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ISO/DIS 23247

Digital Twin Use Case 2

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ISO/TC 184/SC4 WG 15 Industrial Data
ISO 10303-242:2020 STEP
ISO 23952:2020 QIF
ISO/DIS 23247 Digital Twin

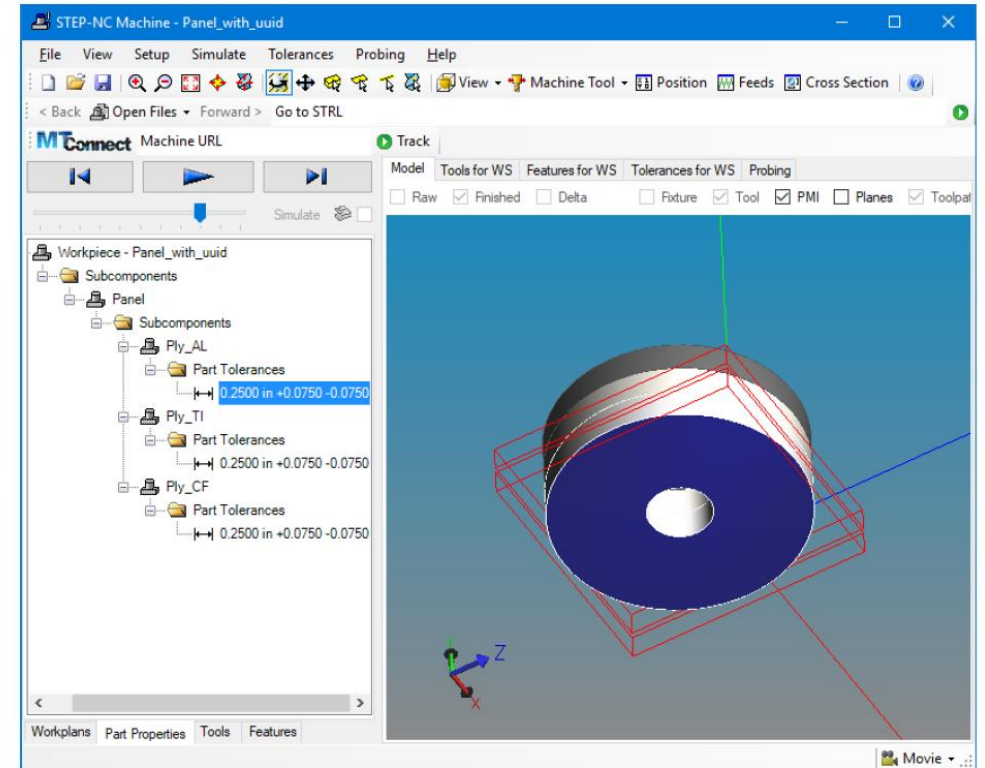
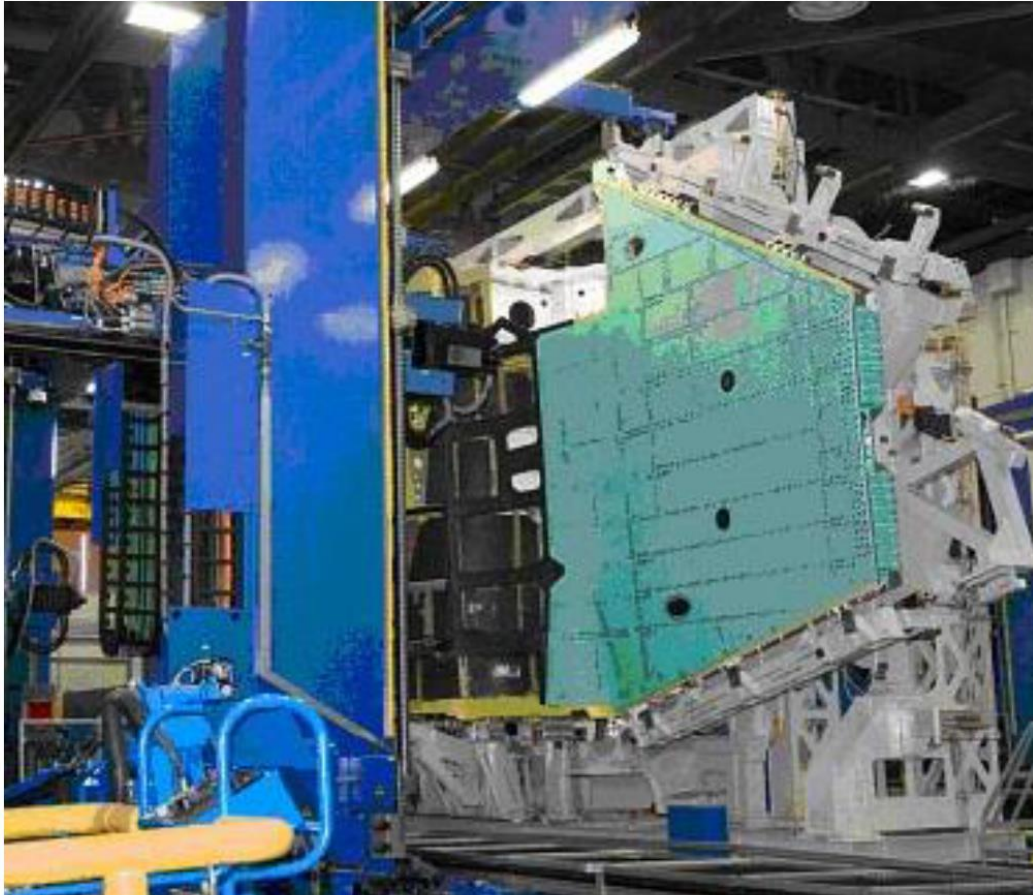
Rehearsal Draft 1 September 2020

