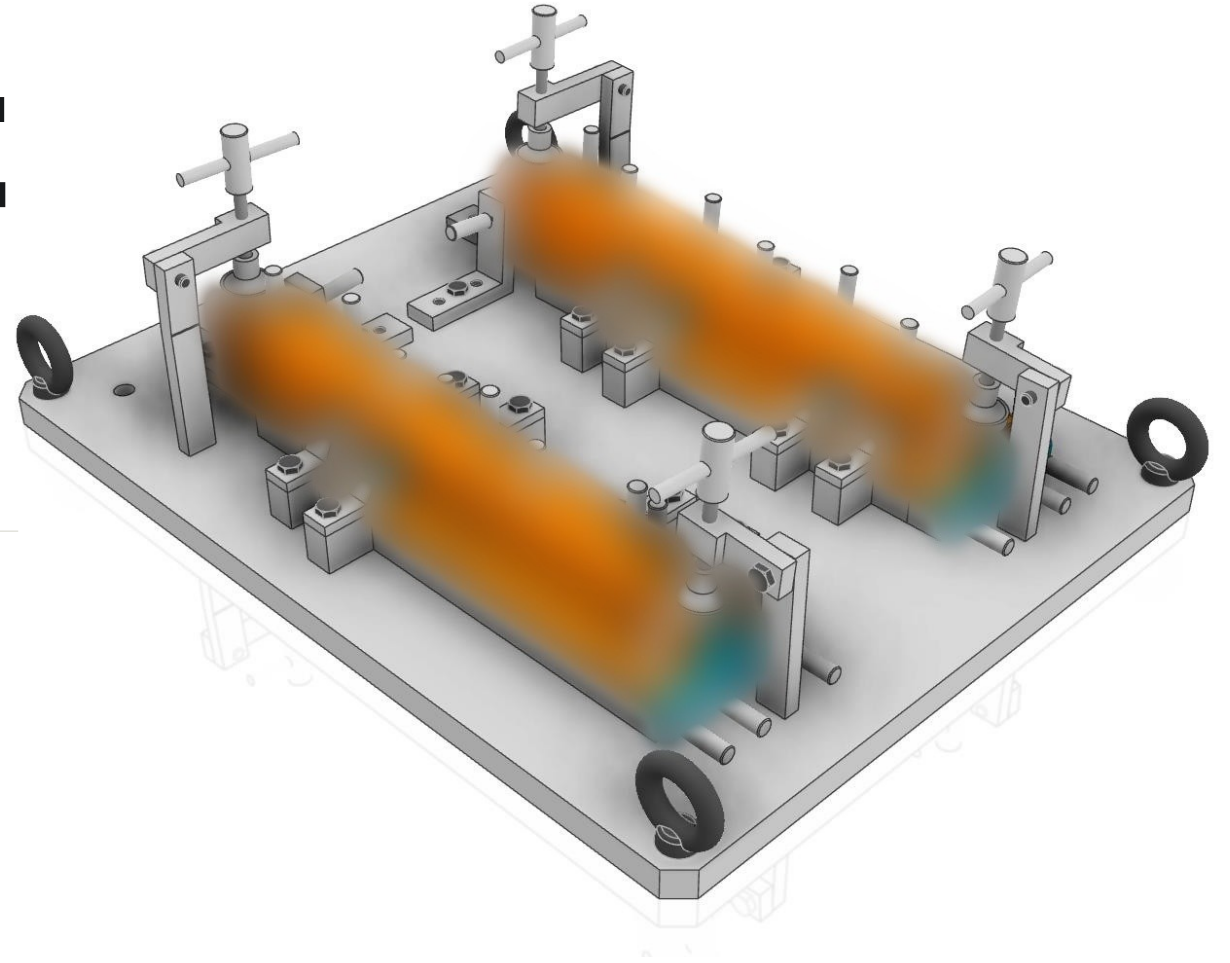


AEROSPACE FIXTURES

LCA MK1A · HTT-40



Welding and inspection fixtures for the pipelines and sheet-metal structures of two military aircraft, **designed with HAL and taken through its approval into production.**

400+

Fixtures designed
Welding and inspection

2

Aircraft
LCA Mk1A and HTT-40

5x

Faster design
Content Center and iLogic

15+

Built in-house
Welding and inspection fixture R&D

0.02_{MM}

Tightest tolerance
0.02 to 0.2 mm across features

IN THIS DOCUMENT

01	Program	03	05	Sheet-metal structures	09	09	Nesting	15
02	Anatomy of a fixture	04	06	Approach	11	10	Channel bases	16
03	Cockpit oxygen lines	05	07	Design approval	13	11	Machining	18
04	Pipeline fixtures	07	08	Drawing sets	14	12	For your line	19

HAL set the requirements and its vendor built the fixtures. **We designed and prototyped them.**

01 HAL

Builds both aircraft, sets the tooling requirements and approves every fixture design before it is made.

02 L1 TOOLING VENDOR

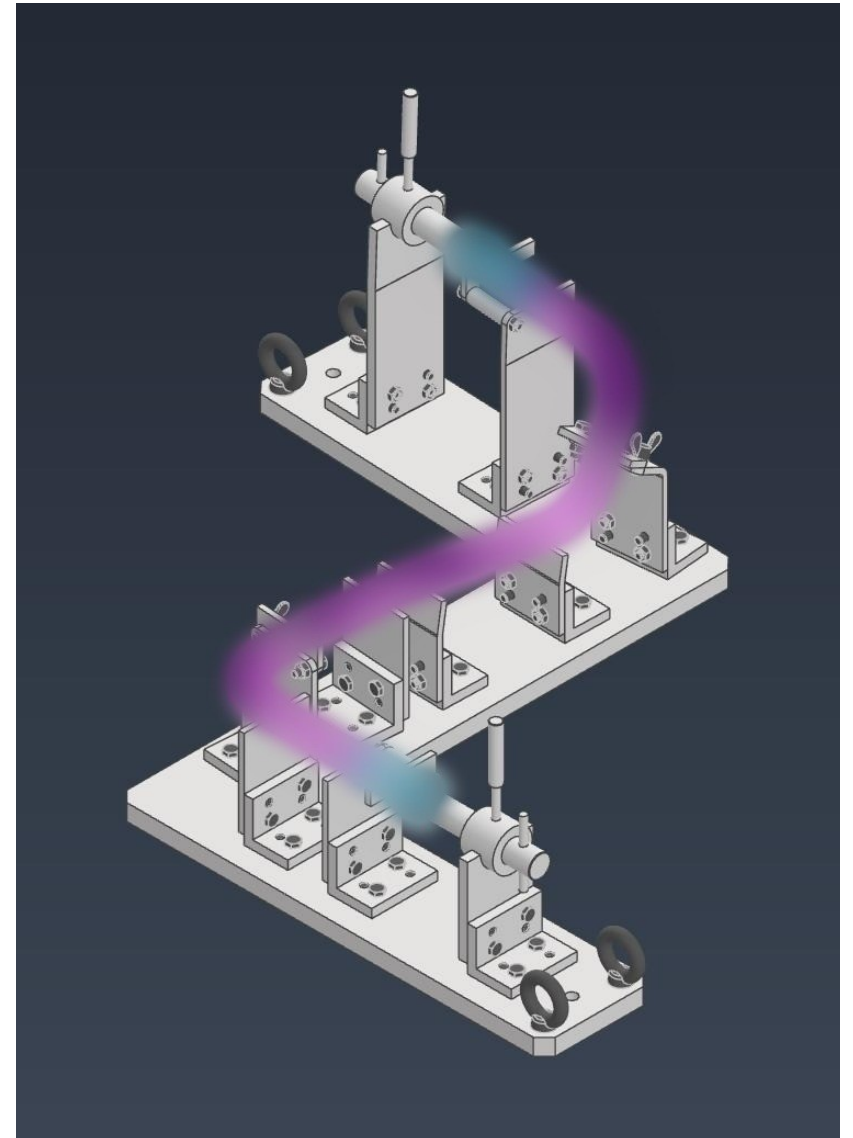
A specialist in ground handling equipment (GHE) and tooling, which manufactured the fixtures.

03 OUR SERVICES

Fixture design and the automation behind it, through to drawings and cut lists for the shop floor, plus R&D into new methods for volume production.

