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Track 1 Fuels & Combustion, Material Handling, Emissions

Track 2 Steam Generators

Track 3 Heat Exchangers & Cooling Systems

Track 4 Turbines, Generators & Auxiliaries

Track 5 Plant Operations

Track 6 Reliability, Availability & Maintainability

Track 7 Plant Systems, Structures, Components & Materials

Track 8 Simple & Combined Cycle Power Plants

Track 9 Advanced Energy Systems

Track 10 Renewables: Wind, Solar, Geothermal, Tidal & Hydro

Track 11 Thermal Hydraulics & CFD

Track 12 Nuclear Plant Design, Licensing & Construction

Track 13 Performance Testing & Performance Test Codes

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SETTING THE STANDARD

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Applications for duct balloons multiply

Gary Werth, the balloon guy, was setting up his portable showcase at a user-group vendor fair recently when the editors wandered by looking for the tray of chocolates he always has at his booth. It wasn't out yet, but the search for goodies paused just long enough to notice a flexible hose running through the classic stack balloon used at many combined-cycle plants to prevent the loss of heat during shutdowns (Fig 1).

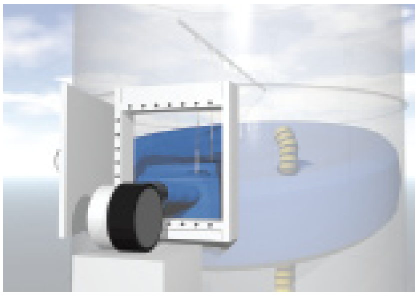
"Something new, Gary?" one of the editors asked. "Somewhat," was the reply. "We're continually adapting and improving the product to provide more powerplant solutions," Werth added, practicing his sales pitch. "Tell us more," the editors requested, "but after you break out the candy."

For readers who may be unfamiliar with stack and/or duct balloons, they are made by Scherba Industries Inc, Brunswick, Ohio, and distributed exclusively by G R Werth & Associates, North Riverside, Ill. You can get background on the product line at www.ductballoon.com.

The standard balloon prevents both (1) precipitation from entering the stack, and (2) the natural flow of air that otherwise would occur on the gas side of the heat-recovery steam generator (HRSG) because of the pressure differential between the gas-turbine (GT) intlet and the top of the stack. Moisture ingress would accelerate the corrosion of finned tubes and allow friable deposits to become cementitious. Such fouling increases the pressure drop through the HRSG and impedes heat transfer.

The enhancement shown in the illustration facilitates the use of dehumidification equipment in the HRSG during shutdowns by allowing it to vent through the stack. Werth said four 16-ft-diam stack balloons with 1-ft-diam vents were meeting expectations at one East Coast combined-cycle facility. Note that the vent hole has a cover flap that seals with industrial Velcro® should the plant want to use the stack balloon without the dehumidifiers.

The discussion moved to new applications for stack/duct balloons and Werth reeled off a long list; most, however, involved work at coal-fired powerplants and had limited or no application in GT-based generating facilities. Examples: isolating ductwork during maintenance of induced-draft fans and during installation of fabric filters, auxiliary sealing of isolation dampers in SCR systems during catalyst maintenance or change-outs, etc.

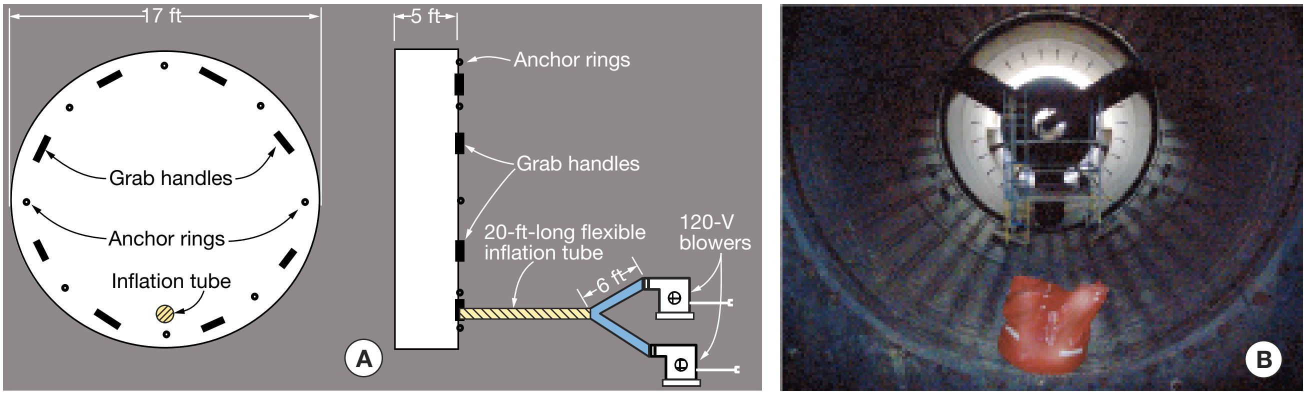


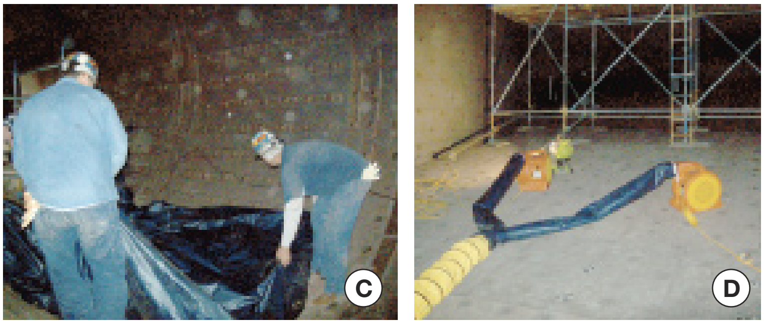
1. Vent hole in balloon allows dehumidifiers to exhaust through the stack while maintaining tight control of the HRSG gas-side environment to prevent corrosion

An application at a combined-cycle facility that caught the editors' attention involved a duct balloon made for Texas Industrial Partners Inc, a plant construction and maintenance contractor based in Grand Prairie, Tex. The company was hired to do some boiler work, which included CO_2 blasting (subcontracted to another firm) the finned-tube heat-transfer surfaces in two F-class HRSGs at the same time another contractor was inspecting and repairing the GTs.

