# What do YOU want to know TODAY?

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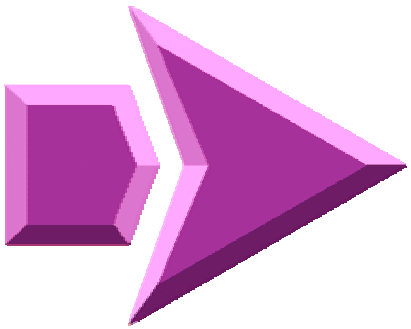
# Technology Analysis



## A tool to minimize R&D risk

## and maximize outcome

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# What we do . . .

- Worldwide technology search
  - What are the options?
  - What is in development?
  - What is in commercial production?
- Technology Analysis
  - What is the right technology for this application?
  - Is it a usable technology or just a bright idea?

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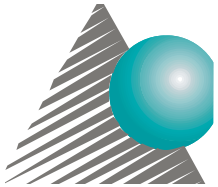
# Fit . . .

- Does the technology really fit the requirements of the application?
- Does it fit the way you need to do things? What about
  - manufacture,
  - depot overhaul,
  - field repair?



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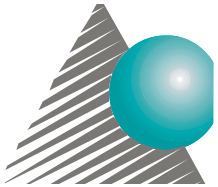
# . . . form . . .

- Does it produce the result you really need?
- Is it so specialized that only one company can do it?



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# . . . and function

- Does it really work?
  - How well?
- Where is it on the Lab-to-Life line?
- What will it take to get it to production?
  - $$,
  - time,
  - effort

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# For example.....

- What makes sense to replace, chrome or cad?
- Does ion implantation makes sense for bearings?
- Is diamond the way to go for large-area flat panel displays?
- Could a new alloy reduce landing gear sustainment cost?
- Can investment casting or laser sintering make near-net shape aircraft parts at lower cost?

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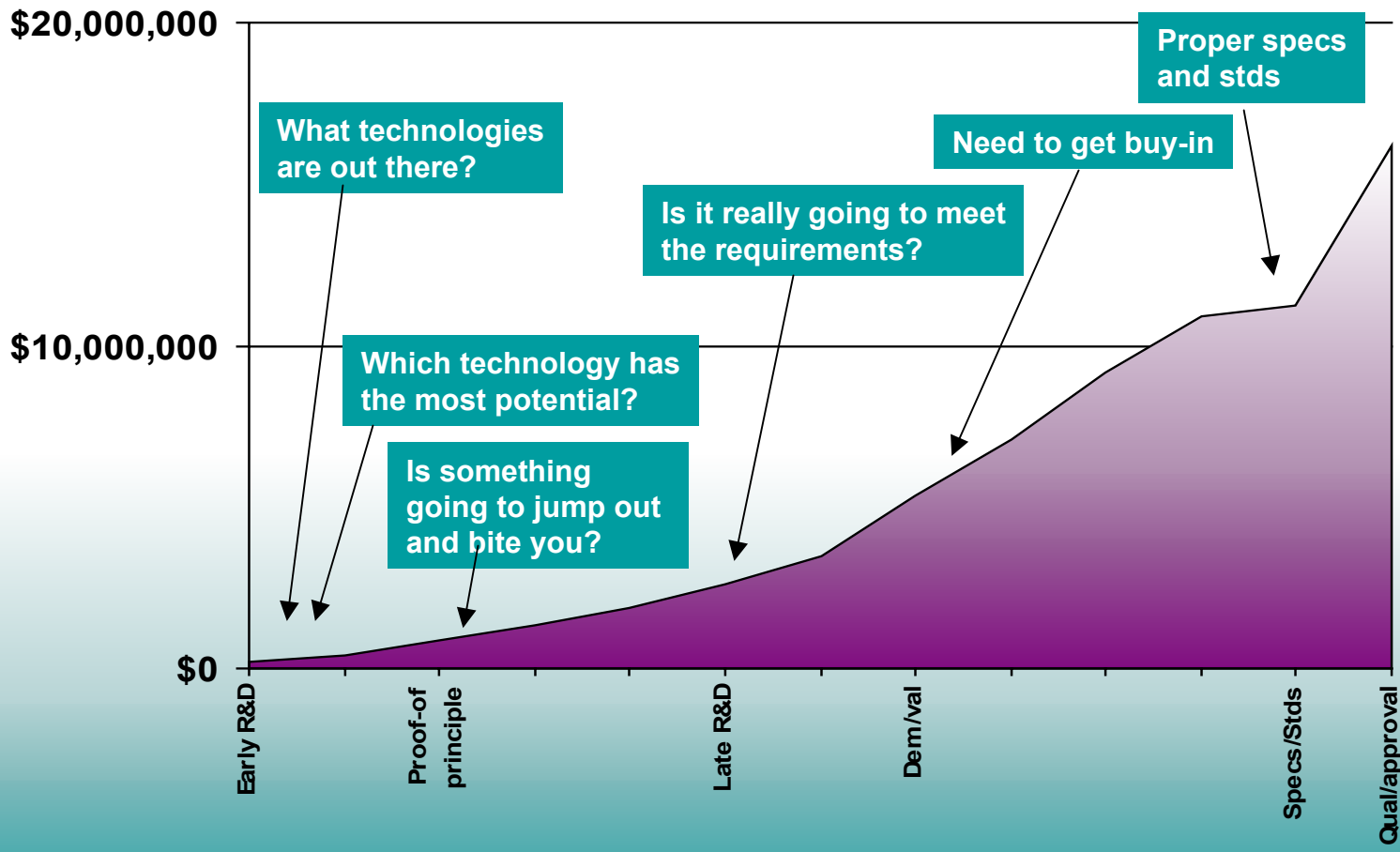
# Getting technology from lab to life



