Recommended Practice for Maintenance and Use of Drilling and Well Servicing Structures

API RECOMMENDED PRACTICE 4G
SECOND EDITION, OCTOBER 1998

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Exploration and Production Department

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Maintenance and Use of Drilling and Well Servicing Structures

1 Scope

1.1 These recommendations should be considered as supplemental to, and not as a substitute for, the manufacturer's instructions and the recommendations in the most current edition of API RP 54, *Recommended Practices for Occupational Safety and Health for Oil and Gas Well Drilling and Servicing Operations*.

1.2 The manufacturer has used great care in design and selection of material for his drilling or well servicing structure. The structure should give satisfactory performance when used within the stipulated load capacities and in accordance with instructions. Every crew member should be given instructions and training in erecting, lowering, and using the structure.

1.3 The safe operation of drilling and well servicing structures depends on whether the foundation is adequate for the load imposed. The design load for foundation requirements should be the sum of the weight of the drilling or well servicing structure, the weight of the machinery and equipment on it, the maximum hook load of the structure, forces due to external guywire loading, and the maximum setback load. (See Section 8, Foundations for Portable Masts with Guylines.)

1.4 In the erecting and lowering operations utilizing the rig drawworks, the slowest practical line speed should be used.

1.5 Loads due to impact, acceleration, and deceleration may be indicated by fluctuation of the weight indicator and the operator should keep the indicator readings within the name plate hook load capacity.

1.6 Some rig designs require that the mast base structure be restrained against uplift from the application of mast hook load. For the requirements of a specific rig, check the manufacturer's operation instructions.

1.7 Each part of a bolted structure is designed to carry its share of the load; therefore, parts omitted or improperly placed may contribute to the failure of the structure. In the erection of bolted structures, so far as it can be done safely, the bolts should be tightened only slightly tighter than finger-tight until the erection of the structure is completed, after which all bolts should be drawn tight. This procedure permits correct alignment of the structure which will result in proper load distribution.

2 References

API

RP 9B	*Application, Care, and Use of Wire Rope for Oil Field Service,* current edition
RP 54	*Occupational Safety for Oil and Gas Well Servicing Operations,* current edition

[1]*Marks' Mechanical Engineers' Handbook*

3 Structural Repair and Modification

3.1 Structural repair and/or modification of a drilling or well servicing structure should be carefully planned prior to initiating work. The manufacturer should be consulted for approval of materials and methods. In absence of the manufacturer's approval, the services of a qualified person (Reference API RP 54, current edition, Section 2 for definition of a *qualified person*) utilizing accepted engineering practices should be employed to make the required repairs and/or modification.

3.2 The following recommendations should be followed when undertaking structural repairs and/or modifications of a drilling or well servicing structure:

a. Repair, straighten, or replace any bent or otherwise damaged members.
b. Use welding procedures approved by the manufacturer or the qualified person directing the repair or modifications, as applicable. Drilling and well servicing structures may use high strength steel which requires specific welding electrodes and welding techniques.
c. Fixtures and accessories are preferably attached to structures by means of suitable clamps. Do not drill or burn holes in any members or perform any welding without first obtaining approval of the manufacturer or the qualified person, as applicable.
d. Girts, braces, and other members should always be in place when the structure is under load.

4 Raising Line Inspection and Replacement

4.1 Three principal factors which may limit the life of a raising line are: wear, corrosion, and damage. Wear is a function of the number of times a mast is raised. Corrosion is related to time and atmospheric conditions, and damage will bear no relation to either, since damage may occur at any time.

4.2 The following points may be useful in determining inspection and replacement procedures:

a. Charting of raising line replacement may show an erratic pattern. Some raising lines require replacement at a relatively early date and others last several years longer. Early replacements generally show incidental damage and it is possible

[1]McGraw-Hill Book Co., Inc., New York, Sixth Edition (1958).

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that some of the longer lived ones are used beyond the time when they should be replaced.

b. It is impractical to determine the remaining strength of a rusty rope; therefore, rusty raising lines should be replaced. Areas adjacent to end connections should be examined closely for any evidence of corrosion.

c. It would be possible to establish a normal raising line life expectancy in terms of the number of locations on which it was used, as long as a set number of months was not exceeded. However, this would not preclude the necessity for careful inspection to guard against incidental damage. A line with any broken wires should be replaced. A line showing kinking, crushing, or any other damage resulting in distortion of the rope should be replaced.

d. Replacement of raising lines based on normal life expectancy will provide some degree of safety, but it is important that such provisions do not cause any degree of laxity in raising line inspection.

e. Raising lines should be maintained in a well lubricated condition. The field lubricants should be compatible with the original lubricant, and to this end the rope manufacturer should be consulted. The object of the rope lubrication is to reduce internal friction and to prevent corrosion.

f. Raising lines should have suitable fittings to prevent the rope from being bent over sharp edges and damaged.

5 Periodic Structural Inspections

5.1 The following routine checks, as applicable, should be made at appropriate intervals:

a. Inspect all welds, particularly in erecting mechanisms, for cracks and other signs of deformity.

b. Follow the manufacturer's instructions in checking hydraulic circuits and in bleeding air from scoping and raising rams before each lowering operation. Make sure of adequate supply of hydraulic fluid.

c. Wire rope, including operating lines, raising lines, and guylines, should be inspected for kinks, broken wires, or other damage. Make certain that guylines are not fouled and that other lines are in place in sheave grooves before and during each raising or lowering operation.

d. Check load transfer mechanisms, guides and scoping ram stabilizers in telescoping masts for free operation and good condition before raising or lowering operation. Keep mechanisms and guides clean and properly lubricated. Make sure scoping ram stabilizers move into proper position as the top section is telescoped up. After the top section is scoped into the working position, check to see that the load transfer mechanisms are fully engaged.

e. Check unit for level and check foundation and supports for correct placement before erecting operation. Level the unit in accordance with manufacturer's recommendations.

f. Check lubrication of crown sheaves.

g. Check lubrication and condition of bearings in all sheaves, sprockets, pins, etc., which are part of the erection mechanism.

h. Check folding ladders for proper position prior to access by personnel and for free operation before lowering operation.

i. During drilling or servicing operation, make scheduled inspections of all bolted connections to ensure that they are tight.

j. Load transfer mechanisms should be checked frequently for proper locking position, preferably on each tour during operations. To develop its rated load capacity, the axis of the structure must be in alignment throughout its length. It is important that load transfer mechanisms be maintained in such condition as to ensure structure alignment.

k. The Visual Field Inspection of Derrick or Mast and Substructure procedure is recommended for use by operating personnel (or a designated representative) to the extent that its use satisfies conditions for which an inspection is intended. A sample report form for this inspection procedure is shown in Appendix A. Forms are available from International Association of Drilling Contractors (IADC)[2].

