Instructions for the preparation and use of

CHANCE®

Protective Grounding-Set Tester

Catalog No. C403-3220 (115/120V) and PSC4033220003 (230V)

These instructions do not claim to cover all details or variations in equipment, nor to provide for all possible conditions to be met with concerning installation, operation, or maintenance of this equipment. If further information is desired or if particular problems are encountered which are not sufficiently covered in this guide, contact Hubbell Power Systems.

NOTE: Because Hubbell has a policy of continuous product improvement, we reserve the right to change design and specifications without notice.

HUBBELL®

P403-3222 Rev. N 8/21

TABLE OF CONTENTS

FUNCTIONAL DESCRIPTION

The PROTECTIVE GROUNDING SET TESTER uses a 5 volt direct current (dc) source to measure resistances in grounding sets. Output current through the grounding set is limited to a maximum of 10 amps by an internal current limiting resistor. The tester switches the 5 volt power supply on, makes a measurement, and switches the power off again for a minimum of 500 milliseconds.

The tester uses a 4 wire resistance measurement approach to obtain accurate resistance measurements. The measurement system is auto ranging to give +/-1% accurate resistance measure from 1mΩ * to 6.5 Ω.

FEATURE DESCRIPTION

The following list of features are referenced with number 1 - 19, and the location of the feature is shown on Figure 1.

1. Test Probes
   Probes are used in troubleshooting mode to locate high resistance area of the ground set.

3. Fixed Input Connections
   When the 'INPUT SELECT' switch is in the fixed position. The resistance measurement shown will be the value of resistance from one fixed connection through the ground set to the other fixed connection.

4. Power Entry Module
   Main power switch illuminates when power to the tester is on, and includes the fuse holder compartment.

5. Preset Resistance Threshold
   This number, shown on the display, is the pass/fail resistance threshold. The '<' symbol displayed means less than. For example, when '<3.333' (mΩ*) is displayed, it means that a ground set resistance which is less than 3.333 mΩ*.

6. Measured Ground Set Resistance
   When the 'INPUT SELECT SWITCH' is in the 'FIXED' position. The value shown will be the resistance measured from one fixed connection (3) through the ground set to the other fixed connection (3). When the 'INPUT SELECT SWITCH' is in the 'PROBE' position. The value shown will be the resistance measured between the probe contact points.

7. Selected Cable Size
   Indicates size of cable under test. This must be changed for each new size cable used.

* mΩ (milli ohm) = 0.001ohm

8. Continuous Test Switch
When switched to the 'ON' position, the ground set tester will continuously make measurements at the rate of 1 per second. When switched to the 'OFF' position, the ground set tester will hold the last measurement made.

9. Fail LED (Red)
Due to changes to ASTM F2249, the LED (Red) is no longer an accurate indicator. Reference the readout on the display. Refer to the latest ASTM F2249 resistance chart for allowable resistance.

10. Cable Size Switch
Used to select the size of cable to be tested. (#2, 1/0, 2/0, 4/0)

11. Pass LED (Green)
Due to changes to ASTM F2249, the LED (Green) is no longer an accurate indicator. Reference the readout on the display. Refer to the latest ASTM F2249 resistance chart for allowable resistance.

12. Power Cord
For connection to AC power supply.

13. Probe Input
When the 'INPUT SELECT' switch is in the 'PROBE' position, the resistance measurement shown will be the value of resistance between probe contact points.

14. Input Select Switch
Allows selection of measurement input between the probes or the fixed connections to the ground set.

15. Single Test Switch
Causes the Ground set tester to make a single resistance measurement and hold the value.

16. Attachment Studs
These tin plated copper studs (P4033120) are threaded into the fixed connection (3), and the ground set clamps can then be attached to the studs.

17. Elbow adapter
Used to adapt ground set with grounding elbow to threaded fixed connection. 15kV elbow adapter (C403-3449) is available as an option.

18. Grounded Parking Stand Adapter
Used to adapt ground set with grounded parking stand to threaded fixed connection. Parking stand adapter (T403-3159) is available as an option.

