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THE CORROSION SOCIETY

# Standard Test Method

# Screening Tests for Evaluating the Effectiveness of Gypsum Scale Removers



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## Foreword

Hydrocarbon production is often accompanied by the production of a brine. Minerals may precipitate from a brine and deposit within the production system. The scale deposits can be located both downhole and in surface equipment. Often the deposit has an adverse effect on production and must be removed.

Producers and service companies devote considerable effort to developing and marketing effective treating chemicals because of the serious impact that gypsum ($CaSO_4 \cdot 2H_2O$) scale formation can have on hydrocarbon production. The performance of these treating chemicals used for scale removal can be verified most effectively after an actual field trial. However, field testing can be very difficult and time-consuming, especially when many chemicals are being evaluated. Although most laboratory tests cannot exactly duplicate field conditions, the advantage of such tests is to provide the user with a comparison of the performance of one scale remover against that of another under standard laboratory conditions. The industry has not established a standard test method to evaluate gypsum scale removers. Consequently, performance tests of a scale remover or collection of scale removers yield widely differing absolute and relative results depending on the test procedure used.

NACE Unit Committee T-1D formed Task Group T-1D-32 in 1987 in response to an expressed need for a standard test method for the evaluation of chemical-based gypsum scale removers.

The initial task group assignment was to compose and publish a technical committee report. That report was issued in 1991 (NACE Publication 1D191[1]). The subsequent assignment was to develop standard test methods for screening gypsum scale remover chemicals, which are addressed in this standard.

This standard presents test methods for screening the effectiveness of two types of gypsum scale removers, one for scale dissolvers, and another for scale converters. These methods are primarily intended for use by those in the petroleum industry who need to use treating chemicals to remove gypsum scale deposits.

This NACE standard was originally prepared in 1997 by Task Group T-1D-32, a component of former Unit Committee T-1D on Corrosion Monitoring and Control of Corrosion Environments in Petroleum Production Operations. It was reaffirmed in 2002 by Specific Technology Group (STG) 31 on Oil and Gas Production—Corrosion and Scale Inhibition and it was reaffirmed in 2012 by STG 31 on Oil and Gas Production—Corrosion and Scale Inhibition. It 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.

# NACE International
# Standard
# Test Method

## Screening Tests for Evaluating the Effectiveness of Gypsum Scale Removers

**Contents**

## Section 1: General

1.1 The test methods described in this standard are static laboratory screening tests designed to measure the ability of chemicals to remove gypsum scale deposits. There are two types of scale-removal chemicals: dissolvers and converters. Scale dissolvers, generally chelating or sequestering agents, can affect the dissolution and removal of gypsum scale in one step. Converters, such as those formulations based on sodium (or potassium) glycolate and sodium (or ammonium) carbonate (or bicarbonate), are used to alter or convert the calcium sulfate to another compound which is then removed by dissolution with dilute mineral acid (typically hydrochloric acid). Test methods for screening both gypsum scale dissolvers and converters are described.

1.2 These test methods are recommended only for ranking the performance of different scale-removal chemicals under the laboratory conditions set by these test methods.

1.3 Many factors such as reaction kinetics, fluid velocity, temperatures and pressures, scale surface area, and scale composition can significantly affect scale removal under field conditions. Detailed consideration of these parameters is outside the scope of this standard. However, field conditions, field brine composition, and others noted above should be considered at some point in the evaluation prior to final selection of a scale remover for field use.

1.4 Tests can be conducted using varying amounts of gypsum to obtain a better comparison of scale removers under the laboratory conditions set by these test methods. The actual ratio of scale remover to gypsum required for a field application may be different from that established by these test methods.

1.5 This standard lists the necessary apparatus, reagents, and procedures for conducting screening tests of both gypsum dissolvers and converters.

1.6 A reference scale dissolver, tetrasodium ethylene-diaminetetraacetate (Na$_4$EDTA), or a reference scale converter, potassium glycolate (the potassium salt of hydroxyacetic acid, $HOCH_2$ COOK), is run along with the scale removers being screened. The test results obtained using a reference chemical of known scale-removal capacity provide a benchmark to verify that the screening test procedures were properly conducted.

## Section 2: Gypsum Scale Dissolver Screening Test

2.1 This section lists the equipment and procedure for conducting the gypsum scale dissolver screening test.

2.2 Equipment and Solutions

2.2.1 Constant-temperature water bath or forced-draft oven capable of maintaining the specified temperature within 1 °C.

2.2.2 60 mL wide-mouth glass bottles with caps that will not react with the test solutions and that will provide an airtight seal. These bottles shall be clean of any contaminating material and shall be dry.

2.2.3 Apparatus for delivering 50.0 ± 0.5 mL, e.g., graduated cylinders or volumetric pipets.

2.2.4 Vacuum filter flask, 0.45 µm membrane filters (47 mm diameter), and filter holder assembly.

2.2.5 Laboratory balance and miscellaneous equipment to weigh, handle, and transfer solids. The balance shall be capable of measurement to 0.01 g or better.

2.2.6 ACS[1] reagent grade gypsum powder ($CaSO_4 \cdot 2H_2O$).[2]

2.2.7 Undiluted and diluted (1:1 [vol] in distilled or deionized water) solutions of the scale dissolver(s).

2.2.8 A 200 g/L solution of reagent grade Na$_4$EDTA. This will be used as a reference scale dissolver with a known gypsum-dissolving capacity to verify that the test operator is conducting the screening test procedures properly and consistently.

(1) American Chemical Society (ACS), 1155 16th St. NW, Washington, DC 20036.