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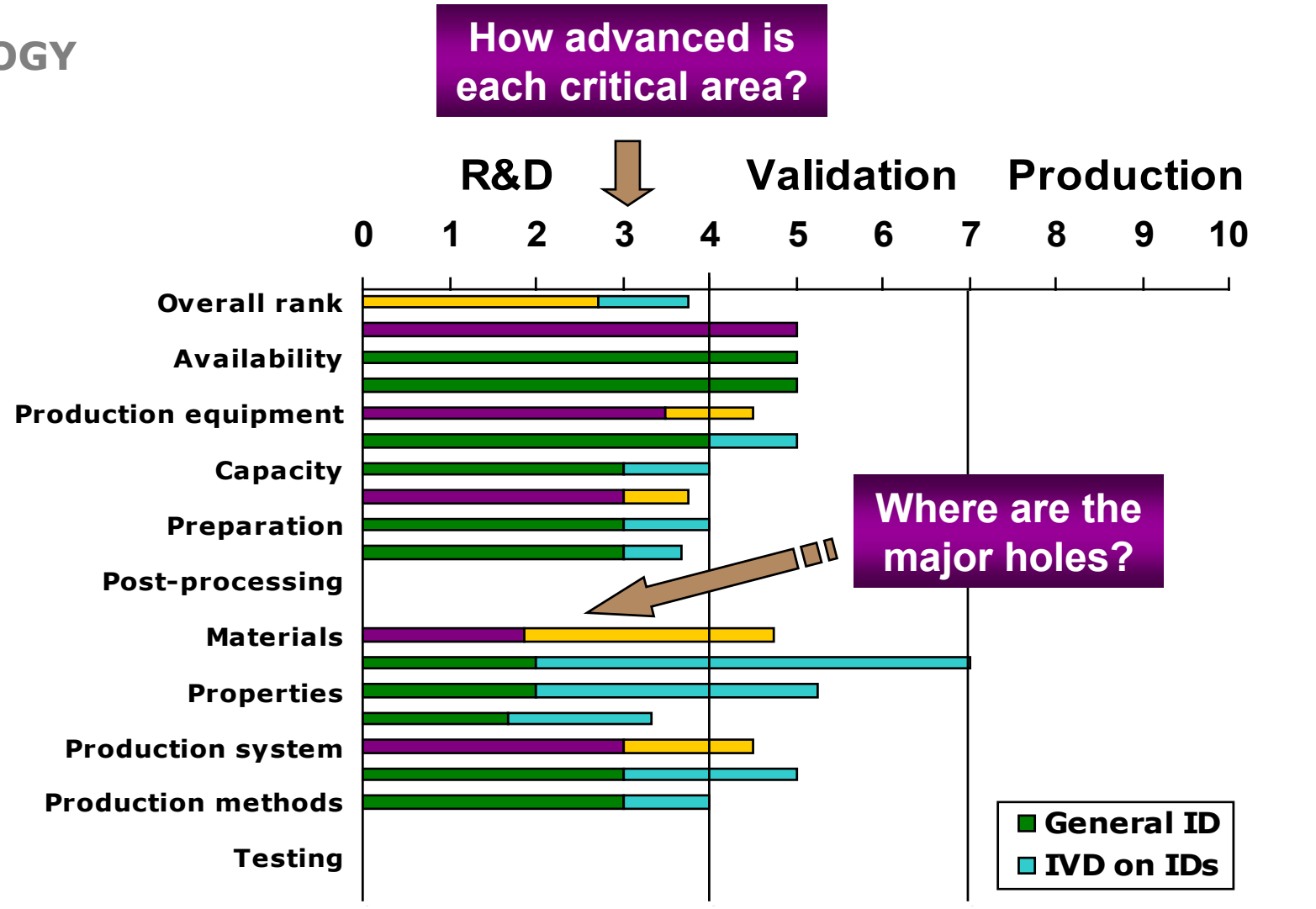
# The Technology Assessment Matrix - Magnetron PVD for IDs



