



## PLANETARY BALL MILL PM 200

**The Planetary Ball Mill PM 200 is a powerful benchtop model with 2 grinding stations for grinding jars with a nominal volume of 12 ml to 125 ml.**

**The extremely high centrifugal forces of Planetary Ball Mills result in very high pulverization energy and therefore short grinding times.**

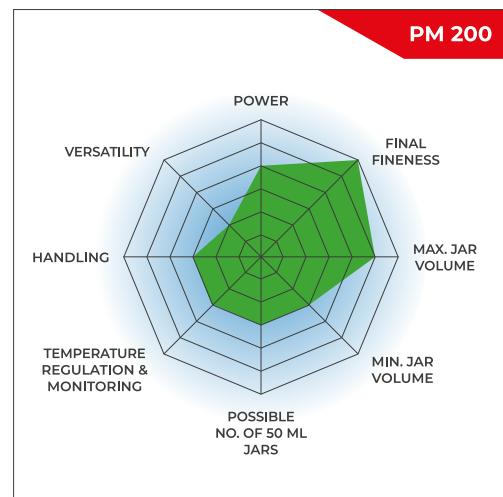
The PM 200 can be found in virtually all industries where the quality control process places the highest demands on purity, speed, fineness and reproducibility.

The mill is ideally suited for tasks in research like mechanochemistry (mechano-synthesis, mechanical alloying and mechanocatalysis), or ultrafine colloidal grinding on a nanometer scale, as well as for routine tasks such as mixing and homogenizing soft, hard, brittle or fibrous materials.



## **TWO GRINDING STATIONS FOR STANDARD APPLICATIONS**

- | Max. speed 650 rpm
- | Up to 10 mm feed size and 0.1 µm final fineness
- | 2 grinding stations for jars from 12 ml up to 125 ml, jars of 12 and 25 ml can be stacked (two jars each)
- | GrindControl to measure temperature and pressure inside the jar.
- | Aeration lids to control the atmosphere inside the jar
- | Storable SOPs and cycle programs, 5 different jar materials for dry and wet grinding



## FAST & POWERFUL

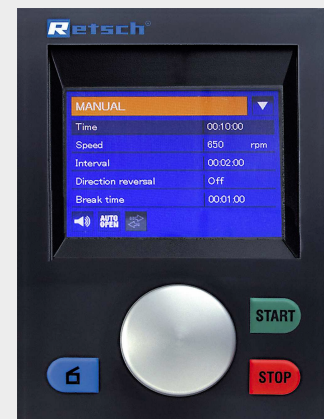
- | Loss-free size reduction down to the submicron range
- | Wet grinding yields particle sizes in the nanometer range (<100 nm)
- | Variable speed from 100 to 650 rpm, speed ratio 1:-2
- | Grinding with up to 33.3 x acceleration of gravity
- | Batch-wise processing with max. 2 x 50 ml sample
- | Wide range of materials for contamination free grinding

**PM 200**

## PLANETARY BALL MILL PM 200

# REPRODUCIBILITY, SAFETY AND EASY HANDLING

- | Reproducible results due to speed control
- | Easy and safe clamping of grinding jars
- | The Safety Slider prevents starting the machine without securely clamped jars
- | Perfect stability on the lab bench thanks to FFCS technology
- | Innovative counterweight and imbalance sensor for unsupervised operation
- | Comfortable parameter setting via display and ergonomic 1-button operation
- | Automatic grinding chamber ventilation
- | 10 SOPs can be stored, programmable starting time
- | Power failure backup ensures storage of remaining processing time



## SETTINGS & OPTIONS

- | Dry and wet grinding possible
- | Suitable for long-term trials, 99 h max.
- | Interval operation allows for cooling breaks
- | Direction reversal helps to minimize caking effects

## THE BEST ALTERNATIVE TO A RETSCH PLANETARY BALL MILL? A RETSCH MIXER MILL.



Benefit from particularly ergonomic handling while achieving the same finenesses down to the nanometer range.

PLANETARY BALL MILL PM 200

## SAFETY FIRST: JAR CLAMPING

Operation of the RETSCH planetary ball mills is particularly safe. They feature a robust Safety Slider which ensures that the mill can only be started after the grinding jar has been securely fixed with a clamping device. The self-acting lock ensures that the jar is seated correctly and securely. This proven solid mechanical system is less failure-prone than electronic solutions - the user has full access to the sample at any time. When the electronic system fails, it is not possible to unlock the jars, for example.