Standards Utilized

1. MBD Dimensional Measurement workflow
 - A. STEP (nominal) for part product definition
 - B. QIF Plans for model-based measurement
 - C. QIF Results from model-based measurement
 - D. STEP (as-built) digital twin assemblies



Use Case 2 – weight reduction

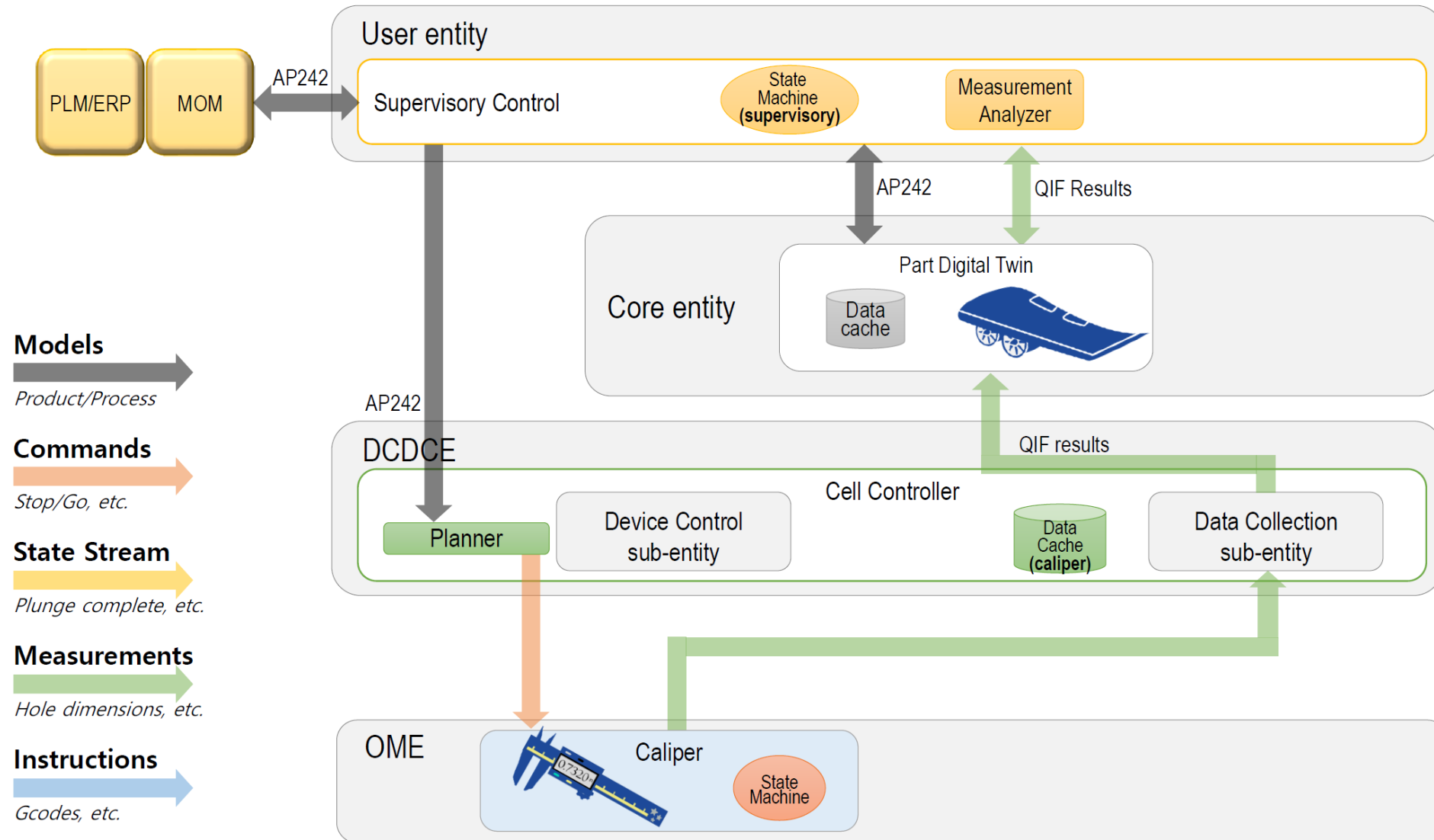


Exact match of fastener to hole depth
can reduce weight by 500lb



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System Diagram

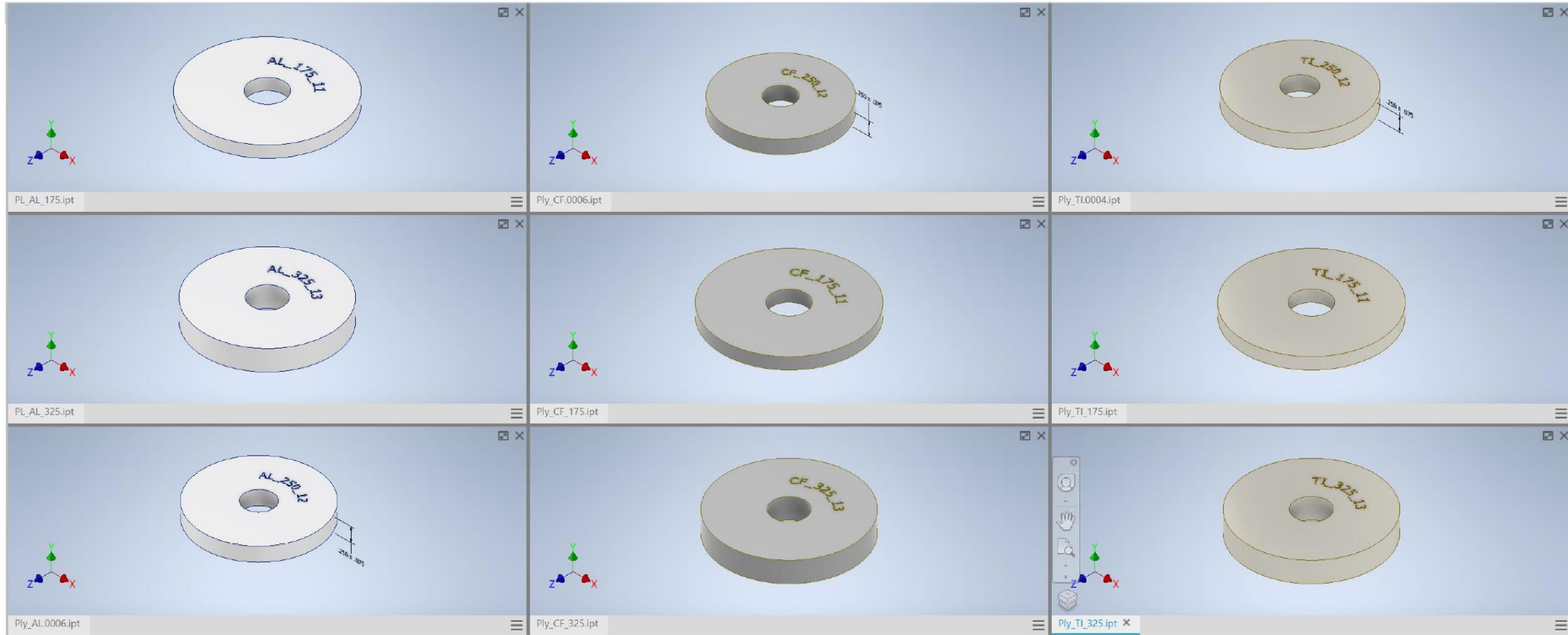


Investigation Goals

- Advance the Manufacturing Readiness Level (MRL) of Model Based Dimensional Metrology for Assemble Digital Twins
- Identify and correct gaps and issues found in the end-to-end process
- Focus on model-based workflow traceability using Characteristic UUIDs
- Develop use cases and document benefits



Measurement samples



QIF Plan Import

The screenshot displays the MesuraLink Console software interface. The main window is titled 'Routine Library' and shows a tree view of the routine library structure. A dialog box titled 'Open QIF Plan File' is open, showing a file explorer view of the '3QIFPlans' folder. The dialog box contains three files: 'AL_250.qif', 'CF_250.qif', and 'TL_250.qif'. The 'File name' field is set to 'AL_250.qif' and the file type is 'QIF XML file (*.qif)'. The 'Open' button is highlighted.

The 'Routine Library' window shows the following structure:

- Routine Library
 - Customer Routines
 - Demo
 - Lockheed Martin Demo
 - AL_250
 - CF_250
 - TL_250

The 'Properties' window for the 'Routine Library' shows the following settings:

Name: Lockheed Martin Demo

Settings:

- Default Routine Options
- Chart
- Export Options
- Traceability
- Assignable Cause
- Data Tests
- Report Options
- Schedule

Design:

- Collect Method: Collect By Part With Tallysheet
- Characteristic By Outlier Range: False

Setting:

- Force Serial Number: True
- Traceability Prompt: Before data is collected, apply to all characteristics.
- Force Lot Number: False
- Allow Delete Run: True
- Fill Missing Data On External Part End: False
- Data Collection Sound: (None)
- Force Note on Modify: True
- Handling of Outlier Data: Accept Observation
- Continuous Polling: Disabled
- Allow Floating Run: False
- Statistics And Capability: AIAG (Cp: 1.33 Cpk: 1.33 Pp: 1.33 Ppk: 1.33 Cm: 1.00 Cmk: 1.00)
- Max Number of Observations per Characteristic: Disabled
- Max Retakes: Unlimited Retakes
- Force Gage Tracking: False
- Auto Suspend Run on External Part End: False
- Auto Suspend Run on End of Import: False
- Calculate Cusum Chart: False
- Advanced Control Limit Calculation: Disabled
- Allow Multiple Assignable Causes: False

Collect Method: What sequence will be when collecting data

Buttons: Save, Reset



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QIF Plan Import

The screenshot displays the MeasurLink Console interface. The main window shows a 3D model of a circular part with a hole, labeled 'AL_250'. A data table is visible, showing 'AL_250' and 'Last Obs: N/A'. A 'Serial Number and Traceability' dialog box is open, showing a list of inspectors: Harry, Jan, Larry, and Martin. A small image in the bottom left shows a hand using a digital caliper to measure a part, with the display showing '0.2500'. The status bar at the bottom indicates 'Ready', 'Next: AL_250.Thickness', and 'DAQ: USB Input Tool'.

