

Hadek Protective Systems

Company profile

- A specialist for internal linings of flue gas ducts and chimneys in fossil fired power stations
- World wide distributor of the PENNGUARD[®] Block Lining System, providing a range of technical services, throughout the power industry



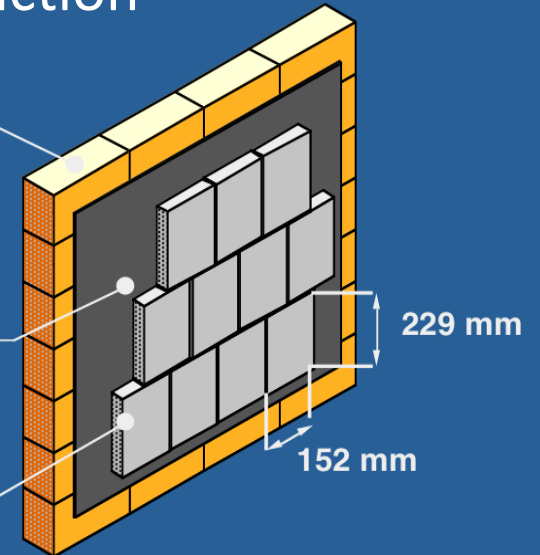
Construction

Substrate

- steel
- FRP
- concrete
- brickwork

Pennguard Adhesive/Membrane
thickness 3 mm

PENNGUARD Block
thickness 38 mm



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PENNGUARD® Block Lining System

Advantages

- Chemical resistance

A Pennguard® lining is suitable for a wide range of fuels (coal, oil, petcoke, lignite, biofuels) and operating conditions – from low-temperature wet flue gas to high temperature untreated flue gas, even with a high SO₃ content

- Temperature resistance

The lining will perform in operating temperatures up to 392°F – and even higher temperatures for short periods



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PENNGUARD® Block Lining System

Advantages

- Thermal shock and cycling resistance
extreme thermal cycles in modern power plants challenge. Most thermal shocks have no effect on Pennguard® linings.
- Low weight – A Pennguard® lining weighs just 2.5 – 3 lbs / sqft, it does not require anchors, and is very suitable for seismic regions



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PENNGUARD® Block Lining System

Advantages

- Long service life

Pennguard® linings installed with Hadek's supervision are highly resilient and durable. Many Pennguard® lining installations are still in use after 30 years, with almost no maintenance or repair

Long term Performance

- Field experience since early 1980's
- Expected service life: more than 30 years
- Very low maintenance requirement
($< 0.1\%$ per year)

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PENNGUARD® Block Lining System

Protecting against fires

- An FGD plant fire could destroy your outlet ductwork and chimney
- FM Approvals tests show that Pennguard® linings protect substrates in case of fire
- At temps of over 932°F, alloy-clad substrates are at risk of collapse, and FRP will likely catch fire, even with fire retardants
- In 1996, an FGD fire at one US power station caused 1,832°F temperatures inside a steel chimney. The Pennguard® lining successfully protected the chimney from collapse



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Pennguard® linings protect chimneys against fire. Why take unnecessary risks?

Firetests by Hadek show that Pennguard® linings protect chimneys in case of fire. At temperatures over 500°C (932°F), alloy-clad flues are at risk of collapse, and FRP flues are likely to catch fire, even with fire retardants.

Please contact Hadek for more information and your copy of the Test Report.

