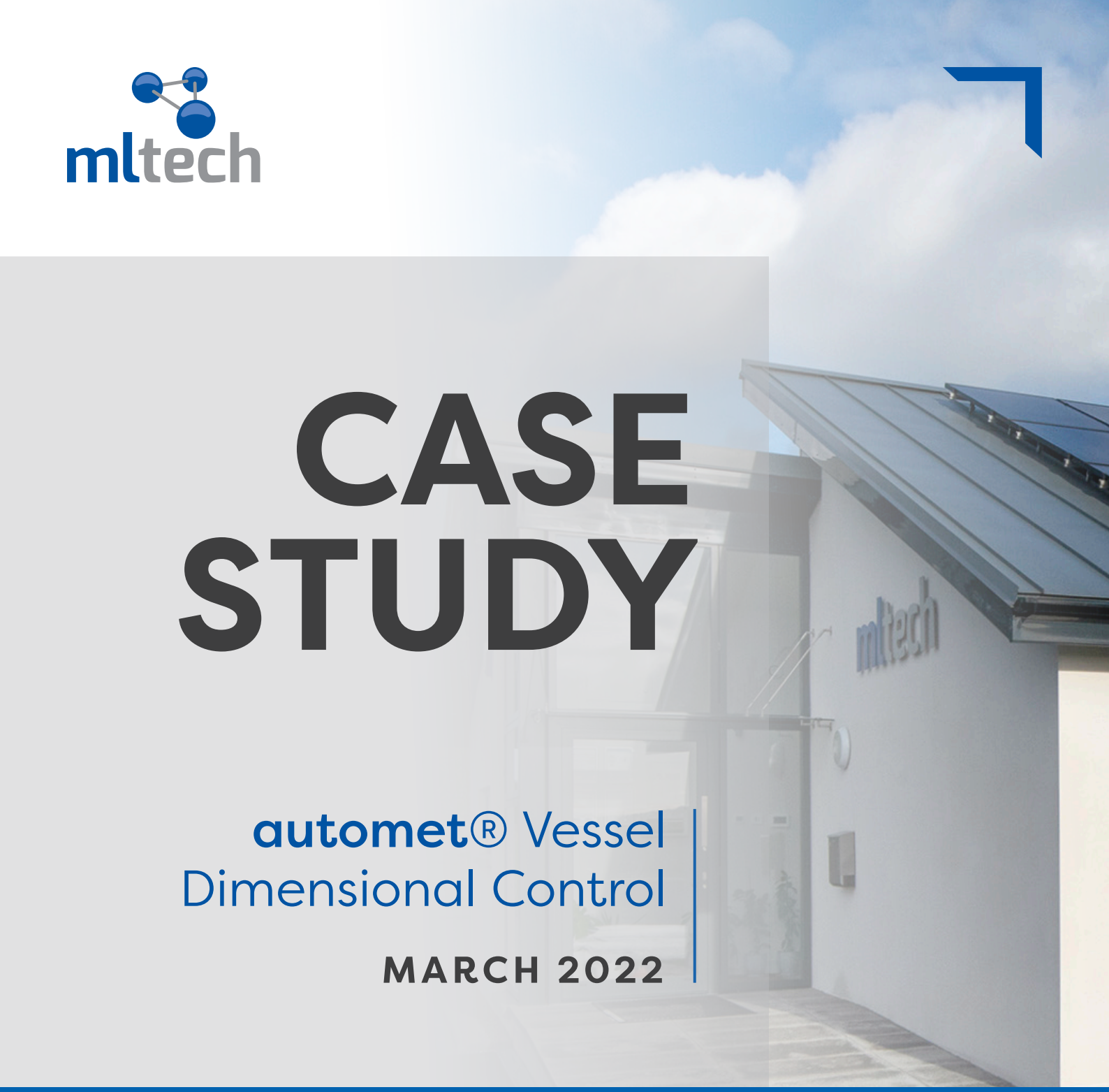

CASE STUDY

automet® Vessel Dimensional Control

MARCH 2022

By **Mike Lloyd Technical Services**
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OVERVIEW

Mike Lloyd Technical Services Ltd (mltech) were asked by Whittaker Engineering Ltd to help them layout and set up vessel-nozzle and support locations using the autometⓇ software.

