Plasma Transferred Arc and HVOF Hardfacing Processes

AWS 2007

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Deloro Stellite®

Coating Processes

Coating processes can be used to provide protection in specific areas to parts made of less expensive materials.

PTA Welding (Plasma Transferred Arc)
HVOF (High Velocity Oxyfuel)
Provide coatings that are especially well suited for wear and corrosion applications

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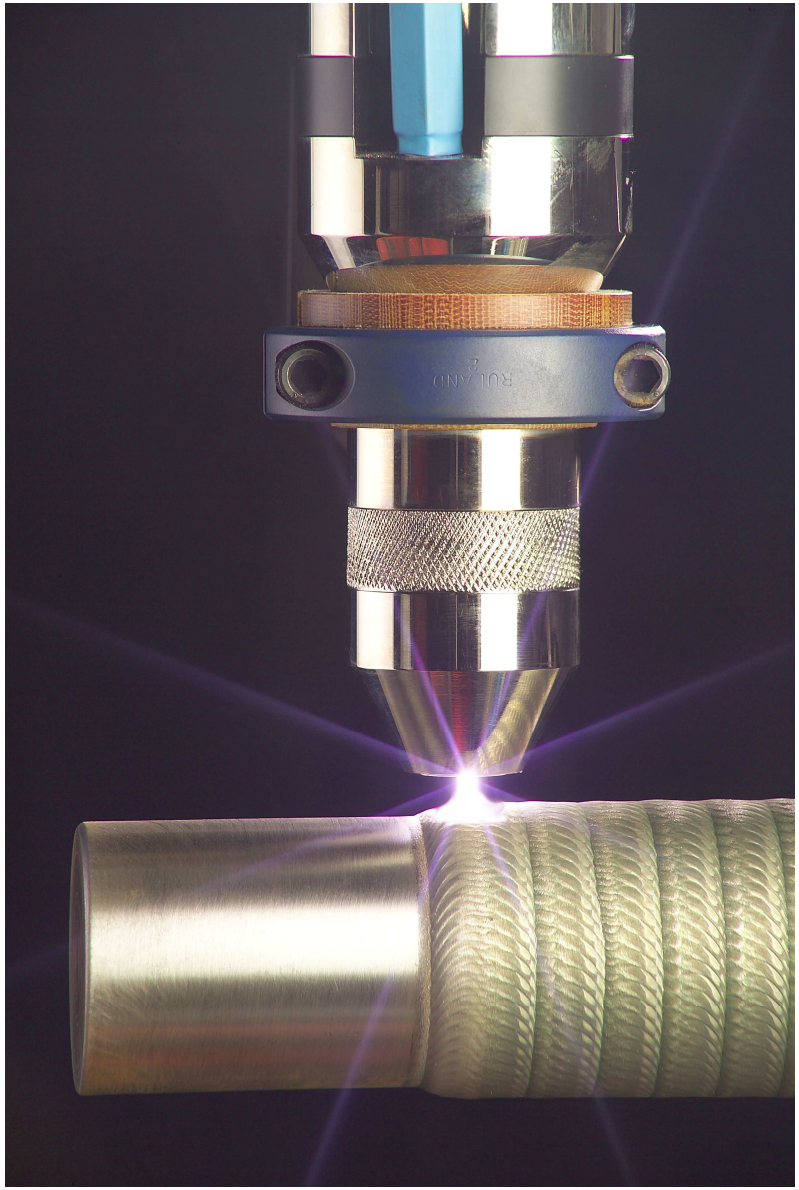
Plasma Transferred Arc Welding



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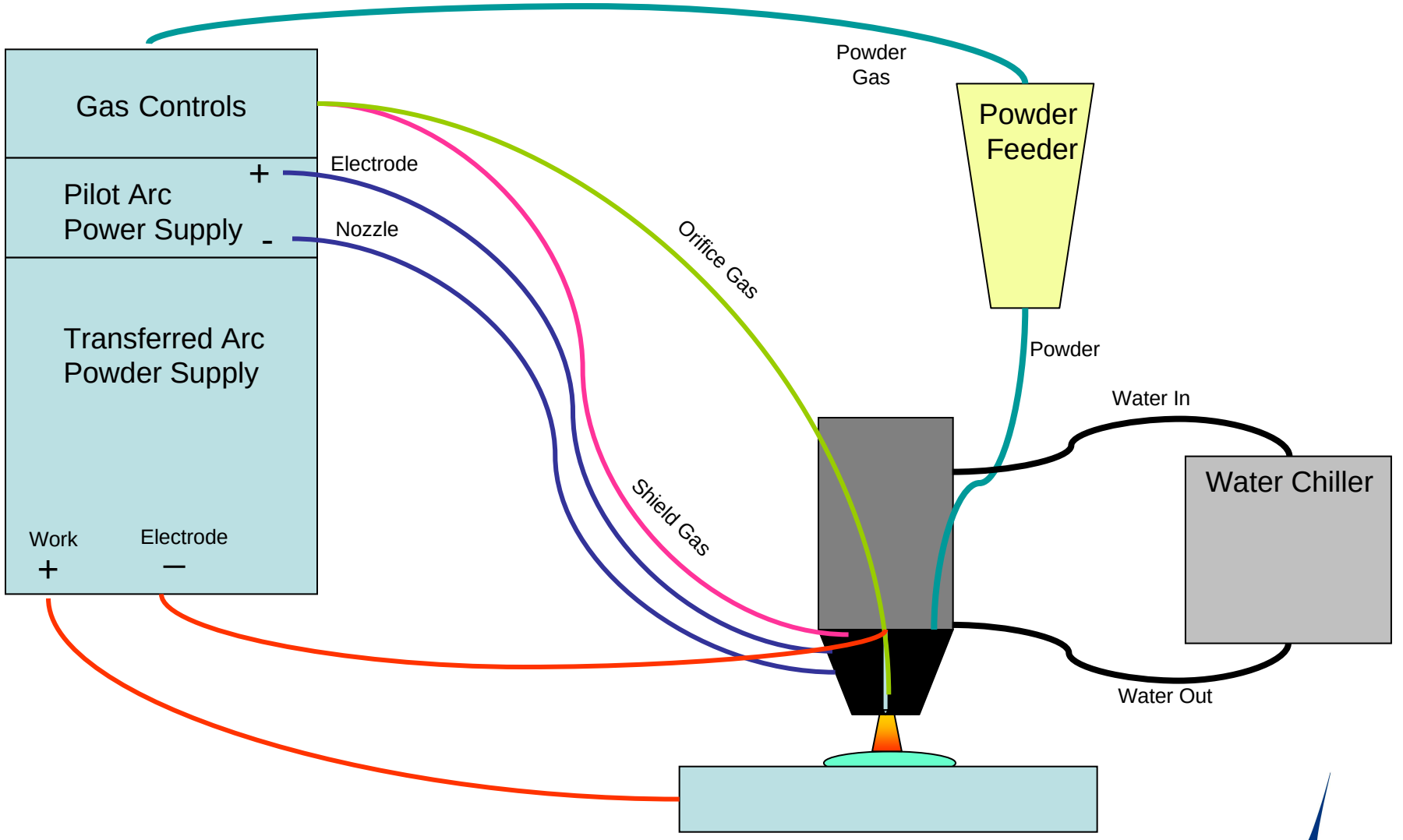
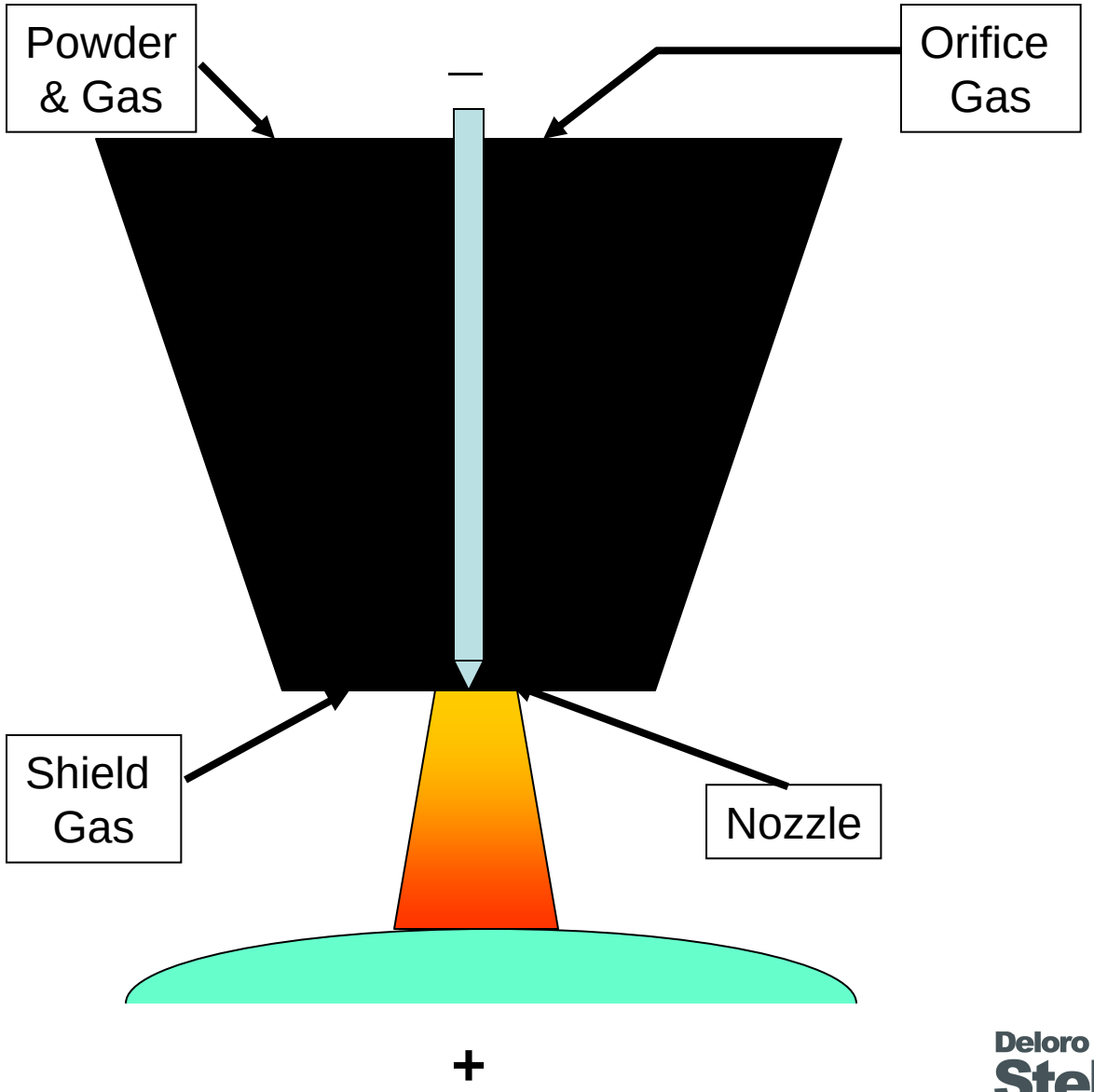
PTA Process Schematic



