MEYER BURGER
SWISS SLICING SYSTEMS

Technical Specification

Wire Saw DS 271

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The drawings and details of this Technical Specification are subject to technical changes that are required to improve the machine or assemblies.

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1 Application

The DS 271 wire saw was specifically developed and designed to slice thin solar wafers. The concept is based on the extremely successful and well established DS 264 that has been on the market for years.

The aim of the DS 271 is not the highest possible throughput, but to slice many more wafers from the basic silicon material for much lower cutting costs.

With a maximum loading length of 1020 mm, the DS 271 guarantees a high yield for extremely low costs per wafer (i.e. higher yield & lower wafer cost).

1.1 Main features

Simple machine concept

The symmetrical machine structure, with high mechanical and thermal stability, guarantees the highest possible quality of the wafers produced.

Setup- and maintenance work can be done quickly and efficiently as a result of the new and modular structure.
Access to the workpieces, wire guide rollers and wire winding reels is guaranteed in optimum conditions.

Stable machining process

The process stability is guaranteed by a constant slurry temperature that is ensured by means of a monitored cooling circuit with an efficient heat exchanger.

The slurry unit matched to the process also ensures a constant slurry flow and guarantees a high repeat accuracy.

User-friendly operation

The entire machining process can be controlled, optimized and monitored by the following, adjustable main parameters:

- wire pretension
- cutting feed
- wire speed
- slurry flow
- slurry temperature

In addition, the main parameters, along with more than 30 process-related values, are stored periodically and can be evaluated later on a standalone PC.

All process parameters are displayed on the operating terminal with colored screen and touch screen.

2 Features

The following value limits describe the technical design and cannot be combined randomly.
All process combinations must be verified and proven

2.1 Workpiece dimensions

Cross-section	max. 210 × 210 mm (Ø 220 mm)
Number of workpieces	2 × 510 mm / 4 × 255 mm
Max. loading length	1020 mm
Min. wafer thickness	0.100 mm*)

*) depending on process parameters

2.2 Wire

Diameter	0.100 – 0.160 mm
Length	up to 640 km for wire Ø 0.160 mm *) up to 800 km for wire Ø 0.140 mm *) up to 1100 km for wire Ø 0.120 mm *)
Speed	up to 15 m/s
Direction	forward or reverse cutting
Bi-directional cycle	programmable (in forward and backward meters)
Acceleration	up to 2 m/s^2
Pre-tension	up to 35 N (depending on wire diameter)

*) applies to reel TA 100

2.3 Wire guide rollers / wire web

Diameter	350 mm
Length	1061 mm
Weight	175 kg
Number	2
Required power	2 × 75 kW
Bearing application	special roller bearings, water-cooled
Horizontal distance between axes	660 mm
Wire web working height	1515 mm
Wire web width	1030 mm

2.4 Wire deflection rollers

Number	3 on each side (2 narrow, 1 wide)
Diameter	160 mm

2.5 Wire winder

Reel axis working height	1160 mm
MC reels	MB 500
Supplier reels	TA 100 and TA 180

2.6 Cutting feed

Speed	0.01 – 10 mm/min, programmable
Rapid traverse	200 mm/min
Working stroke	max. 270 mm

2.7 Slurry supply

Tank capacity	maximum 475 l
Slurry temperature	preselectable from 20 – 27 °C*) constant to +/- 1 °C
Pump delivery rate	max. 12,000 kg/h **) measured and displayed with mass flow meter
Slurry density	displayed
Slurry viscosity	displayed (optional)
Slurry cooling	by heat exchanger

*) for a cooling water inlet temperature of 12 – 17 °C

**) slurry density (25 °C) 1.62kg/dm^3; PEG 300/F600

2.8 Control system

Type	Siemens industrial PC with integrated S7 Control system 416 slot CPU; 317 FCPU
Monitor / operating panel	10.4“ flat panel touch-screen

2.9 Coloring

Machine frame	RAL 9007
Covers	stainless steel
Accentuation	RAL 5013
Control cabinet	RAL 7035

2.10 Noise level

Noise level (free field)	< 75 dB (A)

