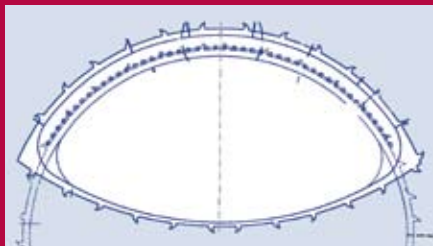
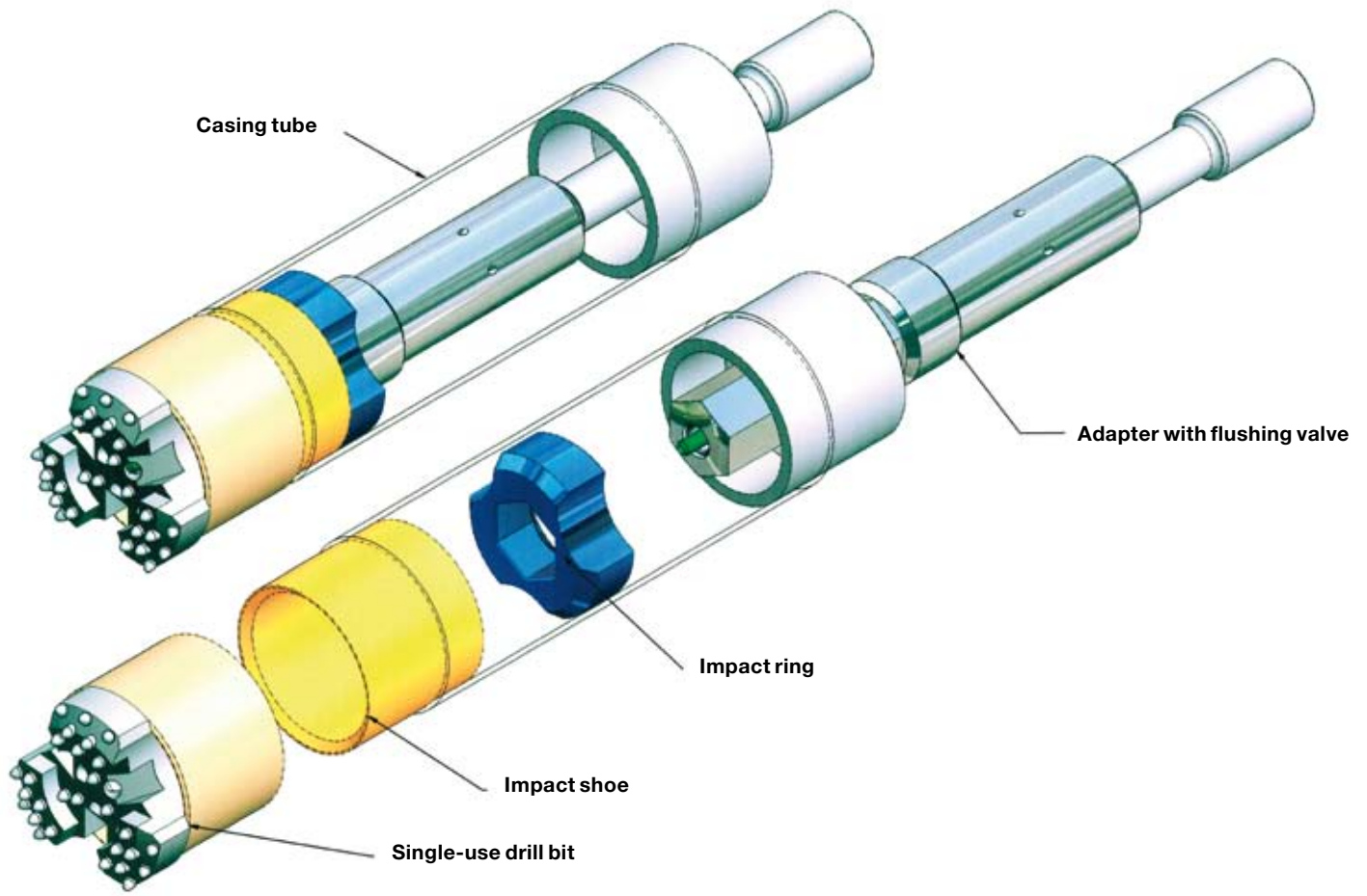


