

المواصفات الفنية الخاصة بالمناقصة

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الخاصة بشراء وتوريد (62) كم كابلات ثانوية (غير

مدرع) مختلفة السعات

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Republic of Yemen

Ministry of Telecommunications & Information Technology

Public Telecommunication Corporation

Technical Specifications for
(SECONDARY UN-ARMORED CABLES)
with Schedule of Quantities

Date of issue: January 2014

CABLE POLYETHYLENE UNIT TWIN FILLED

SECONDARY CABLES (UNARMOR)

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1. GENERAL NOTES:



These specifications cover the construction, properties, testing and packing of polyethylene insulated and filled, moisture barrier sheathed telephone cable.

2. ASSOCIATED DOCUMENTS:

(a) Where international standards are not available, standards in accordance with ASTM (American Society for Testing and Materials), IP (Institute of Petroleum) and BS (British Standards Institute) have been specified. The latest issues should be apply and deemed to be integral parts of the specifications.

(a) The following standards are referred to in this specification:

ASTM B3	Conductor, Quality of copper.
ISO R402	Conductor, Tensile Strength and Elongation.
ASTM D 1248	Insulation and Sheath, Quality of polyethylene material.
IBC 189-2	Color code for conductor insulation and group markers.
IEC 304	Standard for colors.
ASTM D 792	Insulation and Sheath, Density.
ISO R 292	Insulation and Sheath, Melt flow index.
ISO R 527	Insulation and Sheath, Tensile strength and elongation.
ASTMD 1603	Sheath, Carbon Black Content.
ASTMD 1693	Sheath, Environmental Stress Cracking.
BS 6007	Sheath, Spark test.
IEC 708-8	Aluminum tape
IP 31	Filling compound, drop Point.
ASTM D 1169	Filling compound, Volume receptivity.
ASTM D 924	Filling Compound, Dielectric Constant.
ASTM D 93	Filling Compound, flash point.
ASTM D 937	Filling Compound, Penetration.
ASTM D 150	Dissipation Factor.
CCITT	Relevant Publication.
MAT-061	Inspection and testing.
MAT-062	Packing and marking.

IEC 62255-x **The definition of ELFEXT & NEXT**

(b) DEFINATIONS:

(a) Conductor

A solid continuous copper wire, circular in section.

(b) Conductor Insulation

The insulation material **which directly** surrounding a conductor.

(c) Pair

Two identical (except for colors) insulated conductors twisted together.

(d) Group

Ten pairs stranded together with an identification binder appalled over it.

(e) Unit

Five or ten groups stranded together with an identification binder appalled over it.

(f) Core Center

The inner unit(s) of a cable symmetrically arranged around the axis of the cable.

(g) Core

The stranded group(s) or unit(s) lay up and wrapped, before the addition of screen or a sheath.

(h) Lay

The axial length of one complete turnoff the helix formed around an imaginary line between the center of the conductors of a pair or around an imaginary longitudinal line at the center of a unit, group, or core, (whipping, lapping, screening or armouring as applicable)

3. TEMPERATURE AND ENVIRONMENT

- (a) The cable should be retain the mechanical and electrical characteristics, within specified limits detailed in this specification, over a working temperature range of -20 °C to +80 °C.
- (b) The cable should be suffering no deterioration. From corrosive elements found naturally in the ground.

4. CONSTRUCTION OF CABLE:

4.1 Conductor:

- (a) Each conductor should be consist of a solid wire of commercially pure copper annealed, circular in section , uniform in quality and free defects. Conductor should be meeting the requirements of ASTM B3 with the exception of the dimension and permissible variation.
- (b) The nominal conductor's diameter should be 0.5mm.
- (c) The conductor diameter should be within such limits of the specified nominal diameter as to meet the resistance limits given in table 7.

4.2 Conductor Insulation:

- (a) Each conductor should be insulated with foam-skin colored insulating high density polyethylene conforming to ASTM D1248.
- (b) The cells produced by the expanding process should be uniformly distributed circumferentially and should be substantially non-intercommunicating.
- (c) The minimum thickness of the insulation should be such that the electrical requirements of this specification are met and shown in the following table.

