

## Aircraft Engine RVI Resolution Requirements

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1. Introduction
  2. What is Resolution
  3. How to Measure Resolution
  4. Industry Standards
  5. New Technology Performance
  6. Implications
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## Introduction

- Aircraft engine inspection is highly standardized
  - RVI is no different
  - How do we quantify visual inspections?
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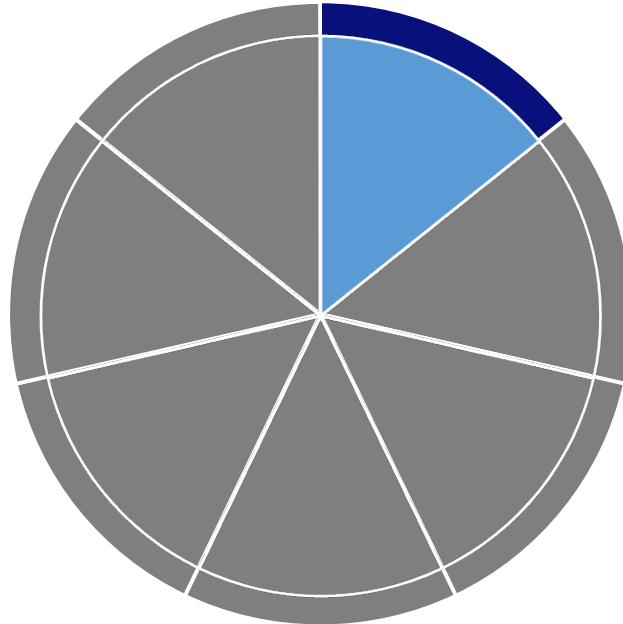
## What is Resolution?

The number of pixels on an imaging chip

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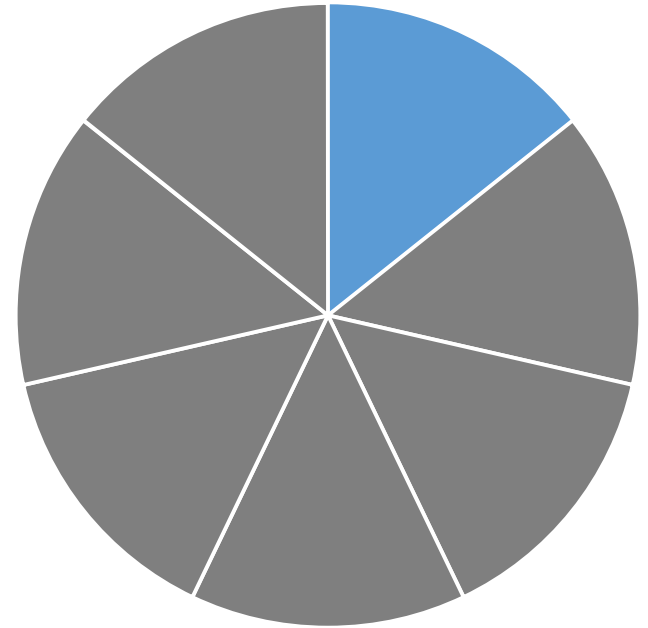
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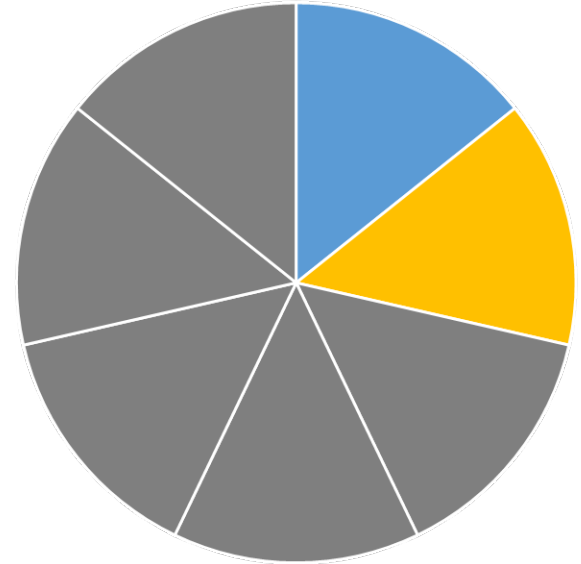
The number of pixels on an imaging chip