[Click to view video](#)

## PLANETARY BALL MILL PM 200

# WET AND NANO-SCALE GRINDING WITH THE PM 200

Wet grinding is used to obtain particle sizes below 5 µm, as small particles tend to get charged on their surfaces and agglomerate, which makes further grinding in dry mode difficult. By adding a liquid or dispersant the particles can be kept separated.

To produce very fine particles of 100 nm or less (nano-scale grinding) by wet grinding, friction rather than impact is required. This is achieved by using a large number of small grinding balls which have a large surface and many friction points. The ideal filling level of the jar should consist of 60 % small grinding balls.

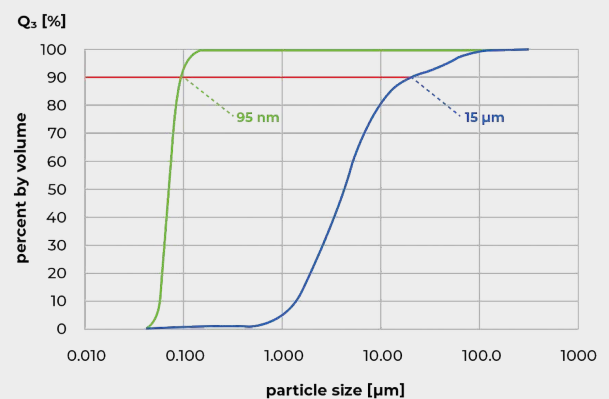
For more details on jar filling, wet grinding and sample recovery watch the video.



[Click to view video](#)

*The video shows wet grinding in the Planetary Ball Mill PM 100.*

The graphic shows the result of grinding barium titanate at 500 rpm in the PM 200. After 5 h of pulverization in heptane and oleic acid mixture with 0.5 mm grinding balls, the D90 value of the original sample was reduced from 15 µm to 95 nm.



*Grinding of barium titanate in heptane and oleic acid mixture with 0.5 mm grinding balls.*

*Blue curve: original sample; green curve: pulverized sample after 5 h.*

## PLANETARY BALL MILL PM 200

## EASYFIT GRINDING JARS FOR EXCELLENT RESULTS

The performance and the result of sample preparation are also determined by the choice of the grinding jar and its ball charge. The EasyFit range of jars has been specially designed for extreme working conditions such as long-term trials, even at maximum speed of 800 rpm, wet grinding, high mechanical loads and maximum speeds as well as for mechanical alloying. This line of jars is suitable for all RETSCH planetary ball mills.

The new EasyFit grinding jar series features a structure on the bottom of the 50-500 ml jars called Advanced Anti-Twist (AAT). This ensures that the jars are tightly fixed without the risk of twisting, even at high speed, and that wear and tear is drastically reduced. Secure clamping of the jars is made much easier: to find the correct clamping position, a maximum twist of 60° is required.

The geometry of the EasyFit jars in the 50 ml and 250 ml sizes has been enlarged in diameter and reduced in height compared to the previous "comfort" models. This offers two advantages: better grinding results and interchangeable lids, as there are only three diameter dimensions for the entire grinding jar range.

### Diameter categories

- | Diameter 1: 12 ml and 25 ml grinding jars
  - | Diameter 2: 50 ml, 80 ml and 125 ml grinding jars
- 
- | Available jar sizes: 12 ml / 25 ml / 50 ml / 80 ml / 125 ml
  - | Innovative Advanced Anti-Twist (AAT) function ensures secure fit of grinding jars
  - | High flexibility thanks to suitability of three lid sizes for all seven jar sizes
  - | Pressure-tight and dust-proof O-ring sealing prevents material spillage
  - | Jars and balls available in 5 materials: hardened stainless steel, tungsten carbide, agate, sintered aluminium oxide, zirconium oxide
  - | Stainless steel protective jacket for agate, sintered aluminum oxide, zirconium oxide and tungsten carbide grinding jars
  - | A groove between jar body and lid allows for easy opening of the lid, e. g. with the help of a spatula, if there are underpressure effects inside the jar



## JARS & LIDS FOR SPECIAL APPLICATIONS

- | For colloidal or wet grinding, the use of a grinding jar with a special closure device is recommended
- | The special closure device is designed for ergonomic handling
- | Aeration lids are designed for working under inert atmosphere, for example if oxygen can influence the grinding process or the mechanosynthesis. The lids allow the introduction of gases like argon or nitrogen into the grinding jar.



