Report of Committee constituted for finalization of posts to be used for ADSS Cable alignment

1.0 A Committee of following Officers was constituted vide letter no. 115-71/2016-CNP(DP) dated 30.12.2016 **(Annexure-'A')** for finalization of specifications of Posts to be used for ADSS Cable alignment :

a) PGM (Radio), BSNL Corporate Office – Chairman and Convener
b) GMM, NTR, Chandigarh - Member
c) GM, Inspection & QA Circle, New Delhi – Member

2.0 The Committee had its meeting on 19.04.2017 and 26.04.2017 in BSNL Corporate office, New Delhi.

3.0 Deliberation of the Committee : The Committee deliberated regarding the requirement of the posts for ADSS alignment , specifically on following issues:

a) Requirement: Till now BSNL was mostly utilizing telecom posts supplied by Telecom Factory, which was supplied basically for alignment of telephone cable / drop wire etc. However now the Telecom Factory has discontinued the product, as the requirement has ceased in the field. Therefore, posts / poles are required for use of ADSS Cable or Aerial OF Cable.

b) BSNL Corporate office has already finalized specification of Aerial OF Cable and its accessories vide letter no. 209-41(1)/NFS OFC-Army/2015/NFS/Vol.III/pt.III/02 Dated 27.08.2015(**Annexure-'B'**) for NFS Project. This also includes the finalized installation practices for Aerial OF Cable including type of posts to be used.

c) BSNL has also floated a tender for Comprehensive Telecom Development Plan of North East Region and specification of poles to be used for Aerial OF Cable specified in that tender are enclosed at **Annexure-'C'.**

d) Inspection & QA Circle, Jabalpur has issued EI no. TR/COFC/I-001 dated 10.06.2011 with amendment dated 07.03.2015 for installation practice of self-supporting metal free Aerial Optical Fibre Cable (**Annexure – D).**

e) Inspection & QA Circle, Jabalpur has prepared Test Schedule for self-supporting metal free Aerial Optical Fibre Cable vide document no INSP/CFA/TS/NFS-Project/107 dated 13.04.2016 (**Annexure – E).**

f) Specification for tubular steel poles for overhead power lines has been defined in IS- 2713 – 1980 (I to III). There are two types of poles defied in this IS i.e. Stepped and Swaged Type. Further, on the basis of the tensile strength, poles are categorized in two types i.e. 410 MPa and 540 MPs.

The Committee took reference from above mentioned documents.

26/4/2017 26/04/2017

4.0 Recommendations of the Committee:

a) Committee recommends use of 410 SP-03 SWAGED Poles made from steel of ultimate Tensile strength 410MPa for ADSS Fiber Cable alignment. Overall length of this pole is 7 meters. Planting depth, as per IS – 2713 (I to III):1980, is 1.25 meters that leaves 5.75 meters as the height of this pole above ground level. A lightning spike cap of 30 cm. shall be welded at the top of the pole. All poles shall be grounded for which a 14mm diameter through hole shall be provided at a height of 300mm above the planting depth of 1.25 meters.

b) For heavy snow prone area, road crossing etc. extra ground clearance shall be required. For such areas, committee recommends to use of 410 SP-13 SWAGED Poles made from steel of ultimate Tensile strength 410MPa for ADSS Fiber Cable alignment. Overall length of this pole is 8 meters. Planting depth, as per IS – 2713 (I to III):1980, is 1.50 meters that leaves 6.50 meters as the height of this pole above ground level. A lightning spike cap of 30 cm. shall be welded at the top of the pole. All poles shall be grounded for which a 14mm diameter through hole shall be provided at a height of 300mm above the planting depth of 1.50 meters.

c) The dimensions and structural properties of these poles have been provided in IS 2713 as enclosed at **Annexure – F & Annexure – G of this report.**

d) **Foundation and earth:** Installation practices, as circulated by BSNL Corporate Office vide letter no. 209-41(1)/NFS OFC-Army/2015/NFS/Vol.III/pt.III/02 Dated 27.08.2015, also include foundation specifications for 410 SP-03 7 meters poles as well as the coil earth for the pole. Committee recommends that same may be followed for the pole recommended at 4.0 (a) above. However for 410 SP-13 SWAGED 8 meters Pole foundation, committee recommends that design may be got prepared from the Civil Wing of BSNL, as details could not be obtained. Coil earth is recommended for 410 SP-13 SWAGED 8 meters Poles also.