## What is Resolution?

The number of pixels on an imaging chip

Light Distribution and Intensity

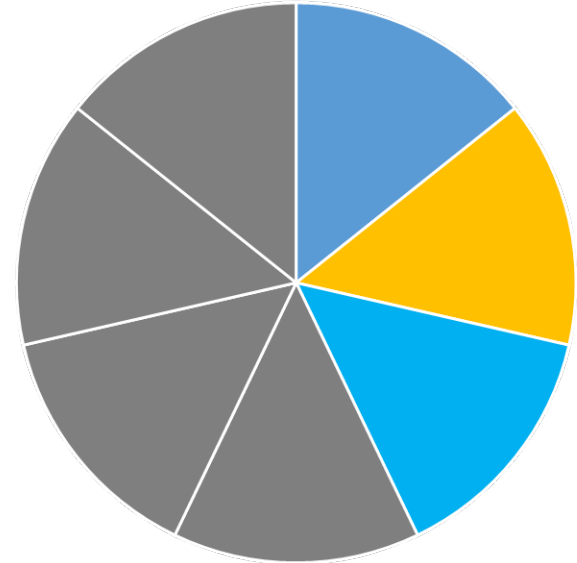


## What is Resolution?

The number of pixels on an imaging chip

Light Distribution and Intensity

Lensing (focal ranges and lens defects)





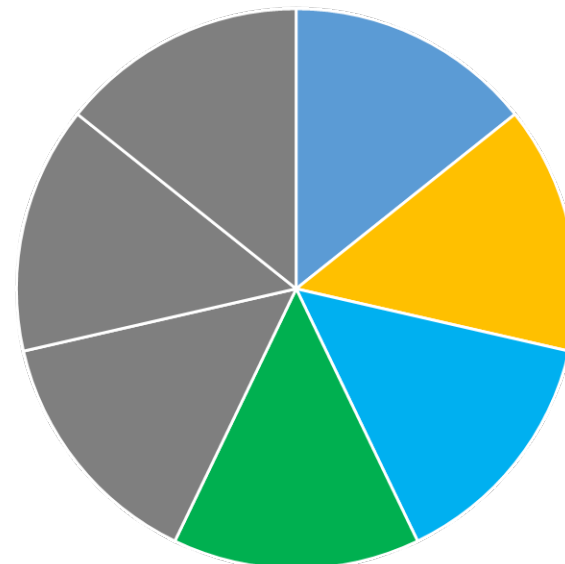
## What is Resolution?

The number of pixels on an imaging chip

Light Distribution and Intensity

Lensing (focal ranges and lens defects)

Image reproduction (Color, Sharpness, Gain, ...)



## What is Resolution?

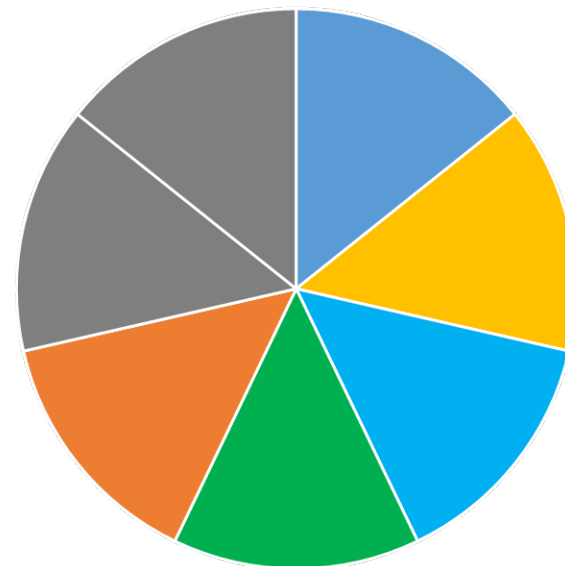
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Light Distribution and Intensity

Lensing (focal ranges and lens defects)

Image reproduction (Color, Sharpness, Gain, ...)

Screen itself



## What is Resolution?

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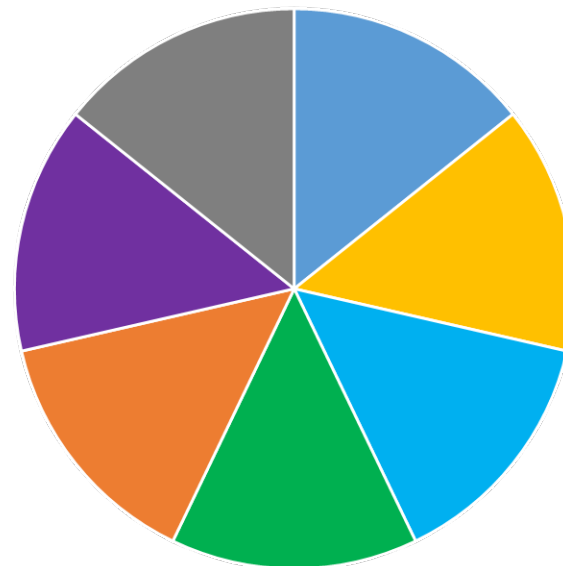
Light Distribution and Intensity

Lensing (focal ranges and lens defects)

Image reproduction (Color, Sharpness, Gain, ...)

