Identification of Special & Inspection Characteristics, Verification requirements

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Program Quality	See Stages	07/26/2024

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1 Purpose & Scope

This Work Instruction provides suppliers with detailed guidelines and instructions for understanding, marking, determining, following up on, and verifying special characteristics in products supplied to Magna Electronics. It aims to ensure that all suppliers consistently meet Magna Electronics' quality standards by clearly defining the processes and responsibilities associated with special characteristics.

2 Goal

Understand various terminology, marking, determination, follow up and verification of special characteristics used in Magna Electronics.

3 Ref.

MQS 03 Layard Process Audits

MQS 07 Control Plan Management

MQS 08 Customer Interface Characteristics

IATF 16949 Automotive Quality Management System Standard

AIAG APQP 3 and Control plan 1

VDA Special Characteristics

VDA manual Maturity Level Assurance

VDA 2 Production process and product approval

VDA 5 Capability of Measurement Processes

ISO26262:2018 Road Vehicles - Functional Safety

Special Characteristics Alignment Form GLO-TP-EP-0156

4 Definitions

4.1 Characteristic

A characteristic is a dimension or a physical, chemical, electrical, mechanical or optical property or a product or material data. All characteristics must be measurable (through variable or attribute) directly or indirectly.

4.2 Attributive characteristics

Attributive characteristics are qualitative data, such as the ones used in a check operation, e.g. the presence of a required component, a go/no go gauge.

Other examples are characteristics that could be measured (i.e. could be treated as variable data), but where the results are recorded in a simple yes/no option, such as test result, a dimension checked with a go/no-go gage, etc. Once recorded, these characteristics could be further used to perform additional analysis such as trend charts, distributions, etc.

4.3 Variable characteristics

Variable characteristics are quantitative data, resulting from a measurement, for instance the diameter of a fixing hole, the bore sight of a camera, a current consumption, the torque of a fastening screw. Those

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characteristics can be continuously measured and expressed in physical units (m, A, V, Nm, ...).

5 Special Characteristics

Special Characteristics are characteristics, which may have an effect on the safety, the compliance with legal provisions or homologation, or whose nonfulfillment will endanger fit, function or the further processing of the product and might lead to severe economic damage (following IATF 16949:2016).

Special Characteristics must be marked without exception in all technically relevant documents of the product and process documentation and run like a common thread through product development and production all the way from the customer requirements to the product manufactured under series conditions.

5.1 Classification of Special Characteristics

According to their importance for the product, Special Characteristics are subdivided into the categories:

SC/S - Special Characteristics related to safety.
SC/L - Special Characteristics related to legal and regulatory requirements.
SC/F - Special Characteristics related to functions and requirements.

Special Characteristics related to Safety Requirements

SC/S: Special Characteristic related to safety, whenever safety aspects (safety requirements, product safety, safety-relevant consequences, functional safety) are concerned. The non-compliance of these characteristics may cause an immediate risk to life and limb. The processes (internal and from suppliers) that manufacture these characteristics must be in statistical control and achieve and maintain process capability indices. These characteristics are not legal or regulatory requirements. (see SC/L)

Special Characteristics related to Legal & regulatory Requirements.

SC/L: Special Characteristics related to legal and regulatory requirements refer to specifications valid at the time of the introduction of the product to the market. These may be legally or approval-relevant (e.g., homologation).

Special Characteristics related to a Product Function.

SC/F: For these characteristics the following aspects could affected:

- Important functional requirements (fit, form, function, performance)
- Technical manufacturing demands (difficult to assemble, etc.)
- Severe economic damage to customer and/or supplier.
- Customer Interface Characteristics should be defined in co-operation by the customer.

  For more detail information (ref. MQS 08 Customer Interface Characteristics).
- Pass Through Characteristics (PTC)

5.2 Inspection Characteristics (IC) for Production.

IC/P: Inspection Characteristics serve primarily to control production processes. They can be defined as mandatory Inspection Characteristics towards the production areas based on experience and process knowhow. These characteristics are defined using the corresponding markings on the drawing (see 6). Once established, these Inspection Characteristics must be incorporated into the Control Plan, with appropriate markings for easy identification. Furthermore, all evidence and test records related to these Inspection Characteristics shall be carefully archived.

5.5 Special Characteristics documentation

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Different documents allow to ensure the traceability of Special Characteristics, including but not limited to:

- FMEAs,
- Special Characteristics Alignment form,
- Technical drawings,
- Control Plan including Incoming inspection,
- Work Instruction including Standardized Work,
- Measurement System Analysis,
- Process Capability reports,
- Quality Alerts,
- Safety Plans.

6   Magna Marking

6.1 Inspection Characteristics

Inspection Characteristics are marked with the following characters:

IC/P - Inspection Characteristics for production.

