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Standard
Material Requirements

Metallic Materials for Sucker-Rod Pumps for Corrosive Oilfield Environments

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Foreword

This standard specifies metallic material requirements for the construction of sucker-rod pumps for service in corrosive oilfield environments. American Petroleum Institute (API)[(1)] Spec 11AX[1] provides dimension requirements that ensure the interchangeability of component parts. However, that document does not provide material specifications or guidelines for the proper application of various API pumps. API RP 11AR[2] does list the general advantages and disadvantages of the various pump types and lists the acceptable materials for barrels and plungers; and API RP 11BR[3] supplements API Spec 11AX by providing corrosion control methods using chemical treatment. This NACE standard is intended for end users (e.g., production engineers) and equipment manufacturers to supplement the use of the aforementioned API publications.

This standard was originally published in 1976 and was revised in 1994 by NACE Task Group T-1F-15 on Sucker-Rod Pumps for Corrosive Environments, a component of Unit Committee T-1F, "Metallurgy of Oilfield Equipment." It was reviewed by Task Group T-1F-28 and reaffirmed by T-1F in 2000, and was reaffirmed in 2006 by Specific Technology Group (STG) 32, "Oil and Gas Production—Metallurgy;" and in 2012 by STG 32. This standard is issued by NACE International under the auspices of STG 32.

In NACE standards, the terms *shall*, *must*, *should*, and may are used in accordance with the definitions of these terms in the *NACE Publications Style Manual*. The terms *shall* and *must* are used to state a requirement, and are considered mandatory. The term *should* is used to state something good and is recommended, but is not considered mandatory. The term is used to state something considered optional.

[(1)] American Petroleum Institute (API), 1220 L St. NW, Washington, DC 20005-4070.

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Contents

Section 1: General

1.1 An adequate chemical treatment program using a selection of proper corrosion inhibitors and application techniques is necessary for optimum performance of sucker-rod pumping equipment in a corrosive environment. However, control of direct attack on pump materials may be accomplished by materials selection alone or by materials selection in combination with chemical treatment.

1.2 The recommended materials in this standard are presented in tables and listed in order of preferred usage in six different environments with varying degrees of corrosiveness and with and without possible abrasion. The listed materials have performed satisfactorily when used in the specified environments. These material recommendations are based on field experience.

1.3 This standard is not intended to preclude the development and testing of new materials that might improve sucker-rod pump performance. It is the responsibility of the user to fully evaluate the performance of any new material prior to its use.

1.4 The designations and mechanical properties of the materials covered by this standard are listed in selected tables.

Section 2: Description of Tables

2.1 The specific quantities of water, hydrogen sulfide (H_2S), and carbon dioxide (CO_2) that are used to classify the corrosiveness of a fluid as mild, moderate, or severe are detailed in Table 1.

2.1.1 Explanations of the mild, moderate, and severe metal-loss corrosion classifications provided in Table 1 are intended to be a guide for the user. Currently, there is no clear consensus on which combination of produced fluids constitutes mild, moderate, or severe corrosive environments for subsurface pumps. There can be amounts of H_2S, CO_2, and water that do not clearly fall into one of the three combinations. The user's operating experiences coupled with analysis of failures should be used to develop the appropriate classification.

2.1.2 The three corrosion classifications are identified by amounts of water, H_2S, and CO_2 in the produced fluids. There are other constituents in the fluid that can influence corrosion. General comments on these constituents follow:

2.1.2.1 Oxygen—Oxygen can be very destructive to the system. If oxygen is discovered, every attempt should be made to free the system of oxygen, or at least bring it to below 50 ppb dissolved oxygen. Severe corrosion can be expected above 50 ppb dissolved oxygen.

2.1.2.2 Chlorides—High chlorides can lead to pitting corrosion. High-chloride service conditions should be assumed to exist when the total dissolved solids exceed 10,000 mg/L and/or total chlorides exceed 6,000 mg/L.

2.1.2.3 H_2S (Sour Service)—Sour service conditions should be assumed to exist when H_2S is present in the system at partial pressures equal to or greater than 0.35 kPa absolute (0.050 psia). When operating in sour service, the material for subsurface pump fittings (connectors, bushings, etc.) should conform to the requirements of NACE MR0175/ISO 15156.[4]

2.1.2.4 Water Content—Generally, if the water content is greater than 20%, the fluid exists as a water phase with oil droplets. If the water content is less than 20%, an oil phase with water droplets can exist. Inhibitors should be used if the water content is greater than 20%.

2.1.2.5 Temperature—The higher the temperature, the greater the rate of corrosion. Temperature below the crystallization point of paraffin results in deposition of a film of paraffin that may act as a corrosion barrier.

2.1.2.6 pH—The pH at bottomhole conditions is frequently lower (more acidic) than that measured at the surface. After acidizing, the pH should be monitored to ensure that the fluid does not attack chrome plate if chrome plate is used in the pump.