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April 1998

BS 1981 : 1991

Specification for

Unified machine screws and machine screw nuts

Confirmed
January 2012

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the General Mechanical Engineering Standards Policy Committee (GME/-) to Technical Committee GME/9, upon which the following bodies were represented:

- BEAMA Ltd.
- British Constructional Steelwork Association Ltd.
- British Industrial Fasteners Federation
- British Railways Board
- British Steel Industry
- British Steel Industry (Wire Section)
- Gauge and Tool Makers' Association
- Ministry of Defence
- Society of Motor Manufacturers and Traders Limited
- Washer Manufacturers' Association of Great Britain

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- British Furniture Manufacturers' Federation
- British Independent Steel Producers' Association
- National Association of Fastener Stockholders

This British Standard, having been prepared under the direction of the General Mechanical Engineering Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 30 August 1991

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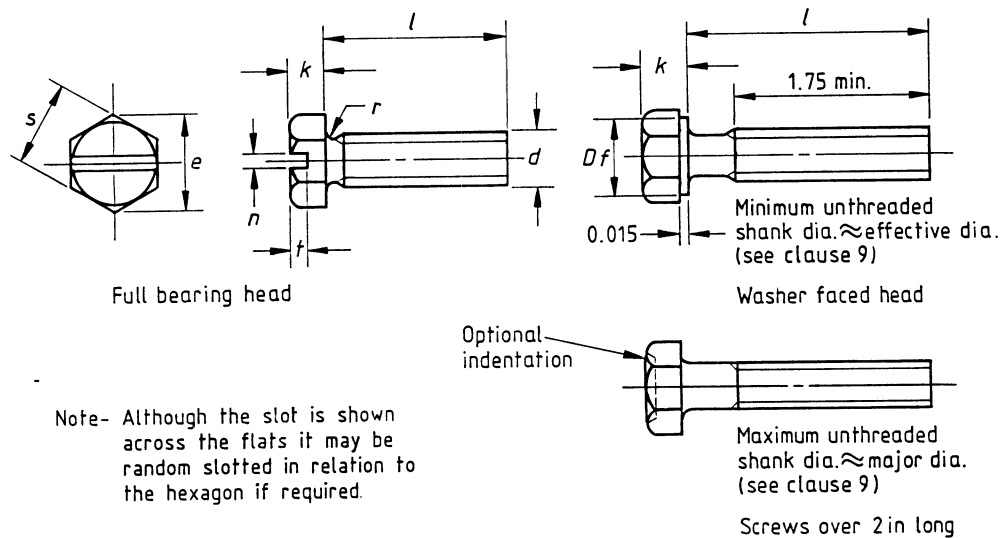
Figure 18. Plain and slotted hexagon head machine screws

Delete the existing figure 18 and substitute the attached figure 18.

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Figure 19. Symmetry and concentricity tolerances

Delete the existing figure 19 and substitute the attached figure 19.



Dimensions are in inches.

