Technical information

The new LEIBINGER High Speed Line

Version 2.4

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1   Introduction

The new High Speed Line from LEIBINGER provides several solutions for high speed applications.
The High Speed Line comprises two groups of printers:

- o   The JET Rapid printer as a solution for general high speed applications.
- o   The JET Rapid Wire printer for applications especially in the cable/wire/tube industry

This document provides:

- o   Technical data
- o   Differences between the features and the possible applications of the printers
- o   Overview on the available inks
- o   Important information about recommended encoders
- o   Overview on the differences regarding the spare parts

The first chapter describes the JET Rapid printer for general high speed applications; the second chapter provides information about the JET Rapid Wire printer.

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Important Information

There are several significant differences between the JET3up and the printers of the JET Rapid series. The differences affect parts of the printer as well as service procedures.

It is highly recommended thoroughly checking the manuals and the accessories catalogue for the differences between the JET3up and the JET3 JET Rapid series.

The following list gives an overview about the parts that are different for the JET Rapid series in comparison to the JET3up:

- o   Controller board
- o   Parts of the Print head (please see details in accessories catalog)
- o   Ink valve (VV)

Regarding service and adjustment procedures the main differences are:

- o   Hydraulic settings
- o   Ink jet adjustments

The differences are described in the manuals that come together with the printers.

There are extracts of the manuals in the addendum of this document.

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2 The JET Rapid printer

2.1 General description of the JET Rapid printer

The JET Rapid comes with the SK6 print head of the JET3up. The main difference to the JET3up is the higher oscillator frequency, which provides more drops per second.

With an oscillator frequency of up to 128 kHz the JET Rapid allows a 30% faster operating speed than the JET3up that works with an oscillator frequency of 96 kHz.

The JET Rapid provides the same print modes as the JET3up. Therefore, the JET Rapid printer is the best solution for high speed applications where the quality of the printouts of the JET3up is not sufficient.

If, for instance, a print job for the JET3up printed with the 32-dot high quality print mode allows a printing speed of 30 meter/minute, it will be possible to print the same job with the JET Rapid at a speed of around 40 m/min.

In order to reach a good quality for the printouts at the faster speeds the recommended distance between print head and substrate is **15 mm.**

The print head of the JET Rapid: the print head has the same dimensions as the SK6 print head of the JET3up.

The JET Rapid works with the same print modes as the JET3up. Due to the higher operating speeds, the recommended distance between print head and substrate is **15 mm.**
Shorter distances bear the risk of contaminating the print head; larger distances may have a negative effect on the quality of the printouts.

2.2 The Speed Plus option

The **SPEED PLUS** option for the JET Rapid comes with a special **Speed Plus print head**, which provides single line printouts up to a speed of 800 m/min.

With the special design, it is possible to mount the print head in a slightly inclined position. This will prevent the printer from contaminations by bursting ink drops.

217 mm / 43 mm
The print head of the option SPEED PLUS: The slightly beveled surface of the head cover allows an optimized mounting of the print head.
Recommended: **5 mm**   Recommended: **5 mm**
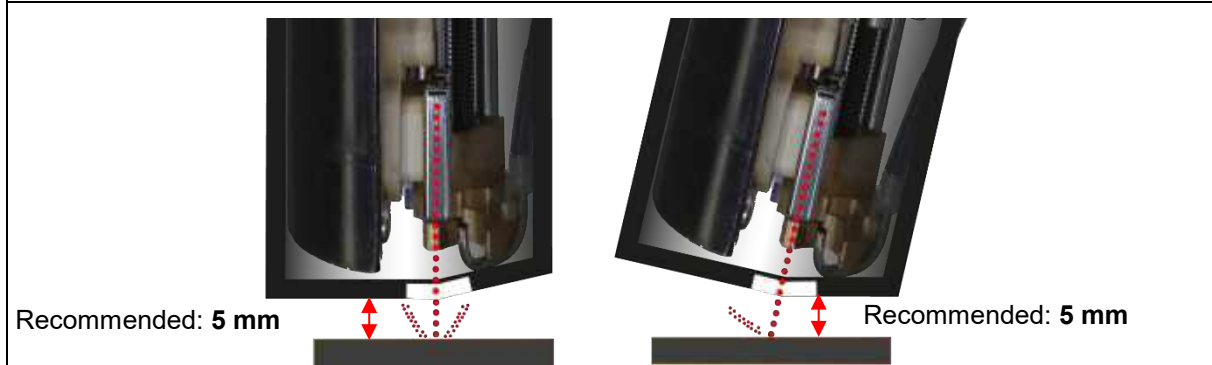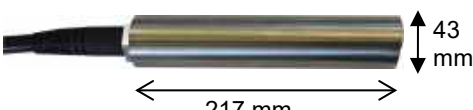
Ink drops that hit the surface of a substrate tend to burst in smaller drops and the substrate will not absorb all drops	With the beveled surface of the outlet of the print head, it is possible to mount the print head in a slightly inclined position.
With a vertically mounted print head, the bursting ink drops may lead to a faster contamination of the print head.	The ink drops will not hit the substrate at a 90° angle. Therefore, the bursting ink drops will take a direction away from the outlet, which will lead to less contamination of the print head.

Generally: the distance between print head and substrate should not be below **5 mm** in order to avoid the contamination of the print head by rebounding ink drops. A larger distance may have negative effects on the quality of the printouts.

2.3   Technical data JET Rapid

2.3.1   Overview JET Rapid

	JET Rapid	Option **Speed Plus**
Print head	SK6	Speed Plus
Print head dimensions	43 mm / 212 mm	43 mm / 217 mm
Maximum printing speed	Up to 30% faster than the JET3up	800 m/min
Characters per inch [cpi]	10 cpi at 413 m/min Print mode: 7x5 dots	8 cpi at 800 m/min Print mode: 5x5 speed
Oscillator frequency	128 kHz	128 kHz
Nozzle size	55 µm	50 µm
Available print modes	Same print modes as JET3up Up to 32 dots	Line Mode 5x5 speed 3x7 tower 5x5 speed small 3x7 tower small 7x5 5x5 7x5 speed 5x5 small
Print lines	Multi line / up to 5 lines	Single line
Available inks	Please see appendix for a detailed ink list	Please see appendix for a detailed ink list
Compressed air required	No. Optional available.	Yes. 2 l/min

2.4   Basic parameters for Print height, Stroke distance and Speed

2.4.1   JET Rapid

The JET Rapid provides the same print modes as the JET3up. The recommended printing distance is 15mm. There are no special recommendations regarding the settings for the print height.

The print mode selected has a direct effect on the maximum printing speed. However, the JET Rapid provides a 30% higher printing speed in comparison to a JET3up with the same print mode settings.

Pos.	Print mode	Annotation
1	2-line 7 dot high speed	
2	5 dot high speed	
3	12 dot high speed	
4	16 dot fast	
5	16 dot speed	
6	24 dot high speed barcode	
7	24 high speed	
8	24 dot fast	
9	24 dot high quality	
10	32 dot high speed	
11	32 dot fast	
12	32 dot high quality	

2.4.2   Option SPEED PLUS

The tables in this chapter provide recommendations for several parameter settings. Working with the tables the following points should be considered:

Print modes

This column shows the print modes available for the JET3up JET Rapid Wire and JET3up Wire PI.

The **speed** modes work with one dot less in full strokes.

The **small** modes place the dots closer to each other than the standard modes.

A combination of **speed mode** and **small mode** has the same height as the **small mode** and one dot less in full strokes a the **speed mode**.

Examples for print modes standard, speed, small and small speed with example character <H>:

5x5 dots	5x5 dots speed	5x5 dots small	5x5 dots speed small

Height [mm]

Height in [mm] shows the height of the printout that can be expected if the operator follows the recommendations for the distances between print head and substrate.

Print height setting [% PH]

The minimum value of the print height settings ([PH in %] is important. A value below minimum may cause contaminations at the gutter that will affect the quality of the printouts.

Recommended Stroke distance

The setting of the stroke distance has to correspond with the maximum speed that is expected for the job. A value too small for the actual printing speed will cause StrokeGo errors. A value too large may have a negative effect on the quality of the printout.

The values in the table are minimum values for the corresponding print modes and speeds.

For instance:

Working with the 5x5 dots print mode the minimum value for the stroke distance at a speed of 800 m/min is 0,62 mm. For the same print mode at a speed of 260 m/min the minimum stroke distance is 0,2 mm.

The basic rule reads as follows:

With increasing speeds, the stroke distance has also to be increased.

Please consider also that stroke distances below 0,25 mm are more theoretical values. Depending on the ink and the substrate on which is printed the diameter of a ink drop on the substrate may already have a diameter of 0,25 mm. In such cases the ink drops may overlap.

Speed [m/min]

The values in each cell of this column are neither minimum values nor maximum values.

The smaller value shows the boundary to the JET3up JET Rapid or JET3up printer. Printers of these types may better cover applications working at printing speeds below these values.

The higher value is a speed recommendation for the corresponding print mode. Technically, it is possible to work at higher speeds. However, the higher the printing speed the more the printing quality is affected negatively.

Parameter Settings for the option Speed Plus

Print mode	Height [mm] Print height setting [% PH]	Recommended stroke distance [mm]	Speed [m/min]
1 dot Line mode	------- 100% PH	0,15 – 0,29	580 - 800
3x7 dots tower small	1,2 – 1,7 mm 70% - 100 % PH	0,3 – 0,52	580 - 800
3x7 dots tower	1,6 – 2,4 mm 70% - 100% PH	0,3 – 0,52	580 - 800
5x5 dots small speed*	1,5 – 1,8 mm 80% - 100% PH	0,2 – 0,52	260 - 800
5x5 dots small	1,5 – 1,8 mm 80% - 100% PH	0,2 – 0,52	260 - 800
5x5 dots	1,7 – 2,1 mm 80% - 100% PH	0,2 – 0,52	260 - 800
5x5 dots speed	1,7 – 2,1 mm 80% - 100% PH	0,2 – 0,52	260 - 800
7x5 dot Speed**	2,1 – 2,4 mm 80% - 100% PH	0,25 – 0,52	240 - 500
7x5 dot	2,1 – 2,4 mm 80% - 100% PH	0,25 – 0,52	240 - 500

*Full stroke with 4 dots **Full stroke with 6 dots

Print mode	Height [mm] Print height setting [% PH]	Recommended stroke distance [mm]	Speed [m/min]

2.5 Features and applications

The JET Rapid printer itself and in combination with option SPEED PLUS cover a wide range of high speed applications.

2.5.1 Overview about features and applications

	JET Rapid	Option SPEED PLUS
Features	• Up to 30% faster than the JET3up • Multi-line printing with up to 5 lines • There are the same print modes available as for the JET3up • There is a range of approved inks available for various applications and substrates	• Up to 800 m/min maximum printing speed in high quality • Single line printing for high speed applications • There is a range of approved inks available for various applications and substrates
Applications	• JET3up applications that require higher production speeds especially if there is a 2- or 3-line printout required. E.g. filling systems or bottling plants.	• Single-line high speed printing with a maximum print height of 2,5 mm. • E.g. serial numbers, expiry dates, lot numbers
Restrictions	• There is a smaller range of approved inks available than for the JET3up • For optimal results the recommended **distance** between print head and substrate 15 mm. Shorter distances bear the risk of contaminating the print head, larger distances may have a negative effect on the quality of the printouts.	• Single-line printing • There is a smaller range of approved inks available than for the JET3up • Restricted number of print modes: • Line Mode • 3x7 tower • 3x7 tower small • 5x5 • 5x5 small • 5x5 speed • 5x5 speed small • 7x5 • 7x5 speed • The recommended **distance** between print head and substrate is 5 mm. Shorter distances bear the risk of contaminating the print head, larger distances may have a negative effect on the quality of the printouts.

2.5.2 Ink list JET Rapid

INK	JET Rapid	Option SPEED PLUS
	55µm	**50µm**
70-030	✓	✗
70-031	✓	✗
70-101	✓	✗
70-106	✓	✓
70-126	✓	✓
70-134	✓	✓
72-102	✓	✓
76-101	✓	✓

All inks are approved for a ink temperature range between 20°C and 45°C. The temperature delta during operation must not exceed +/- 7° C based on the ink temperature at the time of the last calculation of the drop-break-off point whereby the ink temperature should never fall below 20°C and never exceed 45°C.

2.5.3 Cleaning requirements

Due to their compositions, some inks have limitations concerning their cleaning intervals. Especially inks that contain soot particles also require a more intensive cleaning. With such inks, rinsing the electrode block and the deflection plates with cleaning fluid may not be sufficient. With such inks, we recommended cleaning the deflection plates with a soft tissue in order to remove all stains and particles.

	Attention
⚠️	Due to the higher printing speed of the JET Rapid printers, the number of printouts per time unit may be much higher than with the JET3up. Therefore, it is necessary to check the gutter tube for ink staining on a regular basis. When required the gutter tube has to be cleaned from any ink stains. Please see the manual and service documentation for the respective cleaning instructions.

2.6 Print samples

2.6.1 Print samples: JET Rapid in comparison with JET3up – 2D codes

The print samples show that the JET Rapid provides the same print quality as the JET3up but at a 30% higher production speed. The printouts of the JET Rapid are a shade lighter than the printouts of the JET3up. However, a quality check of the 2-D code shows that the code has the highest readability level.

0 123456 789128	PRINTMODE: 32DOT_HQ PRINTSPEED: 28m/min PRINTHEIGHT: 95% HEAD DISTANCE: 14mm	▦	**JET Rapid** **55 µm nozzle** 28 m/min
0 123456 789128	PRINTMODE: 32DOT_HQ PRINTSPEED: 20m/min PRINTHEIGHT: 95% HEAD DISTANCE: 14mm	▦	**JET3up** **60 µm nozzle** 20 m/min

PQA (print quality assessment) for the two printouts

JET Rapid at 95% print height	JET3up at 95% print height
DATAMATRIX 01234 >> PQA from Hand Held Products <<	DATAMATRIX 01234 >> PQA from Hand Held Products <<
DATA MATRIX ECC200: 16 x 16 modules in size	DATA MATRIX ECC200: 16 x 16 modules in size
Data Field: 12 data & 12 chks in 1 block(s) of GF(256)	Data Field: 12 data & 12 chks in 1 block(s) of GF(256)
X roughly = 0.017"	X roughly = 0.019"
[A] < Fixed Patterns: 0 module errors	[A] < Fixed Patterns: 0 module errors
[A] < Data Safety Margin = 83%	[A] < Data Safety Margin = 100%
[A] < Horizontal Print Growth = -3% of X	[A] < Horizontal Print Growth = -14% of X
[A] < Vertical Print Growth = +19% of X	[A] < Vertical Print Growth = -4% of X

The PQA does not show any significant differences between the code readability of the two printouts.

