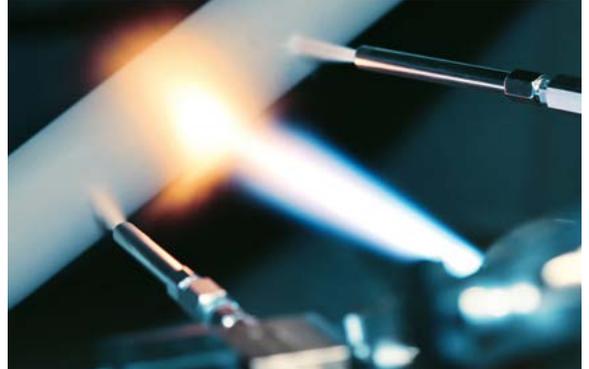


LINSPRAY®. CO₂ cooling for thermal spraying.

The overheating challenge

During thermal spraying, the heat applied to the base material can be extremely high. This is particularly true of high-energy spray processes such as high velocity oxyfuel flame (HVOF) or plasma spraying. When coating thin-walled substrates or substrates with very low thermal conductivity, or when using temperature-sensitive coating materials, overheating problems often arise if cooling is not employed. Differences in heat expansion rates can even cause the coating to flake off.

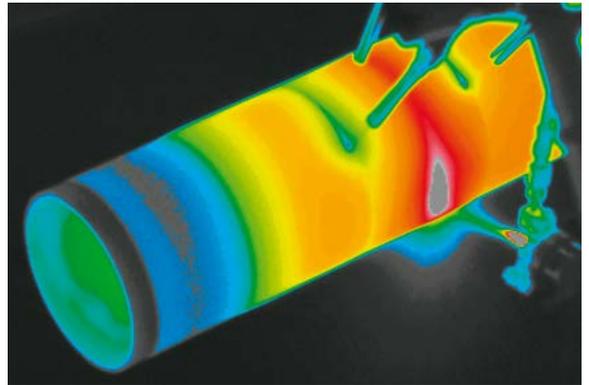


Linde's answer

Our LINSPRAY® carbon dioxide (CO₂) cooling solutions avoid the problem of overheating by effectively cooling the workpiece around the flame. CO₂ is fed from a pressure vessel at a low (18 bar) or high pressure (56 bar). Normally, a tank is used to supply these cooling applications, but small-volume or occasional users may find cylinder bundles (56 bar) adequate.

Why cool with CO₂

Compared with other cooling methods using air or nitrogen, CO₂ is a highly effective cooling medium. Although nitrogen has an extremely low temperature (-195°C), this cooling power cannot be applied effectively as there is no direct contact between the liquid nitrogen and the component to be cooled. A natural gas cushion, which functions like an insulation layer, always forms between the component and the nitrogen. The nitrogen cannot penetrate this layer, instead acting like a droplet of water skittering across the hotplate of a stove. CO₂ snow particles, on the other hand, are propelled directly onto the surface, thus penetrating the insulation layer.

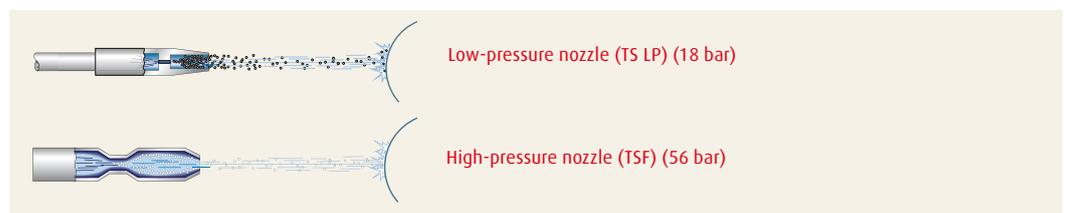


Ideal temperature profile with CO₂ shown by infrared thermography

On contact with the surface, the CO₂ snow sublimates (i.e. changes from a solid to a gas state), thus releasing maximum cooling power. The speed and performance benefits of CO₂ snow open up new applications for thermal spraying. To maximise the efficiency and performance gains of CO₂ cooling, we complement our gas and service offering with custom-developed hardware and nozzles. These sophisticated, commercially viable devices bring our customers the added bonus of ease of use.

Why cool with Linde nozzles

Our nozzles feature a pre-chamber at the mouth end, where liquid CO₂ is expanded via a calibrated slit nozzle. The patented design of this pre-chamber ensures extremely effective expansion. The precision-manufactured mouth opening ensures an exact, turbulence-free jet shape and avoids nozzle blockage. The proportion of CO₂ snow in the cooling jet disappears after it hits the substrate surface, resulting in optimum heat removal. To suit individual needs, we have developed different nozzle models for a fanned or focused effect. These nozzles also come in different sizes to enable operators to tailor cooling power to individual application requirements. Cooling power can only be adjusted by means of the nozzle as liquid CO₂ is always supplied at a constant pressure.



Nozzle sizes and CO₂ flow rates

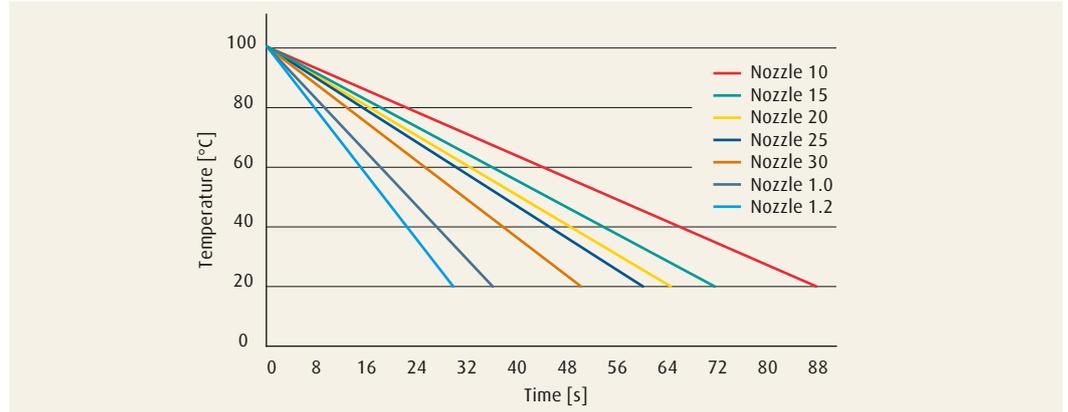
Benefits at a glance

- Fast-acting, effective cooling power
- Custom-designed supply hardware and nozzles
- Focused or fanned effect
- Ease of use
- Maximum convenience with all-in-one kits

Possible applications

- Temperature-sensitive substrate materials such as carbon-fibre-reinforced plastic (CFRP), titanium, aluminium, magnesium
- Thin-walled components
- Components with poor thermal conductivity
- Oxide-sensitive spray materials
- Products with different heat expansion rates, which can cause the coating to flake off

CO₂ nozzle efficiency



CO₂ consumption and scope of supply

Our CO₂ cooling system is available as a complete system, including all the necessary operating components.

Product	kg/min		Order number
CO ₂ kit			03 - 2523566
CO ₂ nozzles			
TSFK 1.2	1,400		03 - 1068712
TSF 10/15	320	with filter	03 - 1068688
TSF 10/20	480	with filter	03 - 1068696
TSF 10/25	620	with filter	03 - 1068720
TSF 10/30	730	with filter	03 - 1068704
TS LP 0.4	280		03 - 1068689



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