RSV
Rohrleitungssanierungs-
verband e.V.

RSV-Factsheet 12.1

Cleaning of renovated Sewers

Transmission of DIN 19523 into practice

(July 2022)

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Preface

How can renovated pipes be cleaned? How sensitive are the surfaces to strong water pressure? Operators of sewer networks are confronted with these questions and want more than just the statement that a high-pressure flushing test was carried out in accordance with the test standard DIN 19523 as part of the suitability test.

Due to the smooth surfaces resulting from the materials used in renovation (e. g. CIPP), renovated pipelines can be cleaned with significantly lower pressure. If on the other hand too much power is used, damage can be caused depending on the nozzle parameters. The choice of the appropriate cleaning nozzle and determination of the flushing pressure are decisive for safe cleaning. Because of this, the RSV has developed a guideline on how to set the optimal cleaning parameters for renovated sewer pipes. This serves as a handbook for sewer cleaning companies, contractors and principals.

The factsheet was developed in cooperation with the German company Sausgruber Kanaltechnik, which prepared the tables exclusively for the RSV in the wake of ist participation in the RSV work group 1.1. In view of the fact that this is a cross-sectional topic for other applications as well, the statements on cleaning were transferred to a separate factsheet.

With the current revision of the fact sheet from June 2021, the cleaning tables have been simplified following suggestions from practical users. In addition, the method of calculation is described more clearly in chapter 3.4.

With the revision of May 2022, specifications for cleaning before the optical inspection have been added. Moreover, additional explanations on the standard, water quality and documentation have been included based on suggestions from practical experience.

You are welcome to tell us about your experiences with the application of this fact sheet. We would also be glad to complement this information sheet with the results of other suppliers and manufacturers of cleaning nozzles and systems.

Hamburg,
July 2022

RSV – Rohrleitungssanierungsverband e.V.

Table of Content

Guide for special labels

In this factsheet, we indicate special contents at various points. These are graphically marked with symbols.

Symbol	Meaning
	**Information on the Internet** You can find more information on the Internet at www.rsv-ev.de or on a corresponding website. In the PDF, the symbol contains the relevant link.
	**General Content** This information is not specific to this factsheet, but also applies to other rehabilitation topics.
	**Need for regulation** The content published here points to regulatory gaps that should be addressed in future regulations.
	**Comment** These are comments on existing regulations. They may contain statements that differ from those regulations.
	**Exclusive Information** Here you will find exclusive content and information that can be seen as an addition to existing rules and regulations.
	**Recommendation** This is a recommendation by the RSV, that deserves special attention for users.
	**Quote** At this point we quote or refer to other factsheets. If there are further questions, it is recommended that the other factsheets are consulted

1 Range of application

This factsheet applies to the cleaning of predominantly underground, non-pressure sewers and pipes in the public and non-public sector that have been rehabilitated by means of renovation procedures. It provides information on the selection of cleaning techniques and documentation.

The RSV factsheet derives from DIN 19523: 2008-08 „Requirements and test methods for determination of the jetting resistance of components of drains and sewers".

The information in the factsheet can also be applied to repaired pipes, assuming the repair systems have been suitability-tested in accordance with DIN 19523. The manufacturer's specifications for the respective repair system must be considered.

2 Definitions

drain	Mostly underground pipe for discharging wastewater and/or rainwater from the point of origin to the sewer
sewer pipe	Mostly underground pipeline or other device for the drainage of waste water and/or rainwater from several sources
diffusion angle of the flushing jet	jetting nozzle Angle of the flushing jet expansion related to the jet flushing stream axle
nozzle insert	Special ceramic component for focusing the jet stream
high pressure jetting	Use of high pressure devices for the removal of obstacles and deposits in wastewater pipes and sewers
hydraulic roughness	Measure of the unevenness of the inner wall of the pipe
sewer rehabilitation	Process of upgrading existing sewer pipelines by methods such as pipe relining, curing and sealing that do not require open excavation to replace or repair pipes and has become a method of choice when it comes to rehabilitating sewer pipelines
repair	Methods of trenchless construction to restore or improve the stability, integrity or usefulness of an underground conduit or pipe
sewer renovation	Methods for restoring or improving existing piping systems by means of repair, renovation and renewal
jetting stream power	Energy of the jetting stream per unit of time leaving the nozzle
jet energy density	Jetting stream power, related to the impact area