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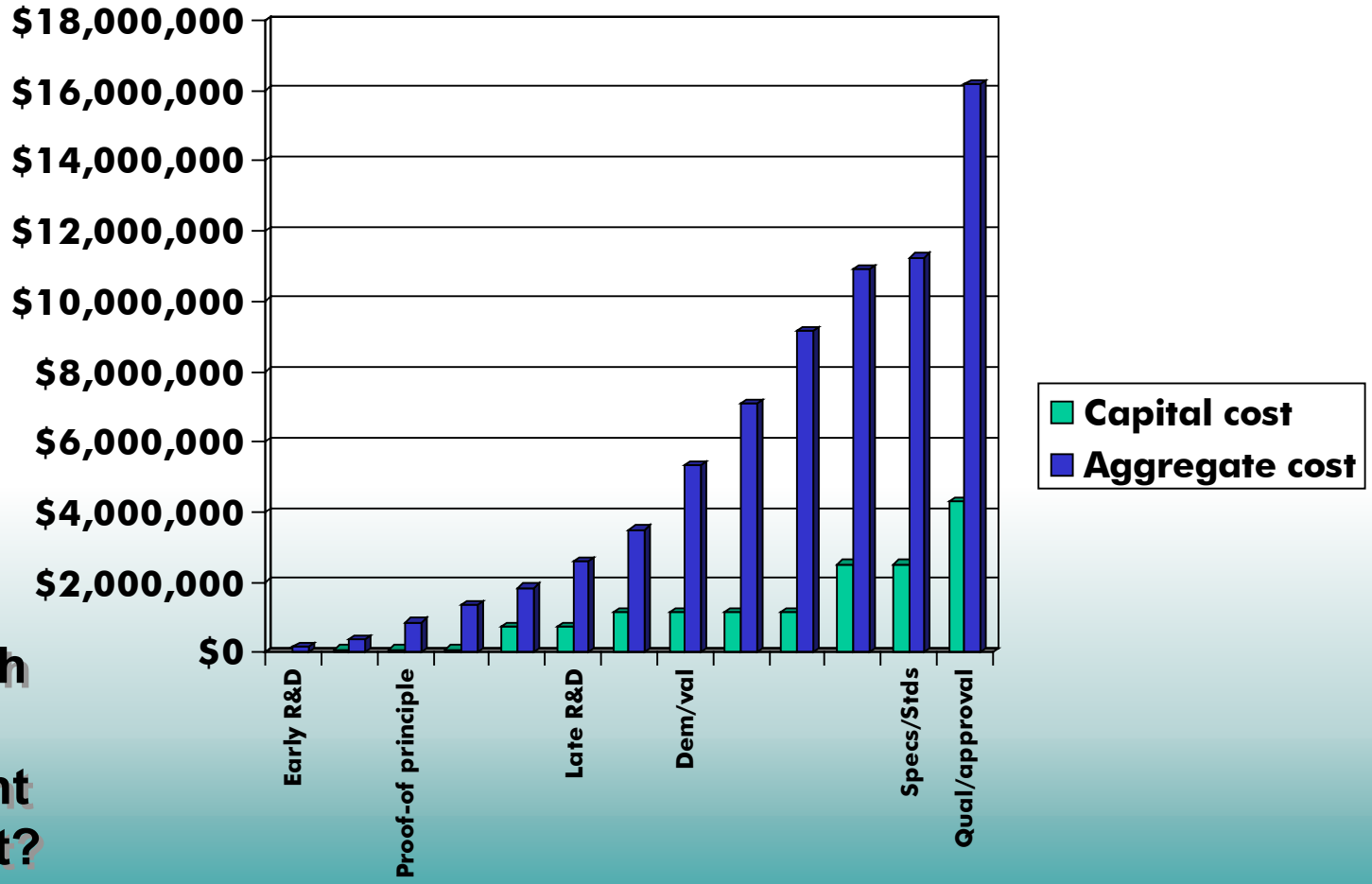
# Projected technology development cost




