

Technical Catalog of Tunnel Support Systems

Micropiles

Utility and Field of Application

Micropiles are small-diameter piles (60-140 mm) that transfer loads to resistant strata. They are used for:

- **Stabilization of excavation fronts** by creating micropile umbrellas.
- **Reinforcement of arches and side walls** in areas with soft or fractured soils.
- **Settlement control** in soft or highly fractured soils.

Injection Process and Valves

Cement grout is pumped from inside the pipe-reinforcement to the base of the micropile; the material exits through the tip and returns through the annular space, cleaning debris and ensuring continuous shaft-ground contact. For localized reinforcements, the pipe can incorporate check valves (manchettes) that allow injection at different depths.

Advantages

- Simultaneous drilling and injection installation, reducing construction phases.
- Adaptability to confined spaces and water-bearing ground.
- Possibility of repetitive injections to optimize adhesion.
- Transfer of tensile, compressive, and cyclic loads.

Table of Commercial Dimensions

Outer Ø (mm)	Thickness (mm)	Cross-sectional Area (cm ²)	Weight (kg/m)	Allowable Load (T)
60,3 × 5,5	5,5	9,47	8	28
73,0 × 6,0	6,0	12,63	11	37
88,9 × 7,0	7,0	18,01	14	50
88,9 × 9,0	9,0	22,59	19	64
101,6 × 7,0	7,0	20,80	17	59
101,6 × 9,0	9,0	26,18	21	72
114,3 × 9,0	9,0	29,77	24	83
127,0 × 9,0	9,0	33,36	28	94
139,7 × 11,0	11,0	44,48	36	123

Support Bolts

Bolts are essential components to guarantee the stability of underground excavations. The most common types are described below:

1. Self-Drilling Anchors

Utility and Field of application

Self-Drilling Anchors are hollow bars that combine drilling and anchoring in a single operation. Where conventional drilling is not feasible, they are used for:

- Primary support in tunnels.
- Slope stabilization
- Forepoling and reinforcement of unconsolidated soils.

Injection Process

Grout (water-cement 0.4-0.5) circulates through the hollow core of the bolt, displacing debris and filling the borehole with continuous cementation. Fast-setting two-component resins can be used for cases requiring high capacity and short times.

Advantages

- Rapid assembly without separate drilling and purging phases.
- Effective anchors in very unstable soils.
- Instantaneous improvement of external friction.
- Flexibility in diameters and lengths according to the project.

Table of Series and Capacities

Serie	Ø (mm)	Ultimate Load (kN)
R32	32	300
R38	38	440
R51	51	620

2. Swellex Bolts (MN12, MN16, MN24) Utility and Field of Application

Swellex bolts are hydraulic immediate-friction anchors used for rapid reinforcements in mining and tunnels, especially where high deformations occur. They provide immediate anchoring.

Equipment and Pressures

A specialized pump (pneumatic, hydraulic, or electric) is required to inject water at 24-30 MPa (240-300 bar). These pieces of equipment regulate pressure and flow rate and stop automatically when the established pressure is reached.

Advantages

- Instantaneous anchoring without grout.
- Simple installation in confined spaces.
- Portable and easy-to-handle equipment.
- Immediate support with high load capacity.

Table of Models and Measurements

Model	tube Ø (mm)	Drilling (mm)	Thickness (mm)	Typical Load (indicative) (kN)	Lengths (m)
MN12	28	32-39	2,0	110	Upon request
MN16	36	43-52	2,0	150	Upon request
MN24	36	43-52	3,0	220	Upon request

3. Split Set Bolts

Utility and Field of Application

Split Sets are slotted steel tubes that are inserted into boreholes of slightly smaller diameter, generating anchoring by mechanical friction. They are ideal for temporary support in tunnels and mines and hard-to-access locations.

Resin Injection

In highly fractured rock masses, before inserting the bolt, a low-viscosity two-component polyester resin is injected; upon setting, it improves adhesion and accelerates stabilization.

Advantages

- Fast placement and extraction.
- Do not require cleaning or grouting phases.
- Easy to perform in-situ retention tests.
- Combination of friction and adhesion with resin.

Tabella delle dimensioni comuni

Nominal Ø (mm)	Thickness (mm)	Length(m)	Breaking Load (kN)	Recommended Drill Bit (mm)
36,25	2,0 / 2,5	0,6 – 3,0	85 – 90	35 – 38
46,30	3,2	0,6 – 3,0	120 – 130	43 – 51

4. Deformed Bars and threaded rod

Utility and Field of Application

- **Deformed bars:** Ribbed rods that, when injected with grout, provide permanent anchors for linings and arches and reinforce structural elements in tunnels.
- **threaded rod:** High-strength rods with continuous threading, suitable for active tensioning in permanent structures.

Advantages

- **Deformed bars:** Excellent adhesion to the shaft, versatile diameters, and good corrosion resistance with special grouts. Small diameters for confined spaces.
- **threaded rod** High strength (670 – 1,770 N/mm²), flexible couplings, suitable for tensioning and subsequent readjustments.

Table of standard continuously threaded bars (fy 500 MPa.).

Ø (mm)	Section (mm ²)	Carico di servizio (kN)
25	491	245
32	804	405
40	1256	630
50	1963	980
63,5	3170	1760