Obs	Sbg	Value

Inspector	Item
Harry	
Jan	
Larry	
Martin	



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Measurement Routine from QIF Plan

The screenshot displays the MeasurLink Console software interface. The main window is titled "MeasurLink Console - [Support Center]". The interface includes a menu bar with "File", "Home", "Tools", "Modules", and "Routine Library". Below the menu bar is a toolbar with icons for "New Routine Folder", "New Routine", "Import QIF Plan", "Find", "Save", "Reset", "Rename", "Delete", "Refresh", "Properties", "Copy", "Paste", and "Copy Mapping".

The "Routine Library" pane on the left shows a tree view with the following structure:

- Routine Library
 - Customer Routines
 - Demo
 - Lockheed Martin Demo
 - AL_250
 - AL_250.Thickness (selected)
 - CF_250
 - TI_250

The "Properties" pane on the right is titled "Routine Library" and shows the configuration for the selected routine "AL_250.Thickness". The "Name" field is "AL_250.Thickness" and the "Description" field is empty. The "Settings" tab is active, showing a "Revision" dropdown set to "Rev.1".

The "Tolerance Specification" section includes a "Standard" dropdown and a "Grade" dropdown. Below this is a table of tolerance limits:

	Low	Target	High
Tolerance	0.1750	0.2500	0.3250
Warning Limits	0.2125		0.2875
Outlier Limits	0.1375		0.3625
Control Limit (X)	0.1750	0.2500	0.3250
Control Limit (R)	0.0000	0.0282	0.0922
Subgroup Size	1		
Std. Dev. Unit	3.0000	Sigma Est.	0.02500