PTA Torch Schematic



Why PTA ?

Precise control of parameters

Suitable for automation

High quality deposit

Wide range of consumables

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PTA Powder

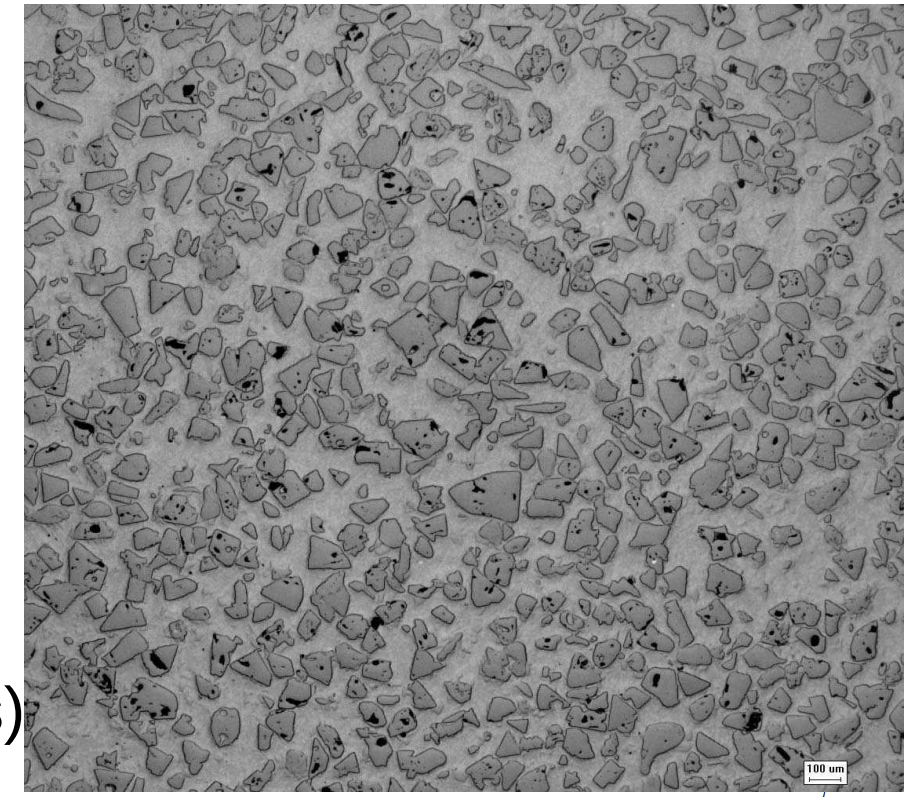
Materials that cannot be made into other forms

80/230 mesh

Gas atomized (Spherical)

Composites WC-Ni

Small lots are possible (100kgs)



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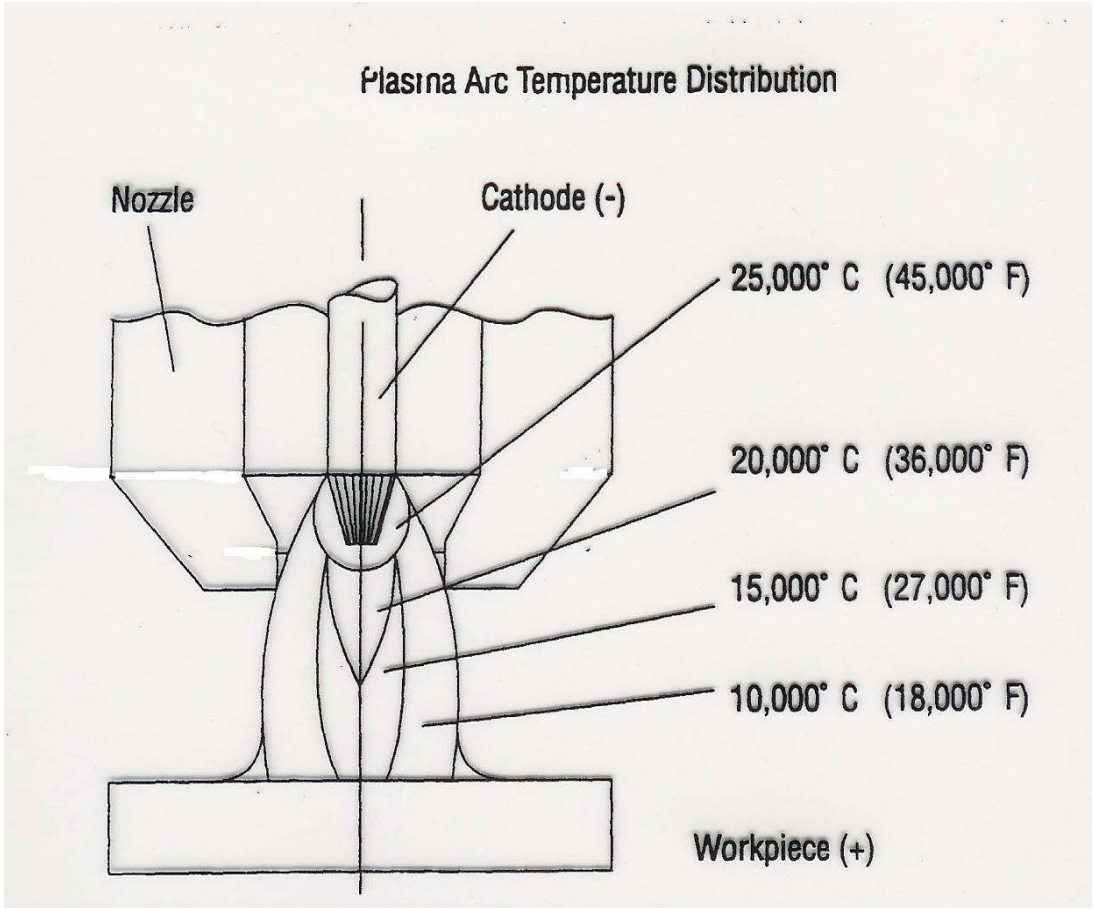
Temperature distribution



