COSTS

METERING

COLOR GRAPHS (NOT INCLUDED IN ALL BOOKS)

LINE CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		ENGINEER'S STANDARDS INDEX	
REVISED: 5–1–2000	CHECKED BY: DLT	APPROVED BY: SET	DRAWN BY: DLT
NO. INDEX E1	DATE: JANUARY 1997	SCALE: 1"= 1"	NO. INDEX E1

TOTAL GROUND LINE MOMENT FROM TRANSVERSE WIND LOAD IS DETERMINED BY TOTALING THE MOMENT CAUSED BY WIND ON CONDUCTORS AND MOMENT CAUSED BY WIND ON THE POLE SURFACE. A SAFETY FACTOR IS APPLIED AND THE TOTAL MOMENT IS COMPARED TO THE RESISTING MOMENT OF THE POLE BEING CONSIDERED. SEE EP0490 AND 0491 FOR CHARTS ON 70' AND 75' POLES.

MOMENT CAUSED BY WIND ON CONDUCTORS (FROM PENDER–DELMAR 14–94)

$$M_2 = \frac{P_2 H_2 n d (S_1 + S_2)}{24}$$

WHERE
- M_2 = MOMENT AT GROUND IN LB–FT.
- P_2 = WIND PRESSURE IN LBS/FT^2 ON CONDUCTORS
- H_2 = HEIGHT OF CONDUCTORS ABOVE GROUND IN FT.
- n = NUMBER OF CONDUCTORS
- d = DIAMETER OF CONDUCTORS IN INCHES
- S_1+S_2 = LENGTHS OF ADJACENT SPANS IN FT.

AN ALTERNATE METHOD REQUIRES PRECALCULATED LBS/FT. FACTORS FOR VARIOUS CONDUCTORS.

$$M_2 = n W \frac{(S_1 + S_2) H_2}{2}$$

WHERE
- M_2 = MOMENT AT GROUND IN LB/FT.
- n = NUMBER OF CONDUCTORS
- W = PRESSURE IN LBS/FT. OF CONDUCTOR
- S_1+S_2 = LENGTH OF ADJACENT SPANS IN FT.
- H_2 = HEIGHT OF CONDUCTORS ABOVE GROUND

PRESSURE (LBS/FT) ON CONDUCTORS FROM EXTREME WINDS OF 26 LBS/FT^2 (102 MPH) NO ICE (N.E.S.C. RULE 250–C) PER FOOT OF CONDUCTOR

ACSR	AAC	AAAC
#1/0 = .8623 LBS/FT.	336 MCM = 1.443 LBS/FT.	4/0 = 1.2198 LBS/FT.
#4/0 = 1.2198	556 MCM = 1.854	
336 MCM = 1.4820	795 MCM = 2.223	
556 MCM = 1.7940	1272 MCM = 2.8167	

PRESSURE ON CONDUCTORS FROM 4 LB. WIND, 1/4" ICE (N.E.S.C. RULE 250–B)

ACSR	AAC	AAAC
#1/0 = .2993 LBS/FT.	336 MCM = .3887 LBS/FT.	4/0 = .3543 LBS/FT.
#4/0 = .3543	556 MCM = .4520	
336 MCM = .3947	795 MCM = .5087	
556 MCM = .4757	1272 MCM = .6000	

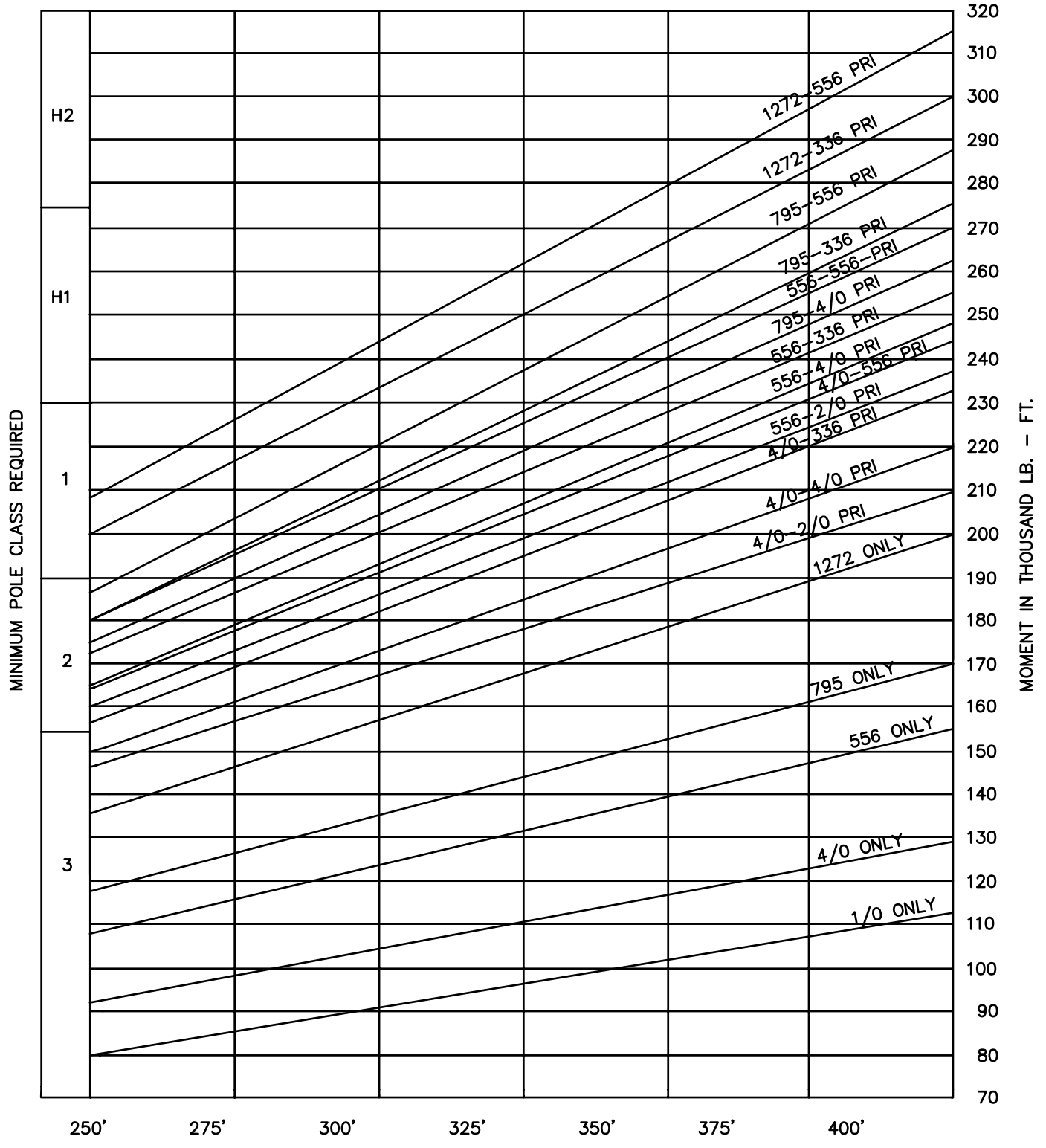
MOMENT AT GROUNDLINE DUE TO WIND ON POLE (FROM PENDER–DELMAR 14–94, 63)

$$M_1 = \frac{P_1 H_1^2 (D_1 + 2D_2)}{72}$$

WHERE
- M_1 = MOMENT AT GROUND LINE IN LB/FT.
- P_1 = WIND PRESSURE IN LBS/FT^2 OF PROJECTED AREA OF POLE
- H_1 = HEIGHT OF POLE IN FT.
- D_1 = DIAMETER OF POLE AT GROUND IN INCHES
- D_2 = DIAMETER AT POLE TOP IN INCHES

RESISTING MOMENTS OF VARIOUS CLASSES OF 70' AND 75' POLES ARE DETERMINED BY THE FORMULA $M = 0.000\ 264\ f\ C^3$. WHERE f = MAXIMUM FIBER STRESS (7400 LBS/IN^2 FOR DOUGLAS FIR) C = CIRCUMFERENCE OF POLE AT GROUNDLINE.
ALSO SEE EP0490, EP0491.
MOMENT CAUSED BY WIND ON COMMUNICATION CONDUCTORS MUST ALSO BE INCLUDED IN TOTAL.

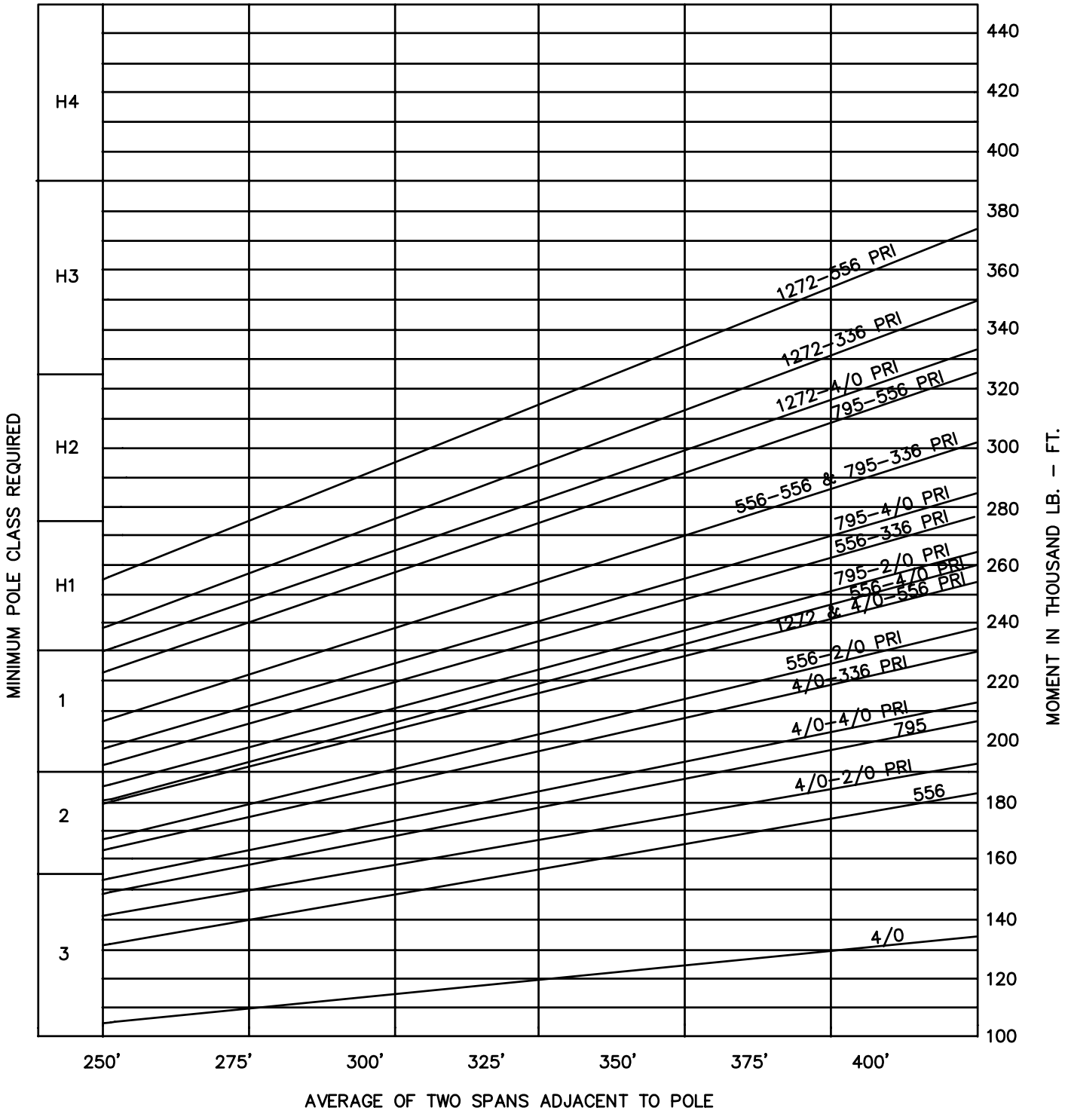
CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON	METHODS OF CALCULATING TRANSVERSE WIND LOADS ON TRANSMISSION POLES AND CONDUCTORS	
	CHECKED BY: PAP	APPROVED BY: SET	DRAWN BY: DLT
NO. EP 0560	DATE: 5–27–82	SCALE: 1" = 1"	NO. EP 0560



ADDITIONAL MOMENT CAUSED BY WIND ON COMMUNICATION CONDUCTORS, SECONDARY CONDUCTORS AND TRANSFORMERS MUST BE CONSIDERED.

*BASED ON MEDIUM LOADING DISTRICT, 4 LB. TRANSVERSE WIND, 1/4" ICE. GRADE B CONSTRUCTION, SAFETY FACTOR 4. RULE 250-B N.E.S.C. FOR COASTAL OR EXPOSED AREAS USE EXTREME WIND CRITERIA - EP 0491. POLES FRAMED SP 0830.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		MINIMUM POLE CLASSES FOR 70' AND 75' TANGENT TRANSMISSION - BASED ON MEDIUM DISTRICT LOADS	
	CHECKED BY: PAP	APPROVED BY: SET	DRAWN BY: DLT
NO. EP 0561	DATE: 5-20-82	SCALE: 1" = 1"	NO. EP 0561



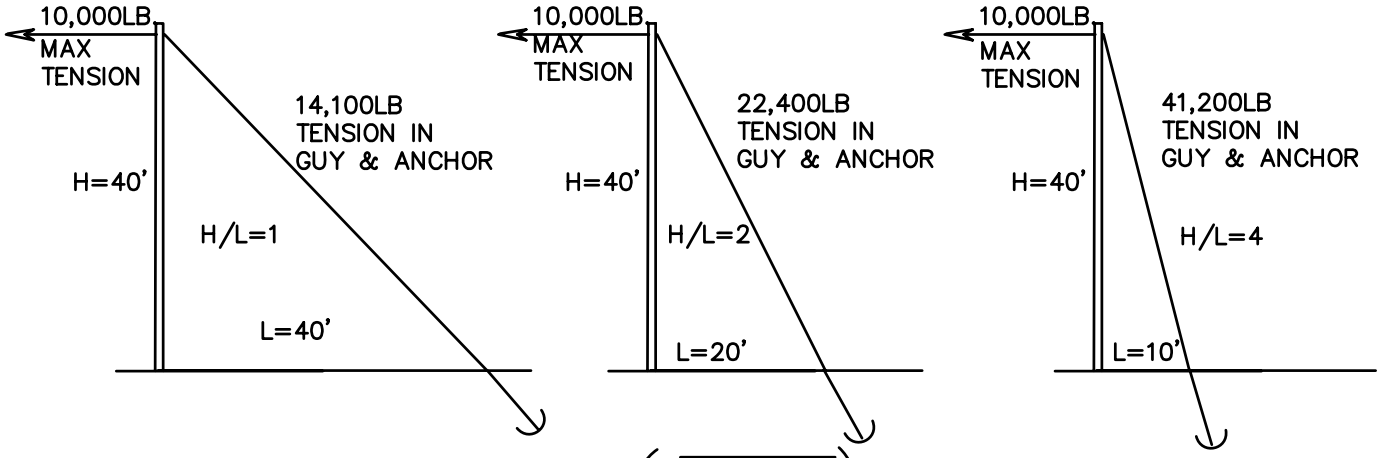
ADDITIONAL MOMENT CAUSED BY WIND ON COMMUNICATION CONDUCTORS, SECONDARY CONDUCTORS AND TRANSFORMERS MUST ALSO BE CONSIDERED.
BASED ON NESC RULE 250-C, 26 LB/FT^2 TRANSVERSE WIND LOAD ON CONDUCTORS AND POLE, ALL WITHOUT ICE, SAFETY FACTOR 1.
(NOTE: REA RECOMMENDS A 1.5 SAFETY FACTOR FOR GRADE B CONSTRUCTION.) POLES FRAMED SP 0830.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		MINIMUM POLE CLASSES FOR 70' AND 75' TANGENT TRANSMISSION – BASED ON EXTREME WIND LOADS	
	CHECKED BY: PAP	APPROVED BY: SET	DRAWN BY: DLT
NO. EP 0562	DATE: 5-20-82	SCALE: 1" = 1"	NO. EP 0562

INDEX OF ENGINEERING STANDARDS ON ANCHORING AND GUYING:
EP 1500P1, EP 1500P2 NOTES ON ANCHORING AND GUYING
EP 1510 USING ANCHORING/GUYING CHARTS AND EXAMPLE.
EP 1522 H/L RATIOS FOR SERVICE POLES AND GUY STUBS.
EP 1524 H/L RATIOS FOR PRIMARY GUYING.
EP 1528 H/L RATIOS FOR TRANSMISSION SINGLE GUYS.
EP 1530 FOR TRANSMISSION DOUBLE AND TRIPLE GUYS.
EP 1540 LINE ANGLE LOADS FOR ONE CONDUCTOR
EP 1544 LINE ANGLE LOADS FOR TWO CONDUCTORS
EP 1550 LINE ANGLE LOADS FOR THREE CONDUCTORS
EP 1554 LINE ANGLE LOADS FOR FOUR CONDUCTORS
EP 1560 DEADEND LOADS FOR DISTRICT CONDUCTORS
EP 1570 MAXIMUM GUY STRAND LOADS FOR GUY LEADS
EP 1580 MAXIMUM ANCHOR HOLDING CAPACITIES

1. LONG GUY LEADS ARE BEST. H/L RATIOS OF 1 OR LESS ALLOW LOWER GUY AND ANCHOR LOADS.

THE FOLLOWING EXAMPLES ILLUSTRATE TYPICAL INCREASED LOADS ON ANCHORS AND GUYS WITH SHORTER LEADS:



$$\text{GUY TENSION} = (\text{TOTAL LINE TENSION}) \left(\sqrt{(H/L)^2 + 1} \right)$$

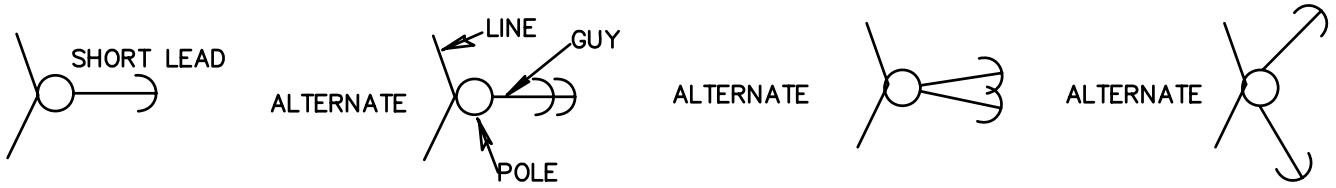
VALUE PRECALCULATED IN CHARTS BELOW:

H/L RATIO	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8
MULTIPLIER	1.04	1.08	1.17	1.28	1.41	1.56	1.72	1.89	2.06	2.24	2.42	2.6	2.79	2.97

H/L RATIO	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.4	6.0	7.0
MULTIPLIER	3.16	3.35	3.54	3.74	3.93	4.12	4.32	4.51	4.71	4.9	5.1	5.5	6.08	7.07

H/L RATIOS FOR 30' AND 35' POLES ARE SHOWN ON EP 1522. H/L RATIOS FOR PRIMARY GUYS ARE ON EP 1524. H/L RATIOS FOR SINGLE TRANSMISSION GUYS ARE SHOWN ON EP 1528. H/L RATIOS FOR DOUBLE AND TRIPLE TRANSMISSION GUYS ARE SHOWN ON EP 1530.