**What is each stage of development likely to cost?**

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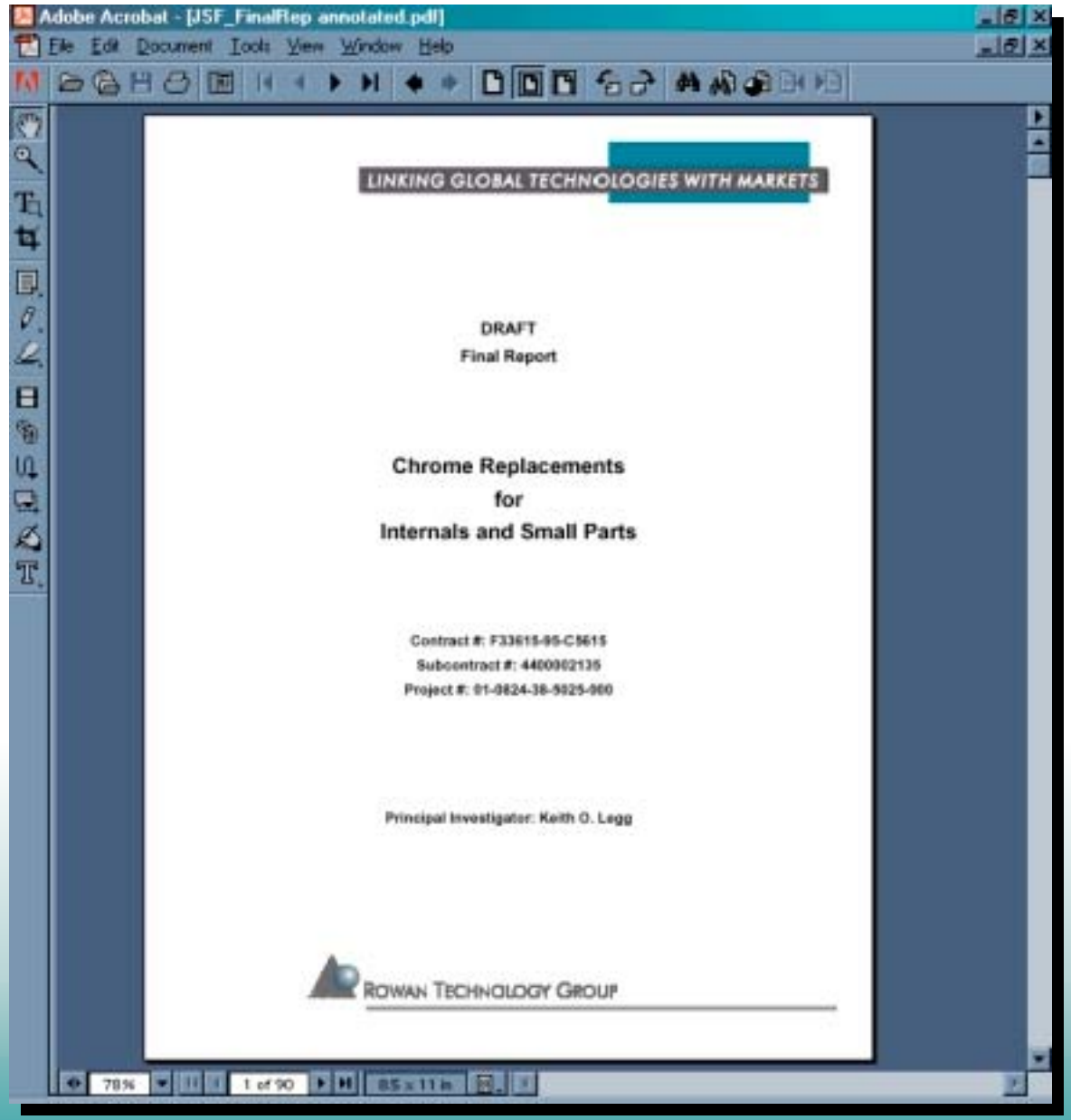
Adobe Acrobat Format for easy navigation