04 SCOPE

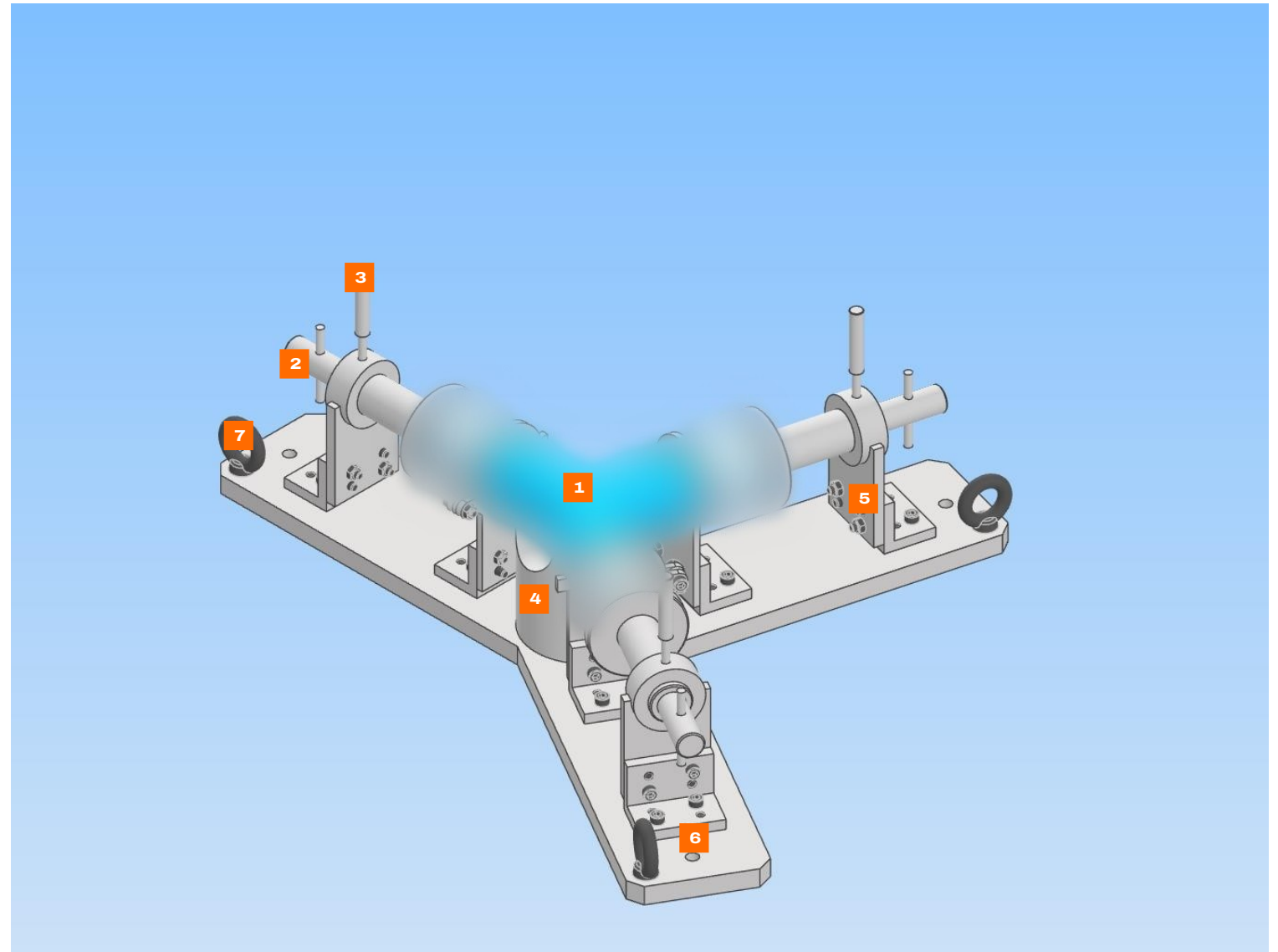
Hydraulic, pneumatic, cabin oxygen and every other pipeline type, plus internal sheet-metal structures.



HOW A WELDING FIXTURE WORKS

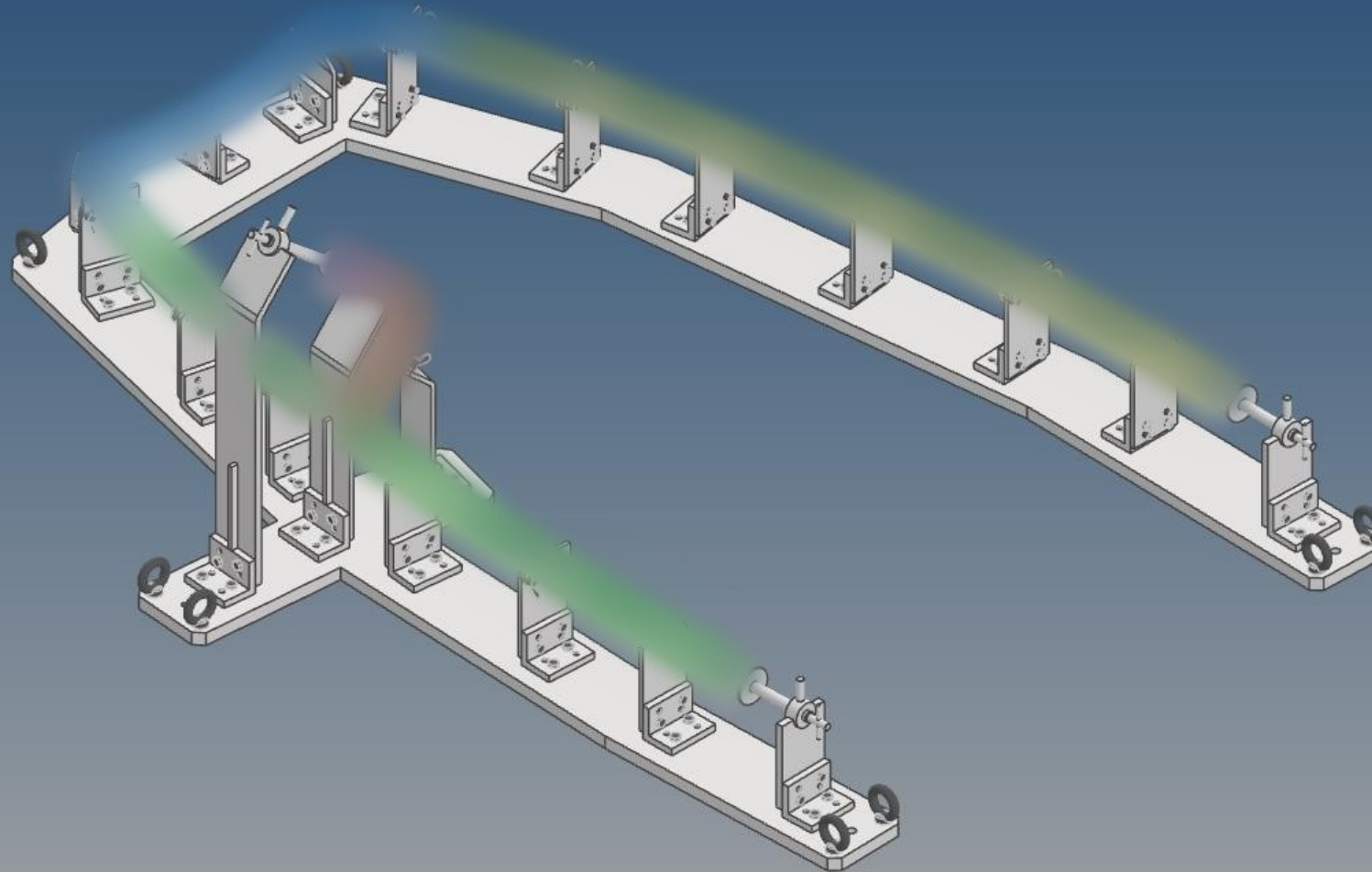
A welding fixture holds every tube, fitting and bracket in its installed position while the joints are tacked and welded. The same locators are then used to check the finished part, so one tool covers welding and inspection. Feature tolerances are held within 0.05 mm, and within 0.2 mm including stack-up to the furthest hard points.

- 1 Part being welded
- 2 End-fitting mandrel
- 3 Locking pin
- 4 Cradle support
- 5 Location plate
- 6 Base plate
- 7 Lifting eye bolt



OXYGEN DELIVERY SYSTEM

LCA MK1A



COCKPIT OXYGEN CANOPY

The oxygen lines run up and over the cockpit, and the fixture follows them. Several sections are located, clamped and welded in place.