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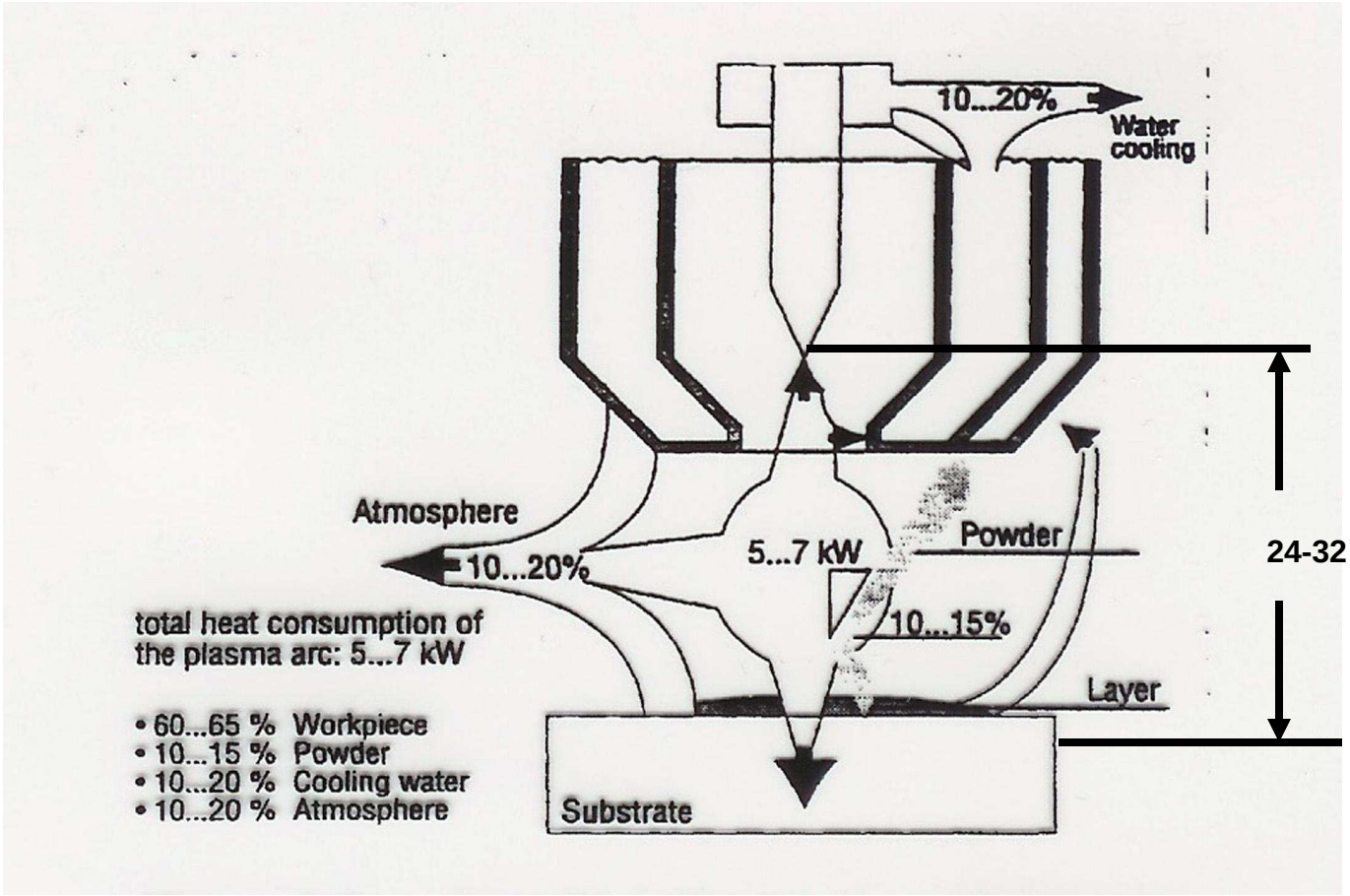
Power Distribution



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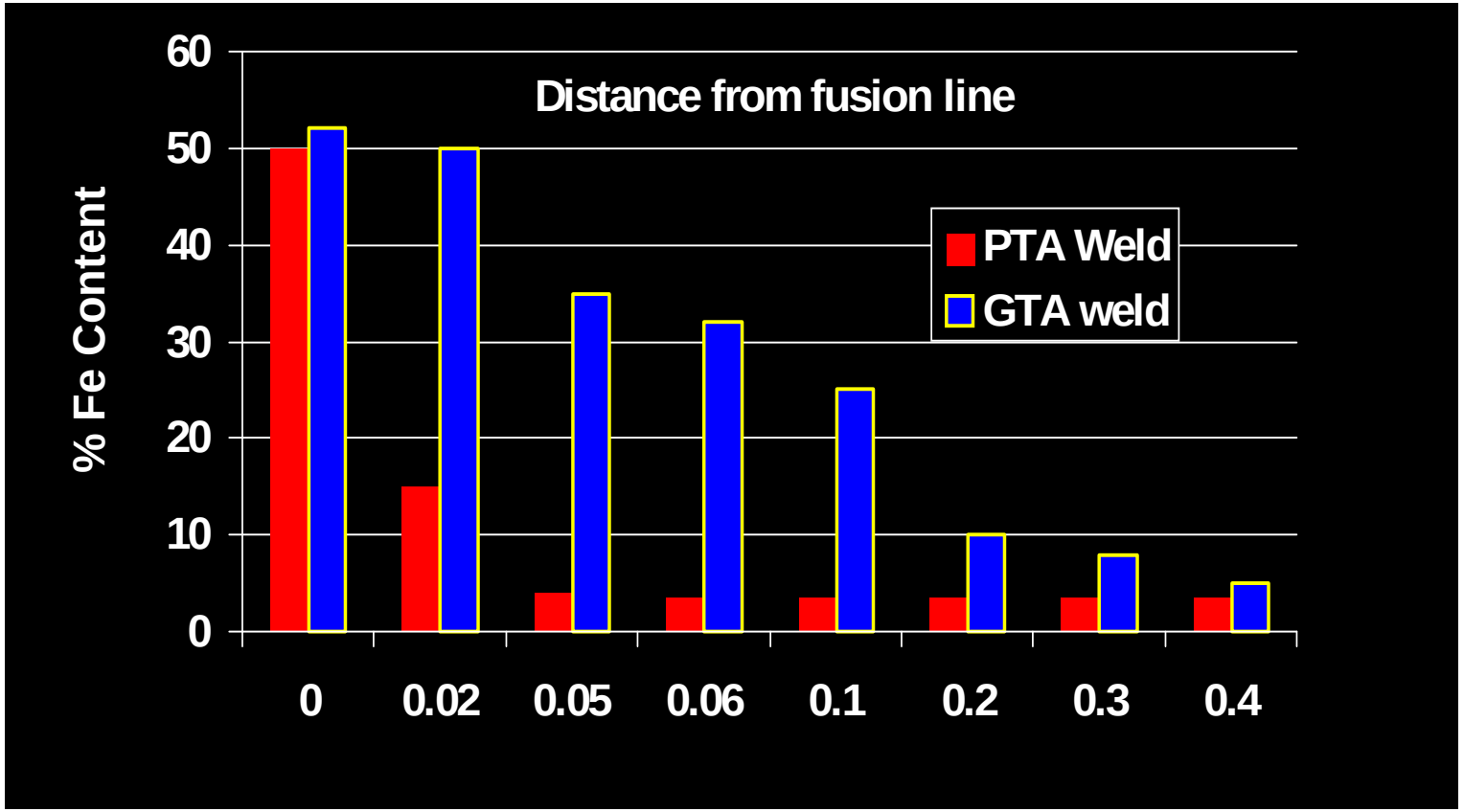
Dilution



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Deposition Rates

Process	Heat Input	Alloy Dilution	Material Variety	Thickness mm	Deposit Rate kg/hr
OFW	Low	Low	Medium	4-6	2
SMAW	Medium	High	Medium	4-6	3
GMAW	High	High	Low	6-10	4
SAW	High	High	Low	6-12	10
GTAW	Medium	Medium	Medium	4-10	6
PTAW	Low	Low	High	2-10	8
LBW	Low	Low	High	1-5	4

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Factors to consider

Heat input

Distortion

Coating Thickness 2-10mm

Residual Stess

Finishing

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Applications

Coal Crushing Hammer

Stelcar Composite

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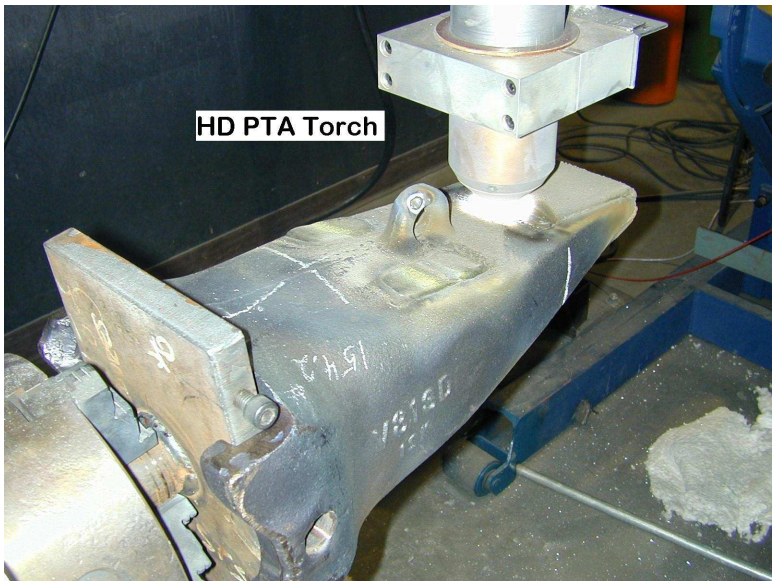
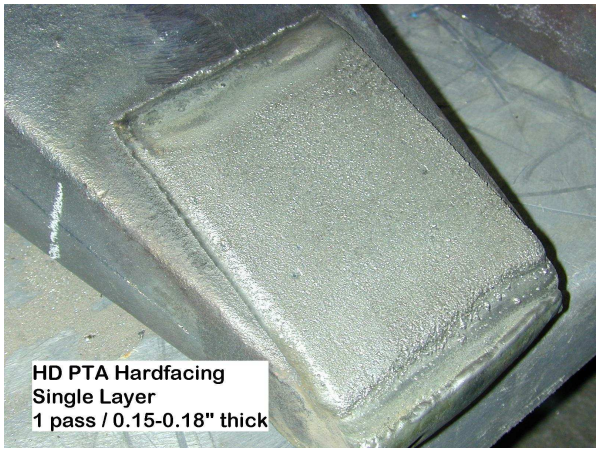
Applications