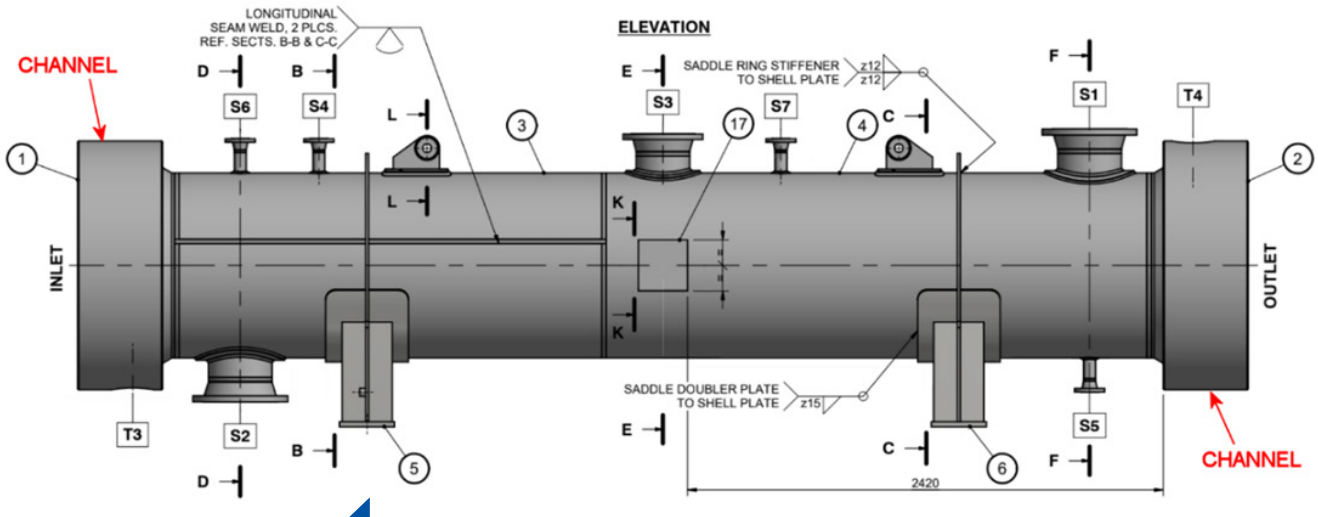
Whittaker have been using the autometⓇ system for several years for pipe-spool measurement.

> Whittaker have successfully used AutometⓇ software for pipe spool fabrications for some years now and there have always been discussions with Mike regarding its use in our pressure vessel manufacturing
>
> **KYLE MORRISON**
> FABRICATION WORKSHOP FOREMAN

Pressure vessel shells are made up of heavy wall sections and can be a challenge to layout accurately; they are notorious for roundness issues before the channels/dishes are fitted.

The traditional method for large-cylinder layouts uses ‘tangent-lines’ or ‘tan-line’ measurements. These lines marked at each end of the cylinder are used for referencing nozzle and support layout. Setting out the tan line accurately takes a high level of skill and errors creep in due to the shape of the cylinder and the physical limits of laying out the line around the full circumference of the cylinder. The tan line must be orthogonal to the cylinder centre-line, meaning it must be perpendicular at all positions around the circumference. Then there’s the issue of laying out from the tan-lines to the nozzles and supports. How do you keep parallel to the centre line, especially when the diameter of the cylinder is large?

