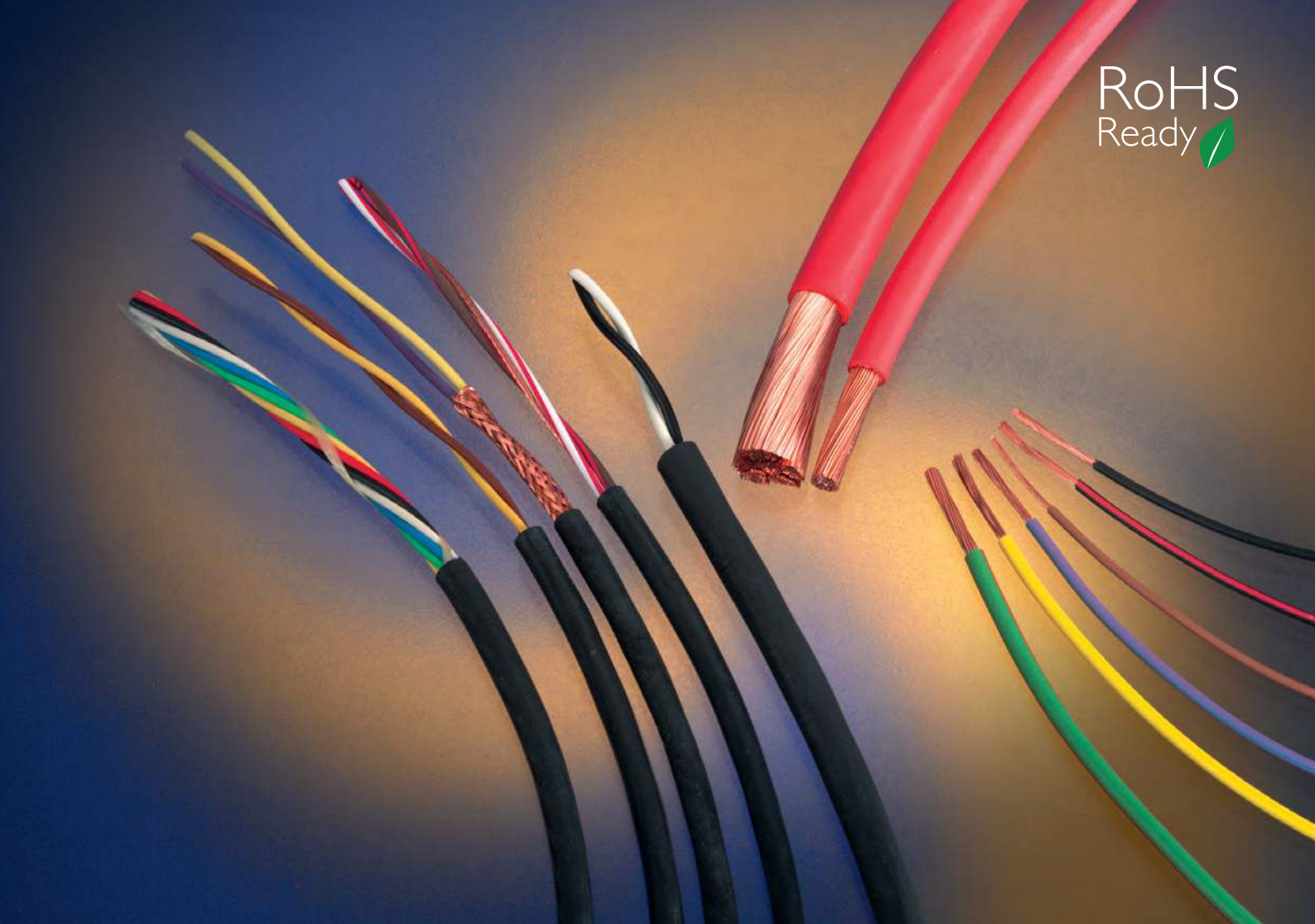


RoHS  
Ready 



# Wire and Cable Products for the Automotive Industry





## THE 5 APPLICATION AREAS

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## INNOVATIVE TECHNOLOGIES

***TE Automotive - a business segment of TE Connectivity - follows the globalization goals of our customers, speeds up the integration of new technologies and enables our customers access to our vast product portfolio and services.***

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### TERMINALS & CONNECTORS



TE Automotive offers a broad range of high quality terminals and connectors. Our electrical/electronic interconnection products and solutions are used to electrically and mechanically join wires and cables, printed circuit boards, integrated circuit packages and batteries. TE Automotive expanding capabilities include new copper and fiber-optic connectors, wires, cables/cable management systems that are designed to meet automotive industry demands. Our brands encompass the broadest range of connectors in the world, including high-density, high-speed designs for leading-edge communications equipment.

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### Hybrid & Electric Mobility Solutions



Complete the connections you need to safely, and reliably make hybrid and electric mobility a reality for everyone, everyday. With over 50 years experience in automotive, industrial and energy connectivity, TE is an expert in pushing innovation from one industry to the next. Our portfolio of AMP+ high voltage relays, resistors, AMP+ headers, connectors, IPT/APT and cable assemblies and vehicle charging solutions are designed to connect and protect electric distribution inside and outside of the vehicle.

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### CABLE ASSEMBLY SYSTEMS



TE Automotive is your partner for special cable assemblies. We offer research and development capabilities, prototyping, samples as well as manufacturing facilities for special cable assemblies. This includes overmold technology, semi/fully automatic manufacturing, testing equipment and appliances for handling of high volume production.

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## SENSORS



Contact-less measuring eliminates interference effects, wear and tear, and provides increased reliability. TE Automotive, one of the largest technology providers for the automobile industry, offers contact-less sensors for a variety of applications.

As sensor manufacturer and processing partner, TE Automotive also provides project planning support for new sensor applications, assistance in the selection of the appropriate sensor technology for the respective application, and assistance with defining the corresponding mechanical, electrical and magnetic interface.

TE Automotive has a broad electro-mechanical portfolio that includes robust housing technologies, connector systems, and temperature stable designs based on foil and cable networks. This combination of technologies and experience ensures that reliable and cost effective sensor solutions are available for all application types.

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## INFOTAINMENT



TE Automotive is the technology leader in high speed data communication in the automotive industry. TE Automotive offers high performance connectors based on optical, coaxial as well as shielded electrical cables.

Through a deep understanding of the technical properties and requirements of signal integrity and combined with our application knowledge both in the vehicle as well as in the logistics chain, TE Automotive is well positioned to offer the right solution for all current and next generation Infotainment Systems.

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## INDUCTIVE COIL SYSTEMS



TE Automotive is your source for interconnection technologies for automotive, truck and off-highway OEMs and Tier 1 suppliers. With our global design center in Belgium and manufacturing sites in all regions, TE Automotive's Inductive Systems (ICS) group is ready to design your next-generation coil modules and provide local production support.

The ICS group maintains a leading market position in braking modules and other automotive coil applications. Through early involvement with you on your next design, TE Automotive can offer the benefits of miniaturization, design-in of platform components and optimized process flow for your standard, hybrid and E.V. project needs.

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## TE Automotive Online

The TE Automotive website is an innovative and interactive source for application information, product updates and technical solutions. Please contact us at:  
[www.te.com/automotive](http://www.te.com/automotive)

## Internet

- [www.te.com](http://www.te.com)
- [www.te.com/automotive](http://www.te.com/automotive)
- [www.te.com/automotive/sensors](http://www.te.com/automotive/sensors)
- [www.te.com/automotive/most](http://www.te.com/automotive/most)
- [www.te.com/en/industries/hybrid-electric-mobility-solutions](http://www.te.com/en/industries/hybrid-electric-mobility-solutions)

## Electronic Internet Catalog

[www.te.com/components](http://www.te.com/components)



- [www.te.com/automotive](http://www.te.com/automotive)
- [www.te.com/automotive/sensors](http://www.te.com/automotive/sensors)
- [www.te.com/automotive/most](http://www.te.com/automotive/most)
- [www.te.com/en/industries/hybrid-electric-mobility-solutions](http://www.te.com/en/industries/hybrid-electric-mobility-solutions)



## Product and Machine Literature

TE Automotive offers a variety of product specific catalogs, brochures and high impact flyers to help better serve you!

For more information on literature for TE Automotive, please contact your local organization or go to [www.te.com/automotive](http://www.te.com/automotive)

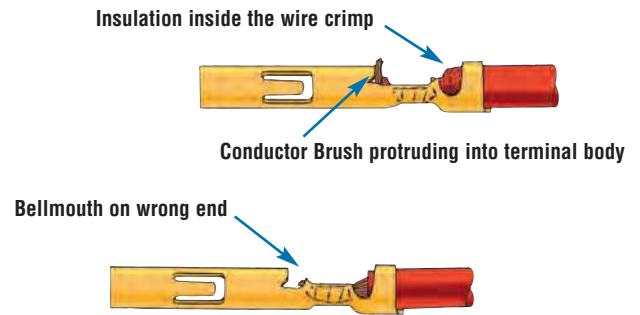
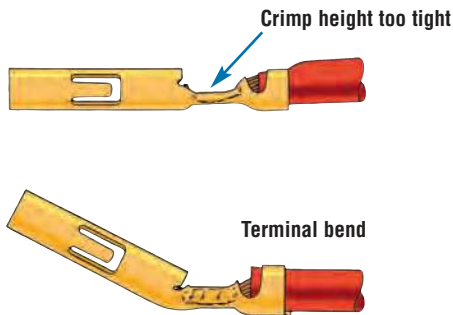
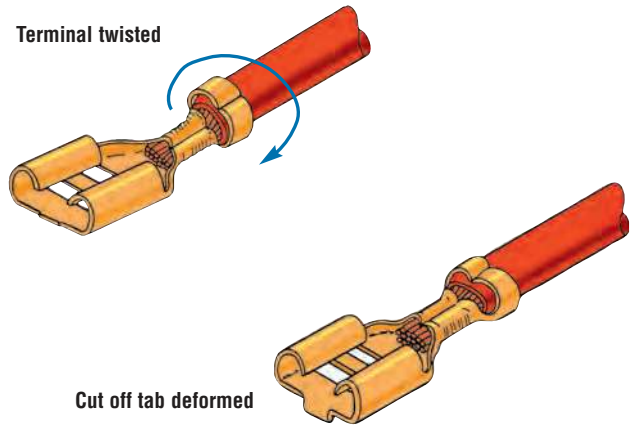
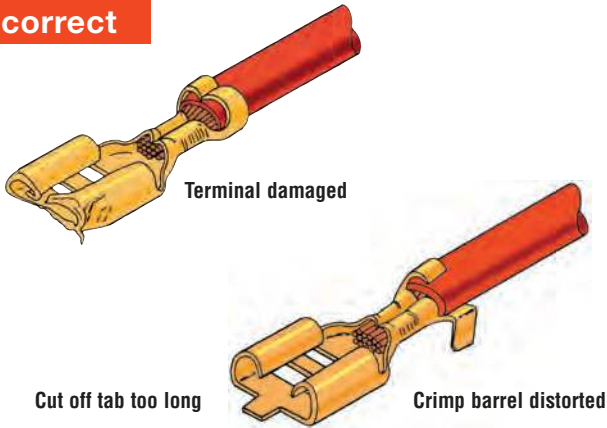
## Product Information Center (PIC)

You can rely on TE Connectivity's PIC Team to provide you support for answers to your general information or technical questions in an efficient and effective manner. To reach our PIC staff, please contact your local organization or see our Global Contacts page. Please contact us at:  
<http://www.te.com/customersupport/support.asp>

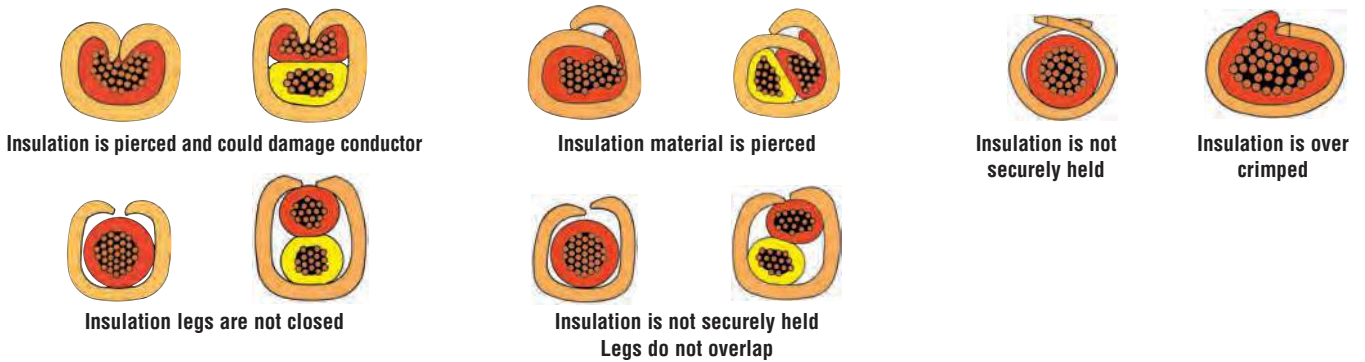


Quality Guidelines

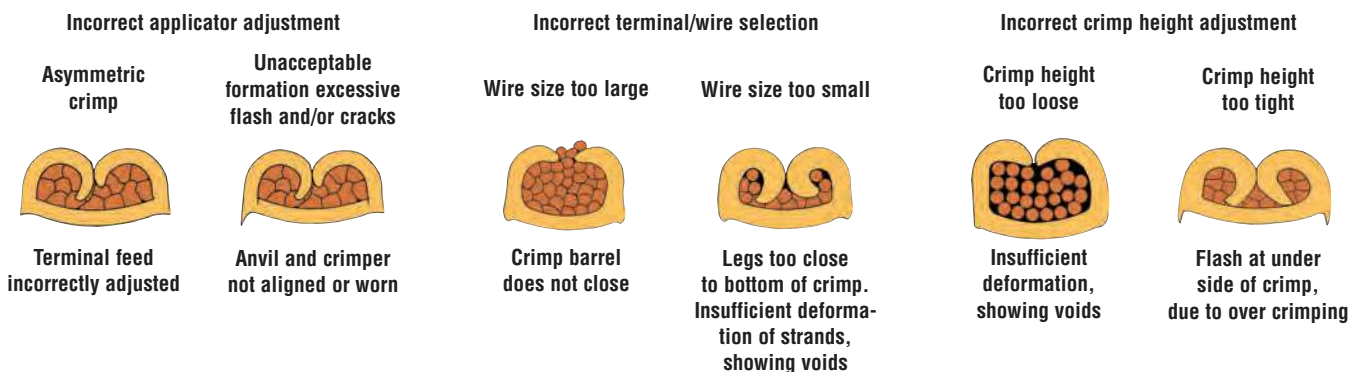
**Incorrect**



**INSULATION CRIMP**



**WIRE CRIMP**





Quality Guidelines

**Correct**

**WIRE CRIMP**

Insulation Present  
Conductor Present

Bellmouth must always be present  
Bellmouth Permissible

Cut off tabs present

Locking lances and terminal body not deformed

Correct selection of wire, terminal and applicator

Crimp barrel is closed, legs support each other

Sufficient gap between legs and bottom of crimp

All strands are equally distributed and deformed

**INSULATION CRIMP**

Correct Insulation Diameter, Applicator and Terminal

**F-CRIMP**

Insulation is securely held  
Crimp barrel closed

For double wire applications with different size wires always place wire with smallest outer diameter in the bottom

**OVERLAP CRIMP**

Insulation is securely held  
Legs overlap

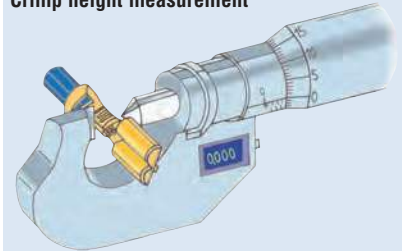
**WRAP OVER CRIMP**

Insulation securely held  
Legs must pass each other

**Test**

**WIRE CRIMP**

Crimp height measurement



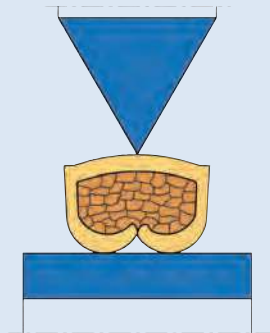
Crimp heights and tolerances

For crimp height tolerances for any given contact, please refer to the relevant application specification.

Examples:

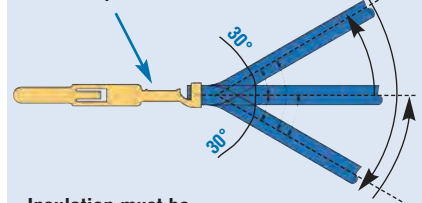
Contact	Part No.	Wire Range (mm <sup>2</sup> )	Tolerance (mm)	Application Spec.
MQS	962885 962886	0.2-0.5	±0.03	114-18025
JPT	927775	0.5-1.0	±0.05	114-18050
JPT	927773	1.5-2.5	±0.05	114-18050

Digital Crimp Height Micrometer  
(0.001 mm increments) acc. to DIN ISO 9001  
Part No. 547203-1



**INSULATION CRIMP**

Wire crimp without conductor



Insulation must be securely held after bend test

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## Restriction on the Use of Hazardous Substances (RoHS)

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### Restriction on the Use of Hazardous Substances (RoHS)

At TE Connectivity, we're ready to support your RoHS requirements. We've assessed more than 1.5 million end items/components for RoHS compliance, and issued new part numbers where any change was required to eliminate the restricted materials. Part numbers in this catalog are identified as:

#### RoHS Compliant

Part numbers in this catalog are RoHS Compliant, unless marked otherwise.

These products comply with European Union Directive 2002/95/EC as amended 1 January 2006 that restricts the use of lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE in certain electrical and electronic products sold into the EU as of 1 July 2006.

**Note:** For purposes of this Catalog, included within the definition of RoHS Compliant are products that are clearly "Out of Scope" of the RoHS Directive such as hand tools and other non-electrical accessories.

#### Non-RoHS Compliant

These part numbers are identified with a "◆" symbol. These products do not comply with the material restrictions of the European Union Directive 2002/95/EC.

#### 5 of 6 Compliant

A "●" symbol identifies these part numbers. These products do not fully comply with the European Union Directive 2002/95/EC because they contain lead in solderable interfaces (they do not contain any of the other five restricted substances above allowable limits). However, these products may be suitable for use in RoHS applications where there is an application-based exception for lead in solders, such as the server, storage, or networking infrastructure exemption.

**Note:** Information regarding RoHS compliance is provided based on reasonable inquiry of our suppliers and represents our current actual knowledge based on the information provided by our suppliers. This information is subject to change. For latest compliance status, refer to our website referenced below.

#### Getting the Information You Need

Our comprehensive on-line RoHS Customer Support Center provides a forum to answer your questions and support your RoHS needs. A RoHS FAQ (Frequently Asked Questions) is available with links to more detailed information. You can also submit RoHS questions and receive a response within 24 hours during a normal work week. The Support Center also provides:

- Cross-Reference from Non-compliant to Compliant Products
- Ability to browse RoHS Compliant Products in our on-line catalog: <http://www.te.com/commerce/alt/RohsAltHome.do>
- Downloadable Technical Data Customer Information Presentation
- More detailed information regarding the definitions used above

RoHS  
Customer  
Support  
Center 

So whatever your questions when it comes to RoHS, we've got the answers at <http://www.te.com/customersupport/rohssupportcenter/>

AWG Conversion Table (Average Value)

**Conversion Tables**

Most of the wire size ranges are mentioned in mm<sup>2</sup>, as well as the insulation diameters which are in many cases only in mm's.

We therefore included the conversion tables on page X and page XI.

Please note that wire and insulation sizes are for guidance only.

Consult the customer drawing for precise detail.

