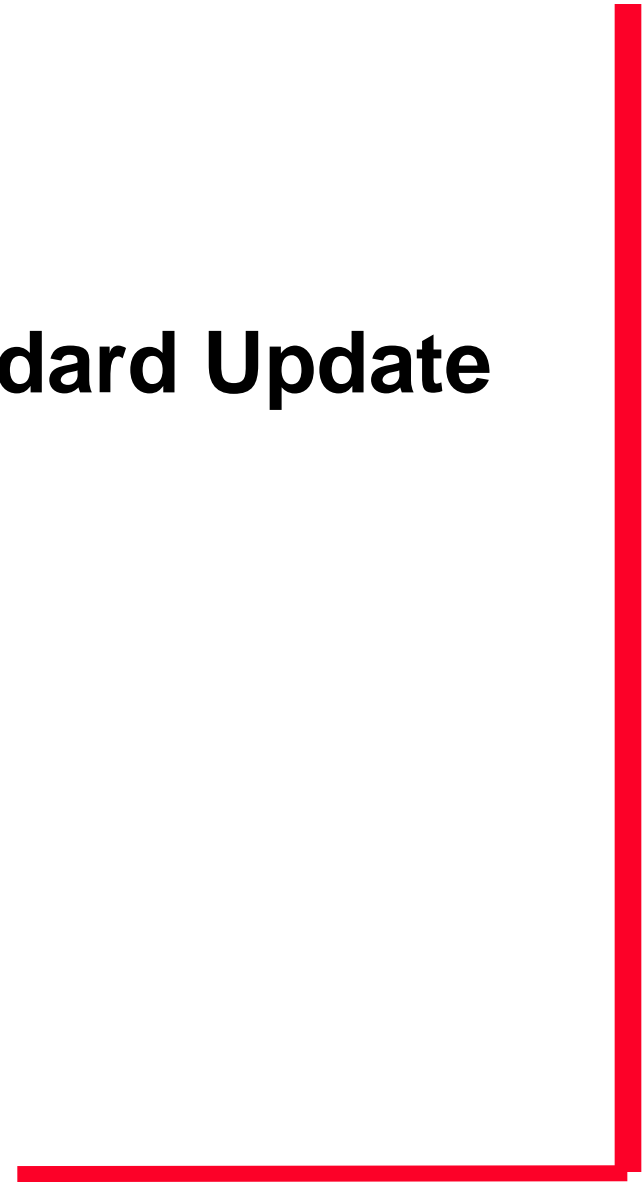




P48 Fiducial Mark Standard Update

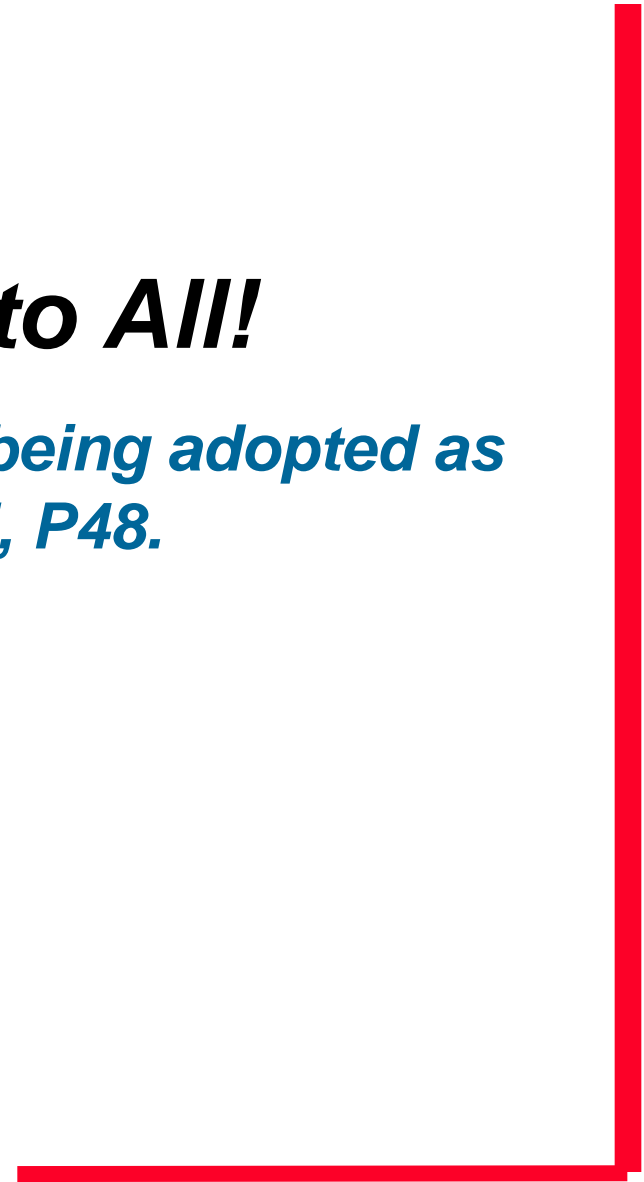
Fiducial Mark TF





Congratulations to All!

EUV blank fiducial mark ballot is being adopted as new industry standard, P48.

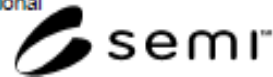




SEMI-4580 Fiducial Mark Ballot Adopted as New Standard P48

- **Yellow ballot voted in Cycle-3 (April – May 2010)**
- **Approved for adoption as new standard at SEMI Microlithography Standard Committee meeting in July 2010**
- **P48 will be published in November 2010.**

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DRAFT
Document Number: 4580
Date: 4/23/2010

