

Documentation Sheet
Standard Reference Black – Set 8
(SRB8 prepared according to ASTM D6915)
(Evaluated per ASTM D4483-99)
Approved by D24.61: June 16, 2015¹
Supersedes: New

Introduction

The first Standard Reference Blacks (SRB) were produced in the early 1960s for the purpose of normalizing the test results from the recently developed oil absorptometer (See ASTM D2414). This initial set consisted of four grades of carbon black.

Subsequent sets were numbered consecutively so this is the eighth such set. Besides the oil absorption test, these later sets have been used to normalize the test results of other test methods. The number of materials and the grades have evolved as needed to cover the range of test results for all the tests for which the SRBs are used

The materials selected for a given SRB set are intended to span as much as possible the range of test results of the selected tests. The SRB8 set consists of seven grades of carbon black; three tread, three carcass, and one thermal. They are available for use to normalize the test results from the following carbon black ASTM test methods: D2414 – Oil Absorption Number; D3265 – Tint Strength; D3493 – Oil Absorption Number of Compressed Sample; and D6556 – Total and External Surface Area by Nitrogen Adsorption. Values have also been developed for D1510 – Iodine Number test method but these values are NOT to be used to normalize the Iodine Number results. A special set of materials (HT or INR) have been developed for this purpose and only those materials should be used to normalize the Iodine Number test results. Information on the HT and INR reference materials is available from Laboratory Standards and Technologies (See footnote 1 for contact information).

This SRB set was initially tested by a limited number of laboratories for the properties and test methods as listed above using the current test method version at the time of testing. The test results were normalized to the previous SRB set, thus maintaining backwards compatibility for the current set. Subsequent to the initial testing, each of the materials has been tested in the Laboratory Proficiency Rating System (LPRS) program of D24. The LPRS program includes a large number of laboratories (typically 60 or more) that represent the testing proficiency of the industry. The initial values and limits have been adjusted, as needed, to the values obtained from the LPRS program. The values and limits listed below are the most current as of the date of this publication. See page 5 of this Documentation Sheet for additional background on this SRB set.

While D24 attempts to produce enough of each SRB material so that they will all be depleted at about the same time and a new SRB set produced, variability in the consumption rate of each material has thwarted this goal. Rather than waste the value of the remaining materials when the first material is depleted, D24 has adopted a program of producing supplemental lots of any

¹ The current version of this document is available from Laboratory Standards and Technologies, Inc., 227 Somerset Street, Borger, TX, 79007, www.carbonstandard.com.

depleted material. The quantity of the supplemental lots is set to be depleted when the last material is depleted, thus extending the life of the set. Every effort is made to have the supplemental lots produced by the same producer location that produced the initial lot. (See ASTM D7849 for information on the nomenclature used for D24 reference materials that identifies these supplemental lots.)

Properties for the SRB8 Set

The testing conducted as part of the SRB8 set development evaluation using ASTM D4483-99, generated accepted reference values (means), AR-values, for the given tests as defined below and 2 and 3 sigma limits on these values or on individual daily values as obtained by any laboratory using the SRB8 set. The 2 and 3 sigma limits apply to a single measurement of the listed test properties. Two times the 2 or 3 sigma limit equals the total 4 or 6 sigma range, respectively.

ASTM D4483-99 uses a one-sided k test to identify outliers having high variability. The LPRS program uses a two-sided k test to identify outliers having high and low variability. This approach is thought to better represent expected variability in real-world testing and helps to offset memory-bias from an individual's repeated testing of the same material(s).

'Accepted Reference Value' or AR-value; this is the average (mean), for the various tests and materials listed below in Tables 1 through 6, obtained in an interlaboratory test program (ITP), i.e., the LPRS program, for a large group of typical laboratories using samples taken from the various material lots. See page 5 for more details on the ITPs.

'Within Typical Laboratory' 2 and 3 sigma value; this is the within laboratory ± 2 and ± 3 standard deviation (S_r) value (for single measurements) on the SRB8 set AR-values for the various tests, as obtained from the same group of typical ITP laboratories.

