DIVISION DIGITAL SERVICE (DDS) -TELKOM
INFRASTRUCTURE ASSURANCE
LABORATORY INFRASTRUCTURE QUALITY ASSURANCE
Gegerkalong Hilir Street No. 47 Bandung 40 152 INDONESIA
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QA TEST REPORT

No. SPK/Order No. : 022/132 / QA / 2019 REPORT No. : 132 / KAB / L / QA / 2019

APPLICANT'S DATA:

NAME : **VOKSEL ELECTRIC Tbk, PT**
ADDRESS : Jl. Raya Narogong KM 16, Cileungsi - Bogor 16820

TEST ITEMS DATA:

NAME OF TEST ITEM : **SINGLE MODE FIBER OPTIC CABLE CONSTRUCTED LOOSE TUBE FOR DIRECT BURIED APPLICATION (KSO DIRECT BURIED)**
BRAND : **VOKSEL**
TYPE : NZDS C LF B WG LT (G 655 C)
SERIAL No : -
CAPACITY : 4 to 96 Core
MADE IN : Indonesia

DATE OF START : August 21st, 2019
DATE OF END : September 13th, 2019
TESTED BY : LAB INFRASTRUCTURE QA - CABLE & FO

GENERAL STATEMENT

a. This test report is only valid for the test item which is stated on the above data.
b. Measuring equipment used in the test (see page 2)
c. Specification / standard document: **STEL K-016-2013 Ver. 3.0**

CONCLUSION

VISUAL TEST	FUNCTIONAL TEST	ELECTRICAL / MECHANICAL TEST
PASS	**PASS**	**PASS**

NOTES:

COMPLY ; NOT COMPLY

BASE ON THE RESULT EVALUATIION AND COMPARING TO THE STANDARD / SPECIFICATION, THE TEST ITEM IS	COMPLY

Bandung, September 17, 2019

Agreed by: Reviewed by:

YUSRIL SINI
SM Infrastructure Assurance

ADI PERMADI
Lab Manager. Infrastructure QA

MEASURING EQUIPMENT ARE USED

NO.	MEASURING INSTRUMENT	BRAND	NUMBER TYPE / MODEL	SERIAL NUMBER	ASSET NUMBER
1.	Optical Time-Domain Reflectometer (OTDR)	PHOTON	8000I-G3-OCL	800GN-JGB0J	QA VOKSEL
2.	Chromatic Dispersion	PE Fiber Optics	YORK S-18	251 086	QA VOKSEL
3.	PMD Tester	UBICS	701	701-118	QA VOKSEL
4.	MFD Tester	Spectral Bench	PK-2210	54452216	QA VOKSEL
5.	Optical Time-Domain Reflectometer (OTDR)	Nettest	CMA 4000i	2110-0533	QA VOKSEL
6.	Cable Bending Tester	Deck-tron	DCS-212 CFX	J1870198	QA VOKSEL
7.	Crush Cable Tester	Deck-tron	DCS-312C	1870198	QA VOKSEL
8.	Cable Impact Tester	Deck-tron	DCS-212	1870198	QA VOKSEL
9.	Torsion Cable Tester	Deck-tron	DCS-342	1870198	QA VOKSEL
10.	Cable Tensile Tester	Oil Gear	DCS-350	97285777	QA VOKSEL
11.	Optical Coating Geometry	PHOTON Kinetics	PK 2400	53782388	106 / CAB
12.	Dielectric Loss	Ando	TR-10C	59 057	006 / CAB
13.	DC Dielectric Test Set	Biddle	220 070	16 107	016 / CAB
14.	Autograph Tensile Tester	Shimadzu	AG5000E	30096828	001 / CAB
15.	Digimatic Caliper	Mitutoyo	CD-12 "C	0066203	101 / CAB
16.	Water Penetration Tester	-	-	-	-

APPENDIX / IMAGES

NO.	NAME	REMARK
1.	Annex 1 - Photo	3 pages

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1. 2.

NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
1.	**CONSTRUCTION**				
a.	**Optical fiber.**	The composition of the optical fibers must consist of core, cladding, a primary protector (coating) and coloring that meets the following conditions:	The composition of the optical fiber consists of a core, cladding, a primary protector (coating) and coloring.	-	√
1)	*Bare fiber*	*Bare fiber* consists of a core and cladding that function as a suppliers and directional light beam so that propagation remain in the core.	*Bare fiber* consists of a core and a cladding.	-	√
2)	Primary protector (coating)	• Primary protector (coating) coats the bare fiber. • Using two layers of UV-curable resin. • The first layer has a low modulus and the second layer has a high modulus.	• Primary protector (coating) coats the bare fiber. • Using two layers of UV-curable resin. • The first layer has a low modulus and the second layer has a high modulus.	-	√
3)	Nominal diameter primary protector (coating) including coloring	Nominal diameter of an optical fiber that has been given the primary protector including the coloring is 250 µm ± 15 µm.	Diameter optical fiber that has been given a primary protector (coating) including the coloring is: 250.60 µm	0.23 µm	√
4)	Fiber Colors	The colors of optical fibers identification for twelve fibers should be as follows: First fiber : Blue Second fiber : Orange Third fiber : Green Fourth fiber : Brown Fifth fiber : Gray Sixth fiber : White Seventh fiber : Red Eighth fiber : Black Ninth fiber : Yellow Tenth fiber : Purple Eleventh fiber : Pink Twelfth fiber : Aqua	The colors of optical fibers identification for twelve fibers are: First fiber : Blue Second fiber : Orange Third fiber : Green Fourth fiber : Brown Fifth fiber : Gray Sixth fiber : White Seventh fiber : Red Eighth fiber : Black Ninth fiber : Yellow Tenth fiber : Purple Eleventh fiber : Pink Twelfth fiber : Aqua	-	√

Note:
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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
b.	**Fiber Optic Cable.**				
1)	Cable core			-	√
a)	Main Strength Member	• Placed in the center of the cable core. • The diameter of main strength member is coated by polyethelene layer for cable with a cable core and one layer consisting 8 loose tubes is 4.5 mm ± 0.1 mm.	• The main strength member is placed the center of the cable core. • The diameter of main strength member is coated by polyethelene layer for cable with a cable core and one layer consisting 8 loose tubes is 4.50 mm	0.03 mm.	√
b)	Additional Strength Member	• In the form of aramid yarn which is placed longitudinally around the cable core. • Weight aramid yarn for cable with a cable core consisting of eight layers of the loose tube is 1.4 kg/km or 1.4 g/meter.	• Additional strength member in the form of aramid yarn is placed longitudinally around the cable core. • Weight aramid yarn for the ply cord 8 of loose tube : 1.6 g / meter.	- 0.01 g / meter	√ √
c)	*Loose Tube*	• In the form of a tube that consists of one or two layers of thermal plastic material that function as secondary protection of several optical fibers • The number of optical fiber in the loose tube should be 12 fibers. • *Loose tube* must be filled with water blocking components made of jelly or yarn. • Each loose tube should be colored for identification purposes. • The colors of the identification of loose Tube cable with a cable core consisting of 8 layers of the loose tube should be as following: Inner Layer First tube : Blue Second tube : Orange Third tube : Green Forth tube : Brown Fifth tube : Gray Sixth tube : White Seventh tube : Red Eighth tube : Black	• In the form of a loose tube with two layers from the thermal plastic material as secondary protection of 12 optical fibers. • The number of optical fiber in the loose tube optical fiber is 12. • *Loose tube* filled with water blocking components made of jelly • Each loose tube is color-coded for identification purposes. • The Colors loose tube cable for a cable with a core consisting of 8 layers of the loose tube as follows. Inner Layer First tube : Blue Second tube : Orange Third tube : Green Forth tube : Brown Fifth tube : Gray Sixth tube : White Seventh tube : Red Eighth tube : Black	- - - - -	√ √ √ √ √

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		• Diameter and thickness of the loose tube are as follows: The inner diameter min: 1.7 mm. Minimum thickness: 0.40 mm.	• Diameter and thickness of the loose tube are as follows: The inner diameter min: 1.78 mm. Minimum thickness: 0.43 mm.	0.03 mm. 0.02 mm.	√ √
		• Structures of the loose tube must be as follows: For a cable with a capacity of 96 fiber optics with 8 loose tube's should be as follows: 8 loose tubes stranded manner around the main strength member as much as 5 to 10 rounds and then reverse as much as 5 to 10 rounds (S-Z twist)	• The Structures of the loose tube for cable with capacity of 96 fiber optic consisting of 8 loose tube is as follows: 8 loose tubes stranded manner around the main strength member by 7 rounds and then reverse as much as 7 rounds (S-Z twist).	-	√
d)	Water blocking for wet-type cable				
(1)	Jelly filling loose tube	*The Thixotropic gel* must be filled equally into the loose tube so that it fills into any interstice in the loose tube.	*The Thixotropic gel* gets filled equally into any interstice in the loose tube.	-	√
(2)	Jelly filler cable	Compound / petro jelly must be filled until the cable core and reaches all interstice that exists in the cable core.	Compound / petro jelly filling all interstice that exists in the cable core until the outside of the loose tube.	-	√
(3)	*Water Blocking tape*	Water blocking tape must be mounted helical or longitudinally on the outside of the cable core with sufficient overlap.	Water blocking tape mounted longitudinally on the outside of the cable core with sufficient overlap	-	√
e)	Filler rod				
	Diameter of filler rod	The diameter of filler rods must be made with the same size as the outer diameter loose tube.	Because the construction cable is 8 loose tubes, the maximum capacity of loose tube is one layer, there are no filler rods	-	√

