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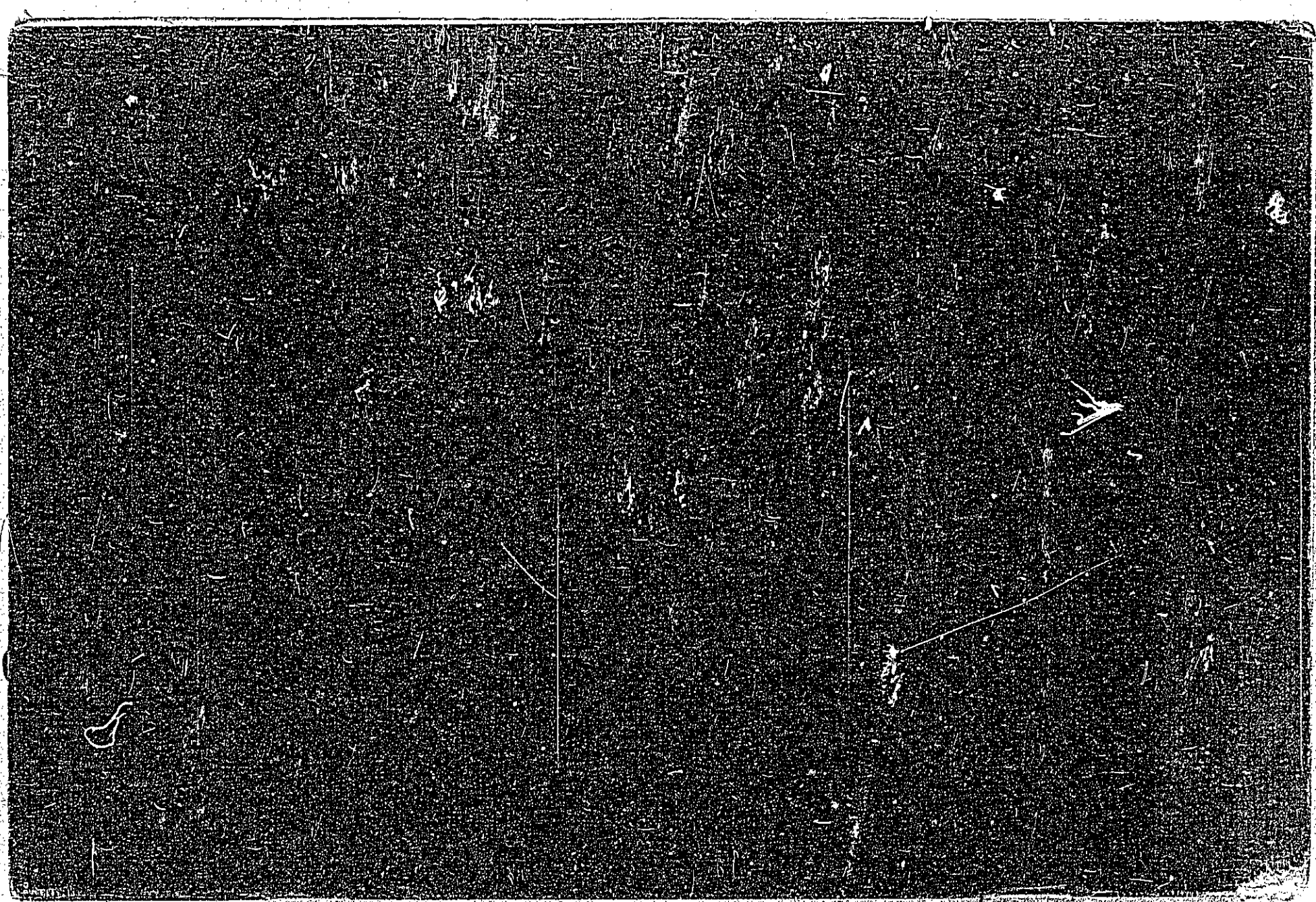

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BRITISH STANDARD SPECIFICATION

TWIST DRILLS AND COMBINED DRILLS AND COUNTERSINKS (CENTRE DRILLS)

B.S. 328 : 1950

(Incorporating B.S. 985)

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THIS BRITISH STANDARD, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 21st August, 1950.