Figure 18. Plain and slotted hexagon head machine screws

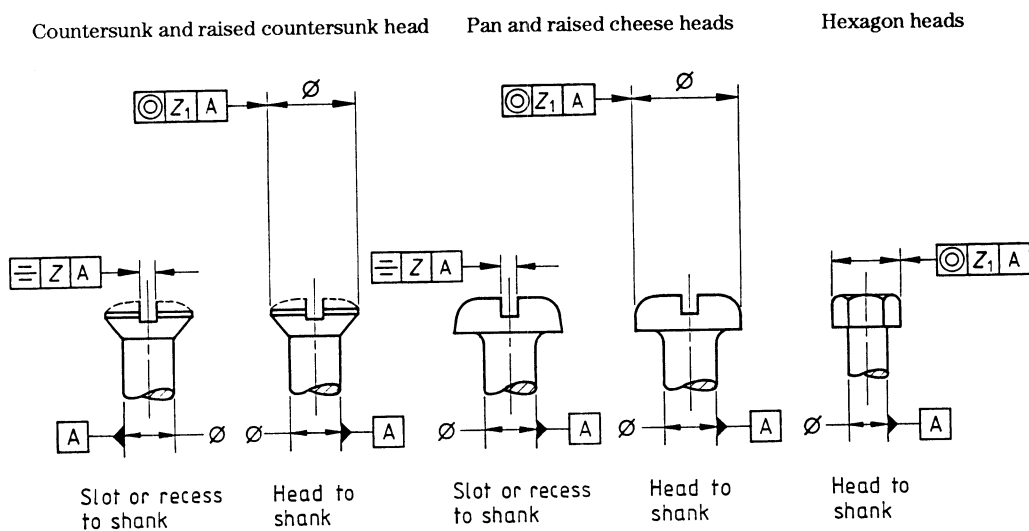


Figure 19. Symmetry and concentricity tolerances

Contents

	Page
Committees responsible	Inside front cover
Foreword	4
Specification	
1 Scope	5
2 Terminology	5
3 Material	5
4 General dimensions	5
5 Heads of screws	5
6 Screw threads	6
7 Nominal length of screws	6
8 Length of thread on screws	6
9 Diameter of unthreaded shank on screws	7
10 Radius under the head of screws	7
11 Ends of screws	7
12 Designation	9
Appendices	
A Dimensions of 80° countersunk head screws	33
B Standard sizes of machine screws	34
C Metric slot widths	39
Tables	
1 Under head radii	8
2 Header point dimensions for UNC screws	9
3 Header point dimensions for UNF screws	9
4 Slotted countersunk head machine screws	10
5 Recessed countersunk head machine screws: details of recess type Z	11
6 Slotted truncated countersunk head machine screws: short length	12
7 Recessed truncated countersunk head machine screws: details of recess type Z	13
8 Slotted raised countersunk head machine screws	14
9 Recessed raised countersunk head machine screws: details of recess type Z	15
10 Slotted truncated raised countersunk head machine screws: short length	16
11 Recessed truncated raised countersunk head machine screws: details of recess type Z	17
12 Slotted and recessed pan head machine screws	18
13 Recessed pan head machine screws: details of recess type Z	19
14 Slotted raised cheese head machine screws	20

	Page
15 Recessed raised cheese head machine screws: details of recess type Z	21
16 Plain and slotted hexagon head machine screws	22
17 Symmetry and concentricity tolerances	23
18 Nominal lengths and tolerances for machine screws	24
19 Dimensions of machine screw nuts: precision type sizes No. 0 to No. 12	25
20 Dimensions of machine screw nuts: pressed type, square and hexagon	26
21 Recessed countersunk head machine screws: details of recess type V	27
22 Recessed truncated countersunk head machine screws: details of recess type V	28
23 Recessed raised countersunk head machine screws: details of recess type V	29
24 Recessed truncated raised countersunk head machine screws: details of recess type V	30
25 Recessed pan head machine screws: details of recess type V	31
26 Recessed raised cheese head machine screws: details of recess type V	32
27 Standard sizes for countersunk head machine screws: ISO inch (Unified) threads	34
28 Standard sizes for raised countersunk head machine screws: ISO inch (Unified) threads	35
29 Standard sizes for pan head machine screws: ISO inch (Unified) threads	36
30 Standard sizes for raised cheese head machine screws: ISO inch (Unified) threads	37
31 Standard sizes for hexagon head machine screws: ISO inch (Unified) threads	38
32 Metric slot widths	39
Figures	
1 Rolled thread end	7
2 Cut thread chamfered end	7
3 Cut thread radiused end	7
4 Cone pointed ends	8
5 Header point	8
6 Slotted countersunk head machine screws	10
7 Recessed countersunk head machine screws: enlarged views of recess type Z	11
8 Slotted truncated countersunk head machine screws	12
9 Recessed truncated countersunk head machine screws: enlarged views of recess type Z	13
10 Slotted raised countersunk head machine screws	14
11 Recessed raised countersunk head machine screws: enlarged views of recess type Z	15