2. MULTIPLE ANCHORS AND GUYS MAY BE USED WHEN LEADS ARE NECESSARILY SHORT.



ENGINEERING STANDARDS
PUBLIC UTILITY DISTRICT NO. 1
GRAYS HARBOR COUNTY, WASHINGTON

NOTES ON ANCHORING AND GUYING.

	CHECKED BY: PHIL PENTTILA	APPROVED BY: R PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1500 P1	DATE: 2-99	SCALE: 1"=1"	NO. EP 1500 P1

3. SIDEWALK GUYS MAY BE USED WHERE LEAD IS SEVERELY RESTRICTED AND OTHER MEANS SUCH AS OVERHEAD GUYS ARE NOT PRACTICAL.
SHORT LEAD SITUATIONS MAY REQUIRE HEAVIER ANCHORS AND GUYS THAN WOULD NORMALLY BE USED FOR A GIVEN CONDUCTOR LOAD.

4. CONSIDER USING BOG SHOES ON HEAVILY GUYED OR SHORT LEAD ANCHORED POLES SET IN SOFT SOILS. A SHORT LEAD ANCHOR TRANSFERS A GREAT DEAL OF HORIZONTAL CONDUCTOR LOAD VERTICALLY TO THE POLE (IN ADDITION TO THE WEIGHTS OF THE POLE, FIXTURES AND CONDUCTORS.)

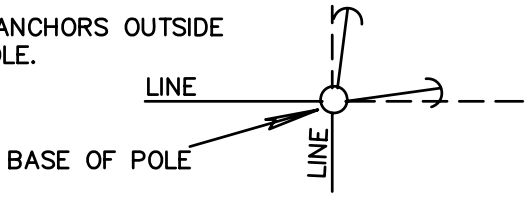
5. CONSIDER USING A HEAVIER POLE CLASS ON HEAVILY GUYED AND/OR SHORT LEAD GUYS.

6. A PUSH BRACE MAY BE USED WHEN RIGHT OF WAY OR TERRAIN WILL NOT ALLOW CONVENTIONAL GUYING. THE PUSH BRACE MUST NOT INTERFERE WITH LOWER ELEVATION CONDUCTORS OR CLEAR ZONE ON THE RIGHT OF WAY. (SP 1580)

7. WHEN THE ANCHOR IS SET AT A LOWER ELEVATIOIN THAN THE POLE, ADD THE ELEVATION DIFFERENCE TO THE "H" IN THE H/L RATIO.

8. SETTING A POLE DEEPER AND/OR KEYING THE POLE CAN BE DONE TO ASSIST IN A SHORT LEAD OR UNGUYED SITUATION. SETTING THE POLE WITH A RAKE COULD ALSO BE USED IN THESE SITUATIONS.

9. WHEN GUYING CORNERS WITH GUYS IN TWO DIRECTIONS SET ANCHORS OUTSIDE OF IN LINE BY A FEW DEGREES TO ALLOW FOR RAKE IN THE POLE.

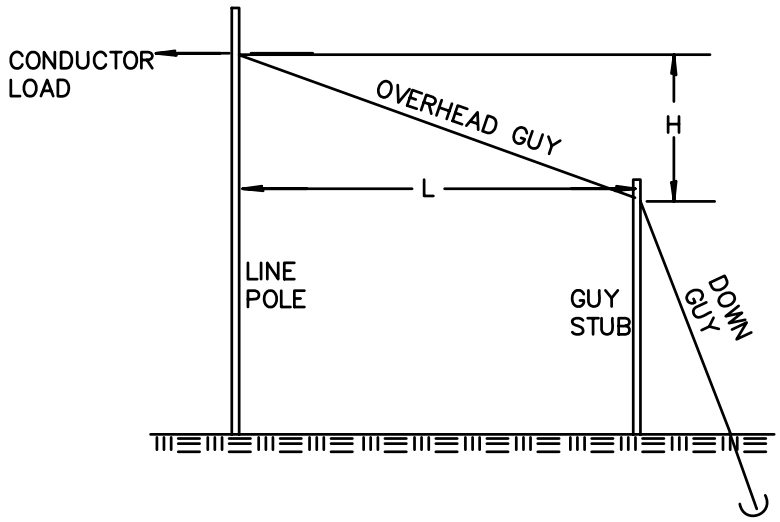


10. SAFETY FACTORS FOR GUY STRAND: GUY STRAND IS DERATED TO 90% OF MINIMUM BREAKING STRENGTH PER NESC. 3/8" UTILITY GRADE GUY STRAND IS DERATED FROM 11,500 LBS. TO 10,350 LBS. 7/16" UTILITY GRADE GUY STRAND IS DERATED FROM 18,500 LBS. TO 16,650 LBS. AND 1/2" UTILITY GRADE GUY STRAND IS DERATED FROM 25,000 LBS. TO 22,500 LBS.

ANCHORS ARE RATED AT 100%

CONDUCTOR TENSION IS CALCULATED AT MAXIMUM DESIGN TENSION TIMES 1.65 PER NESC. MAXIMUM DEADEND TENSION FOR STANDARD DISTRICT CONDUCTORS INCLUDING THE 1.65 SAFETY FACTOR.

11. TO CALCULATE LOAD IN SPAN AND OVERHEAD GUYS :
DIVIDE THE CHANGE IN ELEVATION (H) BY THE SPAN (L) TO OBTAIN THE H/L RATIO.
MOST SPAN GUY H/L RATIOS ARE VERY LOW SO THE MULTIPLIER FOR GUY LOADS IS NEAR ONE, MAKING THE OVERHEAD GUY LOAD APPROXIMATELY EQUAL TO THE TOTAL CONDUCTOR LOAD.



ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		NOTES ON ANCHORING AND GUYING.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1500 P2	DATE: 2-99	SCALE: 1"=1"	NO. EP 1500 P2

1. DETERMINE H/L RATIO:

DIVIDE HEIGHT OF GUY CONTACT BY ANCHOR LEAD FOR H/L RATIO OR OBTAIN H/L FROM EP1530 FOR TRANSMISSION TWO AND THREE GUYS; EP1528 FOR TRANSMISSION SINGLE GUYS; EP 1524 FOR PRIMARY; EP 1522 FOR SERVICE POLES AND GUY STUBS.

2. DETERMINE CONDUCTOR LOAD:

FOR ANGLES FROM:

EP 1540 FOR ONE CONDUCTOR
EP 1544 FOR TWO CONDUCTORS
EP 1550 FOR THREE CONDUCTORS
EP 1554 FOR FOUR CONDUCTORS

FOR DEADENDS FROM:

EP 1560

3. DETERMINE MINIMUM GUY SIZE(S):

FROM EP 1570 USING H/L RATIO AND CONDUCTOR LOAD.
TO DETERMINE ACTUAL LOAD IN GUY MULTIPLY FACTOR AT TOP OF CHART CORRESPONDING TO H/L RATIO BY THE CONDUCTOR LOAD.

4. DETERMINE ANCHOR(S) REQUIRED:

FROM EP 1580 USING GUY LOAD FROM EP 1570.
FIND THE INTERSECT OF SOIL TYPE WITH GUY SIZE AND CHOOSE FROM GUY CURVES ABOVE.

EXAMPLE:

45' POLE WITH FOUR 336 AAC CONDUCTORS AT 15 DEGREE TURN, 20 FT. LEAD ANCHOR IN VERY STIFF CLAY SOIL.

1. DETERMINE H/L RATIO:

TURN TO EP 1524 FOR PRIMARY, FIND 20' LEAD IN THE LEFT VERTICAL COLUMN; MOVE ACROSS RIGHT TO THE INTERCEPT WITH THE PRIMARY CURVE, DROP DOWN TO READ THE H/L RATIO OF 1.9.

OR DETERMINE THE GUY CONTACT HEIGHT AND DIVIDE BY THE LEAD FOR THE H/L RATIO.

2. DETERMINE CONDUCTOR LOAD:

TURN TO EP 1554 FOR FOUR CONDUCTORS, FIND 15 DEGREES ON THE BOTTOM OF THE CHART LOOK UP TO THE INTERCEPT WITH THE 336 AAC LINE; LOOK LEFT TO 6500 LBS CONDUCTOR LOAD.

3. DETERMINE MINIMUM GUY SIZE(S):

TURN TO EP 1570 . FIND THE 1.9 H/L RATIO ALONG THE BOTTOM, FIND THE POINT WHERE THE 1.9 INTERCEPTS THE 6500 LB. LINE FROM THE LEFT. THE MINIMUM GUY CURVE IS ABOVE (7/16")

OR: TO DETERMINE THE ACTUAL LOAD ON THE GUY, MOVE UP VERTICALLY FROM THE 1.9 H/L RATIO TO AN INTERPOLATED MULTIPLIER OF 2.15. MULTIPLY 2.15 BY THE CONDUCTOR LOAD OF 6500 LBS TO OBTAIN THE GUY LOAD OF 13,975 LBS.

FOR VALUES OFF THE CHART, USE THE MULTIPLIER CORRESPONDING TO THE H/L RATIO TIMES THE LINE LOAD AND COMPARE TO THE GUY STRENGTH.

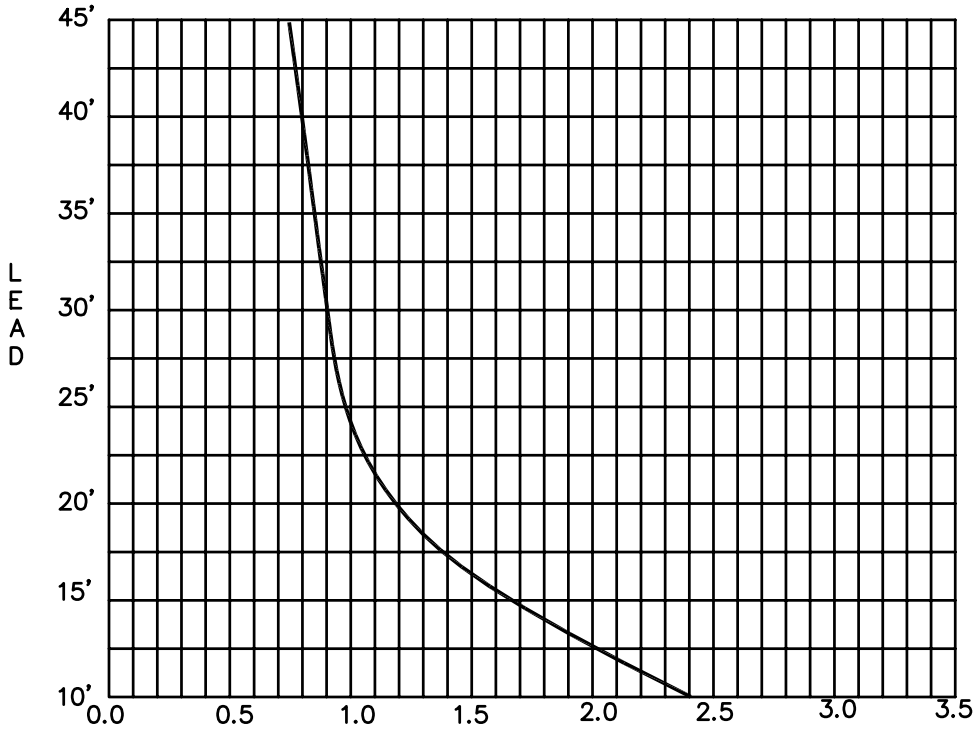
4. DETERMINE ANCHOR(S) REQUIRED

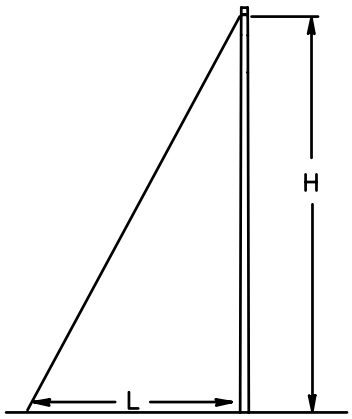
TURN TO EP 1580.
FIND THE GUY SIZE OF 7/16" ON THE LEFT; LOOK RIGHT TO THE THE POINT THE 7/16" LINE INTERSECTS WITH THE SOIL TYPE FROM BELOW (CLASS 4) AND CHOOSE AN ANCHOR (DOUBLE HELIX) FROM THE CURVES ABOVE.

OR: USE THE SAME PROCEDURE EXCEPT USE THE CALCULATED GUY LOAD OF 13,975 LBS. (WHICH WOULD BARELY ALLOW A SINGLE HELIX) THE DOUBLE HELIX WOULD BE A BETTER CHOICE.

ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		USING THE ANCHORING AND GUYING CHARTS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1510	DATE: 2-99	SCALE: 1"=1"	NO. EP 1510

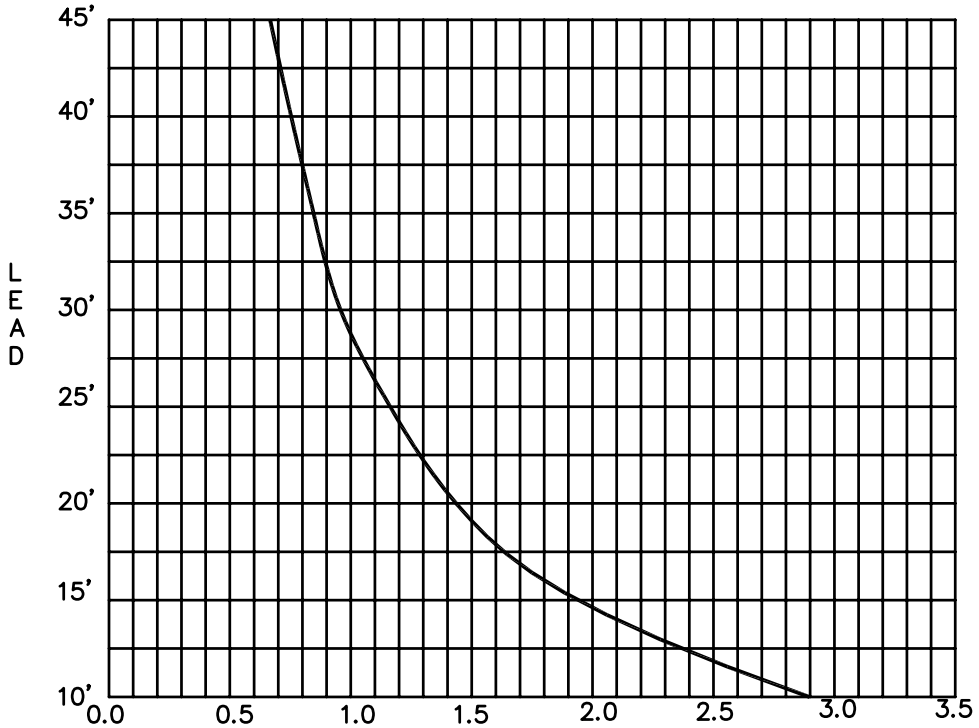
30' POLE

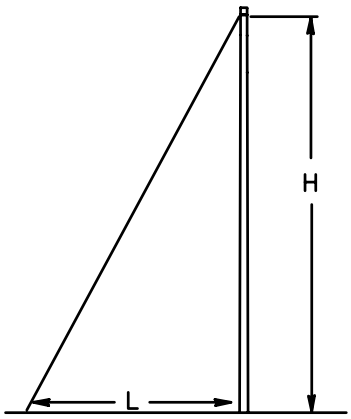




30' POLE

35' POLE

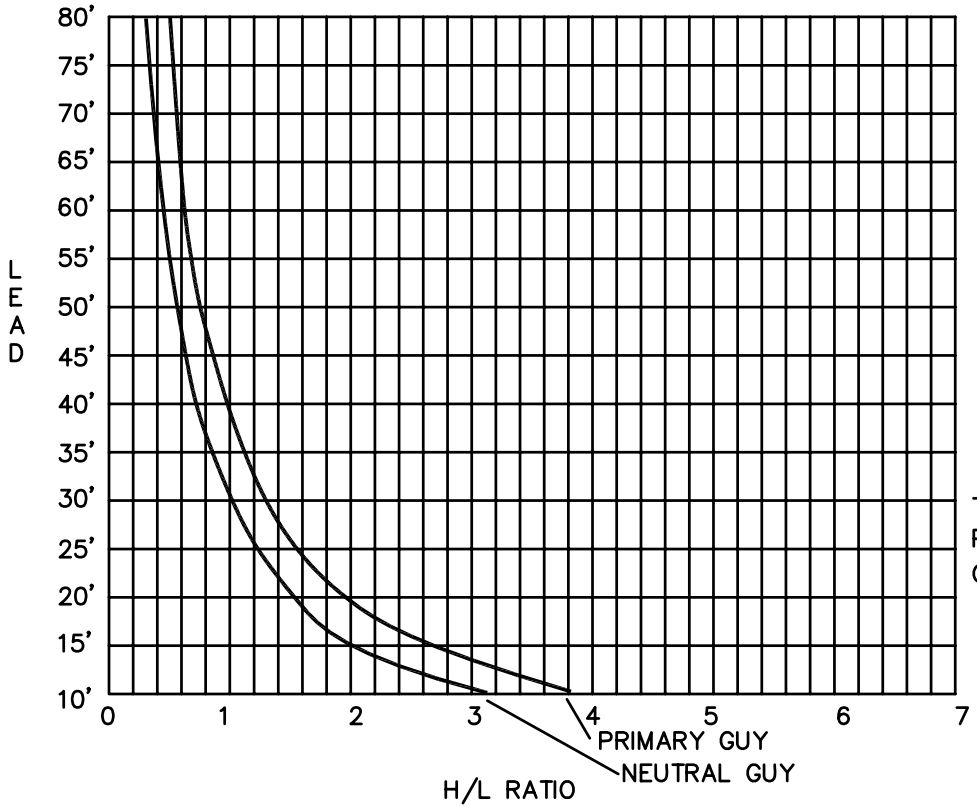


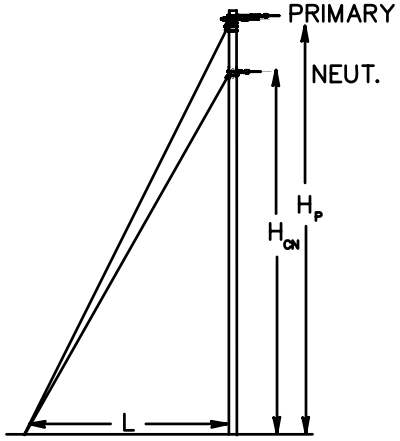


35' POLE

ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		H/L RATIOS FOR SERVICE POLES AND GUY STUBS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1522	DATE: 2-99	SCALE: 1"=1"	NO. EP 1522

