

TYPE APPROVAL CERTIFICATE

This is to certify:

That the High Voltage Cable

with type designation(s)

SEN & TEN 5 kV, SEN & TEN 8 kV, SEN & TEN 15 kV

Issued to

TMC Co., Ltd

CHUNGNAM, Republic of Korea

is found to comply with

Det Norske Veritas' Rules for Classification of Ships, High Speed & Light Craft and Det Norske Veritas' Offshore Standards

IEEE 1580 (2010)

IEC 60332-3-22 (2009-02)

Application :

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.

Type	Voltage (kV)	Temp. class (°C)
SEN & TEN 5 kV	5	90
SEN & TEN 8 kV	8	90
SEN & TEN 15 kV	15	90

This Certificate is valid until **2019-11-30**.

Issued at **Busan** on **2015-12-01**

for **DNV GL**

DNV GL local station: **Seoul**

Approval Engineer: **Eun Sook Kim**

Baeg Soon Choi
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

Product description

Type: SEN & TEN 5 kV & 8 kV & 15 kV
Construction:
Conductors: Tinned, flexible stranded copper
Core insulation: EPR (Type E & E90)
Screening: Tinned copper wire braid
Outer sheath: Type N

SEN 5kV

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
SEN 100%		
1 x 8	15,8	0,622
1 x 6	16,9	0,665
1 x 4	19,0	0,748
1 x 2	20,2	0,795
1 x 1	22,8	0,898
1 x 1/0	24,0	0,945
1 x 2/0	25,2	0,992
1 x 3/0	26,7	1,051
1 x 4/0	28,4	1,118
1 x 262	30,0	1,181
1 x 313	31,7	1,248
1 x 373	33,4	1,315
1 x 444	35,3	1,390
1 x 535	37,4	1,472
1 x 646	39,6	1,559
1 x 777	41,8	1,646
1 x 1111	48,5	1,909

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
SEN 133%		
1 x 8	17,1	0,673
1 x 6	18,1	0,713
1 x 4	20,2	0,795
1 x 2	22,5	0,886
1 x 1	24,0	0,945
1 x 1/0	25,2	0,992
1 x 2/0	26,4	1,039
1 x 3/0	28,0	1,102
1 x 4/0	29,7	1,169
1 x 262	31,2	1,228
1 x 313	32,9	1,295
1 x 373	34,6	1,362
1 x 444	36,5	1,437
1 x 535	38,6	1,520
1 x 646	40,8	1,606
1 x 777	44,5	1,752
1 x 1111	49,7	1,957

TEN 5kV

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
TEN 100%		
3 x 8	31,2	1,228
3 x 6	33,6	1,323
3 x 4	38,1	1,500
3 x 2	40,7	1,602
3 x 1	45,4	1,787
3 x 1/0	48,0	1,890
3 x 2/0	50,6	1,992
3 x 3/0	53,8	2,118
3 x 4/0	57,5	2,264
3 x 262	61,0	2,402
3 x 313	64,6	2,543
3 x 373	68,3	2,689
3 x 444	73,9	2,909
3 x 535	78,4	3,087

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
TEN 133%		
3 x 646	83,1	3,272
3 x 777	87,9	3,461
3 x 1111	99,1	3,902
TEN 133%		
3 x 8	34,0	1,339
3 x 6	36,2	1,425
3 x 4	40,7	1,602
3 x 2	44,8	1,764
3 x 1	48,0	1,890
3 x 1/0	50,6	1,992
3 x 2/0	53,2	2,094
3 x 3/0	56,6	2,228
3 x 4/0	60,3	2,374
3 x 262	63,5	2,500
3 x 313	67,2	2,646

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 Certificate No: **TAE00000T5**

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
3 x 373	72,4	2,850
3 x 444	76,5	3,012
3 x 535	81,0	3,189

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
3 x 646	85,7	3,374
3 x 777	90,5	3,563

SEN 8kV

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
SEN 100%		
1 x 6	18,3	0,720
1 x 4	20,4	0,803
1 x 2	22,7	0,894
1 x 1	24,2	0,953
1 x 1/0	25,4	1,000
1 x 2/0	26,6	1,047
1 x 3/0	28,2	1,110
1 x 4/0	29,9	1,177
1 x 262	31,4	1,236
1 x 313	33,1	1,303
1 x 373	34,8	1,370
1 x 444	36,7	1,445
1 x 535	38,8	1,528
1 x 646	41,0	1,614
1 x 777	44,7	1,760
1 x 1111	49,9	1,965