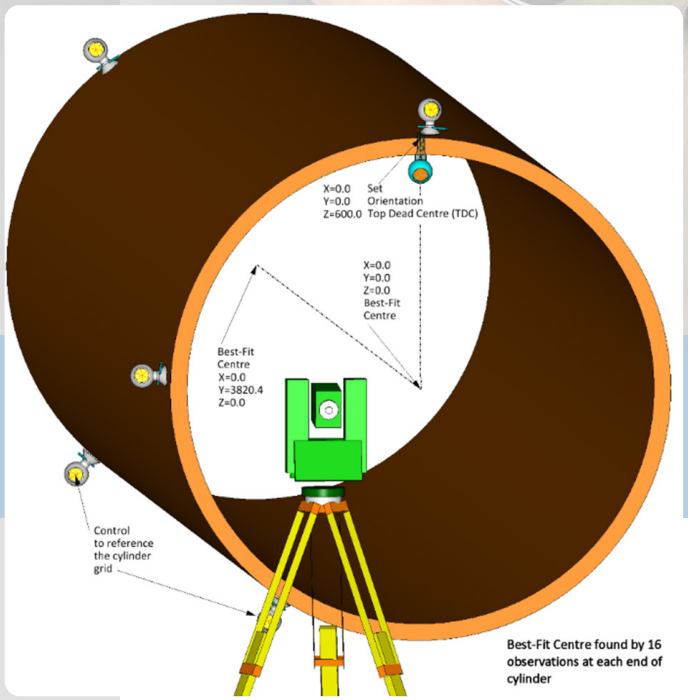
A TYPICAL PRESSURE VESSEL



VESSEL IN THE CASE STUDY

APPROACH

The autoMet software can be used on any cylinder/vessel, however, for this example, we had to make a small change to the procedure. With the inlet channel fitted and welded, the layout of the nozzles and supports was performed using the autoMet software feature: autoAlign.

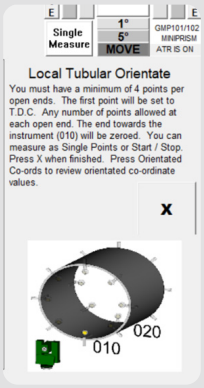


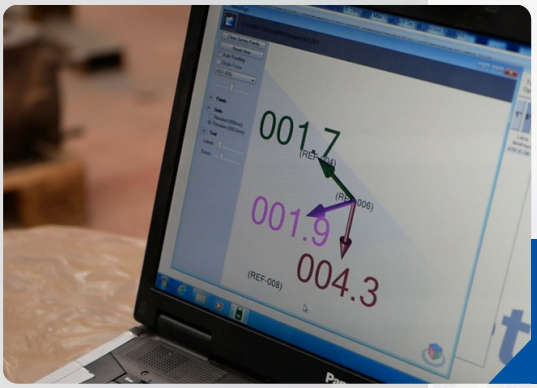
The autoMet® autoAlign software sets up a cylindrical grid. The grid is created by finding the best-fit centre at each end of the tubular which is usually defined by sixteen observations at each end. The two best-fit centres combined with the orientation reference, in this case the channel bolt-holes, create the cylindrical grid.

APPROACH

The layout is performed based on the cylindrical grid. The grid can be re-established at any time by referencing the survey control. All of these functions are controlled with the easy-to-use visual display.

1.



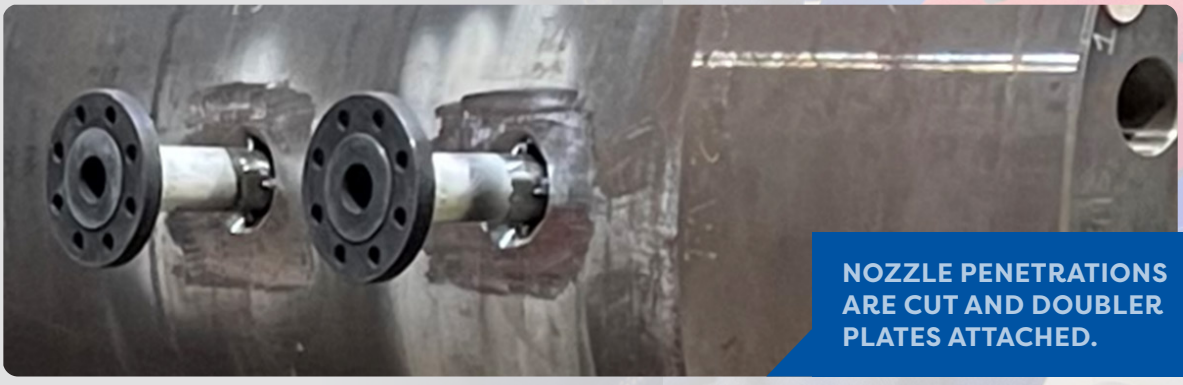


THE NOZZLE AND SUPPORT LOCATIONS ARE SET OUT.

2.

