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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Inspection of Linings in Operating Flue Gas Desulfurization Systems[1]

This standard is issued under the fixed designation D 4619; 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.

1. Scope

1.1 This practice describes procedures for conducting inspections of the conditions of various linings in operating Flue Gas Desulfurization (FGD) system components.

1.2 *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 and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Section 7.

2. Significance and Use

2.1 Periodic inspections are essential to evaluate lining performance, to detect existing damage potential problems, and to plan scheduled maintenance. The frequency of these inspections may diminish or increase with time depending upon lining performance.

3. Recordkeeping

3.1 Lining condition will depend on the operating conditions experienced by the lining systems. Records of these conditions that are maintained by the owner/operator should be evaluated for potential effects upon the linings. These may include:

3.1.1 Dates of lining installation and initial operation,
3.1.2 Solution/gas temperatures in lined components,
3.1.3 Solution/gas chemistry (pH, composition),
3.1.4 Start up/shut down dates,
3.1.5 Gas velocities and particulate loading, and
3.1.6 Ambient conditions.

3.2 Any known change in the process criteria or modifications of the physical design shall be identified and dated.

3.3 All past history pertaining to the lining systems should be available during the inspection process. They may include:

3.3.1 Copies of existing lining specifications and installation procedures.

3.3.2 Quality control documents of the existing lining installation.

3.3.3 Copies of previous inspection reports.

3.3.4 Documentation pertaining to any maintenance of existing lining systems.

4. Inspection Team

4.1 The owner/operator should select a team of experienced personnel to conduct the inspection. Personnel representing the following may be included:

4.1.1 Owner's representative,
4.1.2 Lining manufacturer,
4.1.3 Lining applicator,
4.1.4 Equipment designer,
4.1.5 Architect engineer,
4.1.6 Third party inspectors, and
4.1.7 System designer.

5. Hazards

5.1 All safety requirements of OSHA and the owner/operator, must be met when performing all inspection operations. Residues, including acids, heavy metals, or other hazardous materials, may be present in deposits, on the lining surfaces, or in the atmosphere. Precautions shall be taken to protect personnel. Confined entry safety requirements shall be adhered to where applicable.

6. Pre-Inspection Procedure

6.1 Prior to conducting an inspection of the lining, the owner/operator shall ensure that the following services and equipment are provided.

6.1.1 *Safety*—The inspection team shall verify that the equipment being inspected has been made safe for entry. This shall include lockout procedures for related equipment such as, but not limited to, the boiler, dampers, valves, fans, and pumps.

6.1.2 *Lighting*—Sufficient lighting shall be provided to assure general lighting of the overall area plus localized high intensity lights for close visual observation or taking of photographs, or both. The lighting fixtures shall be equipped with a safety guard to minimize breakage and injury.

6.1.3 *Access to Lining Surfaces*—The access equipment must meet all safety requirements of OSHA and the owner/operator. The equipment must be capable of placing the inspectors close enough to the lining surface to perform all inspection procedures.

6.1.4 *Cleaning*—Selected lining surfaces to be inspected shall be cleaned of any deposits or buildup that will obscure

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examination of the lining. The cleaning procedure selected must not cause damage to the lining.

6.1.5 *Ventilation*—Provisions must be made to assure that adequate fresh air is provided in all FGD components being inspected. If some components are on line, provisions must be taken to adequately isolate such components.

7. Inspection Procedures

7.1 The inspection should include visual examination, photographic examination, mapping of potential problem areas, specific destructive or nondestructive testing, and removal (if required) of representative samples for analysis (see Table 1).

7.2 Temperature may influence observed or tested lining parameters, such as crack width, hardness, and adhesion. During inspection, temperature of the lining surface and the interior and exterior ambient temperatures of the component should be measured and recorded.

7.3 Other parameters important to the inspection should be discussed with the parties involved and agreed to prior to the inspection.

8. Report

8.1 The owner/operator shall designate who is responsible for the preparation of an inspection report.

8.2 Report the following information:

8.2.1 Pertinent background information contained in Section 3,

8.2.2 Date(s) of inspection,

8.2.3 Participants and their affiliation,

8.2.4 Documentation of inspection,

8.2.5 Photographs, as applicable,

8.2.6 Mapping of problem areas,

8.2.7 Test results, and

8.2.8 Conclusions and recommendations.

9. Repairs

9.1 If repairs of the lining are required, the owner/operator or his representative shall prepare specific repair specifications or procedures, or both, with the input of the lining manufacturer(s), the applicator(s), and others as necessary.

9.2 These specifications or procedures, or both, may be prepared in advance or as a result of the inspection.

10. Keywords

10.1 cementitious linings; chemical resistant linings; flue gas desulfurization (FGD); inorganic linings; inspection of linings; organic linings; power generation facility linings

TABLE 1 Lining Maintenance Inspection Parameters

Organic Resins	Organic Elastomers	Inorganic/Cementitious	Inorganic/Masonry
Visual Inspection:	*Visual Inspection:*	*Visual Inspection:*	*Visual Inspection:*
Rust	Rust	Erosion/mechanical damage	Erosion/mechanical damage
Chemical Degradation	Chemical Degradation	Cracking	Cracking:
Surface Effects:	Surface Effects:	Softening	Mortar joint
Abrasion/erosion	Abrasion/erosion	Spalling	Brick face
Aligatoring/checking	Swelling	Rust staining	Spalling
Discoloration/charring	Softening	Efflorescence	Softening:
Flaking	Crazing	Anchor exposure	Brick
Cracking	Cracking	Delaminations	Mortar
Softening	Surface sloughing	Substrate exposure	Expansion joint
Blistering/delamination:	Blistering:	*Physical Testing:*	Color Change:
Size	Size	Hardness (Schmidt hammer)	Brick
Density	Density	Measure crack widths and pattern	Mortar
Entrapped contents for analysis	Entrapped contents for analysis	Core samples, if required	*Physical Testing:*
Mechanical Damage	Mechanical Damage:	Remove cementitious layer to permit visual examination of underlaying membrane/substrate	Hardness (Schmidt hammer)
Physical Testing:	Gouging		Core samples, if required
Lining thickness	Cutting		Petrographic analysis, if required
High voltage holiday testing is not recommended for linings that have been in service	Tearing		
	Overcompression (mating surfaces)		
Adhesion testing, if required	Adhesive failure		
	Cohesive failures		
	Reversion (Reverting to soft conditions with loss of physical properties)		
	Physical Testing:		
	Lining thickness		
	High voltage holiday testing is not recommended for linings that have been in service		
	Adhesion testing, if required		
	Shore durometer hardness		