

DTI - DefectDetector

MLServer Speed trials 3/2/23

Synopsis

3 box-side scans and 4 pin-side scans are ran on the 16" tube. *DefectDetector* is enabled, and detection time is measured for each scan.

- *DefectDetector* limits reported defects to the largest 25, to maintain a smooth PipeScanView UI interaction.
- Same lighting, speed, and sequence conditions are held for each scan. GPU warm-up for each trial.
- One trial subsequently follows the next, in the same UI session.

Findings:

1. Scan times are within 4.8s - 50s, depending on image size, number of defects present, and order of scan.
2. Detection time seems to increase after every scan, hinting at a memory allocation issue. We may need to do some kind of garbage collection, RAM clearing after every detection.
3. Box-side nose scan defects are not that accurate. ML model trained on pin-side thread scan and this could be an emergent property of the model's bias.
4. Model and image input size could be the bottleneck. Model predictions are made from batched 256x256 images, it could be worth exploring other image sizes (48x48 → 96x96 → 512x512, etc...) and measure prediction time to see if there's an optimal input image size.

Synopsis

Trial Name	Sequence Time (sec)	Image	25 clusters max	Prediction Time (sec)
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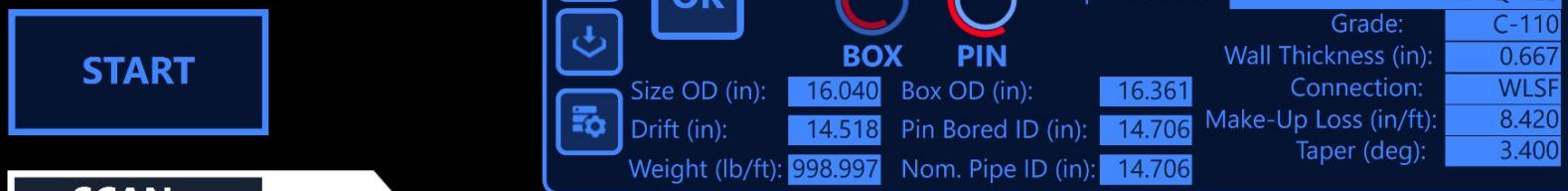
16" pipe - Max defects to visualize = 25

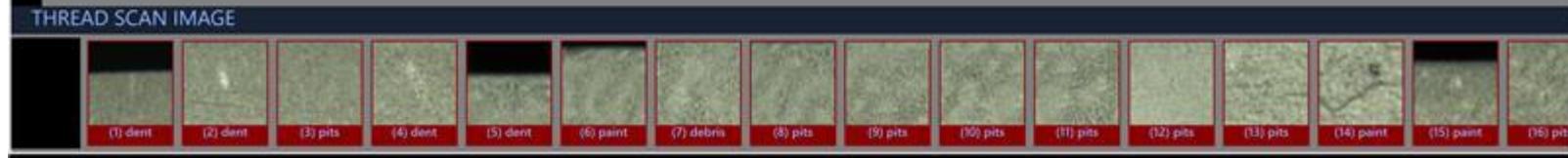
Pin 1	142	Thread	Y	22.59
	142	Nose	Y	4.82
Pin 2	179	Thread	Y	50.87
	179	Nose	Y	12.76
Pin 3	175	Thread	Y	42.65
	175	Nose	Y	16.57
Box 1	171.43	ID Thread	Y	28
	171.43	Nose	Y	17
	171.43	OD Scan	Y	6.49
Box 2	198.154	ID Thread	Y	37.18
	198.154	Nose	Y	31.55
	198.154	OD Scan	Y	9.3
Box 3	211.83	ID Thread	Y	48.614
	211.83	Nose	Y	33.02
	211.83	OD Scan	Y	10.16

16" pipe - All cluseters reported

Pin - All clusters	144	Thread	N - 520	22.8
	144	Nose	N - 20	4.51

PIN SIDE TRIALS





Output



Show output from: Debug

```
        "Location": "1010,100,50,50",
        "Name": "dent",
        "Thumbnail": "System.Windows.Media.Imaging.WriteableBitmap"
    }
]
},
"InnerBoxODScan": null,
"ThreadedScanType": 2,
"FailureMessage": "49 Defects",
"LogDirectory": "C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302130142"
}
```

Data Directory C:\Users\TSI\source\repos\dev_threadinspection\UI.App\bin\x64\Debug\scanlogs\scn20230302130142

>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 142

The thread 0x3cf4 has exited with code 0 (0x0).