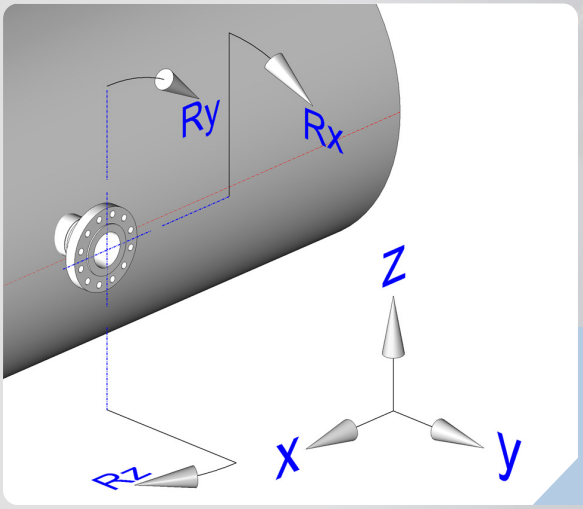
THE NOZZLE AND SUPPORT LOCATIONS ARE MARKED AND CHECKED.

3.



NOZZLE PENETRATIONS ARE CUT AND DOUBLER PLATES ATTACHED.

4.

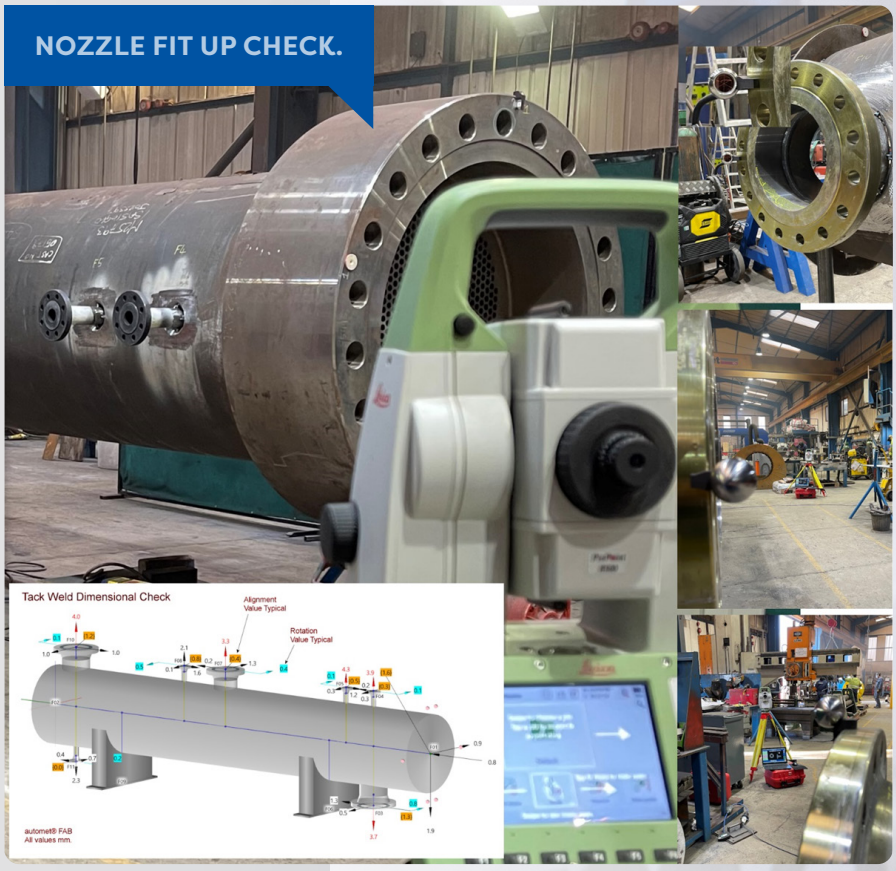


THE AUTOMET® FAB SOFTWARE IS USED TO CHECK THE NOZZLE FIT-UP POSITION AND ORIENTATION.

RESULTS

The autometⓇ FAB software is used to check the nozzle positions at fit up. All the required items are measured and compared to the design. The report created seconds after the completion of the measurement shows any deviations. Any required modifications can be performed before welding.

autometⓇ FAB best fits the measured elements against the design. Modifications to the nozzle positions can be made live and confirmed with autometⓇ; this just takes minutes. The survey instrument can be moved as required to perform the survey. Self-registered control points controlled by a traffic-light system show the overall results as you work.