Mining Shovel Tooth





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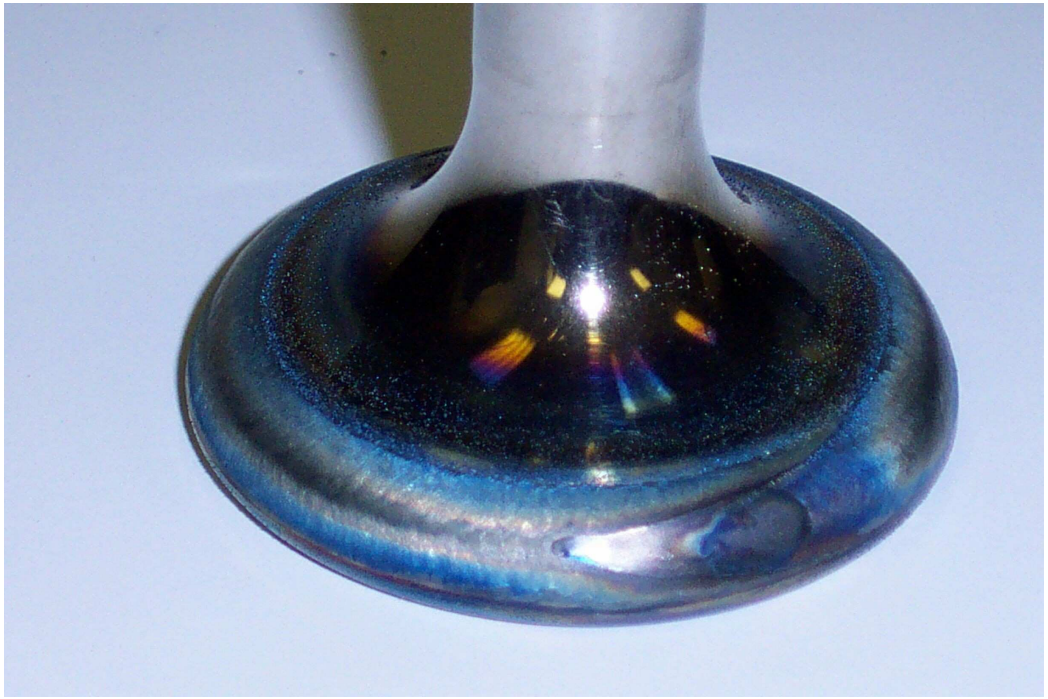
Applications



Engine Exhaust Valve

Stellite 6, F, Tribaloy

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Applications

Mining Tooth

Super Stelcar
WC Composite

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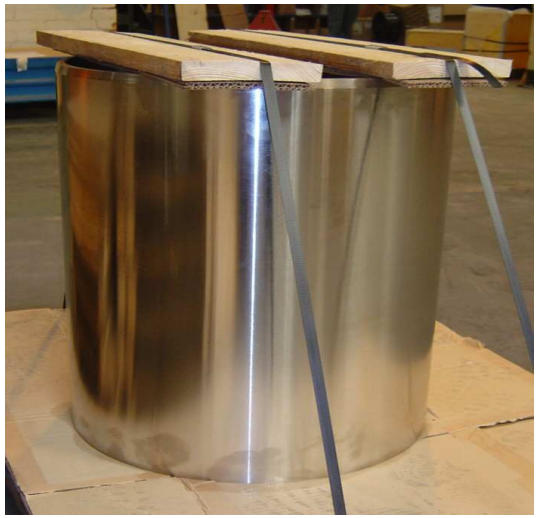
Applications



<u>Defence - Naval</u>

Bearing systems
for Submarines
& War ships

- Steering gear
- Hydroplanes
- Stabilizers

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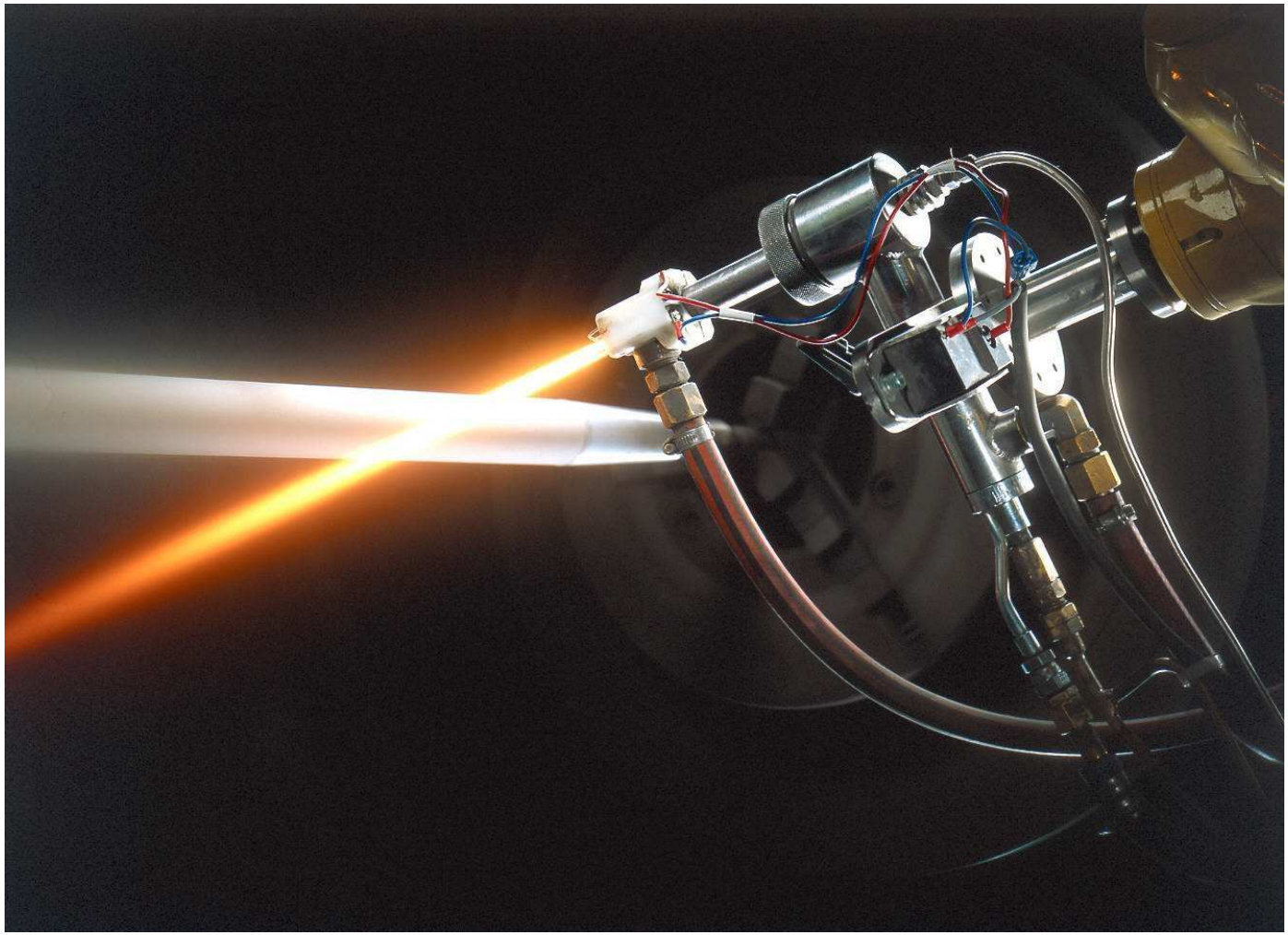
High Velocity Oxy Fuel



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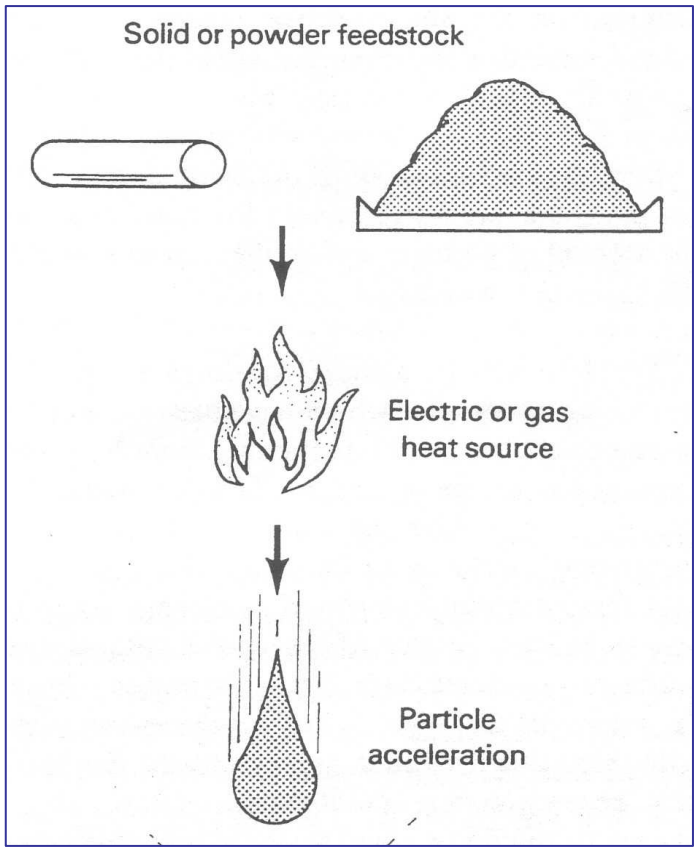
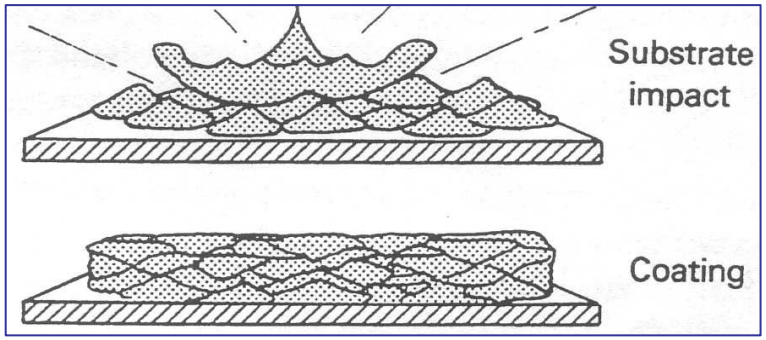
Principle of Thermal Spray





Note:

Figures used in this document are courtesy of ASM® International, TWI U.K. Ltd. and Gordon England.