19. Self Test Cable
Used for testing the functionality of the Protective Ground Set Tester.

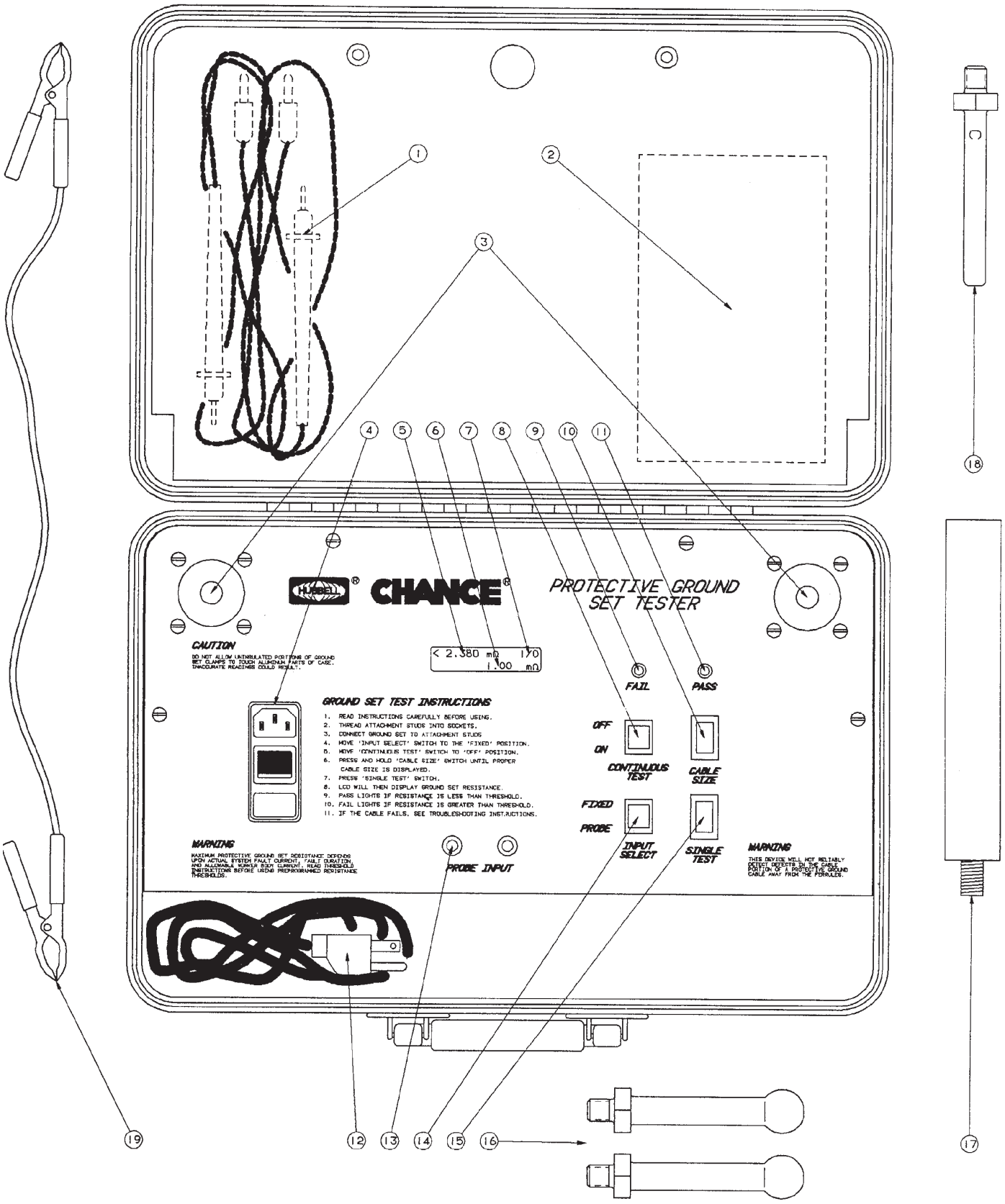

Figure 1: Front Panel of Protective Ground Set Tester Showing Feature Location

SELF TEST PROCEDURE

The operation of the Protective Ground Set Tester can be verified using the Self Test Cable included with the tester. It is not designed to test accuracy.

1. Place the tester on a table of convenient height and plug it into an AC outlet, 110 (Cat. No. C403-3220) or 220 (Cat. No. PSC403-3220003) VAC.

2. Thread the attachment studs into fixed connection inputs.

3. Securely connect Self Test Cable to the attachment studs.

4. Turn on the unit. The power switch will illuminate when the power is on.

5. Place the 'INPUT SELECT' switch in the 'FIXED' position.

6. Place the 'CONTINUOUS TEST' switch in the 'OFF' position.

7. Press the 'SINGLE TEST' switch.

8. The display will show the measured resistance of the self test cable on line 2 of the display. The resistance measured should be between 3.0 and 7.5 mΩ**. If the measured resistance is outside these values, retighten the ball studs and check to make sure that the self test cable has good electrical connections. After retest, if the measured resistance is still not between 3.0 and 7.5 mΩ**, discontinue use of the tester. The Self Test Cable is not designed with tight tolerances for accuracy testing.