P.K. Pandey 26/04/2017
(P K Pandey)
PGM (Radio) BSNL, CO,
New Delhi

26.04.2017
(Sanjay K Agarwal)
GMM, NTR,
Chandigarh

(Kausar Khan)
GM (Inspection & QA),
New Delhi

ANX-(A)

Corporate Office,
Radio Planning Cell,
Room No. 04, IR Hall, Eastern Court,
Janpath, New Delhi-110001.

भारत संचार निगम लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT SANCHAR NIGAM LIMITED
(A Govt. of India Enterprise)

No. 115-71/2016-CNP (DP)/68 Dated: 30.12.2016

With the approval of Dir (Ent.), a committee consisting of following members has been constituted for finalising the specification of posts to be used for ADSS Fibre Cable alignment:-

1. PGM (Radio), BSNL CO, N. Delhi - Chairman & Convener
2. GM, NTR, Chandigarh - Member
3. GM, Inspection & QA Circle, N. Delhi - Member

P.K Pandey
(P. K. Pandey)
PGM (Radio)

Copy to: 1. The CGM, NTR, New Delh .
2. The CGM, Inspection & QA Circle, Jabalpur.
3. All the members of the committee.

PKP

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29/4

Reg. & Corporate Office: Bharat Sanchar Bhawan, H.C. Mathur Lane, Janpath, New Delhi-110001
Corporate Identity Number (CIN): U74899DL200CGOI107739; www.bsnl.co.in
PH:01123359766, FAX: 23359767, email: pkpandey@bsnl.co.in & pkpandey.bsnl@gmail.com

ANX-(B)

Corporate Office,
Network for Spectrum (NFS) Cell,
4th Floor, Bharat Sanchar Bhavan,
Janpath, New Delhi-110001.

भारत संचार निगम लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT SANCHAR NIGAM LIMITED
(A Govt. of India Enterprise)

No. 209-41(1)/NFS OFC-Army/2015/NFS/Vol.III/pt.III/02 Dated 27.08.2015

To

1. M/s Sterlite Technologies Limited.
2. M/s Vindhya Telelinks Limited.
3. M/s Telecommunication consultants of India Ltd.
4. M/s L&T Limited.
5. M/s ITI Limited, Mankapur.
6. M/s ITI Limited, Rae Bareli.

Subject: Specification of Aerial OFC and its accessories for the Tender NO. CA/CNP/ NFS OFC/T-441/2013 dated 21.06.2013 – regarding.

Specification of Aerial OFC, its Accessories and Installation Practices have been finalized for the subject tender and a copy of the same is enclosed herewith for ready reference.

It is requested to follow the same for NFS OFC works wherever aerial has to be laid.

Encl. – As above.

27/08

AGM (NFS-II)
Tel/FAX : 23712524

Copy To

1. Chief General Manager, QA, Bangalore .
2. CGM (NTP/ETP/STP/WTP/NETF).
3. Dir (NFS) Army, Signal Enclave, New Delhi – 10.

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ANX- (C)

Appendix- C

Technical Specifications for Steel Poles

The standard poles for aerial cable installations are galvanized steel poles of the sizes 7 & 8 meters having following specifications. The Steel poles are tabular in design and shall be swaged. They shall withstand a breaking load mentioned in the table applied not less than 0.5 meter form the top. The table below depicts the technical specifications of the pole. The swaged pole to be supplied shall be as per IS 2713/1986 (Part- I- II) with top cap welded and MS base plate 300x300x6mm.

