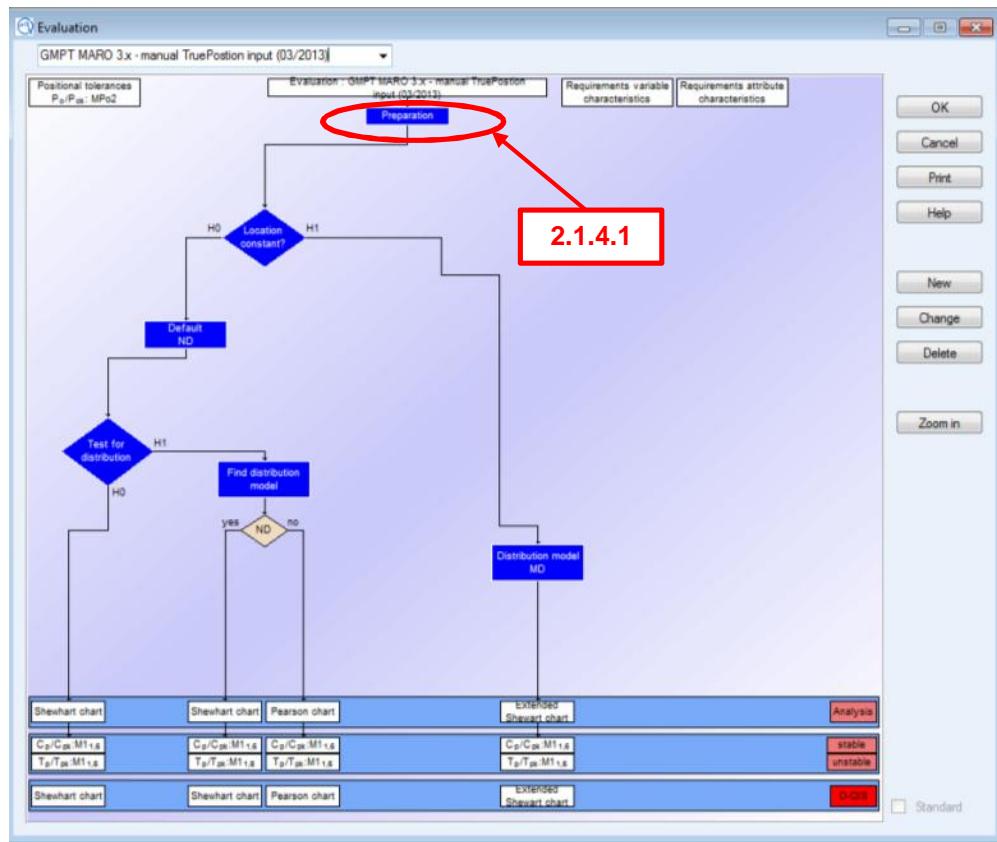
2.1.3 Capability Studies – Saved distribution – Differences from generic method only

This chapter shows the differences to the generic evaluation method as shown in chapter 2.1.1 only.



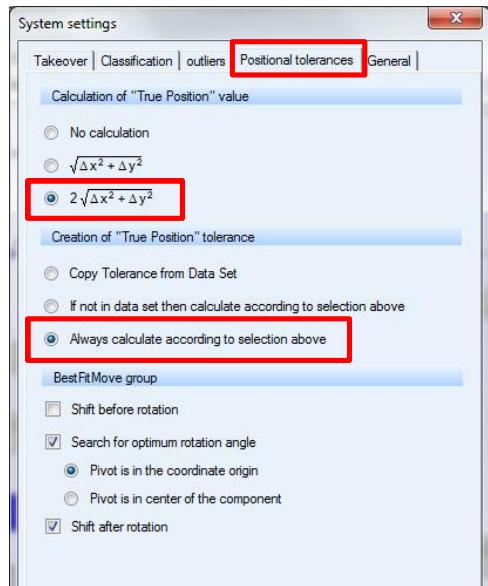
2.1.4 Capability Studies – manual True Position input – Differences from generic method only

This chapter shows the differences to the generic evaluation method as shown in chapter 2.1.1 only.



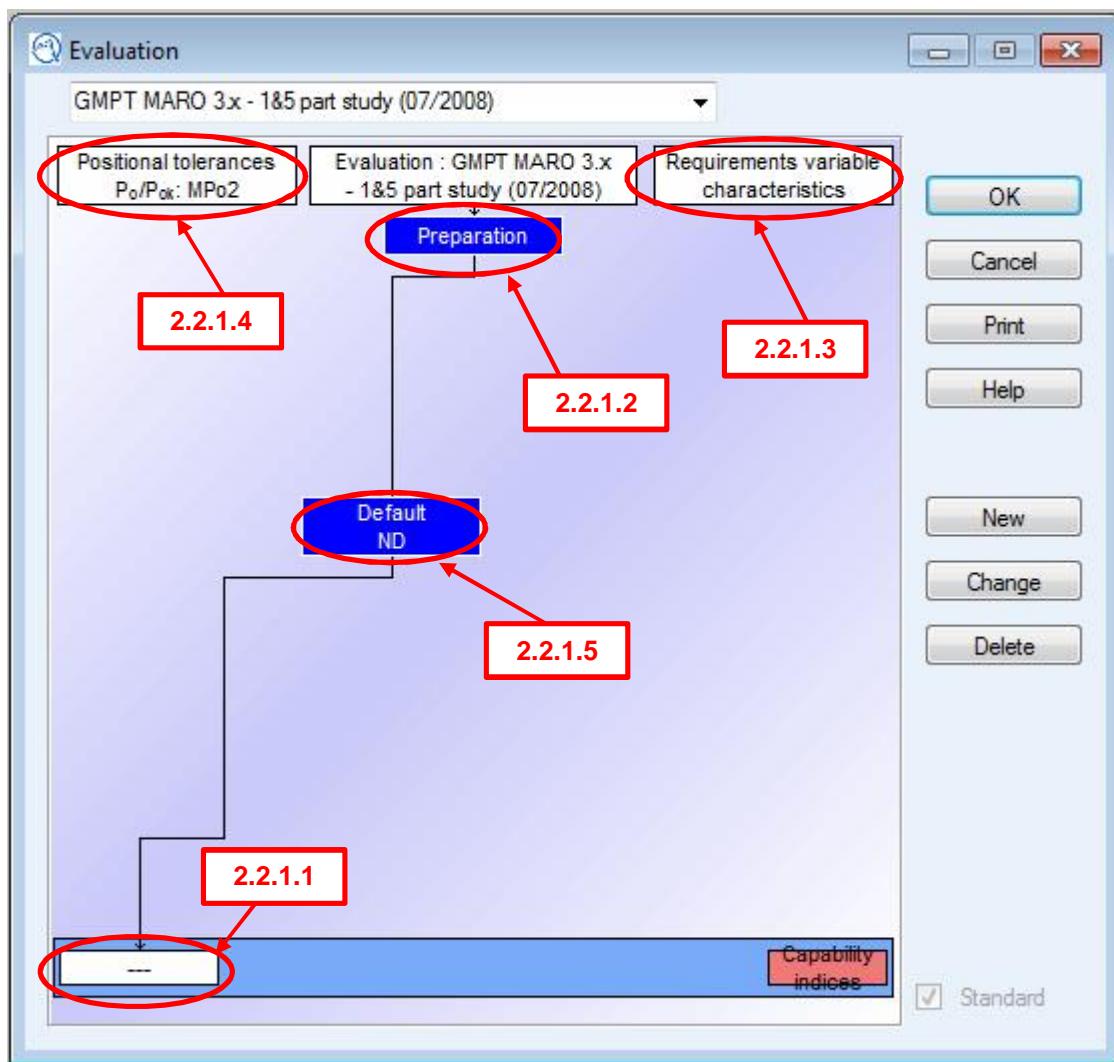
2.1.4.1 Preparations – Differences only

2.1.4.1.1 Preparations – Positional Tolerances – Differences only

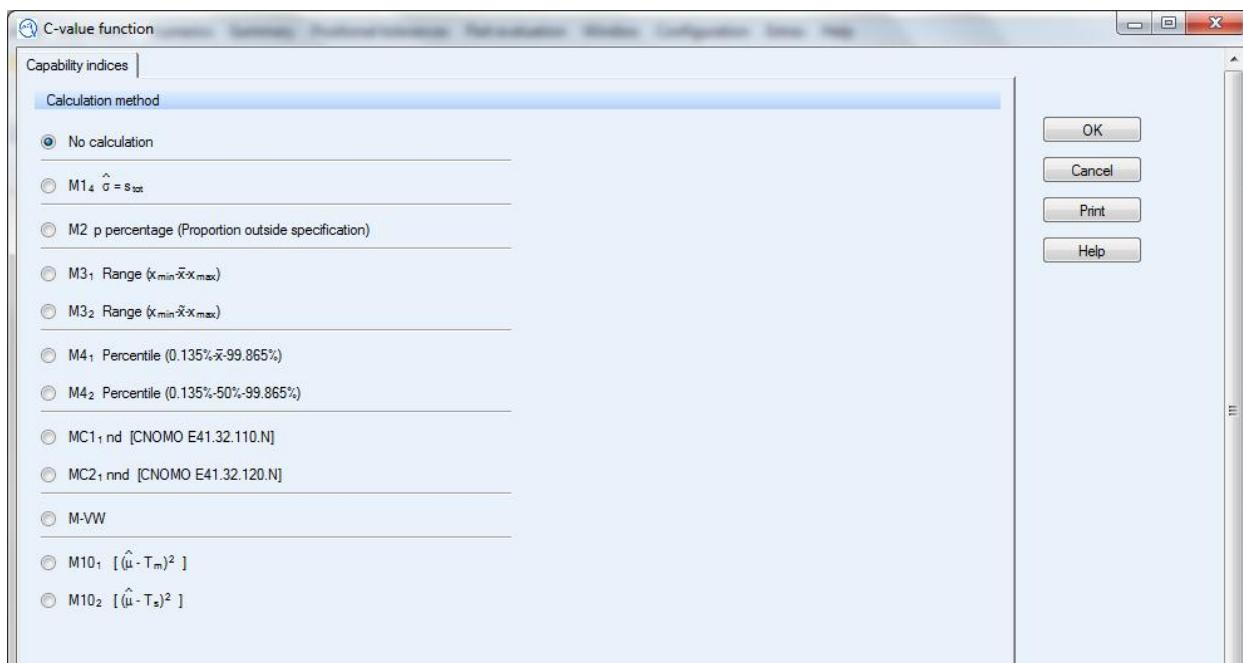


2.2 THE FOLLOWING IS THE CONFIGURATION OF EVALUATION FOR VERSION 3.X IN QS-STAT VERSION ME V10 AND HIGHER FOR SAMPLE ANALYSIS

2.2.1 1 & 5 part Study – Configuration of Evaluation

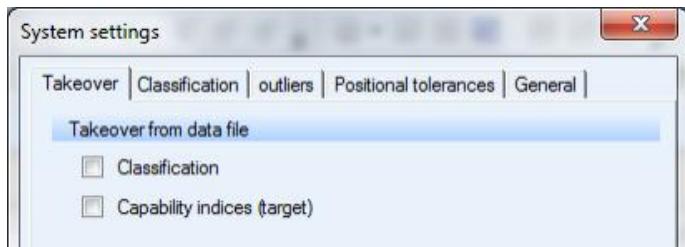


2.2.1.1 C-Value – Capability indices

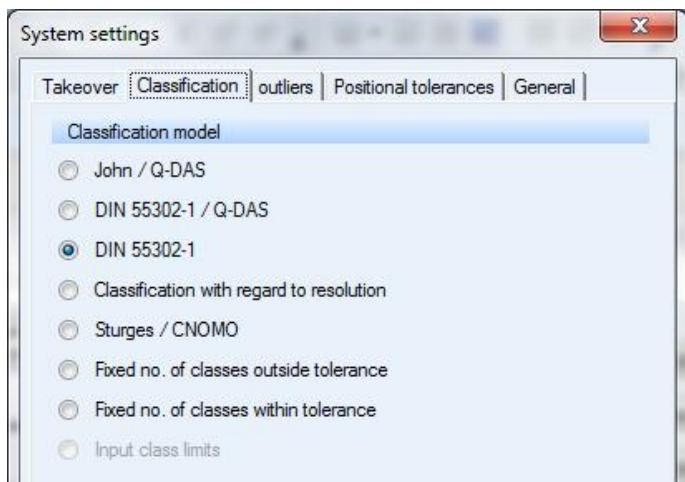


2.2.1.2 Preparation – System Settings

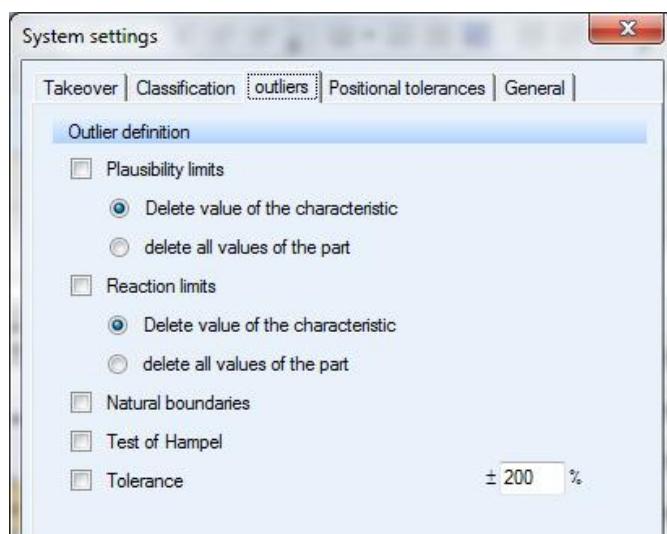
2.2.1.2.1 Preparation – System Settings – Takeover



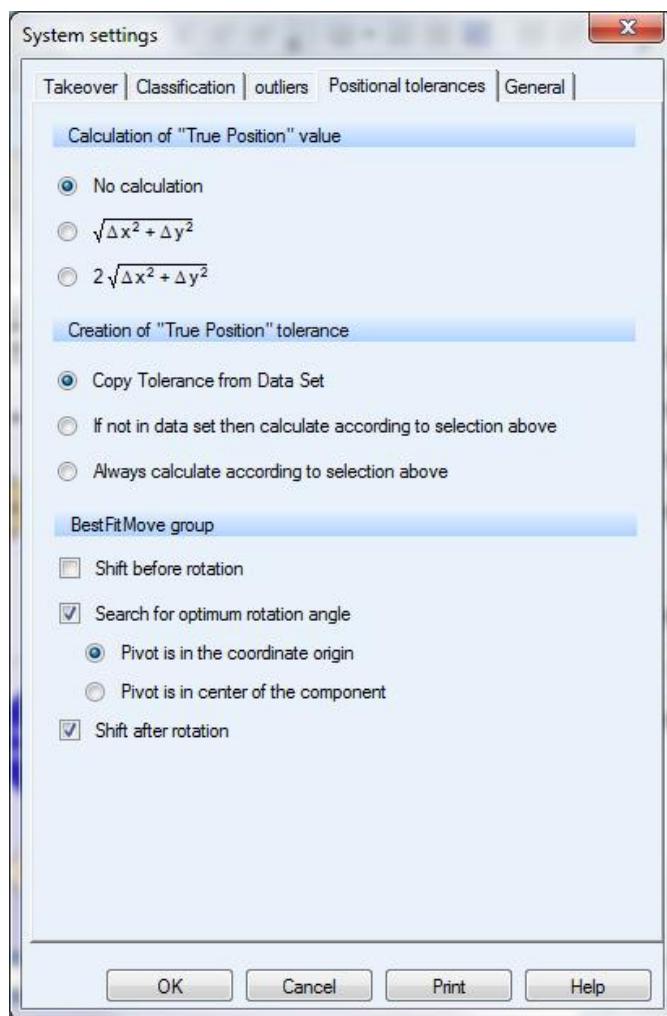
2.2.1.2.2 Preparation – System Settings – Classification