	Page
12 Slotted truncated countersunk head machine screws	16
13 Recessed truncated raised countersunk head machine screws: enlarged views of recess type Z	17
14 Slotted and recessed pan head machine screws	18
15 Recessed pan head machine screws: enlarged views of recess type Z	19
16 Slotted raised cheese head machine screws	20
17 Recessed raised cheese head machine screws: enlarged views of recess type Z	21
18 Plain and slotted hexagon head machine screws	22
19 Symmetry and concentricity tolerances	23
20 Machine screw nuts: precision type, sizes No. 0 to No. 12	25
21 Machine screw nuts: pressed type	26
22 Recessed countersunk head machine screws: enlarged views of recess type V	27
23 Recessed truncated countersunk head machine screws: enlarged views of recess type V	28
24 Recessed raised countersunk head machine screws: enlarged views of recess type V	29
25 Recessed truncated raised countersunk head machine screws: enlarged views of recess type V	30
26 Recessed pan head machine screws: enlarged views of recess type V	31
27 Recessed raised cheese head machine screws: enlarged views of recess type V	32
28 Size of countersunk screw head	33
29 Edge of head of countersunk screw	33

Foreword

This British Standard has been prepared under the direction of the General Mechanical Engineering Standards Policy Committee. This revision of the standard supersedes BS 1981 : 1972 which is withdrawn.

The principal changes that have been made in this edition are as follows.

- (a) The single recess type in the previous edition is now nominated as type Z and recess depth data have been deleted. Penetration values for cross recesses are now required to comply with BS 6605 : 1990.
- (b) New requirements for recess type V have been added. Penetration values for this type are also required to comply with BS 6605.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes will be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Specification

1 Scope

This British Standard specifies requirements for the dimensions, tolerances and mechanical properties of machine screws and machine screw nuts having ISO inch (Unified) screw threads.

Dimensions and tolerances are given for machine screws and nuts in the following diameter ranges:

- (a) hexagon head machine screws from No. 2 to No. 12;
- (b) slotted countersunk and pan head machine screws from No. 0 to $\frac{3}{4}$ in;
- (c) slotted raised cheese head machine screws (non-preferred) from No. 0 to $\frac{1}{2}$ in;
- (d) slotted raised countersunk machine screws from No. 0 to $\frac{3}{8}$ in;
- (e) slotted hexagon head machine screws (non-preferred) No. 4 to 12;
- (f) recessed (types Z and V) pan and countersunk head machine screws from No. 2 to $\frac{1}{2}$ in;
- (g) recessed (types Z and V) raised cheese head machine screws (non-preferred) from No. 2 to $\frac{1}{2}$ in;
- (h) recessed (types Z and V) raised countersunk head machine screws from No. 2 to $\frac{3}{8}$ in;
- (i) square and hexagon machine screw nuts, pressed type, from No. 0 to $\frac{3}{8}$ in;
- (j) hexagon machine screw nuts, precision type, from No. 0 to No. 12.

Mechanical properties are specified for steel, brass and aluminium alloy machine screws and machine screw nuts.

Appendices are included that relate to the dimensioning of 80° countersunk heads, slot widths and standard sizes (not to be confused with stock sizes, see note 1 to table 27).

NOTE 1. Attention is drawn to the fact that it is claimed that the type V recess is the subject of British patent no. 1 521 141 copies of which can be obtained from the Patent Office, 25 Southampton Buildings, London WC2A 1AY. BSI takes no position as to the validity of the patent or whether it is still in force. The patent is irrevocably endorsed 'licences of right' under Section 46 of the Patents Act 1977, which states:

- '(3) Where such an entry is made in respect of a patent —
- (a) any person shall, at any time after the entry is made, be entitled as of right to a licence under the patent on such terms as may be settled by agreement or, in default of agreement, by the Comptroller on the application of the proprietor of the patent or the person requiring the licence'.

Licence details may be obtained from the registered proprietor of the patent.

NOTE 2. Details of precision hexagon screws and nuts $\frac{1}{4}$ in diameter and above are given in BS 1768.

NOTE 3. The titles of the British Standards referred to in this standard are listed on the inside back cover.

2 Terminology

2.1 For the purposes of this British Standard the generic term 'screws' has been adopted as applying to the products whether threaded up to the head or having an unthreaded portion of shank.

2.2 The designations of the various types of screw and nut are in accordance with those commonly used in the United Kingdom.

