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# **Progress review of the bolt hole eddy current POD study - Design of the experiment**

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NDE-SMPL-IAR-NRCC

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National Research  
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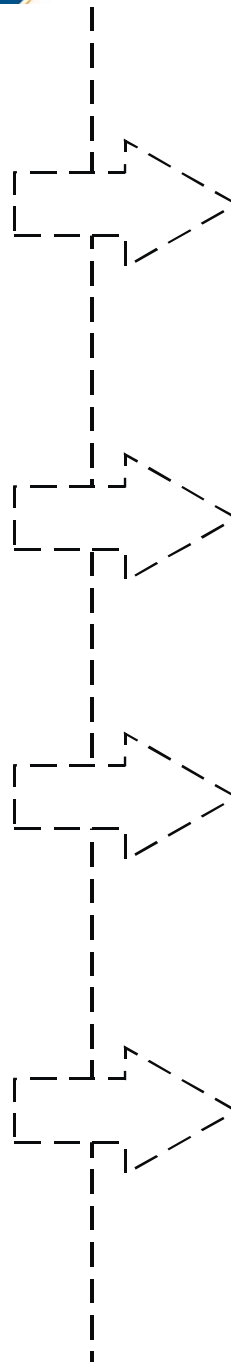
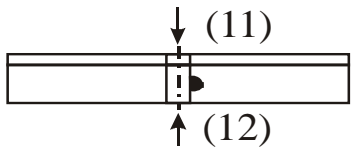
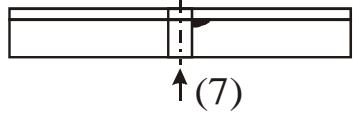
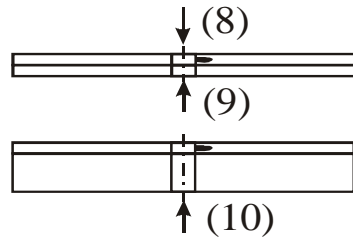
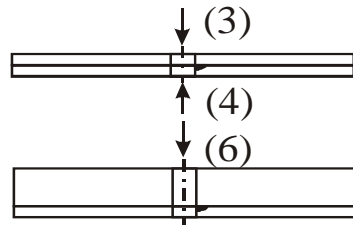
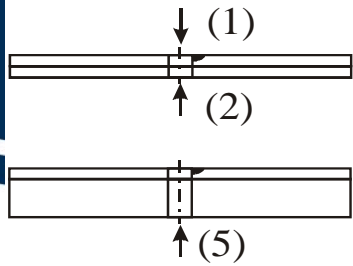
**Canada** 

# Agenda

This presentation will discuss how the experiment is designed and how the inspection will be carried out.

- The specimens;
- The design of experiment (DoE);
- The inspection and data record.





0.090"  
CC<sub>(72)</sub>

+3x72 NC

0.090"  
MB<sub>(72)</sub>

+3x72 NC

0.3125"  
CC<sub>(72)</sub>

+3x72 NC

0.3125"  
MB<sub>(72)</sub>

+3x72 NC

## Specimen boxes and configurations

**0.090"-CC**

1, 2, 3, 4, 5, 6

**0.3125"-CC**

7

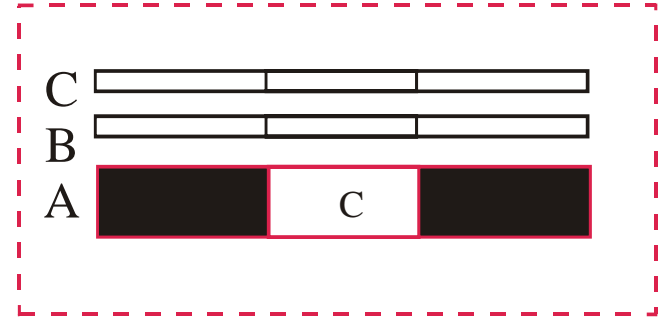
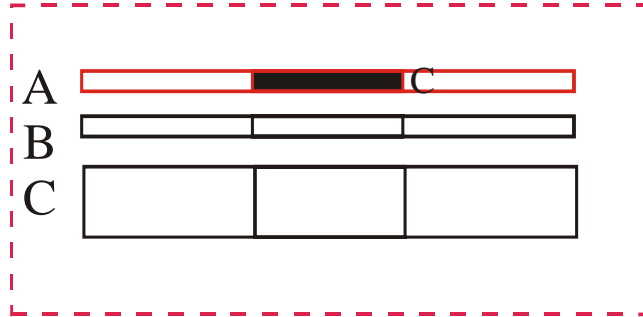
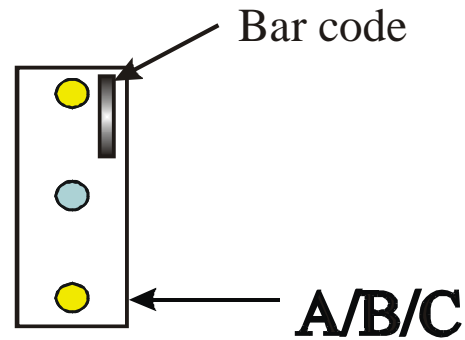
8, 9, 10