Conductor dia. (mm)	Minimum Thickness of insulation(mm)
0.5±0.01	0.28

Table 1

- (d) The insulation should be colored in accordance with IEC 198-2 as shown in table 2; the colors should be readily identifiable and durable. Colors should be corresponded to reasonably with the standard colors shown in the IEC Publication IEC-304.

Number of	Conductor (A)	Conductor (B)
1	White	Blue
2	White	Orange
3	White	Green
4	White	Brown
5	White	Gray
6	Red	Blue
7	Red	Orange
8	Red	Green
9	Red	Brown
10	Red	Gray

Table 2

4.3 Twinning:

Two insulated conductors should be uniformly twisted together to form a pair. The lay should be different for each pair in a group and should not be less than 30mm nor greater than 200mm and the group lay not less than 500mm. The unit lay should not be less than 200mm.

4.4 Stranding:

- (a) Ten pairs, colored as in table 2, should be stranded together to form a group.
- (b) An open lapping of plastic tape(s) or textile threads, durably colored, should be applied over each group as shown in table 3, colors should be correspond to reasonably with the standard colors shown in IEC Publication IEC 304.

The group should be stranded together.

Group Number	Color code
1	Blue
2	Orange
3	Green
4	Brown
5	Gray
6	Red
7	White
8	Black
9	Yellow
10	Violet

Table 3

- (c) Cable up to an including 100pairs should be formed by stranding group together and laid as shown in (table 4). Alternatively the pairs may be stranded in concentric layers.

Adjacent layers should be stranded in opposite directions.

Number of pairs	10pairs group number	
	Center	Layer1
10	1	-
20	1,2	-
30	1-3	-
50	1(1-5)	2-5
70	1	2-7
100	1,2(3)	(3)4-10

Table 4

- (d) An open lapping of durably tape(s) or threads should be applied over each unit or subunit. The binder should be of same color for all units except for the first unit, which should be different color.
- (e) The length of lay of the binder should not be exceeding 100mm when laid in the same rotation as the pairs. When laid in the opposite rotation the length of lay should not be exceeding 200mm.

- (f) Cable with 100pairs or more should have spare pairs as shown in table 5. The spare pairs should be stranded to from a separate unit whipped an open helix of durable colored tape(s).
- (g) The spare pairs should be placed in the interstices of the outer layer. The electrical and physical characteristics of each spare pair should be meeting all pertinent requirements for the standard pairs.

Number of pairs	Number of pairs in the unit	Unit number			Number of spare pairs
		Core center	Layer 1	Layer 2	
10					
20					
30					
50					
70					
100					1
150	50		1-3		2
200	50		1-4		3
300	50		1	2-6	4

Table 5

4.5 Filling:

- (a) The interstices between conductors, groups, units and sheath should be completely filled with a water repellent compound.
- (b) The filling compound must be not have harmful effect upon the other materials of which the cable is made and must be not change or blur the colors of the insulated conductors and identification markers.
- (c) The filling compound should be easily removable from the insulated conductors and must not emit hazardous of unpleasant vapor and must not contain skin irritants or poison.
- (d) The filling compound must be influence the long term stability of the electrical properties of the cable.
- (e) A three-meter length of cable should be stabilized at $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$. A watertight closure should be placed over the jacket. The closure should not be place over the jacket so tightly that the flow of water though preexisting voids or air spaces within the core is restricted. The other end of the sample should be remaining open. The closure should be filled with water to a one-meter head over the sample or placed under the equivalent continuous pressure for one hour. There should be no water leakage in the sheath interfaces, under the core warping or between any insulated conductors in the core. If water leakage is detected, other one 3meters additional adjacent sample from the same reel of cable should be tested. If the remaining sample exhibits water leakage, the entire reel of cable is considered acceptable.

4.6 Core wrapping:

- (a) The stranded units should be wrapped with a continuous layer of no hygroscopic dielectric material forming a compact and circular core. The wrapping should having an overlap of 30% for the wrapping but not less than 5mm. if required for manufacturing reasons, the center core may be similarly wrapped better polyester tape $40\mu\text{m}$.
- (b) The wrapping should not be adhering to the insulation or to the screen.
- (c) The wrapping should be designed to allow the filling compound to penetrate or may be applied with the filling compound for the both sides.

