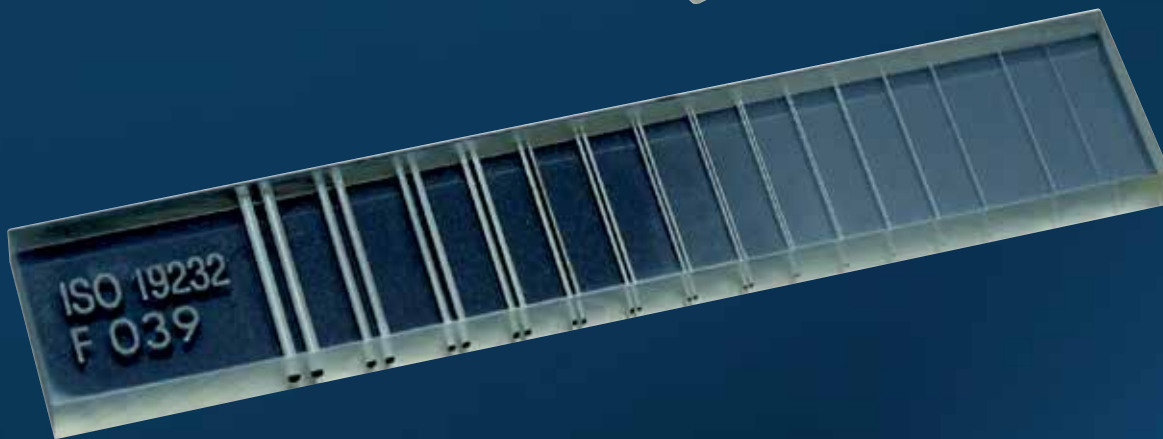
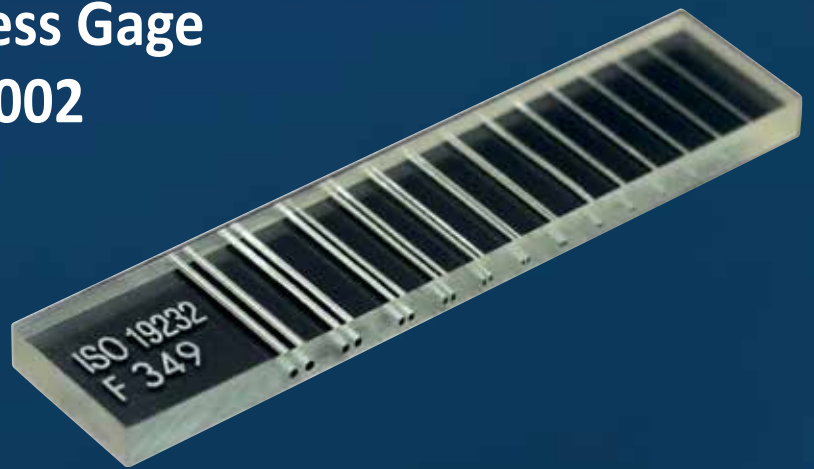


DUPLEX IQI

Duplex Wire Type IQI
according to ISO 19232-5
Total Image Unsharpness Gage
according to ASTM E 2002



Evaluation of
image unsharpness and
basic spatial resolution
of digital X-ray images

Image Quality Indicator for evaluating Total Images Unsharpness

The Duplex IQI is used in many X-ray applications, especially in digital X-ray. Designed for evaluating total image unsharpness of films and additionally basic spatial resolution of digital images according to EN 13068 (Radioscopy), EN 14784 and ISO 16371 (CR – Computed Radiography with imaging plates), ISO 17636-2 (digital radiology of welds – flat panel detectors) or ASTM E 2597 (characterization of digital detector arrays) and ASTM E 2737 (DR Duplex Plate Phantom). ASTM E 2903 describes the Duplex Wire Type IQI application for focal spot size measurements of micro focus X-Ray tubes.

Image valuation with Duplex Wire Type IQI

In radiography the wire pair with largest diameter d has to be identified, which cannot be separated visually. The radiographic film may be magnified up to 4X.

In digital radiology the separation between wires (Dip) is evaluated. The wire pair with largest d , showing Dip less than 20 percent of the wire pair contrast, identifies total image unsharpness ($U = 2d$) and basic spatial resolution ($SR_b = d$) of digital image.



DD	UT (mm)	SR _b (mm)	LP (1/mm)	d (mm)
D 1	1,600	0,800	0,625	0,800
D 2	1,260	0,630	0,790	0,630
D 3	1,000	0,500	1,000	0,500
D 4	0,800	0,400	1,250	0,400
D 5	0,640	0,320	1,560	0,320
D 6	0,500	0,250	2,000	0,250
D 7	0,400	0,200	2,500	0,200
D 8	0,320	0,160	3,130	0,160
D 9	0,260	0,130	3,850	0,130
D 10	0,200	0,100	5,000	0,100
D 11	0,160	0,080	6,250	0,080
D 12	0,130	0,063	7,690	0,063
D 13	0,100	0,050	10,000	0,050
D 14	0,080	0,040	12,500	0,040
D 15	0,064	0,032	15,600	0,032

Specification:

- Duplex IQI consists of 13 or 15 wire pairs from 1D to 13D or 15D
- material for wires 1D to 3D is tungsten and for wires 4D to 15D is platinum
- distance between wires of each wire pair equals exactly diameter of wires
- wires are casted in a transparent, resistant and dimensional stable plastic
- standard and serial number are indelible casted and shown on each image
- design-type test for Duplex IQI is in process at BAM / Berlin