Aeration lid



[Click to view video](#)

Video: Aeration lid

## PLANETARY BALL MILL PM 200

### RECOMMENDED JAR FILLINGS

To produce optimum grinding results, the jar size should be adapted to the sample amount to be processed. The grinding balls are ideally sized 3 times bigger than the largest sample piece. Following this rule of thumb, the number of grinding balls for each ball size and jar volume is indicated in the table below. To pulverize, for example, 50 ml of a sample consisting of 3 mm particles, a 125 ml jar and grinding balls sized at least 10 mm or larger are recommended. According to the table, 30 grinding balls are required.

| Grinding jar nominal volume | Sample amount | Max. feed size | Recommended ball charge (pieces) |           |         |         |         |         |
|-----------------------------|---------------|----------------|----------------------------------|-----------|---------|---------|---------|---------|
|                             |               |                | Ø 5 mm                           | Ø 7 mm    | Ø 10 mm | Ø 15 mm | Ø 20 mm | Ø 30 mm |
| 12 ml                       | up to ≤5 ml   | <1 mm          | 50                               | 15        | 5       | -       | -       | -       |
| 25 ml                       | up to ≤10 ml  | <1 mm          | 95 – 100                         | 25 – 30   | 10      | -       | -       | -       |
| 50 ml                       | 5 – 20 ml     | <3 mm          | 200                              | 50 – 70   | 20      | 7       | 3 – 4   | -       |
| 80 ml                       | 10 – 35 ml    | <4 mm          | 250 – 330                        | 70 – 120  | 30 – 40 | 12      | 5       | -       |
| 125 ml                      | 15 – 50 ml    | <4 mm          | 500                              | 110 – 180 | 50 – 60 | 18      | 7       | -       |

The table shows the recommended charges (in pieces) of differently sized grinding balls in relation to the grinding jar volume, sample amount and maximum feed size.

PLANETARY BALL MILL PM 200

## TYPICAL SAMPLE MATERIALS

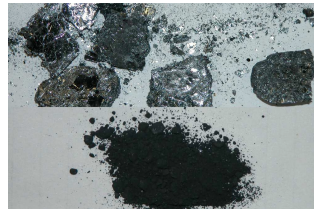
RETSCH planetary ball mills are perfectly suitable for size reduction of, for example, alloys, bentonite, bones, carbon fibres, catalysts, cellulose, cement clinker, ceramics, charcoal, chemical products, clay minerals, coal, coke, compost, concrete, electronic scrap, fibres, glass, gypsum, hair, hydroxyapatite, iron ore, kaolin, limestone, metal oxides, minerals, ores, paints and lacquers, paper, pigments, plant materials, polymers, quartz, seeds, semi-precious stones, sewage sludge, slag, soils, tissue, tobacco, waste samples, wood, etc.

### Medium-hard: biomass



35 g sample  
125 ml stainless steel  
grinding jars  
7 x 20 mm stainless  
steel grinding balls  
15 min at 500 rpm

### Brittle: tin sulfide



52 g sample  
125 ml agate grinding  
jars  
50 x 10 mm agate  
grinding balls  
60 min at 550 rpm  
10 min intervals and  
direction reversal

### Fibrous: straw



7 g sample  
125 ml zirconium oxide  
grinding jars  
50 x 10 mm zirconium  
oxide grinding balls  
40 min at 300 rpm  
10 min intervals and  
direction reversal

### Hard: natural rocks



60 g sample  
125 ml stainless steel  
grinding jars  
7 x 20 mm stainless  
steel grinding balls  
10 min at 420 rpm

PLANETARY BALL MILL PM 200

## FUNCTIONAL PRINCIPLE

The grinding jars are arranged eccentrically on the sun wheel of the planetary ball mill. The direction of movement of the sun wheel is opposite to that of the grinding jars in the ratio 1:-2. The grinding balls in the grinding jars are subjected to superimposed rotational movements, the so-called Coriolis forces.

