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Evaluation of the Carburization of Alloy Tubes Used for Ethylene Manufacture

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Foreword

This AMPP 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 (nonmandatory).

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.

In AMPP standards, the terms *shall* and *must* are used to state requirements and are considered mandatory. The term *should* is used to state something that is recommended, but is not considered mandatory. The term *may* is used to state something considered optional.

Section 1: General

1.1 This standard was developed to address a need for a standardized method to test the relative carburization of various furnace tube alloys used for ethylene manufacture. MTI[1] Publication No. 52[1] provides definitive guidelines for developing standard carburization testing methods for broader applications, and procedures for measuring the test result, but does not specify a standard method. This AMPP standard defines a standard pack bed carburization procedure and standard methods for measurement of the relative carburization of alloy tubes intended for use in ethylene manufacture.

1.2 The pack bed carburization procedure is specified because of its ease of application. Gas carburization procedures require a more complex apparatus. This procedure is designed so that alloys may be carburized without the use of expensive or complicated laboratory equipment. The user of this procedure is cautioned that the pack bed carburization procedure does not duplicate the carburizing conditions in the furnace tubes used for ethylene manufacture. However, it has been shown to be a reliable procedure that produces a standard carburizing environment suitable for the evaluation of the relative carburization of alloys.

1.3 Tubular segments are specified as the test specimens to ensure that the test specimens have similar macrostructures, microstructures, and geometry to those typically used in furnaces for ethylene manufacture. A standard reference test specimen shall be used for each set of carburization exposures. The reference test specimen shall be alloy UNS[2] N08810 (alloy 800H).

1.4 Carburization data for proprietary alloys and for standard alloys such as UNS J94204 (ACI[3] HK-40) have generally been developed by tube suppliers. Because of variations in testing and measuring methodologies, attempts to compare carburization data from one supplier to another for specific temperature ranges have not always provided consistent results. Standardization of the carburization procedure and measurement meth-

[1] Materials Technology Institute (MTI), 1215 Fern Ridge Parkway, Ste. 206, St. Louis, MO 63141-4405, www.mti-global.org.
[2] Unified Numbering System for Metals and Alloys (UNS). UNS numbers are listed in *Metals & Alloys in the Unified Numbering System,* 14th ed. (Warrendale, PA: SAE International and West Conshohocken, PA: ASTM International, 2023).
[3] Alloy Casting Institute (ACI) is part of the Steel Founders' Society of America, 780 McArdle Dr., Unit G, Crystal Lake, IL 60014-8155.