Screen itself

Image saving algorithm



## What is Resolution?

The number of pixels on an imaging chip

Light Distribution and Intensity

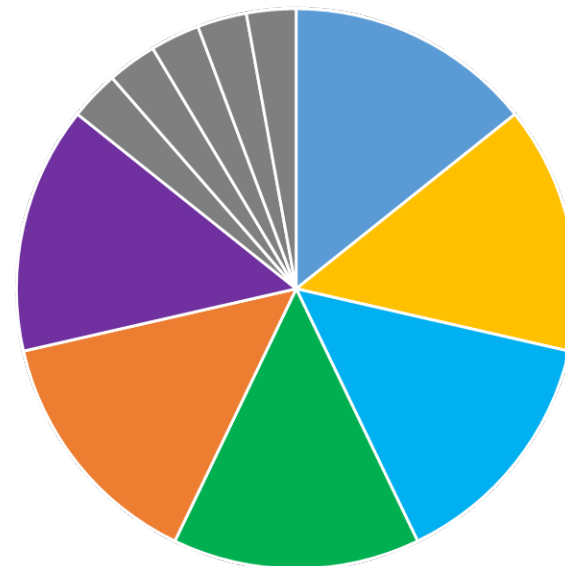
Lensing (focal ranges and lens defects)

Image reproduction (Color, Sharpness, Gain, ...)

Screen itself

Image saving algorithm

Even more variables



## What is Resolution?

Resolution is the smallest size of what you are able to resolve.

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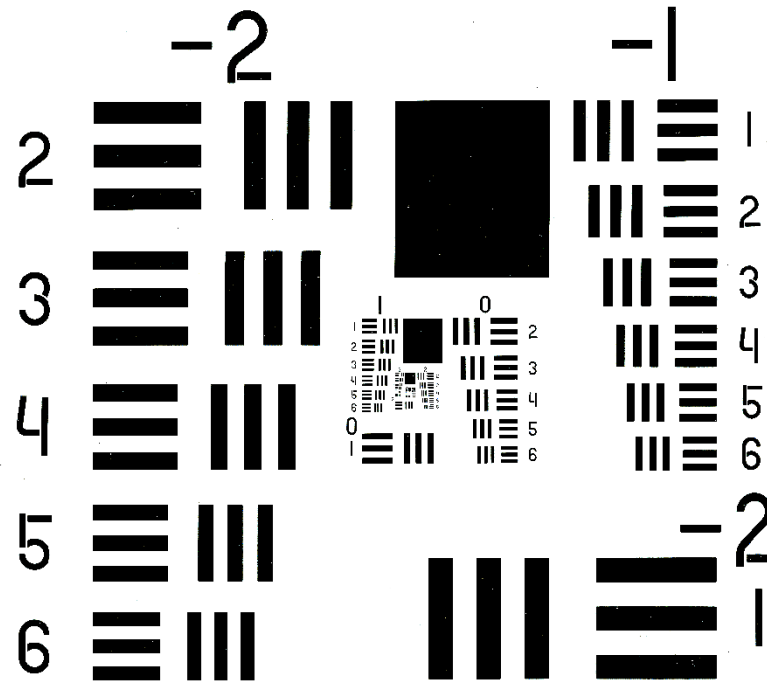
## How to Measure Resolution

We incorporate all the variables by resolving smallest distances.

Most common reference standard is the USAF 1951 resolution chart.

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## How to Measure Resolution



Find smallest Group-Element

1. Line pair/mm
2. Bar width (micrometers)

# How to Measure Resolution

Line pairs/mm

Group Number												
Element	-2	-1	0	1	2	3	4	5	6	7	8	9
1	0.25	0.5	1	2	4	8	16	32	64	128	256	512
2	0.281	0.561	1.12	2.24	4.49	8.98	17.96	35.9	71.8	143.7	287.4	574.7
3	0.315	0.63	1.26	2.52	5.04	10.08	20.16	40.3	80.6	161.3	322.5	645.1
4	0.354	0.707	1.41	2.83	5.66	11.31	22.63	45.3	90.5	181	362	724.1
5	0.397	0.794	1.59	3.17	6.35	12.7	25.4	50.8	101.6	203.2	406.4	812.7
6	0.445	0.891	1.78	3.56	7.13	14.25	28.51	57	114	228.1	456.1	912.3