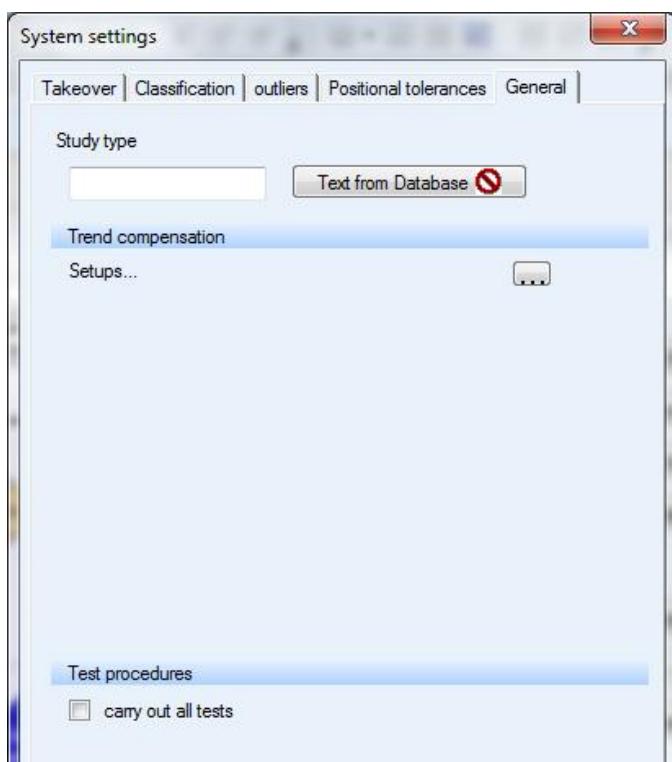
2.2.1.2.3 Preparation – System Settings – Outliers



2.2.1.2.4 Preparation – System Settings – Positional Tolerances

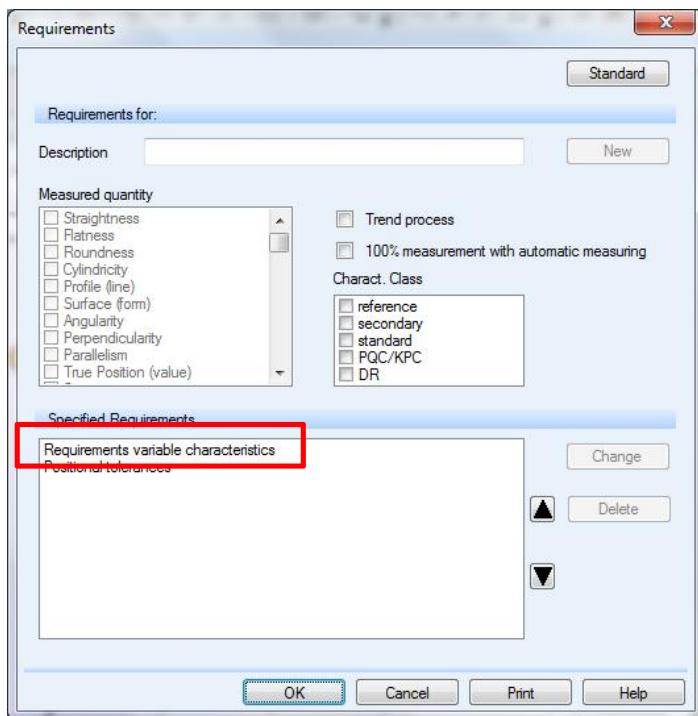


2.2.1.2.5 Preparation – System Settings – General



2.2.1.3 Requirements Variable Characteristics

2.2.1.3.1 Requirements Variable Characteristics



2.2.1.3.1.1 Requirements Variable Characteristics – Requirements

Requirements

Charact. Class	reference	secondary	standard	PQC/KPC	DR
POTENTIAL CAPABILITY INDEX			X	X	X
CRITICAL CAPABILITY INDEX			X	X	X
No outliers were automatically removed (AR)			X	X	X
Tolerance violation? (LV)			X	X	X
Individual value inside n% of a bilateral tolerance					
Individual value inside n% of a tolerance with natural boundary					
Average inside n% of a bilateral tolerance					
Average inside n% of a tolerance with nat. limit					
Range smaller than n% of a bilateral tolerance					

additional setting

Limited capability **Other**

- Limited capability if preliminary C value was used. (L1)
- Limited capability if no distribution model was found. (L2)
- Limited capability if the only problem is adaptation of the C values. (L3)
- Limited capability in case of insufficient values below warning limit (L4)
- Limited capability if outlier was removed automatically and capability given and larger outlier proportion: (L5)

0 %

- Limited capability if outlier was removed automatically and capability given and No. of sequential outliers greater than (L7)

2

- Limited capability if test reacts to test for trend (L6)

additional setting

Limited capability **Other**

Tolerances with natural boundaries

- Apply potential capability index also to the tolerances with natural boundaries
- Always enable display of potential capability index with natural boundaries

unilateral tolerances

- Accept unilateral tolerance without natural limit

Procedure if R=0

- Evaluation possible

Requirement for intrinsic capability index

- Intrinsic capability index must invariably be > M14

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.2.1.3.1.2 Requirements Variable Characteristics – Requirements Pre-run Report

Target values | Requirements | Total part evaluation | Part Anomaly Analysis (PAA) | Additional conditions | Requirements pre-run report | AFNOR settings |

Requirements for the first part

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Individual value inside n% of a bilateral tolerance			25	25	25
Individual value inside n% of a tolerance with natural boundary			62.5	62.5	62.5
Individual value inside a unilateral tolerance					
Single value within n% of a tolerance in a trend process			42.5	42.5	42.5

Requirements for the first subgroup

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Average inside n% of a bilateral tolerance	25	25	25	25	25
Average inside n% of a tolerance with nat. limit	62.5	62.5	62.5	62.5	62.5
Average inside of a unilateral tolerance					
Range smaller than n% of a bilateral tolerance	25	25	25	25	25
Average inside n% of a tolerance with trend process	42.5	42.5	42.5	42.5	42.5

Location of the permitted interval within a bilateral tolerance

- Center around nominal
- Center around tolerance middle
- Center around target value

OK Cancel Print Help

2.2.1.3.1.3 Requirements Variable Characteristics – Target Values (not used)

Target values | Requirements | Total part evaluation | Part Anomaly Analysis (PAA) | Additional conditions | Requirements pre-run report | AFNOR settings |

Capability indices

Index valid?

Normally distributed characteristics: Min. values 50

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	0.01	1.99	C	m
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	1.66	1.66	C	mk

Not normally distributed characteristics: Min. values 50

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	1.99	1.99	C	m
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	1.66	1.66	C	mk

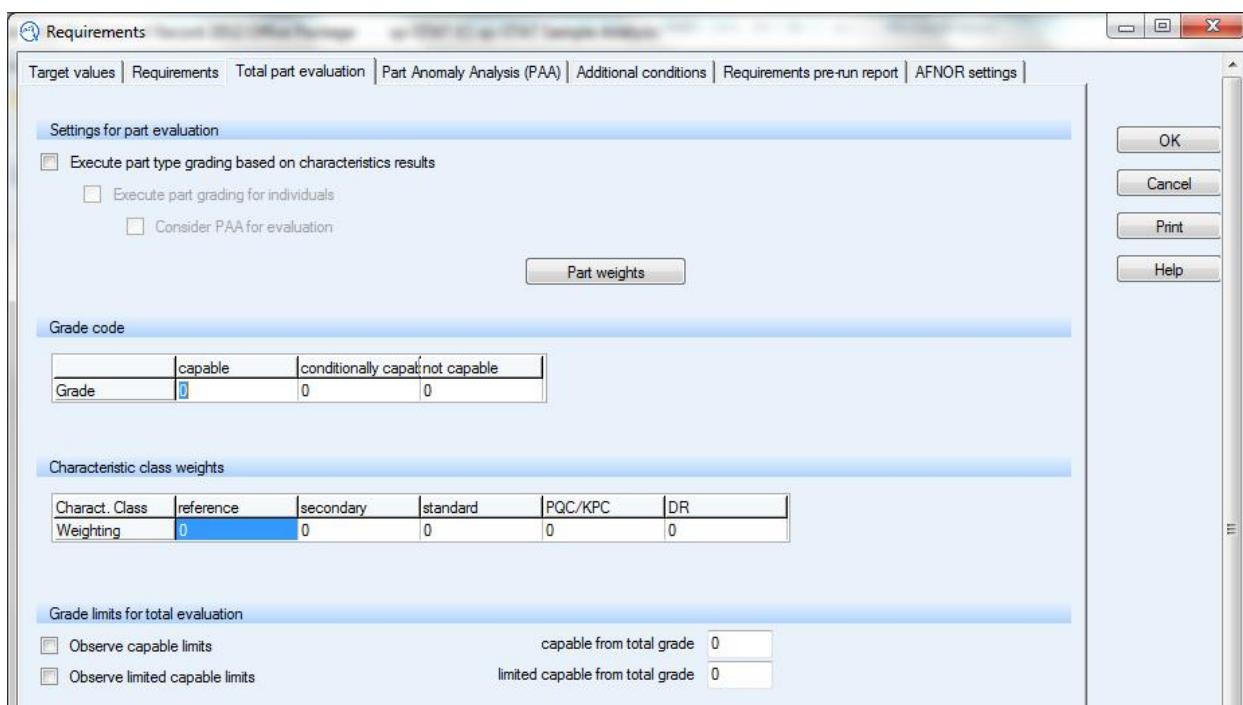
Procedure with few values

Automatic adaptation of target values Limit not depending on Cp and Cpk
 Raise Cp to Cpk.
 Reduce Cpk to Cp

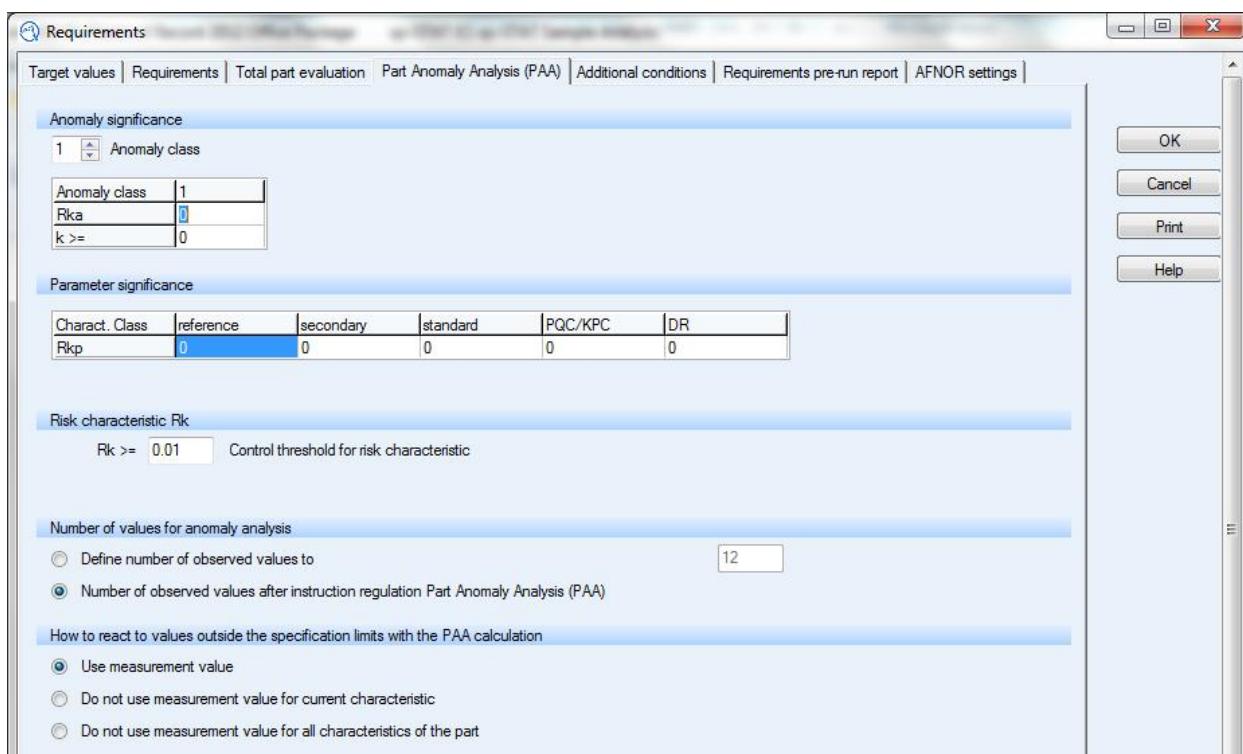
Warning limit for insufficient values Limit

OK Cancel Print Help

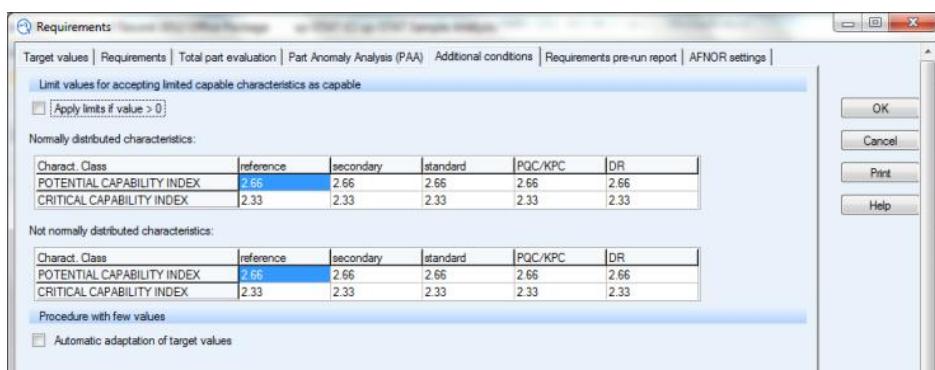
2.2.1.3.1.4 Requirements Variable Characteristics – Total part evaluation (not used)



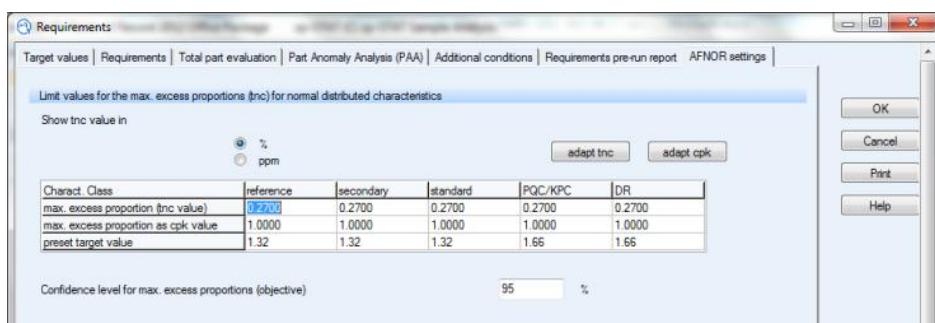
2.2.1.3.1.5 Requirements Variable Characteristics – Part Anomaly Analysis (PAA) (not used)



