DRAWING STANDARDS – D01

Revision
E 10

Scope
These Drawing Standards regulate dimensioning, tolerancing and labelling of technical documents as well as the symbols to be used.

This guideline shall apply for all new parts as well as all applications and departments of HWA AG as well as their suppliers.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

TABLE OF CONTENS

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

1. GENERAL

Normative References
The following norms or standards shall principally apply when these drawing standards are used. In case of dated references, only the indicated edition shall apply; in case of undated references, the latest edition of the indicated document shall apply.

DIN EN ISO 1101	Geometrical product specifications (GPS) - Geometrical tolerancing – Tolerances of form, orientation, location and run-out
DIN EN ISO 1302	Geometrical product specifications (GPS) – Indication of surface texture in technical product documentation
DIN ISO 2768-1	General tolerances; Tolerances for linear and angular dimensions without individual tolerance indications
DIN ISO 2768-2	General tolerances; Tolerances of form and location without individual tolerance indications
DIN EN ISO 5459	Geometrical product specifications (GPS) - Geometrical tolerancing – Datum references and datum reference systems
DIN EN ISO 8015	Geometrical product specifications (GPS) - Fundamentals - Concepts, principles and rules
DIN EN ISO 10579	Geometrical product specifications (GPS) – Dimensioning and tolerancing – Non-rigid parts
DIN ISO 13715	Technical drawings – Work piece edges of undefined shape – Terminology and drawing information
DIN EN ISO 14405-1	Geometrical product specifications (GPS) - Dimensional tolerancing - Part 1: Linear sizes
DIN EN ISO 14405-2	Geometrical product specifications (GPS) – Dimensional tolerancing - Part 2: Dimensions other than linear sizes
DIN EN ISO 14405-3	Geometrical product specifications (GPS) - Dimensional tolerancing - Part 3: Angular sizes
DIN 30630	Technical drawings - General tolerances in mechanical engineering – Tolerance rules and general plan
DIN ISO 2859-1	Sampling procedure for acceptance inspection based on the number of faulty units or defects (inspection by attributes) - Part 1: Well-ordered sampling schemes indexed by acceptable quality limits (AQL) for the inspection of a series of lots
DIN ISO 22514-1	Statistical methods in process management – Capability and performance - Part 1: General principles and terms
ISO 22514-2	Statistical methods in process management - Capability and performance - Part 2: Process capability and performance characteristics of time-dependent process models

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

ISO 22514-3	Statistical methods in process management - Capability and performance - Part 3: Machine performance studies for measured data on discrete parts

3D CAD Model and Drawing
The geometry of a component part shall be completely described with the related 3D CAD model. The drawing derived from the 3D CAD model shall include all other information required for a complete description. The released drawing shall be the binding basis for ordering, for production and quality assurance.

Drawing Contents
The drawing shall include all production-relevant and quality-relevant information which are not an integral part of the 3D CAD model. This shall include, inter alia:

- Item number and designation
- Material
- Weight
- Surface information
- Tension and alignment points as well as direction of gravitational force (for non-rigid parts)
- Data references / data reference system
- Inspection characteristics (e.g. tolerances)

Only for Offer – Drawing of Offer
Non-released drawings which are used, however, for offers of suppliers shall be clearly labelled "**Only for Offer**".

Tolerancing Principle
According to the ISO standard, the independence principle is used as the tolerancing principle (DIN EN ISO 8015).

Unit of Measurement for Dimensions and Tolerances
Unless otherwise specified, all dimensions and tolerances shall be specified in mm.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

Fitting Elements
So that not only dimensional variations but also variations of form will be taken into consideration for fitting elements, the envelope condition according to DIN EN ISO 14405-1 shall be specified for these elements. To this end, the following notice is to be attached in the vicinity of the text field: **"The envelope condition shall apply for all directly dimensioned bores and external cylinders"**.

General Tolerances
When using standards for general tolerances, it shall be carefully taken into account

- which range of values the standard will cover and for which dimensions the tolerances are to be entered directly; and also
- for which types of tolerances of form and location the standard will specify allowable variations and which gaps the standard has.

Tolerances for Linear Dimensions, Radii and Bevel Heights
Using ISO 2768-1 for general tolerances, no tolerances for dimensions smaller 0.5 mm are specified. In this respect, separate information is necessary in the form of "**All nominal dimensions < 0.5 for linear dimensions, radii and bevel height are tolerated at ….**".

Missing Information and Dimensions
Information and dimensions not presented in the drawing shall the gathered from the appropriate 3D CAD model. General tolerances for linear and angular dimensions, for radii and bevel heights shall also apply for the dimensional values obtained from the 3D CAD model. The drawings shall be designated with the following note: **"Missing information and dimensions according to 3D CAD data. General tolerances also apply for measuring values obtained from 3D CAD data."**

Datum Reference System
Every component part shall be provided with a key datum reference system (according to the installation condition in the vehicle) by means of which the component part may be unambiguously positioned and aligned (for example, according to the 3-2-1 rule). The functionally relevant elements are used as datum references and datum reference points. The designation shall be in accordance with DIN EN ISO 5459.
For non-rigid component parts, possible additional datum reference points or datum references are necessary. Reception conditions shall be documented according to DIN EN ISO 10579.