5.2 Small settlements at the beginning of rig-up on a location are normal. Do not use the external guywires for plumbing the mast since neither the mast nor the guying system is intended for this purpose. The foundation must be capable of supporting the rig, substructure and all applied loads in a level and plumb configuration. Rig foundations, guywire anchors and guywire tensions should be checked with each crew change. The following conditions are reasons to discontinue operation until the cause of the discrepancy is located and corrected:

a. There is a large relative movement between the mast support structure and the rotary/setback support structure when the slips are set and the load is removed from the mast, or vice versa.

b. The empty traveling block does not hang over the well center, and/or the mast support structure is not level.

c. The mast support structure or substructure subsides more on one side than the other with the application of load, and/or the guywire on one side becomes noticeably tighter when the tension in the guywire on the opposite side becomes noticeably less.

d. Visual inspection of a guywire anchor reveals damage or movement.

6 Guying for Portable Masts with Guylines

6.1 Any mast designed to utilize guywires for mast stability should have all applicable guywires in position prior to com-

[2]IADC: Publications, P.O. Box 4287, Houston, Texas 77210. Phone: (713) 578-7171.

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mencing work. The number, placement and size of guywires should meet the following criteria, as applicable:

a. Mast manufacturer's recommendations are preferred. *CAUTION:* The manufacturer's warranty may be voided if the manufacturer's recommendation or his approved substitute is not used.
b. In absence of mast manufacturer's recommendations or where mast manufacturer's recommendations cannot be utilized because of obstructions at the wellsite location (such as roads, pits, electric lines, etc.), then the guying pattern shown in Figure 1 is recommended.
c. Other guying patterns may be utilized provided they are based upon the technical recommendations of a qualified person utilizing accepted engineering practices. (reference API RP 54, current edition, Section 2 for definition of a *qualified person.*) These recommendations should include a determination of guywire loads for wellsite-specific conditions including hook load, wind load and foundation adequacy. These recommendations should be available at the wellsite location and should state the loading conditions for which they were developed.
d. Requirements of applicable federal or state laws.

6.2 The guywires should be 6 x 19 or 6 x 37 class regular lay, IPS, IWRC wire rope (Reference API RP 9B, current edition), not previously used in any other application.

6.2.1 They should be visually inspected at least monthly and should be removed from service if the following damage, corrosion or wear exists:

a. Three (3) broken wires are found within one (1) lay length.
b. Two (2) broken wires are found at the end connection in the strand valley.

6.2.2 Other conditions for removal of wire rope from service are:

a. Marked corrosion appears.
b. Corroded wires at end connections.
c. End connections are corroded, cracked, bent, worn, or improperly applied.
d. Evidence of kinking, crushing, cutting, cold working, or bird-caging is observed.

6.3 Guywire end terminations should be made in accordance with good guywire practice and the current edition of API RP 9B. The guywires should never be turned back over small radius eyes when making an end termination. Wirerope thimbles or appropriately sized sheaves should be used to turn back the guywire ends. When wirerope clips are used, double saddle type clips are recommended and should be installed in accordance with the clip manufacturer's recommendations including applying proper torque to the nuts.

Note: When a sheave is used in place of a thimble for turning back the rope, add one additional clip.

6.4 When guying patterns other than those recommended by the mast manufacturer are used, the brackets used to attach the guywires to the mast or tubing board should be checked to make sure they have sufficient capacity for the maximum anticipated loads.

6.5 Guywire hardware such as shackles, turnbuckles, walking boomers, chain come-a-longs, load binders, etc., that remain in the live guywire system should have safe working load capacities that meet or exceed 40% of the breaking strength of the guywire. The handles on walking boomers, etc., should be positively secured to prevent accidental release. The use of grabhooks or open hooks on guywire terminations is not recommended.

6.6 Guywires should be pretensioned to values shown in Figure 1. The catenary or "sag" in the guywire may be used to estimate proper pretension (see Figure 2).

7 Guywire Anchors for Portable Masts with Guylines

7.1 Any type of anchor that meets the following spacing and capacity criteria, as applicable, is acceptable.

a. Mast manufacturer's recommendations are preferred.
b. In absence of mast manufacturer's recommendations or where mast manufacturer's recommendations cannot be utilized because of obstructions at the wellsite location (such as roads, pits, electric lines, etc.), then the values shown in Figure 3 are recommended.
c. Anchors designed to react the guywire loads determined in accordance with Paragraph 6.1.c are acceptable when used with guywire patterns developed in Paragraph 6.1.c. In this case, each anchor should have a minimum verified capacity of at least two (2) times the resultant guywire load(s) imposed on the anchor.
d. Requirements of applicable Federal or State laws.

7.2 The capacity of each anchor should be verified within 24 months prior to commencing work and should be rechecked if changes occur that would decrease the capacity of the anchor. The capacity may be verified by pull testing or other appropriate methods that are based upon accepted engineering practices that yield equivalent results to pull testing.

Note: The intent here is to allow for new and innovative approaches to anchorage. For example:

a. Properly designed substructures and base beams have been successfully used as anchorage for mast guywires. In such cases, dead weight of equipment and fabricated components such as padeyes determine anchor capacity. Since the capacity of such items can be determined through engineering calculations, anchor pull testing is not necessary.
b. Some manufacturers of screw-in type anchors have correlated anchor capacity to torque required to install the anchor. This "torque

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method," when used in accordance with the anchor manufacturer's instructions, is a valid method for determining anchor capacity.

7.3 Where pull testing is utilized to verify anchor capacity, the following should apply:

a. The direction of pull should be applied to the anchor in the plane of the anchor and the wellhead at an angle which approximates the guywire angle.
b. The test pull should be applied for at least two (2) minutes after all anchor movement has stopped.
c. Anchors should be tested by devices equipped with chart recorders to provide a permanent record of the pull test.
d. Devices used to measure and/or record the amount of pull should be calibrated annually by a qualified independent equipment service company and current records of calibration should be maintained with the equipment by the party responsible for the pull test equipment.

