Designation: C795 – 08 (Reapproved 2023)

Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel[1]

This standard is issued under the fixed designation C795; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers non-metallic thermal insulation for use in contact with austenitic stainless steel piping and equipment. In addition to meeting the requirements specified in their individual material specifications, issued under the jurisdiction of ASTM Committee C16, these insulations must pass the preproduction test requirements of Test Method C692, for stress corrosion effects on austenitic stainless steel, and the confirming quality control, chemical requirements, when tested in accordance with the Test Methods C871.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C168 Terminology Relating to Thermal Insulation

C390 Practice for Sampling and Acceptance of Thermal Insulation Lots

C692 Test Method for Evaluating the Influence of Thermal Insulations on External Stress Corrosion Cracking Tendency of Austenitic Stainless Steel

C871 Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

3. Terminology

3.1 *Definitions*—Terminology C168 applies to the terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *basic material specification*—any of the material specifications for homogeneous insulation covered in any of the pertinent *Annual Book of ASTM Standards.*

3.2.2 *lot*—a lot shall be defined in accordance with Practice C390 by agreement between the purchaser and the manufacturer.

3.2.3 *stress corrosion cracking (SCC)*—the failure of metal, taking the form of cracks that potentially occur under the combined influence of certain corrosive environments and applied or residual stresses.

3.2.4 *wicking-type insulation*—insulation material that, by virtue of its physical characteristics, permits a wetting liquid to infiltrate it by capillary attraction.

4. Significance and Use

4.1 Stress corrosion cracking of austenitic stainless steel is a metallurgical phenomenon. One cause of stress corrosion cracking is the presence of contaminants in water solution, which can be concentrated at the stressed surface by evaporation of the water.

4.2 There is an apparent correlation between stress corrosion cracking of austenitic stainless steel and the use of insulation which either contains water-leachable chloride or, by reason of its water absorptivity, acts as a vehicle through which

[1] This specification is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.20 on Homogeneous Inorganic Thermal Insulations.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