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CO-OPERATING ORGANIZATIONS

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations :—

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Associated Offices Technical Committee
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British Chemical Plant Manufacturers' Association
British Compressed Air Society
*British Electrical and Allied Manufacturers' Association
British Engineers' Association
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Ministry of Transport
Ministry of Works
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War Office

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committees entrusted with the preparation of this British Standard :—

General Post Office
Society of British Aircraft Constructors
Society of Motor Manufacturers and Traders
Twist Drill Traders Association

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BRITISH STANDARD SPECIFICATION FOR

TWIST DRILLS AND COMBINED DRILLS AND COUNTERSINKS (CENTRE DRILLS)

FOREWORD

The revision of this British Standard, which was originally prepared in 1928, has been undertaken under the authority of the Mechanical Engineering Industry Standards Committee.

Twist drills and combined drills and countersinks (centre drills) have been dealt with in separate sections. That dealing with twist drills is a rearrangement and revision of the original, together with additional matter. Amendments have been made to the requirements for testing drills.

An interesting innovation is the inclusion of 'preferred sizes' for twist drills. These are indicated in the tables in contradistinction to those the use of which is deprecated. In order to assist in the selection of sizes in connection with the latter, by those who may experience difficulty, a column of recommended alternatives has been included in the table of drill gauge and letter size drills.

By the inclusion of the tables of 'preferred sizes' in this British Standard, emphasis has been laid upon the important function of standardization in reducing the multiplicity of types.

The section dealing with combined drills and countersinks (centre drills) is new and supersedes B.S. 985. The subject matter has been laid out in a manner similar to that used in the section on twist drills, a complete range of definitions being included.

SPECIFICATION

SECTION ONE. GENERAL

SCOPE

1. This British Standard covers the following :—

Section Two. Twist drills. This section deals with the nomenclature, manufacture, dimensions, tolerances and testing of twist drills for general engineering use.

Differentiation between 'preferred' and 'non-preferred' sizes is included and is shown by the use of Roman type for preferred sizes and italic type for non-preferred sizes.

Section Three. Combined drills and countersinks (centre drills). This section deals with the nomenclature, manufacture, dimensions and tolerances of combined drills and countersinks (centre drills).

Details of self-holding tapers, extracted from B.S. 1660, 'Machine tapers,' Part 1, are shown in an Appendix (page 51).

SECTION TWO. TWIST DRILLS

NOMENCLATURE AND DEFINITIONS

2. *a.* For the purpose of this British Standard the following nomenclature and definitions shall apply to the twist drills covered by Tables 4 to 12 inclusive. Each drill is illustrated and defined at the head of the appropriate table. The types of drills are as follows :—

Table 4. Parallel shank jobber series twist drills (fractional sizes).
Table 5. Parallel shank jobber series twist drills (metric sizes).
Table 6. Parallel shank jobber series twist drills (drill gauge and letter sizes).
Table 7. Stub drills.
Table 8. Parallel shank long series twist drills.
Table 9. Taper shank twist drills.
Table 10. Oversize taper shank twist drills.
Table 11. Taper square shank twist drills for ratchet braces.
Table 12. Bit stock twist drills.

