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March 22, 2006

Ms. Blanca S. Bayo, Director
Division of the Commission Clerk
and Administrative Services
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

Re: Docket No. 060077-TL
Proposal to require local exchange telecommunications companies to implement ten-year wood pole inspection program.

Dear Ms. Bayo:

Enclosed are an original and 15 copies of Verizon Florida Inc.'s Protest and Request for Formal Hearing for filing in the above-referenced matter. Service has been made as indicated on the Certificate of Service. If there are any questions regarding this filing, please contact me at 813-483-1256.

Sincerely,

Leigh A. Hyer

Leigh A. Hyer

LAH:tas
Enclosures

CERTIFICATE OF SERVICE

I hereby certify that copies of Verizon Florida Inc.'s Protest and Request for Formal Hearing in Docket No. 060077-TL were sent via U.S. mail on March 22, 2006 to the parties on the attached list.

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BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

In re: Proposal to require local exchange Telecommunications companies to Implement ten-year wood pole inspection Program.	)))))	Docket No. 060077-TL Filed: March 22, 2006

VERIZON FLORIDA INC.'S PROTEST
<u>AND REQUEST FOR FORMAL HEARING</u>

Pursuant to Rules 25-22.029 and 28-106.201, Florida Administrative Code, Verizon Florida Inc. ("Verizon") hereby protests the Proposed Agency Action Order No. PSC-06-0168-PAA-TL (the "PAA Order") and requests a formal hearing.

I. INTRODUCTION

1. In the PAA Order, the Commission orders that local exchange companies in Florida, including Verizon, must conduct pole inspections on an eight-year inspection cycle, which inspections "shall be based on the sound and bore technique for all poles" and must include excavation for all Southern Pine poles. (PAA Order at 10) The Commission bases this ruling on claims that pole deterioration is a major cause of hurricane damage and outages. (PAA Order at 2) The Commission further concludes that the National Electric Safety Code ("NESC") requires scheduled inspections for telephone plant (PAA Order at 2-4, 6) and that "sound and bore inspections, including excavation, are by far the most effective form of inspection for determining the internal condition of the wood poles." (PAA Order at 7)

2. Verizon disputes the factual basis for these conclusions. First, there is no evidence cited in the PAA Order to support a link between pole deterioration and hurricane damage nor is Verizon aware of any such evidence. In 2004-2005, most

hurricane-related outages experienced by Verizon customers were due to loss of commercial power to remote terminals, ***not*** downed poles. And of the Verizon-owned poles that did experience hurricane damage, anecdotal evidence demonstrates that most damage was caused by trees falling on wires and by projectiles, not loss of strength in the poles themselves.[1] In other words, the "fix" that the Commission has ordered has not been shown by objective evidence to be directed toward a verifiable problem and thus cannot be shown to be the least cost alternative to obtain the Commission's regulatory objective – better hurricane preparedness.

3. Second, the Commission has misinterpreted the NESC and thus adopted standards that are irrelevant for most Verizon-owned poles. Indeed, contrary to the PAA Order, the specifically referenced strength requirements of Section 26 of the NESC do not apply to poles that (a) carry only telephone plant or (b) carry both telephone plant and electric facilities that do not exceed 750 volts. This encompasses the substantial majority of Verizon-owned poles in Florida.

4. Third, the particular inspection methodology that the Commission has imposed – the "sound and bore" technique with excavation – is not "the most effective form of inspection," but is a crude, outdated, and inaccurate testing method that imposes environmental and health hazards. The Commission has failed to consider other testing methods that are more accurate, less damaging, and more cost effective

[1] Verizon also notes that the Commission incorrectly found that "Verizon lost 1,690 poles to storms in 2004.". This number came from a Verizon response to a Staff audit request, in which Verizon indicated that it had recorded 1,690 "incidents of damage" in 2004. Verizon indicated in its response that this figure included duplicate damage reports, since the 2004 hurricanes occurred close together in time, and that not all "incidents of damage" were lost poles (e.g., incidents of damage include trees leaning on lines). In fact, Verizon placed only 1,064 poles in 2004 for ***all reasons***, including new placements, replacements of poles damaged by car accidents, and other causes having nothing to do with hurricanes. Thus, the number of poles that were actually "lost" due to storms is far lower than 1,690.

than sound, bore and excavation. The Commission has a statutory duty to consider lower cost alternatives that substantially accomplish the regulatory objectives outlined in the PAA Order. Fla. Stat. §§ 120.54 and 120.541.

5. To be clear, by protesting the Commission's PAA Order, Verizon does not dispute that a pole inspection process coupled with enhanced record-keeping and reporting requirements is a worthy goal. In fact, targeted pole inspections based on reasonable criteria to identify "at risk" poles will help to ensure that Verizon's outside plant facilities continue to be safe and reliable and will assist the Commission in gathering data to determine whether, in fact, pole deterioration is a significant cause of hurricane-related damage and outages – something that has not yet been established in the record of this proceeding. Therefore, notwithstanding this protest, Verizon will comply with the PAA Order's requirement that it submit a comprehensive wood pole inspection plan with the Division of Competitive Markets and Enforcement by April 1, 2006. Verizon believes that, given the flexibility afforded by the Commission in the ordering paragraphs of the PAA Order, along with statements by Staff that it will consider "any functionally equivalent method of inspection" that Verizon would like to propose, Verizon believes that it is quite possible that its plan could be approved under the PAA Order, in which case Verizon will immediately withdraw its protest. However, unless and until its plan is approved, Verizon must bring this protest within the period set forth in the Notice of Further Proceedings or Judicial Review in order to protect its procedural and substantive rights.

II. PETITIONER INFORMATION

6. Verizon received notice of the PAA Order from the Commission's website.

7. All notices, pleadings, staff recommendations, orders or other documents served in this document should be provided to the following representatives:

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8. As explained in detail below, Verizon's interests would be substantially affected if the proposal set forth in the PAA Order were adopted because it would impose significant costs and administrative burdens on the Company with no feasible means of cost recovery and no proven benefit.

III. THE COMMISSION HAS CITED NO EVIDENCE OF A LINK BETWEEN POLE DETERIORATION AND HURRICANE DAMAGE.

9. The Commission justifies its imposition of uniform pole inspection requirements on local exchange telecommunications companies on the ground that hurricane damage from the 2004 and 2005 seasons "severely impacted Florida's telecommunications companies." (PAA Order at 1) While this conclusion is objectively correct, there is no evidence in the record that the damage that telecommunications companies experienced was due to pole deterioration, rather than other causes. In fact, other than incorrect citations to the number of poles lost in the 2004 and 2005 hurricane seasons (without reference to the reasons ***why*** they were lost), there is no evidence cited in the PAA Order to support a link between pole deterioration and hurricane damage.

10. Moreover, Verizon's experience indicates that pole deterioration is not the primary cause of hurricane-related outages. In 2004-2005, most hurricane-related

outages experienced by Verizon customers were due to loss of commercial power to remote terminals, ***not*** downed poles. And of the Verizon-owned poles that did experience hurricane damage, anecdotal evidence demonstrates that most damage was caused by trees falling on wires and by projectiles, not loss of strength in the poles themselves.[2] Additionally, since 2002, Verizon has received only 2 claims for damage to property caused by failed poles, totaling less $5,000. Moreover, studies conducted in the aftermath of the storms indicate that older wood poles did not fare any worse than new wood poles or concrete poles, thus refuting the idea that pole deterioration is a significant factor. Absent a clear connection between pole deterioration and hurricane damage, the cost of comprehensive pole inspections using expensive, invasive techniques cannot be justified in the name of hurricane preparedness. Indeed, diverting resources unnecessarily to pole inspections siphons resources away from other activities that have been shown empirically to harden the telephone network, such as building underground fiber networks as part of Verizon's current FiOS initiative.

IV. THE COMMISSION HAS MISINTERPRETED THE NATIONAL ELECTRIC SAFETY CODE ("NESC").

11. The Commission further justifies its PAA Order on its interpretation of NESC Section 26 to require that telephone poles meet specific strength and loading requirements, deterioration limits, and inspection cycles. The Commission has misinterpreted this NESC provision.

12. Specifically, at page 4 of the PAA Order, the Commission concludes:

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[2] Such experiences are consistent with those of other utilities throughout the United States, for which the vast majority of wind-related damage to pole lines is due to falling tress and wind-blown debris, rather than inadequate pole design or strength issues.

> Section 26 (strength requirements) of the NESC prescribes strength factors for poles which must be maintained for the period poles are in service. The NESC requires the company to strengthen or replace poles equal to or less than 18 meters in length (which would include most telephone poles) that have lost one-third of their original strength at installation under no-load conditions.

This is not correct. NESC Section 26 (i.e., Rule 261, Table 261-1A) does not state that poles that "have lost one-third of their original strength at installation" must be replaced, but rather that the pole must be replaced if the remaining strength falls to "***2/3 of that required when installed***." These are two different propositions.[3]

13. For example, the original pole may have been oversized for the load – which is often the case since Verizon tends to use in-stock, commonly used sizes even though weaker poles would be sufficient for light-duty telephone applications. In such a case, the NESC only requires replacement when the ***required*** strength has fallen by 1/3, which may be significantly less than 2/3 of the original strength of the oversized pole. For example, suppose that, on a scale of 1 to 10, a particular application requires a pole with a strength of "6".[4] However, Verizon uses a pole with a strength of "9" instead. The pole could lose 1/3 of its strength and still have a strength of "6", which is the full strength required for the application. The Commission's erroneous interpretation of NESC Section 26 would nevertheless require replacement of the pole – an unnecessary and wasteful expense. The NESC, on the other hand, would not require replacement of that pole until it reached a strength of "4".

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[3] The PAA Order is also in error when limiting the (mis)stated strength requirement to poles equal to or less than 18 meters (60 ft.) in length. The relevant rule for allowable deterioration, as correctly stated, is applicable to wood poles of all "lengths" or heights above ground.

[4] In practice, wood pole strengths are characterized by their ability to support a lateral (cantilever) load applied near the top of the pole, and are categorized in corresponding "Class" sizes (Ref. ANSI-O5.1, *American National Standard for Wood Poles*). These class sizes do not correspond to the "scale of 1 to 10" used in the present example, which is wholly hypothetical and provided only as a convenient means of simplifying the math.

14. More fundamentally, however, the strength, loading and deterioration requirements of much of NESC Section 26 do not apply to the majority of Verizon-owned telephone poles. The NESC pole strength requirements for communication poles are based on the grades of construction specified in Section 24 of the NESC, Table 242-1 "Grades of Construction for Supply Conductors Alone, at Crossing, or on the Same Structures with Other Conductors" or Table 242-2 "Grades of Construction for Communication Conductors Alone or in Upper Position of Crossing or on Joint Poles."[5] These tables provide that only "Grade N" construction is typically required for communication-only poles. Exceptions include joint use poles where the electric supply cables exceed 750 volts and communication cables crossing railroad tracks and limited-access highways.

15. Since the large majority of the Verizon-owned poles in Florida do not have power attachments at all and do not cross railroad tracks and limited-access highways, they are subject only to Grade N construction.[6] The strength and loading requirements in NESC Section 25 and most of Section 26 (e.g., Rule 261), including those addressing the deterioration limits upon which the Commission's PAA Order is based, ***only*** apply to Grade "B" and "C" poles – not Grade N telephone poles. (See Exhibit A). In fact, the NESC does not provide specific loading and strength requirements for Grade "N" poles.

16. The PAA Order (at 4) further reads:

> The requirements identified in the NESC can only be met if the company in question is conducting pole inspections of a detailed nature necessary to detect specific degree of impairment to poles. Further, these inspections must be conducted on a number of poles that is sufficient to

[5] Verizon's communication cables are always below supply cables on joint use poles.

[6] Although Verizon's poles are primarily only subject to Grade "N" construction rules, Verizon routinely places poles that exceed the Grade "N" requirements.

> be statistically reliable. Neither visual or sounding inspections of poles alone will provide the data necessary to determine the percentage of strength loss. The code is not specific as to the exact schedule with which inspections must be made, but states the following: "Lines and equipment shall be inspected at such intervals as experience has shown to be necessary." (NESC, Rule 214.A.2) The company is responsible for considering the conditions of service to which the installation reasonably can be expected to be exposed.

The Commission again misinterprets the requirements of the NESC. The 2002 edition of the NESC, Rule 214A2 states: "Lines and equipment shall be inspected at such intervals as experience has shown to be necessary." However, the associated *NOTE* further states that "It is recognized that inspections may be performed in a separate operation or while performing other duties, as desired." The NESC handbook explains that previous clarifications to the NESC were made to delete "language [that] could be misinterpreted to imply that a specific schedule was intended."[7] Therefore, planned inspections are not explicitly required by the NESC and thus are not currently required under the NESC rules or this Commission's rules (which incorporate the NESC). Moreover, given that the majority of Verizon-owned Grade "N" poles are not required to meet any specific strength and loading requirements under the NESC, inspections cannot be justified as necessary to ensure compliance with non-existent NESC requirements.

17. In other words, while the Commission may believe that scheduled inspections are a good idea, it cannot claim that scheduled inspections of 100% of Verizon's pole inventory over an eight-year cycle – including inspections of Grade N

[7] NESC Handbook, Fifth Edition, p. 167

poles that carry only communications facilities – are currently ***required*** under existing Commission rules and the NESC, as claimed in the PAA Order. They are not.[8]

18. Under a correct interpretation of the NESC rules, the modified inspection proposal submitted to Staff by BellSouth and Sprint at the February 21 workshop – which imposes different inspection requirements for poles that carry only communications equipment on the one hand, and joint use poles carrying both communications and power attachments on the other – is a rational basis for prioritizing and rationalizing the inspection process in compliance with the NESC. Verizon's comprehensive wood pole inspection plan that it will file on April 1, 2006 will incorporate a similar tiered inspection process that will require scheduled inspections of Grades "B" and "C" poles that are subject to NESC loading and strength requirements, with less emphasis placed on inspections of Grade "N" poles that are not subject to specific NESC strength and loading requirements. Given the flexibility in the ordering paragraphs of the PAA Order, Verizon believes that its inspection plan will sufficiently comply with the PAA Order and the correct interpretation of the NESC rules. If the Commission accepts Verizon's plan, Verizon will withdraw its protest.

V. THE COMMISSION HAS NOT CONSIDERED LESS COSTLY AND LESS INVASIVE INSPECTION TECHNIQUES.

19. The particular inspection methodology that the Commission has imposed – the "sound and bore" technique with excavation – is not "the most effective form of inspection," as claimed in the PAA Order. Rather, "sound and bore" is a crude,

[8] Rule 25-4.036, F.A.C., states "The plant and facilities of the utility shall be designed, constructed, installed, maintained and operated in accordance with provisions of the National Electrical Safety Code (IEEE C2-2002) . . ., which is incorporated herein by reference, pertaining to the construction of telecommunications facilities." Thus, the Commission's existing rules only require inspections to the extent that the NESC requires inspections. As set forth above, the NESC neither requires scheduled inspections, nor does it impose particular standards on telephone plant subject to Grade "N" construction.

outdated, subjective and inaccurate testing method that imposes environmental and health hazards.[9] Specifically, traditional boring is a brute force technique that requires the drilling of 7/8-inch diameter holes at several locations on the pole to test for hollow spots and deterioration. The resulting holes damage the wood pole and require significant remedial treatment, including treatment with environmentally toxic chemicals that are a hazard to employees and the public. Indeed, Verizon does not perform remedial work of this nature today because of the significant adverse health and environmental effects.