Form and Location Tolerances
Geometric requirements on elements of component parts shall be documented with form and location tolerances in accordance with DIN EN ISO 1101.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

Consecutive Numbers
The requirements to be complied with (e.g. dimensions, tolerances) by the component part or, respectively, the assembly shall be documented in the drawing. All test features of a component part which are used in test reports shall have a number. These consecutive numbers shall always be visible in the drawing. The total number of test features shall be documented in the drawing.

Electric Component Parts
For component parts and assemblies from the electrical area, dimensional information and tolerances may be explained by the following notice:
"**All linear dimensions including plugs, for ring terminal ends centre of hole.**
Dimensioning of suspensions and radii relative to neutral fibres.
Tolerances of not directly tolerated cable lengths:
≤100 +10 | >100 to ≤1000 +20 | 1000 +30"

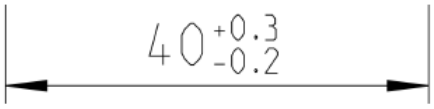
Capability process examination
For all special characteristics for which a capability process examination (Cpk value) is required, this shall be carried out according to ISO 22514.
Requirements with regard to the capability process characteristics shall be according to VDA Volume 2.
The scope of the total sampling required for the analysis shall be at least 25 component parts. Verification of the capability process shall be in a manner adequate for the lot size: In case of a smaller lot size, the capability verification shall only be rendered when the sum of the component parts reaches the specified number. If this quantity is not reached, a 100 % test shall be performed.

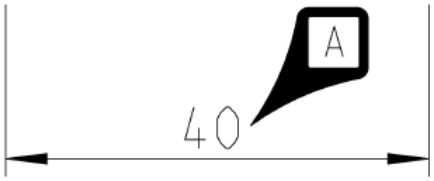
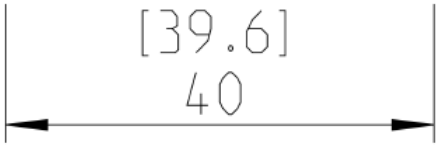
Queries
In case of queries regarding this drawing standard, please contact the division *Qualitätsmanagement* of HWA AG (info-qm@hwaag.com).

Information for Suppliers
In case of discrepancies / errors in the drawings released by HWA, please contact the division *Konstruktion* of HWA AG (info-konstruktion@hwaag.com).

2. SYMBOLS

Symbols used in HWA drawings (remarks regarding the terms marked are found in Section 3.2 Q-Requirements):

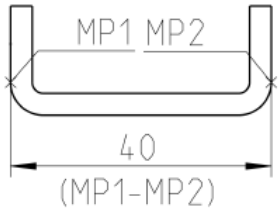
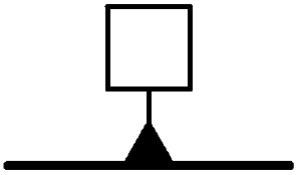
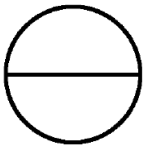
Symbol	Explanation
	**Nominal dimension** General tolerances apply according to text field. (Will not be evaluated in the test report.)
	**Nominal dimension with direct tolerance information** The indicated tolerances have priority over the general tolerances
	**Auxiliary dimension (informational dimension)** [1)] Is an over-dimensioning of the work piece; use for production and control. General tolerances do not apply for an auxiliary dimension.
	**Theoretically precise dimension** Information for the description of nominal geometry. Necessary for datum references and location tolerances.
	**Main dimension:** • For specific requirements which must be defined in the document (e.g. Cp instead of Cpk value). • For features of HWA internal facilities which must be examined at regular intervals.
	**Main dimension: Measured value recording (auxiliary characteristic)** [2)] Auxiliary characteristics must comply with a capability process index Cpk ≥ 1.00
	**Main dimension: Cpk ≥ 1.33 (Key dimension)** [3)] Key dimensions are assembly-relevant and functionally relevant dimensions which must comply with a capability process index Cpk ≥ 1.33.

Symbol	Explanation
	**Main dimension: Cpk ≥ 1.67 (Critical characteristic)** [4)] Critical characteristics as well as safety-relevant and certification-relevant requirements must comply with a capability process index Cpk ≥ 1.67.
	**Main dimension: 100% check** [5)]
	**Gauge test: Measured value recording** [3)] These dimensions shall be tested by means of a special gauge. The item number of the gauge shall be noted in the document!
	**Gauge test: 100% check** [5)] These dimensions shall be tested by means of a special gauge. The item number of the gauge shall be noted in the document!
	**Test characteristic with a consecutive number** Every test characteristic is designated by a symbol which consists of a hexagon and a consecutive number. See Section 1.
	**Adjustment dimension** Tool changes are to be expected. The toolmaker must take care that a cost-neutral change will be possible (removing material).
	**Version marker for changes** All changes (e.g. dimensions, tolerances) are marked with the current drawing version.
	**Current and nominal dimension** The nominal dimension remains 40, but the current, valid dimension is 39.6. If a tool is again produced, this shall be designed for 40.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