The determination are done on a drawing with IC/P and the addition of I "**x**".

IC/P Ix (Ix see 6.3.2)

separated by a space character as the last piece of specification behind the dimension (or other requirements on the drawing),

INSPECTION CHARACTERISTICS	SYMBOL FOR DIMENSIONS	EXAMPLES FOR DIMENSIONS	SYMBOL FOR TEXT & GD&T	EXAMPLES FOR TEXT & GD&T	CORRESPONDING OBSELETE SYMBOLS
IC/P **Inspection Characteristics related to Production Process Parameters**	... IC/P Ix In Eng. Drawing Field: (Default CAD Text Font/Size)	Ø 10.0 ± 0.1 IC/P I3 2x1.52 IC/P I2	... SC/S Ix In Eng. Drawing Field: (Default CAD Text Font/Size) In Text Documents: (Default Text Font; Consistent Text Size)	In Eng. Drawing Field: MECHANICAL CODING ELEMENTS..... SC/S I4 1.52 IC/P I3 In Text Documents: SEALING SURFACE POLISH IN THIS AREA...... SC/S I4	P SC

6.2 Special Characteristics

Due to their high importance the Special Characteristics must be marked in all relevant documents, as far as they are included in these. For a clear identification of Special Characteristics, the following characters are used:

SC/S - Special Characteristics related to safety.

SC/L - Special Characteristics related to legal and regulatory requirements.

SC/F - Special Characteristics related to functions and requirements.

To find the Special Characteristics more easily in free text documents (e.g., work instructions, test instructions), it is recommended to highlight these characters in bold.

The determination of SCs is similar to inspection characteristics and the addition of I "**x**".

For SC/S; SC/L; SC/F are added, separated by space characters **Ix** (see 6.3.2)

Example – SC/S **Ix** ; SC/L **Ix** ; SC/F **Ix**

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Where, Ix - appropriate Inspection level. (see 6.3.2)

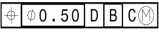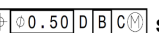| SPECIAL CHARACTERISTICS	SYMBOL FOR DIMENSIONS	EXAMPLES FOR DIMENSIONS	SYMBOL FOR TEXT & GD&T	EXAMPLES FOR TEXT & GD&T	CORRESPONDING OBSELETE SYMBOLS

SC/S
Special Characteristics related to safety
	… SC/S Ⅰ x
	
	In Eng. Drawing Field: (Default CAD Text Font/Size)
		Thickness of Radar-function area 3.14 mm ± 0.05 SC/S Ⅰ 1
		
		Voltage range:
		10V +/-2% SC/S Ⅰ 1
			… SC/S Ⅰ x
			
			In Eng. Drawing Field: (Default CAD Text Font/Size)
			In Text Documents: (Default Text Font; Consistent Text Size)
				In Eng. Drawing Field:
				  MATERIAL……. SC/S Ⅰ 4
				⊕⌀0.50 D B C Ⓜ SC/S Ⅰ 4
				In Text Documents:
				  MATERIAL……. SC/S Ⅰ 4
				CHECK CORRECT SW VER SC/S Ⅰ1
					AS
					
					CC

SC/L
Special Characteristics related to legal and regulatory requirements
	… SC/L Ⅰ x
	
	In Eng. Drawing Field: (Default CAD Text Font/Size)
		76~77Ghz SC/L Ⅰ 1	… SC/L Ⅰ x
			
			In Eng. Drawing Field: (Default CAD Text Font/Size)
			In Text Documents: (Default Text Font; Consistent Text Size)
				In Eng. Drawing Field:
				  Legal Product Marking SC/L Ⅰ 1
				  Homologation SC/L Ⅰ 1
				In Text Documents:
				  100% Check………SC/L Ⅰ 1
					AL
					
					CC S

SC/F
Special Characteristics related to functions and requirements
	… SC/F Ⅰ x
	
	In Eng. Drawing Field: (Default CAD Text Font/Size)
		Ø 10.0 ± 0.1 SC/F Ⅰ 1
		
		2x1.52 SC/F Ⅰ 2
			… SC/F Ⅰ x
			
			In Eng. Drawing Field: (Default CAD Text Font/Size)
			In Text Documents: (Default Text Font; Consistent Text Size)
				In Eng. Drawing Field:
				  INSURE FULL ……..… SC/F Ⅰ 2
				⊕⌀0.50 D B C Ⓜ SC/S Ⅰ 4
				In Text Documents:
				  100% Check………..SC/F Ⅰ 1
					B P Ⅰ
					
					S SC

6.3 Verification Requirements

Fundamentally, each dimension and characteristic given in a drawing are observed by all parts.

