

Doha Cables ENVIGUARD 65[®]

**Advanced Polyamide Cable That Guards The Environment,
DESIGNED for Oil & Gas Sector and Hazardous Environments**



D O H A
C A B L E S

THE FIRST CABLE MANUFACTURER IN QATAR



www.dohacables.com

ENVIGUARD 65[®] (Alternate for Lead Sheath Cables)

ENVIGUARD 65[®] cables is the best in class solution for oil, gas and hazardous chemical environments.

The development of “**ENVIGUARD 65[®]**” product range, shows Doha Cables commitment towards social and sustainable development for the future as well as supporting the global green agenda.



With the compact design of **ENVIGUARD 65[®]**, this special cable is the best replacement for the lead sheath cable where earth fault conducting is not required.

As an alternative for lead sheath cables, “**ENVIGUARD 65[®]**” protects the cables insulation from the aggressive salts, moistures, sulphides, hydrocarbons, acids, alkynes & corrosions, and contribute to a cleaner environment by preventing lead exposure and lead emissions into the surroundings.

ENVIGUARD 65[®] costs less and is also much lighter compared to conventional lead sheath cables.

Doha Cables is playing a vital role in Oil and Gas sector by providing a variety of Low voltage and Medium voltage lead free polyamide cables in different cable sizes in the name of **ENVIGUARD 65[®]** cables.



The **ENVIGUARD 65[®]** cables are completely manufactured and tested at Doha Cables facility in Mesaieed Industrial City, State of Qatar.

Advantages of ENVIGUARD 65[®] Cables over Lead Sheathed Cables:

- Up to 20% direct savings through the diameter and weight reduction
- Triple layer protection for insulation
- Environmentally safe product
- Distinctly lighter weight
- Smaller bending radius
- Easy installation.
- Less number of drums due to longer cutting length
- Less number of joints required due to longer cutting length
- Less splicing time
- Less transportation costs
- Less manpower costs

How ENVIGUARD 65[®] Cable Works:

- Multi layered inner sheath provides optimal protection against any chemical fluids penetration into cable cores.
- Polymer laminated Aluminium tape applied longitudinally to provide radial barrier for various fluids thus ensures cables are watertight.
- HDPE sheath provides resistant to inorganic chemicals.
- Polyamide sheath provides resistant to organic chemicals and hydrocarbons
- FR grade special PVC sheath provides resistant to Sulphide.



Laminated Aluminium tape, HDPE Sheath and Polyamide Sheath triple layers are applied in co-extrusion process making strong bond for fighting against chemical attacks faced in Oil exploration fields.

Polyamide is well known for its ability to provide chemical resistance. It is suitable for functioning at cable operating temperature. It exhibits good flexural modulus and offers low permeability of hydrocarbons and fuels, maintain the main physical and chemical properties in the final cable.



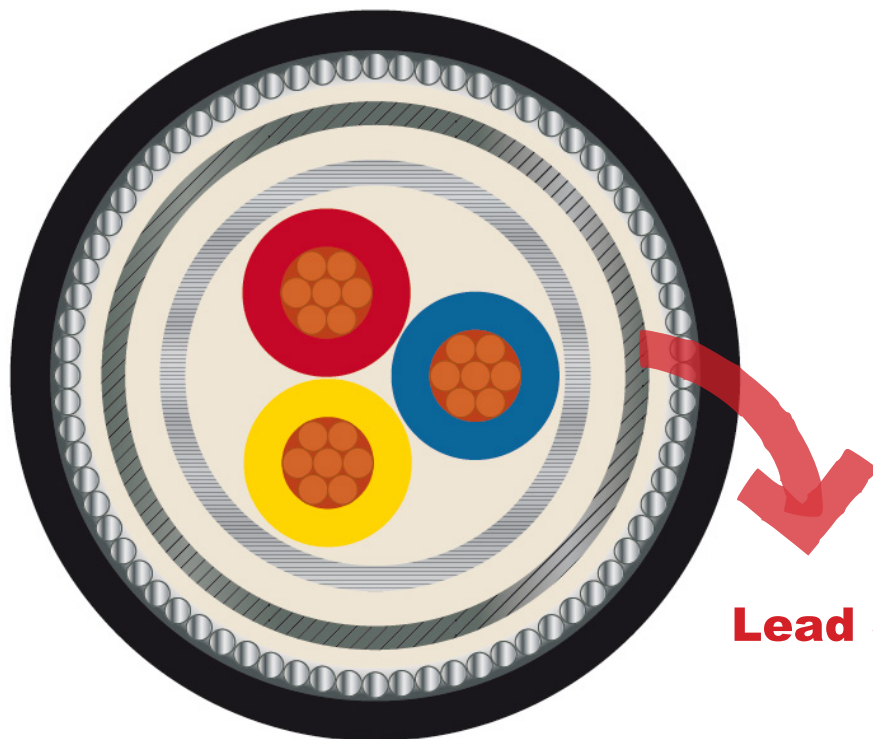
ENVIGUARD 65[®] Cables are designed to meet:

- IEC 60332-3 flame retardant tests in CAT A/B/C as per design.
- Acidic and alkaline resistant
- Aliphatic and Aromatic Hydrocarbons resistant
- Low toxicity
- Sulphide resistant

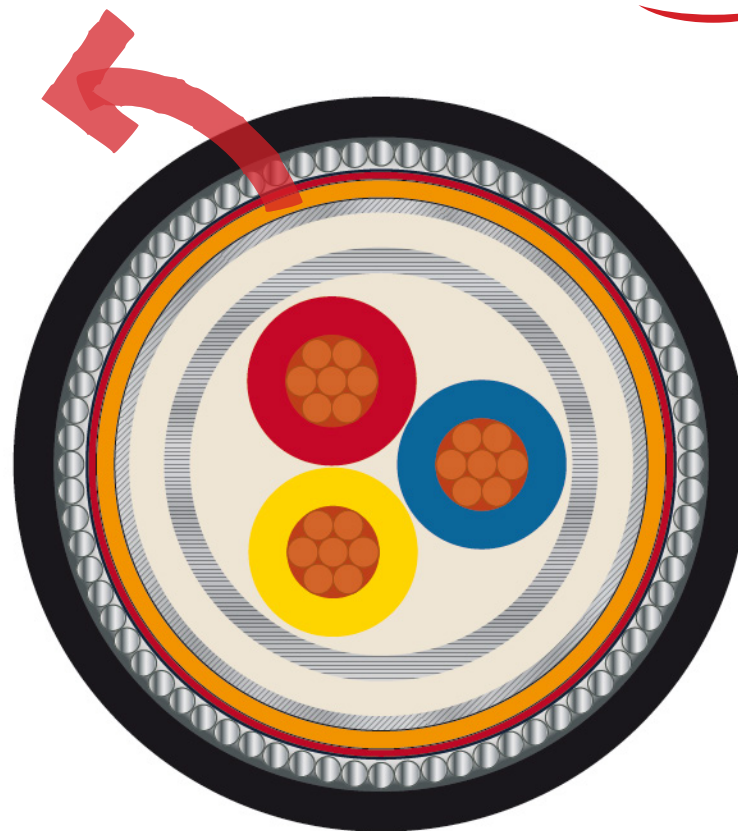
Comparison between Lead Sheathed cables and ENVIGUARD 65[®] Cables

No.	Parameter	Lead Sheathed Cables	ENVIGUARD 65 [®] Cables
1	Weight	Heavier	Lighter
2	Bending Radius	Little Larger	Smaller when compared to Lead Sheath Cables
3	Electrical Conducting for earth fault	Yes	No
4	Terminations	Standard	Standard
5	Number of Layers	One	Combination of three layers
6	Protection against Hydrocarbons	Yes	Yes
7	Protections against acids and alkaline	Yes	Yes
8	Environmentally Safe	No	Yes
9	Splicing	More	Less when compared to Lead Sheathed Cables
10	Transportation Cost	More	Less when compared to Lead Sheathed Cables

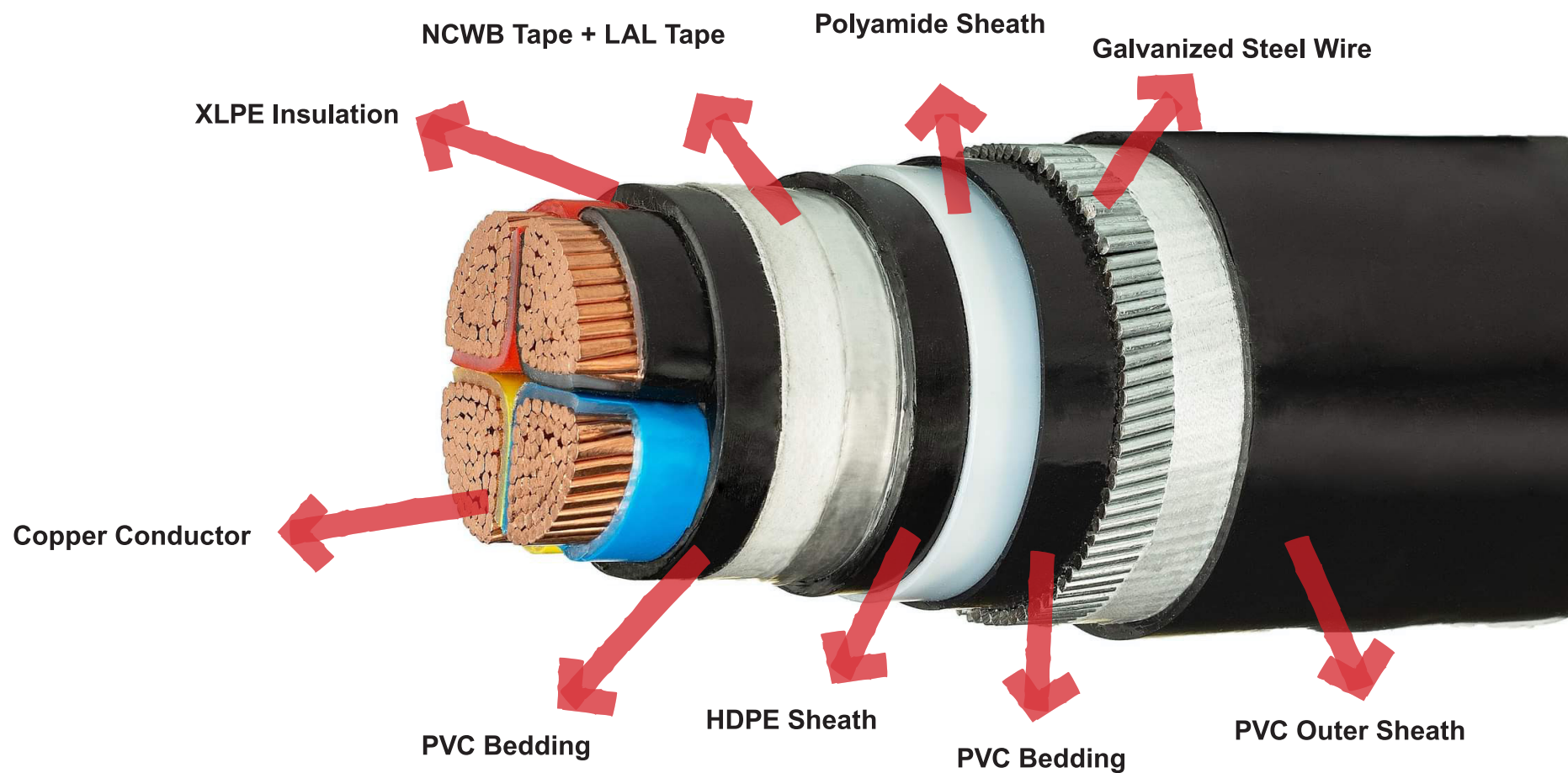
**PE coated aluminium tape,
HDPE Sheath and Polyamide Sheath**



