Designation: D 1765 – 03~~3~~4

Standard Classification System for Carbon Blacks Used in Rubber Products[1]

This standard is issued under the fixed designation D 1765; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

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 surface area 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 Table 1 together with some of their typical properties. ASTM classification numbers ("N" or "S" designation) not listed in Table 1 have either been withdrawn or are not currently assigned. The use of inactive or unassigned N# designations is highly discouraged until such a time as the designation is officially reactivated or assigned by subcommittee D 24.41

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

---

[1] This classification is under the jurisdiction of ASTM Committee D24 on Carbon Black and is the direct responsibility of Subcommittee D24.41 on Carbon Black Nomenclature and Terminology.

Current edition approved Jan. 1~~0~~, 200~~3~~4. Published February 200~~3~~4. Originally approved in 1965. Last previous edition approved in 200~~1~~3 as ~~D 1765 – 01ε1.~~ D 1765 – 03.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension
D 1508 Test Method for Carbon Black, Pelleted Fines and Attrition
D 1510 Test Method for Carbon Black—Iodine Adsorption Number
D 1513 Test Method for Carbon Black, Pelleted—Pour Density
D 1514 Test Method for Carbon Black—Sieve Residue
D 2084 Test Method for Rubber Property—Vulcanization Using Oscillating Disk Cure Meter
D 2414 Test Method for Carbon Black—Oil Absorption Number
D 3053 Terminology Relating to Carbon Black
D 3182 Practice for Rubber—Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
D 3191 Test Methods for Carbon Black in SBR (Styrene-Butadiene Rubber)—Recipe and Evaluation Procedures
D 3192 Test Methods for Carbon Black Evaluation in NR (Natural Rubber)
D 3265 Test Method for Carbon Black—Tint Strength
D 3493 Test Method for Carbon Black—Oil Absorption Number of Compressed Sample
D 6556 Test Method for Carbon Black—Total and External Surface Area by Nitrogen Adsorption

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 curing 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 rate. Blacks may vary considerably in "curing rate" within each of the two letter classifications.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards*, ~~Vol 09.01.~~ volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Carbon Black Properties

NOTE 1—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. All other 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 2—The cure rate of vulcanizates containing carbon black compounded by Test Methods D 3192 may be measured by Test Method D 2084.~~