Note that the thresholds and pass/fail LEDs will function during the self test but do not pertain to the self test.

**mΩ (milliohm) = 0.001 ohm

TEST SETUP

Figure 3 shows the test setup required to test a protective ground set. The protective ground set under test must always be connected between the fixed connection connections regardless of the mode of testing. The ground set carries the test current from one fixed input to the other during testing. Without the ground set, the resulting open circuit prevents the resistance measurement. If the ground set is left unconnected and the 'INPUT SELECT' is in the 'FIXED' position, the display will read 'OVER RANGE' after a test. If the ground set is left unconnected and the 'INPUT SELECT' is in the 'PROBE' position, the display will be erratic. The erratic display is unpredictable and does not indicate resistance.

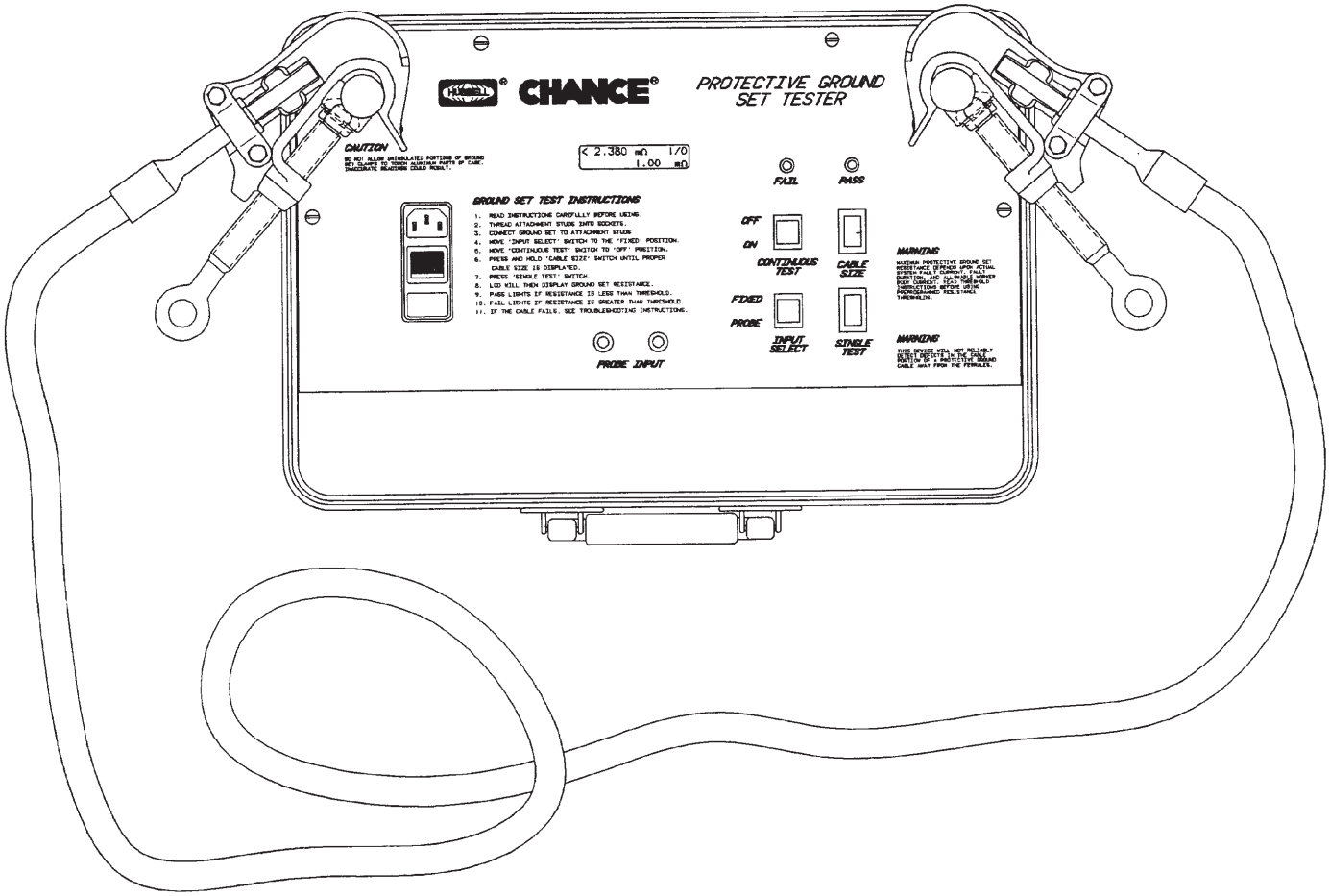

Figure 3: Ground Set Testing Setup

Note: When measuring the ground set, cable length is expressed in feet (ferrule to ferrule measurement to the nearest inch, not including shrouded portion of some ferrules which cover the cable insulation).