2.6.2 Print sample: JET Rapid with 70000-00031 ink

The print samples show that even with a small drop ink like the 70000-00031 the print quality for barcodes with the JET Rapid is still perfect.

‖‖‖‖‖‖‖‖‖‖‖‖‖ 0"123456"789120"	PRINTMODE: 32DOT_HQ INK:70-31 NOZZLE: 55 um PRINTHEIGHT: 95% HEAD DISTANCE: 15 mm	**JET Rapid** **55 µm nozzle** 28 m/min

PQA (print quality assessment) for the printout

JET Rapid at 95% print height	
DATAMATRIX 01234 >> PQA from Hand Held Products <<	
DATA MATRIX ECC200: 16 x 16 modules in size	
Data Field: 12 data & 12 chks in 1 block(s) of GF(256)	
X roughly = 0.018"	
[A] < Fixed Patterns: 0 module errors	
[A] < Data Safety Margin = 66%	
[A] < Horizontal Print Growth = -3% of X	
[A] < Vertical Print Growth = +10% of X	

The PQA show the highest readability for the printouts of a JET Rapid with the small-drop-ink 70000-00031. The smaller nozzle size combined with a small-drop-ink has no significant effects on the Print Quality Assessment (PQA).

2.6.3 Print samples: JET Rapid in comparison with the option SPEED PLUS

The print samples show that with a 7x5 font the option Speed Plus has quality advantages compared with the JET Rapid at a speed higher than 200 m/min

7X5 JET3up RAPID HIGHSPEED 200M/MIN	JET Rapid with Speed Plus option - 200 m/min
7X5 JET3up RAPID UNIVERSAL 200M/MIN	JET Rapid - 200 m/min

7X5 JET3up RAPID HIGHSPEED 300M/MIN	JET Rapid with Speed Plus option - 300 m/min
7X5 JET3up RAPID UNIVERSAL 300M/MIN	JET Rapid - 300 m/min

7X5 JET3up RAPID HIGHSPEED 400M/MIN	JET Rapid with Speed Plus option- 400 m/min
7X5 JET3up RAPID UNIVERSAL 400M/MIN	JET Rapid - 400 m/min

7X5 JET3up RAPID HIGHSPEED 500M/MIN	JET Rapid with Speed Plus option- 500 m/min
7X5 JET3up RAPID UNIVERSAL 500M/MIN	JET Rapid - 500 m/min

2.6.4   Print samples: JET Rapid in comparison with JET3up – 2D codes

The print samples show that the JET Rapid provides the same print quality as the JET3up but at a 30% higher production speed. The printouts of the JET Rapid are a shade lighter than the printouts of the JET3up. However, a quality check of the 2-D code shows that the code has the highest readability level.

	PRINTMODE: 32DOT_HQ PRINTSPEED: 28m/min PRINTHEIGHT: 95% HEAD DISTANCE: 14mm		**JET Rapid** **55 µm nozzle** 28 m/min
	PRINTMODE: 32DOT_HQ PRINTSPEED: 20m/min PRINTHEIGHT: 95% HEAD DISTANCE: 14mm		**JET3up** **60 µm nozzle** 20 m/min

PQA (print quality assessment) for the two printouts

JET Rapid at 95% print height	JET3up at 95% print height
DATAMATRIX 01234 >> PQA from Hand Held Products <<	DATAMATRIX 01234 >> PQA from Hand Held Products <<
DATA MATRIX ECC200: 16 x 16 modules in size	DATA MATRIX ECC200: 16 x 16 modules in size
Data Field: 12 data & 12 chks in 1 block(s) of GF(256)	Data Field: 12 data & 12 chks in 1 block(s) of GF(256)
X roughly = 0.017"	X roughly = 0.019"
[A] < Fixed Patterns: 0 module errors	[A] < Fixed Patterns: 0 module errors
[A] < Data Safety Margin = 83%	[A] < Data Safety Margin = 100%
[A] < Horizontal Print Growth = -3% of X	[A] < Horizontal Print Growth = -14% of X
[A] < Vertical Print Growth = +19% of X	[A] < Vertical Print Growth = -4% of X

The PQA does not show any significant differences between the code readability of the two printouts.

2.6.5   Print sample: JET Rapid with 70000-00031 ink

The print samples show that even with a small drop ink like the 70000-00031 the print quality for barcodes with the JET Rapid is still perfect.
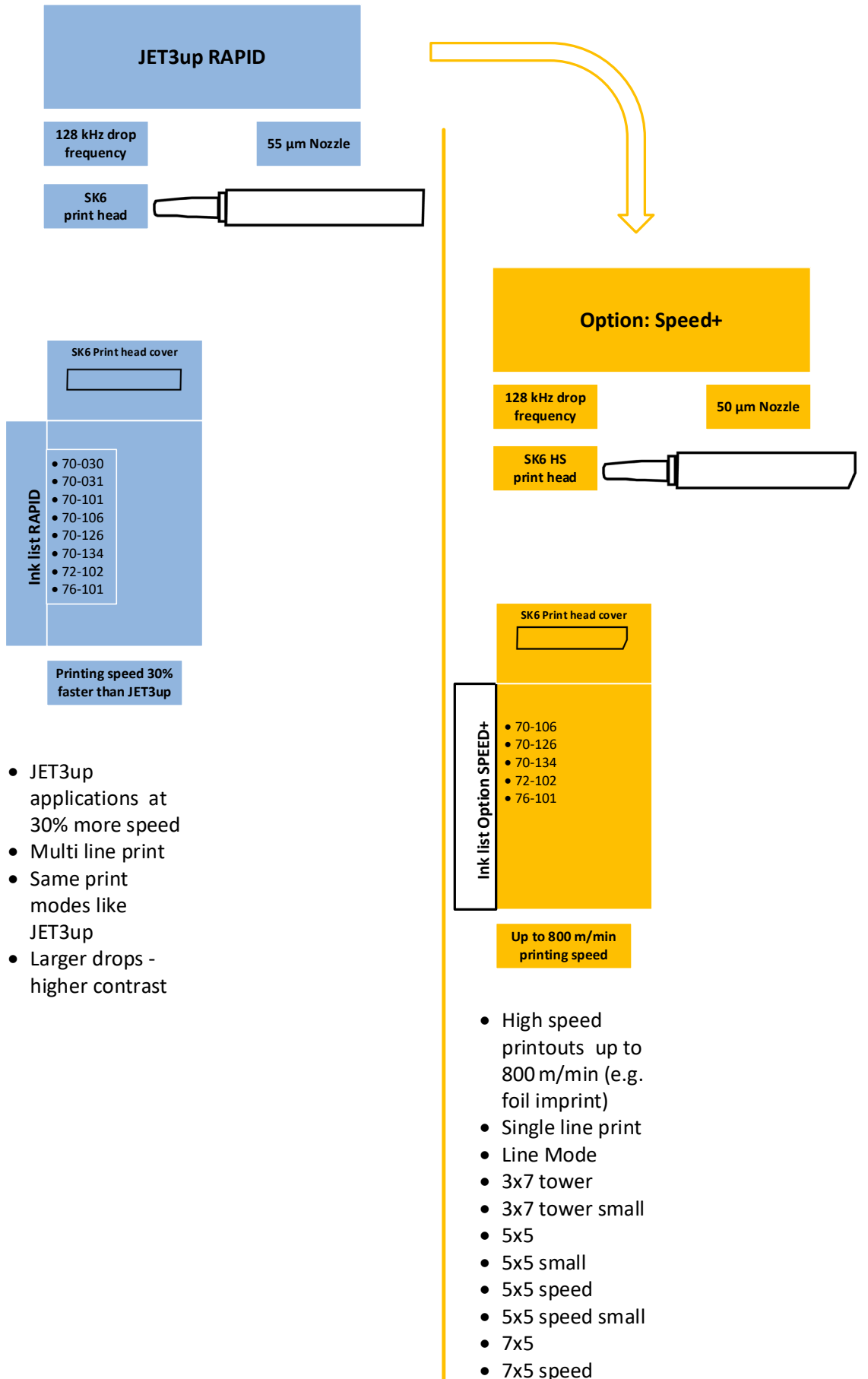
	PRINTMODE: 32DOT_HQ INK: 70-31 NOZZLE: 55 um PRINTHEIGHT: 95% HEAD DISTANCE: 15 mm		**JET Rapid** **55 µm nozzle** 28 m/min

PQA (print quality assessment) for the printout

JET Rapid at 95% print height	
DATAMATRIX 01234 >> PQA from Hand Held Products <<	
DATA MATRIX ECC200: 16 x 16 modules in size	
Data Field: 12 data & 12 chks in 1 block(s) of GF(256)	
X roughly = 0.018"	
[A] < Fixed Patterns: 0 module errors	
[A] < Data Safety Margin = 66%	
[A] < Horizontal Print Growth = -3% of X	
[A] < Vertical Print Growth = +10% of X	

The PQA does shows the highest readability for the printouts of a JET Rapid with the small-drop-ink 70000-00031. The smaller nozzle size combined with a small-drop-ink has no significant effects on the Print Quality Assessment (PQA).

2.7 Overview: The JET Rapid and the option SPEED PLUS

JET3up RAPID

128 kHz drop frequency

55 µm Nozzle

SK6 print head

SK6 Print head cover

Ink list RAPID
- 70-030
- 70-031
- 70-101
- 70-106
- 70-126
- 70-134
- 72-102
- 76-101

Printing speed 30% faster than JET3up

- JET3up applications at 30% more speed
- Multi line print
- Same print modes like JET3up
- Larger drops - higher contrast

Option: Speed+

128 kHz drop frequency

50 µm Nozzle

SK6 HS print head

SK6 Print head cover

Ink list Option SPEED+
- 70-106
- 70-126
- 70-134
- 72-102
- 76-101

Up to 800 m/min printing speed

- High speed printouts up to 800 m/min (e.g. foil imprint)
- Single line print
- Line Mode
- 3x7 tower
- 3x7 tower small
- 5x5
- 5x5 small
- 5x5 speed
- 5x5 speed small
- 7x5
- 7x5 speed

3 The JET Rapid Wire and JET Rapid Wire PI printer

3.1 General description of the JET Rapid Wire and JET Rapid Wire PI

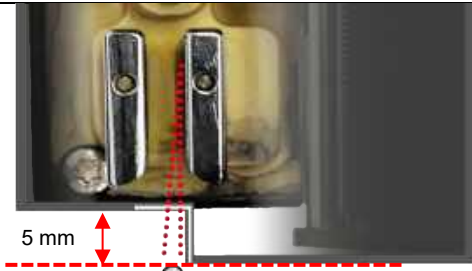The JET Rapid Wire / JET Rapid Wire PI works with a special **Wire print head**. The printer comes with two special head covers:

- o A print head cover with a stepped design
- o A print head cover with a beveled design

3.2 Print head covers

3.2.1 Print head cover with stepped design

The stepped print head cover allows a nearly zero distance between print head and substrate. This makes it possible to work at the highest speeds. Due to its design, the print head is applicable for wires, cables or tubes with a **diameter smaller than 5 mm**.
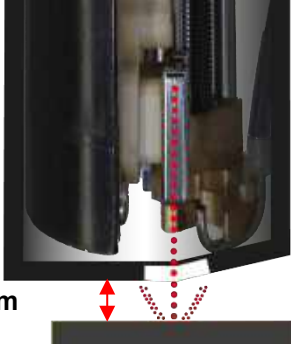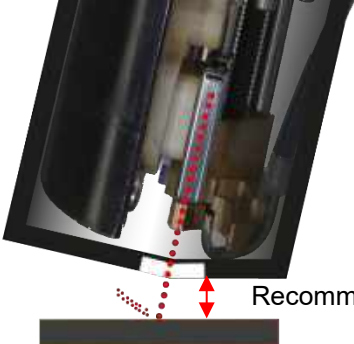
217 mm   Ø 43 mm
The stepped print head cover: designed for printing on wires, cables or tubes with diameters <5mm at high speeds
5 mm   5 mm
Wire diameter = **4 mm**   Wire diameter = **2 mm**
The illustrations show the special Wire print head with a stepped print head cover and wires of different diameters. It is important to get the wire, respectively the print head, in a position that ensures good printout results. The closer the substrate is positioned to the outlet of the print head the better will be the quality of the printout at high speeds. It has also to be considered that the diameter of the wire affects the position of the printout on the cable.

3.2.2 Print head with beveled design

For objects with larger diameters, it is recommended using the beveled print head cover.

With the special design, it is possible to mount the print head in a slightly inclined position. This will prevent the printer from becoming contaminated by bursting ink drops.

Due to the larger distance between print head and substrate, the operation speed with the beveled print head cover is a bit lower than with the stepped print head cover.

217 mm / 43 mm
The print head with the beveled head cover: The slightly angled surface allows an optimized mounting of the print head.
Recommended: **5 mm** / Recommended: **5 mm**

Ink drops that hit the surface of a substrate tend to burst in smaller drops and the substrate will not absorb all drops	With the beveled surface of the outlet of the print head, it is possible to mount the print head in a slightly inclined position.
With a vertically mounted print head, the bursting ink drops may lead to a faster contamination of the print head.	The ink drops will not hit the substrate at a 90° angle. Therefore, the bursting ink drops will take a direction away from the outlet, which will lead to less contamination of the print head.

Generally: With the beveled print head cover, the distance between print head and substrate should not be below **5 mm** in order to avoid the contamination of the print head by rebounding ink drops. A larger distance may have negative effects on the quality of the printouts.

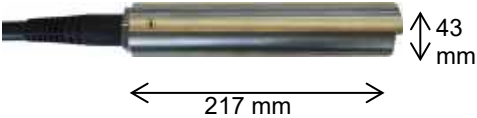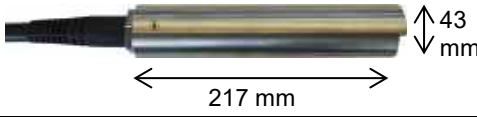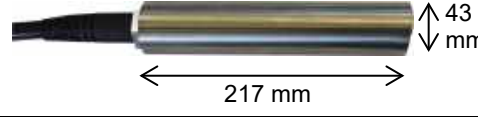|	
	Information
	Given the same print quality, the stepped print head allows for higher printing speeds than the beveled print head. This is because of the different distances between print head and Substrate. Technically, it is possible to print with both print head covers at the same speed. The difference lays in the resulting print quality.