SEMI Draft Document 4580 New Standard: SPECIFICATION OF FIDUCIAL MARKS FOR EUV MASK BLANK

1 Purpose

1.1 This standard specifies key requirements of fiducial marks that can be used as a coordinate system for referencing defect locations on EUV blanks.

2 Scope

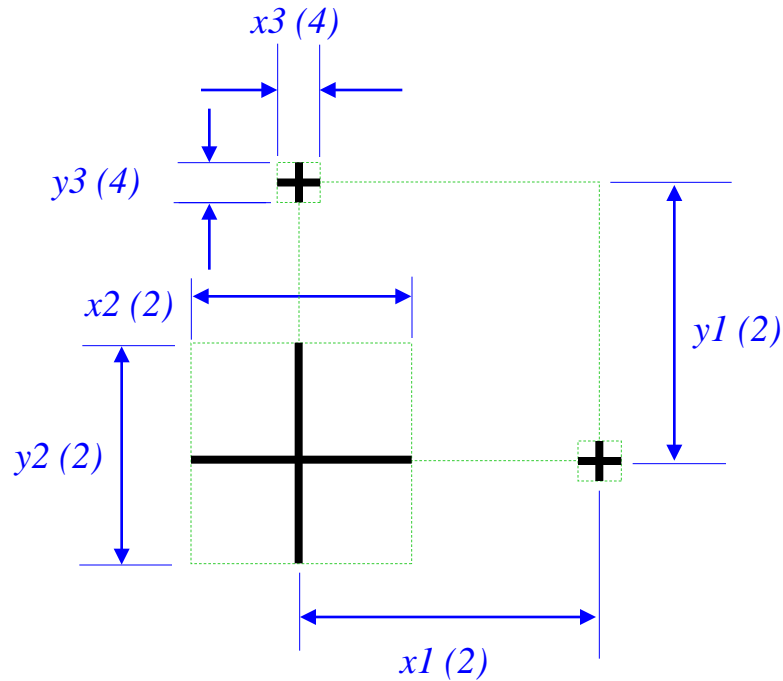
2.1 This standard is intended to set an appropriate level of technical specifications of mask fiducial marks, such as their locations, shapes, sizes, line dimensions, and limits of variation. The marks must be readable by mask metrology and pattern write tools. This standard is not intended to specify how to use the fiducial marks to locate defects on EUV blanks.