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f)	Binder tape for cable core	• Binder tape must be mounted helical around the cable core that has been wrapped with water blocking tape as cable core binder • Binder tape must be made of nylon or polyester or polypropylene.	• Two binder tape are mounted with helical and crossed around the cable core • Binder tape is made of polyester.	- -	√ √
g)	Cable sheath peeling thread (rip cord)	Two pieces of rip cord must be placed longitudinally under a layer of aluminum with 180˚C positions to one another.	Two pieces of rip cord are placed longitudinally parallel to the cable core under a layer of aluminum with the position in 180˚C to one another.	-	√
3)	**Cable Sheath**				
a) (1)	Inner Sheath LAP	In the form polyethylene with high density (High-Density Polyethylene - HDPE) whose inside is coated aluminum tape, which forms a sheath of polyethylene-coated aluminum (Laminated Aluminum Polyethylene - LAP) with a minimum of LAP sheath thickness is 2.2 mm.	The Sheath of Cable is in the form polyethylene with high density (High-Density Polyethylene - HDPE) whose inside is coated by aluminum tape and forms LAP (Laminated Aluminum Polyethylene). LAP sheath thickness is 2.29 mm.	- 0.03 mm.	√ √
(2)	Aluminum Tape	• Layer of aluminum tape should be tight to the polyethylene sheath so that no interstice between them can be traversed by water seepage. • Layer of aluminum tape at LAP sheath mounted longitudinally with an overlap of at least 3.0 mm and must be perfectly connected electrically and mechanically along the cable. • Thickness of Aluminum coating is at least 0.15 mm and coated with a polymeric tape with a minimum thickness of 0.04 mm on both surfaces.	• Layer of aluminum tape is tight to the polyethylene sheath so that there is no interstice in between. • Layer of aluminum tape at LAP sheath mounted longitudinally with overlapping: 5.43 mm. • Minimum aluminum layer thickness: 0.251 mm.	- 0.03 mm. 0.03 mm.	√ √ √ √

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b)	Outer sheath	In the form polyethylene with high density (High-Density Polyethylene - HDPE) whose mounted outside the mechanical protector	The outer sheath is in form polyethylene with high density (High-Density Polyethylene - HDPE) whose mounted outside the mechanical protector	-	√
		The thickness of outer sheath: The cable that uses a mechanical protector in the form of steel tape, so the measured thickness of at least 1.7 mm excluding steel tape.	The thickness of the cable sheath is measured and exclude the steel tape of at least 3.23 mm	0,03 mm	√
c)	Mechanical protector	For mechanical protector in the form of steel tape are as follows:	Mechanical protector in the form of steel bands are as follows:		
		• In the form of two sheets of steel tape coated galvanized with a minimum thickness of 0.3 mm.	• In the form of two sheets of steel tape coated galvanized thickness: 0.35 mm	-	√
		• Two pieces of steel tape are mounted wrapped around a circular (helical) in direction on the above inner sheath	• Two pieces of steel tape are mounted wrapped around a circular (helical) in direction on the above inner sheath	-	√
		• The top layer of steel tape mounted to cover a gap of the steel tape first layer, with an overlap of at least 15% of width tape on both sides.	• The top layer of steel tape mounted to cover a gap of the steel tape first layer, with overlap is 38.0% of width tape on both sides.		√
		• The width of the gap between two winding of steel tape that closest between the top layer and bottom layer of a maximum of 50% of the tape width.	• The width of the gap between two winding of steel tape that closest between the top layer and bottom layer are: 26.0% of the bandwidth.		√
		• Installation of steel tape should be stick strongly so it does not open / peeled at the time of the mechanical tests.	• Installation of steel tape is stick strongly, and it does not open / peeled at the time of the mechanical tests.		√