(*b*) **Parts of drills and associated terms shall be defined as follows (see Figs. 1 and 2) :—**

ELEMENTS

1. *Axis*	The longitudinal centre-line.
2. *Body*	That portion of the drill extending from the extreme cutting end to the commencement of the shank.
3. *Shank*	That portion of the drill by which it is held and driven.
4. *Flutes*	The grooves in the body of the drill which provide lips and permit the removal of chips and allow cutting fluid to reach the lips.
5. *Web (Core)*	The central portion of the drill situated between the roots of the flutes and extending from the point end towards the shank ; the point end of the web or core forms the chisel edge.
6. *Lands*	The cylindrically-ground surfaces on the leading edges of the drill flutes. The width of the land is measured at right angles to the flute helix.
7. *Body clearance*	That portion of the body surface reduced in diameter to provide diametral clearance.
8. *Heel*	The edge formed by the intersection of the flute surface and the body clearance.
9. *Point*	The sharpened end of the drill, consisting of all that part of the drill which is shaped to produce lips, faces, flanks and chisel edge.

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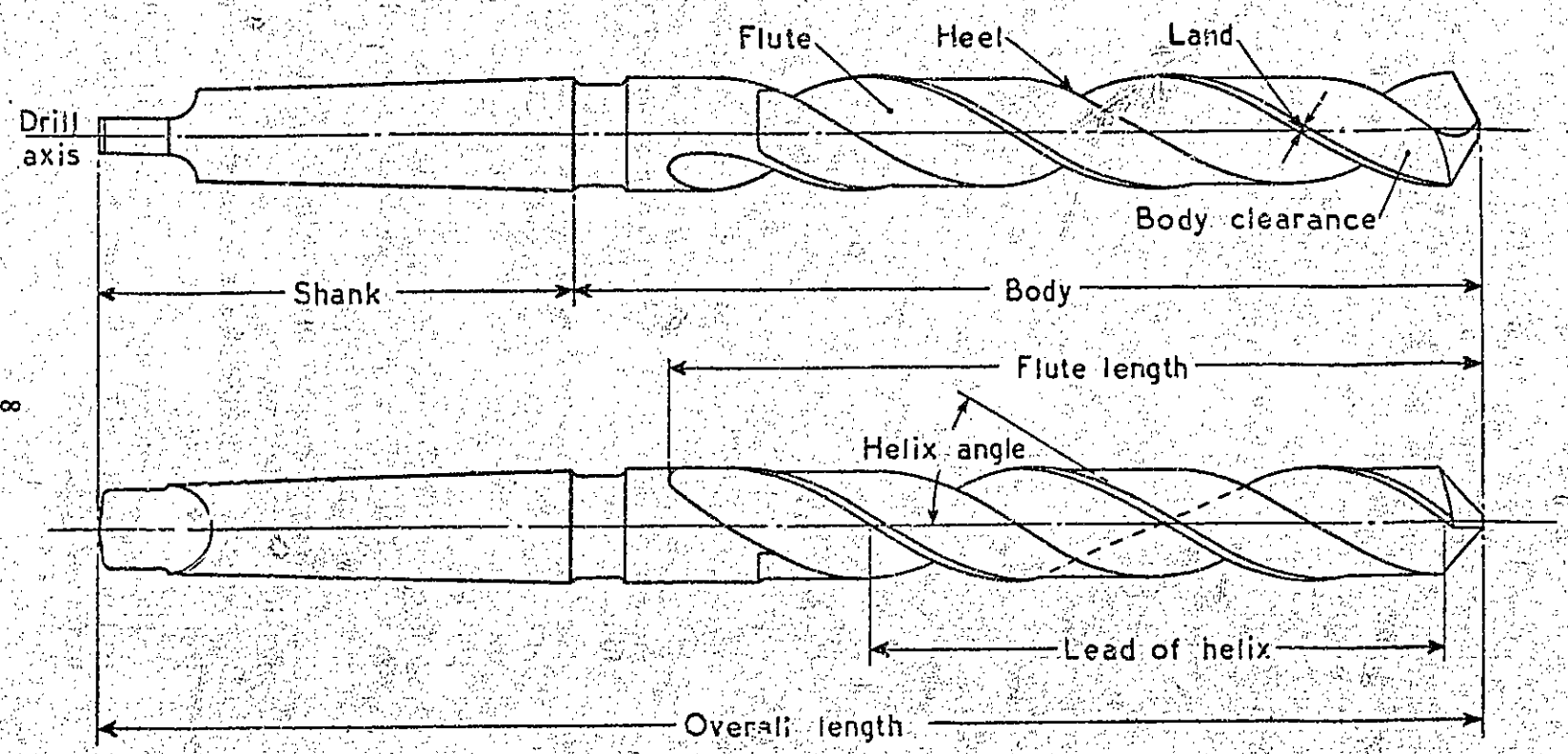

