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Preventive Maintenance Inspection Method For Composite Reinforced Thermosetting Resin Equipment

Phase I

1. Gather all available information on origin and history of equipment – including, but not limited to:
   - Manufacturer and phone/address
   - Date installed or commenced operation
   - Resin type
   - Composite reinforcement content and construction
   - Drawings and specifications
   - Design application–contents, temperature, pressure, vacuum, etc.
   - Current operating conditions–within original design parameters?
   - Review previous inspection records for historical trends from baseline

Phase II

1. Visually inspect all accessible exterior areas of the equipment, including inflow and outflow piping adjacent to the equipment. Inspection marking and notations to include, but not limited to the following:
   - Cracks at flange hubs, in and around supports, at knuckle of vessels, or in laminate wall of shell. Minor cracks in circumferential winds holding lugs are generally resin shrinkage, and not a maintenance concern.
   - Appearance of crystalline build up or discoloration on exterior–may be evidence of penetration of the structural laminate.
   - Condition of the hold down lugs and fasteners for corrosion, loosening, cracks or other damage.
   - Condition of the pad or concrete around the equipment for evidence of leaks, spills and deterioration of the base.
   - If equipment is jacketed or insulated, inspect at weep holes and edges for indications of leakage between the laminate and the insulation.

Phase III

1. Visually inspect all accessible interior areas of the equipment. Note and mark the presence of the following:
   - Identify, if possible, areas subjected to liquid phase and vapor phase and make notation for baseline comparisons.
   - Cracks, hairline crazing, impacts, closed cracks or open “river-bottom” cracking.
   - Delaminations, pockets or blisters.
   - Oxidation, charring, discoloration, or flaking.

2. Inspect all secondary bonded areas (auxiliary components bonded onto the equipment or previously repaired areas) for all the criteria listed above.

Phase IV

1. Take quantitative measurements where ever possible and note:
   - Barcol hardness measurements in areas subject to liquid and vapor phases of interior.
   - Barcol hardness measurements on walls and floor of equipment. Note especially, readings around damaged areas.
   - Barcol readings on exterior laminate where evidence of leaks, spills, discoloration or crystals appear.
   - Thickness readings of total wall by dial caliper or transfer caliper where openings allow. Compare to original specifications or cutouts if they exist.
   - Thickness readings of corrosion barrier where a cut end exists allowing access.
   - Thickness of secondary bonded areas as measured from the wall or floor where they are bonded.

Phase V

1. Perform Repairs.
   - Establish time frame and crew size to complete repairs.
   - Establish criteria for repairs; i.e. type of resin, type and size of reinforcements, sequence and number of layers.
   - Perform bond test to ensure secondary bonding will occur to existing substrate.
   - Perform repairs
   - Supervise initial start up of repairs for correctness of chemistry, materials, surface preparation technique, and workmanship.
   - Inspect all repaired areas for same as above at completion of repairs.

Phase VI

1. Issue report. Should include as a minimum:
   - Brief history of equipment, construction, operating conditions, major upsets, overloads or repairs.
   - Summary of current inspection findings.
   - Summary of current repairs and methods of repair.
   - Conclusions and recommendations for future inspections, repairs or replacements.

Inspection Tools Required:

Barcol tester, dial caliper, high intensity spot light, rounded wand for "sounding" delaminations, marking pen (paint), probe, tape measure, camera.