



Designation: D 2475 – 001

Standard Specification for Felt¹

This standard is issued under the fixed designation D 2475; 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.

1. Scope

1.1 This specification covers all standard types of felt in the form of rolls and sheets that are suitable for mechanical use. Certain special-purpose felts are also covered.

1.2 This specification is not applicable to felt-like products that utilize weaving, knitting, stitching, or bonding such as papermaker's felt.

1.3 Trade practice in the felt industry deals in pounds, yards, and inches, therefore the values stated in inch-pound units are to be regarded as standard. The values in SI units are provided as information only.

1.3.1 The specification referenced in 2.2 uses only inch-pound units.

2. Referenced Documents

~~2.1 ASTM Standards:~~

¹ This specification is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.13 on Wool and Wool Felt. Current edition approved Nov. April 10, 2000~~1~~. Published February June 2001. Originally published as D 2475 – 65 T, replacing D 114. Last previous edition ~~D 2475 – 88~~ (~~2000~~); D 2475 – 00.

D 123 Terminology Relating to Textiles²

D 461 Test Methods for Felt²

D 4845 Terminology Relating to Wool³

2.2 *Federal Standard:*

C-F-206, Felt Sheet: Cloth Felt, Wool, Pressed⁴

2.3 *Felt Manufacturers Council:*

FS14-68/71 Wool Felt Standard Specifications⁵

2.4 *SAE Standard:*⁶

J314b Felts-Wool and Part Wool

3. Terminology

3.1 *Definitions:*

3.1.1 *felt, n*—a textile structure characterized by interlocking and consolidation of its constituent fibers.

3.1.2 *machined felt, n*—a felt structure achieved by the interaction of a suitable combination of mechanical energy, chemical action, moisture and heat causing the constituent fibers to migrate and interlock.

3.1.3 *needled felt, n*—a structure composed entirely of fibers physically interlocked and reoriented through the action of felting needles.

3.1.4 For standard terminology relating to wool, refer to Terminology D 4845.

3.1.5 For definitions of other textile terms used in these test methods, refer to Terminology D 123.

3.1.5.1 *Discussion*—For the purpose of this document, there are only two types of felt, machined and needled. All other terms alluded to as types of felt, such as papermakers, black, unsupported, supported, part wool, wool, etc. are considered to be simply terms describing attributes of these two types of felts.

3.1.6 *relative density, n*—the ratio of the mass of a volume of felt to the mass of an equivalent volume of water, alternatively, use density.

4. Types of Felts

4.1 *ASTM Classification:*

4.1.1 The ASTM Classification number in Tables 1-3 is the units.he percent specific gravity of that class. It may be computed from the mass (weight), thickness, and area values in these tables. This number is followed by the letter R or S, which designates the method of manufacture as roll or sheet form, respectively. The last digit is the overall quality index in decreasing order of quality from one to four (see Note 1).

² Annual Book of ASTM Standards, Vol 07.01.

³ Annual Book of ASTM Standards, Vol 07.02.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

⁵ Available from the Northern Textile Association, 230 Congress Street, Boston, MA 02110.

⁶ Available from the Society of Automotive Engineers, 2 Pennsylvania Plaza, New York, NY 10001.

TABLE 1 2 Roll and Sheet Felt Corresponding Classifications—Properties and General Description

