ASME AG-1 Committee on Nuclear Air and Gas Treatment

Division III Process Gas Treatment Equipment

Walt Drosjack, P.E. Chairman, SC Gas Process Treatment



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ASME AG-1

- Division I General Requirements
- Division II Ventilation Air Cleaning and Conditioning
 - The moving and conditioning of air which is supplied, exhausted, or re-circulated into and from an enclosed space to maintain prescribed ambient conditions. These conditions include pressure, temperature, humidity, and contaminants.

• Division III – Process Gas Treatment

- The transportation of gas and the separation, isolation, and disposal of its constituents by physical, mechanical, chemical, delay, electrical, and thermodynamic means.
- Division IV Testing Procedures



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Division III - Process Gas Treatment

- GA Pressure Vessels, Piping, Heat Exchangers and Valves for Gas Process Treatment Equipment
- GB Noble Gas Hold-up Equipment
- GC Multi-Stage Centrifugal Blowers
- GD Instrumentation for Gas Process Equipment
- GE Hydrogen Recombiners
- GF Gas Sampling
- GG Scrubbers
- GH Cyclones
- GI Membranes
- GJ Filters
- GK Mist Eliminators
- GL Electrostatic Precipitators
- GM Adsorption Media

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GA – Pressure Vessels, Piping, Heat Exchangers and Valves

- Some entities classify gas processing systems as vessels, piping and valves instead of housings, ductwork and dampers.
- Pressure vessels, piping, heat exchangers and valves provide a confinement boundary to contain radioactive and hazards material for processing.
- Purpose of this section is to identify requirements beyond the pressure codes that are applicable to components in gas process treatment systems.



GB – Noble Gas Hold-up Equipment

- Noble gases are chemically inert and are not metabolized or accumulated in plants, animals, or humans. Some isotopes of these gases emit radiation which can be harmful if a person inhales them or is close to an airborne cloud of the gas.
- Noble gas hold-up equipment are components of a system for separating, concentrating and storing radioactive krypton and xenon in the off-gases from a boiling water reactor, wherein adsorption and cryogenic distillation are used for rapid and positive separation and removal of the radioactive noble gases, and for limiting such gases in circulation in the system to low inventory at all times.





GC – Multi-Stage Centrifugal Blowers

- Some gas process treatment systems require higher pressure differentials than what is achievable by equipment applicable under Section BA – Fans and Blowers.
- Applicable Equipment
 - Multi-stage High Pressure Blowers
 - Rotary Lobe Blowers (a.k.a. Roots Blower)





Multi-Stage Centrifugal Blower

• A blower or fan having two or more impellers working in series.

Diagram

- 1 Motor and Shaft Assembly
- 2 Division Head Packing
- 2A Division Head Packing Plate
- 3 Division Head
- 4 Rope Packing for Deflector
- 5 End Head Bolts
- 6 End Head
- 7 Deflector (A, B, etc.)
- 8 Impellers (A, B, etc.)
- 9 Interstage Deflector Packing
- 9A Center Deflector Plates (normally not furnished on 30" or smaller machines)
- 10 Split Clamped Hub or Tapered Bushing Hub
 - (Part of Impeller Assembly)
- 12 End Head Gasket
- 13 Feet
- 14 Spacers
- 15 Drive End Motor Bearing
- 16 Housing
- 17 Motor Base
- 18 Motor Hold-Down Bolts
- 19 Opposite Drive End Motor Bearing



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Rotary Lobe Blower

- Positive displacement pump which operates by pulling air through a pair of meshing lobes not unlike a set of stretched gears. Air is trapped in pockets surrounding the lobes and carried from the intake side to the exhaust.
- A Roots blower diagram:
 - 1 Rotary vane 1
 - 2. Pump body
 - 3. Rotary vane 2
 - a. Intake
 - b. Pumping
 - c. Forced air or air-fuel mixture into intake manifold





GD – Instrumentation

- Similar requirements as Division II Section IA for Ventilation Air Cleaning and Conditioning Systems
- Section GD Project Team is in the process of evaluating applicability to Gas Process Treatment Systems and determining any special needs or considerations



GE – Hydrogen Recombiners

- Hydrogen recombiners are used to limit containment hydrogen concentration to preclude hydrogen combustion so that containment integrity is not jeopardized.
- <u>Conventional Recombiners</u> use heat to combine hydrogen with oxygen and form water vapor. They depend on electric power and other support systems for their operation. The complexities of these systems are inherently unpredictable and require greater levels of maintenance and testing than PAR technology.
- <u>Passive Autocatalytic Recombiners</u> (PARs) are simple devices that are totally passive (i.e., there are no moving parts). They catalytically combine hydrogen and oxygen to produce heat and water vapor as an end product of combination.