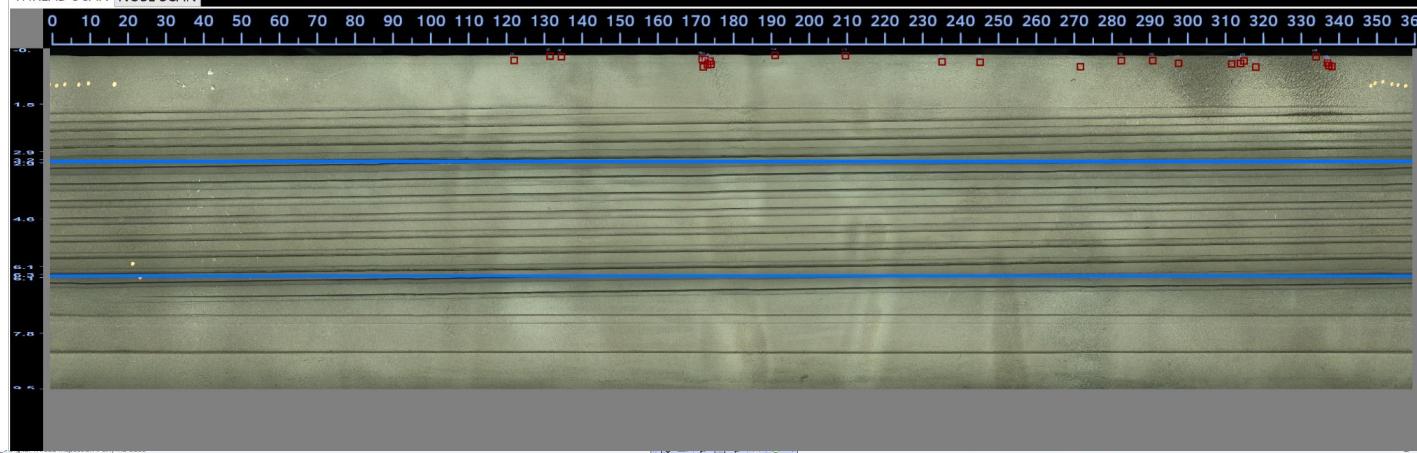
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\WINDOWS\Microsoft.Net\assembly\GAC_MSIL\System.Windows.Input.Manipulations\v4.0_4.

```
redundant event: ENDUIFRAME
[BEGIN SCAN PIPE THREAD AT 3/2/2023 1:03:34 PM. Elapsed 111.6540198]
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\Users\TSI\source\repos\dev_threadinspection\UI.App\bin\x64\Debug\Accord.Imaging.dll'.
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\Users\TSI\source\repos\dev_threadinspection\UI.App\bin\x64\Debug\Accord.dll'. Skip
CLIENT: sending message: C:\Users\TSI\source\repos\dev_threadinspection\UI.MachineLearning\tempImage.jpg
*elapsed time: 4.288190700000001, num defects: 24, path: C:\Users\TSI\source\repos\dev_threadinspection\UI.MachineLearning\tempImage.jpg
CLIENT: sending message: C:\Users\TSI\source\repos\dev_threadinspection\UI.MachineLearning\tempImage.jpg
The thread 0x2f0c has exited with code 0 (0x0).
The thread 0x2adc has exited with code 0 (0x0).
The thread 0x4a78 has exited with code 0 (0x0).
```

```
*elapsed time: 22.591426600000005, num defects: 25, path: C:\Users\TSI\source\repos\dev_threadinspection\UI.MachineLearning\tempImage.jpg
>>> INSPECTION DONE AT 3/2/2023 1:04:04 PM. Elapsed 142.3021289
```

```
{ 
    "DateTime": "2023-03-02T13:01:42.4279245-06:00",
    "InternalDiameterAverage": 374.314,
    "InternalDiameterMinimum": 374.164,
    "InternalDiameterMaximum": 374.418,
    "InternalDiameterEccentricity": 0.0368281437161238,
```