7.4 Anchors should be structurally designed by qualified persons utilizing accepted engineering practices. Steel components should be protected against corrosion.

7.5 Anchors should be installed such that liquids drain away from the anchor shaft. Soil should be mounded up and tightly packed around the anchor shaft to help keep fluids away from subsurface anchor components.

7.6 The rig contractor should be responsible for:

a. Insuring that anchor capacities are verified prior to attaching guywires to the anchors; that the verification is less than 24 months old; and that anchor spacing and capacity is suitable for the mast guying pattern and anticipated loading.
b. Maintaining all guywires and end terminations in good working condition.
c. Inspecting anchors for damage or deterioration prior to rigging up.
d. Inspecting surface ground conditions that might indicate reduced anchor capacity.
e. Properly aligning the rig in relation to the wellhead and anchors.
f. Placing a visible marker on each guywire.

7.7 The wellsite owner/operator should be responsible for:

a. Installing anchors at each wellsite in accordance with 7.1.
b. Providing anchor capacity verification in accordance with 7.2.
c. Replacing anchors that are damaged or excessively deteriorated or that fail anchor capacity verification.
d. Record keeping for anchors which are installed at the wellsite. The most current records of capacity verification should be maintained in a weather-tight container or on a weather resistant tag at the wellsite. The records should indicate the capacity of each anchor, the date of the capacity verification, and the name and telephone number of the party conducting the capacity verification.
e. Placing a visible marker on each anchor furnished, installed or specified by the wellsite owner/operator.

7.8 The party conducting capacity verification on anchors should be responsible for:

a. Maintaining test equipment in good working condition.
b. Providing required records to the rig contractor and/or to the wellsite owner/operator as applicable.

8 Foundations For Portable Masts With Guylines

8.1 Adequate foundations are an essential element in providing stability for portable masts with guylines. Foundation design should consider safe bearing capacity of local ground conditions, concentrated loads at mast and rig carrier support points, supplemental footing required to safely distribute concentrated loads to the ground, and location preparation.

8.2 The safe bearing capacity of local ground conditions may be determined from Table 1 or from appropriate soil core tests, penetrometer test, or other suitable soil test and analysis methods. Where surface conditions are used to determine safe bearing capacity, care must be exercised to ensure that the soil is homogeneous to a depth at least twice the width of supplemental footing used to support the concentrated load. Underlying soft soil layers to this depth should be used to determine safe bearing capacity rather than firmer surface soil.

8.3 Supplemental footing must be provided to distribute the concentrated loads from the mast and rig carrier support points to the ground. The manufacturer's load distribution diagram indicates the location of these concentrated loads and their magnitude for maximum loading conditions. If manufacturer's load distribution diagram is not available, or for loading conditions less than maximum, supplemental footing should be designed to carry the hook load encountered plus the gross weight of mast and mast mount, the traveling equipment, and the vertical components of guywire tensions under loading conditions, and to carry the mast and mast mount weight during mast erection.

The area and the stiffness of the supplemental footing must be such that concentrated loads are distributed to the ground without exceeding the safe bearing capacity of the soil. Steel beams and/or timbers used to construct supplemental footing should be designed so that applicable stresses in the member(s) are within allowable limits. Timbers should be free of excessive knots and free of all splits.

8.4 Location sites for drilling and servicing rigs should be graded and adequately drained. They should be constructed and maintained by the site owner so that oil, water, drilling fluid and other fluids will drain away from the working area. Drainage ditches passing beneath load bearing members in contact with the ground reduce effective bearing area and tend to reduce the ability of adjacent ground to bear load. The

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routing of ditches under load bearing structural members should be avoided. Wet conditions will significantly reduce the safe bearing capacity of soil. A recommended location preparation to provide ground conditions necessary for safe operations is shown in Figure 5.

8.5 Wellhead cellars at a location site may present special considerations for safe operation of a portable mast. Earthen cellars have the potential for cave-in. They also fill with rain, wellbore fluids or other fluids that can seep into the ground under the mast supplemental footing and reduce the safe bearing capacity of the soil. Earthen cellar walls lined with timbers have the same seepage potential. Large concrete cellars may require special steel beams to span the cellar in order to provide suitable mast support. These conditions should be studied by a qualified person to insure that adequate mast foundation is provided.

9 Precautions and Procedures For Low Temperature Operations

9.1 A survey of 13 drilling contractors operating 193 drilling rigs in Northern Canada and Alaska indicated that there is a wide range of experience and operating practices under extremely low temperature conditions. While there is very little precise information available, there have been a sizeable number of failures in portable masts while in the lowering or raising process during winter. Thus, the exposure to low temperature failures focuses on mast lowering and raising operations. Based on reports, however, this operation has been accomplished successfully in temperatures as low as –50° Fahrenheit. While the risk may be considerably greater because of the change in physical characteristics of steel at low temperatures, operators may carry on "normal" operations even at extremely low temperatures. This may be accomplished by a program of closely controlled inspection procedures and careful handling and operation. This should reduce damage and impact loading during raising and lowering operations. At the present, there seems to be no widely accepted or soundly supported basis for establishing a critical temperature for limiting the use of these oil-field structures. Experience in the operation of trucks and other heavy equipment exposed to impact forces indicates that –40° Fahrenheit may be the threshold of the temperature range at which the risk of structural failure may increase rapidly. Precautionary measures should be more rigidly practiced at this point. The following recommended practices are included for reference:

a. To the extent possible, schedule mast raising and lowering operations to take place at the warmest time of the day; take advantage of any sunlight or predictable atmospheric conditions. Take into account wind velocity factors.

b. Make use of any practical, available means to warm sections of the mast, such as using high pressure steam or hot air blowers to heat the points of attachment between the mast and its base.

c. Take up and loosen mast raising lines several times to assure the free movement of all parts.

d. Warm up engines and check the proper functioning of all machinery to assure that there will be no malfunctions which would result in sudden braking or jarring of the mast. Mast travel, once begun, must be slow, smooth, and continuous.

e. Inspection and repair as provided in this recommended practice are extremely critical under low temperature conditions. Masts should be maintained in excellent condition.

f. In general, welding should not be done when the ambient temperature is below 0° F. All steel grades that are commonly used in the fabrication of oilfield structures require preheat when the parts being joined are less than 32° F. Several steel grades require preheat and the maintenance of minimum interpass temperature even if the material is above 32° F. Check with the manufacturer of the structure before welding.