20. Excavation likewise is a time-consuming and invasive activity. Excavation generally requires the digging of a trench around the base of the pole to visually detect signs of deterioration and rot. Many of Verizon-owned poles are placed in paved surfaces, such as sidewalks and privately owned easements, and are located near underground facilities belonging to other utilities. Mandating excavation of these poles would be costly because it would require destruction of the right-of-way with jack-hammers or other equipment and would require extensive repair, including but not limited to repaving, laying new sod, and otherwise repairing destruction to landscaping – a sore issue for many municipalities and homeowners.

21. Verizon has researched alternative inspection techniques that it believes are more accurate, less damaging, and more cost-effective than the

[9] The Commission justifies the requirement for sound and bore and excavation based on the USDA Rural Electric Utility Service ("RUS") Guidelines applicable to rural electric plant. The RUS Guidelines, however, do not apply to telephone plant; they apply only to rural electric providers that receive funding to provide electric service in rural areas of the United States. As a result of receiving such funding, electric providers agree to follow certain guidelines issued by RUS. Verizon receives no such funding, and thus has not agreed to be bound by guidelines into which it has had no input. Indeed, as set forth above, there are significant differences in telephone plant and electric plant, which are specifically recognized by the NESC. Cutting and pasting a set of voluntary guidelines from the rural electric industry for one subset of pole applications into a mandate for the telecommunications industry in Florida using a different type of pole application is arbitrary and capricious.

sound/bore/excavation process mandated by the Commission. In particular, Verizon proposes to use a device known as a Resistograph – a technology commonly used in Europe and Canada – in lieu of traditional boring and excavation techniques. Rather than requiring 7/8-inch holes, the Resistograph device (see Exhibit B) uses thin drill bits to measure the wood resistance and strength of the pole. The drill bits are specially designed to backfill the holes they create, thus eliminating the need for chemical remedial treatment. The drillings can be accomplished in a manner of minutes, thus reducing the per-pole inspection cost significantly and eliminating the need to hire outside contractors. The Resistograph also eliminates the need for excavation by allowing the pole inspector to drill at 45-degree angles at the base of the pole to a depth sufficient to determine the presence of deterioration below grade.

22. The Resistograph is superior to crude sound and bore techniques because it allows for better record-keeping. The device simultaneously measures and records the local condition (degree of deterioration) of the pole on paper as it drills, thus giving the inspector immediate feedback on the strength and soundness of the pole, and it records the readings electronically so that they can be downloaded to a computer database for future reference. Indeed, the quantitative results provide an optimum means to meet the intent of the PAA Order with respect to identifying poles that have lost significant strength, possibly requiring rehabilitation or replacement.[10]

23. Verizon intends to incorporate the Resistograph technology into its comprehensive wood pole inspection plan that it will file with the Commission on April 1, 2006. Because the Resistograph is a boring device, it satisfies the sound and bore

[10] Commercially available software is available that allows the Resistograph data to be used to determine the remaining effective "section modulus" of the pole, a parameter that is directly related to the present pole strength, and a quantitative indication of the degree of deterioration.

requirements of the PAA Order. Moreover, although it does not "excavate" per se, since it does not require that the pole inspector physically dig out the earth around a pole, the Resistograph device accomplishes the same goal as excavation – testing for deterioration and rot below grade level. As such, Verizon believes that this technology satisfies the spirit, if not the letter, of the PAA Order. If the Commission accepts Verizon's plan, Verizon will withdraw its protest.

VI. CONCLUSION

24. For the foregoing reasons, Verizon protests the PAA Order and requests a hearing on the issues identified above. However, in the event that the Commission accepts the comprehensive wood pole inspection plan that Verizon submits on April 1, 2006, Verizon will withdraw this protest and comply with the terms of that plan. Therefore, Verizon respectfully requests that the Commission wait until the Staff reviews Verizon's plan and makes a recommendation to the Commission before scheduling a hearing.

Respectfully submitted on March 22, 2006.

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DOCKET NO. 060077-TL

VERIZON FLORIDA INC.'S PROTEST AND REQUEST FOR FORMAL HEARING

EXHIBIT A

Section 24. Grades of Construction

240. General

A. The grades of construction are specified in this section on the basis of the required strengths for safety. Where two or more conditions define the grade of construction required, the grade used shall be the highest one required by any of the conditions.

B. For the purposes of this section, the voltage values for direct-current circuits shall be considered equivalent to the rms values for alternating-current circuits.

241. Application of Grades of Construction to Different Situations

A. Supply Cables

For the purposes of these rules, supply cables are classified by two types as follows:

Type 1—Supply cables conforming to Rules 230C1, 230C2, or 230C3 shall be installed in accordance with Rule 261I.

Type 2—All other supply cables are required to have the same grade of construction as open-wire conductors of the same voltage.

B. Order of Grades

The relative order of grades for supply and communication conductors and supporting structures is B, C, and N, with Grade B being the highest.

C. At Crossings

Wires, conductors, or other cables of one line are considered to be at crossings when they cross over another line, whether or not on a common supporting structure, or when they cross over or overhang a railroad track or the traveled way of a limited access highway. Joint-use or collinear construction in itself is not considered to be at crossings.

1. Grade of Upper Line

   Conductors and supporting structures of a line crossing over another line shall have the grade of construction specified in Rules 241C3, 242, and 243.

2. Grade of Lower Line

   Conductors and supporting structures of a line crossing under another line need only have the grades of construction that would be required if the line at the higher level were not there.

3. Multiple Crossings

   a. Where a line crosses in one span over two or more other lines, or where one line crosses over a span of a second line, which span in turn crosses a span of a third line, the grade of construction of the uppermost line shall be not less than the highest grade that would be required of either one of the lower lines when crossing the other lower line.

   b. Where communication conductors cross over supply conductors and railroad tracks in the same span, the grades of construction shall be in accordance with Grade B construction. It is recommended that the placing of communication conductors above supply conductors generally be avoided unless the supply conductors are trolley-contact conductors and their associated feeders.

D. Conflicts (see Section 2, Structure Conflict)

The grade of construction of the conflicting structure shall be as required by Rule 243A4.

242. Grades of Construction for Conductors

The grades of construction required for conductors are given in Tables 242-1 and 242-2. For the purpose of these tables certain classes of circuits are treated as follows:

A. Constant-Current Circuit Conductors

The grade of construction for conductors of a constant-current supply circuit involved with a communication circuit and not in Type 1 cable shall be based on either its current rating or on the open-circuit voltage rating of the transformer supplying such circuit, as set forth in Tables 242-1 and 242-2. When the constant current supply circuit is in Type 1 cable, the grade of construction shall be based on its nominal full-load voltage.

B. Railway Feeder and Trolley-Contact Circuit Conductors

Railway feeder and trolley-contact circuit conductors shall be considered as supply conductors for the purpose of determining the required grade of construction.

C. Communication Circuit Conductors Located in the Supply Space

Communication circuit conductors located in the supply space shall have their grade of construction determined as follows:

1. Circuits meeting the requirements of Rule 224A3 may have the same grade of construction as ordinary communication circuits.
2. Circuits not meeting the requirements of Rule 224A3 shall have the same grade of construction as the supply circuits above which they are located.

D. Fire-Alarm Circuit Conductors

Fire-alarm circuit conductors shall meet the strength and loading requirements of communication circuit conductors.

E. Neutral Conductors of Supply Circuits

Supply circuit neutral conductors, which are effectively grounded throughout their length and are not located above supply conductors of more than 750 V to ground, shall have the same grade of construction as supply conductors of not more than 750 V to ground, except that they need not meet any insulation requirements. Other neutral conductors shall have the same grade of construction as the phase conductors of the supply circuits with which they are associated.

F. Surge-Protection Wires

Surge-protection wires shall be of the same grade of construction as the supply conductors with which they are associated.

Table 242-1
Grades of Construction for Supply Conductors Alone, at Crossing, or on the Same Structures With Other Conductors

(The voltages listed in this table are phase-to-ground values for: effectively grounded ac circuits, two-wire grounded circuits, or center-grounded dc circuits; otherwise phase-to-phase values shall be used. The grade of construction for supply conductors, as indicated across the top of the table, shall also meet the requirements for any lines at lower levels except when otherwise noted.)

Conductors, tracks, and rights-of-way at lower levels	Supply conductors at higher levels[1]													
	Constant-potential supply conductors										Constant-current supply conductors		Communication conductors located in the supply space
	0 to 750 V		751 V to 8.7 kV				Exceeding 8.7 kV						
	Urban	Rural	Urban		Rural		Urban		Rural				
	Open or Cable	Open or Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open	Cable	Open or Cable
Exclusive private rights of way	N	N	N[7]	N	N	N	N[2]	N[2]	N	N	B, C, or N; see Rule 242A		C or N; see Rule 242C
Common or public rights-of-way	N	N	C	N	N	N	C[3]	C	N	N			
Railroad tracks and limited-access highways[11]	B	B	B	B	B	B	B	B	B	B	B	B	B
Constant-potential supply conductors 0 to 750 V, open or cable	N	N	C	N	N	N	C[3]	C	C[4]	N	B, C, or N; see Rule 242A		B, C, or N; see Rule 242C
750 V to 8.7 kV Open	C[5]	N	C	C	N	N	C[3]	C	N	N			
Cable	N	N	C	N	N	N	C[3]	C	N	N			
Exceeding 8.7 kV Open	B[5]	C[5]	B	B	N	N	C[3]	C	N	N			
Cable	C[5]	N	C	N	N	N	C[3]	C	N	N			
Constant-current supply conductors; open or cable	B, C, or N; see Rule 242A										B, C, or N; see Rule 242A		B, C, or N; see Rules 242A and 242C
Communication conductors: open or cable, located in the supply space[10]	B, C, or N; see Rule 242C										B, C, or N; see Rules 242A and 242C		B, C, or N; see Rule 242C
Communication conductor: urban or rural, open or cable[6]	N	N	B[7,8]	C	B[7,8]	C	B[8]	C	B[8]	C	B[8,9]	C or N; see Rule 242A	B, C, or N; see Rule 242C

[1] The words "open" and "cable" appearing in the headings have the following meanings as applied to supply conductors: Cable means the Type 1 cables described in Rule 241A; Open means Type 2 cables described in Rule 241A and open wire.

[2] Lines that can fall outside the exclusive private rights-of-way shall comply with the grades specified for lines not on exclusive private rights of way.

[3] Supply conductors shall meet the requirements of Grade B construction if the supply circuits will not be promptly de-energized, both initially and following subsequent breaker operations, in the event of a contact with lower supply conductors or other grounded objects.

[4] Grade N construction may be used if crossing over supply services only.

[5] If the wires are service drops, they may have Grade N sizes and tensions as set forth in Table 263-2.

[6] Grade N construction may be used where the communication conductors consist only of not more than one insulated twisted-pair or parallel-lay conductor, or where service drops only are involved.

[7] Grade C construction may be used if the voltage does not exceed 5.0 kV phase to phase or 2.9 kV phase to ground.

[8] The supply conductors need only meet the requirements of Grade C construction if both of the following conditions are fulfilled:

(a) The supply voltage will be promptly removed from the communications plant by de-energization or other means, both initially and following subsequent circuit-breaker operations in the event of a contact with the communications plant.

(b) The voltage and current impressed on the communications plant in the event of a contact with the supply conductors are not in excess of the safe operating limit of the communications-protective devices.

[9] Grade C construction may be used if the current cannot exceed 7.5 A or the open circuit voltage of the transformer supplying the circuit does not exceed 2.9 kV.

[10] Communication circuits located below supply conductors shall not affect the grade of construction of the supply circuits.

[11] There is no intent to require Grade B over ordinary streets and highways.

Table 242-2
Grades of Construction for Communication Conductors Alone or in Upper Position of Crossing or on Joint Poles

(The voltages listed in this table are phase-to-ground values for: effectively grounded ac circuits, two-wire grounded circuits, or center-grounded dc circuits; otherwise phase-to-phase values shall be used. The grade of construction for supply conductors, as indicated across the top of the table, shall also meet the requirements for any lines at lower levels except when otherwise noted.) (Placing of communication conductors at higher levels at crossings or on jointly used poles should generally be avoided, unless the supply conductors are trolley-contact conductors and their associated feeders.)

Conductors, tracks, and rights-of-way at lower levels	Communication conductors (communication conductors, rural or urban, open or cable, including those run in the supply space.)
Exclusive private right-of-way	N
Common or public rights-of-way	N
Railroad tracks and limited-access highways[5]	B
Constant potential supply conductors [1] 0 to 750 V Open or cable	N
750 V to 2.9 kV Open or cable	C
Exceeding 2.9 kV Open Cable	 B C
Constant-current supply conductors [1] 0 to 7.5 A Open [2]	 C
Exceeding 7.5 A Open [2]	B [3]
Communication conductors, open or cable, urban or rural including those run in the supply space	B, C, or N [4]

[1] The words "open" and "cable" appearing in the headlines have the following meaning as applied to supply conductors: Cable means Type 1 cables as described in Rule 241A1; Open means open-wire and also Type 2 cables, as described in Rule 241A2.

[2] Where constant-current circuits are in Type 1 cable, the grade of construction shall be based on the nominal full-load voltage.

[3] Grade C construction may be used if the open-circuit voltage of the transformer supplying the circuit does not exceed 2.9 kV.

[4] See Rule 242C.

[5] There is no intent to require Grade B over ordinary streets and highways.

243. Grades of Construction for Line Supports

A. Structures

The grade of construction shall be that required for the highest grade of conductors supported except as modified by the following:

1. The grade of construction of jointly used structures, or structures used only by communication lines, need not be increased merely because the communication wires carried on such structures cross over trolley-contact conductors of 0 to 750 V to ground.
2. Structures carrying supply service drops of 0 to 750 V to ground shall have a grade of construction not less than that required for supply line conductors of the same voltage.
3. Where the communication lines cross over supply conductors and a railroad in the same span and Grade B is required by Rule 241C3b for the communication conductors, due to the presence of railroad tracks, the grade of the structures shall be B.
4. The grade of construction required for a conflicting structure (first circuit) shall be determined from the requirements of Rule 242 for crossings. The conflicting structure's conductors (first circuit) shall be assumed to cross the other circuit's conductors (second circuit) for the purposes of determining the grade of construction required for the conflicting structure.

   NOTE: The resulting structure grade requirement could result in a higher grade of construction for the structure than for the conductors carried thereon.