THREAD SCAN NOSE SCAN



THREAD SCAN NOSE SCAN



NOSE SCAN IMAGE



Pin side 2

```
        "Thumbnail": "System.Windows.Media.Imaging.WriteableBitmap"
    }
}
},
"InnerBoxODScan": null,
"ThreadedScanType": 2,
"FailureMessage": "49 Defects",
"LogDirectory": "C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.App\\\\bin\\\\x64\\\\Debug\\\\scanlogs\\\\scn20230302130838"
}
Data Directory C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.App\\\\bin\\\\x64\\\\Debug\\\\scanlogs\\\\scn20230302130838
>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 179
The thread 0xde0 has exited with code 0 (0x0).
```

```
accTrim=207, decTrim=138
Teledyne Event: EndOfFrame
[BEGIN SCAN PIPE THREAD AT 3/2/2023 1:10:30 PM. Elapsed 111.8369899]
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.App\\\\bin\\\\x64\\\\Debug\\\\Accord.Imaging.dll'. 
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.App\\\\bin\\\\x64\\\\Debug\\\\Accord.dll'. 
CLIENT: sending message: C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.MachineLearning\\\\tempImage.jpg
*elapsed time: 12.766952299999957, num defects: 24, path: C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.MachineLearning\\\\tempImage.jpg
CLIENT: sending message: C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.MachineLearning\\\\tempImage.jpg
The thread 0x4530 has exited with code 0 (0x0).
The thread 0x141c has exited with code 0 (0x0).
The thread 0x372c has exited with code 0 (0x0).
*elapsed time: 50.87485719999995, num defects: 25, path: C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.MachineLearning\\\\tempImage.jpg
>>> INSPECTION DONE AT 3/2/2023 1:11:37 PM. Elapsed 179.2758297
{
    "DateTime": "2023-03-02T13:08:38.6226777-06:00",
```



THREAD SCAN NOSE SCAN



NOSE SCAN IMAGE



```
        }
    ],
},
"InnerBoxODScan": null,
"ThreadedScanType": 2,
"FailureMessage": "45 Defects",
"LogDirectory": "C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302131414"
}
Data Directory C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302131414
>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 175
The thread 0x3c2c has exited with code 0 (0x0).
```