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APPENDIX A—REPORT OF VISUAL FIELD INSPECTION OF DERRICK OR MAST AND SUBSTRUCTURE

PURPOSE AND SCOPE OF INSPECTION. This report form and inspection procedure was developed as a guide for making and reporting field inspections in a thorough and uniform manner. The procedure is intended for use by operating personnel (or a designated representative) to the extent that its use satisfies conditions for which an inspection is intended. More detailed and critical inspections may be scheduled periodically, or ordered to supplement a program of these inspections; if masts or derricks are used in the upper range of their load limits, or if structures may have been subjected to critical conditions which could affect safe performance.

MARKING DAMAGE. At the time of inspection, damaged sections or equipment must be clearly and visibly marked so that needed repairs may be made. A bright, contrasting spray-can paint is suggested for this. When repairs are made, the visible markings should be removed by painting over them. It is also necessary for the inspector to write "None" when no damage markings are needed, as this is his indication that the item has passed inspection. It is recommended that inspection be made with assistance of manufacturer's assembly drawing and operating instructions. For items not accessible or that do not apply, draw a line through the item pertaining to the component.

BOLTED STRUCTURES. Section XIV is provided for a rig builder to use in reporting the results of his inspection and tightening bolted connections, in making an inspection of a standing derrick. The rig builder is also to make inspection and report his findings as called for in Sections III, IV, VI, VII, IX, and XV.

Company Name ____ Rig No. ___________________

Location ____ Date _____________________

Mast/Derrick
Identification _______________________________________ Ser. No. ___________________

Rig Standing ________________ Lying Down _______________ Disassembled ______________

Inspected By _________________________________ Representing ___________________________

Original Of Report Sent To ____

DERRICKS AND MASTS

I. Crown Assembly

A. Sheaves

No. ______________ Main Cluster Size ________________ Fastline Size ______________

B. Condition

1. Sheaves: Warped ____ OK ___

   Groove: Worn ____ OK ___

2. Spacers Or Seals: Bad ____ OK ___

   Grease Fitting: Missing ____ OK ___

3. Bearings: Loose ____________ Bad __________________________________ OK ___

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4. Crown Safety Platform: Minor Damage __________ Badly Damaged __________ OK ____
5. Handrails: Minor Damage _____________ Badly Damaged ________________
   Cracked Welds ____ OK ____
6. Crown Frame: Bent Beam Flanges _______ Beam Webs Bent ______________
   Cracked Welds _________________ Location ________________________
7. Comment: Rusty _______________ Needs Repairs ______________________
   Needs Painting ___________________ Other ________________________
8. Number Of Visible Marks Applied ____

II. Additional Sheave Assemblies: Name ____ OK ____
   Or __________________________ No. Of Visible Marks Applied ______________

III. Crown Support Beams
   Beam Flanges Bent ______ Beam Webs Bent ______ Cracked Welds _________
   Needs Repair _________ No. Of Visible Marks Applied ______________________ OK ____

IV. Legs

A. Front Leg, Drillers Side:
   Slight Bow _________ Bad Bow _________ Needs Repairing _______________ OK ____
   Pin Connections: Bad ____ OK ____
   Pin Hole: Bad __________________ Cracked Welds _______________________ OK ____
   Safety Pins: Missing ____ OK ____

B. Front Leg, Off-drillers Side:
   Slight Bow _________ Bad Bow _________ Needs Repairing _______________ OK ____
   Pin Connections: Bad ____ OK ____
   Pin Hole: Bad __________________ Cracked Welds _______________________ OK ____
   Safety Pins: Missing ____ OK ____

C. Rear Leg, Drillers Side:
   Slight Bow _________ Bad Bow _________ Needs Repairing _______________ OK ____
   Pin Connections: Bad ____ OK ____
   Pin Hole: Bad __________________ Cracked Welds _______________________ OK ____
   Safety Pins: Missing ____ OK ____

D. Rear Leg, Off-drillers Side:
   Slight Bow _________ Bad Bow _________ Needs Repairing _______________ OK ____
   Pin Connections: Bad ____ OK ____
   Pin Hole: Bad __________________ Cracked Welds _______________________ OK ____
   Safety Pins: Missing ____ OK ____

E. Number Of Visible Marks Applied ____

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V. Spreaders (Back Panel Trusses)

Slight Damage _________ Badly Damaged ________ Cracked Welds ________

Needs Repairs ____ OK ___

Bolt And Pin: Improper Length ______________________________________ OK ___

Safety Pin: Missing ____ OK ___

Bolt And Pin Holes: Oval ____ OK ___

Number Of Visible Marks Applied ___________________________________

VI. Girts And Bracing

Bent ____ OK ___

Number Bent: Slight _________ Badly _________ Cracked Welds ___________

Need Repairs ____

Number Of Visible Marks Applied ___________________________________

VII. Feet Or Pivots

Damaged ______ Cracked Welds _______ Corroded _____ Worn Holes _____

Worn Pins ____________ Needs Repairs ____________________________ OK ___

Number Of Visible Marks Applied ___________________________________

VIII. A-Frame

A. Legs: Damaged Members ________________ Cracked Welds ________________ OK ___

B. Spreaders Or Trusses: Damaged Members _________ Cracked Welds _________ OK ___

C. Upper Connections: Damaged ____________ Cracked Welds _________________ OK ___

D. Raising Sheaves And Shafts: Damaged ____________________________________ OK ___

Lubrication: ____ OK ___

Fittings: Missing ____________ Cracked Welds ___________________________ OK ___

E. Lower Connections: Corroded ____ OK ___

Pin Connections: Loose ____ OK ___

Pin: Worn ____ OK ___

Safety Pin: Missing ____ OK ___

F. Number Of Visible Marks Applied ___________________________________

IX. Working Platforms

A. Racking Platform:

Frame: Damaged _______________ Cracked Welds __________________________ OK ___

Pin Connections: Worn ____ OK ___

Safety Pins: Missing ____ OK ___

Fingers: Damaged ________ Cracked Welds ________ Needs Repairs _______ OK ___

B. Rod Hangers:

Frame: Damaged ____ OK ___

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Fingers: Damaged ____ OK ____