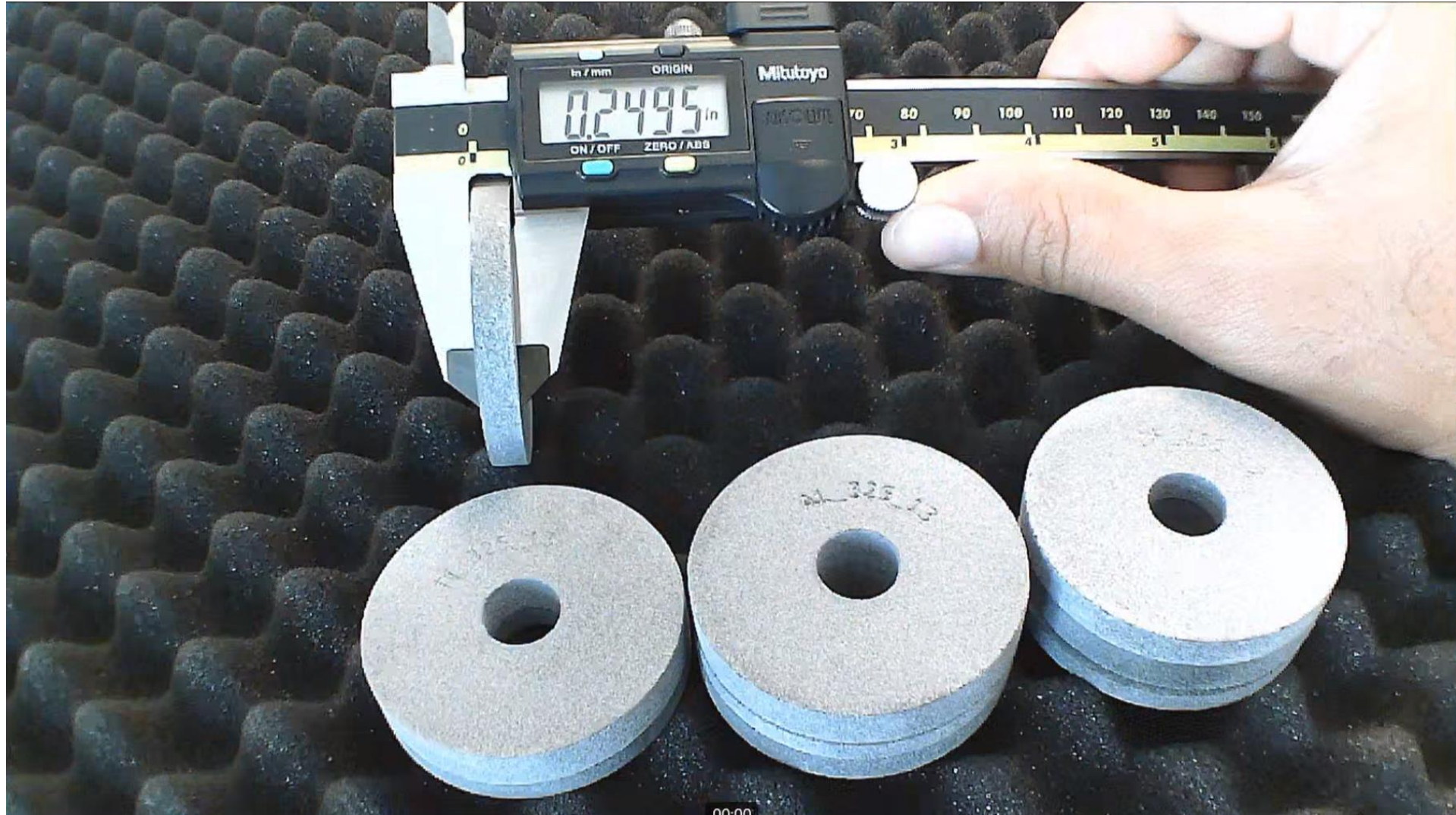
Below the table are "Clear" and "Auto Fill" buttons. The "Decimal Places" section shows a value of 4, with "Round" selected and "Truncate" unselected. The "Units" dropdown is set to "in" and the "Uncertainty" field is empty. The "Limit Type" dropdown is set to "Bilateral". The "Control Method" dropdown is set to "Data", the "Distribution" dropdown is set to "Normal", the "Parameters Estimation" dropdown is set to "Standard", the "Default Chart" dropdown is set to "IMR", and the "Control Chart" dropdown is set to "IMR".

At the bottom of the "Properties" pane are "Save" and "Reset" buttons. The bottom of the console window shows tabs for "Routine Library", "Device Library", "Station Library", and "Traceability Library".



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Direct Digital Gage Input



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Realtime Display

MeasurLink Console - [Real-Time]

Run: 8/28/2020 11:34:21 AM [AL_250]

AL_250		Thickness		
Obs	Sbg	Value	Timestamp	
1	1	0.2500	8/28/2020 12:08:40	
2	2	0.1815	8/28/2020 12:08:55	
3	3	0.3265	8/28/2020 12:09:09	

Last Obs: 0.3265

Target: 0.2500

LTL: 0.1750 UTL: 0.3250 Serial Number: 13

Control Chart Data:

Obs	Value
1	0.2500
2	0.1815
3	0.3265

Ready Next: AL_250.Thickness DAQ: USB Input Tool



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QIF Export

The screenshot displays the MeasurLink Console interface in Real-Time mode. The main window shows a 3D View of a part with a table of data:

Run: 8/28/2020 11:34:1	
AL_250	Obs
Last Obs: 0.3265	1
	2
	3
Target: 0.2500	
LTL: 0.1750	UTL: 0.3250

Below the table is a graph showing a data trend and a photograph of a digital caliper displaying 0.2500. An 'Export' dialog box is open, allowing selection of the output directory and file name. The 'QIF Standard 3.0' option is selected. The 'QIF Output Directory' is set to 'C:\Users\abdel-motalebh\Desktop\QIF\Lockheed_Martin_Demo\QIF_Results' and the 'File Name' is 'AL_250_Results.QIF'. A 'MeasurLink Help - Expo' window is also open, displaying the 'Import QIF' and 'Export Data' sections.