ASTM (NTA) Classifi- cation ^A	Corresponding Classifications		Physical Requirements					General Description			
	SAE J314b	Fed. Spec. C-F- 206	Min. Tensile Strength,		Min. Split Resistance		Color	Normal Width		Thickness: Available Range	
			psi	kPa	lbf/2 in. width	N/50 mm width		in.	cm	in.	mm
14R1	...	...	...	...	...	...	white	72	183	0.125–0.500	3.17–12.7
17R1	...	...	...	...	...	...	white	72	183	0.125–1.000	3.17–25.4
17R2	F26	8R5	...	...	...	...	gray	72	183	0.125–1.000	3.17–25.4
18R1	F10	9R1	225	1551	8	35	white	72	183	0.063–1.000	1.60–25.4
18R2	F11	9R2	200	1379	6	26	gray	72	183	0.063–1.000	1.60–25.4
18R3	F12	9R3	100	690	3	13	gray	72	183	0.063–1.000	1.60–25.4
18R4	F13	9R4	75	517	2	9	gray	72	183	0.063–1.000	1.60–25.4
18R5	F15	9R5	75	517	2	9	gray	72	183	0.063–1.000	1.60–25.4
26R1	F5	12R1	400	2758	18	79	white	60	152	0.063–1.000	1.60–25.4
26R2	F6	12R2	275	1896	16	71	gray	60 or 72	152 or 183	0.063–1.000	1.60–25.4
26R3	F7	12R3	250	1724	12	53	gray	72	183	0.063–1.000	1.60–25.4
26R3X	F55	12R3X	200	1379	...	...	gray	60 or 72	152 or 183	0.063–0.094	1.60–2.39
34R1	F1	16R1	500	3448	33	147	white	60	152	0.125–1.000	3.17–25.4
34R1X	F50	16R1X	500	3448	...	...	white	60	152	0.047–0.092	1.19–2.39
34R2	F2	16R2	500	3448	28	124	not blk or gray	60	152	0.047–1.000	1.19–25.4
34R3	F3	16R3	400	2758	22	97	gray	60	152	0.125–1.000	3.17–25.4
34R3X	F51	16R3X	300	2069	...	...	gray	60 or 72	152 or 183	0.047–0.094	1.19–2.39
38R1	...	18R1	600	4137	35	154	white	60	152	0.125–0.500	3.17–12.7
38R2	...	...	550	3792	30	132	gray	60	152	0.125–0.500	3.17–12.7
26S1	...	12S1	400	2758	18	79	white	36	91	0.125–3.000	3.17–76.2
26S4	...	...	300	2069	16	71	gray	36	91	0.125–3.000	3.17–76.2
34S1	...	16S1	500	3448	32	141	white	36	91	0.125–3.000	3.17–76.2
34S2	...	16S3	400	2758	28	124	white	36	91	0.125–3.000	3.17–76.2
34S3	...	16S4	300	2069	20	89	white	36	91	0.125–3.000	3.17–76.2
34S4	...	...	400	2758	22	97	gray	36	91	0.125–3.000	3.17–76.2
43S1	...	20S1	500	3448	44	196	white	36	91	0.125–3.000	3.17–76.2
43S2	...	20S3	400	2758	40	178	white	36	91	0.125–3.000	3.17–76.2
43S3	...	20S4	300	2069	32	142	white	36	91	0.125–3.000	3.17–76.2
43S4	...	...	400	2758	36	160	gray	36	91	0.125–3.000	3.17–76.2
56S1	...	26S1	600	4137	48	212	white	36	91	0.125–3.000	3.17–76.2
56S2	...	26S3	500	3448	46	205	white	36	91	0.125–3.000	3.17–76.2
56S3	...	26S4	400	2758	36	160	white	36	91	0.125–3.000	3.17–76.2
56S4	...	...	400	2758	40	178	gray	36	91	0.125–3.000	3.17–76.2
68S1	...	32S1	600	4137	50	222	white	36	91	0.125–2.500	3.17–63.5
68S2	...	32S3	500	3448	48	212	natural	36	91	0.125–3.000	3.17–76.2
68S3	...	32S4	400	2758	40	178	natural	36	91	0.125–3.000	3.17–76.2
68S4	...	...	400	2758	46	205	gray	36	91	0.125–2.500	3.17–63.5

^A NTA refers to Northern Textile Association.

TABLE 31 Wool Sheet Felt: Thickness and Mass (Weight)

TABLE 2 3 Roll Felt Thicknesses and Weights

NOTE 1—The F-50, F-51, and F-55 classifications are available in limited thickness ranges. See Table 1.