Symbol	Explanation
	Use of the measuring points shall be necessary where it is not clearly specified between which elements or at which point the measurement is to be made. The measuring points to be used are indicated in parentheses underneath the dimension (“MP1-MP2“ means between the measuring points MP1 and MP2). Optionally, the developer may describe, in the document, specific and functionally especially important surfaces by means of measuring points. The position of these measuring points in coordinates of the key datum reference system shall be indicated in tabular form.
	**Datum reference** Datum references shall be designated with capital letters (e.g. A, B, C, D, AA, BB, CC, AAA). Letters I, O, Q and X should not be used.
	**Datum reference point** Individual reference points shall be designated with the reference point frame.
	**Datum reference system** A datum reference system shall be formed by a well-ordered arrangement of two or three datum references which are accordingly indicated in the tolerance frame.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

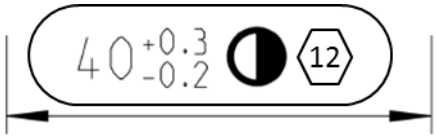
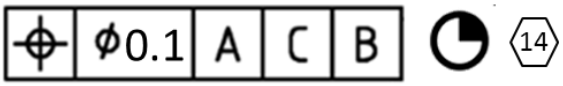
Symbol	Explanation
CCS1	**Documentation of safety relevance** [4)] Safety-relevant requirements shall be designated in the document by the symbol “CCS“ (Critical Characteristic Safety) and a consecutive number (analogously with the designation “DS“ according to Mercedes-Benz Special Terms). Safety-relevant are component parts or systems whose defectiveness or failure may have the consequence of a direct danger to the life and limb of road users. For measurable safety-relevant requirements, the explanation given above shall be applicable regarding the **main dimension: Cpk ≥ 1.67**.
CCH1	**Documentation of certification relevance** [4)] Certification-relevant requirements shall be designated in the document by the symbol “CCH“ (Critical Characteristic Homologation) and a consecutive number (analogously with the designation “DZ“ according to Mercedes-Benz Special Terms). Certification-relevant are component parts or systems whose data, information, verifications, building permits are used in certificates or country-specific application documents or which are checked for type approval. For measurable certification-relevant requirements, the explanation given above shall be applicable regarding the **main dimension: Cpk ≥ 1.67**.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031

3. EXPLANATIONS
3.1. EXAMPLES

Symbol	Explanation
	A main dimension with a tolerance of +0.3 and -0.2 and a Cpk value ≥ 1.67 (applicable for supplier and HWA). It has the consecutive number 12 (for all test reports).
	The positional tolerance with a tolerance zone with the diameter Ø0.1, the primary datum reference A, the secondary datum reference C and the tertiary datum reference B has the consecutive number 14 (for all test reports). The capability process must be Cpk ≥ 1.33.

3.2. Q-REQUIREMENTS

1) Auxiliary dimensions are not measured within the course of sampling. They are used primarily for the design to be better able to explain the function of the component part.

2) Within the course of the capability machine, a capability machine index **Cmk ≥ 1.33** is to be reached for this dimension.
Measured value recordings shall be kept over the entire production and presented at any time upon request by HWA.

3) Within the course of the capability machine, a capability machine index **Cmk ≥ 1.67** is to be reached for this dimension.
The significance of this dimension is to be presented in **FMEA** with **6 to 8**.
Capability process analyses shall be recorded over the entire production and presented at any time upon request by HWA.

4) Within the course of the capability machine, a capability machine index **Cmk ≥ 2** is to be reached for this dimension.
The significance of this dimension is to be presented in **FMEA** with **9**.
Capability process analyses shall be recorded over the entire production and presented at any time upon request by HWA.

5) In ongoing production, this dimension is to be checked 100 %.
Poka Yoke shall be mandatory.
Deliveries of bad parts must be absolutely prevented.
The significance of this dimension is to be presented in **FMEA** with **10**. It must be the risk priority number **RPZ ≤ 80**. A risk analysis is alternatively carried out.
Every measurement shall be recorded and presented at any time upon request by HWA.

6) The incoming goods department of the supplied HWA works shall examine and document these characteristics according to the usual **AQL sampling instructions** in accordance with DIN ISO 2859-1.

HWA AG
Benzstraße 8
71563 Affalterbach
Germany

Telefon +49 (0) 71 44 87 17 - 0
Telefax +49 (0) 71 44 87 18 – 111
info@hwaag.com
www.hwaag.com

Sitz der Gesellschaft: Affalterbach
Vorsitzender der Aufsichtsrat: Hans Werner Aufrecht
Vorstand: Ulrich Fritz (Vorsitzender)
Registergericht: Amtsgericht Stuttgart HRB 721692
USt-IdNr.: DE 197295031