2.2 This standard does not specify techniques to be used or how the fiducial marks are generated.

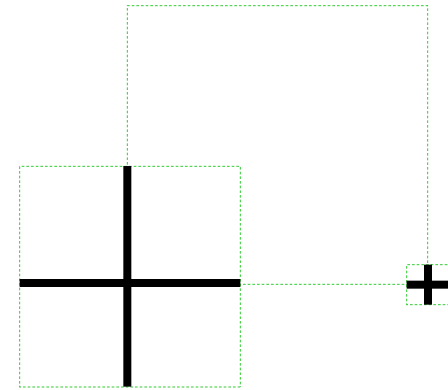
YELLOW) BALLOT



Fiducial Marks (Two Types)



(a) One large cross + two small crosses



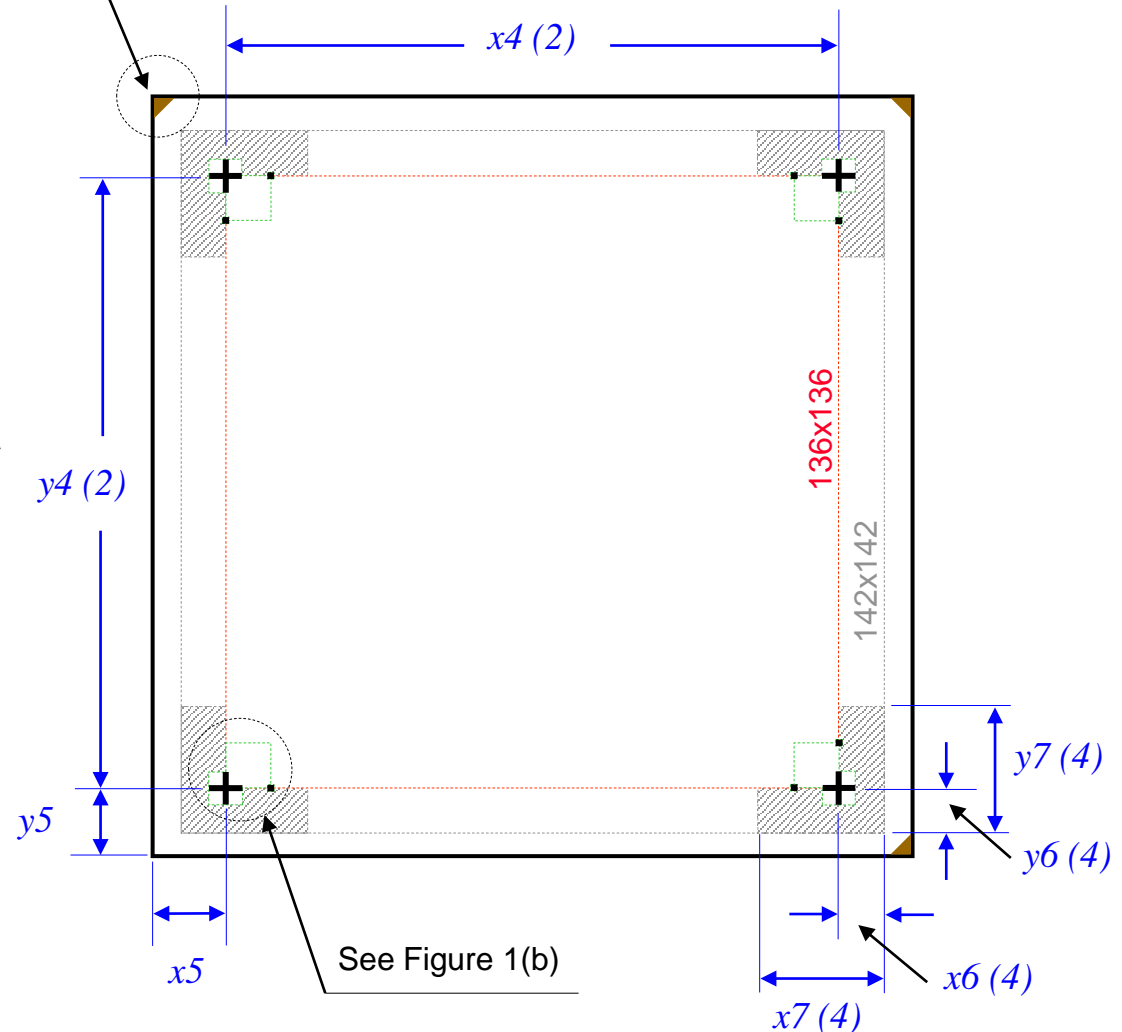
(b) One large cross + one small crosses

Both can be rotated for 90, 180, and 270 degrees on blank

Fiducial Mark Layout

Bevel on back (3)