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2 a.	**CHARACTERISTICS OF RAW MATERIALS** **Optical fiber**	• Type of optical fiber is Single Mode	• Type of optical fiber is Single Mode	-	√
		• Can't be any discontinuous point that exceeds 0.05 dB along the cable when measured by OTDR from one end.	• There is no discontinuous point that exceeds 0.05 dB along the cable as measured by OTDR.	-	√
		• Fiber optics are used in the cable must be adapted to implementation.	• Fiber optic cables are used at **G655C Large Effective Area**	-	√
		• Characteristics of ***Non-zero Dispersion shifted Fiber*** **ITU-T Rec. G. 655 C LF** should be as follows:	• Characteristics of Non-zero Dispersion shifted Fiber ITU-T **G 655C Large Effective Area**:	-	√
		Measurements on fiber			
		a. MFD at a wavelength of 1310nm: 9.6 ± 0.4 µm.	a. MFD min: 9.64 µm.	0.36µm	√
		b. Cladding diameter: 125±1µm.	b. Cladding: 125.19 µm.	0.60µm.	√
		c. *Core concentricity* Maximum error: 0.8µm	c. Core concentricity the maximum error: 0.16 µm.	0.01µm.	√
		d. Cladding non-circularity maximum: 2.0%.	*d. Cladding non-circularity* max =: 0.31 %	0.01 %	√
		e. Cable cut-off wavelength maximum 1450 nm.	*e. Fiber cut-off wavelength* max .: 1310 nm.	26 nm	√
		f. *Macro-bend loss* at a wavelength of 1625 nm with a bending radius of 30 mm by 100 rounds max: 0:10 dB	*f. Macro-bend loss* at a wavelength of 1625 nm with a bending radius of 30 mm by 100 rounds maximum: 0.025dB.	0.020dB.	√
		g. *Chromatic dispersion coefficient*	g. *Chromatic dispersion* coefficient		
		λo min at 1530 ≥ 1.0 ps / nm.km	λo min : 2.54 ps/nm.km	0.31ps/nm.km	√
		λo maks at 1530 ≤ 10 ps / nm.km	λo max : 5.69 ps/nm.km	0.31ps/nm.km	√
		λo maks-λo min ≤ 5.0 ps / nm.km	λo max-λo min: 3.15 ps/nm.km	0.31ps/nm.km	√
		h. *Attenuation coefficient* At: 1550 nm Max: 0.25 dB / km At: 1625 nm Max: 0:38 dB / km	*h. Attenuation coefficient* At: 1550 nm Max: 0.195 dB / km At: 1625 nm Max: 0.252 dB / km	0.080 dB/km 0.080 dB/km	√ √
		i. PMD coefficient Max: 0.10 ps/√km.	i. PMD coefficient max: 0.080 ps/√km,	0001 ps/√km	√

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b.	**Primary protector**	• The primary coating material (primary coating) should have the characteristic: a. Give protection to the optical fiber from damage b. It can maintain the stability of the optical fiber attenuation from the influence of various pressures c. Do not interfere at the process of the optical fiber splicing. d. Easy to strip without damaging the cladding and core.	• The characteristic of the primary protector (primary coating): a. Protect the optical fiber from damage. b. Can maintain the stability of the optical fiber attenuation from the effect of pressure c. Do not interfere at the process of the optical fiber splicing. d. Easy to strip without damaging the cladding and core.	- - - - -	√ √ √ √ √
		• Primary protector must be coated with a color that is not easily fade by cleaning agents alcohol-based or ethanol and shall have transparent characteristic so the light can be injected from the outside into the core for the detection purposes	• The primary protector is coated with a color that is not easily fade by cleaning agents alcohol-based or ethanol and has a transparent characteristic.	-	√
c.	***Loose Tube***				
		• *A loose tube* should be made of thermal plastic material.	• *The loose tube is* made of thermal plastic material.	- -	√ √
		• The thermal plastic is polybutylene terephthalate (PBTP) which must be of high molecular weight and have the characteristic of mechanical, hydraulic and thermal well, with the following characteristics: a. Density ≥ 1.30 gr/cm3 b. The melting point of 220 ~ 250˚C c. Tensile strength ≥ 30 N / mm2 d. Elongation ≥ 200%	• The thermal plastic is polybutylene terephthalate (PBTP) of high molecular weight with the following characteristics: a. Density: 1.3 gr / cm3 b. Melting Point: 225˚C c. Tensile strength: 45 N/mm2 d. Elongation: 225%.	0.1 gr / cm3 3˚C 2.5 % 1%	√ √ √ √