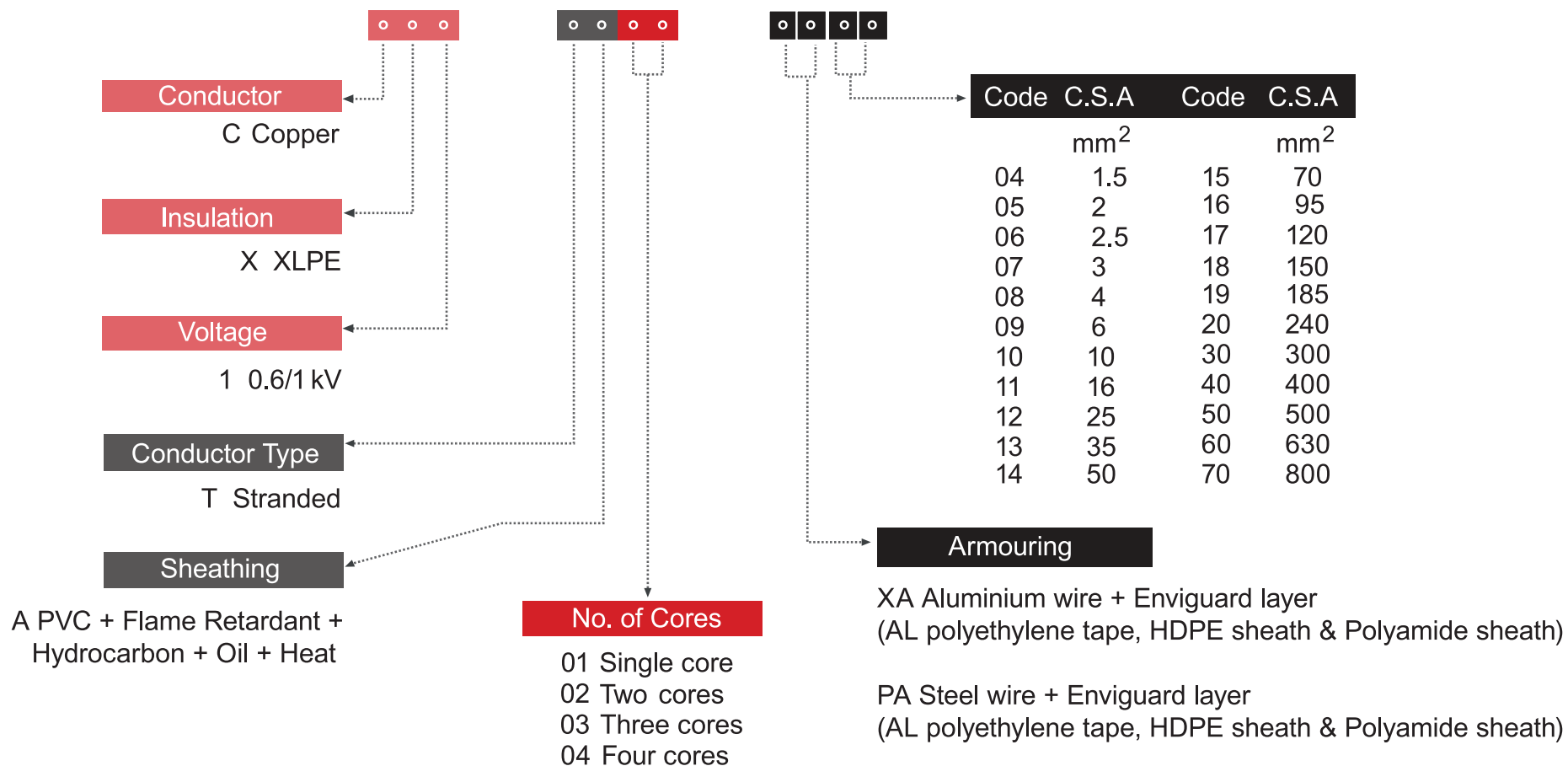
Lead Sheath



CROSS SECTION OF AN ENVIGUARD 65[®] CABLE



System Designation for ENVIGUARD 65[®] Low Voltage Cables



Low Voltage Cables Enviguard 65[®] 0.6/1 (1.2) kV

Single and Multi Cores Cables, with Stranded Copper Conductors, XLPE Insulated extruded by black coloured PVC as bedding, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with aluminium/steel wire and extruded by black coloured UV, hydrocarbon, oil, sulphide resistant, heat and flame retardant PVC.



Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Current Rating						Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C	Laid in Ground			Laid in Free Air				
	mm²	Ω/km	Ω/km	A	A	A	A	A	A	mm	kg/km

Copper Conductors

CX1-TA01-XA10	10	1.8300	2.3300	98	86	68	84	79	68	21.1	555
CX1-TA01-XA11	16	1.1500	1.4700	116	111	87	116	110	95	22.1	638
CX1-TA01-XA12	25	0.7270	0.9270	150	142	110	143	137	121	23.6	778
CX1-TA01-XA13	35	0.5240	0.6690	179	172	137	179	173	152	24.7	901
CX1-TA01-XA14	50	0.3870	0.4940	210	200	163	221	210	184	26.2	1062
CX1-TA01-XA15	70	0.2680	0.3430	263	247	200	278	268	236	28	1308
CX1-TA01-XA16	95	0.1930	0.2480	310	294	242	347	336	289	30.3	1640
CX1-TA01-XA17	120	0.1530	0.1970	357	336	273	404	394	341	31.9	1903
CX1-TA01-XA18	150	0.1240	0.1600	394	373	310	457	446	389	33.7	2235
CX1-TA01-XA19	185	0.0991	0.1290	452	425	352	530	520	441	36	2670
CX1-TA01-XA20	240	0.0754	0.0990	520	488	404	651	641	536	38.5	3234
CX1-TA01-XA30	300	0.0601	0.0810	588	546	457	824	756	620	42	3978
CX1-TA01-XA40	400	0.0470	0.0638	672	620	515	893	872	714	46.5	4991
CX1-TA01-XA50	500	0.0366	0.0517	761	693	572	1008	987	814	50.3	6203
CX1-TA01-XA60	630	0.0283	0.0425	872	777	651	1155	1134	956	55.6	7796
CX1-TA01-XA70	800	0.0221	0.0292	957	861	735	1313	1292	1092	61.7	9805

Table 1A

Single Core Cables, with Stranded Circular Copper Conductors, XLPE Insulated, extruded by black coloured PVC, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with Aluminium Wire and PVC Outer sheath.

Cables are according to IEC 60502-1.

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Current Rating			Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C	Laid Direct in Ground	Laid in Ducts	Laid in Free Air		
	mm ²	Ω/km	Ω/km	A	A	A	mm	kg/km

Two Core Cables

CX1-TA02-PA06	2.5 mm	7.4100	9.4500	37	32	34	21	642
CX1-TA02-PA08	4 mm	4.6100	5.8800	51	41	47	21.5	712
CX1-TA02-PA09	6 mm	3.0800	3.9300	64	53	61	22.5	937
CX1-TA02-PA10	10 mm	1.8300	2.3300	83	70	80	23.7	1074
CX1-TA02-PA11	16 mm	1.1500	1.4700	107	84	106	25.7	1309
CX1-TA02-PA12	25 mm	0.7270	0.9270	140	108	140	29.3	1767
CX1-TA02-PA13	35 mm	0.5240	0.6690	168	135	168	31.3	2095
CX1-TA02-PA14	50 mm	0.3870	0.4940	185	145	184	31.5	2184
CX1-TA02-PA15	70 mm	0.2680	0.3430	220	180	220	34.5	2944
CX1-TA02-PA16	95 mm	0.1930	0.2480	265	210	273	39.6	3830
CX1-TA02-PA17	120 mm	0.1530	0.1970	305	245	315	43.1	4486
CX1-TA02-PA18	150 mm	0.1240	0.1600	335	275	375	47.1	5613
CX1-TA02-PA19	185 mm	0.0991	0.1290	375	310	410	52.9	6866
CX1-TA02-PA20	240 mm	0.0754	0.0990	435	365	488	57	8274
CX1-TA02-PA30	300 mm	0.0601	0.0810	490	405	562	61	9778

Three Core Cables

CX1-TA03-PA06	2.5 mm	7.4100	9.4500	35	29	32	21.2	694
CX1-TA03-PA08	4 mm	4.6100	5.8800	46	37	42	21.9	895
CX1-TA03-PA09	6 mm	3.0800	3.9300	58	46	51	23.2	1030
CX1-TA03-PA10	10 mm	1.8300	2.3300	76	61	69	24.5	1200
CX1-TA03-PA11	16 mm	1.1500	1.4700	98	76	90	27.3	1585
CX1-TA03-PA12	25 mm	0.7270	0.9270	130	103	120	30.5	2050
CX1-TA03-PA13	35 mm	0.5240	0.6690	158	122	147	32.9	2465
CX1-TA03-PA14	50 mm	0.3870	0.4940	185	145	184	33.4	2720
CX1-TA03-PA15	70 mm	0.2680	0.3430	220	180	220	38.5	3871
CX1-TA03-PA16	95 mm	0.1930	0.2480	265	210	273	42.6	4856
CX1-TA03-PA17	120 mm	0.1530	0.1970	305	245	315	46	5774
CX1-TA03-PA18	150 mm	0.1240	0.1600	335	275	375	50.9	7310
CX1-TA03-PA19	185 mm	0.0991	0.1290	375	310	410	55.3	8713
CX1-TA03-PA20	240 mm	0.0754	0.0990	435	365	488	60.8	10803
CX1-TA03-PA30	300 mm	0.0601	0.0810	490	405	562	66.1	12881

Table 2A

Multi Cores Cables, with Stranded Copper Conductors, XLPE Insulated, extruded by black coloured PVC, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with Galvanised Steel Wire and PVC Outer sheath.

