PRYSMIAN

Airborne.

Bare overhead conductors perfectly adapted to New Zealand.

A brand of the Prysmian Group

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Bare overhead conductors perfectly adapted to New Zealand.

What's New Zealand and spans our skies? Prysmian's bare overhead conductors of course! From low voltage to high voltage and everything in between our conductors can be tailor-made to fit your specific needs. Fully compliant to British & Australian/New Zealand Standards. Prysmian gives you the power to soar.

The sky's the limit.

Proudly manufacturing in New Zealand since the 1940's, Prysmian New Zealand Ltd understands local standards and conditions. We know what it takes to overcome the challenges that the tough New Zealand environment presents.

To ensure our conductors survive in New Zealand's harsh marine coastal areas we developed a manufacturing application allowing us to grease conductors to the requirements of IEC 61089. The development was made to ensure a consistent application of grease in manufactured conductors to eliminate preventable premature corrosion due to grease 'holiday'.

This is one example of how our unique combination of local know-how combined with the strength of being a global market leader enables us to provide integrated, value-added solutions for our customers.

Bare overhead power lines vary in size from small capacity low voltage distribution lines to 700 kV transmission lines on steel towers.

Prysmian understands that the conductor materials must be selected to best suit the specific application and standards at hand. Our selection process takes into account the physical and electrical requirements pertaining to each installation whilst at the same time delivering the most cost effective solution.

We take pride ensuring that our customers' needs are met with fit-for-purpose solutions and that's why doing business with us pays off.

CONDUCTORS DESIGNED TO BRITISH STANDARDS

AAC 1350 – ALL ALUMINIUM CONDUCTORS

Standard sizes to BS 215 Part 1

Physical characteristics

Product code	Strand/wire diameter No/mm	Nominal C.S.A. mm²	Nominal O.D. mm	Approximate Mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa*	Coefficient of linear expansion /°C x 10^{-6}
Namu	7/2.11	23.32	6.2	60	4.19	59	23
Poko	7/2.36	30.6	7.1	80	5.09	59	23
Ladybird	7/2.79	42.8	8.37	117	7.28	59	23
Kutu	7/3.00	49.5	9	140	7.99	59	23
Fly	7/3.40	63.55	10.2	174	9.90	59	23
Rango	7/3.66	73.6	11	200	11.19	59	23
Grasshopper	7/3.91	84.1	11.37	230	13.45	59	23
Wasp	7/4.39	106	13.17	290	16.00	59	23
Beetle	19/2.67	106.4	13.35	292	18.08	56	23
Weke	7/4.72	122.5	14.2	335	18.62	59	23
Bee	7/4.90	132	14.7	361	21.12	59	23
Cricket	7/5.36	158	16.1	430	23.9	59	23
Weta	19/3.35	167.5	16.8	461	26.25	56	23
Caterpillar	19/3.53	237.6	20	512	28.6	56	23
Cockroach	19/4.22	265.7	21.1	731	40.40	56	23
Butterfly	19/4.65	322.7	23.25	888	48.75	56	23
Drone	37/3.58	372.4	25.06	1027	59.59	56	23
Centipede	37/3.78	415.2	26.46	1145	63.10	56	23
Cicada	37/4.65	628.3	32.55	1733	100.54	56	23

*Practical value reported as per BS 215 Part 1, Appendix B.

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm²	Alum mm²	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
Namu	14.2	23.3	1.170	1.450	119	201	84	161	2.3	0.324
Poko	18.7	30.6	0.935	1.159	140	231	98	185	2.58	0.317
Ladybird	26.1	42.8	0.669	0.830	176	286	124	228	3.04	0.307
Kutu	30.2	49.5	0.579	0.717	195	314	137	250	3.27	0.302
Fly	38.8	63.6	0.450	0.559	233	369	163	293	3.7	0.294
Rango	44.9	73.6	0.389	0.482	258	405	180	321	3.99	0.289
Grasshopper	51.3	84.1	0.341	0.422	284	441	197	349	4.13	0.287
Wasp	64.7	106.0	0.270	0.335	334	511	231	404	4.78	0.278
Beetle	64.9	106.4	0.270	0.335	336	513	232	405	5.06	0.275
Weke	74.7	122.5	0.234	0.290	370	561	256	442	5.15	0.273
Bee	80.5	132.0	0.217	0.269	390	588	269	464	5.33	0.271
Cricket	96.4	158.0	0.181	0.225	442	660	305	519	5.83	0.266
Weta	102.2	167.5	0.172	0.213	462	686	318	539	6.36	0.260
Caterpillar	113.4	185.9	0.155	0.192	497	734	342	575	6.7	0.274
Cockroach	162.1	265.7	0.108	0.134	639	923	437	720	7,99	0.246
Butterfly	196.8	322.7	0.0892	0.111	733	1046	500	814	8.81	0.240
Centipede	253.3	415.2	0.0694	0.086	876	1231	595	954	10.16	0.231
Cicada	383.3	628.3	0.0459	0.057	1174	1612	792	1241	12.5	0.218

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

ACSR/GZ – ALUMINIUM CONDUCTORS, GALVANISED STEEL REINFORCED

Standard sizes to BS 215 Part 2

Physical characteristics

Product code	Strand/wire diameter No/mm		Cross Sectional Area			Nominal O.D. mm	Approximate Mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa*	Coefficient of linear expansion /°C x 10^{-6}
	Alum No/mm	Steel No/mm	Alum mm²	Steel mm²	Total mm²					
Squirrel	6/2.11	1/2.11	21	3.5	24.5	6.33	84.7	7.87	79	19.3
Gopher	6/2.36	1/2.36	26.2	4.4	30.6	7.1	110	9.6	79	19.3
Flounder**	6/2.36	1/3.81	26.2	7.9	34.1	6.7	140	16.4	79	19.3
Ferret	6/3.00	1/3.00	42.4	7.1	49.5	9.0	170	15.2	79	19.3
Mink	6/3.66	1/3.66	63.1	10.5	73.6	10.98	254.9	21.67	79	19.3
Racoon	6/4.09	1/4.09	78.8	13.1	91.9	12.27	318.9	27.06	79	19.3
Dog	6/4.72	7/1.57	105	13.5	118.5	14.15	394	32.7	75	19.3
Dingo	18/3.35	1/3.35	158.7	8.8	167.5	16.75	506	35.7	66	21.2
Wolf	30/2.59	7/2.59	158.1	36.8	194.9	18.1	730	69.2	80	18.9
Jaguar	18/3.86	1/3.86	210.6	11.7	222.3	19.3	671	46.55	66	21.2
Goat	30/3.71	7/3.71	324.3	75.7	400	25.97	1488	135.13	80	19.4
Zebra	54/3.18	7/3.18	428.9	55.6	484.5	28.62	1621	131.9	69	20.6

*Practical value reported as per BS 215 Part 2, Appendix B.
**Smooth body construction.