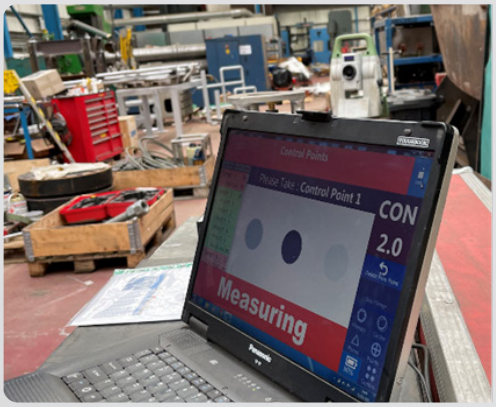


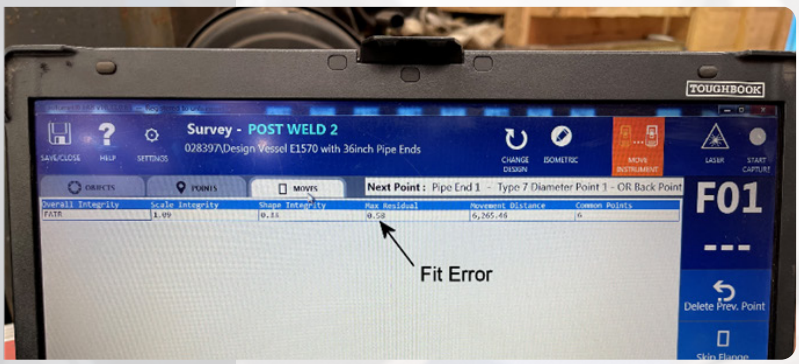
Final Post Weld

The final post-weld survey included nozzles and support base plates, with two instrument positions to complete the survey.

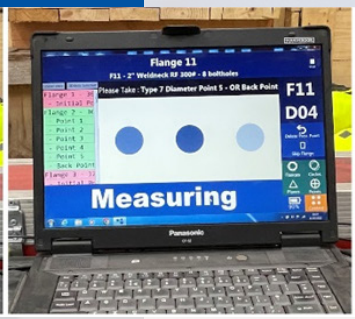
RESULTS

The automet® control is unique in that the control points are not named and the order of observation is not important.