ASTM (NTA) Classification	SAE J314b	Fed. Spec. C-F-206	Color	Trade Designation	Thickness Tolerances						Mass (Weight) Per Unit Area			
					Nominal	Inches		Nominal	Millimetres		Nominal Tolerances			
						Roll	Cutparts		Roll	Cutparts	lb/yd ²	kg/m ²		
14R1	...	...	White	Soft Pad	0.125	± 0.040	± 0.048	3.18	± 1.02	± 1.22	0.83	± 0.10	0.45	± 0.05
					0.250	0.056	0.064	6.35	1.42	1.63	1.65	0.20	0.90	0.11
					0.375	0.072	0.082	9.53	1.83	2.08	2.48	0.30	1.35	0.16
					0.500	0.088	0.098	12.70	2.24	2.49	3.30	0.40	1.79	0.22
17R1	...	...	White	Soft Pad	0.125	0.040	0.044	3.18	1.02	1.12	0.9	0.09	0.49	0.05
					0.250	0.056	0.062	6.35	1.42	1.58	1.8	0.18	0.98	0.10
					0.375	0.072	0.079	9.53	1.83	2.01	2.7	0.27	1.47	0.15
					0.500	0.088	0.098	12.70	2.24	2.49	3.6	0.36	1.95	0.20
17R2	F-26	8R5	Gray	Firm Pad	0.125	0.040	0.044	3.18	1.02	1.12	0.9	0.09	0.49	0.05
					0.250	0.056	0.062	6.35	1.42	1.58	1.8	0.18	0.98	0.10
					0.375	0.072	0.079	9.53	1.83	2.01	2.7	0.27	1.47	0.15
					0.500	0.088	0.098	12.70	2.24	2.49	3.6	0.36	1.95	0.20
18R1	F-10	9R1	White	Firm Pad	0.125	0.020	0.023	3.18	0.51	0.58	1.06	0.08	0.58	0.04
					0.188	0.023	0.026	4.78	0.58	0.66	1.59	0.12	0.86	0.07
					0.250	0.026	0.031	6.35	0.66	0.79	2.12	0.16	1.15	0.09
					0.313	0.029	0.033	7.95	0.74	0.84	2.65	0.20	1.44	0.11
18R2	F-11	9R2	Gray	Firm Pad	0.125	0.020	0.023	3.18	0.51	0.58	1.06	0.08	0.58	0.04
					0.188	0.023	0.026	4.78	0.58	0.66	1.59	0.12	0.86	0.07
					0.250	0.026	0.031	6.35	0.66	0.79	2.12	0.16	1.15	0.09
					0.313	0.029	0.033	7.95	0.74	0.84	2.65	0.20	1.44	0.11
18R3	F-12	9R3	Gray	Firm Pad	0.125	0.026	0.031	6.35	0.66	0.79	2.12	0.16	1.15	0.09
					0.188	0.029	0.033	7.95	0.74	0.84	2.65	0.20	1.44	0.11
					0.250	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.375	0.038	0.044	12.70	0.97	1.12	4.24	0.32	2.31	0.18
18R4	F-13	9R4	Gray	Firm Pad	0.125	0.026	0.031	6.35	0.66	0.79	2.12	0.16	1.15	0.09
					0.188	0.029	0.033	7.95	0.74	0.84	2.65	0.20	1.44	0.11
					0.250	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.375	0.038	0.044	12.70	0.97	1.12	4.24	0.32	2.31	0.18
18R5	F-15	9R5	Gray	Firm Pad	0.125	0.020	0.023	3.18	0.51	0.58	1.06	0.08	0.58	0.04
					0.188	0.023	0.026	4.78	0.58	0.66	1.59	0.12	0.86	0.07
					0.250	0.026	0.031	6.35	0.66	0.79	2.12	0.16	1.15	0.09
					0.313	0.029	0.033	7.95	0.74	0.84	2.65	0.20	1.44	0.11
26R1	F-5	12R1	White	Ex Firm Pad	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
26R2	F-6	12R2	Gray	Ex Firm Pad	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
26R3	F-7	12R3	Gray	Ex Firm Pad & Gray or Black Lining	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
26R3X	F-55	12R3X	...	Lining	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
34R1	F-1	16R1	White	Backcheck & Ball Bearing	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
34R1X	F-50	16R1X	White	Backcheck & Ball Bearing	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
34R2	F-2	16R2	Not Black or Gray	Backcheck	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
34R3	F-3	16R3	Gray	Backcheck & Ball Bearing	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
34R3X	F-51	16R3X	Gray	Backcheck & Ball Bearing	0.125	0.032	0.036	9.53	0.81	0.91	3.18	0.24	1.73	0.13
					0.188	0.035	0.039	12.70	0.97	1.12	4.24	0.32	2.31	0.18
					0.250	0.038	0.044	15.88	1.12	1.27	5.30	0.40	2.89	0.22
					0.375	0.044	0.050	19.05	1.27	1.52	6.36	0.48	3.46	0.26
38R1	...	18R1	White	Laundry	0.125	0.012	0.015	3.18	0.31	0.38	2.25	0.10	1.22	0.05
					0.188	0.013	0.017	4.78	0.33	0.43	3.38	0.15	1.84	0.08
					0.250	0.014	0.020	6.35	0.36	0.51	4.50	0.20	2.44	0.11
					0.313	0.015	0.021	7.95	0.38	0.53	5.63	0.25	3.06	0.14
38R2	...	...	Gray	Laundry	0.125	0.012	0.015	3.18	0.31	0.38	2.25	0.10	1.22	0.05
					0.188	0.013	0.017	4.78	0.33	0.43	3.38	0.15	1.84	0.08
					0.250	0.014	0.020	6.35	0.36	0.51	4.50	0.20	2.44	0.11
					0.313	0.015	0.021	7.95	0.38	0.53	5.63	0.25	3.06	0.14
38R2	...	...	Gray	Laundry	0.375	0.016	0.023	9.53	0.41	0.58	6.75	0.30	3.67	0.16
					0.500	0.019	0.025	12.70	0.48	0.64	9.00	0.40	4.89	0.22

ASTM (NTA) Class	Color	Thickness, in.			Thickness, mm			Mass (Weight) lb/yd ²		Mass (Weight) kg/m ²	
		Nominal	Tolerances		Nominal	Tolerances		Nominal	Tolerances	Nominal	Tolerances
			Sheets	Cut Parts		Sheets	Cut Parts				
26S1	White	0.125	± 0.014	± 0.016	3.17	± 0.35	± 0.41	1.50	± 0.10	0.81	± 0.05
26S4	Gray	0.188	0.016	0.018	4.78	0.41	0.46	2.25	0.15	1.22	0.08
		0.250	0.020	0.022	6.35	0.51	0.56	3.00	0.20	1.63	0.11
		0.313	0.022	0.024	7.95	0.56	0.61	3.75	0.25	2.04	0.14
		0.375	0.024	0.026	9.52	0.61	0.66	4.50	0.30	2.44	0.16
		0.500	0.030	0.032	12.70	0.76	0.81	6.00	0.40	3.26	0.22
		0.625	0.035	0.037	15.88	0.89	0.94	7.50	0.45	4.07	0.24
		0.750	0.040	0.042	19.05	1.02	1.07	9.00	0.50	4.89	0.27