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm²	Alum mm²	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
Squirrel	12.6	20.7	1.368	1.741	109	183	77	147	2.05	0.331
Gopher	15.8	25.9	1.093	1.403	127	210	89	168	2.29	0.324
Flounder**	12.2	20	1.354	1.81	109	182	77	146	2.18	0.327
Ferret	25.5	41.8	0.677	0.9	174	280	122	223	2.92	0.309
Mink	37.9	62.2	0.455	0.632	226	354	157	281	3.56	0.297
Racoon	47.3	77.6	0.364	0.519	261	403	181	319	3.98	0.29
Dog	63.1	103.4	0.273	0.391	319	483	220	381	4.95	0.276
Dingo	95	155.7	0.181	0.223	452	671	311	527	6.5	0.259
Wolf	94.3	154.6	0.183	0.223	466	686	320	537	7.48	0.25
Jaguar	126.1	206.8	0.137	0.168	551	805	378	629	7.48	0.25
Goat	193.5	317.2	0.0891	0.109	773	1089	525	844	10.71	0.227
Zebra	255.8	419.4	0.0674	0.0865	903	1257	611	971	11.59	0.222

**Smooth body construction.

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

ACSR/AC – ALUMINIUM CONDUCTORS, ALUMINIUM CLAD STEEL REINFORCED

Standard sizes to BS 215 Part 2

Physical characteristics

Product code	Strand/wire diameter No/mm		Cross Sectional Area			Nominal O.D. mm	Approximate Mass kg/km**	Calculated minimum breaking load kN	Final modulus of elasticity GPa*	Coefficient of linear expansion /°C x 10^{-6}
	Alum No/mm	Steel No/mm	Alum mm^2	Steel mm^2	Total mm^2					
Hyena	7/4.39	7/1.93	105.95	20.48	126.43	14.57	435	41.6	74	20.6
Coyote	26/2.54	7/1.91	131.74	20.06	151.8	15.89	509	46.9	77	20.3
Wolf	30/2.59	7/2.59	158.12	36.88	195	18.13	700	71.6	82	19.4
Goat	30/3.71	7/3.71	324.31	75.67	399.98	25.97	1436	135.8	82	19.4
Zebra	54/3.18	7/3.18	428.91	55.6	484.51	28.62	1610	137.9	75	20.6
Moa	76/3.72	7/2.89	826	45.92	871.92	38.43	2706	187.3	68	21.8
Chukar	84/3.70	7/3.71	903.2	75.67	978.87	40.73	3137	227.6	71	21.3

*Calculated value reported.
**Calculations relate to greased conductor - Case 2.

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm^2	Alum mm^2	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
Hyena	67.8	111.2	0.2707	0.372	330	499	228	393	5.1	0.274
Coyote	82.7	135.6	0.2082	0.254	414	619	285	486	2.43	0.321
Wolf	101.7	166.8	0.1693	0.207	484	712	332	558	7.48	0.25
Goat	208.8	342.3	0.0825	0.101	804	1132	546	878	10.71	0.227
Zebra	267.1	437.8	0.0646	0.0808	934	1301	633	1005	11.59	0.222
Moa	501.1	821.5	0.0344	0.042	1463	1982	982	1518	15.15	0.206
Chukar	552.2	905.2	0.0312	0.0381	1574	2122	1054	1623	16.29	0.201

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

CONDUCTORS DESIGNED TO AUSTRALIAN/NEW ZEALAND STANDARDS

AAC 1350 – ALL ALUMINIUM CONDUCTORS

Standard sizes to AS/NZS 1531

Physical characteristics

Product code	Strand/wire diameter No/mm	Nominal C.S.A. mm²	Nominal O.D. mm	Approximate Mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
LEO	7/2.50	34.4	7.5	94.3	5.7	65	23
LEONIDS	7/2.75	41.6	8.3	113	6.7	65	23
LIBRA	7/3.00	49.5	9.0	135	7.9	65	23
MARS	7/3.75	77.3	11.3	212	11.8	65	23
MECURY	7/4.50	111	13.5	304	16.9	65	23
MOON	7/4.75	124	14.3	339	18.9	65	23
NEPTUNE	19/3.25	158	16.3	433	24.7	65	23
ORION	19/3.50	183	17.5	503	28.7	65	23
PLUTO	19/3.75	210	18.8	576	31.9	65	23
SATURN	37/3.00	262	21.0	721	42.2	64	23
SIRUS	37/3.25	307	22.8	845	48.2	64	23
TAURUS	19/4.75	337	23.8	924	51.3	65	23
TRITON	37/3.75	409	26.3	1120	62.1	64	23
TROJANS	61/3.00	431	27.0	1192	66.0	64	23
URANUS	61/3.25	506	29.3	1400	75.2	64	23
URSULA	61/3.50	587	31.5	1620	87.3	64	23
VENUS	61/3.75	674	33.8	1860	97.2	64	23
VIRGO	91/4.50	1450	49.5	4010	207	64	23

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm²	Alum mm²	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
LEO	21.3	33.9	0.833	1.02	152	251	107	200	2.72	0.314
LEONIDS	25.8	41.1	0.689	0.842	175	284	122	226	2.99	0.308
LIBRA	30.7	48.9	0.579	0.706	197	317	138	252	3.27	0.302
MARS	47.9	76.3	0.37	0.452	270	422	188	334	4.08	0.288
MECURY	69	110	0.258	0.314	348	532	241	420	4.9	0.277
MOON	76.9	122	0.232	0.282	376	570	260	450	5.17	0.273
NEPTUNE	97	154	0.183	0.223	446	665	307	523	6.16	0.262
ORION	113	180	0.157	0.193	494	730	340	572	6.63	0.258
PLUTO	129	206	0.137	0.168	545	798	374	625	7.1	0.253
SATURN	161	256	0.11	0.135	636	920	435	718	8.06	0.245
SIRUS	189	301	0.094	0.115	713	1020	486	794	8.73	0.240
TAURUS	208	331	0.0857	0.105	760	1081	517	840	9	0.238
TRITON	252	400	0.0706	0.087	870	1223	591	948	10.08	0.231
TROJANS	265	422	0.0671	0.082	905	1269	614	983	10.42	0.229
URANUS	311	495	0.0572	0.071	1006	1397	681	1079	11.29	0.224
URSULA	369	574	0.0593	0.061	1119	1540	755	1186	12.16	0.219
VENUS	414	659	0.0429	0.054	1224	1675	825	1288	13.03	0.215
VIRGO	885	1410	0.02	0.027	2028	2692	1349	2046	19.16	0.191