GROUND SET TEST PROCEDURE

Use the Self Test Procedure to verify operation of the Ground Set Tester before testing Ground Sets.

1. Place the tester on a table of convenient height and plug it into a nominal 120/240V AC outlet.

2. Thread the attachment studs into the fixed connection inputs.

3. Brush the ground clamps to remove any oxidation or contamination and then securely connect the Grounding Set to be tested to the attachment studs. A low resistance connection must be maintained while testing the ground set. (Figure 3 shows typical test setup.)

4. Turn on the unit. The power switch will illuminate when the power is on.

5. Use the 'CABLE SIZE' switch to select the cable size being tested. The cable size is displayed at the end of the first line of the display.

6. Place the 'INPUT SELECT' in the 'FIXED' position.

7. Place the 'CONTINUOUS TEST' switch in the 'OFF' position.

8. Press the 'SINGLE TEST' switch.

9. The display will show the measured resistance between fixed connections on line 2 of the display in mΩ.** When used in fixed mode the resistance displayed includes the contact resistance of the connection studs to the ground set. The value shown in line 2 of the display needs to be less than the maximum resistance value from the tables from the latest ASTM F2249 to be considered a passing ground set. If the measured resistance is higher than the allowable value from ASTM F2249, then probing can be used to locate the areas of high resistance in the ground set.

**mΩ (milli ohm) = 0.001 ohm

⚠ WARNING

Chance protective ground set tester is not designed nor recommended for detecting cable flaws. Problems with the cable, away from the ferrule exit area, are often intermittent in nature.

NOTICE

If the ground set fails, there are two possibilities.

1. **The ground set has a problem. Use probes to identify the high resistance section. See section GROUND SET TROUBLESHOOTING WITH PROBES.**

2. **Cable is improperly sized for the application (AWG or length).**

GROUND SET TROUBLESHOOTING WITH PROBES

The following sections describe how to use the probes in troubleshooting a ground set. Using the probes in this mode, the high resistance areas of the ground set can be identified.

1. Place the tester on a table of convenient height and plug it into a nominal 120/240V AC outlet.
2. Thread the attachment studs into the fixed connection inputs.
3. Connect the Grounding Set to be tested to the attachment studs. A low resistance connection must be maintained while testing the ground set. Figure 3 shows typical test setup.
4. Turn on the unit. The power switch will illuminate when the power is on.
5. Use the 'CABLE SIZE' switch to select the cable size being tested. The cable size is displayed at the end of the first line of the display.
6. Place the 'INPUT SELECT' in the 'PROBE' position.
7. Place the 'CONTINUOUS TEST' switch in the 'ON' position. This causes the ground set tester to repeatedly make measurements at a rate of about 1 per second.
8. In this mode the display will show the resistance across the part(s) of the ground set to which the probes are connected. Start from one end of the ground set. Take resistance readings between attachment stud and clamp body, clamp body to cable ferrule and cable ferrule to cable ferrule. Repeat test on opposite end.
9. The display will show the measured resistance from one probe to the other when contacting the ground set (on line 2 of the display in mΩ).

⚠ WARNING

Chance protective ground set tester is not designed nor recommended for detecting cable flaws. Problems with the cable, away from the ferrule exit area, are often intermittent in nature.

EXPECTED GROUND SET RESISTANCE

The resistance through a Ground Set will be equal to the resistance of the cable itself and the resistance of the cable clamps and connections to the cable. The resistance of the cable is found by multiplying the resistance per foot for Class K copper cable by the number of feet of the cable. Table 2 supplies the resistance per foot for various Class K cable sizes. The cable clamps and connections should be less than 0.16 mΩ*. Since there are 2 clamps 0.32 mΩ* must be added for the clamps and connections. Pass/Fail DC resistance values for Class K, M, H and I copper grounding jumper assemblies can also be found in Tables X1.3, X2.3, X3.3 and X4.3 of ASTM F2249-18.

For example, the expected resistance for a 32 foot 1/0 Ground Set will be less than

1.05 x 32 ft x 0.1030 mΩ/ft + 0.32 mΩ = 3.7808 mΩ**

(See chart below)

CABLE SIZE	4/0	2/0	1/0	#2
mΩ** PER FOOT [11]	0.0520 mΩ	0.0826 mΩ	0.1030 mΩ	0.1640 mΩ

Table 2: Resistance per foot for various sizes of Class K grounding cable at 68°F
** mΩ (milliohm) = 0.001 ohm
* Derived from ASTM F2249-18 Standard.

ERROR MESSAGES

CALIBRATE ERROR

The calibration factors have been corrupted. New calibration factors must be generated. Return to factory for repair.

COP ERROR

Computer Operating Properly Error has occurred. A problem has occurred with the power supply, its connections or an electronics failure. Return to factory for repair.

⚠ WARNING

It is the responsibility of the user to establish and maintain a maximum resistance threshold for the protective ground set to provide a safe working environment.