The difference in speeds between the balls and grinding jars produces an interaction between frictional and impact forces, which releases high dynamic energies. The interplay between these forces produces the high and very effective degree of size reduction of the planetary ball mill.



[Click to view video](#)

## PLANETARY BALL MILL PM 200

### TECHNICAL DATA

|                                             |                                                                                                                                                                                 |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Applications</b>                         | pulverizing, mixing, homogenizing, colloidal milling, mechanical alloying, mechanosynthesis, nano grinding                                                                      |
| <b>Field of application</b>                 | agriculture, biology, chemistry, construction materials, engineering / electronics, environment / recycling, geology / metallurgy, glass / ceramics, medicine / pharmaceuticals |
| <b>Feed material</b>                        | soft, hard, brittle, fibrous - dry or wet                                                                                                                                       |
| <b>Size reduction principle</b>             | impact, friction                                                                                                                                                                |
| <b>Material feed size*</b>                  | < 4 mm                                                                                                                                                                          |
| <b>Final fineness*</b>                      | < 1 µm, for colloidal grinding < 0.1 µm                                                                                                                                         |
| <b>Batch size / feed quantity*</b>          | max. 2 x 50 ml                                                                                                                                                                  |
| <b>No. of grinding stations</b>             | 2                                                                                                                                                                               |
| <b>Speed ratio</b>                          | 1 : -2                                                                                                                                                                          |
| <b>Sun wheel speed</b>                      | 100 - 650 min <sup>-1</sup>                                                                                                                                                     |
| <b>Effective sun wheel diameter</b>         | 157 mm                                                                                                                                                                          |
| <b>G-force</b>                              | 37.1 g                                                                                                                                                                          |
| <b>Type of grinding jars</b>                | EasyFit, optional aeration covers, safety closure devices                                                                                                                       |
| <b>Material of grinding tools</b>           | hardened steel, stainless steel, tungsten carbide, agate, sintered aluminum oxide, silicon nitride, zirconium oxide                                                             |
| <b>Grinding jar sizes</b>                   | 12 ml / 25 ml / 50 ml / 80 ml / 125 ml                                                                                                                                          |
| <b>Stackable grinding jars</b>              | 12 ml / 25 ml                                                                                                                                                                   |
| <b>Setting of grinding time</b>             | digital, 00:00:01 to 99:59:59                                                                                                                                                   |
| <b>Interval operation</b>                   | yes, with direction reversal                                                                                                                                                    |
| <b>Interval time</b>                        | 00:00:01 to 99:59:59                                                                                                                                                            |
| <b>Pause time</b>                           | 00:00:01 to 99:59:59                                                                                                                                                            |
| <b>Storable SOPs</b>                        | 10                                                                                                                                                                              |
| <b>Measurement of input energy possible</b> | yes                                                                                                                                                                             |
| <b>Interface</b>                            | RS 232 / RS 485                                                                                                                                                                 |
| <b>Drive</b>                                | 3-phase asynchronous motor with frequency converter                                                                                                                             |
| <b>Drive power</b>                          | 750 W                                                                                                                                                                           |
| <b>Electrical supply data</b>               | different voltages                                                                                                                                                              |
| <b>Power connection</b>                     | 1-phase                                                                                                                                                                         |
| <b>Protection code</b>                      | IP 30                                                                                                                                                                           |

|                                |                                |
|--------------------------------|--------------------------------|
| <b>Power consumption</b>       | ~ 1250 W (VA)                  |
| <b>W x H x D closed</b>        | 640 x 480 (780) x 420 mm       |
| <b>Net weight</b>              | ~ 76 kg                        |
| <b>Standards</b>               | CE                             |
| <b>Patent / Utility patent</b> | SafetySlider (DE 202008008473) |

\*depending on feed material and instrument configuration/settings

[www.retsch.com/pm200](http://www.retsch.com/pm200)