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d.	**Jelly Filling Loose Tube**	• The materials used as jelly of loose tube filler is thixotropic gel which should have the characteristic: a. Safe to personnel. b. Does not damage the components / other of materials cables. c. Do not cause degradation in the performance of the optical fiber. d. Do not damage the color of the optical fiber. e. Transparent and colorless so that the identity or the color of the optical fiber can still be seen clearly. f. Not easy to moldy. g. Not having a characteristic of conductive to electric. h. Does Not inhibit escape optical fiber from loose tube and does not inhibit to splicing optical fiber. i. Remain in the soft condition and remain in the loose tube at an operational temperature. j. Resistant to moisture. k. Being able to coat all the optical fiber to the interstices in the secondary coating. l. Homogeneous and evenly mixed. m. Free of dirt, metallic particles, or other foreign objects, non-toxic, no smell and easy to clean.	• The materials used as jelly of loose tube filler is a thixotropic gel which have the characteristic: a. Safe to personnel. b. It does not damage the components / other materials cables. c. Do not cause degradation in the performance of the optical fiber. d. Do not damage the color of the optical fiber. e. Transparent and colorless. f. Not easy to moldy. g. Not having a characteristic of conductive to electric. h. It does Not inhibit escape optical fiber from the loose tube and does not inhibit splicing optical fiber i. Remain in mild conditions at operational temperatures. j. Resistant to moisture. k. Able to coat all the optical fiber in the secondary coating (loose tube). l. Homogeneous and evenly mixed. m. Free of dirt, metallic particles, or other foreign objects, non-toxic, no smell and easy to clean	- - - - - - - - - - - - -	√ √ √ √ √ √ √ √ √ √ √ √ √
		• Characteristics jelly of loose tube filler should be as follows: a. Relative Density: 0.9 g / ml b. Cone penetration: 350 mm c. Color: neutral	• Characteristics jelly of loose tube filler: a. Density: 0.9 g / ml. b. Cone penetration: 405 mm c. Color: neutral.	0.1 g / ml 1 mm -	√ √ √

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e.	**Jelly Compound filler cable**			-	√
		• The materials used as jelly of cable filler is compound / petro jelly should have the characteristic: a. Safe to personnel. b. It does not damage the components/materials of other cables. c. Do not cause degradation in the performance of the optical fiber. d. Do not damage the color of the optical fiber. e. Not easy to moldy. f. Not having a characteristic of conductive to electric.	• The materials used as wiring is a gap filler jelly compound / petro jelly that is: a. Safe to personnel. b. Does not damage the components / materials of other cables. c. Do not cause degradation in the performance of the optical fiber. d. Do not damage the color of the optical fiber. e. Not easy to moldy. f. Not having a characteristic of conductive to electric.	- - - - - -	√ √ √ √ √ √
		• Characteristics jelly of cable filler must be as follows: a. Relative Density: 0.9 g / ml b. Cone penetration: 350 mm c. Color: Neutral	• Characteristics jelly gap filler wires: a. Density: 0.90 g / ml b. Cone penetration: 405 mm c. Color: Neutral	 0.01 g / ml 1 mm -	 √ √ √
f.	**Filler rod**	Filler rods must be made of polyethylene or other polymer materials that are non-porous (solid / not hollow).	There is no filler rod	-	√
g.	**Main Strength Member**	Elements of the main strength member must meet the following requirements: a. A composite material made of high-carbon single steel wire or Glass Reinforced Plastic (GRP) or Aramid-Reinforced Plastic (ARP) is coated with polyethylene. b. Able to withstand a tensile load under the characteristics of mechanical testing.	Elements of the main strength member must meet the following requirements: a. The main strength member is made of a single steel wire of high carbon levels that are coated with polyethylene. b. Able to withstand a tensile load under the characteristics of mechanical testing.	-	√

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h.	**Additional strength elements (aramid yarn)**	Additional strength element must meet the following requirements: • Made of aramid material having tensile strength and high modulus. • The characteristics of the aramid yarn as additional strength elements must comply with the following provisions. a. Elongation: ≥ 2.5% b. At temperatures up to 250 ° C aramid yarn must have the following properties: ○ Do not burn or melt. ○ Elongation: ≥ 2%. ○ Degradation of tensile strength: ≤ 20% of the tensile strength of aramid before heated.	Additional strength elements have the following characteristics: • Made of aramid. • The characteristics of the aramid yarn as additional strength elements are as follows. a. Elongation: 2.5% b. At temperatures up to 250°C has the following properties: ○ Do not burn or melt. ○ Elongation: 2.1% ○ Degradation of tensile strength: 6.20%.	- - 0.1% - 0.1% 0.89%	√ √ √ √ √ √
i.	**Cable sheathing**	Material for the sheathing: • High-Density Polyethylene (HDPE) is used as sheathing should have a carbon content of 2.5 ± 0.5%. • Characteristics of High Density Characteristics of High-Density Polyethylene must comply with the following provisions: a. Density: ≥ 0.94 gr/mm2 b. Tensile strength: ≥ 1450 N/cm2 c. Elongation: ≥ 300% d. Strong dielectric: ≥ 2,2x107 V/m. e. Carbon content: 2.5 ± 0.5% f. Softening point: ≥ 70˚C	Material for the sheating: • High-Density Polyethylene (HDPE) is used as the cable sheath has a carbon content of 2.6%. • Characteristics of HDPE under the following provisions: a. Density: 0.952 g/mm2 b. Tensile strength: 1605.1 N/cm2 c. Elongation: 784.6% d. Not tested e. Carbon content: 2.6%. f. Softening point: 120˚C	0.05% 0.0013 gr/mm2 33.4 N/cm2 15% - 0.05% 2,7^{0}C	√ √ √ √ √

