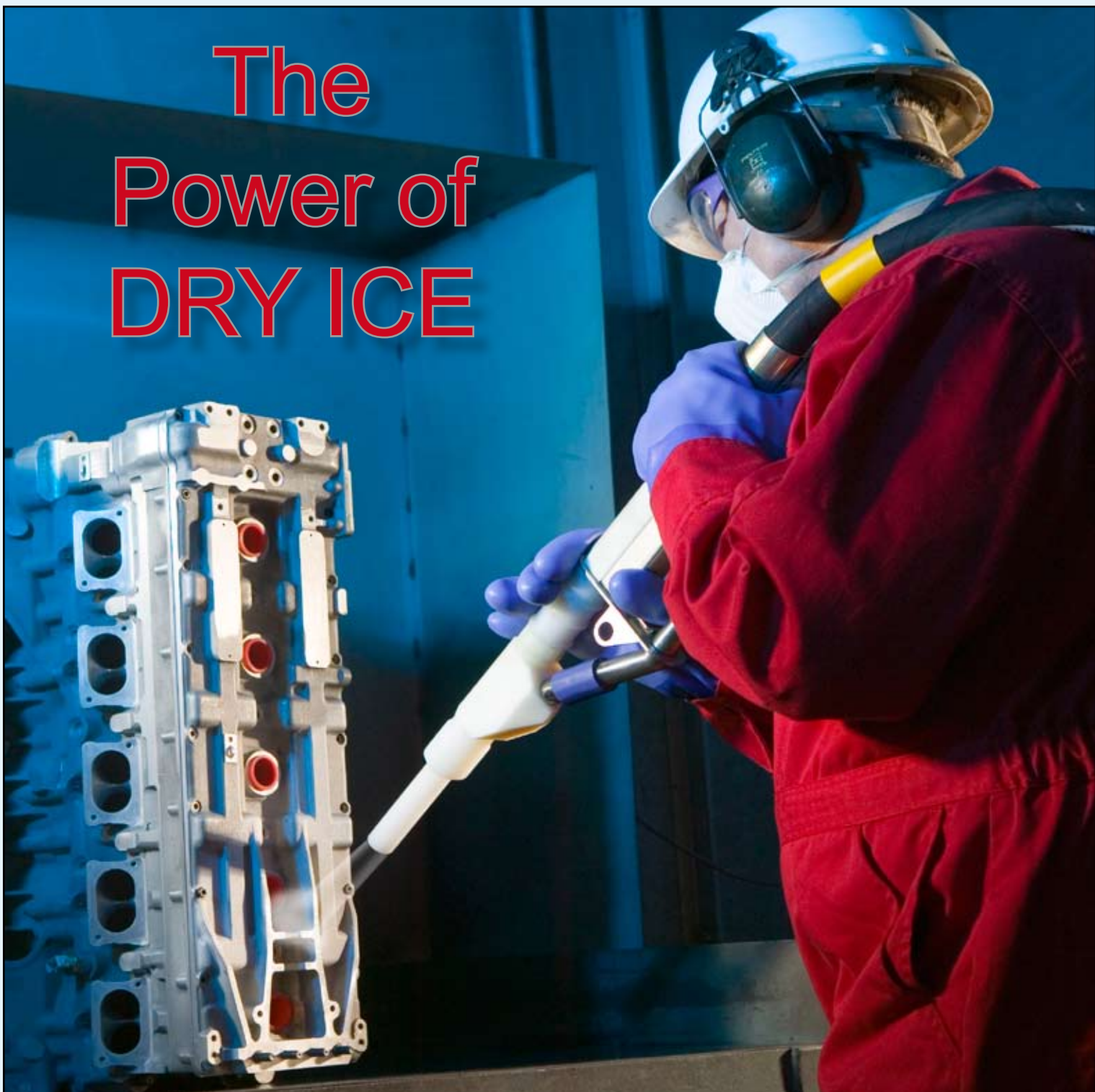


CLEAN *surface*

Designers & Manufacturers of Dry Ice Cleaning Equipment

The Power of DRY ICE



The safe way to clean or remove surface deposits without any media debris, solvent action or damage to the surrounding environment.