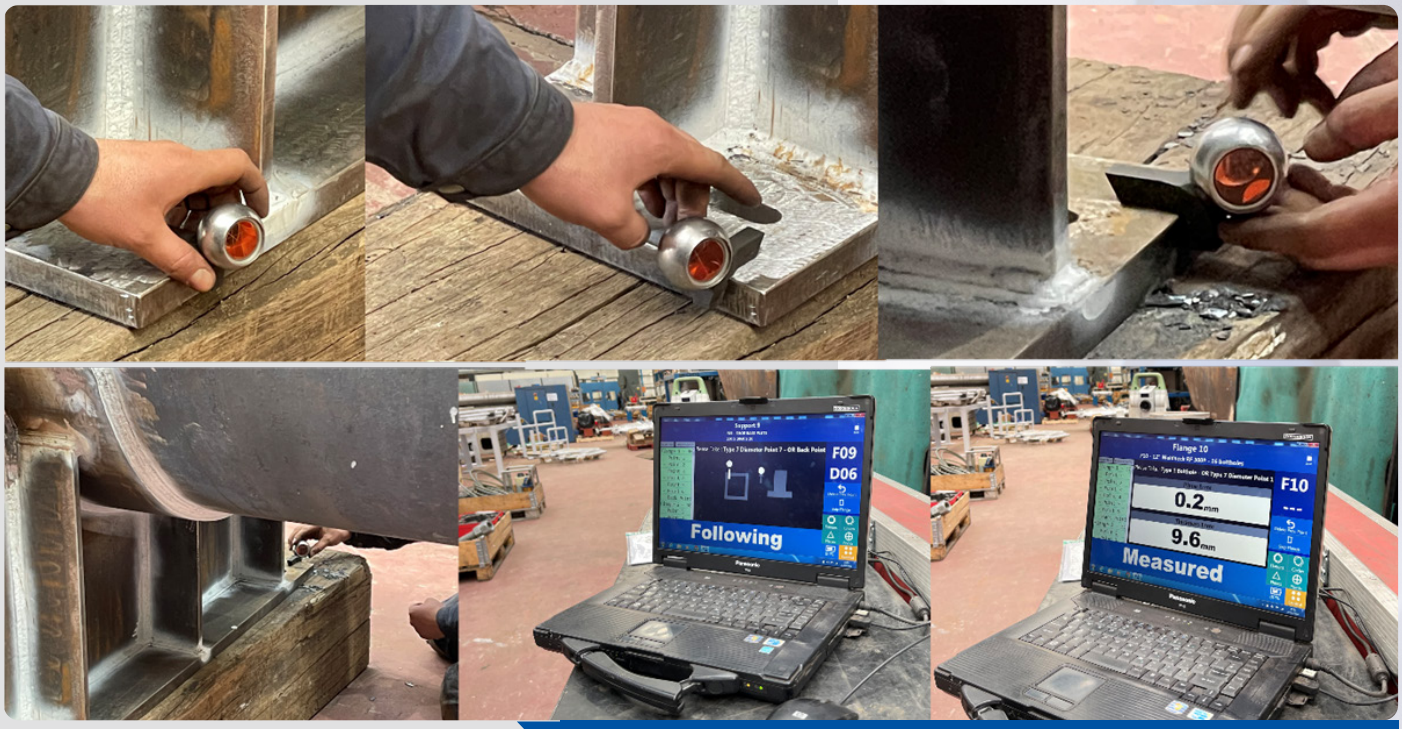




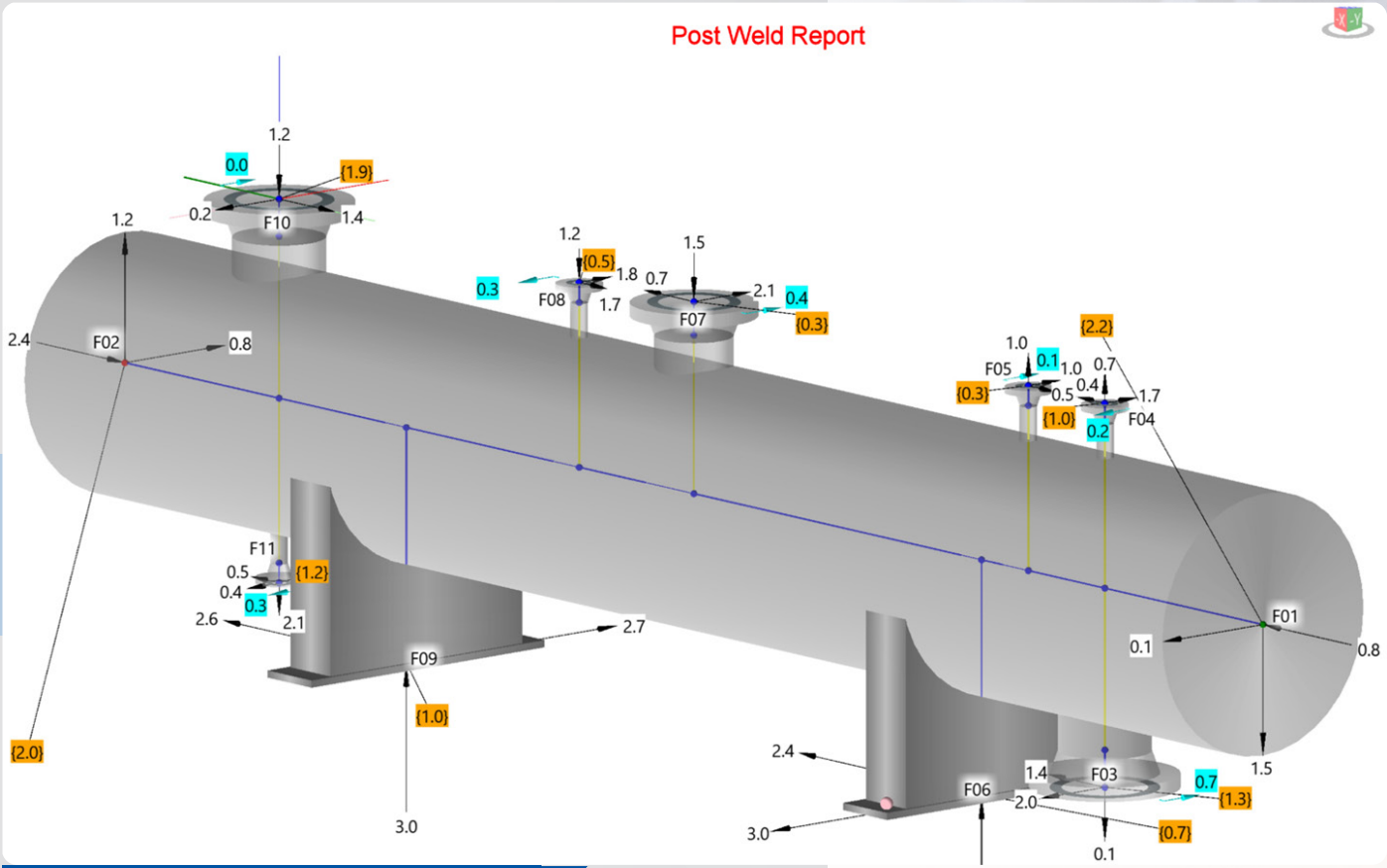
SCREENSHOTS OF THE MEASURING FLANGE 11 WITH LIVE QUALITY ASSURANCE TO CONFIRM ALL OBSERVATIONS ARE ACCURATE.