AWG Code	Diameter (Inch)	Diameter (mm)	F (mm <sup>2</sup> )
000000	0.5800	14.733	170.0
00000	0.5165	13.13	135.0
0000	0.4600	11.684	103.8
000	0.4096	10.40	79.0
00	0.3648	9.27	67.5
0	0.3249	8.25	53.4
1	0.2893	7.34	42.2
2	0.2576	6.55	33.7
3	0.2294	5.82	26.6
4	0.2043	5.18	21.0
5	0.1819	4.62	16.9
6	0.1620	4.115	13.25
7	0.1443	3.66	10.25
8	0.1285	3.26	8.34
9	0.1144	2.90	6.6
10	0.1019	2.59	5.27
11	0.0907	2.30	4.15
12	0.0808	2.05	3.3
13	0.0720	1.83	2.63
14	0.0641	1.63	2.08
15	0.0571	1.45	1.65
16	0.0508	1.29	1.305
17	0.0453	1.14	1.01
18	0.0403	1.02	0.79
19	0.0359	0.91	0.65
20	0.0320	0.81	0.51
21	0.0285	0.72	0.407
22	0.0253	0.64	0.32
23	0.0226	0.57	0.255
24	0.0201	0.51	0.205
25	0.0179	0.455	0.162
26	0.0159	0.40	0.125
27	0.0142	0.36	0.102
28	0.0126	0.320	0.08
29	0.0113	0.287	0.0646
30	0.0100	0.254	0.0516
31	0.0089	0.226	0.04
32	0.0080	0.203	0.0324
33	0.0071	0.180	0.0255
34	0.0063	0.160	0.02
35	0.0056	0.142	0.0158
36	0.0050	0.127	0.0127
37	0.0045	0.114	0.01
38	0.0040	0.101	0.008
39	0.0035	0.089	0.0062
40	0.0031	0.079	0.0049
41	0.0028	0.071	0.00395
42	0.0025	0.064	0.00321
43	0.0022	0.056	0.00246
44	0.00198	0.050	0.00196
45	0.00176	0.045	
46	0.00157	0.040	
47	0.00140	0.036	
48	0.00124	0.031	
49	0.00110	0.028	
50	0.00099	0.025	

**FLK/FLR Cable**

FLK and FLR stand for German DIN (72551) abbreviations.

**FLK means:**

In German:  
 • Fahrzeug Leitung Kunststoff

In English:  
 • Vehicle Cable Plastic

**FLR means:**

In German:  
 • Fahrzeug Leitung Reduziert

In English:  
 • Thin Walled Cable  
 (reduced insulation thickness)

**Remark:** Starting from 0.03 mm<sup>2</sup> (AWG 32) a wire can be crimped.

**Conversion Table – Inch/mm**

<b>Inch</b>	<b>0</b>	<b>0.001</b>	<b>0.002</b>	<b>0.003</b>	<b>0.004</b>	<b>0.005</b>	<b>0.006</b>	<b>0.007</b>	<b>0.008</b>	<b>0.009</b>
0	0	0.0254	0.0508	0.0762	0.1016	0.1270	0.1524	0.1778	0.2032	0.2286
0.010	0.2540	0.2794	0.3048	0.3302	0.3556	0.3810	0.4064	0.4318	0.4572	0.4826
0.020	0.5080	0.5334	0.5588	0.5842	0.6096	0.6350	0.6604	0.6858	0.7112	0.7366
0.030	0.7620	0.7874	0.8128	0.8382	0.8636	0.8890	0.9144	0.9398	0.9652	0.9906
0.040	1.0160	1.0414	1.0668	1.0922	1.1176	1.1430	1.1684	1.1938	1.2192	1.2446
0.050	1.2700	1.2954	1.3208	1.3462	1.3716	1.3970	1.4224	1.4478	1.4732	1.4986
0.060	1.5240	1.5494	1.5748	1.6002	1.6256	1.6510	1.6764	1.7018	1.7272	1.7526
0.070	1.7780	1.8034	1.8288	1.8542	1.8796	1.9050	1.9304	1.9558	1.9812	2.0066
0.080	2.0320	2.0574	2.0828	2.1062	2.1336	2.1590	2.1844	2.2098	2.2352	2.2606
0.090	2.2860	2.3114	2.3368	2.3622	2.3876	2.4130	2.4384	2.4638	2.4892	2.5146
0.100	2.5400	2.5654	2.5908	2.6162	2.6416	2.6670	2.6924	2.7178	2.7432	2.7686
0.110	2.7940	2.8194	2.8448	2.8702	2.8956	2.9210	2.9464	2.9718	2.9972	3.0226
0.120	3.0480	3.0734	3.0988	3.1242	3.1496	3.1750	3.2004	3.2258	3.2512	3.2766
0.130	3.3020	3.3274	3.3528	3.3782	3.4036	3.4290	3.4544	3.4798	3.5052	3.5306
0.140	3.5560	3.5814	3.6068	3.6322	3.6576	3.6830	3.7084	3.7338	3.7592	3.7846
0.150	3.8100	3.8354	3.8608	3.8862	3.9116	3.9370	3.9624	3.9878	4.0132	4.0386
0.160	4.0640	4.0894	4.1148	4.1402	4.1656	4.1910	4.2164	4.2418	4.2672	4.2926
0.170	4.3180	4.3434	4.3688	4.3942	4.4196	4.4450	4.4704	4.4958	4.5212	4.5466
0.180	4.5720	4.5974	4.6228	4.6482	4.6736	4.6990	4.7244	4.7498	4.7752	4.8006
0.190	4.8260	4.8514	4.8768	4.9022	4.9276	4.9530	4.9784	5.0038	5.0292	5.0546
0.200	5.0800	5.1054	5.1308	5.1562	5.1816	5.2070	5.2324	5.2578	5.2832	5.3086
0.210	5.3340	5.3594	5.3848	5.4102	5.4356	5.4610	5.4864	5.5118	5.5372	5.5626
0.220	5.5880	5.6134	5.6388	5.6642	5.6896	5.7150	5.7404	5.7658	5.7912	5.8166
0.230	5.8420	5.8674	5.8928	5.9182	5.9436	5.9690	5.9944	6.0198	6.0452	6.0706
0.240	6.0960	6.1214	6.1468	6.1722	6.1976	6.2230	6.2484	6.2738	6.2992	6.3246
0.250	6.3500	6.3754	6.4008	6.4262	6.4516	6.4770	6.5024	6.5278	6.5532	6.5786
0.260	6.6040	6.6294	6.6548	6.6802	6.7056	6.7310	6.7564	6.7818	6.8072	6.8326
0.270	6.8580	6.8834	6.9088	6.9342	6.9596	6.9850	7.0104	7.0358	7.0612	7.0866
0.280	7.1120	7.1374	7.1628	7.1882	7.2136	7.2390	7.2644	7.2898	7.3152	7.3406
0.290	7.3660	7.3914	7.4168	7.4422	7.4676	7.4930	7.5184	7.5438	7.5692	7.5946
0.300	7.6200	7.6454	7.6708	7.6962	7.7216	7.7470	7.7724	7.7978	7.8232	7.8486
0.310	7.8740	7.8994	7.9248	7.9502	7.9756	8.0010	8.0264	8.0518	8.0772	8.1026
0.320	8.1280	8.1534	8.1788	8.2042	8.2296	8.2550	8.2804	8.3058	8.3312	8.3566
0.330	8.3820	8.4074	8.4328	8.4582	8.4836	8.5090	8.5344	8.5598	8.5852	8.6106
0.340	8.6360	8.6614	8.6868	8.7122	8.7376	8.7630	8.7884	8.8138	8.8392	8.8646
0.350	8.8900	8.9154	8.9408	8.9662	8.9916	9.0170	9.0424	9.0678	9.0932	9.1186
0.360	9.1440	9.1694	9.1948	9.2202	9.2456	9.2710	9.2964	9.3218	9.3472	9.3726
0.370	9.3980	9.4234	9.4488	9.4742	9.4996	9.5250	9.5504	9.5758	9.6012	9.6266
0.380	9.6520	9.6774	9.7028	9.7282	9.7536	9.7790	9.8044	9.8298	9.8552	9.8806
0.390	9.9060	9.9314	9.9568	9.9822	10.0076	10.0330	10.0584	10.0838	10.1092	10.1346
0.400	10.1600	10.1854	10.2108	10.2362	10.2616	10.2870	10.3124	10.3378	10.3632	10.3886
0.410	10.4140	10.4394	10.4648	10.4902	10.5156	10.5410	10.5664	10.5918	10.6172	10.6426
0.420	10.6680	10.6934	10.7188	10.7442	10.7696	10.7950	10.8204	10.8458	10.8712	10.8966
0.430	10.9220	10.9474	10.9728	10.9982	11.0236	11.0490	11.0744	11.0998	11.1252	11.1506
0.440	11.1760	11.2014	11.2268	11.2522	11.2776	11.3030	11.3284	11.3538	11.3792	11.4046
0.450	11.4300	11.4554	11.4808	11.5062	11.5316	11.5510	11.5824	11.6078	11.6332	11.6586
0.460	11.6840	11.7094	11.7348	11.7602	11.7856	11.8110	11.8364	11.8618	11.8872	11.9126
0.470	11.9380	11.9634	11.9888	12.0142	12.0396	12.0650	12.0904	12.1158	12.1412	12.1666
0.480	12.1920	12.2174	12.2428	12.2682	12.2936	12.3190	12.3444	12.3698	12.3952	12.4206
0.490	12.4460	12.4714	12.4968	12.5222	12.5476	12.5730	12.5984	12.6238	12.6492	12.6746
0.500	12.7000									
<b>Inch</b>	<b>0</b>	<b>0.001</b>	<b>0.002</b>	<b>0.003</b>	<b>0.004</b>	<b>0.005</b>	<b>0.006</b>	<b>0.007</b>	<b>0.008</b>	<b>0.009</b>

Conversion Table – Inch/mm (continued)

Inch	0	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009
0.500	12.7000	12.7254	12.7508	12.7762	12.8016	12.8270	12.8524	12.8778	12.9032	12.9286
0.510	12.9540	12.9794	13.0048	13.0302	13.0556	13.0810	13.1064	13.1318	13.1572	13.1826
0.520	13.2080	13.2334	13.2588	13.2842	13.3096	13.3350	13.3604	13.3858	13.4112	13.4366
0.530	13.4620	13.4874	13.5128	15.5382	13.5636	13.5890	13.6144	13.6398	13.6652	13.6906
0.540	13.7160	13.7414	13.7668	13.7922	13.8176	13.8430	13.8684	13.8938	13.9192	13.9446
0.550	13.9700	13.9954	14.0208	14.0462	14.0716	14.0970	14.1224	14.1478	14.1732	14.1986
0.560	14.2240	14.2494	14.2748	14.3002	14.3256	14.3510	14.3764	14.4018	14.4272	14.4526
0.570	14.4780	14.5034	14.5288	14.5542	14.5796	14.6050	14.6304	14.6558	14.6812	14.7066
0.580	14.7320	14.7574	14.7828	14.8082	14.8336	14.8590	14.8844	14.9098	14.9352	14.9606
0.590	14.9860	15.0114	15.0368	15.0622	15.0876	15.1130	15.1384	15.1638	15.1892	15.2146
0.600	15.2400	15.2654	15.2908	15.3162	15.3416	15.3670	15.3924	15.4178	15.4432	15.4686
0.610	15.4940	15.5194	15.5448	15.5702	15.5956	15.6210	15.6464	15.6718	15.6972	15.7226
0.620	15.7480	15.7734	15.7988	15.8242	15.8496	15.8750	15.9004	15.9258	15.9512	15.9766
0.630	16.0020	16.0274	16.0528	16.0782	16.1036	16.1290	16.1544	16.1798	16.2052	16.2306
0.640	16.2560	16.2814	16.3068	16.3322	16.3576	16.3830	16.4084	16.4338	16.4592	16.4846
0.650	16.5100	16.5354	16.5608	16.5862	16.6116	16.6370	16.6624	16.6878	16.7132	16.7386
0.660	16.7640	16.7894	16.8148	16.8402	16.8656	16.8910	16.9164	16.9418	16.9672	16.9926
0.670	17.0180	17.0434	17.0688	17.0942	17.1196	17.1450	17.1704	17.1958	17.2212	17.2466
0.680	17.2720	17.2974	17.3228	17.3482	17.3736	17.3990	17.4244	17.4498	17.4752	17.5006
0.690	17.5260	17.5514	17.5768	17.6022	17.6276	17.6530	17.6784	17.7038	17.7292	17.7546
0.700	17.7800	17.8054	17.8308	17.8562	17.8816	17.9070	17.9324	17.9528	17.9832	18.0086
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0.720	18.2880	18.3134	18.3388	18.3642	18.3896	18.4150	18.4404	18.4658	18.4912	19.5166
0.730	18.5420	18.5674	18.5928	18.6182	18.6436	18.6690	18.6944	18.7198	18.7452	18.7706
0.740	18.7960	18.8214	18.8468	18.8722	18.8976	18.9230	18.9484	18.9738	18.9992	19.0246
0.750	19.0500	19.0754	19.1008	19.1262	19.1516	19.1170	19.2024	19.2278	19.2532	19.2786
0.760	19.3040	19.3294	19.3548	19.3802	19.4056	19.4310	19.4564	19.4818	19.5072	19.5326
0.770	19.5580	19.5834	19.6088	19.6342	19.6596	19.6850	19.7104	19.7358	19.7612	19.7866
0.780	19.8120	19.8374	19.8628	19.8882	19.9136	19.9390	19.9644	19.9898	20.0152	20.0406
0.790	20.0660	20.0914	20.1168	20.1422	20.1676	20.1930	20.2184	20.2438	20.2692	20.2946
0.800	20.3200	20.3454	20.3708	20.3962	20.4216	20.4470	20.4724	20.4978	20.5232	20.5486
0.810	20.5740	20.5994	20.6248	20.6502	20.6756	20.7010	20.7264	20.7518	20.7772	20.8026
0.820	20.8280	20.8534	20.8788	20.9042	20.9296	20.9550	20.9804	21.0058	21.0312	21.0566
0.830	21.0820	21.1074	21.1328	21.1582	21.1836	21.2090	21.2344	21.2598	21.2852	21.3106
0.840	21.3360	21.3614	21.3868	21.4122	21.4376	21.4630	21.4884	21.5138	21.5392	21.5646
0.850	21.5900	21.6154	21.6408	21.6662	21.6916	21.7170	21.7424	21.7678	21.7932	21.8186
0.860	21.8440	21.8694	21.8948	21.9202	21.9456	21.9710	21.9964	22.0218	22.0472	22.0726
0.870	22.0980	22.1234	22.1488	22.1742	22.1996	22.2250	22.2504	22.2758	22.3012	22.3266
0.880	22.3520	22.3774	22.4028	22.4282	22.4536	22.4790	22.5044	22.5298	22.5552	22.5806
0.890	22.6060	22.6314	22.6568	22.6822	22.7076	22.7330	22.7584	22.7838	22.8092	22.8346
0.900	22.8600	22.8854	22.9108	22.9362	22.9616	22.9870	23.0124	23.0378	23.0632	23.0886
0.910	23.1140	23.1394	23.1648	23.1902	23.2156	23.2410	23.2664	23.2918	23.3172	23.3426
0.920	23.3680	23.3934	23.4188	23.4442	23.4696	23.4950	23.5204	23.5458	23.5712	23.5966
0.930	23.6220	23.6474	23.6728	23.6982	23.7236	23.7490	23.7744	23.7998	23.8252	23.8506
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0.960	24.3840	24.4094	24.4348	24.4602	24.4856	24.5110	24.5364	24.5618	24.5872	24.6126
0.970	24.6380	24.6634	24.6888	24.7142	24.7396	24.7650	24.7904	24.8158	24.8412	24.8666
0.980	24.8920	24.9174	24.9428	24.9682	24.9936	25.0190	25.0444	25.0698	25.0952	25.1206
0.990	25.1460	25.1714	25.1968	25.2222	25.2476	25.2730	25.2984	25.3228	25.3492	25.3746
1.000	25.4000									
Inch	0	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009



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# THE PRODUCTS



✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
✓	✓	✓	✓
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Engineering Notes

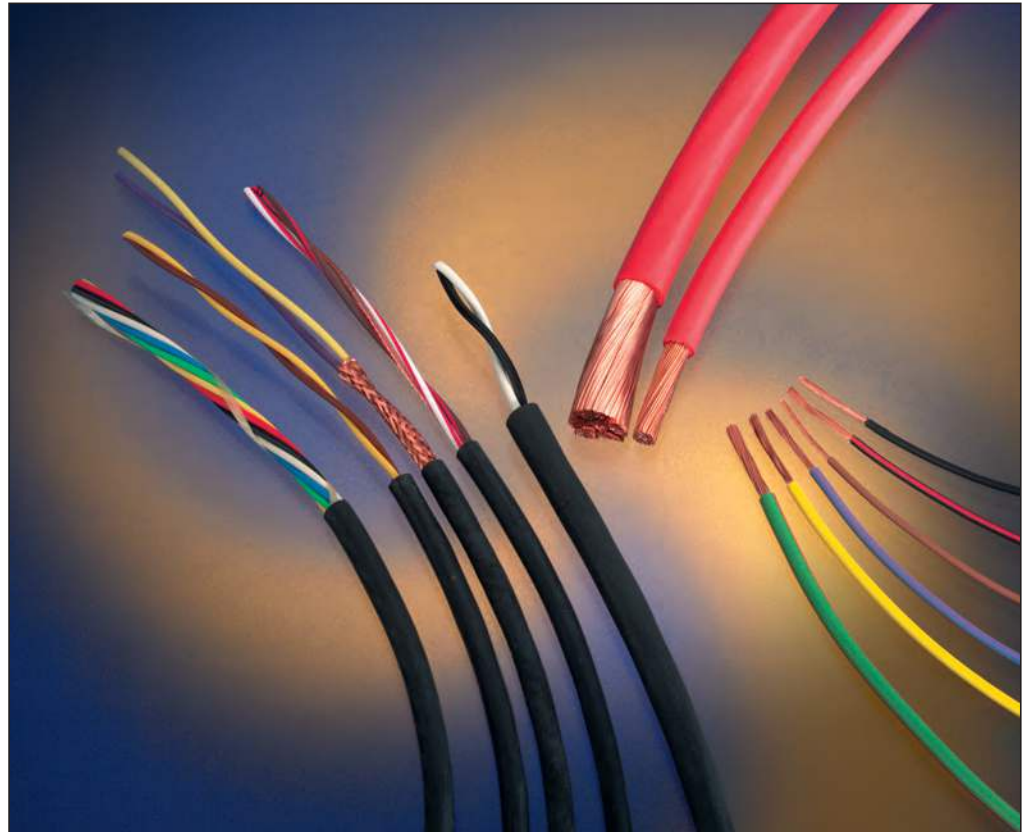
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Introduction



**TE Connectivity's Raychem offers a wide range of high performance wire and cables that are designed to meet or exceed the most rigorous automotive specs. Our wire and cable products use innovative materials and are engineered to be light-weight whilst offering a cost effective solution.**



TE Connectivity's Raychem brand of Automotive Wire and Cable products is recognized worldwide, and is backed by a history of proven performance, reliability, innovation and superior quality.

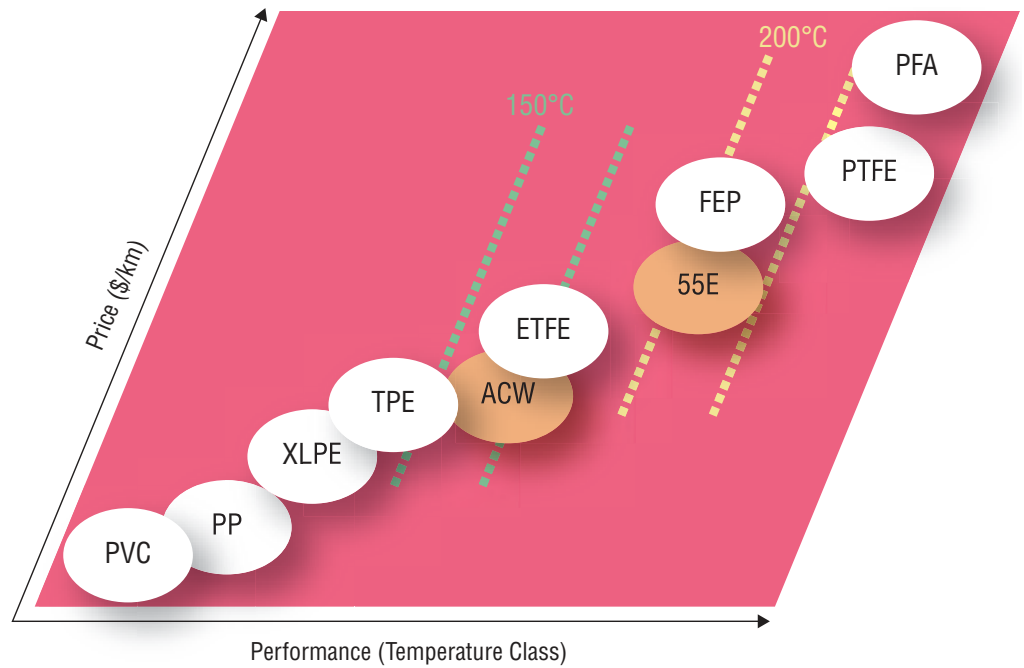
For over forty-five years, customers have recognized the global capabilities of TE Connectivity's Raychem products. Combining these advanced products with superior technical support and a global sales/services organization, customers with worldwide operations count on TE Connectivity's Raychem to supply the knowledge and products they need to solve specific problems and help them take advantage of opportunities, anywhere they arise.