3.3 General technical specifications JET Rapid Wire / JET Rapid Wire PI

3.3.1 Overview JET Rapid Wire

	Wire print head with stepped head cover	Wire print head with beveled head cover
Print head	Wire	Wire
Print head dimensions	43 mm / 217 mm	43 mm / 217 mm
Maximum printing speed	1000 m/min	800 m/min
Characters per inch [cpi]	6 cpi at 1000 m/min Print mode: 5x5 dot speed	8 cpi at 800 m/min Print mode: 5x5 speed
Oscillator frequency	128 kHz	128 kHz
Nozzle size	50 µm	50 µm
Available print modes	Line Mode 5x5 speed 3x7 tower 5x5 speed small 3x7 tower small 7x5 5x5 7x5 speed 5x5 small	Line Mode 5x5 speed 3x7 tower 5x5 speed small 3x7 tower small 7x5 5x5 7x5 speed 5x5 small
Print lines	Single line	Single line
Available inks	Please see appendix for a detailed ink list	Please see appendix for a detailed ink list
Compressed air required	Yes. 2 l/min	Yes. 2 l/min

3.3.2 Overview JET Rapid Wire PI

	Wire printhead with stepped head cover	Wire printhead with beveled head cover
Print head	Wire	Wire
Print head dimensions	43 mm / 217 mm	43 mm / 217 mm
Maximum printing speed	700 m/min	600 m/min
Characters per inch [cpi]	7 cpi at 700 m/min Print mode: 5x5 dot speed	8 cpi at 600 m/min Print mode: 5x5 dot speed
Oscillator frequency	96 kHz	96 kHz
Nozzle size	60 µm	60 µm
Available print modes	Line Mode 5x5 speed 3x7 tower 5x5 speed small 3x7 tower small 7x5 5x5 7x5 speed 5x5 small	Line Mode 5x5 speed 3x7 tower 5x5 speed small 3x7 tower small 7x5 5x5 7x5 speed 5x5 small
Print lines	Single line	Single line
Available inks	Please see appendix for a detailed ink list	Please see appendix for a detailed ink list
Compressed air required	Yes. 2 l/min	Yes. 2 l/min

3.4 Basic parameters for Print height, Stroke distance and Speed

The tables in this chapter provide recommendations for several parameter settings. Working with the tables the following points should be considered:

Print modes

This column shows the print modes available for the JET3up JET Rapid Wire and JET3up Wire PI.

The **speed** modes work with one dot less in full strokes.

The **small** modes place the dots closer to each other than the standard modes.

A combination of **speed mode** and **small mode** has the same height as the **small mode** and one dot less in full strokes at the **speed mode**.

Examples for print modes standard, speed, small and small speed with example character <H>:

5x5 dots	5x5 dots speed	5x5 dots small	5x5 dots speed small

Height [mm]

Height in [mm] shows the height of the printout that can be expected if the operator follows the recommendations for the distances between print head and substrate.

Print height setting [% PH]

The minimum value of the print height settings ([PH in %] is important. A value below minimum may cause contaminations at the gutter that will affect the quality of the printouts.

Recommended Stroke distance

The setting of the stroke distance has to correspond with the maximum speed that is expected for the job. A value too small for the actual printing speed will cause StrokeGo errors. A value too large may have a negative effect on the quality of the printout.

The values in the table are minimum values for the corresponding print modes and speeds.

For instance:

Working with the 5x5 dots print mode the minimum value for the stroke distance at a speed of 800 m/min is 0,62 mm. For the same print mode at a speed of 260 m/min the minimum stroke distance is 0,2 mm.

The basic rule reads as follows:

With increasing speeds, the stroke distance has also to be increased.

Please consider also that stroke distances below 0,25 mm are more theoretical values. Depending on the ink and the substrate on which is printed the diameter of a ink drop on the substrate may already have a diameter of 0,25 mm. In such cases the ink drops may overlap.

Speed [m/min]

The values in each cell of this column are neither minimum values nor maximum values.

The smaller value shows the boundary to the JET3up JET Rapid or JET3up printer. Printers of these types may better cover applications working at printing speeds below these values.

The higher value is a speed recommendation for the corresponding print mode. Technically, it is possible to work at higher speeds. However, the higher the printing speed the more the printing quality is affected negatively.

3.4.1   JET Rapid Wire with Wire print head and stepped print head cover

Print mode	Height [mm] Print height setting [% PH]	Recommended stroke distance [mm]	Speed [m/min]
1 dot Line mode	------- 100% PH	0,15 – 0,26	580 - 1000
3x7 dots tower small	1,0 – 1,3 mm 70% - 100 % PH	0,3 – 0,52	580 - 1000
3x7 dots tower	1,4 – 1,9 mm 70% - 100% PH	0,3 – 0,52	580 - 1000
5x5 dots small speed*	1,2 – 1,7 mm 80% - 100% PH	0,17 – 0,42	260 - 800
5x5 dots small	1,2 – 1,7 mm 80% - 100% PH	0,2 – 0,62	260 - 800
5x5 dots	1,4 – 1,7 mm 80% - 100% PH	0,2 – 0,62	260 - 800
5x5 dots speed*	1,4 – 1,7 mm 80% - 100% PH	0,17 – 0,42	260 - 800
7x5 dot speed**	1,7 – 2,0 mm 80% - 100% PH	0,19 – 0,39	240 - 500
7x5 dot	1,7 – 2,0 mm 80% - 100% PH	0,22 – 0,52	240 - 500

*Full stroke with 4 dots ******Full stroke with 6 dots

3.4.2   JET Rapid Wire with Wire print head and beveled print head cover

Print mode	Height [mm] Print height setting [% PH]	Recommended stroke distance [mm]	Speed [m/min]
1 dot Line mode	------- 100% PH	0,15 – 0,29	580 - 800
3x7 dots tower small	1,2 – 1,7 mm 70% - 100 % PH	0,3 – 0,42	580 - 800
3x7 dots tower	1,6 – 2,4 mm 70% - 100% PH	0,3 – 0,42	580 - 800
5x5 dots small speed*	1,5 – 1,8 mm 80% - 100% PH	0,17 – 0,52	260 - 800
5x5 dots small	1,5 – 1,8 mm 80% - 100% PH	0,2 – 0,63	260 - 800
5x5 dots	1,7 – 2,1 mm 80% - 100% PH	0,2 – 0,63	260 - 800
5x5 dots Speed*	1,7 – 2,1 mm 80% - 100% PH	0,17 – 0,52	260 - 800
7x5 dot Speed**	2,1 – 2,4 mm 80% - 100% PH	0,19 – 0,46	240 - 500
7x5 dot	2,1 – 2,4 mm 80% - 100% PH	0,22 – 0,52	240 - 500

*Full stroke with 4 dots **Full stroke with 6 dots

3.4.3 JET Rapid Wire PI with Wire print head and stepped print head cover

Print mode	Height [mm] Print height setting [% PH]	Recommended stroke distance [mm]	Speed [m/min]
1 dot Line mode	------- 100% PH	0,15 – 0,18	580 - 700
3x7 dots tower small	1,0 – 1,4 mm 60% - 100 % PH	0,3 – 0,37	580 - 700
3x7 dots tower	1,7 – 2,3 mm 80% - 100% PH	0,3 – 0,37	580 - 700
5x5 dots small speed*	1,2 – 1,6 mm 70% - 100% PH	0,17 – 0,39	260 - 600
5x5 dots small	1,2 – 1,6 mm 70% - 100% PH	0,2 – 0,47	260 - 600
5x5 dots	1,5 – 2,0 mm 80% - 100% PH	0,2 – 0,47	260 - 600
5x5 dots speed	1,5 – 2,0 mm 80% - 100% PH	0,17 – 0,39	260 - 600
7x5 dot Speed**	1,9 – 2,2 mm 90% - 100% PH	0,19 – 0,31	240 - 400
7x5 dot	1,9 – 2,2 mm 90% - 100% PH	0,22 – 0,37	240 - 400

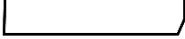*Full stroke with 4 dots **Full stroke with 6 dots

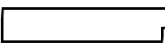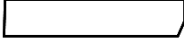### 3.4.4 JET Rapid Wire PI with Wire print head and stepped print head cover

Print mode	Height [mm] Print height setting [% PH]	Recommended stroke distance [mm]	Speed [m/min]
1 dot Line mode	------- 80% – 100% PH	0,15 – 0,16	580 - 600
3x7 dots tower small	1,2 – 1,7 mm 70% - 100 % PH	0,3 – 0,31	580 - 600
3x7 dots tower	1,6 – 2,4 mm 70% - 100% PH	0,3 – 0,31	580 - 600
5x5 dots small speed*	1,5 – 1,8 mm 80% - 100% PH	0,17 – 0,33	260 - 500
5x5 dots small	1,5 – 1,8 mm 80% - 100% PH	0,2 – 0,39	260 - 500
5x5 dots	1,7 – 2,1 mm 80% - 100% PH	0,2 – 0,39	260 - 500
5x5 dots speed	1,7 – 2,1 mm 80% - 100% PH	0,17 – 0,33	260 - 500
7x5 dot Speed**	2,1 – 2,4 mm 80% - 100% PH	0,19 – 0,37	240 - 400
7x5 dot	2,1 – 2,4 mm 80% - 100% PH	0,22 – 0,42	240 - 400

3.5   Features and applications

3.5.1   JET Rapid Wire - Overview about features and applications

Print head cover	Stepped print head cover		Beveled print head cover	
Features	• 1000 m/min maximum printing speed in high quality • A special print head provides a very short distance between print head and substrate. • There are several approved inks especially for cable applications available		• Up to 800 m/min maximum printing speed in high quality • For larger diameters • There are several approved inks available for various applications and substrates	
Applications	• Printing on cable/wire/tubes with diameters up to 5 mm		• Printing on cable/wire/tubes with diameters larger than 5 mm • High speed printing with a maximum print height of 2,5 mm.	

Restrictions	• Only 1 print line
	• There is a smaller range of approved inks available than for the JET3up
	• There are 7 print modes available:
	   o 1 dot
	   o Line mode
	   o 3x7 dots tower small
	   o 3x7 dots tower
	   o 5x5 dots small speed
	   o 5x5 dots small
	   o 5x5 dots
	   o 5x5 dots speed
	   o 7x5 dots
	   o 7x5 dots speed
	• The **diameter** of the substrate must not be larger than 5 mm.
			• Only one print line
			• There is a smaller range of approved inks available than for the JET3up
			• There are 7 print modes available:
			   o 1 dot
			   o Line mode
			   o 3x7 dots tower small
			   o 3x7 dots tower
			   o 5x5 dots small speed
			   o 5x5 dots small
			   o 5x5 dots
			   o 5x5 dots speed
			   o 7x5 dots
			   o 7x5 dots speed
			• The recommended **distance** between print head and substrate is 5 mm. Shorter distances bear the risk of contaminating the print head, larger distances may have a negative effect on the quality of the printouts.	

3.6.1 JET Rapid Wire PI - Overview about features and applications

Print head cover	Stepped print head cover		Beveled print head cover	
Features	• High-speed printing with pigmented inks • 700 m/min maximum printing speed in high quality • A special print head provides a very short distance between print head and substrate. • There are several approved inks especially for cable applications available		• High-speed printing with pigmented inks • Up to 600 m/min maximum printing speed in high quality • For larger diameters • There are several approved inks available for various applications and substrates	
Applications	• Printing with pigmented inks on cables/wires/tubes with diameters up to 5 mm. Eg.: white ink on black cable		• Printing with pigmented ink on cables/wires/tubes with diameters larger than 5 mm • High speed printing with a maximum print height of 2,4 mm.	

Restrictions	• Only 1 print line
	• There is a smaller range of approved inks available than for the JET3up
	• There are 7 printmodes available:
	
	    o 1 dot
	    o Line mode
	    o 3x7 dots tower small
	    o 3x7 dots tower
	    o 5x5 dots small speed
	    o 5x5 dots small
	    o 5x5 dots
	    o 5x5 dots speed
	    o 7x5 dots
	    o 7x5 dots speed
	
	• The **diameter** of the substrate must not be larger than 5 mm.
			• Only one print line
			• There is a smaller range of approved inks available than for the JET3up
			• There are only four fonts available:
			
			    o 1 dot
			    o Line mode
			    o 3x7 dots tower small
			    o 3x7 dots tower
			    o 5x5 dots small speed
			    o 5x5 dots small
			    o 5x5 dots
			    o 5x5 dots speed
			    o 7x5 dots
			    o 7x5 dots speed
			
			• The recommended **distance** between print head and substrate is 5 mm. Shorter distances bear the risk of contaminating the print head, larger distances may have a negative effect on the quality of the printouts.	

3.6.2   Ink list JET Rapid Wire

INK	JET Rapid Wire Stepped head cover		JET Rapid Wire Beveled head cover	
	50µm		50µm	
70-106	✓*)		✓	
70-126	✗		✓	
70-134	✓		✓	
72-102	✗		✓	
76-101	✓		✓	

*) Limitations regarding the cleaning intervals
All inks are approved for a ink temperature range between 20°C and 45°C. The temperature delta during operation must not exceed +/- 7° C based on the ink temperature at the time of the last calculation of the drop-break-off point whereby the ink temperature should never fall below 20°C and never exceed 45°C.

3.6.3   Ink list JET Rapid Wire PI

INK	JET Rapid Wire PI Stepped head cover		JET Rapid Wire PI Beveled head cover	
	60µm		60µm	
70-120	✓*)		✓*)	
74-111	✓		✓	
76-121	✓		✓	
79-106	✓		✓	
79-119	✓		✓	
79-122	✓		✓	

*) Limitations regarding the cleaning intervals
All inks are approved for a ink temperature range between 20°C and 45°C. The temperature delta during operation must not exceed +/- 7° C based on the ink temperature at the time of the last calculation of the drop-break-off point whereby the ink temperature should never fall below 20°C and never exceed 45°C.

3.7   Cleaning requirements

Due to their compositions, some inks have limitations with regards to their cleaning intervals. Especially inks that contain soot particles also require a more intensive cleaning. With such inks, rinsing the electrode block and the deflection plates with cleaning fluid may not be sufficient. With such inks, we recommended cleaning the deflection plates with a soft tissue in order to remove all stains and particles.

	Attention
⚠	Due to the higher printing speed of the JET Rapid printers, the number of printouts per time unit may be much higher than with the JET3up. Therefore, it is necessary to check the gutter tube for ink staining on a regular basis. When required the gutter tube has to be cleaned from any ink stains. Please see the manual and service documentation for the respective cleaning instructions.

3.8   Print samples

The following print samples are all created with 70-101 black ink on different types of JET Rapid printers, at different speeds and with different printing parameters.

3.8.1   Print samples JET Rapid Wire

Not available at the moment

3.8.2   Print samples: JET Rapid Wire in comparison with JET Rapid

The print sample show that with a 7x5 font the JET Rapid Wire has quality advantages compared with the JET Rapid at speed higher than 200 m/min.