Continued in Page 11

Application

For aggressive salts, moistures, acids, alkynes, oil, gas, sulphides, chemical & corrosions environments.

The data is approximate and subjected to manufacturing tolerance.

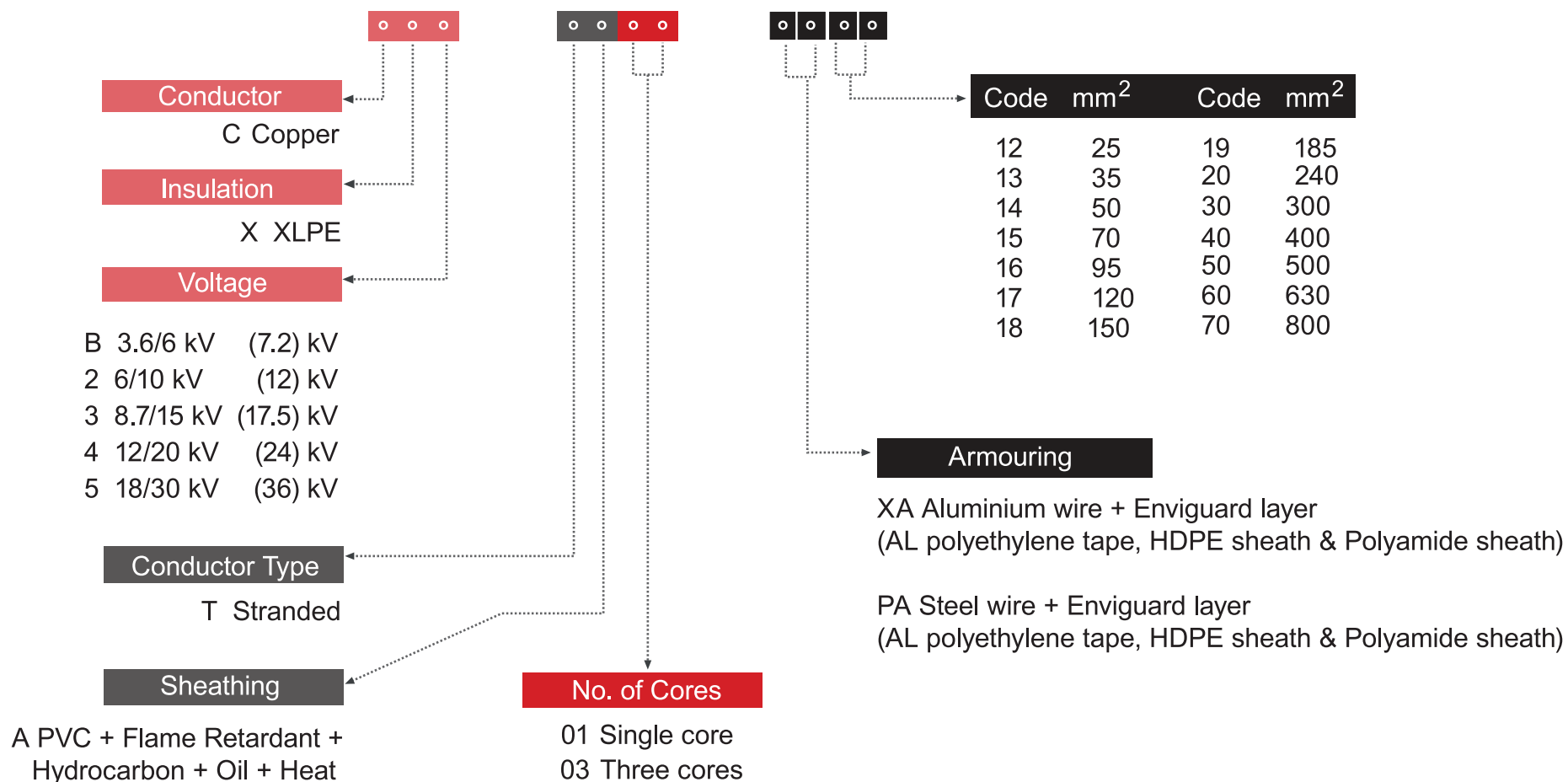
Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Current Rating			Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C	Laid Direct in Ground	Laid in Ducts	Laid in Free Air		
	mm ²	Ω/km	Ω/km	A	A	A	mm	kg/km

Four Core Cables

CX1-TA04-PA06	2.5 rm	7.4100	9.4500	35	29	32	21.7	867
CX1-TA04-PA08	4 rm	4.6100	5.8800	46	37	42	22.9	985
CX1-TA04-PA09	6 rm	3.0800	3.9300	58	46	51	24.4	1150
CX1-TA04-PA10	10 rm	1.8300	2.3300	76	61	69	25.8	1364
CX1-TA04-PA11	16 rm	1.1500	1.4700	98	76	90	28.9	1828
CX1-TA04-PA12	25 rm	0.7270	0.9270	130	103	122	32.5	2388
CX1-TA04-PA13	35 rm	0.5240	0.6690	158	122	147	35.4	2931
CX1-TA04-PA14	50 sm	0.3870	0.4940	185	145	184	38.3	3674
CX1-TA04-PA15	70 sm	0.2680	0.3430	220	180	220	42.8	4758
CX1-TA04-PA16	95 sm	0.1930	0.2480	265	210	273	46.3	5969
CX1-TA04-PA17	120 sm	0.1530	0.1970	305	245	315	52.2	7736
CX1-TA04-PA18	150 sm	0.1240	0.1600	335	275	375	57.1	9195
CX1-TA04-PA19	185 sm	0.0991	0.1290	375	310	410	62.3	10915
CX1-TA04-PA20	240 sm	0.0754	0.0990	435	365	488	68.5	13570
CX1-TA04-PA30	300 sm	0.0601	0.0810	490	405	562	74.5	16282

The above data is approximate and subjected to manufacturing tolerance.

System Designation for ENVIGUARD 65[®] Medium Voltage Cables



Medium Voltage Cables Enviguard 65[®]

3.6 / 6 (7.2) kV

Single & Three Cores Stranded circular compacted Copper conductor, semiconducting layer as conductor screen, XLPE insulated, semiconducting layer as non metallic insulation screen, Copper tape or wire as metallic insulation screen, three cores assembled together with extruded by black coloured PVC as bedding, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with aluminium/steel wire and extruded by red coloured UV, hydrocarbon, oil, sulphide resistant, heat and flame retardant PVC.



Table 1B

3.6 / 6 (7.2) kV
 Single Core Copper Conductors XLPE Insulated,
 Multi-layer sheath (AL polyethylene tape, HDPE sheath &
 Polyamide sheath) and Aluminium Wire Armoured and
 PVC Sheathed.

Cables are according to IEC 60502-2.

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance		Current Rating				Approx. Overall Diameter	Approx. Weight
		20 °C	AC at 90 °C		Trefoil 	Flat 	Laid in Ground		Laid in Free Air			
							Trefoil 	Flat 	Trefoil 	Flat 		
	mm²	Ω/km	Ω/km	µf/km	mh/km	mh/km	A	A	A	A	mm	kg/km

Single Core Cable

CXB-TA01-XA14	50	0.3870	0.4937	0.251	0.393	0.578	187	195	198	242	32.9	1482
CXB-TA01-XA15	70	0.2680	0.3420	0.291	0.370	0.554	229	239	248	303	34.5	1742
CXB-TA01-XA16	95	0.1930	0.2465	0.316	0.357	0.542	272	287	301	364	37.5	2181
CXB-TA01-XA17	120	0.1530	0.1956	0.345	0.344	0.529	309	322	347	420	39.6	2545
CXB-TA01-XA18	150	0.1240	0.1588	0.374	0.336	0.521	345	356	395	473	40.9	2842
CXB-TA01-XA19	185	0.0991	0.1272	0.409	0.322	0.507	390	400	454	541	42.8	3295
CXB-TA01-XA20	240	0.0754	0.0973	0.456	0.310	0.494	451	459	536	635	45.3	3897
CXB-TA01-XA30	300	0.0601	0.0781	0.512	0.301	0.487	508	514	617	726	48.7	4640
CXB-TA01-XA40	400	0.0470	0.0618	0.565	0.292	0.477	569	561	707	810	54.2	5882
CXB-TA01-XA50	500	0.0366	0.0490	0.635	0.282	0.467	640	626	816	926	58.6	7240
CXB-TA01-XA60	630	0.0283	0.0391	0.704	0.275	0.460	714	691	931	1047	62.5	8697
CXB-TA01-XA70	800	0.0221	0.0319	0.795	0.268	0.453	825	930	1102	1406	67.4	10633

Medium Voltage Cables Enviguard 65[®]

3.6 / 6 (7.2) kV

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance	Current Rating		Approx. Overall Diameter	Approx. Weight
		DC at	AC at 90 °C			Laid in Ground	Laid in Free Air		
	mm ²	Ω	Ω/km	µf/km	mh/km	A	A	mm	kg/km

Three Cores, Copper Conductor Cables

CXB-TA03-PA14	50	0.3870	0.4938	0.251	0.352	187	195	54.4	5837
CXB-TA03-PA15	70	0.2680	0.3423	0.291	0.330	227	241	58.1	6858
CXB-TA03-PA16	95	0.1930	0.2469	0.316	0.316	269	289	62.7	8191
CXB-TA03-PA17	120	0.1530	0.1961	0.345	0.311	305	331	66.4	9344
CXB-TA03-PA18	150	0.1240	0.1595	0.374	0.302	340	372	69.6	10530
CXB-TA03-PA19	185	0.0991	0.1282	0.409	0.290	381	423	73.7	12126
CXB-TA03-PA20	240	0.0754	0.0986	0.456	0.280	436	494	81.4	15130
CXB-TA03-PA30	300	0.0601	0.0799	0.512	0.272	485	556	89	18111

Table 2B

3.6 / 6 (7.2) kV
 Three Cores Copper Conductors XLPE Insulated,
 Multi-layer sheath (AL polyethylene tape, HDPE sheath &
 Polyamide sheath) and Steel Wire Armoured and PVC
 Sheathed.