**FM
APPROVED**

PENNGUARD® Block Lining System

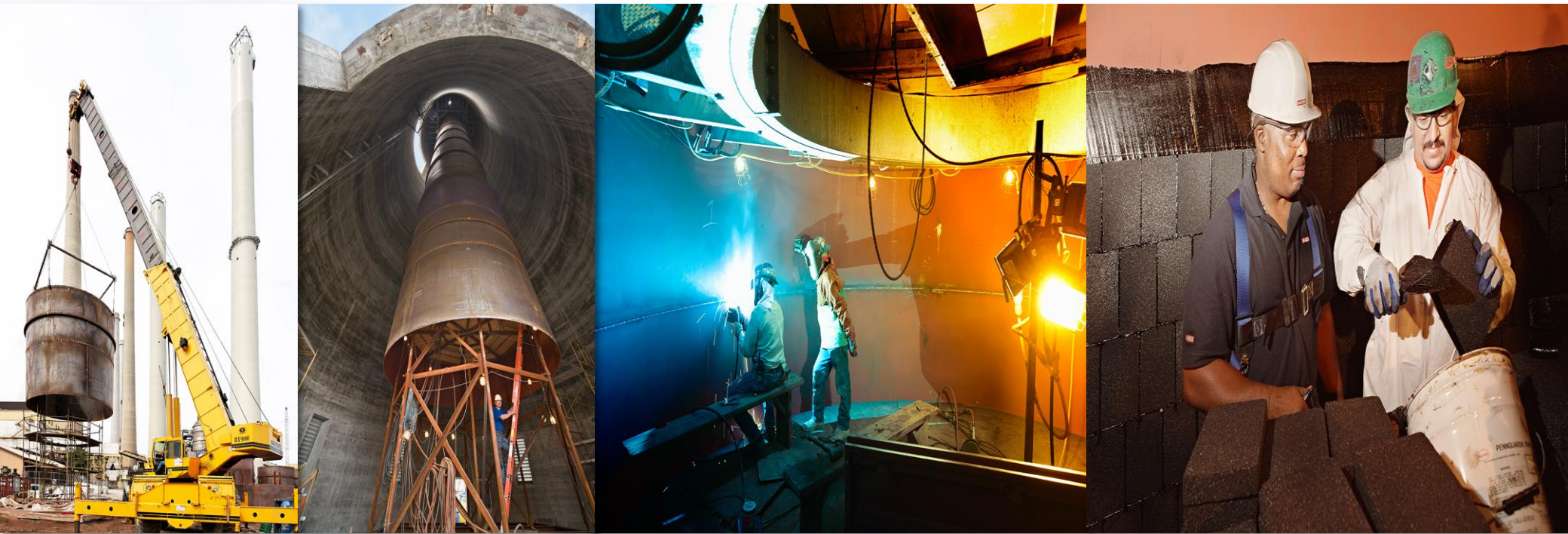
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PENNGUARD[®] Block Lining System in New Steel Chimney Flues

- A method of constructing and lining new steel chimney flues



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PENNGUARD® Block Lining System in New Steel Chimney Flues

- Height: 650 ft
- Two new chimneys
- 21 ft diameter Unit 1, 27.5 ft diameter Unit 2
- Total surface area 87,535 ft²



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PENNGUARD® Block Lining System in Steel Chimney Flues (Retrofit)

- 550 ft. concrete chimney
- Two steel flues for unit #2 & #3
- Total surface area unit #3 flue 29,449 ft²
- Installation Time: 4 weeks including liquid collection system and steel substrate repairs



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PENNGUARD® Block Lining System in Brick Chimney Flues

A new Pennguard® lining can save your stack from the aggressive conditions caused by FGD



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PENNGUARD® Block Lining System in Brick Chimney Flues

Annular Space Condition Prior to Pennguard lining

- Large acid deposits in annular space
- Deteriorated Steel Bands
- Acid deposits on foundation



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PENNGUARD[®] Block Lining System in Brick Chimney Flues

- Pennguard[®] Lining will be completely isolating the brick from flue gas and condensate, protecting the liner bands and chimney foundation
- Insulating it from thermal shocks in case of by-pass
- No liner bands replacement anymore