- 1 FM at each corner
- Only the FM at un-beveled corner is with one small cross, otherwise two small crosses
- Central 136x136mm area is free of marks.
- **Hatched areas at each corner reserved for customization.**



FM Specification

Table 1 Fiducial Mark Specification

<i>Symbol Used</i>	<i>Figure</i>	<i>Value (mm unless specified)</i>	<i>Tolerance (mm unless specified)</i>	<i>Reference Measured From</i>	<i>Feature Measured To</i>
x1, y1	1	1.500	±0.010	Center of the large cross	Center of small crosses
x2, y2	1	0.550	±0.050	One line end of large crosses	The other line end of the large crosses
x3, y3	1	0.100	±0.010	One line end of small crosses	The other line end of the small crosses
x4, y4	2	136.000	±0.010	Center of large crosses	Center of adjacent large crosses
x5, y5	2	8.000	±0.050	Center of large crosses	The two closest blank edges
x6, y6	2	≤2.700		Center of large crosses	Outer lines of exclusion zones
x7, y7	2	≤5.700		Outer lines of exclusion zones	Inner / opposing lines of the zones
FMPS Orthogonality		≤0.015/136.000 (≤ 110 μrad)		Any one side of FMPS	Any adjacent side of FMPS
FMPS Parallelism		≤0.200/136.000 (≤ 14.7 mrad)		Any one side of FMPS	The closest edge of EUV blank

FM Specification (cont'd)

CD		Any value ≥0.004 and ≤0.008		One side of lines	The other side of the lines
Large Cross LER (3σ)		≤10.0 nm (on both sides of lines)		Center of large crosses	0.100 mm out in both directions from the center of crosses
		≤100.0 nm (on both sides of lines)		0.100 mm in both directions from the center of crosses	Line ends of crosses
Small Cross LER (3σ)		≤10.0 nm (on both sides of lines)		One end of the lines of small crosses	The other end of the lines of the crosses
Cross Orthogonality		≤0.5 degrees (≤8.7 mrad)		See ¶ 5.2.3	
Cross Rotational Tolerance		≤0.5 degrees (≤8.7 mrad)		See ¶ 5.2.4	
Fiducial Mark Rotational Tolerance		≤0.5 degrees (≤8.7 mrad)		See ¶ 5.2.5	



Implementation Discussion

-



Thanks you all for great support!



Backup

4580 Voting Results / Proposed Corrections



4580 Ballot Voted in Cycle-3 w/100% Accepts

Voting Results for 4580, New Standard: Specification of Fiducial Marks for EUV Mask Blank

0

As Cast Ballot Tally Summary For Document 4580

Return Percentage: 60.66%	TC Member Returns: 37 TC Member Distribution: 61
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Total votes Received: 41	Number of Abstains: 19
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Number of Accepts: 22 Accept %: 100.00%	Number of Rejects: 0
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Total Comments: 6	Total Rejects: 0
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<i>Comment Issuer(s):</i> <u>AFF_ITSdl</u> - Rafael Vargas-Bernal <u>AFF_NIST</u> - James Potzick <u>AFF_Intel</u> - Long He <u>AFF_IMEC</u> - Rik Jonckheere <u>AFF_KSC</u> - Karl Sommer <u>AFF_WesCon</u> - Wesley Erck	<i>Reject Issuer(s):</i>
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Comments Received

1. Rafael Vargas-Bernal / rvargasbernal@hotmail.com

A full stop (end point) must be placed in several sentences in the document in Sections 3 and 4.

2. James Potzick / potzick@nist.gov

Reference the SEMI Standard for measuring LER.

3. Long He / long.he@intel.com

In Sections 5.3.1, 5.3.2, and 5.3.3, the ballot specifies marks must be readable by certain tools and/or at certain conditions. However, the readabilities are left open to mark makers and users. Intel would like to have readability specified in the ballot, such as, in term of image contracts. We understand discussions were made in the past on this topic.