	Target Values[A]		Typical Descriptive Values[A]					
ASTM Classification	Iodine Adsorption No.,[B] D 1510, g/kg	Oil Absorption No. D 2414, 10^{-5} m^3/kg	Oil Absorption No. Compressed Sample, D 3493, 10^{-5} m^3/kg	NSA Multipoint D 6556, 10^3 m^2/kg (m^2/g)	STSA D 6556 10^3 m^2/kg (m^2/g)	Tint Strength, D 3265	Pour Density, D 1513, kg/m^3 (lb/ft^3)	~~Δ Stress[C] at 300 % Elongation, MPa(psi), cured at 145°C, D 412, D 3182, and D 3192~~
~~30 min~~								
N110	145	113	97	127	115	123	345 (21.5)	–3.2 (–470)
N115	160	113	97	137	124	123	345 (21.5)	–3.1 (–440)
N120	122	114	99	126	113	129	345 (21.5)	–0.4 (–60)
N121	121	132	111	122	114	119	320 (20.0)	–0.1 (–10)
N125	117	104	89	122	121	125	370 (23.0)	–2.6 (–380)
N134	142	127	103	143	137	131	320 (20.0)	–1.5 (–210)
N135	151	135	117	141	. . .	119	320 (20.0)	–0.4 (–60)
S212	. . .	85	82	120	107	115	415 (26.0)	–6.4 (–930)
N219	118	78	75	. . .	. . .	123	440 (27.5)	. . .
N220	121	114	98	114	106	116	355 (22.0)	–2.0 (–280)
N231	121	92	86	111	107	120	400 (25.0)	–4.6 (–670)
N234	120	125	102	119	112	123	320 (20.0)	–0.1 (–10)
N293	145	100	88	122	111	120	380 (23.5)	–5.2 (–750)
N299	108	124	104	104	97	113	335 (21.0)	0.7 (90)
S315	. . .	79	77	89	86	117	425 (26.5)	–6.4 (–930)
N326	82	72	68	78	76	111	455 (28.5)	–3.6 (–530)
N330	82	102	88	78	75	104	380 (23.5)	–0.6 (–80)
N335	92	110	94	85	85	110	345 (21.5)	0.2 (30)
N339	90	120	99	91	88	111	345 (21.5)	0.9 (140)
N343	92	130	104	96	92	112	320 (20.0)	1.4 (210)
N347	90	124	99	85	83	105	335 (21.0)	0.5 (70)
N351	68	120	95	71	70	100	345 (21.5)	1.1 (160)
N356	92	154	112	91	87	106		1.4 (200)
N358	84	150	108	80	78	98	305 (19.0)	2.3 (330)
N375	90	114	96	93	91	114	345 (21.5)	0.4 (60)
N539	43	111	81	39	38	. . .	385 (24.0)	–1.3 (–180)
N550	43	121	85	40	39	. . .	360 (22.5)	–0.6 (–90)
N582	100	180	114	80	. . .	67		–1.8 (–260)
N630	36	78	62	32	32	. . .	500 (31.0)	–4.4 (–640)
N642	36	64	62	39	. . .	. . .		–5.4 (–780)
N650	36	122	84	36	35	. . .	370 (23.0)	–0.7 (–110)
N660	36	90	74	35	34	. . .	440 (27.5)	–2.3 (–330)
N683	35	133	85	36	34	. . .	355 (22.0)	–0.4 (–60)
N754	24	58	57	25	24	. . .		–6.6 (–960)
N762	27	65	59	29	28	. . .	515 (32.0)	–4.6 (–660)
N765	31	115	81	34	32	. . .	370 (23.0)	–0.3 (–40)
N772	30	65	59	32	30	. . .	520 (32.5)	–4.7 (–690)
N774	29	72	63	30	29	. . .	490 (30.5)	–3.8 (–550)
N787	30	80	70	32	32	. . .	440 (27.5)	–4.2 (–610)
N907	. . .	34	. . .	9	9	. . .	640 (40.0)	–9.4 (–1360
N908	. . .	34	. . .	9	9	. . .	355 (22.0)	–10.2 (–1480
N990	. . .	43	37	8	8	. . .	640 (40.0)	–8.6 (–1250
N991	. . .	35	37	8	8	. . .	355 (22.0)	–10.2 (–1480

[A] See Note 1 above.

[B] In general, Test Method D 1510 can be used to estimate the surface area of furnace blacks but not channel, oxidized, and thermal blacks.

~~[C] Δ Stress = stress at 300 % elongation of test black minus the stress at 300 % elongation of IRB No. 7.~~

[D] New numbers are marked to designate that the requestor has a one-year period, starting from the number's approval date as shown in Footnote 1, to revise, by letter ballot, target and typical values.

3.2 The second character in the system is a digit to designate the average surface area of the carbon black as measured by nitrogen surface area. The surface area range of the carbon blacks has been divided into ten arbitrary groups, and each has been assigned a digit to describe that group. These groups are as follows:

Group No.	Average Nitrogen Surface Area, m^2/g
0	>150
1	121 to 150
2	100 to 120
3	70 to 99
4	50 to 69
5	40 to 49
6	33 to 39
7	21 to 32
8	11 to 20
9	0 to 10

NOTE 1—Some of the carbon blacks in Table 1 were assigned prior to the establishment of the surface area classification system and may fall outside of the specified ranges.

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 and typical physical properties prescribed in Table 1.

