TITOMIC

Cold Spray Challenges

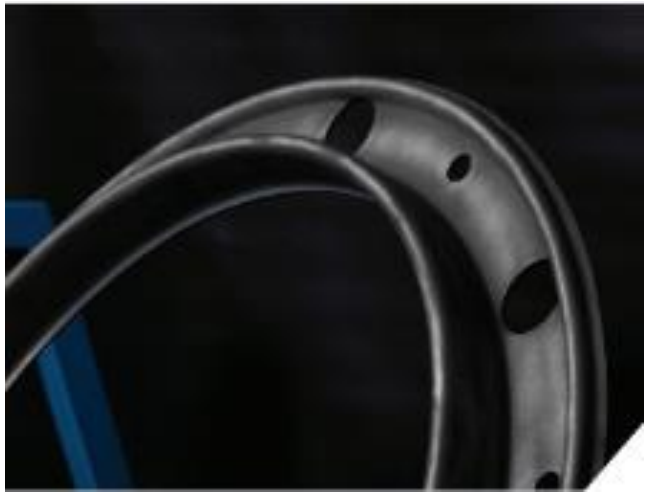
October 2024

Background

long sprays are in demand

- Titomic have run numerous *(15+)* AM projects involving large products.
- These spray have required long *(24+ hr)* continuous sprays. In some instances, 2+ days, max. 3.5 days.
- Demand for these products continues to increase.
- Cold Spray as a technology is well positioned relative to other forms of AM to service the large part segment, therefore long sprays are inevitable.
- Titomic has undertaken 24+ hr builds in Titanium, Invar, 4340, Stainless Steel and soon in Inconel.

Examples:



Titanium Rocket Staging Ring (circa 15hr spray),

4340 Steel Barrel Segment (circa 34hr spray, 130kg),

Titanium Carbon Fiber Layup Mold (circa 20hr spray),

Long Spray Challenges

similar to short sprays, but more challenging

Numerous issues and challenges are encountered during long sprays and long list of aspects to manage.

All with their own mitigators.

For example – and there are many more….

PART

- Part handling, weight / bulkiness (operator risks, vibrations and concentricity etc for out of round)
- Residual temperature (operator risks, burns etc working near hot parts)
- Management of stress (cracking etc - spray strategy, robot paths, heat cycling and thermal management.
- Quality (build inconsistencies, long stoppages – per below)

PRODUCTION CELL

- Powder build up (risk of fire - in particular Ti64, slips, trips and falls, inhalation)
- Low Oxygen conditions (risk of asphyxiation, due to long Nitrogen build up).

EQUIPMENT

- Wear and tear (nozzles, powder feeder spreaders etc, sealing rings etc).
- Inconsistencies (fluctuations in performance – in particular powder feeders).
- Interruptions (such as Nitrogen supply – overnight icing on converter etc).

Powder Feeders

our current feeder technology is challenging during long sprays and needs development

Currently;

<u>There is no continuous feed powder feeder available,</u>

- requiring regular and repeated powder loads, these create stoppages which risk part thermal cycling and cracking/surface oxidation (depends on material).

<u>Powder feeder delivery is inconsistent and fluctuates,</u>

- The current rotating disc and aperture feed technology is open to wear and clogging, especially with irregular powders and in particular with Ti.
- Irregularities create build inconsistencies bringing into question part quality (although this can be managed). Requires absolute vigilance and proactive management (challenging on night shift).
- We need closed loop feedback in systems.

<u>Parts with overlapping builds challenging to manufacture (eg iso-structures),</u>

- Need closed loop programmable capability to interrupt supply for intermittent periods.
- This is limiting some applications – eg rocket wall structures with iso/ortho grids.

Need for certification

- How to certify the application or process
- The need for an industrial partner?
- The part for certification must be an existing part with coldspray as a good alternative for casting and not too complex.
- What do we need for certification:

1. Good documentation
2. Schooled personal
3. Calibrated machines
4. Certified powder suppliers
5. Parameter control
6. Etc.