B. Crossarms and Support Arms

The grade of construction shall be that required for the highest grade of conductors carried by the arm concerned except as modified by the following:

1. The grade of construction of arms carrying only communication conductors need not be increased merely because the conductors cross over trolley-contact conductors of 0 to 750 V to ground.
2. Arms carrying supply service drops of 0 to 750 V to ground shall have a grade of construction not less than that required for supply line conductors of the same voltage.
3. Where communication lines cross over supply conductors and a railroad in the same span and Grade B is required by Rule 241C3b for the communication conductors due to the presence of railroad tracks, the grade of the arm shall be B.

C. Pins, Armless Construction Brackets, Insulators, and Conductor Fastenings

The grade of construction for pins, armless construction brackets, insulators, and conductor fastenings shall be that required for the conductor concerned except as modified by the following:

1. The grade of construction need not be increased merely because the supported conductors cross over trolley-contact conductors of 0 to 750 V to ground.
2. Supply service drops of 0 to 750 V to ground require only the same grade of construction as supply-line conductors of the same voltage.
3. When Grade B construction is required by Rule 241C3b for the communication conductors due to the presence of railroad tracks, Grade B construction shall be used when supporting communication lines that cross over supply conductors and a railroad in the same span.
4. When communication conductors are required to meet Grade B or C, only the requirements for mechanical strength for these grades are required.
5. Insulators for use on open conductor supply lines shall meet the requirements of Section 27 for all grades of construction.

Section 25.
Loadings for Grades B and C

250. General Loading Requirements and Maps

A. General

1. It is necessary to assume the wind and ice loads that may occur on a line. Two weather loadings are specified in Rules 250B and 250C. Where both rules apply, the required loading shall be the one that has the greater effect.
2. Where construction or maintenance loads exceed those imposed by Rule 250A1, which may occur more frequently in light loading areas, the assumed loadings shall be increased accordingly.
3. It is recognized that loadings actually experienced in certain areas in each of the loading districts may be greater, or in some cases, may be less than those specified in these rules. In the absence of a detailed loading analysis, no reduction in the loadings specified therein shall be made without the approval of the administrative authority.
4. The structural capacity provided by meeting the loading and strength requirements of Sections 25 and 26 provides sufficient capability to resist earthquake ground motions.

B. Combined Ice and Wind Loading

Three general degrees of loading due to weather conditions are recognized and are designated as heavy, medium, and light loading. Figure 250-1 shows the districts where these loadings apply.

NOTE: The localities are classified in the different loading districts according to the relative simultaneous prevalence of the wind velocity and thickness of ice that accumulates on wires. Light loading is for places where little, if any, ice accumulates on wires.

Table 250-1 shows the radial thickness of ice and the wind pressures to be used in calculating loads. Ice is assumed to weigh 913 kg/m^3 (57 lb/ft^3)

C. Extreme Wind Loading

If no portion of a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level, the provisions of this rule are not required, except as specified in Rule 261A1c or Rule 261A2f. Where a structure or its supported facilities exceeds 18 m (60 ft) above ground or water level the structure and its supported facilities shall be designed to withstand the extreme wind load associated with the Basic Wind Speed, as specified by Figure 250-2. The wind pressures calculated shall be applied to the entire structure and supported facilities without ice. The following formula shall be used to calculate wind load.

$$\text{Load in newtons} = 0.613 \cdot (V_{m/s})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_d \cdot A(m^2)$$

$$\text{Load in pounds} = 0.00256 \cdot (V_{mi/h})^2 \cdot k_z \cdot G_{RF} \cdot I \cdot C_d \cdot A(ft^2)$$

where:

0.613 0.00256	Ambient Air Density Value, the Constants 0.613, metric, and 0.00256, English, reflects the mass density of air for the standard atmosphere, i.e., temperature of 15 °C (59 °F) and sea level pressure of 760 mm (29.92 in) of mercury,
k_z	Velocity Pressure Exposure Coefficient, as defined in Rule 250C1, Table 250-2,
V	Basic Wind Speed, 3 s gust wind speed in m/s at 10 m (mi/h at 33 ft) above ground, Figure 250-2,
G_{RF}	Gust Response Factor, as defined in Rule 250C2,
I	Importance Factor, 1.0 for utility structures and their supported facilities,
C_d	Shape Factor, as defined in Rule 252B,
A	Projected wind area, m^2 (ft^2).

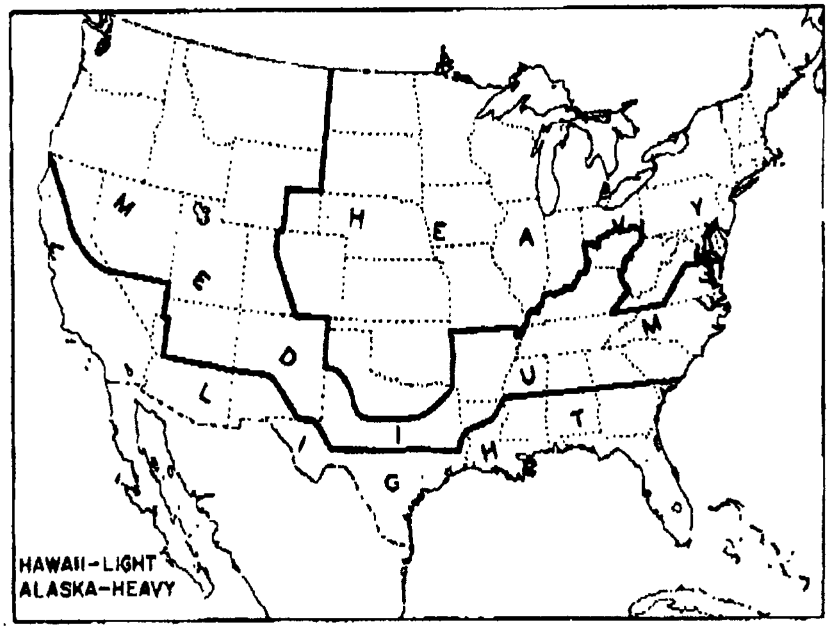


Fig 250-1
General Loading Map of United States
with Respect to Loading of Overhead Lines

Table 250-1
Ice, Wind, and Temperature

	Loading districts (For use with Rule 250B)			Extreme wind loading (For use with Rule 250C)
	Heavy	Medium	Light	
Radial thickness of ice (mm)	12.5	6.5	0	0
(in)	0.50	0.25	0	0
Horizontal wind pressure (Pa)	190	190	430	See Fig 250-2
(lb/ft²)	4	4	9	See Fig 250-2
Temperature (°C)	-20	-10	-1	+15
(°F)	0	+15	+30	+60

The wind pressure parameters (k_z, V, and G_{RF}) are based on open terrain with scattered obstructions (Exposure Category C as defined in ASCE 7-98). Exposure Category C is the basis of the NESC extreme wind criteria. Topographical features such as ridges, hills, and escarpments may increase the wind loads on site-specific structures. A Topographic Factor, K_{zt}, from ASCE 7-98 may be used to account for these special cases.

1. Velocity Pressure Exposure Coefficient, k_z

   The k_z for the structure is based on the total structure height, h, above the groundline. The k_z for the wire is based on the height, h, of the wire at the structure. The numerical values of k_z, for values of structure and conductor height are tabulated in Table 250-2. In special terrain conditions (i.e., mountainous terrain and canyon) where the height of the conductor above ground at mid-span may be substantially higher than at the attachment point, engineering judgment may be used in determining an appropriate value for the wire k_z. The value of k_z may also be determined using the formulas in Table 250-2. When h is > 75 m (250 ft) the formulas shall be used to determine a k_z value.

2. Gust Response Factor, G_{RF}

   The structure and wire gust response factors are tabulated in Table 250-3. The structure Gust Response Factor, G_{RF}, is determined using the total structure height, h. The wire Gust Response Factor is determined using the height of the wire at the structure, h, and the design wind span, L. The structure and wire gust response factors may also be determined using the formulas in Table 250-3. For values of h > 75 m (250 ft) and L > 600 m (2000 ft) the G_{RF} shall be determined using the formulas in Table 250-3. In special terrain conditions (i.e., mountainous terrain and canyon) where the height of the conductor above ground at midspan may be substantially higher than at the attachment point, engineering judgment may be used in determining an appropriate value for the wire G_{RF}. Wire attachment points that are 18 m (60 ft) or less above ground or water level must be considered if the total structure height is greater than 18 m (60 ft) above ground or water.

Table 250-2
Velocity Pressure Exposure Coefficient k_z, Structure and Wire

Height, h (m)	Height, h (ft)	k_z (Structure)	k_z (Wire)
≤ 10	≤ 33	0.92	1.00
> 10 to 15	> 33 to 50	1.00	1.10
> 15 to 25	> 50 to 80	1.10	1.20
> 25 to 35	> 80 to 115	1.20	1.30
> 35 to 50	> 115 to 165	1.30	1.40
> 50 to 75	> 165 to 250	1.40	1.50
> 75	> 250	Use Formulas	Use Formulas
Formulas (Metric):			
Structure	$k_z = 2.01 \cdot (0.67 \cdot h/275)^{(2/9.5)}$		for 18 m ≤ h ≤ 275 m
Wire	$k_z = 2.01 \cdot (h/275)^{(2/9.5)}$		for 10 m < h ≤ 275 m
Formulas (English):			
Structure	$k_z = 2.01 \cdot (0.67 \cdot h/900)^{(2/9.5)}$		for 60 ft ≤ h ≤ 900 ft
Wire	$k_z = 2.01 \cdot (h/900)^{(2/9.5)}$		for 33 ft < h ≤ 900 ft
h = Structure or Wire height as defined in Rule 250C1			
Minimum k_z = 0.85			
Formulas are for Exposure Category C, ASCE 7-98			

m

Table 250-3
Structure and Wire Gust Response Factors, G_{RF}

Height	Structure	Wire G_{RF}, Span Length, L (m)						
h (m)	G_{RF}	≤75	75<L≤150	150<L≤225	225<L≤300	300<L≤450	450<L≤600	L>600
≤ 10	1.02	0.93	0.86	0.79	0.75	0.73	0.69	(1)
> 10 to 15	0.97	0.88	0.82	0.76	0.72	0.70	0.67	(1)
> 15 to 25	0.93	0.86	0.80	0.75	0.71	0.69	0.66	(1)
> 25 to 35	0.89	0.83	0.78	0.73	0.70	0.68	0.65	(1)
> 35 to 50	0.86	0.82	0.77	0.72	0.69	0.67	0.64	(1)
> 50 to 75	0.83	0.80	0.75	0.71	0.68	0.66	0.63	(1)
> 75	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

Formulas:

Structure $G_{RF} = [1 + (2.7 \cdot E_s \cdot B_s^{0.5})]/k_v^2$

Wire $G_{RF} = [1 + (2.7 \cdot E_w \cdot B_w^{0.5})]/k_v^2$

$E_s = 0.346 \cdot [10/(0.67 \cdot h)]^{1/7}$

$E_w = 0.346 \cdot (10/h)^{1/7}$

$B_s = 1/(1 + 0.375 \cdot h/67)$

$B_w = 1/(1 + 0.8 \cdot L/67)$

Where:

E_w = Wire Exposure Factor

E_s = Structure Exposure Factor

B_w = Dimensionless response term corresponding to the quasi-static background wind loads on the wire

B_s = Dimensionless response term corresponding to the quasi-static background wind loads on the structure

$k_v = 1.43$

h = Structure or Wire height, as defined in Rule 250C2, in meters

L = Design Wind Span, in meters

Formulas are for Exposure Category C, ASCE 7-98

(1) For heights greater than 75 m and/or spans greater than 600 m, the formulas shall be used

ft

Table 250-3
Structure and Wire Gust Response Factors, G_{RF}

Height h (ft)	Structure G_{RF}	Wire G_{RF}, Span Length, L (ft) ≤250	250<L≤500	500<L≤750	750<L≤1000	1000<L≤1500	1500<L≤2000	L>2000[1]
≤ 33	1.02	0.93	0.86	0.79	0.75	0.73	0.69	(1)
> 33 to 50	0.97	0.88	0.82	0.76	0.72	0.70	0.67	(1)
> 50 to 80	0.93	0.86	0.80	0.75	0.71	0.69	0.66	(1)
> 80 to 115	0.89	0.83	0.78	0.73	0.70	0.68	0.65	(1)
> 115 to 165	0.86	0.82	0.77	0.72	0.69	0.67	0.64	(1)
> 165 to 250	0.83	0.80	0.75	0.71	0.68	0.66	0.63	(1)
> 250	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)

Formulas:

Structure $G_{RF} = [1 + (2.7 \cdot E_s \cdot B_s^{0.5})]/k_v^2$

Wire $G_{RF} = [1 + (2.7 \cdot E_w \cdot B_w^{0.5})]/k_v^2$

$E_s = 0.346 \cdot [33/(0.67 \cdot h)]^{1/7}$

$E_w = 0.346 \cdot (33/h)^{1/7}$

$B_s = 1/(1 + 0.375 \cdot h/220)$

$B_w = 1/(1 + 0.8 \cdot L/220)$

Where:

E_w = Wire Exposure Factor

E_s = Structure Exposure Factor

B_w = Dimensionless response term corresponding to the quasi-static background wind loads on the wire

B_s = Dimensionless response term corresponding to the quasi-static background wind loads on the structure

$k_v = 1.43$

h = Structure or Wire height, as defined in Rule 250C2, in feet

L = Design Wind Span, in feet

Formulas are for Exposure Category C, ASCE 7-98

(1) For heights greater than 250 ft and/or spans greater than 2000 ft, the formulas shall be used