Import QIF
Overview **QIF** (Quality Information Framework) is a NIST supported XML format for moving information between software systems. MeasurLink supports this XML format for import into MeasurLink and export from MeasurLink. For more information on **QIF** see <https://qifstandards.org/>. It is an offering ...
[MeasurLink/Import and Export Data/Import QIF.htm](#)

Export Data
Export Wizard The Export function is only available when there is a run open in Real-Time. The run currently visible in Real-Time is the run that will be exported. 1. Click on the Export Icon, Tools Menu. 2. Select an output type Text, Excel, AQDEF or **QIF** and, click next. See also ...
[MeasurLink/Import and Export Data/Export Data.htm](#)

At the bottom of the console, the status bar shows 'Ready', 'Next: AL_250.Thickness', and 'DAQ: USB Input Tool'.



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QIF Plan and QIF Results Compare

Left file: C:\Users\maggiano\Desktop\Lockheed Use Case\Working 25 Aug\3QIFPlans\AL_250.qif

Right file: C:\Users\maggiano\Desktop\Lockheed Use Case\Working 25 Aug\4QIFResults\AL_250 Results Keyin.QIF

Show spaces / tabs

Report type: All (Matching and Differences)

Summary: 34 Line(s) match | 15 Block(s) diff | 70 : 203 Line(s) diff

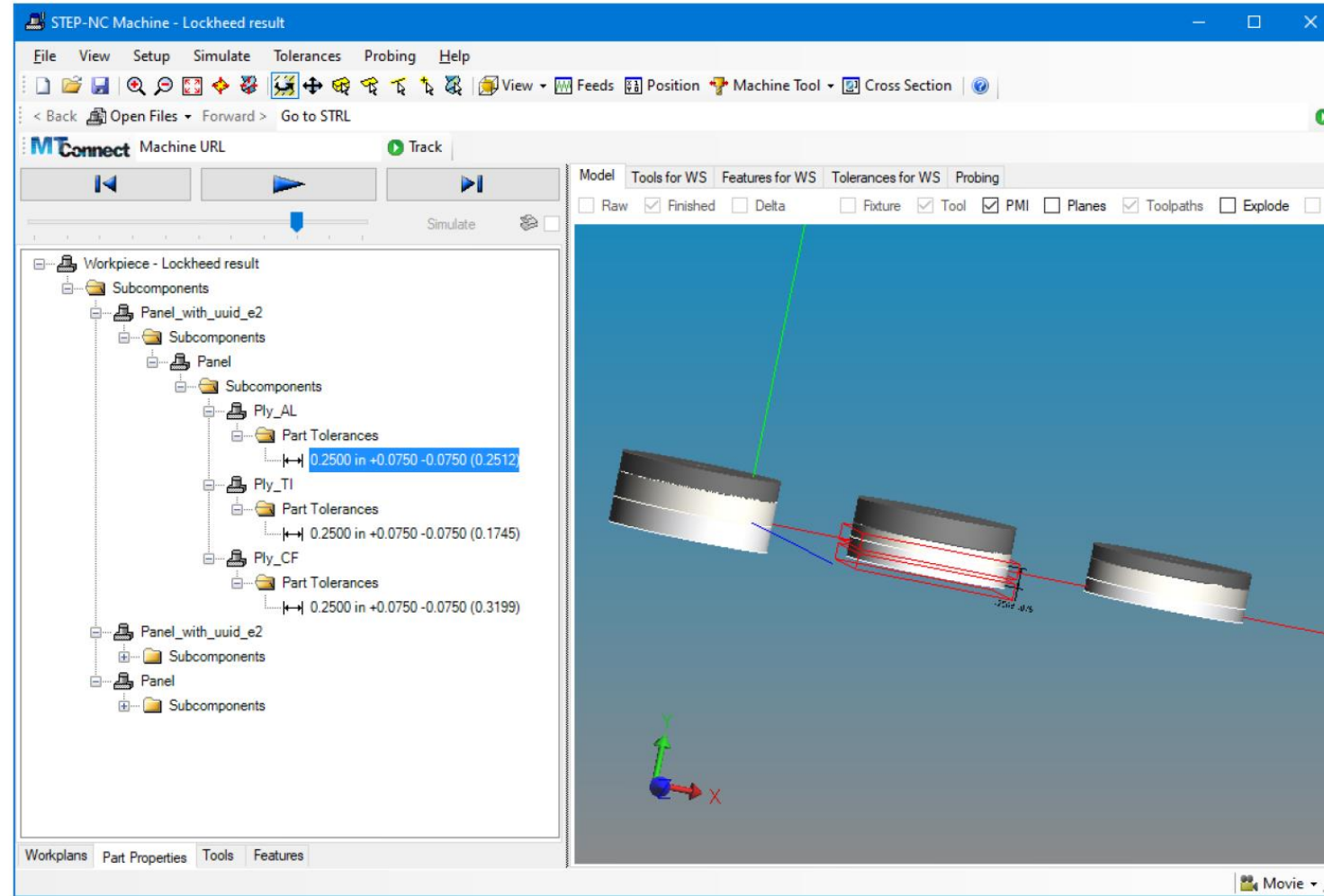
Ignore options: Ignore blank lines | Ignore line terminators

