

Measuring and Testing – Course: Technique for Manual Working of Materials. Instruction Examples for Practical Vocational Training

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Measuring and Testing – Course: Technique for Manual Working of Materials. Instruction Examples for Practical Vocational Training

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Introduction

The present material contains 8 selected instruction examples which are intended to help practising the main techniques of measuring and testing of simple and medium levels of difficulties. This is connected with simple manual operations and practising is possible at any working place without specific requirements (except for good lighting).

Practising the subject working techniques does not require a workpiece to be produced but to check sizes and forms of existing objects which are often used in the workshop and thus to practise handling them.

In order to facilitate the preparation and execution of the work, the necessary materials, measuring and testing tools and accessories are stated. Moreover, knowledge required in addition to knowledge of measuring and testing is mentioned.

For each instruction example a working drawing is attached and the sequence of operations specified giving the most favourable order of steps necessary to achieve the results of measuring and testing.

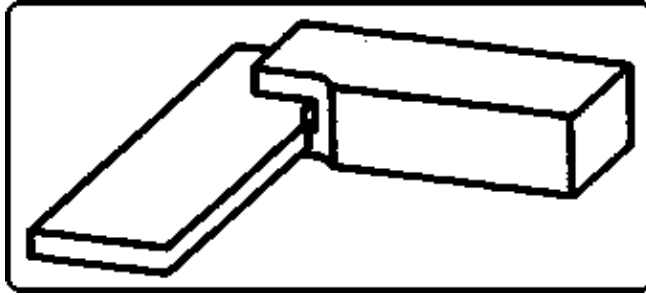
The results of measuring and testing are to be entered in the table on the working drawing for evaluation by the instructor. The order of the instruction examples is given so as to provide for an increasing level of difficulties of measuring and testing. Since measuring and testing tools need to be handled with care, the serviceability of the tools is to be checked prior to starting any measuring and testing, and storing of the measuring and testing tools on a soft support on the work bench is to be ensured.

Instruction example 1.1.: Try square

To practise simple length measurements with common measuring tools, exact reading of measured values on the vernier caliper as well as visual checks according to the light-gap testing method by means of the bevelled steel straightedge.

Material

Common try square of steel of small or medium size



Measuring and testing tools

Steel measuring tool (or tape rule), vernier caliper, depth gauge, bevelled steel straightedge (or bevelled edge square).

Accessories

Working place with a seat, soft support for measuring and testing tools (rag), well-lighted working area, pencil for entries in the table of values.

Required previous knowledge

Reading of drawings, knowledge of decimal numbers and length units, construction and reading of verniers of vernier calipers and depth gauges.

Sequence of operations

Comments

- | | |
|--|--|
| <p>1. Arrange the working place, prepare the working materials.</p> | <p>– Put measuring and testing tools on soft rag. Lay out pencil, drawing and table in easy reach,</p> |
| <p>2. Measure sizes no. (1) to (7) with steel measuring tool (or tape rule) and enter values in table of values.</p> | <p>– Entry in column "coarse" in 1 mm measuring accuracy.</p> |
| <p>3. Measure sizes no. (1) to (6) with vernier caliper and enter values in table of values.</p> | <p>– Entry in column "fine" in 0.1 mm measuring accuracy.</p> |
| <p>4. Measure size no. (7) with depth gauge and enter in table.</p> | <p>– Entry in column "fine" in 0.1 mm measuring accuracy.</p> |
| <p>5. Check edge at size no. (8) for flatness with bevelled steel straightedge – light-gap testing method.</p> | <p>– Entry "flat" or "not flat".</p> |
| <p>6. Measure sizes no. (1) , (3) and (6) with vernier caliper at several points and check for parallelism.</p> | <p>– Entry "parallel" or "not parallel" (first blank space in last line).</p> |
| <p>7. Check outer and inner angles with bevelled edge square.</p> | <p>– Entry "square" or "not square" (second blank space in last line).</p> |
| <p>8. Check all faces diagonally for flatness with bevelled steel straightedge or bevelled edge square.</p> | <p>– Entry "flat" or "not flat" (third blank space in last line).</p> |

