

INTERNATIONAL STANDARD

**ISO
513**

Second edition
1991-11-15

Application of hard cutting materials for machining by chip removal — Designation of the main groups of chip removal and groups of application

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*Application des matériaux durs de coupe pour usinage par enlèvement
de copeaux — Désignation des groupes principaux d'enlèvement de
copeaux et des groupes d'application.*

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Reference number
ISO 513:1991(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

International Standard ISO 513 was prepared by Technical Committee ISO/TC 29, *Small tools*, Sub-Committee SC 9, *Tools with cutting edges made of hard cutting materials*.

This second edition cancels and replaces the first edition (ISO 513:1975), which has been technically revised. In particular, clause 3 "Designation of hard cutting materials" has been included.

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Introduction

The variety of ways in which different manufacturers produce hard cutting materials with differing characteristics makes it impossible at the present time to standardize hard cutting materials graded in accordance with these characteristics.

This International Standard is therefore limited to a classification of hard cutting materials based on their application and to a method of designation (colour marking and distinguishing symbols) for the main types of chip removal and the groups of application which constitute this classification.

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Application of hard cutting materials for machining by chip removal — Designation of the main groups of chip removal and groups of application

1 Scope

This International Standard specifies the designation for hard cutting materials which includes hardmetals, ceramics, diamond, and boron nitride, for machining by chip removal, and establishing their application.

It is not applicable for other uses (such as, for example, mining and other percussion tools, wire drawing dies, tools operating by deformation of the metal, comparator contact tips, etc.).

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Table 1 — Hardmetals

Letter symbol	Group of hardmetal
HW (optional)	Uncoated hardmetal containing primarily tungsten carbide (WC)
HT ¹⁾	Uncoated hardmetal containing primarily titanium carbides (TiC) or titanium nitrides (TiN) or both
HC	Hardmetals as above, but coated
	¹⁾ These hardmetals are also named "cermets".

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 504:1975, *Turning tools with carbide tips — Designation and marking*.

3 Designation

The designation of groups of application for hard cutting materials includes the letter symbols in accordance with tables 1 to 4, followed by a dash and the designation of the main group of chip removal and of the group of application, as specified in clause 4.

Table 2 — Ceramics

Letter symbol	Group of ceramics
CA	Oxide ceramics containing primarily aluminium oxide (Al ₂ O ₃)
CM	Mixed ceramics based on aluminium oxide (Al ₂ O ₃) but containing components other than oxides
CN	Nitride ceramics containing primarily silicon nitride (Si ₃ N ₄)
CC	Ceramics as above, but coated

Table 3 — Diamond

Letter symbol	Group of diamond
DP	Polycrystalline diamond ¹⁾
1) Polycrystalline diamond and polycrystalline boron nitride are also named "superhard cutting materials".	

Table 4 — Boron nitride

Letter symbol	Group of boron nitride
BN	Polycrystalline boron nitride ¹⁾
1) Polycrystalline boron nitride and polycrystalline diamond are also named "superhard cutting materials".	

EXAMPLES

- HW — P 10 or P 10 (optionally)
- HC — K 20
- CA — K 10

4 Classification

4.1 General

Hard cutting materials are classified in table 5, according to their application, in main groups of chip removal and these groups are subdivided into groups of application.

The groups of application are designated by a letter (P, M or K) indicating the relevant main group followed by a distinguishing number and these groupings define the fields of application within which manufacturers of hard cutting materials may classify their own particular grades of hard cutting materials.

The letters P, M and K are thus intended exclusively for the general classification of hard cutting materials and should never be used, either separately or in conjunction with another letter, as a commercial designation for a particular grade.

4.2 Main groups of chip removal

This International Standard provides for three main groups of chip removal, based on three broad classes of material to be machined, as indicated in table 5, which are designated by the letters P, M and K respectively.

These letters are purely conventional and have no other significance in themselves; they are not the initials of particular words.

Each of these groups has a corresponding distinctive colour marking, blue, yellow or red.

4.3 Groups of application

Each main group is subdivided into groups of application based on the working conditions in which it is used.

These working conditions are expressed in table 5 in very general terms and manufacturers of hard cutting materials may possibly describe them, for their own purposes, in terms more directly related to the fields of use for the hard cutting materials which they manufacture.

The groups of application are designated by the letter for the main group to which they belong, followed by a distinguishing number.

The higher the number within each main group, the lower is the wear resistance and the greater the toughness of the hard cutting material.

Where there is a real need for an intermediate group of application, it should be designated by an intermediate number, for example K 15 between K 10 and K 20, but there should never be more than one group interpolated between two of the tabulated groups of application; there is no point in introducing such a group unless the hard cutting material so classified differs appreciably from the neighbouring groups and this would not be the case if too many further interpolations were adopted.

In the particular case of the P 01 group of application, however, this group may be subdivided by using the decimal designations P 01.1, P 01.2, P 01.3, etc., if necessary, to distinguish the different degrees of wear resistance and toughness in the finishing operations on materials with long chips which constitute this group of application.