2.2.1.3.1.6 Requirements Variable Characteristics – Additional conditions (not used)

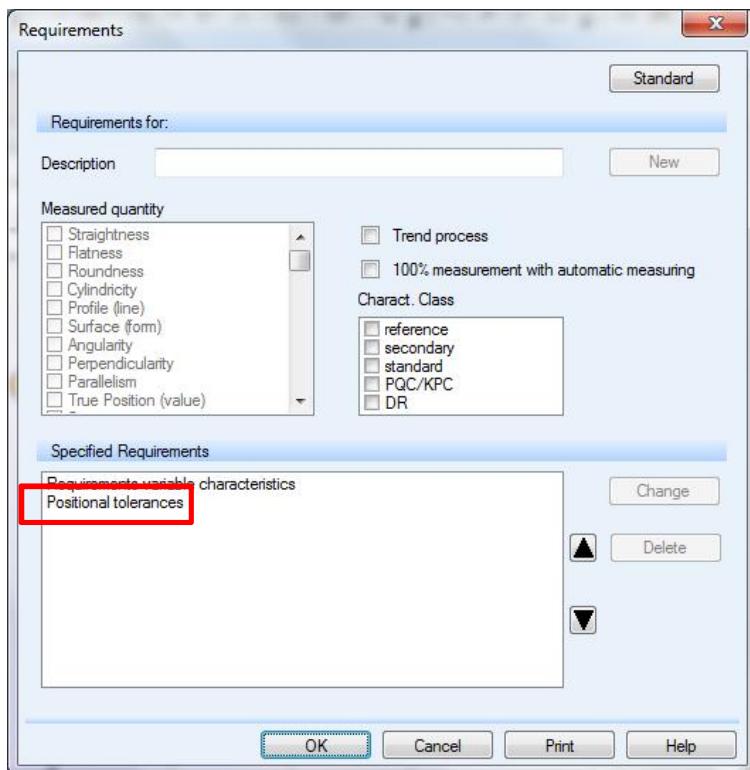


2.2.1.3.1.7 Requirements Variable Characteristics – AFNOR settings (not used)

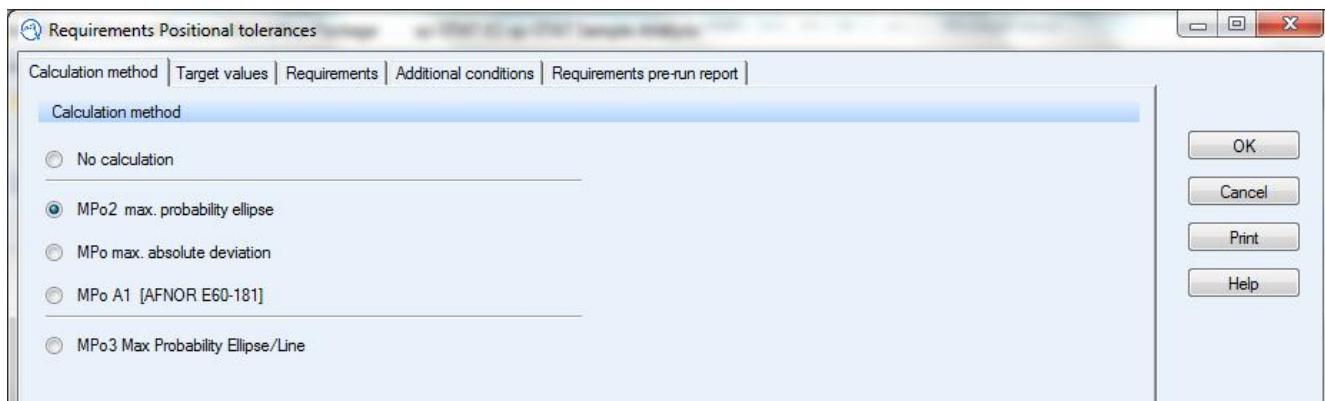


2.2.1.4 Requirements Positional Tolerances P_o/P_{ok} : MPo2

2.2.1.4.1 Requirements Positional Tolerances



2.2.1.4.1.1 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Calculation Method



2.2.1.4.1.2 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Target Values

Requirements Positional tolerances

Calculation method | Target values | Requirements | Additional conditions | Requirements pre-run report |

Capability indices

Index valid?

all characteristics: Min. values 5

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	0.01	0.01	2	2.2	2	P	o
CRITICAL CAPABILITY INDEX	0.01	0.01	2	2.2	2	P	ok

Procedure with few values

Automatic adaptation of target values Limit: not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

Warning limit for insufficient values Limit:

OK Cancel Print Help

2.2.1.4.1.3 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Requirements

Requirements Positional tolerances

Calculation method | Target values | Requirements | Additional conditions | Requirements pre-run report |

Selection of acceptance criteria

Marked specification limits used for capability study

Charact. Class	reference	secondary	standard	PQC/KPC	DR
POTENTIAL CAPABILITY INDEX			X	X	X
CRITICAL CAPABILITY INDEX			X	X	X
No outliers were automatically removed (AR)					
Tolerance violation? (LV)			X	X	X

OK Cancel Print Help

additional setting

Limited capability |

Limited capability if preliminary C value was used. (L1)
 Limited capability if no distribution model was found. (L2)
 Limited capability if the only problem is adaptation of the C values. (L3)
 Limited capability in case of insufficient values below warning limit (L4)
 Limited capability if outlier was removed automatically and capability given and larger outlier proportion: (L5)
 Limited capability if outlier was removed automatically and capability given and No. of sequential outliers greater than (L7)
 Limited capability if test reacts to trend (L6)

0 %
2

2.2.1.4.1.4 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Requirements Pre-run Report

Requirements Positional tolerances

Calculation method | Target values | Requirements | Additional conditions | Requirements pre-run report | Requirements pre-run report.

Only filled-in fields are used

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Individual value inside n% of a bilateral tolerance			50	50	50
Individual value inside n% of a tolerance with natural boundary			50	50	50
Individual value inside a unilateral tolerance			50	50	50
Single value within n% of a tolerance in a trend process			50	50	50

Requirements for the first subgroup

Size of the first subgroup: 5

Only filled-in fields are used

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Average inside n% of a bilateral tolerance					
Average inside n% of a tolerance with nat. limit					
Average inside of a unilateral tolerance					
Range smaller than n% of a bilateral tolerance					
Average inside n% of a tolerance with trend process					

Location of the permitted interval within a bilateral tolerance

Center around nominal
 Center around tolerance middle
 Center around target value

OK Cancel Print Help

2.2.1.4.1.5 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Additional conditions (not used)

Requirements Positional tolerances

Calculation method | Target values | Requirements | Additional conditions | Requirements pre-run report | Requirements pre-run report.

Limit values for accepting limited capable characteristics as capable

Apply limits if value > 0

all characteristics:

Charact. Class	reference	secondary	standard	PQC/KPC	DR
POTENTIAL CAPABILITY INDEX	2.66	2.66	2.66	2.66	2.66
CRITICAL CAPABILITY INDEX	2.33	2.33	2.33	2.33	2.33

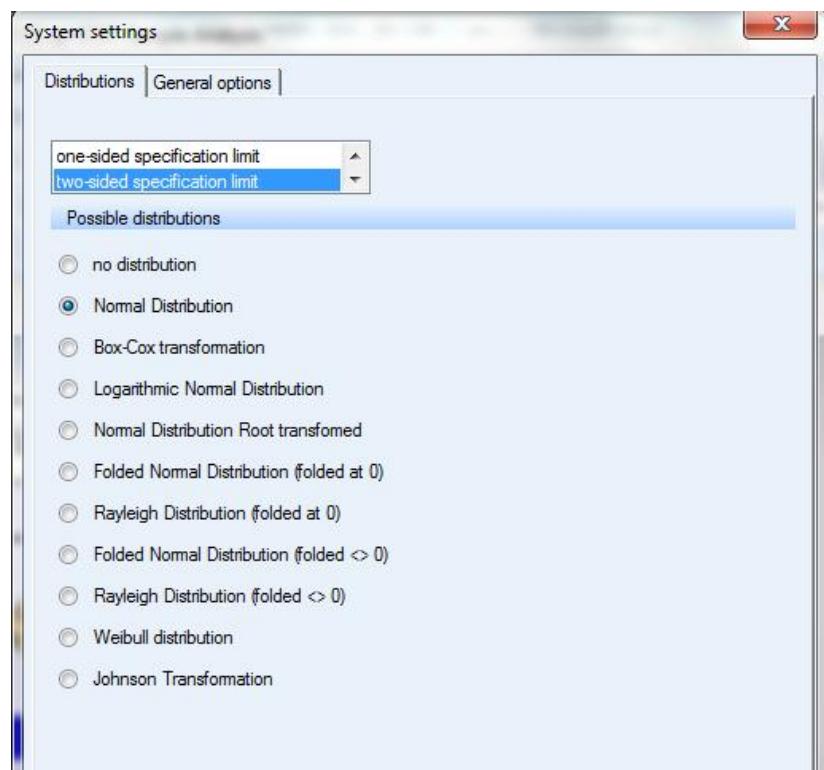
Procedure with few values

Automatic adaptation of target values

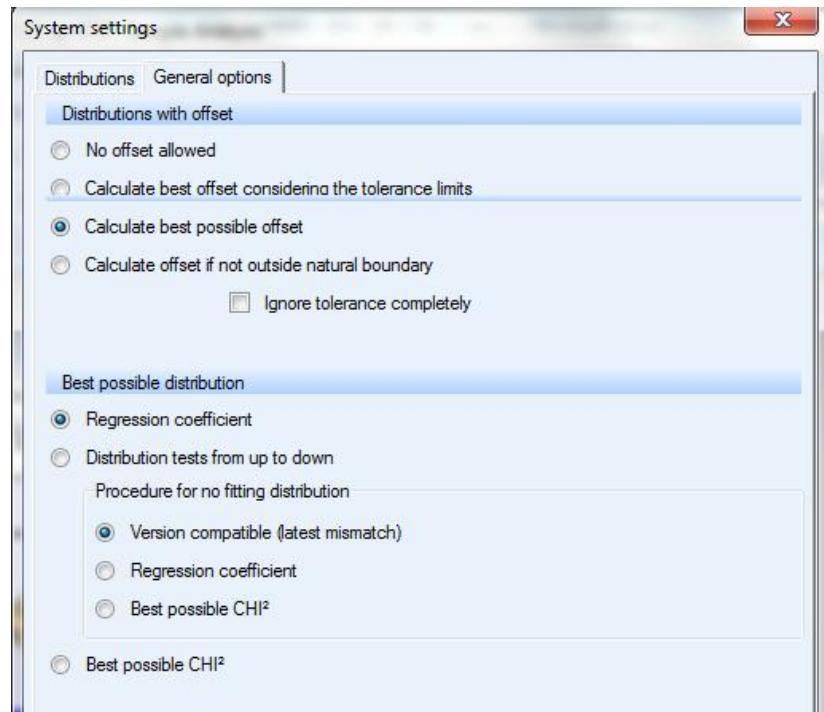
OK Cancel Print Help

2.2.1.5 Default ND

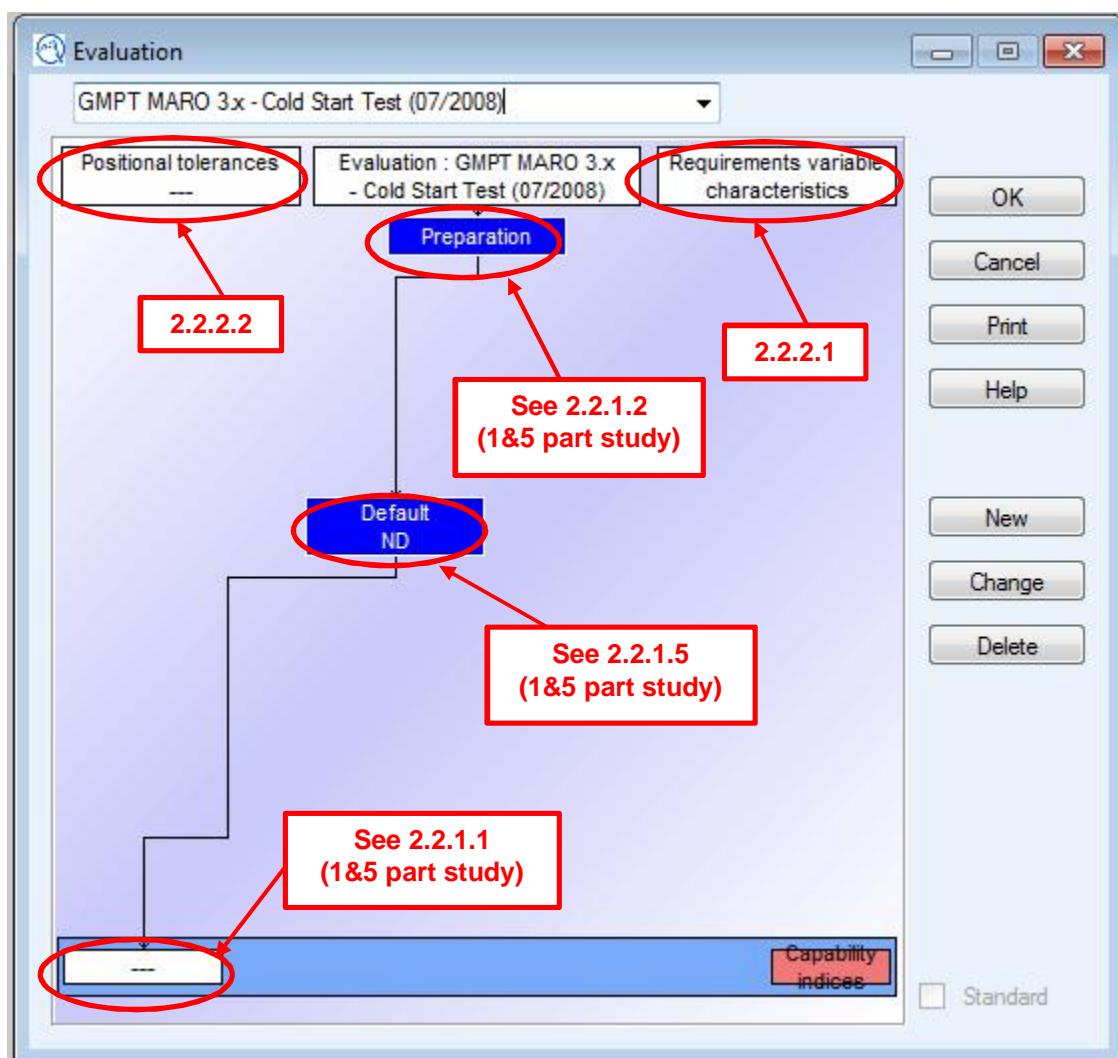
2.2.1.5.1 Default ND – Distributions



2.2.1.5.2 Default ND – General Options

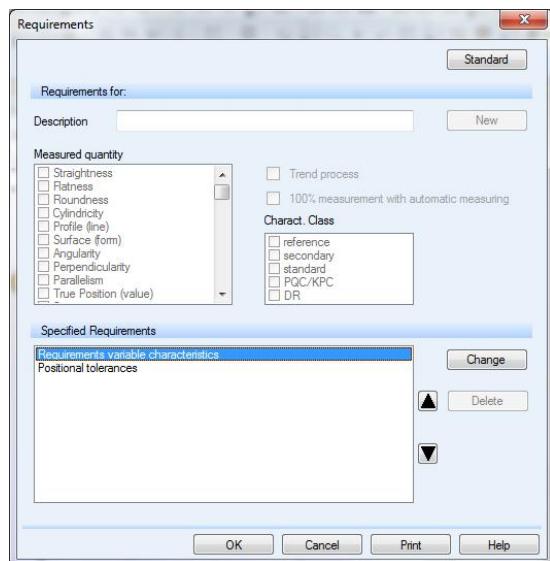


2.2.2 Cold Start Test – Configuration of Evaluation



2.2.2.1 Requirements Variable Characteristics

2.2.2.1.1 Requirements Variable Characteristics



2.2.2.1.1.1 Requirements Variable Characteristics – Requirements

Charact. Class	reference	secondary	standard	PQC/KPC	DR
POTENTIAL CAPABILITY INDEX					
CRITICAL CAPABILITY INDEX					
No outliers were automatically removed (AR)					
Tolerance violation? (LV)	X	X	X	X	X
Individual value inside n% of a bilateral tolerance					
Individual value inside n% of a tolerance with natural boundary					
Average inside n% of a bilateral tolerance					
Average inside n% of a tolerance with nat. limit					
Range smaller than n% of a bilateral tolerance					

additional setting

Limited capability | Other |

- Limited capability if preliminary C value was used. (L1)
- Limited capability if no distribution model was found. (L2)
- Limited capability if the only problem is adaptation of the C values. (L3)
- Limited capability in case of insufficient values below warning limit (L4)
- Limited capability if outlier was removed automatically and capability given and larger outlier proportion: (L5)

0 %

- Limited capability if outlier was removed automatically and capability given and No. of sequential outliers greater than (L7)
- 2
- Limited capability if test reacts to test for trend (L6)

Confidence interval for capability indices 95 % Confidence interval for target value adaptation 99 %

2.2.2.1.1.2 Requirements Variable Characteristics – Requirements pre-run Report

Requirements

Target values | Requirements | Total part evaluation | Part Anomaly Analysis (PAA) | Additional conditions | Requirements pre-run report | AFNOR settings |

Requirements for the first part
Only filled-in fields are used

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Individual value inside n% of a bilateral tolerance			25	25	25
Individual value inside n% of a tolerance with natural boundary			62.5	62.5	62.5
Individual value inside a unilateral tolerance			X	X	X
Single value within n% of a tolerance in a trend process			25	25	25

Requirements for the first subgroup
Size of the first subgroup: 5
Only filled-in fields are used

Charact. Class	reference	secondary	standard	PQC/KPC	DR
Average inside n% of a bilateral tolerance	85	85	85	85	85
Average inside n% of a tolerance with nat. limit	92.5	92.5	92.5	92.5	92.5
Average inside of a unilateral tolerance	X	X	X	X	X
Range smaller than n% of a bilateral tolerance					
Average inside n% of a tolerance with trend process	85	85	85	85	85

Location of the permitted interval within a bilateral tolerance
 Center around nominal
 Center around tolerance middle
 Center around target value

OK **Cancel** **Print** **Help**

2.2.2.1.1.3 Requirements Variable Characteristics – Target Values (not used)

Requirements

Target values | Requirements | Total part evaluation | Part Anomaly Analysis (PAA) | Additional conditions | Requirements pre-run report | AFNOR settings |

Capability indices
 Index valid?