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

AAAC 1120 – ALL ALUMINIUM ALLOY CONDUCTORS

Standard sizes to AS/NZS 1531

Physical characteristics

Product code	Strand/wire diameter No/mm	Nominal C.S.A. mm^2	Nominal O.D. mm	Approximate Mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
CHLORINE	7/2.50	34.4	7.5	94.3	8.2	65	23
CHROMIUM	7/2.75	41.6	8.3	113	9.9	65	23
FLOURINE	7/3.00	49.5	9.0	135	11.8	65	23
HELIUM	7/3.75	77.3	11.3	212	17.6	65	23
HYDROGEN	7/4.50	111	13.5	304	24.3	65	23
IODINE	7/4.75	124	14.3	339	27.1	65	23
KRYPTON	19/3.25	158	16.3	433	37.4	65	23
LUTETIUM	19/3.50	183	17.5	503	41.7	65	23
NEON	19/3.75	210	18.8	576	47.8	65	23
NITROGEN	37/3.00	262	21.0	721	62.2	64	23
NOBELUM	37/3.25	307	22.8	845	72.8	64	23
OXYGEN	19/4.75	337	23.8	924	73.6	64	23
PHOSPHORUS	37/3.75	409	26.3	1120	93.1	64	23
RHODIUM	61/3.00	431	27.0	1192	97.0	64	23
SLELNIUM	61/3.25	506	29.3	1400	114	64	23
SILICON	61/3.50	587	31.5	1620	127	64	23
SULPHUR	61/3.75	674	33.8	1860	145	64	23
XENON	91/4.50	1450	49.5	4010	300	64	23

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm^2	Alum mm^2	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
CHLORINE	20.6	32.8	0.864	1.05	150	247	105	197	2.72	0.314
CHROMIUM	24.9	39.7	0.713	0.866	172	280	121	223	2.99	0.308
FLOURINE	29.6	47.2	0.601	0.731	194	311	135	248	3.27	0.302
HELIUM	46.3	73.7	0.383	0.468	265	414	185	328	4.08	0.288
HYDROGEN	66.7	106	0.266	0.325	342	523	237	413	4.9	0.277
IODINE	74.3	118	0.239	0.292	370	560	256	442	5.17	0.273
KRYPTON	93.9	150	0.189	0.231	439	654	302	514	6.16	0.262
LUTETIUM	109	173	0.163	0.198	488	721	335	565	6.63	0.258
NEON	125	199	0.142	0.174	536	785	367	614	7.1	0.253
NITROGEN	155	248	0.114	0.14	625	903	427	705	8.06	0.245
NOBELUM	182	291	0.0973	0.119	701	1003	478	781	8.73	0.24
OXYGEN	208	320	0.0884	0.109	746	1061	508	825	9	0.238
PHOSPHORUS	243	387	0.0731	0.09	855	1202	581	932	10.08	0.231
RHODIUM	256	408	0.0694	0.085	889	1247	603	965	10.42	0.229
SLELNIUM	300	478	0.0592	0.073	992	1378	672	1064	11.29	0.224
SILICON	348	555	0.0511	0.063	1101	1515	743	1167	12.16	0.219
SULPHUR	400	637	0.0444	0.056	1202	1645	810	1265	13.03	0.215
XENON	855	1632	0.0207	0.028	1991	2644	1325	2009	19.16	0.191

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

ACSR/GZ – ALUMINIUM CONDUCTORS. GALVANISED STEEL REINFORCED

Standard sizes to AS/NZS 3607

Physical characteristics

Product code	Strand/wire		Cross sectional area			Nominal O.D. mm	Approximate mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
	Alum No/mm	Steel No/mm	Alum mm^2	Steel mm^2	Total mm^2					
QUINCE	3/1.75	4/1.75	7.2	9.6	16.8	5.3	96	12.7	136	13.9
RAISIN	3/2.50	4/2.50	14.7	19.6	34.3	7.5	193	24.4	136	13.9
SUPER SULTANA	3/3.00	4/3.00	21.2	28.3	49.5	9.0	280	35.0	136	13.9
SULTANA	4/3.00	3/3.00	28.3	21.2	49.5	9.0	242	28.3	119	15.2
WALNUT	4/3.75	3/3.75	44.2	33.1	77.3	11.3	379	43.9	119	15.2
ALMOND	6/2.50	1/2.50	29.2	4.9	34.4	7.5	119	10.5	83	19.3
APRICOT	6/2.75	1/2.75	35.6	5.9	41.5	8.3	144	12.6	83	19.3
APPLE	6/3.00	1/3.00	42.4	7.1	49.5	9.0	171	14.9	83	19.3
BANANA	6/3.75	1/3.75	66.3	11.0	77.3	11.3	268	22.8	83	19.3
CHERRY	6/4.75	7/1.60	106	14.1	120	14.3	404	33.2	80	19.9
GRAPE	30/2.50	7/2.50	147	34.4	182	17.5	677	63.5	88	19.4
LEMON	30/3.00	7/3.00	212	49.5	262	21.0	973	90.4	88	19.4
LYCHEE	30/3.25	7/3.25	249	58.1	307	22.8	1140	105	88	19.4
LIME	30/3.50	7/3.50	289	67.3	356	24.5	1320	122	88	19.4
MANGO	54/3.00	7/3.00	382	49.5	431	27.0	1440	119	75	20.6
ORANGE	54/3.25	7/3.25	448	58.1	506	29.3	1690	137	75	20.6
OLIVE	54/3.50	7/3.50	519	67.3	587	31.5	1960	159	75	20.6
PAW PAW	54/3.75	19/2.25	596	75.5	672	33.8	2240	178	74	20.7
PEACH	54/4.75	19/2.85	957	121	1078	42.8	3600	284	74	20.7

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm^2	Alum mm^2	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
QUINCE	5.5	8.7	3.25	4.05	66	114	47	92	0.7	0.399
RAISIN	11.2	17.8	1.59	2.02	108	178	76	142	1	0.376
SUPER SULTANA	16.1	25.7	1.1	1.43	138	223	97	177	1.2	0.365
SULTANA	19.8	31.5	0.897	1.17	153	246	107	196	1.5	0.351
WALNUT	30.9	49.2	0.573	0.773	206	322	143	255	1.87	0.337
ALMOND	18.2	29	0.975	1.27	136	225	96	180	2.43	0.321
APRICOT	22	35.1	0.805	1.06	155	252	109	201	2.68	0.314
APPLE	26.2	41.8	0.677	0.9	174	280	122	223	2.92	0.309
BANANA	41	65.2	0.433	0.601	234	365	163	290	3.65	0.295
CHERRY	65.8	104.7	0.271	0.403	315	477	218	376	4.61	0.28
GRAPE	90.4	144	0.196	0.24	443	655	304	513	7.22	0.252
LEMON	130.2	207	0.136	0.167	572	827	391	645	8.66	0.241
LYCHEE	153.2	244	0.116	0.142	641	918	437	714	9.38	0.236
LIME	177.3	282.3	0.1	0.123	710	1007	483	782	10.11	0.231
MANGO	234.4	373.4	0.0758	0.0967	834	1169	566	905	10.93	0.226
ORANGE	275	438	0.0646	0.0827	932	1294	631	999	11.84	0.221
OLIVE	319	508.1	0.0557	0.0716	1033	1421	697	1095	12.76	0.216
PAW PAW	366.2	583.2	0.0485	0.0628	1134	1553	764	1194	13.67	0.212
PEACH	586.5	934	0.0303	0.0408	1552	2085	1038	1592	17.31	0.197