Width of each bar in micrometers

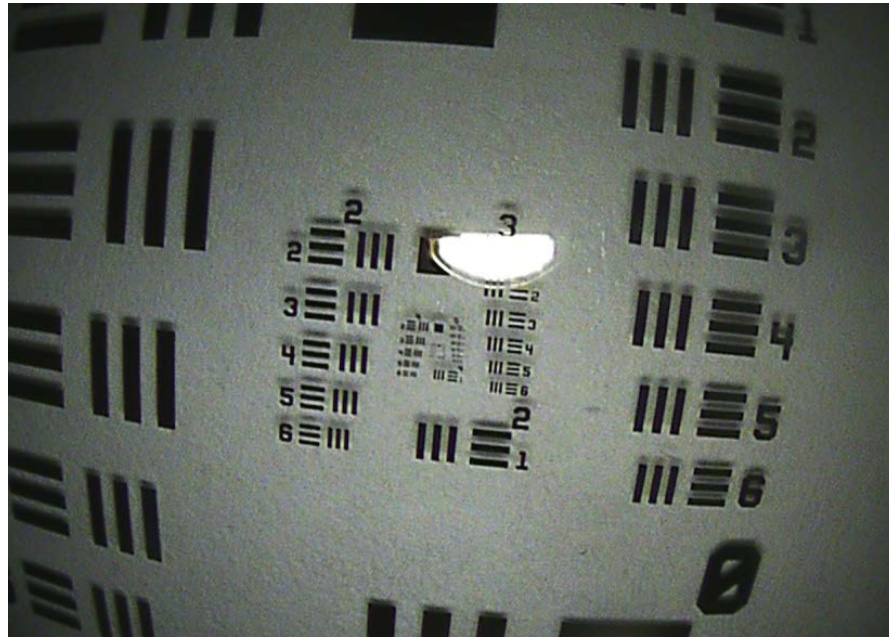
Group Number												
Element	-2	-1	0	1	2	3	4	5	6	7	8	9
1	2000	1000	500	250	125	62.5	31.25	15.63	7.81	3.91	1.95	0.98
2	1781.8	890.9	445.45	222.72	111.36	55.68	27.84	13.92	6.96	3.48	1.74	0.87
3	1587.4	793.7	396.85	198.43	99.21	49.61	24.8	12.4	6.2	3.1	1.55	0.78
4	1414.21	707.11	353.55	176.78	88.39	44.19	22.1	11.05	5.52	2.76	1.38	0.69
5	1259.92	629.96	314.98	157.49	78.75	39.37	19.69	9.84	4.92	2.46	1.23	0.62
6	1122.46	561.23	280.62	140.31	70.15	35.08	17.54	8.77	4.38	2.19	1.1	0.55

Find smallest Group-Element

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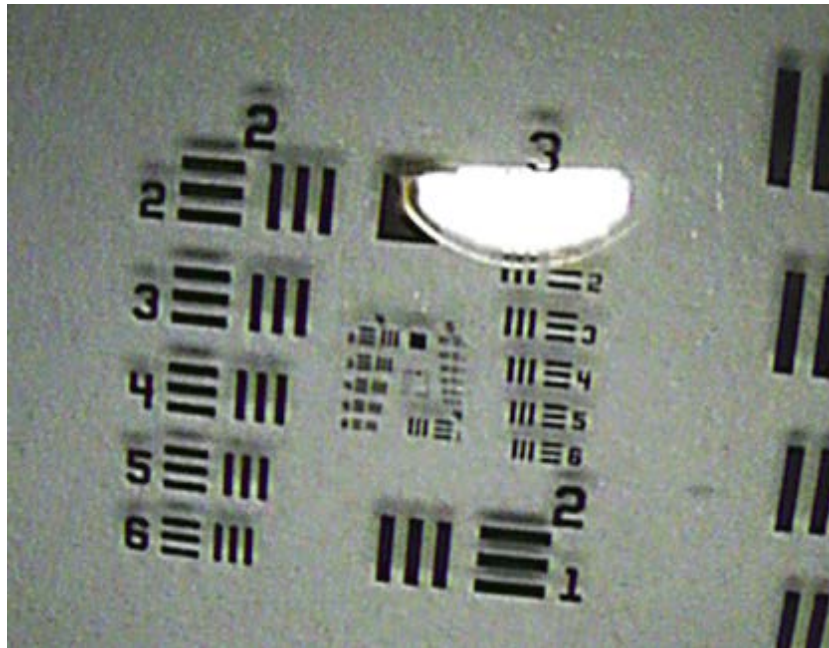
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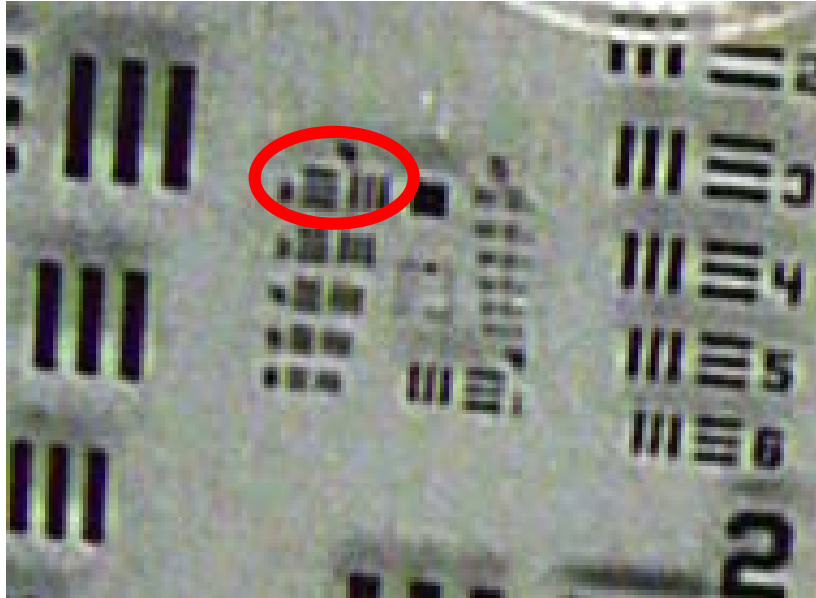
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## Industry Standards