4.7 Identification:

- (a) An identification tape durably marked with (R.Y – P.T.C - the manufacturers' name - the year of manufacture of the cable) should be placed longitudinally, straight or in spiral, under or over the wrapping.
- (b) This information should be repeated at intervals of maximum 300mm.

4.8 Moisture Barrier (Screen):

- (a) Over the core wrapping should be applied a moisture barrier sheath. This should be consisting of a metallic foil bonded to polyethylene sheath.
- (b) The metallic foil may be consisting of tape or a 0.3mm aluminum tape on both sides with a protective plastic coating. The thickness of the coating on each side should be minimum 0.03mm.
- (c) The metallic foil should be electrically continuous throughout the cable length.
- (d) The metallic foil should be applied longitudinally with an overlap of at least 6mm.
- (e) The polyethylene sheath should be fuse with a coated metallic foil.

4.9 Outer sheath:

- (a) An outer sheath of high density black polyethylene meeting the requirement according to A STM D 1248 should be extended over the screen.
- (b) The polyethylene sheath should be consist of tough, weather resistant, high molecular, weight polyethylene compound meeting the requirement of A STM D 1248.
- (c) The sheath should be circular, free from pinholes, joints mended places and other defects. The ratio of maximum/minimum diameter should not be exceeding 1.2 at any point for cables with a nominal diameter not greater than 25mm.
- (d) The average thickness at any cross-section should not be less than 90% of the nominal thickness. The minimum spot thickness should be not less than 70% of the nominal thickness.
- (e) The nominal thickness of the sheath should be as shown in table 6.

Average external diameter of cable core(mm)	Nominal radial thickness of sheath (mm)
Up to 10	1.4
10 – 15	1.6
15 – 20	1.8
20 – 25	2.0
25 – 30	2.2
35 – 40	2.5
40 – 45	2.6
50 – 55	2.8
55 - 60	2.9
60 – 65	3.0
65 – 70	3.1
70 – 75	3.2
80 – 85	3.4
85 – 90	3.5
90 – 95	3.6

Table 6

4.10 Length marking:

Sequentially numbered length markers should be placed at regular intervals of 1m longitudinally on the outside sheath. Continuous sequential numbering should be employed for any single length. The number should not be less than 3mm in height and spaced to produce good legibility. The numbers should be of clear distinguishable contrast marking.

The accuracy of the length marking should be within $\pm 1\%$.

An occasional illegible is permissible if there is a legible marking on either side of it.

4.11 Identification marking:

Each length of cables should be identified with the manufacturers name and with the Ministry of Telecommunication & Information Technology, Republic of Yemen and PTC so as to have the type of cable.

The number of pairs and gauge of conductor marked on the outer surface of the polyethylene sheath. The interval of the marking should be approximately two meters. Marking should be indented to give permanency.

4.12 Cable size:

The cable size should be as specified in schedule of quantities.

5. ELECTRICAL REQUIREMENTS AT 20°C

5.1 Conductor resistance:

For any length of cable the conductor resistance should not be exceed the values given in table 7. The resistance temperature coefficient for copper conductors used in the cable should be specified.

Conductor diameter (mm)	Conductor Resistance (Ohm/Km)
0.5	96

Table 7

5.2 Resistance unbalance:

The resistance unbalance between the two conductors of pair should not be exceeding the values shown in the following table8.

Conductor diameter (mm)	Maximum average (%)	Maximum individual (%)
0.5	0.75	2.5

Table 8

$$\text{Resistance unbalance\%} = \frac{\text{Max Res} - \text{Min Res}}{\text{Min Res}} \times 100\%$$

5.3 Mutual capacitance:

The mutual capacitance should be measured with 800Hz or 1000Hz. The average mutual capacitance should be 44±6nF/Km and individual values should be within, tolerance for average and individual values of 46nF/Km and ±8nF/Km respectively may apply.