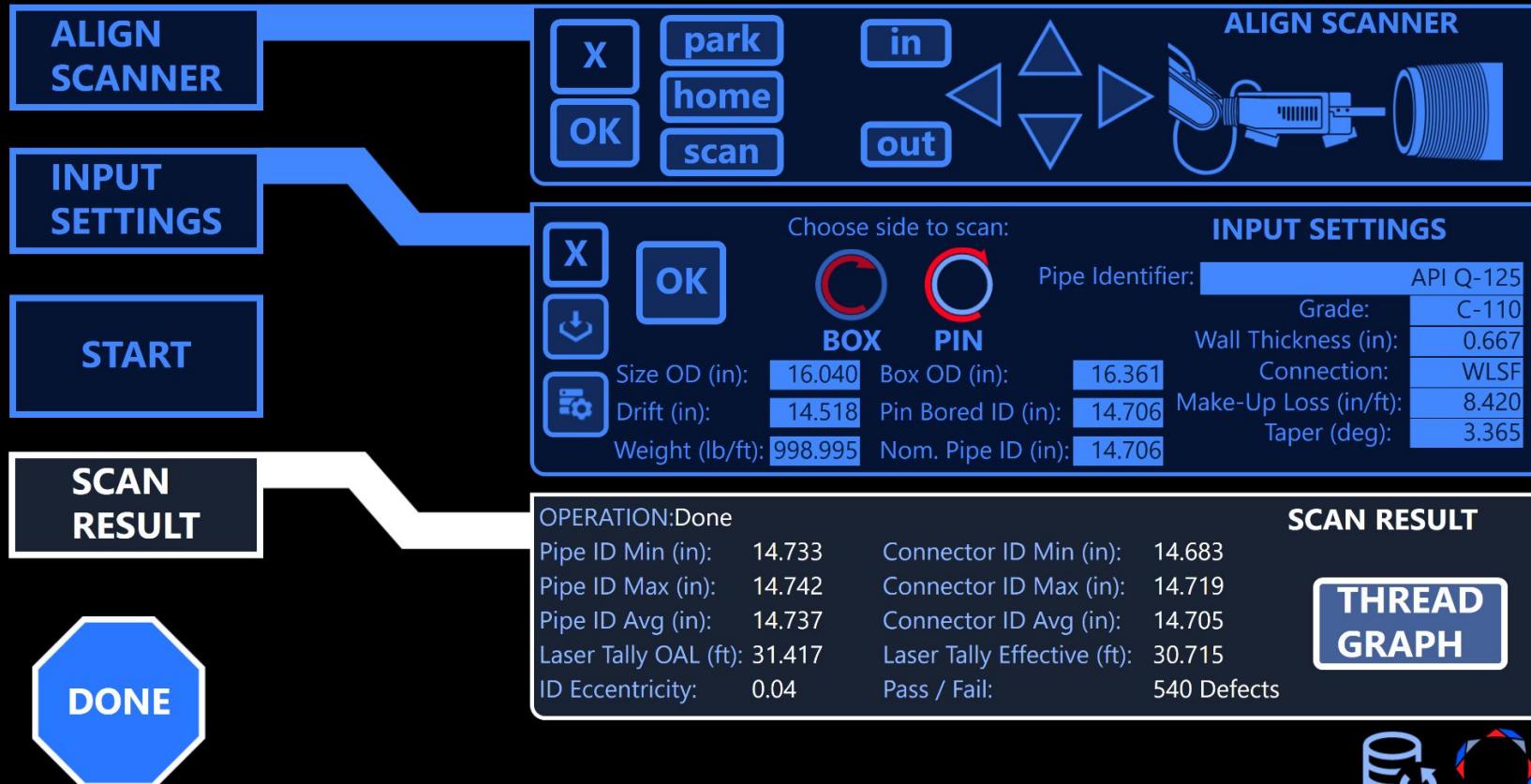
Pin side 3

```
pipeRadius10PatnRadiusRatio=0.76/955400/1421, speed=100, genoverridepercentage=100, exposure_us=250, linekate=1580.25161212856
accTrim=207, decTrim=138
Teledyne Event: EndOfFrame
[BEGIN SCAN PIPE THREAD AT 3/2/2023 1:16:07 PM. Elapsed 112.3215319]
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.Imaging.dll'.
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.dll'. Skip
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
*elapsed time: 16.570650900000032, num defects: 20, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x22d4 has exited with code 0 (0x0).
The thread 0x1cb0 has exited with code 0 (0x0).
*elapsed time: 42.46532429999991, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
>>> INSPECTION DONE AT 3/2/2023 1:17:09 PM. Elapsed 174.916841
{
    "DateTime": "2023-03-02T13:14:14.708737-06:00",
    "InternalDiameterAverage": 374.396,
    "InternalDiameterMinimum": 374.285,
    "InternalDiameterMaximum": 374.488,
```

