TECHNICAL REPORT

ISO TR 12245

First edition
1994-07-15

Carbon blacks used in rubber products — Classification system

Noirs de carbone utilisés dans les produits en caoutchouc — Système de classification

Reference number
ISO/TR 12245:1994(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.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;

— type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 12245, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 3, *Raw materials (including latex) for use in the rubber industry*.

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland
Printed in Switzerland

Carbon blacks used in rubber products — Classification system

1. SCOPE

1.1 This classification system is used to classify rubber grade carbon blacks by the use of a four-character nomenclature system. The first character gives some indication of the influence of the carbon black on the rate of cure of a typical rubber compound containing the black. The second character gives information on the average particle size of the carbon black. The last two characters are assigned arbitrarily.

1.2 All rubber grade carbon blacks for which a number is currently assigned at the time of publication of this classification system are listed in Tables1 and 2 together with some of their typical properties.

1.3 Assignment of a number is exclusively the ASTM D-24 Committee's responsibility.

2. REFERENCES

2.1 ISO Standards

37-1977 Rubber, vulcanized - Determination of tensile stress-strain properties.

1304-1985 Rubber compounding ingredients - Carbon black - Determination of iodine adsorption number - Titrimetric method.

1306-1987 Rubber compounding ingredients - Carbon black (pelletized) - Determination of the pour density.

2393-1994 Rubber test mixes - Preparation, mixing and vulcanization - Equipment and procedures.

3257-1992 Rubber compounding ingredients - Carbon black - Method of evaluation in styrene-butadiene rubber.

3417-1991 Rubber - Measurement of vulcanization characteristics with the oscillating disc cure meter.

4652-1994 Rubber compounding ingredients - Carbon black - Determination of specific surface area - Nitrogen adsorption methods.

4656/1-1985 Rubber compounding ingredients - Carbon black - Determination of dibutylphtalate absorption number - Part 1: method using absorptometer.

5435-1994 Rubber compounding ingredients - Carbon black - Determination of tinting strength.

6810-1985 Rubber compounding ingredients - Carbon black - Determination of surface area - CTAB adsorption methods.

6894-1991 Rubber compounding ingredients - Carbon black - Preparation of samples for determination of dibutylphtalate absorption number (compressed sample).

2.2 ASTM Standards

D-3192 Test methods for Carbon Black evaluation in NR (Natural Rubber).

D-1765 Standard classification system for Carbon Blacks used in Rubber Products.

3. BASIS OF CLASSIFICATION

3.1 The first character in the nomenclature system for rubber grade carbon blacks is a letter indicating the effect of the carbon black on the cure rate of a typical rubber compound containing the black. The letter "N" is used to indicate a normal cure rate typical of furnace blacks that have received no special modification to alter their influence on the rate of cure of rubber. The letter "S" is used for channel blacks or for furnace blacks that have been modified to effectively reduce the curing rate of rubber. Channel blacks characteristically impart a slower rate of cure to rubber compounds. Thus, the letter "S" designates a slow cure black. Blacks may vary considerably in "curing rate" within each of the two letters classifications.

3.2 The second character in the system is a digit to designate the typical average particle size of the carbon black as determined by electron microscope measurement. The particle size range of rubber-grade carbon blacks has been divided into 10 arbitrary groups, and each group has been assigned a digit to describe that group. These groups are as follows:

Group number	Typical average particle size, nm
0	1 to 10
1	11 to 19
2	20 to 25
3	26 to 30
4	31 to 39
5	40 to 48
6	49 to 60
7	61 to 100
8	101 to 200
9	201 to 500

3.3 The third and fourth characters in this system are arbitrarily assigned digits.

4. TYPICAL PROPERTIES OF CARBON BLACKS

4.1 Each of the standard grades of carbon black shall have target values and typical physical properties prescribed in Table 1 and Table 2 respectively.

4.2 Vulcanizates containing each of the standard grades of carbon black shall have typical physical properties prescribed in Table 2.

4.2.1 The 300 % stress values shown in Table 2 represent the typical differences between the values obtained for the test black and those obtained for Industry Reference Black No. 6.

In practice, the black compounds shall be mixed and tested at the same time using the formulation in ASTM Test Methods D-3192.

NOTE 1: Industry Reference Black No. 6 is an N 330 type black prepared at one location[1] and physically blended to obtain uniformity. A large volume (409.000 kg) of this black was prepared since it is used as a standard black. The black has an iodine number of 80.0 and DBP number of 100.0.

NOTE 2: For comparison of IRB No. 5 to IRB No. 6 in SBR 1500, see Table 3.

4.3 The properties enumerated shall be determined in accordance with the test methods shown in Tables 1 and 2.

4.4 The values shown in Table 2 are often an average of typical values from the various suppliers of a particular grade of carbon black.

