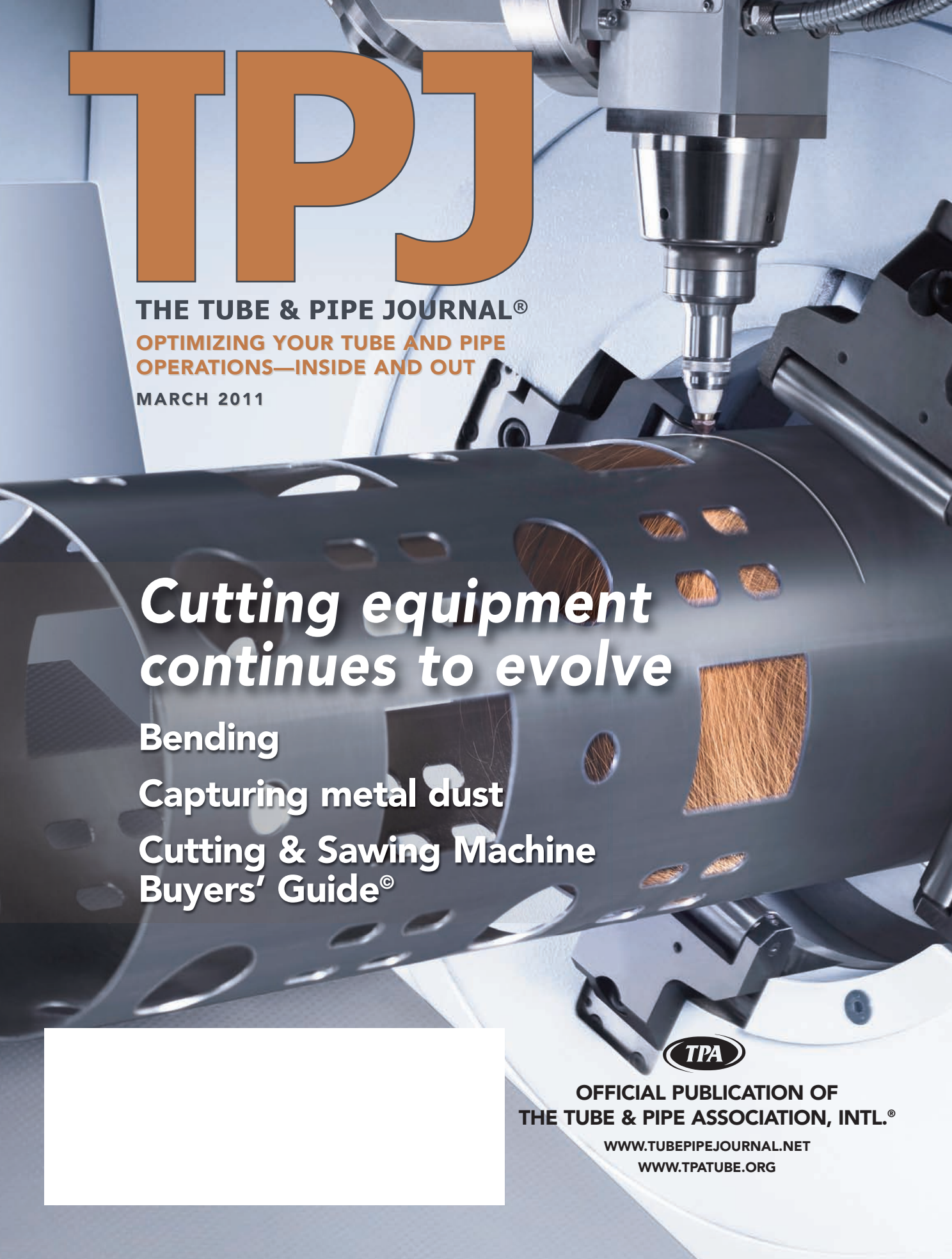

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DESIGNING A DUST COLLECTION SYSTEM FOR WELD SEAM REMETALLIZING

Ventilation and safety for tube, pipe producers

By Scott McLaughlin

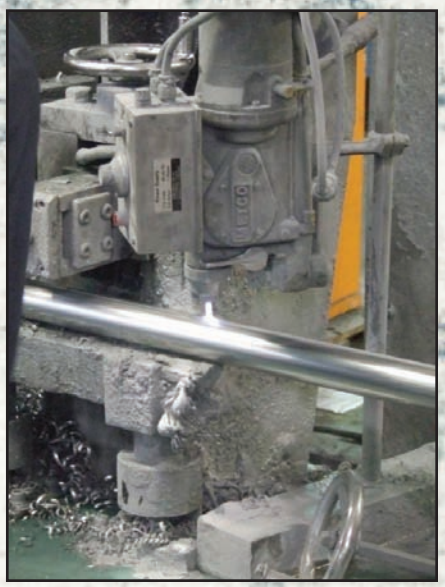

Photo courtesy of Phoenix Tube Co. Inc., Aurora, Ill.

AS Washington grapples with budget shortfalls and deficit spending, many federal agencies are being asked to become self-supporting, according to some sources. Others say that two 2010 events, explosions at Massey Energy's Upper Big Branch mine and on BP's Deepwater Horizon rig, increased the federal government's attention to worker safety. Regardless of the reason, the Occupational Safety and Health Administration (OSHA) has been stepping up enforcement actions. According to a report issued by OMB Watch, the number of OSHA violations increased from 25,000 in 2008 to 114,000 in 2010.[1] If these numbers are a trend, manufacturers can expect greater OSHA scrutiny and stricter enforcement in the future.

In addition, OSHA has stepped up enforcement activities with recent directives because of accidents involving combustible dusts.[2] This is an area of concern for tube and pipe producers that use remetallizing operations. Improper ventilation of thermal spray dust and overspray are likely targets because of their impact on worker health and safety.

DANGEROUS DUSTS, FUMES

Tube or pipe producers that use thermal spray to remetallize the weld seam or coat threads for corrosion protection, and any interested in adding remetallizing capability, should be aware that the two main hazards associated with the process are fumes and metal dust.