~~4.2 Vulcanizates containing each of the standard grades of carbon black shall have typical physical~~

4.2 The properties ~~prescribed in Table 1.~~

~~4.2.1 The 300 % stress values shown in Table 1 represent the typical differences between the values obtained for the test black and those obtained for Industry Reference Black No. 7. In practice, the black compounds shall be mixed and tested at the same time using the formulation in Test Methods D 3192.~~

~~NOTE 2—Industry Reference Black No. 7[3] is an N330 type carbon black prepared at one location, then evaluated by ASTM D 24 to insure uniformity. A large volume (225 000 kg (495 000 lb)) of this carbon black was prepared since it is used daily as a standard reference material by carbon black producers. The carbon black has an iodine number of 83.0 and DBP No. of 101.6.[4]~~

~~NOTE 3—For comparison of IRB No. 6 to IRB No. 7 per SBR-1500, see Table 3.~~

~~4.3 The properties~~ enumerated shall be determined in accordance with the ASTM test methods shown in Table 1.

4.~~4~~3 The following carbon black properties are not included in Table 1 but do have previously established maximum values.

4.~~4~~3.1 *Sieve Residue*— Test Method D 1514. Screen sizes 500 µm (No. 35), maximum 0.0010 %, and 45 µm (No. 325), maximum 0.10 % for all grades.

4.~~4~~3.2 *Fines*—Test Method D 1508. Screen size 125 µm (No. 120). Maximum 7 % fines on bulk units for all grades except thermal blacks. The 5-min fines test shall be used, and samples shall be taken from sample ports.

4.~~5~~4 The typical values shown in Table 1 are consensus values based on input from the various carbon black producers. Typical values often vary between suppliers; therefore, the range of data used to define the typical values is shown in Table A2.1. These ranges in no way should be viewed as being related to specification ranges.

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, to the attention of the chairman of Subcommittee D24.41 on Carbon Black Nomenclature and Terminology.

5.2 Data to be submitted shall consist of typical values for the following:

Property	Test Procedure
Nitrogen adsorption, total and external surface area	D 6556
~~DBP absorption number, compressed sample~~	~~D 3493~~
Oil absorption number, compressed sample	D 3493
Tint strength	D 3265
Pour density	D 1513 ~~Stress at 300 % Elongation, 30 min.~~

and target values for the following properties:

Property	Test Procedure

[3] Supporting data are available from ASTM Headquarters. Request RR: D24-1005.

[4] Available from Balentine Enterprises, 227 Somerset, Borger, TX 79007 U.S.A.

Iodine number	D 1510
~~DBP absorption number~~	~~D 2414~~
Oil absorption number	D 2414

5.3 When the chairman of Subcommittee D24.41 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 meets the scope of Committee D24.

5.3.2 Confirmation that the new carbon 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.

5.3.5 A classification number that has been approved by ASTM subcommittee D 24.41 is no longer available for assignment, regardless of its status as active or withdrawn. Table 1 lists the active designation numbers. The following designations are classified as inactive and unavailable for reassignment:

N119	N155	N166	N195	N230	N242	N270	N285
N294	N296	S300	S301	N327	N332	N341	N345
N363	N367	N440	N472	N542	N568	N601	N724
N741	N761	N770	N779	N785	N790	N880	N881

5.3.6 Target and typical values for a new standard, noted by Footnote D in Table 1, are often based upon samples taken from a limited number of production runs. These table values may change slightly when the sample results taken over a longer period are pooled. The requestor of a new standard grade may pursue a revision of the table values by letter ballot during the first year of publication to utilize the additional pooled data. Changes to the table after the first year of publication would normally require the assignment of a new ASTM designation.

6. Keywords

6.1 carbon black; classification of carbon blacks; industry reference blacks; typical properties of carbon black types

ANNEXES

(Mandatory Information)

A1. LISTING OF THE PROPERTIES OF INDUSTRY REFERENCE BLACKS

A1.1 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 I_2 ~~number, DBP~~ number, OAN number, ~~DBP~~ OAN CS number, and tint strength are listed. Values for tensile stress at 300 % elongation or "modulus" and tensile strength are given in relation to the previous IRB as a "difference."