AIRCRAFT	LCA Mk1A
PARTS	33 in the parts list



NOTE :-

- ALL DIMENSIONS ARE IN MM
- TOLERANCES ON FREE DIMENSIONS AS PER 1F.11.03
- ALL DIMENSIONS AND CONTOURS ARE TO BE MACHINED AS PER 3D MODEL
- WHERE EVER THE PART IS TOUCHING THE FIXTURE, CONTOUR TO BE MACHINED ENLARGED FOR +0.2 WITH THE TOLERANCE OF ±0.2 MM
- EYE BOLTS ARE TO BE USED AS PER THE IS-4190
- ROUND OFF ALL UNNECESSARY SHARP EDGES
- ALL LOOSE ITEMS TO BE CHAINED SUITABLY
- DIMENSIONS GIVEN FOR REF ONLY
- ANTI CORROSIVE TREATMENT AS PER OH 647-82
- CLEAR INTERFERENCE IF ANY
- WELD BY ELECTRIC ARC WELDING AS PER IS-816, CLEAN THE SEAMS
- STAMP TOOL NO, COMP NO, HAL NK, DIV, LCA-TEJAS

33	SUPPORT PLATE	1		C-45 IS:1570-61	
32	SUPPORT PLATE	1		C-45 IS:1570-61	
31	SUPPORT PLATE	1		C-45 IS:1570-61	
30	CLAMP	2		C-45 IS:1570-61	
29	LOCKING PIN	2		C-45 IS:1570-61	
28	GUIDE PIN	2		C-45 IS:1570-61	
27	LOCKING PIN	2	Ø5 X 60	C-45 IS:1570-61	
26	LOCKING PIN	4	Ø10 X 110	C-45 IS:1570-61	
25	TRIMMING PLATE	16	60 X 24 X 5	C-45 IS:1570-61	
24	SUPPORT PLATE	1		C-45 IS:1570-61	
23	SUPPORT PLATE	1		C-45 IS:1570-61	
22	LOCATION BLOCK	1		C-45 IS:1570-61	
21	LOCATION BLOCK	1		C-45 IS:1570-61	
20	LOCATION PLATE	1	60 X 66 X 5	C-45 IS:1570-61	
19	LOCATION PLATE	1	60 X 5	C-45 IS:1570-61	
18	LOCATION PLATE	3	60 X 66 X 5	C-45 IS:1570-61	
17	LOCATION PLATE	1	60 X 119 X 5	C-45 IS:1570-61	
16	LOCATION PLATE	1	60 X 5	C-45 IS:1570-61	
15	LOCATION PLATE	1	60 X 110 X 5	C-45 IS:1570-61	
14	LOCATION PLATE	1	60 X 5	C-45 IS:1570-61	
13	LOCATION PLATE	1	60 X 110 X 5	C-45 IS:1570-61	
12	LOCATION PLATE	1	60 X 109 X 5	C-45 IS:1570-61	
11	LOCATION PLATE	1	60 X 108 X 5	C-45 IS:1570-61	
10	LOCATION PLATE	1	60 X 107 X 5	C-45 IS:1570-61	
9	SUPPORT PLATE	2		C-45 IS:1570-61	
8	BASE PLATE	1		C-45 IS:1570-61	
7	LOCATION PLATE	2	60 X 108 X 5	C-45 IS:1570-61	
6	LOCATION PLATE	1	60 X 108 X 5	C-45 IS:1570-61	
5	LOCATION PLATE	1	60 X 108 X 5	C-45 IS:1570-61	
4	LOCATION PLATE	1	60 X 5	C-45 IS:1570-61	
3	LOCATION PLATE	1	60 X 109 X 5	C-45 IS:1570-61	
2	L ANGLE PLATE	19	60 X 40 X 40	C-45 IS:1570-61	
1	BASE PLATE	1	1200 X 900 X 15	C-20 IS:1570-2-1	

ITEM	PART NUMBER	DESCRIPTION	QTY	SIZE	MATERIAL	REMARK
PARTS LIST						

ITEM	COMP ISSUE	TOOL ISSUE

0.05-0.8µ SUPER FINISH	1.6-6.3µ FINE	10-40µ MEDIUM	80-320µ ROUGH	AS PRODUCED
NAME :				

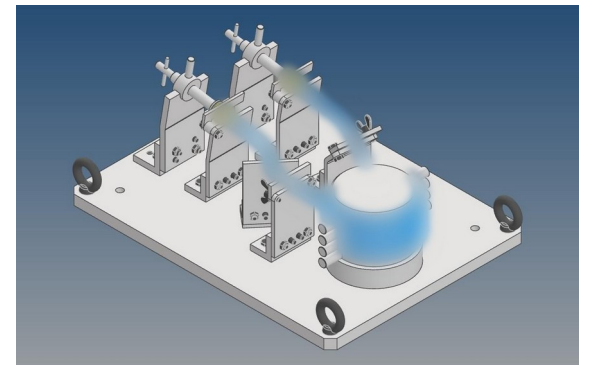
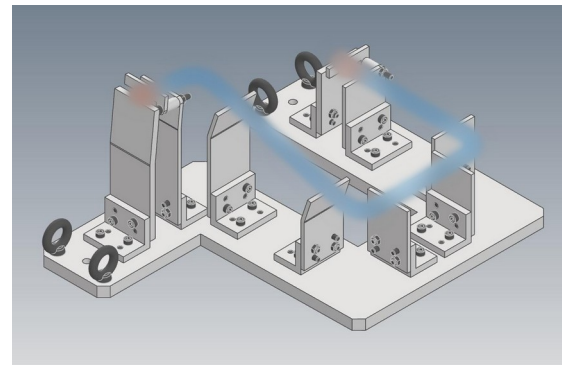
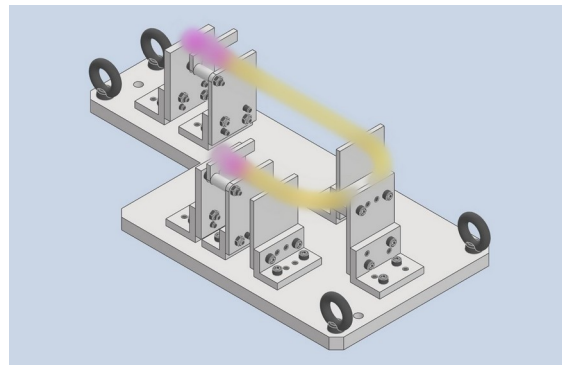
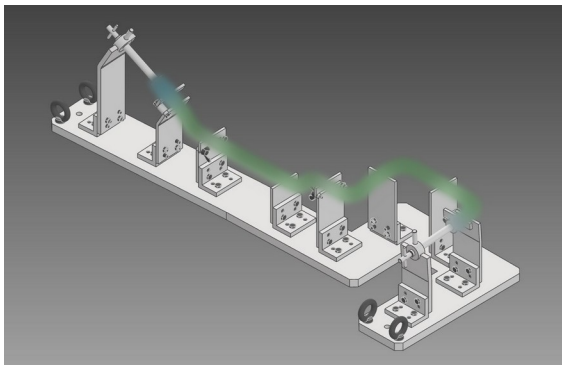
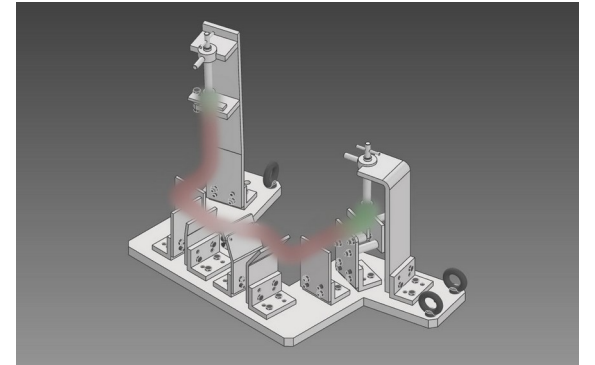
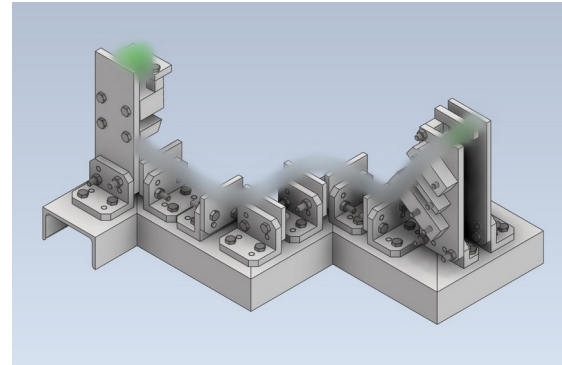
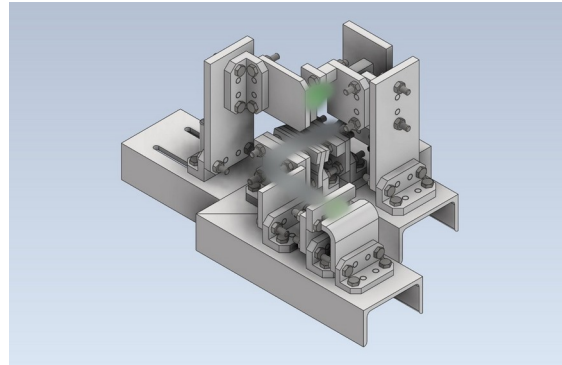
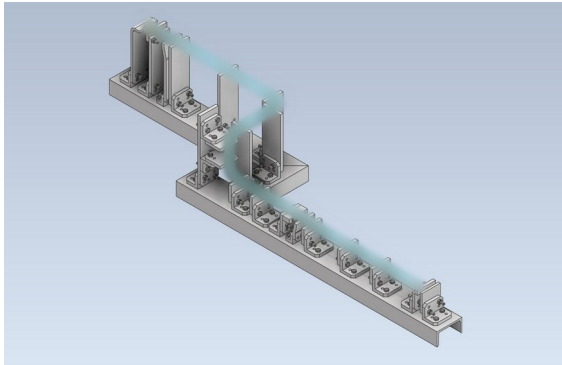
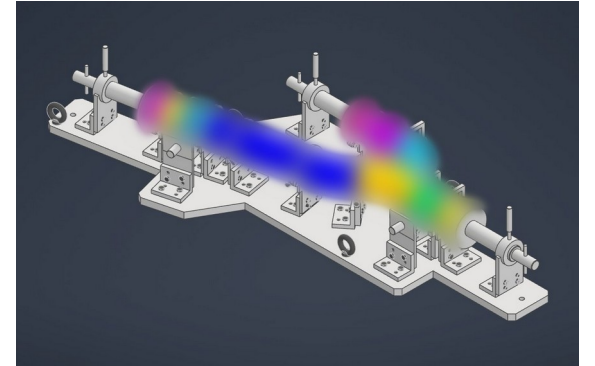
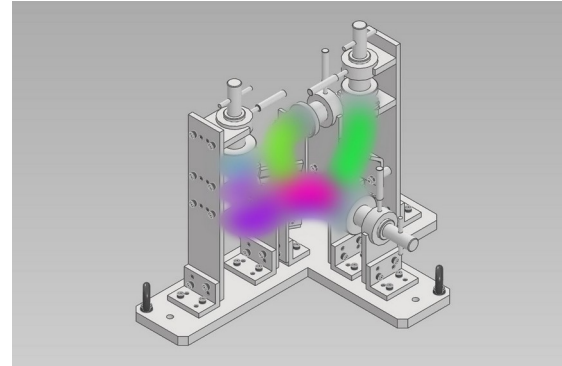
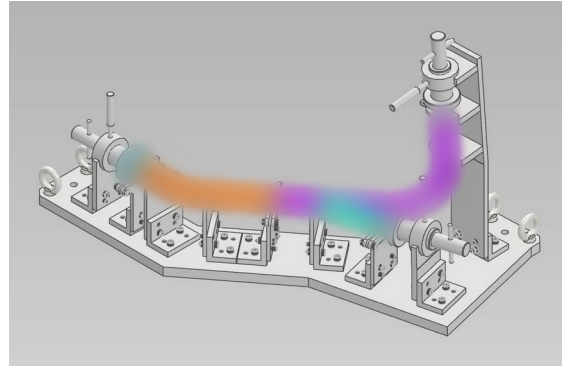
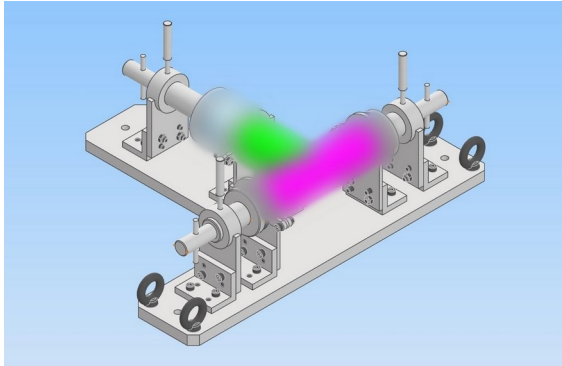
REASON	SIGNATURE
WELDING AND INSPECTION FIXTURE	
SHOP : 05	