[1] Available in the USA from J. M. Huber Customer Service Dept., P. O. Box 2831, Borger, TX 79008 - 2831, Available in Europe from Degussa AG, AC-KP-VK, Postfach 11 05 33, Weißfrauenstraße 9, D-60311 Frankfurt

ISO/ASTM Designation	Iodine Adsorption No. (1)	DBP No.
	ISO 1304 g/kg	ISO 4656/1 $10^{-5}m^3/kg$
N 110	145	113
N 115	160	113
N 121	121	132
N 125	117	104
N 134	142	127
N 135	151	135
S 212	---	85
N 220	121	114
N 231	121	92
N 234	120	125
N 293	145	100
N 299	108	124
S315	---	79
N 326	82	72
N 330	82	102
N335	92	110
N 339	90	120
N 343	92	130
N 347	90	124
N 351	68	120
N356	92	154
N 358	84	150
N 375	90	114
N 472	250	178
N 539	43	111
N 550	43	121
N 582	100	180
N 630	36	78
N 642	36	64
N 650	36	122
N 660	36	90
N 683	35	133
N 754	24	58
N 762	27	65
N 765	31	115
N 772	30	65
N 774	29	72
N 787	30	80
N 907	---	34
N 908	---	34
N 990	---	43
N 991	---	35

TABLE 1: Carbon Black Target Values

The iodine adsorption number and DBP number values represent target values. a target value is defined as an agreed upon value on which producers center their production process and users center their specifications.

(1) In general, method ISO 1304 can be used to estimate the surface area of furnace blacks but not channel, oxidized, and thermal blacks.

ISO/ASTM Designation	DBP No. Compressed Sample ISO 6894 and 4656/1 $10^{-5}m^3/kg$	CTAB ISO 6810 $10^3m^2/kg$	Nitrogen Adsorption ISO 4652 $10^3m^2/kg$	Tinting Strength ISO 5435	Pour Density ISO 1306 kg/m^3	ΔStress at 300 % Elongation (1) ISO 37, ISO 2393 and ASTM D-3192 MPa
N 110	98	126	143	124	335	0
N 115	96	128	145	123	345	-0.2
N 121	112	121	132	121	320	+3.3
N 125	89	126	132	123	370	+0.6
N 134	102	134	146	132	320	+2.5
N 135	117	127	145	119	320	+2.7
S 212	82	119	117	115	400	-3.3
N 220	100	111	119	115	345	+0.9
N 231	86	108	117	117	390	-1.4
N 234	100	119	126	124	320	+2.3
N 293	92	114	130	117	375	-1.6
N 299	105	104	108	113	335	+3.3
S315	75	95	88	—	450	-3.2
N 326	69	83	84	112	465	-1.7
N 330	88	82	83	103	375	+1.7
N335	94	88	88	110	345	+3.3
N 339	101	93	96	110	345	+3.4
N 343	104	95	97	114	336	+5.2
N 347	100	87	90	103	335	+3.1
N 351	97	73	73	100	345	+3.7
N356	112	93	94	105	280	+4.5
N 358	112	88	87	99	290	+5.4
N 375	97	96	100	115	345	+2.9
N 472	114	145	270	—	255	-1.8
N 539	84	41	41	—	385	+1.4
N 550	88	42	42	—	360	+1.7
N 582	114	76	80	67	190	+1.3
N 630	62	35	38	—	465	-1.2
N 642	62	34	37	—	513	-2.3
N 650	87	38	38	—	370	+1.7
N 660	75	36	35	—	425	-0.1
N 683	—	39	37	—	335	+2.3
N 754	57	29	—	—	495	-3.5
N 762	57	29	28	—	505	-2.6
N 765	86	33	31	—	375	+1.2
N 772	58	33	32	—	505	-2.6
N 774	62	29	29	—	495	-1.4
N 787	74	31	30	—	450	-1.0
N 907	—	—	11	—	—	-6.2
N 908	—	—	—	—	—	-7.0
N 990	40	9	9	—	—	-5.5
N 991	38	8	7	—	—	-7.0

TABLE 2: Carbon Black Typical Properties

The properties shown are averages of typical values supplied by several manufacturers. Typical properties are dependent upon the target values and may vary from producer to producer at the same iodine adsorption and DBP absorption numbers because of the differences in processing equipment.

NOTE 1: IRB data was obtained from tests performed during the certification of IRB No. 6 carbon black.

NOTE 2: The cure rate of vulcanizates containing carbon black compounded by Test Methods ASTM D-3192 may be measured by Test Method ISO 3417.

(1) ΔStress = stress at 300 % elongation of test black - stress at 300 % elongation of IRB No. 6, vulcanized 30 minutes at 45 °C.

