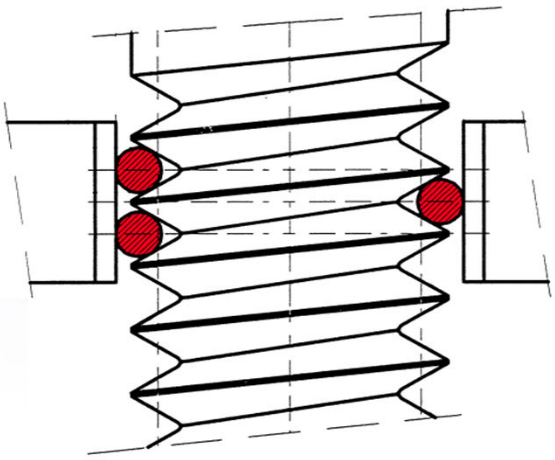
Three-Wire Thread Measurement Method
Guide to using and calculating test dimensions

All calculational bases and information in this guide have been carefully prepared with reference to EURAMET/cg-10/v.01 of July 2007 and various standard procedures. The selection aids for suitable test wire diameters are based on DIN 2269 : 1998-11.
However, mistakes, errors and changes cannot be ruled out. We offer no warranty, guarantee or liability in this respect. The user is solely responsible for the suitability of the measuring equipment and procedures chosen and their correct implementation. We recommend that you observe the current version of the EURAMET/cg-10 guideline (formerly EA-10/10; German translation offered by the Swiss Accreditation Service SAS: "Leitfaden für die Bestimmung des Flankendurchmessers von parallelen Gewindelehren durch mechanische Prüfung", document no. 211.dw), relevant standards and literature on this subject.

Three-wire thread measurement:



The three-wire measuring process is one of the most precise procedures for determining the pitch diameter of threads.

The M+T thread measuring wires with micrometer holders combine this procedure with unique handling ease, measuring security of the highest order and absolute efficiency.

The corresponding measuring wires position themselves after they have been affixed, through the integrated washer spring, to the spindle of the measuring screw using the pair of holders.

The selection and calculation aids listed below provide additional practical assistance.

easy to use - highly accurate results

MARTIN + TSCHOPP GmbH
CH-4434 Hölstein / Switzerland
Tel.: +41 (0)61 956 17 00 - Fax: +41 (0)61 956 17 09 - E-mail: info@mt-swiss.com - www.mt-swiss.com

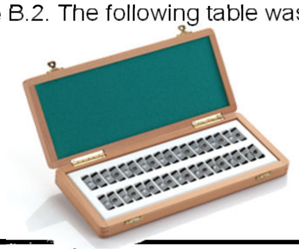
Selecting fitting thread measuring wires and calculating test dimensions:
By referring to the tables below you can approximately calculate and express the test dimensions for the measurement of outer threads using the three-wire method if the thread specification is known. The threads to be tested must meet the following minimum requirements:

Cylindrical form, i.e. parallel thread / straight flanks / positive flank angles / single-thread

Determining a suitable thread measuring wire diameter:
In theory thread measuring wires must have the right size to fit snugly in the flank diameter of the tested thread (see also DIN 2269 : 1998-11 / Table B.1). The most suitable measuring wire diameter can be calculated as follows:

$$d_D = \frac{P}{2 \cdot \cos\frac{\alpha}{2}}$$

In practice, you will often be working with a graded thread measuring wire diameter in accordance with the Zeiss thread measuring wire series. This can be found in DIN 2269 : 1998-11 / Table B.2. The following table was compiled with reference to this DIN standard.



M+T thread measuring wires with holders in a set with commonly used diameters of the Zeiss series