Normally distributed characteristics: Min. values: 50

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	0.01	1.99	C	m
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	1.66	1.66	C	mk

Not normally distributed characteristics: Min. values: 50

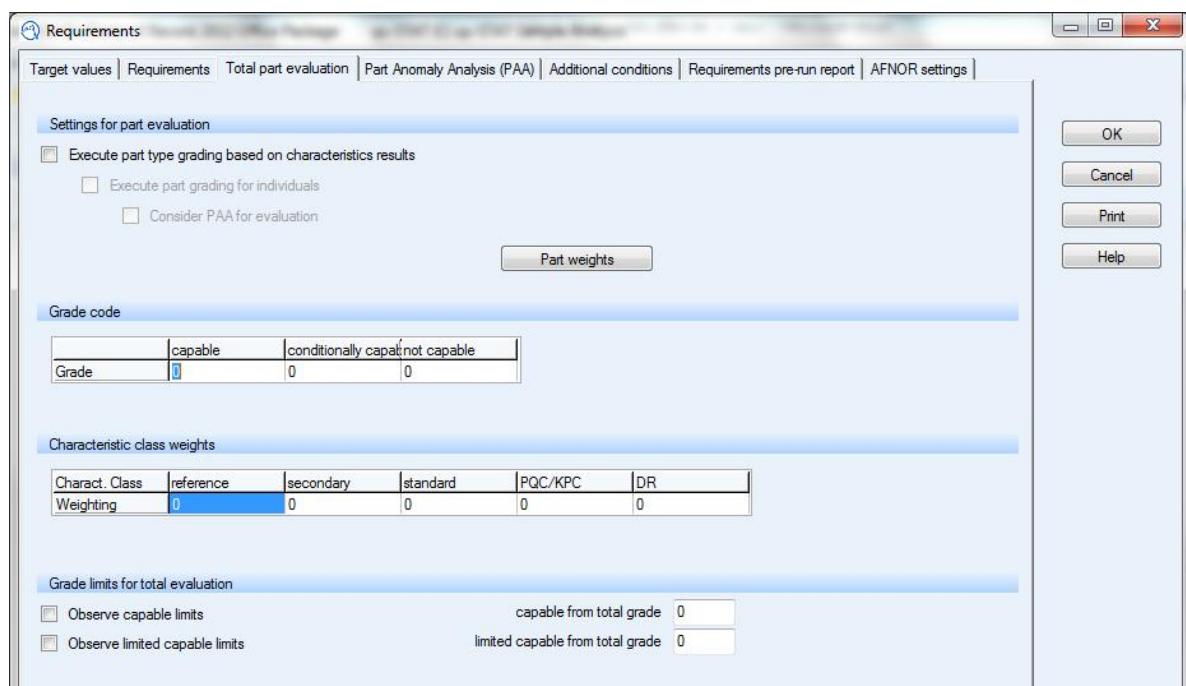
Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	1.32	1.32	1.32	1.99	1.99	C	m
CRITICAL CAPABILITY INDEX	1.32	1.32	1.32	1.66	1.66	C	mk

Procedure with few values
 Automatic adaptation of target values Limit:
 not depending on Cp and Cpk
 Raise Cp to Cpk
 Reduce Cpk to Cp

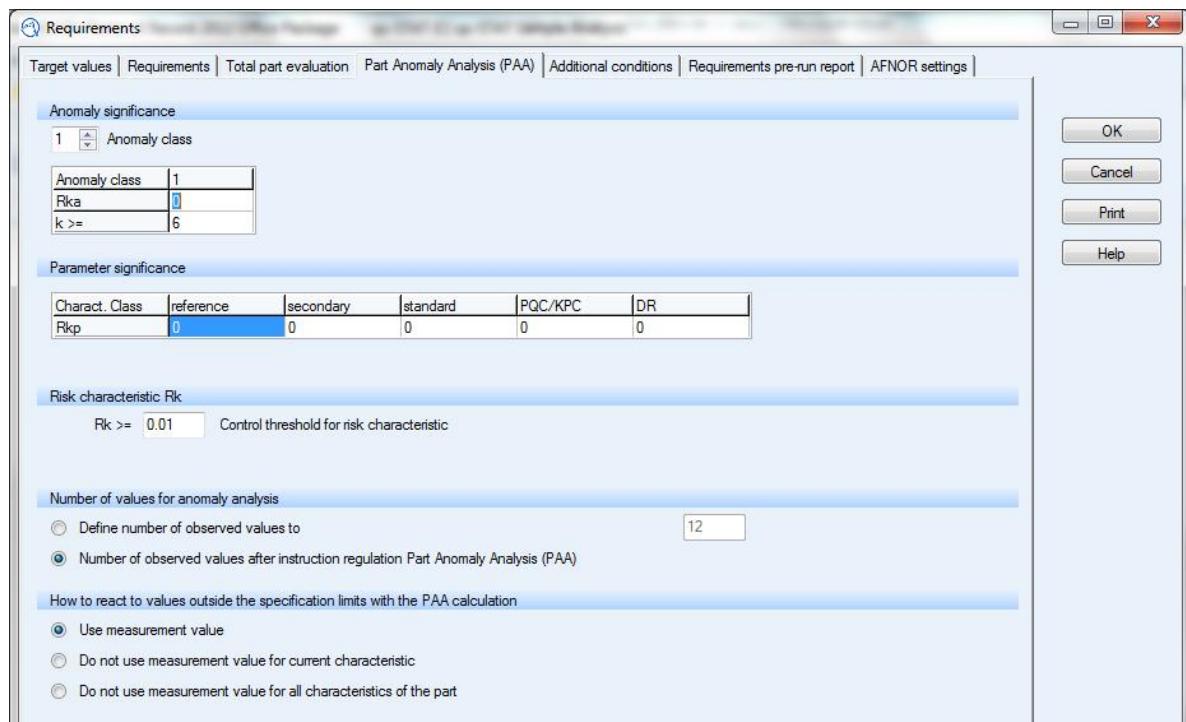
Warning limit for insufficient values Limit:

OK **Cancel** **Print** **Help**

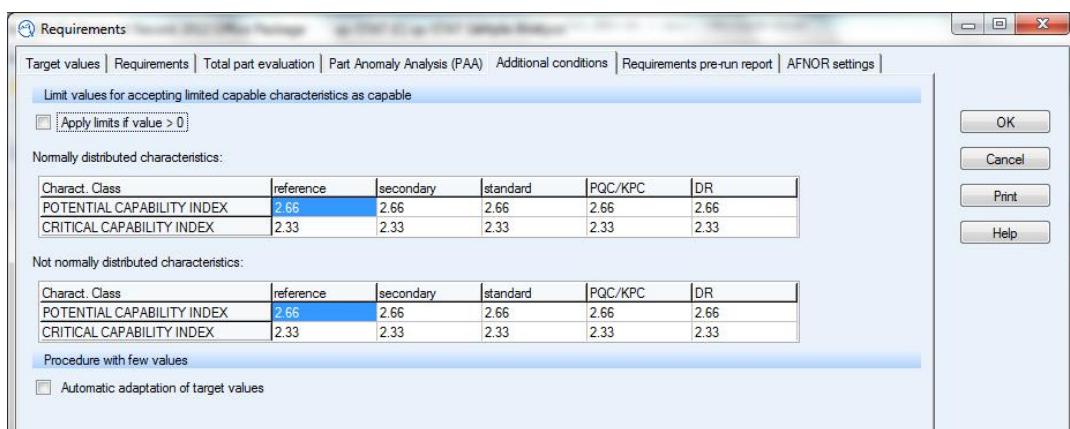
2.2.2.1.1.4 Requirements Variable Characteristics – Total part evaluation (not used)



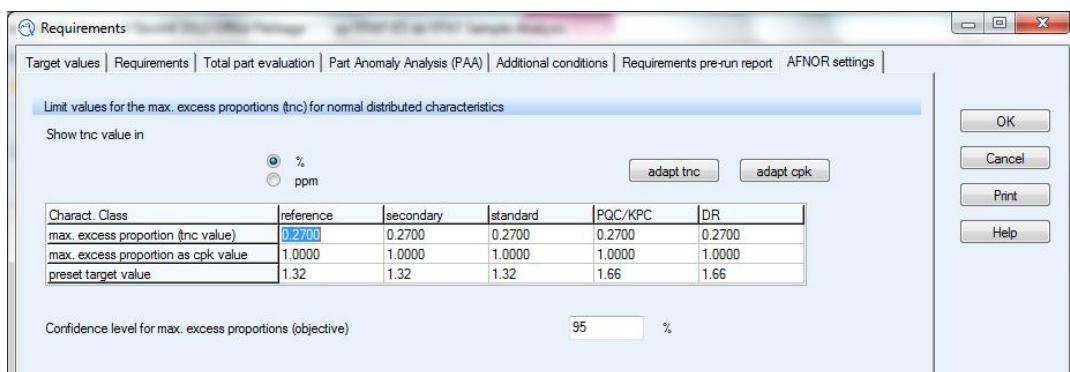
2.2.2.1.1.5 Requirements Variable Characteristics – Part Anomaly Analysis (PAA) (not used)



2.2.2.1.1.6 Requirements Variable Characteristics – Additional conditions (not used)

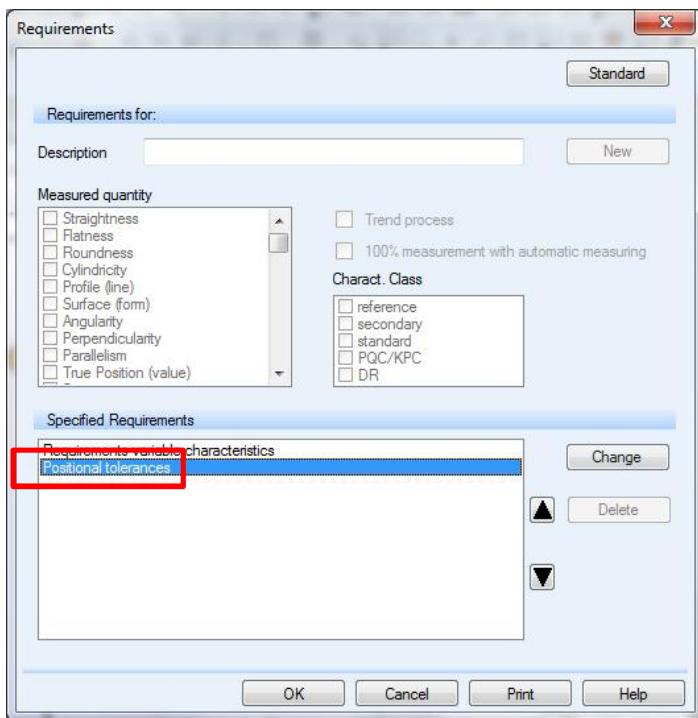


2.2.2.1.1.7 Requirements Variable Characteristics – AFNOR settings (not used)

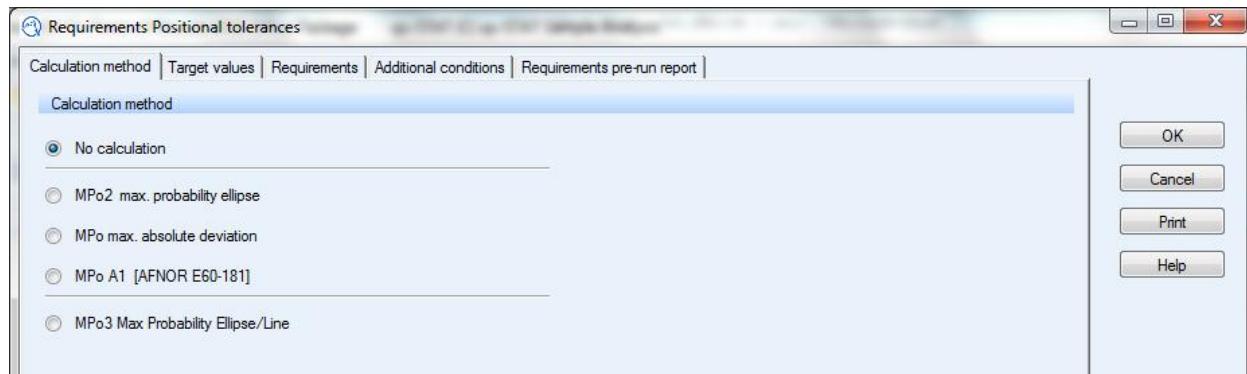


2.2.2.2 Requirements Positional Tolerances P_o/P_{ok} : MPo2

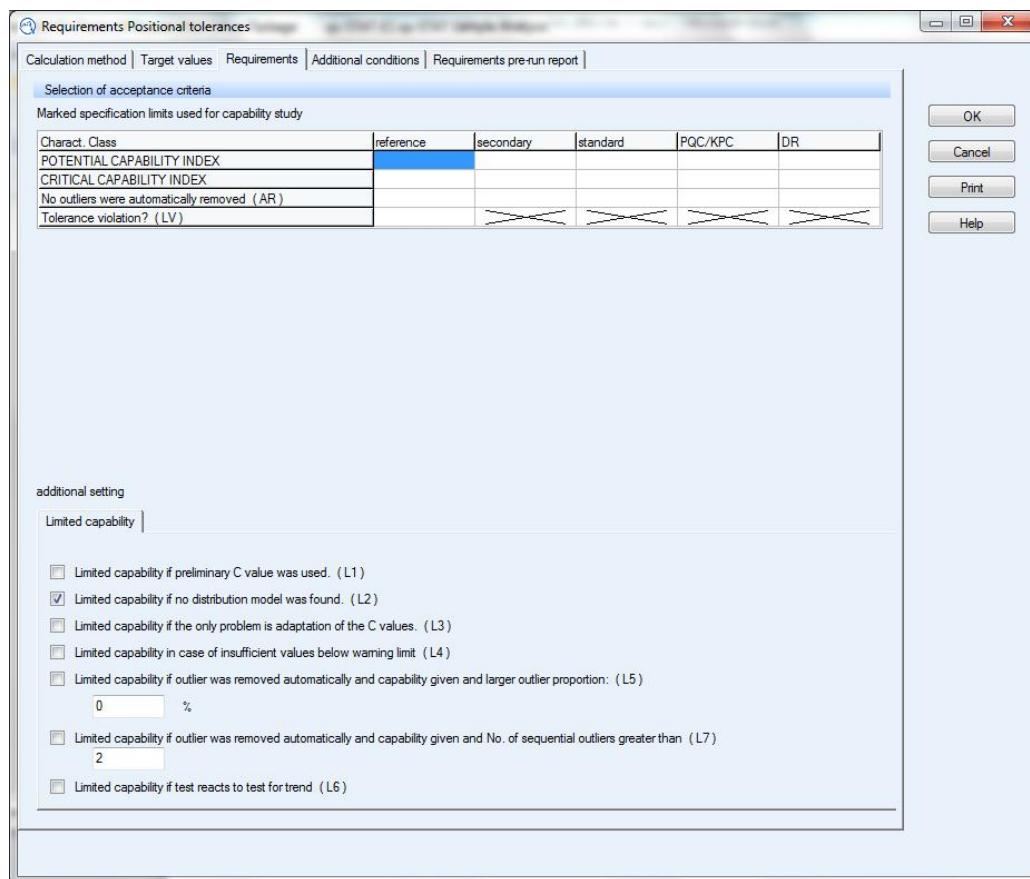
2.2.2.2.1 Requirements Positional Tolerances