GF – Gas Sampling

- Purpose is to provide guidance as to standard methods and equipment for gas sampling to obtain data for monitoring and verifying performance of Process Gas Treatment...
 - Equipment



GG – Scrubbers

- Wet Scrubber
 - An air pollution control device that uses a high energy liquid spray to remove aerosol and gaseous pollutants from an air stream.
 - The gases are removed either by absorption or chemical reaction.
 - Scrubbers also reduce the temperature of the emission.
 - Types of scrubbers
 - Spray Tower
 - Plate Tower
 - Packed Bed Tower
 - Venturi Scrubber
- Dry Scrubber
 - Unlike the wet scrubber, does not saturate the flue gas stream that is being treated with moisture. In some cases no moisture is added; while in other designs only the amount of moisture that can be evaporated in the flue gas without condensing is added.
 - Dry scrubbers do not have a stack steam plume or wastewater handling/disposal requirements. Dry scrubbing systems are used to remove acid gases (such as SO₂ and HCI) primarily from combustion sources.

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GH – Cyclones

- Cyclonic spray scrubbers are an air pollution control technology that use the features of both the dry cyclone and the spray chamber to remove pollutants from gas streams.
- Generally, the inlet gas enters the chamber tangentially, swirls through the chamber in a corkscrew motion, and exits. At the same time, liquid is sprayed inside the chamber. As the gas swirls around the chamber, pollutants are removed when they impact on liquid droplets, are thrown to the walls, and washed back down and out.





GI – Membranes

- Applies to membranes used in gas separation process of nuclear facilities.
 - Filtering
 - Concentrating
- Materials
 - Metal
 - Ceramic
 - Glass fibers





GJ – Filters

- Similar requirements as Division II Ventilation Air Cleaning and Conditioning Systems...
 - Section FB: Medium Efficiency Filters
 - Section FC: HEPA Filters
 - Section FI: Metal Media Filters
 - Section FJ: Low Efficiency Filters
 - Section FK: Special HEPA Filters
- Section GJ Project Team is in the process of evaluating applicability to Gas Process Treatment Systems and determining any special needs or considerations



GK – Mist Eliminators

- Similar requirements as Division II Ventilation Air Cleaning and Conditioning Systems
 - Section FA: Moisture Separators Applicable to modular, impingement-type liquid droplet separators
- Section GK Project Team is in the process of evaluating applicability to Gas Process Treatment Systems and determining any special needs or considerations
 - Inertial impaction (impingement type)
 - Interception (direct impaction)
 - Diffusion (molecular motion)



GL – Electrostatic Precipitators

- ESP: An electrostatic precipitator (ESP) is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge.
 - ESPs are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream.
- WESP: Electrostatic precipitation is typically a dry process, but spraying moisture to the incoming air flow helps collect the exceptionally fine particulates, and helps reduce the electrical resistance of the incoming dry material to make the process more effective.
 - A wet electrostatic precipitator (WESP) merges the operational methods of a wet scrubber with an electrostatic precipitator to make a self-washing, self-cleaning yet still high-voltage device.



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GM – Adsorption Media

- The purpose of this Section is to ensure that adsorbent media used in nuclear facilities for nuclear safety-related air and gas treatment systems are acceptable in all aspects of performance, design, and testing.
- This Section will include different media unique to gas processing equipment in nuclear facilities.





Steps for Preparation of New Section

- Prepare Project Initiation Form (PIF)
- Review & Approve PIF
 - Executive Committee
 - Main Committee
- Prepare New Section
 - Outline
 - Draft
- Sub-Committee
 - Review & Comment
 - Resolution of Comments
- Main Committee & BNCS
 - Letter Ballot
 - Vote
 - Resolution of Comments
- Section Approved
 - Issue Closure Letter
 - Publish



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Status of New Sections

- GA Draft prepared and in SC review
- GB Preparing Outline and Draft
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- GD Preparing Outline and Draft
- GE Preparing Outline and Draft
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HELP!

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