**0.090"-MB**

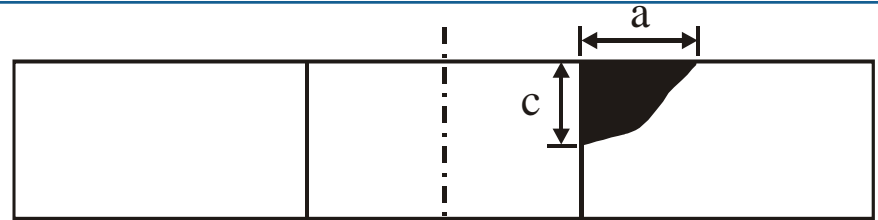
11, 12

**0.3125"-MB**

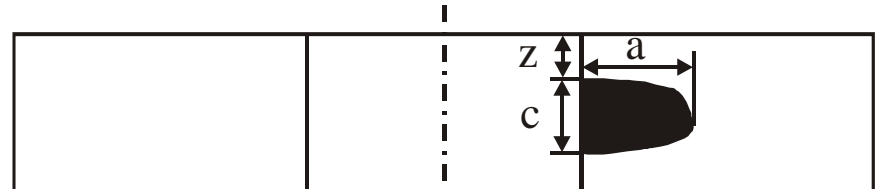
# Plates organized in a reference standard unit



3 pieces; only one piece with crack (A)



Corner Crack



Mid-bore Crack

**Reference Standard**

Reference standard	Piece ID	Crack present	Crack type	Crack size (inch)			Hole Diameter	notes
				a	c	z		
	A	1	CC-L				0.182	
	B	0	NC					
	C	0	NC					

**Crack Type: NC/ CC-L / MB-L / CC-E / MB - E**

## II. DoE

- Inspectors;
- Crack type (Lab/EDM);
- Configuration (location, thickness, and origin).

# Variables and configurations

	Crack location	Thickness	Crack origin
0	1 <sup>st</sup> layer	0.090"	MB (mid-bore)
1	2 <sup>nd</sup> layer	0.3125"	CC (corner)

Location	Thickness	Crack origin	Configuration	Notes
0	0	0	8	0.090" – MB
0	0	1	1 / 4	.090" – CC
0	1	0	12	0.3125" – MB
0	1	1	7	0.3125" – CC
1	0	0	9, 10	0.090" – MB
1	0	1	2(5) / 3(6)	0.090" – CC
1	1	0	(11)	0.3125" – MB
1	1	1	N/A	

- If we do the full inspection. Each inspector will need to inspect 4320 sites. (This may take more than one month !)
- In terms of NDI signal response, some configuration does not introduce any difference.
- Select representative subsets for study.

1
2, 5
3, 4, 6, 7
8, 9, 10, 11, 12

Thickness may not  
be a variable!

# Assignment of inspection tasks

Subset	ATESS	QETE	NRC	Config.	Origin	Time (days)
I	LG(72)+EDM(36)=108 * 4 =432			7	CC	~3
II			432	1	CC	~3
III			432	5	CC	~3
IV			432	12	MB	~3

- Any value at 90/95 smaller than 0.050”?
- Relation between LG and EDM (signal response)?
- The impact of crack location;
- The impact of crack origin (CC vs. MB);
- The impact of different inspectors

# Experiment matrix

Inspector-1	7	Inspector-2	2
Inspector-1	1	Inspector-2	12
Inspector-1	5	Inspector-2	7
Inspector-1	12	Inspector-2	1

When multiple configurations are involved.

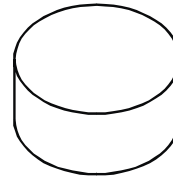
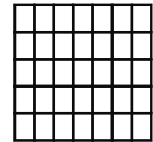
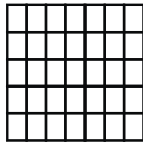
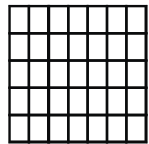
# III. The procedure