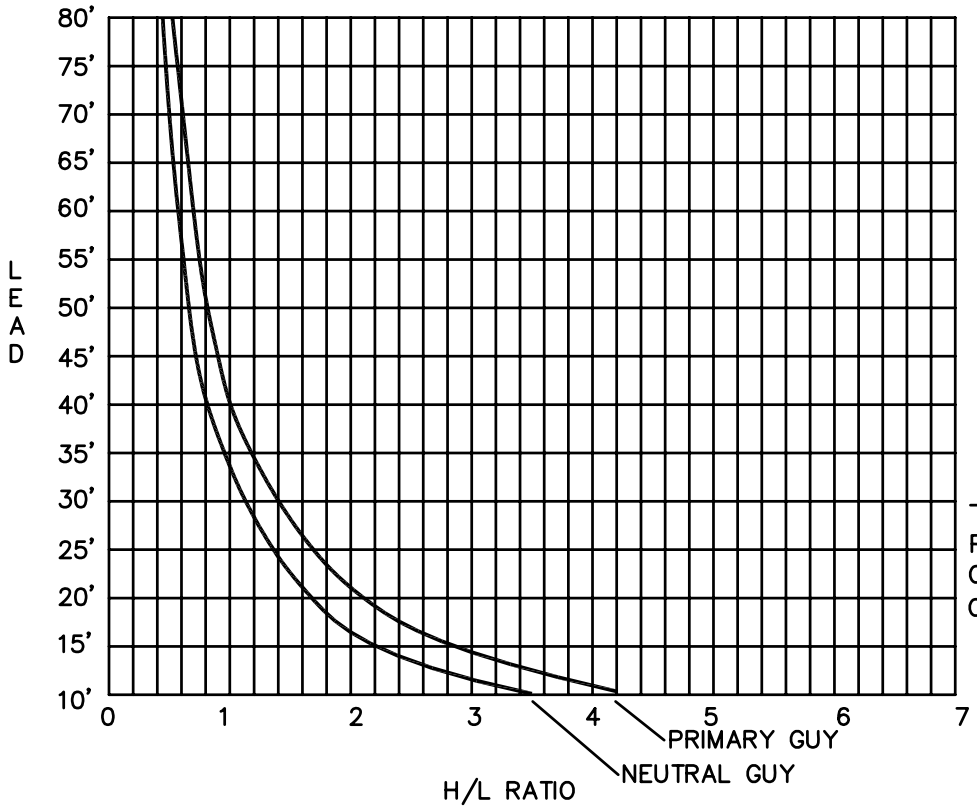
45 FOOT POLE DEADEND OR ANGLE FRAMING

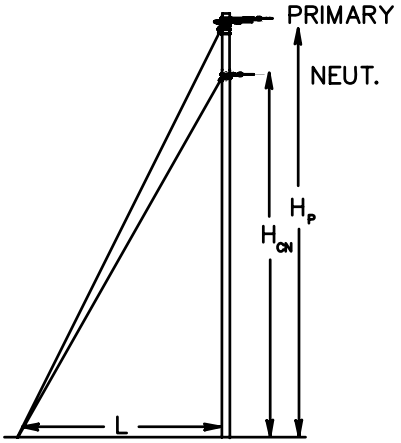




PRIMARY ON 45' POLE OR
ON 70' MSP11B POLE .

50 FOOT POLE DEADEND OR ANGLE FRAMING

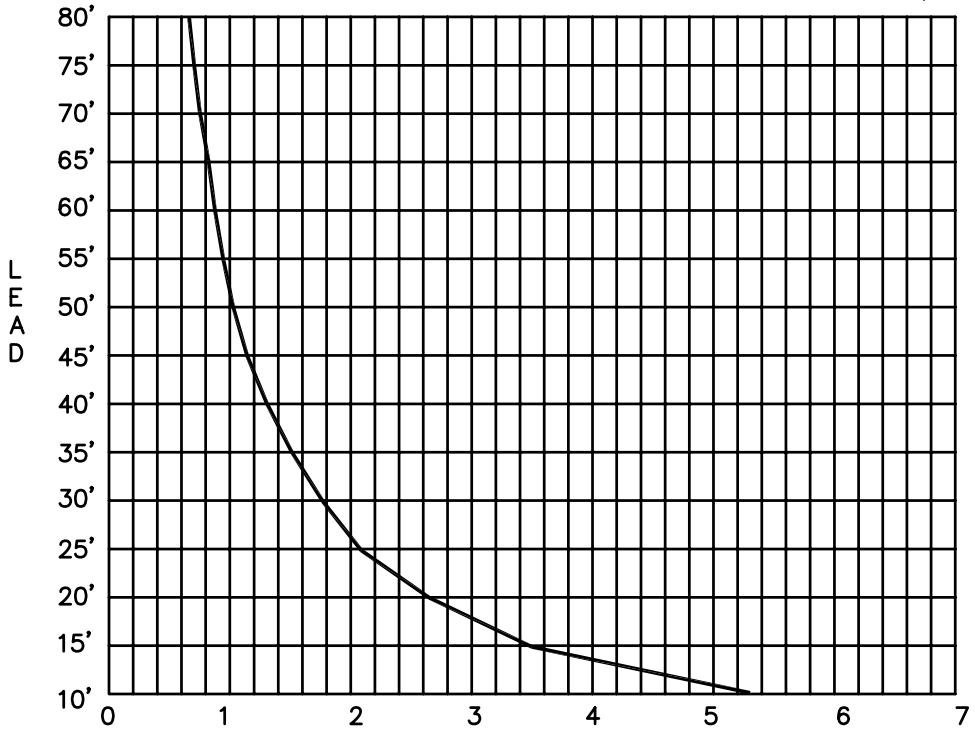


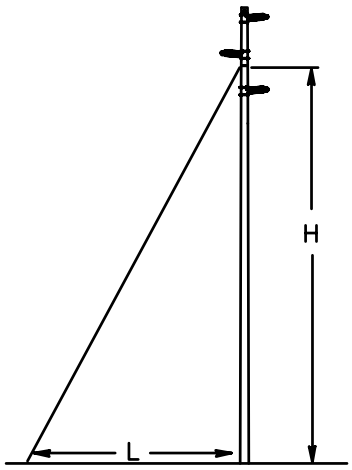


PRIMARY ON 50' POLE OR
ON 75' MSP11B POLE OR ON
ON 80' MSP10C POLE.

ENGINEERING STANDARDS **PUBLIC UTILITY DISTRICT NO. 1** **GRAYS HARBOR COUNTY, WASHINGTON**		H/L RATIOS FOR PRIMARY GUYING	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1524	DATE: 2-99	SCALE: 1"=1"	NO. EP 1524

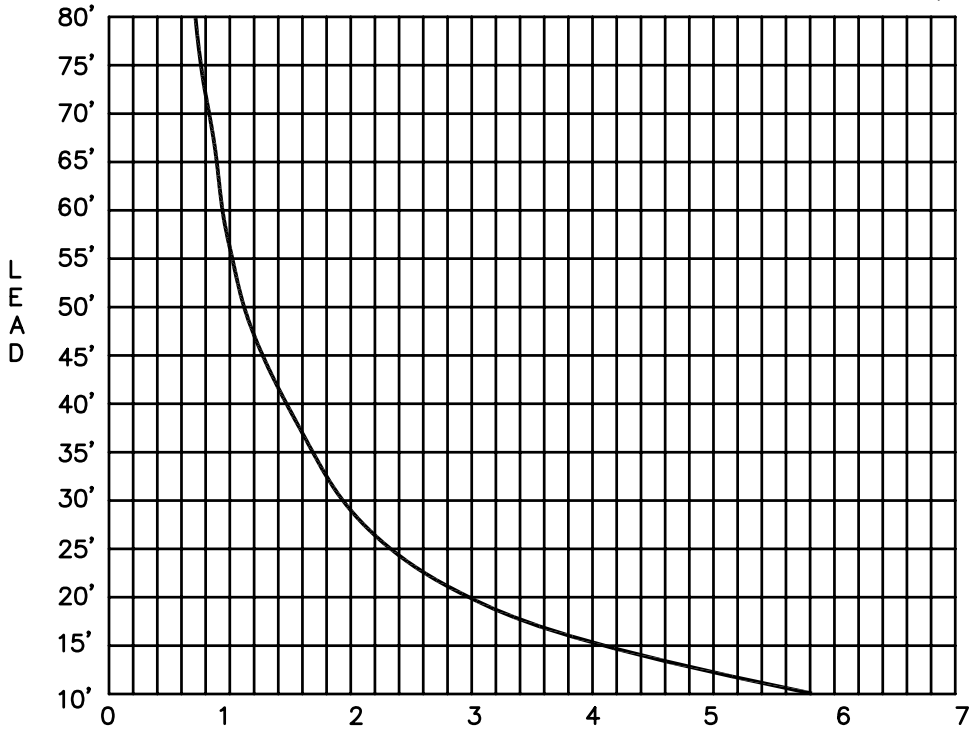
70 FOOT POLE STAGGERD SIDE POST TRANSMISSION FRAMING (ONEGUY)

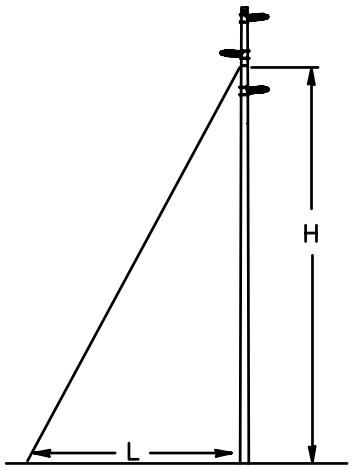




TRANSMISSION
VERY LIGHT ANGLE
70' POLE

75 FOOT POLE STAGGERED SIDE POST TRANSMISSION FRAMING (ONEGUY)

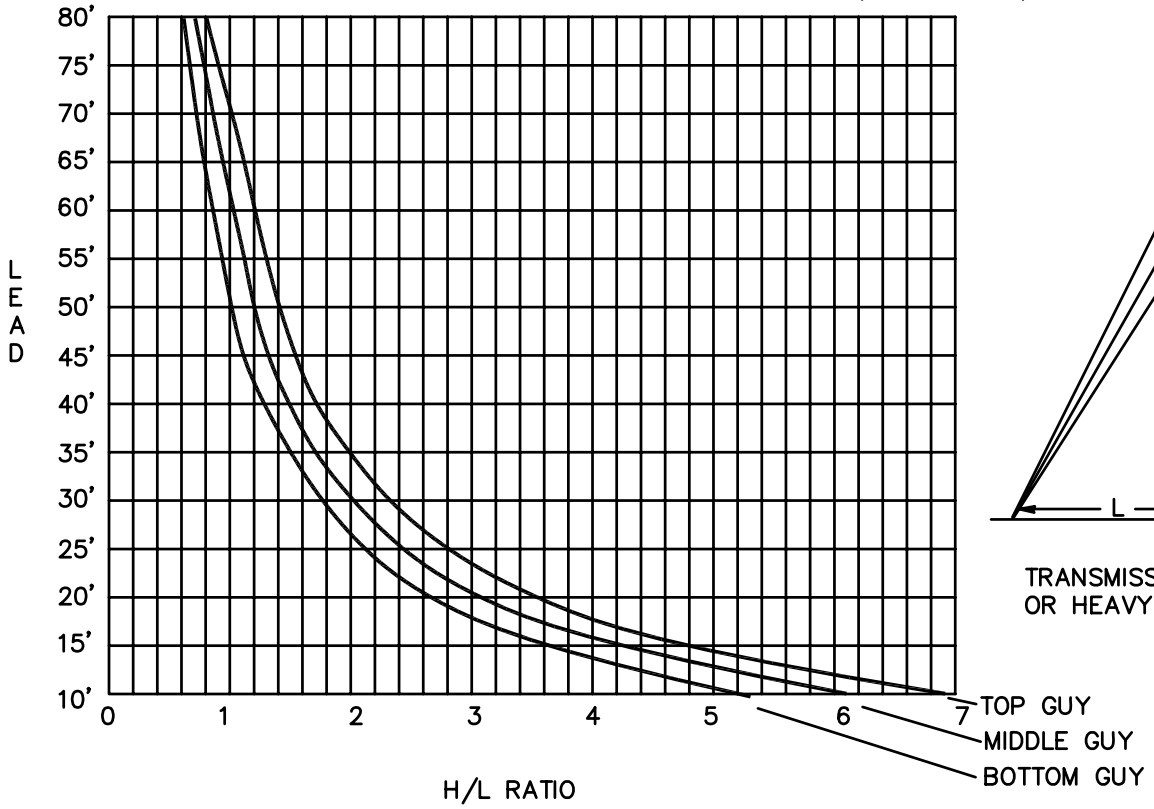


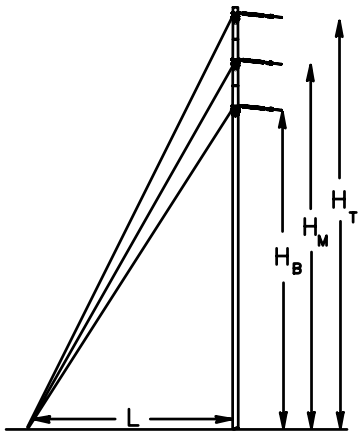


TRANSMISSION
VERY LIGHT ANGLE
75' POLE

ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		H/L RATIOS FOR TRANSMISSION SINGLE GUYS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1528	DATE: 2-99	SCALE: 1"=1"	NO. EP 1528

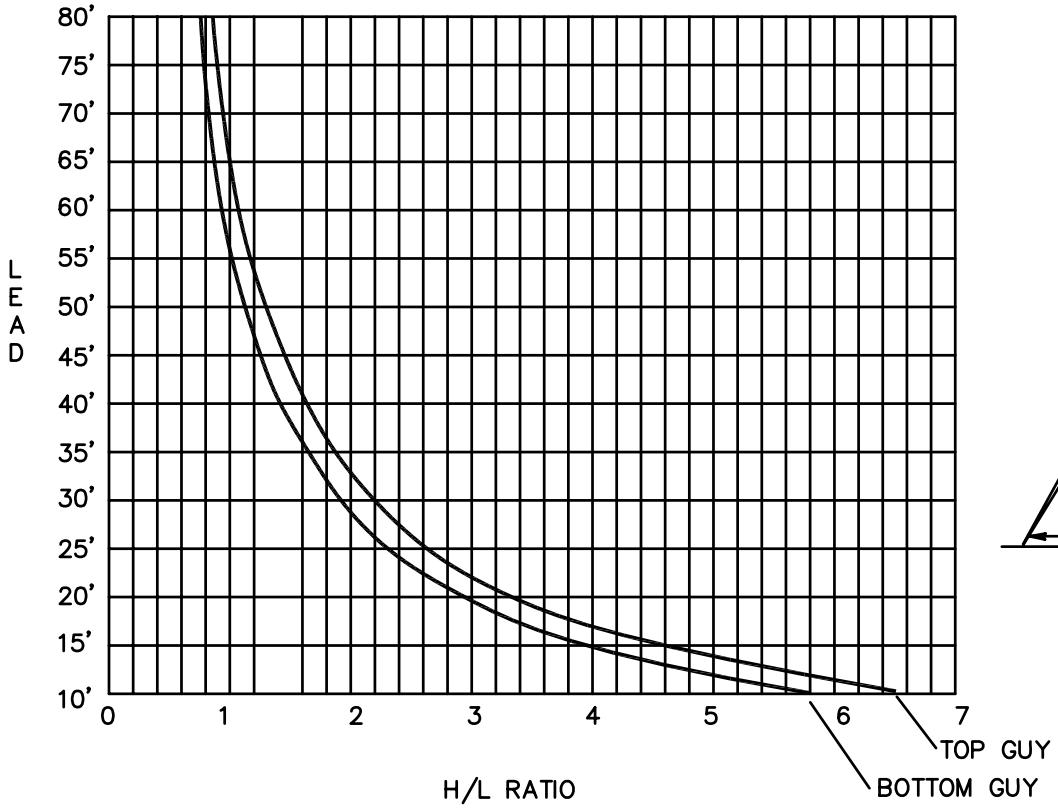
80 FOOT POLE VERTICAL TRANSMISSION FRAMING (THREE GUYS)