HINDUSTAN AERONAUTICS LTD	SCALE	NTS
AMD NASHIK	TRACED	
	DESIGNED	
	CHECKED	
	APPROVED	
DWG NO :		
SHEET 1 OF 35		
SHEET SIZE : A4		
LCA-TEJAS		

ASSEMBLY DRAWING

A 3D CAD model of a mechanical assembly, possibly a pump or a valve, is shown. The assembly is composed of several interconnected parts, including a base plate, a central body, and various fittings and pipes. A colorful stress distribution overlay is applied to the central body, indicating areas of high stress (red) and low stress (blue). The assembly is mounted on a base plate with several mounting holes and a central circular feature. The overall design is complex and detailed, with various components labeled with numbers and letters.

07/20



SHEET-METAL STRUCTURES

Internal sheet-metal structures needed their own fixtures. Parts for the bleed-air system, the gun ammunition tray and avionics enclosures, in aluminum, titanium, steel and Inconel. These fixtures locate formed panels, ducts and trays by their critical features.

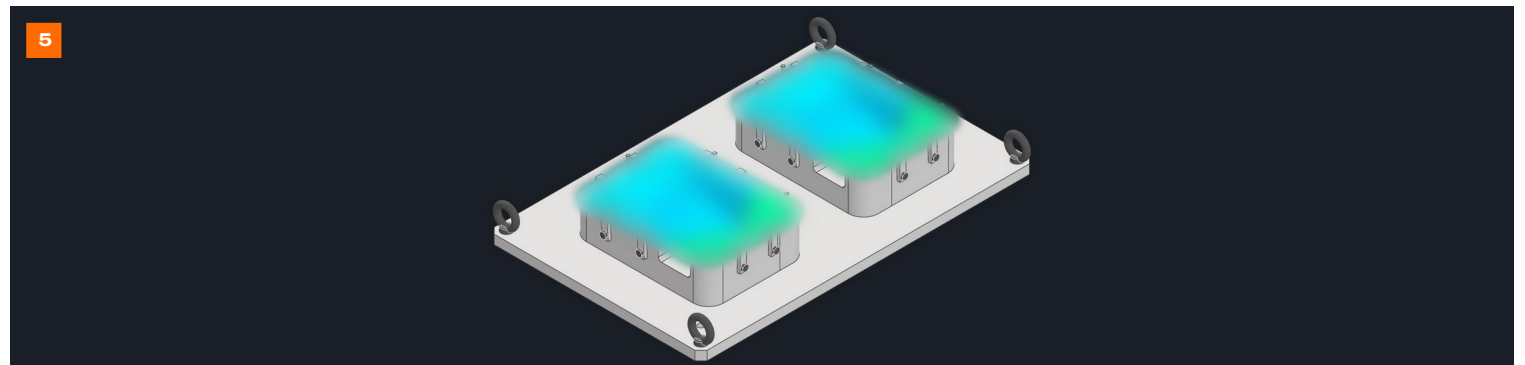
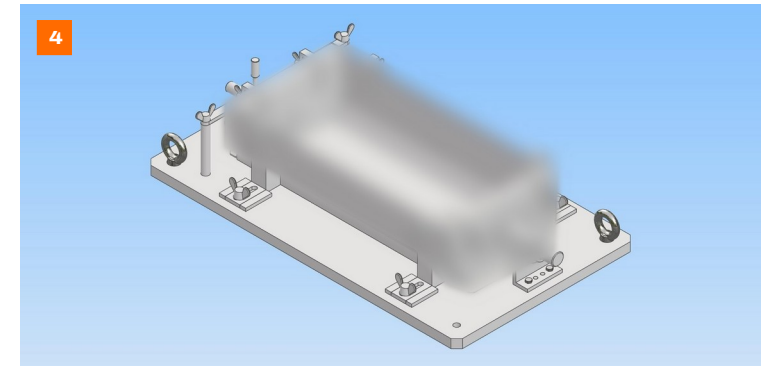
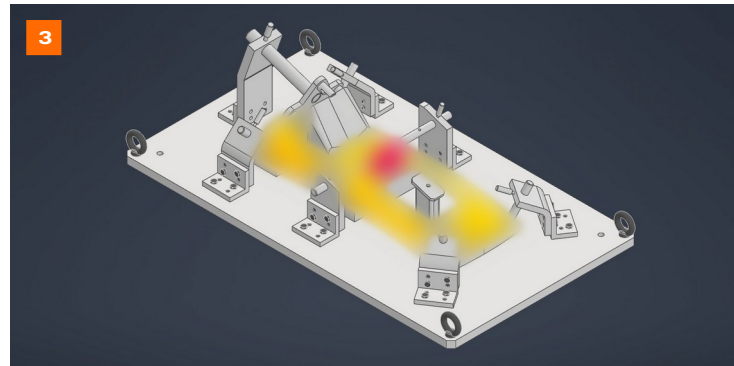
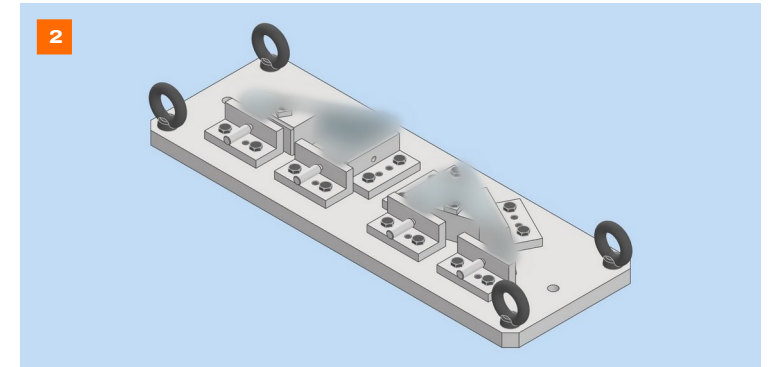
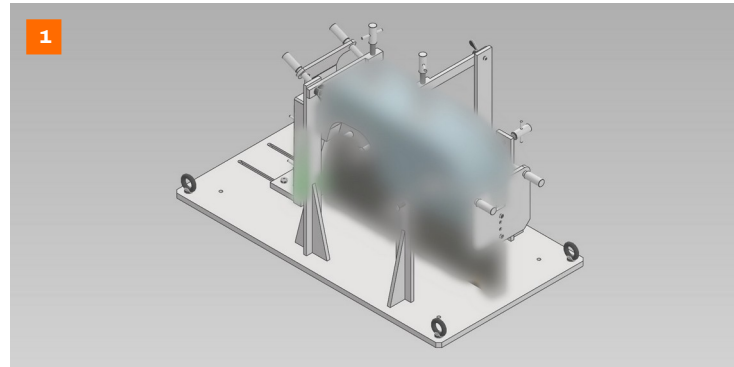
1 Formed housing

