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Geometrical Product Specifications (GPS)

Squares 90° -

Part 1: Steel squares 90°

Foreword

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1. Scope

This standard applies to steel squares, try squares, and straight edges with a square of 90° and a leg length up to 1,500 mm. It specifies the main design and metrological features and their testing.

2. Normative references

DIN 875-1:2005-07 Geometrical Product Specifications (GPS) Squares 90° - Part 1: Steel squares 90°

SASO ISO 1, Geometrical Product Specification (GPS) - Reference temperature for geometrical product specification and verification.

SASO ISO 14253-1, Geometrical Product Specification (GPS) - Inspection of workpieces and measuring equipment by measurement - Part 1: Decision rules for verifying conformity or nonconformity with specifications.

SASO ISO 1101([1]), Technical drawings - Shape and position tolerances - Shape tolerances, directional tolerances, orc tolerances and running tolerances; General, definitions, symbols, drawing entries

SASO ISO 2768-1, General tolerances - Tolerances for linear and angular dimensions without individual tolerance entries.

3. Definitions

The terms defined in SASO ISO 1101 apply to the application of this document.

4. Dimensions, Designation

4.1 Dimensions

Dimensions according to table 1.

Table 1 — Dimensions

Dimensions in millimeters

nominal length ***l****/1*		5	75	100	150	200	250	300	500	750	1 000	1 500
/2	tolerance class 00; 0 and 1	40	50	70	100	130	165	200	330	500	660	1 000
	Tolerance class 2							175	250	375	500	750
a For C and E shape square only.												

General Tolerances: ISO 2768 – v

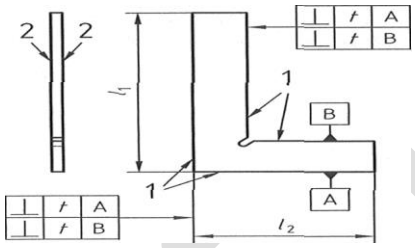
Form and positional tolerances according to Section 5.

[1] Undergoing revision.

The squares do not need to correspond to the pictorial representation; only the specified dimensions are to be adhered to. Unspecified details are to be chosen appropriately.

The cross-sectional dimensions of the square sides are not standardized. However, they should be chosen in such a way that the squareness, flatness and straightness tolerances specified in Section 5 are observed under normal operating conditions.

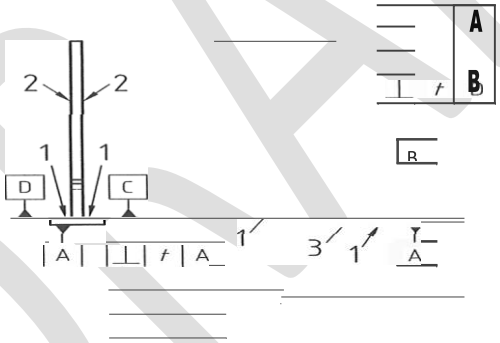
For squares that do not correspond to the dimensions specified in 4.1, the other specifications in Sections 4 to 6 should be based on agreement.



Legend
1. Test surface
2. Side face

Picture 1 — Flat square Form A

Legend



1. Test surface
2. Side face
3. Stop plate

Picture 2 — Try square Form B

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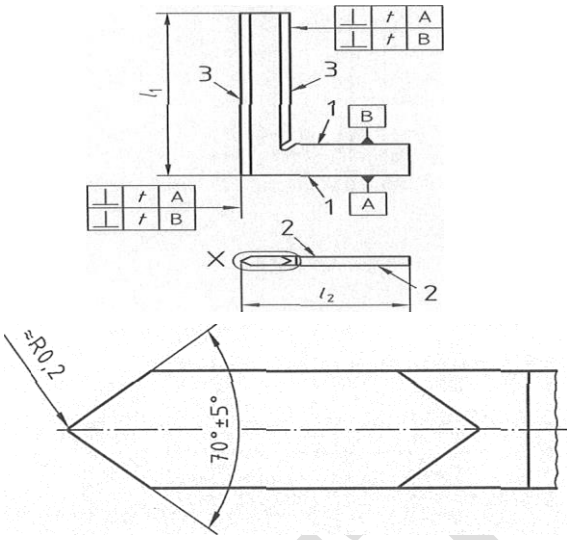
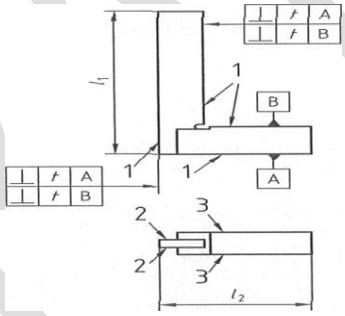


