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GUYWIRE ANCHOR SYSTEMS

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MEC-135 EXAM PREVIEW

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Exam Preview:

1. The American Petroleum Institute (API) in its Specification 3E "Specification for Drilling and Well Servicing Structures" sets forth a "Recommended Guying Pattern General Conditions."
    a. True
    b. False
2. According to the reference material, which of the following anchor types has a direct correlation between anchor capacity and torque required to install the anchor?
    a. Expanding plate anchor
    b. Screw anchor
    c. Flat plate anchor
    d. Pivoting anchor
3. According to the reference material, when surface conditions are used to determine bearing capacity, care must be exercised to ensure that the soil is homogeneous to a depth of at least _____ the width of supplemental footing used to support the concentrated load.
    a. 2X
    b. 3X
    c. 4X
    d. 5X
4. According to the reference material, a tubing board guy can have a pre-tension of 1000 pounds, independent of being pole, single or double mast.
    a. True
    b. False

5. Figure IV:1-5. Catenary Method provides guidance on guywire sag, as it relates to the distance from well to anchor. Using the provided chart, for a Single Mast Tubing Board Guy at 100 feet, what is an acceptable amount of guywire sag?
    a. 17 inches
    b. 22 inches
    c. 26 inches
    d. 32 inches
6. When discussing stability conditions and the foundation for the guywire, it is critical that the area should be graded, leveled, and maintained so that oil, water, drilling fluid, and other fluids will drain away from the working area.
    a. True
    b. False
7. According to the reference material, Guywires should be 6×19 or 6×__ class, regular lay, made of improved plow steel (IPS) or better with independent wire-rope core (IWRC) and not previously used for any other application.
    a. 24
    b. 35
    c. 36
    d. 37
8. Figure IV:1-4. Anchor Capacity Requirements for Each Zone lists capacity for each zone based on the previous Figure IV:1-2. Anchor Location Diagram. Using the table, which of the following anchor capacity corresponds Zone D for a Doubles Mast?
    a. 11.5
    b. 5.0
    c. 7.4
    d. 9.0
9. According to Figure IV:1-4. Anchor Capacity Requirements for Each Zone, the capacity requirements displayed assume that there is a Maximum wind load of 70 mph.
    a. True
    b. False
10. Figure IV:1-2. Anchor Location Diagram shows the different guywire zones and where they attach to the mast. According to this figure, which zone attaches to the highest points on the mast?
    a. Zone B
    b. Zone A
    c. Zone C
    d. Zone D

Oil Well Derrick Stability: Guywire Anchor Systems

Table of Contents:

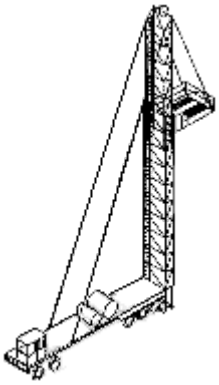
NOTE: This technical manual is based upon the outdated API Specification 4E, which has been superseded by API Specification 4F, June 1995. The API RP 4G provides a "Recommended Guyline Anchor Spacing and Load Chart." AESC has published "Guidelines on the Stability of Well Servicing Derricks." There has been considerable progress within the industry to design procedures to assure the integrity of the stability system without the necessity of conducting individual pull tests on each of the anchors.

I. Introduction

Work-over rigs are mast type devices that vary significantly from crane or other boom (mast) type equipment. Work-over rigs experience constant and varying dynamic loading conditions. They are subjected to various compression forces, along with jarring and wind loading. Other forces induced by pipe, tubing, etc. being stacked in the derrick and workers aloft on the derrick platform, as well as an ever-changing number of lateral and vertical forces are also present. Because of a work-over rig's dynamic environment, the health and safety of the operation is dependent upon the stability of the rig and its guy anchor system.

A. **Causal Factors**

Figure IV:1-1. Oilwell Servicing Derrick



1. There is no specific OSHA standard that addresses the stability of derricks in the oilwell drilling and servicing industry (Figure IV:1-1). But because of the fatality record there is a need for a guideline detailing the type of temporary stability systems according to the type of soil and its holding capacity, methods of installing guywire anchors, integrity of the system, and acceptable parameters in lieu of actual pull testing should be established.
2. Investigation into each fatal incident has determined that the cause of the upset was component failure rather than total system failure. This clearly illustrates the fact that the integrity of the system is no sounder than its weakest component.

B. **Industry Recommendations**

1. The American Petroleum Institute (API) in its Specification 4E "Specification for Drilling and Well Servicing Structures" sets forth a "Recommended Guying Pattern General Conditions." The Association of Oilwell Servicing Contractors (AOSC), in its publication *Recommended Safe Procedures and Guidelines for Oil and Gas Well Servicing,* recommends the same guying patterns as are set forth in API Specification 4E.
2. Though not present in the AOSC publication, the API Specification 4E provides a "Recommended Guyline Anchor Spacing and Load Chart." This is discussed in detail in the Guidelines on the Stability of Well Servicing Derricks. There has been considerable progress within the industry to design procedures to assure the integrity of the stability system without the necessity of conducting individual pull tests on each of the anchors.