This philosophy has earned TE Connectivity's Raychem a reputation for leadership in materials science technologies.

Developed from these technologies, TE Connectivity's Raychem high performance Automotive Wires and Cables perform from  $-40\text{ }^{\circ}\text{C}$  to  $+200\text{ }^{\circ}\text{C}$ . They are engineered to meet or exceed the most rigorous automotive specifications, and are the solution for challenging environments and demanding applications.

This catalog brings together some of the unique, tried and tested technologies pioneered by TE Connectivity's Raychem. Materials with unique properties, manufacturing techniques finely honed with experience and research and development expertise combine to provide some of the most innovative Automotive Wires and Cables today.

The TE Connectivity's Raychem Approach



The TE Connectivity's Raychem brand started to produce wires in the late 50s by introducing two new technologies in the market: Irradiation cross-linking and dual-wall insulation systems combining two different polymers to offer the best benefits of both.

The "chem" in our brand comes from chemistry, our product development team are continuously looking for new ways to enhance the performance of "off-the-shelf" materials.

Our strategy was, and still is, to add value to the market by offering products which out-perform commodities either in cost or in properties to provide the best value alternative to a given specification.

This is what the graph above shows:

- 55E is the T6 wire offering the best balance of cost/performance, in the automotive market and we achieved it by chemically modifying the base polymer and then cross-linking it using an e-beam.
- ACW is the T4 wire offering the best balance of cost/performance, in the automotive market and we achieved it by creating a dual-wall insulation system, chemically modified and also e-beam irradiated. A key factor in the success of ACW is the fact that the two walls are bonded and behave as a single insulation during the handling processes in harness shops.

Core Technologies

**TE Connectivity's Raychem Wire and Cable Technology:**

**Materials Challenges – Leading Edge Solutions**

TE Connectivity's Raychem has pioneered, since the 1950's, many of the breakthrough technologies used to create today's most advanced insulation/protection systems. TE Connectivity's Raychem products are in service throughout the world in automotive, telecommunications, power distribution, aerospace and defence applications.

Renowned for their unrivalled performance and reliability in the most demanding of environments, they include a comprehensive range of Automotive Wire and Cable products. Combined with TE Connectivity's Raychem state-of-the-art manufacturing facilities and processes, these products offer the most cost-effective and robust solution to all your wiring and interconnection needs.

**Pioneers in Automotive Wire and Cable**

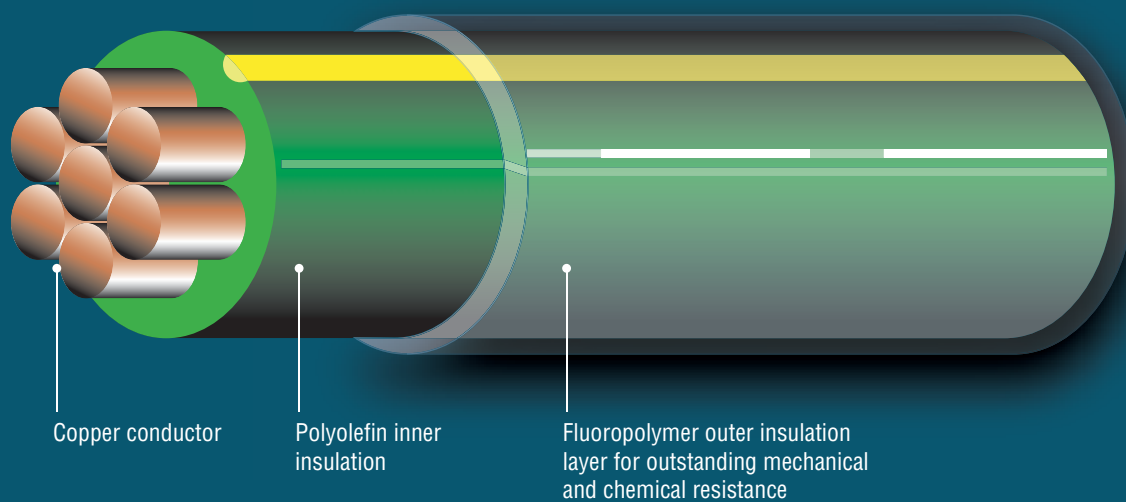
TE Connectivity's Raychem was the first company to commercialize radiation cross-linking of insulation, initially for aerospace applications. The high-performance technologies developed were later adapted and further developed for high-volume automotive applications. Maintaining its position as the pre-eminent force in radiation cross-linked insulation materials to the present day.

**55E Wire: 200 °C Automotive Engine Compartment Wire**

First developed by TE Connectivity's Raychem for the aerospace industry, where ultra-reliability is a must, the predecessor of this wire has been in service in commercial and military aircraft for the past 30 years with an unparalleled safety record. It is a cross-linked fluoropolymer insulation, and as such, maintains an excellent balance of properties at extremes of temperature.

In its automotive version, it possesses superior robustness, markability and overmolding characteristics to rival insulation types, and is essentially immune to all forms of chemical attack by automotive fluids.

**ACW: Automotive Composite Wire – Dual layer bonded insulation technology**



Core Technologies

**ACW Wire:  
The Leader in Dual Wall  
Technology for 150 °C  
Automotive Applications**

In the 1960s, TE Connectivity's Raychem developed the first successful dual-layer insulation, balancing some key performance advantages of fluoropolymer materials, with some of the cost advantages of polyolefin insulation. This was achieved by extruding a fluoropolymer outer layer over an inner layer of polyolefin insulation, and cross-linking the resulting product.

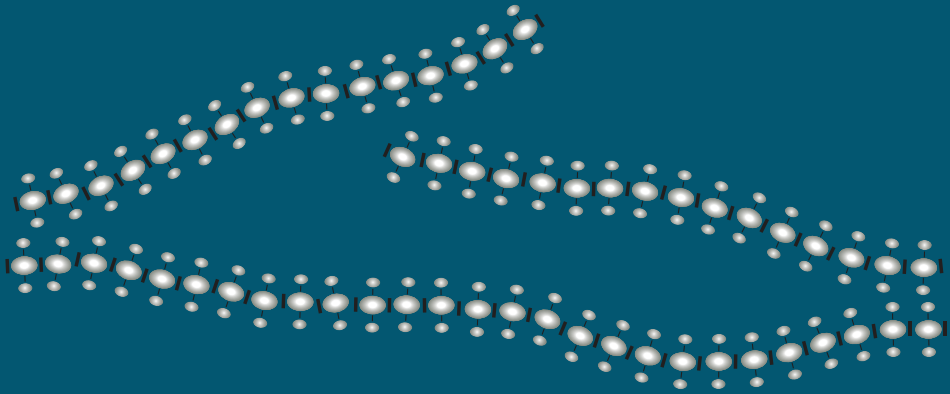
In the late 1990s, TE Connectivity's Raychem took this technology to the next level, inventing a way to bond these seemingly incompatible layers together, to create a true composite insulation structure for the first time. In fact the name "ACW" stands for "Automotive Composite Wire".

This breakthrough enabled TE Connectivity's Raychem to provide the automotive industry with an outstandingly robust and cost-effective product, with some critical advantages over competing technologies (including non-bonded "lookalike" products).

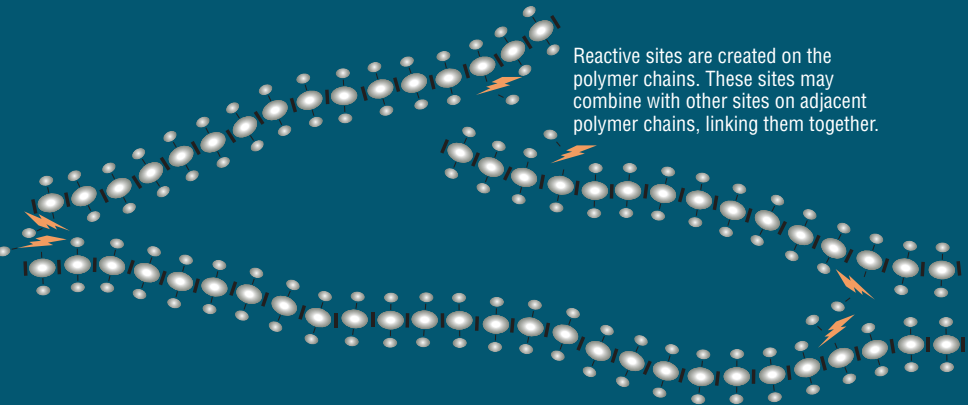
In addition to meeting the most demanding 150 °C specifications, the product possesses superb automated handling and stripping characteristics. As a result of these benefits, ACW has quickly become the dominant 150 °C wire in use today by OEMs, and its use continues to grow.

**What is Radiation Cross-Linking?**

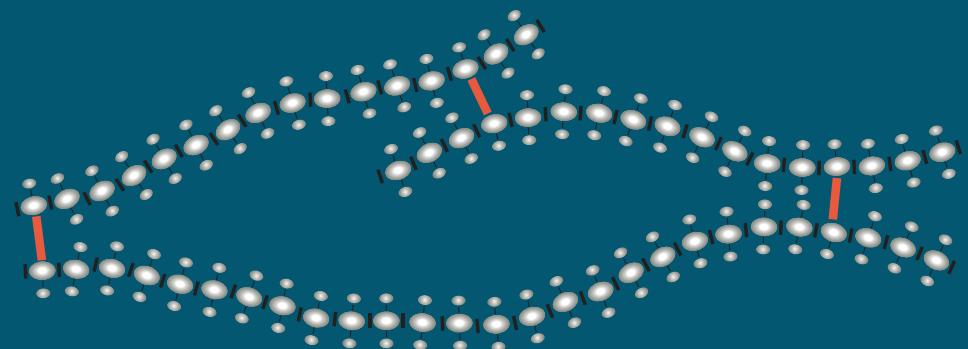
Uncross-linked polymer chains in insulation immediately after extrusion:  
Long chain molecules are free to slide over each other – polymer can be melted.



To cross-link the insulation, high energy electrons are fired at it in a special chamber:



The resulting structure is a network of linked molecules:  
This acts as a single giant molecule. Because the chains are no longer free to move over one another, the cross-linked molecules will not melt.



Core Technologies



As part of our advanced product development facility we have a comprehensive suite of analytical equipment that aids product design.

Picture: Scanning electron microscope



During product development wires are tested against many requirements outside of the OEMs specification. The way the wire behaves in the many harness shop processes is critical to the design.

Picture: Ultrasonic welding machine

**TE Connectivity's Raychem Product Design Philosophy**

**• Innovation is Key:**

We don't focus on "me too" products. We concentrate instead on adding significant technology, cost, and quality benefits to our customers. We achieve this by taking a radical approach to product design, focussing on the optimum solution for the application, rather than on the characteristics of existing solutions.

**• Testing Products to their Limits and Beyond:**

We ensure the robustness of our products by extensive testing, not just to customers specification requirements, but well beyond them, to ensure that we fully understand the performance envelope of our products. Thus we ensure that the claims we make for the reliability and performance of our wire and cable products can be backed up by hard experimental data.

**• Meeting the Customer's Real Needs:**

We have long recognised that a great product need not only meet the formal specifications, but also a whole range of performance characteristics. We have conducted extensive work with a range of customers to define these characteristics, and in conjunction with them, have developed our own "handling specification", an internal requirement which we ensure our products pass before we release them commercially. This document comprises a rigorous series of tests, often under extreme conditions. It assesses a wire's ability to pass successfully through all the major operations (e.g. cutting, stripping, termination, welding) to which it is likely to be subjected during the manufacture of harnesses, or installation into a vehicle.

**• Continuous Improvement:**

We visit our customers frequently, to ensure their ongoing satisfaction with our products, and are always keen to listen to their views on any further refinements they would like to see. We also continuously review the performance and competitiveness of our products, and introduce efficiency, quality, and/or technical improvements with every iteration. Thus we ensure that our customers are able to benefit from TECHNICALLY advanced products, and we aim always to provide products with the leading price/performance ratio in each temperature class.

**• Commitment to Quality:**

Our ISO TS 16949 approved manufacturing plants are able to provide guaranteed quality products, manufactured to the most demanding performance and dimensional specifications on precision extrusion and processing equipment.

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Core Technologies

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**Summary**

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**TE Connectivity's Raychem –  
Technical Leadership in the  
Wire and Cable Industry**

- We were pioneers of radiation cross-linking, and one of the leading suppliers of such products worldwide.
- All our major product lines use insulation formulations developed in-house, and tailored to give optimum performance for each specific need.
- When we develop any new product, we test it well beyond the limits of international and OEM specifications, to ensure that it will not only exceed expectations in service, but will be as easy to process and install as possible.
- We employ state-of-the-art manufacturing techniques to ensure that consistent product quality is achieved.
- We provide comprehensive handling guidelines with our products, and our expert technical support team is always on hand to respond to any technical queries that may arise.

**Quality/Environment**

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**End of Life  
Vehicles Directive**

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All of our products (in this catalog – must be specific and must be checked) meet the requirements of the published EC Directive on “End of Life Vehicles”, 2000/53/EC, in that they do not contain cadmium, mercury, lead or hexavalent chromium.

According to amendment reference 2002/525/EC of Directive 2000/53/EC, we do not declare materials below a maximum concentration value up to 0.1 % by weight for lead, hexavalent chromium and mercury and up to 0.01% by weight for cadmium, if these substances are not intentionally introduced.

**Declarable and Restricted  
Materials Reporting**

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Our standard electronic reporting method for product material content, including declarable or restricted materials, is via the International Material Data System (IMDS), by means of Material Data Sheet (MDS) submissions to our customers upon request or new part approval.












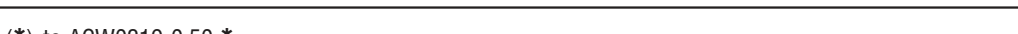
In the IMDS, all materials used for car manufacture are archived and maintained. Only in this way is it possible to meet the obligations placed on car manufacturers, and thus on their suppliers, by national and international standards, laws and regulations.

Compliance with other OEM's material reporting requirements is maintained by submission of relevant declaration forms as required against individual OEM specifications.

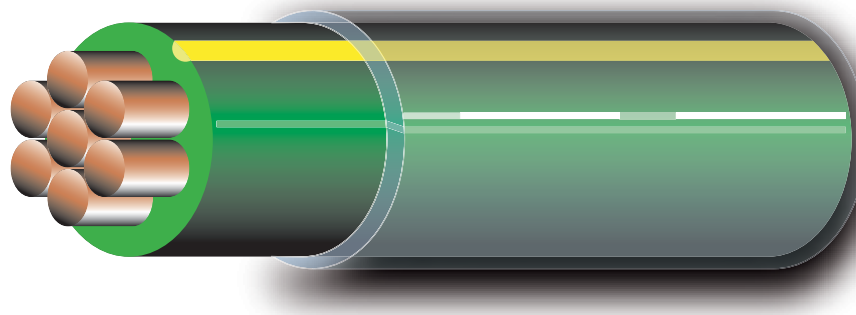


Color Code Cross Reference

Color Coding Chart

0	Black	
1	Brown	
2	Red	
2L	Pink	
3	Orange	
4	Yellow	
45	Yellow/Green	
5	Green	
6	Blue	
7	Violet	
8	Gray	
9	White	

(\*) to ACW0219-0.50-\*



**ACW0219**  
**Ordering Example:**

**ACW0219-0.50-54**

The “\*” in the part number shall be replaced by a standard numerical color code designator as per above.

Additional number after base color indicates stripe:  
e.g. ACW0219-0.50-54 is a green base color with yellow stripe.

Where stripes are required the wire carries two co-extruded longitudinal stripes of the same color.

The individual stripe width is a minimum of 10 % of the wire circumference with an overall stripe coverage of 30 % maximum.

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Engineering Notes

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# Automotive Wire and Cable Application Documents

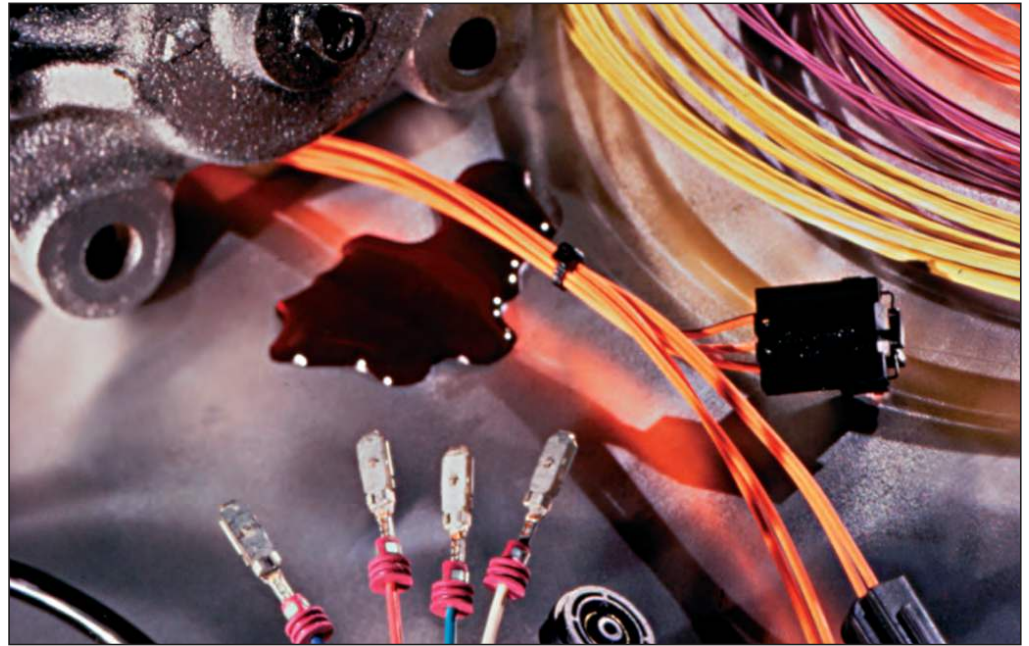


Interconnection Wiring



**150 °C Rated T4 Class D Thin-Wall Engine Harness Wire**

TE Connectivity's Raychem ACW is mechanically tough and provides smaller, lighter 150 °C engine harness wires. Its high performance fluoropolymer outer layer provides excellent fluid resistance.



**The Challenge Facing Manufacturers**

The need for 150°C rated engine harness wires may occur throughout the engine compartment. These wires have to withstand attack from a range of automotive fluids, including water, antifreeze, brake fluid and engine oil. These fluids can often be trapped or kept in contact with the harness at high temperatures. Engine oil, in particular, can be very harmful to some wire insulation types when hot.

Manufacturers need tough, yet flexible wires, able to meet fluid resistance requirements across the operating temperature range. The wire must be fully compatible with the wide variety of automated handling equipment used in harness assembly plants.

**Conventional Solutions**

ETFE insulated wires offer excellent mechanical strength and fluid resistance, but are expensive compared to other insulation types. Polyester wires offer good performance and low cost, but can react adversely with a number of different materials commonly found in the engine compartment. Cross-linked polyethylene insulated wires offer limited mechanical protection, poor resistance to oil and are not sufficiently mechanically robust to be used in thin-wall constructions.

**The TE Connectivity's Raychem Solution**

TE Connectivity's Raychem ACW is a composite construction with a tough radiation cross-linked fluoropolymer outer layer. This outer layer is bonded to a radiation cross-linked polyolefin.

**TE Connectivity's Raychem Products**

- ACW

**Benefits**

- Lower unit cost – at true T4 performance level.
- Smaller, lighter more flexible wires – providing easier installation.
- Designed to be compatible with typical wire-handling equipment used in harness shops through the unique bonding of the two layers.
- High level of compatibility with materials used in the harnessing process.
- Thin-wall designs – providing improved handling and space savings and manufactured connector compatibility benefits.
- Low friction characteristics – slides over bundles (resists blocking at high temperatures).