Application

For aggressive salts, moistures, acids, alkynes, oil, gas,
 sulphides, chemical & corrosions environments.

The above data is approximate and subjected to manufacturing tolerance.

Medium Voltage Cables Enviguard 65[®]

6 / 10 (12) kV

Single & Three Cores Stranded circular compacted Copper conductor, semiconducting layer as conductor screen, XLPE insulated, semiconducting layer as non metallic insulation screen, Copper tape or wire as metallic insulation screen, three cores assembled together with extruded by black coloured PVC as bedding, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with aluminium/steel wire and extruded by red coloured UV, hydrocarbon, oil, sulphide resistant, heat and flame retardant PVC.

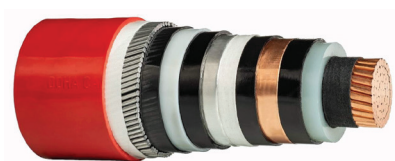


Table 1C

6 / 10 (12) kV
 Single Core Copper Conductors XLPE Insulated,
 Multi-layer sheath (AL polyethylene tape, HDPE sheath &
 Polyamide sheath) and Aluminium Wire Armoured and
 PVC Sheathed.

Cables are according to IEC 60502-2.

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance		Current Rating				Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C		Trefoil 	Flat 	Laid in Ground		Laid in Free Air			
							Trefoil 	Flat 	Trefoil 	Flat 		
	mm ²	Ω/km	Ω/km	μf/km	mh/km	mh/km	A	A	A	A	mm	kg/km

Single Core Cable

CX2-TA01-XA14	50	0.3870	0.4937	0.251	0.393	0.578	187	195	198	242	34.9	1605
CX2-TA01-XA15	70	0.2680	0.3420	0.291	0.370	0.554	229	239	248	303	37	1939
CX2-TA01-XA16	95	0.1930	0.2465	0.316	0.357	0.542	272	287	301	364	39.9	2360
CX2-TA01-XA17	120	0.1530	0.1956	0.345	0.344	0.529	309	322	347	420	41.3	2644
CX2-TA01-XA18	150	0.1240	0.1588	0.374	0.336	0.521	345	356	395	473	42.9	2990
CX2-TA01-XA19	185	0.0991	0.1272	0.409	0.322	0.507	390	400	454	541	44.6	3420
CX2-TA01-XA20	240	0.0754	0.0973	0.456	0.310	0.494	451	459	536	635	46.9	4019
CX2-TA01-XA30	300	0.0601	0.0781	0.512	0.301	0.487	508	514	617	726	51.1	4935
CX2-TA01-XA40	400	0.0470	0.0618	0.565	0.292	0.477	569	561	707	810	55.2	5984
CX2-TA01-XA50	500	0.0366	0.0490	0.635	0.282	0.467	640	626	816	926	59	7275
CX2-TA01-XA60	630	0.0283	0.0391	0.704	0.275	0.460	714	691	931	1047	62.9	8747
CX2-TA01-XA70	800	0.0221	0.0319	0.795	0.268	0.453	825	930	1102	1406	67.8	10661

Medium Voltage Cables Enviguard 65[®]

6 / 10 (12) kV

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance	Current Rating		Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C			Laid in Ground	Laid in Air		
	mm ²	Ω/km	Ω/km	µf/km	mh/km	A	A	mm	kg/km

Three Cores, Copper Conductor Cables

CX2-TA03-PA14	50	0.3870	0.4938	0.251	0.352	187	195	58.7	6494
CX2-TA03-PA15	70	0.2680	0.3423	0.291	0.330	227	241	62.8	7597
CX2-TA03-PA16	95	0.1930	0.2469	0.316	0.316	269	289	67.2	8944
CX2-TA03-PA17	120	0.1530	0.1961	0.345	0.311	305	331	70.7	10072
CX2-TA03-PA18	150	0.1240	0.1595	0.374	0.302	340	372	73.9	11307
CX2-TA03-PA19	185	0.0991	0.1282	0.409	0.290	381	423	79.6	13722
CX2-TA03-PA20	240	0.0754	0.0986	0.456	0.280	436	494	87	16247
CX2-TA03-PA30	300	0.0601	0.0799	0.512	0.272	485	556	92.8	18688

Table 2C

6 / 10 (12) kV
 Three Cores Copper Conductors XLPE Insulated,
 Multi-layer sheath (AL polyethylene tape, HDPE sheath &
 Polyamide sheath) and Steel Wire Armoured and PVC
 Sheathed.

Application

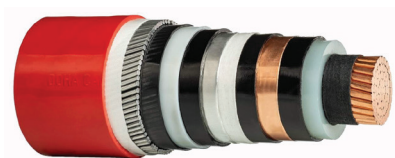
For aggressive salts, moistures, acids, alkynes, oil, gas,
 sulphides, chemical & corrosions environments.

The above data is approximate and subjected to manufacturing tolerance.

Medium Voltage Cables Enviguard 65[®]

8.7 / 15 (17.5) kV

Single & Three Cores Stranded circular compacted Copper conductor, semiconducting layer as conductor screen, XLPE insulated, semiconducting layer as non metallic insulation screen, Copper tape or wire as metallic insulation screen, three cores assembled together with extruded by black coloured PVC as bedding, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with aluminium/steel wire and extruded by red coloured UV, hydrocarbon, oil, sulphide resistant, heat and flame retardant PVC.



Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance		Current Rating				Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C		Trefoil 	Flat 	Laid in Ground		Laid in Free Air			
							Trefoil 	Flat 	Trefoil 	Flat 		
	mm²	Ω/km	Ω/km	µf/km	mh/km	mh/km	A	A	A	A	mm	kg/km

Single Core Cable

CX3-TA01-XA14	50	0.3870	0.4937	0.251	0.393	0.578	187	195	198	242	38.2	1873
CX3-TA01-XA15	70	0.2680	0.3420	0.291	0.370	0.554	229	239	248	303	41	2257
CX3-TA01-XA16	95	0.1930	0.2465	0.316	0.357	0.542	272	287	301	364	43.5	2648
CX3-TA01-XA17	120	0.1530	0.1956	0.345	0.344	0.529	309	322	347	420	44.9	2934
CX3-TA01-XA18	150	0.1240	0.1588	0.374	0.336	0.521	345	356	395	473	46.3	3260
CX3-TA01-XA19	185	0.0991	0.1272	0.409	0.322	0.507	390	400	454	541	47.1	3777
CX3-TA01-XA20	240	0.0754	0.0973	0.456	0.310	0.494	451	459	536	635	54.4	4609
CX3-TA01-XA30	300	0.0601	0.0781	0.512	0.301	0.487	508	514	617	726	54.4	5342
CX3-TA01-XA40	400	0.0470	0.0618	0.565	0.292	0.477	569	561	707	810	58.1	6356
CX3-TA01-XA50	500	0.0366	0.0490	0.635	0.282	0.467	640	626	816	926	61.9	7654
CX3-TA01-XA60	630	0.0283	0.0391	0.704	0.275	0.460	714	691	931	1047	65.6	9149
CX3-TA01-XA70	800	0.0221	0.0319	0.795	0.268	0.453	825	930	1102	1406	70.4	10998

Table 1D

8.7 / 15 (17.5) kV

Single Core Copper Conductors XLPE Insulated, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath) and Aluminium Wire Armoured and PVC Sheathed.

Cables are according to IEC 60502-2.

Medium Voltage Cables Enviguard 65[®]

8.7 / 15 (17.5) kV

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance	Current Rating		Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C			Laid in Ground	Laid in Free Air		
	mm	Ω/km	Ω/km	µf/km	mh/km	A	A	mm	kg/km

Three Cores, Copper Conductor Cables

CX3-TA03-PA14	50	0.3870	0.4938	0.251	0.352	187	195	64.3	7223
CX3-TA03-PA15	70	0.2680	0.3423	0.291	0.330	227	241	68.1	8322
CX3-TA03-PA16	95	0.1930	0.2469	0.316	0.316	269	289	72.6	9686
CX3-TA03-PA17	120	0.1530	0.1961	0.345	0.311	305	331	77.5	11610
CX3-TA03-PA18	150	0.1240	0.1595	0.374	0.302	340	372	80.9	12931
CX3-TA03-PA19	185	0.0991	0.1282	0.409	0.290	381	423	85.2	14665
CX3-TA03-PA20	240	0.0754	0.0986	0.456	0.280	436	494	90.8	17143
CX3-TA03-PA30	300	0.0601	0.0799	0.512	0.272	485	556	97.6	20030

Table 2D

8.7 / 15 (17.5) kV

Three Cores Copper Conductors XLPE Insulated, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath) and Steel Wire Armoured and PVC Sheathed.

Application

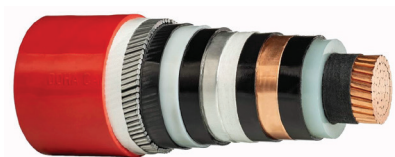
For aggressive salts, moistures, acids, alkynes, oil, gas, sulphides, chemical & corrosions enviroments.