2 Flat brackets

3 Formed panel

4 Box enclosure

5 Formed trays

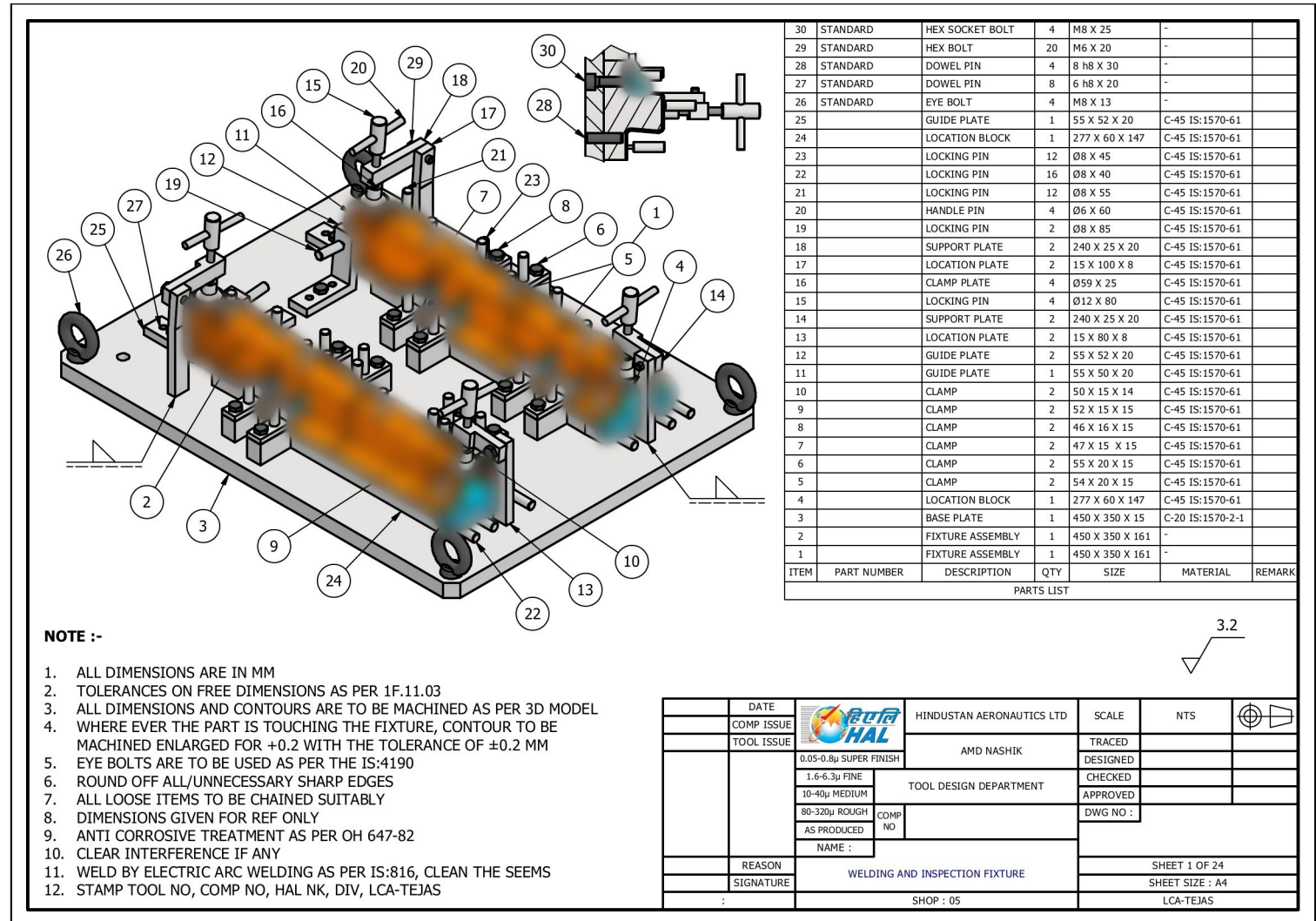
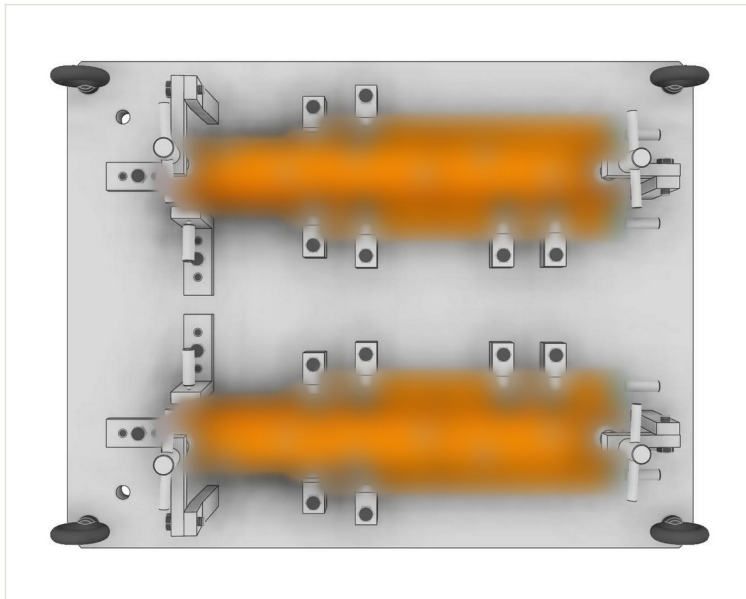


A TWIN-SECTION FIXTURE

Two long formed sections are held along their flanges by rows of clamps, pins and support plates on one base, so both are welded and checked in a single setting.

AIRCRAFT **LCA Mk1A**

PARTS 30 in the parts list



ASSEMBLY DRAWING

Over 400 fixtures were too many to draw one by one. **We built a library smart enough to do it.**

01 STANDARDIZE

Location plates, L-angles, pins, clamps and fasteners drawn once, in set sizes, and reused on every fixture.

02 AUTOMATE

Inventor Content Center holds the library, and iLogic rules size, place and number each part automatically.

03 DOCUMENT

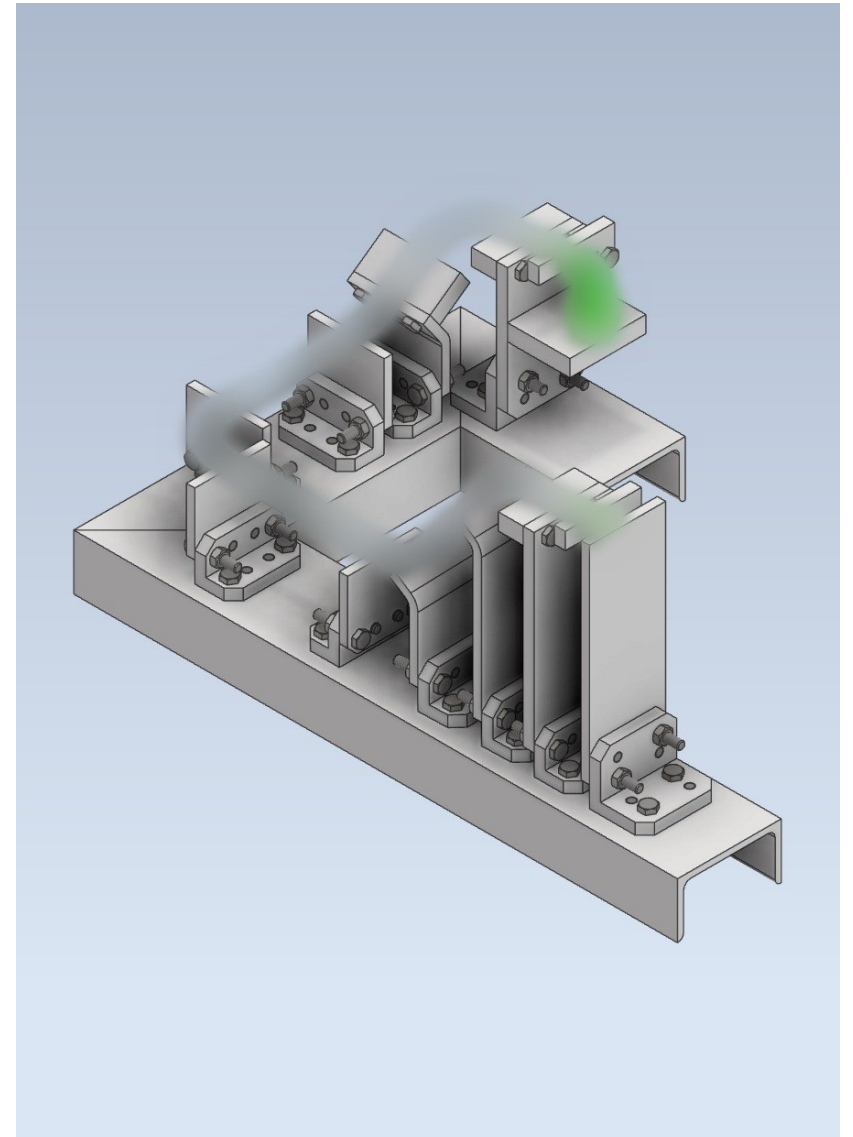
Shop-floor drawing sets and parts lists come out in a few clicks, all to one company standard.