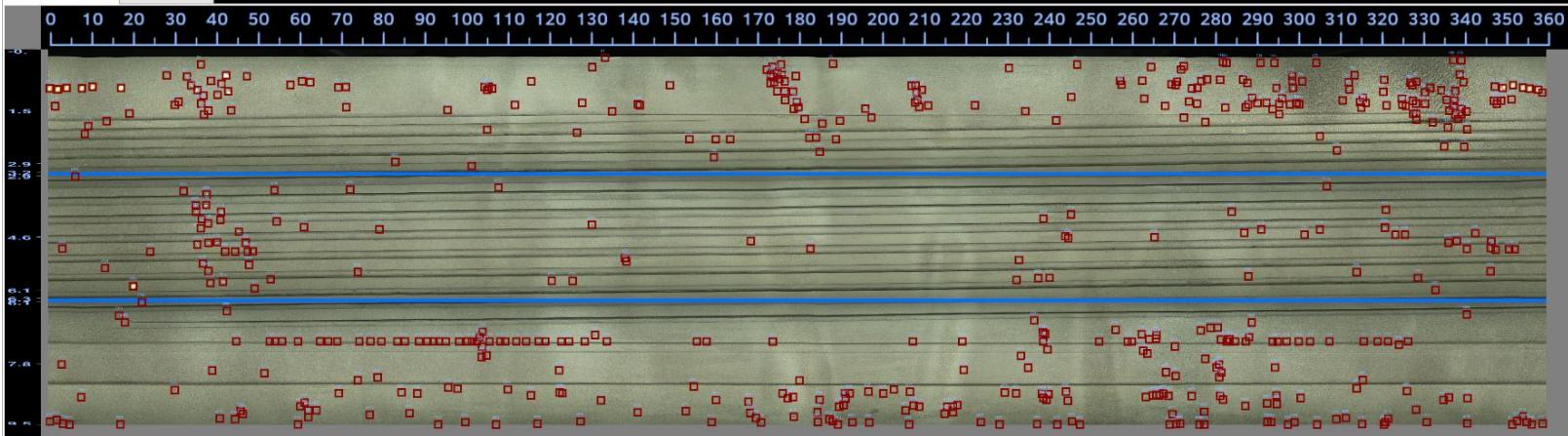
Pin side - all clusters

```
        "Thumbnail": "System.Windows.Media.Imaging.WriteableBitmap"
    }
}
],
"InnerBoxODScan": null,
"ThreadedScanType": 2,
"FailureMessage": "540 Defects",
"LogDirectory": "C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302133414"
}
Data Directory C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302133414
>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 144
The thread 0x2a0c has exited with code 0 (0x0).
```

```
accTrim=207, decTrim=138
Teledyne Event: EndOfFrame
[BEGIN SCAN PIPE THREAD AT 3/2/2023 1:36:06 PM. Elapsed 111.9492917]
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.Imaging.dll'.
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.dll'. Skip
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
*elapsed time: 4.151785700000005, num defects: 20, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.j
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0xd78 has exited with code 0 (0x0).
The thread 0xd7c has exited with code 0 (0x0).
The thread 0x3b8c has exited with code 0 (0x0).
*elapsed time: 22.814344000000006, num defects: 520, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage
>>> INSPECTION DONE AT 3/2/2023 1:36:38 PM. Elapsed 143.9714048
{
```



THREAD SCAN NOSE SCAN



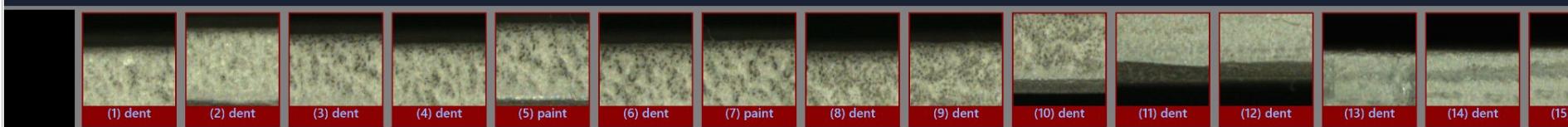
THREAD SCAN IMAGE



THREAD SCAN NOSE SCAN



NOSE SCAN IMAGE



BOX SIDE TRIALS

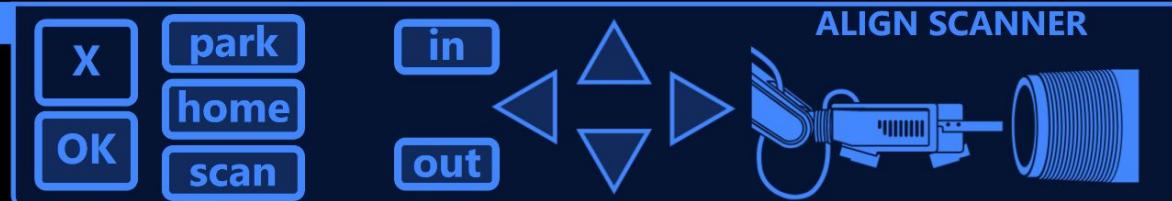
**ALIGN
SCANNER**

**INPUT
SETTINGS**

START

**SCAN
RESULT**

DONE



Choose side to scan:

BOX **PIN**

Size OD (in):	16.040	Box OD (in):	16.361
Drift (in):	14.518	Pin Bored ID (in):	14.706
Weight (lb/ft):	998.996	Nom. Pipe ID (in):	14.706