4. Rik Jonckheere / Rik.Jonckheere@imec.be

- In 4.2.4 and 4.2.7 use stack instead of stacks

- In 4.2.10 insert "the locations of" after "connecting"

- Figure 1 shows $y_2(2)$ incorrectly !!! Wrong length of arrow.

- Figure 2 may be somewhat misleading as it may visualize an non-existing relation between y_6 , y_7 and the bevel size

- In Table 1, row x_4 , y_4 : in right hand-side column replace "adjacent large cross" by "other large cross"

5. Karl Sommer / karl-sommer@t-online.de

1. Page 4 – Fig 1 (a)

Top projection line of dimension y_2 is not aligned;

6. Wesley Erck / wes.erck@sbcglobal.net

Editorial corrections should be made to Figure 1:

A) the upper end of the arrow for y_2 should match the upper end of the cross (as specified in Table 1).

B) the number of places for x_3 and y_3 should be 3 instead of 4, since there are only 3 small crosses in Figure 1.



Changes/Corrections Proposed

1. Reference the SEMI Standard for measuring LER

Done! Inserted one line in Section 3.1: “SEMI P47-0307 - Test Method for Evaluation of Line-Edge Roughness and Linewidth Roughness“

2. Recommendations for editorial change:

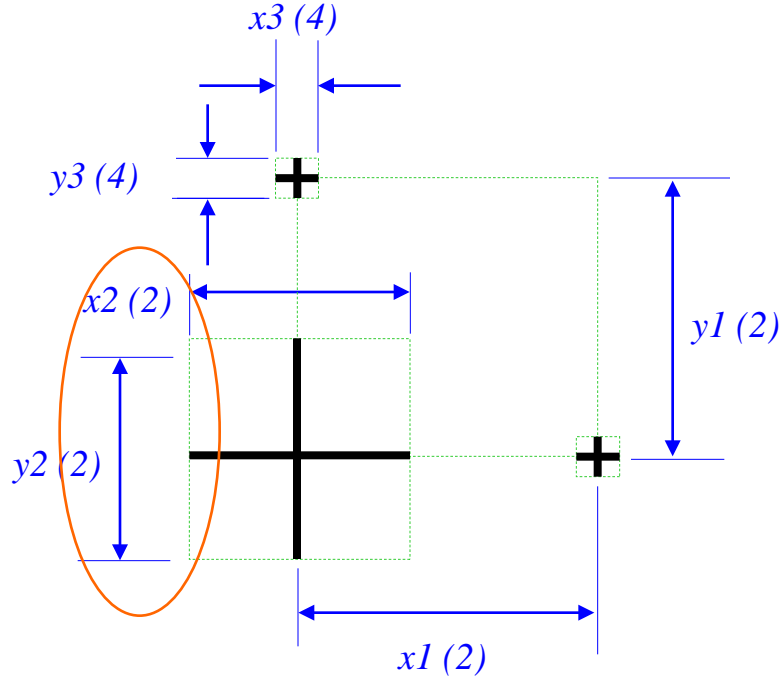
- A full stop (end point) must be placed in several sentences in the document in Sections 3 and 4.
- In 4.2.4 and 4.2.7 use stack instead of stacks
- In 4.2.10 insert “the locations of” after “connecting”
- In Table 1, row x4,y4: in right hand-side column replace “adjacent large cross” by “other large cross”

Done!