The above data is approximate and subjected to manufacturing tolerance.

Medium Voltage Cables Enviguard 65[®]

12 / 20 (24) kV

Single & Three Cores Stranded circular compacted Copper conductor, semiconducting layer as conductor screen, XLPE insulated, semiconducting layer as non metallic insulation screen, Copper tape or wire as metallic insulation screen, three cores assembled together with extruded by black coloured PVC as bedding, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with aluminium/steel wire and extruded by red coloured UV, hydrocarbon, oil, sulphide resistant, heat and flame retardant PVC.



Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance		Current Rating				Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C		Trefoil 	Flat 	Laid in Ground		Laid in Free Air			
							Trefoil 	Flat 	Trefoil 	Flat 		
	mm²	Ω/km	Ω/km	µf/km	mh/km	mh/km	A	A	A	A	mm	kg/km

Single Core Cable

CX4-TA01-XA14	50	0.3870	0.4937	0.251	0.393	0.578	187	195	198	242	40.2	2031
CX4-TA01-XA15	70	0.2680	0.3420	0.291	0.370	0.554	229	239	248	303	42	2316
CX4-TA01-XA16	95	0.1930	0.2465	0.316	0.357	0.542	272	287	301	364	44.3	2711
CX4-TA01-XA17	120	0.1530	0.1956	0.345	0.344	0.529	309	322	347	420	45.7	3002
CX4-TA01-XA18	150	0.1240	0.1588	0.374	0.336	0.521	345	356	395	473	47.1	3336
CX4-TA01-XA19	185	0.0991	0.1272	0.409	0.322	0.507	390	400	454	541	50	3945
CX4-TA01-XA20	240	0.0754	0.0973	0.456	0.310	0.494	451	459	536	635	53.1	4679
CX4-TA01-XA30	300	0.0601	0.0781	0.512	0.301	0.487	508	514	617	726	56.5	5482
CX4-TA01-XA40	400	0.0470	0.0618	0.565	0.292	0.477	569	561	707	810	60	6494
CX4-TA01-XA50	500	0.0366	0.0490	0.635	0.282	0.467	640	626	816	926	64	7850
CX4-TA01-XA60	630	0.0283	0.0391	0.704	0.275	0.460	714	691	931	1047	67.9	9343
CX4-TA01-XA70	800	0.0221	0.0319	0.795	0.268	0.453	825	930	1102	1406	72.8	11312

Table 1E

12 / 20 (24) kV
Single Core Copper Conductors XLPE Insulated,
Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath) and Aluminium Wire Armoured and PVC Sheathed.

Cables are according to IEC 60502-2.

Medium Voltage Cables Enviguard 65[®]

12 / 20 (24) kV

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance	Current Rating		Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C			Laid in Ground	Laid in Free Air		
	mm ²	Ω/km	Ω/km	µf/km	mh/km	A	A	mm	kg/km

Three Cores, Copper Conductor Cables

CX4-TA03-PA14	50	0.3870	0.4938	0.251	0.352	187	195	69	8134
CX4-TA03-PA15	70	0.2680	0.3423	0.291	0.330	227	241	72.9	9328
CX4-TA03-PA16	95	0.1930	0.2469	0.316	0.316	269	289	80.6	11570
CX4-TA03-PA17	120	0.1530	0.1961	0.345	0.311	305	331	84	12817
CX4-TA03-PA18	150	0.1240	0.1595	0.374	0.302	340	372	87.6	14230
CX4-TA03-PA19	185	0.0991	0.1282	0.409	0.290	381	423	91.7	15987
CX4-TA03-PA20	240	0.0754	0.0986	0.456	0.280	436	494	97.5	18604
CX4-TA03-PA30	300	0.0601	0.0799	0.512	0.272	485	556	104.5	21679

Table 2E

12 / 20 (24) kV
 Three Cores Copper Conductors XLPE Insulated,
 Multi-layer sheath (AL polyethylene tape, HDPE sheath &
 Polyamide sheath) and Steel Wire Armoured and PVC
 Sheathed.

Application

For aggressive salts, moistures, acids, alkynes, oil, gas,
 sulphides, chemical & corrosions environments.

The above data is approximate and subjected to manufacturing tolerance.

Medium Voltage Cables Enviguard 65[®]

18 / 30 (36) kV

Single & Three Cores Stranded circular compacted Copper conductor, semiconducting layer as conductor screen, XLPE insulated, semiconducting layer as non metallic insulation screen, Copper tape or wire as metallic insulation screen, three cores assembled together with extruded by black coloured PVC as bedding, Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath), armoured with aluminium/steel wire and extruded by red coloured UV, hydrocarbon, oil, sulphide resistant, heat and flame retardant PVC.



Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance		Current Rating				Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C		Trefoil 	Flat 	Laid in Ground		Laid in Free Air			
							Trefoil 	Flat 	Trefoil 	Flat 		
	mm²	Ω/km	Ω/km	µf/km	mh/km	mh/km	A	A	A	A	mm	kg/km

Single Core Cable

Table 1F

18 / 30 (36) kV
 Single Core Copper Conductors XLPE Insulated,
 Multi-layer sheath (AL polyethylene tape, HDPE sheath & Polyamide sheath) and Aluminium Wire Armoured and PVC Sheathed.

Cables are according to IEC 60502-2.

CX5-TA01-XA14	50	0.3870	0.4937	0.251	0.393	0.578	187	195	198	242	45.9	2548
CX5-TA01-XA15	70	0.2680	0.3420	0.291	0.370	0.554	229	239	248	303	46.9	2782
CX5-TA01-XA16	95	0.1930	0.2465	0.316	0.357	0.542	272	287	301	364	51	3432
CX5-TA01-XA17	120	0.1530	0.1956	0.345	0.344	0.529	309	322	347	420	52.6	3750
CX5-TA01-XA18	150	0.1240	0.1588	0.374	0.336	0.521	345	356	395	473	54.2	4123
CX5-TA01-XA19	185	0.0991	0.1272	0.409	0.322	0.507	390	400	454	541	56.1	4597
CX5-TA01-XA20	240	0.0754	0.0973	0.456	0.310	0.494	451	459	536	635	58.7	5320
CX5-TA01-XA30	300	0.0601	0.0781	0.512	0.301	0.487	508	514	617	726	61.9	6105
CX5-TA01-XA40	400	0.0470	0.0618	0.565	0.292	0.477	569	561	707	810	65.6	7157
CX5-TA01-XA50	500	0.0366	0.0490	0.635	0.282	0.467	640	626	816	926	69.6	8535
CX5-TA01-XA60	630	0.0283	0.0391	0.704	0.275	0.460	714	691	931	1047	73.3	10032
CX5-TA01-XA70	800	0.0221	0.0319	0.795	0.268	0.453	825	930	1102	1406	78	12010

Medium Voltage Cables Enviguard 65[®] 18 / 30 (36) kV

Product - Code	Nominal Cross Sectional Area	Max. Conductor Resistance		Operating Capacitance	Inductance	Current Rating		Approx. Overall Diameter	Approx. Weight
		DC at 20 °C	AC at 90 °C			Laid in Ground	Laid in Free Air		
	mm ²	Ω/km	Ω/km	µf/km	mh/km	A	A	mm	kg/km

Three Cores, Copper Conductor Cables

CX5-TA03-PA14	50	0.3870	0.4938	0.251	0.352	187	195	82.9	11155
CX5-TA03-PA15	70	0.2680	0.3423	0.291	0.330	227	241	87.9	12475
CX5-TA03-PA16	95	0.1930	0.2469	0.316	0.316	269	289	92.4	14132
CX5-TA03-PA17	120	0.1530	0.1961	0.345	0.311	305	331	96.2	15535
CX5-TA03-PA18	150	0.1240	0.1595	0.374	0.302	340	372	99.8	17042
CX5-TA03-PA19	185	0.0991	0.1282	0.409	0.290	381	423	104.1	18896
CX5-TA03-PA20	240	0.0754	0.0986	0.456	0.280	436	494	108.1	21213
CX5-TA03-PA30	300	0.0601	0.0799	0.512	0.272	485	556	114.9	24429

Table 2F

18 / 30 (36) kV
Three Cores Copper Conductors XLPE Insulated,
Multi-layer sheath (AL polyethylene tape, HDPE sheath &
Polyamide sheath) and Steel Wire Armoured and PVC
Sheathed.

Application

For aggressive salts, moistures, acids, alkynes, oil, gas,
sulphides, chemical & corrosions environments.

The above data is approximate and subjected to manufacturing tolerance.

Standards Related to Power Cables

IEC Standard

S/N	No. of IEC	Subject
1.	60028	International Standard of Resistance for Copper.
2.	60060-1	High-Voltage Test Techniques
3.	60121	Recommendation for commercial annealed aluminum electrical conductor wire.
4.	60183	Guide to the selection of high voltage cables.
5.	60228	Conductors of insulated cables.
6.	60229	Tests on cable over-sheaths which have a special protection function and are applied by extrusion.
7.	60230	Impulse tests on cables and their accessories.
8.	60270	Partial discharge measurements
9.	60287	Current rating equations (100% load factor) and calculation of losses
10.	60332	Test on electric cables under fire conditions.
11.	60502	Cables for rated voltages of 0.6 kV ($U_m=1\text{kV}$) up to and including 30kV ($U_m=36\text{kV}$).

Continued in page 24

Standards Related to Power Cables

IEC Standard

S/N	No. of IEC	Subject
12.	60724	Guide to the short-circuit temperature limits of electric cables with a rated voltage not exceeding 0.6/1 kV.
13.	60811	Common test methods for insulating and sheathing materials of electric cables
14.	60840	Test method and requirements
		Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um=36kV) up to 150 kV (Um=170kV).
15.	60853	Calculation of the cyclic and emergency current rating of cables.
16.	60885	Electrical test for electric cables
17.	60888	Zinc-Coated steel wires for stranded conductors
18.	60949	Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects.
19.	60986	Guide to the short-circuit temperature limits of electric cables with a rated voltage from 1.8/3 (3.6) kV to 18/30 (36) kV.