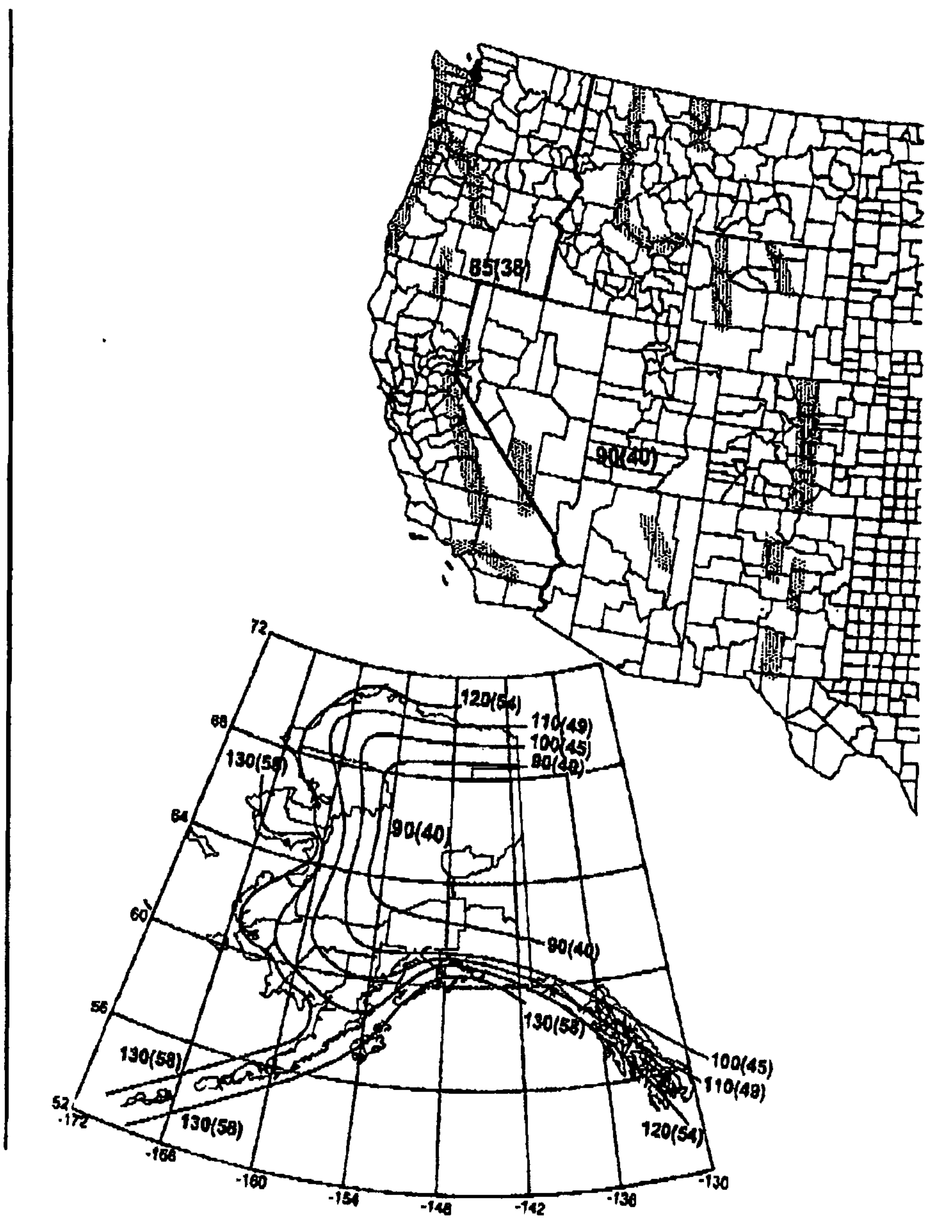
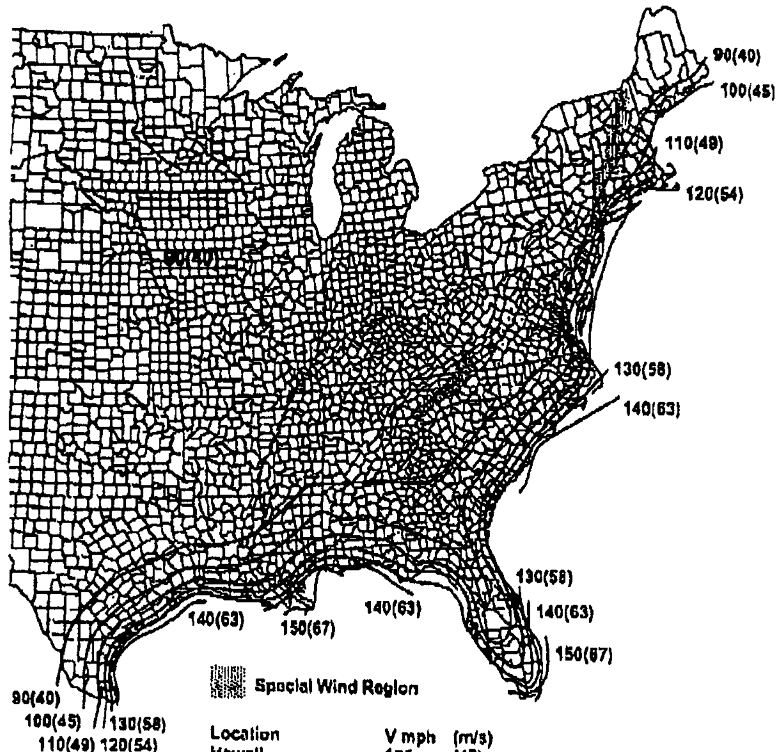


Fig 250-2(a)
Basic Wind Speeds*

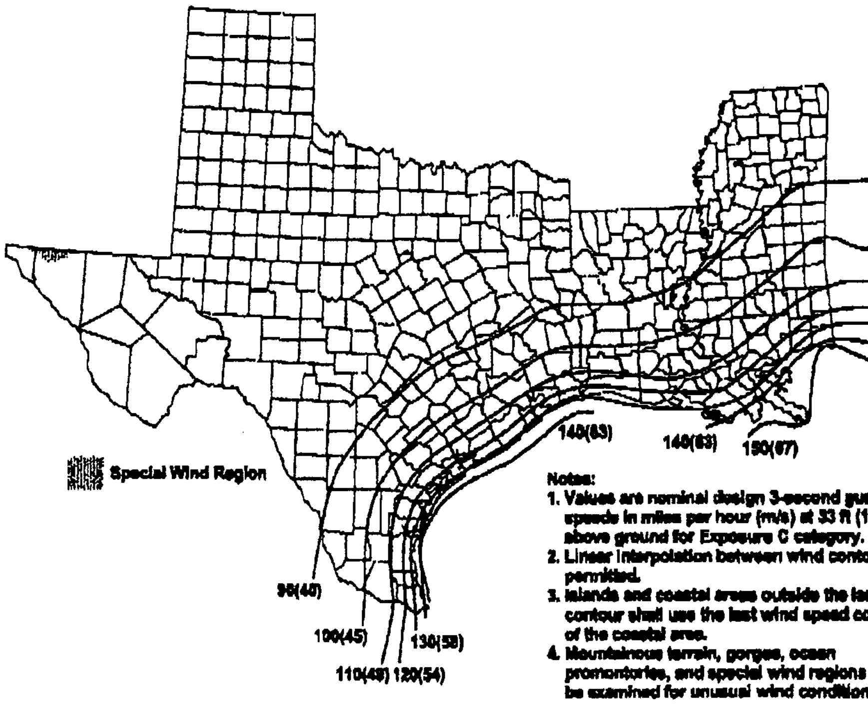
*Fig 250-2(a), Fig 250-2(b), Fig 250-2(c), Fig 250-2(d), and Fig 250-2(e) reprinted with the permission of ASCE Publications, 1801 Alexander Bell Dr., Reston, VA 20191 from ASCE 7-98, Minimum Design Loads for Buildings and Other Structures. Copyright © 1998.



Location	V mph	(m/s)
Hawaii	105	(47)
Puerto Rico	145	(65)
Guam	170	(76)
Virgin Islands	145	(65)
American Samoa	125	(56)

Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

Fig 250-2(b)
Basic Wind Speeds*



Notes:
1. Values are nominal design 3-second gust wind speeds in miles per hour (m/s) at 33 ft (10 m) above ground for Exposure C category.
2. Linear interpolation between wind contours is permitted.
3. Islands and coastal areas outside the last contour shall use the last wind speed contour of the coastal area.
4. Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

Fig 250-2(c)
Western Gulf of Mexico Hurricane Coastline*

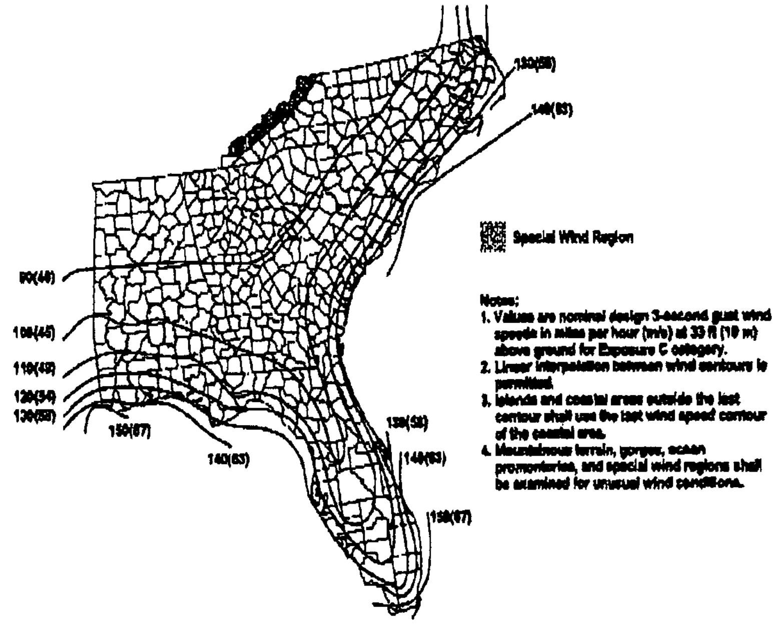


Fig 250-2(d)
Kastern Gulf of Mexico and Southeastern US Hurricane Coastline*

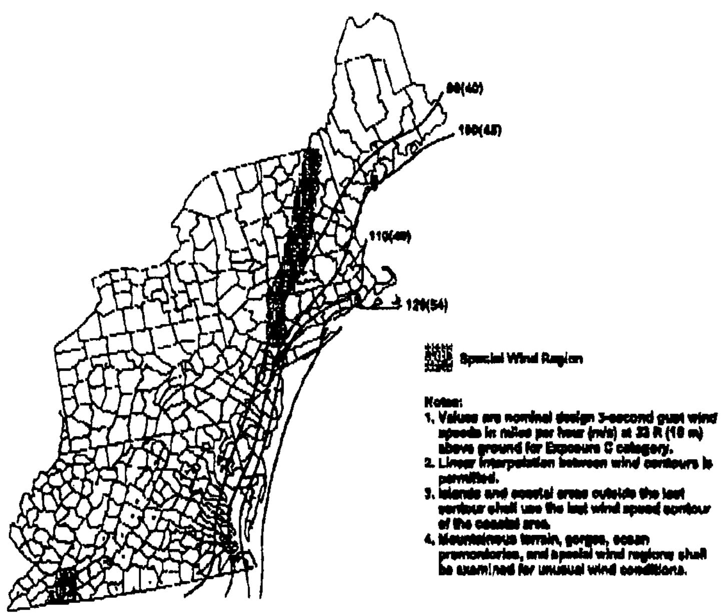


Fig 250-2(e)
Mid und Northern Atlantic Hurricane Coastline*

251. Conductor Loading

A. General

Ice and wind loads are specified in Rule 250.

1. Where a cable is attached to a messenger, the specified loads shall be applied to both cable and messenger.
2. In determining wind loads on a conductor or cable without ice covering, the assumed projected area shall be that of a smooth cylinder whose outside diameter is the same as that of the conductor or cable. The shape factor for cylindrical surfaces is assumed to be 1.0.

   NOTE: Experience has shown that as the size of multiconductor cable decreases, the actual projected area decreases, but the roughness factor increases and offsets the reduction in projected area.
3. An appropriate mathematical model shall be used to determine the wind and weight loads on ice-coated conductors and cables. In the absence of a model developed in accordance with Rule 251A4, the following mathematical model shall be used:
   a. On a conductor, lashed cable, or multiple-conductor cable, the coating of ice shall be considered to be a hollow cylinder touching the outer strands of the conductor or the outer circumference of the lashed cable or multiple-conductor cable.
   b. On bundled conductors, the coating of ice shall be considered as individual hollow cylinders around each subconductor.
4. It is recognized that the effects of conductor stranding or of non-circular cross section may result in wind and ice loadings more or less than those calculated according to assumptions stated in Rule 251A2 and Rule 251A3. No reduction in these loadings is permitted unless testing or a qualified engineering study justifies a reduction.

B. Load Components

The load components shall be determined as follows:

1. Vertical Load Component

   The vertical load on a wire, conductor, or messenger shall be its own weight plus the weight of conductors, spacers, or equipment that it supports, ice covered where required by Rule 250.
2. Horizontal Load Component

   The horizontal load shall be the horizontal wind pressure determined under Rule 250 applied at right angles to the direction of the line using the projected area of the conductor or messenger and conductors, spacers, or equipment that it supports, ice covered where required by Rule 250.
3. Total Load

   The total load on each wire, conductor, or messenger shall be the resultant of components 1 and 2 above, calculated at the applicable temperature in Table 251-1, plus the corresponding constant in Table 251-1. In all cases the conductor or messenger tension shall be computed from this total load.

Table 251-1
Temperatures and Constants

	Loading districts (for use with Rule 250B)			Extreme wind loading (for use with Rule 250C)
	Heavy	Medium	Light	
Temperature (°C)	−20	10	−1	+15
(°F)	0	+15	+30	+60
Constant to be added to the resultant (all conductors) in N/m	4.4	2.9	0.73	0.0
in lb/ft	0.30	0.20	0.05	0.0

252. Loads on Line Supports

A. Assumed Vertical Loads

The vertical loads on poles, towers, foundations, crossarms, pins, insulators, and conductor fastenings shall be their own weight plus the weight that they support, including all wires and cables, in accordance with Rules 251A and 251B1, together with the effect of any difference in elevation of supports. Loads due to radial ice shall be computed on wires, cables, and messengers, but need not be computed on supports.

B. Assumed Transverse Loads

The total transverse loads on poles, towers, foundations, crossarms, pins, insulators, and conductor fastenings shall include the following:

1. Transverse Loads from Conductors and Messengers

   The transverse loads from conductors and messengers shall be the horizontal load determined by Rule 251.

   EXCEPTION: In medium- and heavy-loading districts, where supporting structures carry ten or more conductors on the same crossarm, not including cables supported by messengers, and where the horizontal pin spacing does not exceed 380 mm (15 in), the transverse wind load may be calculated on two-thirds of the total number of such conductors if at least ten conductors are used in the calculations.

2. Wind Loads on Structures

   The transverse load on structures and equipment shall be computed by applying, at right angles to the direction of the line, the appropriate horizontal wind pressure determined under Rule 250. This load shall be calculated using the projected surfaces of the structures and equipment supported thereon, without ice covering. The following shape factors shall be used.

   a. Cylindrical Structures and Components

      Wind loads on straight or tapered cylindrical structures or structures composed of numerous narrow relatively flat panels that combine to form a total cross section that is circular or elliptical in shape shall be computed using a shape factor of 1.0.

   b. Flat Surfaced (Not Lattice) Structures and Components

      Wind loads on flat surfaced structures, having solid or enclosed flat sides and an overall cross section that is square or rectangular, shall be computed using a shape factor of 1.6.

   c. Lattice Structures

      Wind loads on square or rectangular lattice structures or components shall be computed using a shape factor of 3.2 on the sum of the projected areas of the members of the front face if structural members are flat surfaced or 2.0 if structural surfaces are cylindrical. The total, however, need not exceed the load that would occur on a solid structure of the same outside dimension.

      EXCEPTION: The shape factors listed under Rules 252B2a, 252B2b, and 252B2c may be reduced if wind tunnel tests or aerodynamic analysis justifies a reduction.