INPUT SETTINGS

Pipe Identifier: API Q-125
Grade: C-110
Wall Thickness (in): 0.667
Connection: WLSF
Make-Up Loss (in/ft): 8.420
Taper (deg): 3.342

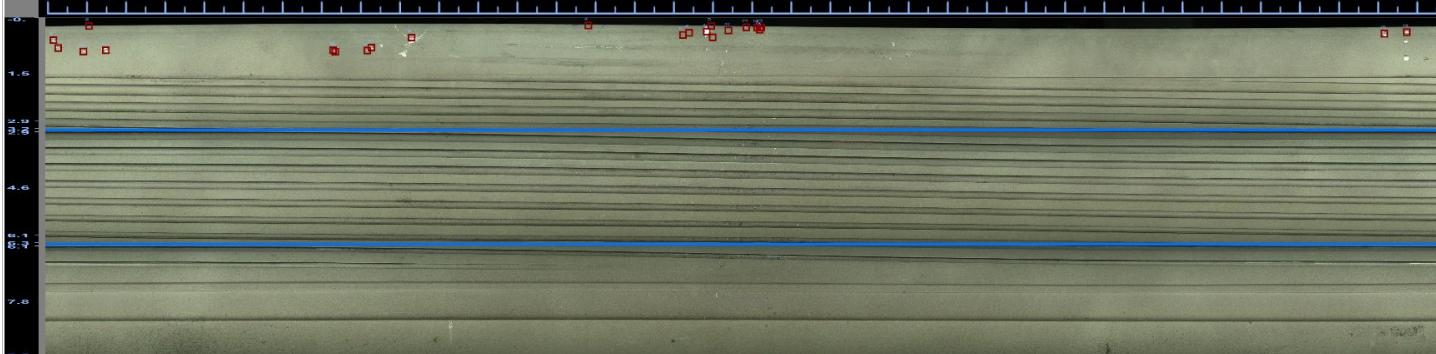
OPERATION: Done		SCAN RESULT	
Pipe ID Min (in):	14.722	Connector ID Min (in):	0.000
Pipe ID Max (in):	14.762	Connector ID Max (in):	0.000
Pipe ID Avg (in):	14.738	Connector ID Avg (in):	0.000
Laser Tally OAL (ft):	31.346	Laser Tally Effective (ft):	30.644
ID Eccentricity:	0.07	Pass / Fail:	75 Defects

**THREAD
GRAPH**



THREAD SCAN NOSE SCAN BOX SCAN

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360



THREAD SCAN IMAGE



START
MARKING

INVERT



THREAD SCAN NOSE SCAN BOX SCAN



NOSE SCAN IMAGE



THREAD SCAN NOSE SCAN BOX SCAN



8.3

7.6

6.9

6.2

5.5

4.8

4.1

3.4

2.7

2.0

1.3

0.6

0

BOX OD SCAN



START
MARKING

INVERT



Box side 1

```
        "Thumbnail": "System.Windows.Media.Imaging.WriteableBitmap"
    }
]
},
"ThreadedScanType": 1,
"FailureMessage": "75 Defects",
"LogDirectory": "C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302121547"
}
Data Directory C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302121547
>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 171
The thread 0x170c has exited with code 0 (0x0).
The thread 0xf38 has exited with code 0 (0x0).
```

```
pipeRadiusToPathRadiusRatio=0.706734507660022, speed=250, genoverridePercentage=100, exposure_us=250, lineRate=3180.3052844701
accTrim=477, decTrim=318
Teledyne Event: EndOfFrame
[BEGIN SCAN PIPE THREAD AT 3/2/2023 12:17:42 PM. Elapsed 115.5140182]
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.Imaging.dll'.
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.dll'. Skip
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
*elapsed time 6.49352420000001, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x4784 has exited with code 0 (0x0).
*elapsed time: 17.0035278, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg , no
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x477c has exited with code 0 (0x0).
The thread 0x2960 has exited with code 0 (0x0).
*elapsed time 28.06426790000004, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
>>> INSPECTION DONE AT 3/2/2023 12:18:38 PM. Elapsed 171.4387966
{
    "DateTime": "2023-03-02T12:15:47.3082285-06:00",
    "InternalDiameterAverage": 374.355,
    "InternalDiameterMinimum": 373.937,
    "InternalDiameterMaximum": 374.962,
    "InternalDiameterEccentricity": 0.073890107950087242,
```