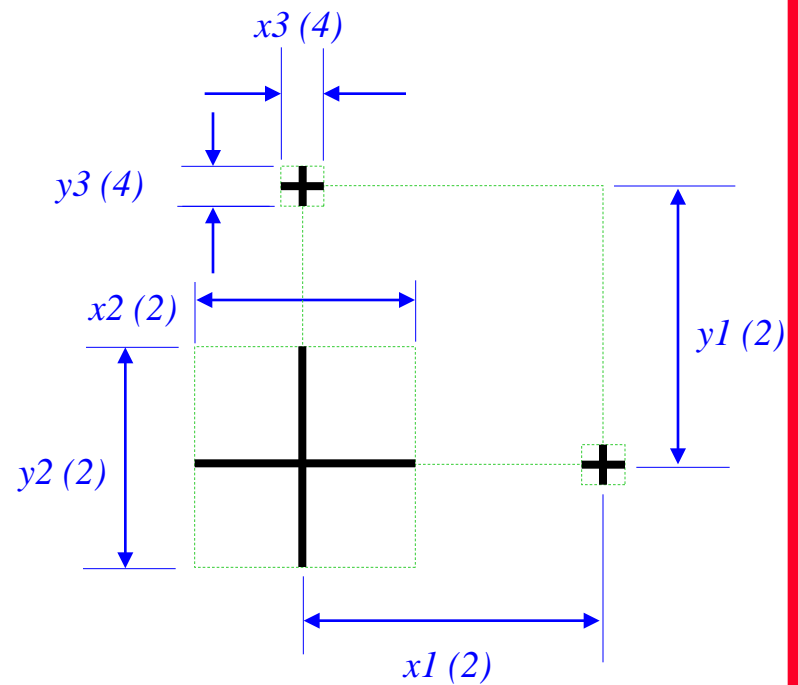
Changes/Corrections Proposed

3. In Figure 1, the upper end of the arrow for y_2 should match the upper end of the cross (as specified in Table 1).

Done! Correction has been made accordingly.



(a)

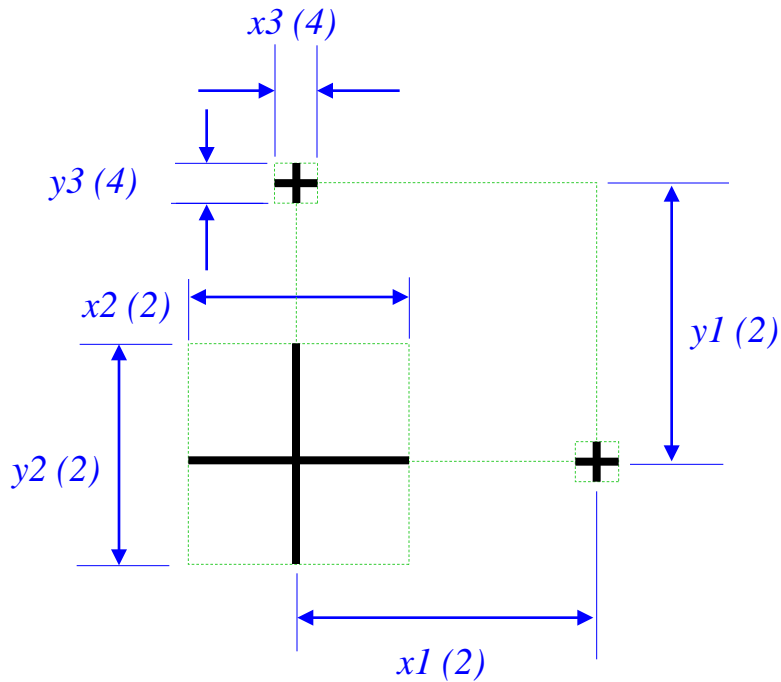


(a)

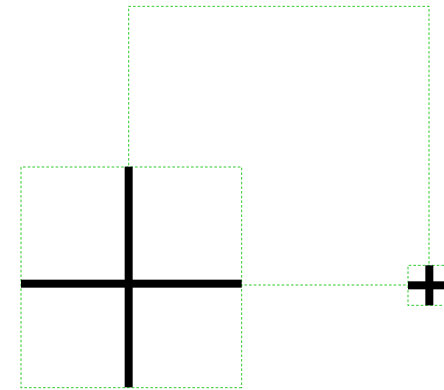
Changes/Corrections Proposed

4. In Fig 1, the number of places for x_3/y_3 should be 3, not 4, since there are only 3 small crosses in Figure 1.

No change, since the “4” in $x_3(4)/y_3(4)$ indicates the four (4) horizontal and vertical edges of the two small dot-lined green squares in (a).