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

ACSR/AC – ALUMINIUM CONDUCTORS. ALUMINIUM CLAD STEEL REINFORCED

Standard sizes to AS 3607

Physical characteristics

Product code	Strand/wire		Cross sectional area			Nominal O.D. mm	Approximate mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
	Alum No/mm	Steel No/mm	Alum mm²	Steel mm²	Total mm²					
SKATING	3/1.75	4/1.75	7.2	9.6	16.8	5.3	83	12.3	119	15.3
SOCCER	3/2.50	4/2.50	14.7	19.6	34.3	7.5	171	24.9	119	15.3
SWIMMING	4/3.00	3/3.00	28.3	21.2	49.5	9.0	218	28.9	106	16.5
TENNIS	4/3.75	3/3.75	44.2	33.1	77.3	11.3	340	42.6	106	16.5
ANGLING	6/2.50	1/2.50	29.5	4.9	34.4	7.5	113	10.6	79	20.1
ARCHERY	6/3.00	1/3.00	42.4	7.1	49.5	9.0	163	15.1	79	20.1
BASEBALL	6/3.75	1/3.75	66.3	11.0	77.3	11.3	254	22.3	79	20.1
BOWLS	6/4.75	7/1.60	106	14.1	120	14.3	385	32.7	76	20.6
CRICKET	30/2.50	7/2.50	147	34.4	182	17.5	636	64.4	82	19.4
DARTS	30/3.00	7/3.00	212	49.5	262	21.0	913	91.6	82	19.4
DICE	30/3.25	7/3.25	249	58.1	307	22.8	1070	106	82	19.4
DIVING	30/3.50	7/3.50	289	67.3	356	24.5	1240	122	82	19.4
GOLF	54/3.00	7/3.00	382	49.5	431	27.0	1380	120	75	20.6
GYMNASTICS	54/3.25	7/3.25	448	58.1	506	29.3	1620	139	75	20.6
HURDLES	54/3.50	7/3.50	519	67.3	587	31.5	1880	159	75	20.6
LACROSSE	54/3.75	19/2.25	596	75.5	672	33.8	2150	180	74	20.7
RUGBY	54/4.75	19/2.85	957	121	1078	42.8	3450	288	74	20.7

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm²	Alum mm²	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
SKATING	6.5	10.3	2.75	3.35	73	126	52	101	0.7	0.399
SOCCER	13.3	21.1	1.34	1.63	120	198	85	159	1	0.376
SWIMMING	22	35	0.807	1.05	162	260	113	207	1.5	0.351
TENNIS	34.4	54.7	0.517	0.689	218	341	152	270	1.87	0.337
ANGLING	19.3	30.7	0.923	1.1198	145	239	102	191	2.43	0.321
ARCHERY	27.7	44.1	0.641	0.844	180	290	126	231	2.92	0.309
BASEBALL	43.3	69	0.41	0.555	243	380	169	301	3.65	0.295
BOWLS	68.7	109.4	0.259	0.356	335	507	232	400	4.61	0.28
CRICKET	97.6	155.4	0.182	0.223	460	679	316	533	7.22	0.252
DARTS	140.5	223.8	0.126	0.155	594	858	406	670	8.66	0.241
DICE	164.9	262.6	0.108	0.133	663	948	452	738	9.38	0.236
DIVING	191.3	304.6	0.0928	0.114	738	1046	502	813	10.11	0.231
GOLF	244.6	389.6	0.0726	0.0908	860	1206	584	934	10.93	0.226
GYMNASTICS	287.1	457.3	0,0619	0.078	959	1332	649	1029	11.84	0.221
HURDLES	330	530.3	0.0533	0.0678	1061	1461	717	1125	12.76	0.216
LACROSSE	381.8	608.1	0.0465	0.0598	1162	1591	783	1224	13.67	0.212
RUGBY	612.6	975.7	0.029	0.04	1568	2106	1048	1608	17.31	0.197

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

AACSR/GZ – ALUMINIUM ALLOY CONDUCTORS. GALVANISED STEEL REINFORCED

Standard sizes to AS/NZS 3607

Physical characteristics

Product code	Strand/wire		Cross sectional area			Nominal O.D. mm	Approximate mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
	Alum No/mm	Steel No/mm	Alum mm^2	Steel mm^2	Total mm^2					
APPLE 1120	6/3.00	1/3.00	42.4	7.1	49.5	9.0	171	18.3	83	19.3
BANANA 1120	6/3.75	1/3.75	66.3	11.0	77.3	11.3	268	27.9	83	19.3
CHERRY 1120	6/4.75	7/1.60	106	14.1	120	14.3	402	40.7	80	19.9
GRAPE 1120	30/2.50	7/2.50	147	34.4	182	17.5	677	74.4	88	19.4
LEMON 1120	30/3.00	7/3.00	212	49.5	262	21.0	973	107	88	19.4
LYCHEE 1120	30/3.25	7/3.25	249	58.1	307	22.8	1140	126	88	19.4
LIME 1120	30/3.50	7/3.50	289	67.3	356	24.5	1320	143	88	19.4
MANGO 1120	54/3.00	7/3.00	382	49.5	431	27.0	1440	149	78	20.6
ORANGE 1120	54/3.25	7/3.25	448	58.1	506	29.3	1690	174	78	20.6
OLIVE 1120	54/3.50	7/3.50	519	67.3	587	31.5	1960	197	78	20.6

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm^2	Alum mm^2	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
APPLE 1120	25.4	40.4	0.7	0.928	172	276	120	220	2.92	0.309
BANANA 1120	39.7	63.2	0.448	0.62	230	360	160	285	3.65	0.295
CHERRY 1120	63.5	101.2	0.279	0.413	311	471	215	371	4.61	0.28
GRAPE 1120	87.3	139.1	0.203	0.249	435	643	299	504	7.22	0.252
LEMON 1120	126	200	0.141	0.173	562	812	384	634	8.66	0.241
LYCHEE 1120	147.6	235.1	0.12	0.147	630	902	430	702	9.38	0.236
LIME 1120	171.2	272.6	0.104	0.128	696	987	474	767	10.11	0.231
MANGO 1120	226.4	360.5	0.0784	0.0997	821	1151	557	891	10.93	0.226
ORANGE 1120	265.7	423.1	0.0669	0.0854	917	1273	621	983	11.84	0.221
OLIVE 1120	308.1	490.7	0.0578	0.0741	1015	1397	685	1076	12.76	0.216