P4033120
Replacement Ball Stud

PSC4034035
Ball Stud, 30MM

T4033159
Straight Stud Terminal

C4033449
Elbow Adapter,
15&25kV for .50" Probe

PSC4032947
Elbow Adapter, 35kV
for .50" Probe

PSC4033796
A Elbow Adapter, 35kV
for .75" Probe

PST6003541
Bus Bar Clamp
Adapter

TABLE X1.3 Class K Cable Rmax Limits — DC Resistance (mΩ) (Cable + Terminations)												
Cable Length (Ft.)	Maximum Resistance Pass / Fail - DC Resistance, mΩ											
	#2 Cable			1/0 Cable			2/0 Cable			4/0 Cable		
	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)
1	0.48205	0.49220	0.50235	0.42178	0.42815	0.43452	0.40162	0.40673	0.41184	0.37138	0.37460	0.37782
2	0.64409	0.66440	0.68471	0.52355	0.53630	0.54905	0.48323	0.49346	0.50369	0.42275	0.42920	0.43565
3	0.80614	0.83660	0.86706	0.62533	0.64445	0.66357	0.56485	0.58019	0.59553	0.47413	0.48380	0.49347
4	0.96819	1.00880	1.04941	0.72711	0.75260	0.77809	0.64647	0.66692	0.68737	0.52551	0.53840	0.55129
5	1.13023	1.18100	1.23177	0.82888	0.86075	0.89262	0.72808	0.75365	0.77922	0.57688	0.59300	0.60912
6	1.29228	1.35320	1.41412	0.93066	0.96890	1.00714	0.80970	0.84038	0.87106	0.62826	0.64760	0.66694
7	1.45433	1.52540	1.59647	1.03244	1.07705	1.12166	0.89132	0.92711	0.96290	0.67964	0.70220	0.72476
8	1.61637	1.69760	1.77883	1.13421	1.18520	1.23619	0.97293	1.01384	1.05475	0.73101	0.75680	0.78259
9	1.77842	1.86980	1.96118	1.23599	1.29335	1.35071	1.05455	1.10057	1.14659	0.78239	0.81140	0.84041
10	1.94047	2.04200	2.14354	1.33777	1.40150	1.46524	1.13617	1.18730	1.23844	0.83377	0.86600	0.89824
11	2.10251	2.21420	2.32589	1.43954	1.50965	1.57976	1.21778	1.27403	1.33028	0.88514	0.92060	0.95606
12	2.26456	2.38640	2.50824	1.54132	1.61780	1.69428	1.29940	1.36076	1.42212	0.93652	0.97520	1.01388
13	2.42660	2.55860	2.68060	1.64309	1.72595	1.80881	1.38101	1.44749	1.51397	0.98789	1.02980	1.07171
14	2.58865	2.73080	2.87295	1.74487	1.83410	1.92333	1.46263	1.53422	1.60581	1.03927	1.08440	1.12953
15	2.75070	2.90300	3.05530	1.84665	1.94225	2.03785	1.54425	1.62095	1.69765	1.09065	1.13900	1.18735
16	2.91274	3.07520	3.23766	1.94842	2.05040	2.15238	1.62586	1.70768	1.78950	1.14202	1.19360	1.24518
17	3.07479	3.24740	3.42001	2.05020	2.15855	2.26690	1.70748	1.79441	1.88134	1.19340	1.24820	1.30300
18	3.23684	3.41960	3.60236	2.15198	2.26670	2.38142	1.78910	1.88114	1.97318	1.24478	1.30280	1.36082
19	3.39888	3.59180	3.78472	2.25375	2.37485	2.49595	1.87071	1.96787	2.06503	1.29615	1.35740	1.41865
20	3.56093	3.76400	3.96707	2.35553	2.48300	2.61047	1.95233	2.05460	2.15687	1.34753	1.41200	1.47647
21	3.72298	3.93620	4.14942	2.45731	2.59115	2.72499	2.03395	2.14133	2.24871	1.39891	1.46660	1.53429
22	3.88502	4.10840	4.33178	2.55908	2.69930	2.83952	2.11556	2.22806	2.34056	1.45028	1.52120	1.59212
23	4.04707	4.28060	4.51413	2.66086	2.80745	2.95404	2.19718	2.31479	2.43240	1.50166	1.57580	1.64994
24	4.20912	4.45280	4.69648	2.76264	2.91560	3.06856	2.27880	2.40152	2.52424	1.55304	1.63040	1.70776
25	4.37116	4.62500	4.87884	2.86441	3.02375	3.18309	2.36041	2.48825	2.61609	1.60441	1.68500	1.76559
26	4.5321	4.79720	5.06119	2.96619	3.13190	3.29761	2.44203	2.57498	2.70793	1.65579	1.73960	1.82341
27	4.69526	4.96940	5.24354	3.06797	3.24005	3.41213	2.52365	2.66171	2.79977	1.70717	1.79420	1.88123
28	4.85730	5.14160	5.42590	3.16974	3.34820	3.52666	2.60526	2.74844	2.89162	1.75854	1.84880	1.93906
29	5.01935	5.31380	5.60825	3.27152	3.45635	3.64118	2.68688	2.83517	2.98346	1.80992	1.90340	1.99688
30	5.18140	5.48600	5.79061	3.37330	3.56450	3.75571	2.76850	2.92190	3.07531	1.86130	1.95800	2.05471
31	5.34344	5.65820	5.97296	3.47507	3.67265	3.87023	2.85011	3.00863	3.16715	1.91267	2.01260	2.11253
32	5.50549	5.83040	6.15531	3.57685	3.78080	3.98475	2.93173	3.09536	3.25899	1.96405	2.06720	2.17035
33	5.66753	6.00260	6.33767	3.67862	3.88895	4.09928	3.01334	3.18209	3.35084	2.01542	2.12180	2.22818
34	5.82958	6.17480	6.52002	3.78040	3.99710	4.21380	3.09496	3.26882	3.44268	2.06680	2.17640	2.28600
35	5.99163	6.34700	6.70237	3.88218	4.10525	4.32832	3.17658	3.35555	3.53452	2.11818	2.23100	2.34382
36	6.15367	6.51920	6.88473	3.98395	4.21340	4.44285	3.25819	3.44228	3.62637	2.16955	2.28560	2.40165
37	6.31572	6.69140	7.06708	4.08573	4.32155	4.55737	3.33981	3.52901	3.71821	2.22093	2.34020	2.45947
38	6.47777	6.86360	7.24943	4.18751	4.42970	4.67189	3.42143	3.61574	3.81005	2.27231	2.39480	2.51729
39	6.63981	7.03580	7.43179	4.28928	4.53785	4.78642	3.50304	3.70247	3.90190	2.32368	2.44940	2.57512
40	6.80186	7.20800	7.61414	4.39106	4.64600	4.90094	3.58466	3.78920	3.99374	2.37506	2.50400	2.63294
41	6.96391	7.38020	7.79649	4.49284	4.75415	5.01546	3.66628	3.87593	4.08558	2.42644	2.55860	2.69076
42	7.12595	7.55240	7.97885	4.59461	4.86230	5.12999	3.74789	3.96266	4.17743	2.47781	2.61320	2.74859
43	7.28800	7.72460	8.16120	4.69639	4.97045	5.24451	3.82951	4.04939	4.26927	2.52919	2.66780	2.80641
44	7.45005	7.89680	8.34355	4.79817	5.07860	5.35903	3.91113	4.13612	4.36111	2.58057	2.72240	2.86423
45	7.61209	8.06900	8.52591	4.89994	5.18675	5.47356	3.99274	4.22285	4.45296	2.63194	2.77700	2.92206
46	7.77414	8.24120	8.70826	5.00172	5.29490	5.58808	4.07436	4.30958	4.54480	2.68332	2.83160	2.97988
47	7.93619	8.41340	8.89061	5.10350	5.40305	5.70260	4.15598	4.39631	4.63664	2.73470	2.88620	3.03770
48	8.09823	8.58560	9.07297	5.20527	5.51120	5.81713	4.23759	4.48304	4.72849	2.78607	2.94080	3.09553
49	8.26028	8.75780	9.25532	5.30705	5.61935	5.93165	4.31921	4.56977	4.82033	2.83745	2.99540	3.15335
50	8.42233	8.93000	9.43768	5.40883	5.72750	6.04618	4.40083	4.65650	4.91218	2.88883	3.05000	3.21118