Fig. 1. Twist drill nomenclature

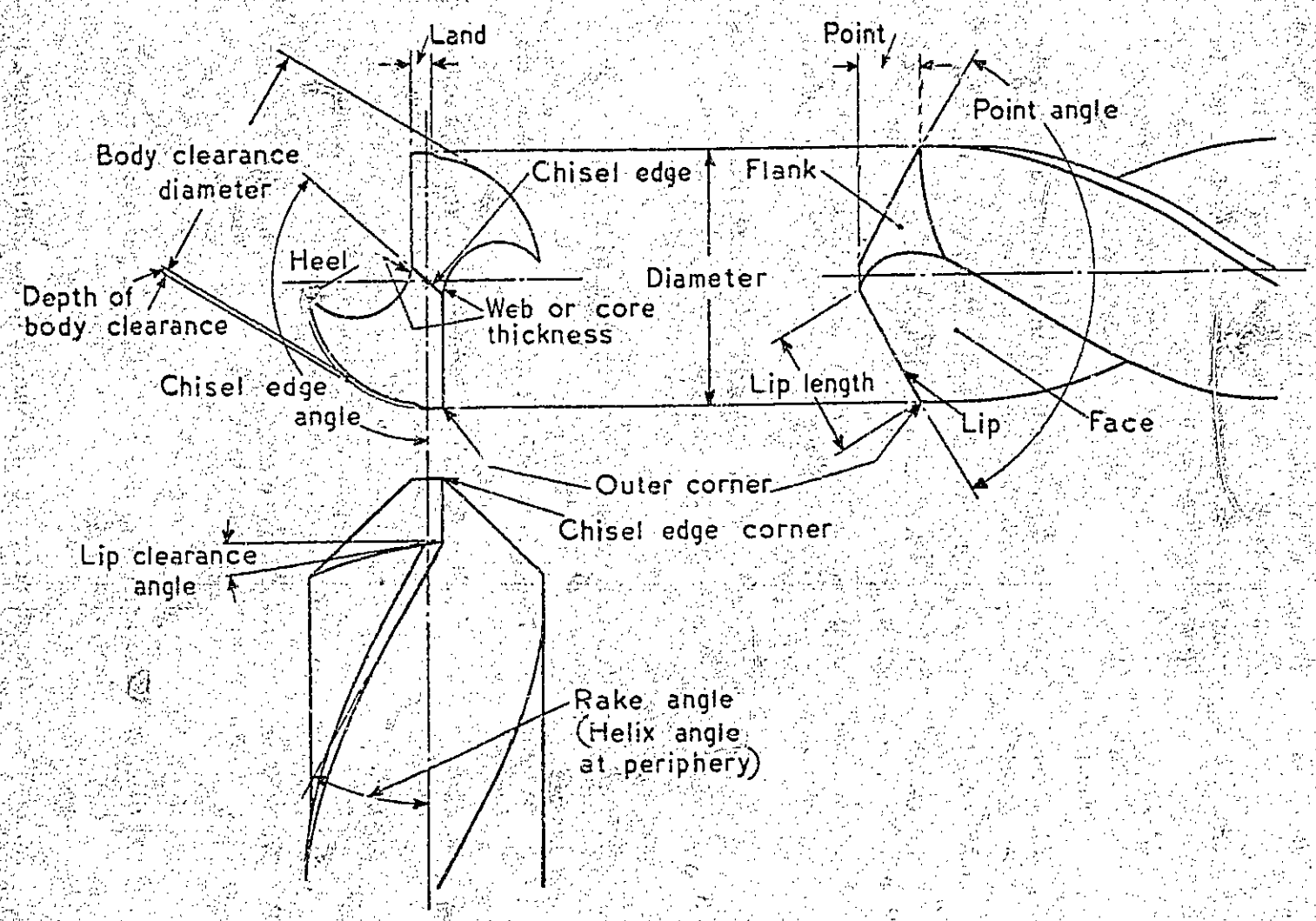

Fig. 2. Twist drill nomenclature

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10. *Face*	That portion of the flute surface adjacent to the lip on which the chip impinges as it is cut from the work.
11. *Flank*	That surface on a drill point which extends behind the lip to the following flute.
12. *Lip (Cutting edge)*	The edge formed by the intersection of the flank and face.
13. *Outer corner*	The corner formed by the intersection of the lip and the leading edge of the land.
14. *Chisel edge*	The edge formed by the intersection of the flanks.
15. *Chisel edge corner*	The corner formed by the intersection of a lip and the chisel edge.
16. *Rotation of cutting*	*Right-hand cutting drill.* A drill which rotates in a counter-clockwise direction when viewed on the point end of the drill. *Left-hand cutting drill.* A drill which rotates in a clockwise direction when viewed on the point end of the drill.

LINEAR DIMENSIONS

17. *Diameter*	The measurement across the cylindrical lands at the outer corners of the drill.
18. *Overall length*	The length over the extreme ends of the point and the shank.
19. *Flute length*	The axial length from the extreme end of the point to the termination of the flutes at the shank end of the body.
20. *Lead of helix*	The distance measured parallel to the drill axis between corresponding points on the leading edge of a flute in one complete turn of the flute.
21. *Back taper (Longitudinal clearance)*	The reduction in diameter per inch length of drill from the point towards the shank.
22. *Depth of body clearance*	The amount of diametral reduction per side to provide body clearance.
23. *Body clearance diameter*	The diameter over that surface of the drill body situated behind the lands.