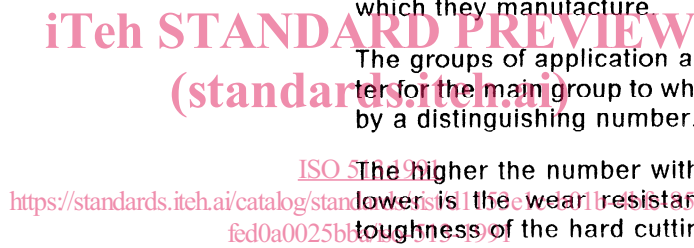


Table 5 — Classification of hard cutting materials according to use

Main groups of chip removal			Groups of application		Direction of increase in characteristic								
Symbol	Broad categories of material to be machined	Distinguishing colours	Designation	Material to be machined	Use and working conditions	of cut	of hard cutting materials						
P	Ferrous metals with long chips	BLUE	P 01	Steel, steel castings	Finish turning and boring; high cutting speeds, small chip sections, accuracy of dimensions and fine finish, vibration-free operation. Turning, copying, threading and milling, high cutting speeds, small or medium chip sections. Turning, copying, milling, medium cutting speeds and chip sections, planing with small chip sections. Turning, milling, planing, medium or low cutting speeds, medium or large chip sections, and machining in unfavourable conditions. ¹⁾ Turning, planing, slotting, low cutting speeds, large chip sections with the possibility of large cutting angles for machining in unfavourable conditions ¹⁾ and work on automatic machines. For operations demanding very tough hard cutting materials: turning, planing, slotting, low cutting speeds, large chip sections, with the possibility of large cutting angles for machining in unfavourable conditions ¹⁾ and work on automatic machines.	Increasing speed	Wear resistance						
			P 10	Steel, steel castings									
			P 20	Malleable cast iron with long chips									
			P 30	Steel, steel castings Malleable cast iron with long chips									
			P 40	Steel Steel castings with sand inclusion and cavities									
			P 50	Steel Steel castings of medium or low tensile strength, with sand inclusion and cavities									
			M	Ferrous metals with long or short chips and non-ferrous metals				YELLOW	M 10	Steel, steel castings, manganese steel Grey cast iron, alloy cast iron	Turning, medium or high cutting speeds. Small or medium chip sections. Turning, milling. Medium cutting speeds and chip sections. Turning, milling, planing. Medium cutting speeds, medium or large chip sections. Turning, parting off, particularly on automatic machines.	Increasing speed	Wear resistance
									M 20	Steel, steel castings, austenitic or manganese steel, grey cast iron			
									M 30	Steel, steel castings, austenitic steel, grey cast iron, high temperature resistant alloys			
									M 40	Mild free cutting steel, low tensile steel Non-ferrous metals and light alloys			

Main groups of chip removal		Groups of application		Direction of increase in characteristic		
Symbol	Broad categories of material to be machined	Designation	Use and working conditions	of cut	of hard cutting materials	
K	<p>https://standards.iteh.ai/catalog/standards/sist/1b-46fc-8572-2020/iso-513-1991</p> <p>Ferrous metals with short chips, non-ferrous metals and non-metallic materials</p>	<p>Very hard grey cast iron, chilled castings of over 85 Shore, high silicon aluminium alloys, hardened steel, highly abrasive plastics, hard cardboard, ceramics</p>	Turning, finish turning, boring, milling, scraping.	←	←	
		K 10	Grey cast iron over 220 HB, malleable cast iron with short chips, hardened steel, silicon aluminium alloys, copper alloys, plastics, glass, hard rubber, hard cardboard, porcelain, stone.	Turning, milling, drilling, boring, broaching, scraping.	←	←
		K 20	Grey cast iron up to 220 HB, non-ferrous metals: copper, brass, aluminium	Turning, milling, planing, boring, broaching, demanding very tough hard cutting materials.	←	←
		K 30	Low hardness grey cast iron, low tensile steel, compressed wood	Turning, milling, planing, slotting, for machining in unfavourable conditions ¹⁾ and with the possibility of large cutting angles.	←	←
		K 40	Soft wood or hard wood Non-ferrous metals	Turning, milling, planing, slotting, for machining in unfavourable conditions ¹⁾ and with the possibility of large cutting angles.	←	←

1) Raw material or components in shapes which are awkward to machine: casting or forging skins, variable hardness, etc., variable depth of cut, interrupted cut, work subject to vibrations.

5 Important remarks

5.1 Particular attention is drawn to the fact that a group of application is not a grade of hard cutting material and should not be confused with the latter. It only defines the extent of the field of use and the working conditions and the manufacturers are responsible for classifying their hard cutting materials within the group. Grades classified in the same group of application by different manufacturers may differ from one another as far as their properties for machining by chip removal are concerned; for this reason, no combination of groups of application and grades of hard cutting materials can be regarded as representing "a comparative table of hard cutting material grades".

This is why the letters P, M and K, intended exclusively for the general classification of the main groups of chip removal, should never be used, either separately or in conjunction with another letter, as a commercial designation for a particular grade; the

groups of application which are essentially designated by these letters cannot, in fact, be identified with grades of hard cutting materials and the latter therefore cannot have the same designations.

5.2 The practice of distinguishing grades of hard cutting materials by colours as well as by symbols has, until now, given rise to more inconvenience than simplification, but only because the multiplicity of grades led to the simultaneous use of a number of colours.

This practice should be abandoned, and the use of colours in accordance with this International Standard reserved solely for the indication of the main groups of chip removal.

The symbols and distinguishing colours shall be used for the marking of tools in accordance with the requirements of ISO 504.

5.3 On lathe tools, the symbols and colour markings shall be applied as specified in ISO 504.

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