3 Cleaning of renovated sewers

DIN EN 752 specifies which special requirements are applicable in the operation of renovated pipelines and how this has to be taken into account in the operation and maintenance plan. Especially when cleaning and visually inspecting renovated pipes, specific requirements for the cleaning and inspection procedures must be observed. The most frequently used cleaning method is the high-pressure jetting method. In addition, the use of surge or accumulating flushing for the cleaning of renovated pipes is possible without restriction.. In rehabilitated pipes, sewer cleaning with the help of mechanical devices (e.g. chain spinner, root cutter, scraper) is only to be carried out with adequate prior consideration. Such devices can damage the renovated pipe and reduce its lifetime. The installation staff must be trained in the handling of renovated pipes.

3.1 Suitability test according to DIN 19523

DIN 19523 specifies test methods for determining the resistance of new pipes and fittings, including joints, for drains and sewers to the stresses of cleaning by high-pressure jetting. These test methods are also applicable for renovated sewers and drains according to DIN EN 752.

The materials used in the renovation processes have provided proof of resistance to high-pressure jetting in accordance with DIN 19523. This proof is provided by a material test (procedure 1) and a practical test (procedure 2). The test water is of drinking water quality in each case.

The practical test (procedure 2) consists of 60 jetting cycles (back and forth in each case) and thus simulates 50 years of operation. DIN 19523 regulates the requirements for testing and specifies a jetting stream power density of 330 W/mm^2 for operational maintenance cleaning.

A simple transfer of the spray jet power density of 330 W/mm^2 into practice is not possible. By applying DIN 19523, the parameters for cleaning with the usual high-pressure jetting nozzles can be set in such a way that the corresponding spray jet power density is not exceeded in practice on-site. This has been carried out for various nozzle types of one manufacturer in this sheet (cf. chapter 3.4, ***table 1*** to ***table 8***).

DIN 19523 also includes a material test (method 1) with a jetting stream power density of 450 W/mm^2, consisting of three test cycles each (forward and backward). This material test simulates the hydraulic loads caused by a temporary jetting stream of higher power density. Because higher surface loads can appear when using rotary nozzles, a transfer of this jetting stream power density to practical use is given in this sheet (cf. Chapter 3.4, ***Table 9***).

No proof of suitability of the renovation systems is available for jetting stream outputs that exceed the requirements of DIN 19523. In this case, the materials could be damaged and the lifetime of the renovated pipe reduced.

3.2 Parameters for high pressure flushing

The jetting stream power density in high-pressure jetting depends on various parameters, e.g.

- Pump pressure and water volume,
- Length and material of the high pressure hose,
- Nozzle type, nozzle inserts and jet angle,
- Cleaning medium (fresh water, recycled water).

The choice of the nozzle type and the jetting pressure is crucial for the secure cleaning of renovated pipes. Due to the low hydraulic roughness of the renovation systems, lower jetting outputs are often sufficient for cleaning in the case of high-pressure jetting.

Recommendation: Cleaning should be done with as little pressure as possible and a nozzle with the smallest possible jet angle should be selected. This prevents the risk of damage. The following applies: The flatter the angle, the lower the force effect of the water jet and thus the jetting stream power density on the pipe surface.

If no detailed data on flushing performance is available, the following approximations can be used:

- Nozzles with a jet angle of less than 15°: It can generally be assumed that these can be used without exceeding the permitted jetting stream power.
- Nozzles with a jet angle of up to 30°: If the maximum pressure at the nozzle is limited to maximum 70 bar, it is generally possible to use it without exceeding the permitted jetting stream power.
- Nozzles with a jet angle larger than 30°: In this case, control or limitation of the jetting performance is necessary.