24. *Web (Core) thickness*	The minimum dimension of the web or core measured at the point end of the drill.
25. *Web (Core) taper*	The increase in the web or core thickness from the point of the drill to the shank end of the flutes.
26. *Lip length*	The minimum distance between the outer corner and the chisel edge corner of the lip.

ANGLES

27. *Helix angle*	The angle between the leading edge of the land and the drill axis.
28. *Rake angle*	The angle between the face and a line parallel to the drill axis. At the periphery of the drill it is equivalent to the helix angle.
29. *Point angle*	The included angle of the cone formed by the lips.
30. *Lip clearance angle*	The angle formed by the flank and a plane at right angles to the drill axis; the angle is normally measured at the periphery of the drill.
31. *Chisel edge angle*	The obtuse angle included by the chisel edge and a line from either outer corner to the corresponding end of the chisel edge; the angle is measured in a plane perpendicular to the drill axis.

MANUFACTURE OF TWIST DRILLS

3. *a.* The *drills* shall be sharpened ready for use and well finished.

b. The *flutes* shall be so designed that the cutting lips are equal. The drills shall be provided with adequate body clearance.

c. The *point* shall be ground to provide lip clearance. The included point angle shall be approximately 118°, each lip being equally inclined to the axis of the drill. The point shall be concentric with the shank.

d. A *back taper* (longitudinal clearance) shall be provided on the diameter from point to shank, within the following limits:—

*Up to and incl. 1½ in. nominal diameter	0·0005 in. to 0·001 in. per inch (0·0005 mm. to 0·001 mm. per mm.)
Over 1½ in. nominal diameter	0·0005 in. to 0·0015 in. per inch (0·0005 mm. to 0·0015 mm. per mm.)