# How a typical report is viewed



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## 6.1. Introduction

Thermal sprays are standard hard coating and repair methods for aerospace components that are now in widespread use at OEMs, commercial O&R shops, and DoD depots. Their primary aerospace uses are

- turbine engines (shafts, turbine blades, thermal barrier coatings, erosion coatings, abradable coatings, anti-fretting coatings)
- landing gear, flap and slat tracks, and for spot problem-solving in high wear areas
- chrome replacement for landing gear inner cylinders, axles and pins

***Table 5. Summary information - Thermal Spray***

| | |
|---|---|
| **Process name** | Thermal spray (plasma spray, HVOF) |
| **Description** | Powder fired through flame or plasma softens and builds up coating |
| **Coating materials** | WC-Co, $Cr_3C_2$-NiCr, oxides (e.g. $Al_2O_3$, $Cr_2O_3$), alloys (e.g. Stellite, Tribaloy) |
| **Temperature** | 150 - 400C surface temperature of part during deposition |
| **Minimum ID** | 1.5" (plasma spray), 11" (HVOF) |
| **Maximum depth** | 26" standard. Can go to almost any depth |
| **Stage of development** | Production |
| **Primary advantages** | Direct fit with existing thermal spray chrome replacements (methods and materials).<br>Capable of OEM and rebuild use.<br>Direct fit with current O&R methods |
| **Primary disadvantages** | Plasma spray not as dense as HVOF<br>Difficulties with coating quality in blind holes.<br>Heat removal in confined spaces. |

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## 2. Current usage of ID hard chrome

### 2.1. Typical ID Coated Components

#### 2.1.1. Introduction

Since the JSF has not yet been designed, we do not know exactly what will be the geometry and materials in the final aircraft. However, by looking at what is currently in general use for military aircraft, we have identified a fairly broad range of different types of items that are frequently chrome plated, but that are not easily amenable to HVOF. In addition, engineers at Boeing and Messier-Dowty have identified specific items on existing systems that cannot be readily HVOF coated.