3 Technical data and connected loads

3.1 Dimensions and weight

Length × width × height	5193 × 3000 × 3406 mm
Weight of cutting unit	approx. 9900 kg
Weight of control cabinet	approx. 1800 kg
Weight of media module	approx. 750 kg (without process fluid)
Weight of slurry tank	approx. 1000 kg (empty weight approx. 350 kg)
Weight of winder modules	approx. 3100 kg
Total weight of unit	approx. 16,600 kg

3.2 Electric power

Mains configuration	TN-S without neutral wire
Line voltage / frequency	3 × 400 V ±10 % / 50 Hz
	3 × 480 V ±10 % / 60 Hz
Power fuse	500 A gG-gL fast acting
Clamp cross section	max. 240 mm^2
Connection power	190 kW
Max. operating power	165 kW
Average operating power	105 - 135 kW*)
UPS system for PC	integrated
IP protection class (electrical cabinet, touch-screen)	IP 54
Connection network (Ethernet)	RJ 45

*) depending on process parameters

3.3 Slurry

3.3.1 Slurry specification

--> See separate document entitled “Slurry Specification”

3.3.2 Slurry tank

Tank capacity	maximum 475 l
Weight	approx. 1000 kg (filled)
Filling/draining connection (interface)	Kamlok coupling, male part Type: 633-FW DS 1 inch

3.3.3 Automatic slurry supply (optional)

The DS 271 can be operated with an automatic slurry supply system (slurry management) as an option.

Feed line

A switching valve with the following specification must be fitted in the ring line on the customer's premises for the feed system:

Type	membrane valve with actuator closed without pressure; connection without 'dead volume'
Size/flow	depends on customer's ring line
Control	5.5 bar pneumatic (optional electrical)
Compressed air connection	Ø 6 mm

Return line

There must be no back pressure present in the ring line for "old" slurry

Slurry must be introduced into the ring line from the top.

Draining/venting

Meyer Burger recommends fitting an additional valve to drain/vent the line (specifications equal to those for the feed line valve).

Control functions on the machine

- Valve in main supply line open/closed
- Venting valve open/closed

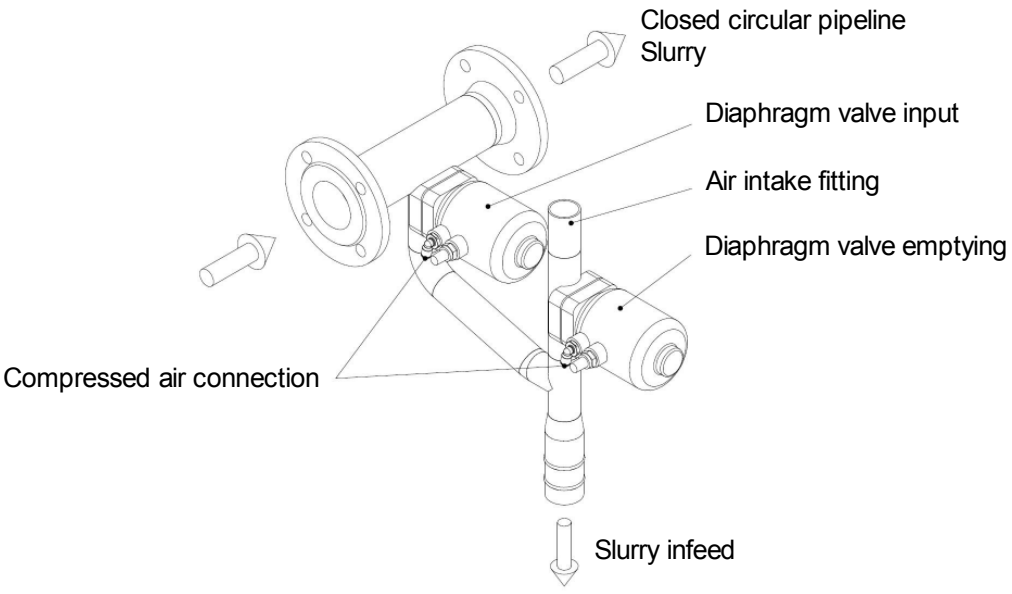

Fig 1: Feed line (membrane valves not scope of supply)

3.4 Compressed air

Minimum compressed air quality under ISO 8573-1	
Maximum particle diameter (class 4)	15 µm
Maximum particle density (class 4)	8 mg/m^3
Maximum residual oil content (class 4)	5 mg/m^3
Maximum residual water content (class 4)	6 g/m^3
Pressure dew point	+ 3 °C
Minimum input pressure	5.5 – 8 bar
Average consumption	approx. 15 m^3/h
Additional consumption with automatic slurry supply (optional), membrane pump	approx. 24 m^3/h
Connection (interface)	Ø 13 mm hose fitting