TABLE A1.1 Industry Reference Blacks

~~IRB No.~~	~~Producer~~	~~Lot Size, lb~~	~~Date of ASTM Acceptance~~	~~Iodine Adsorption No., D 1510, g/kg~~	~~DBP No., D 2414, $10^{-5}m^3/kg$~~	~~DBP No. Compressed Sample, D 3493, $10^{-5}m^3/kg$~~	~~Tint Strength, D 3265~~	~~Difference from previous IRB, MPa (psi)~~						
								IRB No.	Producer	Lot Size, lb	Date of ASTM Acceptance	Iodine Adsorption No., D 1510, g/kg	OAN No., D 2414, $10^{-5}m^3/kg$	OAN No. Cor
				D 3192		D 3191								
				Modulus	Tensile	Modulus	Tensile							
1	Phillips	150 000	12/59	81	97[A]	. . .	. . .	15-min	. . .	. . .	35-min	. . .	. . .	
								30-min	. . .	. . .	50-min	. . .	. . .	
2	Continental	200 000	6/65	82	92	83	. . .	15-min	–0.3 (–50)	+1.9 (+275)	35-min	. . .	. . .	
								30-min	–0.2 (–25)	+1.2 (+175)	50-min	. . .	. . .	
3	Ashland	300 000	6/69	84.8	99.9	87.8	100.0	15-min	+0.7 (+100)	–0.5 (–75)	35-min	. . .	. . .	
								30-min	+0.5 (+75)	–0.5 (–75)	50-min	. . .	. . .	
4	Cabot	600 000	11/73	82.1	97.1	86.5	107.1	15- min	+0.2 (+30)	+0.9 (+130)	35-min	. . .	. . .	
								30-min	+0.5 (+70)	+0.8 (+110)	50-min	. . .	. . .	
5	Columbian	500 000	12/79	81.9	102.1	89.6	101.5	15-min	+1.2 (+170)	0.0 (0.0)	35-min	+1.4 (+210)	+0.1 (+20)	
								30-min	+0.9 (+130)	–0.6 (–90)	50-min	+1.2 (+180)	+0.2 (+30)	
6	Huber	900 000	6/85	80.0	100.0	87.2	99.2	15-min	–1.7 (–245)	–0.9 (–130)	35-min	–2.6 (–375)	–1.5 (–220)	
								30-min	–2.2 (–320)	–0.9 (–130)	50-min	–2.7 (–390)	–1.2 (–175)	
7	Sid Richardson	495 000	6/97	83.0	101.6	89.0	106.8	30-min	+3.2 (+460)	+1.5 (+220)	50-min	+3.8 (+550)	+1.6 (+230)	

[A] Hand oil absorption.

All of these 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.

A1.1.1 The rubber properties of carbon black are typically reported as the difference between the values obtained for the test and those obtained for Industry Reference Black No. 7.

NOTE A1.1—Industry Reference Black No. 7[3] is an N330 type carbon black prepared at one location, then evaluated by ASTM committee D 24 to insure uniformity. A large volume (225 000 kg (495 000 lb)) of this carbon black was prepared since it is used daily as a standard reference material by carbon black producers. The carbon black has an iodine number of 83.0 and OAN No. of 101.6[4].

A1.2 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.

A1.3 The listing of the properties of IRB No. 7 is given in Table A1.2.

A2. LISTING OF DATA RANGES USED TO DERIVE TYPICAL VALUES

A2.1 Although producers are encouraged to center their process at the typical value level defined in Table 1, differences in manufacturing technology and process conditions such as reactor design, feedstock oil source, etc., exist. Consequently, any grade of carbon black produced at target values may deviate from the documented typical value.

A2.2 Table A2.1 contains the range of mean values reported by each carbon black producer that were used to define the values in Table 1. These ranges in no way should be viewed as being related to specification ranges.