AT - Casing System



System Description AT - Casing System



Cross-section pipe umbrella support system



Single pipe umbrella support system



Double pipe umbrella support system



Field of application AT - Pipe Umbrella Support System

- Tunneling in heterogeneous, soft, or subsidence-sensitive ground
- Tunneling through fault zones
- Unstable ground conditions at the working area
- Shallow tunnels in urban areas

AT - Pipe Umbrella Support System - mode of action

- Support of the tunnel wall in the region of the face
- Distribution of loads in the longitudinal direction
- Ground improvement ahead of the tunnel face by grouting
- Reduction of subsidence due to ground improvement and load distribution
- Drainage and ground support also by non-injected casing tubes

System Description AT - Casing System

Field of application AT - Drainage System

- Drainage of the ground ahead of excavation
- Drainage of sliding endangered slopes or embankments

Field of application AT - GRP Injection System

- Ground improvement for mechanical excavation
- Tunneling through zones of heterogeneous, soft, or subsidence-sensitive ground



Standard structural properties AT - Pipe Umbrella Support System

Outer diameter casing tube x wall thickness [mm]

- AT - 76: 76,1 x 5,6
- AT - 89: 88,9 x 6,3
- AT - 114: 114,3 x 6,3
- AT - 139: 139,7 x 8,0 or 142,0 x 10,0
- AT - 168: 168,0 x 12,5

Optionally, the AT - Pipe Umbrella Support System is also available in combination with a particular pipe connection. This so-called "threaded nipple coupling" enables the extension of pipes without reducing the pipe's strength in the section of the threads. Thereby, the total and constant load-bearing capacity of the casing pipes is warranted over the entire length of the pipe umbrella.

Standard structural properties AT - Drainage System

- AT - 76/DR
- AT - 118/DR

Standard structural properties AT - GRP Injection System

- AT - 76/GFK

Depending on project requirements and customer demands, the AT - Casing System can be adjusted by changing the structural properties.



Single pipe umbrella support system with overlap to a double pipe umbrella support system



Single pipe umbrella support system with drainage



Slope drainage

AT - Pipe Umbrella Support System



AT - Drainage System



AT - GRP Injection System



Advantages AT - Casing System



The AT - Casing System is a system solution being adjusted to customer needs

- The application of the AT - Casing System is independent of the drilling machine available on-site
- No additional equipment is necessary to install the pipe umbrella; the drilling of casing tubes, anchors, and blasting holes can be accomplished with the same boom
- Pipe umbrella drilling works can be implemented by the standard personnel under supervision of application engineers
- Simultaneous drilling and tubing
- Possible drilling with multiple booms, depending on the excavation geometry

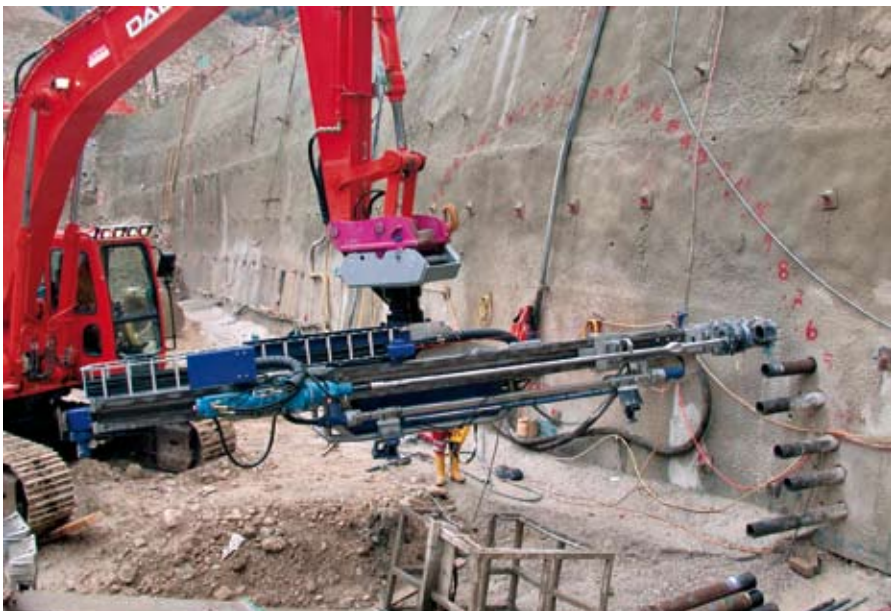
The AT - Casing System offers a variety of technical advantages