*This shall not be obligatory on diameters below ¼ in. (6·35 mm.) but in no case shall the diameter measured across the outer corners be less than that of any part of the fluted portion.

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DIMENSIONS OF TWIST DRILLS

4. The drills shall be made in accordance with the dimensions given in Tables 4 to 12 inclusive. The shanks shall be parallel, standard taper (see Appendix) or square taper as may be specified. Intermediate sizes take the flute length and overall length of the next larger size.

LIMITS ON TWIST DRILLS

5. The diameters, measured across the outer corners, and the overall lengths shall be within the following limits :—

TABLE 1

1	2
Nominal diameter	Limits of tolerance on diameter
Up to and including ¼ in. (6·35 mm.)	+ 0·000 0 in. − 0·000 5 in. (0·013 mm.)
Over ¼ in. (6·35 mm.) and up to and including 1 in. (25·40 mm.)	+ 0·000 0 in. − 0·001 0 in. (0·025 mm.)
Over 1 in. (25·40 mm.) and up to and including 2 in. (50·80 mm.)	+ 0·000 0 in. − 0·001 5 in. (0·038 mm.)
Over 2 in. (50·80 mm.)	+ 0·000 0 in. − 0·002 0 in. (0·051 mm.)

TABLE 2

1	2
Nominal diameter	Limits of tolerance on overall length
Up to and including ¼ in. (6·35 mm.)	± 1/16 in. (1·59 mm.)
Over ¼ in. up to and including 1 in. (25·40 mm.)	± ⅛ in. (3·18 mm.)
Over 1 in. up to and including 2 in. (50·80 mm.)	± 3/16 in. (4·76 mm.)
Over 2 in. (50·80 mm.)	± ¼ in. (6·35 mm.)

MARKING

6. The drills shall be neatly and legibly marked whenever possible, preferably by rolling, with the manufacturer's name or trade mark and

the size of the drill. The marking shall be so applied and finished that it does not interfere with the secure holding of the drill. Drills made from high speed steel shall be marked with the letters H.S. where practicable.

TESTING OF 2-FLUTE TWIST DRILLS

7. *a. Test samples.* Not more than 2 per cent of the twist drills or, in the case of deliveries of less than 100, not more than 2 drills, may be taken at random for testing.

b. Test billet. The test billet shall have the following analysis and properties :—

Carbon	between 0·60 and 0·65 per cent.
Silicon	between 0·15 and 0·30 per cent.
Manganese	between 0·60 and 0·70 per cent.
Sulphur	not more than 0·05 per cent.
Phosphorus	not more than 0·05 per cent.
Nickel, Chromium	combined not more than 0·3 per cent.

The Brinell hardness number of the steel test billets shall be between 200 and 215 and the grain size shall be between Number 3 and Number 5.

The thickness of the steel billets shall be such that the twist drill points do not break through when the billets are drilled to the depths specified in the table of penetrations.

c. Testing. (i) The drills ⅛ in. diameter and over selected for testing shall be subjected to test by drilling a series of holes as continuously as possible in the test billet.

When the tests are required on drills below ⅛ in. diameter, the tests to be applied shall be agreed between the user and the manufacturers.

(ii) The drills shall be flooded with lubricant throughout the test.

(iii) The drills shall be started by hand and the power feed shall be thrown into mesh immediately the outer corners of the drill reach the surface of the test billet.

(iv) The penetration per minute and the number and depth of the holes to be drilled shall be in accordance with the values given in Table 3.

The revolutions per minute and the feed per revolution shall be left to the discretion of the manufacturer.

(v) The drills shall withstand the specified tests without seizing, choking or fusing. The points of the drills and the lips shall be fit for further service on completion of the tests.

(vi) Should any of the drills first selected not fulfil the test requirements, two further drills from the same batch shall be selected and, if either of these drills fail, the batch represented shall be liable to rejection.

(vii) The tests shall be carried out at the manufacturer's works, or elsewhere as may be mutually agreed.