7X5 JET3up RAPID HIGHSPEED 200M/MIN	JET Rapid Wire - 200 m/min
7X5 JET3up RAPID UNIVERSAL 200M/MIN	JET Rapid - 200 m/min

7X5 JET3up RAPID HIGHSPEED 300M/MIN	JET Rapid Wire - 300 m/min
7X5 JET3up RAPID UNIVERSAL 300M/MIN	JET Rapid - 300 m/min

7X5 JET3up RAPID HIGHSPEED 400M/MIN	JET Rapid Wire - 400 m/min
7X5 JET3up RAPID UNIVERSAL 400M/MIN	JET Rapid - 400 m/min

7X5 JET3up RAPID HIGHSPEED 500M/MIN	JET Rapid Wire - 500 m/min
7X5 JET3up RAPID UNIVERSAL 500M/MIN	JET Rapid - 500 m/min

3.8.3 Print sample: JET Rapid Wire cable printouts

The following example show the printout quality of the JET Rapid Wire a printer at 800 m/min with the beveled print head and at 1000 m/min with the stepped print head.

Printout JET Rapid Wire / 1000 m/min / 3x7 tower font/ full printout

Printout JET Rapid Wire / 1000 m/min / 3x7 tower font / details

Printout JET Rapid Wire / 800 m/min / 5x5 font/ full printout

Printout JET Rapid / 800 m/min / 5x5 font / details

4 Which printer for which applications?

Mainly, this is a question of the substrate (cables/wire/ foil / cardboard packages etc), the speed required and the type of printout (characters, barcodes, 2-D codes etc.)

With the JET Rapid Wire or Wire PI it is possible to cover all high speed applications concerning printouts on wires, cables, pipes or tubes.

For these high speed applications, the print modes available are restricted to small size matrixes (3x7 tower, 4x5, 5x5, 7x5). These print modes are good for small size characters to be printed at high speeds up to 1000 m/min.

The JET Rapid is a good choice for applications for which the JET3up is not fast enough for the printout quality required. The JET Rapid provides the same print modes as the JET3up but it is possible to work at speeds that are up to 30% higher in comparison with the JET3up.

For single-line high speed printouts, the JET Rapid with the option SPEED PLUS is the best choice.

The following diagram shows how to find the best printer for a certain application.

4.1 Overview: The LEIBINGER HIGH SPEED LINE

LEIBINGER High Speed Line

High Speed Applications for wires, cables, pipes and tubes

JET Rapid Wire PI

- 96 kHz drop frequency
- Wire print head
- 60 µm Nozzle

Print head cover, beveled
- 70-120*
- 74-111
- 76-121
- 79-106
- 79-119
- 79-122

Ink list JET Rapid Wire PI

Print head cover, stepped
- 70-120*
- 74-111
- 76-121
- 79-106
- 79-119
- 79-122

Up to 600 m/min printing speed

Up to 700 m/min printing speed

- Exclusively for cable printing for cables with a diameter larger than 5 mm
- Printing speed up to 600 m/min
- Single line print
- Line Mode
- 3x7 tower
- 3x7 tower small
- 5x5
- 5x5 small
- 5x5 speed
- 5x5 speed small
- 7x5
- 7x5 speed
- For pigmented and non-pigmented ink
- Larger drops-higher contrast

- Exclusively for cable printing for cables with a diameter up to 5 mm
- Printing speed up to 700 m/min
- Single line print
- Line Mode
- 3x7 tower
- 3x7 tower small
- 5x5
- 5x5 small
- 5x5 speed
- 5x5 speed small
- 7x5
- 7x5 speed
- For pigmented and non-pigmented ink
- Larger drops-higher contrast

JET Rapid Wire

- 128 kHz drop frequency
- Wire print head
- 50 µm Nozzle

Print head cover, beveled
- 70-106
- 70-126
- 70-134
- 72-102
- 76-101

Ink list JET Rapid Wire

Print head cover, stepped
- 70-106*
- 70-134
- 76-101

Up to 800 m/min printing speed

Up to 1000 m/min printing speed

- Exclusively for cable printing for cables with a diameter larger than 5 mm
- Printing speed up to 800 m/min
- Single line print
- Line Mode
- 3x7 tower
- 3x7 tower small
- 5x5
- 5x5 small
- 5x5 speed
- 5x5 speed small
- 7x5
- 7x5 speed

- Exclusively for cable printing for cables with a diameter up to 5 mm
- Printing speed up to 1000 m/min
- Single line print
- Line Mode
- 3x7 tower
- 3x7 tower small
- 5x5
- 5x5 small
- 5x5 speed
- 5x5 speed small
- 7x5
- 7x5 speed

High Speed Applications Except wires, cables, pipes and tubes

Option: Speed Plus

- 128 kHz drop frequency
- Speed Plus print head
- 50 µm Nozzle

Beveled print head cover
- 70-106
- 70-126
- 70-134
- 72-102
- 76-101

Ink list Option Speed Plus

Up to 800 m/min printing speed

- High speed printouts up to 800 m/min (e.g. foil imprint)
- Single line print
- Line Mode
- 3x7 tower
- 3x7 tower small
- 5x5
- 5x5 small
- 5x5 speed
- 5x5 speed small
- 7x5
- 7x5 speed

JET Rapid

- 128 kHz drop frequency
- Rapid print head
- 55 µm Nozzle

5K6 Print head cover
- 70-030
- 70-031
- 70-101
- 70-106
- 70-126
- 70-134
- 72-102
- 76-101

Ink list JET Rapid

Printing speed 30% faster than JET3up

- JET3up applications at 30% more speed
- Multi line print
- Same print modes like JET3up
- Larger drops - higher contrast

5   JET Rapid Wire: The print head ventilation

The JET Rapid Wire printers and the Option Speed Plus come with a print head ventilation. The print head ventilation ensures longer cleaning intervals and reduces the risk of condensation within the print head.

5.1   Basics about the functionality

The print head of the JET Rapid Wire has to be mounted at a distance between nearly zero und 5 mm to the substrate. This close installation provides the shortest trajectories for ink droplets. This is the basic requirement for a fast and precise printout. However, it also bears the risk of contaminating the print head by bursting ink droplets.

With the head ventilation there is a constant air stream at the outlet of the print head that works like a protective shield against the remains of ink droplets that burst on the surface of the substrate.

Example: print head ventilation with the JET Rapid Wire

The print head of the JET Rapid Wire during the printing process. The ink jet is illustrated as a series of **red droplets**. With the JET Rapid Wire the distance between the substrate, normally a cable, and the print head is nearly zero.	The illustration shows an enlargement of the print head. The **red ink droplets** burst on the surface of the substrate, causing smaller droplets that are bouncing back in the direction of the outlet of the print head. The compressed air of the head ventilation is illustrated as **blue droplets**. With the slight over pressure in the print head, the compressed air prevents the intrusion of ink droplets into the print head.

5.2   Technical details

The JET Rapid Wire and the option Speed Plus are equipped with a connector for compressed air.
The connector is located on the back panel of the hydraulic cabinet.

Connector for compressed air
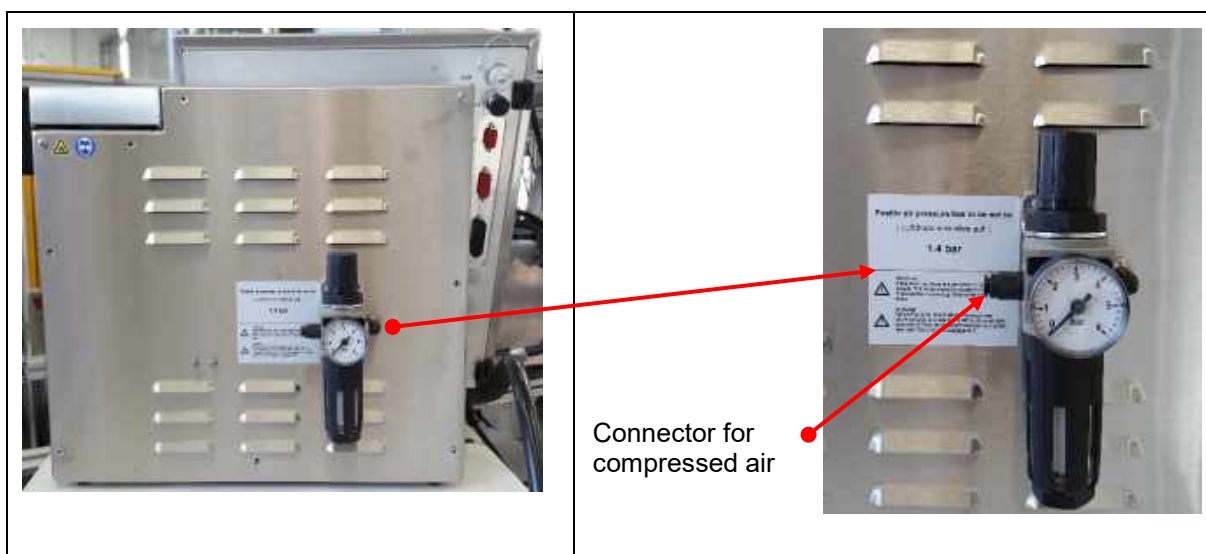
Technical data

Maximum input pressure: 10 bar (145.035 psi)

Factory preset for the pressure control: 1,4 bar (20.305 psi)

Recommended flow: **2** l/min for JET Rapid Wire and JET Rapid Wire PI,
with stepped or beveled print head cover

2 l/min for JET Rapid with option Speed Plus

⚠	⚠ **Warning**
	Operation is only permissible with clean, dry, oil-free and filtered compressed air (Filtering 8 µm). Using compressed air that does not meet these requirements may cause serious damages to the print head.

🛈	**Attention**

	Make sure that there is a permanent compressed air supply!
	
	   o The printer does not monitor the permanent compressed air supply!
	   o There will be no warning in case the permanent compressed air supply fails!

6 Information about encoders

Regarding the encoders that are used for a high speed application, there are two limitations to be considered. The first one is the maximum output frequency of the encoder and the other one is the maximum input frequency of the **X1** encoder input interface of the printer.

6.1 Basics

Regarding speed measuring the JET Rapid printers work with internal speed as well as with an external encoder.

An external encoder has the advantage that a varying production speed would not affect the quality of the printout. Additionally the printer would recognize a stop of the production line.

Nevertheless, using an encoder for high speed printing requires a careful selection of the encoder.

6.2 The resolution and the output frequency of the encoder

The resolution of an encoder indicates the number of pulses per rotation.

An encoder, for instance, with a resolution of **2.500** indicates that the encoder provides 2.500 pulses per rotation of the encoder axis.

Normally there is a measuring wheel with a circumference mounted on the axis of the encoder. The given circumference of the measuring wheel and the resolution of the encoder results in the pulses per mm.

$$\frac{number\ of\ pulses\ per\ rotation}{Circumference\ measuring\ wheel\ [mm]} = pulses/mm$$

If, for instance, the circumference of the measuring wheel is 200 mm the resolution is:

$$\frac{2.500}{200}\frac{pulses}{mm} = 12{,}5\ pulses/mm$$

In order to determine the output frequency of the encoder, which represents also the input frequency at the **X1** encoder interface of the printer, the resolution has to be multiplied with the actual production speed.

$$Input\ frequency\ X1 = \frac{pulses}{mm} * \frac{mm}{minute}$$

If, for instance, the production speed is 1000 m/min → 1.000.000 mm/min the input frequency is:

$$Input\ frequency\ X1 = \frac{12{,}5\ pulses}{mm} * \frac{1.000.000\ mm}{minute} = \frac{12.500.000\ pulses}{minute} = 208.333{,}33\ \frac{pulses}{second} = 208{,}33\ kHz$$
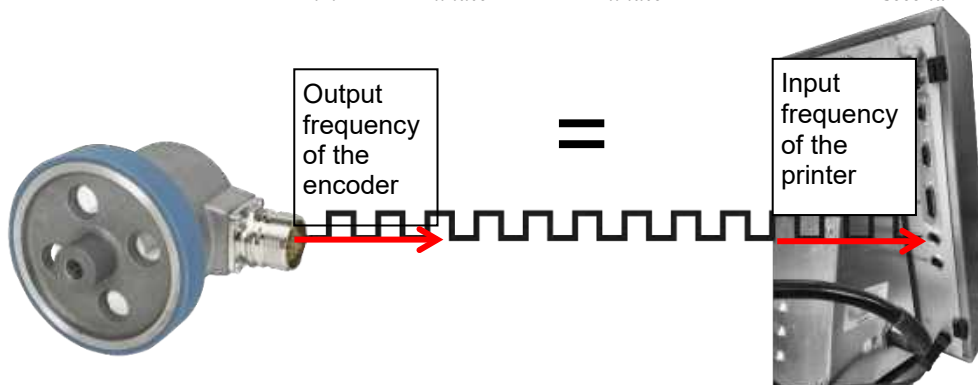
Important:

It is highly recommended thoroughly checking the technical specifications of the encoder that is used. An encoder with a high resolution leads to high output frequencies at high speed operations. **Make sure that the encoder is able to manage such frequencies!**

6.3 The specifications of the encoder input of the printer

The JET Rapid printer offers 3 different signal inputs:

- o An input for RS422 signals
- o An input for HTL signals
- o An input for TTL signals

Each type of input has its own specifications regarding the voltage levels, the input resistance and the maximum frequency. For high speed applications, the maximum input frequency is of particular importance.

Input specifications for interface X1 – Input for encoder signals
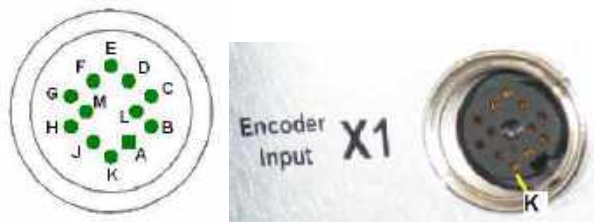
Pin	Description	Pin	Description
A	+5 V (max. 400 mA)	G	encoder channel /B RS422
B	GND	H	encoder channel A TTL (5V)
C	+24 V (1)	J	encoder channel B TTL (5V)
D	encoder channel A RS422	K	encoder channel A HTL (24V)
E	encoder channel /A RS422	L	encoder channel B HTL (24V)
F	encoder channel B RS422	M	PowerOn Option

Signal	Parameter	Value
RS422	Input level	Differential: +/-200mV Input voltage range: -0,3 to 5,5V
	Max. frequency	10 MHz
	Terminating resistance	120 Ohm
TTL	Input level high	2,4V to 5,5V
	Input level low	-0,5V to 0,7V
	Max. frequency	500 kHz
	Input resistance	1 MOhm
HTL	Input level high	12 to 28V
	Input level low	-0,5 to 3,5V
	Max. frequency	500 kHz
	Input resistance	3.3 kOhm

As the table shows, the RS422 input with 10 MHz allows the highest maximum input frequency.

The TTL and the HTL inputs are designed for a maximum frequency of 500 kHz.

> Even encoders for high speed applications cannot provide output frequencies higher than 350 kHz. Therefore, the inputs of the printer are not the limiting factor regarding the higher encoder frequencies during high speed printing.
>
> *Make sure that the encoder is able to provide the output frequency that is required for the application!*

6.4 Recommendations regarding the encoder / Printer combination for high speed applications

Normally the limiting factor is the encoder. Even high speed encoders do not provide output frequencies above 350 kHz. Therefore, the main reason for malfunctions with respect to the encoder/printer combination is either an inappropriate encoder or the operation of the encoder beyond its specifications.