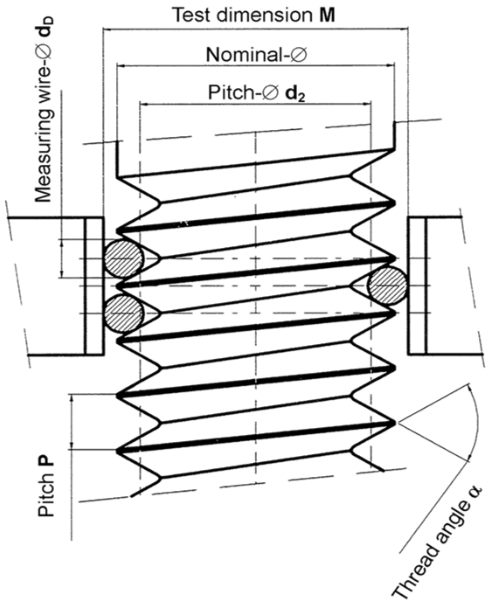
Nominal diameter d_D [mm]	Metric ISO thread according to standards of DIN 13 series Pitch P [mm]	Whitworth and Whitworth pipe thread acc. to BS 84 : 1956, DIN 2999-1, DIN ISO 228-1 Threads per inch	Unified thread UN, UNC, UNF, UNEF acc. to ANSI/ASME B 1.1 : 1989 Threads per inch	Trapezoidal thread acc. to standards of DIN 103 series Pitch P [mm]
0.17	0.25 0.3	-	-	-
0.195	-	-	80	-
0.22	0.35	-	72	-
0.25	0.4	-	64	-
0.29	0.45 0.5	-	56	-
0.335	0.6	40	48 44	-
0.39	-	-	40	-
0.455	0.7 0.75 0.8	-	36	-
0.53	-	32 28	32 28	-
0.62	1	26 24	24	-
0.725	1.25	22 20 19	20	-
0.895	1.5	18 16	18 16	1.5
1.1	1.75	14	14 13	2
1.35	2	12 11	12 11	-
1.65	2.5	10 9	10 9	3
2.05	3 3.5	8 7	8 7	4
2.55	4 4.5	6	6	5
3.2	5 5.5	5 $4\,^{1}/_{2}$	5 $4\,^{1}/_{2}$	6
4	6	4 $3\,^{1}/_{2}$	4	7 8
5.05	8[2)]	$3\,^{1}/_{4}$ 3 $2\,^{7}/_{8}$ $2\,^{3}/_{4}$	-	9 10
6.35	-	$2\,^{5}/_{8}$ $2\,^{1}/_{2}$	-	12

[2)] E DIN ISO 261

MARTIN + TSCHOPP GmbH
CH-4434 Hölstein / Switzerland
Tel.: +41 (0)61 956 17 00 - Fax: +41 (0)61 956 17 09 - E-mail: info@mt-swiss.com - www.mt-swiss.com

V1.1 - 06/2018

Known variables (please enter in white area of table):
Pitch **P** [mm]
Pitch-∅ $\mathbf{d_2}$ **max.** and $\mathbf{d_2}$ **min.** [mm]
Thread angle α [°]
Measuring wire-∅ $\mathbf{d_D}$ [mm] (acc. to Zeiss series or sep. calculation)
(After all data has been entered the calculated values will appear;
see example for thread M3)



Variables to be calculated (shown in black area of table):
Test dimension $\mathbf{M_1}$ **max.** and $\mathbf{M_1}$ **min.** [mm] (without rake correction)
Measuring wire rake correction δ [mm] (using approximation formula)
Test dimension $\mathbf{M_2}$ **max.** and $\mathbf{M_2}$ **min.** [mm] (with rake correction δ)

Calculating test dimension $\mathbf{M_1}$:
Without taking into account measuring wire rake correction or deformation

$$M_1(\mathrm{max./min.}) = d_2(\mathrm{max./min.}) + \frac{d_D}{\sin\frac{\alpha}{2}} - \frac{P}{2\tan\frac{\alpha}{2}} + d_D$$

Approximate calculation and consideration of measuring wire rake correction δ:
Approximate calculation for symmetrical thread with a small pitch angle and not too steep flanks
(sufficient in many cases)

$$\delta = \frac{d_D}{2}\tan^2\psi \cdot \cos\frac{\alpha}{2} \cdot \cot\frac{\alpha}{2} \qquad \text{with} \qquad \tan\psi = \frac{P}{\pi \cdot \frac{d_2\,\mathrm{max.} + d_2\,\mathrm{min.}}{2}}$$

$$M_2(\mathrm{max./min.}) = M_1(\mathrm{max./min.}) + \delta$$

In the interests of simplicity, corrections for possible deformation of the measuring wires and measurement uncertainty are not taken into account in the following tables.

Thread	P [mm]	d_2 max. [mm]	d_2 min. [mm]	α [°]	d_D [mm]	M_1 max. [mm]	M_1 min. [mm]	δ [mm]	M_2 max. [mm]	M_2 min. [mm]	M_2 - d_2 [mm]
M3	0.50	2.675	2.627	60.0	0.290	3.112	3.064	0.001	3.113	3.065	0.438

Determining the flank diameter $\mathbf{d_2}$ using the measured test dimension M:
By reversing the calculation bases shown above it is possible to calculate the flank diameter for a known thread specification on the basis of the measured test dimension M. The following table may be used (assumptions and calculation bases as above).

Thread	P [mm]	α [°]	d_D [mm]	M [mm] measured	d_2 [mm] w/o δ	δ [mm]	d_2 [mm] with δ
M3	0.50	60.0	0.290	3.113	2.676	0.001	2.675

MARTIN + TSCHOPP GmbH
CH-4434 Hölstein / Switzerland
Tel.: +41 (0)61 956 17 00 - Fax: +41 (0)61 956 17 09 - E-mail: info@mt-swiss.com - www.mt-swiss.com