TABLE A1.2

Property	IRB No. 7
Tint Strength, D 3265, % ITRB	106.8
Iodine Adsorption No., D 1510, g/kg (mg/g)	83.0
NSA, D 6556, 10^3 m^2/kg (m^2/g)	78.1
STSA, D 6556, 10^3 m^2/kg (m^2/g)	77.0
~~DBP No., D 2414, 10^{-5} m^3/kg~~	~~101.6~~
OAN No., D 2414, 10^{-5} m^3/kg	101.6
~~DBP No. Compressed Sample, D 3493, 10^{-5} m^3/kg~~	~~89.0~~
OAN No. Compressed Sample, D 3493, 10^{-5} m^3/kg	89.0
Pour Density, D 1513, kg/m^3(lb/ft^3)	380 (23.8)
Ash Content, D 1506, %	0.27
Fines Content, D 1508, %	3.0
Heating Loss, D 1509, %	0.3
Sieve Residue, D 1514, mg/kg (ppm)	27
Toluene Discoloration, D 1618, %	98.2
Mean Pellet Hardness, D 5230, mN (gf)	257.7 (26.3)
Maximum Pellet Hardness, D 5230, mN (gf)	467.5 (47.7)

TABLE A2.1 Range of Data

~~ASTM Classification~~	~~DBP No. Compressed $10^{-5}m^3/kg$ ($cm^3/100g$)~~	~~NSA 10^3 m^2/kg (m^2/g)~~	~~STSA 10^3 m^2/kg (m^2/g)~~	~~Tint %ITRB~~	~~Pour Density kg/m^3~~	~~Modulus ΔIRB#7 MPa~~
ASTM Classification	OAN No. Compressed $10^{-5}m^3/kg$ ($cm^3/100g$)	NSA 10^3 m^2/kg (m^2/g)	STSA 10^3 m^2/kg (m^2/g)	Tint %ITRB	Pour Density kg/m^3	Modulus ΔIRB#7 MPa
N110	96–98	124–130	—[A]	122–124	335–353	–4.0 to –2.5
N115	96–98	136–138	—[A]	122–125	331–353	–3.5 to –2.6
N121	111–112	121–122	—[A]	118–121	312–321	–0.9 to 0.7
N125	—[A]	—[A]	—[A]	—[A]	—[A]	—[A]
N134	102–105	140–146	—[A]	128–133	305–337	–1.9 to –1.0
N220	96–100	112–115	105–107	116–117	337–361	–2.3 to –1.4
N231	85–88	108–113	—[A]	119–121	379–417	—[A]
N234	100–103	116–121	109–114	120–124	307–337	–0.5 to 0.3
N299	—[A]	103–104	—[A]	112–115	336–345	—[A]
N326	68–69	77–80	74–78	110–113	446–470	–4.2 to –3.0
N330	85–89	76–80	74–76	103–105	370–393	–1.2 to –0.1
N339	96–101	89–92	85–89	110–112	328–353	0.8 to 1.2
N343	100–107	95–96	—[A]	111–114	310–326	1.1 to 1.7
N347	97–101	85–86	82–84	103–106	324–345	0.2 to 0.9
N351	95–97	70–72	68–71	99–101	332–353	0.8 to 1.3
N358	108–109	—[A]	—[A]	98–99	—[A]	—[A]
N375	95–98	91–95	90–91	114–115	345–350	0.3 to 0.6
N539	80–82	—[A]	—[A]	. . .	377–385	–1.5 to –1.0
N550	83–87	39–41	38–40	. . .	353-369	–1.0 to 0.1
N650	81–86	33–38	32–36	. . .	358–377	–1.0 to –0.2
N660	72–75	34–36	34–35	. . .	432–458	–2.4 to –2.0
N683	80–88	34–37	33–35	. . .	342–353	–0.8 to –0.1
N762	57–61	26–32	26–30	. . .	490–530	–4.9 to –4.2
N772	58–60	31–32	30–31	. . .	507–530	–4.8 to –4.6
N774	59–65	28–32	27–31	. . .	469–514	–4.6 to –2.9
N990	36–37	7–9	6–9	. . .	642–653	—[A]
N991	—[A]	7–9	7–9	. . .	—[A]	—[A]

[A] Either all values reported were the same or only one company submitted a value for this carbon black. Note: Carbon blacks with data from a single producer are not included.