RESULTS



SUPPORT BASE-PLATE LOCATION AND FLATNESS CHECKS.



FINAL SURVEY REPORT POST WELD.

RESULTS

THE QA REPORT SHOWS THE MEASUREMENT ENTIRETY.

mltech

QUALITY ASSURANCE REPORT

automet®

Job No.	028397	Surveyor	D Buchan	Date	31-Mar-22	Time	03:19 PM
Client	PD&MS	Ref Drg.	J028397-01-01 Rev 03	Spool No.	Vessel E1570 with 36inch Pipe Ends		

Survey File	C:\SURVEY DATA\WHITTAKER VESSEL CASE STUDY\SURVEY VESSEL E1570 WITH 36INCH PIPE ENDS POST WELD 01 CALCULATED.SUR
Design File	C:\SURVEY DATA\WHITTAKER VESSEL CASE STUDY\DESIGN VESSEL E1570 WITH 36INCH PIPE ENDS.DES

			'D' points			Support base plate			Diameter		PCD	
	Fitting	Device	Coverage	Plane	Pitch	Length	Width	Thickness	Avg	Max	Avg	Max
1	**36" Pipe End**	Type 7	VERY GOOD	0.1	0.0	N/A	N/A	N/A	350.9	0.4	N/A	N/A
10	**12" Weldneck RF 300#**	Auto	VERY GOOD	0.4	9.6	N/A	N/A	N/A	0.2	0.1	-0.1	2.2
11	**2" Weldneck RF 300#**	Auto	VERY GOOD	0.0	0.3	N/A	N/A	N/A	1.0	0.5	-0.4	-2.3
2	**36" Pipe End**	Type 7	VERY GOOD	0.5	0.0	N/A	N/A	N/A	352.8	0.3	N/A	N/A
3	**12" Weldneck RF 300#**	Auto	GOOD	0.3	12.0	N/A	N/A	N/A	-0.5	0.3	-0.4	-1.2
4	**2" Weldneck RF 300#**	Auto	VERY GOOD	0.0	0.2	N/A	N/A	N/A	0.2	0.1	0.1	0.7
5	**2" Weldneck RF 300#**	Auto	VERY GOOD	0.2	0.0	N/A	N/A	N/A	0.6	0.1	-0.1	-1.4
6	**SHOE BASE PLATE 230 x 1060 x 25**	Type 7		0.5	0.0	50.4	63.3	3.2	N/A	N/A	N/A	N/A
7	**10" Weldneck RF 300#**	Auto	VERY GOOD	0.1	7.2	N/A	N/A	N/A	1.2	0.1	0.4	0.7
8	**2" Weldneck RF 300#**	Auto	VERY GOOD	0.0	0.5	N/A	N/A	N/A	0.3	0.0	0.1	0.9
9	**SHOE BASE PLATE 230 x 1060 x 25**	Type 7		0.2	0.0	48.7	63.6	4.6	N/A	N/A	N/A	N/A

Instrument Movements

Number	Controls	Movement Distance	Max Error	Integrity
1	6.00	6265.5	0.6	FAIR

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automet® Version - 10.30.0.0

CONCLUSION

Setting up and marking vessel tan lines can take many hours and provide results which have a low level of accuracy. The mltech and automet® software allowed the layout task to be completed within +/-0.3mm and considerably faster.

> **Having now seen it in action, the results speak for themselves, providing a much easier, efficient and accurate method of marking nozzle penetrations and any other required positions in the manufacture of pressure equipment**

KYLE MORRISON
FABRICATION WORKSHOP FOREMAN

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