SEPT 2009



APRIL 2007



MAY 2006



MARCH 2005

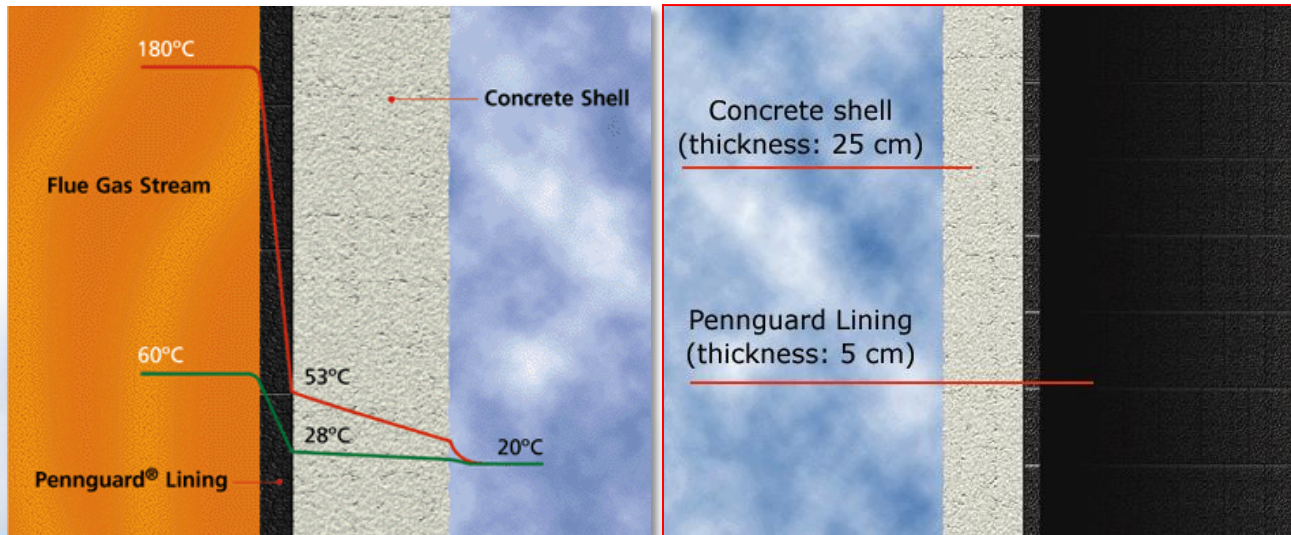
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Hadek's New Chimney Design

- A revolutionary new type of chimney that consists of a reinforced concrete shell with a Pennguard[®] lining applied directly to its concrete surface
- Makes internal flues obsolete
- Faster and less expensive to build
- Virtually no maintenance



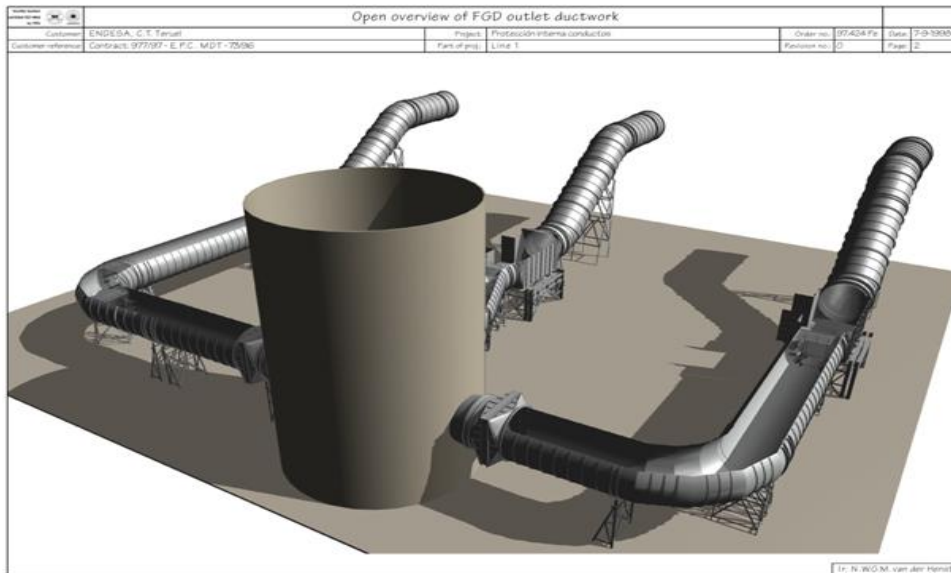
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PENNGUARD® Block Lining System in Flue Gas Ducts

- FGD Outlet ducts lined 87,535 ft²
- Lower 167 ft of brick chimney flue
- Non-insulated ducts



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PENNGUARD® Block Lining System in Flue Gas Ducts

Mechanical protection of Pennguard®
lining on floor with Tufchem® acid
resistant concrete



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Project Services offered to PENNGUARD® Customers

- Hadek Technical Services



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