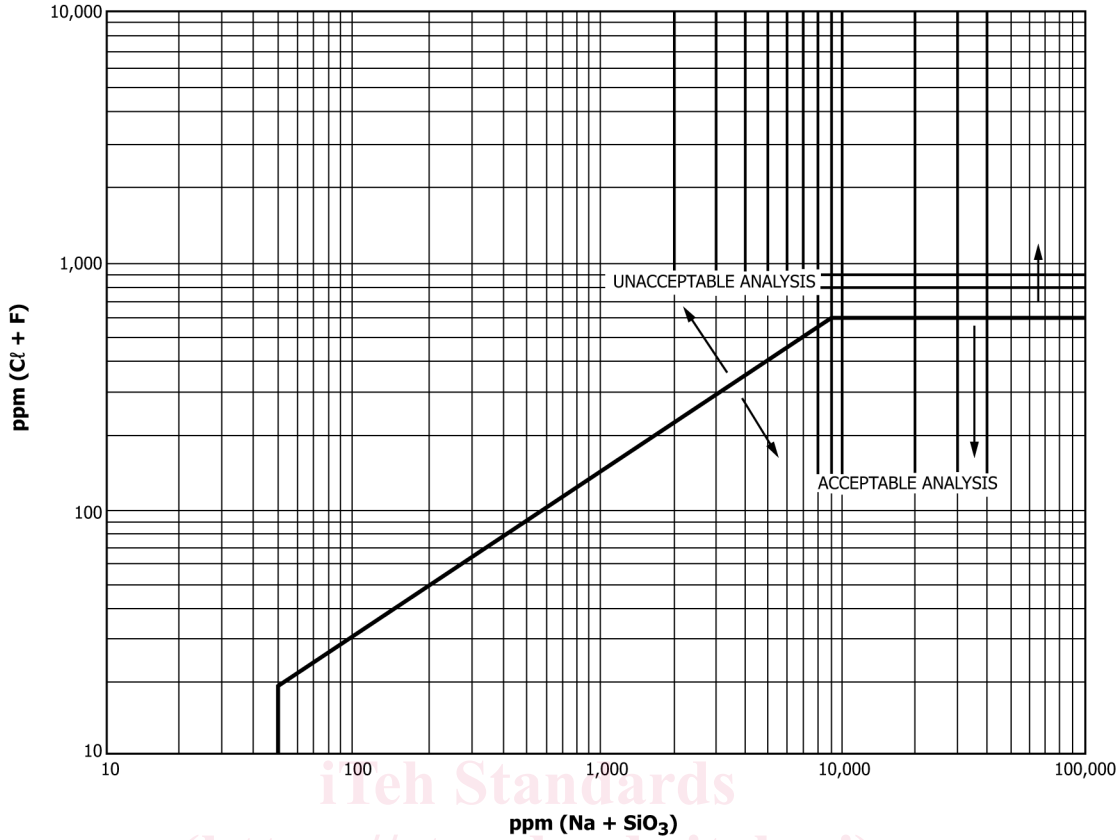

FIG. 1 Acceptability of Insulation Material on the Basis of the Plot Points of the (Cl + F) and the (Na + SiO_3) Analyses

chlorides from outside the system are concentrated at the surface of the stainless steel.[3,4,5]

4.3 Studies have shown that insulation containing certain water-soluble compounds have the capacity to retard or prevent stress corrosion. Numerous materials thought to inhibit stress corrosion cracking have been tried with varying degrees of success. An inhibiting compound commonly used is sodium silicate. Present knowledge indicates that the sodium silicate dissociates in the presence of water, leaving the silicate ion to form a protective mechanism that inhibits or prevents the chloride ion from attacking the stainless steel. Under adverse environmental conditions, this protective agent will possibly be leached from the product with time and permanent protection is not afforded.

4.4 Test Method C692 contains a procedure for determining whether or not stress corrosion cracking will occur with a given thermal insulation. The procedure is used to evaluate insulation materials have the potential to inhibit, to be passive, or actively contribute to stress corrosion cracking of austenitic stainless steels.

4.5 Research has indicated that in addition to the halide ion chloride, fluoride ions have the potential to induce SCC in the absence of inhibiting ions.[6] Two widely used insulation specifications that are similar to C795 and are specific to SCC allow the use of the same Test Methods C692 and C871 for evaluation of insulation materials. Both specifications require fluoride ions to be included with chloride ions when evaluating the extractable ions and plotting them on the Fig. 1 acceptability graph. Fluoride has been added to chloride in Section 13 and on Fig. 1 to be consistent with the other standards.

4.6 Physical and chemical changes can occur when thermal insulation, various binders, or adhesives, or a combinations thereof, are heated. Insulation materials are often exposed to process temperatures that are sufficient to cause changes. Various compounds thermally decompose increasing the solubility of some ions that leach out when exposed to water. Other compounds have the potential to become less soluble after thermal exposure.

4.7 The inhibitory qualities of sodium silicate compounds have been found to be different for different molar ratios of sodium to silicate. The current specifications treat them as being added together for a total ppm value.[6]

[3] Schaffer, L. D., and Klapper, J. A., "Investigation of the Effects of Wet, Chloride-Bearing, Thermal Insulation on Austenitic Stainless Steel," *Report No. ESI-25-(a)-1,* Oak Ridge National Laboratory, and Ebasco Services Inc., November 1, 1961.

[4] Dana, A. W., Jr., "Stress-Corrosion Cracking of Insulated Austenitic Stainless Steel," *ASTM Bulletin,* October 1957.

[5] Louthan, M. R., Jr., "Initial Stages of Stress Corrosion Cracking in Austenitic Stainless Steels," *Corrosion*, NACE, September 1965.

[6] Whorlow, Kenneth M., Woolridge, Edward and Hutto, Francis B., Jr., "Effect of Halogens and Inhibitors on the External Stress Corrosion Cracking of Type 304 Austenitic Stainless Steel"; *STP 1320 Insulation Materials: Testing and Applications*, Third Volume, Ronald S. Graves and Robert R. Zarr, editors, ASTM West Conshohocken, PA, 1997 page 485 .

4.8 A variety of acids and ionic chemical solutions are known to induce metal pitting, hydrogen embrittlement, intergranular corrosion and stress corrosion cracking on sensitized austenitic stainless steel. The results of Test Methods C692 corrosion test are expected to indicate if there is an untested agent in the insulation that will induce cracking.