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## Interconnection Wiring

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### **TE Connectivity's Raychem ACW**

ACW is a dual-wall automotive wire with a polyalkene inner layer and a tough fluoropolymer outer layer. The unique bonding between the dissimilar inner and outer layers of ACW give the additional benefit of substantial improvement in the mechanical performance of the wire.

### **Product Features**

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- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (3000 hrs)
- Unique bonded composite-wall insulation system
- Tough, fluoropolymer outer jacket
- Superior fluid resistance compared to cross-linked polyolefins
- Compatible with all harness components
- Available in thin wall dimensions only
- Very cost competitive
- Mechanically tough
- Designed to be compatible with all harness shop processes

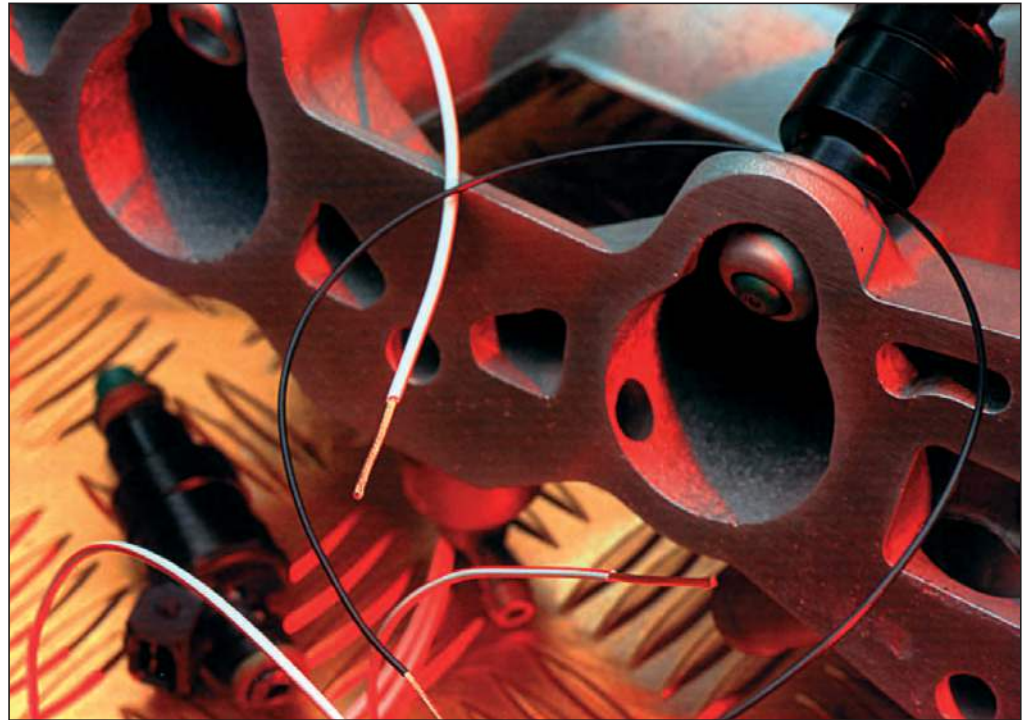
**For full technical information on TE Connectivity's Raychem ACW please see pages 30–33.**

Interconnection Wiring



**200 °C Rated T6, Class F Thin-Wall and Ultra Thin-Wall Engine Harness Wire**

Using TE Connectivity's Raychem high performance fluoropolymer insulations provide smaller, lighter and lower cost 200 °C engine harness wires and is particularly suitable for environments with aggressive fluids, such as hot oils.



**The Challenge Facing Manufacturers**

200 °C engine harness wires are usually specified for the hottest underbonnet areas in cars. These include wires running in close proximity to the exhaust system, wires in the link between the Lambda (O<sub>2</sub>) sensor to the ECU and wires inside the engine cover in applications such as common diesel injection, direct injection, and electronic valves.

As well as high temperatures, 200 °C engine harness wires must also be capable of coping with engine movement and vibration and resist automotive fluids. Wire cost is, of course, a critical issue for manufacturers, but additional requirements often include good flexibility, reduced flammability, improved handling and strippability.

**Conventional Solutions**

Many manufacturers use PTFE and FEP insulated wires in 200 °C applications, however, these materials are expensive and have a number of problems.

PTFE offers poor mechanical cut-through performance and as a result, is often overprotected, increasing costs still further. In addition, PTFE and FEP cannot be supplied in thin-wall wire designs, which provide improved handling, space savings and constructional benefits, particularly when designing miniaturized connectors. PTFE and FEP are also both susceptible to cold flow.

It is important that wires do not melt if in contact with a hot surface for a period of time.

FEP insulated wires may exhibit short circuit failure on contact with hot surfaces such as exhaust systems, since the uncross-linked insulation will melt.

**The TE Connectivity's Raychem Solution**

Using tough advanced, TE Connectivity's Raychem radiation cross-linked fluoropolymer insulation, offers exceptional high temperature performance and resistance to hot surface damage.

It also increases safety in case of accidental contact with hot surfaces, with a lower unit cost compared to alternative fluoropolymer solutions. The tough mechanical characteristics also allows TE Connectivity's Raychem to produce these wires in thin-wall constructions, providing superior harness shop processing as well as significant space and weight savings, whilst offering the opportunity to remove overprotection.

**TE Connectivity's Raychem Products**

- 55E Wire

**Benefits**

- Lower unit cost at true T6 performance level.
- Designed to be compatible with typical wire handling equipment used in harness shops.
- Smaller, lighter wires – with the same temperature performance.
- Thin-wall designs – providing improved handling, space savings and miniaturized connector compatibility benefits.
- Improved mechanical and abrasion performance – compared to PTFE and FEP.
- Irradiation cross-linked insulation does not melt when touching hot surfaces.
- Offers the opportunity to remove costly overprotection.

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**Interconnection Wiring**

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**TE Connectivity's Raychem  
55E Wire**

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TE Connectivity's Raychem 55E is a modified radiation cross-linked fluoropolymer insulated wire combining flexibility for easy handling with excellent all round performance.

It has a high temperature rating and the thin-wall construction allows high wiring densities to be achieved. TE Connectivity's Raychem 55E is easy to install and can be processed using standard lead preparation equipment.

**Product Features**

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- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$  (3000 hrs)
- Mechanically tough across operating temperature range
- Resistance to hot surface damage, e.g. accidental contact with exhaust manifolds
- Outstanding resistance to automotive fluids
- Small size, light-weight
- Superior cold-flow and cut-through performance compared to PTFE or FEP
- Solder iron resistance

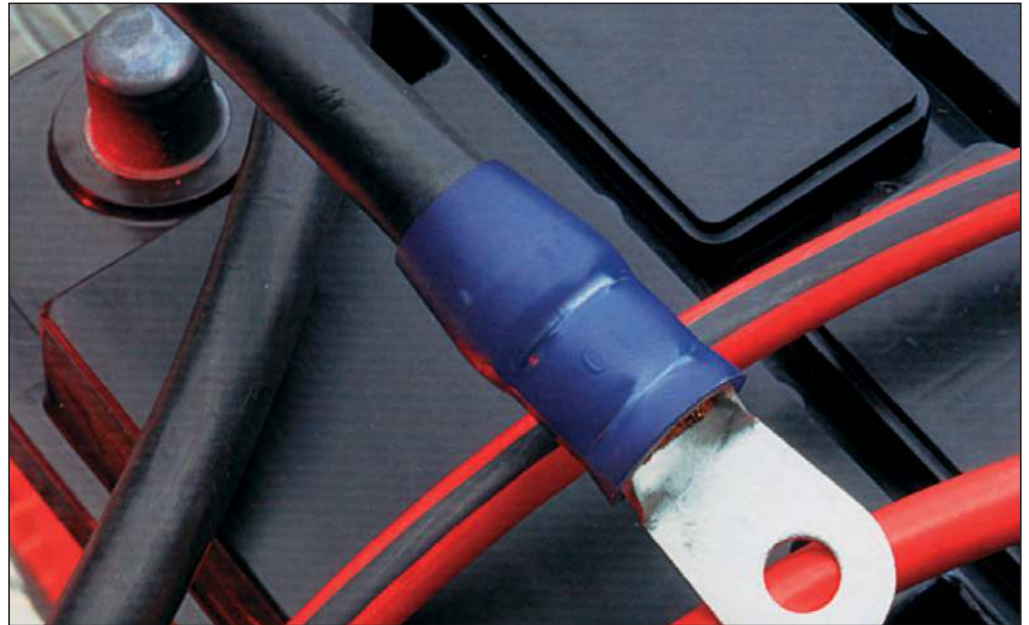
**For full technical information on TE Connectivity's Raychem 55E wire please see pages 34–37.**

Interconnection Wiring



**150 °C and 200 °C  
Cost Effective Battery  
and Power Cables**

Tough TE Connectivity's Raychem modified polymer insulated power cables can cost-effectively replace cables that require subsequent, expensive overprotection



**The Challenge Facing Manufacturers**

Automotive power cables, running from the alternator to the battery, the battery to the starter motor, the battery to the fuse box, or when used in electric vehicles such as motor wiring can carry high current. Cables carrying these high currents present a significant fire risk particularly if they short circuit against other components or the vehicle frame. Insulation systems must therefore offer adequate abrasion and cut-through resistance in the automotive environment. This entails resistance to automotive fluids and extremes of temperature. Temperature requirements vary according to the routing of the cable, the cable cross-section and the current loading. The graph on next page shows typical current rating curves for 105 °C, 125 °C, 150 °C and 200 °C for 25 mm<sup>2</sup> power cables in free air. There is often a trade off between the maximum permitted temperature of the insulation system, the size of conductor used and the level of mechanical overprotection required.

**Conventional Solutions**

PVC or silicone insulations are traditionally used for power cables in cars, however, their poor mechanical strength and abrasion resistance means they usually have to be provided with some form of thick overprotection, adding costs. Cross-linked polyethylene insulation systems offer enhanced performance over PVC but they are costly and offer poor mechanical performance above the crystalline melting point of polyethylene (~127 °C). Short-term current ratings of these cables are therefore very limited. Battery cable currents peak when the starter motor is turned but the running load on these cables is also considerable due to the requirement to smooth power consumption. New applications including electrical heating place high current drains on the battery whilst the engine is not running. It is therefore critical to consider not only the ambient temperature but also the temperature rise due to resistance heating in the cable when choosing the insulation system.

**The TE Connectivity's Raychem Solution**

For 150 °C applications TE Connectivity's Raychem bonded dual-wall technology offers a unique combination of a cross-linked polyalkene inner layer and a tough fluoropolymer outer layer. The result is a highly flexible cable that is resistant to automotive fluids and mechanical abuse at 150 °C and for short-term excursions well above this temperature.

Occasionally power cables must withstand extreme temperatures. In these cases TE Connectivity's Raychem offer a modified fluoro-elastomer insulation system that can be rated at 200 °C for 3000 hours in the automotive environment.

**TE Connectivity's Raychem Products**

- ACW
- MPCB
- HTPC

**Benefits**

- Reduced need for overprotection – through increased abrasion resistance
- Higher current rating at a given ambient temperature
- Safe operation during short-term high current loading
- Flexible for easy handling



Interconnection Wiring

**TE Connectivity's Raychem ACW**

ACW is a dual-wall automotive wire with a polyalkene inner layer and a tough fluoropolymer outer layer. The recently developed unique bonding between the dissimilar inner and outer layers of ACW give the additional benefit of substantial improvement in the mechanical performance of the wire.

**Product Features**

- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (3000 hrs)
- Unique bonded composite-wall insulation system
- Tough, fluoropolymer outer jacket
- Superior fluid resistance compared to cross-linked polyolefins
- Compatible with all harness components
- Available in thin wall dimensions only
- Very cost competitive
- Mechanically tough
- Designed to be compatible with all harness shop processes

For full technical information on TE Connectivity's Raychem ACW please see pages 30–33.

**TE Connectivity's Raychem MPCB**

MPCB has been developed to offer cost-effective solutions for power distributions in the car.

**Product Features**

- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (3000 hrs)
- Available in reduced wall only
- Very cost competitive
- Mechanically tough
- Outstanding resistance to automotive fluids
- Compatible with all harness components
- Light-weight

For full technical information on TE Connectivity's Raychem MPCB please see pages 42–43.

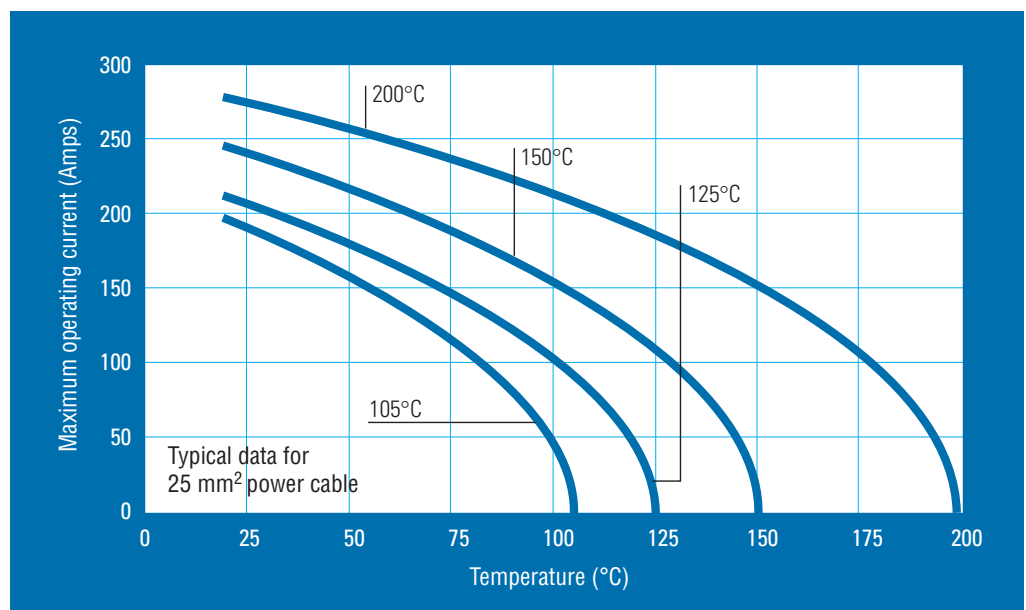
**TE Connectivity's Raychem HTPC**

HTPC has been developed to offer cost-effective solutions for power distributions in the car.

**Product Features**

- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$  (3000 hrs)
- Available in reduced wall only
- Very cost competitive
- Mechanically tough
- Outstanding resistance to automotive fluids
- Compatible with all harness components
- Light-weight

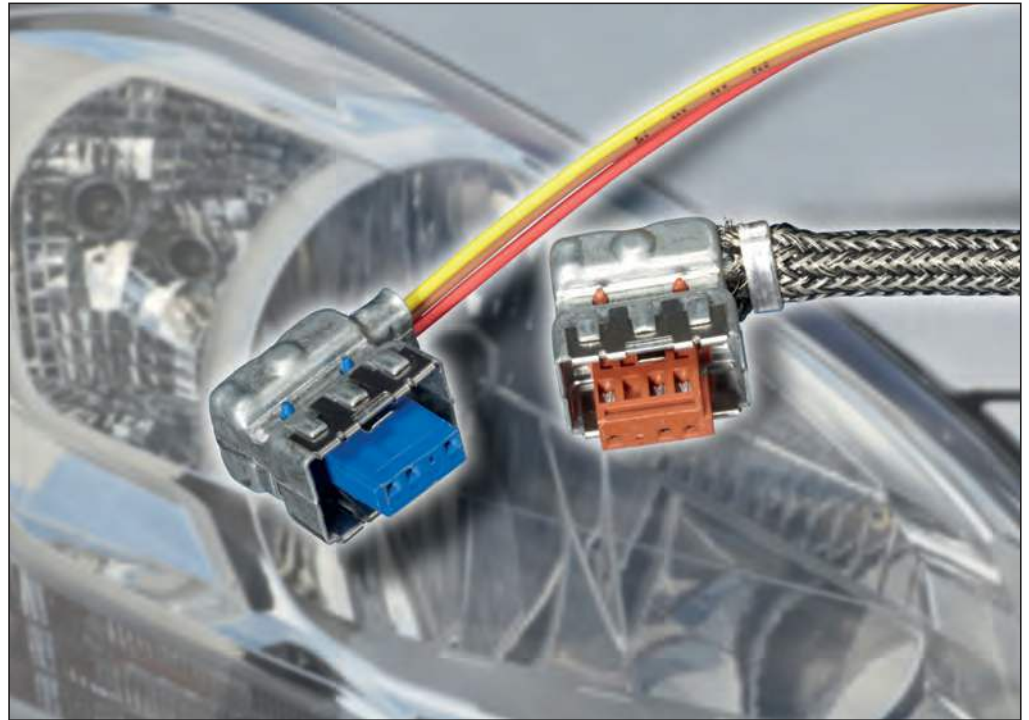
For full technical information on TE Connectivity's Raychem HTPC please see pages 42–43.



Interconnection Wiring



Lower Cost and Thinner Lighting Wires



TE Connectivity's Raychem high performance insulations systems provide smaller, lighter and lower cost high temperature lighting wires

The Challenge Facing Manufacturers

Vehicle head lamp and fog lamp housings frequently contain many wires – both to power and control the lamp itself and to connect associated components such as light valves and adjusting motors. Lamp housings get extremely hot and insulation materials capable of withstanding high temperatures for sustained periods are often required. Small wire size can also be an advantage for manufacturers in helping to reduce lamp housing sizes, and good flexibility is essential to aid the installation of wires, lamps and connectors in enclosed lamp surrounds.

Conventional Solutions

Many manufacturers use ETFE and fluoropolymer insulated wires in high temperature lighting applications, however, these materials are expensive. Silicon insulated wires are often used in fog lamp housings due to their low cost and excellent flexibility. However, silicon offers poor mechanical performance and poor resistance to fluids leading to the use of additional expensive overprotection.

The TE Connectivity's Raychem Solution

TE Connectivity's Raychem tough insulations offer exceptional high temperature performance with lower unit costs compared to ETFE and fluoropolymer insulated designs. The properties of these insulations also allows TE Connectivity's Raychem to provide smaller wires for ease of handling and installation in crowded lighting housings.

TE Connectivity's Raychem Products

- ACW
- ASC's

Benefits

- High temperature lighting wires – at a lower unit cost compared to ETFE and fluoropolymer designs.
- Smaller, lighter wires – providing improved handling and space savings in enclosed lighting housings.
- Available in thin-wall designs – with screening if required.
- Improved mechanical performance compared to silicon insulated wires – eliminating the need for costly overprotection.
- Compatible with wire-handling equipment used in harness shops.

Interconnection Wiring

**TE Connectivity's Raychem ACW**

ACW is a dual-wall automotive wire with a polyalkene inner layer and a tough fluoropolymer outer layer. The unique bonding between the dissimilar inner and outer layers of ACW give the additional benefit of substantial improvement in the mechanical performance of the wire.

**Product Features**

- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (3000 hrs)
- Unique bonded composite-wall insulation system
- Tough, fluoropolymer outer jacket
- Superior fluid resistance compared to cross-linked polyolefins
- Compatible with all harness components
- Available in thin wall dimensions only
- Very cost competitive
- Mechanically tough
- Designed to be compatible with all harness shop processes

**For full technical information on TE Connectivity's Raychem ACW please see pages 30–33.**

**TE Connectivity's Raychem ASC's**

TE Connectivity's Raychem automotive signal wires can be constructed to meet the most demanding lighting wire applications. The wide choice of components, screening options and jacket materials means cables can be tailored to suit virtually any combination of temperature, flexibility, screening and mechanical protection requirements.