3.5 Air exhaust

Quantity	max. 250 m^3/h *)
Connection (interface)	PVC pipe, internal Ø 126 mm

*) at the connection (interface)

3.6 Water

Water quality	Clean water, Free of substances produced by rust and algae Silting is to be actively prevented. Cooling water must not contain any particles
pH value	6.5 to 8.5
Total hardness	6° to 8° dH
Maximum particle size	100 µm
Water temperature at input	constant 12 – 17 °C *)
Maximum water requirement	350 l/min
Average water requirement	approx. 240 – 290 l/min**)
Min. / max. pressure	2 to 5 bar
Differential pressure of installation line	at least 2 bar during cutting
Maximum cooling power (capacity)	135 kW
Supply connection	G 2“(internal thread)
Return connection	G 2“(internal thread)

*) when the water temperature is > 17 °C, the minimum slurry temperature increases to > 20 °C

**) depends on cooling input temperature, differential pressure and process parameters

3.7 Ambient conditions

The DS 271 is designed for an industrial environment and is intended for operation in closed rooms only.

Direct solar radiation on parts of the unit is to be avoided.

Ambient temperature	15 °C – 25 °C
Temperature fluctuation	max. 2 °C per cutting process max. 1 °C over 1 hour
Relative average air humidity	50 % ± 10 %

3.8 Structural requirements

Important

The following details are reference values and can be conclusively assessed by an engineer on site.

Recommended foundation thickness	200 mm (depending on subsoil)
Concrete quality	strength category C 25/30
Differential setting	max. 0.8 mm/m
Ground evenness	± 5 mm over 3 m
Ground load of the individual support points	see layout plan
Minimal doorway dimension (transport)	Height 2900 mm*); width 2700 mm
	*) without welded machine support

3.9 Storage and transport of the wire guide rollers:

Ambient temperature for transport and storage	> 0 °C
Relative average air humidity	50 % ± 10 %

3.10 Dimension and weight of the transport crates

Crate 1 (machine)	4000 × 2400 × 2890 mm	approx. 12,200 kg
Crate 2 (winder modules)	4000 × 2400 × 2520 mm	approx. 6000 kg
Crate 3 (accessories)	4000 × 2400 × 2890 mm	approx. 5500 kg
Crate 4 (accessories crate small)	2400 × 2400 × 2520 mm	

In case of open transport

Transport base 1 (machine)	3990 × 2400 × 2860 mm	approx. 11,400 kg
Crate 2 (winder modules))	3990 × 2400 × 2510 mm	approx. 5200 kg
Crate 3 (accessories)	3990 × 2400 × 2890 mm	approx. 5500 kg
Crate 4 (accessories crate small)	2400 × 2400 × 2520 mm	