Fumes generated from the spray process must be vented away from the work area to ensure a safe environment for the operators. Spraying zinc creates fumes that, when inhaled by workers, cause nausea and other symptoms.

The other hazard, the metal's dust, is much more severe: It is explosive.

Aluminum and zinc are the two most common metals used to remetallize the weld seam in tube mills. Aluminum dust's theoretical Kst value, which is a quantitative measure of explosivity, is between 200 and 300; however, it can be as high as 1,100. For zinc, the theoretical Kst value is below 200. This doesn't mean that zinc is safe; the National Fire Protection Association (NFPA) defines any dust with a Kst above 0 as explosive.

Testing a sample is necessary to determine the actual Kst value of an alloy's dust. Various factors such as the metal's purity and the presence of byproducts, moisture, and oxides affect the Kst value. Most collector manufacturers can determine a metal dust's Kst value for a fee; independent labs also offer this service.

COLLECTOR DESIGN

The purpose of a ventilation system for the remetallizing process is to move air and the fumes and dust it contains. The airflow's linear velocity at the dust source (the spray gun) should be between 75 and 200 feet per minute (FPM).[3] This ensures adequate capture of the dust and fumes without disturbing the spray plume. Higher velocities can cause the spray plume to vary and result in low bond strength and coating porosity. The ductwork should have a minimum conveying velocity of 4,500 FPM.[4] Bends, ledges, and other internal disruptions should be minimized to reduce dust buildup. Internal lap joints should be designed so that they don't impede airflow.[5] Proper electrical grounding of the collector and ductwork is important to reduce static electricity buildup.