6.3.1 Verification Requirements for Special and Inspection Characteristics

For each Special Characteristic, the inspection level are marked on the drawing (see 6). The inspection levels and the related minimum requirements are described in 6.3.2

Details relating to the inspections (extent and frequency of random sampling, reaction plan, requalification tests) are agreed between the manufacturer and the customer and stated in the Control Plan (pre-series and series).
The tests according to the Control Plan have to be executed and documented by the manufacturer throughout the entire series production. The results must be made available on request.

A Special Characteristics as well as Inspection Characteristics play an essential role in ensuring product and process quality, it must be ensured by means of initial qualification and continuous process monitoring that the requirements relating to Inspection and Special Characteristics are always fulfilled on all manufactured parts/devices.

6.3.2 Definition of Inspection Level

Proof of machine and process capability values is executed according to MAGNA-internal procedure.

Inspection level I1
  Measured variables:

1) Proof of short-term-/machine capability C_{mk} for Initial Sampling Inspection Report (ISIR)/PSW.
   Calculation basis ≥ 50 pcs per tool/nest.

2) Proof of preliminary process capability P_{pk}
   Calculation basis ≥ 125 pcs,
   (e.g. collected in 25 shifts at 5 pcs each.)

3) Proof of long-term process capability C_{pk} or P_{pk} respectively with instable processes
   Calculation basis: production period ≥ 20 days and ≥ 250 pcs
   (e.g. 2 x 5 parts per shift in 2-shift production: 400 parts after 20 production days; or 1 x 5 per

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shift in 1-shift production: 250 parts after 50 production days).

4) The collection of random samples for preliminary and long-term process capability must be accompanied by a process control chart (Statistical Process Control Chart). It must be maintained over the entire production period. The test frequency must be selected to ensure a sensible statistical process control suitable for the production process. Random sampling size ≥ 5 pcs.

Requirements 1 - 4: For processes with very small production volumes (e.g., annual requirement produced in < 5 shifts) or for special processes (e.g., production of sealing rings in a 50-cavity tool), special agreements can be made between manufacturer and customer.

If short-term capability, preliminary capability, or long-term process capability cannot be proven, 100% testing of the characteristic is required. In case of destructive tests or very complex tests, a suitable random sampling test including control card monitoring may be executed instead. The actual reaction plan must be described in the Control Plan, in agreement with the internal customer or MAGNA for external suppliers.

Documentation (MAGNA-internal: Minitab-reports):
Req. 1), 2), 3) Initial:
- Capability indices, distribution, mode of calculation
- Actual value, mean value, standard deviation.
  Req. 4) Permanent:
- SPC-card

Attributive characteristics:
100% testing must be executed throughout the entire production period.
The documentation/proof of 100% testing (measured variables as well as attributive characteristics) will be determined project-specifically.

Inspection level I2

1) Proof of short-term/machine capability (C_{mk}) for Initial Sampling Inspection Report (ISIR)/PSW.
   Calculation basis ≥ 50 pcs per tool/nest

2) Regular random sampling for actual values (frequency depends on the potential changes in the process, such as material batch changes etc.) with random sample size of ≥ 5 pcs per tool/nest.

Documentation (MAGNA-internal: Minitab-reports):
Req. 1) Initial:
- Capability indices, distribution, mode of calculation
- Actual value, mean value, standard deviation.
Req. 2) Permanent:
- Actual values

Inspection level I3

1) Proof for Initial Sampling Inspection Report (ISIR)/PSW: Actual values lie within the specification.

   Sample size ≥ 5 pcs per tool/nest.

2) Regular random sampling for actual values (frequency depends on the potential changes in the process, such as material batch changes, tool wear depending on the number of shots etc.) with sample size ≥ 5 pcs per tool/nest.

Documentation:
Requirements. 1) Initial:
- Actual values

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Requirements. 2) Permanent:

- Actual values

Inspection level I4

The verification requirements of inspection level I4 correspond to those of I3, but they are used for attributive characteristics or measured variables which will be tested with a gauge during production.
1) Proof for Initial Sampling Inspection Report (ISIR)/PSW: Actual values lie within the specification.
For attributive characteristics a clear ok. /Not ok. result is sufficient.

Sample size ≥ 5 pcs per tool/nest.

2) Regular random sampling with an attributive test, e.g., o.k./not ok. gauge (frequency depends on the potential changes in the process, such as material batch changes, tool wear depending on the number of

shots etc.) with sample size ≥ 5 pcs per tool/nest.

Documentation:
Req. 1) Initial:
Actual values (measured variables) or test result ok/not ok (attributive characteristics)
Req. 2) Permanent:
Test result o.k./not o.k.