> When designing a high speed application for a JET Rapid printer, the first step has to be the selection of an appropriate encoder!

The following chapter provides an example based on the shaft encoder from the LEIBINGER accessories catalogue.

6.5 Example for an encoder / printer combination

The encoder with the LEIBINGER article number **54-002352** K is designed for the use with LEIBINGER printers. The encoder has a TTL compatible RS 422 interface and a resolution of 2500 pulses/rotation.

The maximum number of revolutions permitted mechanically is 6.000 rotations per minute.

The maximum output frequency is 300 kHz.

At the maximum number of revolutions permitted mechanically the frequency at the output of the encoder is:

$$6000 \frac{rotations}{minute} \times 2500 \frac{pulses}{rotation} = 15.000.000 \frac{pulses}{minute} = 250.000 \frac{pulses}{second} = 250 \, kHz$$

Therefore, at the maximum speed permitted mechanically the output frequency stays below the 300 kHz allowed.

How to calculate the actual output frequency

In order to calculate the actual number of revolutions per minute the following parameters are required:

- The resolution per rotation of the encoder
- The circumference of the measuring wheel that is used
- The maximum production speed

This example calculates with the following values:

- resolution per rotation of the encoder (article number 54-002352 K): **2.500 per rotation**
- Circumference of the measuring wheel: **200 mm**
- Maximum production speed: **1.000 m/minute** (or: **1.000.000 mm/minute**)

The first value to be calculated is the value for the pulses per mm:

$$\frac{2.500}{200} \frac{pulses}{mm} = \mathbf{12,5 \, pulses/mm}$$

The next value to be calculated is the output frequency of the encoder:

$$Output \; frequency \; encoder = \frac{pulses}{mm} * \frac{mm}{minute}$$

$$Output \; frequency \; encoder = \frac{12,5 \, pulses}{mm} * \frac{1.000.000 \, mm}{minute} = 208.333,33 \frac{pulses}{second} = \mathbf{208 \, kHz}$$

The output frequency of **208 kHz** stays below the limit of 300 kHz. Therefore, it is possible to use the encoder with a measuring wheel whose circumference is **200 mm** at a speed of **1000 m/min**.

> **It is not recommended using encoders with a higher resolution than 2.500 pulses/rotation. A higher resolution has no advantages and it bears the risk of malfunctions caused by an encoder output frequency that exceeds the value permitted for the encoder that is used.**

7 Appendix

	Information
ℹ️	Regarding the graphic user interface there is no differences between the JET3up and the printers of the JET Rapid series. The differences appear in the available type of inks and print modes. The main difference regarding the service work are the adjustments of the print head and the ink jet. The following chapters are extracts from the manual that comes together with each printer. Please see the manual for more detailed information.

7.1 Hydraulic settings and printout parameters

7.1.1 Ink selection

Ink selection (JET Rapid , JET Rapid Wire):

The availability of inks depends on the type of JET Rapid. There are specific ink types tested and approved for the JET Rapid printer series and for these inks, the operator will find default settings in the hydraulic menu. For **inks that are not approved t**here are no default settings available.

	Attention
⚠️	• Using an ink that is not approved for high speed printing may result in printouts of dissatisfying quality! • Additionally, an ink that is not approved may cause serious issues through ink contaminations of the print head!

The following tables show the inks available (December 2017)

INK	JET Rapid Wire Stepped head cover		JET Rapid Wire Beveled head cover	
	50µm		50µm	
70-106	✓*)		✓	
70-126	✗		✓	
70-134	✓		✓	
72-102	✗		✓	
76-101	✓		✓	

INK	JET Rapid Wire PI Stepped head cover		JET Rapid Wire PI Beveled head cover	
	60µm		60µm	
70-120	✓*)		✓*)	
74-111	✓		✓	
76-121	✓		✓	
79-106	✓		✓	
79-119	✓		✓	
79-122	✓		✓	

INK	JET Rapid	Option SPEED PLUS
	55µm	50µm
70-030	✓	✗
70-031	✓	✗
70-101	✓	✗
70-106	✓	✓
70-126	✓	✓
70-134	✓	✓
72-102	✓	✓
76-101	✓	✓

Example: Differences between approved – unapproved ink

The following examples shows the differences between an approved and an unapproved ink:

1. Select the option <**HydraulicSettings**> from the drop-down menu „**Settings**"

With an ink approved ✓

2. Select the approved ink **70000-00134**. The default settings are displayed on the right side of the dialog box.
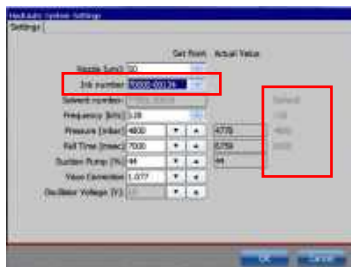
The appropriate default values for:

- o   Max. Frequency (KHz)
- o   Pressure (mbar) and
- o   Fall Time (msec)

are displayed on the right side of the dialog box in the same line as the corresponding input field.

3. The settings are confirmed with a click on the button **<Yes>**.

Confirm the settings

With an unapproved ink X

The ink **70000-00105** is **not** approved for the JET Rapid printer. With this ink selected, no default values will be listed.
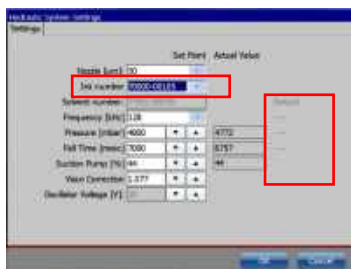
No defaults value will be listed for an unapproved ink!

Using an unapproved ink may cause problems with the printouts!

7.1.2 Print modes

Depending on the printer type, there are certain print modes available.

7.1.2.1 Available print modes for the JET Rapid

The following steps show how to get to the <Printstyle> tab in the <Job settings> dialog box.

- Select **<Settings>** in the menu of the job editor and then select the **<Printstyle>** tab.

	Information
	The available print modes for the JET Rapid are the same as for the JET3up.
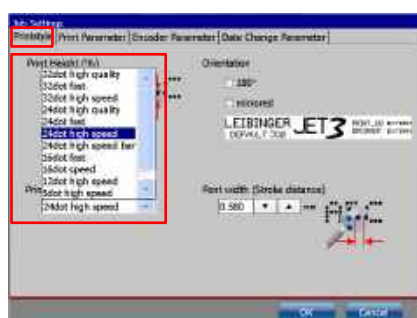
For the JET Rapid are the same print modes available as for the JET3up.

7.1.2.2 Available print modes for the JET Rapid with the Option Speed Plus

The following steps show how to get to the **<Printstyle>** tab in the **<Job settings>** dialog box.

- Select **<Settings>** in the menu of the job editor and then select the **<Printstyle>** tab.

	Information
	Depending on the selected oscillator frequency, a different number of print modes are available.

Oscillator frequency: **128 KHZ**

Nozzle size: **50 µm**

9 Printmodes available:

The 9 print modes of the JET Rapid with the option Speed Plus

7.1.2.3 Available print modes for the JET Rapid Wire / Rapid Wire PI

The following steps show how to get to the **<Printstyle>** tab in the **<Job settings>** dialog box.

- Select **<Settings>** in the menu of the job editor and then select the **<Printstyle>** tab.

	Information
	Depending on the selected oscillator frequency, a different number of print modes are available.

Oscillator frequency: 128 KHZ

Nozzle size:

Rapid Wire 50 µm

Rapid Wire PI: 60 µm

9 Printmodes available:
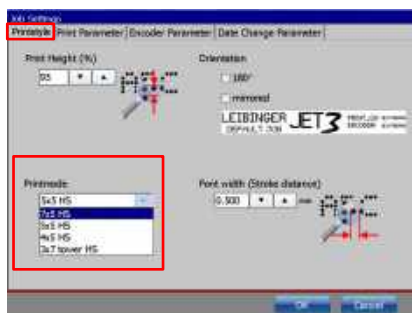
The 9 print modes of the JET Rapid Wire / Rapid Wire PI

7.2 JET Rapid Wire – Rapid Wire PI - JET Rapid with option Speed Plus - Print head adjustments and exchange of print head-parts

There are some significant differences between the JET3up and the printers of the JET Rapid series regarding the print head adjustments and the exchange of some mechanical parts of the print head.

Attention
The following service documentation has three sections:
Adjustment of the ink jet for JET Rapid Wire, Rapid Wire PI and JET Rapid with option Speed Plus. For JET Rapid see chapter *7.3 JET Rapid - Print head adjustments and exchange of print head- parts*
• describes how the ink jet has to be positioned inside the gutter tube.   • The inspection and if applicable the adjustment of the ink jet position is only necessary if there evident signs of a misadjustment like a contamination of the gutter with ink.
Adjustment of the drop production unit
• The adjustment of the drop production unit is necessary after a disassembled print head was reassembled.   • **This is not a standard procedure. You must not change the adjustment if the print head was not disassembled.**
Exchange of the oscillator
• describes the removal and the mounting of the oscillator unit.

Important
Before using the JET Rapid printer or after any adjustments and service works please check: ■ The free movement of the swivel mechanic   ■ The correct ink jet position inside the **charging tunnel** and the **gutter tube**   This is important in order to avoid the contamination of the print head.

7.2.1 Adjustment of the Ink jet position inside the gutter tube

JET Rapid Wire - JET Rapid Wire PI – JET Rapid option Speed Plus

Required tools:

- o Sixfold magnifier
- o 2mm hex key
- o T6x50 torx.

1. Switch on the JET3up JET Rapid and wait while the system is bleeding.

2. Touch the soft key **<Hydraulic settings>** (1) and change to the menu **<Print head>** (2). Turn off the function **<Ink-Flow-Sensor>** (3).

1 – Softkey <Hydraulik settings>

2 – Menu <Print head>

3 – Button <Ink Flow Sensor>

3. Use the hex key to untighten the mounting screws of the cover. **You do not have to remove the screws.**
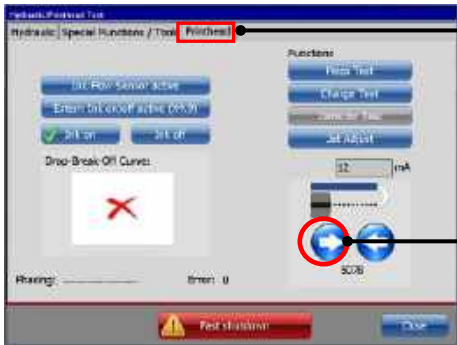
Untighten the mounting screws.

Do not remove them!

Remove the cover.

4. Switch to the tab **<Print head>** (1) and touch the left arrow button in order to open the nozzle (2) **completely**.

1 – Tab <Print head>
2 – Arrow Button for opening the nozzle

The wire print head with the nozzle opened

5. Untighten the fixing screw **A** on the top side of the nozzle retainer (see picture below) only as far as it is necessary to adjust the ink jet with the adjusting srews.

⚠	**Attention**
	Use the **T6 torx** only!
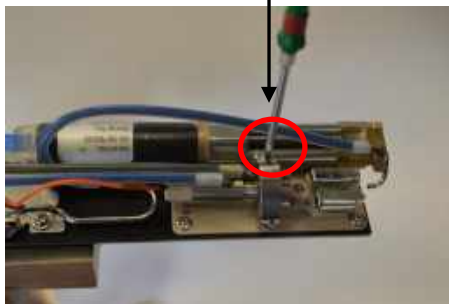
Unloose the fixing **A** screw using a T6
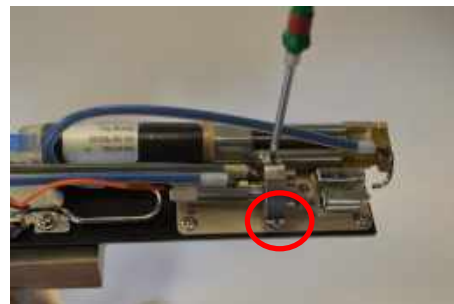
Fixing screw **B**

⚠	**Attention**
	• The two adjusting screws **1** and **2** are only for the fine adjustment • If the drop production unit is completely misaligned, you must additionally untighten the fixing screw **B** and perform a rough adjustment by moving the complete drop production unit. For a first rough adjustment or if the adjusting screws **A** and **B** are at the limits: • Untighten the fixing screws **A** and **B** • Adjust the ink jet by moving the drop production unit • Tighten screw **B** • Carry on with the fine adjustment using screw **1** and screw **2**
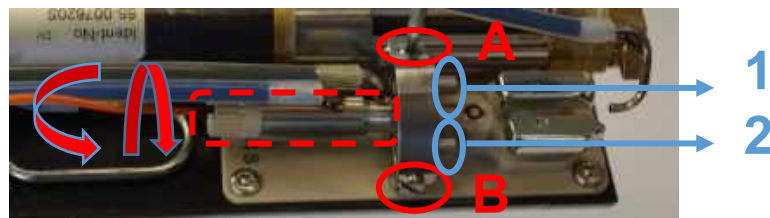
6. Use a 1,5 hex key for the two adjusting screws **1** and **2** of the nozzle retainer to adjust the ink jet.
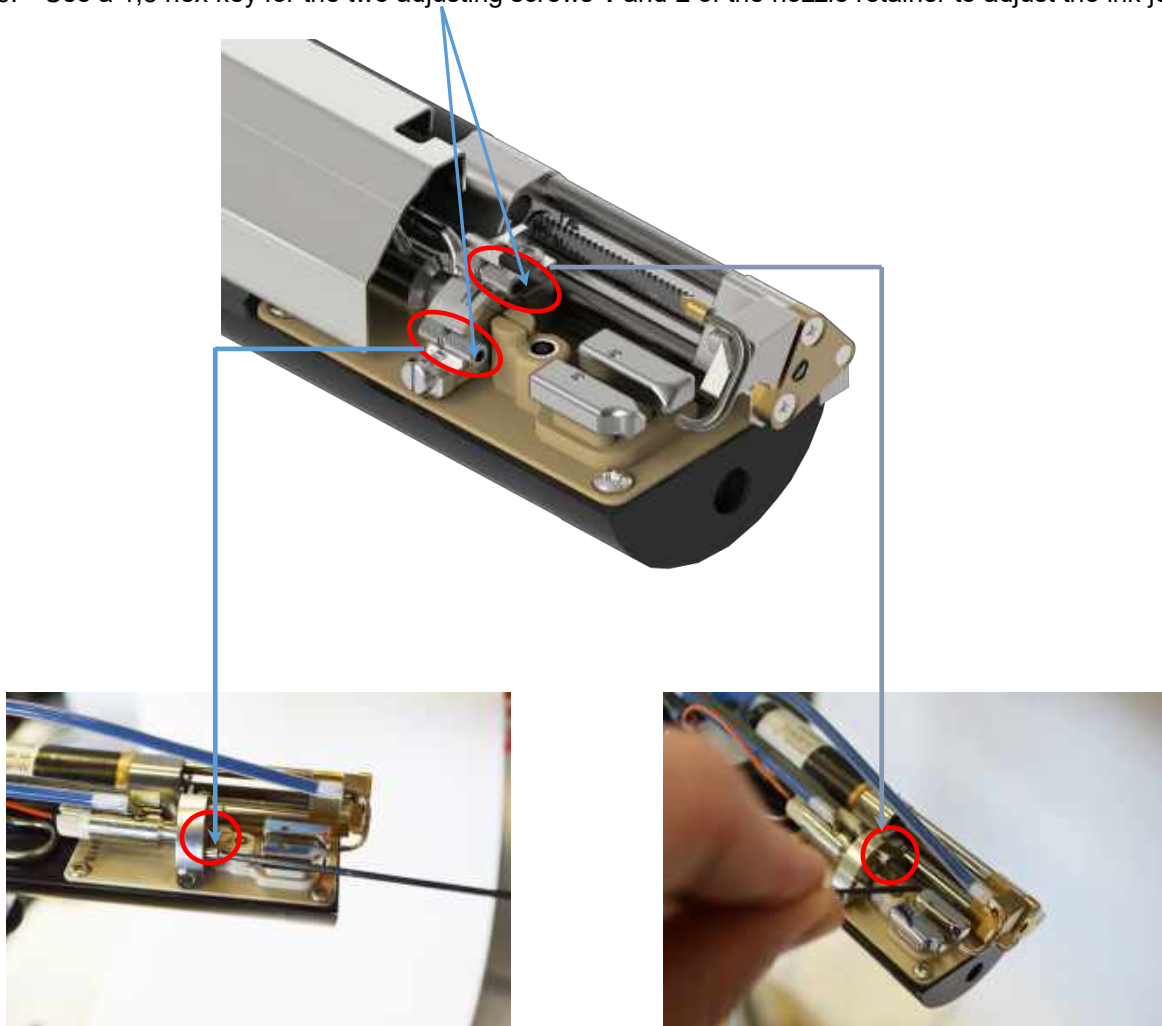
Screw **2:** Jet adjustment **left /right**   Screw **1:**   Jet adjustment **up/down**