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The Power of Dry Ice

This photograph shows 3mm dry ice pellets releasing their cleaning power while rapidly subliming on the top of a Clean Surface blast unit.

Dry ice pellets, which are pure solid carbon dioxide, are made by decompressing liquid CO₂ to create CO₂ snow. The snow is then compacted and extruded through a die plate to form solid CO₂ pellets.

Dry ice is unstable above minus 78.6 °C, but instead of melting into CO₂ liquid when it warms up, it sublimates directly into CO₂ gas. It is this sublimation process that creates the cleaning effect when dry ice is used as a blast medium.

During blasting the pellets are accelerated to speeds between 200 and 300 m/s with compressed air. They break up as they travel through the blaster and arrive at the work surface as fast moving pinhead sized particles. The particles embed themselves in the pores of any surface deposits and very quickly sublime into a much larger volume of CO₂ gas. This rapid generation of gas within an enclosed space breaks up the surface deposit, releases its bond with the substrate and blows it away. The CO₂ then diffuses into the atmosphere leaving no debris other than the material removed, which is usually found as a fine dust.

What can be cleaned or removed with Dry Ice?

If the substrate is strong enough to resist the effect of the gas generation it will not be damaged or abraded and, because CO₂ is chemically inert, there will be no chemical reactions to alter the substrate's surface finish. Also, as sublimation takes place on first impact, there is no secondary impact to cause undesirable effects to the surrounding area or localised equipment, all of which makes the process safe and ideal for use in an open environment, and as an in-situ tool cleaner.



Alumina based die coating removal at 300°C



Cleaning a V10 Le Mans racing engine

What cannot be cleaned or removed with Dry Ice?

If the substrate is porous so that gas generation can also occur within its pores the cleaning may not be abrasion free. With porous substrates the deciding factor is the strength of the material. A porous sintered metal will withstand the gas generation, but a friable material like soft wood or plaster will not. Also, composite materials will show differing effects. For example the talc will be leached out of the surface of talc filled plastic leaving the surface roughened, whilst the same plastic without the talc, will clean without damage.

If the solid dry ice particles find it difficult to penetrate the layer that should be removed, cleaning will be very slow or impossible. Typical materials that are hard to penetrate are oven cured paints or enamels and elastic materials commonly used as sealants. Dry ice cleaning is slower than an abrasive process on many materials and cannot create any specific surface finish standard, e.g. rust will be removed, but the underlying steel surface will remain pitted.

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Some typical Customer applications and work done by Clean Surface on site and in the test facility:

Cleaning:

- Aircraft wing paint booths
- Aircraft components
- Automotive welding robots and jigs
- Automotive interior cladding formers
- Before NDT
- Boiler membrane walls
- Braking systems on cars, planes and trains
- Can lacquer lines and printers
- Chemical plant
- Chocolate moulds and process machinery
- Cigarette manufacturing machinery
- Classic car components
- Curing ovens
- Dirt and grease from machinery
- Electric train conductors and control gear
- Film casting bands and equipment
- Food contact surfaces
- Food processing machinery
- Generating equipment
- Heat exchangers and radiators
- Hot and cold core boxes
- Injection moulding tools
- Laminate flooring machinery
- Latex formers
- High performance racing engines
- Metallising ovens
- Packaging machinery
- Pattern boxes
- Petrochemical heater tubes
- Plastic sheet and film extrusion dies
- Plastic casting tools
- Rotational moulding tools
- Rubber moulding tools
- Sluice gate chains
- Turbine blades

Removing:

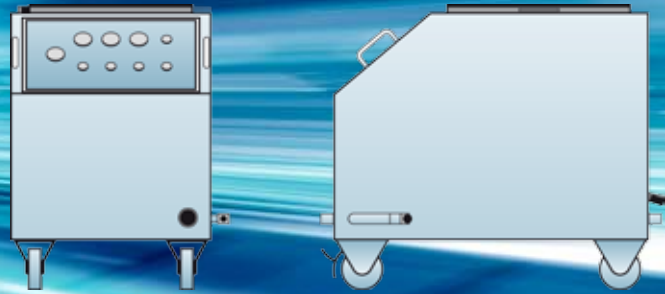
- Ageing deposits from brickwork and hardwood
- Alumina based die coatings from LP casting dies
- Antifouling coatings from boat hulls
- Anti-wetting films prior to brazing or welding
- Baking residues from baking bands
- Coatings from high value complex parts
- Carbon (coke) from racing engines
- Condensates from plastic moulding tools
- Epoxy resins from mixing equipment
- Film deposits from optical components
- Flash from foiled mobile phone lenses
- Flavouring deposits from food conveyors
- Fluxes or coatings applied incorrectly
- Gasket residues from engine heads
- Glue residues from wood presses
- Graphite based die coating from HP casting dies
- Greasy films prior to application of adhesives
- Ink from printing and packaging processes
- Masking media
- Paint from carbon fibre parts
- Plaster from complex castings
- Production spillages or leftovers from machinery
- Protective coatings
- Radioactive deposits
- Smoke damage

Refurbishing:

- Aircraft
- Classic cars
- Cutting and forming machinery
- Printing and envelope machinery
- Process machinery
- Road transport vehicles
- Trains
- Military equipment

If in doubt about an application please arrange for us to conduct a trial in our test facility

Technical Data



Equipment and Operating Requirements

The Clean Surface Blaster is a pneumatic low maintenance dual hose unit that can be fitted with a full range of blast nozzle sizes and configurations. All nozzles operate with air pressures ranging from 4 to 10 bar with just 30 kg/h of dry ice.

For frequent periods of light cleaning, e.g. plastic moulding tools or hot diecasting dies etc, the compressed air can be taken from the factory ring main, typically fed from a 7 bar compressor. The system must be able to supply a minimum of 3 m³/min (105 cfm) of dry air without pressure loss. For tougher applications it may be necessary to upgrade to a high pressure/high volume system.

The most common nozzle sizes and operating conditions are listed in Table I, together with cleaning times for a standard test plate. For applications where cleaning times need to be kept to a minimum it is important to consider the high pressure option even if it means additional investment for a compressor upgrade. This is because the cleaning efficiency increases as the air pressure increases and greater efficiency will give considerable savings in operator costs and down time.

If the factory system cannot provide sufficient air volume a mobile diesel driven compressor can be used. Mobile compressors must always be fitted with an aftercooler and water separator or dryer package to prevent the formation of water ice within the system. Water ice will not only wet and slightly abrade the surface being cleaned but also quickly build up in the nozzle and block the dry ice flow.



TV250/ TV500 /TV750 standard interlocking straight nozzle



TV250/45/LR/80 long reach nozzle with diffuser angled at 45 degrees

Table I: Nozzle Capacity & Performance

| Nozzle Size/Type | Pressure bar | Volume m3/min | CT sec | Noise dB(A) |
|------------------|--------------|---------------|--------|-------------|
| TV250HP | 5.5 | 2.5 | 38 | 112 |
| TV250LN | 5.0 | 2.5 | 52 | 106 |
| TV250 | 5.5 | 2.5 | 62 | 110 |
| TV500 | 7.5 | 5.0 | 25 | 117 |
| TV750 | 9.5 | 7.5 | 12 | 120 |

Suffix: HP = High Performance LN = Low Noise

CT is the time taken to remove a 50 x 60 mm area of standard Polyester paint from a steel substrate at 50% Rh.

Noise levels are measured 1m above and behind the nozzle exit. The actual noise generated by the equipment will depend on many local factors and care must be taken to provide all exposed personnel with adequate protection.

Table II: Technical Specification

| Blast Unit | |
|----------------------------|-------------------|
| Dimensions L x W x H | 770 x 490 x 700mm |
| Dry ice hopper capacity | 20kg |
| Dry ice feed rate | 20 - 40kg/h |
| Compressed air connection | 1 inch BSP |
| Weight (empty) | 55 kg |
| Standard hoses | |
| Air supply hose | 25mm NB x 10m |
| Blast hose assembly with: | |
| Air hose and | 25mm NB x 5m |
| Ice hose sheathed together | 19mm NB x 5m |
| Maximum Working Pressures: | |
| Compressed air hoses | 16 bar |
| Dry ice hose | 10 bar |
| Blast Unit | 15 bar |

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