Basket: Damaged ________________ Cracked Welds ____________________ OK ____

C. Working Platform: Damaged ___________ Cracked Welds _________________ OK ____

D. Tubing Support Frame: Damaged ______________________________________ OK ____

Connections: Damaged ___________ Cracked Welds _____________________ OK ____

E. Handrails:

Damages: Minor _________ Major _________ Cracked Welds ___________ OK ____

Connections: Need Repairs ____ OK ____

F. Number Of Visible Marks Applied ______________________________________

X. Ladders: Cracked Welds ________ Bad Rungs _______ Bad Connections ________ OK ____

Damages: Minor ___________ Major __________________________________

Number Of Visible Marks Applied ______________________________________

XI. Raising And Telescoping System

A. Wireline System—Refer To API Specification 4E/Specification 4F For Specifications

1. Wireline: Frayed _________ Kinked _________ Corroded ________________ OK ____

2. Cable Clamps: Loose __________ No. Of Clamps Properly Installed _________ OK ____

3. Sheaves And Mountings: Damaged ___________________________________ OK ____

4. Equalizer Assembly: Damaged ______________________________________ OK ____

5. Sockets And Pins: Damaged ____ OK ____

B. Hydraulic System:

1. Hydraulic Cylinders:

a. Raising: Leaking ________ Exposed Surface ________ Corroded _______ OK ____

b. Scoping: Leaking ________ Exposed Surface ________ Corroded _______ OK ____

2. Connections: Leaking ____ OK ____

3. Hoses & Hose End Fitting: Exposed Wire _________ Corroded ___________ OK ____

Damaged ____ OK ____

4. Pin Holes: Oval ____ OK ____

5. Scoping Cylinder Stabilizers: Bent __________________________________ OK ____

Lubrication: OK ____

C. Mast Guides: Cleaned And Lubricated _________ Needs Attention __________ OK ____

D. Number Of Visible Marks Applied ______________________________________

XII. Locking Device & Seats—Telescoping Masts

A. Pins, Bars or Pawls: Damaged ____ OK ____

B. Seats: Deformed ____ OK ____

C. Mechanism: Damaged _________ Needs Cleaning & Lubrication ____________ OK ____

D. Number Of Visible Marks Applied ______________________________________

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XIII. Guylines Anchorage

A. Guyline: Damaged _______ Needs Adjusting _______ Needs Replacing ______ OK ___

B. Cable Clamps: Loose _______ Properly Installed ________ Some Missing ______ OK ___

C. Pins And Safety Pins: Missing ____ OK ___

D. Turnbuckles: Locked ________ Damaged ________ Replace _______________ OK ___

E. Anchor & Deadmen: Replace ____ OK ___

F. Number Of Visible Marks Applied ____

XIV. Bolted Structures

All bolted connections are to be inspected, tightened, and missing parts replaced or visibly marked as missing or damaged and in need of repair.

A. All bolted connections found to be satisfactory as checked and loose bolts tightened, or OK ___

B. All bolted connections visually inspected and spot-checked for tightness and no further bolt-tightening or repairs necessary. OK ___

C. Number Of Visible Marks Applied ____

XV. Summary Of Inspection

A. Was Manufacturer's Assembly Drawing Used? Yes _________ No ________

B. Appearance: Good ________ Fair ________ Poor ________________________

C. Repairs Needed: None ________ Minor ________ Major ___________________

D. Number Of Missing Parts ____

SUBSTRUCTURE & VERTICAL EXTENSION

I. Shoes, Pedestals, Or Pivots: Damaged ______________________________________ OK ___

Holes: Worn ____ OK ___

Bolts: Need Replacing ____ OK ___

Pins: Worn ____ OK ___

Safety Pins: Missing ____ OK ___

Support Beams: Damaged _______________ Corroded ____________________ OK ___

Number Of Visible Marks Applied ____

II. Flooring:

Damages: Minor __________________ Major _____________________________ OK ___

Number Of Visible Marks Applied ____

III. Substructures For Derrick Or Mast: OK ___

Damages: Minor ________________ Major ___________________________________

Corrosion: Minor ________________ Major ____________ None ______________

Connections: Worn ______________ Cracked Welds ___________________________ OK ___

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Safety Pins: Missing ____ OK ____

Number Of Visible Marks Applied ____________________________________

IV. Sub-spreaders & Rotary Beams: ____________________________________ OK ____

Damages: Minor ____________ Major ______________________________

Corrosion: None ____________ Minor _____________ Major _________________

Connections: Worn ______________ Cracked Welds _________________________ OK ____

Safety Pins: Missing ____ OK ____

Number Of Visible Marks Applied ____________________________________

V. Engine Foundation: OK ____

Damages: Minor ____________ Major ______________________________

Corrosion: Minor ____________ Major ______________ None ________________

Connections: Worn _______________ Cracked Welds _________________________ OK ____

Safety Pins: Missing ____ OK ____

Number Of Visible Marks Applied ____________________________________

VI. Engine Foundation Spreaders:______________________________________ OK ____

Damages: Minor ____________ Major ______________________________

Corrosion: Minor ____________ Major ______________ None ________________

Connections: Worn ______________ Cracked Welds _________________________ OK ____

Safety Pins: Missing ____ OK ____

Number Of Visible Marks Applied ____________________________________

VII. Stairways, Landings, And Handrails:

Damages: Minor ________________ Major ___________________________

VIII. Hold Down And Anchoring Connections:

Bolts Tight _____ Bolts Missing _____ Damaged _____ Needs Repairing _______ OK ____

IX. Foundation:

Adequate: Yes ________ No ________ Why _______________________________

X. Summary Of Inspection:

Appearance: Good ____________ Fair ____________ Poor ___________________

Repairs Needed: None _________ Minor __________ Major _________________

Was Manufacturer's Assembly Drawing Used? Yes __________ No ____________

Number Of Missing Parts ____

DEADLINE ANCHOR & SUPPORTS

I. Deadline Anchor: Damaged ________________ Corroded _____________________ OK ____

II. Supports: Damaged _______________ Corroded ____________________________ OK ____

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Bolts: Need Replacing ____ OK ___

III. Number Of Visible Marks Applied ____

Remarks and References To Additional Special Inspection Reports ___________________________