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

AACSR/AC – ALUMINIUM ALLOY CONDUCTORS. ALUMINIUM CLAD STEEL REINFORCED

Standard sizes to AS/NZS 3607

Physical characteristics

Product code	Strand/wire		Cross sectional area			Nominal O.D. mm	Approximate mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
	Alum No/mm	Steel No/mm	Alum mm^2	Steel mm^2	Total mm^2					
ARCHERY 1120	6/3.00	1/3.00	42.4	7.1	49.5	9.0	163	18.4	79	20.1
BASEBALL 1120	6/3.75	1/3.75	66.3	11.0	77.3	11.3	254	27.6	79	20.1
BOWLS 1120	6/4.75	7/1.60	106	14.1	120	14.3	385	40.0	76	20.6
CRICKET 1120	30/2.50	7/2.50	147	34.4	182	17.5	636	75.2	82	19.4
DARTS 1120	30/3.00	7/3.00	212	49.5	262	21.0	913	108	82	19.4
DICE 1120	30/3.25	7/3.25	249	58.1	307	22.8	1070	127	82	19.4
DIVING 1120	30/3.50	7/3.50	289	67.3	356	24.5	1240	143	82	19.4
GOLF 1120	54/3.00	7/3.00	382	49.5	431	27.0	1380	150	75	20.6
GYMNASTICS 1120	54/3.25	7/3.25	448	58.1	506	29.3	1620	176	75	20.6
HURDLES 1120	54/3.50	7/3.50	519	67.3	587	31.5	1880	197	75	20.6

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm^2	Alum mm^2	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
ARCHERY 1120	26.8	42.7	0.662	0.833	181	292	127	232	2.92	0.309
BASEBALL 1120	41.9	66.7	0.424	0.539	247	386	172	306	3.65	0.295
BOWLS 1120	66.4	105.8	0.267	0.346	340	515	235	406	4.61	0.28
CRICKET 1120	94.3	150.5	0.188	0.231	451	667	310	523	7.22	0.252
DARTS 1120	135.7	216.7	0.13	0.96	239	345	163	269	8.66	0.241
DICE 1120	159.7	254	0.111	0.137	653	934	445	727	9.38	0.236
DIVING 1120	185.2	295	0.0961	0.118	725	1028	494	799	10.11	0.231
GOLF 1120	236.6	377	0.075	0.0937	847	1187	575	919	10.93	0.226
GYMNASTICS 1120	277.7	442.3	0.0639	0.0801	947	1315	641	1015	11.84	0.221
HURDLES 1120	322.1	513	0.0552	0.0697	1046	1441	707	1110	12.76	0.216

The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

HDCU – HARD DRAWN COPPER CONDUCTORS

Standard sizes to AS 1746

Physical characteristics

Product code	Strand/wire diameter No/mm	Nominal C.S.A. mm^2	Nominal O.D. mm	Approximate Mass kg/km	Calculated minimum breaking load kN	Final modulus of elasticity GPa	Coefficient of linear expansion /°C x 10^{-6}
7100HDCU	7/1.00	5.5	3.00	49.3	2.32	120	17
7125HDCU	7/1.25	8.6	3.75	76.9	3.59	120	17
7175HDCU	7/1.75	17	5.25	151	6.89	120	17
7200HDCU	7/2.00	22	6.00	197	8.89	120	17
7275HDCU	7/2.75	42	8.25	375	16.2	120	17
7350HDCU	7/3.50	67	10.5	607	25.4	120	17
7375HDCU	7/3.75	77.28	11.3	696	28.8	120	17
19175HDCU	19/1.75	46	8.75	413	18.3	118	17
19200HDCU	19/2.00	60	10.0	538	23.6	118	17
19275HDCU	19/2.75	113	13.8	1020	43.1	118	17
19300HDCU	19/3.00	134	15.0	1210	50.8	118	17
37175HDCU	37/1.75	89	12.3	806	35.6	117	17
37225HDCU	37/2.25	147	15.8	1331	57.6	117	17
37250HDCU	37/2.50	182	17.5	1640	70.3	117	17
37275HDCU	37/2.75	220	19.3	1990	83.9	117	17
37300HDCU	37/3.00	262	21.0	2370	98.9	117	17
61275HDCU	61/2.75	362	24.8	3280	138	117	17

Electrical characteristics

Product code	Equivalent area		Resistance		Current ratings (Rural weathered)				Geometric mean radius mm	Inductive reactance (X_a) to 0.4m Ω/km
					Winter night		Summer noon			
	Copper mm^2	Alum mm^2	D.C. at 20°C /km	A.C. at 75°C /km	Still air Amps	1 m/s wind Amps	Still air Amps	1 m/s wind Amps		
7100HDCU	7/1	8.68	3.25	3.93	54	100	39	81	1.09	0.371
7125HDCU	7/1.25	13.6	2.09	2.53	73	132	52	107	1.36	0.357
7175HDCU	7/1.75	26.6	1.06	1.28	118	203	83	163	1.9	0.336
7200HDCU	7/2	34.7	0.815	0.986	142	240	100	193	2.18	0.327
7275HDCU	7/2.75	65.3	0.433	0.524	221	359	155	286	2.99	0.308
7350HDCU	7/3.5	106	0.268	0.325	309	487	215	387	3.81	0.292
7375HDCU	7/3.75	121	0.233	0.283	341	532	237	422	4.08	0.288
19175HDCU	19/1.75	71.7	0.395	0.479	236	382	166	304	3.31	0.301
19200HDCU	19/2	93.6	0.303	0.367	285	452	199	359	3.79	0.293
19275HDCU	19/2.75	177	0.16	0.194	446	680	309	537	5.21	0.273
19300HDCU	19/3	211	0.134	0.163	505	760	348	599	5.68	0.267
37175HDCU	37/1.75	139	0.203	0.247	377	583	262	462	4.7	0.279
37225HDCU	37/2.25	230	0.123	0.15	537	803	370	632	6.05	0.263
37250HDCU	37/2.5	284	0.0996	0.122	621	918	427	720	6.72	0.257
37275HDCU	37/2.75	344	0.0823	0.101	710	1037	487	811	7.39	0.251
37300HDCU	37/3	409	0.0691	0.0857	799	1154	546	901	8.06	0.245
61275HDCU	61/2.75	566	0.05	0.0632	995	1409	677	1094	9.56	0.235

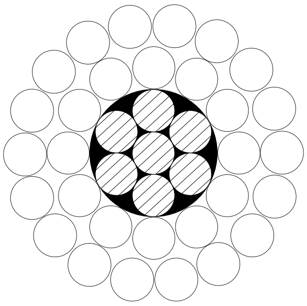
The cables described in this technical manual are designed to be used for the supply of electrical energy in fixed applications up to the rated voltages at a nominal power frequency between 49Hz and 61Hz.