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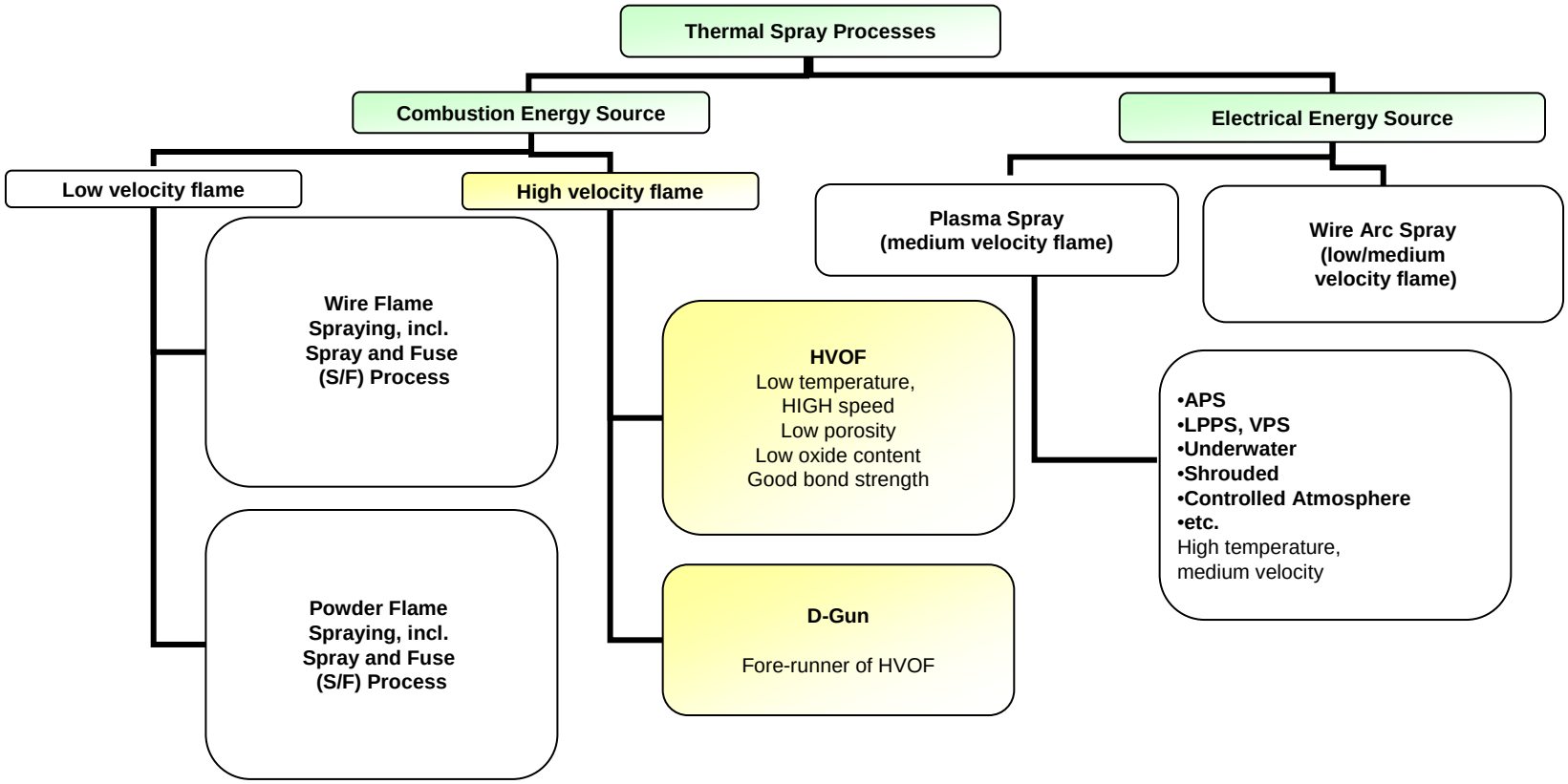
Types of Thermal Spray Processes



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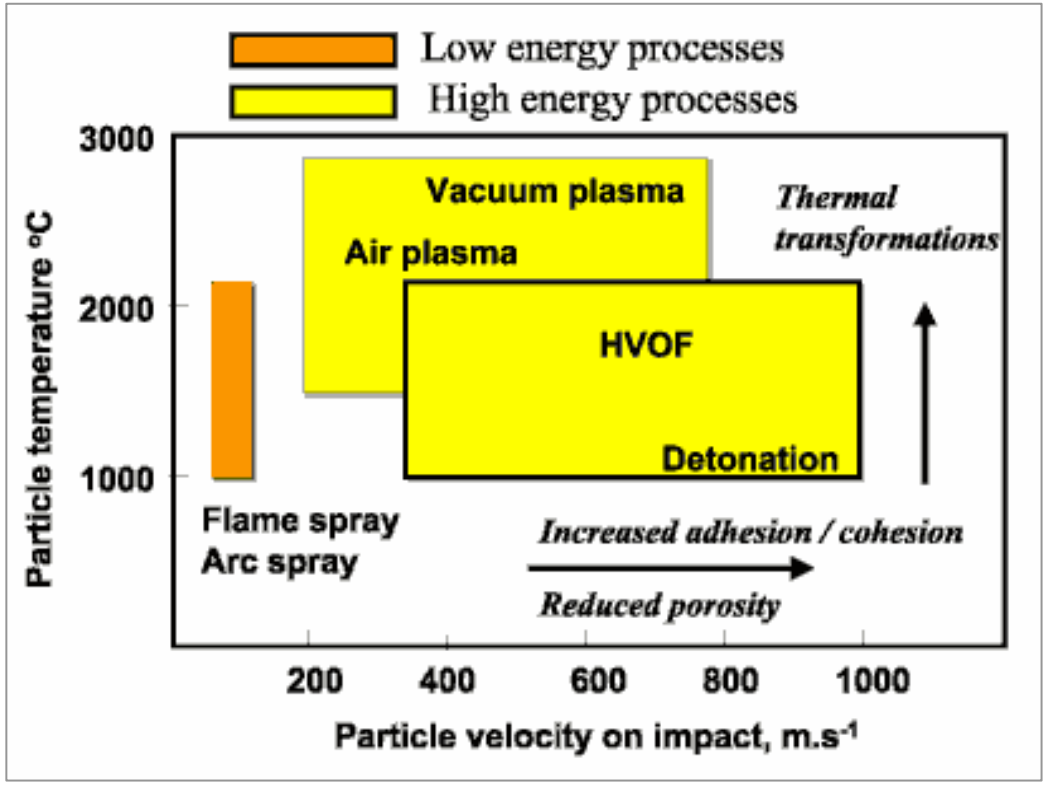
Types of Thermal Spray Processes



Low energy:

Flame spray, arc spray (powder or wire)