AM Part, Ball valve segment

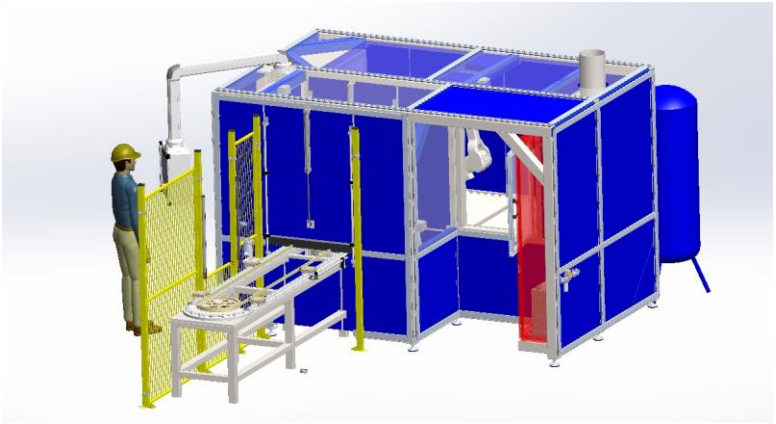
Industrialization

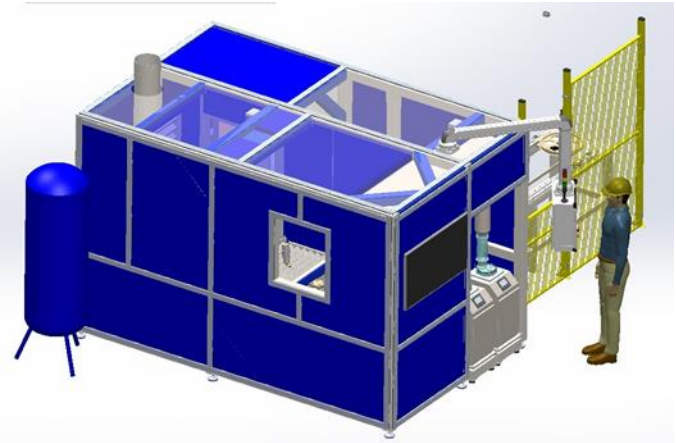
Use case glass bottle industry

- The need for robot programming optimalisation, each clients has 600 plus article shapes that needs a robot program.

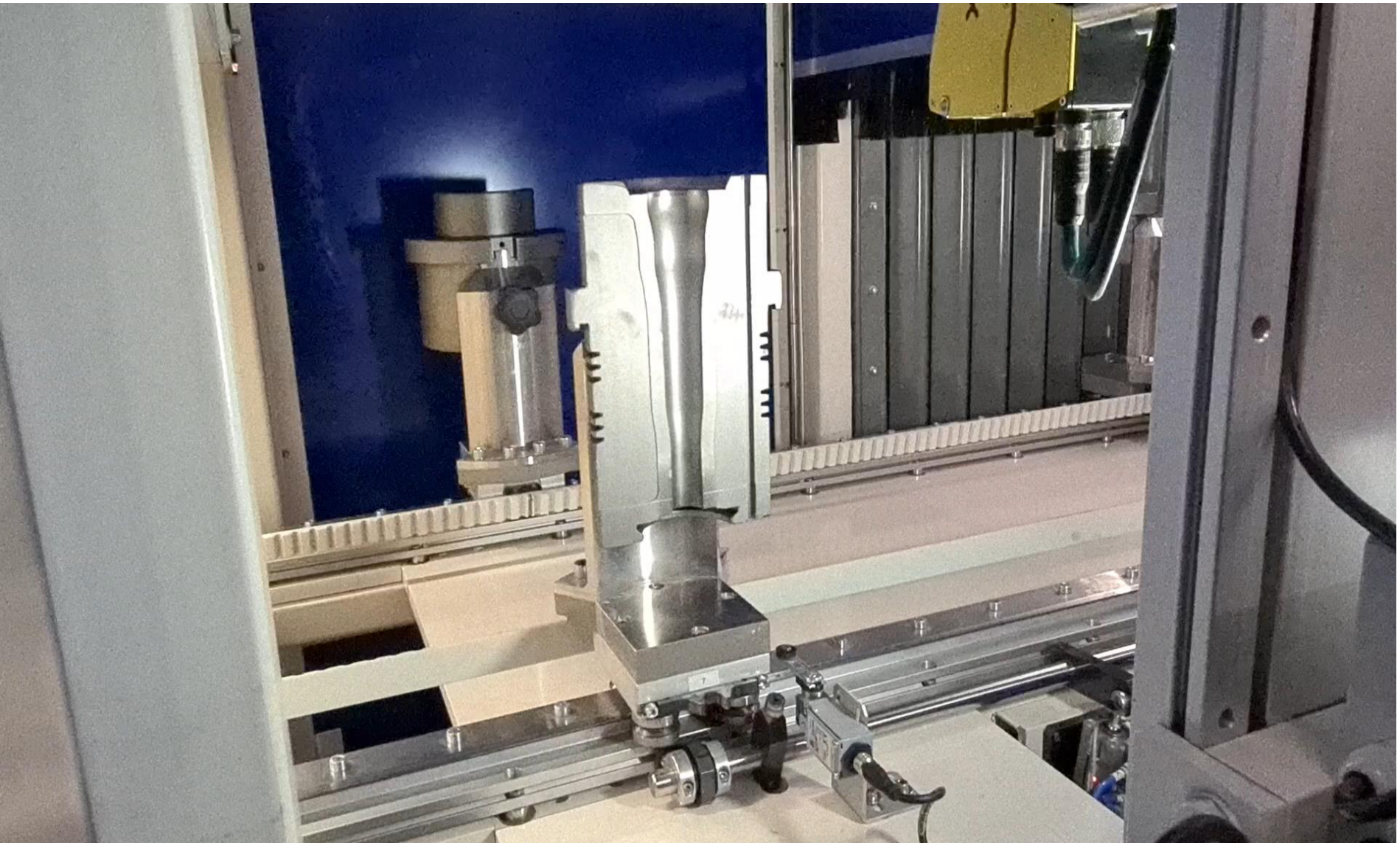
After successful testing procedure with coldspray for this application the problem of programming for each individual part was the reason for not selling the Techniek in the first place.