#### 2.1.2. General items

The following geometries are generally problematic for HVOF:

- Holes (blind and through) in hydraulics, including landing gear and actuators
- Pins such as those used in landing gear and actuators
- Lugs and other items where the coating is external, but access to the area is difficult

2.1.2.1. Blind and through holes in hydraulic cylinders

Shallow holes or shallow areas within deep holes can be coated with standard HVOF methods.

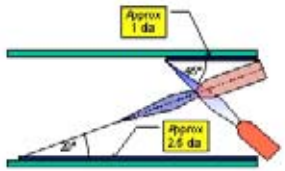


Figure 1. Small ID coating by HVOF.

Only on the largest aircraft are the landing gear cylinders large enough in diameter to accommodate a standard HVOF ID gun, which can coat inside holes only above about 11" ID. Outer cylinder IDs of both landing gear and actuators are often chrome plated for wear resistance (against seals) and for corrosion resistance against water contamination in the fluid. In many cases the coating material used is thin dense chrome rather than standard chrome plate. Unlike standard chrome plate, thin dense chrome is quite difficult to plate and there are very few vendors capable

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| | |
|---|---|
| **Stage of development** | Production |
| **Primary advantages** | Direct fit with existing thermal spray chrome replacements (methods and materials).<br>Capable of OEM and rebuild use.<br>Direct fit with current O&R methods. |
| **Primary disadvantages** | Plasma spray not as dense as HVOF.<br>Difficulties with coating quality in blind holes.<br>Heat removal in confined spaces. |

6.2. Documents

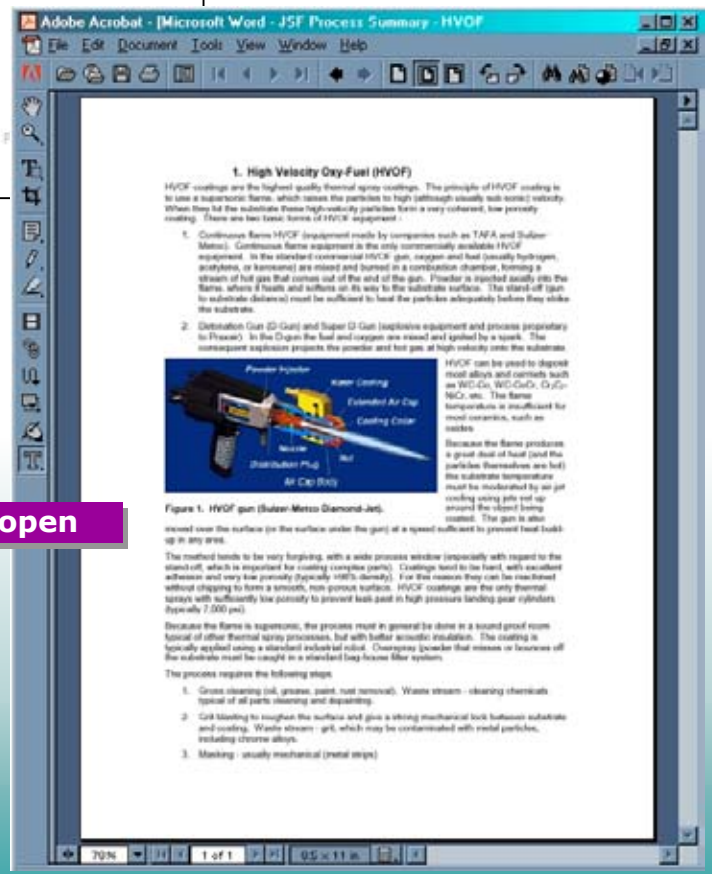
Documents in this section:

HVOF.pdf

*JSF Process Summary – HVOF.pdf*
Title: R&D Status Report. Author: Keith Legg

**To read this document**

**Click on the link ➤**




**and open**

# Links to embedded documents

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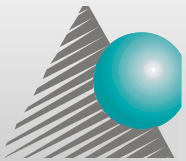
# Technology Assessment

- Accurate information
- Thorough analysis
- Deep technical understanding
- Clear, concise recommendations

# Thank you for your time and attention



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