Pole Length (m)	Length of the sections			Outside dia and thickness of sections			Approx weight of Pole (Kg)	Breaking load N (kgf)	Crippling Load N (kgf)	Working Load N (kgf)
	H3	H2	H1	Bottom	Middle	Top				
	M	M	M	MM	MM	MM				
7	4.5	1.5	1	139.7x4.85	114.3x3.65	88.9x 3.25	97	4630 (472)	3280 (335)	1650 (168)
8	4.5	1.75	1.75	139.7x4.85	114.3x4.5	88.9x 3.25	111	4440 (453)	3160 (322)	1580 (161)

All poles supplied by the manufacturer shall be hot dipped galvanized as per IS specification (65-86 Micro Average). The top of the pole shall not remain open, it is to be sealed with cap.

Note: The diagrams given in Appendix – 'D' are also to be referred for construction of OFC Routes.

PKP

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ANX-. 'D'

यांत्रिक अनुदेश

ENGINEERING INSTRUCTION

सेल्फ सपोर्टिंग मेटल फ्री एरिअल ओ.एफ.सी. केबिल की संस्थापन प्रक्रिया

INSTALLATION PRACTICE OF SELF SUPPORTING METAL FREE AERIAL OPTICAL FIBRE CABLE

क्रमांक : टी.आर./ सी.ओ.एफ.सी./आई-001

(NO.: TR/COFC/I-001)

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जारी करने का दिनांक (Date of Issue)	:	

केवल भारत संचार निगम कर्मचारियों के उपयोग हेतु
(Restricted use by BSNL Employees only)

All efforts have been made to incorporate all relevant up to date information available, any discrepancies or need for addition or deletion is felt necessarily may please be intimated to this office for further improvement, on E-Mail Id agmcfa@gmail.com.

BSNL
Connecting India

भारत संचार निगम लिमिटेड,
(भरत सरकार का उपक्रम)
निरीक्षण परिमंडल,
(आई.एस.ओ. 9001:2008 प्रमाणित)
संचार विकास भवन,
रेसीडेंसी रोड, जबलपुर,
मध्यप्रदेश - 482001

BHARAT SANCHAR NIGAM LIMITED
(A Govt. of India Enterprise)
INSPECTION CIRCLE,
(ISO 9001:2008 Certified)
SANCHAR VIKAS BHAWAN,
RESIDENCY ROAD, JABALPUR,
MP-482001

ANX-(E)

BHARAT SANCHAR NIGAM LTD

INSPECTION & QA CIRCLE JABALPUR

TEST SCHEDULE

SELF SUPPORTING METAL FREE AERIAL OFC INSTALLATION

Document No.:	INSP/CFA/TS/NFS-Project/107
No of Pages. :	03
Issue No.:	01
Issued By:	Inspection & QA Circle Jabalpur
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Approved by:	
Date of Issue:	

"FIX IT RIGHT FOR THE FIRST TIME"

26/4

TEST SCHEDULE- SELF SUPPORTING METAL FREE AERIAL OFC INSTALLATION

Part A: Check Pre A/T Documents:

S.No	Documents to submitted
1	Supporting Document for laying Aerial OFC – Letter of approval from the competent authority fc installation of Aerial OFC instead of U/G.
2	RID should be prepared indicating position of poles,actual distance between poles, type of pole (tension and suspension) , weather an existing pole or old, Road/Bridge/Calvert crossing, splice locations and land marks.

Part B: General Guide lines to be observed during A/T:

S.No	Test Item	Reference/Procedure	Remarks
1	Check of material used in installation of line.	As per vetted Bill of Material (BoM) /PO.	Only physical property of the material i;e. quantity and type to be checked.
2	Check whether poles are erected accordingly to the submitted RID		Physical check
3	Check for strength of poles	- length of Pole burried underground should be 1.2 mts - Poles shall be placed inside RCC muff having ID/OD : 300/360 and concreated with 1:2:4 Mix	Physical check
4	Check of span length and sag between poles.		Normal span length must not exceed 90 meters. For heavy Snowfall area-25 mts (Max) For Angle location-40mts (Max) Maximum sag allowed without excess load is 2% and withload is 3% of span length. (Physical check)
5	Check that alignment is easily accessible.		As per RID. (Physical check)
6	Check that ground clearance along/crossing of road.	EI No-TR/COFC/I-001 Ammendment-1 dated 07.03.2015	I. Minimum 12 feet in non-obstructing area. II. Minimum 16 feet at road crossing. (Physical check)
7	Check for the Tension Pole		a. Tension Poles are Dead end or Termination Poles. b. Every fifth pole should be a Tension Pole in the straight