Solution: need for atomization with vision and robotics

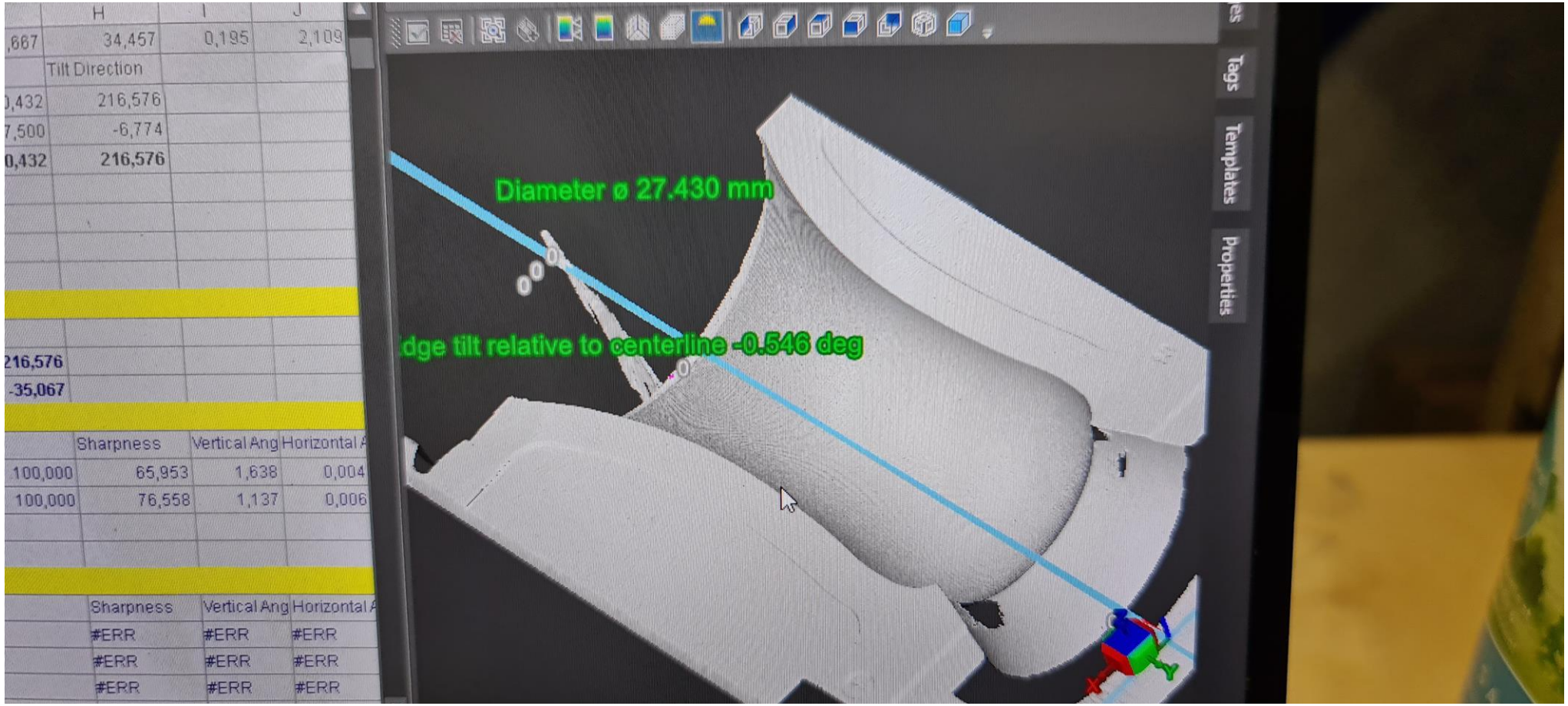




Vision and Robotics



Scan result


H
,667
34,457
0,195
2,109
Tilt Direction
0,432
216,576
7,500
-6,774
0,432
216,576
216,576
-35,067
Sharpness
Vertical Ang
Horizontal A
100,000
65,953
1,638
0,004
100,000
76,558
1,137
0,006
Sharpness
Vertical Ang
Horizontal A
#ERR
#ERR
#ERR
#ERR
#ERR
#ERR
#ERR
#ERR
#ERR
Diameter ø 27.430 mm
dge tilt relative to centerline -0.546 deg
Tags
Templates
Properties

Robot Program

- After scan the coordinates are being transferred to Robot.

The programming use to take up 8 to 10 hours for path generation and outlining the robot to the object, after implementation of vision it took 15 seconds to make the scan and to transfer the data.

Benefits:

1. No programming knowledge needed
2. No downtime between different shapes
3. Far less man hours
4. High production rate
5. Stable coating quality

Downside:

Product needs to be dull to avoid reflections.

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