size	coarse	fine	size	coarse	fine
1			5		
2			6		
3			7		
4			8		

				1.1.
	Try Square			3101

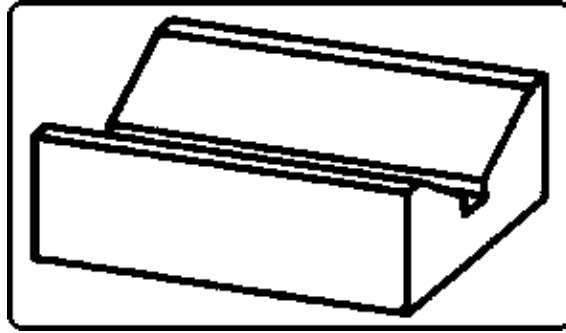
Try Square

Instruction example 1.2.: Vee

To practise simple length measurements with steel measuring tool, vernier caliper and depth gauge, exact reading of measured values for fine measurements, measuring of an angle.

Material

Common Vee as auxiliary means for scribing and drilling of round stock (smaller size).



Measuring and testing tools

Steel measuring tool (or tape rule), vernier caliper, depth gauge, protractor, bevelled steel straightedge (or bevelled edge square).

Accessories

Working place with seat, soft support for measuring and testing tools (rag), well-lighted working area, pencil for entries in the table of values.

Required previous knowledge

Reading of drawings, knowledge of decimal numbers and length units, construction and reading of verniers of vernier calipers, depth gauges and of scales of protractors.

Sequence of operations

1. Arrange the working place, prepare the working materials,
2. Measure sizes no. (1) to (7) with steel measuring tool (or tape rule) and enter values in table of values.
3. Measure sizes no. (1) to (3) and (6) and (7) with vernier caliper and enter values in table of values,
4. Measure sizes no. (4) and (5) with depth gauge and enter values.
5. Measure size no. (8) with protractor and enter values.
6. Check all faces for flatness and squareness with bevelled steel straightedge and bevelled edge square.

Comments

- Put measuring and testing tools on soft rag. Lay out pencil and drawing with table in easy reach.
- Entry in column "coarse" in 1 mm measuring accuracy.
- Entry in column "fine" in 0.1 mm measuring accuracy.
- Entry in column "fine" with 0.1 mm measuring accuracy.
- Entry "flat" and "square", respectively, in blank spaces of last line.

size	coarse	fine
1		
2		
3		
4		
5		
6		
7		
8	4	

			1,2.
	Vee		3101

Vee

Instruction example 1.3.: Tap wrench

To practise length measurements of higher level of difficulties with exact finding of measuring points, exact reading of measured values for fine measurements, measuring of an angle.

Material

Common tap wrench of small or medium size.



Measuring and testing tools

Steel measuring tool, vernier caliper, protractor.

Accessories

Working place with a seat, soft support for measuring and testing tools (rag), well-lighted working area, pencil for entries in the table of values.

Required previous knowledge

Reading of drawings, knowledge of decimal numbers and length units, construction and reading of verniers of vernier calipers and of scales of protractors.