EXCLUSIVE

If possible, the use of rotary nozzles in the course of operational maintenance cleaning should be avoided. If rotary nozzles are necessary , the radial inserts (90°) must be closed in advance (cf. ***Table 8***) or use the specifications of ***Table 7***. When cleaning with rotating nozzles before the visual inspection of the renovated pipe, the specifications of ***Table 9*** can be used (cf. Chapter 3.4.2). The rotary nozzles must be used with a minimum distance from the pipe surface.

The nozzles must always be adjusted to the vehicle and function properly (e.g. no clogging, nozzle insert diameter specified by the manufacturer). Avoid shock loads from the nozzle and stand jetting.

3.3 Documentation of the high-pressure jetting

For traceability of the jetting stream power, each jetting process should be documented. The following flushing-, vehicles- and nozzle parameters are important::

- Pipe length
- Pipe diameter
- Pipe material
- Nozzle type
- Nozzle manufacturer
- Number, diameter and jet angle of the nozzle inserts
- Flushing pressure used
- Number of jetting cycles
- Water quality: Drinking/ process/ recycled water

Automatic jetting and cleaning data acquisition systems are available on the market that enable comprehensive documentation. If these are not currently in use, then corresponding cleaning logs are to be kept. In these or in the daily report items to be documented are:

- Inserted nozzle
- Jetting pressure on the vehicle
- Number of jetting cycles
- Volumetric flow, if specified.

The vehicle parameters are already defined via the used vehicle.

The network operator must give the cleaning company or crew specific instructions on how to clean the renovated pipeline.

3.4 Recommendations for common jetting nozzles

The recommendations for the high-pressure cleaning of renovated pipelines with common jetting nozzles have been calculated by the authors of this factsheet by applying DIN 19523. They are based on nozzles that are adjusted to the vehicle and function without any problems. The calculation is based on drinking water quality, because when using process water or treated water, different grain sizes of suspended solids cannot be represented mathematically. In sewer cleaning practical work, process water or recycled water is usually used. The guidelines in this fact sheet serve as orientation nevertheless.

Note: Depending on the grain size of the suspended solids contained, additional reductions may have to be taken into account. The grain size results from the respective processing plant (typical ranges are grain sizes between 0.2 mm and 0.6 mm).

The calculations for the considered nozzle types were made starting from the angular position that meets the pipe wall most steeply. All nozzles of a given type with a flatter angular position therefore do not have to be calculated separately.

The reference point on the jetting vehicle is the outlet pressure at the pump. The maximum pressure that may be applied to the pressure gauge could be calculated using the jetting power density formula of DIN 19523. Taking into account common pump types, hose types and lengths, the final pressure at the nozzle was determined, which results from the losses over the hose length. These calculations were made using the "JetCalc" software.

3.4.1 Operational maintenance cleaning

DIN 19523 simulates an annual operational maintenance cleaning (cf. chapter 3.1). The basis of the calculations is the maximum jet flushing stream power density of 330 W/mm².

Table 1 to ***Table 8*** summarise the results of the calculations. For selected jetting nozzles, the maximum output pressure at the jetting vehicle is given here as a function of the cleaning parameters.

Comment: DIN 19523 does not provide for any special consideration of flat jet inserts with a larger angle of spread and thus a lower force effect on the pipe wall, so that an additional consideration with spreading of the flat jets has been calculated here for a nozzle (Table 4, according to DIN 19523 incl. actual dispersion).

3.4.2 Cleaning for optical inspection

Over the operating cycle of a renovated pipeline, three to four cleanings are generally required prior to an inspection (warranty acceptance, two to three inspections over the service life). For in-service sewers, rotary nozzles are used to remove screen skin for inspection and provide a streak-free view. For the transfer of these inserts, a separate calculation has been carried out with reference to the material test of DIN 19523 (cf. Chapter 3.1) with an increased jetting stream power density.