**Product Features**

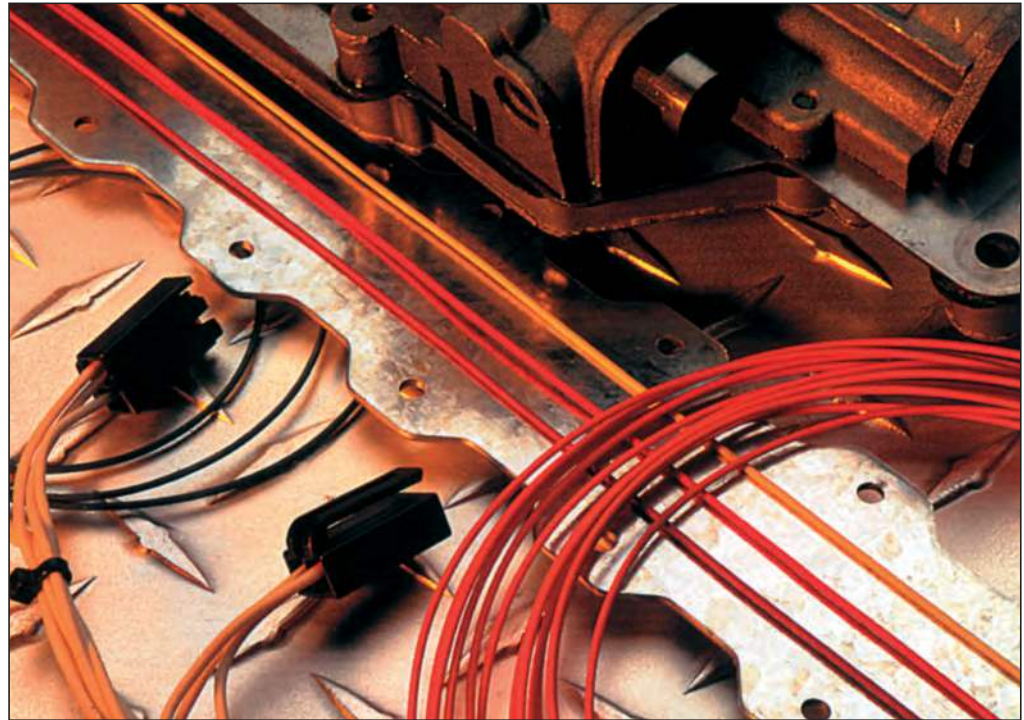
- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$  (3000 hrs)
- Choice of conductors, screens and jacket materials to suit the most demanding lighting and engine sensor applications
- Screening options include bare copper braid, braid with drainwire, optimised braids with guaranteed superior surface transfer impedance characteristics, and aluminum foil with drainwire
- Jacket material options to provide high flexibility and excellent mechanical protection
- High diesel fuel resistance
- Designed for stripping and over-molding
- Choice of cable dimensions
- Preferred Component Wires:
  - ACW0219 –  $150^{\circ}\text{C}$  rating
  - 44E0119 –  $150^{\circ}\text{C}$  rating
  - 44E0111 –  $150^{\circ}\text{C}$  rating
  - FLTA0119 –  $150^{\circ}\text{C}$  rating
  - FLTA0111 –  $150^{\circ}\text{C}$  rating
  - 55E0119 –  $200^{\circ}\text{C}$  rating
- Preferred Jackets:
  - ACJ general purpose cable jacket –  $150^{\circ}\text{C}$  rating
  - Fluoroelastomer –  $200^{\circ}\text{C}$  rating

**For full technical information on TE Connectivity's Raychem ASC please see pages 40–41.**

Interconnection Wiring



**Low Cost, Highly Fluid-Resistant Automatic Transmission Wire**



TE Connectivity's Raychem insulated ATF wire has outstanding resistance to automatic transmission fluid and offers significantly reduced wire costs compared with ETFE and other fluoropolymer insulated wires. This wire has been approved for use by US based OEM's as an automatic transmission wire.

**The Challenge Facing Manufacturers**

Today's automatic gearbox is a complex electronically controlled device which typically contains sensors for speed, fluid temperature, fluid pressure and a range of other functions. These sensors are connected to an outside ECU via several meters of wires inside the gearbox. Internal gearbox wires are often immersed in hot, aggressive transmission fluid which can rapidly degrade standard polymer insulations.

Manufacturers have traditionally selected high performance polymer insulations which carry significant cost penalties.

**Conventional Solutions**

ETFE and other fluoropolymer insulation wires are often used in automatic transmission gearbox applications to provide the necessary transmission fluid-resistant performance. However, these materials are expensive and can present significant cost penalties since between 10 and 20 meters of wire may be contained in an automatic gearbox.

**The TE Automotive Solution**

Using TE Connectivity's Raychem ATF wire which is a specially modified radiation cross-linked fluoropolymer material with excellent long term performance when immersed in hot automatic transmission fluid. ATF wires provide similar transmission fluid-resistant performance to ETFE and PTFE materials, but at a lower price.

**Benefits**

- Reduces automatic transmission wire costs
- Outstanding resistance to automatic transmission fluid
- Mechanically tough – to withstand shop processing and in-service needs

**TE Connectivity's Raychem Products**

- ATF Wire

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**Interconnection Wiring**

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**TE Connectivity's Raychem  
ATF Wire**

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ATF wire is specifically designed for electronic automatic transmission applications and combines durability with excellent fluid resistance and thermally stable insulation materials.

TE Connectivity's Raychem ATF wire provides a similar performance to fluoropolymer wires, at a lower price and is easy to handle using standard lead preparation equipment.

**Product Features**

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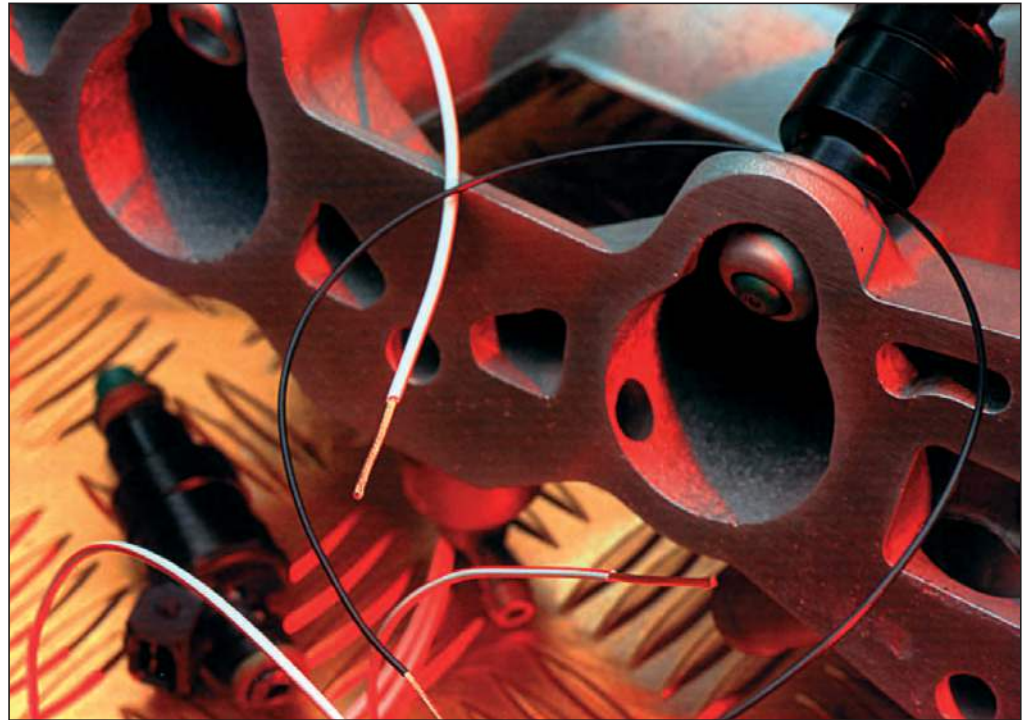
- Temperature rating  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (3000 hrs)
- Outstanding transmission fluid resistance
- Light-weight, small size

**For full technical information on  
TE Connectivity's Raychem ATF  
Wire please see pages 38–39.**

Interconnection Wiring



**High Performance Diesel Engine Injector Wires and Cables**



TE Connectivity's Raychem diesel resistant cables provide mechanical and diesel fuel-resistant performance comparable with fluoropolymer cables, but at a lower price

**The Challenge Facing Manufacturers**

In both – cars and trucks, the injectors and the pump are connected to the electronic control unit by wires or cables. These wires and cables can come into contact with hot diesel fuel and mist which is very aggressive and capable of weakening most insulation materials.

Cables may also need to be compatible with overmolding processes where protection is placed over the injector and pump terminations. This places further demands on cable insulation materials and cable production processes.

**Conventional Solutions**

Fluoropolymer insulations such as FEP and PTFE are often used on wires in this application to provide resistance against diesel fuel. However, these materials are expensive and offer lower levels of mechanical performance compared to TE Connectivity's Raychem 55E or ACW options. These conventional materials also possess a vulnerability to cold flow under conditions of pressure, even below the crystalline melting point of the polymer.

**TE Connectivity's Raychem Products**

- ACW
- 55E
- ASC's with cross-linked fluoroelastomer jacket

**The TE Connectivity's Raychem Solution**

Using TE Connectivity's Raychem 55E and ACW wire which are both radiation cross-linked modified polymer insulation systems. The polymer formulations combined with the cross-linked structure offer many benefits in this application.

The fluid resistance of the insulation is improved, with increased resistance to swelling of the insulation in the presence of hot oil and fuels. Cold flow is also arrested by the cross-linking process, improving the long term performance of the wire.

TE Connectivity's Raychem wires have been extensively trialed through automated handling procedures. TE Connectivity's Raychem can also supply long continuous lengths of wire and cable to facilitate low cost assembly.

**Benefits**

- Superior price/performance ratio
- Higher temperature, diesel fuel resistance and pinch resistance – than PVC and cross-linked polyethylene cables
- Smaller size and lighter weight – compared to PVC and cross-linked polyethylene cables
- Balance of flexibility and toughness
- High column strengths – aiding plugging of terminals into connectors
- Temperature ratings to +200 °C
- Compatible with overmolding processes used for sensors
- Outstanding diesel fuel resistance

Interconnection Wiring

**TE Connectivity's Raychem ACW Wire**

ACW is a dual-wall automotive wire with a polyalkene inner layer and a tough fluoropolymer outer layer. The unique bonding between the dissimilar inner and outer layers of ACW give the additional benefit of substantial improvement in the mechanical performance of the wire.

**Product Features**

- Continuous operating temperature from -40 °C to +150 °C (3000 hrs)
- Unique bonded composite-wall insulation system
- Tough, fluoropolymer outer jacket
- Superior fluid resistance compared to cross-linked polyolefins
- Compatible with all harness components
- Available in thin wall dimensions only
- Very cost competitive
- Mechanically tough
- Designed to be compatible with all harness shop processes
- Available in twisted pairs and triples

**For full technical information on TE Connectivity's Raychem ACW Wire please see pages 30-33.**

**TE Connectivity's Raychem 55E Wire**

TE Connectivity's Raychem 55E is a modified radiation cross-linked ETFE insulated wire combining flexibility for easy handling with excellent all round performance. TE Connectivity's Raychem 55E is compatible with modern high-density connectors and its wire constructions are around 10% lighter than other ETFE, FEP and PTFE-based wire systems.

**Product Features**

- Continuous operating temperature from -40 °C to +200 °C (3000 hrs)
- Mechanically tough across operating temperature range
- Resistance to hot surface damage, e.g. accidental contact with exhaust manifolds
- Outstanding resistance to automotive fluids
- Small size, light-weight
- Superior cold-flow and cut through performance compared to PTFE or FEP
- Solder iron resistance

**For full technical information on TE Connectivity's Raychem 55E Wire please see pages 34-37.**

**TE Connectivity's Raychem ASC with Radiation Cross-Linked Modified Fluoroelastomer Jacket**

TE Connectivity's Raychem automotive signal wires can be combined with a radiation cross-linked modified fluoroelastomer outer jacket to provide an extremely flexible cable with excellent diesel fuel resistance.

**Product Features**

- Continuous operating temperature from -40 °C to +200 °C (3000 hrs)
- Choice of conductors, screens and jacket materials to suit the most demanding lighting and engine sensor applications
- Screening options include bare copper braid, braid with drainwire, optimised braids with superior surface transfer impedance characteristics, and aluminum foil with drainwire
- Jacket material options to provide high flexibility and excellent mechanical protection
- Outstanding diesel fuel resistance
- Designed for stripping and over-molding
- Choice of cable dimensions
- Preferred Component Wires:
  - ACW0219 – 150 °C rating
  - 44E0119 – 150 °C rating
  - 44E0111 – 150 °C rating
  - FLTA0119 – 150 °C rating
  - FLTA0111 – 150 °C rating
  - 55E0119 – 200 °C rating
- Preferred Jackets:
  - ACJ general purpose cable jacket – 150 °C rating
  - Fluoroelastomer – 200 °C rating

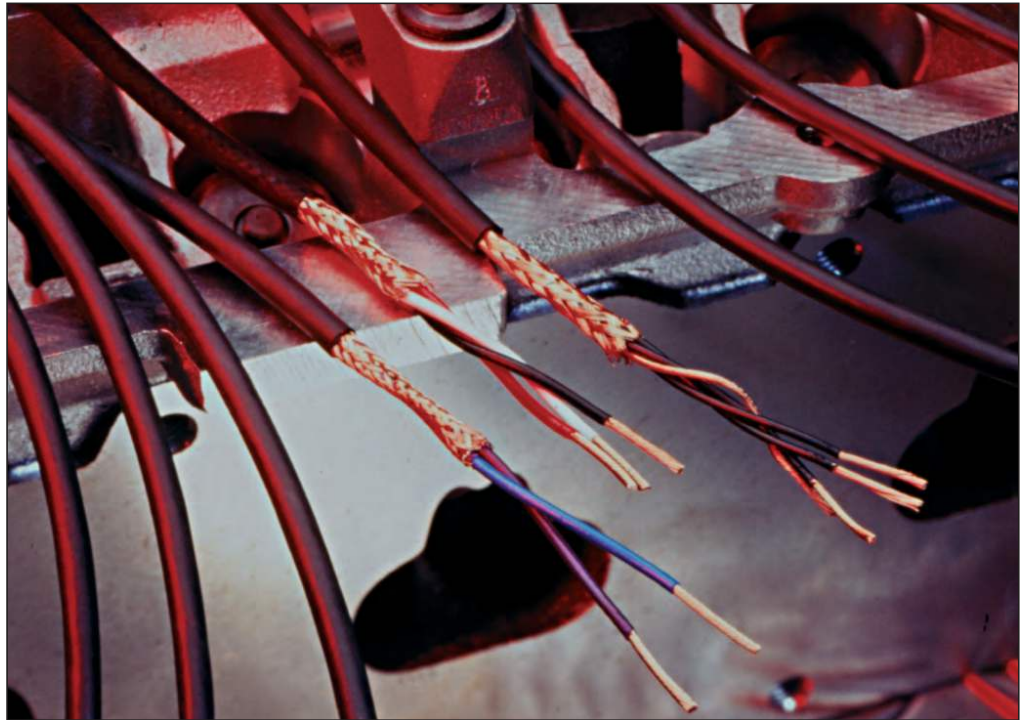
**For full technical information on TE Connectivity's Raychem ASC Cable please see pages 40-41.**

Interconnection Wiring



**Cost Competitive,  
Custom-Designed  
Engine Sensor Cables**

TE Connectivity's Raychem's wide choice of components, screening options and jacket materials offer manufacturers the advantages of custom-designed engine sensor cables, even for low volume applications.



**The Challenge Facing  
Manufacturers**

Modern car engines are now universally electronically controlled. The car's ECU receives data from a range of engine sensors which monitor functions such as water and oil temperature, crankshaft speed and position, fuel pump pressure and ignition settings.

These sensors are connected to the ECU via cables which plug into the main harness. Each cable is highly application specific and needs to be constructed to withstand a particular set of environmental factors, from exposure to fluids, to high temperatures and mechanical abuse. In addition to this many of these cables carry sensitive electronic signals prone to electromagnetic interference, and high levels of screening are often required to ensure the signal integrity.

A low cost range of products with a wide choice of insulations, components, jackets and screens is required to allow cables to be individually tailored to meet specific needs.

**Conventional Solutions**

Conventional engine sensor cable products tend to be based around a limited choice of insulation or jacket materials – typically fluoropolymers for higher temperatures and polyurethane, polyethylene or PVC-based constructions for lower temperatures. Inevitably this approach leads to compromise solutions – either in terms of cable size, weight and stiffness, or excessive cable cost.

**The TE Connectivity's Raychem  
Solution**

TE Connectivity's Raychem combines its advanced materials technology and robust manufacturing processes with its proven design capabilities to offer:

- Custom-designed engine sensor cables, also available for lower volume applications.
- A choice of components and jacket materials to match demanding requirements.
- The manufacturing capability to make handleable, over-moldable cables.
- The EMC expertise to deal with all screening and compatibility issues.

**TE Connectivity's Raychem  
Products**

- ASC's
- ACW 6 Series

**Benefits**

- Smaller cables providing easier handling and space savings
- Lower unit cost at the true performance level required
- Compatible with wire-handling equipment used in harness shops
- Compatible with over-molding processes and materials used in sensor assembly



Interconnection Wiring

**TE Connectivity's Raychem ASC's**

TE Connectivity's Raychem automotive sensor cables can be constructed to meet the most demanding applications. The wide choice of components, screening options and jacket materials means cables can be tailored to suit virtually any combination of temperature, flexibility, screening and mechanical protection requirements.

**Product Features**

- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$  (3000 hrs)
- Choice of conductors, screens and jacket materials to suit the most demanding lighting and engine sensor applications
- Screening options include bare copper braid, braid with drainwire, optimised braids with superior surface transfer impedance characteristics, and aluminum foil with drainwire
- Jacket material options to provide high flexibility and excellent mechanical protection
- Outstanding diesel fuel resistance
- Designed for stripping and over-molding
- Choice of cable dimensions
- Preferred Component Wires:
  - ACW0219 –  $150^{\circ}\text{C}$  rating
  - 44E0119 –  $150^{\circ}\text{C}$  rating
  - 44E0111 –  $150^{\circ}\text{C}$  rating
  - FLTA0119 –  $150^{\circ}\text{C}$  rating
  - FLTA0111 –  $150^{\circ}\text{C}$  rating
  - 55E0119 –  $200^{\circ}\text{C}$  rating
- Preferred Jackets:
  - ACJ general purpose cable jacket –  $150^{\circ}\text{C}$  rating
  - Fluoroelastomer –  $200^{\circ}\text{C}$  rating

**For full technical information on TE Connectivity's Raychem ASC Cable please see pages 40–41.**

**TE Connectivity's Raychem ACW 4 & 6 Series**

TE Connectivity's Raychem standard ranges of T4 unshielded/shielded sensor cables. Designed for demanding engine and drive-train applications, these cables are light-weight and offer excellent temperature resistance.

**Product Features**

- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$  (3000 hrs)
- Choice of PET wrap or aluminum foil screen with drainwire termination
- Available in a range of conductor cross sections with up to four ACW component wires.
- Small overall diameter for light-weight and space savings

**For full technical information on TE Connectivity's Raychem ACW 4 & 6 Series Cable please see pages 40–41.**

Interconnection Wiring



**High Performance  
ABS Cables**



High performance TE Connectivity's Raychem sensor cable insulations, allow the use of smaller and lower cost conductors, and provide enhanced flex life

**The Challenge Facing  
Manufacturers**

ABS sensor cables – connecting the wheel sensor to the extension wire and onto the ECU – flex millions of times during their lifetime. They are also exposed to a high degree of abrasion and mechanical damage – caused by flying stones and gravel.

**Conventional Solutions**

Most sensor cables use thick-wall insulations to achieve the required level of performance. These insulations are typically uncross-linked and are susceptible to melting if subjected to thermal overload. The use of thick-wall insulations result in large cable designs, that restrict the routing and positioning options of the cable.

**TE Connectivity's Raychem  
Products**

- ASC's

**The TE Connectivity's Raychem  
Solution**

Using TE Connectivity's Raychem high performance irradiation cross-linked insulation materials in both the jacket and cable components. The cross-linking means that the cable is capable of surviving excursions well above the maximum continuous service temperature for short periods of time without melting. The same tough, durable insulation allows the construction of miniaturized cables with the same copper section, providing cheaper cables which are more flexible, smaller and easier to install.

**Benefits**

- Resistance to high temperature excursions without melting
- Low cost at the true performance level required
- Provides smaller, more flexible cables that are easier to handle and install
- Tough durable insulations with outstanding mechanical and abrasion performance
- Compatible with high-speed, high temperature overmolding machines

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## Interconnection Wiring

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### **TE Connectivity's Raychem ASC's**

TE Connectivity's Raychem automotive sensor cables can be constructed to meet the most demanding applications. The wide choice of components, screening options and jacket materials means cables can be tailored to suit virtually any combination of temperature, flexibility, screening and mechanical protection requirements.