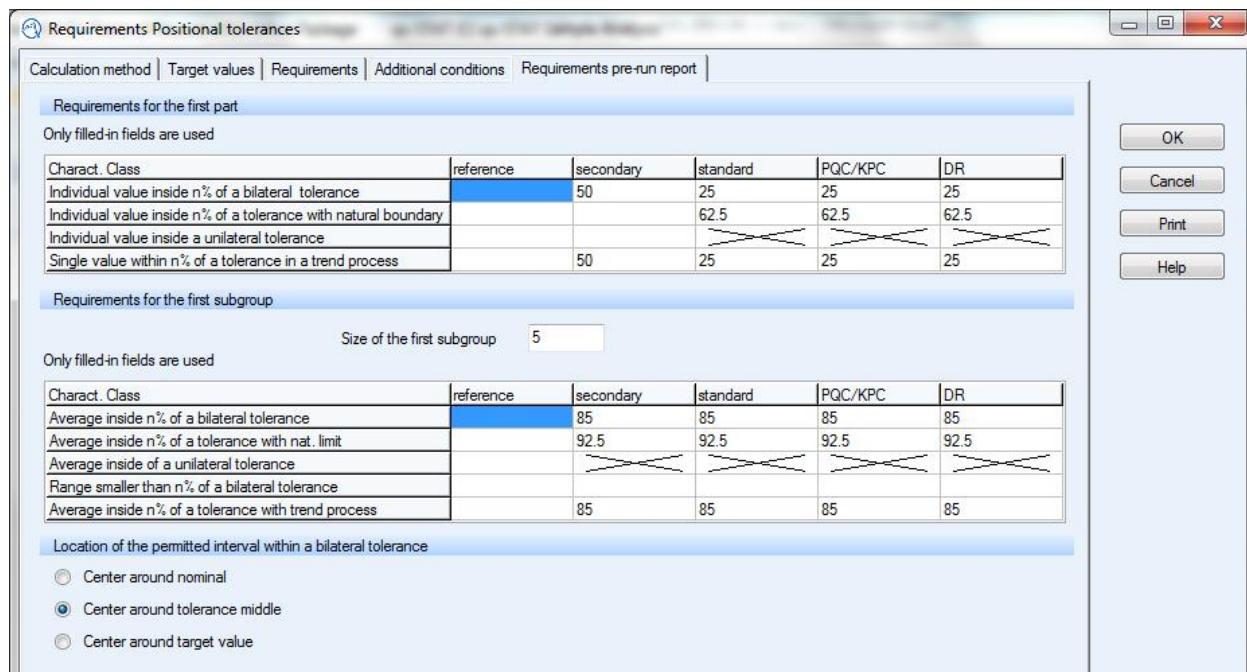
2.2.2.2.1.1 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Calculation Method



2.2.2.2.1.2 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Requirements



2.2.2.2.1.3 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Requirements pre-run report



2.2.2.2.1.4 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Target Values (not used)

The dialog box shows the 'Target values' tab selected. It includes sections for 'Procedure with few values' and 'Procedure with many values'. The 'Procedure with few values' section contains checkboxes for 'Automatic adaptation of target values' and 'Warning limit for insufficient values', along with input fields for 'Limit' and radio buttons for 'not depending on Cp and Cpk', 'Raise Cp to Cpk', and 'Reduce Cpk to Cp'.

Charact. Class	reference	secondary	standard	PQC/KPC	DR	Description	Index
POTENTIAL CAPABILITY INDEX	0.01	0.01	1.99	2.49	2.49	P	o
CRITICAL CAPABILITY INDEX	0.01	0.01	1.99	2.49	2.49	P	ok

2.2.2.2.1.5 Requirements Positional Tolerances P_o/P_{ok} : MPo2 – Additional conditions (not used)

The dialog box shows the 'Additional conditions' tab selected. It includes sections for 'Procedure with few values' and 'Procedure with many values'. The 'Procedure with few values' section contains checkboxes for 'Automatic adaptation of target values' and 'Apply limits if value > 0', along with input fields for 'Limit'.

Charact. Class	reference	secondary	standard	PQC/KPC	DR
POTENTIAL CAPABILITY INDEX	2.66	2.66	2.66	2.66	2.66
CRITICAL CAPABILITY INDEX	2.33	2.33	2.33	2.33	2.33

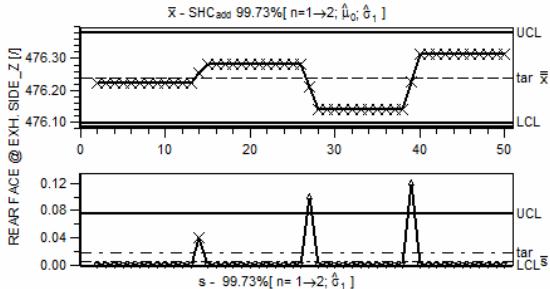
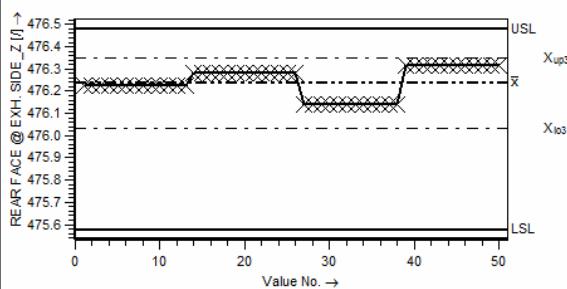
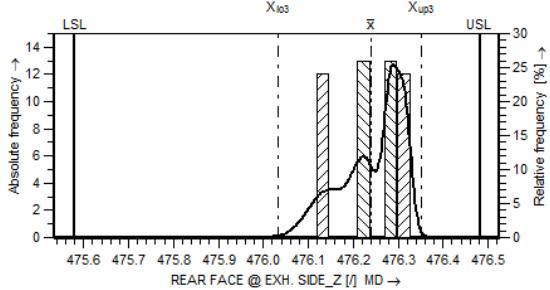
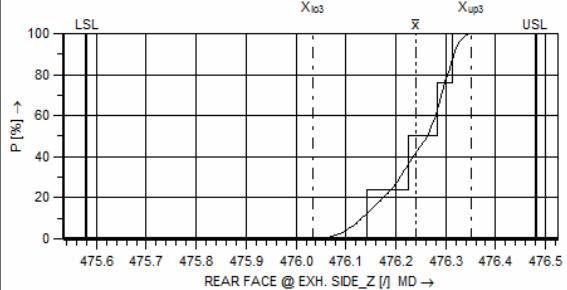


2.3 STANDARD REPORTS FOR PROCESS CAPABILITY ANALYSIS

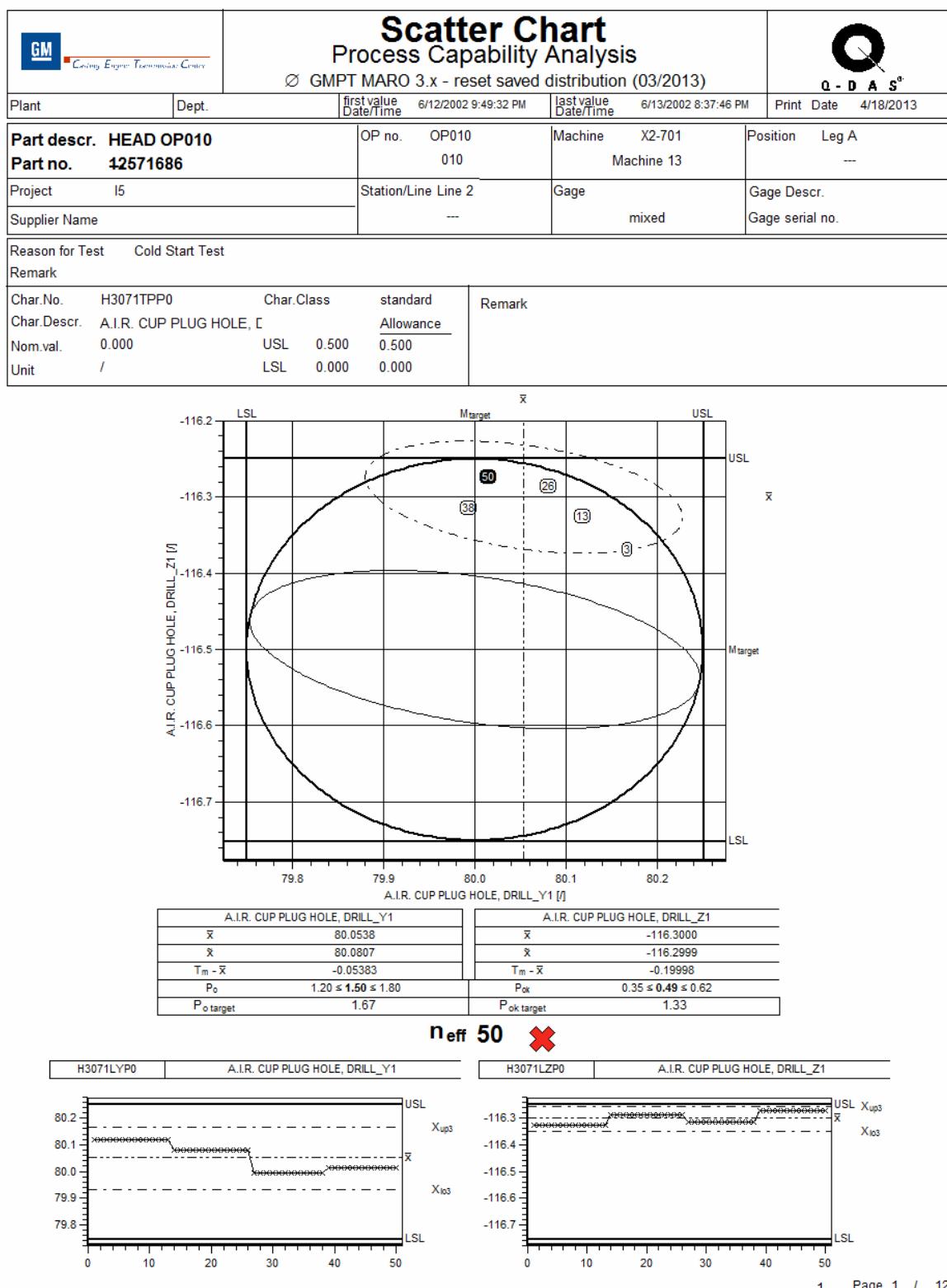
2.3.1 Characteristic Summary Report

Plant		Characteristic Summary Report Process Capability Analysis ∅ GMPT MARO 3.x - reset saved distribution (03/2013)										Q-DAS			
Plant	Dept.	Project	I5	Supp.Name			Print Date	4/18/2013							
Part descr. HEAD OP010		OP no. OP010		Mach. X2-701			Position Leg A		---						
Part no. 12571686		010		Machine 13											
Remark				Station/Line Line 2		Gage 12344		mixed							
Reason for Test Cold Start Test				---											
Seq. #	Char.No.	Char.Descr.	Char.Class	n _{eff}	Nom.val.	LSL	USL	\bar{x}	n < LSL	n > USL	Index	Index	Overall eva		
61	S3001LZP0	MFG.HOLE_TO_XYZ_Z2	PQC/KPC	50	77.000	76.825	77.175	76.9052	0	0	P _p 3.33	P _{pk} 1.69	😊		
62	S3001TPP0	MFG.HOLE_TO_XYZ_Id	PQC/KPC		0.000	0.000	0.350						---		
63	S3001LYP0	MFG.HOLE_TO_XYZ_Y2	PQC/KPC	50	7.780	7.605	7.955	7.7857	0	0	T _p 3.52	T _{pk} 2.51	😊		
64	S3002IDP0	MFG.HOLE_SFINREAM_D	standard	50	10.012	10.000	10.025	10.0094	0	0	T _p 2.93	T _{pk} 2.80	😊		
65	H3002TPP0	MFG.HOLE_TO_XYZ_Id	PQC/KPC	50	0.000	0.000	0.350	0.2059	---	0	P _o 2.43	P _{pk} 0.93	✖		
66	H3002LYP0	MFG.HOLE_TO_XYZ_Y1	PQC/KPC	50	7.780	7.605	7.955	7.7217	0	0	T _p 4.84	T _{pk} 3.49	😊		
67	H3002LZP0	MFG.HOLE_TO_XYZ_Z1	PQC/KPC	50	251.500	251.325	251.675	251.5837	0	0	T _p 4.04	T _{pk} 3.08	😊		
68	H3003TPP0	TRANS.HOLE_TO_XYZ_Id	standard	50	0.000	0.000	0.500	0.2522	---	0	P _o 3.39	P _{pk} 1.86	😊		
69	H3003LYP0	TRANS.HOLE_TO_XYZ_Y1	standard	50	108.000	107.750	108.250	107.9351	0	0	T _p 9.37	T _{pk} 6.02	😊		
70	H3003LZP0	TRANS.HOLE_TO_XYZ_Z1	standard	50	-45.500	-45.750	-45.250	-45.3936	0	0	T _p 5.66	T _{pk} 4.88	😊		
71	H3003IDP0	TRANS.HOLE_TO_XYZ_D1	standard	50	10.000	9.880	10.120	9.9690	0	0	T _p 24.49	T _{pk} 17.85	😊		
72	H3004TPP0	TRANS.HOLE_TO_XYZ_Id	standard	50	0.000	0.000	0.500	0.2630	---	0	P _o 3.12	P _{pk} 1.69	😊		
73	H3004LYP0	TRANS.HOLE_TO_XYZ_Y1	standard	50	108.000	107.750	108.250	107.8850	0	0	T _p 7.89	T _{pk} 4.96	😊		
74	H3004LZP0	TRANS.HOLE_TO_XYZ_Z1	standard	50	224.500	224.250	224.750	224.5602	0	0	T _p 5.20	T _{pk} 4.93	😊		
75	H3004IDP0	TRANS.HOLE_TO_XYZ_D1	standard	50	10.000	9.880	10.120	9.9682	0	0	T _p 23.80	T _{pk} 21.30	😊		
76	H3004-3TP	TRANS.HOLE H3004-3_Id	standard	50	0.000	0.000	0.350	0.0929	---	0	P _o --- 989	P _{pk} --- 989	--- 10		
77	H3004-3LY	TRANS.HOLE H3004-3_Y	standard	50	0.000	-0.175	0.175	0.0000	0	0			‼		
78	H3004-3LZ	TRANS.HOLE H3004-3_Z	standard	50	270.000	269.825	270.175	269.9536	0	0	P _p 17.02	P _{pk} 16.10	😊		
79	H3004-3CD	H3004-3CD	standard	50	270.000	269.825	270.175	269.9536	0	0	P _p 17.02	P _{pk} 16.10	😊		
80	H3002-1TP	MFG.HOLE H3002-1_Id	standard	50	0.000	0.000	0.100	0.0207	---	0	P _o --- 989	P _{pk} --- 989	--- 10		
81	H3002-1LY	MFG.HOLE H3002-1_Y	standard	50	0.000	-0.050	0.050	0.0000	0	0			‼		
82	H3002-1LZ	MFG.HOLE H3002-1_Z	standard	50	328.500	328.450	328.550	328.4897	0	0	T _p 4.55	T _{pk} 2.38	😊		