			alignment. c. If the alignment takes a sharp turn at a pole then that pole should be a Tension Pole. d. Splice locations should be a tension Pole.
8	Check the accessories and fixtures/fitting for Tension Poles.	1. J-shaped tension hook 2. Turn buckle 3. Extension link 4. Clevis thimble 5. Protective helix (t) 6. Terminating helix 7. Jumper cable clamp 8. Pole mounted stay clamp (tubular) or pole mounted stay clamp (rail)	D-shakle may be used in place of J-shaped tension hook. The fixtures and fitting to be properly gritted. (Physical check) Refer EI No-TR/COFC/I-001 Ammendment-1 dated 07.03.2015
9	Check the accessories and fixtures/fitting for Suspension Poles..	1. Pole mounted stay clamp (tubular) or Pole mounted stay calmp (rail) 2. Tiwsted eye link 3. Protective helix (s) 4. Armour grip helix 5. Suspension clipper with elastomer pad 6. Spiral vibration damper (svd)	The fixtures and fitting to be properly gritted. (Physical check) Refer EI No-TR/COFC/I-001 Ammendment-1 dated 07.03.2015
10	Check of splice/ joint location.	Joints are to be made underground i.e., the cable should be brought down through a GI Pipe, using wooden /hard rubber bushes at entry and exist points clamped on the pole and standard practice of Splice chamber is followed.	The decision for placing the joint closure box on the pole or in the joint chamber at ground level will be taken by PICG rep in field based on actual ground situation (Physical check).
11	Check of indication of Pole /splice location.	- Marking shall be provided on a painted strip(dark blue) on the pole with letters(3.5 cm in size) in white colour at a height of 1.5 mts - Strip on Splice locations are to painted with red colour.	-The word NFS OFC shall be further painted in white over the specified back ground.
12	Check of aerial optical fibre cable specifications	a. Operational wind velocity : 75Kms per hour b. Minimum bend radius : 20D (D-Dia of cable) c. Tensile force: 9.81 x 6 x W (where -W is the mass of 1	

			alignment. c. If the alignment takes a shai turn at a pole then that pole should be a Tension Pole. d. Splice locations should be tension Pole.
8	Check the accessories and fixtures/fitting for Tension Poles.	1. J-shaped tension hook 2. Turn buckle 3. Extension link 4. Clevis thimble 5. Protective helix (t) 6. Terminating helix 7. Jumper cable clamp 8. Pole mounted stay clamp (tubular) or pole mounted stay clamp (rail)	D-shakle may be used in place J-shaped tension hook. The fixtures and fitting to be properly gritted. (Physical check) Refer EI No-TR/COFC/I-001 Ammendment-1 dated 07.03.2015
9	Check the accessories and fixtures/fitting for Suspension Poles..	1. Pole mounted stay clamp (tubular) or Pole mounted stay calmp (rail) 2. Tiwsted eye link 3. Protective helix (s) 4. Armour grip helix 5. Suspension clipper with elastomer pad 6. Spiral vibration damper (svd)	The fixtures and fitting to be properly gritted. (Physical check) Refer EI No-TR/COFC/I-001 Ammendment-1 dated 07.03.2015
10	Check of splice/ joint location.	Joints are to be made underground i.e., the cable should be brought down through a GI Pipe, using wooden /hard rubber bushes at entry and exist points clamped on the pole and standard practice of Splice chamber is followed.	The decision for placing the joir closure box on the pole or in th joint chamber at ground level w be taken by PICG rep in field based on actual ground situatio (Physical check).
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12	Check of aerial optical fibre cable specifications	a. Operational wind velocity : 75Kms per hour b. Minimum bend radius : 20D (D-Dia of cable) c. Tensile force: 9.81 x 6 x W (where -W is the mass of 1	

		km length of cable, in kg) d. Orange colour marks on Jacket of Aerial OFC to differentiate with UG cable.	
13	Check provision for Earthing arrangement and Lightening conductor arrangement	Lightening conductor of single spike 30 cm long at the pole top to be provided with grounding conductor	(Physical Check)

Note – For A/T of OF Cable, A/T schedule No.-INSP/CFA/TS/NFS-Project/54 issue-II dated 10.07.2015 is to be followed.