High thermal energy (temperature):
Plasma Spray

High kinetic energy (particle speed):
HVOF, D-Gun

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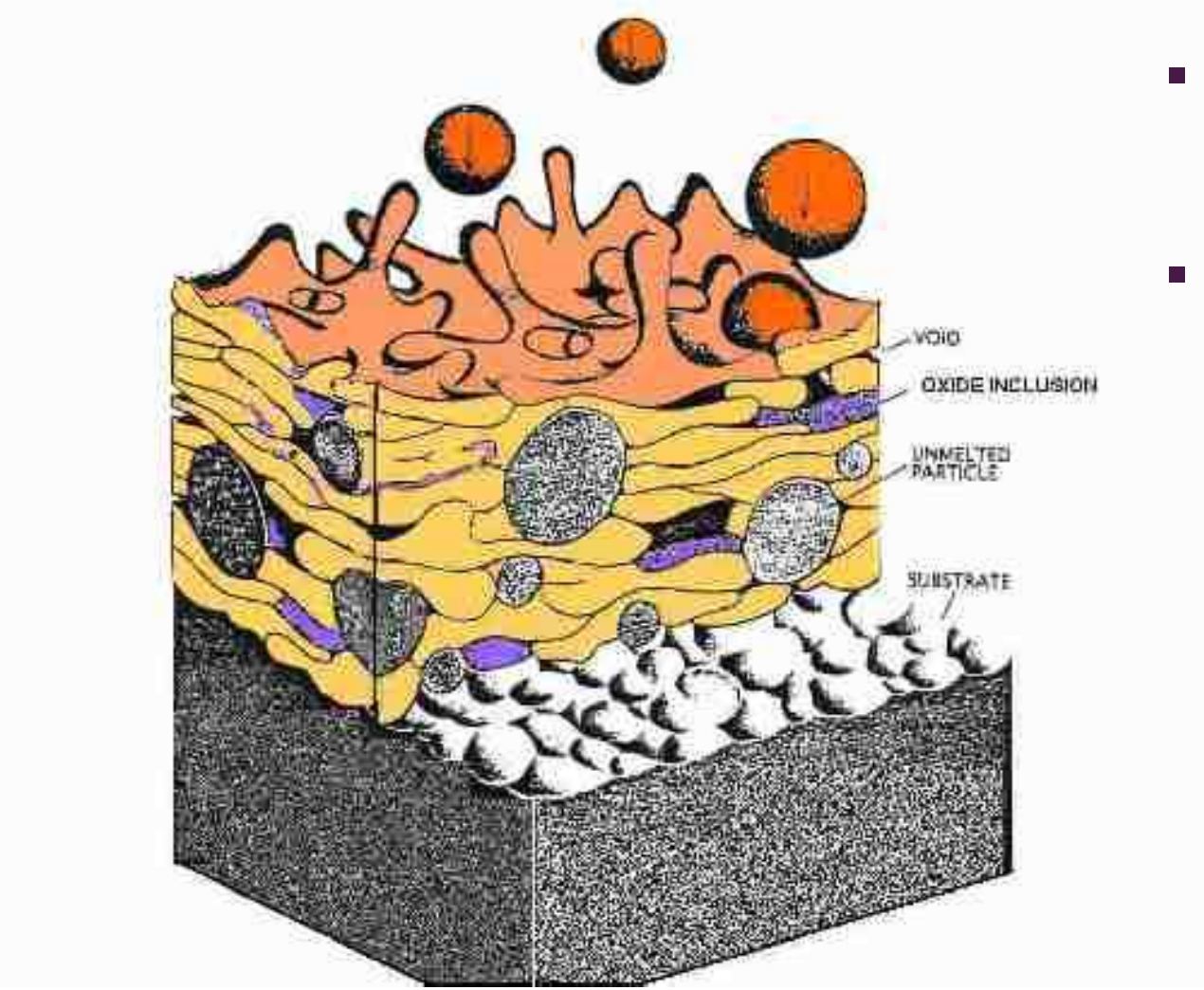
Features in Thermal Spray Coatings



- Flame and Plasma Spray coatings have a greater tendency to form oxides, porosity and unmelted particles, than HVOF coatings.
- HVOF generally produces a denser coating with less oxides.

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Limitations of Thermal Spray Coatings

Coatings adhere by a mechanical bond, which is not as strong as the metallurgical bond of a weld deposit. Their impact resistance is lower.

Parts too large to manipulate (rotate) are a problem

Only materials that are available in the correct powder/wire size can be used as coatings

Complex geometries such as inside diameters where low spray angle would be necessary leads to lower coating quality

Coatings can have Tensile or Compressive residual stresses

Thickeness of 0.1 to 0.5 mm

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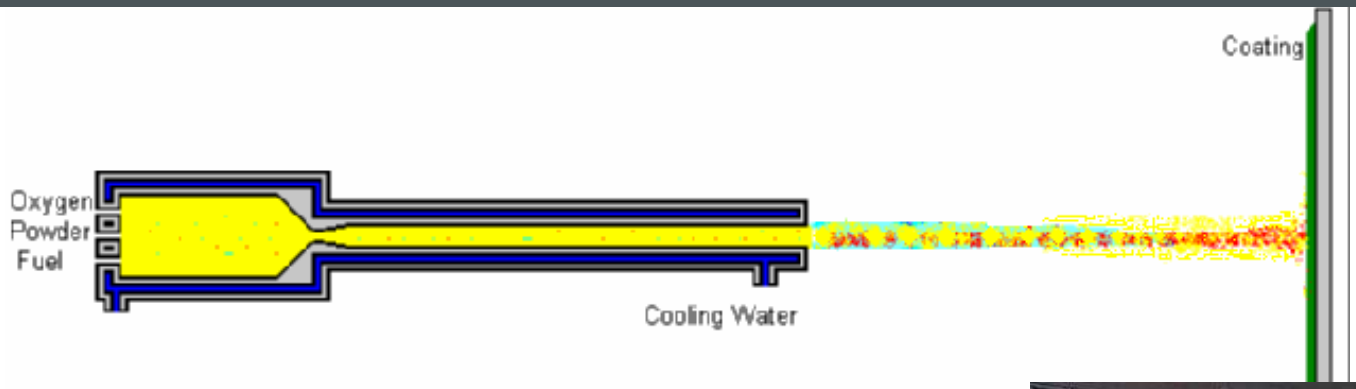
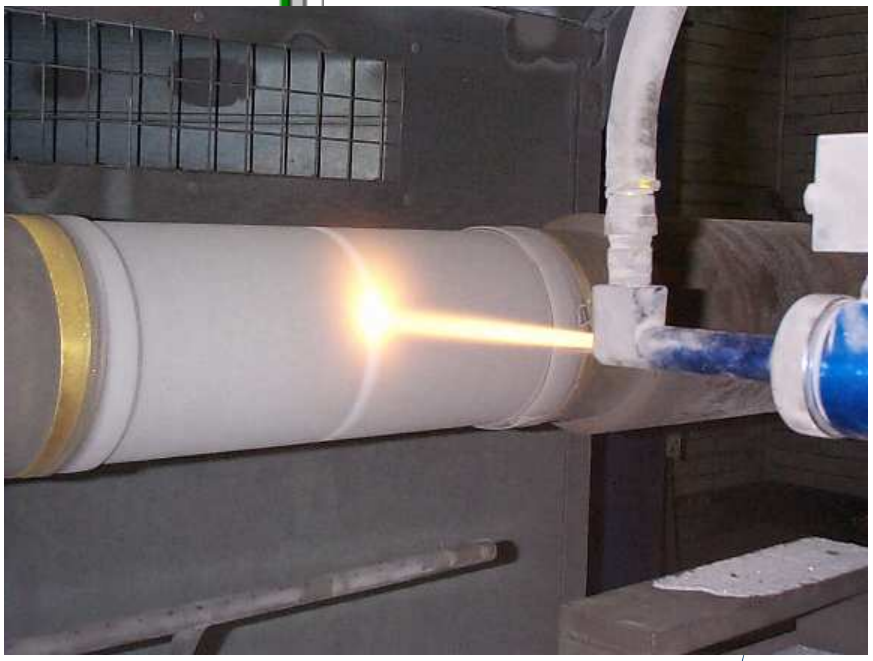
The HVOF Process



High Velocity Oxy Fuel.



Lower temperatures than plasma spray

Good for metals, alloys.

Ideal for carbides (decomposition).

Not ideal for ceramics (high melting point).

Supersonic flame.