Legend

1. Test surface
2. Side face
3. Inspection edge

Picture 3 — knife-edge square Form C



Legend

1. Test surface
2. Side face of the long side
3. Side face of the short side

Picture 4 — Try Square with wide short side Form D

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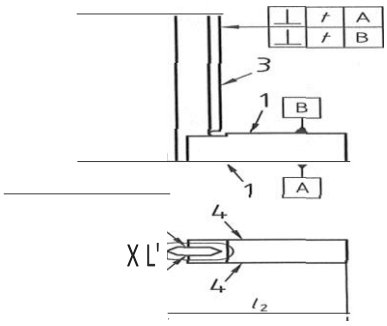

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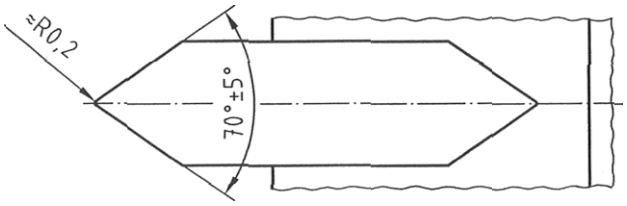

Legend
1. Test surface
2. Side face of the long side
3. Inspection edge
4. Side face of the short side

Picture 5 — knife-edge square with a wide, short side, Form E

4.2 Description

This is the designation for a steel square of form A with leg lengths l_1 = 200 mm and l_2 = 130 mm, tolerance class 1, in hardened execution (g), according to the DIN 875 standard for squares and straight edges.

Steel square DIN 875 — A 200 × 130 — 1— g

5. Requirements

5.1 Reference temperature

20°C according to SASO ISO 1

5.2 Form and Positional Tolerances

For the squareness tolerances, the test surfaces of the short leg are used as reference elements.

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5.2.1 Squareness tolerance for interior and exterior angles

The perpendicularity tolerance

— For an inspection edge relative to the corresponding inspection surface for squares of forms C and E (see images 3 and 5).

— For the squareness tolerance between two inspection surfaces forming a 90-degree angle for squares of forms A, B, and D (see images 1, 2, and 4).

is calculated according to the formulas specified in Table 2.

Table 2 — Formulas for the squareness tolerance of the test surface

Tolerance class	squareness tolerance t
00[a]	$2\ \mu m + 1 \cdot 10^{-5} \cdot \ell_1$
0[b]	$5\ \mu m + 2 \cdot 10^{-5} \cdot \ell_1$
1[b]	$10\ \mu m + 5 \cdot 10^{-5} \cdot \ell_1$
2[b]	$20\ \mu m + 10 \cdot 10^{-5} \cdot \ell_1$
For knife-edge square only. Only for squares of forms A, B, and D.	

According to the formulas in Table 2, the tolerances given in Table 3 are rounded.

Table 3 — Squareness tolerances

ℓ_1	squareness tolerance compared to tolerance class			
mm	00 µm	0 µm	1 µm	2 µm
50	3	–	–	
75	3	7	14	28
100	3	7	15	30
150	4	8	18	35
200	4	9	20	40
250	5	10	23	45
300	5	11	25	50
500	7	15	35	70
750	10	20	48	95
1 000	12	25	60	120
1 500	17	35	85	170

the Squareness tolerance of the side faces for squares of forms A, B, and D to each adjacent test face of the short side is equal to six times the corresponding perpendicularity tolerances given in Table 3.

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5.2.2 Flatness tolerance or straightness tolerance

The flatness tolerances of the inspection surfaces and the straightness tolerances of the inspection edges are determined by the formulas specified in Table 4.

Table 4 — Flatness Tolerance and Straightness Tolerance Formulas

Tolerance class	Flatness tolerance or straightness tolerance
00	$2\ \mu m + 4 \cdot 10^{-6} \cdot /_n{}^a$
0	$2\ \mu m + 10 \cdot 10^{-6} \cdot /_n$
1	$4\ \mu m + 20 \cdot 10^{-6} \cdot /_n$
2	$8\ \mu m + 40 \cdot 10^{-6} \cdot /_n$
[a] n= 1; 2	

The tolerances specified in Table 5 are obtained by rounding the values calculated using the formulas in Table 4.