## ORDER DATA

### PLANETARY BALL MILL PM 200

**(please order grinding jars and balls separately)**

20.640.0001  PM 200 with 2 grinding stations, speed ratio 1 : -2

**other electrical versions available for the same price**

### ACCESSORIES PLANETARY BALL MILLS

22.661.0003  Clamping unit for PM 200

03.025.0178 Adapter for stacking grinding jars 50 ml - 80 ml

02.728.0048  Counter aid for sun wheel PM 100, PM 200 and PM 400

03.486.0062 Opening aid for clamping unit of planetary ball mills

99.200.0008  IQ/OQ Documentation for PM 200

### GRINDING JARS EASYFIT

**(grinding jars EasyFit are suitable for all planetary ball mills)**

#### HARDENED STAINLESS STEEL

01.462.0239  12 ml

01.462.0240  25 ml

01.462.0516 50 ml

01.462.0517 80 ml

01.462.0518 125 ml

#### TUNGSTEN CARBIDE

|             |        |
|-------------|--------|
| 01.462.0494 | 50 ml  |
| 01.462.0495 | 80 ml  |
| 01.462.0527 | 125 ml |

#### AGATE

|             |        |
|-------------|--------|
| 01.462.0509 | 50 ml  |
| 01.462.0511 | 80 ml  |
| 01.462.0515 | 125 ml |

#### SINTERED ALUMINUM OXIDE

|             |        |
|-------------|--------|
| 01.462.0507 | 50 ml  |
| 01.462.0512 | 125 ml |

#### ZIRCONIUM OXIDE

|             |        |
|-------------|--------|
| 01.462.0508 | 50 ml  |
| 01.462.0510 | 80 ml  |
| 01.462.0513 | 125 ml |

## ACCESSORIES FOR GRINDING JARS EASYFIT FOR WET GRINDING, GRINDING WITH INERT ATMOSPHERE AND MECHANICAL ALLOYING (MA)

#### AERATION LIDS (INCL. INLAY)

|             |                                                                    |
|-------------|--------------------------------------------------------------------|
| 22.107.0613 | for grinding jars EasyFit 50 ml - 125 ml, hardened stainless steel |
| 22.107.0616 | for grinding jars EasyFit 50 ml - 125 ml, tungsten carbide         |
| 22.107.0617 | for grinding jars EasyFit 50 ml - 125 ml, agate                    |
| 22.107.0615 | for grinding jars EasyFit 50 ml - 125 ml, zirconium oxide          |
| 22.864.0001 | Spare valve set for aeration lids M8x1                             |



#### INLAY FOR AERATION LID

|             |                                                                    |
|-------------|--------------------------------------------------------------------|
| 03.474.0225 | for grinding jars EasyFit 50 ml - 125 ml, hardened stainless steel |
|-------------|--------------------------------------------------------------------|

|             |                                                            |
|-------------|------------------------------------------------------------|
| 03.474.0207 | for grinding jars EasyFit 50 ml - 125 ml, tungsten carbide |
| 03.474.0208 | for grinding jars EasyFit 50 ml - 125 ml, agate            |
| 03.474.0206 | for grinding jars EasyFit 50 ml - 125 ml, zirconium oxide  |

## AERATION LIDS FOR GRINDING JARS EASYFIT

INCL. O-RINGS AND SINTERED FILTER (PLEASE ORDER LID INSERT AND GRINDING JAR SEPARATELY)

|             |                                                       |
|-------------|-------------------------------------------------------|
| 22.107.0636 | Aeration lid for grinding jar EasyFit 50 ml - 125 ml  |
| 22.107.0637 | Aeration lid for grinding jar EasyFit 250 ml - 500 ml |

### INSERT FOR GRINDING JAR EASYFIT

|             |                                                                                   |
|-------------|-----------------------------------------------------------------------------------|
| 03.474.0261 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, stainless steel  |
| 03.474.0262 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, zirconium oxide  |
| 03.474.0263 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, tungsten carbide |
| 03.474.0268 | Aeration lid insert for grinding jar EasyFit 50, 80 oder 125 ml, agate            |
| 22.186.0007 | Sintered filter with O-ring, set of 10 pieces                                     |
| 22.864.0001 | Valve set M8x1 for GrindControl and aeration lids                                 |



## SAFETY CLOSURE DEVICES

|             |                                          |
|-------------|------------------------------------------|
| 22.867.0011 | for grinding jars EasyFit 50 ml - 125 ml |
| 02.486.0055 | Opening aid for safety closure device    |