2.3.2 Individual Characteristic Report

GM Casting Engine Transmission Center		Individual Characteristic Report Process Capability Analysis ∅ GMPT MARO 3.x - reset saved distribution (03/2013)				 Q - D A S^a																																																																																																					
Plant	Dept.	first value Date/Time	6/12/2002 9:49:32 PM	last value Date/Time	6/13/2002 8:37:46 PM	Print Date	4/18/2013																																																																																																				
Part descr. HEAD OP010 Part no. 42571686		OP no.	OP010 010	Machine	X2-701 Machine 13	Position	Leg A ---																																																																																																				
Project	I5	Station/Line	Line 2	Gage		Gage Descr.																																																																																																					
Supplier Name		---		mixed		Gage serial no.																																																																																																					
Reason for Test Cold Start Test																																																																																																											
Remark																																																																																																											
Char.No.	S0600LZ11	Char.Class	standard	Remark																																																																																																							
Char.Descr.	REAR FACE @ EXH. SIDE	Allowance																																																																																																									
Nom.val.	476.280	USL	476.480	0.200																																																																																																							
Unit	/	LSL	475.580	-0.700																																																																																																							
 																																																																																																											
 																																																																																																											
<table border="1"> <thead> <tr> <th colspan="2">Drawing Values</th> <th colspan="2">Collected Values</th> <th colspan="2">Statistics</th> </tr> </thead> <tbody> <tr> <td>Nom.val.</td> <td>476.280</td> <td>X_{min}</td> <td>476.141</td> <td>X̄</td> <td>476.2410</td> </tr> <tr> <td>LSL</td> <td>475.580</td> <td>X_{max}</td> <td>476.313</td> <td>X_{lo3}</td> <td>476.0339</td> </tr> <tr> <td>USL</td> <td>476.480</td> <td>R</td> <td>0.172</td> <td>X_{up3}</td> <td>476.3513</td> </tr> <tr> <td>T</td> <td>0.900</td> <td>n = T_p</td> <td>50</td> <td>X_{up3} - X_{lo3}</td> <td>0.3174</td> </tr> <tr> <td>Tool wear type</td> <td>undefined</td> <td>n = USL</td> <td>0</td> <td>P = T_p</td> <td>1000000.00 ppm</td> </tr> <tr> <td>Demand capability index:</td> <td></td> <td>n = LSL</td> <td>0</td> <td>P = USL</td> <td>0.00 ppm</td> </tr> <tr> <td>T_ptarget</td> <td>1.67</td> <td>n_{tot}</td> <td>50</td> <td>P = LSL</td> <td>0.00 ppm</td> </tr> <tr> <td>T_{pk}target</td> <td>1.33</td> <td>T_{pl}</td> <td>3.19</td> <td>n_{eff}</td> <td>50</td> </tr> <tr> <td>P_{pl}target</td> <td>1.66</td> <td></td> <td></td> <td>T_{pu}</td> <td>2.17</td> </tr> <tr> <td colspan="4">Model distribution</td> <td colspan="4">Mixed Distribution</td> </tr> <tr> <td colspan="4">POTENTIAL PERFORMANCE INDEX</td> <td>=</td> <td>T_p</td> <td colspan="2">2.28 ≤ 2.84 ≤ 3.39</td> </tr> <tr> <td colspan="4">CRITICAL PERFORMANCE INDEX</td> <td>=</td> <td>T_{pk}</td> <td colspan="2">1.73 ≤ 2.17 ≤ 2.61</td> </tr> <tr> <td colspan="2">  </td> <td colspan="4">The requirements were met (T_p, T_{pk}, LV)</td> <td colspan="2">  </td> </tr> <tr> <td colspan="8">∅ GMPT MARO 3.x - reset saved distribution (03/2013)</td> </tr> </tbody> </table>								Drawing Values		Collected Values		Statistics		Nom.val.	476.280	X _{min}	476.141	X̄	476.2410	LSL	475.580	X _{max}	476.313	X _{lo3}	476.0339	USL	476.480	R	0.172	X _{up3}	476.3513	T	0.900	n = T _p	50	X _{up3} - X _{lo3}	0.3174	Tool wear type	undefined	n = USL	0	P = T _p	1000000.00 ppm	Demand capability index:		n = LSL	0	P = USL	0.00 ppm	T _p target	1.67	n _{tot}	50	P = LSL	0.00 ppm	T _{pk} target	1.33	T _{pl}	3.19	n _{eff}	50	P _{pl} target	1.66			T _{pu}	2.17	Model distribution				Mixed Distribution				POTENTIAL PERFORMANCE INDEX				=	T _p	2.28 ≤ 2.84 ≤ 3.39		CRITICAL PERFORMANCE INDEX				=	T _{pk}	1.73 ≤ 2.17 ≤ 2.61				The requirements were met (T _p , T _{pk} , LV)						∅ GMPT MARO 3.x - reset saved distribution (03/2013)							
Drawing Values		Collected Values		Statistics																																																																																																							
Nom.val.	476.280	X _{min}	476.141	X̄	476.2410																																																																																																						
LSL	475.580	X _{max}	476.313	X _{lo3}	476.0339																																																																																																						
USL	476.480	R	0.172	X _{up3}	476.3513																																																																																																						
T	0.900	n = T _p	50	X _{up3} - X _{lo3}	0.3174																																																																																																						
Tool wear type	undefined	n = USL	0	P = T _p	1000000.00 ppm																																																																																																						
Demand capability index:		n = LSL	0	P = USL	0.00 ppm																																																																																																						
T _p target	1.67	n _{tot}	50	P = LSL	0.00 ppm																																																																																																						
T _{pk} target	1.33	T _{pl}	3.19	n _{eff}	50																																																																																																						
P _{pl} target	1.66			T _{pu}	2.17																																																																																																						
Model distribution				Mixed Distribution																																																																																																							
POTENTIAL PERFORMANCE INDEX				=	T _p	2.28 ≤ 2.84 ≤ 3.39																																																																																																					
CRITICAL PERFORMANCE INDEX				=	T _{pk}	1.73 ≤ 2.17 ≤ 2.61																																																																																																					
		The requirements were met (T _p , T _{pk} , LV)																																																																																																									
∅ GMPT MARO 3.x - reset saved distribution (03/2013)																																																																																																											

2.3.3 Scatter Chart





2.3.4 Characteristic Summary Report 100% Automatic Gaging

Plant		Characteristic Summary Report 100% Automatic Gaging Process Capability Analysis Ø GMPT MARO 3.x - reset saved distribution (03/2013)											Q - D A S*	
Part descr.	Dept.	Project		Supp.Name		Print Date		4/18/2013						
Part no.	90537965	OP no. L850				Mach. 73-04265				Position 10-RH				
Remark	Test Part Run				Station/Line ---				Gage Measurement Laboratory					
Reason for Test	Preliminary Acceptance													
Seq.	Char.No.	Char.Descr.	Char.Class	100% measuremen	n _{eff}	Nom.val.	LSL	USL	\bar{x}	n < LSL	n > USL	TU _{max}	Overall evaluation	Overall e
1	1	Test 1	PQC/KPC	1	15	20.000	19.960	20.040	20.0053	0	0	55.00%	The requirements were met (LV,%T)	(Smile)
2	2	Test 2	PQC/KPC	1	15	14.0700	14.0600	14.0750	14.06774	0	0	26.67%	The requirements were met (LV,%T)	(Smile)
3	3	Test 3	PQC/KPC	1	15		129.90	130.25	130.038	0	0	54.29%	The requirements were met (LV,%T)	(Smile)
4	4	Test 4	PQC/KPC	1	15			5.0	0.56	---	0	---	The requirements were met (LV)	(Smile)
5	5	Test 5	PQC/KPC	1	15	500	500	920	734.0	0	0	38.10%	The requirements were met (LV,%T)	(Smile)
6	6	Test 6	PQC/KPC	1	15	0.000	0.000	0.100	0.0233	---	0	49.00%	The requirements were met (LV,%T)	(Smile)
7	7	Test 7	PQC/KPC	1	15		0.000	0.040	0.0105	---	0	40.00%	The requirements were met (LV,%T)	(Smile)
8	8	Test 8	PQC/KPC	1	15		29.870	30.130	30.0100	0	0	15.38%	The requirements were met (LV,%T)	(Smile)
9	9	Test 9	PQC/KPC	1	15		19.70	20.30	20.086	0	0	46.67%	The requirements were met (LV,%T)	(Smile)
10	10	Test 10	PQC/KPC	1	15	0.0	60.0	70.0	65.27	0	0	40.00%	The requirements were met (LV,%T)	(Smile)
11	11	Test 11	PQC/KPC	1	15		2.0	7.0	4.41	0	0	32.00%	The requirements were met (LV,%T)	(Smile)
12	12	Test 12	PQC/KPC	1	15		26.00	27.00	26.448	0	0	62.00%	The requirements were met (LV,%T)	(Smile)
13	13	Test 13	PQC/KPC	1	15		28.200	28.800	28.5429	0	0	40.00%	The requirements were met (LV,%T)	(Smile)



2.3.5 Machinery and Equipment Acceptance Report



Casting Engine Transmission Center

first value Date/Time	5/7/1992 1:43:08 PM	last value Date/Time	5/7/1992 1:47:48 PM	Print Date	4/18/2013
Plant	Dept.	Project		Supp.Name	
Part descr. CRANKSHAFT	OP no. L850	Mach.	73-04265	Position	10-RH
Part no. 00537965	---	---	---	---	---
Reason for Test Preliminary Acceptance		Station/Line	---	Gage	Measurement Lab

Machinery and Equipment Acceptance

Measurements obtained by	Signature	Organization	Date
Report prepared by	Signature	Organization	Date
Approved: <input type="checkbox"/> Yes <input type="checkbox"/> No	Remark	Test Part Run	
<hr/> <hr/> <hr/>			
Study reviewed by	Signature	Organization	Date



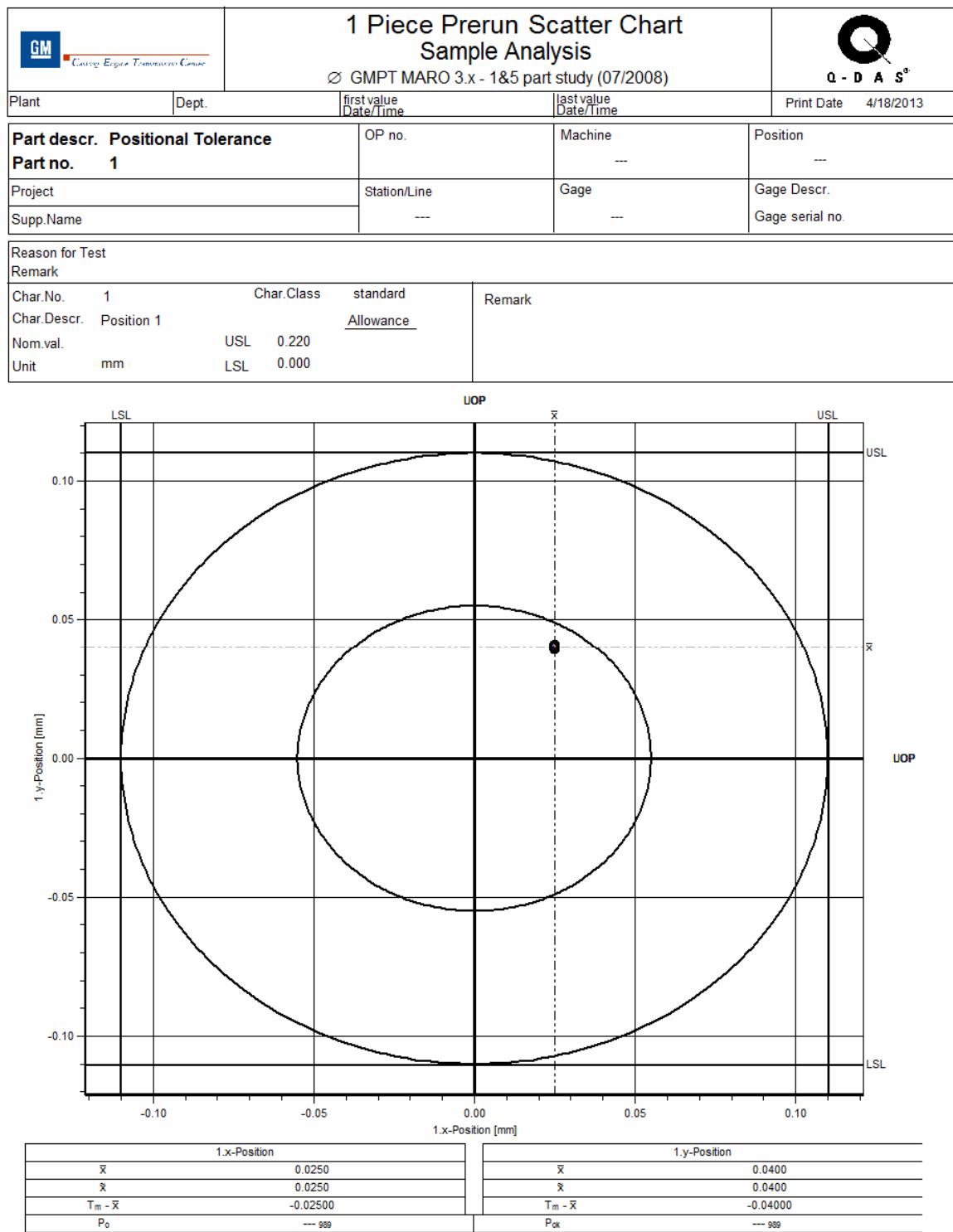
2.4 SAMPLE REPORTS FOR SAMPLE ANALYSIS

2.4.1 1 Piece Prerun Summary Report

Plant		1 Piece Prerun Sample Analysis ∅ GMPT MARO 3.x - 1&5 part study (07/2008)							Q-DAS			
Part descr.	CRANKSHAFT	Dept.	Project	first value Date/Time	5/7/1992 1:43:08 PM	last value Date/Time	5/7/1992 1:43:08 PM	Print	Date	4/18/2013		
Part no.	90537965	OP no.	L850	Machine	73-04265	Position	10-RH	---	---	---		
Remark	Test Part Run				Station/Line	Gage	Measurement Laboratory	---	---	---		
Reason for Test	Preliminary Acceptance				---	---	---	---	---	---		
Supp.Name												
Seq. #	Char.No.	Char.Descr.	Char.Class	LSL	USL	x	Nom.val.	x-T _m	(x-T _m)/T	[(x-T _m)/T]target	[(x-T _m)/T]target up	Requirem
1	1	Test 1	PQC/KPC	19.960	20.040	19.993	20.000	-0.00700	-8.75%	-12.50%	12.50%	😊
2	2	Test 2	PQC/KPC	14.0600	14.0750	14.0681	14.0700	0.000600	4.00%	-12.50%	12.50%	😊
3	3	Test 3	PQC/KPC	129.90	130.25	130.04		-0.0350	-10.00%	-12.50%	12.50%	😊
4	4	Test 4	PQC/KPC	0.0	5.0	2.0		-0.500	-10.00%	-12.50%	12.50%	😊
5	5	Test 5	PQC/KPC	500	920	670	500	-40.00	-9.52%	-12.50%	12.50%	😊
6	6	Test 6	PQC/KPC	0.000	0.100	0.011	0.000	0.0110	11.00%	0.00%	62.50%	😊
7	7	Test 7	PQC/KPC	0.000	0.040	0.008		0.00800	20.00%	0.00%	62.50%	😊
8	8	Test 8	PQC/KPC	29.870	30.130	30.010		0.0100	3.85%	-12.50%	12.50%	😊
9	9	Test 9	PQC/KPC	19.70	20.30	20.10		0.100	16.67%	-12.50%	12.50%	✖️
10	10	Test 10	PQC/KPC	60.0	70.0	64.5	0.0	-0.500	-5.00%	-12.50%	12.50%	😊
11	11	Test 11	PQC/KPC	2.0	7.0	4.7		0.200	4.00%	-12.50%	12.50%	😊
12	12	Test 12	PQC/KPC	26.00	27.00	26.61		0.110	11.00%	-12.50%	12.50%	😊
13	13	Test 13	PQC/KPC	28.200	28.800	28.503		0.00300	0.50%	-12.50%	12.50%	😊