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j.	Cable sheath peeling thread (rip cord)	Rip cord is made of aramid. • Rip cord must be ripped the aluminum layer and sheath, but thin enough so it does not cause a reduction in the thickness of the cable sheath at the location of the rip cord. • Characteristics of aramid yarns as a rip cord should be the following requirements: a. Elongation: ≥ 2% b. At temperatures up to 250 ° C aramid yarn must have the following properties: ○ Do not burn or melt. ○ Elongation: ≥ 2%. ○ Degradation of tensile strength: ≤ 20% of the tensile strength of aramid before heated	A rip cord is made of aramid. • Rip cord capable of ripped the aluminum layer and sheath, but thin enough so it does not cause a reduction in the thickness of the cable sheath. • Characteristics of aramid yarns as a rip cord as follows: a. Elongation: 2.5% b. At temperatures up to 250 °C has the following properties: ○ Do not burn or melt. ○ Elongation: 2.1%. ○ Degradation of tensile strength: 6.20% of the tensile strength of aramid before heated	- - 0.1% - 0.1% 0.89%	√ √ √ √ √ √
k.	**Mechanical protector**	Mechanical protective form of corrugated steel tape 1) Made of corrugated steel tape coated with polyethylene on both sides. 2) Polyethylene layer is not easy to peel.	Mechanical protective form of corrugated steel tape 1) Made steel tape coated with polyethylene on both sides. 2) Polyethylene layer is not easy to peel.	-	

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k.	**Water Blocking Tape**	The characteristic of water blocking tape should be as follows: a. Must have a high absorption of water and moisture. b. Safe to personnel. c. It does not damage the components/materials of other cables. d. Do not damage the color of the optical fiber. e. Not easy to moldy. f. Not having a characteristic of conductive to electric. g. It does not inhibit splicing optical fiber h. Characteristics of water blocking tape should: Thickness: 0.30 mm Density: 110 gr/m³ Tensile strength:> 40 N/cm Limit elongation:> 12% *Swelling speed* > 7 mm/1st min *Swelling height* :> 10 mm/3 min	The characteristic of a single coating of water blocking tape as follows: a. It has a high absorption capacity against water and humidity. b. Safe to personnel. c. It does not damage the components/materials of other cables. d. Do not damage the color of the optical fiber. e. Not easy to moldy. f. Not having a characteristic of conductive to electric. g. It does not inhibit splicing optical fiber h. Characteristics of Water Blocking tape: Thickness: 0.30 mm Density: 119 gr/m³ Tensile strength: 43 N/cm Elongation limit: 12% Swelling speed : 9 mm/1st min Swelling height : 13 mm/3 min	- - - - - - - - 0.01 mm. 1.47 gr/m³ 2 N/cm 1% 1 mm/1st min 0.4 mm/ 3min	√ √ √ √ √ √ √ √ √ √ √ √ √

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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
3.	**MECHANICAL REQUIREMENTS**				
a.	**Tensile Strength**	• Fiber optic cables must be resistant to a tensile strength of up to tensile load limits is 2,850kN. • Tensile strength testing method refers to IEC 60794-1-2-E1 with the following provisions: a. Buried cable samples that have been installed on the machine tensile strength test given tensile load to achieve load of 3.00 kN. b. The tensile load is maintained for 10 minutes and is returned the cable to position without tensile load (relaxed) for 40 seconds. c. Increased attenuation of optical fibers during tensile strength testing should be ≤ 0.05 dB.	• Buried fiber optic cable resistant to a tensile strength of up to 2,850 kN tensile load limits appropriate test method IEC 60794-1-2-E1. • Increased optical fiber attenuation during testing of tensile strength: 0.010 dB.	0.02dB.	√
b.	***Cable Bending***	• Fiber optic cable must be resistant to bending test on a mandrel with a diameter of 22 times the cable diameter • Repeated bending test method refers to IEC 60794-1-2-E11 with the following provisions: a. Fiber optic cables are bent on a mandrel diameter of 22 times the cable diameter with the position 180˚of the U-shaped for 5 minutes and reverse for 5 minutes and then returned to its normal position with the bending diameter is 22 times the outer diameter of the cable. b. Increased attenuation during cable bending test should be ≤ 0.05 dB.	• Buried fiber optic cable resistant to bending test on a mandrel with a diameter of 22 times the cable diameter corresponding to the test method IEC 60794-1-2-E11. • Increased optical fiber attenuation during testing of cable bending test 0.012 dB.	-	√