5.4 Capacitance unbalance:

- The capacitance unbalance should be measured with 800Hz or 1000Hz and should be corrected to 500m length of cable. The correction factor should be L/500 for RMS values (L: length of cable in meters).
- The maximum pair-to-pair capacitance unbalance within a group should be 22pF/500m RMS and 150pF/500m for individual values.
- The maximum pair-to-pair capacitance unbalance between adjacent groups or units should be 20pF/500m for RMS values and 50pF/500m for individual values.
- The pair-to-ground unbalance should be measured at 800Hz or 1000Hz. The maximum pair to screen capacitance unbalance should be 400pF/Km for RMS values and 1500pF/Km for individual values. Regarding screen refer to point 5.8 "Moisture barrier".

5.5 Insulation resistance:

Each insulated conductor in the completed cable should be tested with a potential of 500 volts DC, applied for one minute. Each insulated conductor should have a minimum insulation resistance of 5000megaohm for 1000m.

Throughout the test all insulated conductors other than those under measurement and screen should be earthed. Several pairs may be tested at the same time.

5.6 Dielectric strength:

- In each length of completed cable the insulation should be capable of withstanding DC potential for three seconds as following table.

Conductor diameter (mm)	Test potential (volts)	
	Conductor to conductor	Conductor to ground
0.5	3,000	5,000

Table 9

5.7 Spark test of sheath:

The sheath should be spark tested in accordance with BS 6007 at the voltage shown in table 10. The test may be making during sheath extrusion process.

Radial thickness of sheath (mm)	Test voltage (Volts)DC
1.0	6,000
2.0	10,000
2.7-3.0	12,000

Table 10

5.8 Insertion loss (Attenuation):

Maximum insertion loss should not be exceeding the values in the following table:

Conductor diameter (mm)	Maximum insertion loss (dB/Km)				
	1KHz	40KHz	150KHz	200KHz	300KHz
0.5	1.45	6.2	8.5	9.5	11.0

Table 11

5.9 Crosstalk:

It is recommended that the power sum loss (PSL) values of Near-end crosstalk (NEXT) and equivalent level far-end crosstalk (ELFEXT) on twisted pair cable for broadband digital transmission cable meet the values of [IEC 62255-x]. Example values of PSL are given in Table 12 below:

Frequency (KHz)	Minimum NEXT PSL (dB)	Minimum FEXT PSL (dB)
150	56	54
300	52	48
1000	44	38

Table 12

6. MECHANICAL REQUIREMENTS

All tests should be performed as specified in inspection and test of PTC's specification.

6.1. Conductor:

The tensile strength should be minimum 200N/mm². The percentage permanent elongation after completed test should not be less than shown in table 13.

Conductor diameter (mm)	Permanent elongation
0.5	12%

Table 13

6.2 Insulation:

- (a) The maximum melt flow index should be 0.5 g\10 min.
- (b) The tensile strength should not be less than 10N/mm² and the ultimate elongation not less than 300%.
- (c) The dielectric constant should not be exceeding 2.4 when measured at (100 KHz & 1 MHz).

6.3 Filling compound properties:

- (d) The drop point should not be lower than +80°C.
- (e) The flash point should not be less than +230°C.
- (f) The dissipation factor should not be exceeding 0.0005 at 1 KHz(100 KHz & 1 MHz) .
- (g) The volume resistivity should not be less than 10¹⁶ ohm-cm.
- (h) The dielectric constant should not be exceeding 2.3.
- (i) There should be no separation of the constituents forming the compounds .

6.4 Screen:

The minimum force required to peel the screen from the cable sheath should not be less than 20N for a width of 25mm when tested in accordance with IEC specification 708-I .

6.5 Sheath:

- (a) The maximum melt flow index should not be exceeding 0.28 g/10 minute.
- (b) The tensile strength should not be less than 12.5N/mm² and the ultimate elongation not less than 400%.
- (c) Resistance to environment stress cracking should not be allowed more than 2 failures from 10 tested specimens.
- (d) The carbon black content should be 2.5±0.5 percent (weight).
- (e) The water vapor permeation rate should not be exceeding 0.13xD g/100N/week (where D is the internal diameter of the polyethylene sheath in millimeters).

