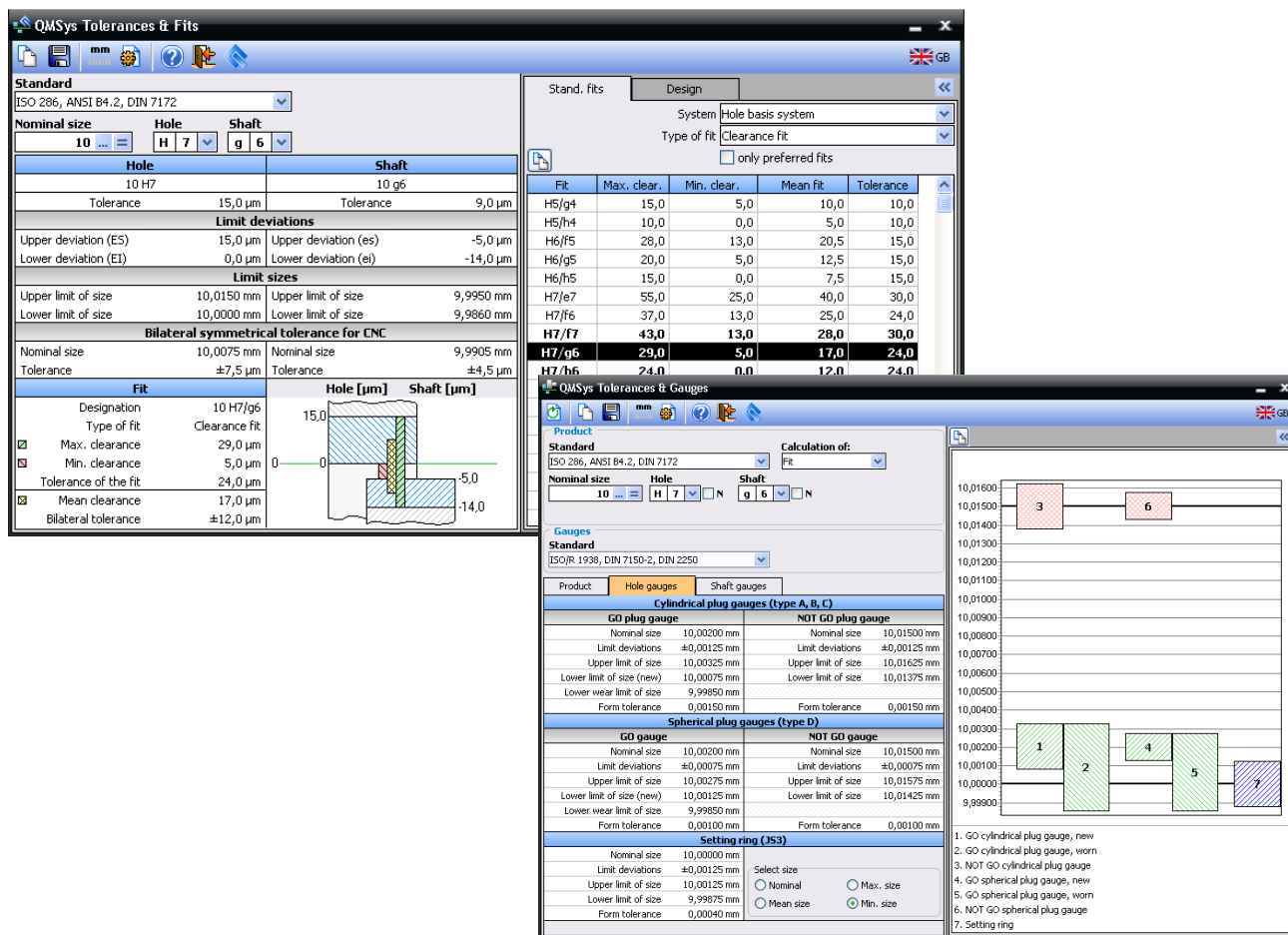


QMSys - Tolerances & Fits

QMSys - Tolerances & Gauges

Software for computation of
tolerances, fits and plane gauges



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Introduction

The software products **QMSys Tolerances & Gauges, Tolerances & Fits** can be used to choose a fit and determine tolerances and deviations of machine parts according to the following international, European and national standards:

- **ISO 286, ANSI B4.2** for nominal dimensions up to 3150mm
- **ISO 286, ANSI B4.2, GOST 25346** for nominal dimensions up to 3150mm
- **DIN 7172** for nominal dimensions over 3150mm up to 10000mm
- **GOST 25348** for nominal dimensions over 3150mm up to 10000mm
- **ANSI B4.1** for nominal dimensions up to 200 inch
- **ISO 2768-1** for nominal dimensions without individual tolerance indications up to 3150mm

Data base and techniques for calculating the nominal sizes and limit values of the following gauges have been included in the program **QMSys Tolerances & Gauges**:

- Plug gauges, ring gauges, snap gauges, checking plug gauges and setting plugs according to **ISO 1938, DIN 7150-2**, setting rings according to **DIN 2250** for nominal sizes up to 500 mm and tolerance grade IT ≥ 5
- Plug gauges, ring gauges, snap gauges, master rings and master disks with class **XXXX** up to **ZZ** according to **ASME B89.1.5, ASME B89.1.6** for nominal sizes from 0.0009 inches up to 19.69 inches.
- Plug gauges, ring gauges and setting plugs according to **BS 969**, setting rings acc. to **BS 4064, BS 4065** for workpiece tolerances from 0.009 mm up to 3.2 mm, respectively from 0.00035 inches up to 0.12500 inches.
- Limit gauges (plug, ring and snap gauges) according to **NF E 02-202**, setting rings according to **NF E 11-011** and setting plugs according **NF E 11-012** for nominal sizes up to 500 mm and tolerance grade IT ≥ 5
- Acceptance gauges (plug, ring and snap gauges) according to **NF E 02-205**, setting rings according to **NF E 11-011** and setting plugs according **NF E 11-012** for nominal sizes up to 500 mm and tolerance grade IT ≥ 5

Note: All numerical values of tolerances and deviations mentioned in this paragraph are given in the metric system and relate to parts with dimensions specified at 20°C.

Program activation

In the software shareware versions the full version is already included, which can be activated by unlock keys only.

When the program is started after a new installation, a dialog window is displayed containing the software license key (hardware identification code). For the successful activation of the program it is necessary to obtain a correct unlock key (activating key). The unlock key is provided by the program manufacturer or by the dealer.

To obtain an unlock key, you will need to:

- have the program already installed
- buy software license
- advise program license key by e-mail or fax
- enter the received unlock key.

After entering the received unlock key and selecting the "Activation" button, the program is registered and can be used without any restrictions.

You can receive further information on our web site: www.qsyst.com.

Free trial unlock keys

QMSYS software is available as a free trial for 30 days. Upon expiration of the trial period, the user can open the software in demonstration mode only.

You can request a trial unlock key by sending an email to sales@qsyst.com or qualisyst@qsyst.com, including your contact details (Name and Organization) and product names (or product license keys), and you will have the full version for a **30-day evaluation period**.



Software description

The menu and functional buttons are located in the title bar of the program. Standard and tolerances for the hole and/or for the shaft are entered in field "Product". Standard for the plane gauges is selected in the field "Gauges".

Tolerances are entered in the following ways:

- selection of a standard tolerance – a combination of basic deviation and tolerance grade
- entering of non-standard tolerances by the limit sizes of the hole and shaft
- entering of non-standard tolerances by the limit deviations of the hole and shaft.