Definitions

Definitions of dimensional values

- 1. Nominal value**
Value by which a quantity is designated and which is often used in tables. Usually, in IEC standard, nominal values give rise to values to be checked by measurements taking into account specified tolerances.
- 2. Approximate value**
Value which is neither guaranteed nor checked; it is used, for example, for the calculation of other dimensional values.
- 3. Median value**
When several test results have been obtained and ordered in an increasing (or decreasing) succession, the median value is the middle value if the number of available values is odd, and the mean of the two middle values if the number is even.
- 4. Fictitious value**
Value calculated according to the “fictitious method” described in annex A in IEC 60502.

Definitions concerning Tests

- 1. Routine Tests**
Tests made by the manufacturer on each manufactured length of cable to check that each length meets the specified requirements.
- 2. Sample Tests**
Tests made by the manufacturer on samples of completed cable or components taken from a completed cable, at a specified frequency, so as to verify that the finished product meets the specified requirements.
- 3. Type Tests**
Test made before supplying, on a general commercial basis, a type of cable covered by this standard, in order to demonstrate satisfactory performance characteristics to meet the intended application. These tests are of such a nature that, after they have been made, they need not be repeated, unless changes are made in the cable materials or design or manufacturing process, which might change the performance characteristics.
- 4. Electrical test after installation**
Tests made to demonstrate the integrity of the cable and its accessories as installed.

Technical Data & Cables Parameters

1. Resistance

The values of conductor DC resistance given in the following tables are based on 20 °C. In case the DC resistance is required at any other temperature the following formula is used

$$R_{\theta} = R_{20} [1 + \alpha (\theta - 20)] \quad \Omega/\text{km}$$

Where

R_{θ} : Conductor DC resistance at θ °C Ω/km
 R_{20} : Conductor DC resistance at 20 °C Ω/km
 θ : Operating temperature °C
 α : Resistance temperature coefficient 1 / °C
 = 0.00393 for Copper
 = 0.00403 for Aluminium

To get AC resistance of the conductor at its operating temperature the following formula is used

$$R_{AC} = R_{\theta} (1 + y_p + y_s)$$

Where

y_p and y_s are proximity and skin effect factors respectively which depend on operation frequency and cable spacing.

2. Inductance

The self and mutual inductance are formulated as follow:

$$L = K + 0.2 \ln \left(\frac{2S}{d} \right) \quad \text{mh/km}$$

Where

L : Inductance mh/km
 K : Constant depends on the conductor's number of wires
 d : Conductors diameter mm
 S : Axial spacing between cables in trefoil formation mm
 S : 1.26 x axial spacing between cables in flat formation mm

3.Capacitance

The capacitance is formulated as follow

$$C = \frac{\epsilon_r}{18 \ln \frac{D}{d}} \quad \mu\text{f/km}$$

Where

C : Capacitance $\mu\text{f/km}$
 ϵ_r : Relative permittivity of insulation material
 D : Diameter over insulation mm
 d : Conductor diameter mm

Technical Data & Cables Parameters

4. Insulation Resistance

The Insulation Resistance is formulated as follow

$$R = K \ln \left(\frac{D}{d} \right)$$

Where

R	: Insulation resistance	MΩ/km
K	: Constant depends on the insulation material	
d	: Diameter of the conductor (including the semiconducting layer)	mm
D	: Diameter of the insulated core	mm

5. Charging Current

The charging current is the capacitive current which flows when AC voltage is applied to the cables as a result of the capacitance between the conductor and earth, and for a multicore cable in which cores are not screened, between conductors. The value can be derived from the following equation.

$$I_C = U_0 \omega C 10^{-6} \quad \text{A/km}$$

Where

I_C	: Charging current	A/km
U_0	: Voltage between phase and earth.	V
ω	: $2 \pi f$	
f	: Frequency	Hz
C	: Capacitance to neutral	μf/km

6. Dielectric Losses

The dielectric losses of an AC cable are proportional to the capacitance, the frequency, the phase voltage and the power factor. The value can be derived from the following equation.

$$W_D = 2 \pi f C U_0^2 \tan \delta 10^{-6} \quad \text{watt/km/phase}$$

Where

W_D	: Dielectric losses	watt/km/phase
f	: Frequency	Hz
C	: Capacitance to neutral	μf/km
U_0	: Voltage between phase and earth	V
$\tan \delta$	: Dielectric power factor	

7. Cable Ampacity

Cable ampacity or current carrying capacity is defined as the continuous maximum current the cable can carry at its maximum operating temperature.

In the technical information tables the following installation conditions were assumed during the current calculation:

- Ambient air temperature = 40 °C
- Ground temperature = 35 °C
- Ground thermal resistivity = 120 °C. cm/Watt
- Burial depth = 0.5 mt.

- In case of installation conditions are different from the stated, derating factors tabulated in table 2 to 9 must be used for calculating the new current carrying capacity.

- All cable ampacities are based on IEC 60287

Technical Data & Cables Parameters

8.Cable Short Circuit Capacity

Tables 11 & 12 give the short circuit current for conductor and screen based on the following conditions

- A- Short circuit starts from the maximum operating conductor/screen temperature.
- B- Maximum temperature during short circuit
- C- Maximum short circuit current duration is 5 seconds.

If the short circuit current is required at duration not metioned in the catalogue, it is obtained by dividing the short circuit current for 1 second by the square root of the required duration as follows:

$$I_{s.c.t} = \frac{I_{s.c.1}}{\sqrt{t}}$$

Where

$I_{s.c.t}$	: Short circuit current for t second	kA
$I_{s.c.1}$	: Short circuit current for 1 second	kA
t	: Duration	Sec.

9.Voltage Drop

When current flows in a cable conductor there is a voltage drop between the ends of the conductor which is the product of the current and the impedance.

The following equations should be used to calculate the voltage drop:

A.Single phase circuit.

$$V_d = 2 I \ell (R \cos \phi + X \sin \phi) \quad V$$

B.Three phase circuit.

$$V_d = \sqrt{3} I \ell (R \cos \phi + X \sin \phi) \quad V$$

Where

V_d	: Voltage drop	V
I	: Load current	A
R	: AC Resistance	Ω / km
X	: Reactance	Ω / km
$\cos \phi$	: Power factor	
ℓ	: Length	km
$X = \omega L 10^{-3}$		Ω / km
$\omega = 2 \pi f$		
L	= from tables	
	mh/km	

Relation between $\cos \phi$ and $\sin \phi$

Cos ϕ	1.0	0.9	0.8	0.71	0.6	0.5
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Sin ϕ	0.0	0.44	0.6	0.71	0.8	0.87
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* L.V. cable systems should be planned so as not to exceed voltage drop 3-5 % in normal operating conditions.

* Voltage drop data for L.V. Cable (Single & Multi Core) are tabulated in Tables 13 & 14.

Metals Used for Cables

Electrical Properties

Metal	Relative Conductivity Copper 100%	Electrical Resistivity at 20 °C ohm. m (10 ⁻⁸)	Temperature Coefficient of Resistance per °C
Copper (annealed)	100	1.7241	0.00393
Aluminium	61	2.8264	0.00403

Physical Properties

Property	Unit	Copper	Aluminium
Density at 20 °C	kg / m ³	8890.0	2703.0
Coeff. thermal expansion	Per °C x 10 ⁻⁶	17.0	23.0
Melting point	°C	1083.0	659.0
Thermal conductivity	W/cm °C	3.8	2.4
Ultimate tensile strength	Mn/m ²	225.0	70-90

Table 1

Derating Factors



Ground Temperature Derating Factor

Ground Temperature °C	15	20	25	30	35	40	45	50	55
XLPE cables rated 90 °C	1.16	1.13	1.09	1.04	1.00	0.95	0.90	0.85	0.80

Table 2

Derating Factors

Air Temperature Derating Factor

Air temperature °C	20	25	30	35	40	45	50	55
XLPE cables rated 90 °C	1.18	1.14	1.10	1.05	1.00	0.90	0.89	0.84

Table 3

Burial Depth Derating Factor

Depth of Laying mt.	Cables Cross Section		
	Up to 70 mm ²	95 up to 240 mm ²	300 mm ² & above
0.50	1.00	1.00	1.00
0.60	0.99	0.98	0.97
0.80	0.97	0.96	0.94
1.00	0.95	0.93	0.92
1.25	0.94	0.92	0.89
1.50	0.93	0.90	0.87
1.75	0.92	0.89	0.86
2.00	0.91	0.88	0.85

Table 4

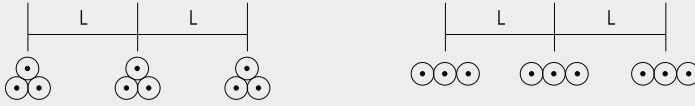
Soil Thermal Resistivity Derating Factor

Soil Thermal Resistivity in °C. cm/Watt	80	90	100	120	150	200	250	300
Rating factor	1.17	1.12	1.07	1.0	0.91	0.80	0.73	0.67

Table 5

Derating Factors

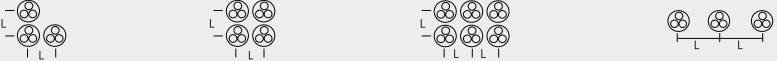
Trefoil or Flat Formation Derating Factors for Three Single Core Cables Laid Direct in Ground

Number of Circuits						
	Trefoil formation		Flat formation			
	Touching		Spacing = 0.15 M		Spacing = 0.30 M	
nr	Trefoil	Flat	Trefoil	Flat	Trefoil	Flat
2	0.77	0.80	0.82	0.85	0.88	0.91
3	0.66	0.69	0.73	0.76	0.80	0.83
4	0.60	0.63	0.68	0.71	0.74	0.77
5	0.56	0.59	0.64	0.67	0.72	0.75
6	0.53	0.57	0.61	0.64	0.70	0.73

* L = Spacing

Table 6

Trefoil Formation Derating Factors for Multi-core Core Cables Laid Direct in Ground