TABLE 31 *Continued*

ASTM (NTA) Class	Color	Thickness, in.			Thickness, mm			Mass (Weight) lb/yd ²		Mass (Weight) kg/m ²	
		Nominal	Tolerances		Nominal	Tolerances		Nominal	Tolerances	Nominal	Tolerances
			Sheets	Cut Parts		Sheets	Cut Parts				
		0.875	0.046	0.048	22.23	1.17	1.22	10.50	0.55	5.70	0.30
		1.000	0.051	0.053	25.40	1.30	1.35	12.00	0.60	6.52	0.33
		1.250	0.062	0.065	31.75	1.57	1.65	15.00	0.70	8.15	0.38
		1.500	0.072	0.075	38.10	1.83	1.91	18.00	0.80	9.77	0.43
		1.750	0.083	0.085	44.45	2.11	2.16	21.00	0.90	11.40	0.49
		2.000	0.094	0.098	50.80	2.39	2.49	24.00	1.00	13.03	0.54
		2.500	0.115	0.119	63.50	2.92	3.02	30.00	1.05	16.29	0.57
		3.000	0.136	0.141	76.20	3.45	3.58	36.00	1.10	19.55	0.60
34S1	White	0.125	0.012	0.014	3.17	0.30	0.36	2.00	0.10	1.09	0.05
34S2	White	0.188	0.012	0.014	4.78	0.30	0.36	3.00	0.15	1.63	0.08
34S3	White	0.250	0.016	0.018	6.35	0.41	0.46	4.00	0.30	2.17	0.16
34S4	Gray	0.313	0.017	0.019	7.95	0.43	0.48	5.00	0.35	2.71	0.19
		0.375	0.019	0.021	9.52	0.48	0.53	6.00	0.40	3.26	0.22
		0.500	0.022	0.024	12.70	0.56	0.61	8.00	0.50	4.34	0.27
		0.625	0.026	0.028	15.88	0.66	0.71	10.00	0.60	5.43	0.33
		0.750	0.029	0.031	19.05	0.74	0.79	12.00	0.70	6.52	0.38
		0.875	0.032	0.034	22.23	0.87	0.86	14.00	0.75	7.60	0.41
		1.000	0.036	0.038	25.40	0.91	0.97	16.00	0.80	8.69	0.43
		1.250	0.042	0.045	31.25	1.07	1.14	20.00	0.90	10.86	0.49
		1.500	0.049	0.052	38.10	1.24	1.32	24.00	1.00	13.03	0.54
		1.750	0.056	0.059	44.45	1.42	1.50	28.00	1.10	15.20	0.60
		2.000	0.063	0.067	50.80	1.60	1.70	32.00	1.20	17.38	0.65
		2.500	0.076	0.080	63.50	1.93	2.03	40.00	1.25	21.72	0.68
		3.000	0.090	0.095	76.20	2.29	2.41	48.00	1.30	26.06	0.71
43S1	White	0.125	0.012	0.014	3.17	0.30	0.36	2.50	0.30	1.36	0.16
43S2	White	0.188	0.012	0.014	4.78	0.30	0.36	3.75	0.35	2.04	0.19
43S3	White	0.250	0.014	0.016	6.35	0.36	0.41	5.00	0.40	2.71	0.22
43S4	Gray	0.375	0.016	0.019	9.52	0.41	0.48	7.50	0.50	4.07	0.27
		0.500	0.019	0.022	12.70	0.48	0.56	10.00	0.60	5.43	0.33
		0.625	0.022	0.025	15.88	0.56	0.64	12.50	0.70	6.79	0.38
		0.750	0.025	0.028	19.05	0.63	0.71	15.00	0.80	8.15	0.43
		0.875	0.027	0.030	22.23	0.69	0.76	17.50	0.90	9.50	0.49
		1.000	0.030	0.033	25.40	0.76	0.84	20.00	1.00	10.86	0.54
		1.250	0.036	0.040	31.15	0.91	1.02	25.00	1.10	13.56	0.60
		1.500	0.041	0.045	38.10	1.04	1.14	30.00	1.20	16.29	0.65
		1.750	0.047	0.051	44.45	1.19	1.30	35.00	1.30	19.00	0.71
		2.000	0.053	0.058	50.80	1.35	1.47	40.00	1.40	21.72	0.76
		2.500	0.064	0.070	63.50	1.63	1.78	50.00	1.45	27.15	0.79
		3.000	0.075	0.082	76.20	1.90	2.08	60.00	1.50	32.58	0.81
56S1	White	0.125	0.010	0.014	3.17	0.25	0.36	3.25	0.40	1.76	0.22
56S2	White	0.188	0.010	0.014	4.78	0.25	0.36	4.90	0.50	2.66	0.27
56S3	White	0.250	0.011	0.016	6.35	0.28	0.41	6.50	0.60	3.53	0.33
S654	Gray	0.375	0.013	0.018	9.52	0.33	0.46	9.75	0.80	5.29	0.43
		0.500	0.016	0.022	12.70	0.41	0.56	13.00	1.00	7.06	0.54
		0.625	0.018	0.024	15.88	0.46	0.61	16.25	1.10	8.82	0.60
		0.750	0.020	0.026	19.05	0.51	0.66	19.50	1.20	10.59	0.65
		0.875	0.022	0.028	22.23	0.56	0.71	22.75	1.30	12.35	0.70
		1.000	0.025	0.031	25.40	0.63	0.79	26.00	1.40	14.12	0.76
		1.250	0.029	0.036	31.75	0.74	0.91	32.50	1.50	17.65	0.81
		1.500	0.033	0.040	38.10	0.84	1.02	39.00	1.60	21.18	0.87
		1.750	0.038	0.046	44.45	0.97	1.17	45.50	1.70	24.71	0.92
		2.000	0.042	0.051	50.80	1.07	1.30	52.00	1.80	28.24	0.98
		2.500	0.050	0.061	63.50	1.27	1.55	65.00	1.85	35.29	1.00
		3.000	0.058	0.070	76.20	1.47	1.78	78.00	1.90	42.35	1.03
68S1	White	0.125	0.007	0.013	3.17	0.18	0.33	4.00	0.50	2.17	0.27
68S2	White	0.188	0.007	0.014	4.78	0.18	0.36	6.00	0.75	3.26	0.41
68S3	White	0.250	0.007	0.015	6.35	0.18	0.38	8.00	1.00	4.34	0.54
68S4	Gray	0.375	0.009	0.018	9.52	0.23	0.46	12.00	1.10	6.52	0.60
		0.500	0.011	0.020	12.70	0.28	0.51	16.00	1.20	8.69	0.65
		0.625	0.013	0.022	15.88	0.33	0.56	20.00	1.30	10.86	0.71
		0.750	0.015	0.024	19.05	0.38	0.61	24.00	1.40	13.03	0.76
		0.875	0.017	0.026	22.23	0.43	0.66	28.00	1.50	15.20	0.81
		1.000	±0.019	±0.028	25.40	±0.48	±0.71	32.00	±1.60	17.38	±0.87
		1.250	0.022	0.032	31.75	0.56	0.81	40.00	1.70	21.72	0.92
		1.500	0.026	0.036	38.10	0.66	0.91	48.00	1.80	26.06	0.98
		1.750	0.029	0.041	44.45	0.74	1.04	56.00	1.90	30.41	1.03
		2.000	0.032	0.046	50.80	0.81	1.17	64.00	2.00	34.75	1.09
		2.500	0.038	0.055	63.50	0.97	1.40	80.00	2.05	43.44	1.11