	Attention
⚠️	The adjusting screws have a lost motion. Changing the rotational direction during the adjustment procedure will not have an immediate effect. Instead it takes some turns of the screw until the jet moves. **Example:** Turn screw **2** clockwise to adjust the ink stream to the right side. When you change to counter clockwise turns, it will take a few turns until the jet position actually reacts. The same is true for the up/down adjustment with screw **1**. **You must not tighten the adjustment screws. Doing so could damage the thread!**

	Attention
⚠️	• It is important to adjust the ink jet as close as possible to the edge of the gutter tube but the ink jet **must not touch** the gutter tube! • The pictures below show the **JET Rapid Wire**. The adjustment procedure for the JET Rapid or the JET Rapid with the option Speed Plus is just the same!

Correct adjustment ✓

0% ... **ca. 90%**
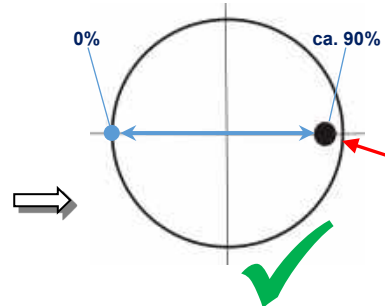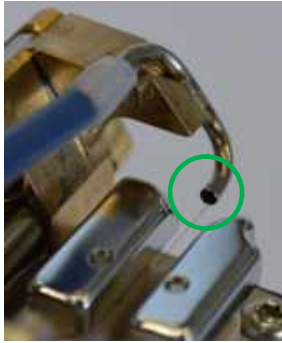
Correct ink jet position inside the gutter tube. The ink jet should be **as close as possible** (ca. 90%) to the outer edge of the gutter tube. ✓

Incorrect adjustment ✗

0% ... **60%**
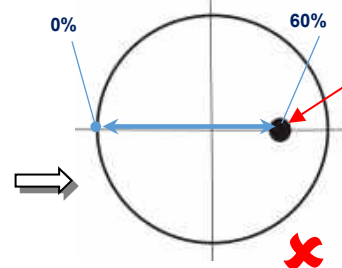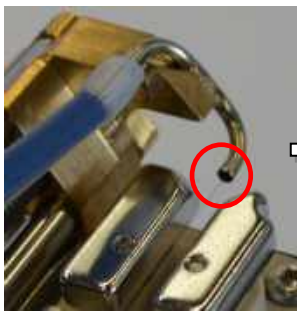
The ink jet position inside the gutter tube is **too far** in the middle. ✗

Incorrect adjustment ✗

0% ... **99%**
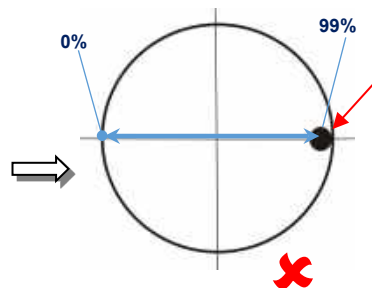
The ink jet position inside the gutter tube is **too near** to the outer edge of the gutter tube. This causes ink- sediments ✗

7. When finished, refasten the mounting screws and check the correct ink jet position

	Attention
⚠️	Use the **T6 torx** only!

7.2.2 Adjustment of the drop production unit

JET Rapid Wire - JET Rapid Wire PI – JET Rapid with option Speed Plus

⚠️	**Attention**
	• The following steps are only necessary after the entire drop production unit was disassembled and reassembled e.g. after exchanging defective parts.
	• **The adjustment of the drop production unit is not a standard procedure.**
	• **Do not carry out these steps for a standard ink jet adjustment!**

After a complete disassembling and reassembling of the print head it may be necessary to align the entire drop production unit with the charging tunnel and deflecting plates. After the ink jet adjustment in the gutter tube you need to adjust the entire drop production unit in the charging tunnel and deflecting plates. The ink jet has to pass in parallel to the inner edges of the charging tunnel.
To avoid parallax errors you need to point your perspective exactly vertically above the charging tunnel.

Top view

1 The charging tunnel

2 The inner edge of the charging tunnel

Charging electrode with charging tunnel and deflection electrode
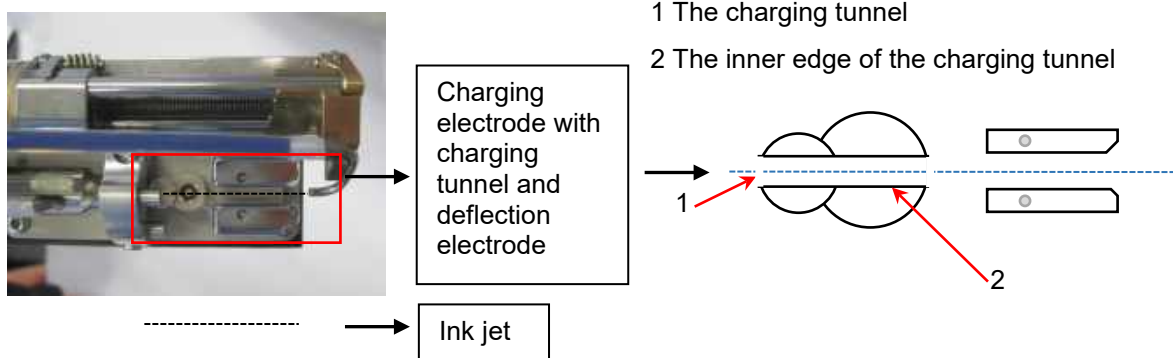
Ink jet

ℹ️	**Information**
	During the adjustment of the swivel mechanic in step 2 you should also check the ink jet position (step 4).

1. To adjust the drop production unit you need to untighten the five mounting screws of the fixing plate. Do not remove the screws. It should be possible to move the drop production unit.
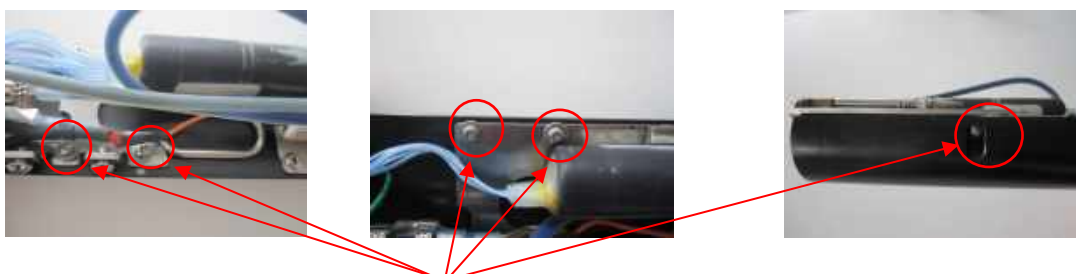
5x mounting screws

2. Adjustment of the swivel mechanic. For the adjustment of the swivel mechanic, it is recommended using a feeler gauge. The distance between the nozzle plate and the charging electrode has to be **0,1 mm ***.

Information

> ℹ️ * The distance of **0,1mm** must also be checked and/or adjusted after:
>
> - - Exchange or removal of nozzle / sealing ring
> - - Exchange of removal retaining plate
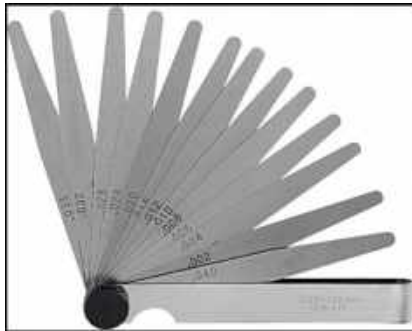
Use a feeler gauge with a **0,1 mm** blade.
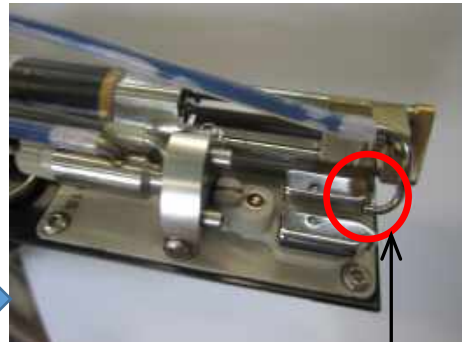
Bring the print head in **adjustment position** and switch **OFF** the ink jet.

Insert the 0,1 mm blade between the drop production unit and the charging electrode.

⚠️ **Attention**

Take care that the nozzle is not covered by the blade, so that the ink stream is not affected.
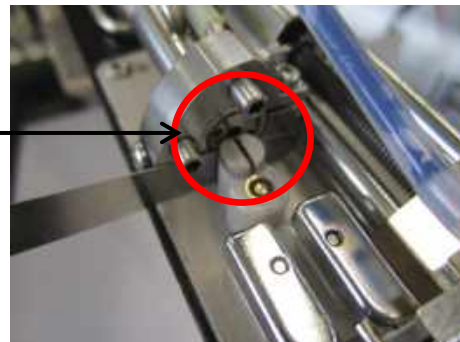
Optimal adjustment:

It should be easily possible to insert the blade of the feeling gauge without clearance. The swivel mechanic should work without touching the block of the charging electrode.

3. During the adjustment of the swivel mechanic, the ink jet has to be constantly checked.

4. Check and adjust the ink stream position

- Switch on the Ink flow sensor by pushing the button **<Ink flow sensor active>** (1) again.
- Push the button **<Jet Adjust>** (2). The nozzle opens automatically to the **<Jet adjust position> (ca. 2100 -2300)**
- Check the ink jet: The jet must be positioned at the __inner edge__ of the charging tunnel:

Top view

1 The charging tunnel

2 Ink jet at the __inner edge__ of the charging tunnel
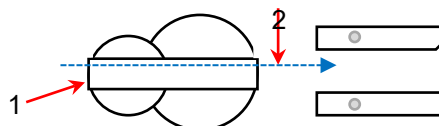
1 – Button <Ink Flow Sensor active>

2 – Button <Jet Adjust>

- Now open the nozzle seal **completely** using the **<arrow key>** (1). Check the ink jet again: Now the Ink stream must be in the __middle of the charging tunnel__ and parallel to the deflecting plates:

Top view

1 The charging tunnel

2 Ink jet in the middle of the charging tunnel
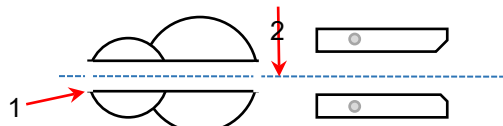
	Important
	It may happen that you have to re-adjust the drop production unit again after adjusting the ink jet. Both procedures affect each other.

5. After adjusting the ink jet and swivel mechanic, refasten the five mounting screws. Then recheck the position of the ink jet.

6. Close the nozzle seal and mount the cover.

⚠	**Attention**
	Be careful not to damage any tubes or cables.
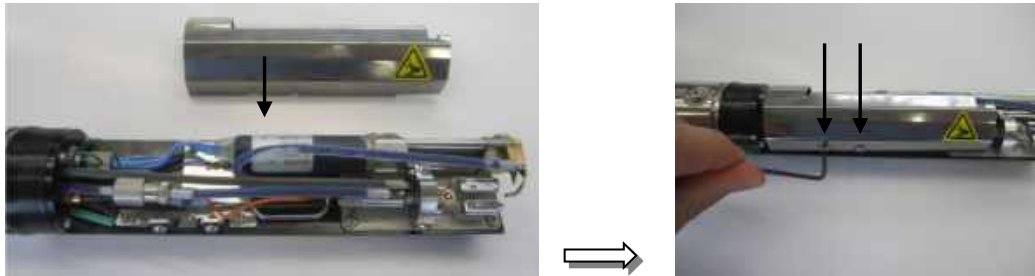
Reassemble the cover and fix the mounting screws

7. Open the nozzle seal again and control the Ink stream position again to finish the adjustment.

7.2.3 Adjusting the distance between ink jet and ink drop voltage detector

JET Rapid Wire - JET Rapid Wire PI – JET Rapid option Speed Plus

After a reassembling of the drop production unit, it may be necessary to adjust the distance between the ink drop voltage detector and the ink jet.
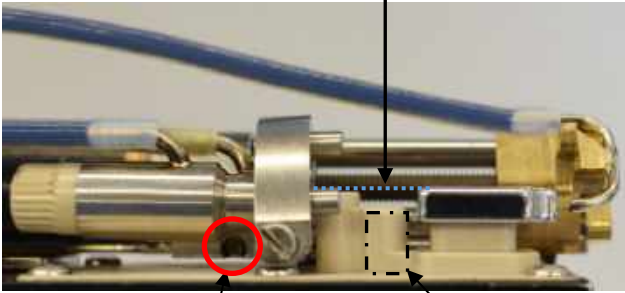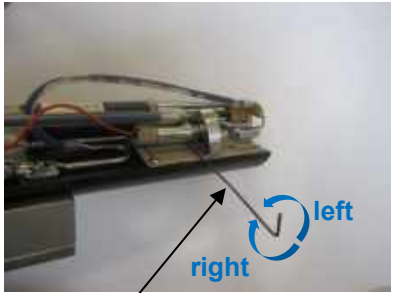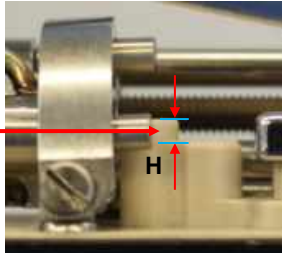
⚠️	**Attention**
	The following steps are only necessary after the entire drop production unit was disassembled and reassembled e.g. after exchanging defective parts.
	Do not carry out these steps for a standard ink jet adjustment!