## GASKETS FOR GRINDING JARS EASYFIT

### O-RINGS

|             |                                                 |
|-------------|-------------------------------------------------|
| 05.114.0086 | O-ring for 12 ml grinding jar EasyFit           |
| 05.114.0085 | O-ring for 25 ml grinding jar EasyFit           |
| 05.114.0056 | O-ring for 50 ml - 125 ml grinding jars EasyFit |
| 03.111.0438 | Flat gasket for 50 ml, 80 ml or 125 ml          |



## GRINDING BALLS

### HARDENED STEEL

05.368.0029  5 mm Ø

05.368.0030  7 mm Ø

05.368.0059  10 mm Ø

05.368.0032  12 mm Ø

05.368.0108  15 mm Ø

05.368.0033  20 mm Ø

### STAINLESS STEEL

22.455.0010  2 mm Ø, 500 g (approx. 110 ml)

22.455.0011  3 mm Ø, 500 g (approx. 120 ml)

22.455.0002  3 mm Ø, 200 pieces (approx. 6 ml)

22.455.0001  4 mm Ø, 200 pieces (approx. 14 ml)

22.455.0003  5 mm Ø, 200 pieces (approx. 25 ml)

05.368.0034  5 mm Ø

05.368.0035  7 mm Ø

|             |                                                                                   |         |
|-------------|-----------------------------------------------------------------------------------|---------|
| 05.368.0063 |  | 10 mm Ø |
| 05.368.0037 |  | 12 mm Ø |
| 05.368.0109 |  | 15 mm Ø |
| 05.368.0062 |  | 20 mm Ø |

#### TUNGSTEN CARBIDE

|             |                                                                                     |                                    |
|-------------|-------------------------------------------------------------------------------------|------------------------------------|
| 22.455.0006 |    | 3 mm Ø, 200 pieces (approx. 6 ml)  |
| 22.455.0005 |    | 4 mm Ø, 200 pieces (approx. 14 ml) |
| 22.455.0004 |   | 5 mm Ø, 200 pieces (approx. 25 ml) |
| 05.368.0038 |  | 5 mm Ø                             |
| 05.368.0039 |  | 7 mm Ø                             |
| 05.368.0071 |  | 10 mm Ø                            |
| 05.368.0041 |  | 12 mm Ø                            |
| 05.368.0110 |  | 15 mm Ø                            |
| 05.368.0070 |  | 20 mm Ø                            |

#### AGATE

|             |                                                                                     |        |
|-------------|-------------------------------------------------------------------------------------|--------|
| 05.368.0024 |  | 5 mm Ø |
|-------------|-------------------------------------------------------------------------------------|--------|

|             |                                                                                   |         |
|-------------|-----------------------------------------------------------------------------------|---------|
| 05.368.0025 |  | 7 mm Ø  |
| 05.368.0067 |  | 10 mm Ø |
| 05.368.0027 |  | 12 mm Ø |
| 05.368.0111 |  | 15 mm Ø |
| 05.368.0028 |  | 20 mm Ø |

#### SINTERED ALUMINUM OXIDE

|             |                                                                                     |         |
|-------------|-------------------------------------------------------------------------------------|---------|
| 05.368.0021 |    | 10 mm Ø |
| 05.368.0112 |   | 15 mm Ø |
| 05.368.0054 |  | 20 mm Ø |

#### ZIRCONIUM OXIDE

|             |                                                                                     |                                   |
|-------------|-------------------------------------------------------------------------------------|-----------------------------------|
| 32.368.0005 |  | 0.1 mm Ø, 0.5 kg (approx. 135 ml) |
| 32.368.0003 |  | 0.5 mm Ø, 0.5 kg (approx. 135 ml) |
| 32.368.0004 |  | 1 mm Ø, 0.5 kg (approx. 135 ml)   |
| 05.368.0089 |  | 2 mm Ø, 0.5 kg (approx. 135 ml)   |
| 05.368.0090 |  | 3 mm Ø, 0.5 kg (approx. 140 ml)   |
| 22.455.0007 |  | 3 mm Ø, 200 pieces (approx. 6 ml) |

22.455.0009 5 mm Ø, 200 pieces (approx. 25 ml)



05.368.0146 7 mm Ø

05.368.0094 10 mm Ø



05.368.0096 12 mm Ø



05.368.0113 15 mm Ø