3. At Angles

   Where a change in direction of wires occurs, the loads on the structure, including guys, shall be the vector sum of the transverse wind load and the wire tension load. In calculating these loads, a wind direction shall be assumed that will give the maximum resultant load. Proper reduction may be made to the loads to account for the reduced wind pressure on the wires resulting from the angularity of the application of the wind on the wire.

4. Span Lengths

   The calculated transverse load shall be based on the average of the two spans adjacent to the structure concerned.

C. Assumed Longitudinal Loading

1. Change in Grade of Construction

   The longitudinal loads on supporting structures, including poles, towers, and guys at the ends of sections required to be of Grade B construction, when located in lines of lower than Grade B construction, shall be taken as an unbalanced pull in the direction of the higher grade section equal to the larger of the following values:

a. Conductors with Rated Breaking Strength of 13.3 kN (3000 lb) or less

The pull of two-thirds, but not less than two, of the conductors having a rated breaking strength of 13.3 kN (3000 lb) or less. The conductors selected shall produce the maximum stress in the support.

b. Conductors with Rated Breaking Strength of more than 13.3 kN (3000 lb)

The pull resulting from one conductor when there are eight or less conductors (including overhead ground wires) having rated breaking strength of more than 13.3 kN (3000 lb), and the pull of two conductors when there are more than eight conductors. The conductors selected shall produce the maximum stress in the support.

2. Jointly Used Poles at Crossings Over Railroads, Communication Lines, or Limited Access Highways

Where a joint line crosses a railroad, a communication line, or a limited access highway, and Grade B is required for the crossing span, the tension in the communication conductors of the joint line shall be considered as limited to one-half their rated breaking strength, provided they are smaller than Stl WG No. 8 if of steel, or AWG No. 6 if of copper.

3. Deadends

The longitudinal load on a supporting structure at a deadend shall be an unbalanced pull equal to the tensions of all conductors and messengers (including overhead ground wires); except that with spans in each direction from the dead end structure, the unbalanced pull shall be the difference in tensions.

4. Unequal Spans and Unequal Vertical Loads

The structure should be capable of supporting the unbalanced longitudinal load created by the difference in tensions in the wires in adjacent spans caused by unequal vertical loads or unequal spans.

5. Stringing Loads

Consideration should be given to longitudinal loads that may occur on the structure during wire stringing operations.

6. Longitudinal Capability

It is recommended that structures having a longitudinal strength capability be provided at reasonable intervals along the line.

7. Communication Conductors on Unguyed Supports at Railroad and Limited Access Highway Crossings

The longitudinal load shall be assumed equal to an unbalanced pull in the direction of the crossing of all open-wire conductors supported, the pull of each conductor being taken as 50% of its rated breaking strength in the heavy loading district, 33 1/3% in the medium loading district, and 22-1/4% in the light-loading district.

D. Simultaneous Application of Loads

Where a combination of vertical, transverse, or longitudinal loads may occur simultaneously, the structure shall be designed to withstand the simultaneous application of these loads.

NOTE: Under the extreme wind conditions of Rule 250C, an oblique wind may require greater structural strength than that computed by Rules 252B and 252C.

| 253. Overload Factors for Structures, Crossarms, Support Hardware, Guys, Foundations, and Anchors

Loads due to the combined ice and wind loads in Rule 250B and the extreme wind loading condition in Rule 250C shall be multiplied by the overload factors in Table 253-1 or the alternate overload factors in Table 253-2. Table 253-1 shall be used with Table 261-1A. Table 253-2 shall be used with Table 261-1B.

For wood and reinforced (not prestressed) concrete, two methods for determining the capacity are included herein. Either method meets the basic requirements for safety.

Table 253-1
Overload Factors for Structures,[1] Crossarms, Support Hardware, Guys, Foundations, and Anchors to Be Used with the Strength Factors of Table 261-1A

	Overload Factors	
	Grade B	**Grade C**
Rule 250B Loads		
Vertical Loads[3]	1.50	1.90[6]
Transverse Loads		
Wind	2.50	2.20[4]
Wire Tension	1.65[2]	1.30[5]
Longitudinal Loads		
At Crossings		
In general	1.10	no requirement
At deadends	1.65[2]	1.30[5]
Elsewhere		
In general	1.00	no requirement
At deadends	1.65[2]	1.30[5]
Rule 250C Loads	1.00	1.00

[1] Includes pole.

[2] For guys and anchors associated with structures supporting communication conductors and cables only, this factor may be reduced to 1.33.

[3] Where vertical loads significantly reduce the stress in a structure member a vertical overload factor of 1.0 should be used for the design of such member. Such member shall be designed for the worst case loading.

[4] This factor may be reduced to 1.75 when the span being supported is not at a crossing.

[5] For metal or prestressed concrete portions of structures and crossarms, guys, foundations, and anchors, use a value of 1.10.

[6] For metal or prestressed concrete portions of structures, crossarms, guys, foundations, and anchors, use a value of 1.50.

Table 253-2
Alternate Overload Factors for Wood and Reinforced (Not Prestressed) Concrete Structures[1,5] to Be Used with the Strength Factors of Table 261-1B

	Overload Factors			
	Grade B		Grade C	
	When Installed	At Replacement[2,3]	When Installed	At Replacement[2,3]
Rule 250B Loads				
Vertical loads[4]	2.20	1.50	2.20	1.50
Transverse loads				
Wind (at crossings)	4.00	2.67	2.67	1.33
Wind (elsewhere)	4.00	2.67	2.00	1.33
Wire tension	2.00	1.33	1.33	1.00
Longitudinal loads				
In general	1.33	1.00	No requirement	No requirement
At deadends	2.00[6]	1.33[7]	1.33	1.00
Rule 250C Loads	1.33	1.00	1.33	1.00

[1] Includes poles.

[2] Where a wood structure is built for temporary service, the overload factors at replacement may be used provided the designated fiber stress is not exceeded during the life of the structure. Where a reinforced concrete (not prestressed) structure is built for temporary service, the overload factors at replacement may be used.

[3] When structure strength deteriorates to the level of the loads multiplied by the overload factors required at replacement, the structure shall be replaced or rehabilitated. If a structure is replaced, it shall meet the "when installed" overload factors at replacement. Rehabilitated portions of structures shall have overload factors at the time of rehabilitation greater than of those required "at replacement."

[4] Where vertical loads significantly reduce the stress in a structural member, a vertical overload factor of 1.0 should be used for the design of such member. Such members shall be designed for the worst-case loading.

[5] Metal portions of a structure may be designed using the overload factors in Table 253-1.

[6] For unguyed wood poles supporting communication conductors and cables only, this factor may be reduced to 1.33.

[7] For unguyed wood poles supporting communication conductors and cables only, this factor may be reduced to 1.0.

Section 26.
Strength Requirements

260. General (see also Section 20)

A. Preliminary Assumptions

1. It is recognized that deformation, deflections, or displacement of parts of the structure may change the effects of the loads assumed. In the calculation of stresses, allowance may be made for such deformation, deflection, or displacement of supporting structures including poles, towers, guys, crossarms, pins, conductor fastenings, and insulators when the effects can be evaluated. Such deformation, deflection, or displacement should be calculated using Rule 250 loads prior to application of the overload factors in Rule 253. For crossings or conflicts, the calculations shall be subject to mutual agreement.
2. It is recognized that new materials may become available. While these materials are in the process of development, they must be tested and evaluated. Trial installations are permitted where qualified supervision is provided.

B. Application of strength factors

1. Structures shall be designed to withstand the appropriate loads multiplied by the overload factors in Section 25 without exceeding their strength multiplied by the strength factors in Section 26.
2. Unless otherwise specified, a strength factor of 0.80 shall be used for the extreme wind loading conditions specified in Rule 250C for all supported facilities.

   NOTE: The latest edition of the following documents are among those available for determining structure design capacity with the specified NESC loads, overload factors, and strength factors:

   ANSI/ASCE-10, Design of Latticed Steel Transmission Structures

   ASCE-91, Design of Guyed Electrical Transmission Structure

   ASCE-PCI, Guide for the Design of Prestressed Concrete Poles

   ASCE-72, Design of Steel Transmission Pole Structures

   PCI, Design Handbook-Precast and Prestressed Concrete

   ACI-318, Building Code Requirements for Structural Concrete

   IEEE Std 751-1990, Trial-Use Design Guide for Wood Transmission Structures

   AISI, Specification for the Design of Cold-Formed Steel Structural Members

   The Aluminum Association, Aluminum Design Manual

261. Grades B and C Construction

A. Supporting Structures

The strength requirements for supporting structures may be met by the structures alone or with the aid of guys or braces or both.

1. Metal, Prestressed , and Reinforced-Concrete Structures
   a. These structures shall be designed to withstand the loads in Rule 252 multiplied by the appropriate overload factors in Table 253-1 or Table 253-2 without exceeding the permitted load.
   b. The permitted load shall be the strength multiplied by the strength factors in Tables 261-1A or 261-1B (where guys are used, see Rule 261C).
   c. All structures including those below 18 m (60 ft) shall be designed to withstand, without conductors, the extreme wind load in Rule 250C applied in any direction on the structure.
   d. Spliced and Reinforced Structures

      Reinforcements or permanent splices to a supporting structure are permitted provided they develop the required strength of the structure.

2. Wood Structures

Wood structures shall be of material and dimensions to meet the following requirements:

a. Wood structures shall be designed to withstand the loads in Rule 252 multiplied by the appropriate overload factors in Table 253-1 or 253-2, without exceeding the permitted stress level.

NOTE: When determining a fiber stress for column loads, buckling needs to be considered.

EXCEPTION 1: When installed, naturally grown wood poles acting as single-based structures or unbraced multiple-pole structures, shall meet the requirements of Rule 261A2a without exceeding the permitted stress level at the ground line for unguyed poles or at the points of attachment for guyed poles.

EXCEPTION 2: At a Grade B crossing, in a straight section of line, wood structures complying with the transverse strength requirements of Rule 261A2a, without the use of transverse guys, shall be considered as having the required longitudinal strength, providing the longitudinal strength is comparable to the transverse strength of the structure. This *EXCEPTION* does not modify the requirements of this rule for deadends.

EXCEPTION 3: At a Grade B crossing of a supply line over a highway or a communication line where there is an angle in the supply line, wood structures shall be considered as having the required longitudinal strength if all of the following conditions are met:

(a) The angle is not over 20 degrees.

(b) The angle structure is guyed in the plane of the resultant of the conductor tensions. The tension in this guy under the loading in Rule 252 multiplied by an overload factor of 2.0 shall not exceed the rated breaking strength multiplied by the strength factor in Table 261-1A.

(c) The angle structure has sufficient strength to withstand, without guys, the transverse loading of Rule 252 multiplied by the appropriate overload factors in Table 253-1 or 253-2, which would exist if there were no angle at that structure without exceeding the permitted stress level.

b. Permitted Stress Level

(1) Natural Wood Pole

The permitted stress level of natural wood poles of various species meeting the requirements of ANSI O5.1-1992 shall be determined by multiplying the designated fiber stress set forth in that standard by the appropriate strength factors in Tables 261-1A or 261-1B.

(2) Sawn or Laminated Wood Structural Members, Crossarms, and Braces

The permitted stress level of sawn or laminated wood structural members, crossarms, and braces shall be determined by multiplying the appropriate ultimate fiber stress of the material by the appropriate strength factors in Tables 261-1A or 261-1B.

c. Strength of Guyed Poles

Guyed poles shall be designed as columns, resisting the vertical component of the tension in the guy plus any other vertical loads.

d. Spliced and Reinforced Poles

Reinforcements or permanent splices at any section along the pole are permitted provided they develop the required strength of the pole.

e. Average Strength of Three Poles

A pole (single-base structure) not individually meeting the transverse strength requirements will be permitted when reinforced by a stronger pole on each side, if all of the following are met:

(1) The average strength of the three poles meets the transverse strength requirements,

(2) The weak pole shall have not less than 75% of its required strength,

(3) The sag and tension of the wires, conductors, and cables in the adjacent spans shall provide adequate additional support for the weak pole, and

(4) The average of the spans does not exceed 45 m (150 ft).

EXCEPTION 1: The span may exceed 45 m (150 ft), but shall not be greater than 91 m (300 ft), if overhead guys are run between the three poles and the line section is head-guyed and back-guyed.

An extra pole inserted in a normal span for the purpose of supporting a service drop may be ignored in this strength determination.

EXCEPTION 2: This rule does not apply to crossings over railroads, communication lines, or limited access highways.

f. All structures including those below 18 m (60 ft) shall be designed to withstand, without conductors, the extreme wind load in Rule 250C applied in any direction on the structure.

3. Transverse Strength Requirements for Structures Where Side Guying Is Required, But Can Be Installed Only at a Distance

Grade B: If the transverse strength requirements of this section cannot be met except by the use of side guys or special structures, and where it is physically impractical to employ side guys, the transverse strength requirements may be met by side-guying the line at each side of, and as near as practical to, the crossing, or other transversely weak structure, and with a distance between such side-guyed structures of not over 250 m (800 ft), provided that:

a. The side-guyed structures for each such section of 250 m (800 ft) or less shall be designed to withstand the calculated transverse load due to wind on the supports and ice-covered conductors, on the entire section between side-guyed structures.

b. The line between such side-guyed structures shall be substantially in a straight line and the average span between the side-guyed structures shall not exceed 45 m (150 ft).

c. The entire section between the structures with the required transverse strength shall comply with the highest grade of construction concerned in the given section, except as to the transverse strength of the intermediate poles or towers.

Grade C: The above provisions do not apply to Grade C.

4. Longitudinal Strength Requirements for Sections of Higher Grade in Lines of a Lower Grade Construction

a. Methods of Providing Longitudinal Strength

Grade B: The longitudinal strength requirements for sections of line of higher grade in lines of a lower grade (for assumed longitudinal loading, see Rule 252) may be met by placing a structure of the required longitudinal strength at each end of the higher grade section.

Where this is impractical, the structures of the required longitudinal strength may be located away from the section of higher grade, within 150 m (500 ft) on each side and with not more than 250 m (800 ft) between the structures of the required longitudinal strength. This is permitted provided the following conditions are met:

(1) The structures and the line between them meet the requirements for transverse strength and stringing of conductors of the highest grade occurring in the section, and

(2) The line between the structures of the required longitudinal strength is approximately straight or suitably guyed.

The longitudinal strength requirement of the structures may be met by using guys.

Grade C: The above provisions do not apply to Grade C.

b. Flexible Supports

Grade B: When supports of the section of higher grade are capable of considerable deflection in the direction of the line, it may be necessary to increase the clearances required in Section 23 or to provide line guys or special reinforcements to reduce the deflection.

Grade C: The above provision does not apply to Grade C.

B. Strength of Foundations, Settings, and Guy Anchors

Foundations, settings, and guy anchors shall be designed or be determined by experience to withstand the loads in Rule 252 multiplied by the overload factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1A.

NOTE: Excessive movement of foundations, settings, and guy anchors or errors in settings may reduce clearances or structure capacity.

C. Strength of Guys and Guy Insulators

The strength requirements for guys and guy insulators are covered under Rules 264 and 279A1c, respectively.