'Between Typical Laboratory' 2 and 3 sigma value); this is the between laboratory ± 2 and ± 3 standard deviation (S_R) value (for single measurements) on the SRB8 set AR-values for the various tests, as obtained from the same group of typical ITP laboratories.

2 sigma versus 3 sigma use considerations: Most carbon black test properties (with the exception of pellet hardness maximum) have an acceptable approximation to a normal distribution. With a normal distribution, 95.5% of all the test values are expected to fall within the limits of mean ± 2 sigma and 99.7% will fall within the limits of mean ± 3 sigma. This means that with only random variation present, approximately 1 in 20 results will fall outside the 2 sigma limits and 3 in 1000 will fall outside the 3 sigma limits. This means that when using 2 sigma limits the laboratory will be looking for a problem 1 in 20 test results when there is no problem to be found. This is a waste of valuable resources. On the other hand, when using 3 sigma limits the laboratory will be looking for a problem when there is not a problem only 3 in 1000 test results. However, if the consequences of allowing a problem to go undetected for a long time are too high, using 3 sigma limits may not give adequate warning in sufficient time to implement timely corrective action. Using 2 sigma limits will give an earlier warning of the presence of a problem. It is up to the user to balance the costs of untimely warnings versus the costs of searching for problems that do not exist.

Special consideration for bias: When no absolute reference standard exists, such as is the case with carbon black testing, a laboratory's bias can be defined as the difference between its results and the mean result from an ITP involving many laboratories, such as the LPRS program. Every laboratory can be expected to have some level of bias due to the unique combination of testing conditions (equipment, materials, manpower, environment, etc.) that exists within a given laboratory. The level of bias for a given laboratory may or may not be significant. A laboratory that did not participate in the ITP may find that it cannot maintain control within the control limits due to factors unique to that laboratory causing bias in its values, increased variation, or both. The laboratory should conduct an investigation to identify the presence and cause(s) of the bias and variation and eliminate them so that it is aligned with the ITP data. Participation in a multi-laboratory precision study, such as the LPRS program, may help to identify the unique sources of bias and variation. The SRB8 set can be used to assist a laboratory in determining the presence and magnitude of bias and variation using the values given in the Tables 1 to 6 below. See ASTM D4821 for specific instructions on how to use these values to evaluate a laboratory's testing proficiency (bias and variability).

Table 1 Mean (AR-value) and Limit Values for D1510, Iodine Number Methods A & B

Units	g/kg	Within Laboratory			Between Laboratories		
Material	Mean (AR-value)	Sr	2 x Sr	3 x Sr	SR	2 x SR	3 x SR
SRB-8B2 (N134)	146.3	0.57	1.14	1.70	1.70	3.40	5.09
SRB-8C (HS Tread)	138.8	0.68	1.36	2.04	2.11	4.21	6.32
SRB-8B (N134)	135.6	0.68	1.35	2.03	1.93	3.86	5.80
SRB-8A (N326)	80.5	0.36	0.73	1.09	0.88	1.76	2.64
SRB-8A2 (N326)	78.1	0.88	1.76	2.64	1.33	2.67	4.00
SRB-8F2 (N683)	36.1	0.41	0.81	1.22	0.65	1.29	1.94
SRB-8F (N683)	35.9	0.32	0.63	0.95	0.57	1.14	1.70
SRB-8E (N660)	35.8	0.32	0.64	0.97	0.60	1.21	1.81
SRB-8D (LS Carcass)	21.7	0.28	0.57	0.85	0.55	1.09	1.64