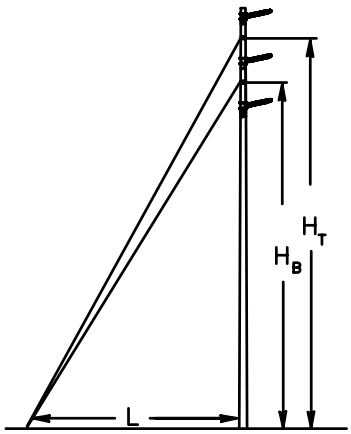




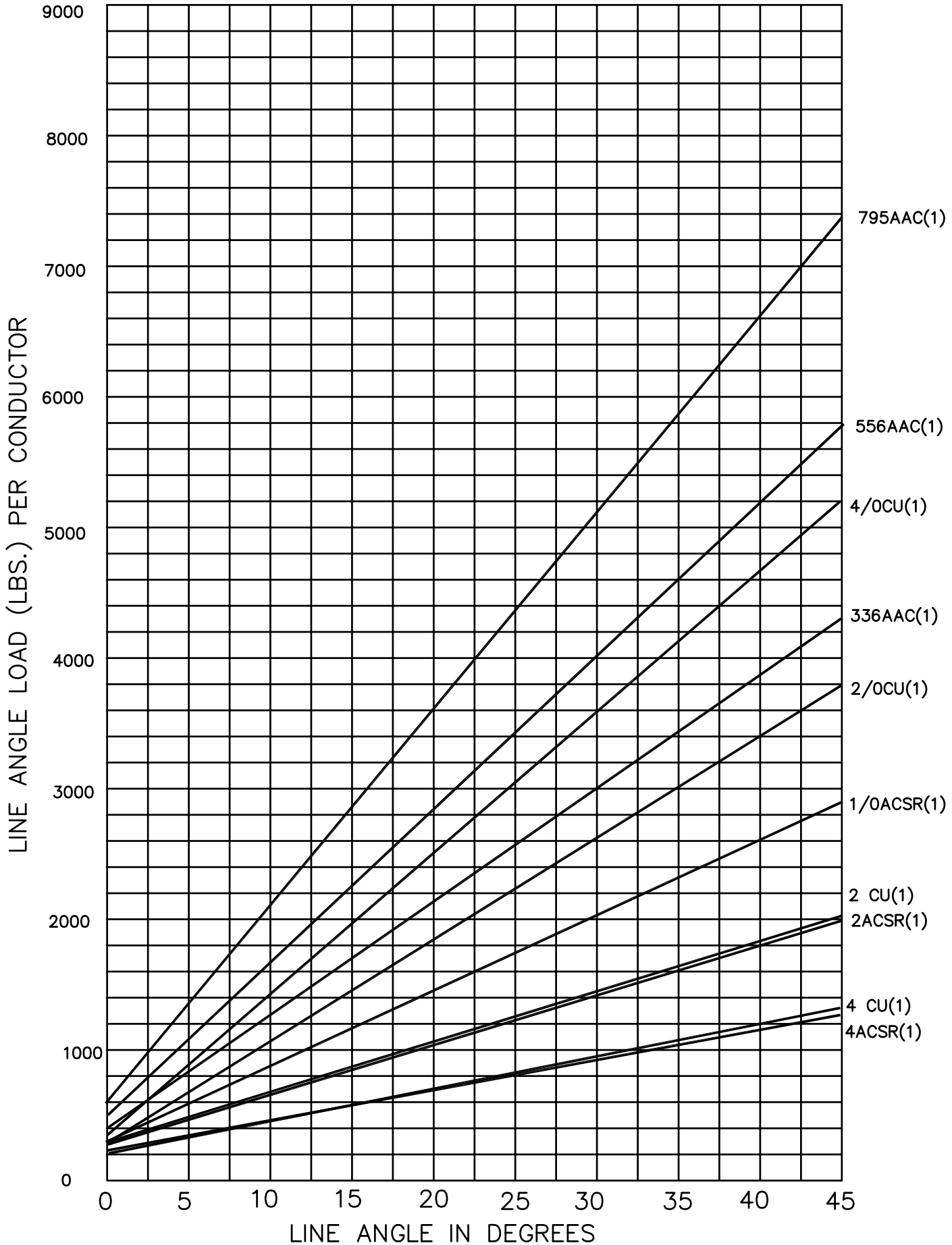
TRANSMISSION DEADEND
OR HEAVY ANGLE

80 FOOT POLE LIGHT ANGLE VERTICAL TRANSMISSION FRAMING (TWO GUYS)

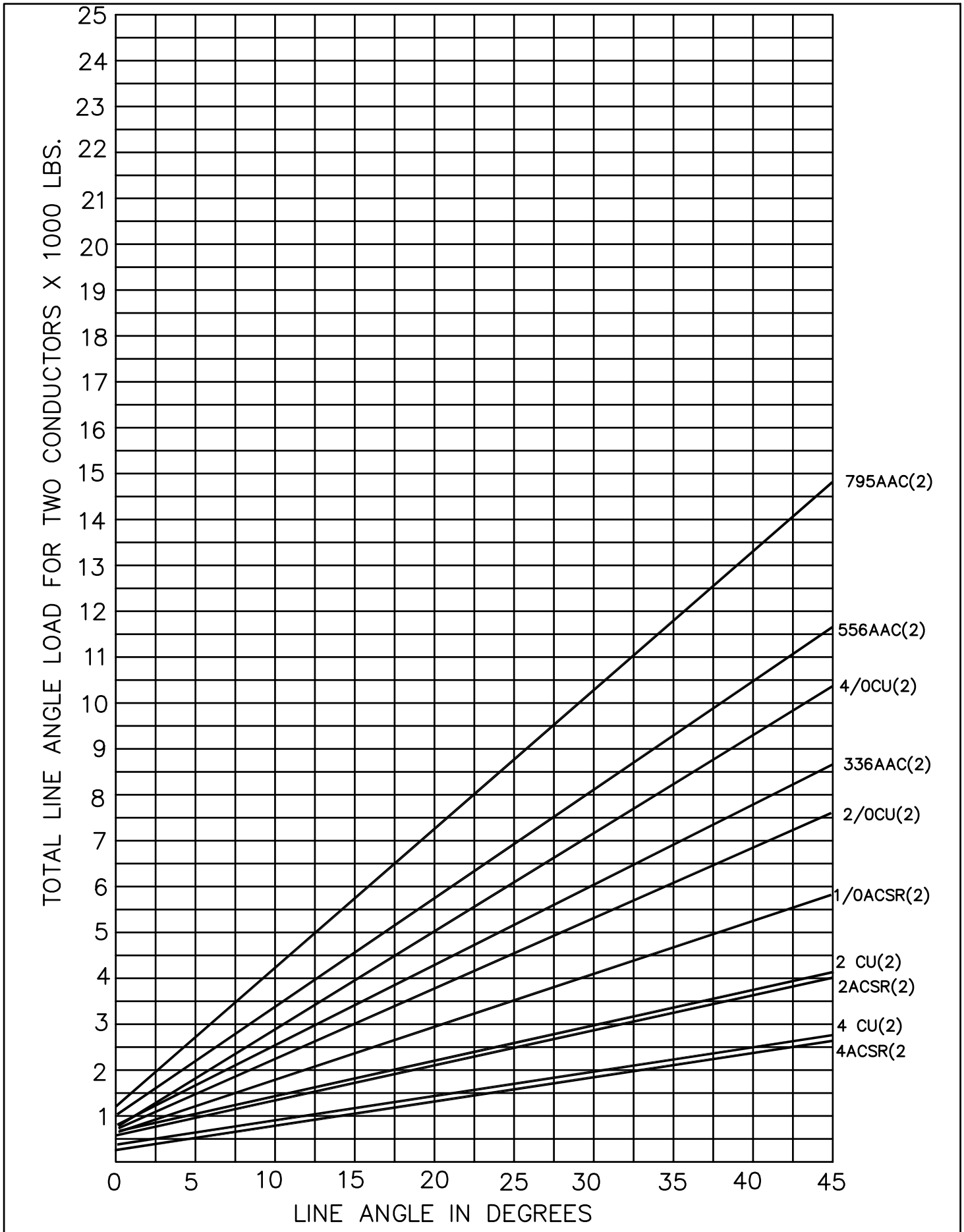




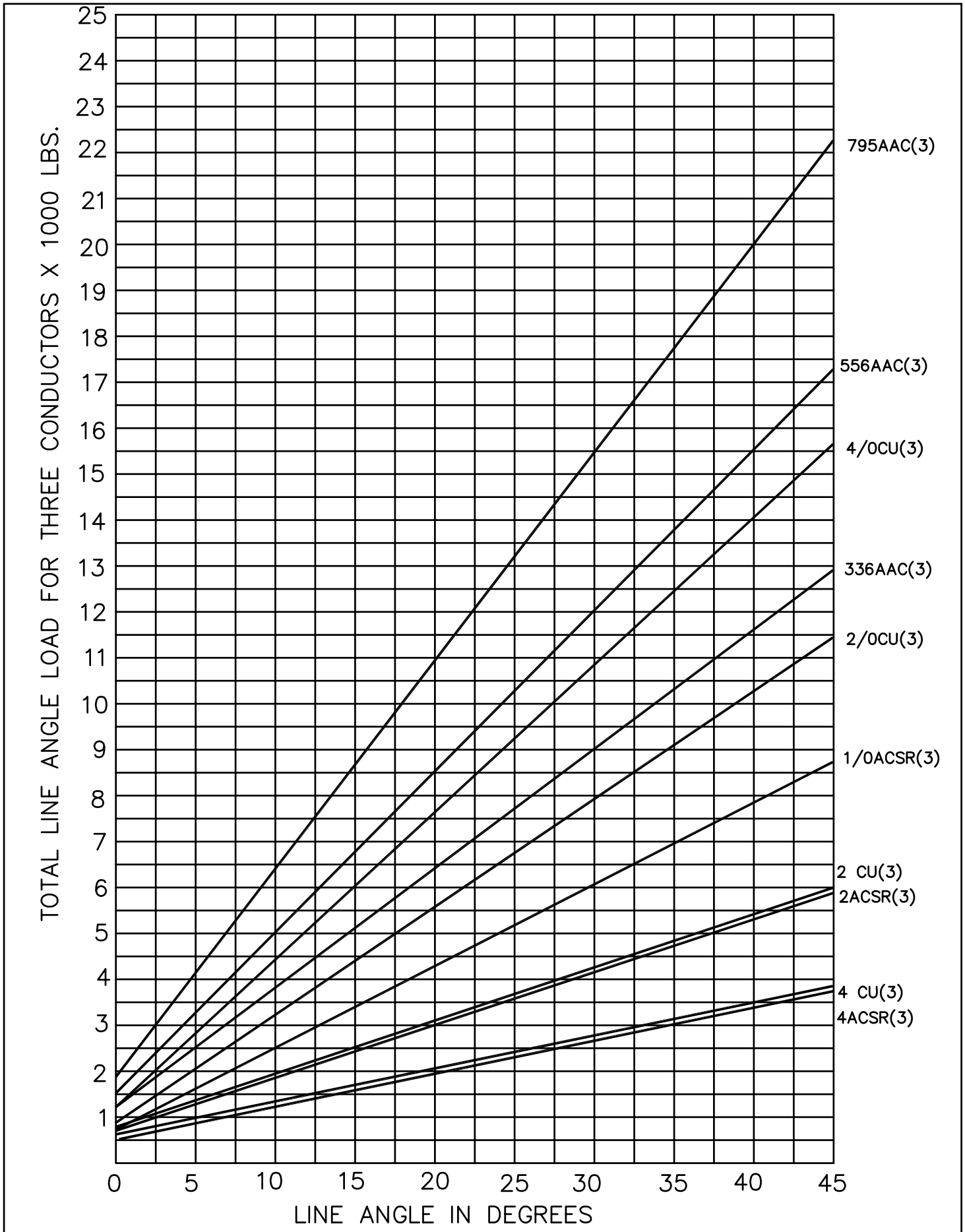
ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		H/L RATIOS FOR TWO AND THREE TRANSMISSION GUYS	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1530	DATE: 2–99	SCALE: 1"=1"	NO. EP 1530



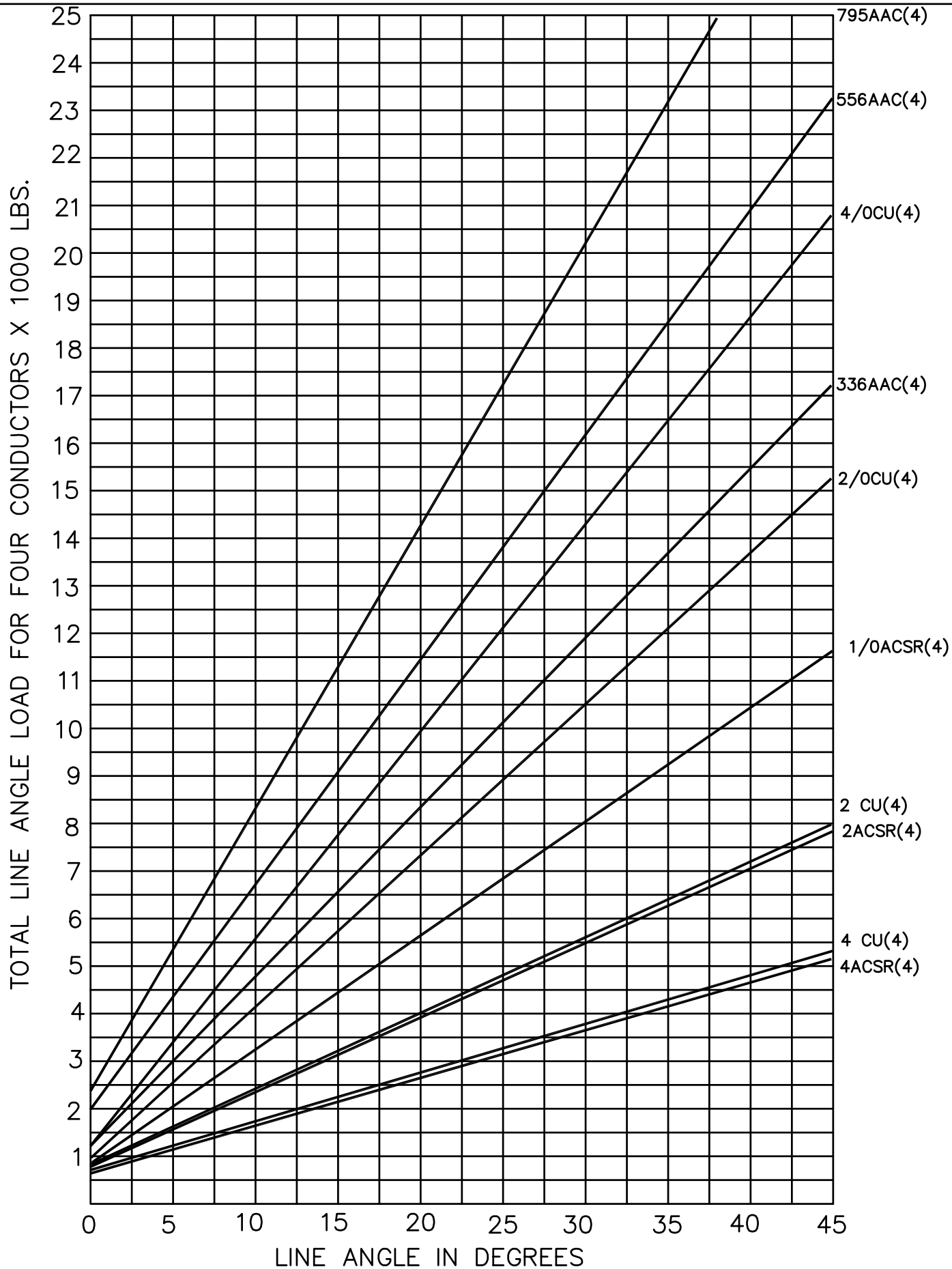
ENGINEERING STANDARDS **PUBLIC UTILITY DISTRICT NO. 1** **GRAYS HARBOR COUNTY, WASHINGTON**		LINE ANGLE LOADS **FOR ONE CONDUCTOR** INCLUDES 1.65 TENSION OVERLOAD AND 2.5 WIND OVERLOAD FACTORS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1540	DATE: 1–99	SCALE: 1"=1"	NO. EP 1540



ENGINEERING STANDARDS **PUBLIC UTILITY DISTRICT NO. 1** **GRAYS HARBOR COUNTY, WASHINGTON**		LINE ANGLE LOADS **FOR TWO CONDUCTORS** INCLUDES 1.65 TENSION OVERLOAD AND 2.5 WIND OVERLOAD FACTORS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1544	DATE: 2-99	SCALE: 1"=1"	NO. EP 1544



ENGINEERING STANDARDS **PUBLIC UTILITY DISTRICT NO. 1** **GRAYS HARBOR COUNTY, WASHINGTON**		LINE ANGLE LOADS **FOR THREE CONDUCTORS** INCLUDES 1.65 TENSION OVERLOAD AND 2.5 WIND OVERLOAD FACTORS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1550	DATE: 2–99	SCALE: 1"=1"	NO. EP 1550



ENGINEERING STANDARDS **PUBLIC UTILITY DISTRICT NO. 1** **GRAYS HARBOR COUNTY, WASHINGTON**		LINE ANGLE LOADS **FOR FOUR CONDUCTORS** INCLUDES 1.65 TENSION OVERLOAD AND 2.5 WIND OVERLOAD FACTORS.	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1554	DATE: 2–99	SCALE: 1"=1"	NO. EP 1554

ALUMINUM CONDUCTOR DEADEND LOADS:

	ONE CONDUCTOR	TWO CONDUCTORS	THREE CONDUCTORS	FOUR CONDUCTORS
NO.4 ACSR	1510 LBS	3020 LBS	4530 LBS	6040 LBS
NO. 2 ACSR	2300 LBS.	4600 LBS.	6900 LBS.	9200 LBS.
NO. 1/0 ACSR	3500 LBS.	7000 LBS.	10500 LBS.	14000 LBS.
NO. 4/0 AAAC	4500 LBS.	9000 LBS.	13500 LBS.	18000 LBS.
336 KCM AAC	5100 LBS.	10200 LBS.	15300 LBS.	20400 LBS.
556 KCM AAC	7100 LBS.	14200 LBS.	21300 LBS.	28400 LBS.
795 KCM AAC	9000 LBS.	18000 LBS.	27000 LBS.	36000 LBS.

COPPER CONDUCTOR DEADEND LOADS:

	ONE CONDUCTOR	TWO CONDUCTORS	THREE CONDUCTORS	FOUR CONDUCTORS
NO.4	1500 LBS	3000 LBS	4500 LBS	6000 LBS
NO. 2	2300 LBS.	4600 LBS.	6900 LBS.	9200 LBS.
NO. 2/0	4500 LBS.	9000 LBS.	13500 LBS.	18000 LBS.
NO. 4/0	6800 LBS.	13600 LBS.	20400 LBS.	27200 LBS.