Sequence of operations

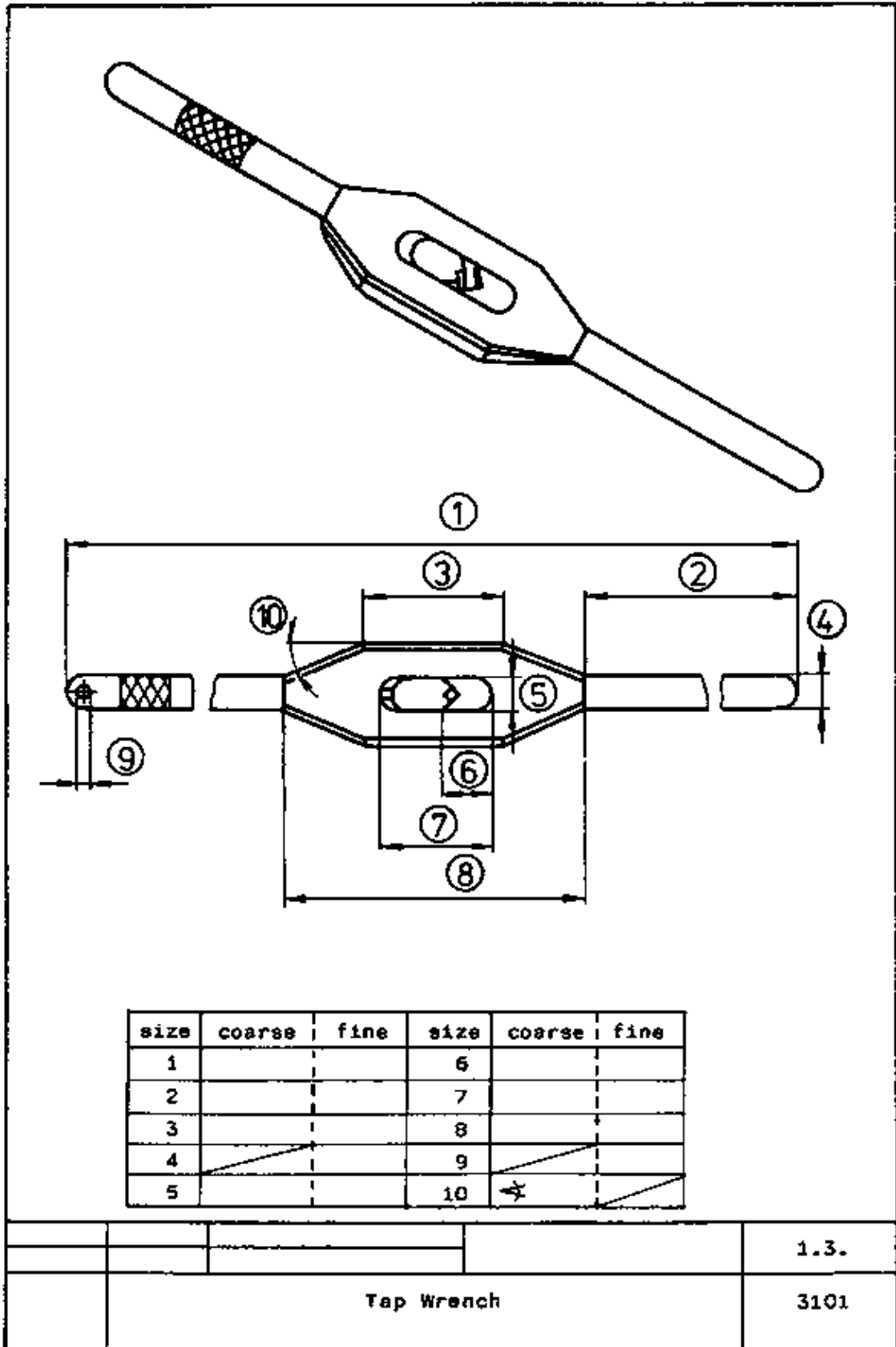
1. Arrange the working place, prepare the working materials.
2. Measure sizes no. (1) to (3) and (5) to (8) with steel measuring tool and enter values in table of values.
3. Measure sizes no. (1) to (9) with vernier caliper and enter values in table of values,
4. Measure size no. (10) with protractor and enter value in table of values.

Comments

- Put measuring and testing tools on soft rag. Lay out pencil and drawing with table in easy reach.
- Entry in column "coarse" in 1 mm measuring accuracy.
- Entry in column "fine" in 0,1 mm measuring accuracy.

To continue practising, if necessary:

Further sizes to be specified by the instructor and to be measured.



Tap Wrench

Instruction example 1.4.: Outside caliper

To practise simple length measurements and, particularly, roundness tests of outside and inside radii as well as measuring of an angle. The light-gap testing method shall be safely mastered.

Material

Common outside caliper of small or medium size.



Measuring and testing tools

Steel measuring tool (or tape rule), vernier caliper, radius gauges for outside and inside radii, protractor.

Accessories

Well-lighted working place with a seat and soft support for measuring and testing tools, pencil, possibly dividers and paper.

Required previous knowledge

Reading of drawings, knowledge of decimal numbers and length units, term "radius" and knowledge of angle quantities.