DD Duplex Wire Number

UT Corresponding Unsharpness

SR_b Corresponding Basic Spatial Resolution

LP Corresponding Line Pair Value

d Wire Diameter and Spacing

Scope of supply:

Duplex Wire Type IQI in wooden box with Instructions, Declaration of Conformity according to ISO/IEC 17050-1 and individual Test Certificate according to ASTM E 2002, ISO 19232-5 with all relevant measurements

Duplex Wire Type IQI - 13D

with wire pairs from 1D to 13D

Article no. 11 00155

Duplex Wire Type IQI - 15D HiRes

with wire pairs from 1D to 15D

Article no. 11 00160

Duplex IQI Bracket

for easy wire pair identification for 13D

Article no. 11 00156

for easy wire pair identification for 15D

Article no. 11 00161



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Bildgüteprüfkörper für die Ermittlung der Bildunschärfe / Doppeldraht-BPK
ISO 19232-5 / ASTM E2002

Anwendung des Doppeldraht-BPK

Zur Bestimmung der Bildunschärfe (Film und Digitalbild) bzw. der Basisortsauflösung im digitalen Durchstrahlungsbild nach EN 13068 (Radioskopie), EN 14784 (Computer-Radiographie mit Speicherfolien), ISO 17636-2 (digitale Schweißnahtprüfung) oder ASTM E 2597 (Charakterisierung von digitalen Detektor-Arrays).

In der digitalen Radiologie sollte der Doppeldraht-BPK in Verbindung mit einem Draht-BPK- oder Stufe/Loch-Bildgüteprüfkörper zum Nachweis der Bildqualität eingesetzt werden.

Zur Ermittlung der Gesamtbildunschärfe muss der Doppeldraht-BPK auf der, der Strahlenquelle zu gewandten Seite des Prüfgegenstandes platziert werden. Zur Bestimmung der Basisortsauflösung von digitalen Detektoren wird er direkt auf das Strahleneintrittsfenster positioniert. Seine Längsachse sollte um 2°... 5° gegenüber den Pixelzeilen gedreht werden, um Aliasing-Effekte zu vermeiden.

Auswertung der Abbildung des Doppeldraht-BPKs

Auf dem Röntgenfilm wird mit Hilfe einer Lupe (mit bis zu 4X Vergrößerung) das Drahtpaar mit dem größten Durchmesser d gesucht, welches gerade noch nicht visuell getrennt erkannt wird.

Im Digitalbild wird mittels einer Profilkurvenfunktion senkrecht zur Drahttrichtung die Trennung zwischen den beiden Drähten (Dip) bewertet. Das Drahtpaar mit dem größten d , welches einen Dip von kleiner 20% des Drahtpaarkontrastes aufweist, bestimmt die Bildunschärfe.

Die Bildunschärfe U wird durch $2d$ gegeben, wobei d der Durchmesser eines Drahtes und der Drahtabstand ist. Die Basisortsauflösung wird durch den Drahtdurchmesser d bestimmt.

Anmerkung: Der Doppeldraht-BPK ist keine Alternative zum Draht-BPK- oder Stufe/Loch-BPK, da er nur zur Bestimmung der Bildunschärfe dient.

Element Nr. D = duplex	Bildunschärfe U mm	Draht-Ø und -abstand d mm	Element No. D = duplex	Image Unsharpness U mm	Wire-Ø and -distance d mm
4 D	0,800	0,400	11 D	0,160	0,080
5 D	0,640	0,320	12 D	0,130	0,063
6 D	0,500	0,250	13 D	0,100	0,050
7 D	0,400	0,200	14 D	0,080	0,040
8 D	0,320	0,160	15 D	0,064	0,032
9 D	0,260	0,130	16 D	0,050	0,025
10 D	0,200	0,100	17 D	0,040	0,020

Image Quality Indicator for determination of image unsharpness / Duplex Wire Type IQI
according to ISO 19232-5 / Total Image Unsharpness Gage according to ASTM E2002

Application of Duplex Wire Type IQI / Total Image Unsharpness Gage

For evaluation of image unsharpness (film and digital image) and basic spatial resolution in digital images according to EN 13068 (Radioscopy), EN 14784 (Computed Radiography with imaging plates), ISO 17636-2 (digital radiology of welds) or ASTM E 2597 (characterization of digital detector arrays).

In digital radiology the Duplex Wire Type IQI should always be used together with a Wire Type IQI or a Hole Type IQI. The Duplex Wire Type IQI has to be placed on the source-side of the specimen for determination of the total image unsharpness. It has to be placed directly on the input window of the digital detector for measurement of its basic spatial resolution. The IQI axis should be tilted between 2°... 5° relative to the detector pixel lines to avoid Aliasing effects.

Image valuation of Duplex Wire Type IQI

The radiographic film image should be examined with a low power magnifying glass (with magnification up to X 4) and the wire pair with the largest d identified, which cannot be separated visually.

In digital radiology the IQI image is evaluated by a profile function perpendicular to the IQI wires for the separation (dip) between the wires pairs. The wire pair with the largest d determines the image unsharpness, whose dip separation is below 20% of the wire pair contrast.

The image unsharpness U is given by $2d$ (with d as diameter of wire and distance between wires) and shown against the element number in the table above. The basic spatial resolution is given by d .

Note: Duplex Wire Type IQI is not an alternative to Wire Type IQIs or Hole Type IQIs, as it is only for examination of Image Unsharpness.

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