GENERAL & TECHNICAL INFORMATION

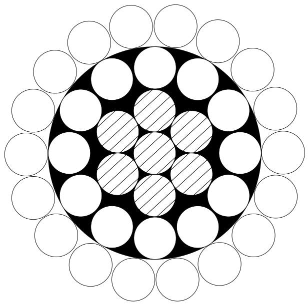
General information

CONDUCTOR GREASING

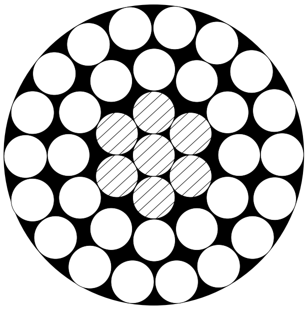
When grease is required for bare conductors to reduce the risk of corrosion, Prysmian has developed a manufacturing application allowing us to calculate and control the required mass of grease following the IEC 61089 Standard. The process eliminates 'grease holidays' and other substandard applications of grease which can lead to advanced corrosion and premature conductor aging, a common conductor ailment known to shave 40% to 50% off the conductor lifespan.



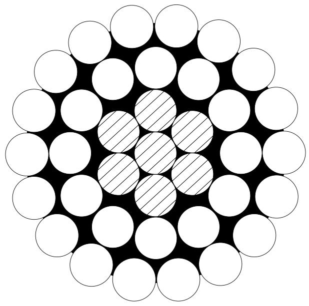
Case 1



Case 2



Case 3



Case 4

Case 1: Steel core only greased.

Case 2: All the conductor is greased except the outer layer.

Case 3: All the conductor is greased including the outer layer.

Case 4: All the conductor is greased except the outer surface of the wires in the outer layer.

OVERHEAD CONDUCTOR STANDARDS

Overhead conductors in common use in New Zealand follow designs specified in the Australia and New Zealand Standards as well as the British Standards. Other existent international standards are US, DIN or IEC standards, all listed in the following table:

Conductor designation	Conductor description	AS/NZS	Related standards			IEC
			UK	US	Europe	
AAC	All aluminium conductor	1531	BS 215-1	ASTM B231	DIN 48201-5	61089 A1
AAAC	All aluminium alloy conductor	1531	BS 3242	ASTM B399	DIN 48201-6	61089 A2/A3
ACSR/GZ	Aluminium conductor, galvanised steel reinforced	3607	BS 215-2	ASTM B232	DIN 48204	61089 A1/S1A
ACSR/AC	Aluminium conductor, aluminium clad steel reinforced	3607	BS 215-2	ASTM B549	DIN 48200-8	
SC/GZ	Galvanised steel conductor	1222-1		ASTM A363		
SC/AC	Aluminium clad steel conductor	1222-2		ASTM B416	DIN 48201-8	
HD copper	Hard drawn copper conductor	1746		ASTM B8	DIN 48201-1	

The ASTM standards are specified in imperial measurements.
The following table gives conversions for the more common units used.

To convert from	Multiply by	AWG	= mm^2
inch^2 to mm^2	645.16	4/0	107.2
cmil to mm^2	0.0005067	3/0	85.0
lbf to kN	0.004448	2/0	67.4
Kips to kN	4.448	0	53.2
Tons/sq in to GPa	0.01544	1	42.4
pounds/sq in to MPa	0.0068948	2	33.6
lbs/1000 yd to kg/km	0.49605	3	26.7
lbs/mile to kg/km	0.28185	4	21.1
lbs/1000 yd to kg/km	0.62137	6	13.3

MATERIALS USED IN OVERHEAD CONDUCTORS

Conductor materials used include aluminium, aluminium alloy, galvanised steel, aluminium clad steel and copper. Aluminium wires in all aluminium conductors (AAC) and aluminium conductors steel reinforced (ACSR) are manufactured from high purity electrical grade aluminium. Conductor wires are drawn from continuously cast aluminium rod having extremely uniform physical and electrical properties. Aluminium alloy wires may be used in all aluminium alloy conductors (AAAC) and aluminium alloy conductor steel reinforced (AACSR). The alloy predominantly used in New Zealand is alloy 1120, which attains greater strength than conventional AAC by controlled additions of copper and magnesium, with only a very small increase in electrical resistivity. International standards specify other aluminium alloys such as alloy 6201, a heat treatable alloy with additions of magnesium and silicon. This material did not attain extensive use and is no longer offered in New Zealand because of the increased processing costs associated with heat treatment, the greater increase in electrical resistivity compared to alloy 1120 and the lack of practical value for its increased strength in most New Zealand climatic conditions. Copper wires used in hard drawn copper conductors are manufactured from electrolytic tough pitch, high conductivity copper. Copper conductors are now rarely used for bare overhead transmission and find their main application as Catenary in railway electrification work. Galvanised steel wires are used in the manufacture of ACSR/GZ and SC/GZ. The wires are made from fully killed steel to AS 1442 and are galvanised by a hot dipping process to give a coating between 200 and 260 g/m^2. Aluminium clad steel wires use the same base steel as galvanised wires, and are used in the manufacture of ACSR/AC and SC/AC. The wires have an aluminium coating of not less than 5% of the wire diameter.

PROPERTIES OF CONDUCTOR MATERIALS

Property	Unit	AAC	AAAC 1120	SC/GZ	SC/AC	HD copper
Conductivity	%IACS	61.0	52.5	10.1	20.3	97.0
Volume resistivity at 20°C	Ω.mm	28.3	32.8	190	84.8	17.77
Density at 20°C	g/cm^3	2.703	2.70	7.8	6.59	8.89
Ultimate tensile strength	MPa	160-190	230-250	1310	1180-1340	405-460
Temp co-efficient of resistance at 20°C	$°C^{-1}$	0.00403	0.00390	0.0044	0.0036	0.00381
Co-efficient of linear expansion at 20°C	$°C^{-1}$	23×10^{-6}	23×10^{-6}	11.5×10^{-6}	12.9×10^{-6}	17×10^{-6}
Modulus of elasticity	GPa	68	68	193	162	124
Specific heat at 20°C	$Jg^{-1}°C^{-1}$	0.9	0.9	0.5	0.5	0.4
Temperature co-efficient of specific heat	$°C^{-1}$	4.5×10^{-4}	4.5×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	2.90×10^{-4}

SELECTION OF CONDUCTOR MATERIAL

Phase conductors

The selection of the optimum material for overhead lines is dictated by the conditions of each installation. Some of these considerations are:

- Required current carrying capacity
- Length of line: electrical losses
- Climatic: prevailing weather conditions
- Corrosion: proximity to sea or polluted atmosphere
- Physical: maximum span and tower/pole height