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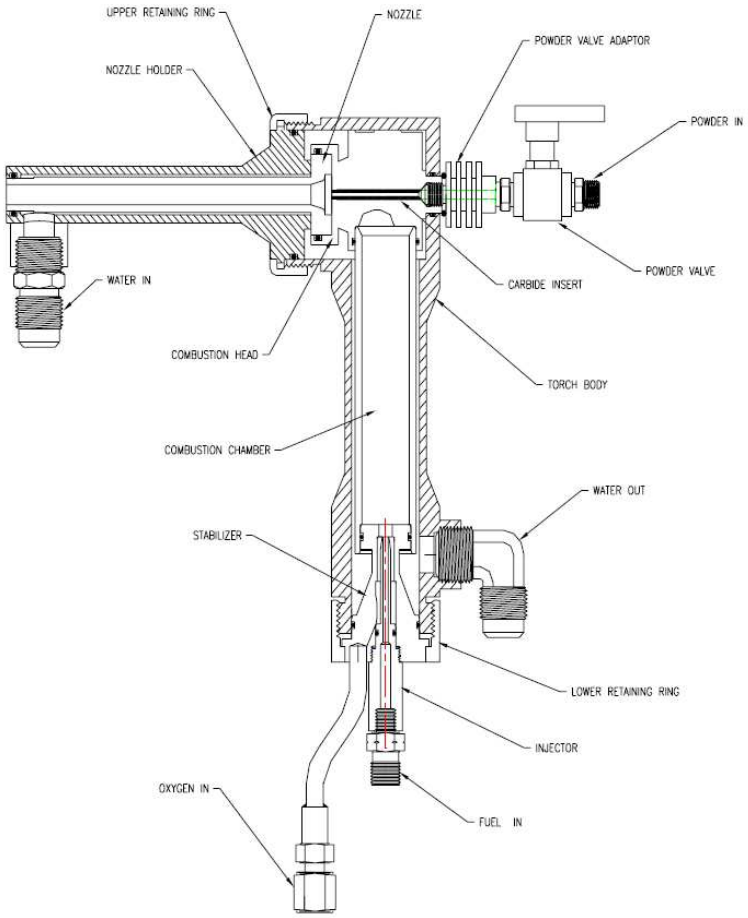
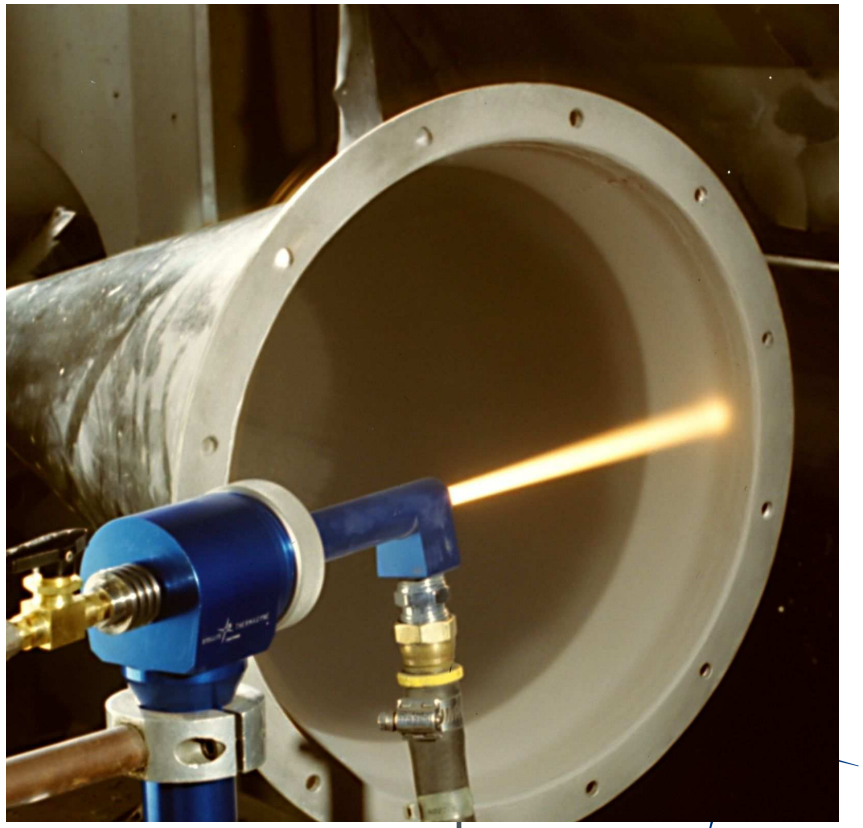
Jet Kote® HVOF Gun





JK120H Coating Structure

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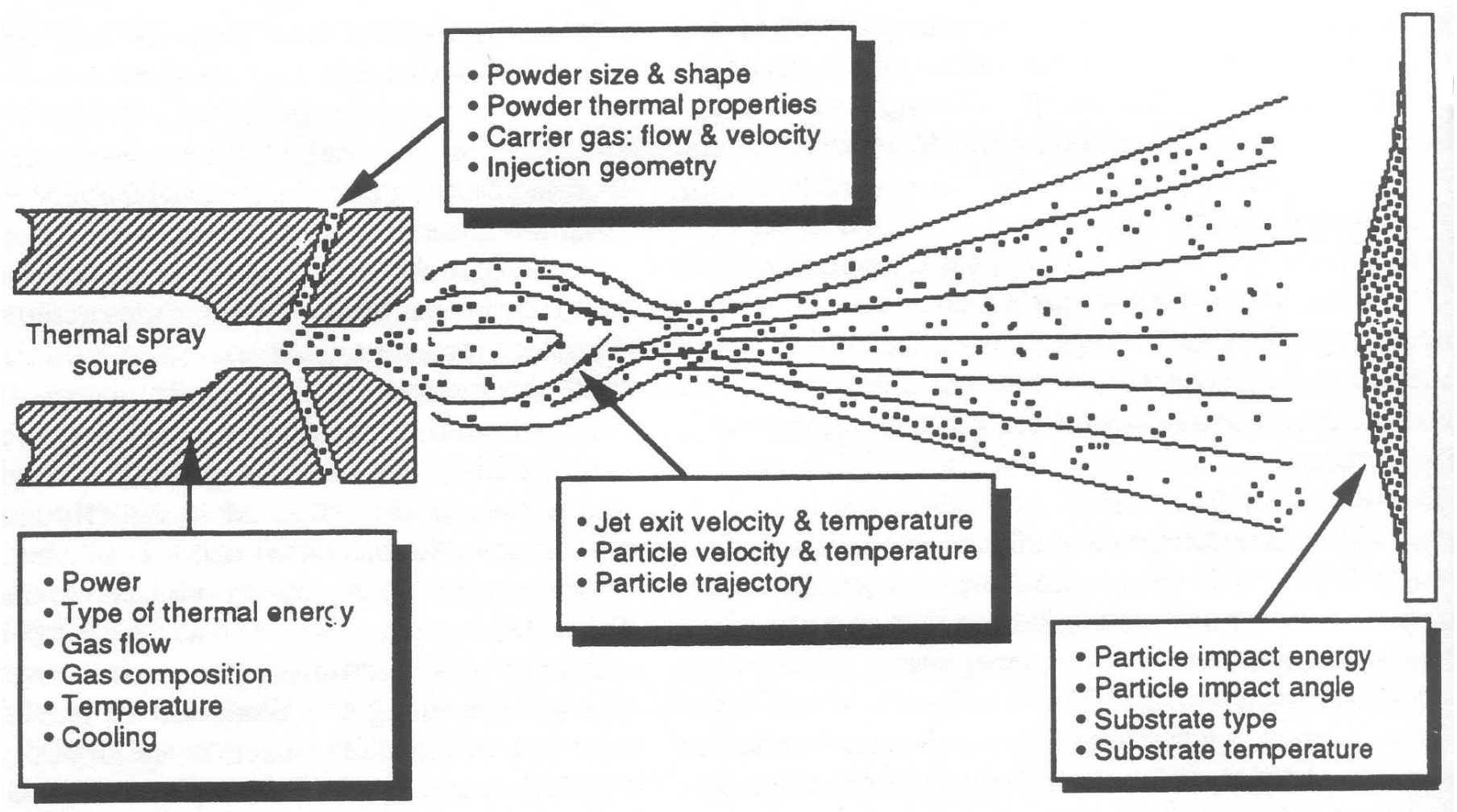
Factors influencing coating quality



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SO WHAT'S IMPORTANT?

- POWDER
  - Particle sizes and distribution
  - Method of manufacture, sintered, agglomerated ,coated

- SURFACE
  - CLEANLINESS (proper degreasing, no touching)
  - ROUGHNESS (correct grit blasting with clean alumina grit, correct pressure & stand off)
  - INTERFACE (over-blasting results in too much grit in bond line)
  - NO MOISTURE OR OXIDES (max. 4 hours wait before spraying, preheat pass to remove moisture)

- SPRAY PARAMETERS
  - HOW YOU HEAT AND ACCELERATE THE POWDER (gas flow settings)
  - CORRECT ANGLE AND STAND-OFF (robot programme & rpm)

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Steps in the thermal spray process

Degrease/clean the metal surface

Mask the areas not to be coated

Grit blast the surface to roughen it

Apply coating (within 4 hours)

Remove masking, deburr coating edges

Inspect for size and general appearance

Test coated samples for hardness, porosity, bond strength, etc.

Grind and/or polish the coating surface to the required finish.