Table 2 Mean (AR-value) and Limit Values for D6556, NSA

Units	$10^3 \text{ m}^2/\text{kg} (\text{m}^2/\text{g})$	Within Laboratory			Between Laboratories		
Material	Mean (AR-value)	Sr	2 x Sr	3 x Sr	SR	2 x SR	3 x SR
SRB-8B (N134)	142.0	0.47	0.95	1.42	1.44	2.87	4.31
SRB-8B2 (N134)	138.0	0.31	0.62	0.93	0.79	1.58	2.37
SRB-8C (HS Tread)	126.4	0.44	0.88	1.32	1.07	2.13	3.20
SRB-8A (N326)	76.5	0.33	0.67	1.00	0.84	1.68	2.53
SRB-8A2 (N326)	75.9	0.29	0.57	0.86	0.70	1.40	2.10
SRB-8E (N660)	36.7	0.23	0.46	0.69	0.53	1.05	1.58
SRB-8F (N683)	36.7	0.21	0.41	0.62	0.38	0.77	1.15
SRB-8F2 (N683)	32.4	0.19	0.38	0.57	0.55	1.11	1.66
SRB-8D (LS Carcass)	21.6	0.18	0.36	0.55	0.30	0.60	0.90
SRB-8G (N990)	9.1	0.12	0.24	0.36	N/A	N/A	N/A

Units	$10^3 \text{ m}^2/\text{kg} (\text{m}^2/\text{g})$	Within Laboratory			Between Laboratories		
Material	Mean (AR-value)	Sr	2 x Sr	3 x Sr	SR	2 x SR	3 x SR
SRB-8B (N134)	133.1	0.71	1.41	2.12	1.39	2.77	4.16
SRB-8B2 (N134)	126.7	0.56	1.11	1.67	2.02	4.05	6.07
SRB-8C (HS Tread)	115.8	0.48	0.95	1.43	1.06	2.12	3.19
SRB-8A (N326)	77.2	0.41	0.83	1.24	1.15	2.30	3.45
SRB-8A2 (N326)	76.0	0.47	0.94	1.40	1.23	2.46	3.70
SRB-8E (N660)	35.8	0.34	0.68	1.02	0.71	1.43	2.14
SRB-8F (N683)	35.4	0.33	0.65	0.98	0.69	1.38	2.06
SRB-8F2 (N683)	32.1	0.26	0.52	0.78	0.65	1.30	1.96
SRB-8D (LS Carcass)	21.2	0.26	0.52	0.78	0.54	1.07	1.61
SRB-8G (N990)	8.4	0.20	0.40	0.60	N/A	N/A	N/A

Units	$10^{-5} \text{ m}^3/\text{kg} (\text{cm}^3/100 \text{ g})$	Within Laboratory			Between Laboratories		
Material	Mean (AR-value)	Sr	2 x Sr	3 x Sr	SR	2 x SR	3 x SR
SRB-8C (HS Tread)	174.9	0.50	1.00	1.49	1.08	2.15	3.23
SRB-8B2 (N134)	125.2	0.42	0.84	1.26	0.97	1.94	2.90
SRB-8B (N134)	123.5	0.45	0.89	1.34	0.91	1.81	2.72
SRB-8A2 (N326)	71.5	0.46	0.93	1.39	1.56	3.12	4.68
SRB-8A (N326)	70.9	0.46	0.92	1.38	0.93	1.86	2.79
SRB-8F2 (N683)	134.5	0.54	1.08	1.62	1.65	3.30	4.95
SRB-8F (N683)	132.0	0.41	0.82	1.23	0.91	1.83	2.74
SRB-8E (N660)	87.8	0.36	0.72	1.08	1.30	2.60	3.90
SRB-8D (LS Carcass)	36.9	0.26	0.52	0.78	1.09	2.18	3.28
SRB-8G (N990)	36.2	0.25	0.50	0.75	N/A	N/A	N/A

Units	$10^{-5} \text{ m}^3/\text{kg} (\text{cm}^3/100 \text{ g})$	Within Laboratory			Between Laboratories		
Material	Mean (AR-value)	Sr	2 x Sr	3 x Sr	SR	2 x SR	3 x SR
SRB-8C (HS Tread)	130.6	0.54	1.07	1.61	1.47	2.94	4.42
SRB-8B2 (N134)	103.1	0.50	1.00	1.51	1.03	2.06	3.09
SRB-8B (N134)	99.4	0.47	0.93	1.40	1.03	2.06	3.09
SRB-8A2 (N326)	67.5	0.35	0.69	1.04	1.08	2.16	3.24
SRB-8A (N326)	66.7	0.42	0.85	1.27	0.87	1.74	2.61
SRB-8F (N683)	88.6	0.40	0.79	1.19	0.91	1.82	2.73
SRB-8F2 (N683)	85.5	0.35	0.70	1.05	1.17	2.35	3.52
SRB-8E (N660)	74.7	0.36	0.71	1.07	0.99	1.99	2.98
SRB-8D (LS Carcass)	36.9	0.26	0.52	0.78	0.96	1.92	2.89