04 SOURCE

Plates are nested across fixtures for laser cutting, with stock sizes and materials taken from the parts lists.

05 MACHINE

Machined parts are nested and sent to CNC from the same 3D model, so nothing is redrawn on the shop floor.



RULE-BASED FIXTURE LIBRARY

The fixture library lives in Inventor Content Center, with every part in a set range of sizes. iLogic rules place parts along the pipe model, size each plate to its locator, set the hole patterns and fill in part numbers, materials and stock sizes. Drawing generation is fully automated and takes on 80% of the drafting workload.

IN THE LIBRARY

Location plates

L-angle plates

Mandrels and guide pins

Support brackets

Clamps and wing screws

Eye bolts and fasteners

01



PIPE MODEL
IN

02



LIBRARY PARTS
PLACED

03



ILOGIC SIZES
AND DRILLS

04



DRAWINGS AND
PARTS LIST

05

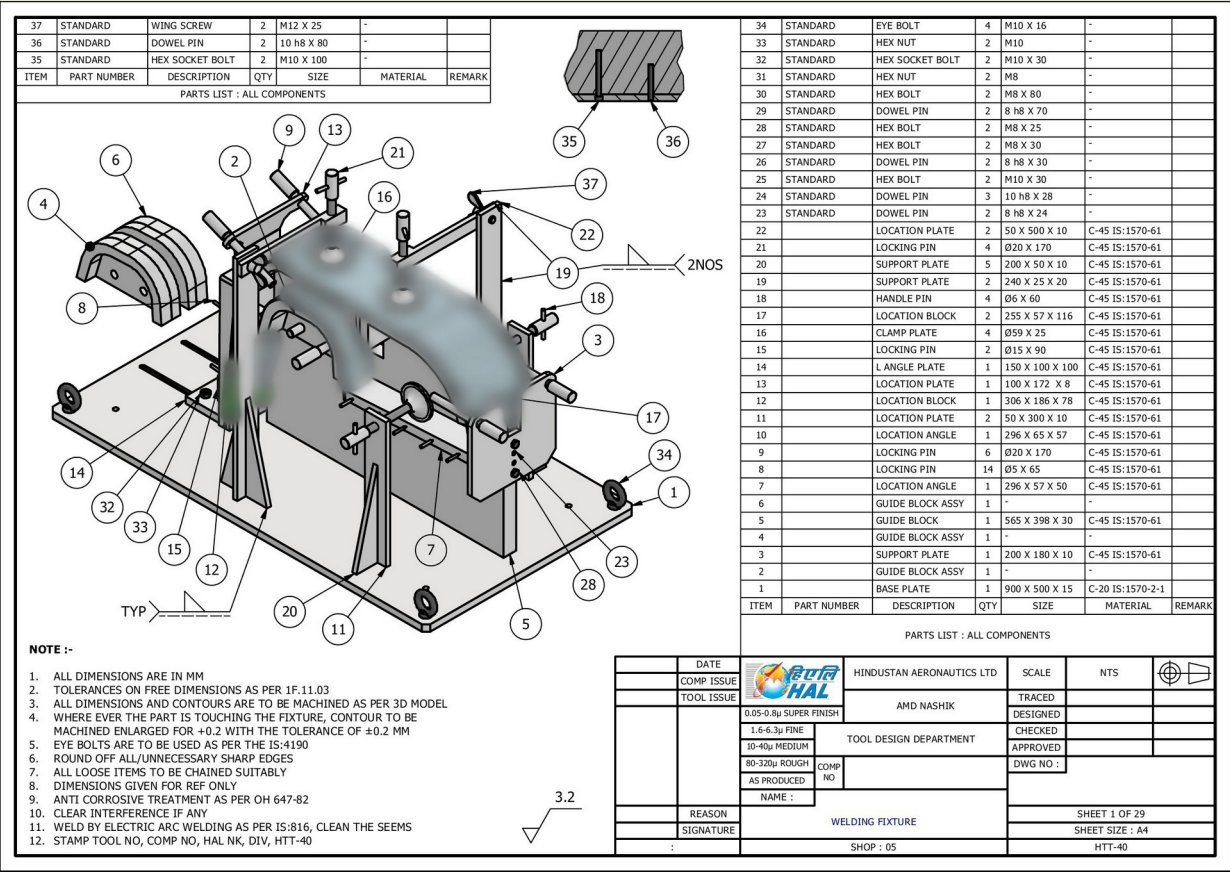


NESTED FOR
LASER CUTTING

06



RELEASED TO
THE SHOP

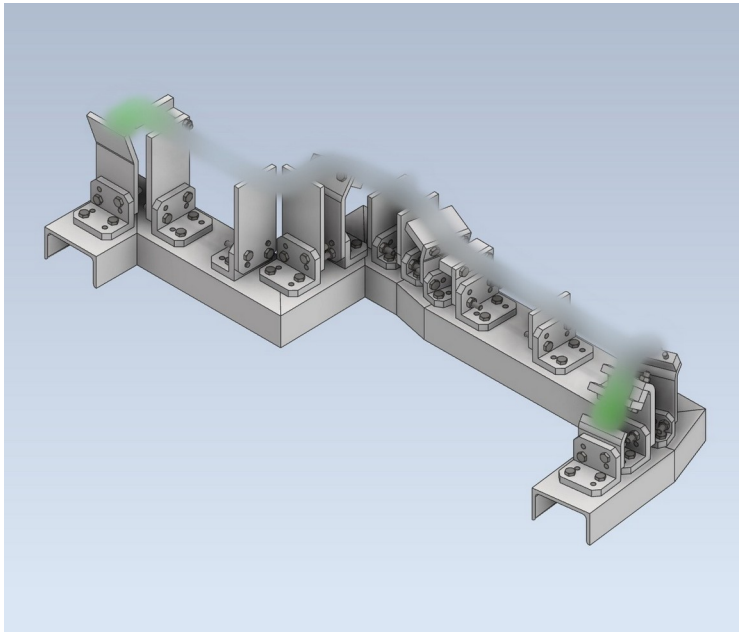


HTT-40 WELDING FIXTURE. BALLOONS AND PARTS LIST FILLED IN BY THE SYSTEM.

HAL DESIGN APPROVAL

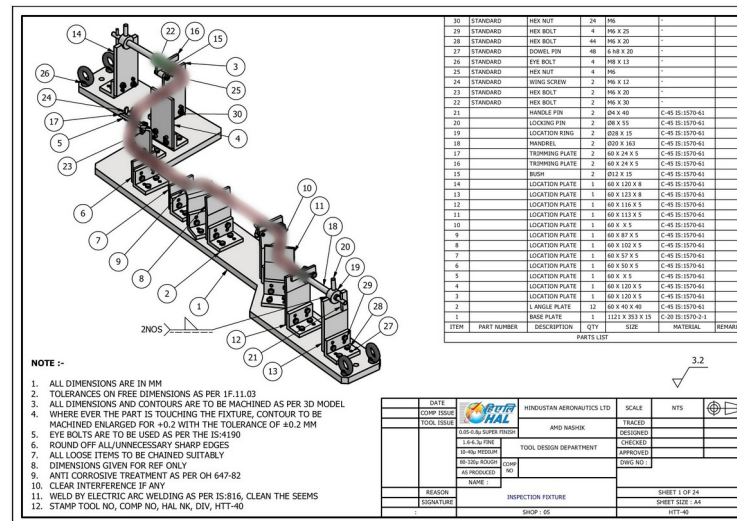
01 3D MODEL

The fixture model was reviewed first: locating scheme, clamping, torch access, removal of the welded part, portability and stiffness.