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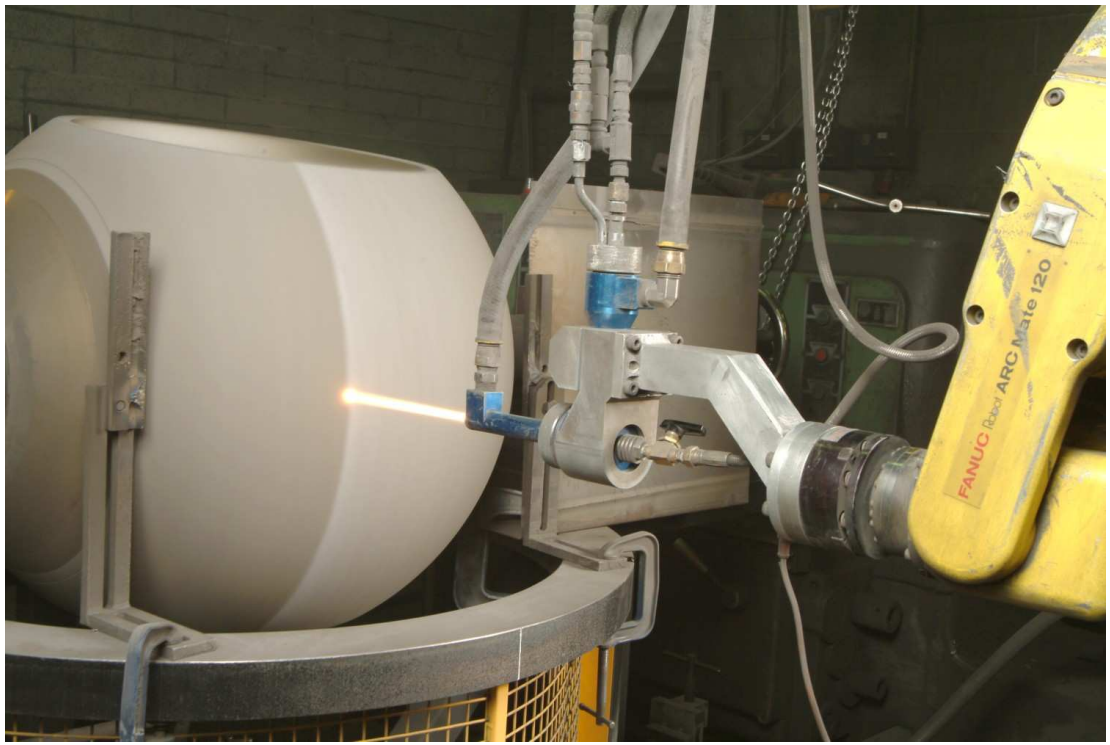
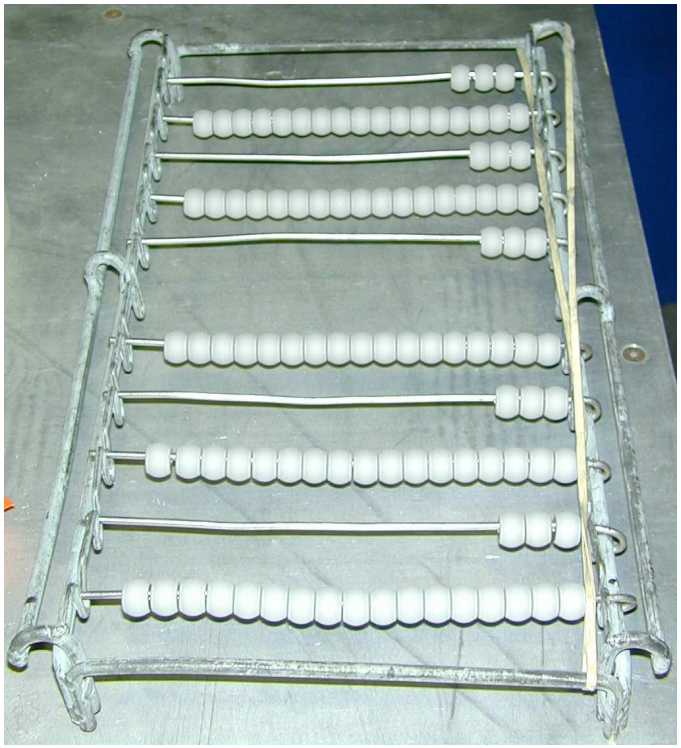
Petrochemical Ball valves and Ball Joints



Petrochemical Ball Valve



Ball Joints

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Gas Turbine

Transition Duct

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Valves

Valve body (JK591 – corrosion resistant)

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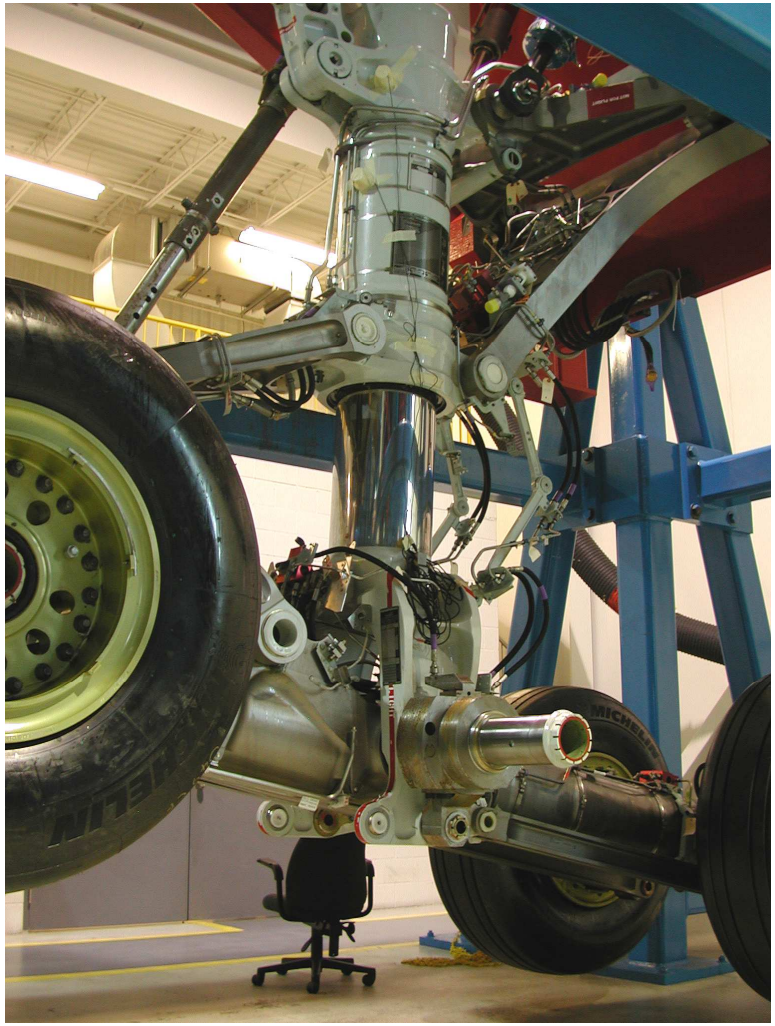
Aircraft Landing Gear



- A380 Landing Gear Coated with HVOF WCCoCr coating as alternative to Chrome Plating

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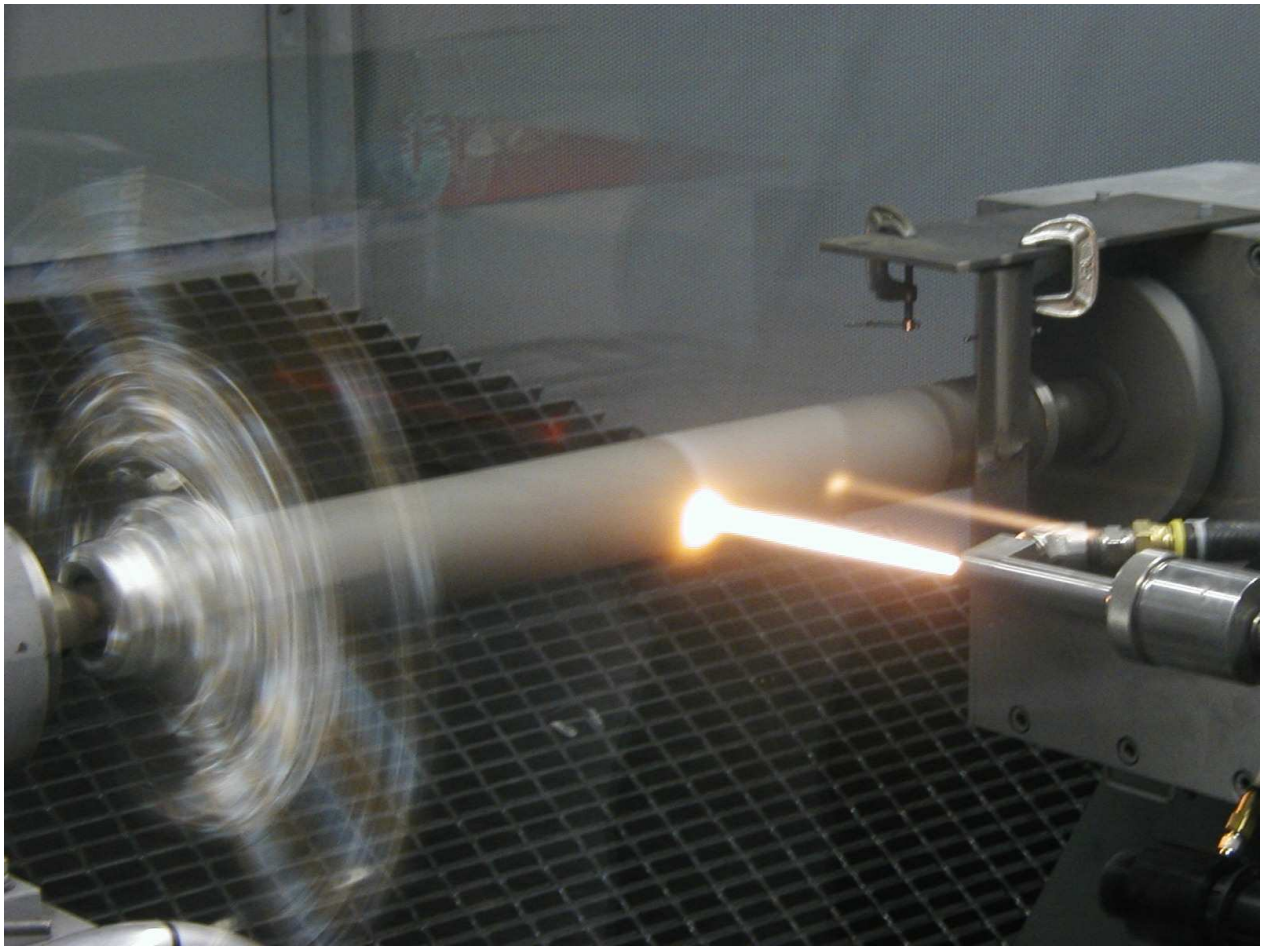
Aircraft Landing Gear

- Regional Jet Landing Gear Main Strut



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Gas Compressor Rods

Compressor rods in H_2S Service.

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