The following data is situated on separate pages:

- nominal and limit sizes of the workpiece, tolerance designation, fit parameters
- nominal and limit sizes of gauges for checking holes
- nominal and limit sizes of gauges for checking shafts

Program menu and button bar

	The "Language" button allows you to select another language for the program texts.
	Calculates workpiece and gauges parameters.
	Prints the calculation results in TXT, RTF, XML, XLS or HTML format.
	Copies the data to the clipboard.
	Saves the calculation results in file with TXT, RTF, XML, XLS or HTML format.
	The key "mm/inch" allows you to select the proper measurement unit.
	Opens the settings window: - units for tolerances, limit deviations and - "mm/inch" or "µm/milli inch" - Decimal places - number of right-of-comma positions in mm and inch - copies and exports with units - shows pressure fits with sign "-" - consumed tolerance for ASME gauges and masters.
	Through the key "Exit" the program is closed.
	Opens the software help file or shows information about the software.
	Entry of nominal size, catalogue with preferred number and "Calculation".
	Selection of basic deviation.
	Selection of tolerance grade.
	Selection of a standard tolerance – a combination of basic deviation and tolerance grade.
	Selection of class for gauges acc. to ASME B89.1.5, ASME B89.1.6.
	Selection of class for setting rings acc. to BS 4064, BS 4065.



Plain limit gauges, master rings and master disks according to ASME B89.1.5, ASME B89.1.6 are calculated for the selected class: XXXX, XXX, XX, X, Y, Z or ZZ. The software offers automatically the suitable class of gauge after each calculation.

Setting rings according to BS 4064, BS 4065 are calculated for the selected class: AA, A or B.

The software offers for the calculation of setting ring and plugs the selection of one of the workpiece sizes: nominal, mean, maximum, minimum.

Software application

1. Select the standard for calculation of tolerances and fits.
2. Enter nominal size in [mm] or [in]. The software offers selection of suitable sizes from the preferred number series R5 to R80 according to ISO 3, ANSI Z17.1.
3. Select an ISO tolerance for the hole and/or shaft. The ISO tolerance is a combination of basic deviation and tolerance grade. When it is possible to use the recommended tolerances in standard ISO 286:1988, the preferred tolerances have been designed in bold type.

Tolerances for the hole and/or for the shaft are entered in the following ways:

- select a standard tolerance – a combination of basic deviation and tolerance grade
- enter non-standard tolerances by the limit sizes of the hole and shaft
- enter non-standard tolerances by the limit deviations of the hole and shaft.

When only the hole or only the shaft has a non-standard tolerance, it is necessary to select a standard tolerance first, and then to enter the non-standard for the hole or shaft – the standard tolerance entered is stored.

4. Alternatively, a recommended fit can be selected which defines the tolerances of the hole and the shaft.

When selecting a fit, the system of the fit should be selected first, and then the type of fit. The preferred ISO fits are given in bold type.

5. Select the standard for calculation of plane gauges.

Select also a standard for determining the degree of accuracy of the hole and shaft when presetting a non-standard tolerance.

- Large (ISO 286) – when the non-standard tolerance entered falls between two tolerance grades from the margin tolerance table according to ISO 286-1, the next higher tolerance grade is chosen
- Small (ISO 286) - when the non-standard tolerance entered falls between two degrees of accuracy from the margin tolerance table according to ISO 286-1, the next lower degree of accuracy is chosen.

6. Tolerances, limit deviations and limit sizes of the workpiece and gauges are calculated automatically, the location of margin tolerances is visualized graphically as well, depending on selected page of parameters of the workpiece or gauges.

Design of fits according ISO 286

This window can be used for a design of a suitable standardized fit for a known clearance or interference respectively. The fit design is based on the standard ISO 286. The fit design is processed automatically and after its completion, the calculation provides the user with a set of fits whose parameters meet the best requirements entered.

After setting all desired parameters of the fit initiate automatic fit design using the button "Search".

The qualitative criterion for selection of a fit includes a sum of absolute deviations of limit values of the clearance or interference resp. of the designed fit from desired values.

After completing the calculations, the selected fits are transferred to the table. The table includes selected fits listed from the best to the least optimal. The preferred fits are given in bold type.

After selecting any fit in the table, its parameters are displayed in left window.

When designing other types of fits, it is required to observe the following rules:

- The fit should be in "Hole basis system" or "Shaft basis system"
- The tolerance grade of the hole should be greater or equal to the tolerance grade of the shaft
- The tolerance grade of the hole and the shaft should not differ by more than two orders.



