

# Evaluation of the Carburization of Alloy Tubes Used for Ethylene Manufacture

This NACE International standard represents a consensus of those individual members who have reviewed this document, its scope, and provisions. Its acceptance does not in any respect preclude anyone, whether he or she has adopted the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not in conformance with this standard. Nothing contained in this NACE standard is to be construed as granting any right, by implication or otherwise, to manufacture, sell, or use in connection with any method, apparatus, or product covered by letters patent, or as indemnifying or protecting anyone against liability for infringement of letters patent. This standard represents minimum requirements and should in no way be interpreted as a restriction on the use of better procedures or materials. Neither is this standard intended to apply in all cases relating to the subject. Unpredictable circumstances may negate the usefulness of this standard in specific instances. NACE assumes no responsibility for the interpretation or use of this standard by other parties and accepts responsibility for only those official NACE interpretations issued by NACE in accordance with its governing procedures and policies which preclude the issuance of interpretations by individual volunteers.

Users of this NACE standard are responsible for reviewing appropriate health, safety, environmental, and regulatory documents and for determining their applicability in relation to this standard prior to its use. This NACE standard may not necessarily address all potential health and safety problems or environmental hazards associated with the use of materials, equipment, and/or operations detailed or referred to within this standard. Users of this NACE standard are also responsible for establishing appropriate health, safety, and environmental protection practices, in consultation with appropriate regulatory authorities if necessary, to achieve compliance with any existing applicable regulatory requirements prior to the use of this standard.

**CAUTIONARY NOTICE:** NACE standards are subject to periodic review, and may be revised or withdrawn at any time in accordance with NACE technical committee procedures. NACE requires that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of initial publication and subsequently from the date of each reaffirmation or revision. The user is cautioned to obtain the latest edition. Purchasers of NACE standards may receive current information on all standards and other NACE publications by contacting the NACE *FirstService* Department, 15835 Park Ten Place, Houston, TX 77084-5145 (tel: +1 281-228-6200, email: [firstservice@nace.org](mailto:firstservice@nace.org)).

## **ABSTRACT**

*This NACE standard establishes a standard test procedure for pack bed carburization of alloys used for ethylene manufacture. The pack bed carburization procedure is specified in this standard because it is simple to perform. The test specimen geometry chosen reflects the intent of the procedure to be used for evaluation of carburization of furnace tube alloys intended for ethylene manufacture.*

*This standard also establishes two recommended methods—combustion analysis and chemical etching—for measuring the relative carburization of alloys for tubes intended for service in ethylene manufacture, or for assessing the performance of these tubes after service. Application procedures for the two methods are defined in detail.*

## **KEYWORDS**

*pack bed carburization, ethylene, furnace tubes, combustion analysis, chemical etching, TG 124*

## Foreword

***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.***

This NACE standard establishes a standard test procedure for pack bed carburization of alloys used for ethylene manufacture. The pack bed carburization procedure is specified in this standard because it is simple to perform. The test specimen geometry chosen reflects the intent of the procedure to be used for evaluation of carburization of furnace tube alloys intended for ethylene manufacture.

This standard also establishes two recommended methods—combustion analysis and chemical etching—for measuring the relative carburization of alloys for tubes intended for service in ethylene manufacture, or for assessing the performance of these tubes after service. Application procedures for the two methods are defined in detail. The combustion analysis method is preferred because it is quantitative. The chemical etching method is simpler and less expensive, but is only semiquantitative. Other methods considered and the reasons they are not recommended are discussed in Appendix A (non-mandatory).

The carburization measurement methods in this standard may be used independently from the pack bed carburization procedure when assessing the condition of tubes after service or when other carburization procedures have been performed.

This standard is intended to assist designers, operators, producers, fabricators, users, and testing laboratories in the selection of furnace tube alloys used for ethylene manufacture.

This standard was originally prepared in 1998 by Task Group (TG) T-5B-11, a component of Unit Committee T-5B on High-Temperature Materials Performance. It was reaffirmed in 2002 by Specific Technology Group (STG) 37, “Process Industry—High Temperature.” It was revised in 2006 by TG 124, “Furnace Tubes: Evaluating Carburization Resistance of Ethylene Cracking,” which is administered by STG 37. It was revised in 2014 by TG 124 and reaffirmed in 2018 by STG 37. This standard is issued by NACE International under the auspices of STG 37.

# Evaluation of the Carburization of Alloy Tubes Used for Ethylene Manufacture

1.	General .....	4
2.	Definitions .....	5
3.	Test Specimens for the Pack Bed Carburization Procedure .....	5
4.	Carburizing Media .....	5
5.	Pack Bed Containment Vessel.....	6
6.	Carburizing Temperature.....	7
7.	Carburizing Procedure .....	7
8.	Carburization Measurement and Reporting .....	8
9.	Combustion Analysis Measurement Method .....	8
10.	Chemical Etching Measurement Method .....	10
	References.....	13
	Bibliography .....	13
	Appendix A: Other Carburization Measurement Methods (Nonmandatory).....	15

## Figures

1.	.....	6
2.	.....	9
3.	.....	9
4.	.....	11