C. **Application.** This chapter is intended to form the basis of a minimum safety guideline, for the use of Temporary Guywire Anchor Systems on derricks, in the oil well drilling and servicing industry. Recommended procedures, practices, equipment, and requirements have been developed based on availability, capability, adaptability, dependability, and reliability of the various types of systems.

II. Types of Guywire Anchors

A. **Manufactured Anchors**

1. There are four basic types of manufactured anchors: the screw or helix anchor, the expanding plate anchor, the flat plate anchor, and the pivoting anchor. Holding capacity of these anchors varies; detailed information on holding capacity, comparison charts with illustrations, and characteristics specific to each design may be found in Section 2 of the support manual.
2. When installed in conformance with manufacturer specifications and evidence thereof is provided, this would satisfy the requirement for individual pull testing.
3. Screw(helix)-type anchors have a direct correlation between anchor capacity and the torque required to install the anchor. Following the manufacturer's specific recommendations as to torquing, with proof thereof, is a valid method of determining anchor holding capacity. Torquing according to manufacturer's specifications is an acceptable nonpull-test method of determining anchor capacity.

B. **Shop-Made (In-house Fabricated) Anchors**. These anchors should be designed by a registered engineer and conform to accepted engineering practices. Written procedures shall be established for installation.

These manufactured anchors should be proof tested for structural integrity and holding capacity. Records shall be maintained of test protocols and holding capacity based on soil type. Individual pull testing will not be required if anchors are installed in accordance with written procedures. Proof thereof will be required of installation protocols and proof-tested holding capacities.

III. Stability Considerations

A. **Foundation**

1. The area should be graded, leveled, and maintained so that oil, water, drilling fluid, and other fluids will drain away from the working area.
2. Safe Bearing Capacity shall be determined from the use of an appropriate table, soil core test, penetrometer test, flat-plate test, or other suitable soil test. When surface conditions are used to determine bearing capacity, care must be exercised to insure that the soil is homogeneous to a depth of at least twice the width of supplemental footing used to support the concentrated load.
3. Supplemental footing shall be provided to distribute the concentrated loads from the mast and rig support points. The manufacturer's load distribution diagram will indicate these locations. In the absence of a manufacturer's diagram, the supplemental footing shall be designed to carry the maximum anticipated hook load, the gross weight of the mast, the mast mount, the traveling equipment, and the vertical component of guywire tension under operational loading conditions. These footings must also support the mast and mast weight during mast erection.
4. Wellhead cellars present special foundation considerations. In addition to the obvious ones such as collecting water and fluids that can seep into the ground, cellars also require unique mast support considerations. These should be analyzed by a qualified person to insure that an adequate mast foundation is provided.
5. Small settlements (soil subsidence) at the beginning of rig-up is considered normal. External guywires should never be used for plumbing the mast. Rig foundations, guywire anchors and guywire tension should be checked at each tower (shift) change.

Figure IV:1-2. Anchor Location Diagram

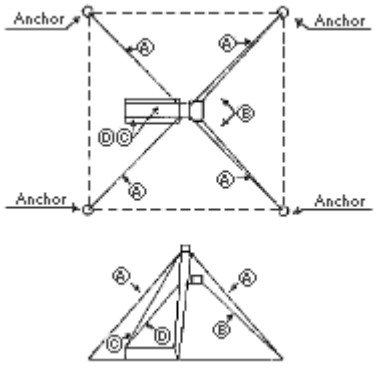
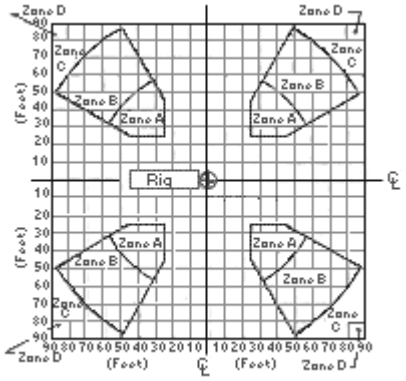


Figure IV:1-3. Recommended Anchor Locations



B. **Guywires**

1. All guywires, as indicated by the manufacturer's diagram, should be in position and properly tensioned prior to commencing any work. In the absence of manufacturer recommendations, or where mast manufacturer's recommendations cannot be implemented, the diagram in Figure IV:1-2 may be used.
2. Other guying patterns may be used; however, they must be based on sound engineering principles as determined by a qualified person. These recommendations should be posted on the mast in a weatherproof container and should state the loading conditions for which they were prepared. Guywires should be 6×19 or 6×37 class, regular lay, made of improved plow steel (IPS) or better with independent wire-rope core (IWRC) and not previously used for any other application. Double saddle clips should be used, and wire rope should be installed in accordance with the manufacturer's recommendations. In the absence of manufacturer recommendations, API RP 9B shall be followed.