Sequence of operations

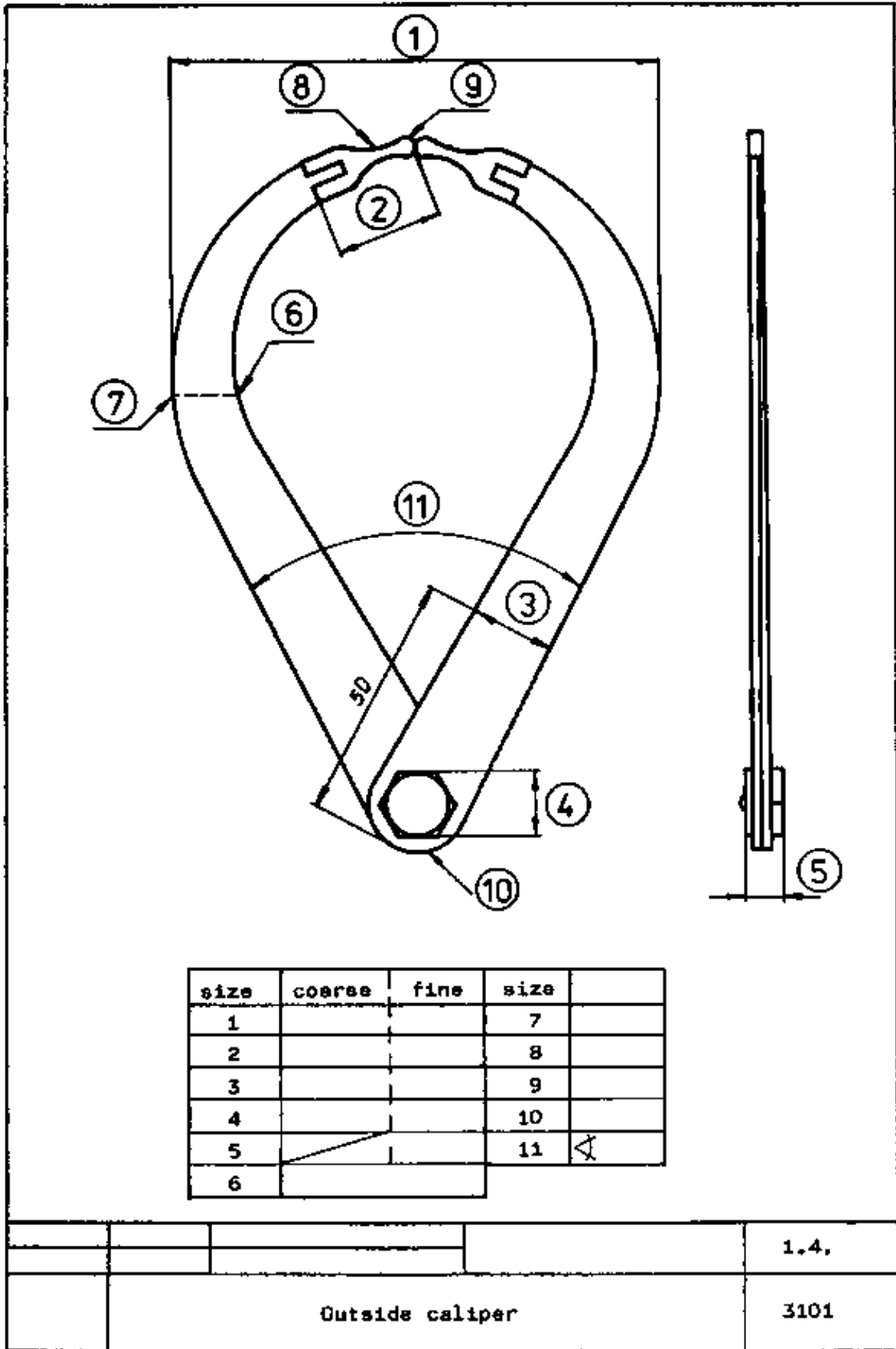
1. Arrange the working place, prepare the outside caliper to be tested in folded position.
2. Measure sizes no. (1) to (4) with steel measuring tool (or tape rule) and enter values in table of values.
3. Measure sizes no. (1) to (5) with vernier caliper and enter values.
4. Test sizes no. (6) and (7) with adequate radius gauges, mark the testing point with pencil.
5. Test sizes no. (8), (9) and (10) with small radius gauges and enter values in table.
6. Measure the folded outside caliper with protractor and enter value of size no. (11).

Comments

- Put measuring and testing tools on soft rag, lay out pencil and dividers in easy reach.
- Entry in column "coarse" in 1 mm measuring accuracy.
- Entry in column "fine" in 0.1 mm measuring accuracy.
- Test the folded caliper exactly at the widest point (enter values in table).

Note:

If operation 4 cannot be performed because of lack of radius gauges, the radii can be determined indirectly by putting the caliper on paper, drawing the radii with pencil and testing with dividers.



Outside caliper

(...)