1. Metal and Prestressed-Concrete Structures

Guys shall be considered as an integral part of the structure.

2. Wood and Reinforced-Concrete Structures

When guys are used to meet the strength requirements, they shall be considered as taking the en tire load in the direction in which they act, the structure acting as a strut only, except for those structures considered to possess sufficient rigidity so that the guy can be considered an integral part of the structure.

NOTE: Excessive movement of guys may reduce clearances or structure capacity.

D. Crossarms and Braces

1. Concrete and Metal Crossarms and Braces

   Crossarms and braces shall be designed to withstand the loads in Rule 252 multiplied by the overload factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1A.

2. Wood Crossarms and Braces

   a. Strength

      (1) Crossarms and braces shall be designed to withstand the loads in Rule 252 multiplied by the overload factors in Table 253-1 or 253-2 without exceeding their permitted stress level.

      (2) The permitted stress level of solid sawn or laminated wood crossarms and braces shall be determined by multiplying their ultimate fiber stress by the strength factors in Table 261-1A or 261-1B.

   b. Material and Size

      Wood crossarms and braces of select Southern pine or Douglas fir shall have a cross section of not less than those in Table 261-2. Crossarms of other species may be used provided they have equal strength.

3. Crossarms and Braces of Other Materials

   Crossarms and braces should meet the strength requirements of Rule 261D2.

4. Additional Requirements

   a. Longitudinal Strength

      (1) General

         (a) Crossarms shall be designed to withstand a load of 3.1 kN (700 lb) applied at the outer conductor attachment point without exceeding the permitted stress level for wood crossarms or the permitted load for crossarms of other materials, as applicable.

         (b) At each end of a transversely weak section, as described in Rule 261A3, the longitudinal load shall be applied in the direction of the weak section.

      (2) Methods of Meeting Rule 261D2a(1)

         Grade B: Where conductor tensions are limited to a maximum of 9.0 kN (2000 lb) per conductor, double wood crossarms having cross sections in Table 261-2 and properly assembled will comply with the longitudinal strength requirements in Rule 261D2a(1).

         Grade C: This requirement is not applicable.

      (3) Location

         At crossings, crossarms should be mounted on the face of a pole away from the crossing, unless special bracing or double crossarms are used.

   b. Bracing

      Crossarms shall be supported by bracing, if necessary, to support expected loads, including line personnel working on them.

   c. Double Crossarms or Brackets

      Grade B: Where pin-type construction is used, double crossarms, each crossarm having the strength required by Rule 261D2a, or a support assembly of equivalent strength shall be used at each crossing structure, at ends of joint use or conflict sections, at deadends, and at corners where the angle of departure from a straight line exceeds 20 degrees. Under similar conditions, where a bracket supports a conductor operated at more than 750 V to ground and there is no crossarm below, double brackets shall be used.

      EXCEPTION: The above does not apply where communication cables or conductors cross below supply conductors and either are attached to the same pole, or where supply conductors are continuous and of uniform tension in the crossing span and each adjacent span. This exception does not apply to railroad crossings and limited access highways except by mutual agreement.

      Grade C: The above requirement is not applicable.

E. Insulators

The strength requirements for insulators are covered under Rules 277 and 279.

F. Strength of Pin-Type or Similar Construction and Conductor Fastenings

1. Longitudinal Strength

a. General

Pin-type or similar construction and ties or other conductor fastenings shall be designed to withstand the applicable longitudinal loads in Rule 252, multiplied by the overload factors in Table 253-1, or 3.1 kN (700 lb) applied at the pin, whichever is greater.

b. Method of Meeting Rules 261F1a

Grade B: Where conductor tensions are limited to 9.0 kN (2000 lb) and such conductors are supported on pin insulators, double wood pins and ties or their equivalent will be considered to meet the requirements of Rule 261F1a.

Grade C: No requirement.

c. At Deadends and at Ends of Higher Grade Construction in Line of Lower Grade

Grade B: Pins and ties or other conductor fastenings connected to the structure at a deadend or at each end of the higher grade section shall be designed to withstand an unbalanced pull due to the conductor load in Rule 251 multiplied by the overload factors in Rule 253-1.

Grade C: This requirement is not applicable except for deadends.

d. At Ends of Transverse Sections Described in Rule 261A3

Grade B: Pins and ties or other conductor fastenings connected to the structure at ends of the transverse section as described in Rule 261A3 shall be designed to withstand the unbalanced pull in the direction of that transverse section under the load in Rule 252 multiplied by the overload factors in Rule 253-1.

Grade C: No requirement.

2. Double Pins and Conductor Fastenings

Grade B: Double pins and conductor fastenings shall be used where double crossarms or brackets are required by Rule 261D4c.

EXCEPTION: The above does not apply where communication cables or conductors cross below supply conductors and either are attached to the same pole, or where supply conductors are continuous and of uniform tension in a crossing span and each adjacent span. This exception does not apply in the case of railroad crossings and limited access highway crossings except by mutual agreement.

Grade C: No requirement.

3. Single Supports Used in Lieu of Double Wood Pins

A single conductor support and its conductor fastening, when used in lieu of double wood pins, shall develop strength equivalent to double wood pins and their conductor fastenings as specified in Rule 261F1a.

G. Armless Construction

1. General

Open conductor armless construction is a type of open conductor supply line construction in which conductors are individually supported at the structure without the use of crossarms.

2. Insulating Material

Strength of insulating material shall meet the requirements of Section 27.

3. Other Components

Strengths of other components shall meet the requirements of Rules 260 and 261.

H. Open Supply Conductors and Overhead Shield Wires

1. Sags and Tensions

a. The supply conductor and overhead shield wire tensions shall be not more than 60 percent of their rated breaking strength for the load of Rule 250B in Rule 251 multiplied by an overload factor of 1.0.

b. The tension at 15 °C (60 °F), without external load, shall not exceed the following percentages of their rated breaking strength:

Initial unloaded tension	35%
Final unloaded tension	25%

EXCEPTION: In the case of conductors with a generally triangular cross section, such as cables composed of three wires, the final unloaded tension at 15 °C (60 °F) shall not exceed 30% of the rated breaking strength of the conductor.

NOTE: The above limitations are based on the use of recognized methods for avoiding fatigue failures by minimizing chafing and stress concentration. If such practices are not followed, lower tensions should be employed.

2. Splices, Taps, Dead End Fittings, and Associated Attachment Hardware
   a. Splices should be avoided in crossings and adjacent spans. If it is impractical to avoid such splices, they shall have sufficient strength to withstand the maximum tension resulting from the loads of Rule 250B in Rule 251 multiplied by an overload factor of 1.65. If Rule 250C is applicable, splices shall not be stressed beyond 80% of their rated breaking strength under the loads of Rule 250C in Rule 251 multiplied by an overload factor of 1.0.
   b. Taps should be avoided in crossing spans but, if required, shall be of a type that will not impair the strength of the conductors to which they are attached.
   c. Dead-end fittings, including the associated attachment hardware, shall have sufficient strength to withstand the maximum tension resulting from the loads of Rule 250B in Rule 251 multiplied by an overload factor of 1.65. If Rule 250C is applicable, deadend fittings shall not be stressed beyond 80% of their rated breaking strength under the loads of Rule 250C in Rule 251 multiplied by an overload factor of 1.0.
3. Trolley-Contact Conductors

   In order to provide for wear, no trolley-contact conductor shall be installed of less size than AWG No. 0, if of copper, or AWG No. 4, if of silicon bronze.

I. Supply Cable Messengers

Messengers shall be stranded and shall not be stressed beyond 60% of their rated breaking strength under the loads of Rule 250B in Rule 251 multiplied by an overload factor of 1.0. If Rule 250C is applicable, messengers shall not be stressed beyond 80% of their rated breaking strength under the loads of Rule 250C in Rule 251 multiplied by an overload factor of 1.0.

NOTE: There are no strength requirements for cables supported by messengers.

J. Open-Wire Communication Conductors

Open-wire communication conductors in Grade B or C construction shall have the tensions and sags in Rule 261H2 for supply conductors of the same grade.

EXCEPTION: Where supply conductors are trolley contact conductors of 0 to 750 V to ground, WG No. 12 Stl may be used for communication conductors for spans of 0 to 30 m (0 to 100 ft), and Stl WG No. 9 may be used for spans of 38 to 45 m (125 to 150 ft).

K. Communication Cables

1. Communication Cables

   There are no strength requirements for communication cables supported by messengers. See Rule 261K2 for the strength requirements for messengers supporting communication cables.
2. Messenger

   The messenger shall not be stressed beyond 60% of its rated breaking strength under the loads of Rule 250B in Rule 251 multiplied by an overload factor of 1.0. If Rule 250C is applicable, messengers shall not be stressed beyond 80% of their rated breaking strength under the loads of Rule 250C in Rule 251 multiplied by an overload factor of 1.0.

L. Paired Communication Conductors

1. Paired Conductors Supported on Messenger

a. Use of Messenger
A messenger may be used for supporting paired conductors in any location, but is required for paired conductors crossing over trolley-contact conductors of more than 7.5 kV to ground.

b. Sag of Messenger
Messenger used for supporting paired conductors required to meet Grade B construction because of crossing over trolley-contact conductors shall meet the sag requirements for Grade B.

c. Size and Sag of Conductors
There are no requirements for paired conductors when supported on messenger.

2. Paired Conductors Not Supported on Messenger

a. Above Supply Lines
Grade B: Sizes and sags shall be not less than those in Rule 261H1 for supply conductors of similar grade.
Grade C: Sizes and sags shall be not less than the following:
Spans 0 to 30 m (0 to 100 ft)—No sag requirements.
Each conductor shall have a rated breaking strength of not less than 0.75 kN (170 lb).
Spans 30 to 45 m (100 to 150 ft)—Sizes and sags shall be not less than required for Grade B communication conductors.
Spans exceeding 45 m (150 ft)—Sizes and sags shall be not less than required for Grade C supply conductors. (See Rule 261H2).

b. Above Trolley-Contact Conductors
Grade B: Sizes and sags shall be not less than the following:
Spans 0 to 30 m (0 to 100 ft)—No size requirements. Sags shall be not less than for AWG No. 8 hard-drawn copper. (See Rule 261H2.)
Spans exceeding 30 m (100 ft)—Each conductor shall have a rated breaking strength of not less than 0.75 kN (170 lb). Sags shall be not less than for AWG No. 8 hard-drawn copper. (See Rule 261H2.)
Grade C: Sizes and sags shall be as follows:
Spans 0 to 30 m (0 to 100 ft)—No requirements.
Spans exceeding 30 m (100 ft)—No sag requirements.
Each conductor shall have a rated breaking strength of not less than 0.75 kN (170 lb).

M. Support and Attachment Hardware
The strength required for all support and attachment hardware not covered by Rule 261F or Rule 261H2 shall be not less than the load times the appropriate overload factor given in Section 25. For appropriate strength factors, see Rule 260B.

Table 261-1A

Strength Factors for Structures,[1] Crossarms, Support Hardware, Guys, Foundations, and Anchors for Use with Overload Factors of Table 253-1

[It is recognized that structures will experience some level of deterioration after installation, depending upon materials, maintenance, and service conditions. The table values specify strengths required at installation. Footnotes specify deterioration allowed, if any. When new or changed facilities add loads to existing structures (a) the strength of the structure when new shall have been great enough to support the additional loads and (b) the strength of the deteriorated structure shall exceed the strength required at replacement. If either (a) or (b) cannot be met, the structure must be replaced, augmented, or rehabilitated.]

	Grade B	Grade C
Strength factors for use with loads of Rule 250B		
Metal and Prestressed-Concrete Structures[6]	1.0	1.0
Wood and Reinforced-Concrete Structures[2, 4]	0.65	0.85
Support Hardware	1.0	1.0
Guy Wire[5, 6]	0.9	0.9
Guy Anchor and Foundation[6]	1.0	1.0
Strength factors for use with loads of Rule 250C		
Metal and Prestressed-Concrete Structures[6]	1.0	1.0
Wood and Reinforced-Concrete Structures[3, 4]	0.75	0.75
Support Hardware	1.0	1.0
Guy Wire[5, 6]	0.9	0.9
Guy Anchor and Foundation[6]	1.0	1.0

[1] Includes poles.

[2] Wood and reinforced concrete structures shall be replaced or rehabilitated when deterioration reduces the structure strength to 2/3 of that required when installed. If a structure is replaced, it shall meet the strength required by Table 261-1A. Rehabilitated portions of structures shall have strength greater than 2/3 of that required when installed.

[3] Wood and reinforced concrete structures shall be replaced or rehabilitated when deterioration reduces the structure strength to 3/4 of that required when installed. If a structure is replaced, it shall meet the strength required by Table 261-1A. Rehabilitated portions of structures shall have strength greater than 3/4 of that required when installed.

[4] Where a wood or reinforced concrete structure is built for temporary service, the structure strength may be reduced to values as low as those permitted by footnotes (2) and (3) provided the structure strength does not decrease below the minimum required during the planned life of the structure.

[5] For guy insulator requirements, see Rule 279.

[6] Deterioration during service shall not reduce strength capability below the required strength.

Table 261-1B

Strength Factors for Structures[1, 2] and Crossarms for Use with Overload Factors of Table 253-2

[It is recognized that structures will experience some levels of deterioration after installation, depending upon materials, maintenance, and service conditions. The table values specify strengths required at installation. Footnotes specify deterioration allowed for wood and reinforced concrete structures. When new or changed facilities add loads to existing structures (a) the strength of the structure when new shall have been great enough to support the additional loads, and (b) the strength of the deteriorated structure shall exceed the strength required at replacement. If either (a) or (b) cannot be met, the structure must be replaced, augmented, or rehabilitated.]

	Grade B	Grade C
Strength factors for use with loads of Rule 250B and Rule 250C		
Wood and Reinforced-Concrete Structures	1.0	1.0

[1] Includes poles.

[2] Where a wood or reinforced-concrete structure is built for temporary service, the structure strength may be reduced to values as low as those permitted by the *at replacement* overload factors in Table 253-2, footnotes (2) and (3) provided the structure strength does not decrease below the minimum required during the planned life of the structure.

Table 261-2
Dimensions of Crossarm Cross Section of Select Southern Pine and Douglas Fir

Crossarm Length		Grades of Construction	
		Grade B	Grade C
1.20 m or less	mm:	75 × 100	70 × 95
4 ft or less	in:	3 × 4	2-3/4 × 3-3/4
2.45 m	mm:	82 × 108	75 × 100
8 ft	in:	3-1/4 × 4-1/4	3 × 4
3.0 m	mm:	82 × 108	75 × 100
10 ft	in:	3-1/4 × 4-1/4	3 × 4

262. Number 262 not used in this edition.

263. Grade N Construction

The strength of Grade N construction need not be equal to or greater than Grade C.

A. Poles
Poles used for lines for which neither Grade B nor C is required shall be of initial size or guyed or braced to withstand expected loads, including line personnel working on them.

