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Standard Practice

Preparation, Installation, Analysis, and Interpretation of Corrosion Coupons in Oilfield Operations

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Foreword

This standard practice was prepared to encourage the use of uniform and industry-proven methods to monitor mass-loss and pitting corrosion in oilfield operations. This standard outlines procedures for preparing, installing, and analyzing metallic corrosion coupons. Factors considered in the interpretation of results obtained from these corrosion coupons are also included for the use of oil and service industry personnel.

This standard was originally prepared in 1975 by NACE Task Group T-1C-6, a component of Unit Committee T-1C, "Detection of Corrosion in Oil Field Equipment," to provide procedures for the preparation, installation, and analysis of corrosion coupons. It was revised by Task Group T-1C-11 in 1986 and by T-1C-23 in 1991. T-1C was combined with Unit Committee T-1D, "Corrosion Monitoring and Control of Corrosion Environments in Petroleum Production Operations," and this standard was revised by Task Group T-1D-54 in 1999. It was reaffirmed in 2005 and in 2012 by Specific Technology Group (STG) 31, "Oil and Gas Production—Corrosion and Scale Inhibition." This standard is issued by NACE International under the auspices of STG 31.

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 *may* is used to state something considered optional.

Standard Practice

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Contents

1. General....1
2. Processing of Corrosion Coupons....1
3. Installation of Corrosion Coupons....7
4. Recording Data on Corrosion Coupon Report....16
5. Interpretation of Corrosion Coupon Data....16
References....17
Appendix A: Typical Corrosion Coupon Report (Nonmandatory)....19
FIGURES
Figure 1: Circular (washer-type) coupon and typical mounting in a ring joint flange....8
Figure 2: Drill pipe corrosion ring coupon....9
Figure 3: Flat coupon holder using a 60 mm nominal OD (2 in NPT) threaded pipe plug....9
Figure 4: Round (rod-type) coupon holder using a 60 mm nominal OD (2 in NPT) threaded pipe plug and special insulating disk that can accommodate eight round (rod-type) coupons....11
Figure 5: Tool for installing and removing coupons in systems under pressure....12
Figure 6: Extractor tool for inserting and removing coupons in systems under pressure....12
Figure 7: Wire-line-operated tubing stop adapted as downhole coupon holder....14
Figure 8: Choice of location for coupon installation and interpretation of coupon corrosion rate measurements....15
TABLES
Table 1: Density of Metals....5
Table 2: Qualitative Categorization of Carbon Steel Corrosion Rates for Oil Production Systems 17

Section 1: General

1.1 This standard is presented for the use of corrosion coupons in oilfield drilling, production, and transportation operations. Oilfield operations include oil-, water-, and gas-handling systems, and drilling fluids. (When used in this standard, *system* denotes a functional unit such as a producing well; flowline and tank battery; water, oil, or gas collection facility; water or gas injection facility; or a gas dehydration or sweetening unit.) Corrosion coupon testing consists of the exposure of a small specimen of metal (the coupon) to an environment of interest for a period of time to determine the reaction of the metal to the environment. Corrosion coupons are used to evaluate corrosiveness of various systems, to monitor the effectiveness of corrosion-mitigation programs, and to evaluate the suitability of different metals for specific systems and environments. The coupons may be installed in the system itself or in a special test loop or apparatus. Corrosion rates shown by coupons and most other corrosion-monitoring devices seldom duplicate the actual rate of corrosion on the system piping and vessels. Accurate system corrosion rates can be determined by nondestructive measurement methods or failure frequency curves. Data furnished by corrosion coupons and other types of monitors must be related to system requirements. High corrosion rates on coupons may be used to verify the need for corrective action. If a corrosion-mitigation program is initiated and subsequent coupon data indicate that corrosion has been reduced, the information can be used to approximate the effectiveness of the mitigation program. This standard does not contain information on monitoring for intergranular corrosion, stress corrosion cracking (SCC), or sulfide stress cracking (SSC). The latter aspects are discussed elsewhere.[1,2]

1.2 This standard describes preparation and handling techniques for metal coupons prior to and following exposure. Corrosion rate calculations and a typical form for recording data are also included.

1.3 Coupon size, metal composition, surface condition, and coupon holders may vary according to the test system design or the user's requirements. Coupons are often installed in pairs for simultaneous removal and average mass-loss determination. Coupons may be used alone but they should be used in conjunction with other monitoring methods such as test nipples, hydrogen probes, galvanic probes, polarization instruments, resistance-type corrosion monitors, chemical analysis of process streams and nondestructive metal thickness measurements, caliper surveys, and corrosion failure records.

1.4 Corrosion coupons used as recommended in this standard measure the total metal loss during the exposure period. They show corrosion that has already occurred. A single coupon cannot be used to determine whether the rate of metal loss was uniform or varying during the exposure period. Information on the change in corrosion rate can be obtained by installing several coupons at one time and removing and evaluating individual coupons at specific short-term intervals. Other monitoring methods mentioned in Paragraph 1.3 can be used to provide more accurate information on short-term rates of corrosion. Data provided by corrosion coupons can provide excellent backup for "event-indicating" corrosion-monitoring instruments.

1.5 In addition to mass loss, important factors to consider in the analysis and interpretation of coupon data include location, time onstream, measured pit depth, surface profile (blistering, erosion), corrosion product and/or scale composition, and operating factors (e.g., downtime, system flow velocities, upsets, or inhibition).

1.6 Coupon corrosion rates in one system should not be compared directly with those in other unrelated systems. However, corrosion rates in similar systems (e.g., two systems handling identical environments) often correlate. Additional information can be obtained within a system by varying one exposure parameter at a time (e.g., location or duration of exposure). For example, corrosion rates can be affected by changes in fluid velocity within a system. Corrosion rates can vary dramatically upstream and downstream from the point of entry of a corrodent, such as oxygen.

Section 2: Processing of Corrosion Coupons

2.1 Coupon Preparation. The following procedure should be used to prepare coupons for corrosion testing. Coupons should be new; do not reuse coupons after exposure and analysis.

2.1.1 Choose a method of coupon preparation that does not alter the metallurgical properties of the metal. Grinding operations must be controlled to avoid high surface temperatures that could change the microstructure of the coupon.

2.1.2 Etch or stamp a permanent serial number on the coupon. It is possible for a coupon or holder to undergo SCC if the conditions in Paragraphs 2.1.2.1 and 2.1.2.2 are met:

2.1.2.1 Exposure to an environment capable of cracking the alloy used for the coupon or holder.