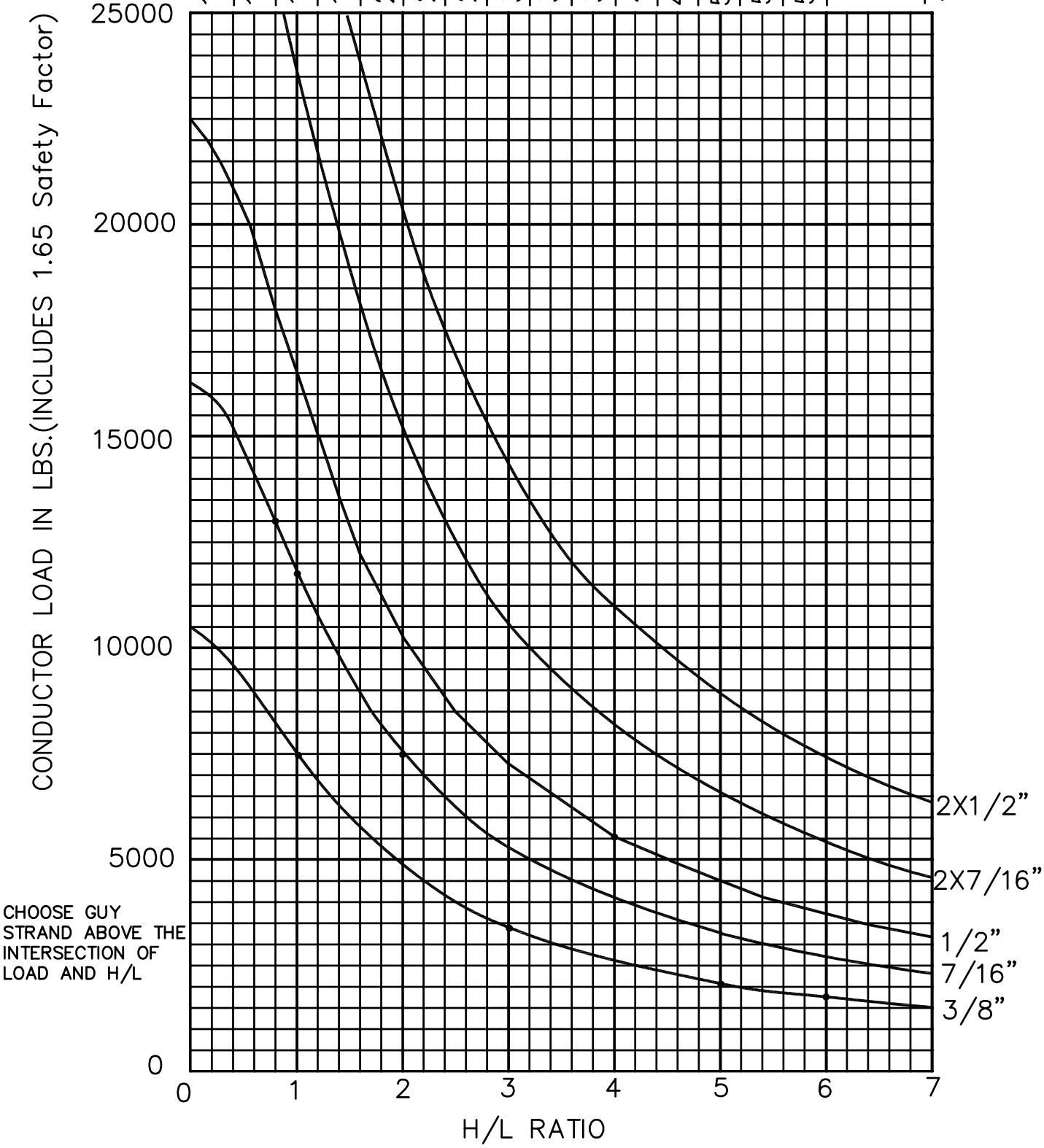
ALL LOADS INCLUDE NESC 1.65 SAFETY FACTOR

ENGINEERING STANDARDS **PUBLIC UTILITY DISTRICT NO. 1** **GRAYS HARBOR COUNTY, WASHINGTON**		**DEADEND** LOADS FOR DISTRICT CONDUCTORS	
	CHECKED BY: PHIL PENTTILA	APPROVED BY: RON PIEFFER	DRAWN BY: DAVID TRASK
NO. EP 1560	DATE: 2-99	SCALE: 1"=1"	NO. EP 1560

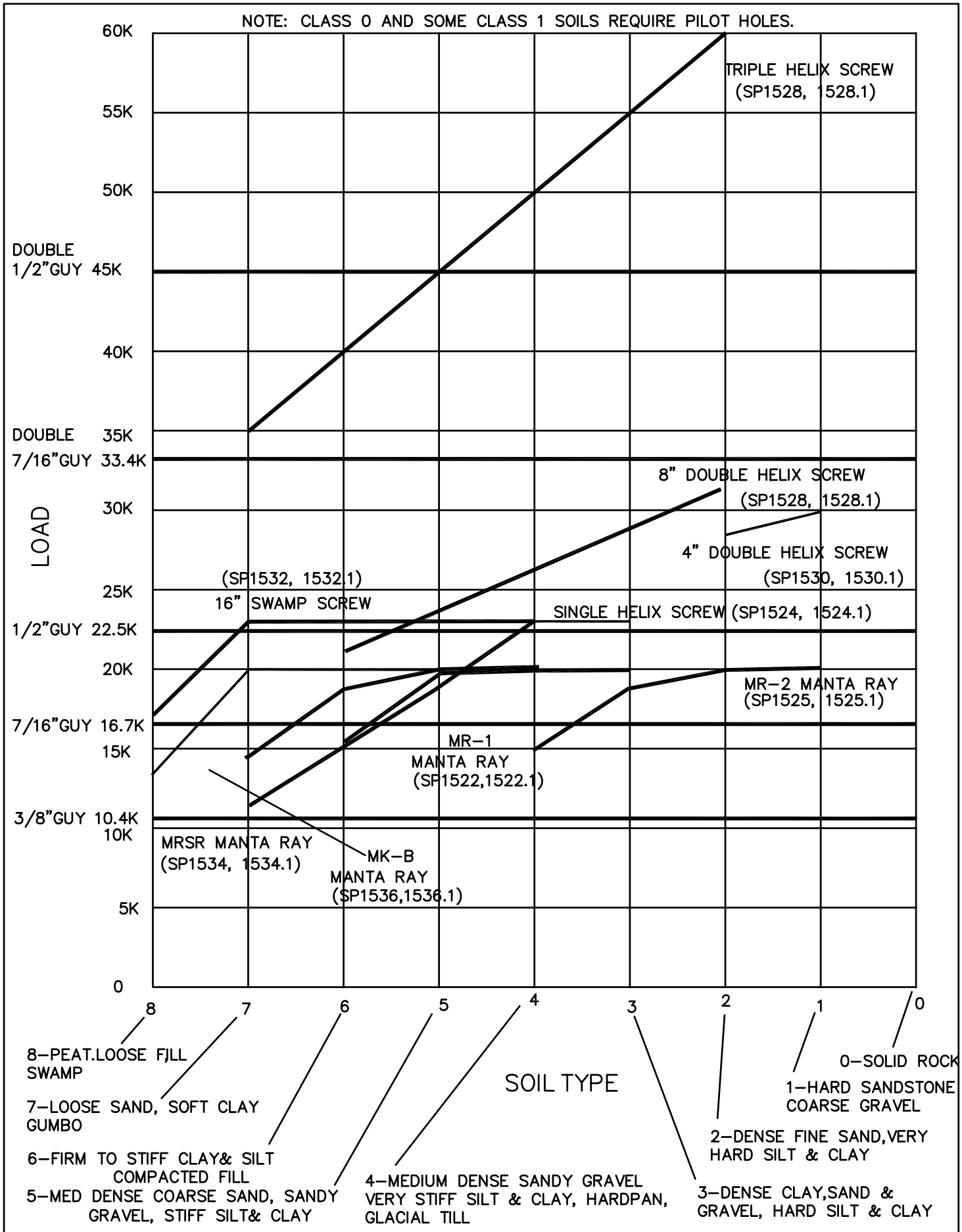
GUY CURVES SHOWN AT 90% OF ULTIMATE STRENGTH

(FACTOR BELOW)(CONDUCTOR LOAD)=GUY LOAD

1.04	1.08	1.17	1.28	1.41	1.56	1.72	1.89	2.06	2.24	2.42	2.6	2.79	2.97	3.16	3.35	3.54	3.74	3.93	4.12	4.32	4.51	4.71	4.9	5.1	5.3	5.5	5.67	5.89	6.08	7.07



ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		MAXIMUM GUY STRAND LOADS FOR GUY LEADS	
	CHECKED BY: PAP	APPROVED BY:	DRAWN BY: DAVID TRASK
NO. EP 1570	DATE: 2-99	SCALE: 1"=1"	NO. EP 1570



ENGINEERING STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		MAXIMUM ANCHOR HOLDING CAPACITIES. THESE VALUES ARE NOT ABSOLUTE THEY REPRESENT ACHIEVABLE VALUES ONLY.	
	CHECKED BY: PAP	APPROVED BY:	DRAWN BY: DAVID TRASK
NO. EP1580	DATE: 2-99	SCALE: 1"=1"	NO. EP 1580

		THREE PHASE LOAD (@ 240 VOLTS)											
3 ϕ KVA →		5	10	15	20	25	30	35	40	45	50	60	75
3 ϕ AMPS →		12	24	36	48	60	72	84	96	108	120	145	180
SINGLE PHASE LOAD KVA ↓	AMPS @ 240V ↓	KICKER TRANSFORMER KVA											
		15	15	15	15	25	25	25	25	50	50	50	50
		LIGHTING TRANSFORMER KVA											
3	12	15	15	15	15	25	25	25	25	50	50	50	50
5	21	15	15	15	25	25	25	25	25	50	50	50	50
10	42	15	15	15	25	25	25	25	25	50	50	50	75
15	63	25	25	25	25	25	25	25	50	50	50	50	75
20	83	25	25	50	50	50	50	50	50	50	50	75	75
25	104	50	50	50	50	50	50	50	50	50	75	75	75
30	125	50	50	50	50	50	50	50	75	75	75	75	100
35	146	50	50	50	50	50	50	75	75	75	75	75	100
40	166	NA	NA	50	50	75	75	75	75	75	75	75	100
45	187	NA	NA	NA	NA	75	75	75	75	75	75	100	100
50	208	NA	NA	NA	NA	NA	NA	75	75	75	75	100	100

NOTES:

1. THE LIGHTING TRANSFORMER SHOULD BE TAPPED TO A PHASE LEADING THE KICKER TRANSFORMER PHASE. SEE SP 9154 FOR SUBSTATION PHASE ROTATION.
2. THE MAXIMUM THREE PHASE MOTOR ALLOWED ON OPEN BANKS IS 30 HP.
3. SEE SP 3623 FOR CONNECTION.
4. TABLE IS BASED ON 95% PF SINGLE PHASE AND 80% PF THREE PHASE.
5. TABLE IS BASED ON 2% MAXIMUM VOLTAGE IMBALANCE.
6. STANDARD DISTRICT TRANSFORMER SIZES OF 15,25,50,75 AND 100 KVA ARE USED IN THIS TABLE.
7. SINGLE PHASE–THREE PHASE COMBINATIONS NOT SHOWN OR MARKED "NA" ON THIS CHART EXCEED THE 2% VOLTAGE IMBALANCE LIMITATION AND SHOULD BE SERVED WITH A CLOSED BANK OR WITH SEPARATE BANKS.
8. SEE SP 3661 FOR ALLOWABLE LOADS ON EXISTING TRANSFORMER BANKS.

LINE CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		OPEN TRANSFORMER BANK SIZING FOR COMBINATION SINGLE PHASE / THREE PHASE LOADS.(NEW BANKS)	
	CHECKED BY: PAP	APPROVED BY: SET	DRAWN BY: D. TRASK
NO. EP 3619	DATE: 1–89	SCALE: NONE	NO. EP 3619

LOADING:

TRANSFORMERS SHOULD NORMALLY BE LOADED TO 75% TO 100% OF ANTICIPATED DEMAND UPON INSTALLATION.
TRANSFORMERS SHOULD BE CHANGED OUT WHEN DEMAND EXCEEDS 125% OF NAMEPLATE KVA.

LATERAL FUSES SHOULD BE CHECKED FOR POSSIBLE INCREASE IN SIZE WHEN NEW TRANSFORMERS ARE INSTALLED.

CHECK PHASE LOADING BEFORE INSTALLING A TRANSFORMER ON A THREE PHASE PRIMARY LOAD.

CIRCUIT AND CALL FOR TAPPING THE NEW TRANSFORMER TO THE PHASE WITH THE LIGHTEST

MISCELLANEOUS:

STAINLESS STEEL TRANSFORMERS SHOULD BE USED IN THE OCEAN BEACH AREAS.

SEPARATE SINGLE PHASE TRANSFORMERS SHOULD BE INSTALLED WHEN THREE PHASE LOADS EXCEEDING 10 HP ARE SERVED AND MORE THAN THE THREE PHASE CUSTOMER IS SERVED WITH SINGLE PHASE FROM THE BANK.

TRANSFORMERS MAY BE INSTALLED ON SINGLE PHASE PRIMARY RISER POLES IF THERE ARE NO GUYS OR GUYS IN NO MORE THAN ONE DIRECTION FROM THE POLE.

TRANSFORMERS MAY NOT BE INSTALLED ON PRIMARY CORNER POLES.
(EITHER A LATERAL FROM THE LINE OR A CORNER WITH GUYS IN TWO DIRECTIONS.)

TRANSFORMERS SHOULD BE PLACED NO CLOSER THAN EIGHT FEET FROM A BUILDING UNLESS THERE IS A FIRE WALL. THE EIGHT FEET IS MEASURED HORIZONTALLY FROM A VERTICAL LINE ALONG THE OUTERMOST PART OF THE BUILDING SUCH AS A GUTTER.

PARALLEL (BANKED) TRANSFORMERS:

TRANSFORMERS HAVE BEEN PARALLELED (BANKED) ACROSS SPANS OF SECONDARY IN THE PAST. THIS IS NO LONGER DONE ON NEW INSTALLATIONS.
EXISTING BANKED TRANSFORMERS MAY REMAIN EVEN WHEN REPLACING UNITS.
NO MORE THAN TWO TRANSFORMERS SHOULD BE BANKED. IN CASES WHERE THREE OR MORE TRANSFORMERS ARE BANKED THEY SHOULD BE BROKEN UP INTO NO MORE THAN TWO BANKED UNITS.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		SINGLE PHASE TRANSFORMER INFORMATION.	
	CHECKED BY: PAP	APPROVED BY: SET	DRAWN BY: DAVID TRASK
NO. EP 3628	DATE: 2-28-95	SCALE: 1" = 1"	NO. EP 3628

GROUNDED BANKS AND SERVICES WITH NEUTRALS:

ALL NEW SERVICES PROVIDED AFTER 3–1–95 SHALL BE FROM GROUNDED BANKS WITH A GROUNDED SECONDARY NEUTRAL CARRIED INTO THE CUSTOMER'S METER BASE.

EXISTING THREE WIRE, THREE PHASE SERVICES SHALL NOT BE FED FROM FOUR WIRE THREE PHASE TRANSFORMER BANKS WITH A GROUND ON THE SECONDARY.

FOUR WIRE THREE PHASE SERVICES SHALL NOT BE RUN FROM EXISTING THREE PHASE THREE WIRE TRANSFORMER BANKS WITH NO GROUND ON THE SECONDARY.

SEPARATE TRANSFORMER BANKS MUST BE PROVIDED BY THE DISTRICT WHERE FOUR WIRE THREE PHASE SERVICES AND EXISTING THREE WIRE THREE PHASE SERVICES IN THE SAME VICINITY; THIS INCLUDES SERVICES FED FROM THE SAME POLE.

CUSTOMERS WITH EXISTING THREE WIRE, THREE PHASE SERVICE WILL BE REQUESTED TO CONVERT TO FOUR WIRE THREE PHASE SERVICE WHEN REPLACING OR UPGRADING THEIR SERVICE ENTRANCES, IF PRACTICAL.

THREE TRANSFORMER BANKS REQUIRED (OVERHEAD OR WHEN USING SEPARATE ONE PHASE PADS.):

THE USE OF FULL BANKS FOR 120/240 VOLT/ 240 VOLT THREE PHASE SERVICE IS REQUIRED FOR THREE PHASE LOADS OF OVER 10 HP WHERE THREE PHASE PRIMARY IS AVAILABLE.

OPEN BANKS ALLOWED:

240 V OPEN DELTA BANKS MAY BE USED FOR THREE PHASE LOADS OF UP TO 30HP(ONE MOTOR) OR A TOTAL LOAD OF 50 HP ON TWO PHASE PRIMARY LINES ONLY. THESE CUSTOMERS MUST BE ADVISED BY LETTER THAT IMBALANCE PROBLEMS MAY CAUSE PROBLEMS WITH MOTORS AND ELECTRONICS.
SEE EP 3619 FOR A GUIDE FOR SIZING NEW OPEN TRANSFORMER BANKS.
SEE SP 3618 FOR A GUIDE TO EXISTING OPEN BANKS.

LOADING:

SEPARATE SINGLE PHASE TRANSFORMERS SHOULD BE INSTALLED WHEN THREE PHASE LOADS EXCEEDING 10 HP ARE SERVED AND MORE CUSTOMERS THAN THE THREE PHASE CUSTOMER ARE SERVED WITH SINGLE PHASE FROM THE BANK.

WHEN SINGLE PHASE LOADS ARE NOT EVENLY SPLIT ON ALL THREE PHASES ON A THREE PHASE PAD MOUNT TRANSFORMER, THE PAD MUST BE SIZED FOR THREE TIMES THE HIGHEST SINGLE PHASE LOAD PER PHASE PLUS THE THREE PHASE LOAD.

TRANSFORMER BANKS SHOULD BE LOADED TO APPROXIMATELY 75% TO 100% OF NAMEPLATE UPON INSTALLATION (USING THE ANTICIPATED KVA DEMAND). INCLUDE REACTIVE LOAD IN DEMAND CALCULATIONS.
THREE PHASE BANKS SHOULD BE UPGRADED WHEN DEMANDS REACH 125% OF NAMEPLATE.

OPEN BANKS MUST BE DERATED TO 86.6% OF NAMEPLATE FOR THREE PHASE LOADS.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		THREE PHASE TRANSFORMER BANK INFORMATION.	
	CHECKED BY: R LOVELY	APPROVED BY: S TUOMINEN	DRAWN BY: DAVID TRASK
NO. EP 3670P1	DATE: 10–31–96	SCALE: 1" = 1"	NO. EP 3670P1

LINE LOADING:

LATERAL AND LINE FUSES SHOULD BE CHECKED FOR POSSIBLE INCREASE IN SIZE WHEN NEW TRANSFORMERS ARE INSTALLED.

FUSING:

SEE SP 3610 FOR FUSING POLE MOUNT TRANSFORMERS.
SEE SP 3612 FOR FUSING PAD MOUNT TRANSFORMERS.

MISCELLANEOUS:

STAINLESS STEEL TRANSFORMERS SHOULD BE USED IN THE OCEAN BEACH AREAS.

TWO OR THREE PHASE TRANSFORMER BANKS SHALL NOT BE INSTALLED ON PRIMARY RISER POLES.

TRANSFORMER BANKS MAY NOT BE INSTALLED ON PRIMARY CORNER POLES. (EITHER A LATERAL FROM THE LINE OR A CORNER WITH GUYS IN TWO DIRECTIONS.)

TRANSFORMERS SHOULD BE PLACED NO CLOSER THAN EIGHT FEET TO A BUILDING UNLESS THERE IS A FIRE WALL. THE EIGHT FEET IS MEASURED HORIZONTALLY FROM A VERTICAL LINE ALONG THE OUTERMOST PART OF THE BUILDING SUCH AS A GUTTER.

THREE PHASE TRANSFORMER BANKS SHALL NOT BE PLACED ON PRIMARY OR TRANSMISSION SWITCH POLES.

THREE PHASE POLE MOUNT TRANSFORMER BANKS LARGER THAN 225 KVA MAY REQUIRE SPECIAL FOUNDATIONS OR LARGER CLASS POLES IN SOME SITUATIONS.

CONNECTIONS:

SEE SP3660 FOR 120/240 V OPEN WYE– OPEN DELTA CONNECTION.

SEE SP3698 FOR 120/240 V WYE– DELTA CONNECTION.

SEE SP3698 FOR 480 V WYE– DELTA CONNECTION.

SEE SP3778 FOR 120/208 V WYE– WYE CONNECTION.

SEE SP3828 FOR 277/480 V WYE– WYE CONNECTION.