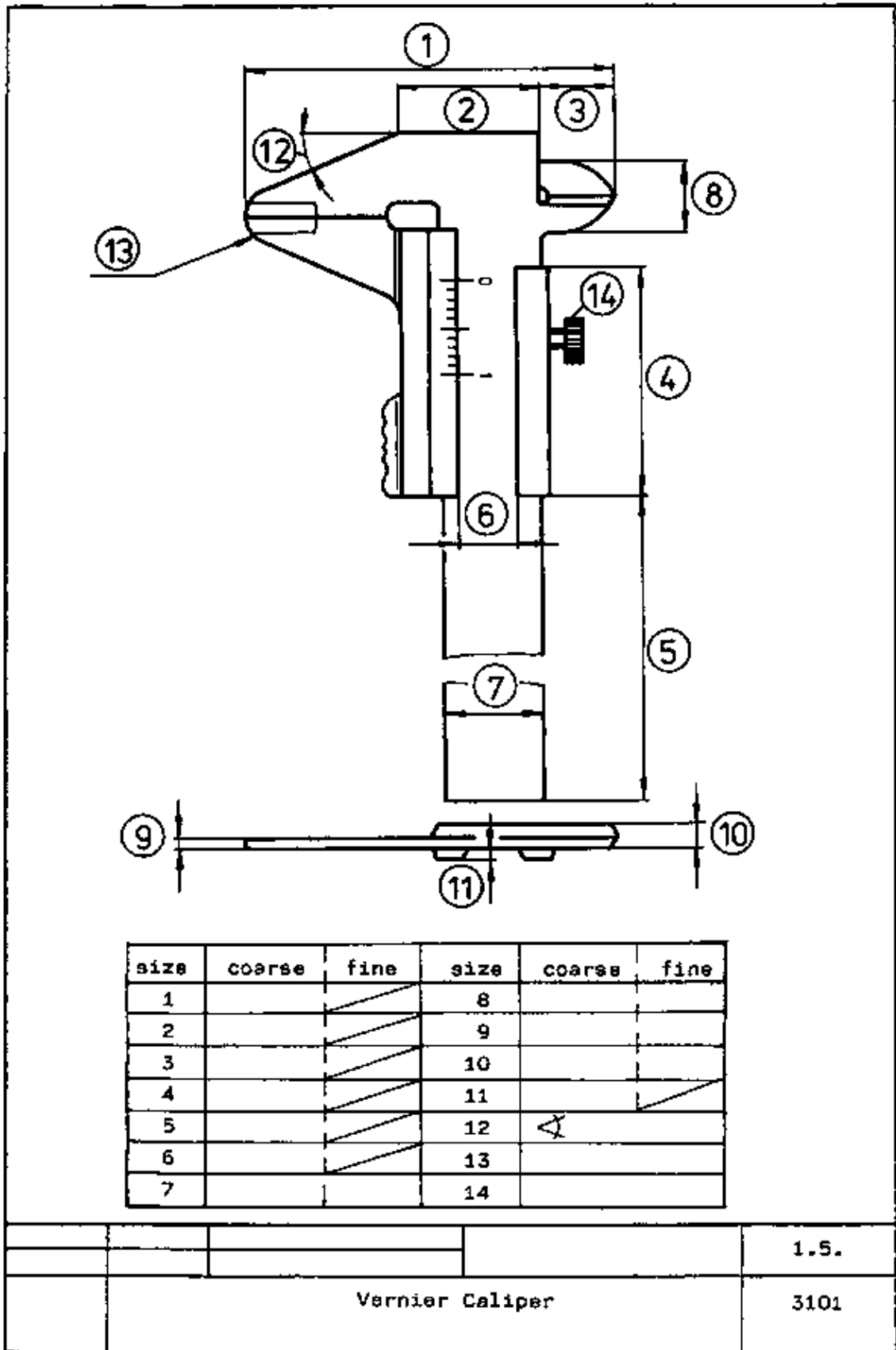
Sequence of operations

1. Arrange the working place, lock vernier caliper to be tested in 0-position.

Comments

- Prepare the materials.