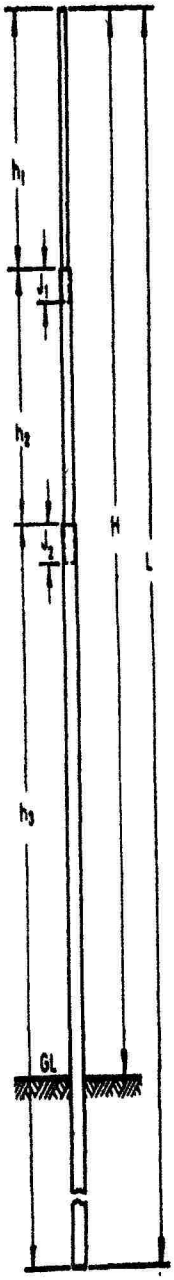
PLACE:	JTO/SDE A/T	JTO/SDE Installer	PICG Representative
DATE:	NAME	NAME	NAME

ANX-'F'

TABLE 2 SWAGED POLES MADE FROM STEEL OF ULTIMATE TENSILE STRENGTH 410 MPa (42 kgf/mm²)

(Clauses 2.1 and 5.1)

Designation	Overall Length L	Planting Depth	Load Applied from Top at a Distance of	Height Above Ground H	Length of Sections			Outside Diameter and Thickness of Sections			Approx Weight of Pole	Breaking Load	Crippling Load	Working Load		Load for Permanent Set not Exceeding 13 mm	Load for Temporary Deflection of 157·5 mm
					Bottom h_3	Middle h_2	Top h_1	Bottom	Middle	Top				Col 14 2	Col 15 2·5		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(mm)	(mm)	(mm)	(kg)	N(kgf)	N(kgf)	N(kgf)	N(kgf)	N(kgf)	N(kgf)
410 SP-1	7·00	1·25	0·90	5·75	4·00	1·50	1·50	114·3×3·65	88·9×3·25	76·1×3·25	62	2 570 (262)	1 820 (186)	912 (93)	1 090 (105)	1 245 (127)	785 (80)
410 SP-2	7·00	1·25	0·90	5·75	4·00	1·50	1·50	114·3×4·50	88·9×4·05	76·1×3·25	73	3 100 (316)	2 240 (224)	1 100 (112)	1 240 (126)	1 510 (154)	941 (96)
410 SP-3	7·00	1·25	0·90	5·75	4·00	1·50	1·50	114·3×5·40	88·9×4·85	76·1×3·25	85	3 630 (370)	2 580 (263)	1 280 (131)	1 450 (148)	1 760 (180)	1 090 (111)
410 SP-4	7·50	1·25	0·90	6·25	4·50	1·50	1·50	114·3×3·65	88·9×3·25	76·1×3·25	67	2 350 (240)	1 670 (170)	1 320 (135)	941 (96)	1 150 (117)	627 (64)
410 SP-5	7·50	1·25	0·90	6·25	4·50	1·50	1·50	114·3×4·50	88·9×4·05	76·1×3·25	79	2 760 (281)	1 960 (200)	981 (100)	1 100 (112)	1 340 (137)	745 (76)
410 SP-6	7·50	1·25	0·90	6·25	4·50	1·50	1·50	114·3×5·40	88·9×4·85	76·1×3·25	93	3 320 (339)	2 360 (241)	1 180 (120)	1 330 (136)	1 620 (165)	873 (89)
410 SP-7	7·50	1·25	0·90	6·25	4·50	1·50	1·50	139·7×4·50	114·3×3·65	88·9×3·25	97	4 330 (442)	3 060 (314)	1 540 (157)	1 740 (177)	2 110 (215)	1 400 (143)
410 SP-8	7·50	1·25	0·90	6·25	4·50	1·50	1·50	139·7×4·85	114·3×3·65	88·9×3·25	103	4 630 (472)	3 280 (335)	1 650 (168)	1 850 (189)	2 250 (229)	1 480 (151)
410 SP-9	7·50	1·25	0·90	6·25	4·50	1·50	1·50	139·7×5·40	114·3×3·65	88·9×3·25	110	5 100 (520)	3 620 (369)	1 810 (185)	2 040 (208)	2 480 (253)	1 600 (163)
410 SP-10	8·00	1·50	0·90	6·50	4·50	1·75	1·75	114·3×3·65	88·9×3·25	76·1×3·25	70	2 260 (230)	1 600 (163)	804 (82)	902 (92)	1 100 (112)	520 (53)
410 SP-11	8·00	1·50	0·90	6·50	4·50	1·75	1·75	114·3×4·50	88·9×4·05	76·1×3·25	83	2 730 (278)	1 930 (197)	971 (99)	1 090 (111)	1 320 (135)	618 (63)