This chart is for Class K Cable only. For Class H, I, and M Cable, please reference the complete ASTM F2249-18 Standard

TABLE X2.3 Class M Cable Rmax Limits — DC Resistance (mΩ) (Cable + Terminations)												
Cable Length (Ft.)	Maximum Resistance Pass / Fail - DC Resistance, mΩ											
	#2 Cable			1/0 Cable			2/0 Cable			4/0 Cable		
	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)
1	0.48402	0.4943	0.50458	0.42276	0.4292	0.43564	0.4024	0.40757	0.41274	0.37178	0.37502	0.37826
2	0.64804	0.6686	0.68916	0.52553	0.5384	0.55127	0.48481	0.49514	0.50547	0.42355	0.43004	0.43653
3	0.81206	0.8429	0.87374	0.62829	0.6476	0.66691	0.56721	0.58271	0.59821	0.47533	0.48506	0.49479
4	0.97608	1.0172	1.05832	0.73105	0.7568	0.78255	0.64962	0.67028	0.69094	0.5271	0.54008	0.55306
5	1.1401	1.1915	1.2429	0.83382	0.866	0.89818	0.73202	0.75785	0.78368	0.57888	0.5951	0.61132
6	1.30412	1.3658	1.42748	0.93658	0.9752	1.01382	0.81442	0.84542	0.87642	0.63065	0.65012	0.66959
7	1.46814	1.5401	1.61206	1.03934	1.0844	1.12946	0.89683	0.93299	0.96915	0.68243	0.70514	0.72785
8	1.63216	1.7144	1.79664	1.14211	1.1936	1.24509	0.97923	1.02056	1.06189	0.7342	0.76016	0.78612
9	1.79618	1.8887	1.98122	1.24487	1.3028	1.36073	1.06164	1.10813	1.15462	0.78598	0.81518	0.84438
10	1.96021	2.063	2.1658	1.34764	1.412	1.47637	1.14404	1.1957	1.24736	0.83776	0.8702	0.90265
11	2.12423	2.2373	2.35037	1.4504	1.5212	1.592	1.22644	1.28327	1.3401	0.88953	0.92522	0.96091
12	2.28825	2.4116	2.53495	1.55316	1.6304	1.70764	1.30885	1.37084	1.43283	0.94131	0.98024	1.01917
13	2.45227	2.5859	2.71953	1.65593	1.7396	1.82327	1.39125	1.45841	1.52557	0.99308	1.03526	1.07744
14	2.61629	2.7602	2.90411	1.75869	1.8488	1.93891	1.47366	1.54598	1.6183	1.04486	1.09028	1.1357
15	2.78031	2.9345	3.08869	1.86145	1.958	2.05455	1.55606	1.63355	1.71104	1.09663	1.1453	1.19397
16	2.94433	3.1088	3.27327	1.96422	2.0672	2.17018	1.63846	1.72112	1.80378	1.14841	1.20032	1.25223
17	3.10835	3.2831	3.45785	2.06698	2.1764	2.28582	1.72087	1.80869	1.89651	1.20018	1.25534	1.3105
18	3.27237	3.4574	3.64243	2.16974	2.2856	2.40146	1.80327	1.89626	1.98925	1.25196	1.31036	1.36876
19	3.43639	3.6317	3.82701	2.27251	2.3948	2.51709	1.88568	1.98383	2.08198	1.30373	1.36538	1.42703
20	3.60041	3.806	4.01159	2.37527	2.504	2.63273	1.96808	2.0714	2.17472	1.35551	1.4204	1.48529
21	3.76443	3.9803	4.19617	2.47803	2.6132	2.74837	2.05048	2.15897	2.26746	1.40729	1.47542	1.54355
22	3.92845	4.1546	4.38075	2.5808	2.7224	2.864	2.13289	2.24654	2.36019	1.45906	1.53044	1.60182
23	4.09247	4.3289	4.56533	2.68356	2.8316	2.97964	2.21529	2.33411	2.45293	1.51084	1.58546	1.66008
24	4.25649	4.5032	4.74991	2.78632	2.9408	3.09528	2.2977	2.42168	2.54566	1.56261	1.64048	1.71835
25	4.42051	4.6775	4.93449	2.88909	3.05	3.21091	2.3801	2.50925	2.6384	1.61439	1.6955	1.77661
26	4.58453	4.8518	5.11907	2.99185	3.1592	3.32655	2.4625	2.59682	2.73114	1.66616	1.75052	1.83488
27	4.74855	5.0261	5.30365	3.09461	3.2684	3.44219	2.54491	2.68439	2.82387	1.71794	1.80554	1.89314
28	4.91257	5.2004	5.48823	3.19738	3.3776	3.55782	2.62731	2.77196	2.91661	1.76971	1.86056	1.95141
29	5.07659	5.3747	5.67281	3.30014	3.4868	3.67346	2.70972	2.85953	3.00934	1.82149	1.91558	2.00967
30	5.24062	5.549	5.85739	3.40291	3.596	3.7891	2.79212	2.9471	3.10208	1.87327	1.9706	2.06794
31	5.40464	5.7233	6.04196	3.50567	3.7052	3.90473	2.87452	3.03467	3.19482	1.92504	2.02562	2.1262
32	5.56866	5.8976	6.22654	3.60843	3.8144	4.02037	2.95693	3.12224	3.28755	1.97682	2.08064	2.18446
33	5.73268	6.0719	6.41112	3.7112	3.9236	4.136	3.03933	3.20981	3.38029	2.02859	2.13566	2.24273
34	5.8967	6.2462	6.5957	3.81396	4.0328	4.25164	3.12174	3.29738	3.47302	2.08037	2.19068	2.30099
35	6.06072	6.4205	6.78028	3.91672	4.142	4.36728	3.20414	3.38495	3.56576	2.13214	2.2457	2.35926
36	6.22474	6.5948	6.96486	4.01949	4.2512	4.48291	3.28654	3.47252	3.6585	2.18392	2.30072	2.41752
37	6.38876	6.7691	7.14944	4.12225	4.3604	4.59855	3.36895	3.56009	3.75123	2.23569	2.35574	2.47579
38	6.55278	6.9434	7.33402	4.22501	4.4696	4.71419	3.45135	3.64766	3.84397	2.28747	2.41076	2.53405
39	6.7168	7.1177	7.5186	4.32778	4.5788	4.82982	3.53376	3.73523	3.9367	2.33924	2.46578	2.59232
40	6.88082	7.292	7.70318	4.43054	4.688	4.94546	3.61616	3.8228	4.02944	2.39102	2.5208	2.65058
41	7.04484	7.4663	7.88776	4.5333	4.7972	5.0611	3.69856	3.91037	4.12218	2.4428	2.57582	2.70884
42	7.20886	7.6406	8.07234	4.63607	4.9064	5.17673	3.78097	3.99794	4.21491	2.49457	2.63084	2.76711
43	7.37288	7.8149	8.25692	4.73883	5.0156	5.29237	3.86337	4.08551	4.30765	2.54635	2.68586	2.82537
44	7.5369	7.9892	8.4415	4.84159	5.1248	5.40801	3.94578	4.17308	4.40038	2.59812	2.74088	2.88364
45	7.70092	8.1635	8.62608	4.94436	5.234	5.52364	4.02818	4.26065	4.49312	2.6499	2.7959	2.9419
46	7.86494	8.3378	8.81066	5.04712	5.3432	5.63928	4.11058	4.34822	4.58586	2.70167	2.85092	3.00017
47	8.02896	8.5121	8.99524	5.14988	5.4524	5.75492	4.19299	4.43579	4.67859	2.75345	2.90594	3.05843
48	8.19298	8.6864	9.17982	5.25265	5.5616	5.87055	4.27539	4.52336	4.77133	2.80522	2.96096	3.1167
49	8.357	8.8607	9.3644	5.35541	5.6708	5.98619	4.3578	4.61093	4.86406	2.857	3.01598	3.17496
50	8.52103	9.035	9.54898	5.45818	5.78	6.10183	4.4402	4.6985	4.9568	2.90878	3.071	3.23323