7. COMPLIANCE

The tenderer should be state their compliance with specification in figures and detailed statements any deviation suggested by manufacture should be fully documented and may be presented the word (comply) is not sufficient for this purpose.

8. SUPPLY EXPERIENCE

The tenderer should be submitting document of supply experience.

9. SAMPLES

- (a) The samples must be bringing with offer with length not less 40cm, clearly showing all the cable layer.
- (b) The sample must be stamp by Manufacture Company.

10. DELEVERY LENGTH

The cables should be delivered on drums in standard length or as specified by order.

11. INSPECTION Mat 061

- (a) Manufacturer should be keep suitable summary records for a period not less than five years of all electrical and physical tests required in such a form that test data, for a particular drum may readily available to the ministry upon request and easily readable form.

- (b) Following test results should be supplied with each cable drum:
- a) Continuity.
 - b) Conductor resistance.
 - c) Resistance unbalance.
 - d) Mutual capacitance.
 - e) Capacitance unbalance.
 - f) Insulation resistance.
 - g) Dielectric strength.
- (c) PTC should have a right to depute a representative to inspect at factory during the manufacture of the cable on the cost of the tenderer.
- (d) **The approval to attend two PTC engineers to test the cables during the manufacture on the cost of the tenderer.**

12. PACKING AND MARKING Mat 062

- (a) Packing and marking should be performed according to PTC's specification MAT-062.
- (b) The cable should be coiled on strong wooden drums. The ends should be firmly secured in order to withstand all transportation conditions.
- (c) When viewed from ends of the cable the direction of the rotation of the color scheme of pairs should be indicated by making the clockwise and anti-clockwise ends with red and green bands respectively the end of cable should provide with metal cap/row ring for the pulling.
- (d) Unless otherwise specified, the lengths should be so drummed that the rotation of the color scheme at the running end is clockwise cables normally need not be so drummed if, for some unforeseen manufacturing reason, this direction is reversed.
- (e) The cable should be tested after being coiled on drums and if found satisfactory by the engineer, or his representative, the drum should be lagged with stout closely fitting battens to prevent damage to the cable during storage or transportation.
- (f) All cable ends should be sealed against the ingress of dirt and moisture. Cable should not be stored or transported without the ends being sealed.
- (g) Drum axle diameter should be 110mm.
- (h) A distinguishing number and the following information should be plainly marked on the outside of each drum:
- i. Manufacturer's name and country of origin.
 - ii. Contract number.
 - iii. M.T.I.T.R.Y.P.T.C
 - iv. Tender number.
 - v. Year of manufacture.
- (i) Description of cable in short, stating the type, the number of pairs and conductor size.
- i. Length in meters.
 - ii. Net and gross weights.
- (j) An arrow should be painted on the drum to show direction of rolling (i.e in the opposite direction to that in which the outer end of the cable points) and the words 'ROLL THIS WAY' should be lettered on the drums. Drums should be lettered 'HANDLE WITH CARE' and 'SLING THROUGH CENTER HOLE ONLY' in English language and also in Arabic.
- (k) All cables should be protected against damage by insects, vermin's, termites and other similar creatures.

Information to be submitted with the tender:-

Tenderers should be give details of the construction of cable, electrical characteristics and mechanical characteristics relating to the concerned tender in the form given in the table below:-