Number of Circuits						
	Trefoil Formation		Flat Formation			
	Touching		Spacing = 0.15 M		Spacing = 0.30 M	
nr	Trefoil	Flat	Trefoil	Flat	Trefoil	Flat
2	0.81	0.81	0.87	0.87	0.91	0.91
3	0.69	0.70	0.76	0.78	0.82	0.84
4	0.62	0.63	0.72	0.74	0.77	0.81
5	0.58	0.60	0.66	0.70	0.73	0.78
6	0.54	0.56	0.63	0.67	0.70	0.76

* L = Spacing

Table 7

Derating Factors

Reduction factors for groups of more than one multi-core cable in air
 To be applied to the current-carrying capacity for one multi-core cable in free air

Number of Trays	Number of Cables						Method of installation
	1	2	3	4	6	9	
1	1.00	0.88	0.82	0.79	0.76	0.73	Cables on perforated trays
2	1.00	0.87	0.80	0.77	0.73	0.68	
3	1.00	0.86	0.79	0.76	0.71	0.66	
1	1.00	1.00	0.98	0.95	0.91	-	Cables on vertical perforated trays
2	1.00	0.99	0.96	0.92	0.87	-	
3	1.00	0.98	0.95	0.91	0.85	-	
1	1.00	0.88	0.82	0.78	0.73	0.72	Cables on ladder supports, cleats, etc.
2	1.00	0.88	0.81	0.76	0.71	0.70	
1	1.00	0.91	0.89	0.88	0.87	-	
2	1.00	0.91	0.88	0.87	0.85	-	Cables on ladder supports, cleats, etc.
1	1.00	0.87	0.82	0.80	0.79	0.78	
2	1.00	0.86	0.80	0.78	0.76	0.73	
3	1.00	0.85	0.79	0.76	0.73	0.70	
1	1.00	1.00	1.00	1.00	1.00	-	Cables on ladder supports, cleats, etc.
2	1.00	0.99	0.98	0.97	0.96	-	
3	1.00	0.98	0.97	0.96	0.93	-	

NOTE 1 Values given are averages for the cable types and range of conductor sizes considered. The spread of values is generally less than 5%
 NOTE 2 Factors apply to single layer groups of cables as shown above and do not apply when cables are installed in more than one layer touching each other. Values for such installations may be significantly lower and must be determined by an appropriate method.
 NOTE 3 Values are given for vertical spacing between trays of 300 mm and at least 20 mm between trays and wall. For closer spacing, the factors should be reduced.
 NOTE 4 Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back. For closer spacing the factors should be reduced.

Table 8

Derating Factors

Reduction factors for groups of more than one circuit of single-core cables (Note 2)
 To be applied to the current-carrying capacity for one circuit of single-core cables in free air

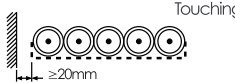
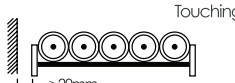
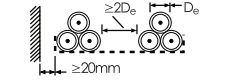
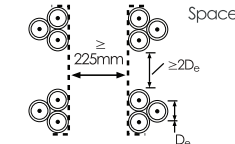
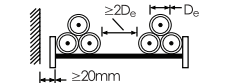
Number of Trays	Number of Cables			Use as a multiplier to rating for	Method of installation
	1	2	3		
1	0.98	0.91	0.87	Three cables in horizontal formation	Perforated trays (Note 3) 
2	0.96	0.87	0.81		
3	0.95	0.85	0.78		
1	1.00	0.97	0.96	Three cables in horizontal formation	Ladder supports, cleats, etc. (Note 3) 
2	0.98	0.93	0.89		
3	0.97	0.90	0.86		
1	1.00	0.98	0.96		Perforated trays (Note 3) 
2	0.97	0.93	0.89		
3	0.96	0.92	0.86		
1	1.00	0.91	0.89	Three cables in trefoil formation	Vertical perforated trays (Note 4) 
2	1.00	0.90	0.86		
3	1.00	0.94	0.90		
1	1.00	1.00	1.00		Ladder supports, cleats, etc. (Note 3) 
2	0.97	0.95	0.93		
3	0.96	0.94	0.90		

Table 9

- NOTE 1 Values given are averages for the cable types and range of conductor sizes considered. The spread of values is generally less than 5%.
- NOTE 2 Factors are given for single layers of cables (or trefoil groups) as shown in the table and do not apply when cables are installed in more than one layer touching each other. Values for such installations may be significantly lower and should be determined by an appropriate method.
- NOTE 3 Values are given for vertical spacings between trays of 300 mm. For closer spacing, the factors should be reduced.
- NOTE 4 Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back. For closer spacing, the factors should be reduced.
- NOTE 5 For circuits having more than one cable in parallel per phase, each three phase set of conductors should be considered as a circuit for the purpose of this table.

Short Circuit Current

Max. Short Circuit Temperature for Cable Components

Material	Item	Temp. °C
Insulation	XLPE insulation	250
Jacket	PVC sheathing	200
Metal	Copper	250
	Aluminum	250

Table 10

kA Short Circuit Current - Copper Conductor - XLPE Insulated

C.S.A. mm ²	Duration sec.									
	0.1	0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0
16	7.2	5.1	4.2	3.6	3.2	2.3	1.6	1.3	1.1	1.02
25	11.3	8.0	6.5	5.7	5.1	3.6	2.5	2.1	1.8	1.60
35	15.8	11.2	9.1	7.9	7.1	5.0	3.5	2.9	2.5	2.24
50	22.6	16.0	13.1	11.3	10.1	7.2	5.1	4.1	3.6	3.20
70	31.7	22.4	18.3	15.8	14.2	10.0	7.1	5.8	5.0	4.5
95	43.0	30.4	24.8	21.5	19.2	13.6	9.6	7.8	6.8	6.1
120	54.3	38.4	31.3	27.1	24.3	17.2	12.1	9.9	8.6	7.7
150	67.8	48.0	39.2	33.9	30.3	21.5	15.2	12.4	10.7	9.6
185	83.7	59.2	48.3	41.8	37.4	26.5	18.7	15.3	13.2	11.8
240	108.5	76.7	62.7	54.3	48.5	34.3	24.3	19.8	17.2	15.3
300	135.7	95.9	78.3	67.8	60.7	42.9	30.3	24.8	21.5	19.2
400	180.9	127.9	104.4	90.4	80.9	57.2	40.4	33.0	28.6	25.6
500	226.1	159.9	130.5	113.1	101.1	71.5	50.6	41.3	35.8	32.0
630	284.9	201.4	164.5	142.4	127.4	90.1	63.7	52.0	45.0	40.3
800	361.8	255.8	208.9	180.9	161.8	114.4	80.9	66.0	57.2	51.2

Table 11

Short Circuit Current

kA Short Circuit Current - Copper Screen

C.S.A. mm ²	Duration Sec.									
	0.1	0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0
16	7.5	5.3	4.3	3.7	3.3	2.4	1.7	1.4	1.2	1.1
25	11.7	8.3	6.8	5.9	5.2	3.7	2.6	2.1	1.9	1.7
35	16.4	11.6	9.5	8.3	7.3	5.2	3.7	3.0	2.6	2.3

Table 12

Conductor temperature before short circuit = 90 °C
 Maximum conductor temperature during short circuit = 250 °C
 Maximum screen temperature before short circuit = 80 °C

Voltage Drop

Voltage Drop for Single Core LV Cables

C.S.A mm ²	Copper Conductor Voltage Drop (mv / AMP / Meter)	
	XLPE Insulation & PVC Sheathed	
	Flat 	Trefoil 
4	8.337	8.277
6	5.628	5.568
10	3.401	3.341
16	2.203	2.142
25	1.440	1.380
35	1.085	1.024
50	0.836	0.776
70	0.624	0.564
95	0.490	0.430
120	0.417	0.357
150	0.366	0.305
185	0.322	0.262
240	0.278	0.218
300	0.253	0.192
400	0.220	0.159
500	0.211	0.150
630	0.191	0.131



Table 13

The data is based on:

- Max. operating temp: 90 °C for XLPE
- Power factor: 0.8 Rat
- Cables are touched in flat formation

Voltage Drop

Voltage Drop for Multi Core LV Cables

C.S.A mm ²	Copper Conductor Voltage Drop (mv / AMP / Meter) XLPE Insulation & PVC Sheathed
1.5	20.341
2.5	13.197
4	7.731
6	5.191
10	3.094
16	1.982
25	1.276
35	0.955
50	0.715
70	0.520
95	0.394
120	0.337
150	0.282
185	0.241
240	0.201
300	0.177
400	0.155

The above data are based on:
 Max. operating temp: 90 °C for XLPE
 Power factor : 0.8 Rated frequency: 50 HZ
 Cables are touched in flat formation

Table 14

Conversion Table

Multiply	By	To obtain
----------	----	-----------

Weight-Imperial

Ounces	28.3495	grams
Pounds (Av)	453.59	grams
Pounds (Av)	0.45359	Kilograms
Tons (short)	907.19	Kilograms
Tons (long)	1016.05	Kilograms

Weight-Metric

Grams	0.03527	Ounces
Grams	0.002205	Pounds
Kilograms	35.274	Ounces
Kilograms	2.2046	Pounds
Kilograms	0.001102	tons (short)
Kilograms	0.0009842	tons (long)

Miscellaneous-Metric

Kg/Km	0.67197	pounds per 1000 feet.
Kg/Km	3.54795	pounds per mile.
Kg.per square mm	1422.34	pounds per square inch.
Kg.per square cm	14.2234	pounds per square inch.
Grams per cubic cm	0.03613	pounds per cubic inch.
Meters per minute	0.05468	feet per second.
Kilometers per hour	0.91134	feet per second.
Kilometer per hour	0.62137	miles per hour.
Ohms per Kilometer	0.3048	ohms per 1000 feet.
Ohms per Kilometer	1.6093	ohms per mile.
Decibels per kilometer	0.3048	decibels per 1000 feet.
Decibels per kilometer	1.6093	decibels per mile.