Table 6 Mean (AR-value) and Limit Values for D3265, Tint Strength							
Units	Tint Strength	Within Laboratory			Between Laboratories		
Material	Mean (AR-value)	Sr	2 x Sr	3 x Sr	SR	2 x SR	3 x SR
SRB-8B2 (N134)	132.1	0.65	1.29	1.94	1.86	3.72	5.57
SRB-8B (N134)	131.4	0.43	0.87	1.30	2.12	4.25	6.37
SRB-8C (HS Tread)	112.0	0.46	0.91	1.37	1.10	2.20	3.30
SRB-8A2 (N326)	111.0	0.49	0.98	1.47	1.15	2.30	3.45
SRB-8A (N326)	110.6	0.40	0.81	1.21	1.23	2.46	3.69
SRB-8E (N660)	61.8	0.30	0.59	0.89	0.95	1.90	2.85
SRB-8F (N683)	52.6	0.28	0.57	0.85	0.77	1.54	2.31
SRB-8F2 (N683)	48.5	0.35	0.70	1.05	1.50	2.99	4.49
SRB-8D (LS Carcass)	42.5	0.26	0.52	0.78	0.73	1.47	2.20

Background and Interlaboratory Test Program Details: SRB8 Set

Background - Standard Reference Blacks (SRBs), used for a number of test methods under the jurisdiction of ASTM Committee D24, are prepared according to D6915, "Evaluation of Standard Reference Blacks" with statistical analysis per D4483-99, "Standard Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries". The objective of D24 is to select reference materials that will have values across the range of possible test results for any given test. Even better would be to select materials whose values are evenly spaced across the test range. Unfortunately, due to the realities of carbon black production and the interdependence of some properties, it is not possible to select materials that cover the test range for all tests, much less be evenly spaced across that range. The materials selected for the SRB8 set represents D24's best attempt to satisfy these objectives.

Evaluation of the SRB8 Set – The production of the various SRB8 materials is shared among the various carbon black producers. See Table 7 for a list of the producers of the various SRB8 materials. Each lot is evaluated for uniformity by the producer. That uniformity data is reviewed with the chairman of subcommittee D24.61 and the final material selected to give the best uniformity possible for all the tests of interest as listed in Tables 1 to 6.

The values listed in Tables 1 to 6 were obtained through D24's LPRS program. In this program a single blind sample is distributed to the participating laboratories. Two samples of different materials are tested each year about six months apart. (Materials other than those in the SRB8 set are also tested in the LPRS program.) Each laboratory selects two technicians to perform the testing (the same two technicians may not have performed all the tests, depending on how the laboratory is staffed and organized) and each technician performs the testing once on two different days for a total of four test results.

In addition to the test results, the LPRS program also collects information on the test conditions when the testing was performed for each sample. A questionnaire is distributed along with the data form asking about the equipment, materials, methods, and testing conditions used when testing each sample. This information is used to help identify sources of variation and bias between laboratories to help improve testing proficiency in the industry. Recently, a testing instruction sheet that specifies the testing conditions to be used for a given sample has been included with the data file because it has been determined that some laboratories were not using the correct conditions when performing the LPRS testing. With this knowledge, D24 logically concluded that only data from those laboratories reporting that they performed the testing per the conditions specified in each test method as included in the testing conditions instructions would be used to determine the mean (AR-value) and limit values for a given material. That is the reason for the rather substantial drop from previous test rounds in the number of laboratories (See Table 7) whose data was used for the calculations of the most recently tested material, SRB-8B2, because only data from those laboratories that reported they followed the test condition instructions was used. (This knowledge is not available for materials tested before 2014.) Future LPRS testing and the use of the knowledge of whether a laboratory's testing conforms per the ASTM Test Method requirements may result in refinement of some of the material values.