This chart is for Class M Cable only. For Class H, I, and K Cable, please reference the complete ASTM F2249-18 Standard

TABLE X3.3 Class H Cable Rmax Limits — DC Resistance (mΩ) (Cable + Terminations)												
Cable Length (Ft.)	Maximum Resistance Pass / Fail - DC Resistance, mΩ											
	#2 Cable			1/0 Cable			2/0 Cable			4/0 Cable		
	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)
1	0.48106	0.49115	0.50124	0.42178	0.42815	0.43452	0.40043	0.40547	0.41051	0.37059	0.37376	0.37693
2	0.64212	0.6623	0.68248	0.52355	0.5363	0.54905	0.48086	0.49094	0.50102	0.42118	0.42752	0.43386
3	0.80318	0.83345	0.86372	0.62533	0.64445	0.66357	0.56129	0.57641	0.59153	0.47177	0.48128	0.49079
4	0.96424	1.0046	1.04496	0.72711	0.7526	0.77809	0.64172	0.66188	0.68204	0.52236	0.53504	0.54772
5	1.1253	1.17575	1.2262	0.82888	0.86075	0.89262	0.72215	0.74735	0.77255	0.57295	0.5888	0.60466
6	1.28636	1.3469	1.40744	0.93066	0.9689	1.00714	0.80258	0.83282	0.86306	0.62353	0.64256	0.66159
7	1.44742	1.51805	1.58868	1.03244	1.07705	1.12166	0.88301	0.91829	0.95357	0.67412	0.69632	0.71852
8	1.60848	1.6892	1.76992	1.13421	1.1852	1.23619	0.96344	1.00376	1.04408	0.72471	0.75008	0.77545
9	1.76954	1.86035	1.95116	1.23599	1.29335	1.35071	1.04387	1.08923	1.13459	0.7753	0.80384	0.83238
10	1.9306	2.0315	2.13241	1.33777	1.4015	1.46524	1.1243	1.1747	1.2251	0.82589	0.8576	0.88931
11	2.09165	2.20265	2.31365	1.43954	1.50965	1.57976	1.20473	1.26017	1.31561	0.87648	0.91136	0.94624
12	2.25271	2.3738	2.49489	1.54132	1.6178	1.69428	1.28516	1.34564	1.40612	0.92707	0.96512	1.00317
13	2.41377	2.54495	2.67613	1.64309	1.72595	1.80881	1.36559	1.43111	1.49663	0.97766	1.01888	1.0601
14	2.57483	2.7161	2.85737	1.74487	1.8341	1.92333	1.44602	1.51658	1.58714	1.02825	1.07264	1.11703
15	2.73589	2.88725	3.03861	1.84665	1.94225	2.03785	1.52645	1.60205	1.67765	1.07884	1.1264	1.17397
16	2.89695	3.0584	3.21985	1.94842	2.0504	2.15238	1.60688	1.68752	1.76816	1.12942	1.18016	1.2309
17	3.05801	3.22955	3.40109	2.0502	2.15855	2.2669	1.68731	1.77299	1.85867	1.18001	1.23392	1.28783
18	3.21907	3.4007	3.58233	2.15198	2.2667	2.38142	1.76774	1.85846	1.94918	1.2306	1.28768	1.34476
19	3.38013	3.57185	3.76357	2.25375	2.37485	2.49595	1.84817	1.94393	2.03969	1.28119	1.34144	1.40169
20	3.54119	3.743	3.94481	2.35553	2.483	2.61047	1.9286	2.0294	2.1302	1.33178	1.3952	1.45862
21	3.70225	3.91415	4.12605	2.45731	2.59115	2.72499	2.00903	2.11487	2.22071	1.38237	1.44896	1.51555
22	3.86331	4.0853	4.30729	2.55908	2.6993	2.83952	2.08946	2.20034	2.31122	1.43296	1.50272	1.57248
23	4.02437	4.25645	4.48853	2.66086	2.80745	2.95404	2.16989	2.28581	2.40173	1.48355	1.55648	1.62941
24	4.18543	4.4276	4.66977	2.76264	2.9156	3.06856	2.25032	2.37128	2.49224	1.53414	1.61024	1.68634
25	4.34649	4.59875	4.85101	2.86441	3.02375	3.18309	2.33075	2.45675	2.58275	1.58473	1.664	1.74328
26	4.50755	4.7699	5.03225	2.96619	3.1319	3.29761	2.41118	2.54222	2.67326	1.63531	1.71776	1.80021
27	4.66861	4.94105	5.21349	3.06797	3.24005	3.41213	2.49161	2.62769	2.76377	1.6859	1.77152	1.85714
28	4.82967	5.1122	5.39473	3.16974	3.3482	3.52666	2.57204	2.71316	2.85428	1.73649	1.82528	1.91407
29	4.99073	5.28335	5.57597	3.27152	3.45635	3.64118	2.65247	2.79863	2.94479	1.78708	1.87904	1.971
30	5.15179	5.4545	5.75722	3.3733	3.5645	3.75571	2.7329	2.8841	3.0353	1.83767	1.9328	2.02793
31	5.31284	5.62565	5.93846	3.47507	3.67265	3.87023	2.81333	2.96957	3.12581	1.88826	1.98656	2.08486
32	5.4739	5.7968	6.1197	3.57685	3.7808	3.98475	2.89376	3.05504	3.21632	1.93885	2.04032	2.14179
33	5.63496	5.96795	6.30094	3.67862	3.88895	4.09928	2.97419	3.14051	3.30683	1.98944	2.09408	2.19872
34	5.79602	6.1391	6.48218	3.7804	3.9971	4.2138	3.05462	3.22598	3.39734	2.04003	2.14784	2.25565
35	5.95708	6.31025	6.66342	3.88218	4.10525	4.32832	3.13505	3.31145	3.48785	2.09062	2.2016	2.31259
36	6.11814	6.4814	6.84466	3.98395	4.2134	4.44285	3.21548	3.39692	3.57836	2.1412	2.25536	2.36952
37	6.2792	6.65255	7.0259	4.08573	4.32155	4.55737	3.29591	3.48239	3.66887	2.19179	2.30912	2.42645
38	6.44026	6.8237	7.20714	4.18751	4.4297	4.67189	3.37634	3.56786	3.75938	2.24238	2.36288	2.48338
39	6.60132	6.99485	7.38838	4.28928	4.53785	4.78642	3.45677	3.65333	3.84989	2.29297	2.41664	2.54031
40	6.76238	7.166	7.56962	4.39106	4.646	4.90094	3.5372	3.7388	3.9404	2.34356	2.4704	2.59724
41	6.92344	7.33715	7.75086	4.49284	4.75415	5.01546	3.61763	3.82427	4.03091	2.39415	2.52416	2.65417
42	7.0845	7.5083	7.9321	4.59461	4.8623	5.12999	3.69806	3.90974	4.12142	2.44474	2.57792	2.7111
43	7.24556	7.67945	8.11334	4.69639	4.97045	5.24451	3.77849	3.99521	4.21193	2.49533	2.63168	2.76803
44	7.40662	7.8506	8.29458	4.79817	5.0786	5.35903	3.85892	4.08068	4.30244	2.54592	2.68544	2.82496
45	7.56768	8.02175	8.47582	4.89994	5.18675	5.47356	3.93935	4.16615	4.39295	2.59651	2.7392	2.8819
46	7.72874	8.1929	8.65706	5.00172	5.2949	5.58808	4.01978	4.25162	4.48346	2.64709	2.79296	2.93883
47	7.8898	8.36405	8.8383	5.1035	5.40305	5.7026	4.10021	4.33709	4.57397	2.69768	2.84672	2.99576
48	8.05086	8.5352	9.01954	5.20527	5.5112	5.81713	4.18064	4.42256	4.66448	2.74827	2.90048	3.05269
49	8.21192	8.70635	9.20078	5.30705	5.61935	5.93165	4.26107	4.50803	4.75499	2.79886	2.95424	3.10962
50	8.37298	8.8775	9.38203	5.40883	5.7275	6.04618	4.3415	4.5935	4.8455	2.84945	3.008	3.16655

This chart is for Class H Cable only. For Class K, M, and I Cable, please reference the complete ASTM F2249-18 Standard

