# High Temperature Effects on Externally Insulated Exhaust Systems

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ABSTRACT:

An exhaust system “system” must perform its primary function of conducting exhaust gases, which can be as high as 1200° F (650° C), safely away from adjacent equipment, work areas and personnel while mitigating turbine exhaust noise. The primary design criteria to achieve this include acoustical, pressure drop, structural (wind, seismic, buckling, resonance, vortex shedding, weld sizing, flow induced vibration and flow pulsation) and emission control (NOx, CO).

This paper presents a review of the secondary design criteria; such as graphitization, creep, thermal expansion, pack migration, pack settling, temperature control, corrosion and tolerance stack-up; for a robust system covering a wide range of operating conditions. Examples will be provided in a case study format. A summary of design criteria is provided in Appendix A. Additional design criteria, listed in the appendix as tertiary, such as shipping, handling, storage, installation and operation requirements, will be touched on at the end of the paper.

Attention will be focused on externally insulated systems since effects on this type of design are exaggerated in comparison to a cooler internally lined or unlined system. Externally clad systems will experience higher and more consistent temperatures, larger cross sections, higher dead loads and lower allowable stresses.

All turbine exhaust systems require proper analysis of thermal effects, but externally clad designs are especially susceptible to creep, graphitization and thermal expansion problems since the system cladding will fully expose the shell (casing) material to the maximum exhaust flow temperature.

The importance of designing for every design criteria is to assure system operating capability and to avoid field failure. The direct and indirect cost of failure can be significant. Direct cost of rework, whether on the mainland with easy access or in remote locations such as a North Sea oil platform, will invariably equal any margin a product was originally sold for and at times even exceed the total sale price. Also, many turbines in remote locations are the prime mode of power and cannot tolerate downtime.