410 SP-12	8·00	1·50	0·90	6·50	4·50	1·75	1·75	114·3×5·40	88·9×4·85	76·1×3·25	97	3 190 (325)	2 270 (231)	1 130 (115)	1 270 (130)	1 550 (158)	725 (74)
410 SP-13	8·00	1·50	0·90	6·50	4·50	1·75	1·75	139·7×4·50	114·3×3·65	88·9×3·25	101	4 160 (424)	2 950 (301)	1 480 (151)	1 670 (170)	2 020 (206)	1 180 (120)
410 SP-14	8·00	1·50	0·90	6·50	4·50	1·75	1·75	139·7×4·85	114·3×4·50	88·9×3·25	11	4 440 (453)	3 160 (322)	1 580 (161)	1 770 (181)	2 160 (220)	1 280 (131)
410 SP-15	8·00	1·50	0·90	6·50	4·50	1·75	1·75	139·7×5·40	114·3×4·50	88·9×3·25	119	4 850 (499)	3 470 (354)	1 740 (177)	1 960 (200)	2 380 (243)	1 380 (140)
410 SP-16	8·50	1·50	0·90	7·00	5·00	1·75	1·75	114·3×3·65	88·9×3·25	76·1×3·25	75	2 090 (213)	1 480 (151)	745 (76)	894 (85)	1 020 (104)	432 (44)
410 SP-17	8·50	1·50	0·90	7·00	5·00	1·75	1·75	114·3×4·50	88·9×4·05	76·1×3·25	89	2 520 (257)	1 790 (182)	893 (91)	1 010 (103)	1 230 (125)	510 (52)
410 SP-18	8·50	1·50	0·90	7·00	5·00	1·75	1·75	114·3×5·40	88·9×4·85	76·1×3·25	104	2 950 (301)	2 100 (214)	1 050 (107)	1 180 (120)	1 430 (146)	598 (61)
410 SP-19	8·50	1·50	0·90	7·00	5·00	1·75	1·75	139·7×4·50	114·3×3·65	88·9×3·25	109	3 844 (392)	2 730 (278)	1 360 (139)	1 540 (157)	1 800 (191)	961 (98)
410 SP-20	8·50	1·50	0·90	7·00	5·00	1·75	1·75	139·7×4·85	114·3×3·65	88·9×3·25	115	4 110 (419)	2 910 (297)	1 460 (149)	1 650 (168)	2 000 (204)	1 010 (103)
410 SP-21	8·50	1·50	0·90	7·00	5·00	1·75	1·75	139·7×5·40	114·3×4·50	88·9×3·25	129	4 530 (462)	3 220 (328)	1 620 (164)	1 810 (185)	2 210 (225)	1 130 (115)
410 SP-22	8·50	1·50	0·90	7·00	5·00	1·75	1·75	165·1×4·50	139·7×4·50	114·3×3·65	141	5 450 (556)	3 870 (395)	1 930 (197)	2 180 (222)	2 650 (270)	1 730 (176)
410 SP-23	8·50	1·50	0·90	7·00	5·00	1·75	1·75	165·1×4·85	139·7×4·50	114·3×3·65	148	5 840 (596)	4 150 (423)	2 080 (212)	2 330 (238)	2 840 (290)	1 820 (186)
410 SP-24	8·50	1·50	0·90	7·00	5·00	1·75	1·75	165·1×5·40	139·7×4·50	114·3×3·65	158	6 450 (658)	4 580 (467)	2 340 (239)	2 579 (263)	3 140 (320)	1 970 (201)
410 SP-25	9·00	1·50	0·90	7·50	5·00	2·00	2·00	114·3×3·65	88·9×3·25	76·1×3·25	78	1 940 (198)	1 380 (141)	686 (70)	775 (79)	941 (96)	333 (34)
410 SP-26	9·00	1·50	0·90	7·50	5·00	2·00	2·00	114·3×4·50	88·9×4·05	76·1×3·25	92	2 940 (299)	1 670 (170)	834 (85)	941 (96)	1 140 (116)	402 (41)
410 SP-27	9·00	1·50	0·90	7·50	5·00	2·00	2·00	114·3×5·40	88·9×4·85	76·1×3·25	108	2 750 (280)	1 950 (199)	971 (99)	1 100 (112)	1 330 (136)	461 (47)