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2.4.2 1 Piece Prerun Scatter Chart



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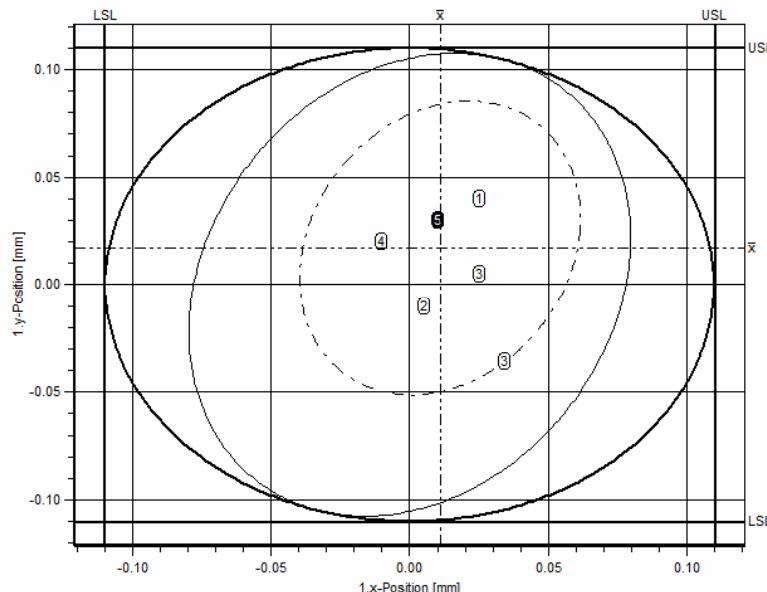
2.4.3 5 Piece Prerun Summary Report

Plant		5 Part Prerun Sample Analysis										Q - D A S			
Dept.	Project	first value Date/Time	5/7/1992 1:43:08 PM	last value Date/Time	5/7/1992 1:43:38 PM	Print Date	4/18/2013								
Part descr.	CRANKSHAFT	OP no.	L850	Machine	73-04265	Position	10-RH								
Part no.	90537965														
Remark	Test Part Run					Station/Line			Gage	Measurement Laboratory					
Reason for Test	Preliminary Acceptance														
Supp.Name															
Seq. i	Char.No.	Char.Dscr.	Char.Class	LSL	USL	X	R	R/T	X-Tm	(X-Tm)/T	((X-Tm /T) s)	Po	Pok	Requireme	
1	1	Test 1	PQC/KPC	19.980	20.040	19.9958	0.00600	7.50%	-0.00420	-5.25%	-12.50%	12.50%		😊	
2	2	Test 2	PQC/KPC	14.0800	14.0750	14.06862	0.00200	13.33%	0.00112	7.47%	-12.50%	12.50%		😊	
3	3	Test 3	PQC/KPC	129.90	130.25	130.018	0.0600	17.14%	-0.0570	-16.29%	-12.50%	12.50%		✗	
4	4	Test 4	PQC/KPC	0.0	5.0	0.88	1.500	30.00%	-1.620	-32.40%	-12.50%	12.50%		✗	
5	5	Test 5	PQC/KPC	500	920	722.0	150.0	35.71%	12.00	2.88%	-12.50%	12.50%		✗	
6	6	Test 6	PQC/KPC	0.000	0.100	0.0242	0.0300	30.00%	0.0242	24.20%	0.00%	82.50%		✗	
7	7	Test 7	PQC/KPC	0.000	0.040	0.0088	0.0100	25.00%	0.00880	22.00%	0.00%	82.50%		😊	
8	8	Test 8	PQC/KPC	29.870	30.130	30.0140	0.01000	3.85%	0.0140	5.38%	-12.50%	12.50%		😊	
9	9	Test 9	PQC/KPC	19.70	20.30	20.114	0.0500	8.33%	0.114	19.00%	-12.50%	12.50%		✗	
10	10	Test 10	PQC/KPC	60.0	70.0	64.64	3.000	30.00%	-0.360	-3.60%	-12.50%	12.50%		✗	
11	11	Test 11	PQC/KPC	2.0	7.0	4.24	0.900	18.00%	-0.260	-5.20%	-12.50%	12.50%		😊	
12	12	Test 12	PQC/KPC	26.00	27.00	26.582	0.140	14.00%	0.0920	9.20%	-12.50%	12.50%		😊	
13	13	Test 13	PQC/KPC	28.200	28.800	28.5174	0.134	22.33%	0.0174	2.90%	-12.50%	12.50%		😊	

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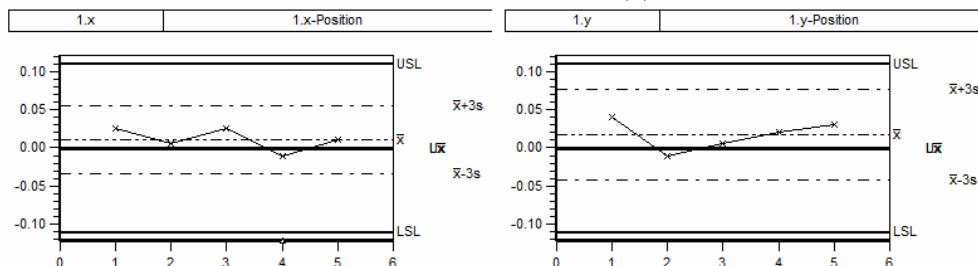
2.4.4 5 Piece Prerun Scatter Chart

GM Casting Engine Transmission Center		5 Part Prerun Scatter Chart Sample Analysis Ø GMPT MARO 3.x - 1&5 part study (07/2008)			 Q - D A S*	
Plant	Dept.	first value Date/Time	last value Date/Time	Print Date 4/18/2013		
Part descr. Positional Tolerance Part no. 1		OP no.	Machine	Position		
Project		Station/Line	Gage	Gage Descr.		
Supp. Name		---	---	Gage serial no.		
Reason for Test Remark						
Char.No. 1	Char.Class standard	Remark				
Char.Descr. Position 1	<u>Allowance</u>					
Nom.val.	USL 0.220					
Unit mm	LSL 0.000					



1.x-Position		1.y-Position	
\bar{x}	0.0110	\bar{x}	0.0170
\bar{x}	0.0100	\bar{x}	0.0200
$T_m - \bar{x}$	-0.01100	$T_m - \bar{x}$	-0.01700
P_{ok}	1.68	P_{ok}	1.35
$P_{ok\ target}$	2.00	$P_{ok\ target}$	2.00

n_{eff} 5



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2.4.5 Cold Start Test Characteristic Summary Report

		∅ GMPT MARO 3.x - Cold Start Test (07/2008)								
		Sample Analysis ∅ GMPT MARO 3.x - Cold Start Test (07/2008)							Q - D A S	
Plant	Dept.	Project	first value Date/Time	5/7/1992 1:43:08 PM	last value Date/Time	5/7/1992 1:44:06 PM	Print	Date	4/18/2013	
Part descr.	CRANKSHAFT	OP no.	L850	Machine	73-04265	Position	10-RH			
Part no.	90537965			---		---				
Remark	Test Part Run	Reason for Test	Preliminary Acceptance	Supp.Name	Station/Line	Gage	Measurement Laboratory			

Two Happy Smileys per characteristic required

Seq. i	Char.No.	Char.Descr.	Char.Class	LSL	USL	n < LSL	n > USL	Overall ev.	X	X-Tm	(X-Tm)/T	[(X-Tm)/T]target	[(X-Tm)/T]target	Requirement
1	1	Test 1	PQC/KPC	19.960	20.040	0	0	😊	20.0029	0.00290	3.63%	-42.50%	42.50%	😊
2	2	Test 2	PQC/KPC	14.0600	14.0750	0	0	😊	14.06795	0.000460	3.07%	-42.50%	42.50%	😊
3	3	Test 3	PQC/KPC	129.90	130.25	0	0	😊	130.033	-0.0420	-12.00%	-42.50%	42.50%	😊
4	4	Test 4	PQC/KPC	---	5.0	---	0	😊	0.64	-4.380	---	0.00%	0.00%	😊
5	5	Test 5	PQC/KPC	500	920	0	0	😊	731.0	21.00	5.00%	-42.50%	42.50%	😊
6	6	Test 6	PQC/KPC	0.000	0.100	---	0	😊	0.0235	0.0235	23.50%	0.00%	92.50%	😊
7	7	Test 7	PQC/KPC	0.000	0.040	---	0	😊	0.0101	0.0101	25.25%	0.00%	92.50%	😊
8	8	Test 8	PQC/KPC	29.870	30.130	0	0	😊	30.0110	0.0110	4.23%	-42.50%	42.50%	😊
9	9	Test 9	PQC/KPC	19.70	20.30	0	0	😊	20.093	0.0930	15.50%	-42.50%	42.50%	😊
10	10	Test 10	PQC/KPC	60.0	70.0	0	0	😊	65.11	0.110	1.10%	-42.50%	42.50%	😊
11	11	Test 11	PQC/KPC	2.0	7.0	0	0	😊	4.37	-0.130	-2.60%	-42.50%	42.50%	😊
12	12	Test 12	PQC/KPC	26.00	27.00	0	0	😊	26.484	-0.0160	-1.60%	-42.50%	42.50%	😊
13	13	Test 13	PQC/KPC	28.200	28.800	0	0	😊	28.5385	0.0385	8.08%	-42.50%	42.50%	😊



2.4.6 Tool Change Report

		Tool change report Sample Analysis GMPT MARO 1.x / Sect 3.3.5									
Plant	Dept.	Project	first value Date/Time	5/7/1992 1:43:08 PM	last value Date/Time	5/7/1992 1:43:38 PM	Print Date	4/18/2013			
Part descr.	CRANKSHAFT	OP no.	L850	Machine	73-04265	Position	10-RH				
Part no.	90537965			---		---	---				
Remark	Test Part Run	Station/Line		Gage	Measurement Laboratory						
Reason for Test	Preliminary Acceptance										
Supp.Name											
Seq. #	Char.No.	Char.Descr.	Char.Class	n _{eff}	LSL	USL	\bar{x}	\bar{x} -Target value	\bar{x} -Target value	\bar{x} -Target value /T	Tool cl
1	1	Test 1	PQC/KPC	5	19.9935	20.0065	19.99580	-0.00312	0.00312	24.00%	
2	2	Test 2	PQC/KPC	5	19.9940	20.0060	19.99580	-0.00312	0.00312	26.00%	
3	3	Test 3	PQC/KPC	5	14.0300	14.0400	14.06862	0.000778	0.000778	7.78%	
4	4	Test 4	PQC/KPC	5	0.0	5.0	0.88	0.314	0.314	6.28%	
5	5	Test 5	PQC/KPC	5	500	920	722.0	3.800	3.800	0.90%	
6	6	Test 6	PQC/KPC	5	0.000	0.100	0.0242	-0.000200	0.000200	0.20%	
7	7	Test 7	PQC/KPC	5	0.000	0.040	0.0088	0.0000400	0.0000400	0.10%	
8	8	Test 8	PQC/KPC	5	29.870	30.130	30.0140	0.00420	0.00420	1.62%	
9	9	Test 9	PQC/KPC	5	19.70	20.30	20.114	0.0260	0.0260	4.33%	
10	10	Test 10	PQC/KPC	5	60.0	70.0	64.64	-0.390	0.390	3.90%	
11	11	Test 11	PQC/KPC	5	2.0	7.0	4.24	-0.190	0.190	3.80%	
12	12	Test 12	PQC/KPC	5	25.50	27.50	26.592	0.0998	0.0998	4.99%	
13	13	Test 13	PQC/KPC	5	28.000	29.000	28.5174	-0.0312	0.0312	3.12%	

3.0 DEFINITIONS AND ACRONYMS

3.1 DEFINITIONS

The following definitions apply to this specification:

Conditional Acceptance is Buyer authorization to ship equipment based upon the Supplier's agreement to make further corrections. These corrections should be detailed on an acceptance report. NA they are detailed on the Problem Tracking Form attached to the corresponding Preliminary Authorization Acceptance Form.

3.2 ABBREVIATIONS, ACCRONYMS AND SYMBOLS

The following abbreviations, acronyms and symbols apply to this specification:

C_{pi}	Intrinsic Potential Index – a measure of intrinsic variation compared to the tolerance
C_{pki}	Intrinsic Capability Index – a measure of intrinsic variation and targeting compared to the tolerance
DR	Documentation Required
GMIO	General Motors International Operations
GM CETC	General Motors Casting Engine & Transmission Center (formerly Powertrain Manufacturing Eng.)
GMPT	General Motors Powertrain
KCC	Key Control Characteristic
KPC	Key Product Characteristic
LSL	Lower Specification Limit
LTL	Lower Tolerance Limit
ME	Manufacturing Engineer / Engineering
NAO	North American Operations
NB	Natural Boundary
Nom.	Nominal
PE	Product Engineer / Engineering
P_o	The bivariate equivalent of P_p
P_{ok}	The bivariate equivalent of P_{pk}
P_p	Process Potential Index – a measure of variation compared to the tolerance
P_{pk}	Process Capability Index – a measure of variation and targeting compared to the tolerance
PQC	Product Quality Characteristic
T_p	Same as P_p , but for processes with a stability violation
T_{pk}	Same as P_{pk} , but for processes with a stability violation
T	Tolerance (UTL-LTL)
TM or Tm	Tolerance Middle
USL	Upper Specification Limit
UTL	Upper Tolerance Limit
\bar{x}	X bar – The average of several values

4.0 APPENDICES

4.1 REFERENCE DOCUMENTS

- [1] Dietrich E. / Schulze A.
Statistical Procedures for Machine and Process Qualification
Q-Das GmbH, Birkenau, 1999
- [2] Dietrich E. / Schulze A.
Guidelines for the Evaluation Measurement Systems and Processes, Acceptance of Production Facilities
Q-Das GmbH, Birkenau, 1999
- [3] Quality Procedures GQBR-016 and GQP-016
Process Capability Procedures
- [4] KCDS
GMW 15049 Global Standard for the Key Characteristic Designation System Process

4.2 BASIS OF CALCULATION

The aim of this section is to simply outline the numerical and statistical methods that will be applied to the data being studied. It is not in the scope of this document to discuss the reasoning behind this basis of calculation, but reference to background material [1 & 2] is strongly advised. It is recommended that the advanced statistical processing be done by the software package qs-STAT®. Sample data is available [1] for calculation approval. It is assumed that the reader understands the basic mathematical and statistical terminology and is familiar with the procedure contained within this specification.

4.2.1 Pre-run Tests

Cold Start Tests:

TM=Tolerance Middle

T=Total Tolerance

NB=Natural Boundary

$$\text{Bilateral Tolerances} \quad \text{Percent Tolerance Mean} = PT_m = 2 * |x - TM| / T \leq 85\%$$

$$\text{Unilateral Tolerances} \quad \text{Percent Tolerance Mean} = PT_m = 2 * |x - NB| / T \leq 92.5\%$$

5 Part Run:

\bar{x} = Average value
 R = Value range

Bilateral Tolerances	$(Nom. - 12.5\% Tol) < \bar{x} < (Nom. + 12.5\% Tol)$ $R < 25\% Tol.$
Unilateral Tolerance	$\bar{x} < 62.5\% Tol$ $R < 25\% Tol.$
Tools which Decrease in size	$(Nom. - 12.5\% Tol) < \bar{x} < (Nom. + 30\% Tol)$ $R < 25\% Tol.$
Tools which Increase in size	$(Nom. - 30\% Tol) < \bar{x} < (Nom. + 12.5\% Tol)$ $R < 25\% Tol.$

100% Automatic Gaging:

TM=Tolerance Middle
 T=Total Tolerance
 NB=Natural Boundary

Bilateral Tolerances	Percent Tolerance = $PT = 2 * Max x_i - TM / T \leq 80\%$
Unilateral Tolerances	Percent Tolerance = $PT = 2 * Max x_i - NB / T \leq 90\%$

4.2.2 Process Capability

The capability indices P_p/P_{pk} are also calculated using the percentile method $(0.135\% - \bar{x} - 99.865\%)$.