Note:
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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
c.	***Repeated Bending***	• Fiber optic cables must be resistant the repeated bending test with repeated 50 times. • Repeated bending test method refers to IEC 60794-1-2-E6 under the following provisions: a. Fiber optic cables are installed on repeated bending test machine b. With a given load of 5.5 kg at the end of the cable that does not move. c. Bending to the right as big as +90˚ and -90˚ leftward from the neutral position repeatedly with frequency 30 cycles per minute for 100 seconds. After repeated bending test finish, return the cable to position to the neutral (relaxed) for 10 seconds. d. Increased optical fiber attenuation during and after the test must be repeated bending ≤ 0.05 dB	• Buried fiber optic cable resistant to the repeated bending test with is repeated 50 times according to the test method IEC 60794-1-2-E6. • Increased optical fiber attenuation during testing of repeated *bending* test: 0,010 dB	0,020 dB	√
d.	***Crush***	• Optical fiber cable shall resistant the crush test with force is 2.2 kN for 10 minutes • Crush test methods refer to IEC 60794-1-2-E3 following the APPENDIX III Table 29. a. Cable Samples is installed on a crush test machine with a crush plate from steel which gives excessive stress evenly along 100 mm. b. The Giving the compressive force with press speed 2.5 mm / min until it reaches the compressive force of 2.2 kN, then the force is maintained for 10 minutes and after that, the load is removed (cable back to position relax) for 10 seconds. c. Increased attenuation during testing must be ≤ 0.05 dB.	• Buried fiber optic cable resistant to crush test with force is 2.2 kN appropriate test method IEC 60794-1-2-E3. • Increased optical fiber attenuation during testing of Crush test: 0.015 dB	0,020 dB	√

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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
e.	***Torsion***	• Fiber optic cable along the 4 meters must be resistant to the torsion test with twist direction is +180˚(right) and -180˚ (left) with repeated for 10 minutes. • Torsion testing methods refer to IEC 60794-1-2-E7 under the following: a. Cable Samples are installed on a torsion test machine. b. Length of torsion test cable (L) is 4 meters. c. The Giving twisting force to the direction the right as big as 180 and to the left as big as 180˚ for 10 minutes at a frequency of 30cpm and after the torsion load is removed (cable back to the relaxed position) for 10 seconds. d. Increased attenuation during testing must be ≤ 0.05 dB.	• Buried fiber optic cable resistant to torsion test with a torsion direction +180˚ (right) and -180˚ (left) repeatedly for 10 minutes as the test method IEC 60794-1-2-E7. • Increased optical fiber attenuation during testing of Torsion test: 0.012 dB	0,020 dB	√
f.	***Impact***	• Fiber optic cables must be resistant to impact tests with metal pendulum weighing 6.5 kg from a height of 150 mm at five locations and three impacts of each, with the change of the optical fiber attenuation ≤ 0.05 dB. • Impact test methods refer to IEC 60794-1-2-E4 under the following provisions: a. Samples cables are installed on the impact test machine. b. The test load in the form of a metal pendulum weighing 6.5 kg is dropped from a height of 150 mm to the surface of the cable at the 5 locations of each 3 times. c. Increased attenuation during testing must be ≤ 0.05 dB.	• Buried fiber optic cable resistant to impact test with metal pendulum weighing 6.5 kg from a height of 150 mm at five locations with 3 impact of each is corresponding method IEC 60794-1-2-E4. • Increased optical fiber attenuation during testing of Impact test: 0.002 dB	0.02 dB	√

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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
4.	**ENVIRONMENTAL REQUIREMENTS**				
a.	**Temperature cycles**	Fiber optic cables must be resistant to the test of temperature cycles for 5 cycles with the following formation: a. The test sample is placed in a temperature cycle chamber with temperature changes in the chamber with the pattern following: • During one hour the temperature change from room temperature to the minus 20°C • For 4 hours the temperature remained at minus 20°C • During 2 hours the temperature remained at minus 20°C to the 70°C • For 4 hours the temperature remained at 70 ° C • During 2 hours the temperature change from the temperature 70° C to room temperature b. Measure attenuation of the optical fiber c. Increased attenuation during the testing process should < 0.05 dB at a wavelength of 1550 nm	Not tested	-	√
b.	**Water penetration**	• Fiber optic cable with three meters long placed horizontally for 24 hours, must not allow the penetration of water in the core of the cable under inner sheath caused by the pressure of one-meter high water pillar. • The Water penetration test was utilized with the method of the letter L where during testing the water penetration should not be the penetration of water in the three-meter core.	• Buried fiber optic cable resistant to water penetration testing with a length of three meters for 24 hours. • Not happen to be penetration of water in the three-meter on cable core which is caused by the pressure of one-meter high water pillar.	- -	√ √