5. Ordering Information

5.1 The requirements of this specification shall be stated by the purchaser for the particular insulation and material application specified. The purchaser shall specify the type, grade, class, dimensions, quantity, and other requirements as available in the basic material specification for a particular insulation.

6. Composition

6.1 The material shall conform to the established requirements of the basic material specification.

7. Physical and Chemical Requirements

7.1 The physical requirements shall conform to the requirements of the basic material specification. The chemical requirements shall conform to the requirements of Section 13 of this specification.

8. Dimensions and Permissible Variations

8.1 The dimensions and permissible variations shall conform to the requirements of the basic material specification.

9. Workmanship, Finish, and Appearance

9.1 The workmanship, finish, and appearance shall conform to the requirements of the basic material specification.

10. Sampling

10.1 The unit sample shall be of sufficient size to perform the preproduction corrosion test and chemical analysis tests specified in this specification. The samples shall be of sufficient size to ensure an acceptable level of confidence that the test results represent the characteristics of the product being purchased. Sample size shall be in accordance with Practice C390.

11. Acceptance and Retests

11.1 *Acceptance*—All specimens in a lot sampling shall meet the chemical requirements of this specification. If the average analysis of the two specimens taken from any sample fails to conform to the requirements of this specification, the lot represented by that sample shall be rejected.

11.2 *Retest*—At the option of the supplier, each individual unit of supply (that is, carton, bag, roll, sheet, drum, and so forth) in rejected lots are allowed to be retested, in accordance with Test Methods C871, at the supplier's expense, by testing samples taken at random from the unit of supply in accordance with this specification. Unless otherwise agreed upon between the purchaser and the manufacturer, the resubmitted material shall require the same number of samples to be tested as required for the initial submittal. If the average analysis of the two specimens taken from each sample fails to conform to the requirements of this specification, the unit of supply represented by that sample shall be rejected. For other than chemical analysis or stress corrosion tests, the number of tests and retests shall be as specified in the basic material specification.

12. Preproduction Corrosion Test

12.1 A corrosion test shall be performed as a preproduction test by each manufacturer. The production lot from which the sample is taken shall be of the same formulation, made by the same production processes and from the same kind, nature, and quality of ingredients as those that will be employed for production of thermal insulation under this specification.

12.2 The corrosion test shall be conducted in accordance with the method presented in Test Method C692. At the end of the test time, none of the prepared coupons of stainless steel shall show a crack when examined in accordance with Test Method C692.

12.3 The test procedure need not be repeated for subsequent orders using the same production process and the same kind, nature, and quality of ingredients unless so required. The manufacturer shall keep records of actual numerical results of the tests available for review on request by those concerned.

13. Chemical Analysis

13.1 A chemical analysis shall be performed on the insulation material in accordance with Test Methods C871 and, in addition, the manufacturer shall demonstrate that his current product has passed the preproduction corrosion test in accordance with Test Method C692.

13.1.1 An acceptable proportion of sodium plus silicate ions to the chloride plus fluoride ions as found by leaching from the insulation is shown in Fig. 1 and was arrived at empirically. Other insulation compositions, whose chemical analysis falls outside of the acceptance area shown in Fig. 1, are possibly acceptable; however, their efficacy shall be determined in accordance with Test Method C692 and subsequently monitored in accordance with Test Methods C871.

13.2 *pH*—The pH of the leach water extracted, in accordance with Test Method C871, shall be measured using a pH meter and probe and shall have a pH no greater than 12.5 at 77 °F (25 °C).

13.3 The specific material supplied shall be analyzed in accordance with Test Methods C871 for the following leachable ions: chloride, fluoride, sodium, and silicate. The "plot point" of these analyses shall fall in the acceptable area of Fig. 1.

13.4 The minimum allowable value of sodium plus silicate shall be 50 ppm. There is no minimum limit on chloride plus fluoride. Extrapolating the chloride plus fluoride level below 10 ppm on Fig. 1 is considered to be in the acceptable area when the sodium and silicate is above 50 ppm.

14. Handling and Application

14.1 See applicable ASTM specifications for handling and application.

15. Keywords

15.1 austenitic stainless steel; chloride; fluoride; pH; silicate; sodium; stress corrosion cracking; thermal insulation