## Assembler sheet

## Inspector sheet

## DoE sheet

## Specimen database

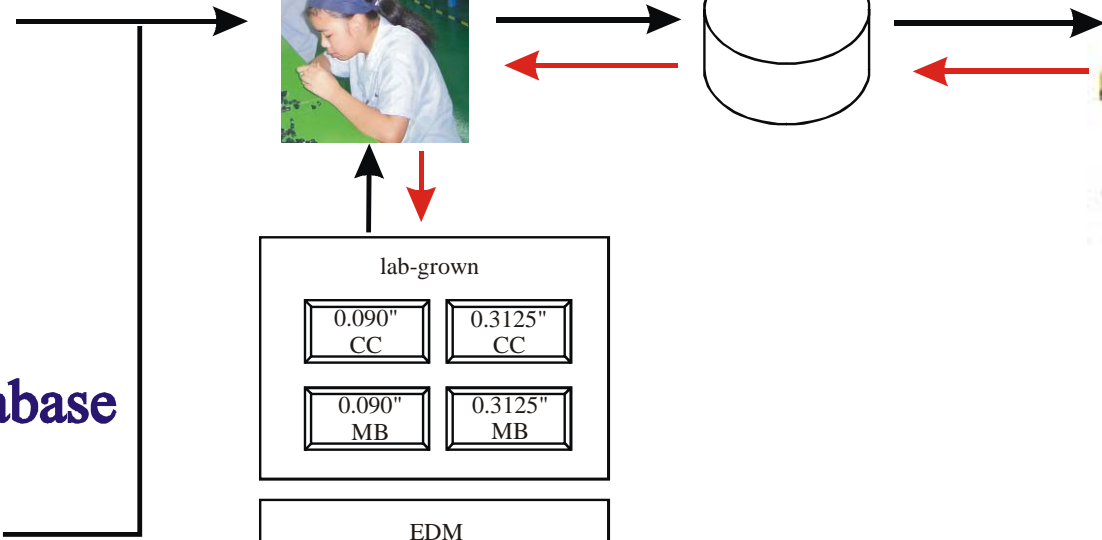


lab-grown

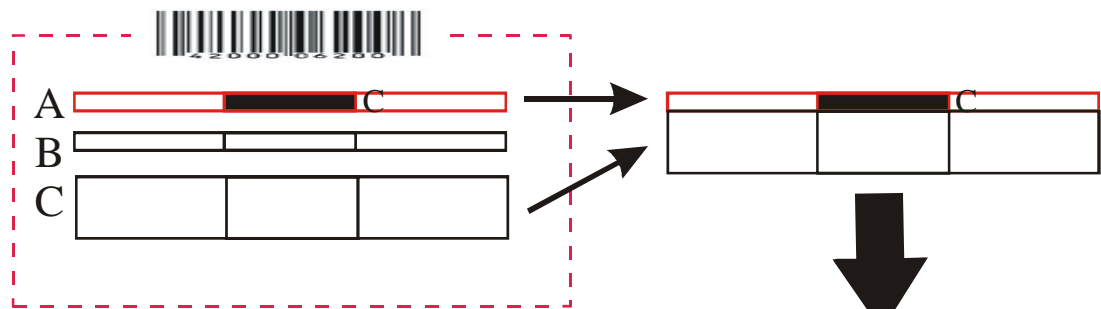
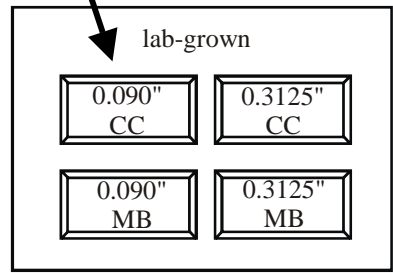
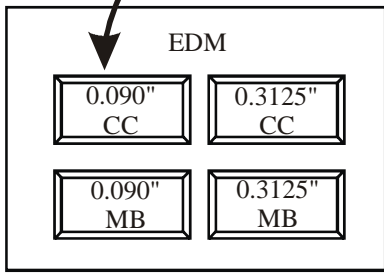
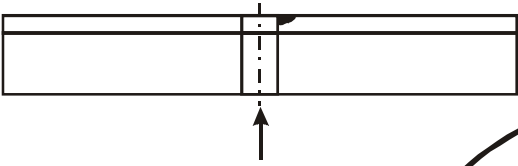
0.090" CC	0.3125" CC
0.090" MB	0.3125" MB

EDM

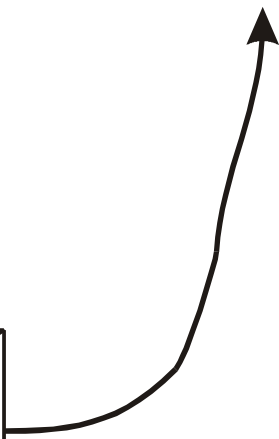
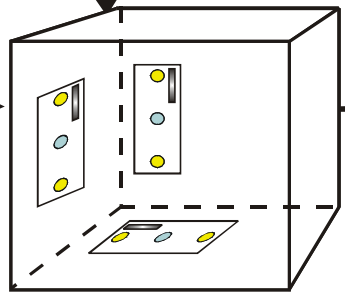
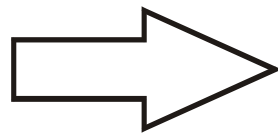
0.090" CC	0.3125" CC
0.090" MB	0.3125" MB



Inspector-1      Config.5



NC



# Record of assembly

## Assembly Sheet

Assembly bar code	Config. Number	Plate mark (top/bottom)	Crack(Lab /EDM)	Notes

# III. Inspection data record

(Date: )		(Configuration: )		(Inspector ID:)	
(Time: start-end)					
(Instrument #)		(Probe #)		(Cable #)	
Inspection Number	Assembly Bar code	Crack indication	Signal magnitude	Phase angle	Notes

# service-retired crack