Remove the head cover: Use the hex key to untighten the mounting screws of the cover. You do not have to remove the screws.

Ink jet

Set screw: **0,9 mm hex**   Ink drop voltage detector   **0,9mm** hex key /
Art Nr. 55-008669K

The optimal distance between ink jet (illustrated as blue dotted line) and the surface of the ink drop voltage detector is the <u>half of the height **H (2mm)** of the **charging tunnel = 1 mm**</u>

Use the **set screw** to adjust the distance:

- turn the screw to the **right** ↻ to increase the distance
- turn the screw to the **left** ↺ to decrease the distance.

Charging tunnel   **Ink jet**

H=1,8 mm

$D = H/2 = 0,8\ mm$

Voltage detector

D= Distance between **ink jet** and the surface of the ink drop **voltage detector**

Optimum:

D = ~ Half of the height **H (1,8 mm)** of the charging tunnel = **0,8 mm**

Fix the inside cover again and put on the head cover

⚠	**Attention**
	Be careful not to damage any tubes or cables!
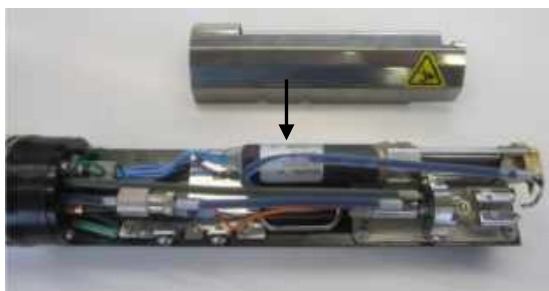
7.2.4 Exchange of the complete drop production body

JET Rapid Wire - JET Rapid Wire PI – JET Rapid option Speed Plus

	Information
ℹ	There are some significant differences between the JET3up and the JET Rapid Wire/JET Rapid Wire PI/JET Rapid with option Speed Plus regarding the exchange of the drop production body.

Necessary tools:

Vario torque tool	Art. Nr.: 55-004557 K	
Torx T6	Art. Nr.: 55-006360 K	
Special inlet for oscillator	Art.-Nr.: 55-006012 S	
Slotted screwdriver		
Tweezers		
Hex key 1,5mm		
Hex key 2mm		
Special tool for nozzle	Art.-Nr.: E55-005548 S	

	Attention
⚠	**Before starting the work** open the nozzle to the position **<Jet adjust>**. Only in this position it is possible to untighten the fixing screw of the nozzle retainer.

1. Open the hydraulic dialog box and select the tab **<Print head>** (1).
2. Push the buttons **<Ink off>** (2) and **<Jet adjust>** (3).
3. De-activate the button **<Ink-Flow-Sensor active>** (4)
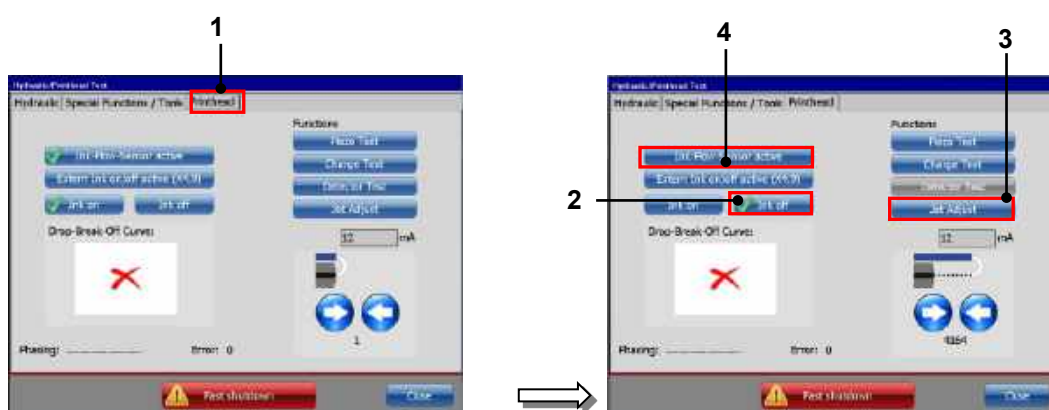
4. Remove head cover. Loose the retaining screws with a 2mm hex key around **one turn** and remove the inner head cover.
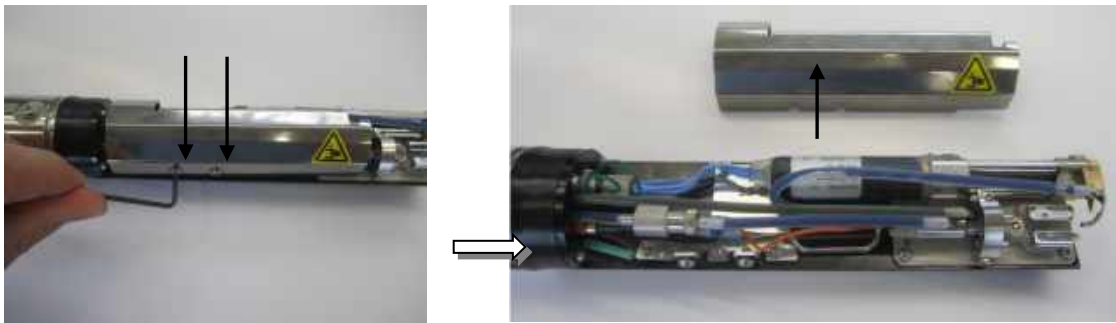
5. Pull out the coax connector of the oscillator by using the tweezers. Remove the retaining screw of the grounding cable. Keep this screw in save place.
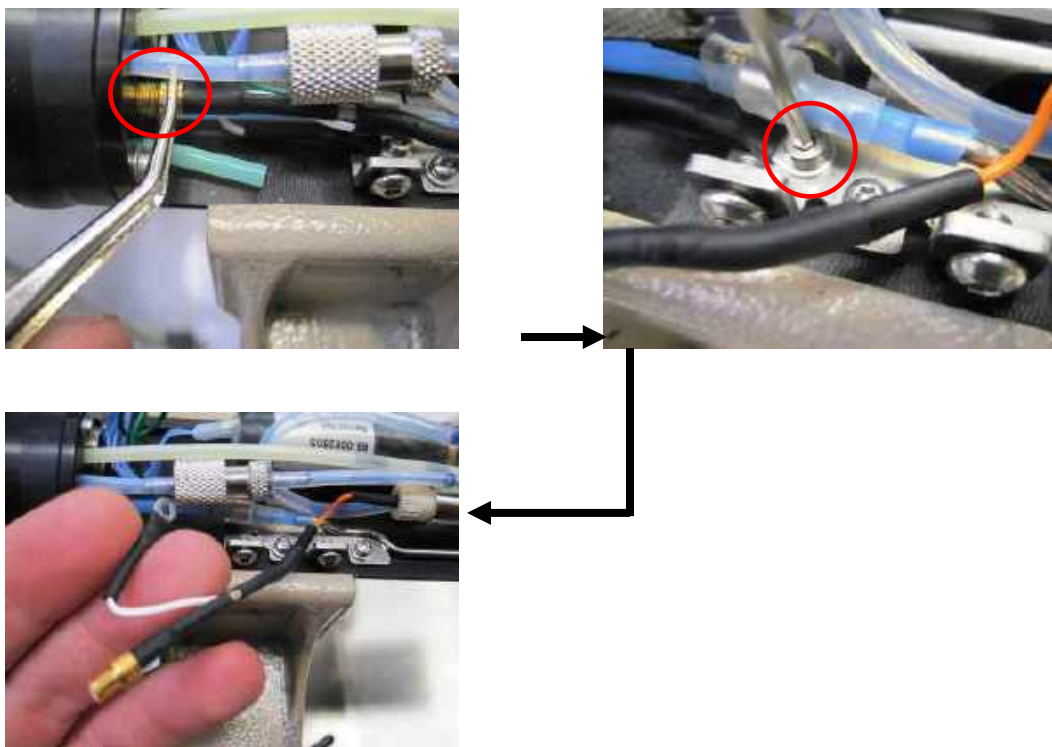
6. Remove the retainer of the drop production body:

Attention
It is important to remove screw **1** before screw **2**.
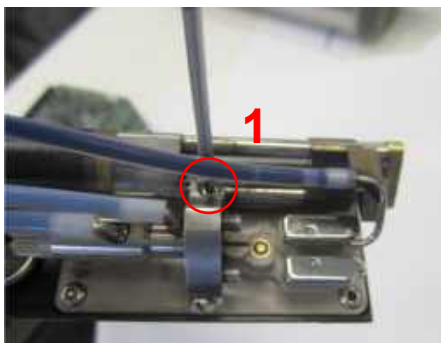
Remove screw **1**   Remove screw 2

7. Remove the old drop production body
8. Mount the new drop production body back on the adapter of the ground plate.
9. Mount screw **2** first, then screw **2**.
10. **Please note:** Do not tighten the screws. First, the drop production body has to adjusted in a correct position.

Mount the new drop production   Mount screw **2** first.   Mount screw **1**
body back on the adapter of the
ground plate.
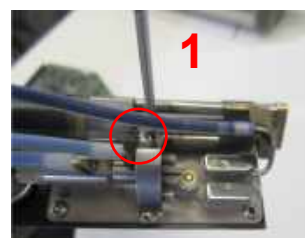
11. The drop production body has to be properly positioned. For this, there are notches on the drop production body and the nozzle retainer on which the drop production body has to be mounted.
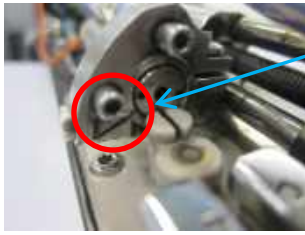
The notch on the drop production unit has to be positioned in alignment with the notch on the nozzle retainer.

- When the position is correct, tighten **screw 1** with a torque of **0,4 Nm**.
- Then hand-tighten screw **2**.

12. Screw the grounding cable back to the ground plate. Plug in the coax cable.
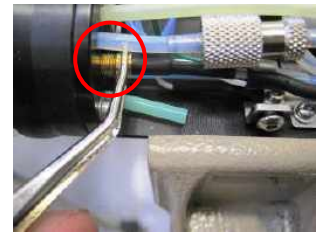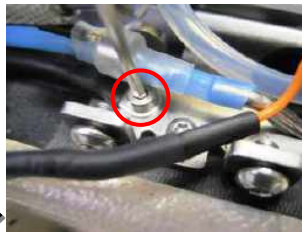
Tighten the grounding cable back on the ground plate.   Plug in the coax cable.

13. Finally adjust the ink jet: see chapter **7.2.1 Adjustment of the Ink jet position inside the gutter tube**

7.3 JET Rapid: Print head adjustments and exchange of print head- parts

7.3.1 Adjustment of the Ink jet position inside the gutter tube

JET Rapid

Required tools:

- o Sixfold magnifier
- o 2mm hex key
- o T6x50 torx.

1. Switch on the JET Rapid and wait while the system is bleeding.

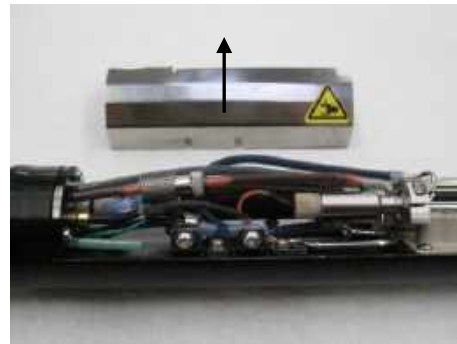2. Touch the soft key **<Hydraulic settings>** (1) and change to the menu **<Print head>** (2). Turn off the function **<Ink-Flow-Sensor>** (3).

1 – Softkey <Hydraulic settings>

2 – Menu <Print head>

3 – Button <Ink Flow Sensor>

3. Use the hex key to untighten the mounting screws of the cover. **You do not have to remove the screws.**
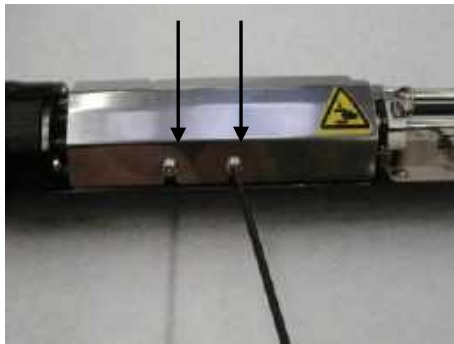
Untighten the mounting screws.
Do not remove them!

Remove the cover.

4. Switch to the tab **<Print head>** (1) and touch the left arrow button in order to open the nozzle (2) **completely**.
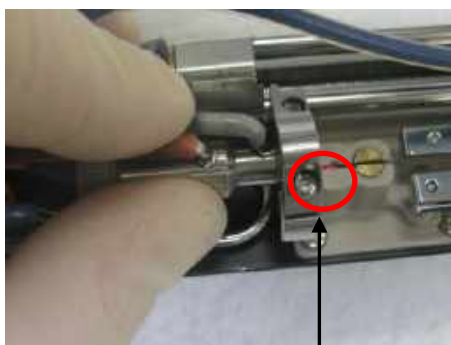

The Rapid print head with the nozzle opened

| 1 – Tab <Print head> |
| 2 – Arrow Button for opening the nozzle |

5. Untighten the right attachment screw (see picture below) of the nozzle retainer just so far that you can adjust the retainer manually. For a better movability It may be necessary to untighten the other screw as well.

| ⚠ | **Attention** |
| | Use the T6 torx only! |

Untighten the **right** attachment screw.

6. Adjust the ink jet just like in the sketch below. The sketch shows the view from nozzle to gutter. The ink jet is adjusted by moving the oscillator body, which is connected, to the nozzle retainer. See picture above. When the ink jet is in the correct position, fix the screws again.