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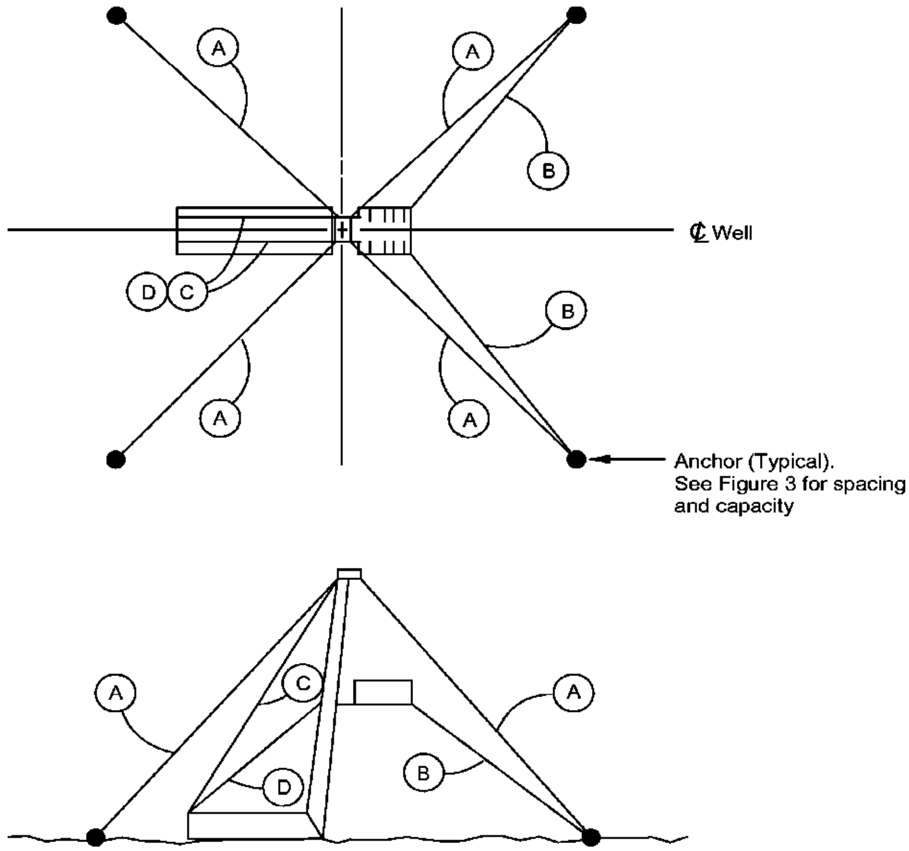

Guyline	Recommended Size	Recommended Pretension	Sag
External Guy A	$^5/_8$ inch	1000 pounds	see Fig. 2
External Guy B	$^9/_{16}$ inch	500 pounds	see Fig. 2
Internal Guy C (Two)	$^7/_8$ inch	1500 pounds (each)	3 inches
Intermediate Guy D (Two) (see note 4)	$^5/_8$ Inch	1000 pounds (each)	3 inches

Notes:
1. All guywires should be 6 x 19 or 6 x 37 class, regular lay, IPS, IWRC.
2. Guywire catenary or sag may be used to estimate pretension, see Figure 2.
3. See Figure 3 for anchor spacing and capacity.
4. Intermediate guywires D are recommended at option of manufacturer only.

Figure A-1—Recommended Guying Pattern

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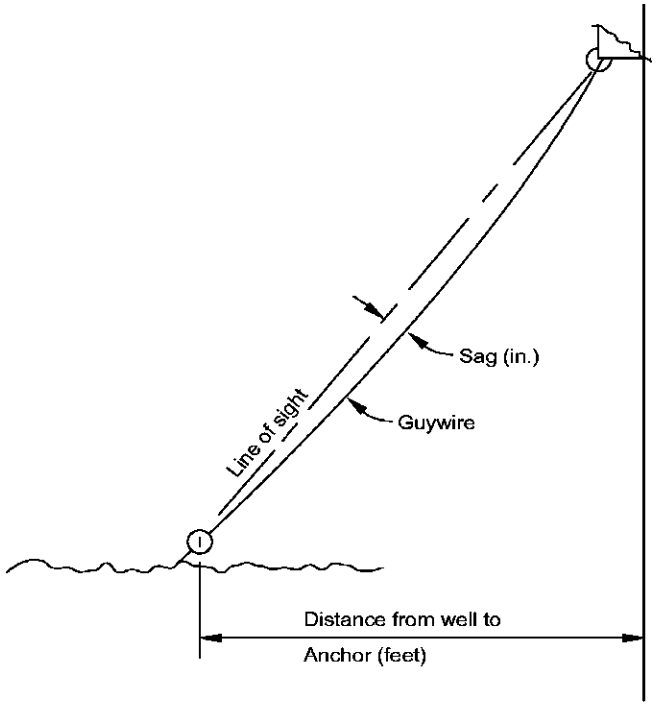

	Guywire Sag (inches)					
	Pole Mast		Single Mast		Doubles Mast	
Distance Well to Anchor (feet)	Tubing Board Guy	Crown-Ground Guy	Tubing Board Guy	Crown-Ground Guy	Tubing Board Guy	Crown-Ground Guy
40	—	4	4	4	6	5
60	—	6	8	6	12	8
80	—	10	15	10	17	11
100	—	14	22	14	26	15
120	—	18	32	18	32	21

Note: The above figures represent pretensions of 1000 pounds in crown-ground guywires and 500 pounds in tubing board guywires.