C:\Users\maggiano\Desktop\Lockheed Use Case\Working 25 Aug\3QIFPlans\AL_250.qif		C:\Users\maggiano\Desktop\Lockheed Use Case\Working 25 Aug\4QIFResults\AL_250 Results Keyin.QIF	
1	<?xml version="1.0" encoding="utf-8"?>	1	<?xml version="1.0" encoding="utf-8"?>
2	* <QIFDocument xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://qifstandards.org/xsd/qif3 ../QIFApplications/QIFDocument.xsd" versionQIF="3.0.0" idMax="12" xmlns="http://qifstandards.org/xsd/qif3">	2	<QIFDocument xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://qifstandards.org/xsd/qif3 ../QIFApplications/QIFDocument.xsd" versionQIF="3.0.0" idMax="19" xmlns="http://qifstandards.org/xsd/qif3">
3	* <QPId>27a30a16-fc38-4993-8f96-1e812a0b843e</QPId>	3	<QPId>1c62e41b-9064-4256-9325-7926618ea1e2</QPId>
4	<Header>	4	<Header>
5	<Application>	5	<Application>
6	* <Name>MiCAT Planner</Name>	6	<Name>MeasurLink application</Name>
7	<Organization>Mitutoyo America Corporation</Organization>	7	<Organization>Mitutoyo America Corporation</Organization>
8	</Application>	8	</Application>
9	</Header>	9	</Header>
92	<CharacteristicDesignator>	73	<CharacteristicDesignator>
93	* <Designator>Thickness</Designator>	74	<Designator>508</Designator>
94	<UUID>6a45ec6c-3b4e-4b17-ae85-aada5131a8ec</UUID>	75	<UUID>6a45ec6c-3b4e-4b17-ae85-aada5131a8ec</UUID>
95	</CharacteristicDesignator>	76	</CharacteristicDesignator>



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Twin model stackup



Conclusions

- STEP AP242 to and from QIF is a valid model based dimensional measurement workflow
- Traceable QIF Plans (Bill of Characteristics) can be extracted from STEP AP242 MBDs
- Traceable QIF Results enable as-built STEP assembled Digital Twins if characteristic UUIDs are maintained throughout



Participants

Lockheed Martin Corporation

STEP Tools, Inc.

Mitutoyo America Corporation