Table 5 — Tolerances for flatness and straightness

/1 or /2 mm	Flatness tolerances or straightness tolerance for tolerance class			
	00 µm	0 µm	1 µm	2 µm
40	2	-	–	–
50	2	3	5	10
70	2	3	5	11
75	2	3	6	11
100	2	3	6	12
130	3	3	7	13
150	3	4	7	14
165	3	4	7	15
175	–	–	–	15
200	3	4	8	16
250	3	5	9	18
300	3	5	10	20
330	3	5	11	
375	-	–	-	23
500	4	7	14	28
660	5	9	17	–
750	5	10	19	38
1000	6	12	24	48
1500	8	17	34	68
For squares of forms C and E, these values apply when the long side is inclined within a range of +15° to the normal of the flatness standard.				

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The test surfaces of the short leg must have a concave shape (see also Section 8 "Test").

For the flatness tolerance of the side surfaces, the sixfold value of the flatness tolerances of the inspection surfaces specified in Table 5 applies.

5.3 trimming

A drop-off of 0.5 mm from the edges of the test surfaces is permissible in the transverse direction. In the longitudinal direction, the drop-off must not exceed 2 mm from the edges.

6. Material

6.1 For Form A, B and D

a) Unhardened squares (u): steel (grade according to the manufacturer's choice or as agreed).
b) Hardened squares (g): hardenable steel (grade according to the manufacturer's choice or as agreed).
Unalloyed or alloyed (stainless) steel (grade according to the manufacturer's choice or as agreed) may be used.

6.2 For Form C and E
Hardenable steel (grade according to the manufacturer's choice or as agreed).
Unalloyed or alloyed (stainless) steel (grade of the manufacturer's choice or by agreement) may be used.

7. Execution
The test surfaces are to be finely machined (according to the manufacturer's choice). The squares must not have any burrs or sharp edges.
The test cutting edges of the knife-edge square are lapped; the test cutting edge surfaces must be free of glare. The squares must be demagnetized.
Squares of forms A, B, and D are available in hardened (g) and unhardened (u) execution; squares of forms C and E are only available in hardened execution.

Hardness of the test surfaces or test edges for hardened squares:

a) For unalloyed steel: Vickers hardness of at least 700 HV 5 (equivalent to a Rockwell hardness of 59 HRC "Hardness / Rockwell C").
b) For stainless steel: Vickers hardness of at least 575 HV 5 (equivalent to a Rockwell hardness of 53 HRC "Hardness / Rockwell C").

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8. Testing

8.1 rectangular deviation as well as flatness deviation or deviation in straightness.

The test surface of the short side of the steel square forms the reference plane. Therefore, it must not be convex. To carry out the test, it is placed on a test plate or supported on two points. It is also permissible to calculate the reference plane in accordance with SASO ISO 1101 based on measured points determined with a coordinate measuring machine.

In case the short side is placed on a test board, the flatness deviation of the test board in the area under consideration (partial test surface) must be less than 50% of the flatness tolerance of the test surface of the short side. The test board must also not be convex.
The testing of the squareness deviation, straightness deviation, or flatness deviation according to SASO ISO 1101 is carried out by comparison with the squareness standard, straightness standard, or flatness standard. Suitable standards include, for example:
- test board with cylindrical (only for steel squares of forms A, B, and D) or square test column (only for steel squares of forms C and E),
- test board with a straight guide aligned at a square,
- framing square (for testing the interior square),
- the axes of a coordinate measuring machine.

The influences of form and positional deviations of the test surfaces of the steel square to be tested and the measuring device must be eliminated or included in the measurement uncertainty budget by the measurement method, e.g. wrap-around method. Deformations of the steel square due to its horizontal or vertical mounting in the measuring device must also be taken into account. Deformations caused by clamping the steel square must be avoided.

8.2 Demonstration of conformity with the specification

SASO ISO 14253-1 applies to proof of compliance and non-compliance with the specification.

9. Identification

Steel square that comply with this standard must be legibly and durably marked with

— the name or trade mark of the manufacturer or distributor,

— the tolerance class (only for flat squares and try squares of form A, B and D). Steel squares must be provided with an individual alphanumeric identification.

10. Application Notes

Flat squares and try squares must not be used for testing in place of a straight square due to improper use (oblique positions or tilting and positioning only one edge), as straightness and squareness tolerances are much smaller for straight squares.

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