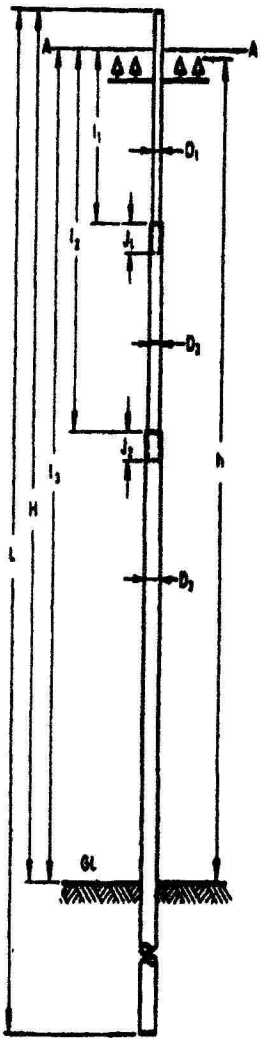
1 kg = 9·806 65 N.

(Continued)

ANX - 'G'

TABLE 4 STRUCTURAL PROPERTIES OF TUBULAR STEEL SWAGED POLES (BOTH HIGH TENSILE AND MILD STEEL POLES)
(Clauses 5.2 of Part II and)III

Designation		Effective Length			Section Modulus			Ratio of Section Modulus and Effective Length *Min* Z/L *Min*	Equivalent Wind Load W_1	Moment of Inertia			Cross-Sectional Area			Joint Length	
		l_1	l_2	l_3	Z_1 Top	Z_2 Middle	Z_3 Bottom			I_1 Top	I_2 Middle	I_3 Bottom	A_1 Top	A_2 Middle	A_3 Bottom	J_1	J_2
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
		cm	cm	cm	cm³	cm³	cm³		N(kgf)	cm⁴	cm⁴	cm⁴	cm²	cm²	cm²	cm	cm
410 SP- 1	540 SP- 1	120	270	545	13·0	18·1	34·0	0·062 4	180 (18·0)	49·44	80·31	194·4	7·44	8·74	12·7	20	23
410 SP- 2	540 SP- 2	120	270	545	13·0	21·9	41·0	0·075 2	186 (18·6)	49·44	97·38	234·3	7·44	10·8	15·5	20	23
410 SP- 3	540 SP- 3	120	270	545	13·0	25·5	48·0	0·088 1	194 (19·4)	49·44	113·46	274·5	7·44	12·8	18·5	20	23
410 SP- 4	540 SP- 4	120	270	595	13·0	18·1	34·0	0·057 1	198 (19·8)	49·44	80·31	194·4	7·44	8·74	12·7	20	23
410 SP- 5	540 SP- 5	120	270	595	13·0	21·9	41·0	0·068 9	198 (19·8)	49·44	87·38	234·3	7·44	10·8	15·5	20	23
410 SP- 6	540 SP- 6	120	270	595	13·0	25·5	48·0	0·080 7	198 (19·8)	49·44	113·46	274·5	7·44	12·8	18·5	20	23
410 SP- 7	540 SP- 7	120	270	595	18·1	34·0	62·6	0·105 2	242 (24·2)	80·31	194·4	437·2	8·74	12·7	19·1	23	30
410 SP- 8	540 SP- 8	120	270	595	18·1	34·0	66·9	0·112 4	242 (24·2)	80·31	194·4	467·6	8·74	12·7	20·5	23	30
410 SP- 9	540 SP- 9	120	270	595	18·1	34·0	73·7	0·123 9	242 (24·2)	80·31	194·4	514·5	8·74	12·7	22·8	23	30
410 SP-10	540 SP-10	145	320	620	13·0	18·8	34·0	0·054 8	201 (20·1)	49·44	80·31	194·4	7·44	8·74	12·7	20	23
410 SP-11	540 SP-11	145	320	620	13·0	21·9	41·0	0·066 1	201 (20·1)	49·44	87·38	234·3	7·44	10·8	15·5	20	23
410 SP-12	540 SP-12	145	320	620	13·0	25·5	48·0	0·077 4	201 (20·1)	49·44	113·46	274·5	7·44	12·8	18·5	20	23