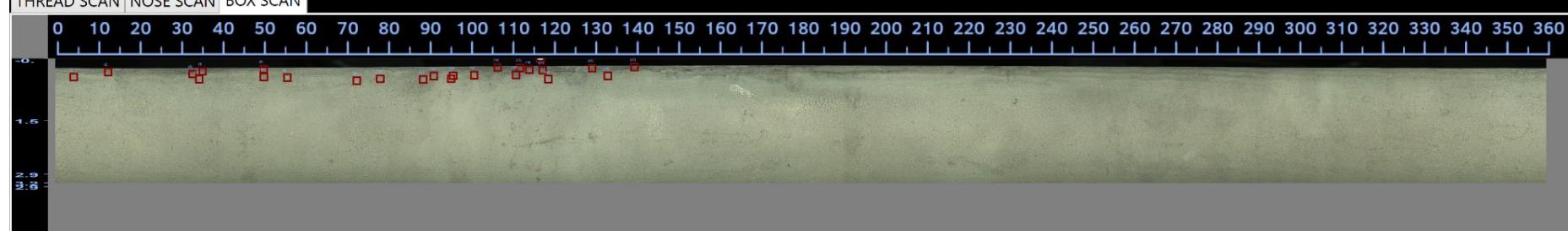
THREAD SCAN NOSE SCAN BOX SCAN



THREAD SCAN NOSE SCAN BOX SCAN



THREAD SCAN NOSE SCAN BOX SCAN



```
"LogDirectory": "C:\\\\Users\\\\TSI\\\\source\\\\repos\\\\dev_threadinspection\\\\UI.App\\\\bin\\\\x64\\\\Debug\\\\scanlogs\\\\scn20230302122229"
}
Data Directory C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302122229
>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 198
The thread 0x401c has exited with code 0 (0x0).
```

Box side 2

```
[BEGIN SCAN PIPE THREAD AT 3/2/2023 12:24:25 PM. Elapsed 115.4705923]
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.Imaging.dll'.
'UI.App.exe' (CLR v4.0.30319: UI.App.exe): Loaded 'C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\Accord.dll'. Skipped
CLIENT: sending message:  C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
*elapsed time 9.325272100000007, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
CLIENT: sending message:  C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x4b24 has exited with code 0 (0x0).
The thread 0x4b20 has exited with code 0 (0x0).
The thread 0x4b1c has exited with code 0 (0x0).
*elapsed time 31.555300200000033, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
CLIENT: sending message:  C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x4830 has exited with code 0 (0x0).
*elapsed time 37.186586499999976, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
>>> INSPECTION DONE AT 3/2/2023 12:25:48 PM. Elapsed 198.1546032
{
    "DateTime": "2023-03-02T12:22:29.9878106-06:00",
```

Box side 3

```
        ]
    },
    "ThreadedScanType": 1,
    "FailureMessage": "75 Defects",
    "LogDirectory": "C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302122929"
}
Data Directory C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302122929
>>> TOTAL RUNTIME FOR SEQUENCE IN SECONDS: 211
The thread 0x466c has exited with code 0 (0x0).
```

```
UI.App.exe (0x10000000) loaded C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.App\\bin\\x64\\Debug\\scanlogs\\scn20230302122929
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
*elapsed time: 10.167048399999999, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x24fc has exited with code 0 (0x0).
The thread 0x45cc has exited with code 0 (0x0).
*elapsed time: 33.02514819999999, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
CLIENT: sending message: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
The thread 0x386c has exited with code 0 (0x0).
*elapsed time: 48.614643999999985, num defects: 25, path: C:\\Users\\TSI\\source\\repos\\dev_threadinspection\\UI.MachineLearning\\tempImage.jpg
>>> INSPECTION DONE AT 3/2/2023 12:33:01 PM. Elapsed 211.8385168
{
    "DateTime": "2023-03-02T12:29:29.572639-06:00",
    "InternalDiameterAverage": 374.309,
    "ExternalDiameterAverage": 373.710
```