

FROSTCRUISE®

Cryogenic in-transit refrigeration system



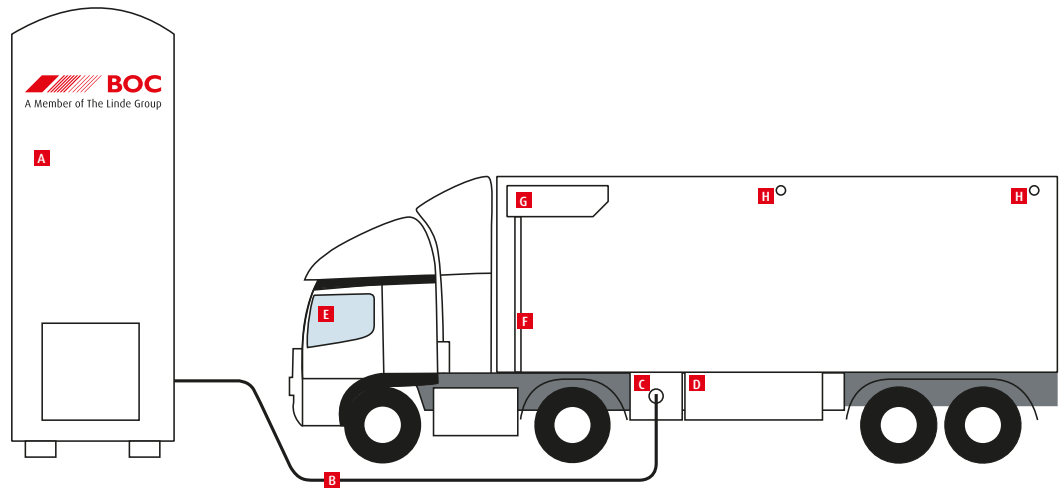
Introduction The majority of the world's chilled and frozen food transport is done by refrigerated vehicles. Namely mechanical or diesel driven truck or trailer units. These refrigeration units typically use diesel to fuel a compressor that circulates a refrigerant.

Diesel units create pollution, CO₂ and NO_x emissions (i.e. greenhouse gases) This environmental issue is receiving increasing focus with steps being made to tighten legislation meaning that the need to address the issue has become much more urgent. In addition these systems usually create noise levels above the PIEK limit for out of hours urban deliveries – often above 80db, even when the truck unit is switched off and the unit stands still during loading and unloading. Moreover, with these systems, fluorocarbon refrigerant leakages create additional emissions, increasing your carbon footprint and your running costs.

Solution FROSTCRUISE® is an efficient, economical, cryogenic alternative for mechanical, diesel-powered truck refrigeration systems. As a safe indirect cooling method, it provides an eco-friendly solution for the transportation of perishable chilled and frozen goods, utilising the cryogenic cooling power of liquid nitrogen (LIN).

Details The system is powered by liquid nitrogen (LIN), which is liquid at a temperature of -196°C. The LIN is stored on-board in an insulated tank, its cooling energy is harnessed when LIN is piped through a heat exchanger with a large surface area. High velocity fans then circulate the chilled air throughout the compartment, providing a safe and efficient temperature pull down.

- Advantages**
- No diesel or refrigerant pollution at delivery locations; reduction of carbon footprint, no particulate and NO_x
 - Very low operating noise (noise reduction at night/in residential areas)
 - Elimination of refrigerants with high global warming potential
 - Improvement of the system user's public image ("greener" image for companies)
 - Fewer moving parts, reduced weight, fewer downtimes, reduced maintenance, reduced service costs
 - Accurate temperature control (+/- 0.5°C of setpoint typically)
 - Fast temperature pull down (2-3 times faster than mechanical systems) maintains the integrity of the cold chain
 - Safe cryogenic filling and easy operation
 - Higher system efficiency, reliability and durability (expected lifetime: 10 years)
 - Sustainability: Nitrogen is a natural component of air
 - Very cost-efficient system



A On-site LIN tank, **B** On-site LIN hose, **C** Control and filling box (valve cabinet), **D** LIN tank, **E** On-board control unit, **F** Piping, **G** Heat exchanger, **H** Sensors

Field trial results **46m³ FROSTCRUISE® truck, London**

LIN tank volume	530 litres
Operating temperature	2°C
Operating time	10 to 20 hours
LIN consumption	20 to 30 litres/hour average depending on operating conditions
Cool-down time	10 minutes from 14°C to 2°C
Exhaust gas temperature	-5°C to -10°C
Noise emission	Less than 60 dB (Piek award)
Expected system lifetime	10 years (as opposed to 5-7 years with mechanical systems, depending on the haulier)
Carbon footprint reduction	Up to 60% reduction in total carbon footprint depending on operating conditions and 100% reduction on the vehicle*

*Results based on trial customer conditions

Service and know-how

As a global gases and engineering company, BOC offers innovative solutions to many business areas within the food industry – especially for chilling and freezing of perishable goods. Amongst others, the meat, poultry, seafood, bakery and prepared foods industries profit from our company's extensive gas application know-how for environmentally friendly, efficient and reliable freezing and chilling methods.

With FROSTCRUISE®, we present an eco-friendly alternative to diesel-powered refrigeration systems. The system's low noise emission and the use of liquid nitrogen as the refrigerant make FROSTCRUISE® an especially sustainable and economical solution.

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