2. Referenced Documents

2.1 ASTM Standards:

D 123 Terminology Relating to Textiles²

D 461 Test Methods for Felt²

D 4845 Terminology Relating to Wool³

2.2 Federal Standard:

C-F-206, Felt Sheet: Cloth Felt, Wool, Pressed⁴

2.3 Felt Manufacturers Council:

FS14-68/71 Wool Felt Standard Specifications⁵

2.4 SAE Standard:⁶

J314b Felts-Wool and Part Wool

3. Terminology

3.1 Definitions:

3.1.1 *felt, n*—a textile structure characterized by interlocking and consolidation of its constituent fibers.

3.1.2 *machined felt, n*—a felt structure achieved by the interaction of a suitable combination of mechanical energy, chemical action, moisture and heat causing the constituent fibers to migrate and interlock.

3.1.3 *needled felt, n*—a structure composed entirely of fibers physically interlocked and reoriented through the action of felting needles.

3.1.4 For standard terminology relating to wool, refer to Terminology D 4845.

3.1.5 For definitions of other textile terms used in these test methods, refer to Terminology D 123.

3.1.5.1 *Discussion*—For the purpose of this document, there are only two types of felt, machined and needled. All other terms alluded to as types of felt, such as papermakers, black, unsupported, supported, part wool, wool, etc. are considered to be simply terms describing attributes of these two types of felts.

3.1.6 *relative density, n*—the ratio of the mass of a volume of felt to the mass of an equivalent volume of water, alternatively, *use density*.