Appendix

1. Field of use of individual tolerances of the system ISO

IT01 to IT6	For production of gauges and measuring instruments
IT5 to IT12	For fits in precision and general engineering
IT11 to IT16	For production of semi-products
IT16 to IT18	For structures
IT11 to IT18	For specification of limit deviations of non-tolerated dimensions

2. Recommended tolerances for hole acc. to ISO 286-2 standard

IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16	IT17	IT18
							B8 C8	A9 B9 C9	A10 B10 C10	A11 B11 C11	A12 B12 C12	A13 B13 C13					
				E5	CD6 D6 E6	CD7 D7 E7	CD8 D8 E8	CD9 D9 E9	CD10 D10 E10	D11	D12	D13					
		EF3 F3	EF4 F4	EF5 F5	EF6 F6	EF7 F7	EF8 F8	EF9 F9	EF10 F10								
		FG3 G3	FG4 G4	FG5 G5	FG6 G6	FG7 G7	FG8 G8	FG9 G9	FG10 G10								
H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17	H18
JS1	JS2	JS3	JS4	JS5	JS6	JS7	JS8	JS9	JS10	JS11	JS12	JS13	JS14	JS15	JS16	JS17	JS18
		K3	K4	K5	J6 K6	J7 K7	J8 K8										
		M3 N3	M4 N4	M5 N5	M6 N6	M7 N7	M8 N8	M9 N9	M10 N10	N11							
		P3	P4	P5	P6	P7	P8	P9	P10								
		R3	R4	R5	R6	R7	R8	R9	R10								
		S3	S4	S5	S6	S7	S8	S9	S10								
				T5 U5	T6 U6	T7 U7	T8 U8	U9	U10								
				V5 X5	V6 X6 Y6	V7 X7 Y7	V8 X8 Y8	X9 Y9	X10 Y10								
					Z6 ZA6	Z7 ZA7	Z8 ZA8	Z9 ZA9	Z10 ZA10	Z11 ZA11							
						ZB7 ZC7	ZB8 ZC8	ZB9 ZC9	ZB10 ZC10	ZB11 ZC11							

Note: For sizes over 500 mm only the tolerances written in bold type are used.



3. Recommended tolerances for shaft acc. to ISO 286-2 standard

IT1	IT2	IT3	IT4	IT5	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14	IT15	IT16	IT17	IT18
							c8	a9 b9 c9	a10 b10 c10	a11 b11 c11	a12 b12 c12	a13 b13					
				cd5 d5	cd6 d6	cd7 d7	cd8 d8	cd9 d9	cd10 d10	d11	d12	d13					
		ef3	ef4	e5 ef5	e6 ef6	e7 ef7	e8 ef8	e9 ef9	e10 ef10								
		f3 fg3	f4 fg4	f5 fg5	f6 fg6	f7 fg7	f8 fg8	f9 fg9	f10 fg10								
		g3	g4	g5	g6	g7	g8	g9	g10								
h1	h2	h3	h4	h5	h6	h7	h8	h9	h10	h11	h12	h13	h14	h15	h16	h17	h18
js1	js2	js3	js4	js5	js6	js7	js8	js9	js10	js11	js12	js13	js14	js15	js16	js17	js18
		k3	k4	j5 k5	j6 k6	j7 k7	k8	k9	k10	k11	k12	k13					
		m3 n3	m4 n4	m5 n5	m6 n6	m7 n7	m8 n8	m9 n9									
		p3	p4	p5	p6	p7	p8	p9	p10								
		r3	r4	r5	r6	r7	r8	r9	r10								
		s3	s4	s5	s6	s7	s8	s9	s10								
				t5 u5	t6 u6	t7 u7	t8 u8	u9									
				v5 x5	v6 x6 y6	v7 x7 y7	v8 x8 y8	x9 y9	x10 y10								
					z6 za6	z7 za7	z8 za8	z9 za9	z10 za10	z11 za11							
						zb7 zc7	zb8 zc8	zb9 zc9	zb10 zc10	zb11 zc11							

Note: For sizes over 500 mm only the tolerances written in bold type are used.