STANDARD SERVICE VOLTAGES:

120/208 VOLT THREE PHASE FOUR WIRE WYE (PREFERRED)

120/240 VOLT THREE PHASE FOUR WIRE DELTA

480 VOLT THREE PHASE THREE WIRE DELTA (EXISTING SERVICES ONLY)

277/480 VOLT THREE PHASE FOUR WIRE WYE (PREFERRED)

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		THREE PHASE TRANSFORMER INFORMATION.	
	CHECKED BY: R LOVELY	APPROVED BY: S TUOMINEN	DRAWN BY: DAVID TRASK
NO. EP 3670P2	DATE: 10–31–96	SCALE: 1" = 1"	NO. EP 3670P2

LOAD	METER	METER BASE	CURRENT TRANSFORMER
120V SMALL RESIDENTIAL	2 WIRE – 120V, 4 TERMINAL	120V. 4 TERMINAL	NONE
120/240 VOLT SINGLE PHASE LOADS, 24 KW FURNACE OR LESS, SCHEDULES 10 AND 50	THREE WIRE, 120/ 240 VOLT, CLASS 200, 4 TERMINAL CONSTANT TYPE	FOUR TERMINAL; AMP RATING TO EQUAL OR EXCEED MAIN BREAKER RATING. NOT TO EXCEED 200 AMPS.	
120/240 VOLT SINGLE PHASE, SCHEDULES 10, 50 AND 55. 25KW FURNACE OR GREATER. MAIN BREAKER CAPACITY NOT IN EXCESS OF 325 AMPS.	THREE WIRE, 120/ 240 VOLT CLASS 320 FOUR TERMINAL SELF CONTAINED. SCHEDULES 50 AND 55 REQUIRE DEMAND	FOUR TERMINAL 400 AMP (320 AMP CONTINUOUS) MANUAL SHORTING DEVICES ALLOWED BUT NOT REQUIRED.	
120/240 VOLT SINGLE PHASE, SCHEDULES 10, 50 AND 55. 25KW FURNACE OR GREATER. MAIN BREAKER CAPACITY NOT IN EXCESS OF 400 AMPS.	THREE WIRE, 120/ 240 VOLT CLASS 400 FOUR TERMINAL BOLT IN METER. SCHEDULES 50 AND 55 REQUIRE DEMAND	CLASS 400 400 AMP FOUR TERMINAL BOLT IN.	
120/240 VOLT SINGLE PHASE, SCHEDULES 10, 50 AND 55. MAIN BREAKER CAPACITY IN EXCESS OF 400 AMPS.	3 WIRE, 240 VOLT, CLASS 20, SIX TERMINAL CONSTANT TYPE METER. SCHEDULES 50 AND 55 REQUIRE DEMAND	100 AMP, SIX TERMINAL BASE WITH PROVISION FOR TEST SWITCH.	TWO CURRENT TRANSFORMERS IN MIN. 24"X 30"X 11" CT ENCLOSURE CT'S WILL BE SIZED TO LOAD INFORMATION.
SINGLE PHASE PRIMARY METERING. SCHEDULES 10, 50 AND 55. SEE SP 5530 FOR OVERHEAD SINGLE PHASE PRIMARY METERING.	TWO WIRE, 120 VOLT CLASS 20, FIVE TERMINAL CONSTANT TYPE METER. SCHEDULES 50 AND 55 REQUIRE DEMAND	100 AMP, FIVE TERMINAL BASE WITH PROVISION FOR TEST SWITCH. IF BASE IS TO BE MOUNTED ON DISTRICT POLE, BASE MUST BE FURNISHED TO MTR. DEPT FOR MOUNTING.	ONE CURRENT TRANSFORMER AND ONE POTENTIAL TRANSFORMER. CT WILL BE SIZED TO CUSTOMER LOAD.

NOTES

1. CURRENT TRANSFORMERS WILL BE SIZED TO NORMALLY OPERATE AT 1/2 TO 2/3 OF NAMEPLATE RATING. RATING FACTORS MAY BE USED TO ALLOW LOADS ABOVE NORMAL.
2. METER LOCATION NO MORE THAN 50' FROM METERING TRANSFORMER ENCLOSURE.
3. NO ACCESS IS ALLOWED TO METERING CONDUCTORS AHEAD OF THE METER.
4. THE METER DEPARTMENT HAS PREWIRED MILBANK METER BASES AND WILL TRADE FOR UNWIRED BASES SO THAT THE ELECTRICAL CONTRACTOR CAN INSTALL A WIRED BASE AT THE JOB.
5. P.U.D. METER DEPT. RUNS #10 & #12 WIRE FROM C.T.'S TO METER BASE.(50' MAXIMUM)
6. METER DEPT. MUST BE NOTIFIED IN ADVANCE OF ALL SPECIAL METERING INSTALLATIONS.
9. METER BASES MUST BE LOCATED OUTSIDE.
10. LOAD INFORMATION MUST BE SUPPLIED TO METER DEPARTMENT AS SOON AS POSSIBLE.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		SINGLE PHASE METER SELECTION GUIDE	
	CHECKED BY: L HEARITIGE	APPROVED BY: S TUOMINEN	DRAWN BY: DLT/PEC
NO. EP 5500	DATE: 3-4-97	SCALE: 1" = 1"	NO. EP 5500

VOLTAGE AND LOAD	METER	METER BASE	CURRENT TRANSFORMER
4 WIRE 120/240V SINGLE PHASE, 240V 3 PHASE, 100 AMP SVC,	240V, CLASS 200 FOUR WIRE DELTA W/ CONSTANT & DEMAND	7 TERMINAL 100 AMP OR GREATER	NONE FOR SERVICES 200 AMPS AND UNDER.
4 WIRE 120/240V SINGLE PHASE, 240V 3 PHASE, TO 200 AMP SVC, RESIDENTIAL	240V, CLASS 200 FOUR WIRE DELTA W/ CONSTANT & DEMAND	7 TERMINAL 200 AMP	
4 WIRE 120/240V SINGLE PHASE, 240V 3 PHASE, 200 AMP SVC, SCHEDULE 55	240V, CLASS 200 FOUR WIRE DELTA W/ CONSTANT & DEMAND	7 TERMINAL 200 AMP	
4 WIRE 120/240V, 1 PHASE/ 240V 3 PHASE OVER 200 AMP SVC W/ MOTOR LOADS UNDER 100 HP.	120 VOLT CLASS 20 4 WIRE WITH DEMAND	13 TERMINAL WITH PROVISION FOR TEST SWITCH. ** AUTO CKT. CLOSER NOT ACCEPTABLE.	USE CT'S FOR SERVICES OVER 200 AMP. THREE CT'S IN MINIMUM 30"X 36"X 11" ENCLOSURE. SEE NOTES 1,2,3, 4, 7 AND 8.
4 WIRE 120/240V, 1 PHASE/ 240V 3 PHASE OVER 200 AMP SVC W/ MOTOR LOADS OVER 100 HP. (SEE NOTE 2)	ELECTRONIC MULTIFUNCTION 120 VOLT CLASS 20 4 WIRE WYE WITH DEMAND AND KVARS.	13 TERMINAL WITH PROVISION FOR TEST SWITCH. ** AUTO CKT. CLOSER NOT ACCEPTABLE.	
4 WIRE 120/ 208 V, 200 AMP SERVICE.	120 VOLT, CLASS 200 FOUR WIRE WITH CONSTANT AND DEMAND.	7 TERMINAL 200 AMP	NONE
4 WIRE 120/ 208 V, OVER 200 A SERVICES WITH MOTOR LOAD UNDER 100 HP.	120V CLASS 20, FOUR WIRE WYE W/ DEMAND.	13 TERMINAL WITH PROVISION FOR TEST SWITCH. ** AUTO CKT. CLOSER NOT ACCEPTABLE.	THREE CT'S IN MINIMUM 30"X 36"X 11" ENCLOSURE. SEE NOTES 1,2,3, 4, 7 AND 8.
4 WIRE 120/ 208 V, OVER 200 A SERVICES WITH MOTOR LOAD OVER 100 HP. (SEE NOTE 2)	ELECTRONIC MULTIFUNCTION CLASS 20, 120 VOLT 4 WIRE WYE WITH DEMAND AND KVARS.	13 TERMINAL WITH PROVISION FOR TEST SWITCH. ** AUTO CKT. CLOSER NOT ACCEPTABLE.	

NOTES:

1. CURRENT TRANSFORMERS MAY BE OVERLOADED TO TWO TIMES THE NOMINAL RATING. SELECTION SHOULD BE BASED UPON ESTIMATION OF ACTUAL AVERAGE DEMAND RATHER THAN CONNECTED LOAD OR SERVICE ENTRANCE RATING.
2. THE METER AND COMMERCIAL DEPARTMENTS SHOULD BE ADVISED WHEN SPECIFYING REACTIVE METERING.
3. MAST MOUNTING CT'S IS ALLOWED ONLY BY SPECIAL PERMISSION & CIRCUMSTANCES(NEVER AT BEACHES)
4. P.U.D. METER DEPT. RUNS #10 & #12 WIRE FROM C.T.'S TO METER BASE (50' MAXIMUM).
5. METER DEPT. MUST BE NOTIFIED IN ADVANCE OF ALL SPECIAL METERING INSTALLATIONS.
6. BOTTOM FEED TYPE METERING FOR C.T. INSTALLATIONS IS NON-STANDARD BUT MAY BE USED WITH PERMISSION OF METER DEPARTMENT. METER AND METER BASE INFORMATION SHOWN ON THIS STANDARD DOES NOT APPLY TO BOTTOM FEED INSTALLATIONS. ("A" BASE)
7. AUTOMATIC CIRCUIT CLOSING ON METER BASES FOR CT INSTALLATIONS IS NOT ALLOWED ON CT INSTALLATIONS AFTER JANUARY 1, 1995. PROVISIONS FOR TEST SWITCHES ARE REQUIRED .

** THE PUD METER SHOP WILL SUPPLY & INSTALL AND WIRE THE TEST SWITCH WHEN CUSTOMER OR CONTRACTOR BRINGS THE METER BASE INTO THE PUD METER SHOP.

8. RECOMENDED METER BASE FOR CT INSTALLATION IS MILBANK UC 3433-XL FOR 13 TERMINAL.
9. METER BASES MUST BE LOCATED OUTSIDE.
10. LOAD INFORMATION MUST BE SUPPLIED TO METER DEPARTMENT AS SOON AS POSSIBLE.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		208 VOLT AND 240 VOLT THREE PHASE METER SELECTION GUIDE	
	CHECKED BY: L HEARITIGE	APPROVED BY: S TUOMINEN	DRAWN BY: DLT/PEC
NO. EP 5504	DATE: 3-4-97 REV. 9-02	SCALE: 1" = 1"	NO. EP 5504

VOLTAGE AND LOAD	METER ***	METER BASE	CURRENT TRANSFORMER
FOUR WIRE 277/480 VOLT THREE PHASE WYE, 200 AMP SERVICE WITH MOTOR LOAD UNDER 100 HP.	CLASS 200, 240 VOLT 4 WIRE WYE WITH CONSTANT AND DEMAND. ***	7 TERMINAL 200 AMP BASE.	NONE
FOUR WIRE 277/480 VOLT THREE PHASE WYE, 200 AMP SERVICE WITH MOTOR LOAD OVER 100 HP.	ELECTRONIC MULTI-FUNCTION CLASS 200	7 TERMINAL 200 AMP BASE.	NONE
4 WIRE 277/480 VOLT 3 PHASE, WYE - OVER 200 AMP SERVICES WITH MOTOR LOADS UNDER 100 HP.	CLASS 20, 240V WYE 4 WIRE WITH DEMAND. ***	13 TERMINAL WITH PROVISION FOR TEST SWITCH. ** AUTO CKT CLOSER IS NOT ACCEPTABLE.	3 CT'S IN MINIMUM 30"X 36"X 11" ENCLOSURE. SEE NOTES
4 WIRE 277/480 VOLT 3 PHASE, WYE - OVER 200 AMP SERVICES WITH MOTOR LOADS OVER 100 HP.	ELECTRONIC MULTIFUNCTION CLASS 20, 240 VOLT WYE W/ DEMAND AND KVARS. ***	13 TERMINAL WITH PROVISION FOR TEST SWITCH (**) AUTO CKT CLOSER IS NOT ACCEPTABLE.	

*** MANUFACTURERS REFER TO 277/480 VOLT WYE METERS AS 240 VOLT WYE.

THREE WIRE THREE PHASE SERVICES WILL NOT BE PROVIDED FOR NEW INSTALLATIONS AFTER 3-1-95
CUSTOMERS ON TWO PHASE PRIMARY LINES WILL BE LIMITED TO 240 VOLT FOUR WIRE THREE PHASE SERVICE.
CUSTOMERS REWIRING EXISTING 480 VOLT 3 WIRE SERVICES ON THREE PHASE PRIMARY LINES MUST CONVERT TO 277/480 VOLT FOUR WIRE SERVICE. THE DISTRICT WILL REPLACE THE THE DELTA BANK WITH A 277/480 VOLT WYE BANK.

NOTES:

1. CURRENT TRANSFORMERS MAY BE OVERLOADED TO TWO TIMES THE NOMINAL RATING. SELECTION SHOULD BE BASED UPON ESTIMATION OF ACTUAL AVERAGE DEMAND RATHER THAN CONNECTED LOAD OR SERVICE ENTRANCE RATING.
2. THE METER AND COMMERCIAL DEPARTMENTS SHOULD BE ADVISED WHEN SPECIFYING REACTIVE METERING.
3. MAST MOUNTING C.T.'S IS ALLOWED ONLY BY SPECIAL PERMISSION.(NEVER AT THE BEACHES)
4. P.U.D. METER DEPARTMENT RUNS #10 WIRE FROM C.T.'S TO METER BASE (50' MAXIMUM)
5. METER DEPARTMENT MUST BE NOTIFIED IN ADVANCE OF ALL SPECIAL METERING INSTALLATIONS.
6. BOTTOM FEED TYPE METERING FOR C.T. INSTALLATIONS IS NON-STANDARD BUT MAY BE USED WITH PERMISSION OF METER DEPARTMENT. METER AND METER BASE INFORMATION SHOWN ON THIS STANDARD DOES NOT APPLY TO BOTTOM FEED INSTALLATIONS. ("A" BASE)
7. AUTOMATIC CIRCUIT CLOSING ON METER BASES FOR CT INSTALLATIONS IS NOT ALLOWED ON CT INSTALLATIONS AFTER JANUARY 1, 1995. PROVISIONS FOR TEST SWITCHES ARE REQUIRED .

** THE PUD METER SHOP WILL INSTALL AND WIRE THE TEST SWITCH WHEN CUSTOMER OR CONTRACTOR BRINGS THE METER BASE INTO THE PUD METER SHOP.

8. RECOMENDED METER BASES FOR CT INSTALLATIONS ARE MILBANK UC 3433-XL FOR 13 TERMINAL; MILBANK UC 3438-XL FOR 8 TERMINAL AND UC 3436-XL FOR 6 TERMINAL.
9. METER BASES MUST BE LOCATED OUTSIDE.
10. LOAD INFORMATION MUST BE SUPPLIED TO METER DEPARTMENT AS SOON AS POSSIBLE.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		277/480 VOLT WYE, THREE PHASE METER SELECTION GUIDE	
	CHECKED BY: L HEARITIGE	APPROVED BY: S TUOMINEN	DRAWN BY: PEC/DLT
NO. EP 5506	DATE: 3-9-95 REV. 9-02	SCALE: 1" = 1"	NO. EP 5506

K_h = WATT–HOURS PER REVOLUTION = DISC CONSTANT.

R_r = NUMBER OF DISC REVOLUTIONS REQUIRED FOR FIRST DIAL REVOLUTION.

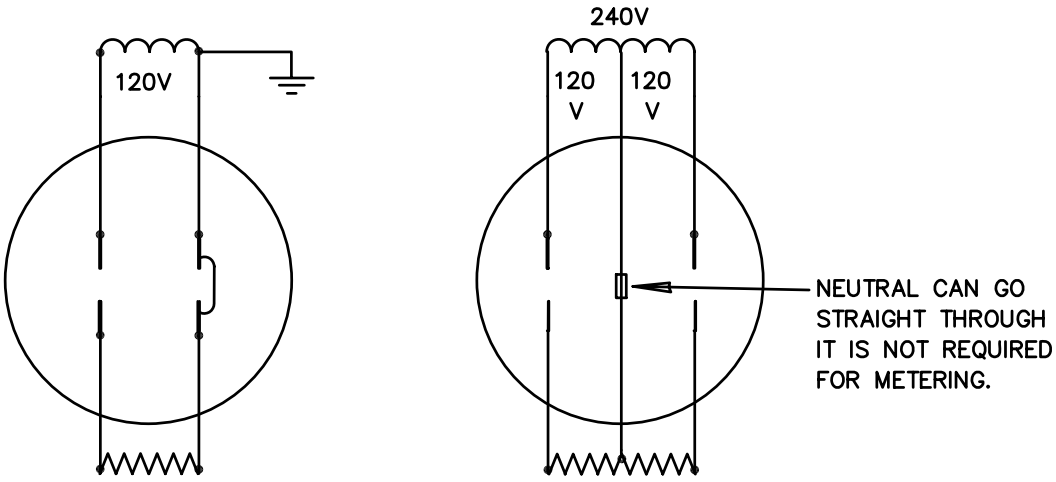
TO CALCULATE LOAD ON METER:

WATTS = DISC RPM(60)(K_h)

OR WATTS = $\frac{\text{DISC REV. (3600)}(K_h)}{\text{SECONDS REQUIRED}}$

(ON CT INSTALLATIONS MULTIPLY WATTS TIMES EXTERNAL MULTIPLIER).