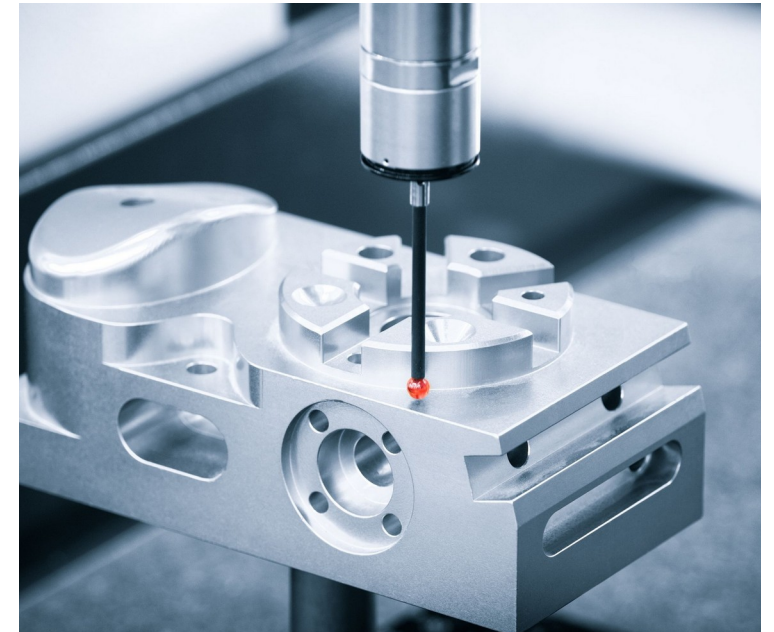
02 2D DRAWINGS

Then the drawing set: a general arrangement, a parts list and a detail sheet for every made part, with tolerances, surface finish and treatment.



03 CMM REPORT

Finally, the vendor measured each built fixture on a CMM against the drawings, and a passing report closed the approval.

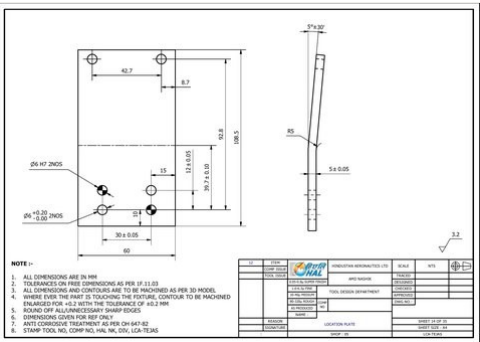
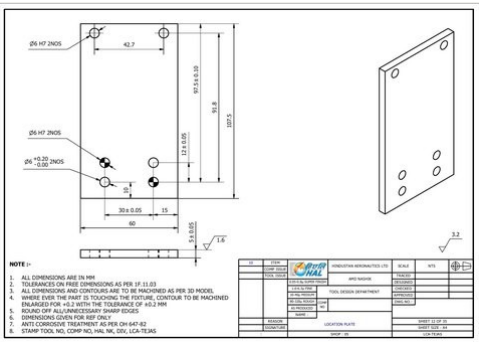
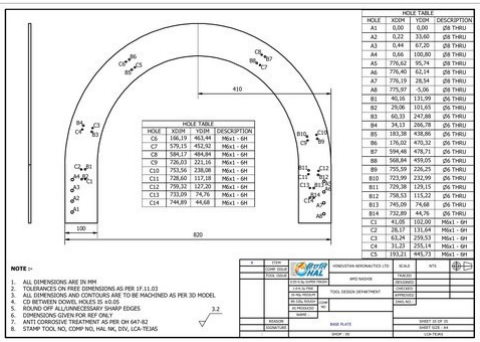
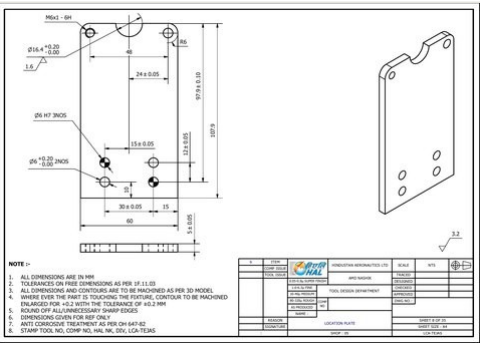
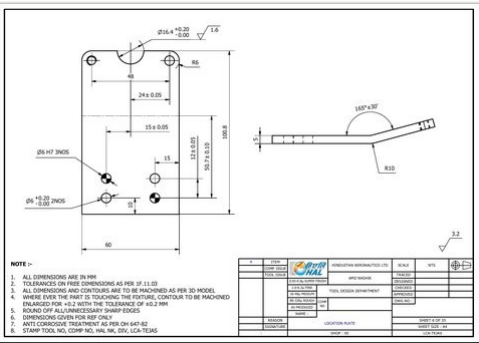
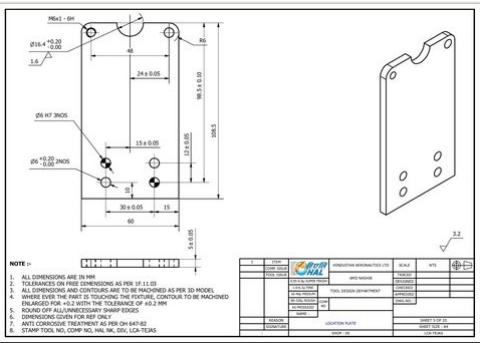
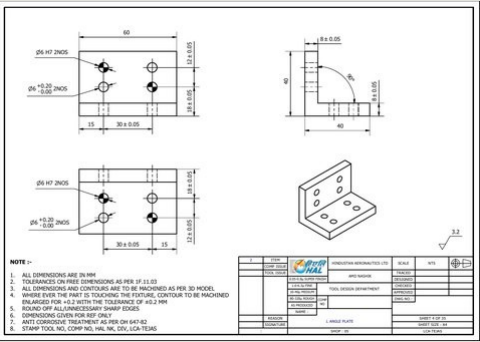
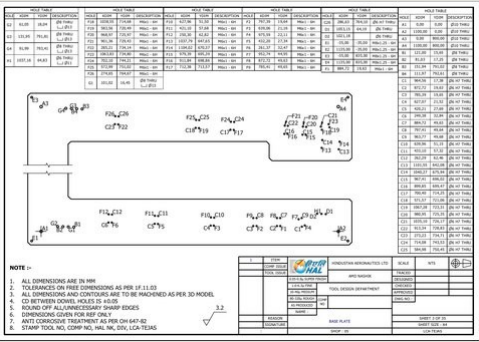
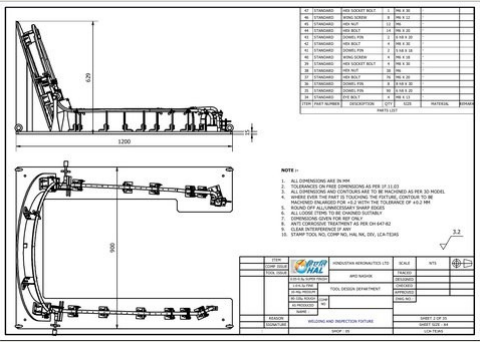


SHOP FLOOR DRAWINGS

A general arrangement, a parts list and a detail sheet for every made part. Each sheet calls up the standard fasteners and the material, welding and finishing standards, with hole tables and configuration layouts to help inspection.