410 SP-13	540 SP-13	145	320	620	18·1	34·0	62·6	0·101 0	245 (24·5)	80·31	194·4	437·2	8·74	12·7	19·1	23	30
410 SP-14	540 SP-14	145	320	620	18·1	41·0	66·9	0·107 9	245 (24·5)	80·31	234·3	467·6	8·74	15·5	20·5	23	30
410 SP-15	540 SP-15	145	320	620	18·1	41·0	73·7	0·118 9	245 (24·5)	80·31	234·3	514·5	8·74	15·5	22·8	23	30
410 SP-16	540 SP-16	145	320	470	13·0	18·1	34·0	0·050 7	214 (21·4)	49·44	80·31	194·4	7·44	8·74	12·7	20	23
410 SP-17	540 SP-17	145	320	470	13·0	21·9	41·0	0·061 2	214 (21·4)	49·44	87·38	234·3	7·44	10·8	15·5	20	23
410 SP-18	540 SP-18	145	320	470	13·0	25·5	48·0	0·071 6	214 (21·4)	49·44	113·46	274·5	7·44	12·8	18·5	20	23
410 SP-19	540 SP-19	145	320	470	18·1	34·0	62·6	0·093 4	261 (26·1)	80·31	194·4	437·2	8·74	12·7	19·1	23	30
410 SP-20	540 SP-20	145	320	470	18·1	34·0	66·9	0·099 9	261 (26·1)	80·31	194·4	467·6	8·74	12·7	20·5	23	30
410 SP-21	540 SP-21	145	320	470	18·1	41·0	73·7	0·110 0	261 (26·1)	80·31	234·3	514·5	8·74	15·5	22·8	23	30
410 SP-22	540 SP-22	145	320	470	34·0	62·6	88·7	0·132 4	329 (32·9)	194·4	437·2	732·6	12·7	19·1	22·7	30	35
410 SP-23	540 SP-23	145	320	470	34·0	62·6	95·0	0·141 8	329 (32·9)	194·4	437·2	784·5	12·7	19·1	24·4	30	35
410 SP-24	540 SP-24	145	320	470	34·0	62·6	105·0	0·156 7	329 (32·9)	194·4	437·2	864·7	12·7	19·1	27·1	30	35
410 SP-25	540 SP-25	170	370	720	13·0	18·1	34·0	0·047 2	230 (23·0)	49·44	80·31	194·4	7·44	8·74	12·7	20	23
410 SP-26	540 SP-26	170	370	720	13·0	21·9	41·0	0·056 9	230 (23·0)	49·44	97·38	234·3	7·44	10·8	15·5	20	23
410 SP-27	540 SP-27	170	370	720	13·0	25·5	48·0	0·066 7	230 (23·0)	49·44	113·46	274·5	7·44	12·8	18·5	20	23
410 SP-28	540 SP-28	170	370	720	18·1	34·0	62·6	0·086 9	282 (28·2)	80·31	194·4	437·2	8·74	12·7	19·1	23	30
410 SP-29	540 SP-29	170	370	720	18·1	41·0	66·9	0·092 9	282 (28·2)	80·31	234·3	467·6	8·74	15·5	20·5	23	30



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