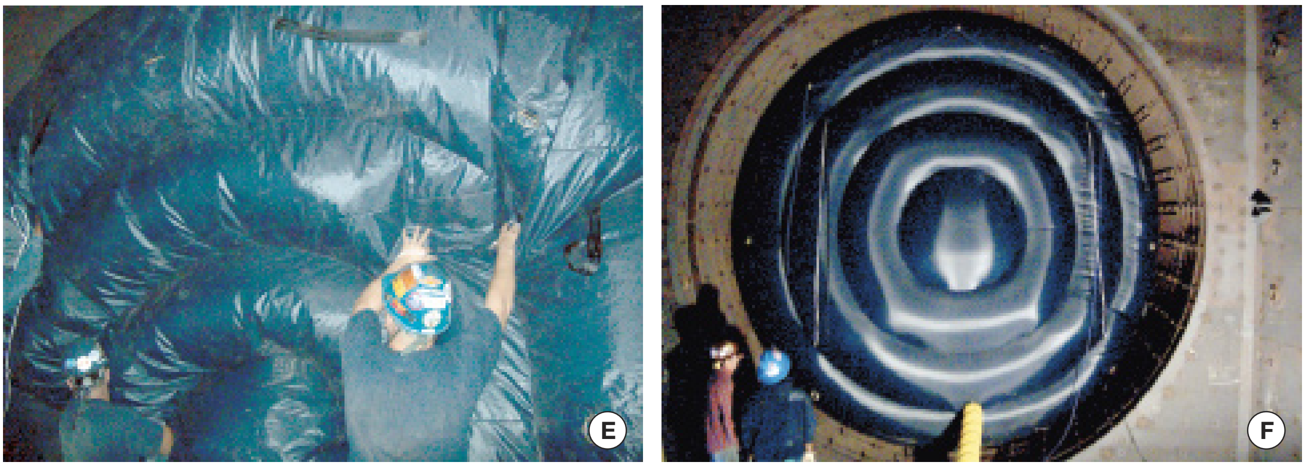
The obvious concern was that CO_2 could leak into the turbine work area if the ductwork were not properly sealed off. Heath Carroll, a division manager at Texas Industrial who had never used a duct balloon previously, worked closely with Werth on the design of a barrier to assure worker safety. The balloon was manufactured to the drawing in Fig 2A.

It was installed about 10 ft downstream of the 7FA's exhaust diffuser and just upstream of the expansion joint at the inlet to the HRSG, as shown in Figs 2B through 2F. A suitable air-quality monitor, complete





2. Duct balloon described in A allowed CO_2 cleaning of the HRSG and gas-turbine maintenance to proceed simultaneously, thereby saving days on the outage critical path. Starting point of the balloon installation is in **B**, looking upstream into the GT exhaust diffuser with the top half of the exhaust frame removed. Personnel unpack and lay out the balloon in **C**. The two fans provided **(D)** are connected to independent circuits to assure a reliable supply of inflation air. After proper fit up of the balloon in the duct is assured **(E),** work can begin **(F)**



with audible alarm, was placed on the GT side of the barrier. The estimated time for CO_2 cleaning was four days and would have extended the outage had the HRSG and GT work not proceeded simultaneously.

Werth explained that all duct balloons are designed to expand larger than the actual duct size to assure a tight seal. A redundant blower setup allowed connections to independent electrical circuits to assure desired inflation even if a given circuit were lost. Keep in mind that very small quantities of air leak by the seams and blowers remain in service throughout the work day. Design of the balloon is such that it can't be over-inflated and a safety relief system is not needed.

The material used to fabricate duct/stack balloons typically is the nylon fabric Cordura®, sometimes referred to as ballistic nylon. The material weights used range from 400 to 1600 denier. For comparison purposes, consider that the flag outside your post office most probably is 200 denier.

The fabric weight is selected by Werth is based on duct size and intended use. Keep in mind that for large ducts, a heavyweight fabric can be difficult to install and to fit through existing manways. For applications where temperature might be an issue, the alternative to Cordura usually is silicone-coated fiberglass fabric.

With safety a major concern in the Texas Industrial combined-cycle application, the editors asked about the possible need for a restraint system to hold a given balloon in position. Werth said his company engaged the Aerospace Laboratory at Penn State to run some tests so he could better respond to such questions.

Engineers developed physical tests to simulate the use of balloons in powerplant applications. Test data were used to develop mathematical models that predict the holding values for balloons of various sizes. Duct pressure, temperature, surface conditions, quality of installation, and other variables factor into the calculation.

Calculations for the TIP example revealed that the balloon would hold back about 750 lb of force by friction alone. Lashing with rope using the balloon's anchor rings increases holding capability to 4200 lb. Steel bars or other structure internal to the duct can boost the holding capability to more than 5100 lb.

If your application requires a restraint system to increase the balloon's holding ability, its structural design should be handled by a professional engineer. CCJ