2. Measure sizes no. (1) to (10) with vernier caliper and enter values in table. – Entry in column "coarse" in 0.1 mm measuring accuracy.
3. Measure sizes no. (7), (8), (9), (10) with outside micrometers and enter values in table. – Entry in column "fine" in 0.01 mm measuring accuracy.
4. Measure size no. (11) with depth gauge and enter value in table. – Entry in column "coarse in 0.1 mm measuring accuracy.
5. Measure size no. (12) with protractor.
6. Determine amounts of radii at sizes no. (13) and (14) with radius gauges.
7. Test the flatness of the slide-ways and of the measuring jaws for inside and outside measurements by light-gap testing methods by means of bevelled steel straightedge. – Entry directly in the working drawing.
8. Determine the nominal thread meter of the clamping screw by vernier caliper. – Entry directly in the working drawing.



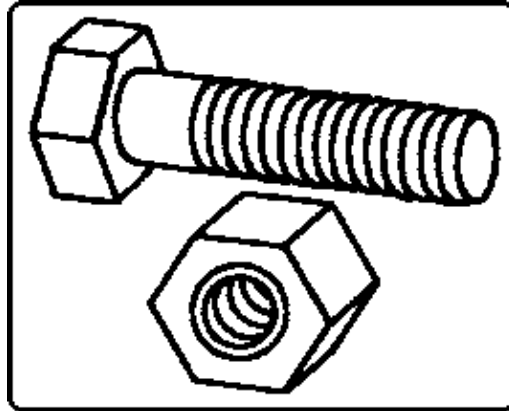
Vernier Caliper

Instruction example 1.6.: Hexagon-head screw and nut

To practise length and angular measurements, in particular determination of threads by means of limit gauges, testing of the accuracy of fit of threads.

Material

Any hexagon-head screw with fitting nut (nominal diameter at least 5 mm).



Measuring and testing tools

Small vernier caliper, small-size outside micrometer, protractor, various limit plug gauges, ring screw gauges, screw pitch gauges,

Accessories

Well-lighted working place with a seat and soft support for measuring and testing tools, pencil.

Required previous knowledge

Reading of drawings, knowledge of decimal numbers, construction and operation of the outside micrometer, of the limit plug gauges and screw pitch gauges, knowledge of coarse and fine pitch threads, knowledge of the terms of thread definition.

Sequence of operations

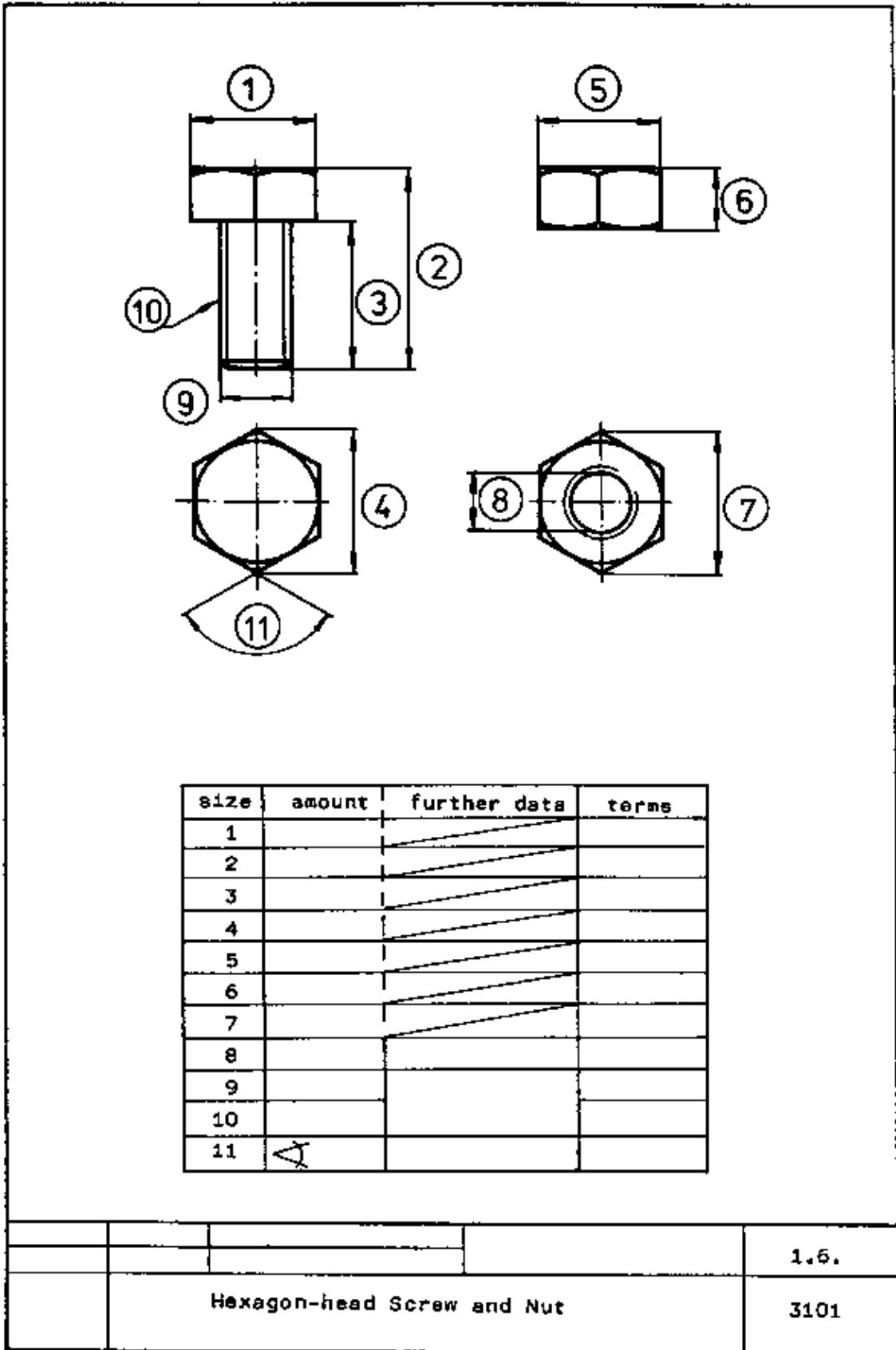
1. Arrange the working place, keep ready cleaned screws and nuts to be tested,
2. Measure sizes no. (1) to (9) with vernier caliper and enter values in table.
3. Determine the pitch at size no. (10) with screw pitch gauge.
4. Find out type of thread by means of amounts of sizes no. (9) and (10) , choose the adequate ring screw gauge and test the accuracy of fit of the screw.
5. Test the accuracy of fit of the nut with adequate limit plug gauge.
6. Estimate the angle at size no. (11) and then measure with protractor.
7. Name the characteristic terms of the screw to valid standards.