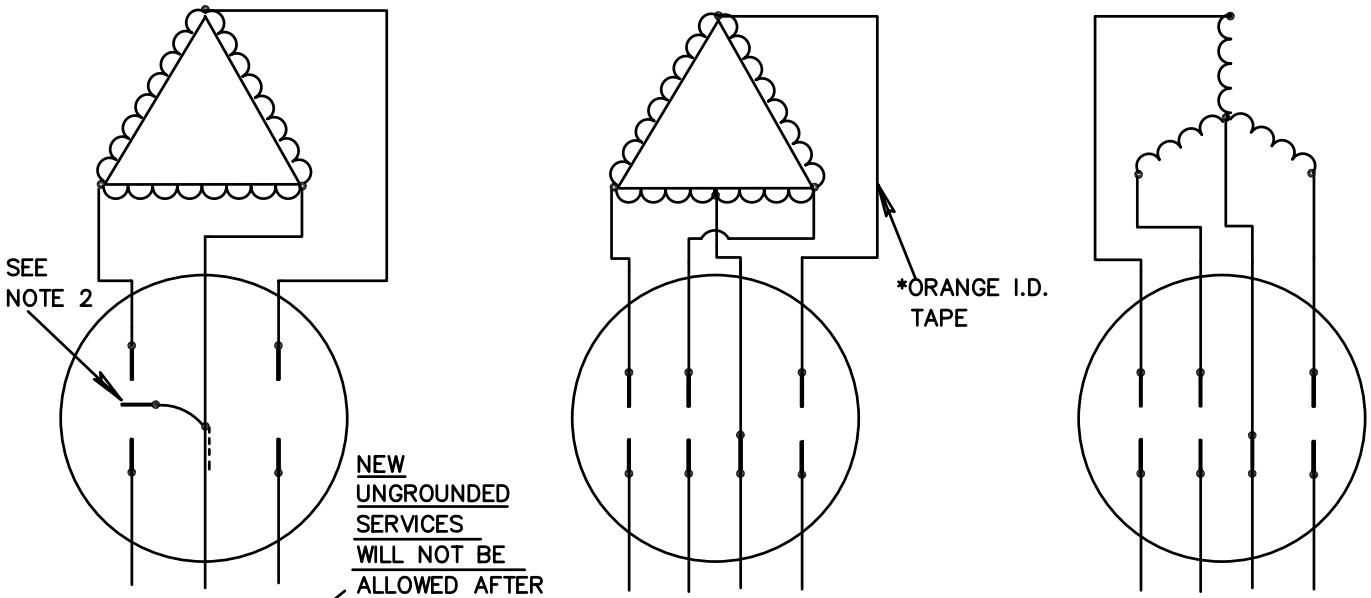
SINGLE PHASE, SELF–CONTAINED METER CONNECTIONS: FRONT VIEW



TWO WIRE
120 VOLT

THREE WIRE
120/240 VOLT

THREE PHASE, SELF–CONTAINED METER CONNECTIONS: FRONT VIEW



NEW UNGROUNDED SERVICES WILL NOT BE ALLOWED AFTER 3–1–95

5 TERMINAL
3–WIRE, 240 VOLT
OR 480 VOLT DELTA

7 TERMINAL
4–WIRE DELTA

7 TERMINAL
4–WIRE, 120/208 VOLT
OR 277/480 VOLT, WYE

*1. HIGH OR WILD LEG MUST BE IDENTIFIED WITH ORANGE TAPE AND MUST BE CONNECTED TO UPPER RIGHT HAND TERMINAL.

2. THIS TERMINAL MAY BE EITHER IN THE 9 O'CLOCK OR THE 6 O'CLOCK POSITION. AND NOT GROUNDED. THIS IS NOT A CURRENT CARRYING CONDUCTOR CAN BE #10 WIRE.

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		METERING FORMULAS AND METER CONNECTIONS	
	CHECKED BY: L HEARITIGE	APPROVED BY: S TUOMINEN	DRAWN BY: PEC/ DLT
NO. EP 5510	DATE: 3–4–97	SCALE: 1" = 1"	NO. EP 5510

MAXIMUM SERVICE LENGTH (IN FEET) FROM A XFMR
TO LIMIT FLICKER TO 4% FOR A 240 V MOTOR
WITH STARTING CURRENTS FROM 100 A TO 170 A.

TABLE 1
4/0 UG TPX

MAXIMUM STARTING CURRENT (LRA) W/ 4% FLICKER								
XFMR SIZE	100 A	110 A	120 A	130 A	140 A	150 A	160 A	170 A
10	0	0	0	0	0	0	0	0
15	60	20	0	0	0	0	0	0
25	221	181	147	119	94	73	54	38
37.5	302	262	228	200	175	154	136	119
50	343	303	269	241	216	195	177	160
75	382	342	308	280	255	234	215	199
100	398	357	324	295	271	250	231	215
167	417	376	343	314	290	269	250	234

MAXIMUM SERVICE LENGTH (IN FEET) FROM A XFMR
TO LIMIT FLICKER TO 4% FOR A 240 V MOTOR
WITH STARTING CURRENTS FROM 100 A TO 170 A.

TABLE 2
350 UG TPX

MAXIMUM STARTING CURRENT (LRA) W/ 4% FLICKER								
XFMR SIZE	100 A	110 A	120 A	130 A	140 A	150 A	160 A	170 A
10	0	0	0	0	0	0	0	0
15	95	31	0	0	0	0	0	0
25	349	285	232	187	149	115	86	60
37.5	477	413	360	315	277	243	214	188
50	542	478	425	380	342	308	279	253
75	604	540	487	442	403	370	340	315
100	628	564	511	466	428	394	365	339
167	658	594	541	496	457	424	395	369

MAXIMUM SERVICE LENGTH (IN FEET) FROM A XFMR
TO LIMIT FLICKER TO 4% FOR A 240 V MOTOR
WITH STARTING CURRENTS FROM 100 A TO 170 A.

TABLE 3
#2 OH TPX

MAXIMUM STARTING CURRENT (LRA) W/ 4% FLICKER								
XFMR SIZE	100 A	110 A	120 A	130 A	140 A	150 A	160 A	170 A
10	0	0	0	0	0	0	0	0
15	25	8	0	0	0	0	0	0
25	93	76	62	50	40	31	23	16
37.5	127	110	96	84	74	65	57	50
50	144	127	113	101	91	82	74	67
75	161	144	130	118	107	98	91	84
100	167	150	136	124	114	105	97	90
167	175	158	144	132	122	113	105	98

ENGINEER'S LINE CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		RESIDENTIAL FLICKER LIMIT TABLES FLICKER LIMIT– 4%	
	CHECKED BY: DLT	APPROVED BY: PAP	DRAWN BY: DSH
NO. EP 6220 P1	DATE: 1–02	SCALE: NONE	NO. EP 6220 P1

MAXIMUM SERVICE LENGTH (IN FEET) FROM A XFMR
TO LIMIT FLICKER TO 4% FOR A 240 V MOTOR
WITH STARTING CURRENTS FROM 100 A TO 170 A.

TABLE 4
1/0 OH TPX

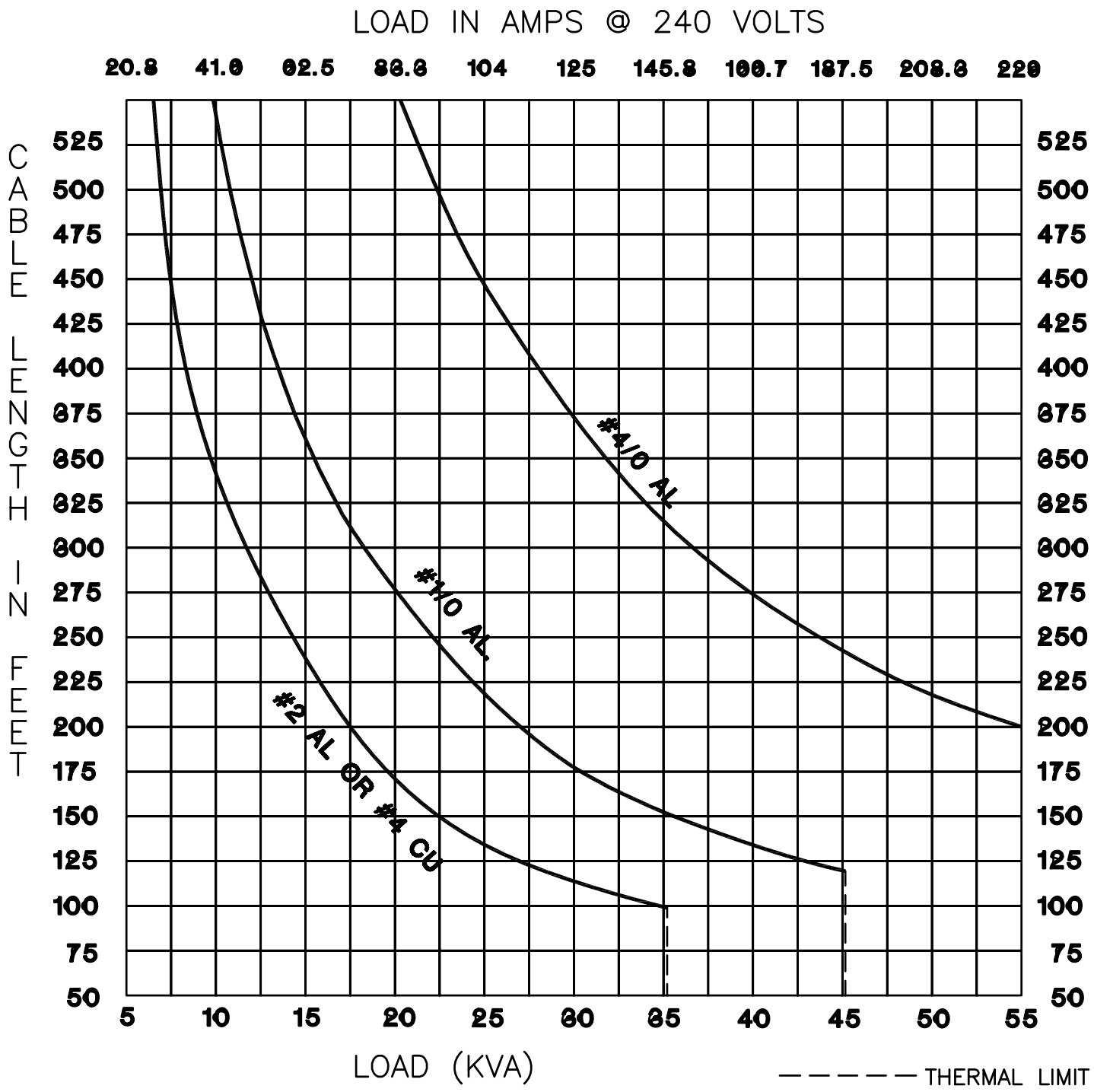
XFMR SIZE	MAXIMUM STARTING CURRENT (LRA) W/ 4% FLICKER							
	100 A	110 A	120 A	130 A	140 A	150 A	160 A	170 A
10	0	0	0	0	0	0	0	0
15	39	13	0	0	0	0	0	0
25	145	119	97	78	62	48	36	25
37.5	199	172	150	131	115	101	89	78
50	226	199	177	158	142	128	116	105
75	251	225	202	184	168	154	142	131
100	261	235	213	194	178	164	152	141
167	274	247	225	206	190	176	164	153

MAXIMUM SERVICE LENGTH (IN FEET) FROM A XFMR
TO LIMIT FLICKER TO 4% FOR A 240 V MOTOR
WITH STARTING CURRENTS FROM 100 A TO 170 A.

TABLE 5
4/0 OH TPX

XFMR SIZE	MAXIMUM STARTING CURRENT (LRA) W/ 4% FLICKER							
	100 A	110 A	120 A	130 A	140 A	150 A	160 A	170 A
10	0	0	0	0	0	0	0	0
15	76	25	0	0	0	0	0	0
25	280	229	186	150	119	92	69	48
37.5	383	332	289	253	222	195	172	151
50	435	384	341	305	274	247	224	203
75	485	433	391	354	324	297	273	253
100	504	453	410	374	343	316	293	272
167	528	477	434	398	367	340	317	296

ENGINEER'S LINE CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		RESIDENTIAL FLICKER LIMIT TABLES FLICKER LIMIT– 4%	
	CHECKED BY: DLT	APPROVED BY: PAP	DRAWN BY: DSH
NO. EP 6220 P2	DATE: 1–02	SCALE: NONE	NO. EP 6220 P2



CABLE LENGTH – LOAD INTERSECT MUST FALL BELOW AND LEFT OF CABLE SIZE LINE FOR LESS THAN 3% VOLTAGE DROP.

FOR LOADS NOT SHOWN ON CHART, USE THE FOLLOWING FORMULA:

$$\text{MAX. CABLE LENGTH (FT.) FOR 3\% E-drop} = \frac{7200}{\text{LOAD AMPS}} \div Y$$

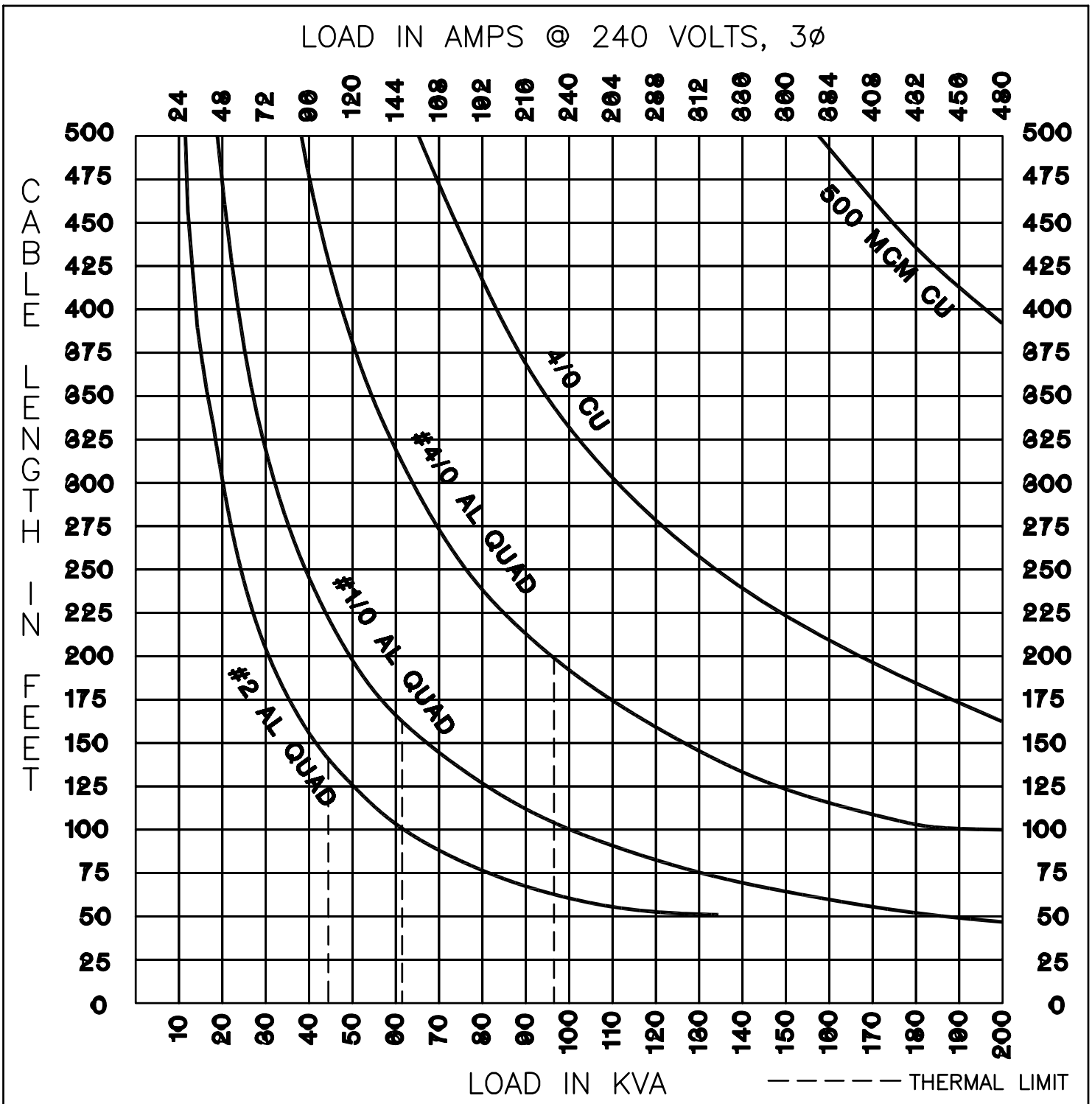
FOR 1% DROP SUBSTITUTE 2400 FOR 7200.
FOR 2% DROP SUBSTITUTE 4800 FOR 7200.
FOR 4% DROP SUBSTITUTE 9600 FOR 7200.

FOR #4 CU. OR #2 AL., Y = .512
FOR #1/0 AL., Y = .322
FOR #4/0 AL., Y = .161

ENGINEERING DEPARTMENT
PUBLIC UTILITY DISTRICT NO.1
GRAYS HARBOR COUNTY, WASHINGTON

3% VOLTAGE DROP CURVES FOR AERIAL TRIPLEX (240 VOLT, SINGLE PHASE LOADS 5 TO 55 KVA)

DATE: 6-2-1976	REVISED:6-1-00 DSR	CK BY: PCE
DR.BY: D TRASK	APPROVED: BJW	
SCALE: NONE	NO.	EP-6244



CABLE LENGTH – LOAD INTERSECT MUST FALL BELOW AND LEFT OF CABLE SIZE LINE FOR LESS THAN 3% VOLTAGE DROP.

FOR LOADS NOT SHOWN ON CHART, USE THE FOLLOWING FORMULA:

$$\text{MAX. CABLE LENGTH (FT.) FOR 3\% E–drop} = \frac{4157}{\text{LOAD AMPS}} \div Y$$

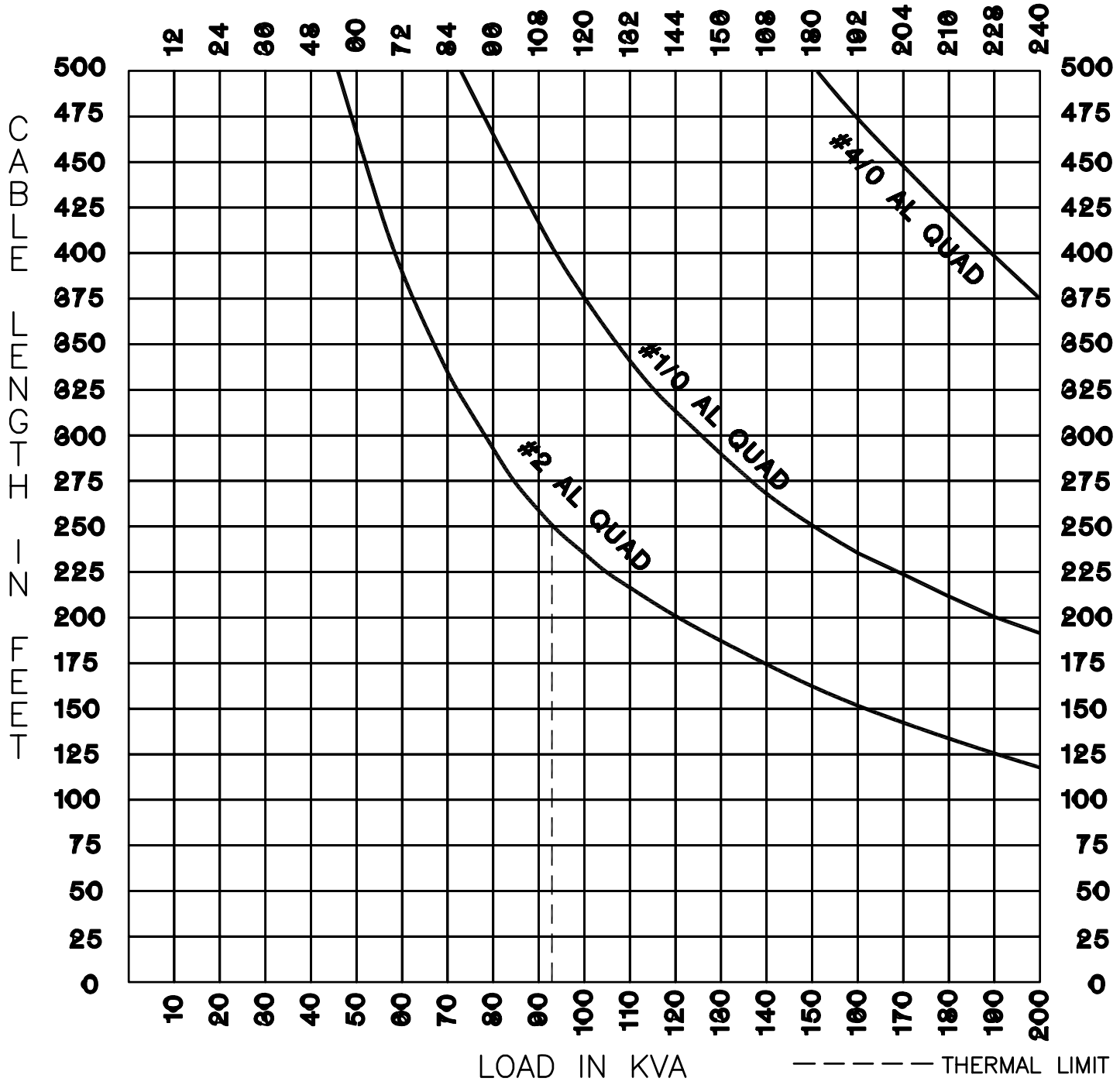
FOR 1% DROP SUBSTITUTE 1385 FOR 4157.
FOR 2% DROP SUBSTITUTE 2770 FOR 4157.
FOR 4% DROP SUBSTITUTE 5540 FOR 4157.