Interlaboratory Test Program (ITP) – See Table 7 for a list of when the various SRB8 materials were tested. Table 7 also shows how many laboratories participated in the testing for each test and how many were removed as outliers for mean (M), high variation (H), or low variation (L). The data was analyzed per D4483-99.

Table 7 SRB8 Information				Number of Laboratories (M/H/L)					
SRB8 Material	Grade	Producer	Test Period	D1510	D6556 NSA	D6556 STSA	D2414	D3493	D3265
SRB-8A	N326	Continental	March 2008	61(0/2/1)	58(0/1/0)	54(1/2/0)	64(1/0/0)	59(1/1/0)	58(0/2/2)
SRB-8A2	N326	Continental	March 2013	71(1/1/2)	67(1/2/0)	63(1/2/0)	72(0/1/1)	65(0/1/0)	64(1/1/2)
SRB-8B	N134	Cabot	June 2009	66(1/2/2)	65(0/3/1)	62(2/2/2)	66(0/0/0)	61(0/0/0)	62(1/3/0)
SRB-8B2	N134	Cabot	March/April 2014	39(3/3/4)	11(1/1/0)	15(1/1/0)	40(3/4/3)	39(2/2/2)	35(2/2/3)
SRB-8C	HS Tread	Columbian	September 2010	64(1/2/5)	63(1/2/0)	58(2/3/0)	66(2/1/0)	63(0/1/0)	61(1/2/3)
SRB-8D	LS Carcass	Cabot	March 2009	67(1/2/2)	64(1/2/2)	60(1/2/0)	67(0/2/0)	60(1/2/0)	61(1/2/0)
SRB-8E	N660	Orion	September 2008	57(0/3/0)	54(1/1/1)	51(1/1/0)	57(1/0/0)	51(0/1/1)	53(0/1/2)
SRB-8F	N683	Orion	March 2010	68(1/1/0)	67(2/2/0)	64(1/1/0)	67(1/1/0)	63(1/0/0)	66(1/1/4)
SRB-8F2	N683	Orion	March 2015	60(1/2/2)	30(0/1/0)	44(2/1/0)	62(1/0/0)	55(1/1/0)	49(2/3/0)
SRB-8G ²	N990	Cancarb	Last half of 1996	N/A	Unknown	Unknown	Unknown	N/A	N/A

²SRB-8G was produced and approved in the last half of 1996 as SRB-5G and has continued to be included in the current SRB sets since that time. At the time it was produced and approved it was D24's practice to only publish the within-laboratory standard deviation, Sr, and associated limits. The between-laboratory standard deviation, SR, was never published and since the data is no longer available it is not possible to calculate or publish the SR values and corresponding limits. The SRB G material was only tested for NSA, STSA, and OAN per the test method version available in 1996.

Using the SRB8 Set – For the test methods listed in Tables 1 to 6 it is strongly recommended that laboratories determine if they are operating in an “in control” manner, by the use of the ± 2 or ± 3 sigma within-laboratory limits as the laboratory may choose to use. Despite rigorous analysis of the ITP data for the AR-value(s) and associated standard deviation(s), the group of laboratories in this (and any) ITP do not represent a typical “in statistical control system” to which the usual 6 sigma limits are applied. All the assignable causes of variation that are typically eliminated to attain ‘statistical control’ have not and cannot be, eliminated for the AR testing.

See ASTM D4821 for detailed instructions on using the SRB8 set values to monitor a given laboratory’s testing proficiency (bias and variability) for the test methods listed in Tables 1 to 6. D4821 also includes instructions on evaluating testing proficiency (bias and variability) between laboratories.

To report corrections or request changes to this document, contact Laboratory Standards and Technologies or the chairman of ASTM subcommittee D24.61.