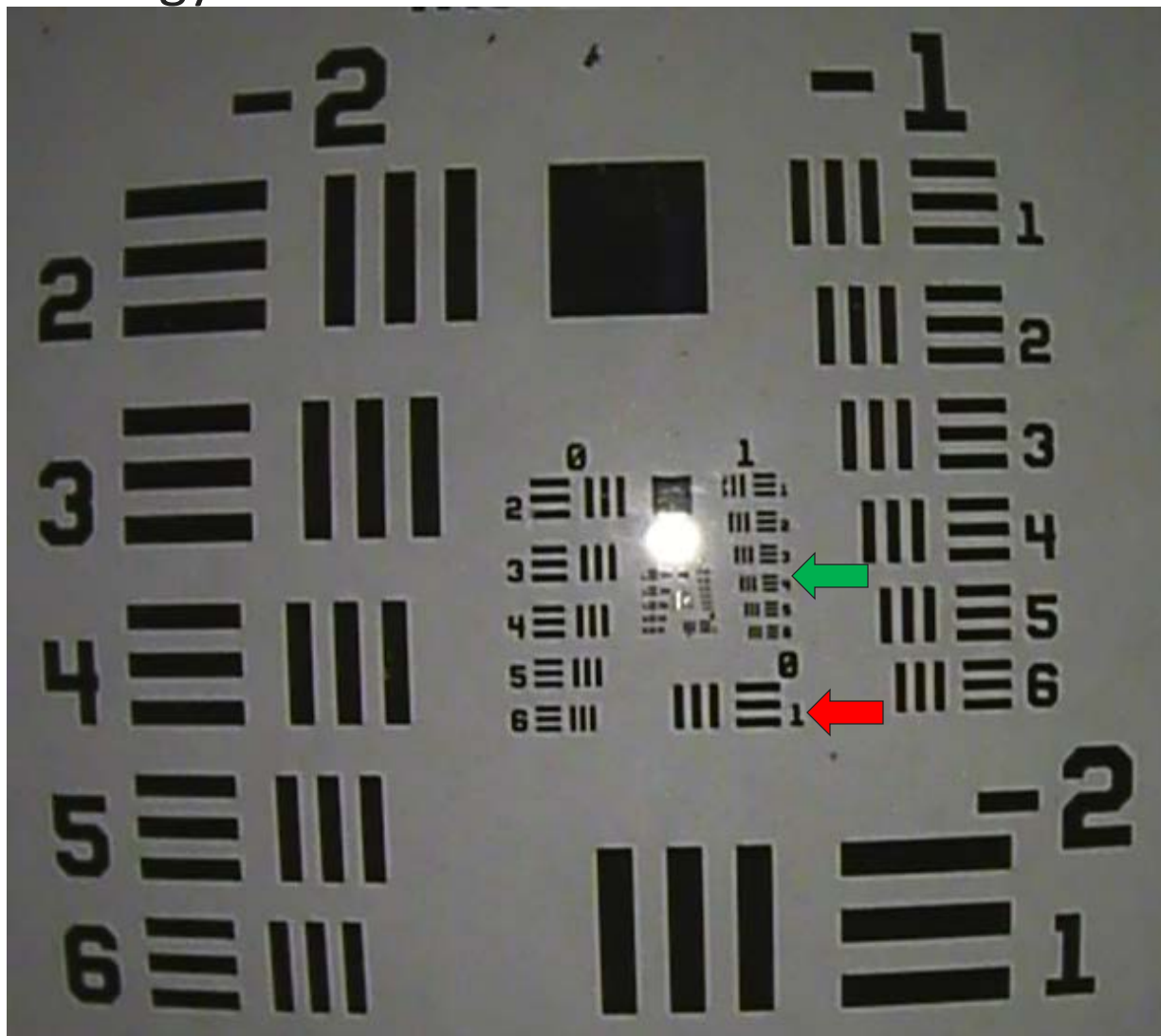
- Distance dependant
  - Different resolution can be dictated per engine section
  - Same for side and direct view tips
  - Standardas are a listed as a minimum
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## New Technology Performance