### **Product Features**

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- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+200^{\circ}\text{C}$  (3000 hrs)
- Choice of conductors, screens and jacket materials to suit the most demanding lighting and engine sensor applications
- Screening options include bare copper braid, braid with drainwire, optimised braids with superior surface transfer impedance characteristics, and aluminum foil with drainwire
- Jacket material options to provide high flexibility and excellent mechanical protection
- Outstanding diesel fuel resistance
- Designed for stripping and over-molding
- Choice of cable dimensions
- Preferred Component Wires:
  - ACW0219 –  $150^{\circ}\text{C}$  rating
  - 44E0119 –  $150^{\circ}\text{C}$  rating
  - 44E0111 –  $150^{\circ}\text{C}$  rating
  - FLTA0119 –  $150^{\circ}\text{C}$  rating
  - FLTA0111 –  $150^{\circ}\text{C}$  rating
  - 55E0119 –  $200^{\circ}\text{C}$  rating
- Preferred Jackets:
  - ACJ general purpose cable jacket –  $150^{\circ}\text{C}$  rating
  - Fluoroelastomer –  $200^{\circ}\text{C}$  rating

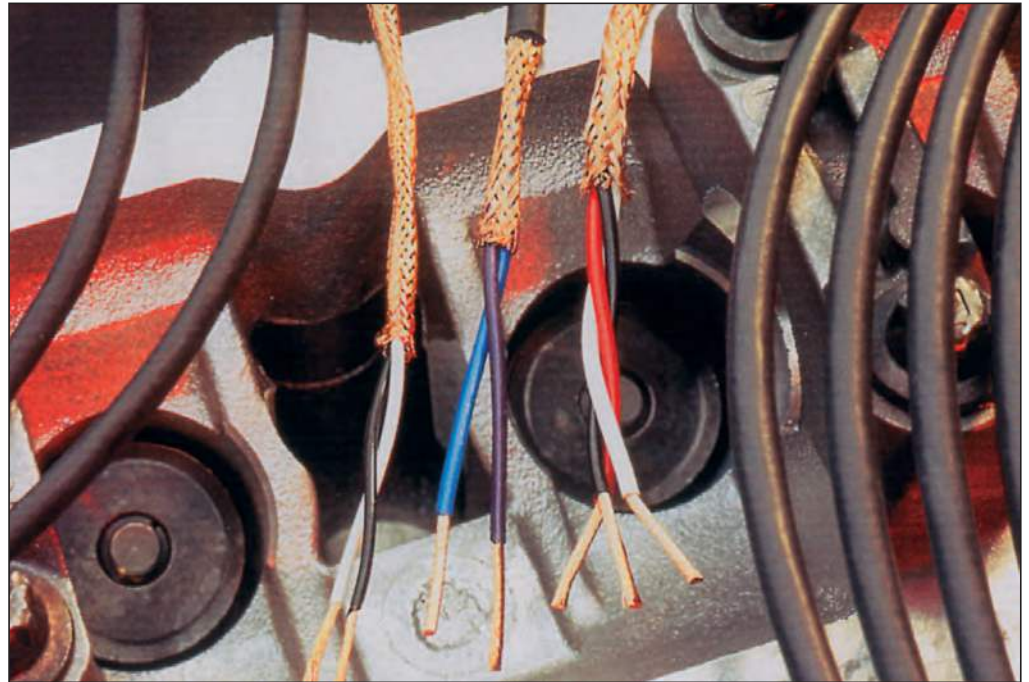
**For full technical information on TE Connectivity's Raychem ASC Cable please see pages 40–41.**

Interconnection Wiring



**High Performance  
Truck Databus Cables  
to SAE J1939  
Requirements**

SAE J1939 sets new standards for databus cabling in commercial vehicles and supports the complex information gathering systems that will be fitted to tomorrow's trucks



**The Challenge Facing  
Manufacturers**

The search for improved vehicle reliability means sensors are often fitted to provide data on a range of functions such as trailer tyre pressures, freezer compartment temperatures, braking system performance, liftgate position and suspension control. These sensors are connected by cable back to a central computer.

Satellite tracking and theft protection systems are also increasingly being used, adding to the number of wiring circuits required. Multiplexing reduces the numbers of wires, sensors and actuators needed to provide information and allows large amounts of information to be transmitted through a single twisted pair cable. US specification SAE J1939 has been recently introduced and provides a protocol and system to provide the functions described above. The SAE J1939 system needs a twisted pair cable, usually screened with tightly controlled impedance in order to operate.

**The TE Connectivity's Raychem  
Solution**

Using TE Connectivity's Raychem SAE J1939 which is a small, light-weight data cable with the capacity to handle more information on trucks using less wiring and less hardware. SAE J1939 provides a standard defining architecture and protocol and can be used for serial control and communications networks.

TE Connectivity's Raychem has developed cables to meet the demanding electrical requirements of SAE J1939 with its high data rates of 25,000 baud per second. These cables are constructed with a tough radiation cross-linked jacket with a specially formed light-weight primary wire to give excellent resistance to diesel fuel and other fluids.

The unique characteristics of TE Connectivity's Raychem dielectric material offer the design of a screened cable construction with no inner jacket, improved flexibility and reduced savings compared to alternatives.

**Benefits of TE Connectivity's  
Raychem SAE J1939 Cables**

- Highly flexible – screened versions are more flexible than alternatives through elimination of inner jackets and use of special low permittivity dielectric constant materials.
- Cost effective – simplified construction leads to cost benefits.
- Easy to terminate – elimination of inner jacket reduced termination costs.
- Excellent screening performance – screened (recommended) and unscreened cable designs available.
- Light-weight – TE Connectivity's Raychem SAE J1939 cables offers weight savings over alternatives.

**TE Connectivity's Raychem  
Products**

- SAE J1939 data cable

**Benefits of TE Connectivity's  
Raychem SAE J1939 Databus  
System**

- Handles more information – with less wiring and less hardware.
- Improves data gathering on trucks – allowing new systems to be introduced.
- Provides new diagnostic capabilities and new repair procedures – enhancing vehicle reliability.
- Allows common diagnostic procedures and methods to be developed – improving fault identification and streamlining servicing procedures.
- High speed information – with baud rate of 25,000 bits per second.

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**Interconnection Wiring**

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**TE Connectivity's Raychem  
SAE J1939 Data Cable**

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Foamed dielectrics are employed to reduce weight and to minimize cable diameters. SAE J1939 has a tough radiation cross-linked jacket which provides excellent fluid resistance and is compatible with over-molding processes.

**Product Features**

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- Continuous operating temperature from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  (3000 hrs)
- Excellent screening performance
- Small size and light-weight
- SAE J1939 is a 120 Ohm impedance twisted pair cable available in screened and unscreened versions.

**For full technical information on TE Connectivity's Raychem SAE J1939 data cables please contact your TE Connectivity Raychem representative.**

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Engineering Notes

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# Automotive Wire and Cable Data Sheets

**Thin-Wall 150°C Automotive Engine Harness Wire ISO 6722 Class D**

**Product Features**

- T4 Rated (3000 hours @ 150°C)
- Unique dual-wall, bonded insulation
- Mechanically tough
- Excellent resistance at high temperature to engine fluids
- Designed to be compatible with all harness shop processes
- Proven high level of compatibility with materials used in the harnessing process
- 50 Volts. Thin-wall
- Available in twisted pairs and triples

ACW or Automotive Composite Wall wire was developed to be the most cost effective wire in the 150°C D class. It was designed to meet both the requirements of the OEMs and the harness shops. The product is dual-wall in construction using a modified polyalkene inner layer and a high performance fluoropolymer outer.

This combination of materials offers outstanding performance at optimum cost. What differentiates ACW from other dual-wall technologies is the bonding that joins the two layers together.

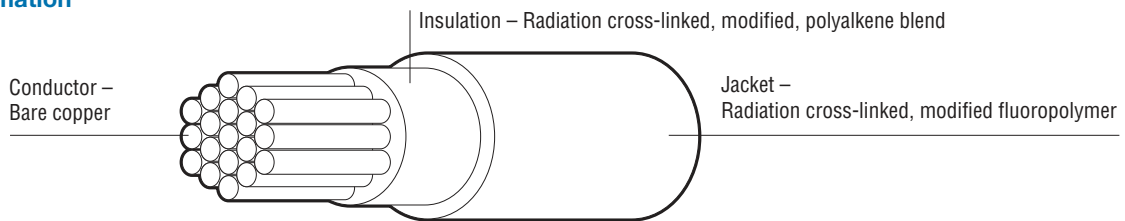
The unique bonding technology ensures that the insulation behaves as a single layered product.

The ACW bonding increases the resistance to mechanical damage during harness manufacture that has been the down side to conventional dual-wall technologies. Taking advantage of the inherent flexibility of the polyalkene inner layer ACW offers excellent handleability.

With conventional dual-wall technologies another risk exists. If the outer layer is damaged it is feasible that fluids, like windscreen wiper solution, can wick down the interface of the insulation to the connector resulting in system interference or failure.

The bonding prevents this happening with ACW. ACW offers a significant cost saving versus traditional 150°C wires like ETFE, superior performance versus cross-linked polyethylene and vastly superior hydrolytic stability versus polyesters. ACW is approved and used by many OEMs and is available in barrels and Maschinenfabrik Niehoff GmbH & Co. KG packaging formats.

**Ordering Information**



Conductor	Finished Wire										
	Part Number	CSA (mm <sup>2</sup> )	Stranding Numbers/ Diameter (mm)	Diameter Maximum (mm)	Minimum Overall Insulation Thickness (mm)	Maximum Resistance @ 20°C (ohms/km)	Diameter			Copper Weight for Information (kg/km)	
							Lower Spec. Limit (mm)	Target (mm)	Upper Spec. Limit (mm)		
	ACW0219-0.35-*	0.35	7/0.25	0.90	0.20	52.00	1.20	1.30	1.40	4.50	3.20
	ACW0219-0.50-*	0.50	19/0.18	1.00	0.22	37.10	1.40	1.50	1.60	6.00	4.40
	ACW0219-0.75-*	0.75	19/0.23	1.20	0.24	24.70	1.70	1.80	1.90	9.40	6.70
	ACW0219-1.00-*	1.00	19/0.25	1.35	0.24	18.50	1.90	2.00	2.10	11.00	8.80
	ACW0219-1.50-*	1.50	19/0.31	1.70	0.24	12.70	2.20	2.30	2.40	16.00	13.00
	ACW0219-2.50-*	2.50	19/0.42	2.20	0.28	7.60	2.70	2.85	3.00	25.00	21.50
	ACW0219-4.0-*	4.00	56/0.30	2.75	0.32	4.70	3.40	3.60	3.70	40.00	35.80
	ACW0219-6.0-*	6.00	84/0.30	3.30	0.32	3.10	4.00	4.20	4.30	61.00	53.90
	ACW0219-10.0-*	10.00	80/0.40	4.50	0.48	1.82	5.50	5.80	6.00	104.00	92.70

Standard Colors	Color	Code	Color	Code	Color	Code
	Black	0	Orange	3	Violet	7
	Brown	1	Yellow	4	Gray	8
	Red	2	Green	5	White	9
	Pink	2L	Blue	6		

**Ordering Description**

The '\*' in the part number shall be replaced by a standard numerical color code designator as per above. Additional number after base color indicates stripe. e.g. ACW0219-0.50-96 is a white base color with blue stripe. Where stripes are required the wire carries two co-extruded longitudinal stripes of the same color. The individual stripe width is a minimum of 10% of the wire circumference with an overall stripe coverage of 30% maximum.

ACW0219 is available in twisted pairs and triples.  
For e.g. a standard part number will be ACW0229-0.50-0/9- mm<sup>2</sup> black and white pair.



**Thin-Wall 150°C Automotive Engine Harness Wire ISO 6722 Class D**

Typical Properties of ACW0219-0.75	Method	Typical Value
Operating temperature	ISO 6722	-40°C to +150°C
Voltage		50 Volts
Thermal life	ISO 6722	3000 hours @ 150°C
Heat shock	ISO 6722	> 240 hours @ 175°C
Abrasion (7 N, 0.45 mm radius blade)	ISO 6722	> 1000 cycles
Flammability	ISO 6722	Pass. 45° < 30 seconds
Insulation strip force		< 40 N
Volume resistivity	ISO 6722	2 x 10 <sup>6</sup> Mohms m
Hot oil (ASTM1)	24 hours @ 135°C	
10 minute dip in ASTM oil	1000 hours @ 150°C	No breakdown @ 1 KV for 1 minute
Battery acid resistance	20 hours @ RT	< 1% swell
Auto transmission fluid (Dexron III)	20 hours @ 50°C	
Ozone resistance (100pphm @ 30°C)	ISO 6722	Pass
Mycological (28 days @ 30°C)	BS2 011 Part 2 1J	Pass
Hydrolysis	21 days, 90°C, 48 V	Pass
Shrinkage @ 150°C for 15 minutes	ISO 6722	< 1%
PVC tape and wire compatibility	3000 hours @ 150°C	No breakdown @ 1 KV

Specifications	Release Specification:	TE Connectivity's Raychem WSD 1223
	Related Specifications:	FORD Motor Company Global Wire Specification ES-AU5T-1A348-AA
		ISO 6722 CLASS D
		Fiat Group Automobiles normazione 9.91107
		Jaguar Land Rover – Engineering Test Procedure TPJLR.18.007
		GM Europe – GM Europe Engineering Standards GME14022
		FORD Motor Company – Engineering Specification WSK1A348-A4

ACW0219 Performance Highlights
Suitable for direct routing through high temperature areas without use of additional protection or heat-shields due to its excellent mechanical properties at elevated temperatures.
Excellent mechanical and high temperature fluid resistance means that ACW is suitable for use in the harsh environment of the car where 150°C performance is required.
Excellent low temperature performance down to -40°C.
Designed to be compatible with wire handling equipment used by all major manufacturers including ultrasonic welding.
Proven high level of compatibility with materials used in the harnessing process. In particular, pvc tapes and wires.
Tough enough to be used in harnesses without conventional secondary protection giving cost, size and weight savings.
Resistance to wicking of fluids between the interface of the insulation system.
Supplied in barrels or on Maschinenfabrik Niehoff GmbH & Co. KG spools for fast automatic handling and lead preparation using standard equipment.

**For Product Application Information please see Pages 10, 14, 16 and 20.**

Hot Oil Resistant Thin-Wall 150°C Automotive Engine Harness Wire ISO 6722 Class D

**Product Features**

- T4 Rated (3000 hours @ 150°C)
- Unique dual-wall, bonded insulation
- Mechanically tough
- Excellent resistance at high temperature to engine fluids
- Designed to be compatible with all harness shop processes
- Proven high level of compatibility with materials used in the harnessing process
- 50 Volts. Thin-wall
- Available in twisted pairs and triples

ACW or Automotive Composite Wall wire was developed to be the most cost effective wire in the 150°C class. It was designed to meet both the requirements of the OEMs and the harness shops. The product is dual-wall in construction using a modified polyalkene inner layer and a high performance fluoropolymer outer.

This combination of materials offers outstanding performance at optimum cost. What differentiates ACW from other dual-wall technologies is the bonding that joins the two layers together.

The unique bonding technology ensures that the insulation behaves as a single layered product.

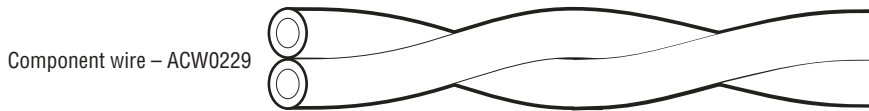
The ACW bonding increases the resistance to mechanical damage during harness manufacture that has been the downside to conventional dual-wall technologies.

Taking advantage of the inherent flexibility of the polyolefinic inner layer ACW offers excellent handleability.

With conventional dual-wall technologies another risk exists. If the outer layer is damaged it is feasible that fluids, like wind-screen wiper solution, can wick down the interface of the insulation to the connector resulting in system interference or failure.

The bonding prevents this happening with ACW. ACW offers a significant cost saving versus traditional 150°C wires like ETFE, superior performance versus cross-linked polyethylene and vastly superior hydrolytic stability versus polyesters. ACW is approved and used by many OEMs and is available in barrels and Maschinenfabrik Niehoff GmbH & Co. KG packaging formats.

**Ordering Information**



Finished Wire	Diameter						
	Part Number	CSA	Lay Length Nominal	Target	Upper Spec. Limit	Nominal Weight	Copper Weight for Information
	(mm <sup>2</sup> )	(mm)	(mm)	(mm)	(kg/km)	(kg/km)	
ACW0229-0-0.50-*/* (36MM)	0.50	36	3.0	3.2	12.6	9.83	

**Construction** Lay length tolerance shall be ±2.0 mm

**Performance Requirement** Component wires shall meet all the requirements of the issue in effect of TE Connectivity's Raychem Specification WSD 1223

**Additional Testing** Insulation Flaws: 100% Spark Test on Finished Wire of 5.0 kV High Frequency AC RMS or equivalent

Standard Colors	Color	Code	Color	Code	Color	Code
	Black	0	Pink	2L	Blue	6
	Brown	1	Orange	3	Violet	7
	Beige	1L	Yellow	4	Gray	8
	Red	2	Green	5	White	9

**Ordering Description**

The '\*' in the part number shall be replaced by a standard numerical color code designator as per above. Additional number after base color indicates stripe. e.g. ACW0229-0.50-96/45 is a white base color with blue stripe and yellow base color with green stripe. Where stripes are required the wire carries two co-extruded longitudinal stripes of the same color.

The individual stripe width is a minimum of 10% of the wire circumference with an overall stripe coverage of 30% maximum.

The number in brackets at the end indicates the lay length of the pair. A description example is: ACW0229-0.50-96/45 (13MM). This is a twisted pair made of 0.50 sq/mm white/blue and yellow/green wires with a lay length of 13 mm.

**Hot Oil Resistant Thin-Wall 150°C Automotive Engine Harness Wire ISO 6722 Class D**

Typical Properties of ACW0229-0.75	Method	Typical Value
Operating temperature	ISO 6722	-40°C to +150°C
Voltage rating		50 Volts
Thermal life	ISO 6722	3000 hours @ 150°C
Abrasion (7 N, 0.45 mm radius blade)	ISO 6722	> 1000 cycles
Flammability	ISO 6722	Pass. 45° < 30 seconds
Flammability	Renault 36-05-009/-L	Pass Vertical
Insulation strip force	ISO 6722	< 45 N
Volume resistivity	ISO 6722	2 x 10 <sup>6</sup> Mohms m
Hot oil (ASTM 1)	24 hours @ 135°C	
10 minute dip in ASTM oil	1000 @ 150°C	No breakdown @ 1 kV for 1 minute
Battery acid resistance	20 hours @ RT	< 1% swell
Auto Transmission fluid (Dexron III)	20 hours @ 50°C	
Ozone resistance (100 pphm @ 65°C)	ISO6722	Pass
Mycological (28 days @ 30°C)	BS 011 Part 2 1J	Pass
Hydrolysis	21 days, 90°C, 48 V	Pass
Shrinkage @ 150°C for 15 minutes	ISO6722	< 1%
PVC tape and wire compatability	3000 hours @ 150°C	No breakdown @ 1 kV for 1 minute

Specifications	Release Specification:	TE Connectivity's Raychem WSD 1223
	Related Specifications:	FORD Motor Company Global Wire Specification ES-AU5T-1A348-AA
		ISO 6722 CLASS D
		Fiat Group Automobiles normazione 9.91107
		Jaguar Land Rover – Engineering Test Procedure TPJLR.18.007
		GM Europe – GM Europe Engineering Standards GME14022
		FORD Motor Company – Engineering Specification WSK1A348-A4

ACW0229 Performance Highlights
Suitable for direct routing through high temperature areas without use of additional protection or heat-shields due to its excellent mechanical properties at elevated temperatures.
Excellent mechanical and high temperature fluid resistance means that ACW is suitable for use in the harsh environment of the car where 150°C is required.
Excellent low temperature performance down to -40°C.
Designed to be compatible with wire handling equipment used by all major manufacturers including sonic welding.
Proven high level of compatibility with materials used in the harnessing process. In particular PVC tapes and wires.
Tough enough to be used in harnesses without conventional secondary protection giving cost, size and weight savings.
Resistance to wicking of fluids between the interface of the insulation system.
Supplied in barrels or on Maschinenfabrik Niehoff GmbH & Co. KG spools for fast automatic handling and lead preparation using standard equipment.