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TABLE 3. TABLE OF PENETRATIONS

1	2	3	4	5	6	7	8	9	10
Size	Decimal equivalents	Metric equivalents	Penetration per minute				Number of holes to be drilled	Depth of holes to be drilled*	
			Carbon		High speed				
in.	in.	mm.	in.	mm.	in.	mm.		in.	mm.
1/8	0·125 0	3·2	3·10	78·7	8·50	215·9	24	7/16	11
5/32	0·156 2	4·0	3·20	81·3	8·80	223·5	24	19/32	15
3/16	0·187 5	4·8	3·29	83·6	9·10	231·1	24	19/32	15
7/32	0·218 8	5·6	3·27	83·1	9·30	236·2	20	3/4	19
1/4	0·250 0	6·4	3·20	81·3	9·50	241·3	20	3/4	19
9/32	0·281 2	7·1	3·05	77·5	9·40	238·8	20	29/32	23
5/16	0·312 5	7·9	2·88	73·2	9·30	236·2	20	29/32	23
11/32	0·343 8	8·7	2·74	69·6	9·20	233·7	18	1 1/16	27
3/8	0·375 0	9·5	2·60	66·0	9·10	231·1	18	1 1/16	27
13/32	0·406 2	10·3	2·45	62·2	8·95	227·3	18	1 7/32	31
7/16	0·437 5	11·1	2·30	58·4	8·80	223·5	18	1 7/32	31
15/32	0·468 8	11·9	2·15	54·6	8·65	219·7	18	1 3/8	35
1/2	0·500 0	12·7	2·02	51·3	8·50	215·9	18	1 3/8	35
9/16	0·562 5	14·3	1·84	46·7	8·20	208·3	15	1 11/16	43
5/8	0·625 0	15·9	1·70	43·2	7·90	200·7	15	1 11/16	43
11/16	0·687 5	17·5	1·60	40·6	7·60	193·0	15	2	51
3/4	0·750 0	19·1	1·50	38·1	7·30	185·4	15	2	51
13/16	0·812 5	20·6	1·44	36·6	7·00	177·8	14	2 5/16	59
7/8	0·875 0	22·2	1·40	35·6	6·80	172·7	14	2 5/16	59
15/16	0·937 5	23·8	1·35	34·3	6·50	165·1	14	2 5/8	67
1	1·000 0	25·4	1·30	33·0	6·25	158·8	14	2 5/8	67
1 1/8	1·125 0	28·6	1·20	30·5	5·80	147·3	9	3	76
1 1/4	1·250 0	31·8	1·10	27·9	5·30	134·6	9	3	76
1 3/8	1·375 0	34·9	1·00	25·4	4·85	123·2	9	3	76
1 1/2	1·500 0	38·1	0·90	22·9	4·45	113·0	9	3	76
1 5/8	1·625 0	41·3	0·82	20·8	4·05	102·9	8	3	76
1 3/4	1·750 0	44·5	0·80	20·3	3·70	94·0	8	3	76
1 7/8	1·875 0	47·6	0·75	19·1	3·40	86·4	8	3	76
2	2·000 0	50·8	0·70	17·8	3·10	78·7	8	3	76
2 1/8	2·125 0	54·0	—	—	2·90	73·7	6	3	76
2 1/4	2·250 0	57·2	—	—	2·70	68·6	6	3	76
2 3/8	2·375 0	60·3	—	—	2·50	63·5	6	3	76
2 1/2	2·500 0	63·5	—	—	2·35	59·7	6	3	76
2 5/8	2·625 0	66·7	—	—	2·20	55·9	4	3	76
2 3/4	2·750 0	69·9	—	—	2·10	53·3	4	3	76
2 7/8	2·875 0	73·0	—	—	2·00	50·8	4	3	76
3	3·000 0	76·2	—	—	2·00	50·8	4	3	76

* From point of drill to surface of billet.
See foot of next page for Note to Table 3.

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