4. Types of Felts

4.1 ASTM Classification:

4.1.1 The ASTM Classification number in Tables 1-3 is (it may be computed from the mass (weight), thickness, and area values in these tables. This number is followed by the letter R or S, which designates the method of manufacture as roll or sheet form, respectively. The last digit is the overall quality index in decreasing order of quality from one to four (see Note 1).

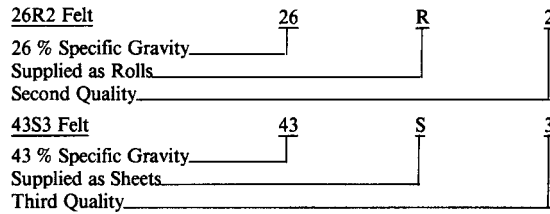
4.1.2 To obtain the average density of the different felts in lb/ft³, multiply the percent specific gravity number of the first column of Tables 1-4 by 0.6243.

4.1.3 To obtain the average density in kg/m³, (1) multiply the percent specific gravity of the first column in Tables 1-4 by 10, or (2) multiply the average density in lb/ft³ by 16.02.

4.1.4 Examples of ASTM classifications are as follows: 26R2 Felt

TABLE 4 Specialty Felt: Corresponding Classifications, Properties and Descriptions

ASTM (NTA) Class	Federal Spec. C-F-206	Std. Color	Trade Designa- tion	Min. Breaking Strength		Std. Width		Thickness				Mass (weight)			
				lbf	N	in.	m	in.		mm		oz/yd ²		kg/m ²	
								Nom.	Tol.	Nom.	Tol.	Nom.	Tol.	Nom.	Tol.
CF1	11A1	White	Coat Front	...	...	80	2.0	0.030 ± 0.005		0.76 ± 0.12		3.04 ± 0.12		0.103 ± 0.004	
CF2	11A2	Gray	Coat Front	...	...	80	2.0	0.030	0.005	0.76	0.12	3.04	0.12	0.103	0.004
L1	10A2	Gray	Lining Gray	8	36	72	1.8	0.065	0.010	1.65	0.25	6.00	0.25	0.204	0.008
L2	9A2	Gray	Lining Gray	10	44	72	1.8	0.075	0.015	1.90	0.38	7.00	0.25	0.238	0.008
LS1	10A1	White	Lining-Shoe Tongue	10	44	72	1.8	0.065	0.010	1.65	0.25	6.00	0.25	0.204	0.008
DA1	6A1	All Colors	Decor & Apparel	30	133	72	1.8	0.063	0.010	1.60	0.25	12.00	1.00	0.407	0.034
DA2	7A1	All Colors	Decor & Apparel	45	200	72	1.8	0.040	0.010	1.02	0.25	10.00	0.75	0.340	0.025
DA3	8A1	All Colors	Decor & Apparel	30	133	72	1.8	0.040	0.010	1.02	0.25	8.00	0.50	0.272	0.017
DA4	...	All Colors	Decor & Apparel	20	89	72	1.8	0.040	0.010	1.02	0.25	7.00	1.00	0.238	0.034
DA5	...	All Colors	Decor & Apparel	10	44	72	1.8	0.040	0.010	1.02	0.25	6.00	1.00	0.204	0.034
lb/yd ²															
OS1	...	White	Ortho & Surgical	20	89	72	1.8	0.063	0.015	1.60	0.38	0.50	0.03	0.27	0.016
OS2	...	White	Ortho & Surgical	40	178	72	1.8	0.125	0.040	3.17	1.02	1.00	0.06	0.54	0.033
OS3	...	White	Ortho & Surgical	...	...	72	1.8	0.250	0.050	6.35	1.27	2.00	0.12	1.08	0.065
OS4	...	White	Ortho & Surgical	...	...	72	1.8	0.375	0.065	9.52	1.65	3.00	0.18	1.63	0.098
OS5	...	White	Ortho & Surgical	...	...	72	1.8	0.500	0.075	12.7	1.90	4.00	0.25	2.17	0.136
M1	3A1	Gray	Midsole	...	...	40 × 60	1 × 1.5	0.258	0.008	6.55	0.20	7.15	0.65	3.88	0.353

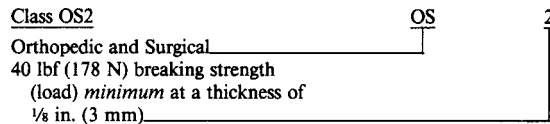


NOTE 1—The terms “Second Quality” and “Third Quality” do not refer to sub-standard levels of quality. Each classification has distinct specifications which are less demanding than its higher classification. See Table 1-2.

4.2 *Corresponding SAE and DoD Classification*—For convenience, Table 1-2 includes the corresponding classifications based on the Society of Automotive Engineers Specification J314b and the U.S. Department of Defense Federal Specification C-F-206.