4 Layout and installation plans

4.1 Machine layout

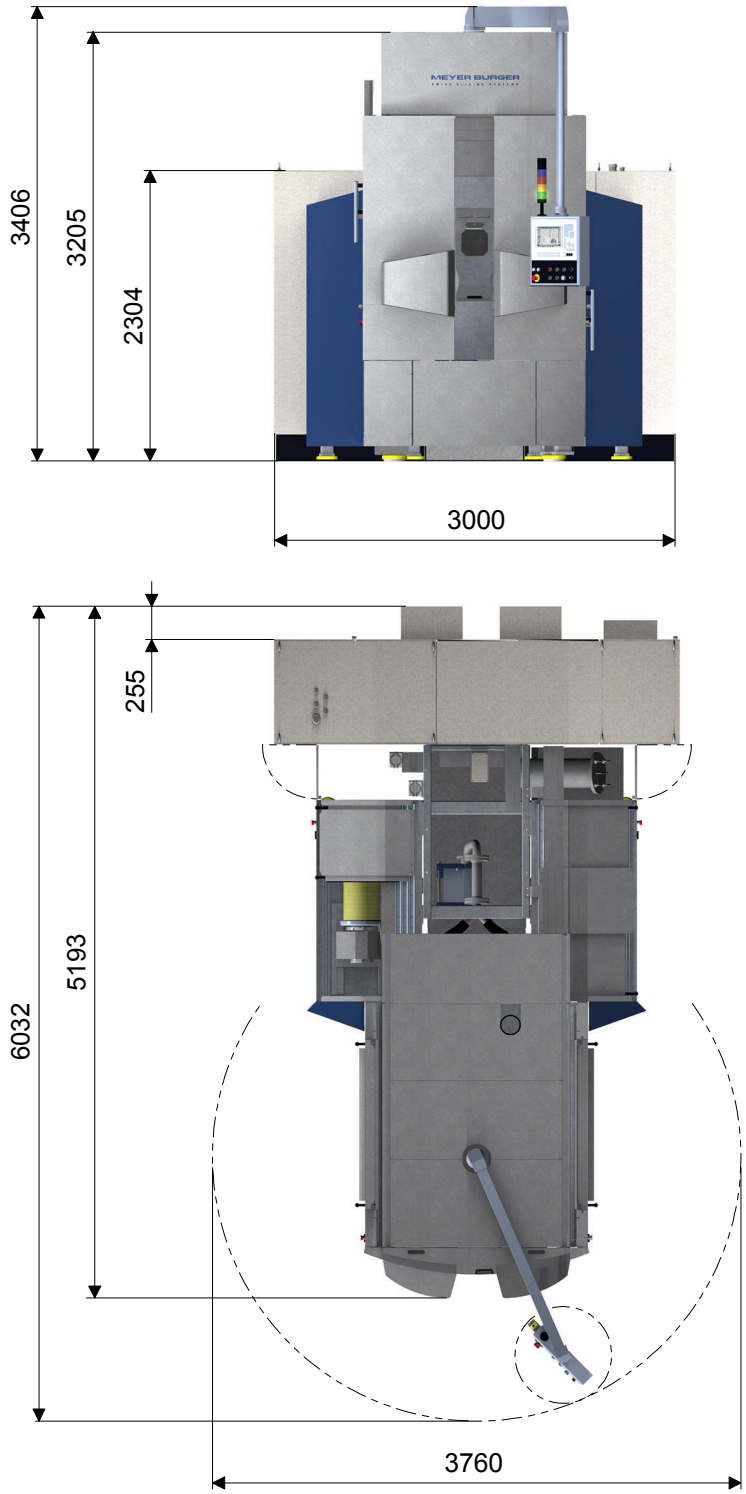

Fig. 2 Machine layout

5 Machine: construction, properties, advantages

5.1 Machine assemblies

5.1.1 Machine stand and feed unit

- The machine stand is a welded construction with high mechanical and thermal stability
- The feed unit is mounted on precise linear guides. The cutting feed process runs from top to bottom
- The workpiece is fixed mechanically in an exact position
- The work room is corrosion-resistant

5.1.2 Wire tensioning system

- The two wire tensioning units, each with one wire winding reel, are arranged symmetrically to the machine
- The wire winding reels are installed horizontally and equipped with a simple and fast tensioning mechanism
- Digital control of the wire pre-tensioning and of the winding process
- Integrated wire break monitoring
- Use of commercial wire reels (see chapter 2.5)
- The wire winding reels can be replaced with minimum time loss using the loading device
- The bearings are protected against slurry ingress by sealing air (air overpressure)

5.1.3 Wire guide rollers with main drives

- Special roller bearings for fixed and movable bearings for the wire guide rollers
- Bearing unit kept outside the cutting room means that wire guide rollers can be replaced quickly (< 2 h)
- Replacement of the wire guide rollers by means of the loading device
- Wire guide rollers made of temperature stable material
- Temperature monitored bearing unit with controlled water cooling
- Drive motor synchronization by means of special drive engineering

5.1.4 Slurry unit

- Easily accessible slurry unit in the machine
- Round slurry tank with stirrer
- Slurry pump with variable delivery rate
- Micro-filtration of the slurry during the cutting process
- Heat exchanger to maintain the pre-selected slurry temperature
- Preparation for automatic slurry exchange (slurry management)

5.1.5 Slurry supply

- A slurry supply both left and right next to the workpiece
- The slurry flow is measured and displayed with a mass flow meter
- Precise flow control