<b>Distance to Target</b>	<b>Standard</b>	<b>Achievable</b>	<b>Difference</b>
7 inches	1	2.52	2.5X
4 inches	1	3.17	3.2X
2 inches	2	7.13	3.6X
1 inch	4	11.31	2.8X
0.4 inches	10	16	1.6X
0.2 inches	10	25.4	2.5X

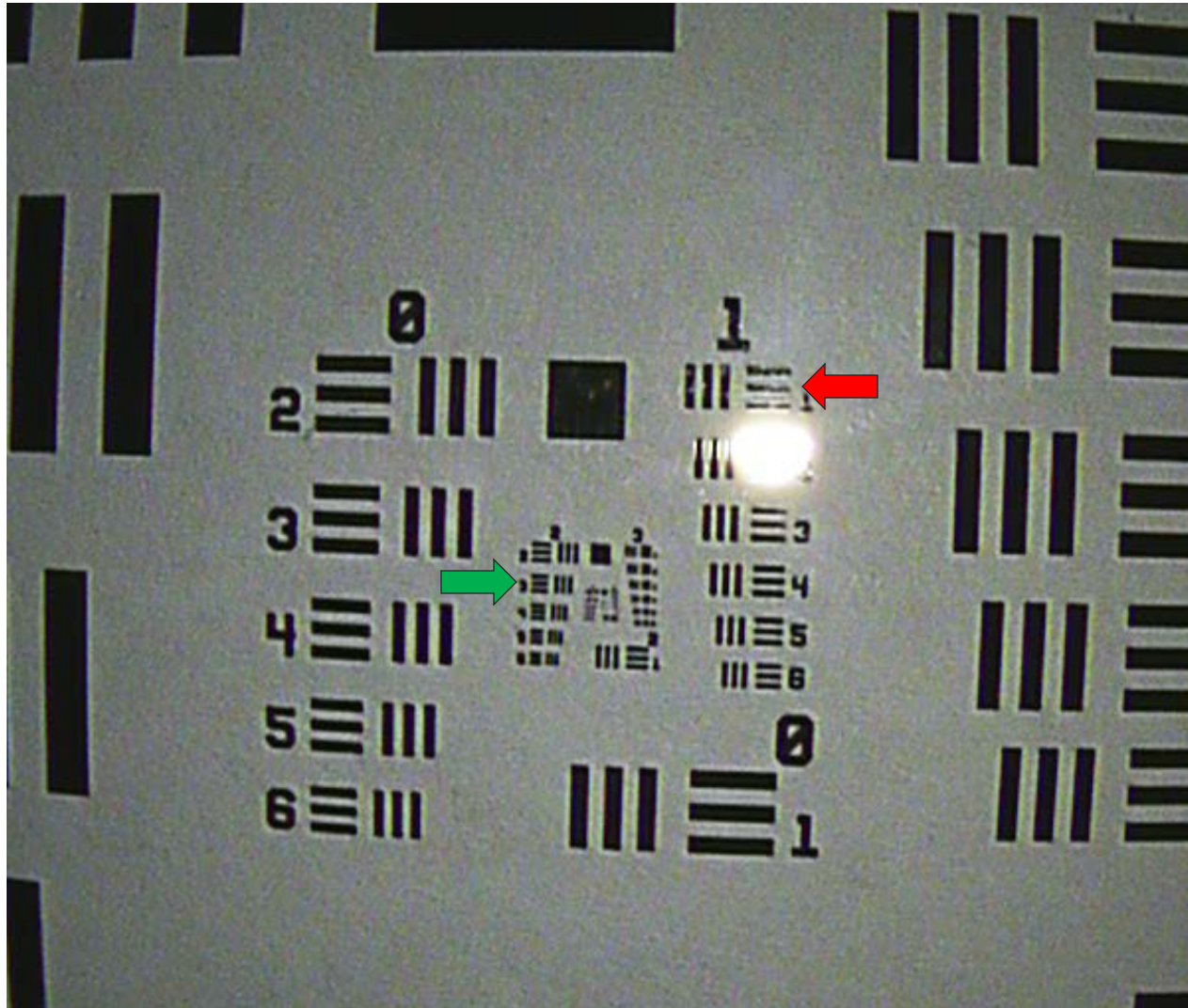
# New Technology Performance



4 inches



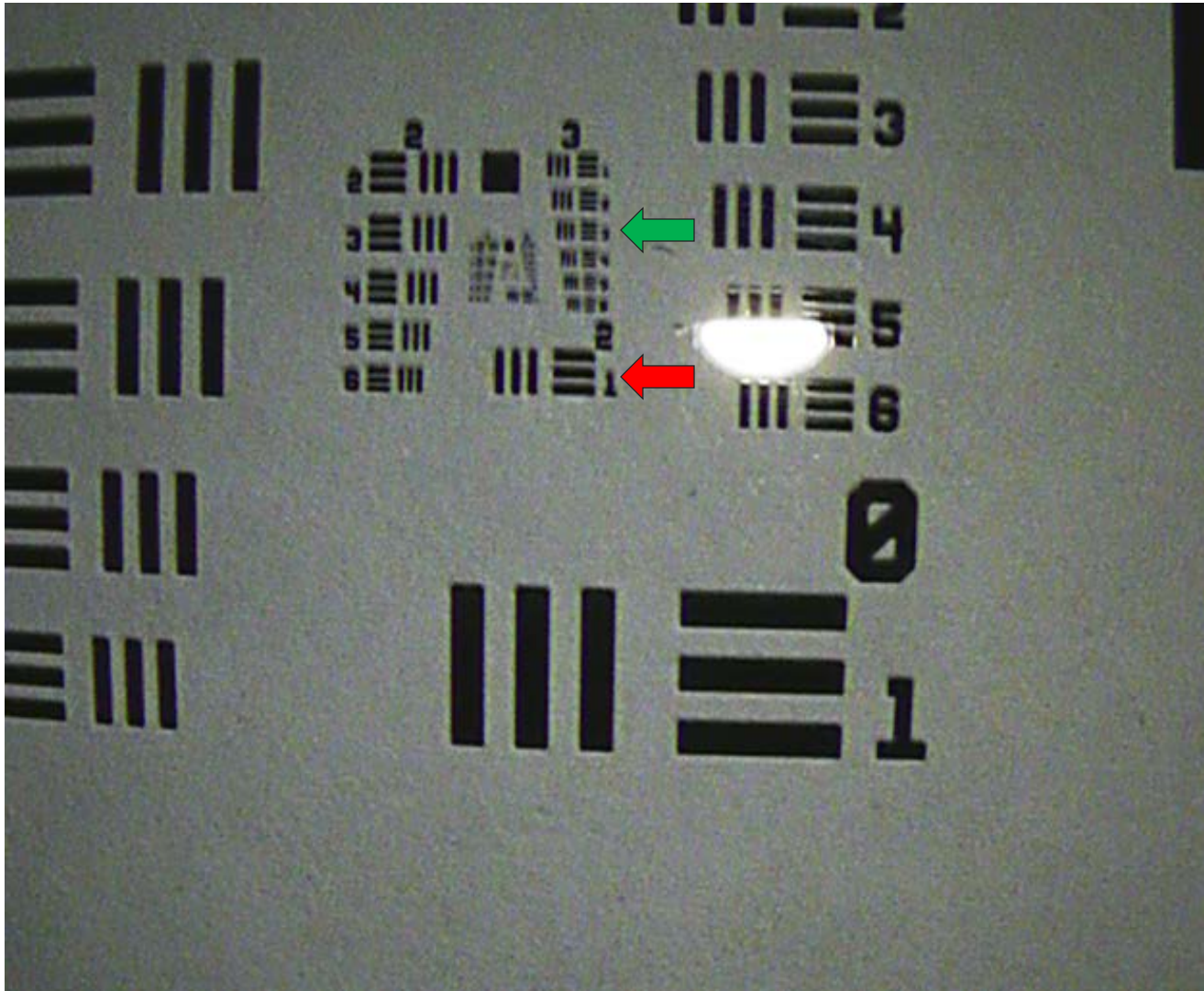
# New Technology Performance



2 inches

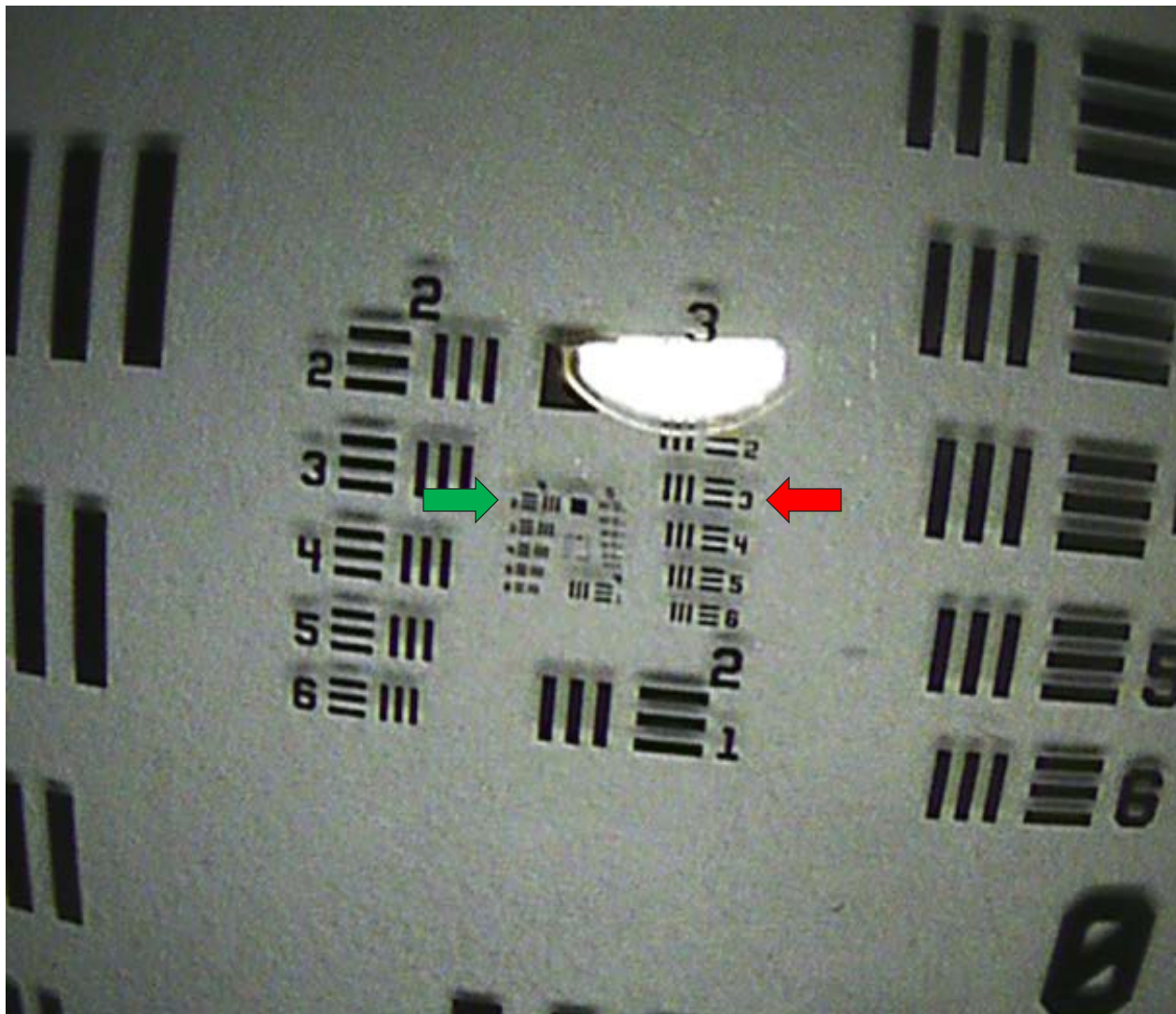


# New Technology Performance



1 inch

## New Technology Performance



0.4 inches

## Implications/Benefits

- See potential problems before it's a problem
  - Better planning
  - Increase inspections as needed
  - Increased safety

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  - You don't have to get as close
  - At close distances, defects are much more obvious
  - Fewer tip adapter changes

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- See potential problems before it's a problem
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    - Increase inspections as needed
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  - Increased inspection efficiency and time reduction at status quo
    - You don't have to get as close
    - At close distances, defects are much more obvious
    - Fewer tip adapter changes
  - Re-Evaluate the status quo
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Thank You

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