Ink jet position in gutter tube
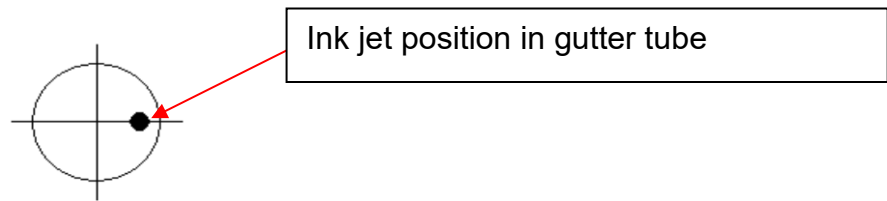
7. After the ink jet adjustment, it may be necessary to adjust the entire drop production unit in order to make sure that the ink jet passes in parallel to the inner edges of the charging tunnel. To avoid parallax faults you need to point your perspective exactly vertical to the charging tunnel.

inner edge of the charging tunnel

8. To adjust the drop production unit you need to untighten the five attachment screws of the fixing plate just so far that you can move the unit manually. After adjusting the unit, fix the attachment screws and check the position of the ink jet.

Attachment screws

9. Turn on the Ink flow sensor by pushing the button **<Ink flow sensor>** (1). Open the nozzle seal complete by using the **<arrow key>** (2). The Ink stream must be in the middle of the charging tunnel and parallel to the inner edges of the tunnel.

1
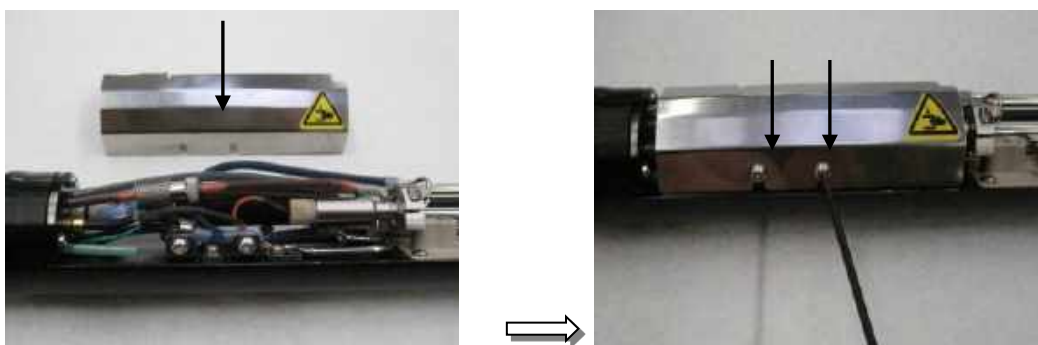
2
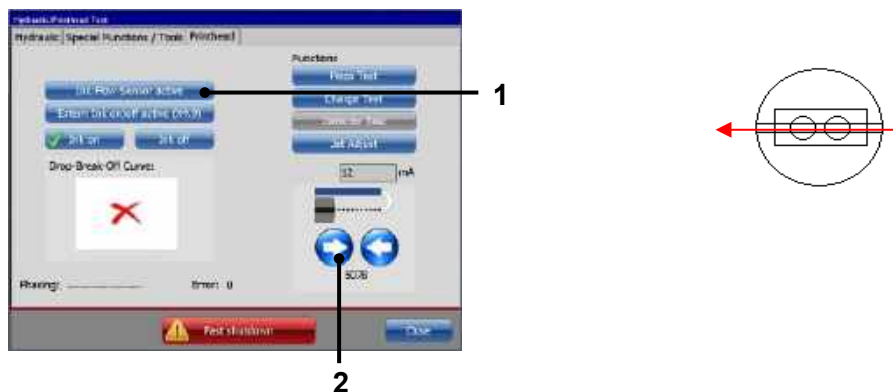
1 – Button <Ink Flow Sensor>

2 – Button <arrow>

	Important
	It may happen that you have to re-adjust the drop production unit again after adjusting the ink jet. Both procedures affect each other.

10. Close the nozzle seal and fix the inside cover.

	Attention
	Be careful not to damage any tubes or cables.

11. Open the nozzle seal again and check the ink jet position to finish the adjustment.

## 7.3.2   JET Rapid: Exchange of the complete drop production body

Necessary tools:

Vario torque tool	Art. Nr.: 55-004557 K	
Torx T6	Art. Nr.: 55-006360 K	
Special inlet for oscillator SK6	Art.-Nr.: 55-006012 S	
Slotted screwdriver		
Tweezers		
Hex key 1,5mm		
Hex key 2mm		
Special tool for nozzle SK6	Art.-Nr.: E55-005548 S	

1. Switch on JET Rapid and wait until bleeding is finished.

2. Select **<ServiceFunctions>** (1) and open the dialog box **<Hydraulic>** (2)**.**
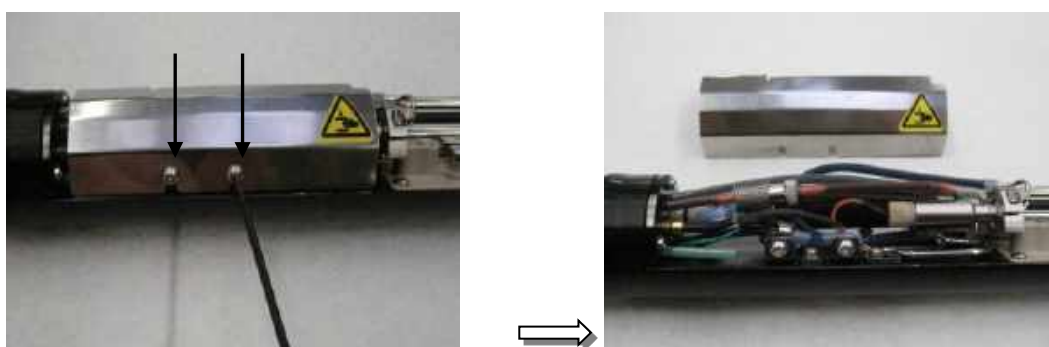3. Select tab **<Printhead>** (3) and push the buttons **<Ink off>** (4) and **<Jet adjust>** (5).
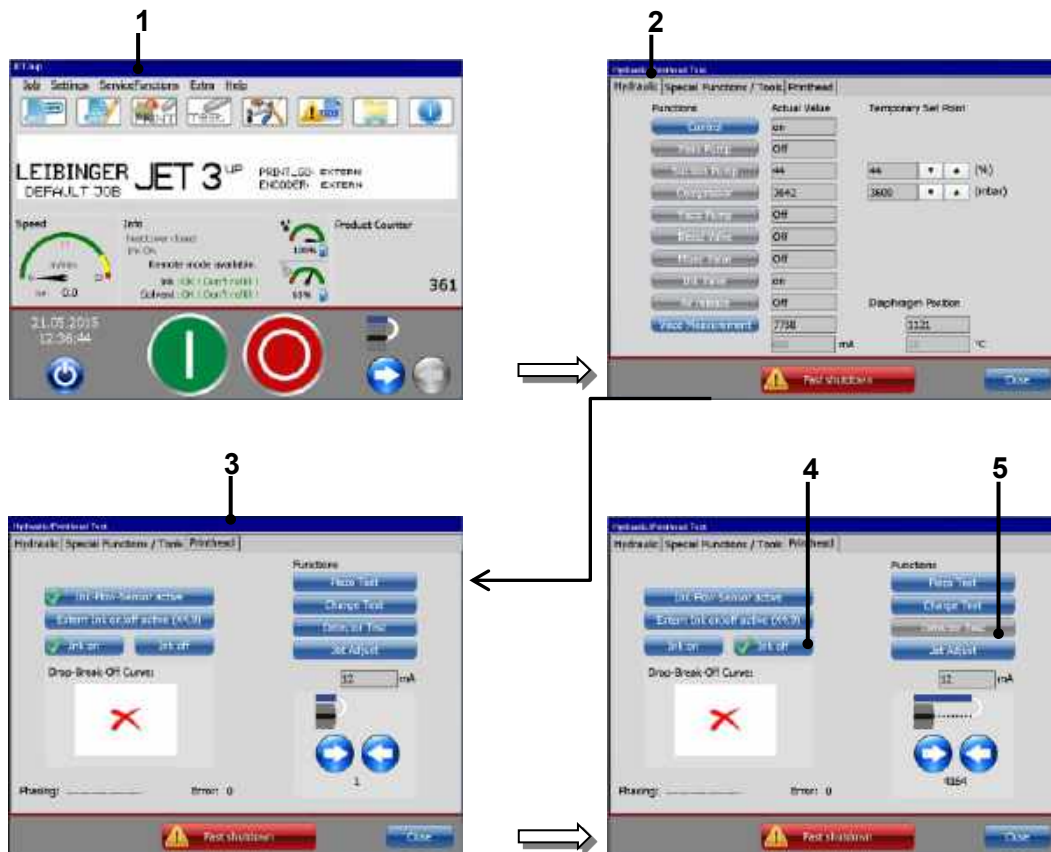
|	
1 – Button <Hydraulic settings>	2 – Menu <Hydraulic>
3 – Menu <Printhead>	4 – Button <Ink off>
5 – Button <Jet Adjust>	

4. Remove the print head head cover. Untighten the retaining screws with a 2mm hex key by **one turn** and remove the inner head cover.
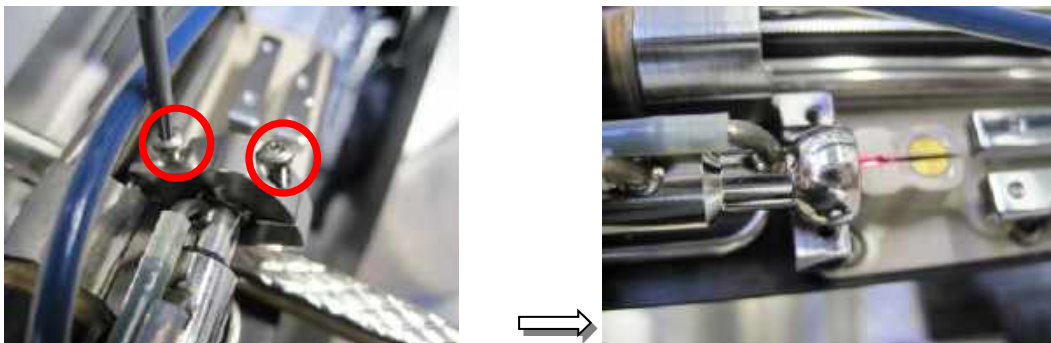

5. Dismantle the nozzle. **Please see the respective service documentation for details**.
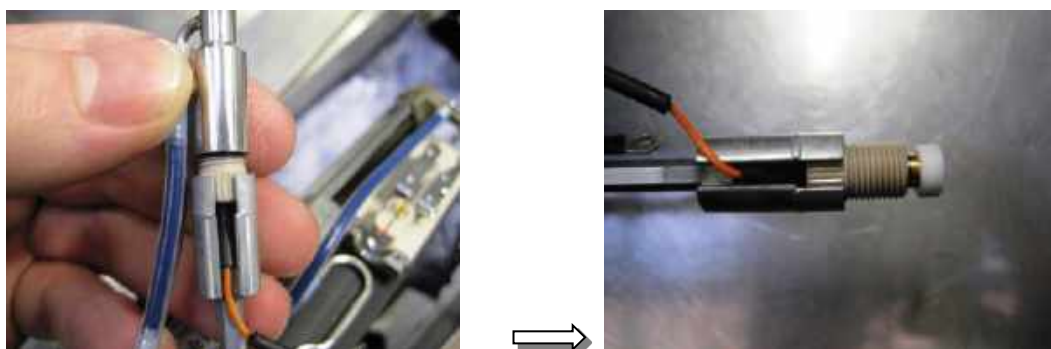
6. Pull out the coax connector of the oscillator by using the tweezers. Screw out the retaining screw of the grounding cable.
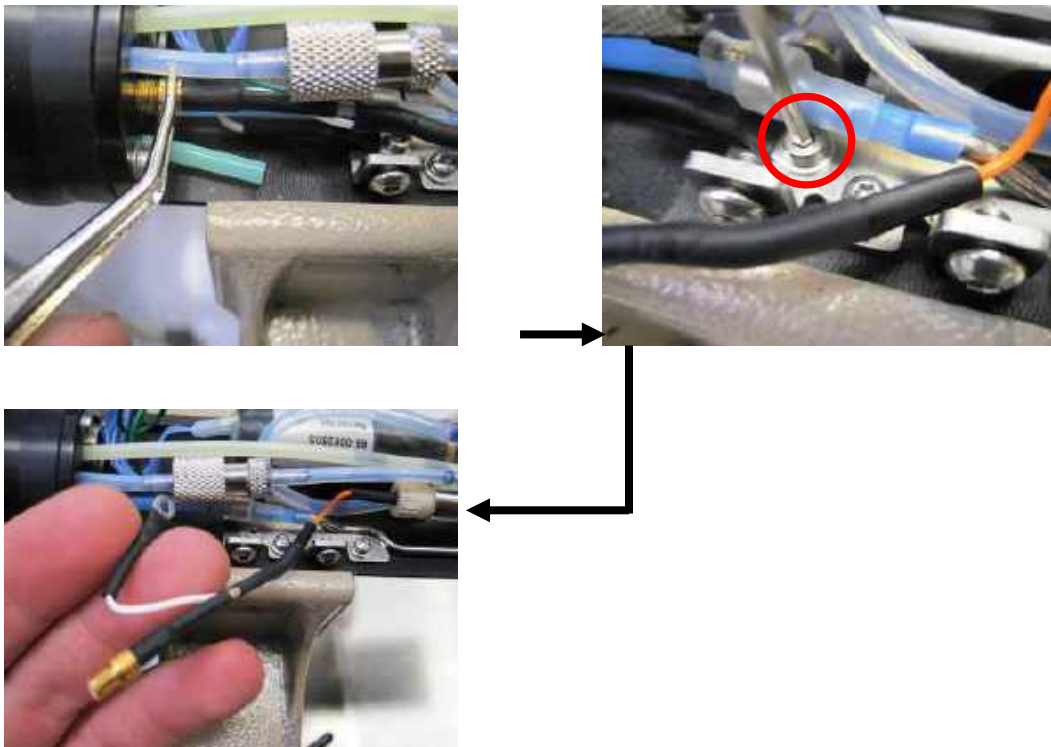
7. Remove the retainer of the tubus after removing the two torx screws.

8. Push the drop production body slightly to the side and remove the oscillator with the special tool. Clean the drop production body with solvent.

9. Plug in the new oscillator into the special tool and screw it into the drop production body. The torque to tighten the oscillator is **0,16 Nm**.

10. Mount the drop production body back on the adapter of the ground plate. Torque to tighten the retaining screws is **0,4 Nm**. The drop production body must be positioned correctly. Use the markings. There is a slot in the drop production body and also in the adapter. Both slots result in one long slot when the drop production body is in the right position.

11. Tighten the grounding cable back on the ground plate. Plug in the coax cable.

12. Mount the nozzle back in the drop production body. **Please see the respective service documentation for details.**
13. Finally the ink stream must be adjusted. Therefor see chapter **7.3.1 Adjustment of the Ink jet position inside the gutter tube**