B. Guys
The general requirements for guys are covered in Rules 264 and 279A.

C. Crossarm Strength
Crossarms shall be securely supported by bracing, if necessary, to withstand expected loads, including line personnel working on them.
NOTE: Double crossarms are generally used at crossings, unbalanced corners, and dead ends, in order to permit conductor fastenings at two insulators to limit the opportunity for slipping, although single crossarms might provide sufficient strength. To secure extra strength, double crossarms are frequently used, and crossarm guys are sometimes used.

D. Supply-Line Conductors
1. Size
Supply-line conductors shall be not smaller than the sizes listed in Table 263-1.
RECOMMENDATION: It is recommended that these sizes for copper and steel not be used in spans longer than 45 m (150 ft) for the heavy-loading district, and 53 m (175 ft) for the medium- and light-loading districts.

E. Service Drops
1. Size of Open-Wire Service Drops
a. Not over 750 V.
Service drops shall be as required by (1) or (2):
(1) Spans not exceeding 45 m (150 ft)
Sizes shall be not smaller than those in Table 263-2.
(2) Spans exceeding 45 m (150 ft)
Sizes shall be not smaller than 8 AWG.

b. Exceeding 750 V

Sizes of service drops of more than 750 V shall be not less than required for supply-line conductors of the same voltage.

2. Tension of Open-Wire Service Drops

The tension of the service drop conductors shall not exceed the strength of the conductor attachment or its support under the expected loads.

3. Cabled Service Drops

Service conductors may be grouped together in a cable, provided the following requirements are met:

a. Size

The size of each conductor shall be not less than required for drops of separate conductors (Rule 263E1).

b. Tension of Cabled Service Drops

The tension of the service drop conductors shall not exceed the strength of the conductor attachment or its support under the expected loads.

F. Trolley-Contact Conductors

In order to provide for wear, trolley-contact conductors shall be not smaller than size AWG No. 0, if of copper, or AWG No. 4, if of silicon bronze.

G. Communication Conductors

There are no specific requirements for Grade N communication line conductors or service drops.

H. Street and Area Lighting Equipment

The lowering rope or chain for luminaires arranged to be lowered for examination or maintenance shall be of a material and strength designed to withstand climatic conditions and to sustain the luminaire safely.

I. Insulators

The strength requirements for insulators are covered under Rules 277 and 279.

Table 263-1
Sizes for Grade N Supply Line Conductors
(AWG for Copper and Aluminum, SII WG for Steel)

	Urban	Rural
Soft copper	6	8
Medium- or hard-drawn copper	8	8
Steel	9	9
	Spans 45 m (150 ft) or less	Spans exceeding 45 m (150 ft)
Stranded aluminum:		
EC	4	2
ACSR	6	4
ALLOY	4	4
ACAR	4	2

Table 263-2
Sizes of Service Drops of 750 V or Less
(Voltages of trolley-contact conductors are voltage to ground.
AWG used for aluminum and copper wires; Stl WG used for steel wire.)

Situation	Copper Wire: Soft-Drawn	Copper Wire: Medium- or Hard-Drawn	Steel Wire	EC aluminum wire[2]
Alone	10	12	12	4
Concerned with communication conductor	10	12	12	4
Over supply conductors of				
0 to 750 V	10	12	12	4
750 V to 8.7 kV[1]	8	10	12	4
Exceeding 8.7 kV[1]	6	8	9	4
Over trolley-contact conductors				
0 to 750 V ac or dc	8	10	12	4
Exceeding 750 V ac or dc	6	8	9	4

[1] Installation of service drops of not more than 750 V above supply lines of more than 750 V should be avoided where practical.
[2] ACSR or high-strength aluminum alloy conductor size shall be not less than No. 6.

264. Guying and Bracing

A. Where Used
When the loads are greater than can be supported by the structure alone, additional strength shall be provided by the use of guys, braces, or other suitable construction. Such measures shall also be used where necessary to limit the increase of sags in adjacent spans and provide sufficient strength for those supports on which the loads are sufficiently unbalanced, for example, at corners, angles, dead ends, large differences in span lengths, and changes of grade of construction.

B. Strength
Guys shall be designed to withstand the loads in Rule 252 multiplied by the overload factors in Table 253-1 without exceeding the permitted load. The permitted load shall be equal to the strength multiplied by the strength factors in Table 261-1A. For guy wires conforming to ASTM Standards, the minimum breaking strength value therein defined shall be the rated breaking strength required in this code.

C. Point of Attachment
The guy or brace should be attached to the structure as near as is practical to the center of the conductor load to be sustained. However, on lines exceeding 8.7 kV, the location of the guy or brace may be adjusted to minimize the reduction of the insulation offered by nonmetallic support arms and supporting structures.

D. Guy Fastenings
Guys having a rated breaking strength of 9.0 kN (2000 lb) or more and that are subject to small radius bends should be stranded and should be protected by suitable guy thimbles or their equivalent. Any

guy having a design loading of 44.5 kN (10 000 lb) or more wrapped around cedar or similar soft-wood poles should be protected by the use of suitable guy shims.

Where there is a tendency for the guy to slip off the shim, guy hooks or other suitable means of limiting the likelihood of this action should be used. Shims are not necessary in the case of supplementary guys, such as storm guys.

E. Guy Markers and Protection

1. The ground end of anchor guys exposed to pedestrian traffic shall be provided with a substantial and conspicuous marker.

   NOTE: Visibility of markers can be improved by the use of color or color patterns that provide contrast with the surroundings.

2. Where an anchor is located in an established parking area, the guy shall either be protected from vehicle contact or marked.

3. Nothing in this rule is intended to require protection or marking of structural components located outside of the traveled ways of roadways or established parking areas. Experience has shown that it is not practical to protect structures from contact by out of control vehicles operating outside of established traveled ways.

F. Electrolysis

Where anchors and rods are subject to electrolysis, suitable measures should be taken to minimize corrosion from this source.

G. Anchor Rods

1. Anchor rods should be installed so as to be in line with the pull of the attached guy when under load.

   EXCEPTION: This is not required for anchor rods installed in rock or concrete.

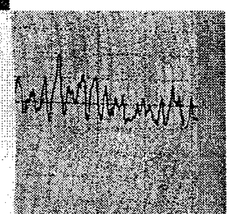
2. The anchor and rod assembly shall have an ultimate strength not less than that required of the guy(s) by Rule 264B.

DOCKET NO. 060077-TL

VERIZON FLORIDA INC.'S PROTEST AND REQUEST FOR FORMAL HEARING

EXHIBIT B

EXHIBIT B



SAVE TIME, COSTS AND GAIN SECURITY

Test and Measuring Instruments for Timber Poles

Instrumenta Mechanik Labor GmbH

WE ARE CONCERNED ABOUT YOUR SAFETY STANDARDS

Timber poles must be examined regularly for stability and traffic security. There is legislation directing that timber poles must correspond to a high level of safety and guarantee optimal function. The problem with 90% of all defects or rot: it is located below the soil level. This decay or rot is often only visible if complex investigations or excavations are made. Therefore, we developed instruments, which can examine the interior life of the timber poles. Our test and measuring instruments are fast, uncomplicated, reliable for use and will give you a good picture to the current condition of the timber pole. This will contribute to the general safety around the pole.

With our units you can:

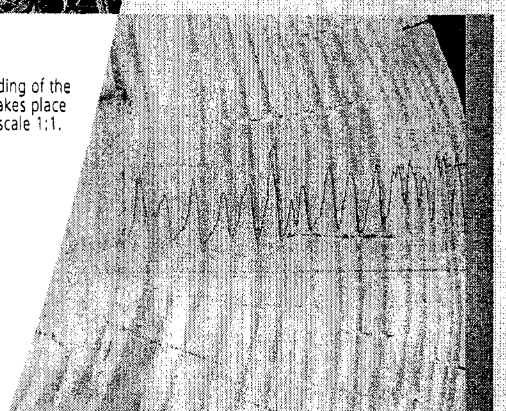
- find decay in various areas
- locate cracks and hollows
- use the right steps for preventive actions
- find quality differences in poles and be able to establish permanent records

THE IML-RESI IS LESS WORK WITH REWARDING RESULTS

The IML-Resi system is a drilling resistance measuring procedure, that is available in different models and drilling depths. For timber pole examination the F-Series and E-Series are best suited for the task. The F-Series is recommended in the field of pole inspection due to its accessibility and ease of use.

With the IML-Resi you are able to examine the timber pole anywhere from below soil level up to the top. The process takes about one minute, which includes the printout of the measuring profile. Therefore, you have the possibility to examine a timber pole for safety before climbing. Another advantage is you are able to map out the interior of the pole by taking cross drillings.

The measurements can be accomplished dig-free at each pole site.



The recording of the measuring curve takes place on a scale 1:1.

The IML-Resi helps you:

- to find localized areas of decay in poles quickly
- to protect the timber poles over time
- to prevent an unnecessary exchange of a timber pole
- to save personnel time and costs

HOW THE IML-RESI WORKS:

You begin by positioning the instrument against the timber pole. Next, engage the motor by pushing the forward button. A drilling needle, 1.5 to 3 mm in diameter, will advance at a constant speed into the pole. As the drilling needle penetrates the pole it measures the resistance that is in direct correlation with the needles depth. The data being collected is recorded either on a waterproof wax paper or to an attached printer in a scale 1:1. Another option is to have your profile stored in an electronic unit that is available for most IML-Resis. The measuring curves are unique in the sense that cracks, rot and other defects can be detected visually. The time it takes to analyze a pole, is minimized by the Resi.

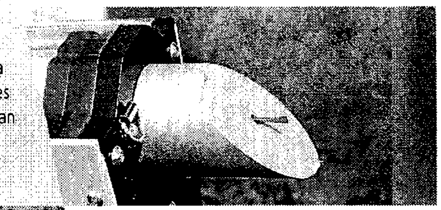
The IML-Resi F " Electronic" stores the drilling profile directly in your instrument. While storing your profile it also saves the time, date, a 12-digit identification number of the pole, as well as the sensitivity level (hard, soft) with each measurement. Thus, all collected data that is assigned to each measurement is easy to retrieve, interpret, and file for future use.

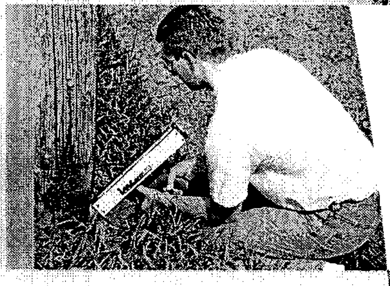
With the new 45° adapter it is possible to examine the timber pole below ground level, which is one of the most critical areas, without having to do the usual soil removal around the pole to perform the examination. This will help save time on the testing procedure.

With our instruments you can:

- save time, thanks to being able to take fast measurements
- High efficiency due to less work having to be done
- Cost reduction due to less timber pole replacement
- Optimized personnel time and application
- Unnecessary wood damages are prevented. The sawdust remains in the bore hole while backing out the drilling needle which almost closes the bore hole fully.

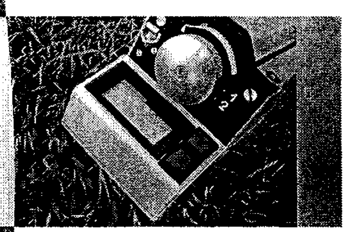
The drilling needle with a diameter of 1.5 to 3mm has a hardened needle tip and a special coating that guarantees a high life span

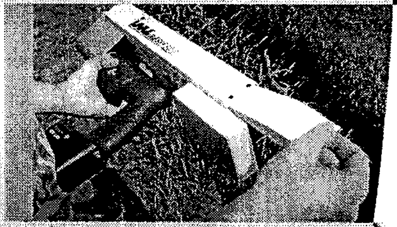




When the measuring process is over, the results can be read off immediately.

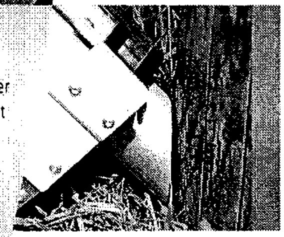
User-friendly with the addition of the F-series "electronic unit."

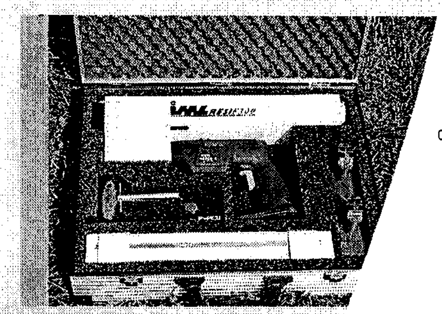




The paper tray holds 50 waterproof wax papers for recording your measurements.

An attachable 45° adapter makes it possible to reach difficult areas more easily.





All IML - Resis have an available carrying case that is specially designed for each instrument.

Since 1990 the manufacturing company IML - Instrumenta Mechanics Laboratory GmbH, has produced test and measuring instruments for trees and timber constructions. IML is located near the city of Heidelberg, Germany. The manufacturing and assembling process is a 24 hour a day operation. IML-Germany works with the newest technology available on the market and consists of a competent and creative co-workmanship to stay at the cutting edge of technology. Erich Hunger, founder of IML, sets his goal on practice-oriented product development. All instruments and devices are tested and examined at the highest level of precision during the manufacturing process. There is a company plan for continuous quality control and management during instrument production.
In addition, the employees make sure that the instruments are ergonomically correct, easy to handle before each instruments leaves the assembly line and later the factory. And that is profitable for you, our customer.

YOUR DIRECT CONNECTION TO US PAYS OFF

If you are interested in our products, order directly from IML. This procedure is to your advantage. You are getting your instruments directly from the expert, including services. Since we are familiar with the operation of the instruments, we can advise you and answer your questions and concerns competently. We will make sure you get the most suitable instrument to meet your needs. This will save you time and additional costs.
Just ask us!

Instrumenta Mechanik Labor GmbH

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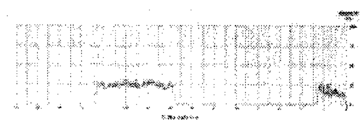
USA, Toll Free: 888-514-8851, Fax: 678-623-0550
Contact: Oliver Hein, E- mail: info@imlusa.com
Website: www.imlusa.com

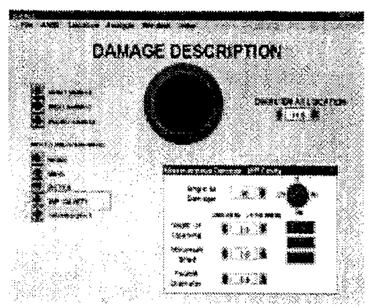
ANDREA KUPFER Grafik, Heidelberg 01/99
Text: Dr. Kupfer, Schwetzingen

Resistograph™ Technology

The Resistograph™ tool evaluates the condition and density of the wood and also to measure the size, shape and location of cavity/decay within the wood pole structure. The field unit comprises a constant force drill and electronic analysis pack. As the drill penetrates the wood the Resistograph unit measures the resistance the wood exerts against it. If the wood resistance output falls to zero, or close to zero, than a cavity of decayed wood is detected. The device is a very effective way to assess decayed and partially-decayed wood.
The output of the Resistograph Drill is immediately displayed to calculate the Remaining Section Modulus of the pole.