3 Material

The material from which the screws and nuts are manufactured shall have a tensile strength not less than the following:

steel	25 tonf/in ² (386 MPa)
brass	20 tonf/in ² (309 MPa)
aluminium alloy	20 tonf/in ² (309 MPa)

NOTE 1. These minimum tensile strengths may be taken as applicable to the finished products.

NOTE 2. Screws and nuts that comply with the requirements of this standard are not normally subjected to test, but where this is required the purchaser is to state so in his enquiry and order.

NOTE 3. If the purchaser requires screws and nuts to be manufactured from steel of a higher tensile strength, or from another material, this is to be subject to agreement between the purchaser and the supplier.

4 General dimensions

4.1 Screws

The general dimensions and tolerances for screws shall be as given in tables 1 to 18 inclusive, clauses 6 to 12 inclusive and tables 21 to 26 inclusive.

4.2 Precision nuts (normal applications)

The general dimensions and tolerances for nuts shall be as given in table 19 and in 6.3.

4.3 Pressed nuts (light duty applications)

The general dimensions and tolerances for pressed nuts shall be as given in table 20 and in 6.4.

5 Heads of screws

5.1 The screw heads shall be concentric with the shank within the tolerances given in table 17, using the head diameter or across flats dimension as datum.

5.2 The slots and recesses shall be clean and free from burrs and shall be symmetrical with the shank within the tolerances given in table 17, using the shank diameter as datum.

5.3 The depth of slot (t) shall be measured from the top of the head to the point at which the slot breaks through the side.

5.4 The depth of the recess shall be such that, when measured in accordance with BS 6605, the penetration of the gauge into the recess complies with the penetration values given in tables 5, 7, 9, 11, 13, 15 and 21 to 26 inclusive.

5.5 The bearing surface of perpendicular bearing surface screw heads shall be at right angles to the axis of the body within 2° .

5.6 The taper of sides of hexagon head screws (see table 16), i.e. the angle between one side and the axis, shall not exceed 2° or 0.004 in, whichever is the greater. The specified limits across flats shall relate to the larger end of taper.

Where edges and corners of hexagon surface or upset type hexagon heads are slightly rounded, the diameter of the bearing surface shall be not less than 90 % of the minimum across flats dimensions.

NOTE. The head height indicated in the dimensional tables represents a metal to metal measurement, i.e. on heads having rounded top surfaces the truncation of the rounded surface due to slot or recess is not considered part of the head height.

6 Screw threads

6.1 General

The screw threads shall be ISO inch (Unified) series threads complying with BS 1580 : Parts 1 & 2 and BS 1580 : Part 3.

6.2 Screws

The external threads shall comply with tolerance class 2A limits of BS 1580.

6.3 Precision nuts (normal applications)

The internal threads shall comply with tolerance class 2B limits of BS 1580 and be subject to gauging made to tolerances specified in BS 919.

6.4 Pressed nuts (light duty applications)

The internal threads shall comply with tolerance class 2B limits of BS 1580 and be subject to gauging made to tolerances specified in BS 919. Checking shall be by means of a GO screw plug gauge and a NOT GO plain plug gauge for the minor diameter.

7 Nominal length of screws

7.1 Countersunk head

The nominal length shall be the distance from the upper surface of the head to the extreme end of the shank, including any chamfer, radius or cone point.

7.2 Raised countersunk head

The nominal length shall be the distance from the upper surface of the head (excluding the raised portion) to the extreme end of the shank, including any chamfer, radius or cone point.

7.3 Pan, raised cheese head and hexagon head

The nominal length shall be the distance from the underside of the head to the extreme end of the shank, including any chamfer, radius or cone point.

7.4 Nominal lengths and tolerances on length

The tolerances on the standard nominal lengths shall be as given in table 18.

NOTE. For preferred sizes of diameters and associated standard lengths see tables 27 to 31 in appendix B.

8 Length of thread on screws

8.1 The length of thread shall be the distance from the end of the screw (including any chamfer, radius or cone point) to the leading face of a nut without counter sink, which has been screwed as far as possible onto the screw by hand.