(a)

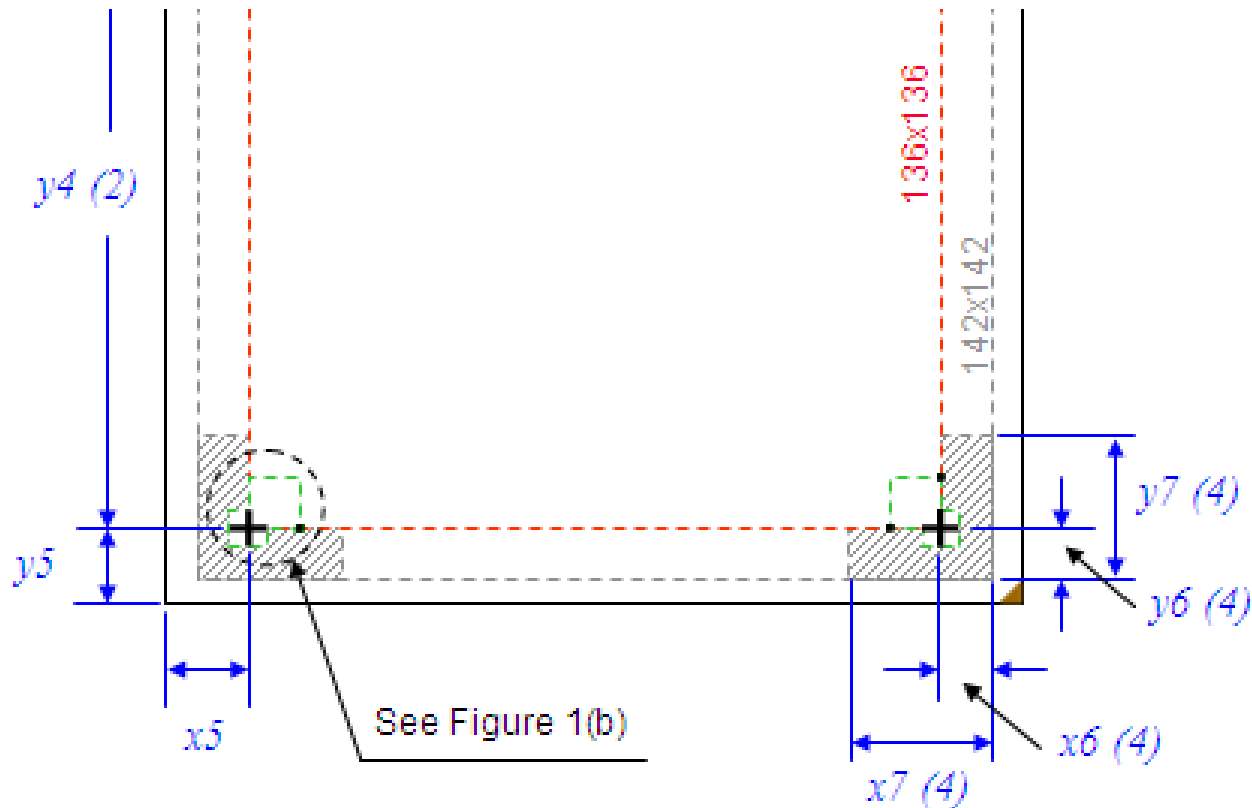


(b)

Changes/Corrections Proposed

5. Figure 2 may be somewhat misleading as it may visualize an non-existing relation between y_6 , y_7 and the bevel size

No change, Figure 2 caption warns: “....The Figure is not drawn to scale....” which is necessary for readability of small dimensions.





Changes/Corrections Proposed

6. In Sections 5.3.1, 5.3.2, and 5.3.3, the ballot specifies marks must be readable by certain tools and/or at certain conditions. However, the readabilities are left open to mark makers and users. Intel would like to have readability specified in the ballot, such as, in term of image contracts. We understand discussions were made in the past on this topic.

No change. There is currently no technical data to guide for an image contrast specification. Comment issuer intended to document that this issue is not closed and needs to specify in the future.



Recommendation: Adopt as New Standard!

- **Fiducial Mark standard is necessary for the industry to mitigate EUV blank defects for successful EUVL insertion.**
 - No defect-free EUV mask blank exists today. The industry needs such a standard now.
 - The specification as balloted meets basic technical requirement.
 - It also allows flexibility and innovation, by dedicating additional areas for customization.