Figure A-2—Guyline Sag (Cantenary) as a Measure of Guywire Pretension

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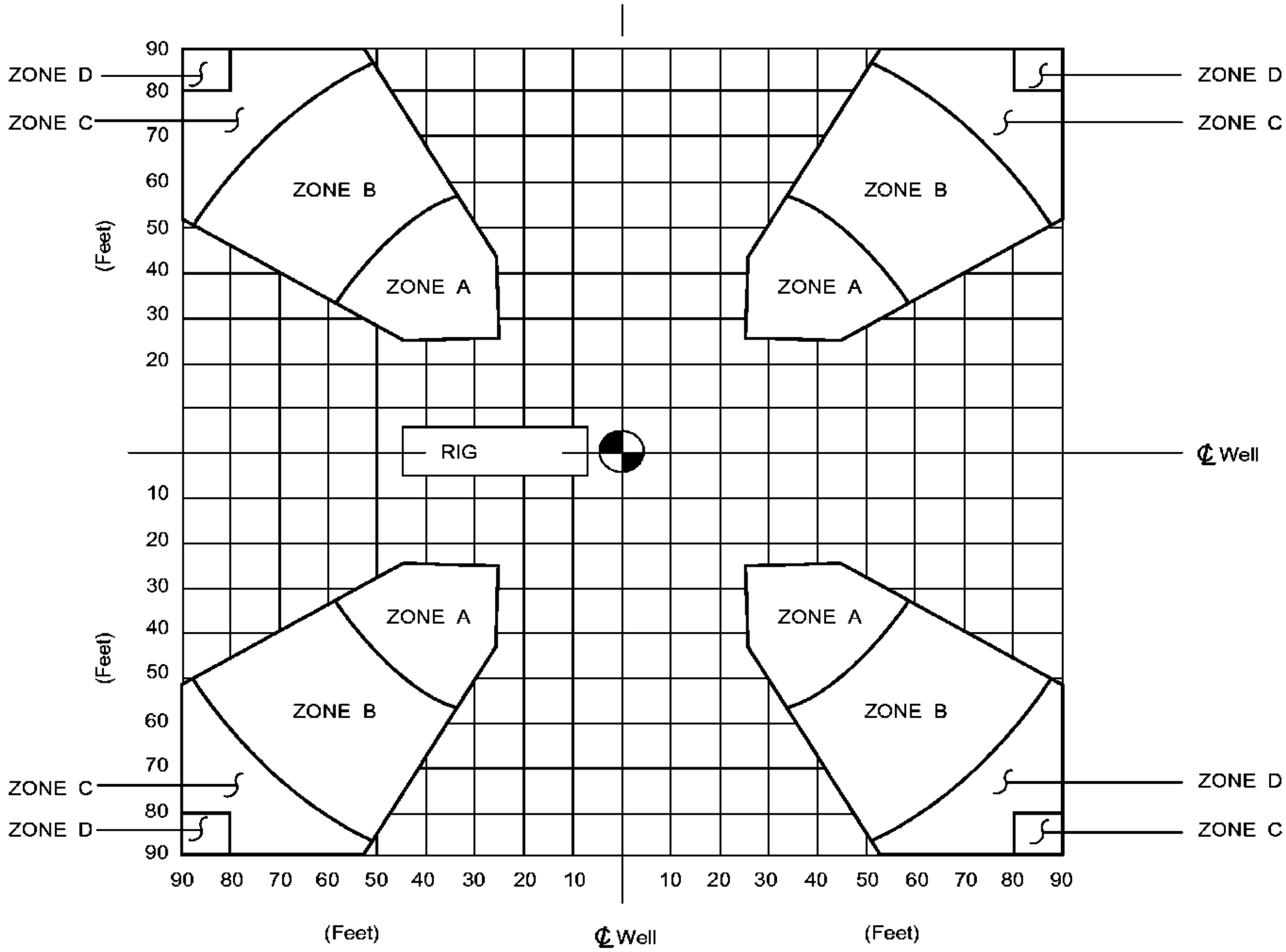

Anchor Capacity (Tons)			
Zone	Doubles Mast	Singles Mast	Pole Mast
A	15.6	7.0	7.0
B	11.5	5.0	5.0
C	9.0	5.0	5.0
D	7.4	5.0	5.0

Note: Anchor capacities shown on this figure assume the following:
1. Adequate foundation support for mast and carrier.
2. Adequate crown-to-carrier internal load guys.
3. Full rod and tubing setback except for pole unit which has no setback.
4. Anchors in the two quadrants on the rig side of the well are located in the same zone and with equal spacing (±10 ft) either side of the horizontal centerline and with equal spacing (±10 ft) either side of the vertical centerline.
5. Maximum wind velocity of 70 mph, or, maximum hook load as follows:
   a. For zone A: 50% of rated mast capacity.
   b. For other zones: subject to mast derating criteria in Figure 4.

Figure A-3—Anchor Spacing and Capacity Criteria

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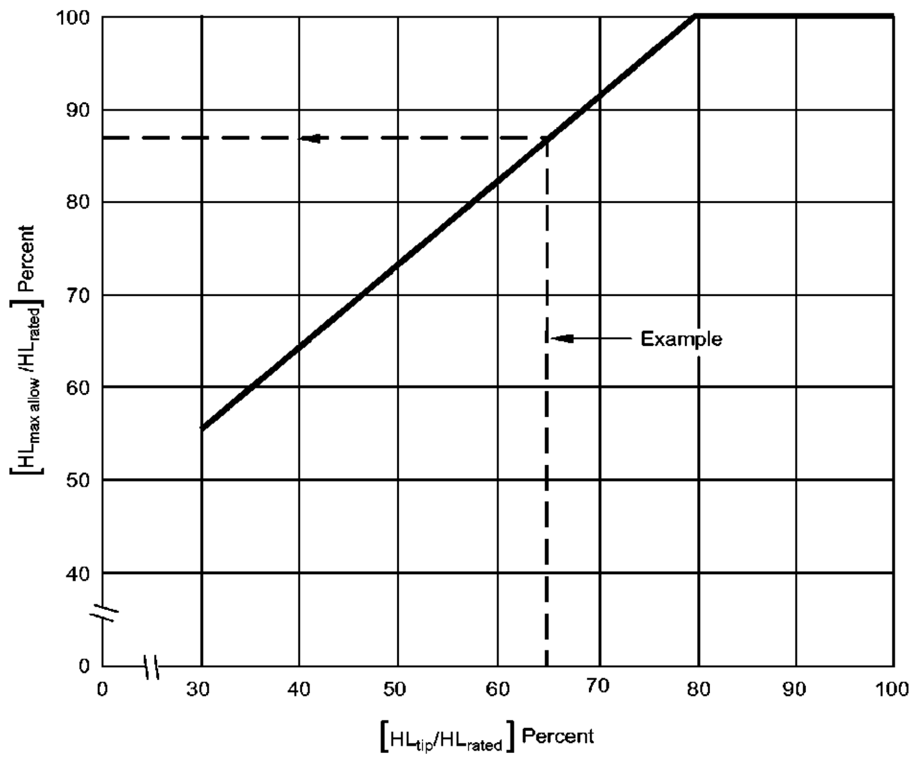

Some portable masts with guylines may have maximum rated hook load capacities (HL_{rated}) that, if applied, could result in overloading of guyline anchors. In such cases, it is necessary to determine the maximum allowed hook load ($HL_{max\ allow}$) which will prevent anchor overload. The chart above can be used to determine the magnitude of mast derating required to insure that anchor capacities shown in Figure 3 are not exceeded.