8.2 The minimum thread length shall be 1.75 in on screws over 2 in long.

8.3 Screws that are too short for the above thread length shall be threaded as far as possible to the head. The length of unthreaded shank under the head shall not exceed $1\frac{1}{2}$ pitches for truncated countersunk and truncated raised countersunk heads and two pitches for all other head styles.

NOTE. The length of unthreaded shank is defined as the distance from the leading face of a nut that has been screwed as far as possible onto the screw by hand up to:

- (a) the junction of the basic major diameter and the countersunk portion of the head on countersunk and raised countersunk heads; or
- (b) the underside of the head on all other types of head.

9 Diameter of unthreaded shank on screws

The diameter of the unthreaded portion of the shank on screws shall be not greater than the basic major diameter of the screw thread and shall be not less than the minimum effective diameter of the screw thread.

NOTE 1. Where it is essential that the diameter of the unthreaded portion of the shank shall be not less than the minimum major diameter of the thread this should be stated by the purchaser.

NOTE 2. The diameter of the unthreaded portion of shank is closely associated with the method of manufacture. It will generally be nearer the major diameter of the thread for turned screws and nearer the effective diameter for those produced by cold heading.

10 Radius under the head of screws

10.1 Screws having heads with perpendicular bearing surface, e.g. pan, hexagon, raised cheese, truncated countersunk and truncated raised countersunk shall have a radius or fillet radius running smoothly into the face of the head and shank without any step or discontinuity.

The minimum and maximum radii shall be in accordance with those given in table 1.

NOTE. The maximum values of radius are based upon 15 % of the basic screw diameter.

10.2 Countersunk and raised countersunk head screws shall have a radius running smoothly into the conical bearing surface of the head and the shank without any step or discontinuity.

The minimum and maximum radii shall be in accordance with those given in table 1.

NOTE. The maximum values of radius are based upon 40 % of the basic screw diameter.

10.3 All radii for flat and conical bearing shall be measured from the screw blank before thread rolling.

11 Ends of screws

NOTE. For convenience, one type of end of screw only is shown in figures 6 to 18 inclusive.

11.1 Rolled thread ends

When screws are made with rolled threads the 'lead' formed by the thread rolling operation shall be regarded as providing the necessary chamfer and no other machining shall be necessary.

NOTE. The approximate form of the end as rolled is shown in figure 1.

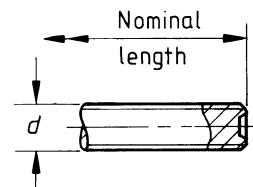


Figure 1. Rolled thread end

11.2 Cut thread ends

The end of screws with cut threads, and with diameters greater than or equal to $\frac{1}{4}$ in, shall be finished with a chamfer complying with the dimensions shown in figure 2.

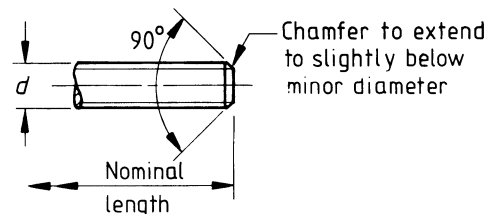


Figure 2. Cut thread chamfered end

NOTE. At the option of the manufacturer, the ends of screws smaller than $\frac{1}{4}$ in diameter may be finished either with a radius approximately equal to $1\frac{1}{4}$ times the nominal diameter of the shank, as shown in figure 3, or with a chamfer complying with the dimensions shown in figure 2.

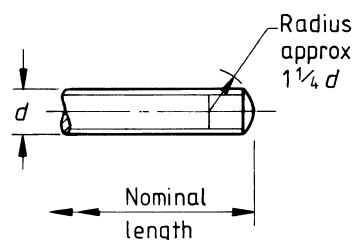


Figure 3. Cut thread radiused end

11.3 Cone points

The dimensions of cone points shall comply with those given in figure 4.

NOTE. Cone points are permissible on cut or rolled thread screws, but should be avoided whenever possible.