NOTE 2—The classification codes of this specification and those of Federal Specification C-F-206 are similar in appearance, but the first elements of the codes have entirely different meanings. Instead of a percent specific gravity, the first element of the federal specification code represents the pounds per square yard of material that is 1 in. thick. When using one of these classification systems, be sure to identify the system.

4.3 *Special-Purpose Classification*—The various types of special-purpose felts appearing in Table 4 are classified by one or two letters, standing for the initial letters of the trade designation, followed by a number indicating the quality index, weight, or both. There is no specific order of presentation intended in this table; for example:



5. Forms of Felt

5.1 In general, less dense and thinner felts are produced in roll form; more dense and thicker felts are produced in sheet form.

5.1.1 Roll felts are usually supplied in lengths of 20 to 60 yd (18 to 55 m).

5.1.2 Sheet felts are usually supplied in flat pieces approximately 1 yd² (0.84 m²). Sheet felts are specified to closer tolerance because of the smaller quantities per unit of manufacture.

5.2 *Specialty Felts*—Specific trade designations for specialty felts are not intended to limit their use solely to these applications.

6. Sampling

6.1 *Lot Sampling*—As a lot sample for acceptance testing, take the number of rolls or sheets specified in the following schedule:

Lot size in yards or sheets Lot size in yards (metres) or sheets	Sample size in	
	Rolls Rolls	Sheets Sheets
800 or less	2	2
800 or less (732 m)	2	2
801 up to and including 22 000	3	3
801 up to and including 22 000 (20 115 m)	3	3
22 001 and over	5	5

6.2 *Laboratory Sample*—Take a laboratory sample as follows:

6.2.1 For testing width and length, use the rolls or sheets in the lot sample as the laboratory sample.

6.2.2 For testing other properties, take from each lot sampling unit a full-width piece 1 yd (1 m) long. Before taking a laboratory sampling unit of roll felt, skip a length at the end of the roll equal to the width of the roll. Mark the pieces to indicate the lengthwise direction of the original roll or sheet.

6.3 *Test Specimens*—Except for testing length or width for which the specimens are the rolls or sheets in the lot sample, take specimens as follows:

6.3.1 From each laboratory sampling unit, cut three specimens at least 5 by 8 in. (13 by 20 cm). Take one specimen from each edge and from the center of the width of the laboratory sampling unit with no specimens being taken less than 6 in. (150 mm) from the edge of the laboratory sampling unit. Identify the specimens as “Edge 1, Lab. Sampling Unit ___,” “Center Lab. Sampling Unit ___,” and “Edge 2, Lab. Sampling Unit ___.”

NOTE 3—A specimen 5 by 9 in. (13 by 23 cm) is commonly used.

NOTE 4—In some cases, the same specimens may be used for more than one test. For example, the specimens for thickness may also be used for mass, air permeability, and wool content.

REQUIREMENTS**7. Chemical Composition**

- 7.1 The chemical properties of roll and sheet felt shall conform to the specifications in ~~Table 1~~2.
- 7.2 The chemical properties of specialty felts shall conform to the specifications in Table 4.
- 7.3 Unspecified chemical properties of felt such as pH, acid content, and others deemed critical for end use shall be as agreed upon by the supplier and the purchaser.

8. Physical Requirements

- 8.1 The physical properties of roll and sheet felt such as width, thickness, and mass (weight) per unit area, shall conform to the requirements in Tables 1-3. The length of roll and sheet felt shall conform to the requirements agreed upon by the supplier and the purchaser.
- 8.2 The physical properties of specialty felts, such as width, thickness, and mass (weight) per unit area, shall conform to the requirements in Table 4. The length of specialty felts shall conform to the requirements agreed upon by the supplier and the purchaser.

TEST METHODS**9. Properties Except Color**

- 9.1 For all properties except color, determine the property as directed in Test Methods D 461.

10. Color

- 10.1 *Scope*—This procedure is applicable only to determine the color of roll or sheet felt.
- 10.1.1 Whether or not rolls or sheets of felt are of acceptable color is based on requirements that result from agreement between purchaser and supplier. Acceptable color is not determined by a set of color standards associated with the evaluation procedure. Each evaluation may be based on a different agreement about central color choice and tolerance.
- 10.2 *Uses and Significance*:
- 10.2.1 The evaluation procedure for the determination of acceptable color rolls or sheets of felt is considered satisfactory for acceptance testing of commercial shipments of felt because it is used in the trade for that purpose. Comparative tests as directed in 10.2.2 may be advisable.
- 10.2.2 In case of a dispute arising from differences in tests results when using the procedure in Specification D 2475 for the acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing and graded as acceptable or not acceptable. The average results from the two laboratories should be compared. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in the light of the bias.
- 10.2.3 Color is important in rolls or sheet felt for esthetic and functional purposes. Minor differences in color are not important.
- 10.2.4 The highest grades of roll and sheet felt are made of white fibers without the presence of naturally colored or dyed fibers. The majority of felts for mechanical applications are gray. Other colors are manufactured for special end uses upon request.
- 10.3 *Apparatus and Standard Materials*:
- 10.3.1 *Viewing Equipment*, acceptable to the purchaser and the supplier, such as daylight through a north window or standardized artificial light sources.
- 10.3.2 *Standard Samples*, acceptable to the purchaser and the supplier. Tolerances around a standard sample shall be to a commercial match as agreed between purchaser and supplier.
- 10.4 *Procedure*—Compare the specimens to the standards and determine if the color is acceptable.
- 10.5 *Report*:
- 10.5.1 Report that the specimens were tested as directed in the color procedure in ASTM Specification D 2475. Describe the material sampled and the method of sampling used.
- 10.5.2 Report whether the specimens had acceptable color.
- 10.6 *Precision and Bias*—No statement is made about either the precision or bias of the procedure in Specification D 2475 for measuring the color of rolls or sheets of felt since the result merely states whether there is conformance to the criteria specified in the procedure.