To use the chart, it is necessary to know the hook load at which the carrier would lift up if the drawworks side crown-to- ground guywires were not in place (HL_{tip}).

The following example illustrates the use of the chart:
Given: HL_{tip} = 140,000 lb
HL_{rated} = 215,000 lb

Solution: $HL_{tip} \div HL_{rated} = {}^{140}/_{215} = 65\%$

- Use the curve to determine that: $HL_{max\ allow}/HL_{rated} = 87\%$
- Determine the maximum allowed hook load for this case as 0.87 x 215,000 lb = 187,000 lb
- Therefore, the mast on this rig must be derated to a maximum hook load of 187,000 lb to insure the anchors are not overloaded.

Figure A-4—Mast Derating Criteria

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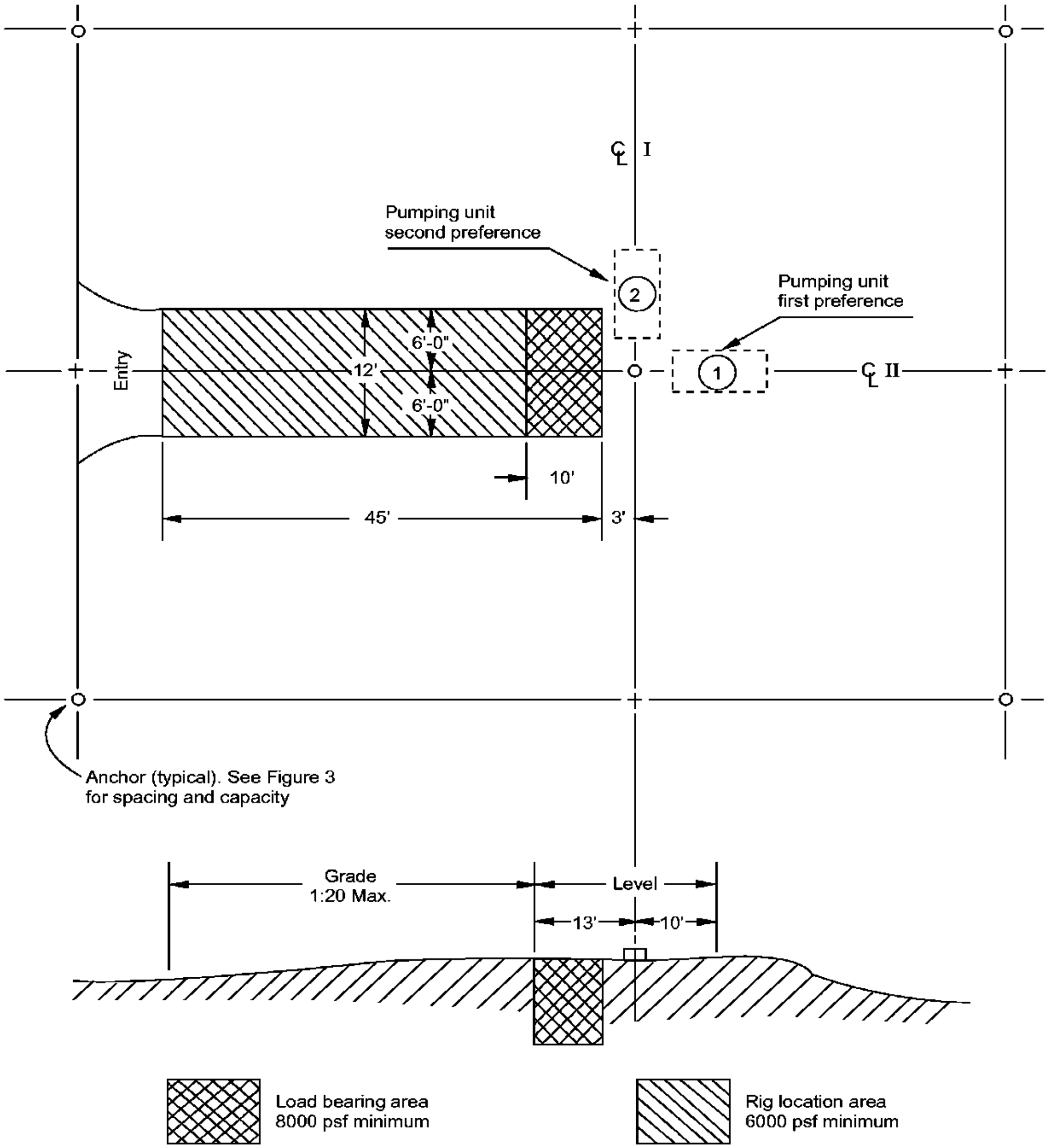

Load bearing area: Compacted sand or gravel requiring picking for removal or better base. Safe bearing capacity desired—min., 8000 psf, level and drained.

Rig location area: May grade away from well along centerline II at max. drop of 1:20. Should be level across grades parallel to centerline I. Safe bearing capacity desired—min., 6000 psf. Allow maneuvering entry for drive in or back in. Drainage of entire area required.

Figure A-5—Portable Mast Location Preparation

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Table A-1—Safe Bearing Capacity of Soils[a]
(lb/ft^2)

Solid ledge of hard rock, such as granite, trap, etc.	50,000
Sound shale and other medium rock requiring blasting for removal	20,000
Hard pan, cemented sand and gravel difficult to remove by picking	16,000
Soft rock, disintegrated ledge; in natural ledge, difficult to remove by picking	10,000
Compact sand and gravel requiring picking for removal	8,000
Hard clay requiring picking for removal	8,000
Gravel, coarse sand, in natural thick beds	8,000
Loose, medium, and coarse sand, fine compact sand	3,000
Medium clay, stiff but capable of being spaded	4,000
Fine loose sand	2,000
Soft clay	less than 2,000

[a] Values taken from *Marks' Mechanical Engineers' Handbook.*

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