5.1.6 Control system

- Siemens SIMATIC S 7 control system (416 slot CPU and 317 FCPU)
- PC built into the control cabinet for operation, data storage and data transmission
- Interface for higher-order computer present
- All software programs are Meyer Burger in-house developments.
- Remote maintenance (direct access with pcAnywhere on the machine's computer)
- Integrated UPS system for controlled switching off of the PC in the event of a power cut

5.1.7 Operation

- Color flat panel touchscreen for displaying and monitoring process data
- Preselection of profiles for pretensioning the wire, cutting feed, wire movement, slurry flow and temperature to optimize the machining process

5.2 Options

- Automatic slurry supply (slurry management)
- Mobile pump station for draining and filling the slurry tank
- Additional flow device for the separate control of the two slurry supply systems
- Slurry viscosimeter
- Loading device for fast loading / unloading of workpieces
- Loading device for replacing the wire guide rollers
- Loading device for replacing the wire winding reels

6 Documentation

A full set of documents containing the following is supplied with the machine:

Product documentation

- Operating manual incl. maintenance manual (OM)
- Equipment list mech.
- Equipment list el.
- Diagrams mech.
- Wiring diagram
- Declaration of conformity or Manufacturer's declaration
- Logbook
- CD-ROM

Additional manuals

- If available operating manuals in hard copy according to packing list, with table of contents

Assembly drawings

- Printout of all assembly drawings according to packing list, with table of contents

7 Factory Acceptance Test

After final assembly, the wire saw is subjected in the factory to a thorough acceptance test. This test ensures delivery of a working and completely equipped machine and is an integral part of the Meyer Burger quality assurance.

The test is carried out under the responsibility of Meyer Burger, but may be attended by the customer.

The acceptance test contains the following points among others:

- Functional test of the control system
- Functional test of all sensors and actuators
- Conduct of air cut (1st machine to be shipped will conduct cut on silicon material with diamond wire)
- Completeness of the delivery

8 Transport, unloading and installation

8.1 Transport and unloading

The responsibility for the transport is part of the sales contract.

The unloading and carrying of the DS 271 to its final installation site is assisted by a Meyer Burger service engineer.

The customer is responsible for:

- Preparation of the installation site in accordance with the layout plan and the document entitled “Site Readiness Declaration” (foundations, ambient conditions, connections)
- Preparation of the transport route from the unloading site to the DS 271 location, bearing in mind the dimensions of the machine
- Organization and provision of the required aids, such as an crane (16t) or a forklift truck (16t) to cope with the structural conditions at the customer’s premises

At least two of the customer’s staff should be available to support the MB service engineer when unloading, shifting and installing the DS 271.

8.2 Pre-installation of the supply lines for the necessary process materials

The customer shall undertake the pre-installation of the supply lines for the process materials such as slurry, air, water and electricity along with his local specialist (electrician, gas installer, sanitary installer,…).

The customer is responsible for ensuring that the pre-installed in accordance with the information on the layout
plan and the document entitled “Site Readiness Declaration” is done before delivery of the DS 271.

9 Commissioning and handover

9.1 Installation and Commissioning

The installation and commissioning of the DS 271 by the Meyer Burger service engineer will not take place until the complete pre-installation has been completed by the customer.

The installation and commissioning of the DS 271 by the Meyer Burger service engineer takes about 3 days. It is recommended that the future machine operators and maintenance staff help with this work in order to familiarize themselves with the system.

If nothing else has been agreed, the Meyer Burger service engineer shall then carry out the operator training after commissioning. Training of the future machine operators takes 2 to 3 days.

During the time between commissioning and conclusion of training the system is available to Meyer Burger personnel.

9.2 Handover/acceptance

If nothing else has been agreed, the machine site acceptance test (SAT) shall take place straight after commissioning. The acceptance test criteria shall be defined before purchase and recorded in writing (integral part of the purchase agreement).

Handover shall take place in the presence of a member of the customer's staff who is empowered to sign the report after successful completion of the acceptance test.

The handover includes:

- Checking to ensure that the product and accessories, including technical documentation, are all present
- Functional test of the complete wire saw
- Cutting of the contractually specified materials in accordance with the recorded acceptance test criteria

10 Maintenance

Maintenance by the operator in accordance with the instructions is a fundamental requirement for guaranteeing
reliable and economic operation of the wire saw.

The DS 271 can also be purchased with an additional maintenance contract. The maintenance contract takes into account the customer’s individual requirements.