Comments

- Prepare the materials.
- Entry in column "amount".
- Entry of the type of thread beside the amounts of sizes no. (9) and (10) as well as "fitting" or "non-fitting".
- Entry beside amount of size no. (8).
- Entry of estimated value and beside entry of measured value.
- Terms like nominal diameter, minor diameter, depth of engagement, width across flats, width across corners, etc. are to be related to the size numbers.

To continue practising, if necessary

Determine further screws and nuts.



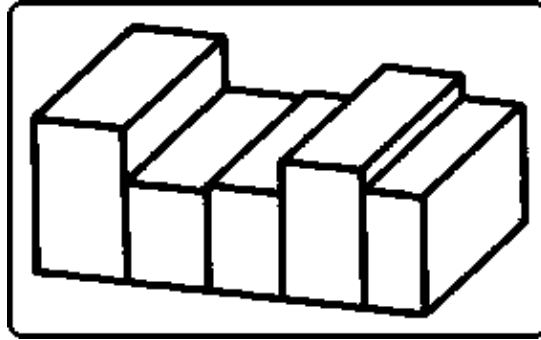
Hexagon-head Screw and Nut

Instruction example 1.7.: Block gauges

To practise differential measurements, setting and reading of values measured at the dial gauge, handling the outside micrometer.

Material

5 block gauges with small differences in length.



Measuring and testing tools Outside micrometer, dial gauge.

Accessories

Flat steel support (surface plate) to bear the dial gauges, magnetic stand for dial gauge, well-lighted working place with seat, soft support for outside micrometer.

Required previous knowledge

Reading of drawings, construction and operation as well as reading of the dial gauge, functioning and use of block gauges.