4. General tolerances acc. to ISO 2768

The standards **ISO 2768-1** and **ISO 2768-2** are designed for tolerancing of dimensions of machine parts produced using cutting operations or forming of sheets. It is advisable to use limit deviations defined here also with non-metallic materials. This standard prescribes limit deviations of linear and angular dimensions in four classes of accuracy.

Note: In case general limit deviations of dimensions according to this standard have to be applied, a respective record must be placed in the drawing (in the description field or in its vicinity). If not in contradiction with constructional and technological requirements, use preferably a medium class of accuracy "m" for machined metal parts.

4.1. Limit deviations for linear dimensions

Permissible deviations in [mm] for ranges in nominal lengths	Tolerance class			
	f (fine)	m (medium)	c (coarse)	v (very coarse)
0.5 up to 3	±0.05	±0.1	±0.2	-
over 3 up to 6	±0.05	±0.1	±0.3	±0.5
over 6 up to 30	±0.1	±0.2	±0.5	±1.0
over 30 up to 120	±0.15	±0.3	±0.8	±1.5
over 120 up to 400	±0.2	±0.5	±1.2	±2.5
over 400 up to 1000	±0.3	±0.8	±2.0	±4.0
over 1000 up to 2000	±0.5	±1.2	±3.0	±6.0
over 2000 up to 4000	-	±2.0	±4.0	±8.0

* With nominal dimensions under 0,5 mm the dimensions are prescribed directly for appropriate nominal dimension



4.2. Limit deviations for external radii and chamfer heights

Permissible deviations in [mm] for ranges in nominal lengths	Tolerance class			
	f (fine)	m (medium)	c (coarse)	v (very coarse)
0.5 up to 3	±0.2	±0.2	±0.4	±0.4
over 3 up to 6	±0.5	±0.5	±1.0	±1.0
over 6	±1.0	±1.0	±2.0	±2.0

* With nominal dimensions under 0,5 mm the dimensions are prescribed directly for appropriate nominal dimension

4.3. Limit deviations for angular dimensions

Permissible deviations in degrees and minutes for ranges in nominal lengths	Tolerance class			
	f (fine)	m (medium)	c (coarse)	v (very coarse)
up to 10	±1°	±1°	±1° 30'	±3°
over 10 up to 50	±0° 30'	±0° 30'	±1°	±2°
over 50 up to 120	±0° 20'	±0° 20'	±0° 30'	±1°
over 120 up to 400	±0° 10'	±0° 10'	±0° 15'	±0° 30'
over 400	±0° 5'	±0° 5'	±0° 10'	±0° 20'

4.4. Tolerances for form and position

Ranges in nominal lengths in [mm]	Tolerance class		
	H	K	L
up to 10	0.02	0.05	0.1
over 10 up to 30	0.05	0.1	0.2
over 30 up to 100	0.1	0.2	0.4
over 100 up to 300	0.2	0.4	0.8
over 300 up to 1000	0.3	0.6	1.2
over 1000 up to 3000	0.4	0.8	1.6

4.5 Tolerances for perpendicularity

Ranges in nominal lengths in [mm]	Tolerance class		
	H	K	L
up to 100	0.2	0.4	0.6
over 100 up to 300	0.3	0.6	1
over 300 up to 1000	0.4	0.8	1.5
over 1000 up to 3000	0.5	0.8	2

4.6 Tolerances for symmetry

Ranges in nominal lengths in [mm]	Tolerance class		
	H	K	L
up to 100	0.5	0.6	0.6
over 100 up to 300	0.5	0.6	1
over 300 up to 1000	0.5	0.8	1.5
over 1000 up to 3000	0.5	1	2

4.7 Tolerances for run-out

Tolerance class		
H	K	L
0.1	0.2	0.5



5. Relationship of tolerance to surface finish

Tolerance grade	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Lapping															
Honing															
Superfinishing															
Cylindrical/centrelees grinding															
Diamond turning															
Plan grinding															
Broaching															
Reaming															
Boring, Turning															
Sawing															
Milling															
Planing, Shaping															
Extruding															
Cold Rolling, Drawing															
Drilling															
Die Casting															
Forging															
Sand Casting															
Hot rolling, Flame cutting															