	IRB 5	IRB 6	Difference
35 Min. stress at 300 % elongation	16.2	13.6	-2.6
35 Min. tensile strength	27.5	26.0	-1.5
50 Min. stress at 300 % elongation	19.6	16.9	-2.7
50 Min. tensile strength	28.3	27.1	-1.2

TABLE 3: Comparison of IRB No. 5 to IRB No. 6 in SBR 1500 (Test methods ISO 37, ISO 2393 and ISO 3257, data in MPa)

5. PROCEDURES FOR CLASSIFYING A NEW CARBON BLACK

5.1 Data for classification of a new grade of carbon black are to be submitted to ASTM Headquarters, for the attention of the Chairman of Subcommittee D-24-41 on Carbon Black Nomenclature and Terminology.

5.2 Data to be submitted shall consist of:

- target values for the following properties:

  - Iodine Number ISO 1304
  - DBP Absorption number ISO 4656/1

- and typical values for the following properties:

  - Particle size -
  - CTAB surface area ISO 6810
  - Nitrogen adsorption ISO 4652
  - DBP absorption number, compressed sample ISO 6894 and ISO 4656/1
  - Tinting strength ISO 5435
  - Pour density ISO 1306
  - Stress at 300 % elongation (30 minutes at 145 °C) ASTM D-3192

5.3 When the Chairman of Subcommittee D-24-41 receives a request to assign a classification number to a new carbon black, the following action is taken:

5.3.1 Confirmation that the new carbon black meets the scope of Committee D-24.

5.3.2 Confirmation that the new carbon black is commercially available.

5.3.3 Establishment of the "N" or "S" first character assignment and the second character (number) assignment based upon the data submitted with the request.

5.3.4 Establishment of the third and fourth character (number) assignments based upon the information from the requestor. Without specific information from the requestor, these characters are arbitrarily assigned by the Chairman of Subcommittee D-24-41.

5.4 A simultaneous subcommittee and committee ballot is conducted to add the black to Table 1 as a standard grade. If no negative votes are cast, the subcommittee chairman will inform all members of the committee of the acceptance of the new black and the designation assigned to it. Final approval will be conferred by the society's Committee on Standards after a society ballot. If any negative votes are cast, the application will be discussed at the next meeting of the subcommittee.

ANNEX

LISTING OF THE PROPERTIES OF INDUSTRY REFERENCE BLACKS

A1 The listing of properties for Industry Reference Blacks (IRBs) is given in Table A1.1. This spans a period of 20 years. The absolute values for Iodine number, DBP number, DBP compressed sample number and tinting strength are listed. Values for tensile stress at 300 % elongation ("modulus") and tensile strength are given in relation to the previous IRB as a "difference". All of there represent average values as determined by testing programs carried out prior to the dates listed for each reference black. Since the purpose of an Industry Reference Black is the elimination of the major part of laboratory-to-laboratory variation, it is used as a reference material within each laboratory to correct actual measured property values in that laboratory.

A2 The user of this table is cautioned against attempting to add the differences listed in the modulus and tensile strength columns to determine the relationship of two carbon blacks not adjacent in time. Such an addition is likely to produce spurious results due to additive errors.

Table A1: Industry Reference Blacks

IRB No.	Producer	Lot Size	Date of ASTM Acceptance	Iodine Adsorption No.	DBP No.	DBP No. Compressed Sample	Tinting strength	Difference from previous IRB, MPa			
								ASTM D-3192		ISO 3257	
				ISO 1304	ISO 4656/1	ISO 6894, ISO 4656/1	ISO 5435				
		kg		g/kg	$10^{-5}m^3/kg$	$10^{-5}m^3/kg$		Modulus	Tensile	Modulus	Tensile
1	Phillips	68000	12/59	81	97(1)	---	---	15-min ----	---	35-min ----	---
								30-min ----	---	50-min ----	---
2	Continental	91000	6/65	82	92	83	---	15-min -0.3	+1.9	35-min ----	---
								30-min -0.2	+1.2	50-min ----	---
3	Ashland	136000	6/69	84.8	99.9	87.8	100.0	15-min +0.7	-0.5	35-min ---	---
								30-min +0.5	-0.5	50 min ---	---
4	Cabot	272000	11/73	82.1	97.1	86.5	107.1	15-min +0.2	+0.9	35-min ---	---
								30-min +0.5	+0.8	50-min ---	---
5	Columbian	227000	12/79	81.9	102.1	89.6	101.5	15-min +1.2	0.0	35-min +1.4	+0.1
								30-min +0.9	-0.6	50-min +1.2	+0.2
6	Huber	409000	6/85	80.0	100.0	87.2	99.2	15-min -1.7	-0.9	35-min -2.6	-1.5
								30-min -2.2	-0.9	50-min -2.7	-1.2

(1) Hand oil absorption