**For Product Application Information please see Pages 10, 14, 16 and 20.**

High Temperature, High Performance Automotive Wire ISO 6722 Class F

**Product Features**

- T4 Rated (3000 hours @ 200°C)
- Mechanically tough
- Excellent resistance to all known automotive fluids
- Compatible with all harness components
- Excellent harness shop processability
- 50 Volts. Ultra thin-wall
- Excellent solder iron resistance
- Available in twisted pairs and triples

TE Connectivity's Raychem 55E wire is insulated with a modified radiation cross-linked fluoropolymer. It has a temperature rating of -40°C to +200°C (ca. 3000 hours) and combines the easy handling of a flexible wire with excellent all round performance.

Chosen for its balance of properties, TE Connectivity's Raychem 55E wire has outstanding resistance to chemicals and solvents. The flame retarded flexible polymer is easy to handle and install and can be processed using standard lead preparation equipment.

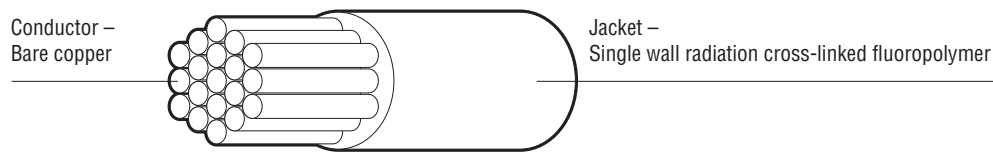
The ultra thin-wall construction enables high wiring densities to be achieved and the high temperature rating enables wire bundles to be routed through areas in which conventional wires cannot be used.

TE Connectivity's Raychem 55E offers excellent overmoldability versus PTFE and FEP and due to its cross-linked structure, resistance to melting if in unavoidable contact with hot metal surfaces as a result of routing.

TE Connectivity's Raychem 55E wire is a cost effective alternative to PTFE and FEP insulated wires.

TE Connectivity's Raychem 55E is approved and used by many OEMs and is supplied in barrels and Maschinenfabrik Niehoff GmbH & Co. KG packaging formats.

**Ordering Information**



Conductor	Finished Wire									
	Part Number	CSA	Stranding Numbers/Diameter	Diameter Nominal	Maximum Resistance @ 20°C	Diameter			Nominal Weight	Copper Weight for Information
						Lower Spec. Limit	Target	Upper Spec. Limit		
	(mm <sup>2</sup> )	(mm)	(mm)	(ohms/km)	(mm)	(mm)	(mm)	(kg/km)	(kg/km)	
55E0119-0.35-*	0.35	7/0.25	0.75	52.00	1.10	1.15	1.20	4.18	3.25	
55E0119-0.50-*	0.50	19/0.18	0.87	37.10	1.21	1.26	1.31	5.54	4.65	
55E0119-0.60-*	0.60	19/0.20	0.97	31.30	1.33	1.38	1.43	6.58	5.59	
55E0119-0.75-*	0.75	19/0.23	1.06	24.70	1.41	1.46	1.51	7.93	6.90	
55E0119-1.0-*	1.00	19/0.25	1.23	18.50	1.57	1.62	1.67	10.15	8.90	
55E0119-1.5-*	1.50	19/0.32	1.49	12.70	1.82	1.88	1.95	14.47	13.30	
55E0119-2.0-*	2.00	19/0.36	1.73	9.80	2.07	2.13	2.20	18.83	17.56	
55E0119-2.5-*	2.50	19/0.41	1.91	7.73	2.29	2.35	2.42	23.51	22.00	
55E0119-3.0-*	3.00	37/0.32	2.16	6.40	2.50	2.56	2.63	28.38	27.14	
55E0119-4.0-*	4.00	56/0.30	2.42	4.70	2.75	2.82	2.88	37.09	36.00	
55E0119-6.0-*	6.00	85/0.30	2.88	3.10	3.20	3.28	3.35	55.73	54.00	

Standard Colors	Color	Code	Color	Code	Color	Code
	Black	0	Orange	3	Violet	7
	Brown	1	Yellow	4	Gray	8
	Red	2	Green	5	White	9
	Pink	2L	Blue	6		

**Ordering Description**

The '\*' in the part number shall be replaced by a standard numerical color code designator as per above. Additional number after base color indicates stripe. e.g. 55E0119-0.50-96 is a white base color with blue stripe. Where stripes are required the wire carries two co-extruded longitudinal stripes of the same color. The individual stripe width is a minimum of 10% of the wire circumference with an overall stripe coverage of 30% maximum.

High Temperature, High Performance Automotive Wire ISO 6722 Class F

**Typical Properties of 55E0119-1.00**

	<b>Method</b>	<b>Typical Value</b>
Operating temperature	ISO 6722	-40°C to 200°C (3000 hours)
Voltage rating		50 Volts
Thermal life	ISO 6722	> 300 hours @ 200°C
Heat shock	Fiat 9 91107	> 375 hours @ 230°C
Flammability	ISO 6722	Pass. 45° 0 seconds afterburn
Shrinkage	WSD 1254	Pass (0%) 230°C for 1 hour
Volume resistivity	ISO 6722	2.95 x 10 <sup>16</sup> ohms/cm
Cold bend	WSD 1254	Pass at -40°C
Thermal overload	WSD 1254	48 hours @ 255°C
Hot oil (ASTM No 1)	200 hours @ 200°C	No breakdown @ 1 KV for 1 minute
IRM 902	200 hours @ 200°C	< 1% swell
IRM 903	200 hours @ 200°C	
Ozone resistance	100 pphm @ 65°C for 192 hours	Pass. No cracks
Transmission oil (BOT 320)	240 hours @ 155°C	
Strip force	ISO 6722	< 40 N
Fuel resistance (M15)	1000 hours @ 60°C	Pass < 1% swell

**Specifications**

<b>Release Specification:</b>	TE Connectivity's Raychem WSD 1254
<b>Related Specifications:</b>	Fiat Auto normazione 9 91107
	ISO 6722 CLASS F
	Renault Automobiles 36-05-009/--L

**55E0119 Performance Highlights**

Suitable for direct routing through high temperature areas without use of additional protection or heat-shields.  
 Minimal deterioration of performance due to exposure to fluids, and can be used in applications where it is continually immersed.  
 Tough enough to be used in harnesses without conventional secondary protection giving cost, size and weight savings.  
 Improved mechanical and abrasion performance compared to FEP or PTFE.  
 Superior cold-flow and cut-through performance compared to FEP or PTFE.  
 Supplied in barrels or on Maschinenfabrik Niehoff GmbH & Co. KG spools for fast automatic handling and lead preparation using standard equipment.

**For Product Application Information please see Pages 12 and 20.**

High Temperature, High Performance Automotive Wire ISO 6722 Class F

**Product Features**

- T4 Rated (3000 hours @ 200°C)
- Mechanically tough
- Excellent resistance to all known automotive fluids
- Compatible with all harness components
- Excellent harness shop processability
- 50 Volts. Ultra thin-wall
- Excellent solder iron resistance
- Available in twisted pairs and triples

Spec 55E wire is insulated with a modified radiation cross-linked fluoropolymer. It has a temperature rating of -40°C to +200°C (3000 hours) and combines the easy handling of a flexible wire with excellent all round performance.

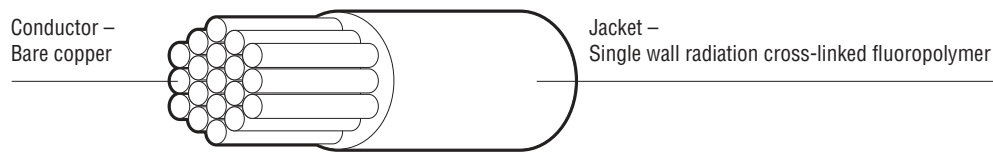
Chosen for its balance of properties, Spec 55E wire has outstanding resistance to chemicals and solvents. The flame retarded flexible polymer is easy to handle and install and can be processed using standard lead preparation equipment.

The ultra thin-wall construction enables high wiring densities to be achieved and the high temperature rating enables wire bundles to be routed through areas in which conventional wires cannot be used.

Spec 55E offers excellent over-moldability versus PTFE and FEP and due to its cross-linked structure, resistance to melting if in unavoidable contact with hot metal surfaces as a result of routing. Spec 55E wire is a cost effective alternative to PTFE and FEP insulated wires.

Spec 55E is approved and used by many OEMs and is supplied in barrels and Maschinenfabrik Niehoff GmbH & Co. KG packaging formats.

**Ordering Information**



Part Number	Conductor				Finished Wire				
	CSA (mm <sup>2</sup> )	Stranding Numbers/ Diameter (mm)	Diameter Nominal (mm)	Maximum Resistance @ 20°C (ohms/km)	Diameter			Nominal Weight (kg/km)	Copper Weight for Information (kg/km)
					Lower Spec. Limit (mm)	Target (mm)	Upper Spec. Limit (mm)		
55E0219-0.50-*	0.50	19/0.18	0.87	37.10	1.40	1.50	1.60	5.54	4.65
55E0219-0.75-*	0.75	19/0.23	1.07	24.50	1.70	1.80	1.90	9.36	6.90
55E0219-1.0-*	1.00	19/0.25	1.23	18.50	1.90	2.00	2.10	10.20	8.90
55E0219-1.5-*	1.50	19/0.32	1.49	12.70	2.20	2.30	2.40	14.50	13.30

Standard Colors	Color	Code	Color	Code	Color	Code
		Black	0	Orange	3	Violet
	Brown	1	Yellow	4	Gray	8
	Red	2	Green	5	White	9
	Pink	2L	Blue	6		

**Ordering Description**

The '\*' in the part number shall be replaced by a standard numerical color code designator as per above. Additional number after base color indicates stripe. e.g. 55E0219-0.50-96 is a white base color with blue stripe. Where stripes are required the wire carries two co-extruded longitudinal stripes of the same color. The individual stripe width is a minimum of 10% of the wire circumference with an overall stripe coverage of 30% maximum.

High Temperature, High Performance Automotive Wire ISO 6722 Class F

**Typical Properties of 55E0219-0.50**

	<b>Method</b>	<b>Typical Value</b>
Operating temperature	ISO 6722	-40°C to +200°C (3000 hours)
Voltage rating		50 Volts
Winding resistance	ISO 6722	No damage Pass 1 kV/30 minutes
Adherence of insulation	ISO 6722 (10-30N)	16.8N
Flammability	ISO 6722	Pass. 45° 0 seconds afterburn
Shrinkage	WSD 1254	Pass (0%) 230°C for 1 hour
High temperature	ISO 6722	No breakdown up to 3 kV
Abrasion	ISO 6722	>500 cycles
Hot oil (ASTM No 1)	200 hours @ 200°C	No breakdown at 1 kV
IRM 902	200 hours @ 200°C	for 1 minute
IRM 903	200 hours @ 200°C	< 1% swell
Ozone resistance	100 pphm @ 65°C for 192 hours	Pass. No cracks
Transmission oil (BOT 320)	240 hours @ 155°C	
Strip force	ISO 6722	< 40 N
Fuel resistance (M15)	1000 hours @ 60°C	Pass < 1% swell

**Specifications**

<b>Release Specification:</b>	TE Connectivity's Raychem WSD 1254
<b>Related Specifications:</b>	Renault Automobiles 36-05-009/--L ISO 6722 CLASS F

**55E0219 Performance Highlights**

Suitable for direct routing through high temperature areas without use of additional over-protection or heat-shields.  
 Minimal deterioration of performance due to exposure to fluids, and can be used in applications where it is continually immersed.  
 Tough enough to be used in harnesses without conventional secondary protection giving cost, size and weight savings.  
 Improved mechanical and abrasion performance compared to FEP or PTFE.  
 Superior cold-flow and cut-through performance compared to FEP or PTFE.  
 Supplied in barrels or on Maschinenfabrik Niehoff GmbH & Co. KG spools for fast automatic handling and lead preparation using standard equipment.

**For Product Application Information please see Pages 12 and 20.**

**Low Cost, Fluid Resistant Automatic Transmission Wire**

**Product Features**

- T4 Rated (3000 hours @ 150°C)
- Modified radiation cross-linked fluoropolymer insulation
- Mechanically tough
- Outstanding resistance to automatic transmission fluids
- Designed to be compatible with all harness shop processes
- 600 Volts. Available in various wall thicknesses
- Available in twisted pairs and triples

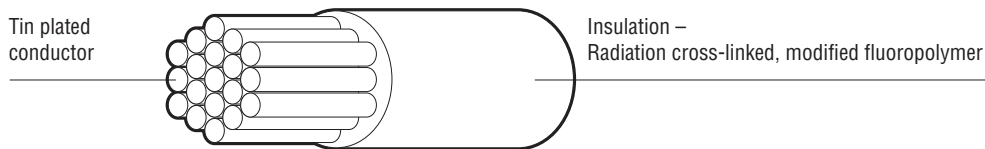
Today's electronic automatic transmissions have exacting harness component performance standards. ATF wire is specifically fabricated for electronic automatic transmission applications. The combination of durability, fluid resistance and thermally stable insulation materials enable ATF wire to stand up to high performance demands.

ATF is designed to be used in DC circuits only. ATF wire is available in sizes 22 to 14 AWG with conductors using 7, 19 or 37 strands. It is also available in a range of wall thicknesses.

ATF\*0611 is the standard having a nominal wall thickness of 0.3 mm whilst ATF0411 has a wall thickness of 0.35 mm.

ATF wire is designed to be an alternative to the more expensive fluoropolymer wires, providing similar performance at a lower price. Traditional insulations include ETFE and PTFE.

**Ordering Information**



Conductor	Finished Wire										
	Part Number	CSA (mm <sup>2</sup> )	Stranding Numbers/ Diameter (mm)	Diameter Maximum (mm)	Minimum Overall Insulation Thickness (mm)	Maximum Resistance @ 20°C (ohms/km)	Diameter			Approximate Weight (kg/km)	Copper Weight for Information (kg/km)
							Lower Spec. Limit (mm)	Target (mm)	Upper Spec. Limit (mm)		
ATFC0311-22-*	22	19/34	0.80	0.16	51.80	1.12	1.17	1.22	4.46	3.35	
ATFC0311-20-*	20	19/32	1.00	0.16	33.10	1.32	1.37	1.42	6.70	5.48	
ATFC0311-18-*	18	19/30	1.19	0.18	21.00	1.55	1.60	1.65	9.82	8.51	
ATFC0311-16-*	16	19/29	1.35	0.17	16.10	1.68	1.75	1.83	12.20	10.77	
ATFC0311-14-*	14	19/27	1.70	0.21	10.20	2.11	2.18	2.26	19.20	16.85	
ATFD0311-16-*	14	37/32	1.42	0.14	16.40	1.70	1.78	1.85	12.50	10.96	
ATFD0311-14-*	14	37/32	1.91	0.18	10.20	2.26	2.36	2.46	22.50	17.14	
ATFB0411-20-*	20	7/28	0.97	0.32	34.10	1.61	1.66	1.71	7.59	5.08	
ATFB0411-18-*	18	19/30	1.19	0.33	21.00	1.84	1.89	1.94	11.30	8.51	
ATFC0611-21-*	21	19/33	0.91	0.28	39.00	1.47	1.52	1.57	6.92	3.45	
ATFC0611-20-*	20	19/32	0.97	0.28	33.10	1.52	1.57	1.63	7.37	5.48	
ATFC0611-18-*	18	19/30	1.19	0.28	21.00	1.75	1.80	1.85	10.80	8.51	
ATFC0611-16-*	16	19/29	1.35	0.27	16.10	1.88	1.96	2.03	13.30	10.77	
ATFC0611-14-*	14	19/27	1.70	0.26	10.20	2.21	2.29	2.36	19.90	16.90	
ATFC0611-16-*	16	19/32	1.42	0.25	16.40	1.91	1.98	2.06	13.40	10.96	
ATFC0611-14-*	14	19/30	1.91	0.23	10.20	2.36	2.46	2.57	23.10	16.90	

Standard Colors	Color	Code	Color	Code	Color	Code
	Black	0	Orange	3	Violet	7
	Brown	1	Yellow	4	Gray	8
	Red	2	Green	5	White	9
	Pink	2L	Blue	6		

**Ordering Description**

The '\*' in the part number shall be replaced by a standard numerical color code designator as per above. For e.g. ATFC0311-20-6 is a blue 20 AWG wire.



**Low Cost, Fluid Resistant Automatic Transmission Wire**

Typical Properties of ATFC0311-20-	Method	Typical Value
Operating temperature	ISO 6722	-40°C to +150°C
Voltage		600 Volts
Thermal life	ISO 6722	3000 hours @ 150°C
Immersion at 150°C in Motorcraft Mercon V		3000 hours @ 150°C, 0.8% diameter swell
Immersion at 150°C in Exxon H-FN-1975	1000 hours @ 150°C	8000 hours @ 150°C
Immersion at 150°C in Dexron III	1000 hours @ 150°C	4000 hours @ 150°C
Immersion at 150°C in Valvoline II E	1000 hours @ 150°C	12000 hours @ 150°C
Tensile strength before ageing	> 20.6 Mpa	44 Mpa
Tensile strength after ageing (168 hours @ 200°C)		38 Mpa
Elongation before ageing	150% minimum	423%
Elongation after ageing (168 hours @ 200°C)		411%
Pinch resistance	SAE J1128	22.3 lbs

Specifications	Release Specification:	TE Connectivity's Raychem Spec 63 See individual product specification control drawings (SCD)
----------------	------------------------	--

ATF*0*11 Performance Highlights	Outstanding resistance to automatic transmission fluid. Excellent mechanical and high temperature fluid resistance means that ATF is suitable for use in the harsh environment of the car where 150°C performance is required. Excellent low temperature performance down to -55°C. Designed to be compatible with wire handling equipment used by all major manufacturers. To be used in DC circuits only.
---------------------------------	---

**For Product Application Information please see Page 18.**

High Temperature Automotive Sensor Cables

**Product Features**

- T4, T6 rated (3000 hours @ 150 °C or 200 °C)
- Choice of component wires
- Choice of insulation materials
- Choice of cable dimensions
- Full range of screening options
- Designed for stripping and overmolding

TE Connectivity's Raychem Automotive Sensor Cables (ASCs) have been developed to offer harness makers and sensor manufacturers a robust and cost-effective solution for sensor cabling.

These cables are designed to survive in oil-contaminated high temperature environments where they are exposed to abrasion and constant flexing. The automotive industry demands that cables are compatible with high speed stripping, termination and over-molding processes. Compatibility with over-molding resins is fundamental to achieving reliable sensor assemblies.

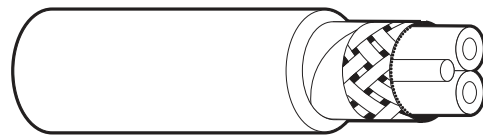
TE Connectivity's Raychem ASC cables are built on advanced materials-based technologies: high performance automotive 150 °C and 200 °C primary wires, a range of electro-magnetic screening options and advanced insulation options.

Using the latest high volume cable assembly techniques and TE Connectivity's Raychem proprietary processes these technologies can be married together to produce cost effective, high performance cables.