FOR #2 AL., Y = .2931 Ω/M
FOR #1/0 AL., Y = .1843 Ω/M
FOR 4/0 AL., Y = .092 Ω/M
FOR #4/0 CU., Y = .053 Ω/M
FOR 500 MCM, Y = .0222 Ω/M

ENGINEERING DEPARTMENT
PUBLIC UTILITY DISTRICT NO.1
GRAYS HARBOR COUNTY, WASHINGTON

3% VOLTAGE DROP CURVES
FOR 240 VOLT 3ø SERVICE
– LOADS TO 200 KVA

DATE: 1–24–1977	REVISED: 3–25–02 DLT	CK BY: SET
DR.BY: D. TRASK	APPROVED: BJW	
SCALE: NONE	NO.	EP–6246



CABLE LENGTH – LOAD INTERSECT MUST FALL BELOW AND LEFT OF CABLE SIZE LINE FOR LESS THAN 3% VOLTAGE DROP.

FOR LOADS NOT SHOWN ON CHART, USE THE FOLLOWING FORMULA:

$$\text{MAX. CABLE LENGTH (FT.) FOR 3\% E–drop} = \frac{8310}{\text{LOAD AMPS}} \div Y$$

FOR 1% DROP SUBSTITUTE 2770 FOR 8310.
FOR 2% DROP SUBSTITUTE 5540 FOR 8310.
FOR 4% DROP SUBSTITUTE 11080 FOR 8310.

FOR #2 AL., Y = .2931 Ω/M
FOR #1/0 AL., Y = .1843 Ω/M
FOR 4/0 AL., Y = .092 Ω/M

ENGINEERING DEPARTMENT
PUBLIC UTILITY DISTRICT NO.1
GRAYS HARBOR COUNTY, WASHINGTON

3% VOLTAGE DROP CURVES
FOR 480 VOLT 3ø SERVICE
– LOADS TO 200 KVA

DATE: 1–21–1977	REVISED: 6–1–00 DSR	CK BY: SET
DR.BY: D. TRASK	APPROVED: BJW	
SCALE: NONE	NO.	EP–6248

24" HORIZONTAL CLEARANCE AT SUPPORTS		30" HORIZONTAL CLEARANCE AT SUPPORTS		
CONDUCTOR	APPROXIMATE MAXIMUM SPAN	CONDUCTOR	APPROXIMATE MAXIMUM SPAN	SAG CHART
#4 ACSR	325'	#4 ACSR	360'	SP 6456
#2 ACSR	425'	#4 ACSR	500'	SP 6460
#1/0 ACSR	370'	#1/0 ACSR	450'+*	SP 6465
#4/0 AAAC	450'+*	#4/0 AAAC	450'+*	SP 6468
336 ACSR	330'	336 ACSR	450'	SP 6470
336 AAC	330'	336 AAC	440'	SP 6473
556 AAC	325'	556 AAC	440'	SP 6480

THIS DOES NOT APPLY TO SUSPENSION INSULATOR INSTALLATIONS.

* ALLOWABLE SAG EXCEEDS STANDARD PUD SAG CHART – FOR LONGER SPANS CALCULATE SAG AND USE THE FOLLOWING FORMULA TO DETERMINE MINIMUM CLEARANCE.

CLEARANCE = 0.3 IN/KV + 8 $\sqrt{S/12}$ WHERE "S" IS SAG IN INCHES AT 60°F FINAL, UNLOADED.

(FROM NESC. (1981) TABLES 235–3 AND 235–2 PAGE 187 AND PUD SAG CHARTS SP 6456, 6460, 6465, 6468, 6470, 6473, AND 6480)

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		MAXIMUM 12.5 KV PRIMARY SPANS BASED ON HORIZONTAL CONDUCTOR CLEARANCES AT SUPPORTS	
	CHECKED BY: PAP	APPROVED BY: SET	DRAWN BY: DLT
NO. EP 6304	DATE: 4–16–82	SCALE: 1" = 1"	NO. EP 6304

MARKER LOCATIONS WILL BE SHOWN ON WORK SKETCHES BY THE SYMBOL 

STATE AND COUNTY RIGHTS OF WAY

PLACE MARKERS EVERY 500 FEET ALONG LONGITUDINAL LINES – OFFSET TO ONE FOOT FROM THE RIGHT OF WAY LINE OR THE TREE OR BRUSH LINE, WHICHEVER IS LEAST, SO AS TO MINIMIZE INTERFERENCE WITH MAINTENANCE.

PLACE MARKERS TO NOTE CHANGES IN DISTANCE FROM CABLE TO CENTERLINE.

PLACE MARKERS AT THE RIGHT OF WAY LINES OR TREE LINE TO INDICATE CROSSINGS.

PLACE MARKERS NEAR CULVERTS OR OTHER AREAS WHICH ARE LIKELY TO REQUIRE EXCAVATING WORK.

PRIVATE PROPERTY

PLACE MARKERS WHERE THEY CAN BE SEEN BUT YET BE CLEAR OF ROAD OR YARD MAINTENANCE WORK.

PLACE MARKERS AT MAJOR CHANGES OF DIRECTION IN THE CABLE ROUTE.

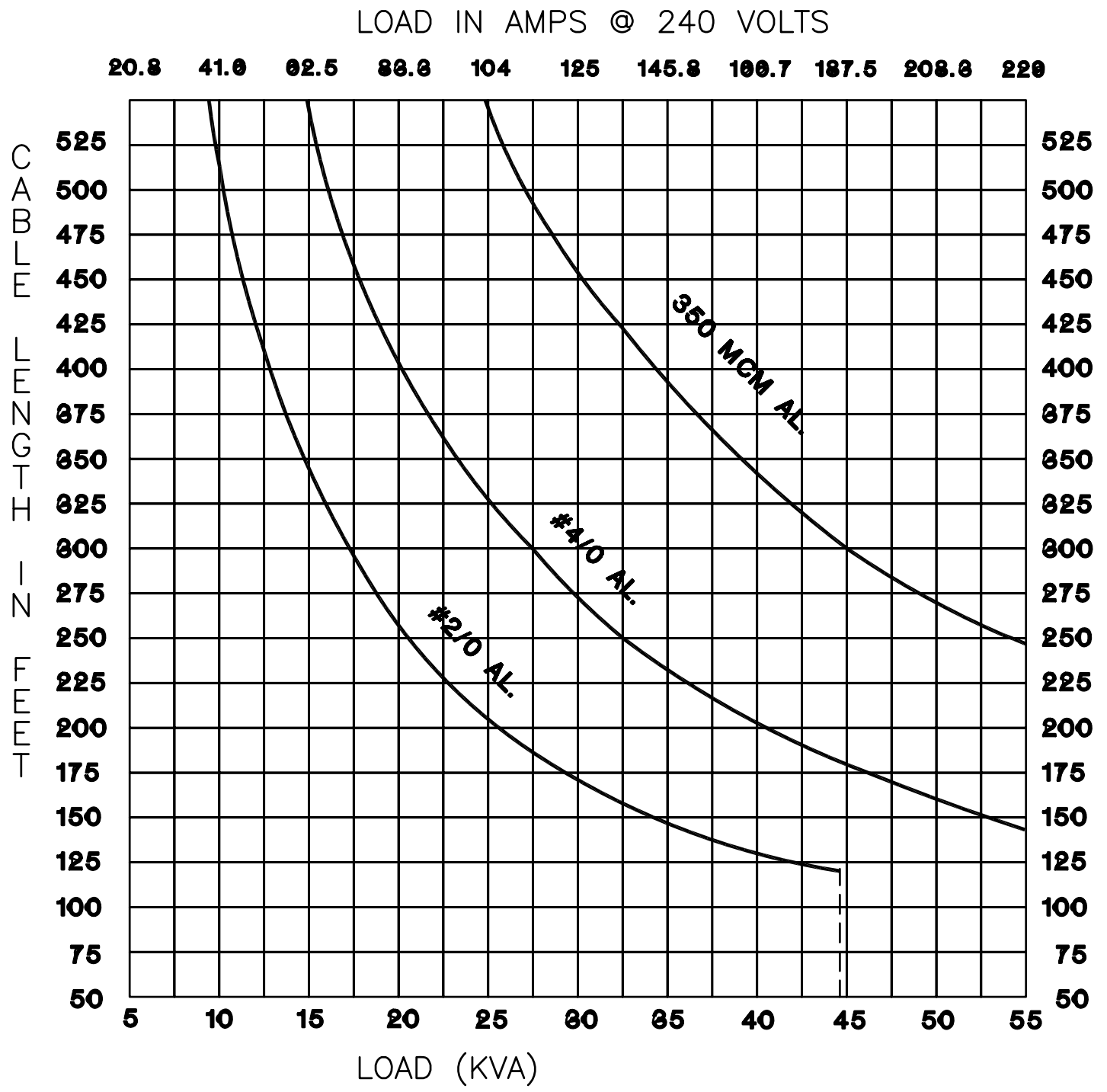
PLACE MARKERS NEAR CULVERTS, GARDENS, POTENTIAL FENCE LINES OR OTHER AREAS WHERE FUTURE EXCAVATING IS LIKELY.

CREWS MUST WRITE THE OFFSET, THE DIRECTION OF CABLE FROM MARKER AND THE CABLE VOLTAGE ON THE SIGN WITH INDELIBLE MARKING PEN.

SEE MSP 20.201 FOR SIGN AND STAKE SPECIFICATIONS.

CODE 611

CONSTRUCTION STANDARDS PUBLIC UTILITY DISTRICT NO. 1 GRAYS HARBOR COUNTY, WASHINGTON		GUIDE FOR CABLE WARNING SIGN PLACEMENT	
	CHECKED BY: JCE	APPROVED BY: BJW	DRAWN BY: LT
NO. EP 7432	DATE: 7-7-75	SCALE: 1" = 1"	NO. EP 7432



CABLE LENGTH – LOAD INTERSECT MUST FALL BELOW AND LEFT OF CABLE SIZE LINE FOR LESS THAN 3% VOLTAGE DROP.

FOR LOADS NOT SHOWN ON CHART, USE THE FOLLOWING FORMULA:

$$\text{MAX. CABLE LENGTH (FT.) FOR 3\% E–drop} = \frac{7200}{\text{LOAD AMPS}} \div Y$$

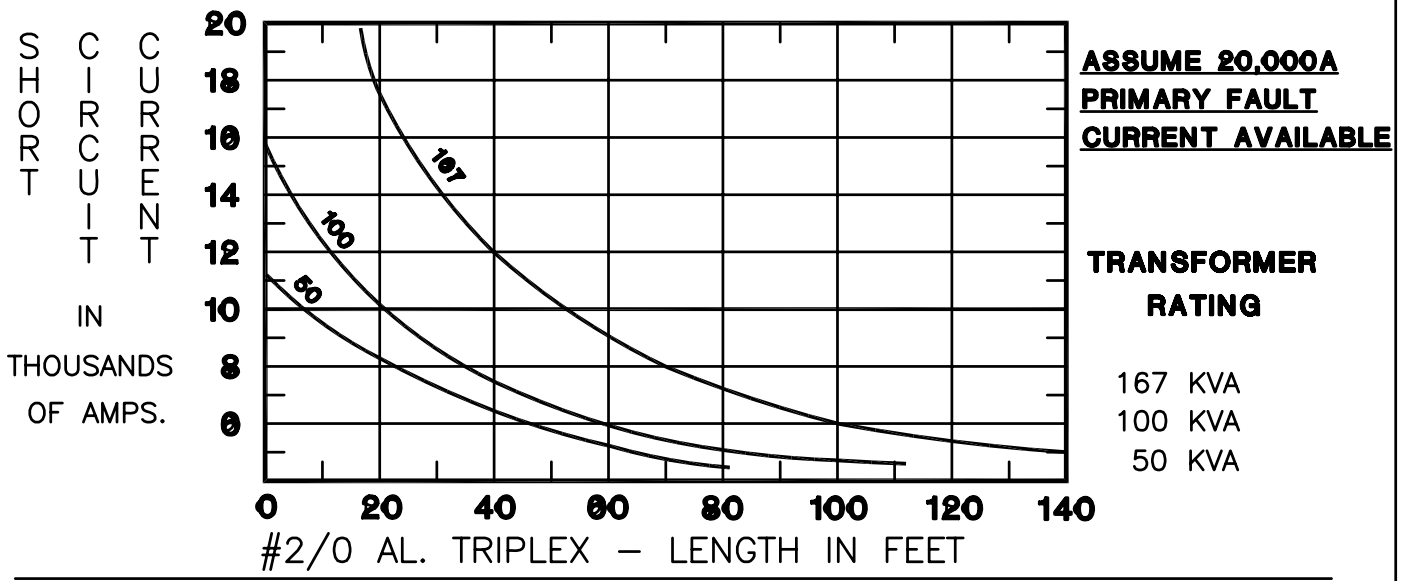
FOR 1% DROP SUBSTITUTE 2400 FOR 7200.
FOR 2% DROP SUBSTITUTE 4800 FOR 7200.
FOR 4% DROP SUBSTITUTE 9600 FOR 7200.

FOR #2/0, Y = .334
FOR #4/0, Y = .21
FOR 350 MCM, Y = .127

ENGINEERING DEPARTMENT
PUBLIC UTILITY DISTRICT NO.1
GRAYS HARBOR COUNTY, WASHINGTON

3% VOLTAGE DROP CURVES FOR UNDERGROUND SECONDARY CABLES (1ø LOADS, 5 TO 55 KVA)

DATE: 10/31/96		CK BY:
DR.BY: D TRASK	APPROVED:	
SCALE: 1:1	NO.	EP–8210



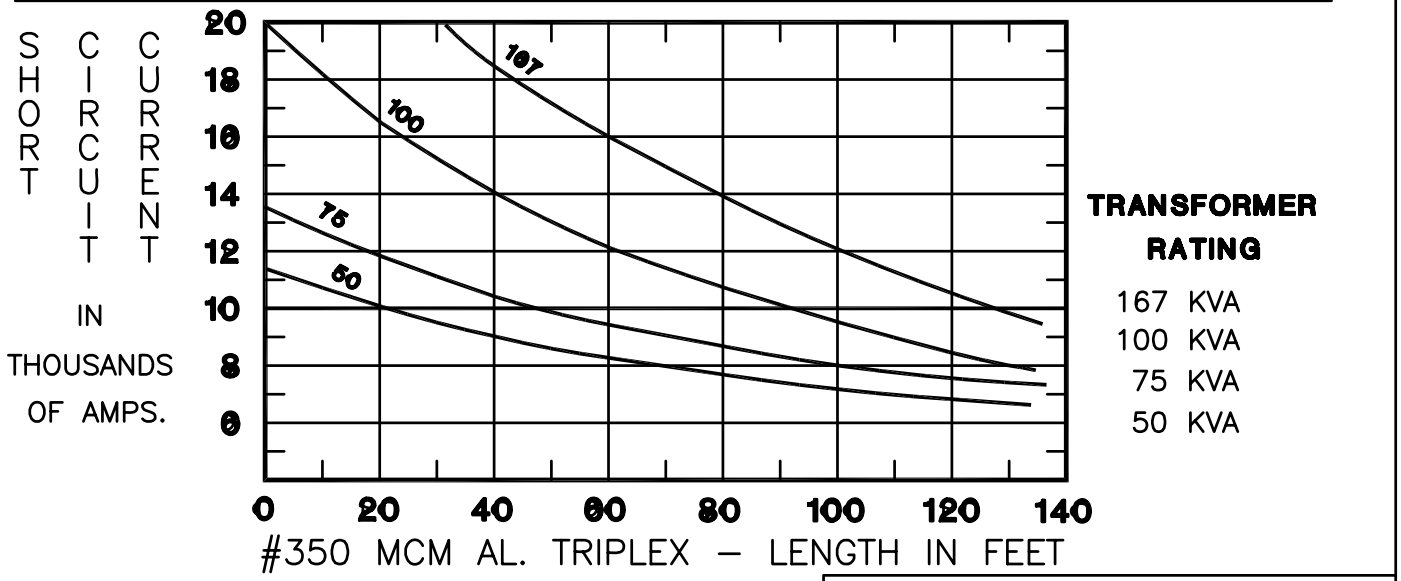
ASSUME 20,000A PRIMARY FAULT CURRENT AVAILABLE

TRANSFORMER RATING

167 KVA
100 KVA
50 KVA

TRANSFORMER RATING

167 KVA
100 KVA
75 KVA
50 KVA



TRANSFORMER RATING

167 KVA
100 KVA
75 KVA
50 KVA

NOTE:

EXCESSIVE SHORT CIRCUIT CURRENT CAN MOST READILY BE REDUCED BY ADDING SERVICE LENGTH. USE "HAIRPIN" METHOD RATHER THAN COILING.

ENGINEERING DEPARTMENT
PUBLIC UTILITY DISTRICT NO.1
GRAYS HARBOR COUNTY, WASHINGTON

SHORT CIRCUIT CURRENTS AT 240V SERVICE ENT.

DATE: 11/1/96		CK BY:
DR.BY: D TRASK	APPROVED: SET	
SCALE: 1:1	NO.	EP–8214