characteristics	10P	20P	30P	50P	70P	100P	150P	200P	300P
1- CONSTRUCTION OF CABLE:-									
1.1 conductor: Min, Max & nominal diameter and material									
1.2 conductor insulation: material and minimum thickness(mm)									
1.3 color code for: - conductor insulation - binders									
1.4 No. of pairs in a group									
1.5 Number and location of spare pairs in the cable									
1.6 Average lay of: - single pair (mm) - group (mm) - unit(mm)									
1.7 Filling compound - material									
1.8 Identification Marking									
1.9 Core wrapping - material and thickness (mm)									
1.10 Screen: - material & thickness (mm) - Min thickness of polymer coating									
1.11 Outer sheath - material and nom. Thickness (mm)									
1.12 outer diameter of cable (mm)									
1.13 cable core diameter									
1.14 carbon content of cable %									
1.15 weight of copper per Km of conductor									
1.16 weight of copper per Km of cables									
1.17 weight of copper per Km of cables with spares									
1.18 weight of copper per Km									
1.19 Drawing for cable construction									
1.20 standard length (m)									
1.21 Dram axle dia. (spindle hole=110mm)									
2. ELECTRICAL CHARACTERISTICS AT 20°C									
2.1 Conductor resistance: - Max average resistance for all pairs - Max resistance of any single pair									
2.2 average resistance unbalance between two conductors									
2.3 Mutual capacitance per Km at 150KHz: - Average mutual capacitance - Maximum individual value									
2.4 Capacitance unbalance; - Max pair to pair unbalance within 10 pairs group- r.m.s/Indi. (for 500m) - max pair to screen capacitance unbalance									

r.m.s/Indi. Per Km									
2.5 Min. insulation resistance of conductors per km with 500V megger in mega Ohm.									
2.6 Dielectric strength for 3sec test: - wire to wire - wire to ground									
2.7 Spark test of sheath for 1minute test									
2.8 Nominal characteristic impedance									
2.9 Maximum insertion loss (dB/Km) at: - 1KHz - 40 KHz - 150 KHz - 200 KHz - 300 KHz									
2.10 Cross-talk loss (dB) at (150KHz , 300KHz & 1MHz) : - equivalent level Far-end cross-talk - Near-end crosstalk									
3. MECHANICAL CHARACTERISTICS									
3.1 Tensile strength and elongation of conductor									
3.2 Tensile strength and elongation of conductor insulation									
3.3 Tensile strength and elongation of sheath									
3.4 Water penetration of cable for 24h									
3.5 Operating temperature & relative humidity									
3.6 Appearance of cable ends in the drum									

*** END OF SPECIFICATIONS***

Schedule to Tender No. ()

For the supply of

Secondary (Un-Armored) Cables

No.	Item description	Quantity (km)	Drum length (m)
1.	Secondary (un-armored) cable 300P/0.5mm	9	1000
2.	Secondary (un-armored) cable 200P/0.5mm	10	1000
3.	Secondary (un-armored) cable 150P/0.5mm	9	1000
4.	Secondary (un-armored) cable 100P/0.5mm	12	1000
5.	Secondary (un-armored) cable 50P/0.5mm	14	1000
6.	Secondary (un-armored) cable 30P/0.5mm	8	1000

NOTES:

The Tenderers must reply to the following points:-

- 1- Respond to and comply with PTC Technical Schedules.
- 2- Catalogues and documents containing instructions on how to install cables.
- 3- Samples showing the quality of the product must be attached to the submitted offer.
- 4- Two PTC engineers must attend the factory inspection.
- 5- The laboratory response from the manufacturing company on all of PTC's specifications (compliance statement).
- 6- The manufacturer must submit company supply record.
- 7- Test Certificates.
- 8- Certificate of Quality of the factory.
- 9- Documents proving the manufacturing company's experience in manufacturing the required items for a period not less than five years.

الملاحظات:

على مقدم العرض الإجابة على الآتي:-

- 1- الإجابة على والالتزام بالموصفات الفنية الموضحة في الجداول الفنية.
- 2- إحضار الكتالوجات والوثائق التي توضح كيفية تركيب الكابلات المطلوبة من قبل الشركة المصنعة.
- 3- تقديم عينات من الشركة المصنعة تدل على جودة التصنيع على أن يكون مطبوع عليها اسم الشركة المصنعة وتاريخ الصنع.
- 4- حضور الفحص المصنعي من قبل (2) من مهندسي المؤسسة.
- 5- الإجابة العملية من الشركة المصنعة على كل مواصفات المؤسسة (عروض الإستجابة).
- 6- الخبرة التزويدية للمصنع.
- 7- شهادة الاختبارات.
- 8- شهادة جودة للمصنع.
- 9- الوثائق التي تثبت خبرة الشركة المصنعة في تصنيع الأصناف المطلوبة لمدة لا تقل عن عشر سنوات.

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