In normal New Zealand conditions, AAAC 1120 has been the material of choice for the past 15 years for large transmission lines. This is because of all materials available it represents the best compromise between conductor strength, electrical properties and cost. Whilst some materials or combinations of materials are available with higher strength to weight ratios, it is often not practical to use this extra strength to achieve reduced sag because of problems with Aeolian vibration when lines are strung over certain critical tensions. AAC conductors are generally used in situations where the conductor spans are relatively short and thus their lesser strength is not so important. Their greatest application is usually in the smaller power distribution applications. The extra strength offered by ACSR conductors may be needed in situations where a line is being constructed in an area that has extreme climatic conditions. In these situations the extra strength may be required to withstand the heavier conductor loads resulting from cyclonic winds or ice and snow loading. Where no specific information exists on the prevailing climate, specifiers are referred to AS/NZS 7000, which includes details of wind velocity for each region of New Zealand. ACSR or AACSR may also be preferred if the proposed design includes very long spans between towers. For steel reinforced conductors, the decision to use galvanized or aluminium clad steel is most often dictated by the assessment of the need of the extra corrosion protection offered by aluminium clad wire against its greater cost. Many transmission lines in close proximity to the coast require this extra corrosion resistance if steel is specified, but in drier inland areas, a galvanized reinforced conductor with the steel core suitably protected with high dropping point grease is satisfactory. The higher conductivity of aluminium clad steel means that an ACSR conductor with this material will have a higher current carrying capacity that an otherwise identical conductor with galvanised reinforcement.

Earthwire

Because earthwires are usually required to have less sag than the phase conductors they are normally either ACSR or all steel construction. The size of the earthwire will be dictated by the fault current requirement of the line and/ or the level of isoceraunic activity in the area. The choice between galvanised and aluminium clad steel is made under the same criteria as phase conductors though recently, most major lines have specified aluminium clad steel. Many new lines constructed recently have included optical fibre in at least one of the earthwires. This conductor, termed OPGW (Optical groundwire) provides the means for internal line protection, communication and control and also opens up the possibility of an additional revenue stream through leasing of fibre to third parties. OPGW containing from 6 to 144 fibres has been installed in New Zealand. Because of the need to guarantee a long service life and the high cost of replacement, nearly all OPGWs include aluminium clad steel in their constructions. Because of changing circumstances such as reduced access to microwave frequencies and the possibility of leasing fibre to third parties, some New Zealand authorities have retrofitted OPGW onto existing transmission lines. All OPGW is currently being produced oversees and most manufacturers produce OPGW to international IEC or IEEE standards. This will normally guarantee compliance to related New Zealand standards.

Technical information – Mechanical

ERECTION OF CONDUCTORS AND EARTHWIRE

Care should be exercised during erection of conductors to prevent the loosening of strands an the picking up of foreign inclusions such as ground matter between the strands. Extreme looseness can result in the condition known as bird-caging which can be the result of one of the following:

- Inadequate control of tension during unwinding.
- Bending conductor sharply through the use of under diameter sheaves or rollers.
- Unwinding conductor with the tail end of the conductor still firmly attached to the drum.
- Use of an incorrectly reeved tensioner.

Bending radius of bare overhead conductors.

In order to prevent distortion to the wires in each conductor layer and to prevent twisting and loosening of wires, it is recommended that sheave diameters should be not less than 20 times the conductor diameter.

SAGS AND TENSIONS

A conductor strung between two supports will naturally assume a catenary shape. However for most normal spans, the shape is very close to that of a parabola.

Using the parabolic form, the sag in a level span may be expressed as:

$$D = \frac{WL}{8T}$$

where:
D = sag (m)
L = span (m)
W = mass/unit length of the conductor (kg/m)
T = conductor tension (kgf)

In arriving at a sag value, two important values are normally considered.

1. Maximum working tension:
This is the maximum tension exerted on the conductor at the time of the most adverse climatic conditions predicted for the installation area e.g. maximum wind plus ice load and minimum temperature. This is normally taken at 50% of the conductor breaking load (CBL).

2. Everyday tension:
This is the condition that the conductor will be expected to be under for the majority of time and is generally nominated as a conductor tension at a specified temperature. E.g. 20% of CBL at 25°C. This is referred to as the everyday tension (EDT).

The every day tension should be set so that under the expected worst climatic conditions, the maximum working tension is not exceeded at any time during the conductors installed life.

The maximum sag will occur when the conductor is operating at its maximum operating temperature (normally 75°C). This condition will be that of minimum ground clearance. Many commercial programmes are now available to perform sag tension calculations. However, the accuracy in these programmes is dependant on the accuracy of the conductor physical parameters which must be supplied to the calculations to be made. Information to be input will include conductor breaking load, 10 year creep, modulus of elasticity and coefficient of thermal expansion.

A detailed analysis of sag and tension calculations may be found in Appendix S of AS/NZS 7000.

CONDUCTOR CREEP

Metallurgical creep occurs in all overhead conductors. Over a period of time this results in slightly increased conductor sag.

The effects of creep can be minimised by pre stressing the conductor. This involves over tensioning the conductor for a short period of time before the final sagging operations are carried out. The initial high tension will remove a large proportion of the creep, minimising the amount which later occurs in the life of the conductor.

MODULUS OF ELASTICITY

The modulus of elasticity of an overhead conductor is dependant on the conductor material plus the construction and conditions of manufacture. The modulus is another parameter which must be quantified if accurate sag tension predictions are to be made. Unless stated otherwise on a specific table, the values for modulus in this catalogue are based on the calculated modulus which is normally slightly higher than the actually measured value.

CONDUCTOR TESTING

Prysmian New Zealand maintains fully equipped testing facilities capable of testing full conductor breaking load, modulus of elasticity and co-efficient of thermal expansion. Prysmian can also perform creep tests at both room and elevated temperature which will provide the customer with 10 year creep values.

Technical information – Electrical

CALCULATION OF CONDUCTOR ELECTRICAL PROPERTIES

Equivalent aluminium area:
This term denotes the area of a solid aluminium rod having the same resistance as the stranded conductor. For a homogenous conductor this is obtained by multiplying the area of one wire by that conductor's stranding constant and then by the ratio of the resistivity of aluminium to that of the conductor material. For aluminium clad steel reinforced conductors, the equivalent aluminium area of each component is calculated and then added together. For construction which are galvanized steel reinforced the steel component is ignored.

Mass:
A similar technique is used to calculate conductor mass, whereby a mass constant which includes allowances for material density as well as wire over length is used. The area of one wire is simply multiplied by the mass constant for a homogenous conductor.

DC resistance:
The resistance is obtained by multiplying the resistance of a single wire by the appropriate resistance constant. For aluminium clad steel reinforced conductor the resistance is calculated by summing in parallel the resistances of the aluminium and steel components.

e.g. $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

For galvanised steel reinforced conductor the contribution of the steel wires is not considered.