Multiply	By	To obtain
----------	----	-----------

Miscellaneous-Imperial

Pounds per 1000 feet	1.48816	Kg/Km
Pounds per mile	0.28185	Kg/Km
Pounds per square inch	0.0007031	Kg. per square mm.
Pounds per square inch	0.07031	Kg. per square cm.
Pounds per cubic	27.68	grams per cubic cm.
Feet per second	18.288	meters per minute.
Feet per second	1.09728	Kilometers per hour.
Miles per hour	1.60935	Kilometers per hour.
Ohms per 1000 feet	3.28083	ohms per Kilometer.
Ohms per mile	0.62137	ohms per Kilometer.
Decibels per 1000 feet	3.28083	decibels per Kilometer.
Decibels per mile	0.62137	decibels per Kilometer.
Decibels	0.1153	neper.

Temperature

° Fahrenheit	5/9(°F)-32	°Celsius
° Celsius	9/5(°C)+32	°Fahrenheit

Length-Imperial

Mils	0.001	inches.
Mils	0.0254	mm.
Inches	1000	mils.

Conversion Table

Multiply	By	To obtain
----------	----	-----------

Length-Imperial

Inches	25.40	mm.
Inches	2.54	cm.
Feet	30.48	cm.
Feet	0.3048	meters.
Feet (thousands of)	0.3048	kilometers.
Yards	0.9144	meters.
Miles	1.6093	kilometers

Length-Metric

Millimeters	39.37	mils.
Millimeters	0.03937	inches.
Centimeters	0.3937	inches.
Centimeters	0.032808	feet.
Meters	39.37	inches.
Meters	3.2808	feet.
Meters	1.0936	yards.
Kilometers	3280.83	feet.
Kilometers	0.62137	miles.

Volume-Metric

Cubic cm	0.06102	cubic inches.
Cubic meters	35.3145	cubic feet.
Liters	1.05668	quarts (liquid U.S)
Liters	0.26417	gallons (U.S.)

Multiply	By	To obtain
----------	----	-----------

Area-Imperial

Square mils	1.2732	circular mils
Square mils	0.000001	square inches
Circular mils	0.7854	square mils
Circular mils	0.0000007854	square inches
Square mils	0.0005067	square mm.
Square inches	1000000	square mils
Square inches	1273240	circular mils
Square inches	645.16	square mm.
Square inches	6.4516	square cm.
Square feet	0.09290	square meters
Square yards	0.8361	square meters

Area-Metric

Square millimeters	1973.52	circular mils
Square millimeters	0.00155	square inches
Square centimeters	0.155	square inches
Square meters	10.7638	square feet
Square meters	1.19599	square yards

Volume-Imperial

Cubic inches	16.38716	cubic cm.
Cubic feet	0.028317	cubic meters

Volume-U.S.

Quarts (liquid)	0.9463	liters
Gallons	3.7854	liters.

Bureau Veritas Type Test Reports



Industry & Facilities Division
Third Party Inspection Report

Page 1 of 29

INSPECTION REPORT No. BVLDOA.21.IND.002.07A.IR.04.REV.0.DK Revision No. 0

☐ Initial ☐ Interim ☒ Final ☐ Resident ☐ Remote

Inspection requested by: Doha Cables, Qatar.

Inspection performed as Recognised Authority: ☒ Yes ☐ No

BV Job Nr: BVLDOA.21.IND.002.07A

Project: North Field Expansion Project IPO Ref (if applicable): N/A

BV Client: Doha Cables, Qatar. Plo nr: (Client to BV)

Manufacturer/Vendor: M/s. Doha Cables – Qatar W.L.L., Qatar. Plo nr: (Client to Manufacturer)-NA

Sub-Vendor (if applicable): N/A

Inspection Location (Address): M/s. Doha Cables – Qatar W.L.L., Qatar. Previous Inspection (if applicable): NA

Inspection Location (GPS Coordinates): Next Inspection (if applicable): NA

Inspection performed on: 28-Dec-2021, 04-Jan-2022, 05-Jan-2022, 18-Jan-2022, 27-Jan-2022, 01-Feb-2022 and 17-Feb-2022. Total No. of Inspection Days: 7 days

MATERIAL / SUBJECT OF INSPECTION	ITEM / TAG Nr	QTY As per P/O	QTY Offered for inspection
☐ Refer to attachment section J instead			
1x800 mm ² 0.6/1 (1.2) kV CU/XLPE/AL-HDPE/PA/AWA/PVC (ENVIGUARD 65)-Type test inspection.	Sample	150 Mtr	150 Mtr

A – INSPECTION RESULT

☒ Satisfactory (Without comments) ☐ Satisfactory with comments (Any of trailing Punch or Non Conformity items is still open) ☐ Not Satisfactory (NCR raised during the inspection)

Inspection Summary: (for details refer to section E)
Type test inspection carried out and the test results found satisfactory

Open Non Conformities: ☐ Yes, details in section G ☒ No

Open Punch List Items: ☐ Yes, details in section H ☒ No

Release Note Issued: ☐ Yes, number(s): (Release Note Number) ☒ No

BV Traceability Stamping: ☐ Yes ☒ No

BV Inspector: Devendrakumar

BV Coordinator: Midhun Chandran

Technical Manager: Sherif Ramadan

BV Office: Inspection Report Date: 17-02-2022

Distribution: ☒ CLIENT ☒ BV ☒ MANUFACTURER ☐ OTHER:

Attachments Report: ☒ Yes, details in section J ☐ No

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Industry & Facilities Division
Third Party Inspection Report

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INSPECTION REPORT No. BVLDOA.21.IND.002.07A.IR.001.REV.0.DK Revision No. 0

☐ Initial ☐ Interim ☒ Final ☐ Resident ☐ Remote

Inspection requested by: Doha Cables, Qatar.

Inspection performed as Recognised Authority: ☒ Yes ☐ No

BV Job Nr: BVLDOA.21.IND.002.07A

Project: North Field Expansion Project IPO Ref (if applicable): N/A

BV Client: Doha Cables, Qatar. Plo nr: (Client to BV)

Manufacturer/Vendor: M/s. Doha Cables – Qatar W.L.L., Qatar. Plo nr: (Client to Manufacturer)-NA

Sub-Vendor (if applicable): N/A

Inspection Location (Address): M/s. Doha Cables – Qatar W.L.L., Qatar. Previous Inspection (if applicable): NA

Inspection Location (GPS Coordinates): Next Inspection (if applicable): NA

Inspection performed on: 28-Dec-2021, 04-Jan-2022, 05-Jan-2022, 18-Jan-2022, 27-Jan-2022, 01-Feb-2022 and 17-Feb-2022. Total No. of Inspection Days: 7 days

MATERIAL / SUBJECT OF INSPECTION	ITEM / TAG Nr	QTY As per P/O	QTY Offered for inspection
☐ Refer to attachment section J instead			
1x800 mm ² 19/33 (36) kV CU/XLPE/AL-HDPE/PA/AWA/PVC (ENVIGUARD 65) Type test inspection.	Sample	150 Mtr	150 Mtr

A – INSPECTION RESULT

☒ Satisfactory (Without comments) ☐ Satisfactory with comments (Any of trailing Punch or Non Conformity items is still open) ☐ Not Satisfactory (NCR raised during the inspection)

Inspection Summary: (for details refer to section E)
Type test inspection carried out and the test results found satisfactory

Open Non Conformities: ☐ Yes, details in section G ☒ No

Open Punch List Items: ☐ Yes, details in section H ☒ No

Release Note Issued: ☐ Yes, number(s): (Release Note Number) ☒ No

BV Traceability Stamping: ☐ Yes ☒ No

BV Inspector: Devendra Kumar

BV Coordinator: Midhun Chandran

Technical Manager: Sherif Ramadan

BV Office: Inspection Report Date: 17-02-2022

Distribution: ☒ CLIENT ☒ BV ☒ MANUFACTURER ☐ OTHER:

Attachments Report: ☒ Yes, details in section J ☐ No

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Industry & Facilities Division
Third Party Inspection Report

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INSPECTION REPORT No. BVLDOA.21.IND.002.07A.IR.003.REV.0.DK Revision No. 0

☐ Initial ☐ Interim ☒ Final ☐ Resident ☐ Remote

Inspection requested by: Doha Cables, Qatar.

Inspection performed as Recognised Authority: ☒ Yes ☐ No

BV Job Nr: BVLDOA.21.IND.002.07A

Project: North Field Expansion Project IPO Ref (if applicable): N/A

BV Client: Doha Cables, Qatar. Plo nr: (Client to BV)

Manufacturer/Vendor: M/s. Doha Cables – Qatar W.L.L., Qatar. Plo nr: (Client to Manufacturer)-NA

Sub-Vendor (if applicable): N/A

Inspection Location (Address): M/s. Doha Cables – Qatar W.L.L., Qatar. Previous Inspection (if applicable): NA

Inspection Location (GPS Coordinates): Next Inspection (if applicable): NA

Inspection performed on: 28-Dec-2021, 04-Jan-2022, 05-Jan-2022, 18-Jan-2022, 27-Jan-2022, 01-Feb-2022 and 17-Feb-2022. Total No. of Inspection Days: 7 days

MATERIAL / SUBJECT OF INSPECTION	ITEM / TAG Nr	QTY As per P/O	QTY Offered for inspection
☐ Refer to attachment section J instead			
4x300 mm ² 0.6/1 (1.2) kV CU/XLPE/AL-HDPE/PA/AWA/PVC (ENVIGUARD 65)-Type test inspection.	Sample	150 Mtr	150 Mtr

A – INSPECTION RESULT

☒ Satisfactory (Without comments) ☐ Satisfactory with comments (Any of trailing Punch or Non Conformity items is still open) ☐ Not Satisfactory (NCR raised during the inspection)

Inspection Summary: (for details refer to section E)
Type test inspection carried out and the test results found satisfactory

Open Non Conformities: ☐ Yes, details in section G ☒ No

Open Punch List Items: ☐ Yes, details in section H ☒ No

Release Note Issued: ☐ Yes, number(s): (Release Note Number) ☒ No

BV Traceability Stamping: ☐ Yes ☒ No

BV Inspector: Devendrakumar

BV Coordinator: Midhun Chandran

Technical Manager: Sherif Ramadan

BV Office: Inspection Report Date: 17-02-2022

Distribution: ☒ CLIENT ☒ BV ☒ MANUFACTURER ☐ OTHER:

Attachments Report: ☒ Yes, details in section J ☐ No

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