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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
5.	**MARKING**	• Along the cable must be made the number sequentially and sustainable to mark the length of the cable is printed out to each one meter with a tolerance limit is ± 1%. • In between the two marks length must be print out the cable marking with the following format: Name of producer-TELKOM - production year - CABLE OPTIK- aaa - nn B mm LT xx / yy Where: • aaa: types of fiber optic. • NZDS C: Non-Zero Dispersion Fiber Type G shifted 655C • B: Application as Buried cable • mm: The type of material retaining water blocking. • LT: Construction loose tube. • xx: The number of fibers in the cable. • yy: Number of the loose tube.	• Along the cable made the number sequentially to mark the length of the cable is printed out to each one meter with a tolerance limit is ± 1%. • In between the two marks length printed out the cable marking of as follows: **VOKSEL TELKOM KABEL OPTIK 2019 NZDS C LF B WG LT 96 / 8T** • NZDS.C: Non-Zero Dispersion Fiber Type G shifted 655C • **B** : Applications Buried. • **WG** : Components jellies and gels Thixotropic • **LT** : Construction loose tube. • **96** : The amount of fiber. • **8** : Number of the loose tube	- - -	√ √ √

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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
6.	**PACKAGING**	• The cable will be sent to be transported and placed in the haspel. • The inner diameter of the haspel should be large enough to prevent damage to cables during shipping, transportation, and handling. • The outer end of the cable must be fitted with a clamp /a strongly fastened on the outer haspel wall to prevent the cable from becoming loose during the transportation process. The initial end of the cable shall be taken out into a slot in the side outside of the haspel, or into a housing in the inner side of the haspel in such a way as make it readily available if required for electrical and optical testing. • Nails, staples, or another fastening tool that penetrates the cable sheath should not be used. • Fiber optic cables must be fitted with a protective cover and a cable end of the cable to protect the cable during shipping and storage.	• Cable to be tested are placed in a haspel . • The inner diameter of the haspel is large enough so that no damage to the cables. • The outer end of the cable fitted with a clamp / strongly fastened on the wall in a haspel. The inner end of the cable is taken out from through the inner diameter of the haspel. • Nails, staples, or other fastening tool nothing penetrate the cable sheath. • Fiber optic cables equipped with cable end cover.	- - - - -	√ √ √ √ √

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NO.	TEST ITEM	SPECIFICATION	TEST RESULTS	UNCERTAINTY	REMARKS
		On both the outer sides of the cable's haspel should be identified by including the following data: a. Gross weight and net weight. b. This type of cable, the amount of fiber. c. Cable length in meters. d. Haspel numbers. e. Sign arrow which showed the direction of the rolls at each side f. The manufacturer's name.	• On both the outer side of the cable's haspel be identified with the following data: a. Gross weight: 850 KG. b. Cable type, number of fibers: **NZDS.C LF B WG LT 96 / 8T** c. Cable length : 2000 meters d. Haspel umber: **0001-0001** e. Sign arrow which showed direction of the rolls on each side. f. The manufacturer's name: **VOKSEL**	-	√

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Annex 1- Photos

Photo # 1: Sample of Single Mode Fiber Optic Cable with Construction Loose Tube for Buried application G 655 C capacity 96 / 8T with brand VOKSEL

Date: August 21 till September 13, 2019
Temperature: 28˚C to 32˚C
Humidity: 50% to 65%

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Photo # 2: Marking of Haspel Samples Single Mode Fiber Optic Cable with Construction Loose Tube for Buried application G 655 C capacity 96 / 8T with brand VOKSEL

Date: August 21 till September 13, 2019
Temperature: 28˚C to 32˚C
Humidity: 50% to 65%

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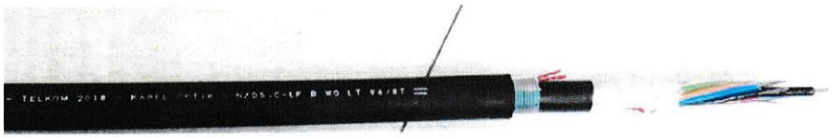

Photo # 3: Construction Single Mode Optical Fiber Cable with Construction Loose Tube for Buried application G 655 C brand's VOKSEL

Photo # 4: Markings Single Mode Optical Fiber Cable with Construction Loose Tube for Buried application G 655 C capacity 96 / 8T with brand's VOKSEL

Photo # 5: Fiber Optics brand CORNING G.655.C that used on Single Mode Optical Fiber Cable with Construction Loose Tube for the BURIED application capacity 96/8T with brand's VOKSEL

Date: August 21 till September 13, 2019
Temperature: 28˚C to 32˚C
Humidity: 50% to 65%

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