A.C. resistance:
The alternating current resistance is greater than the direct current resistance because of:

1. Skin effect:
With alternating current, there is a greater proportion of current flowing in the surface layers of the conductor than in the conductor body. This results in an increase in conductor resistance.

2. Magnetic effect of steel core:
In ACSR conductor, the spiralling effect of the current in the aluminium later gives rise to axial magnetic fields which lead to power losses in the steel core. With conductors having an even number of aluminium layers the magnetic effects of each layer tend to cancel and the effect is negligible. However, with an odd number of layers, the effect can be considerable.

The AC resistance figures in the data tables have been corrected for skin effect and core magnetization. It is necessary to determine the AC resistance of a conductor to accurately calculate its current rating.

CURRENT RATINGS

Factors affecting current rating of overhead conductors:

1. Emissivity:
The standard value for bright new conductor is taken as 0.3. After weathering, the emissivity increases up to a maximum value of 0.5 for a rural weathering and 0.8 in an industrial / polluted environment. Small changes in Emissivity have little effect on current rating.

2. Ambient temperature:
The standard generally adopted for New Zealand is 30°C. for summer noon conditions, leaving a 45°C temperature rise for the purposes of summer current rating calculation. Similarly 10°C is used for winter night conditions (ie 65°C maximum temperature rise).

3. Absorbance:
The standard value for a bright conductor is 0.6. Weathering will reduce this value to 0.5 for a rural environment with a corresponding increase in current rating.

4. Solar radiation:
The solar radiation intensity changes with the altitude of the sun and the clearness of the sky. A value of 1000 W/m² is taken as the standard for direct solar radiation and 100 W/m² for diffuse solar radiation for summer noon conditions as being appropriate for general conditions throughout New Zealand.

5. Wind angle:
Ratings are generally based on the wind being at right angles to the phase conductors. Current ratings are reduced by over 30% if the wind is blowing along the axis of the conductor.

6. Wind velocity:
A minimum current rating occurs with zero wind speed and heat losses occurring by convection only. Current carrying capacities have been provided for the theoretical extreme condition of still air and for wind speeds of 1.0 m/s. Current ratings are substantially increased at higher wind velocities.

The current ratings quoted in this catalogue have been calculated according the method described in the IEEE 738. The standard conditions adopted are as follows:

	Summer day	Winter night
Ambient Temperature	30°C	10°C
Operating Conductor Temperature	75°C	75°C
Wind Speed	still (0m/s) & 1m/s	
Angle between wind and conductor	90°	90°
Emissivity	0.5	0.5
Solar Absoptivity	0.5	0.5
Elevation of Conductor above see level	0	0
Total solar and sky radiated heat intensity	1000 W/m²	0

GEOMETRIC MEAN RADIUS

The GMR represents the radius of an infinitely thin tube having the same inductance under the same current loading as the conductor.

The GMR is expressed as:
$GMR = 0.5 \times D \times K_g$

Where:
GMR = geometric mean radius (m)
D = overall conductor diameter (m)
K_g = layer factor

The layer factor depends on the type of conductor and layer geometry. The layer factor for single layer ACSR conductors varies with conductor size and current loading and must be experimentally determined.

Conductor stranding	Layer factor (K_g)
ACSR conductors	
6/1, 4/3, 3/4	Varies
22/7	0.7949
26/7	0.8116
30/7	0.8250
45/7	0.7939
54/7	0.8099
54/19	0.8099
All aluminium conductors	
7W	0.7256
19W	0.7577
37W	0.7678
61W	0.7722
91W	0.7743

VOLTAGE DROP

Approximate voltage drop may be calculated from the impedance of the transmission line.

$Z = \sqrt{(R^2 \times X^2)}$

Where:
Z = impedance (ohm/km)
R = AC resistance (ohm/km)
X = total inductive reactance (ohm/km)

and

$V = I \times Z$

Where:
V = voltage drop (volts/km)
I = current (amps)

Because the total inductive reactance (X) component of the above formula is dependant on line design, subsequently no figures for voltage drop are published in this catalogue.

INDUCTIVE REACTANCE (X)

The inductive reactance of a conductor is calculated using the concepts of geometric mean radius (GMR) and geometric mean distance (GMD). Whilst no energy loss is directly related to inductive reactance, a slight increase in the I^2R loss occurs in the conductors because of it.

The total inductive reactance (X) is the sum of:

$X_a + X_d$ where:
X_a = Inductive reactance due to both the internal magnetic flux and that external to the conductor to a nominated radius.

$$X_a = 0.1736 \left[\frac{f}{60}\right] \log \left[\frac{a}{GMR}\right] \text{ ohm/km}$$

Where:
a = nominated radius, normally 0.4 metre
GMR = geometric mean radius (m)
X_a = inductive reactance (ohm/km)
f = frequency (Hz)

and

X_d = Inductive reactance due to both the magnetic flux surrounding the conductor from the nominated radius out to the equivalent return conductor.

$$X_d = 0.1736 \left[\frac{f}{60}\right] \log \left[\frac{GMD}{a}\right] \text{ ohm/km}$$

Where:
GMD = geometric mean distance (m)
For a 3 phase transmission line:
$GMD = 3\sqrt{(d_1 \times d_2 \times d_3)}$
where d_1, d_2 and d_3 are conductor separations (m)

As the inductive reactance resulting from the equivalent return conductor (X_d) is dependant on line design, the data sheets included in this catalogue only quote the inductive reactance from magnetic flux (X_a) to a 0.4 metre radius Where inductive reactance and GMR are nominated for a single layer ACSR conductor, the values are based on those published by the Aluminium Association and maybe considered as accurate to 3%.

PRYSMIAN

Referenced documents

AS/NZS 1531 -1991	Conductors – Bare Overhead – Aluminium And Aluminium Alloy
AS/NZS 3607 - 1989	Conductors – Bare Overhead. Aluminium And Aluminium Alloy – Steel Reinforced
AS/NZS 1746 - 1991	Conductors – Bare Overhead – Hard-Drawn Copper
AS/NZS 1222.1 - 1992	Steel Conductors And Stays – Bare Overhead Part 1: Galvanized (SC/GZ)
AS/NZS 1222.2 - 1992	Steel conductors And Stays – Bare Overhead Part 2: Aluminium Clad (SC/AC)
AS/NZS 7000	Overhead Line Design – Detailed Procedures
IEEE 738-2012	Standard for Calculating the Current-Temperature Relationship of Bare Overhead Conductors
ICE 159 - 1995 - 2005	Overhead Electrical Conductors – Calculation Methods For Stranded Bare Conductors
IEEE STD 524 - 2003	IEEE guide to the installation of overhead transmission line conductors Aluminium Electrical Conductor Handbook, The Aluminium Association, 1971
BS 215 PART 1	Aluminium stranded conductors
BS 215 PART 2	Aluminium conductors steel – reinforced

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