Summary
- DFI oxyfuel for highest possible heat transfer, 250–300 MBTU/hr/ft²
- 30% capacity increase
- DFI oxyfuel unit effectively cleans strip, no strip pre-cleaning section is necessary
- No extension of furnace or line

Customer
ThyssenKrupp Steel, Finnentrop, Germany.

Background
ThyssenKrupp Steel (TKS) has been searching for an easy-to-implement and effective solution to increase the galvanizing capacity of an existing production line at the Finnentrop works. The galvanizing line at TKS Finnentrop (FBA 3) processes both hot and cold rolled strip with a width of 25-60 inches and thicknesses of 0.012 - 0.13in for automotive, white goods, and construction applications. The total furnace length is 430 ft, where 220ft is airfuel-fired. The highest strip speed is 10 ft/s and the maximum output was limited to 82 tons/hour.

Customer objective
TKS had identified that by increasing strip heating, the line could reach 105 tons/hour. It was also determined that the appropriate heating solution should free the strip surface from unwanted contaminants. Such contaminants originate from the upstream strip production process and include emulsions, oils, grease, and particles. Additionally, the boosting unit should allow for strict control of the required surface properties needed to successfully galvanize the strip. With these specifications in mind, TKS met with Linde at the end of 2004 to discuss the possibilities of applying oxyfuel in galvanizing lines.
DFI oxyfuel

Direct Flame Impingement (DFI) oxyfuel is based on Linde’s vast experience in oxyfuel combustion and its application in steel heating processes. This expertise was adapted to continuous and large-scale use in reheating and annealing furnaces. With our DFI technology, where controlled oxyfuel flames are fired directly onto the moving metal, the heat transfer is drastically improved. Tests have verified the higher level with local heat flux for the DFI oxyfuel technology, reaching levels of 250–300 MBTU/hr/ft².

**Features**

- DFI oxyfuel unit, 17 MMBTU/hr, 120 oxyfuel flames from 4 burner row sets
- 80–90% thermal efficiency
- Compact unit size, 9ft long, 9ft wide and 4ft high
- 10ft of recuperative zone removed for installation of DFI
- Option for 2 more burner arrays, (+8.5 MMBTU/hr possible within the same outer dimensions)
- Complete safety and flow control system
- Automatic width adjustment
- Flow trains for natural gas and oxygen
- Installation, commissioning, & fine tuning
- Guaranteed performance

**Benefits**

- 30% more galvanizing capacity
- The oxyfuel flames effectively burn off and clean the strip from residues, oil, etc.
- DFI oxyfuel effectively cleans the strip to remove strip pre-cleaning section (82ft)
- DFI oxyfuel allows for modification of metal surface properties
- Specific fuel consumption reduced 6%
- No extension of line or furnace necessary
- Improved annealing properties over the entire strip width
- Short installation time for a limited production down-time.

**REBOX® oxyfuel solutions**

Linde’s REBOX® oxyfuel solutions provide more capacity and flexibility at lower total costs for more than 90 installations in reheating and annealing furnaces.

Direct Flame Impingement oxyfuel is one of the leading solutions within the REBOX® portfolio. The broad REBOX® technology and application experience drives the development work and results in fast and safe project handling. We provide turnkey installations with guaranteed performance.