Table 9 shows the results of the calculation for the use of the rotary nozzle for the preparation of the optical inspection. In addition, the specifications of ***Table 8*** can be applied.

Hallow Jet Nozzle

maximum jet angle 30°

Application:
Maintenance cleaning, removal of bouldersl, faeces, gravel, soft depostion, with flat blasting conditional area of application before TV

Noozle[1]	Volume (l/min)	Max. pipe pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	124	114
			140	132	120
			160	140	127
			180	148	133
			200	156	140
1" DN 25	345	205	120	128	118
			140	137	125
			160	205	132
			180	205	205
			200	205	205
5/4" DN 32	408	175	120	97	92
			140	100	96
			160	104	98
			180	107	101
			200	111	104
5/4" DN 32	470	150	120	104	98
			140	109	102
			160	113	106
			180	118	110
			200	123	113

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, color: black

4 Plastic hose, main component PVC, color: green, blue or other.

Table 1: *Pressure specifications for operational maintenance cleaning with Hallow Jet Nozzles*

Standard Cleaning Nozzle

maximum jet angle 30°

Application:
sludge deposits and cloggings

Nozzle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	124	114
			140	170	120
			160	170	170
			180	170	170
			200	170	170
1" DN 25	345	205	120	128	118
			140	205	125
			160	205	132
			180	205	205
			200	205	205
5/4" DN 32	408	175	120	97	92
			140	100	96
			160	104	98
			180	107	101
			200	112	104
5/4" DN 32	470	150	120	104	98
			140	109	102
			160	113	106
			180	118	110
			200	123	113

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

Table 2: *Pressure specifications for operational maintenance cleaning with the standard cleaning nozzle*

360° Grenade Bomb

maximum beam angle 45° (flat jet inserts), dispersion 30° at the insert - without consideration of flat jet dispersion

Application:
Cleaning of pipe walls (grease, biofilm), cleaning and removal of loose

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	104	94
			140	112	100
			160	120	107
			180	170	170
			200	170	170
1" DN 25	345	205	120	108	97
			140	117	105
			160	126	112
			180	135	119
			200	144	126
5/4" DN 32	408	175	120	76	72
			140	80	75
			160	84	78
			180	87	81
			200	91	84
5/4" DN 32	470	150	120	84	78
			140	89	82
			160	94	85
			180	98	89
			200	150	94

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

Table 3: *Pressure specifications for operational maintenance cleaning with 360° Grenade Bomb*

360° Grenade Bomb

maximum jet angle 45° (flat jet inserts), dispersion 30° at the insert - without consideration of flat jet dispersion

Application:
Cleaning of pipe walls (grease, biofilm), cleaning and removal of loose

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	170	170
			140	170	170
			160	170	170
			180	170	170
			200	170	170
1" DN 25	345	205	120	205	205
			140	205	205
			160	205	205
			180	205	205
			200	205	205
5/4" DN 32	408	175	120	175	175
			140	175	175
			160	175	175
			180	175	175
			200	175	175
5/4" DN 32	470	150	120	150	150
			140	150	150
			160	150	150
			180	150	150
			200	150	150

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

***Table 4:** Pressure specifications for operational maintenance cleaning with 360° Grenade Bomb – with consideration of flat jet dispersion*

Poking noozle/ pointed noozle

maximum jet angle 25°

Application:
Penetration of blocked pipes

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	129	119
			140	170	170
			160	170	170
			180	170	170
			200	170	170
1" DN 25	345	205	120	133	123
			140	205	130
			160	205	137
			180	205	205
			200	205	205
5/4" DN 32	408	175	120	102	97
			140	105	100
			160	109	103
			180	113	106
			200	116	109
5/4" DN 32	470	150	120	109	103
			140	114	107
			160	118	111
			180	123	115
			200	128	118

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

Table 5: *Pressure specifications for operational maintenance cleaning with poking nozzle/ pointed nozzle*