Sequence of operations

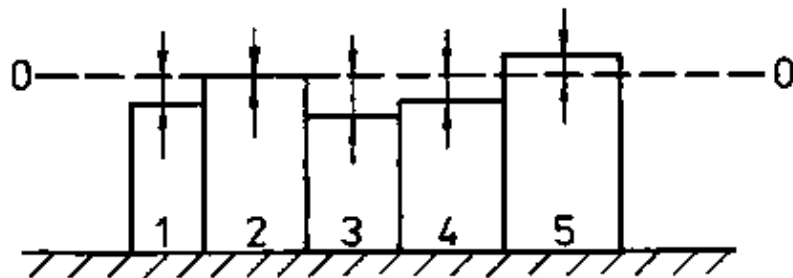
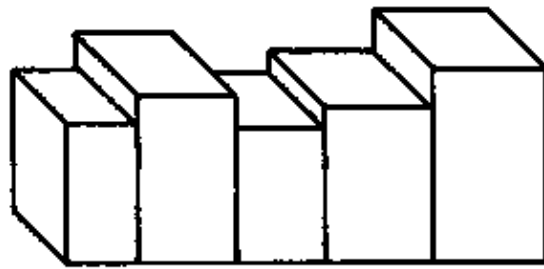
1. Arrange the working place.
2. Wring/push together the block gauges to be measured.
3. Clamp dial gauge in stand and set to nominal size (0-plane).
4. Guide feeler over block gauges and measure step by step.
5. Measure width and depth of individual block gauges with outside micrometer and enter values in table.

Comments

- Prepare the materials.
- (Possible in clean condition only)
- Nominal size to be specified by the instructor (e.g. 2nd test specimen as per drawing)
- Entry in column "variation in nominal size".
- Entry in columns "width" and "depth".

To continue practising, if necessary:

1. Test block-type bodies with clean surface by means of other measuring and testing tools, such as flat limit gauge for determination of fit. – Exact objective to be specified by the instructor.
2. Test slot depths and slot widths on any workpiece by means of block gauges.
3. Join test specimens of any size and measure difference.



No.	Variation in nominal size	width	depth
1			
2			
3			
4			
5			

				1.7.
	Block Gauges			3101

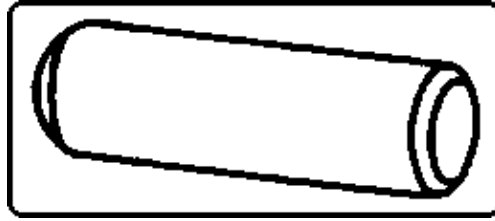
Block Gauges

Instruction example 1.8.: Plain pins

To practise diameter measurements by means of outside micrometer, finding out and calculation of tolerances to standard values,

Material

Common plain pins of small size (examples as per table of sizes).



Measuring and testing tools

Vernier caliper, outside micrometer, limit snap gauges as per plain pins specified in the table of sizes.

Accessories

Well-lighted working place with seat and soft support for measuring and testing tools, holder for outside micrometer, pencil, standard table for shafts.

Required previous knowledge

Safe handling of the outside micrometer, knowledge of tolerance terms and application of standards, operation of limit snap gauges.

Sequence of operations

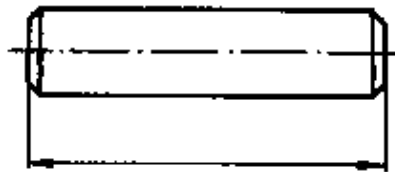
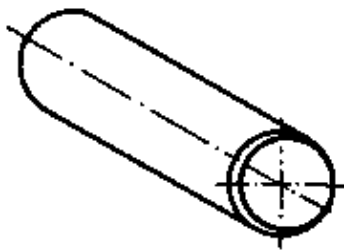
1. Arrange the working place, keep ready the plain pins to be tested in clean condition.
2. Coarse check of plain pins by vernier caliper for length and diameter.
3. Determine the tolerance for each plain pin to standard table, entry in table of sizes.
4. Measure the actual diameter by outside micrometer, measure two times to avoid measuring errors.
5. Determine the quality of fit by adequate limit snap gauges.

To continue practising, if necessary:

Test further plain pins or shafts after preceding operation.

Comments

- Prepare the materials.
- Store in given order (entry not necessary yet).
- Tolerance = maximum size – minimum size.
- Maximum size a nominal diameter + upper deviation.
- Minimum size = nominal diameter + lower deviation.
- Entry in column "measurement 1st and 2nd"
- Entry "go" or "not go" in column "fit".



Description	Tolerance	Maximum size	Measurement		Fit
		Minimum size	1st	2nd	
2.5 m 6 x 5		-----			
5h 9 x 7		-----			
6h 9 x 8		-----			
8a 5 x 10		-----			
10a 6 x 12		-----			
12h 9 x 22		-----			

				1.8
	Plain pins			3101

Plain pins