Bilateral Tolerances	$P_p = Tolerance / (U_{p3} - L_{p3})$
Unilateral Tolerances	$P_{pk} = Min [(UTL - \bar{x}) / (U_{p3} - \bar{x}), (\bar{x} - LTL) / (\bar{x} - L_{p3})]$

The type of control chart used depends on the distribution of the data and ANPVA study of within subgroup versus subgroup-to-subgroup variation. The preferred generic chart type is the location and deviation (\bar{x} s) chart.

Normal distribution	Shewhart chart
Selected non-normal distribution	Pearson chart
Mixed distribution	Extended Shewhart chart

Estimator for Control charting are:

$$\text{Process average} \quad \mu_1 = \bar{x}$$

$$\text{Estimated deviation} \quad \sigma = \sqrt{s^2}$$



4.2.3 Stability

The stability criteria used is that recommended by Q-DAS, referred to as level 2

If instability is present, the indices can still be calculated. To demonstrate the significance of this (or act as a warning to those using the index as the only acceptance criteria) the index call-outs are changed to T_p/T_{pk} .

For a more detailed explanation of the stability criteria please refer to the background text [1 & 2].

4.2.4 Shewhart Chart with Extended Limits

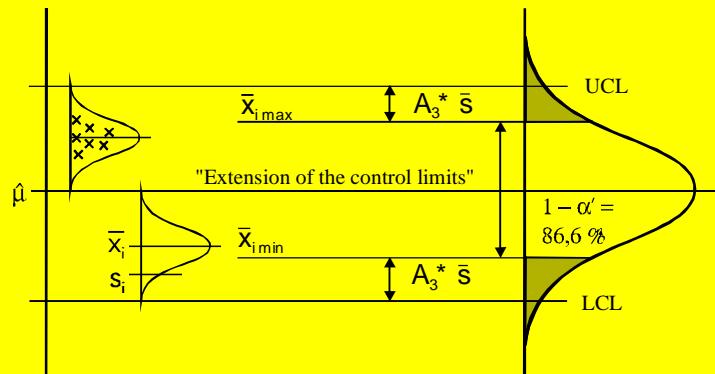
For more detail explanation of the Shewhart chart with extended limits, please refer to the background text [1 & 2].

Thus, the extended control limits are calculated by the following formula [1]:

$$\begin{aligned} UCL &= \bar{x} + (A_3 * \bar{s} + 1.5 * \hat{\sigma}_A) \\ LCL &= \bar{x} - (A_3 * \bar{s} + 1.5 * \hat{\sigma}_A) \end{aligned}$$

where $\hat{\sigma}_A$ is the standard deviation between the random samples according to ANOVA model II [1].

The extension of the limits is controlled by the factor 1.5. This factor has proved successful by experience. If $\hat{\sigma}_A$ cannot be ascertained by a computer system, the difference between the maximum and the minimum mean values ($\bar{x}_{max} - \bar{x}_{min}$) has to be applied instead of "1.5* $\hat{\sigma}_A$ " to extend the limits. As described under "Process mean values constant", the process stability has to be judged analogously and subsequently the capability indices have to be determined.



Distribution of mean values with $\hat{\sigma}_A$ from ANOVA, computer based or manually by $\bar{x}_{i\max}$ and $\bar{x}_{i\min}$

4.3 EVALUATION OF POSITIONAL TOLERANCES

4.3.1 Tolerance Zone

Geometric Dimensioning and Tolerancing (GD&T) often provides situations that create bonus tolerances. For the purpose of the evaluation, the additional position provided by Bonus Tolerance shall not be used. This bonus exists on features that are dimensioned as Maximum Material Condition (MMC). These features shall be evaluated as Regardless of Feature Size (RFS).

Depending on the assigned tolerances of the measurement coordinates, the tolerance zone for a true position feature is an ellipse (Figure 4.3.1-1). The shape of the ellipse depends on the scaling of the axes and the specification limits. As a special case, when tolerances and axis scaling are equal, the zone will be a circle.

The consideration of the true position tolerance as a rectangle is not allowed because of the extra tolerance area around the corner points that may allow values to be accepted erroneously. This may lead to problems during later manufacturing steps. This means that values outside the circular area (Figure 4.3.1-1) are to be regarded as outside tolerance.

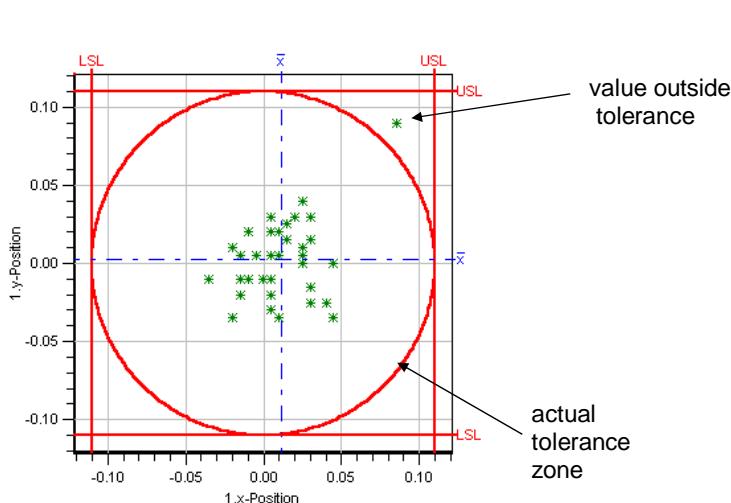


Figure 4.3.1-1: Circle versus square tolerance zones

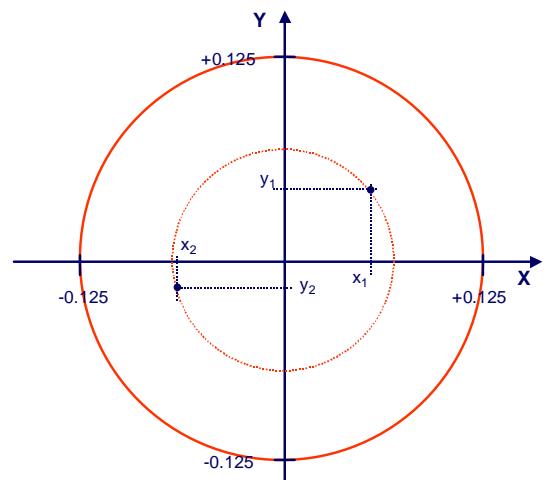


Figure 4.3.1-2: True position values

4.3.2 Studying Positional Tolerances Using the True Position Value

The definition of true position can be thought of as – “*The minimum diameter circle, centered on the theoretically exact location that will encompass the point*”. If analysis is done using the true position value (this is a scalar quantity) then we get the situation where two measurements can give the same true position but actually are at a different location (Figure 4.3.1-1). This means we lose vector information when using true position values. This loss of information can lead to problems rationalizing the evaluation of such processes.

4.3.3 Positional Capability Using Data without Reference to Correlation

If a capability study of the axis components of the positional feature is done treating each axis individually a problem (Figure 4.3.3-1) can occur.

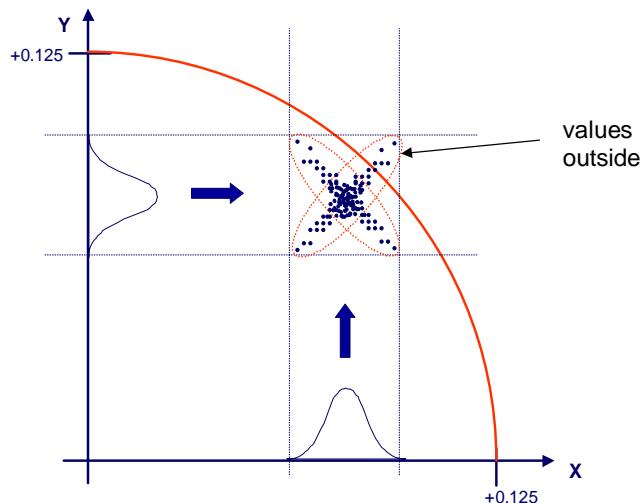


Figure 4.3.3-1: Problem of studying axes independently

If we study a 2-dimensional process by using two 1-dimensional data sets, we lose correlation (relationship) information. (In a 2-d process, there will always be some correlation). With reference to Figure 4.3.3-1, two instances of data scatter patterns have been superimposed. Each of these scatter patterns looks the same from the point of view of the individual axes. Obviously, one instance indicates parts out of specification. This situation is unacceptable for predicting process capability effectively.

4.3.4 P_o/P_{ok} Capability Indices

In order to solve this problem, capability indices that reflected the 2-dimensional distribution pattern (Figure 4.3.4-1) have been created by Q-DAS [2]. The index “o” was selected to mark the ‘Position Tolerance’.

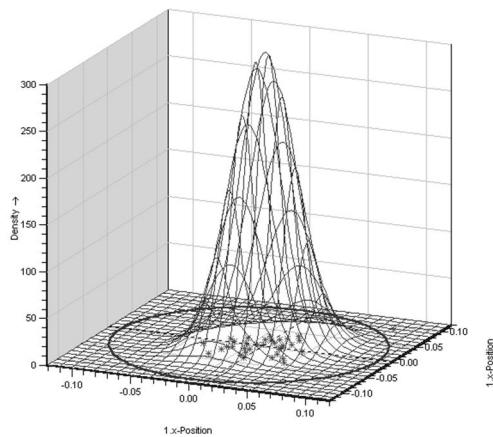


Figure 4.3.4-1: 2-Dimensional distribution

4.3.4.1 Process Potential Index, P_o

In order to determine the elliptical random spread region and thus the capability graphically, the center point of the distribution ellipse is laid over the tolerance center point (Figure 4.3.4.2-1). Consider this expanding so it is just touching the tolerance ellipse. The ratio between these ellipses is used as an approximation of P_o .

4.3.4.2 Process Capability Index, P_{ok}

In order to determine the capability graphically, consider the elliptical random spread region again expanding, this time without an offset to tolerance average, so it is just touching the tolerance ellipse (Figure 4.3.4.2-1). This ratio between these ellipses is an approximation of P_{ok} .

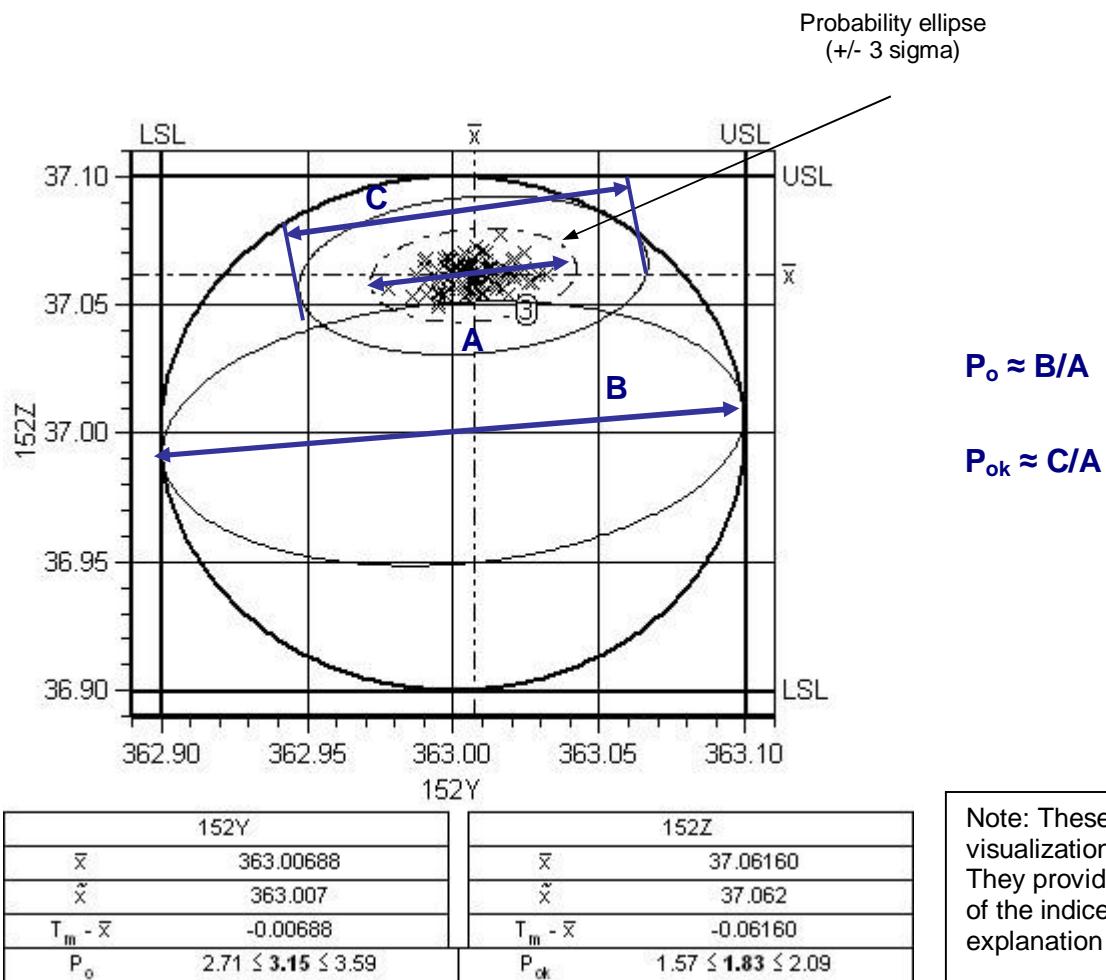


Figure 4.3.4.2-1: Determination of positional capability indices

The probability ellipse indicates the region in “tolerance space” that 99.73% of the values are expected to lie (equivalent to $\pm 3\sigma$).

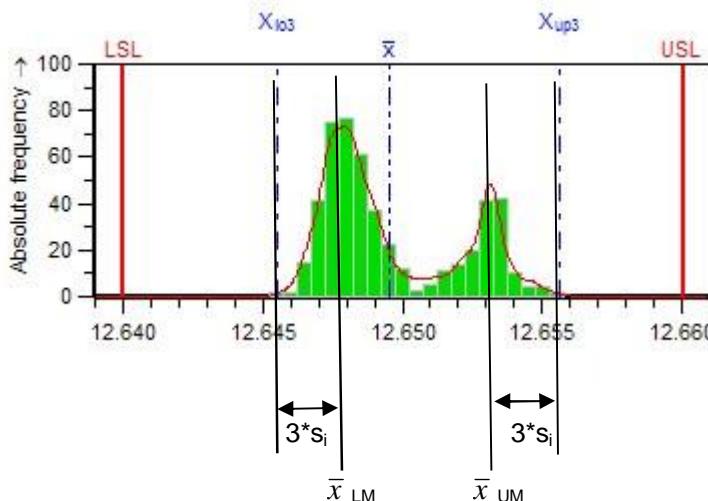
4.3.5 Intrinsic Capability Indices

The Intrinsic Capability indices C_{pi} and C_{pki} are indices that use the intrinsic estimator of sigma (s_i). These indices are used with the mixed distribution and estimate the capability for the extreme modes of a mixed distribution. The critical index C_{pki} is defined as the minimum of

$$(\bar{x}_{LM} - LSL)/(3*s_i) \text{ or } (USL - \bar{x}_{UM})/(3*s_i)$$

Where \bar{x}_{LM} equals $x_{lp3} + (3*s_i)$ and \bar{x}_{UM} equals $x_{up3} - (3*s_i)$

Where $s_i = \sqrt{\sum s^2/k}$ where s is the sigma of each individual subgroup and k is the number of subgroups.



This analysis technique is available in Q-DAS version ME 7.7 and later. In older versions the s_i values to make the manual calculation may be determined from the Calculate QCC tab then go to parameters the $s1$ value is the correct estimator for sigma. The x_{lp3} and x_{up3} can be determined from the "Numerics" selection, then Form sheet 3 in the of Q-DAS ME 5 or ME 6. These values are those that represent 99.73 percent of the distribution as calculated by the percentile method.

The indices C_{pi} and C_{pki} are only for extended runs or ongoing production.