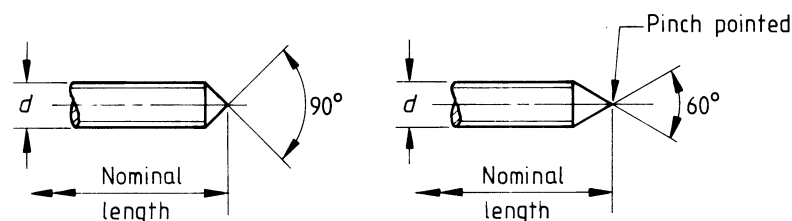


Figure 4. Cone pointed ends

11.4 Header points

Header points shall comply with the dimensions shown in figure 5 and given in tables 2 and 3.

NOTE. After thread rolling, the end produced approximates to the chamfered end shown in figure 2 for cut thread screws.

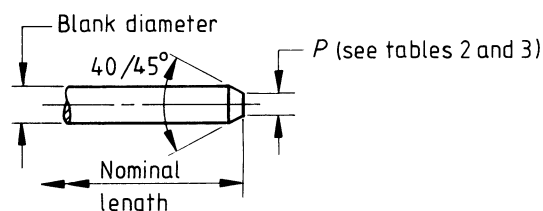


Figure 5. Header point

12 Designation

When designating standard machine screws or machine screw nuts in an enquiry or order the following information shall be given:

- details of the material;
- whether screw or nut;
- the style of head and whether slotted or recess type;
- the diameter and thread series (UNC or UNF), and, in the case of screws, the length;
- the type of end (if a special point is required);
- the number of this British Standard, i.e. BS 1981;
- details of the plating required, if any, in accordance with the appropriate British Standard, e.g. BS 3382 : Parts 1 & 2.

Examples

- Steel slotted countersunk head screws
No. 10 UNC $\times \frac{1}{2}$ in to BS 1981, zinc plated to BS 3382 : Part 2.
- Brass square nut No. 6 UNC to BS 1981.

Table 1. Under head radii

Nominal screw size	<i>r</i> min.	<i>r</i> max.	
	All heads	Heads complying with 10.1	Heads complying with 10.2
	in	in	in
0	0.004	0.009	0.024
1	0.004	0.010	0.029
2	0.004	0.012	0.034
3	0.004	0.015	0.040
4	0.004	0.016	0.045
5	0.004	0.019	0.050
6	0.004	0.021	0.055
8	0.008	0.024	0.065
10	0.008	0.028	0.076
12	0.008	0.032	0.086
$\frac{1}{4}$	0.010	0.037	0.100
$\frac{5}{16}$	0.016	0.047	0.125
$\frac{3}{8}$	0.016	0.055	0.150
$\frac{7}{16}$	0.024	0.065	0.175
$\frac{1}{2}$	0.024	0.075	0.200
$\frac{5}{8}$	0.024	0.093	0.250
$\frac{3}{4}$	0.024	0.112	0.300

Table 2. Header point dimensions for UNC screws

Nominal diameter	Number of threads per inch	Diameter of header point <i>P</i>	
		Max.	Min.
		in	in
4	40	0.074	0.065
5	40	0.086	0.076
6	32	0.090	0.080
8	32	0.114	0.102
10	24	0.125	0.112
12	24	0.149	0.134
$\frac{1}{4}$	20	0.171	0.157
$\frac{5}{16}$	18	0.222	0.206
$\frac{3}{8}$	16	0.271	0.253
$\frac{7}{16}$	14	0.318	0.298
$\frac{1}{2}$	13	0.369	0.347
$\frac{5}{8}$	11	0.468	0.452
$\frac{3}{4}$	10	0.545	0.515

Table 3. Header point dimensions for UNF screws

Nominal diameter	Number of threads per inch	Diameter of header point <i>P</i>	
		Max.	Min.
		in	in
4	48	0.079	0.070
5	44	0.088	0.079
6	40	0.098	0.087
8	36	0.118	0.106
10	32	0.138	0.124
12	28	0.156	0.141
$\frac{1}{4}$	28	0.187	0.173
$\frac{5}{16}$	24	0.237	0.221
$\frac{3}{8}$	24	0.294	0.276
$\frac{7}{16}$	20	0.342	0.322
$\frac{1}{2}$	20	0.400	0.378
$\frac{5}{8}$	18	0.507	0.481
$\frac{3}{4}$	16	0.614	0.584