Filter cartridge alignment is another design consideration. *The American Society of Heating, Refrigerating, and Air-Conditioning Engineers Handbook* states that horizontal cartridges present challenges because dust tends to collect on the top side of the cartridges.[6] Vertically mounted cartridges do not have this problem.

For existing collectors, a simple test can determine if the airflow velocity is adequate: Drill a hole into the ductwork and insert the probe of an airflow meter.

Regular ductwork inspections are necessary to ensure that remetallizing dust hasn't accumulated, which can lead to an explosion and fire. Ductwork that requires frequent cleaning indicates inadequate airflow.

CARTRIDGE DESIGN

The air-to-cloth (A/C) ratio is a primary design factor for cartridge collectors. For twin-wire arc spray (also known as electric arc spray, or EAS), cartridge collectors should have an A/C ratio of 0.6. For combustion spray (also known as flame spray), the A/C ratio should be 1.3.

Used at the proper A/C ratio, cartridge filters should last about a year.

Running a collector at a higher A/C ratio than recommended doesn't necessarily cause an unsafe condition, but it can cause filters to clog up prematurely. Replacing cartridges more frequently increases the total cost of ownership of the collector. Costs include cartridge purchase, maintenance time to change them, and disposal.

Flame-retardant filter media is a must for all thermal spray operations. This media costs more than standard media, but this is not the place to save money. In most cases, high-efficiency media is not recommended. Most top-line collectors have an efficiency of 99.99 percent for particles of 5 micron or larger by weight. However, some local regulations may require a downstream HEPA filter to comply with emission standards.

COLLECTOR SAFETY EQUIPMENT AND LOCATION

The collector for a remetallizing operation must have several safety features. Explosion vents, required for all thermal spray processes, direct the internal pressures of an explosion in the dust collection system away from workers and equipment.

If possible, the collector should be placed outside. This allows the explosion vents to be directed away from workers and equipment. If a collector must be placed indoors, the design must allow the explosion vents to direct pressure and flame fronts safely out and away from the building and any personnel. Ductwork should be as short as possible.

Collectors also should have spark trap inlets or drop-out modules to reduce the chance of hot embers reaching the filter media. Drop-out modules also can reduce the total cost of ownership of a collector by extending the life of cartridges.

Depending on the local fire code, a sprinkler system or some other type of fire suppression system may be required. The best course of action when adding a new remetallizing line to a tube or pipe mill is to contact local

EPA and fire officials to get their feedback and direction early in the process.

OPERATIONAL MATTERS

It is necessary to keep moisture out of the collector when spraying aluminum. Moisture can react with the aluminum dust to create hydrogen gas, which is explosive.[7] It's also necessary to empty the hoppers frequently. The hopper is not intended to be a storage bin for overspray metals; some directives state that hoppers should be emptied daily.[8]

Finally, recycling the zinc or aluminum dust can turn a cost center into a profit center. Many recyclers pay for the metal dust that accumulates in the hoppers. TPJ

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American Society of Heating, Refrigerating, and Air-Conditioning Engineers, 800-527-4723, www.ashrae.org

Environmental Protection Agency, 202-272-0167, www.epa.gov

National Fire Protection Association, 617-770-3000, www.nfpa.org

Occupational Safety and Health Administration, 800-321-6742, www.osha.gov

Notes

1. OMB Watch: www.ombwatch.org/files/regs/obamamidtermenforcementreport.pdf.
2. OSHA Directive: CPL 03-00-008, March 11, 2008.
3. Thermal Spray Society, "Environment, Health and Safety Guidelines," October 2008, p. 73.
4. NFPA 484 Standard for Combustible Metals, 8.4.3.4.
5. NFPA 484 Standard for Combustible Metals, 12.2.5.2.
6. ASHRAE Handbook 29.14, 2008.
7. Interview with Tony Supine, plant manager, Camfil Farr, Jonesboro, Ark., Dec. 13, 2010.
8. NFPA 484.