C. **Guywire Anchors**

1. The mast manufacturer's recommendations shall be followed. In the absence of manufacturer recommendations the location diagram, Figure IV:1-3, may be used.
2. Each zone requires an anchor of different holding capacity. If anchors are located in more than one zone, then all anchors should be of the capacity required for the greater capacity zone. For example, if one anchor is located in "ZONE C" and the remaining anchors are located in "ZONE D," all anchors shall meet the holding capacity specified in the chart for "ZONE C." See Figure IV:1-4.

Figure IV:1-4. Anchor Capacity Requirements for Each Zone

Anchor Capacity (Tons)

Zone	Doubles Mast	Singles Mast	Post 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

Anchor Capacities shown assume the following:

1. Adequate foundation support for mast and carrier.
2. Adequate crown-to-carrier internal load guys.
3. Maximum wind load -- 70 mph.
4. Maximum hook load, as described elsewhere in this chapter.
5. Full rod and tubing setback (N/A for Pole unit).

IV. Observations, Directions, and Conclusions

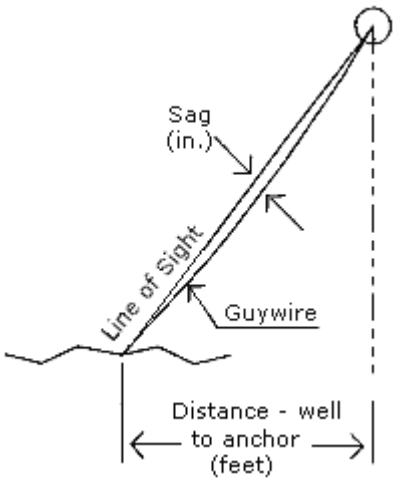
A. **Visual Observations**

1. There are characteristic visual observations that can serve as indicators of rig stability. They include, but are not limited to, the following:

   - The foundation supports the rig, substructure, and all applied loads while in an operational mode, without excessive movement, basically in a level and plumb configuration.
   - No large movement is observable 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.
   - The empty travel block hangs plumb with the centerline of the wellbore and the mast support structure remains level.
   - The mast support structure and/or substructure does not lean to one side more than the other when the load is applied. The guywire on one side becomes noticeably taut while the guywire on the opposite side becomes slack.
   - The guywire anchor(s) show(s) no visible signs of movement during the loading and unloading of the system while in operational mode.

2. The chart presented in Figure IV:1-5 may be used as a guide to the pretensioning of guywires. This method is commonly referred to as the Catenary Method (guywire sag method).

Figure IV:1-5. Catenary Method



	Guywire Sag (inches)					
	Pole Mast		**Single Mast**		**Double Mast**	
Distance Well to anchor (ft)	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

	Guywire Sag (inches)					
	Pole Mast		**Single Mast**		**Double Mast**	
Pre tension (Pounds)	500	1000	500	1000	500	1000

B. **Support Manual.** The support manual, entitled *Guideline on the Stability of Well Servicing Derricks,* is divided into work sections and intended to supplement this chapter. It provides a detailed analysis of existing guides and standards along with state-of-the-art developments.

Section 3 provides the direction and guidance necessary to evaluate and select the proper system to assure rig stability. Section 4 discusses the installation of guywire anchor systems. It is extremely important to point out that stability is dependent on the entire system, and not on a single component. In the absence of support documentation or manufacturer specifications, Section 6 sets forth the criteria for performing effective pull testing. It further identifies what would be acceptable in lieu of actual pull testing.

C. **Conclusion**

1. No set of observations or recommendations should be so restrictive or subjective as to preclude the use of innovative approaches to derrick stability systems. Properly designed substructures and base beams have been used effectively and safely as anchorages for guywires.
2. Engineering calculations based on sound engineering principles may also be used as evidence of an acceptable alternative to pull testing. Dead weight of equipment, fabricated components (i.e. padeyes) and other appurtenances are all considerations in determining rig stability.
3. The derrick manufacturer's specifications and recommendations should be the preferred and primary means of determining derrick stability. Guywire anchors, newly installed according to the manufacturer's specifications, may be used without the requirement for actual pull testing. (This would qualify as meeting the criteria as an acceptable alternative to pull testing.) If, however, there is a change in conditions, e.g. frozen ground to thawed ground, or if use of the anchor has been interrupted, the anchor shall be pull tested, with documentation thereof, prior to being placed back in service.

V. Bibliography

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