Inspection level I5

1) Proof for Initial Sampling Inspection Report (ISIR)/PSW: Actual values lie within the specification. For attributive characteristics a clear ok/not ok result is sufficient. Sample size ≥ 5 pcs.
2) Inspection level I5 is applied for all Special Characteristics which change very slowly, if at all, and which do therefore not require series-accompanying monitoring. A deviating random sampling number can be defined, it does, however, require agreement with the internal customer or MAGNA. I5 characteristics are to be tested 1x per year unless agreed otherwise.

Inspection Levels						
	Inspection Levels	**I 1**	**I 2**	**I 3**	**I 4**	**I 5**
Initial study	**Proof**	1.) Short-term/machine capability C_{mk} 2.) Preliminary process capability P_{pk} 3.) Long-term process capability C_{pk} or P_{pk} for instable processes	Short-term/machine capability C_{mk}	Actual values lie within the specification	Actual values lie within the specification or clear ok/not ok. Result (for Attributive characteristics)	Actual values lie within the specification or clear ok/not ok. Result (for Attributive characteristics)
	Sampling	1.) ≥ **50** pcs per tool/nest 2.) ≥ **125** pcs e.g. collected in **25 shifts, 5 each** 3.) Production period ≥ **20 days** and ≥ **250 pcs**	≥ **50 pcs per tool/nest**	≥ 5 pcs per tool/nest	≥ 5 pcs per tool/nest	≥ 5 pcs per tool/nest
	Documentation	Capability index, distribution, mode of calculation, actual values, mean value, standard Deviation	Capability index, distribution, mode of calculation, actual values, mean value, standard deviation	Actual values	Actual values (measured variables) or test result ok/not ok (attributive characteristics)	Actual values (measured variables) or test result ok/not ok (attributive characteristics)
Permanent	**Proof**	Keeping of a process control card (SPC)	Regular random sampling for actual values	Regular random sampling for actual values	Regular random sampling with an attributive test	Annual testing unless otherwise specified
	Sampling	≥ 5 pcs	≥ 5 pcs /tool/nest	≥ 5 pcs/ tool/nest	≥ 5 pcs/ tool/nest	≥ 5 pcs
	Documentation	Process control card (SPC)	Actual values	Actual values	Test result ok/not ok	Test result ok/not ok
Amendments	**Complementary regulations**	100% testing is required if one of the capabilities cannot be proven. For attributive characteristics, 100% testing is required				A deviating sample size may be defined, but requires agreement with the internal customer / Magna
	Quick Guide	Variable / Attribute Data - 100% testing required w/ SPC	Variable Data w/o SPC	Variable Data w/o SPC	Variable Data w/o SPC	Attribute Data / Yearly Qualification

6.3.3 Verification of compliance

For Special Characteristics with a Process capability, a statistical Process Control is mandatory, because it is not possible to detect the low percentage of potential defect parts in a capable process with a random sample test. The number of necessary test samples to detect a potential failure contribution is too high for an effective process check in the production line.

Corelation between Process Capability Index and number of potential Parts outside the Tolerance. The Process Capability shows the potential number of parts outside the Tolerance:

± ns	Cpk	% in the Tolerance	% Outside Tolerance	ppm

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± 1s	0,33	68,27%	31,83%	317211 ppm
± 2s	0,67	95,35%	4,55%	45500 ppm
± 3s	1,0	99,73%	0,27%	2700 ppm
± 4s	1,33	99,994%	0,006%	63 ppm
± 5s	1,67	99,99994%	0,00006%	0,6 ppm
± 6s	2,0	99,9999998%	0,0000002%	0,002 ppm

The following table shows the minimum requirements, higher customer requirements must be regarded. A deviation from the requirements is only allowed if the requirement cannot be fulfilled in a reasonable

way or would be completely undo *(if the requirement is of customer, Customer approval required)*.

	SC/S	SC/L	SC/F	IC/P	Refer
Machine acceptance	Cm, Cmk ≥ 2.0	Cm, Cmk ≥ 2.0	Cm, Cmk ≥ 1.67	Cm, Cmk ≥ 1.67	Inspection level defined in SCAF
PPAP	Pp, Ppk ≥ 2.0	Pp, Ppk ≥ 1.67	Pp, Ppk ≥ 1.67	Pp, Ppk ≥ 1.67	
Serial production	Cp, Cpk ≥ 1.67	Cp, Cpk ≥ 1.67	Cp, Cpk ≥ 1.33	Cp, Cpk ≥ 1.33	

* if process capability cannot be achieved, a 100% control is mandatory.

Note: When there is a unilateral tolerance Pp/Cp cannot calculate since it requires an upper and lower specification limit. In this situation, disregard the Pp/Cp requirement and only monitor the Ppk/Cpk requirement.

See chapter 6.3.2, for definition of inspection levels defined on drawing by engineering. Accordingly refer appropriate requirements per above table.

7 Modification Index

Version #	Date/Author	Modification
V1.0	07/26/2024 Nikhil Kishor Jangle	Initial version.