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
SEN 133%		
1 x 6	19,6	0,772
1 x 4	22,8	0,898
1 x 2	24,0	0,945
1 x 1	25,5	1,004
1 x 1/0	26,7	1,051
1 x 2/0	27,9	1,098
1 x 3/0	29,5	1,161
1 x 4/0	31,2	1,228
1 x 262	32,7	1,287
1 x 313	34,4	1,354
1 x 373	36,1	1,421
1 x 444	38,0	1,496
1 x 535	40,1	1,579
1 x 646	42,3	1,665
1 x 777	46,0	1,811
1 x 1111	51,2	2,016

TEN 8kV

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
TEN 100%		
3 x 6	36,6	1,441
3 x 4	41,1	1,618
3 x 2	45,2	1,780
3 x 1	48,5	1,909
3 x 1/0	51,0	2,008
3 x 2/0	53,6	2,110
3 x 3/0	57,1	2,248
3 x 4/0	60,7	2,390
3 x 262	64,0	2,520
3 x 313	67,6	2,661
3 x 373	72,8	2,866
3 x 444	76,9	3,028
3 x 535	81,4	3,205
3 x 646	86,2	3,394
3 x 777	90,9	3,579

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
TEN 133%		
3 x 6	39,4	1,551
3 x 4	45,4	1,787
3 x 2	48,0	1,890
3 x 1	51,3	2,020
3 x 1/0	53,8	2,118
3 x 2/0	56,4	2,220
3 x 3/0	59,9	2,358
3 x 4/0	63,5	2,500
3 x 262	66,8	2,630
3 x 313	71,9	2,831
3 x 373	75,6	2,976
3 x 444	79,7	3,138
3 x 535	84,2	3,315
3 x 646	89,0	3,504
3 x 777	93,7	3,689

SEN 15kV

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
SEN 100%		
1 x 2	26,2	1,031
1 x 1	27,7	1,091
1 x 1/0	28,9	1,138
1 x 2/0	30,1	1,185
1 x 3/0	31,6	1,244
1 x 4/0	33,3	1,311
1 x 262	34,9	1,374
1 x 313	36,6	1,441
1 x 373	38,3	1,508
1 x 444	40,2	1,583
1 x 535	42,3	1,665
1 x 646	46,0	1,811
1 x 777	48,2	1,898
1 x 1111	53,4	2,102

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
SEN 133%		
1 x 2	28,0	1,102
1 x 1	29,5	1,161
1 x 1/0	30,7	1,209
1 x 2/0	31,9	1,256
1 x 3/0	33,5	1,319
1 x 4/0	35,2	1,386
1 x 262	36,7	1,445
1 x 313	38,4	1,512
1 x 373	40,1	1,579
1 x 444	42,0	1,654
1 x 535	45,6	1,795
1 x 646	47,8	1,882
1 x 777	50,0	1,969
1 x 1111	55,2	2,173

TEN 15kV

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
TEN 100%		
3 x 2	52,8	2,079
3 x 1	56,0	2,205
3 x 1/0	58,6	2,307
3 x 2/0	61,2	2,409
3 x 3/0	64,4	2,535
3 x 4/0	68,1	2,681
3 x 262	73,0	2,874
3 x 313	76,7	3,020
3 x 373	80,3	3,161
3 x 444	84,4	3,323
3 x 535	89,0	3,504
3 x 646	93,7	3,689
3 x 777	98,4	3,874

Number of cores x conductor cross-section	Overall Diameter Approx.	Overall Diameter Approx.
AWG/MCM	mm	inches
TEN 133%		
3 x 2	57,1	2,248
3 x 1	60,3	2,374
3 x 1/0	62,9	2,476
3 x 2/0	65,5	2,579
3 x 3/0	68,9	2,713
3 x 4/0	74,1	2,917
3 x 262	77,3	3,043
3 x 313	81,0	3,189
3 x 373	84,6	3,331
3 x 444	88,7	3,492
3 x 535	93,3	3,673
3 x 646	98,0	3,858
3 x 777	102,8	4,047

Application/Limitation

The requirements of SOLAS Amendments Chapter II-1, Part D, Reg. 45, 5.2 (provision to be taken to limit Fire Propagation along Bunches of Cables or Wires) are fulfilled without any additional measures.

Type Approval documentation

Tests carried out

Type test according to IEEE 1580, UL 1072, IEEE 1202, UL 1309 and IEC 60332-3-22.

Marking of product

TMC – SEN or TEN– size – 5 kV or 8 kV or 15 kV

Job Id: **262.1-003643-2**
Certificate No: **TAE00000T5**

Periodical assessment

The scope of the retention/renewal survey is to verify that the conditions stipulated for the Type approval is complied with and that no alterations are made to the product design or choice of materials.

The main elements of the survey are:

- Inspection on factory samples, selected at random from the production line (where practicable)
- Results from Production Sample Tests (PST) and Routines (RT) checked (if not available tests according to PST and RT to be carried out)
- Review of type approval documentation
- Review of possible change in design, materials and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate.

Survey to be performed at least every second year.

END OF CERTIFICATE