CONFORMANCE**11. Conformance**

- 11.1 The purchaser and ~~seller~~ supplier may agree on a procedure to establish conformance, including control charts furnished by the ~~seller~~, supplier, a sequential-sampling plan, or the double sampling plan outlined in 11.2.

11.2 In the absence of a control-chart or sequential-sampling plan, proceed as directed in 11.2.1-11.2.3.

11.2.1 If the test results for the lot conform to the requirements for all characteristics specified, consider the lot a valid delivery.

11.2.2 If the test results for one or more characteristics do not conform to the specifications, take a new laboratory sample from either the original lot sample or a new lot sample. Test the new sample for the characteristic(s) that did not conform to the specifications in the first test, and average the results of the first and second samples as if all results were from one test. If the new average(s) conform(s) to the specifications, consider the lot a valid delivery.

11.2.3 If the test results obtained as directed in 11.2.2 do not conform to the specifications, consider the lot a nonvalid delivery.

12. Keywords

12.1 acceptance; conformance; specification; color; mass per unit area; solubility relationships; specific gravity; splitting; tension (tensile) properties/tests; thickness; width; felt

APPENDIX

(Nonmandatory Information)

X1. DESIGN DATA FOR FELT PRODUCTS

X1.1 Although not part of the specification, the typical design data in Table X1.1 shows representative characteristics that will assist the equipment designer in the use of felt. These typical design characteristics should not be used for specification purposes unless mutual agreement is established.

X1.2 Test Method for Percent Compression Resistance (NTA):

X1.2.1 Average compressional resistance is defined as the percent decrease in the initial thickness (T_1) of approximately 1/2 in. (13 mm) measured after 1 min at a compressive stress of 0.625 psi (4.3 kPa). (T_2) is measured 1 min after loading with a compressive stress of 100 psi (689 kPa). Using Eq X1.1, compute percent compressional resistance as follows:

$$\% \text{ Compressional Resistance} = 100 T_2/T_1 \quad (X1.1)$$

TABLE X1.1 Typical Design Data

ASTM (NTA) Classification	Compressional Resistance, %	Compressional Recovery, %
14R1	35	80
17R1	45	85
17R2	40	80
18R1	50	85
18R2	50	85
18R3	50	80
18R4	50	80
18R5	50	80
26R1	65	97
26R2	65	95
26R3	65	95
34R1	75	98
34R2	75	97
34R3	75	95
38R1	80	98
38R2	80	98
26S1	65	97
26S4	65	95
34S1	80	95
34S2	80	93
34S3	80	93
34S4	80	93
43S1	85	98
43S2	85	98
43S3	85	98
43S4	85	98
56S1	90	98
56S2	90	98
56S3	90	98
56S4	90	98
68S1	92	99
68S2	92	99
68S3	92	98
68S4	92	98

where:

T_1 = initial thickness (1/2 in.) (approximately 13 mm), and

T_2 = compressed thickness at 100 psi (689 kPa).

This property is a measure of the felt's ability to resist loading.

X1.3 Test Method of Percent Compressional Recovery (NTA):

X1.3.1 Average compressional recovery is the percentage difference between the original measured thickness (T_1) of approximately 1/2 in. (13 mm) and a measured thickness as determined after a compressive stress of 100 psi (689 kPa) has been exerted for a 1-min duration and thereafter released for 1 min before measuring thickness (T_3). Both initial and final thickness are measured at a compressive stress of 0.625 psi (4.3 kPa). Using Eq X1.2, compute percent compressional recovery as follows:

$$\% \text{ Compressional Recovery} = 100 T_3/T_1 \quad (\text{X1.2})$$

where:

T_1 = initial thickness (1/2 in.) (approximately 13 mm), and

T_3 = final thickness measured 1 min after unloading.

Compressional recovery is a measure of the felt's ability to recover after loading. It is sometimes referred to as compression set.

X1.3.2 Specific data on other typical design properties are available.

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