An Optional Structural Analysis Software Package (D-Calc) can be used for recording purposes. The image on the right shows a typical Resistograph output for a decayed pole. This particular pole has a large pocket of decay which is where the wood resistance plot falls to zero. In order to measure the 'depth' of this decay a second drilling is made perpendicular to the first, through the mid-point of the decayed region. Further Drillings are made by Inspectors, as required, to determine the extent of the decay.



HOW THE RESISTOGRAPH WORKS:
You begin by positioning the instrument against the timber pole.

Next, engage the motor by pushing the forward button. A drilling needle, 1.5 to 3 mm in diameter, will advance at a constant speed into the pole.

As the drilling needle penetrates the pole it measures the resistance that is in direct correlation with the needles depth.

The data being collected is recorded either on a waterproof wax paper or to an attached printer in a scale 1:1.

Another option is to have your profile stored in an electronic unit.
The measuring curves are unique in the sense that voids, rot and other defects can be detected visually using this device.

The IML "Electronic unit" stores the drilling profile directly in your instrument. While storing your profile it also saves the time, date, a 12-digit identification number of the pole, as well as the sensitivity level (hard, soft) with each measurement. Thus, all collected data that is assigned to each measurement is easy to retrieve, interpret, and file for future use.

With the 45° adapter it is possible to examine the timber pole below ground level, without having to do the usual soil removal around the pole to perform the examination.

- . **Arborist Consultants**
- . **Tree Specialist Contractors**
- . **Building Inspectors**
- . **Pest Control Contractors**
- . **Utility Owners**
- . **Park and Playground Owners**
- . **Workplace Safety Officers**

THE IML RESISTOGRAPH

Trees and wooden constructions often do not show their internal state. The Resistograp the guesswork by electronically controlled drill resistance measurements.

Resistographs are an invaluable testing and measuring devices, working upon the principle of measuring the resistance while timber pole and delivering detailed information about the inside. The devices are precise and fast, while causing minimal injur application. The use of a Resistograph can prevent accidents and helps to save valuable tree populations.

The world in which we live contains objects that contain structural members made of wood, telephone poles, trees, bridges, pl are just a few of these items. We assume they are structurally solid and are safe for use but in the past we have had few ways of the wood in these structures. The Resistograph is a tool that allows the nondestructive analysis of the wood quality includin decayed wood or the formation of cavities inside the object. In some tree species the Resistograph can also be used to measu diameter and bark thickness.

A drill bit less than 3mm in diameter and made of spring steel is pushed by a power drill through the wooden object at a consta the bit is narrower than the tip so that drag on the shaft is minimized. The amount of pressure required to drive the bit into the t one to one ratio on a piece of graph paper by a point attached to the drill. The shaft of the bit is narrower than the tip so that dr minimized. The amount of pressure required to drive the bit into the tree is graphed out at a one to one ratio on a piece of grap attached to the drill.

The Resistograph has been developed for the following applications:

- **Tree Care Industry**
- **Utility Pole Industry**
- **Termite and Pest Control Industry**
- **Building Inspection Industry**
- **Timber Bridge Inspection Industry**
- **Playground Inspection Industry**

Researchers and Scientists, as well as industry professionals recognize the utility of the data generated from this instrument in

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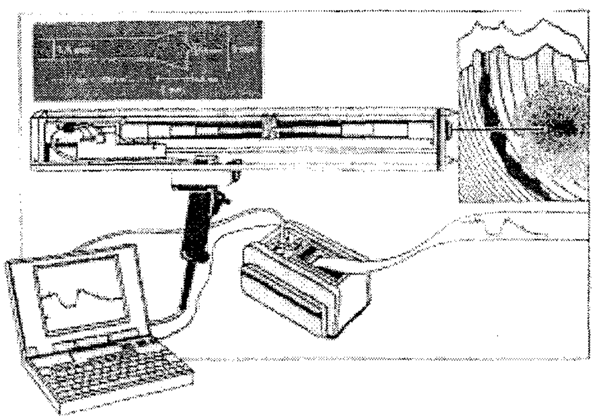
HOW IT WORKS

The differences in torque required to drill through different wood types are recorded. Le: (power/force) is required to drill through decayed wood.



The IML- Resistograph is based on a drilling resistance measuring method. A drilling needle with a diameter of 1.5 mm to 3.0 r wooden object with a regular advance, and the drilling resistance is measured. The data is recorded on a paper or wax paper : or saved for review at a later date.

The advantages of the Resistograph are quite obvious: The wood will be insignificantly injured, as the drill hole closes itself. A program serves for creating measuring profiles, on the basis of which the data may collected and rapidly and exactly analyzed the data can easily be archived and will instantly be available for comparative measurements.

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TECHNICAL PROPERTIES

The basic idea of the device is to measure the capacity demand of a bore bit rotating motor as a function of the drilling depth. 1 a drilling unit and an accumulator unit . The drilling unit has two electronically controlled 24 V DC motors, with which the bit fee speeds are kept constant. The bore bit is a flexible needle with a tungsten steel tip and it can be used up to 100 drillings in har diameter is 3 mm. The maximum drilling depth is 500 mm.

The weight of the drilling unit is about 3 kg, so it is suitable for working in field conditions. In case of dry wood (MC = 10 %) the coefficient between the wood density and drilling resistance is r = 0,92.

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THE ELECTRONIC UNIT

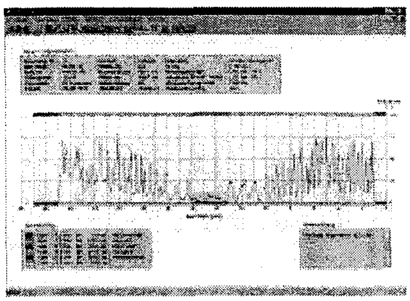
The F-Series Resistograph has now been improved by development of an electronic data collection unit. The new upgrade per downloaded into the "Cavity Detection" software. Older instruments can easily be upgraded to the new electronic data collectic

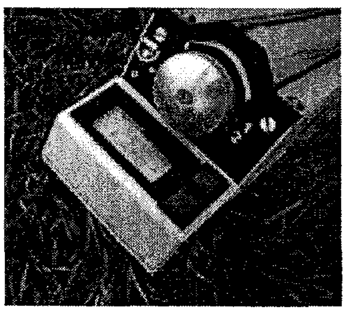
The RESI F- Electronic records the drilling profile to its memory while drilling. The date, current time, a twelve digital identificati mode for drilling (soft or hard wood) are recorded together with the measurement results. So later on the complete set of data, retrieve in the original combination.

The standard version of the instrument stores an overall drilling length of 22.8m, which corresponds to 76 drillings for the F300 drillings for the F400s Resistograph and 45 drillings with the F500s Resistograph. If shallower drilling depth is used, the electrc maximum of 400 measurements. If required, the data storage capacity can be doubled or even quadrupled.

The following data will be shown on the digital display:

- **Drilling depth and advance speed during the drilling process**
- **Number of measurements stored**
- **Remaining drilling length**
- **12-digit ID number**
- **Drilling Stage (hard, soft)**
- **Charge capacity of storage battery**
- **Date and hour**
- **Display is available in 4 different languages! (English, German, French, Spanish.)**





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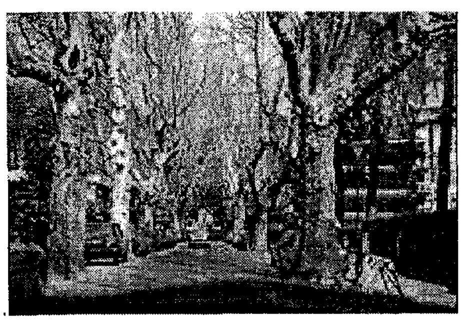
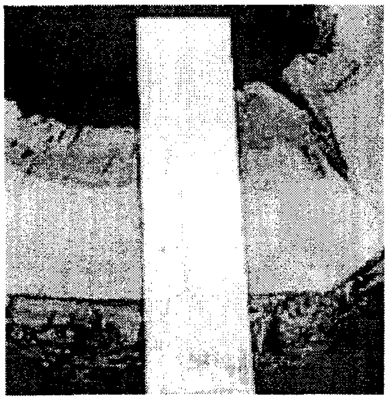
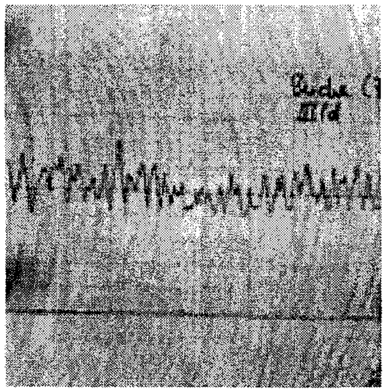
TREE CARE

Control and Measuring Instruments for Trees

Trees along roadsides need to be tested regularly. The Resistograph is an assisting instrument in testing decayed and hollow :



The pictures below show graph profiles that were placed over the cross section of the wooden samples. The profile matches p annual rings.

Resistograph for Trees:

- **Fast, accurate and reliable**
- **Find wood decay, rot, hollow areas and cracks**
- **Analyze annual ring structures**
- **Determine growth tendency according to the width of annual rings**
- **High efficiency due to less work having to be done**
- **Unnecessary wood damage is prevented**

UTILITY POLE CARE

SAVE TIME, COSTS AND GAIN SECURITY

Test and Measuring Instruments for utility poles

Utility poles have to be examined regularly for stability and traffic security. There is legislation directing that utility poles must c level of safety and guarantee optimal function.

The problem with 90% of all defects or rot is that it is located below the soil level. This decay or rot is often only visible if compl excavations are made. Therefore, we developed instruments, which can examine the interior life of the utility poles. Our test ar instruments are fast, uncomplicated, reliable for use and will give you a good picture to the current condition of the utility pole. the general safety around the pole.

With our units you can:

- **find decay in various areas**
- **locate cracks and hollows**
- **use the right steps for preventive actions**
- **find quality differences in poles and be able to establish permanent records.**

The following Utility Asset owners are using Resistographs for testing poles.

- **German Telecom**
- **British Telecom**

- Spanish Telecom
- Italian Telecom
- French Telecom (Case Study Available)
- Most of USA and Canada.

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BUILDING INSPECTION

IF THE INSIDE IS STABLE THE OUTSIDE IS SAFE

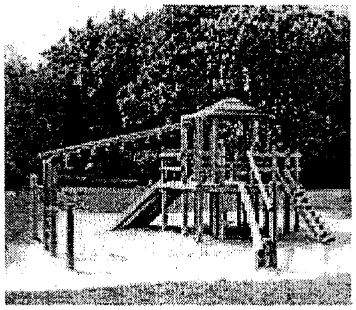
Test and measuring instruments for construction wood

When you surround old timbers with new timbers, it has to meet different quality standards. No matter if you have a house or a on stilts- Stability and Quality have to be the highest standards and guarantee optimal function. Therefore, construction has to regular basis. The problem is most defects and damages are located in the interior of the old surrounded timbers- decay and r if complex investigations or excavations are made.

Therefore, with the IML developed Resistograph, you can examine the interior life of construction wood. The Resistograph is fa reliable for use and will give you a good picture of the current condition of the wood. This will contribute to the general safety a

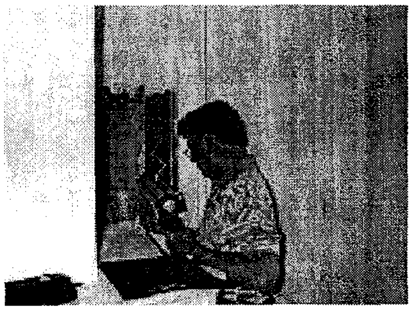
With our units you can:

- find decay in various areas
- locate cracks and hollows
- use the right steps for preventive actions
- find quality differences in construction wood and be able to establish permanent re



TERMITE INSPECTION

The Resistograph F150-S was designed for finding termite galleries inside finished walls without damage to the wall surface. T technology offers an added level of professionalism to the termite industry. Now, you can be certain of the damage and activity without costly repair bills.



The Resistograph F-Series Can Help With:

- **Damage Claims - reduce average costs by only repairing actual damaged areas**
- **Termiticide (Liquid or Bait) Research - conduct detailed ongoing analysis**
- **Treatment Sales - more high tech and confident inspection of homes**
- **Pretreatments - end the cycle of constant pretreatments on the same house**
- **Treatment Accuracy - provide surgical precision for termite treatments**
- **Bait Treatment Monitoring - provide peace-of-mind and increased accuracy**
- **Reduce Liability of New Company Acquisitions - thorough evaluations**

How the Resistograph F150-S Works to Find Damage:

The Resistograph F150-S finds termite galleries by detecting voids inside the wood. As each location is probed, a small piece graph paper is generated which shows sound wood (medium graph line), rotted wood (1/4 height on graph), or void (zero on g graph spikes (up and down), from termites eating only soft wood and leaving the rings, make subterranean termites easy to ide such as dry wood termites, Carpenter ants and Formosan termites can also be detected with this new technology. The Resisto accidentally show a void that is not there. If a graph shows a zero drop, it most certainly indicates a void in the wood. Termite distinguished from other damage by the characteristic up and down of the graph showing the hollowed soft wood, followed by a void again. The only way to further verify a positive graph readout is to probe nearby areas for a second or third verification c second or third readout will all but eliminate any misreads by an untrained operator.

How the Resistograph F150-S helps to find Live Termites:

The Resistograph F150-S eliminates the need to drill numerous holes into studs to find possible live termites. Unlike surface b inspect the outside of a stud in a wall void, the Resistograph F150-S pinpoints the spot in the wood for direct observation with and a 1/4" drill hole. Live termites can be observed in damaged timbers by drilling holes in the stud large enough for magnified

The waterproof wax graph paper will indicate the depth to find galleries, making it possible to find termites quickly and easily.

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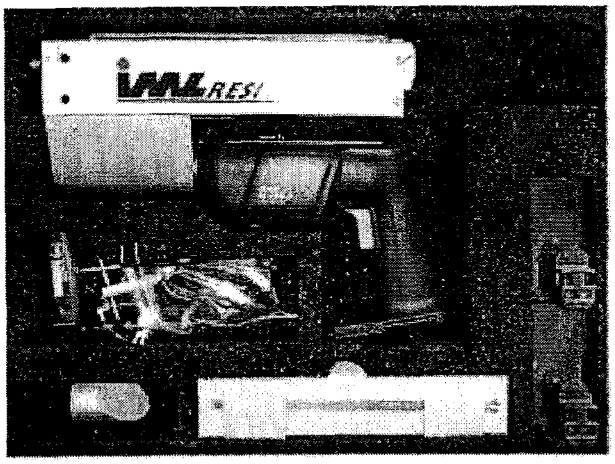
Variations available:

Model	Drilling Depth
F150S Resistograph	**150mm**



F300S Resistograph 300mm

F500S Resistograph 500mm