Silt Cleaning/ Scraper

maximum jet angle 5°

Application:
Cleaning of large profiles in the sole area

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	170	170
			140	170	170
			160	170	170
			180	170	170
			200	170	170
1" DN 25	345	205	120	205	205
			140	205	205
			160	205	205
			180	205	205
			200	205	205
5/4" DN 32	408	175	120	175	175
			140	175	175
			160	175	175
			180	175	175
			200	175	175
5/4" DN 32	470	150	120	150	150
			140	150	150
			160	150	150
			180	150	150
			200	150	150

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

Table 6: *Pressure specifications for operational maintenance cleaning with Silt Cleaner/ Scraper*

Bulldog rotating noozle

maximum jet angle 90°

Application:
Removal of grease, roots and harder incrustations

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	89	79
			140	97	85
			160	105	92
			180	113	98
			200	131	105
1" DN 25	345	205	120	93	82
			140	102	90
			160	111	97
			180	120	104
			200	129	111
5/4" DN 32	408	175	120	61	57
			140	65	60
			160	69	63
			180	72	66
			200	76	69
5/4" DN 32	470	150	120	69	63
			140	73	67
			160	78	71
			180	83	74
			200	88	78

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

***Table 7:** Pressure specifications for operational maintenance cleaning cleaning with Bulldog rotating nozzle*

Bulldog rotating noozle

maximum jet angle 45°, 90° noozles cloed

Application:
Removal of grease, roots and harder incrustations

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	170	170
			140	170	170
			160	170	170
			180	170	170
			200	170	170
1" DN 25	345	205	120	205	205
			140	205	205
			160	205	205
			180	205	205
			200	205	205
5/4" DN 32	408	175	120	175	175
			140	175	175
			160	175	175
			180	175	175
			200	175	175
5/4" DN 32	470	150	120	150	150
			140	150	150
			160	150	150
			180	150	150
			200	150	150

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

***Table 8:** Pressure specifications for operational maintenance cleaning and cleaning for optical inspection with Bulldog rotating nozzle – with closed 90° nozzle inserts*

Bulldog rotating noozle

maximum jet angle 90°

Application:
Removal of grease and deposits in preparation for optical inspection

Noozle[1]	Volume (l/min)	Max. pressure (bar)	Hose length (m)	Recommended maximum pressure at the manometer of the pump[2] (bar)	
				Rubber tube[3]	Plastic tube[4]
1" DN 25	330	170	120	109	99
			140	117	106
			160	125	112
			180	133	119
			200	142	125
1" DN 25	345	205	120	113	103
			140	122	110
			160	131	117
			180	140	124
			200	149	131
5/4" DN 32	408	175	120	82	77
			140	122	110
			160	131	117
			180	140	124
			200	149	131
5/4" DN 32	470	150	120	89	83
			140	94	87
			160	99	91
			180	103	95
			200	108	99

1 All nozzles must be mechanically in perfect condition and optimally adjusted to the respective vehicle parameters. Equipment with nozzle insert diameters specified by the manufacturer!

2 The recommended maximum pressure on the pressure gauge is a calculated value taking into account friction losses over the length of the hose. The results may deviate by small percentage values. The values are calculated for enz® Jetmax nozzle inserts.

3 Rubber hose, (natural) rubber, colour: black

4 Plastic hose, main component PVC, colour: green, blue or other.

Table 9: *Pressure specifications for cleaning for optical inspection with Bulldog rotating nozzle*

4 Laws, standards and regulations

DIN 19523 Requirements and test methods for determining the high-pressure jet resistance and flushing resistance of pipeline components for waste water pipes and sewers.

DIN EN 752 Drain and sewer systems outside buildings

5 Safety regulations

The existing laws and regulations with regard to occupational safety, environmental protection and waste recycling and disposal need to be complied with.

6 List of tables

7 Authors

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If you have any questions, please feel free to contact us!
We look forward to hearing from you.

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