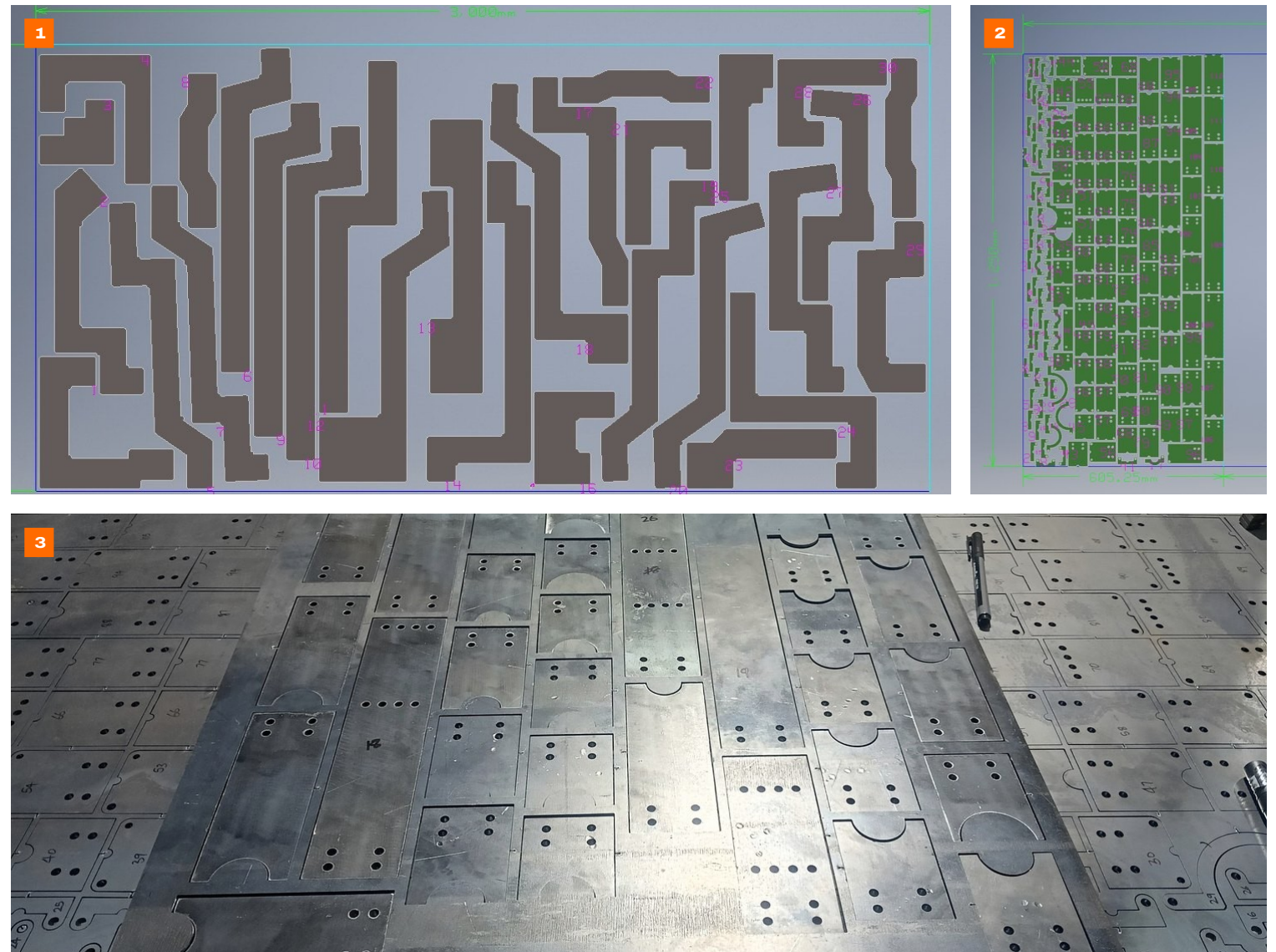
STANDARDS ON THE DRAWINGS

IS:1570-2	C-20 steel for base plates
IS:1570-61	C-45 steel for locators, pins and clamps
IS:816	Electric arc welding
IS:4190	Eye bolts
OH 647-82	Anti-corrosive treatment
1F.11.03	Tolerances on free dimensions
FITS	Contours +0.2 mm, dowels ±0.05 mm
MARKING	Tool and component numbers stamped



NESTED ACROSS FIXTURES

Plates from many fixtures were nested together on full sheets for laser cutting, so one sheet could feed several tools. Stock sizes and materials came from the parts lists, which kept purchasing simple and offcuts small. Thousands of locators and hundreds of base plates were made and tracked this way, each laser cut and engraved with its item number.



1 Base plates on a 3,000 mm sheet

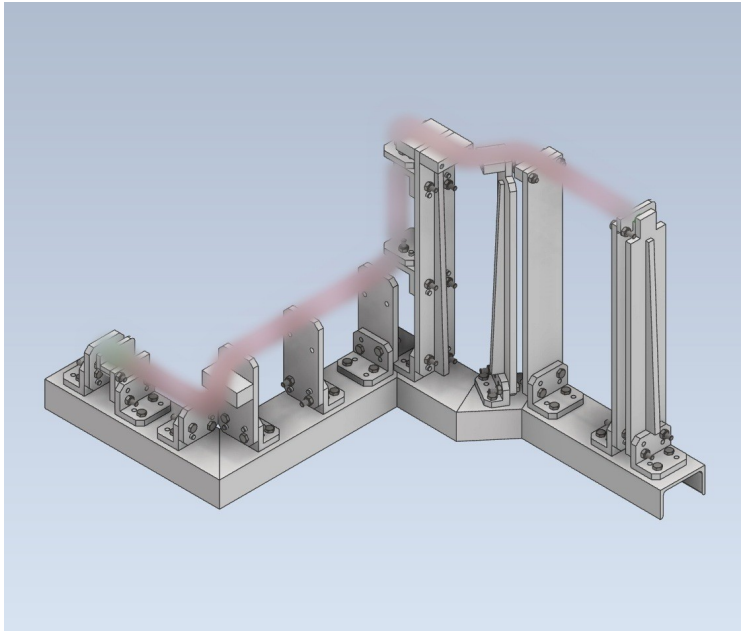
2 Location plates, nested

3 A cut sheet on the shop floor

A NOVEL EXPERIMENT

01 THE IDEA

Stock C-channel in place of thick plate: lighter, stiff for its weight, and far less material to machine. In practice, accuracy fell to worse than 1 mm.



02 THE PROBLEM

Cut by hand and MIG welded, the channels warped. Face milling to restore flatness kept growing, and hole center distances drifted across hundreds of holes drilled with a manual DRO.



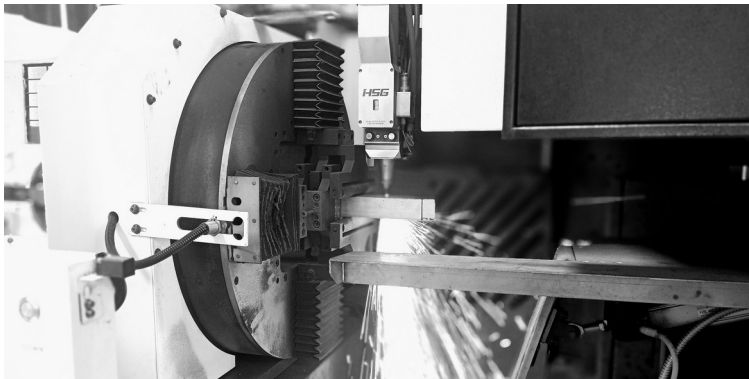
03 THE FIX

The channel is now cut and drilled on a laser tube cutter, set on a guide template with locating pins and laser welded, which keeps heat and distortion low.



CUT, LOCATED AND LASER WELDED

Built this way, the channel bases held their flatness and hole positions without heavy face milling, with far fewer manual errors and a much faster turnaround on the hardest step.

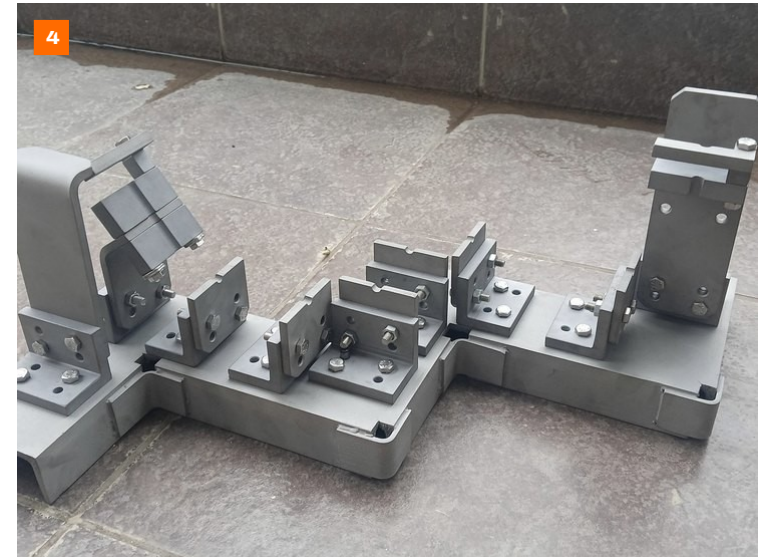


1 Sections located and clamped on the guide

2 Sections laser welded

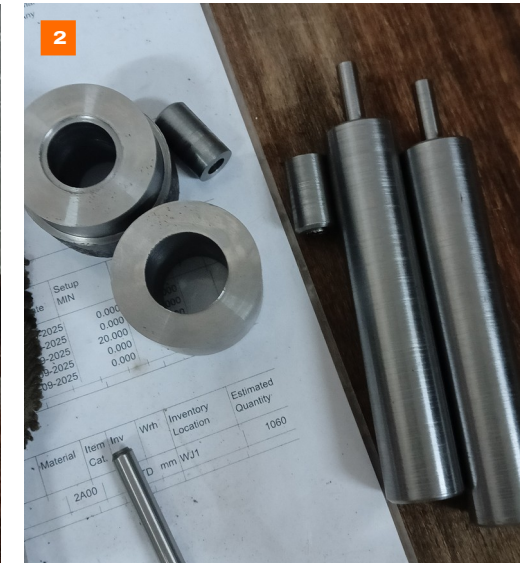
3 Base cleaned and face ground

4 Finished fixture, fully assembled



MACHINED WHERE PRECISION COUNTS

Plates, locators and mandrels were CNC machined straight from the 3D model, with contours held to tolerance for reliable location and clamping. iLogic automation also ran 1D nesting to pick the most efficient cut lengths of raw stock, saving machining time and cost where hundreds of parts were needed.



1 Machined and ground aluminum plate

2 T-shaped base plate

3 Machined locators on a base

4 Locators, side view

The same library, rules and process can be set up for **any shop that builds precision parts at scale.**

- | | | |
|-----------|---------------------------|--|
| 01 | FIXTURE DESIGN | Welding, inspection and assembly fixtures, taken through your own approval process. |
| 02 | TOOLING LIBRARIES | Content Center libraries of your own standard tooling parts. |
| 03 | DESIGN AUTOMATION | iLogic rules that size, place and document parts for you, bridging design and the shop-floor machines. |
| 04 | SHOP-FLOOR RELEASE | Drawing sets, BOMs, nests and stock lists, ready to build. |
| 05 | TOOLMAKING | Practical, R&D-tested ways to build fixtures for less. |



LET'S BUILD THE NEXT ONE

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WEBSITE www.tactiledesign.in