**Cable Information**



High performance insulation systems



Choice of screening systems

Jacket	Insulation Description	Polymer Base	Temperature Rating (°C)
	ACJ	Cross-linked modified polyolefin	150°C
	Fluoroelastomer	Cross-linked fluoroelastomer	200°C

Component Wire	Description	Polymer Base	Conductor	Temperature Rating (°C)
	FLTA0111/FLTA0119	Cross-linked PVDF over XLPE	Sn/Cu	150°C
	ACW0219	Cross-linked PVDF over XLPE	Cu	150°C
	55E0119	Cross-linked ETFE	Cu	200°C
	55E0219	Cross-linked ETFE	Cu	200°C

Screening Options	Description	Termination
	None	N/A
	Aluminum/PET wrap	Drain wire
	Spiral copper braid	Braid or drain wire
	Copper braid	SolderSleeve or drain wire
	Optimised copper braid	SolderSleeve or drain wire

Cable Examples	Components	Jacket	Screening	Outer Diameter (mm)
	2 x FLTA0119-0.50	ACJ	None	3.2 mm
	2 x FLTA0119-0.50	ACJ	None	4.4 mm
	2 x FLTA0111-0.50	ACJ	None	4.4 mm
	2 x ACW0219-0.50	ACJ	Aluminum wrap and drain wire	4.4 mm
	2 x FLTA0119-1.00	ACJ	None	6.2 mm
	2 x 55E0119-0.50	Fluoroelastomer	None	4.4 mm
	2 x 55E0119-0.50	Fluoroelastomer	Optimized copper and drain wire	4.4 mm

High Temperature Automotive Sensor Cables

Typical Jacket Properties	ACJ	Fluoroelastomer
Operating temperature	3000 hours @ 150°C	3000 hours @ 200°C
Short-term operating temperature	240 hours @ 175°C	160 hours @ 250°C, 6 hours @ 300°C
Cold bend	-40°C	-25°C
Flammability	45° 70 seconds	45° 30 seconds
Abrasion (ISO 6722)	> 500 cycles	> 1000 cycles
Petrol	15 minutes @ 23°C < 10% swell	30 minutes @ 23°C < 1% swell
Diesel	6 hours @ 23°C < 10% swell	30 minutes @ 23°C maximum 1% swell
Battery acid	6 hours @ 23°C < 10% swell	20 hours @ 23°C maximum 1% swell
Screenwash fluid	6 hours @ 23°C < 10% swell	20 hours @ 23°C maximum 1% swell
Engine coolant	6 hours @ 50°C < 10% swell	20 hours @ 50°C maximum 1% swell
Transmission fluid	6 hours @ 50°C < 10% swell	20 hours @ 50°C maximum 1% swell
Brake fluid	6 hours @ 50°C < 10% swell	Not tested in brake fluid
Engine oil	6 hours @ 50°C < 10% swell	24 hours @ 90°C maximum 1% swell

Specifications	Release Specification:
	TE Connectivity's Raychem WSD 1525
	TE Connectivity's Raychem WCD 51
	TE Connectivity's Raychem WSD 1800
	TE Connectivity's Raychem WSD 2366

ASC Performance Highlights
Designed for high-speed automated cutting, stripping and termination.
The jacket materials have proven over-molding characteristics and bond to industry standard molding materials.
ASCs offer appropriate EMC levels for a given system, many modern sensors operate with very low voltages and/or high frequencies. The increasingly complex EMC environment within a car has lead to significant improvements in automotive cable screening technologies.
ACW0219 meets the most demanding 150°C primary wire specifications in the world and is widely accepted by OEMs.
55E0119 meets the most demanding 200°C primary wire specifications in the world and is widely accepted by OEMs.
ASCs meet all the existing automotive environmental European legislations.
Suitable for direct routing through high temperature areas without use of additional protection or heat-shields due to excellent mechanical properties at elevated levels.

Part Number	CSA (mm <sup>2</sup> )	No. of Components	Overall Diameter (mm)		Nominal Weight (kg/km)	Copper Weight (kg/km)
			Minimum	Maximum		
<b>Standard Range of T4 150°C Shielded Cables available</b>						
ACW6219-0.50-X-0	0.50	1	3.6	4.0	21.0	9.8
ACW6219-0.75-X-0	0.75	1	4.3	4.7	28.0	14.5
ACW6219-1.00-X-0	1.00	1	4.5	4.9	30.0	19.0
ACW6229-0.50-X/X-0	0.50	2	4.0	4.4	23.0	14.7
ACW6229-0.75-X/X-0	0.75	2	4.6	5.0	28.0	19.9
ACW6229-1.00-X/X-0	1.00	2	5.0	5.4	37.0	26.1
ACW6239-0.50-X/X/X-0	0.50	3	4.5	4.9	31.0	19.7
ACW6239-0.75-X/X/X-0	0.75	3	5.2	5.6	43.0	29.0
ACW6239-1.00-X/X/X-0	1.00	3	5.7	6.1	53.0	38.0

<b>Standard Range of T4 150°C Unshielded Cables available</b>						
ACW4229-0.35-X/X-0	0.35	2	3.8	4.2	18.1	6.4
ACW4229-0.50-X/X-0	0.50	2	4.2	4.6	22.5	9.2
ACW4229-0.75-X/X-0	0.75	2	4.8	5.2	28.7	13.5
ACW4229-1.00-X/X-0	1.00	2	5.2	5.6	35.2	17.6
ACW4239-0.35-X/X/X-0	0.35	3	4.0	4.4	23.2	9.6
ACW4239-0.50-X/X/X-0	0.50	3	4.4	4.8	29.1	13.8
ACW4239-0.75-X/X/X-0	0.75	3	5.1	5.5	39.0	20.2
ACW4239-1.00-X/X/X-0	1.00	3	5.5	5.9	47.1	26.4
ACW4249-0.35-X/X/X-X-0	0.35	4	4.3	4.7	30.5	12.8
ACW4249-0.50-X/X/X-X-0	0.50	4	4.8	5.2	38.7	18.3
ACW4249-0.75-X/X/X-X-0	0.75	4	5.5	5.9	51.3	27.0
ACW4249-1.00-X/X/X-X-0	1.00	4	6.0	6.4	62.4	35.2

For Product Application Information please see Pages 16, 20, 22 and 24.

**150°C and 200°C Cost-Effective Battery and Power Cables**

**Product Features**

- T4, T6 rated (3000 hours)
- Mechanically tough
- Excellent resistance to automotive fluids
- Compatible with all harness components
- Light-weight
- 600 Volts. Thin-wall

TE Connectivity's Raychem automotive power cables have been developed to offer cost-effective solutions for power distribution in the car. Often required to carry several hundred Amps the insulation must be resistant to abrasion and cut-through damage as well as being resistant to automotive fluids and extremes of temperature.

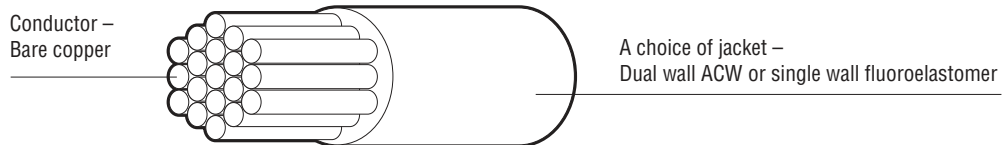
The range of insulation materials offered means that there is a solution for all routing requirements. Often power cables have to be routed through high temperature regions. TE Connectivity's Raychem power cables have a solution at 150°C and 200°C.

If flexibility is an issue there are a range of products available that take advantage of high strand count conductors or flexible insulation materials.

ACW is available. For 4, 6 and 10 sq mm please see ACW0219 datasheet.

If a high level of flexibility is required fluoroelastomer insulated power cables are available.

**Ordering Information**



Conductor		Finished Wire								
Examples of Part Number	Insulation Material	CSA (mm <sup>2</sup> )	Stranding Numbers/ Diameter (mm)	Diameter Maximum (mm)	Maximum Resistance @ 20°C (ohms/km)	Diameter			Copper Approximate Weight (kg/km)	Weight for Information (kg/km)
						Lower Spec. Limit (mm)	Target (mm)	Upper Spec. Limit (mm)		
MPCB-16.0-*	Fluoroelastomer	16.00	133/0.40	5.99	1.16	N/A	N/A	7.21	174.00	150.00
MCPB-20.0-*	Fluoroelastomer	20.00	259/0.30	6.20	0.96	N/A	N/A	7.67	210.00	21.00

Standard Colors	Color	Code	Color	Code	Color	Code
Please note that for some sizes colors are restricted	Black	0	Orange	3	Violet	7
	Brown	1	Yellow	4	Gray	8
	Red	2	Green	5	White	9
	Pink	2L	Blue	6		

**Ordering Description** The '\*' in the part number shall be replaced by a standard numerical color code designator as per above. For e.g. ACW0219-10-0 is a black cable.

**150 °C and 200 °C Cost-Effective Battery and Power Cables**

Typical properties of power cables	ACW0219-10-0	MPCB-16	HTPC-16
Operating temperature	3000 hours @ 150°C	3000 hours @ 150°C	3000 hours @ 200°C
Short-term operating temperature	240 hours @ 175°C	240 hours @ 175°C	240 hours @ 225°C
Cold bend	-40°C	-40°C	-40°C
Flammability	45° 30 seconds	45° 30 seconds	45° 30 seconds
Abrasion (ISO 6722)	-	>3500 cycles (Ford 597)	>3500 cycles (Ford 597)
Petrol	30 mins @ 23°C, no breakdown @ 1 kV, <1% swell	30 mins @ 23°C, no breakdown @ 1 kV, <1% swell	30 mins @ 23°C, no breakdown @ 1 kV, <1% swell
Diesel	30 mins @ 23°C, no breakdown @ 1 kV, maximum 1% swell	30 mins @ 23°C, no breakdown @ 1 kV, maximum 1% swell	30 mins @ 23°C, no breakdown @ 1 kV, maximum 1% swell
Battery acid	20 hours @ 23°C, no breakdown @ 1 kV, maximum 1% swell	20 hours @ 23°C, no breakdown @ 1 kV, maximum 1% swell	20 mins @ 23°C, no breakdown @ 1 kV, maximum 1% swell
Screenwash fluid	-	20 hours @ 23°C, no breakdown @ 1 kV, maximum 1% swell	20 mins @ 23°C, no breakdown @ 1 kV, maximum 1% swell
Engine coolant	20 hours @ 50°C, no breakdown @ 1 kV, <1% swell	20 hours @ 50°C, no breakdown @ 1 kV, maximum 1% swell	20 hours @ 50°C, no breakdown @ 1 kV, maximum 1% swell
Transmission fluid	24 hours @ 135°C, no breakdown @ 1 kV, <1% swell	20 hours @ 50°C, no breakdown @ 1 kV, maximum 1% swell	20 hours @ 50°C, no breakdown @ 1 kV, maximum 1% swell
Brake fluid	-	-	-
Engine oil	20 hours @ 50°C, no breakdown @ 1 kV, <1% swell	24 hours @ 50°C, no breakdown @ 1 kV, maximum 1% swell	24 hours @ 50°C, no breakdown @ 1 kV, maximum 1% swell
<b>Specifications</b>	<b>Release Specification:</b>	TE Connectivity's Raychem WSD 1223, 1734 & 2234	
	<b>Related Specifications:</b>	ISO 6722	
		Ford Motor Company – Engineering Specification WSK 1A348-A4	
		LV112 (2002)	
		Fiat Group Automobiles normazione 9.91107	
		Ford Motor Company Global Wire Specification ES-AU5T-1A348-AA	

<b>Power Cable Performance Highlights</b>	Suitable for direct routing through high temperature areas without use of additional protection or heat-shields due to its excellent mechanical properties at elevated temperatures.
	Excellent fluid resistance at elevated temperatures.
	Easily processable on standard stripping equipment.
	Proven high level of compatibility with materials used in the harnessing process. In particular, pvc tapes and wires.
	Supplied in barrels or on Maschinenfabrik Niehoff GmbH & Co. KG spools for fast automatic handling and lead preparation using standard equipment.

**For Product Application Information please see Pages 14.**

Engineering Notes

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Packaging of Primary Wires

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# Packaging

Packaging of Primary Wires

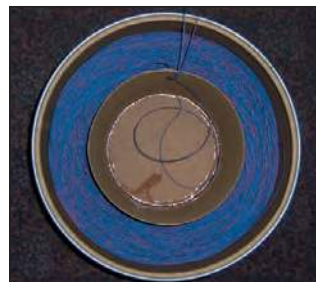
**Barrels**

**Benefits**

- Multi use cost effective returnable package
- Large volume capacity
- Compact package

**Dimensions**

**Height:** 463 mm  
**Outer Diameter:** 400 mm  
**Weight:** 2.5 kg empty



**Selection Guide by Product**

Quantity per pack indicated

CSA	55E0119	55E0219
0.35	7.5 km	not available
0.50	7.5 km	5.0 km
0.60	7.5 km	not available
0.75	5.0 km	5.0 km
1.0	5.0 km	4.0 km
1.5	4.0 km	2.5 km
2.0	2.5 km	not available
2.5	2.0 km	not available
3.0	1.5 km	not available
4.0	1.0 km	not available



Packaging of Primary Wires

Maschinenfabrik Niehoff GmbH & Co. KG Spools

Benefits

- Robust package for long distance shipment
- The natural lay of the wire in the barrel minimizes set
- Recyclable

Dimensions

- Height:** 410 mm
- Outer Diameter:** 500 mm
- Core Diameter:** 315 mm
- Weight:** 4.5 kg empty



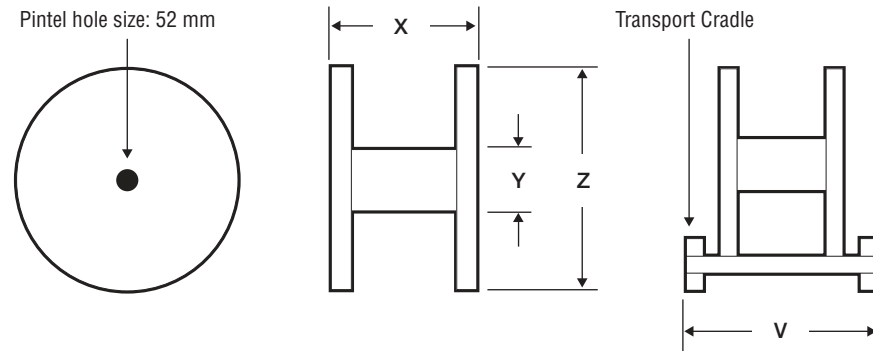
Selection Guide by Product

Quantity per pack indicated

CSA	ACW	55E
0.35	15.0 km	15.0 km
0.50	10.0 km	10.0 km
0.60	not available	not available
0.75	8.0 km	8.0 km
1.0	6.0 km	6.0 km
1.5	4.0 km	4.0 km
2.0	not available	not available
2.5	3.0 km	3.0 km

Packaging of Primary Wires

**Wooden Reels**



**Standard Reel Sizes**

Reel	Flange Diameter (Z)	External Width (X)	Core Diameter (Y)	Reel Weight (kg)	Cradle Width (V)	Cradle Weight (kg)
16	400	320	210	2	660	6
24	600	330	243	6	660	6
30	750	384	302	10	711	9
36	914	492	368	22	711	9
48	1216	553	512	65	711	9

All dimensions (in mm) are nominal

**Sensor Cables**

A standard reel would be selected from reel sizes 16–36 with the actual size being determined by the cable OD, quantity required and any customer weight limit.

**Power Cables**

CSA	Typical Outer Dia. (mm)	Standard Reel Sizes					Minimum Length (m)	Lengths per Reel
		16 Typical (m)	24 Maximum (m)	30 Quantity (m)	36 (m)	48 (m)		
10	6.60	450	1250	2250	n/a	n/a	50	5
16	8.00	300	850	1500	n/a	n/a	50	5
25	10.00	200	500	1000	n/a	n/a	50	5
30	10.30	150	500	750	1000	n/a	50	5
35	11.00	150	400	750	1000	n/a	50	5
50	13.00	n/a	n/a	500	750	1000	25	5
70	15.00	n/a	n/a	n/a	500	750	25	5

- Special reel sizes available based on quantity required and any customer weight limit.
- For cable weight refer to the product data sheet.

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## Restriction on the Use of Hazardous Substances (RoHS)

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### Restriction on the Use of Hazardous Substances (RoHS)

At TE Connectivity, we're ready to support your RoHS requirements. We've assessed more than 1.5 million end items/components for RoHS compliance, and issued new part numbers where any change was required to eliminate the restricted materials. Part numbers in this catalog are identified as:

#### RoHS Compliant

Part numbers in this catalog are RoHS Compliant, unless marked otherwise.

These products comply with European Union Directive 2002/95/EC as amended 1 January 2006 that restricts the use of lead, mercury, cadmium, hexavalent chromium, PBB, and PBDE in certain electrical and electronic products sold into the EU as of 1 July 2006.

**Note:** For purposes of this Catalog, included within the definition of RoHS Compliant are products that are clearly "Out of Scope" of the RoHS Directive such as hand tools and other non-electrical accessories.

#### Non-RoHS Compliant

These part numbers are identified with a "◆" symbol. These products do not comply with the material restrictions of the European Union Directive 2002/95/EC.

#### 5 of 6 Compliant

A "●" symbol identifies these part numbers. These products do not fully comply with the European Union Directive 2002/95/EC because they contain lead in solderable interfaces (they do not contain any of the other five restricted substances above allowable limits). However, these products may be suitable for use in RoHS applications where there is an application-based exception for lead in solders, such as the server, storage, or networking infrastructure exemption.

**Note:** Information regarding RoHS compliance is provided based on reasonable inquiry of our suppliers and represents our current actual knowledge based on the information provided by our suppliers. This information is subject to change. For latest compliance status, refer to our website referenced below.

#### Getting the Information You Need

Our comprehensive on-line RoHS Customer Support Center provides a forum to answer your questions and support your RoHS needs. A RoHS FAQ (Frequently Asked Questions) is available with links to more detailed information. You can also submit RoHS questions and receive a response within 24 hours during a normal work week. The Support Center also provides:

- Cross-Reference from Non-compliant to Compliant Products
- Ability to browse RoHS Compliant Products in our on-line catalog: <http://www.te.com/commerce/alt/RohsAltHome.do>
- Downloadable Technical Data Customer Information Presentation
- More detailed information regarding the definitions used above

RoHS  
Customer  
Support  
Center 

So whatever your questions when it comes to RoHS, we've got the answers at <http://www.te.com/customersupport/rohssupportcenter/>

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## Disclaimer and Trademarks

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Engineering Notes

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Engineering Notes

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Phone: +49-6251-133-1999  
Fax: +49-6251-133-1988

**Greece** – Athens  
Phone: +30-210-9370-396/397  
Fax: +30-210-9370-655

**Hungary** – Budapest  
Phone: +36-1-289-1000  
Fax: +36-1-289-1010  
**Product Information Center:**  
Phone: +36-1-289-1016  
Fax: +36-1-289-1017

**India** – Bangalore  
Phone: +91-80-2854-0800  
Fax: +91-80-2854-0814

**Italy** – Collegno (Torino)  
Phone: +39-011-4012-111  
Fax: +39-011-4031-116  
**Product Information Center:**  
Phone: +39-011-4012-632  
Fax: +39-011-4028-7632

**Lithuania and Latvia**  
**Lithuania** – Vilnius  
Phone: +370-5-213-1402  
Fax: +370-5-213-1403

**Netherlands** – 's-Hertogenbosch  
Phone: +31-73-6246-246  
Fax: +31-73-6212-365  
**Product Information Center:**  
Phone: +31-73-6246-999  
Fax: +31-73-6246-998

**Norway** – Nesbru  
Phone: +47-66-77-88-50  
Fax: +46-8-50-72-50-01  
**Product Information Center:**  
Phone: +46-8-50-72-50-20  
Fax: +46-8-50-72-52-20

**Poland** – Warsaw  
Phone: +48-22-4576-700  
Fax: +48-22-4576-720  
**Product Information Center:**  
Phone: +48-22-4576-704  
Fax: +48-22-4576-720

**Romania** – Bucharest  
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Fax: +40-21-312-0574

**Russia** – Moscow  
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Fax: +7-495-721-1893  
**Product Information Center:**  
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Fax: +7-495-721-1893

**Russia** – Yekaterinburg  
Phone: +7-343-2531-153  
Fax: +7-343-2531-152

**Russia** – Nizhniy Novgorod  
Phone: +7-831-220-33-05/-06  
Fax: +7-831-220-33-39/-40

**Slovenia** – Ljubljana  
Phone: +386-1561-3270  
Fax: +386-1561-3240

**South Africa** – Port Elizabeth  
Phone: +27-41-503-4500  
Fax: +27-41-581-0440

**Spain** – Barcelona  
Phone: +34-93-291-0330  
Fax: +34-93-201-7879  
**Product Information Center:**  
Phone: +34-93-291-0366  
Fax: +34-93-209-1030

**Sweden** – Upplands Väsby  
(Switchboard)  
Phone: +46-8-50-72-50-00  
Fax: +46-8-50-72-50-01  
**Product Information Center:**  
Phone: +46-8-50-72-50-20  
Fax: +46-8-50-72-52-20

**Switzerland** – Steinach  
Phone: +41-71-447-0447  
Fax: +41-71-447-0444  
**Product Information Center:**  
Phone: +41-71-447-0447  
Fax: +41-71-447-0400

**Turkey** – Istanbul  
Phone: +90-212-281-8181/2/3  
+90-212-282-5130/5430  
Fax: +90-212-281-8184

**Ukraine** – Kiev  
Phone: +380-44-206-2265  
Fax: +380-44-206-2264  
**Product Information Center:**  
Phone: +380-44-206-2265  
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**United Kingdom and Ireland** – Swindon  
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Fax: +44-208-954-6234  
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