TABLE X4.3 Class I Cable Rmax Limits — DC Resistance (mΩ) (Cable + Terminations)												
Cable Length (Ft.)	Maximum Resistance Pass / Fail - DC Resistance, mΩ											
	#2 Cable			1/0 Cable			2/0 Cable			4/0 Cable		
	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)	5°C (41°F)	20°C (68°F)	35°C (95°F)
1	0.48106	0.49115	0.50124	0.42178	0.42815	0.43452	0.40083	0.40589	0.41095	0.37088	0.37408	0.37727
2	0.64212	0.6623	0.68248	0.52355	0.5363	0.54905	0.48166	0.49178	0.5019	0.42177	0.42815	0.43453
3	0.80318	0.83345	0.86372	0.62533	0.64445	0.66357	0.56249	0.57767	0.59285	0.47265	0.48223	0.4918
4	0.96424	1.0046	1.04496	0.72711	0.7526	0.77809	0.64332	0.66356	0.6838	0.52353	0.5363	0.54907
5	1.1253	1.17575	1.2262	0.82888	0.86075	0.89262	0.72415	0.74945	0.77476	0.57442	0.59038	0.60634
6	1.28636	1.3469	1.40744	0.93066	0.9689	1.00714	0.80497	0.83534	0.86571	0.6253	0.64445	0.6636
7	1.44742	1.51805	1.58868	1.03244	1.07705	1.12166	0.8858	0.92123	0.95666	0.67618	0.69853	0.72087
8	1.60848	1.6892	1.76992	1.13421	1.1852	1.23619	0.96663	1.00712	1.04761	0.72706	0.7526	0.77814
9	1.76954	1.86035	1.95116	1.23599	1.29335	1.35071	1.04746	1.09301	1.13856	0.77795	0.80668	0.8354
10	1.9306	2.0315	2.13241	1.33777	1.4015	1.46524	1.12829	1.1789	1.22951	0.82883	0.86075	0.89267
11	2.09165	2.20265	2.31365	1.43954	1.50965	1.57976	1.20912	1.26479	1.32046	0.87971	0.91483	0.94994
12	2.25271	2.3738	2.49489	1.54132	1.6178	1.69428	1.28995	1.35068	1.41141	0.9306	0.9689	1.0072
13	2.41377	2.54495	2.67613	1.64309	1.72595	1.80881	1.37078	1.43657	1.50236	0.98148	1.02298	1.06447
14	2.57483	2.7161	2.85737	1.74487	1.8341	1.92333	1.45161	1.52246	1.59331	1.03236	1.07705	1.12174
15	2.73589	2.88725	3.03861	1.84665	1.94225	2.03785	1.53244	1.60835	1.68427	1.08325	1.13113	1.17901
16	2.89695	3.0584	3.21985	1.94842	2.0504	2.15238	1.61326	1.69424	1.77522	1.13413	1.1852	1.23627
17	3.05801	3.22955	3.40109	2.0502	2.15855	2.2669	1.69409	1.78013	1.86617	1.18501	1.23928	1.29354
18	3.21907	3.4007	3.58233	2.15198	2.2667	2.38142	1.77492	1.86602	1.95712	1.23589	1.29335	1.35081
19	3.38013	3.57185	3.76357	2.25375	2.37485	2.49595	1.85575	1.95191	2.04807	1.28678	1.34743	1.40807
20	3.54119	3.743	3.94481	2.35553	2.483	2.61047	1.93658	2.0378	2.13902	1.33766	1.4015	1.46534
21	3.70225	3.91415	4.12605	2.45731	2.59115	2.72499	2.01741	2.12369	2.22997	1.38854	1.45558	1.52261
22	3.86331	4.0853	4.30729	2.55908	2.6993	2.83952	2.09824	2.20958	2.32092	1.43943	1.50965	1.57987
23	4.02437	4.25645	4.48853	2.66086	2.80745	2.95404	2.17907	2.29547	2.41187	1.49031	1.56373	1.63714
24	4.18543	4.4276	4.66977	2.76264	2.9156	3.06856	2.2599	2.38136	2.50282	1.54119	1.6178	1.69441
25	4.34649	4.59875	4.85101	2.86441	3.02375	3.18309	2.34073	2.46725	2.59378	1.59208	1.67188	1.75168
26	4.50755	4.7699	5.03225	2.96619	3.1319	3.29761	2.42155	2.55314	2.68473	1.64296	1.72595	1.80894
27	4.66861	4.94105	5.21349	3.06797	3.24005	3.41213	2.50238	2.63903	2.77568	1.69384	1.78003	1.86621
28	4.82967	5.1122	5.39473	3.16974	3.3482	3.52666	2.58321	2.72492	2.86663	1.74472	1.8341	1.92348
29	4.99073	5.28335	5.57597	3.27152	3.45635	3.64118	2.66404	2.81081	2.95758	1.79561	1.88818	1.98074
30	5.15179	5.4545	5.75722	3.3733	3.5645	3.75571	2.74487	2.8967	3.04853	1.84649	1.94225	2.03801
31	5.31284	5.62565	5.93846	3.47507	3.67265	3.87023	2.8257	2.98259	3.13948	1.89737	1.99633	2.09528
32	5.4739	5.7968	6.1197	3.57685	3.7808	3.98475	2.90653	3.06848	3.23043	1.94826	2.0504	2.15254
33	5.63496	5.96795	6.30094	3.67862	3.88895	4.09928	2.98736	3.15437	3.32138	1.99914	2.10448	2.20981
34	5.79602	6.1391	6.48218	3.7804	3.9971	4.2138	3.06819	3.24026	3.41233	2.05002	2.15855	2.26708
35	5.95708	6.31025	6.66342	3.88218	4.10525	4.32832	3.14902	3.32615	3.50329	2.10091	2.21263	2.32435
36	6.11814	6.4814	6.84466	3.98395	4.2134	4.44285	3.22984	3.41204	3.59424	2.15179	2.2667	2.38161
37	6.2792	6.65255	7.0259	4.08573	4.32155	4.55737	3.31067	3.49793	3.68519	2.20267	2.32078	2.43888
38	6.44026	6.8237	7.20714	4.18751	4.4297	4.67189	3.3915	3.58382	3.77614	2.25355	2.37485	2.49615
39	6.60132	6.99485	7.38838	4.28928	4.53785	4.78642	3.47233	3.66971	3.86709	2.30444	2.42893	2.55341
40	6.76238	7.166	7.56962	4.39106	4.646	4.90094	3.55316	3.7556	3.95804	2.35532	2.483	2.61068
41	6.92344	7.33715	7.75086	4.49284	4.75415	5.01546	3.63399	3.84149	4.04899	2.4062	2.53708	2.66795
42	7.0845	7.5083	7.9321	4.59461	4.8623	5.12999	3.71482	3.92738	4.13994	2.45709	2.59115	2.72521
43	7.24556	7.67945	8.11334	4.69639	4.97045	5.24451	3.79565	4.01327	4.23089	2.50797	2.64523	2.78248
44	7.40662	7.8506	8.29458	4.79817	5.0786	5.35903	3.87648	4.09916	4.32184	2.55885	2.6993	2.83975
45	7.56768	8.02175	8.47582	4.89994	5.18675	5.47356	3.95731	4.18505	4.4128	2.60974	2.75338	2.89702
46	7.72874	8.1929	8.65706	5.00172	5.2949	5.58808	4.03813	4.27094	4.50375	2.66062	2.80745	2.95428
47	7.8898	8.36405	8.8383	5.1035	5.40305	5.7026	4.11896	4.35683	4.5947	2.7115	2.86153	3.01155
48	8.05086	8.5352	9.01954	5.20527	5.5112	5.81713	4.19979	4.44272	4.68565	2.76238	2.9156	3.06882
49	8.21192	8.70635	9.20078	5.30705	5.61935	5.93165	4.28062	4.52861	4.7766	2.81327	2.96968	3.12608
50	8.37298	8.8775	9.38203	5.40883	5.7275	6.04618	4.36145	4.6145	4.86755	2.86415	3.02375	3.18335

This chart is for Class I Cable only. For Class H, K, and M Cable, please reference the complete ASTM F2249-18 Standard

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Hubbell / Chance, USA
210 N. Allen Street
Centralia, Mo. 65240-1395
573-682-5521
Fax: 573-682-8475