- Higher drilling progress by using hydraulic rotary-percussion rock drills
- Flushing with water – avoidance of dust formation
- Recirculation of the flushing water inside the casing tube – protection of the surrounding ground
- Accurate alignment of the casing tubes
- Reduction of displacements by immediate support of the drill hole
- Easy extension of the casing tubes even in case of little excavation geometries or starting shafts
- Flexibility regarding the drilling depth due to extendable casing tubes with a standard length of 3 m
- The structural properties of the AT - Casing System can be fitted to the project or customer requirements

The AT - Casing System is an efficient and technically mature product

- Time savings due to the minimization of non-productive times
- Cost reduction due to the faster creation of a complete pipe umbrella
- Practical experience over several years





Advantages AT - Automation Unit

- Automated installation and time-optimized pipe umbrella drilling
- Cost reduction due to lower installation times
- Remote-controlled manipulation
- Increased occupational safety
- Lower personnel requirements
- Reduction of non-productive times
- Lower head room for pipe umbrella drilling necessary
- Smaller saw tooth profile – less overexcavation and shotcrete consumption



AT - Mortar-Mixing Pumps

For injection and infilling works, DSI recommends mortar-mixing pumps of the type M400 NT and M400 EASY. Accessories and other types of mortar-mixing pumps are available on request.

Characteristics of AT - Mortar-Mixing Pumps

- Tough design and galvanized pump-casing
- Low empty weight
- Simple operation and maintenance due to modular design
- Low start-up and cleaning times
- Minor breakdown susceptibility
- Low filling and overall height
- High delivery rate at continuous pressure
- Variable discharge
- All-purpose equipment



M400 EASY



M400 NT

Specifications

Parameter	Unit	M400 NT	M400 EASY
Nominal power	[kW]	6,2	4,5
Power supply	[V / Hz]	400 / 50	400 / 50
Min. requirement power set	[kVA]	16	16
Electrical connection	[A]	3 x 12,1 (5-pole)	3 x 9,5 (5-pole)
Min. fuse protection	[A]	3 x 32	3 x 16
Flow rate ¹⁾	[l/h]	400-2000	400-2000
Max. delivery range	[m]	60	40
Max. operating pressure	[bar]	40	40
Length x width x height	[mm]	1730 x 570 x 960	1520 x 585 x 900
Total weight	[kg]	217	136

1) Depending on the W/C ratio, consistency, and grain size distribution of the material as well as the delivery range



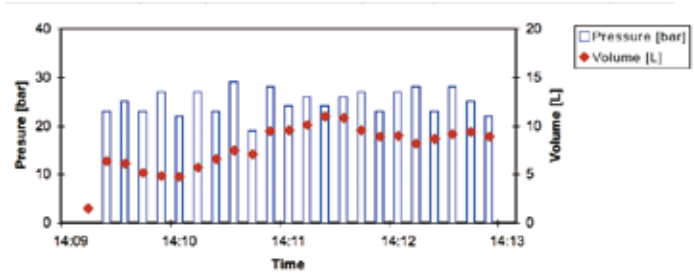
AT - Injection Flow-Pressure Meter

Controlled injection with the AT - Injection Flow-Pressure Meter

- Accurate and comprehensible documentation of the ground improvement
- Comprehensible control of given injection stop criteria
- Easy operation via a touch-screen
- Digital data recording of flow and pressure for every single injection hole
- Data readout over a serial interface
- Evaluation of the raw data on a PC

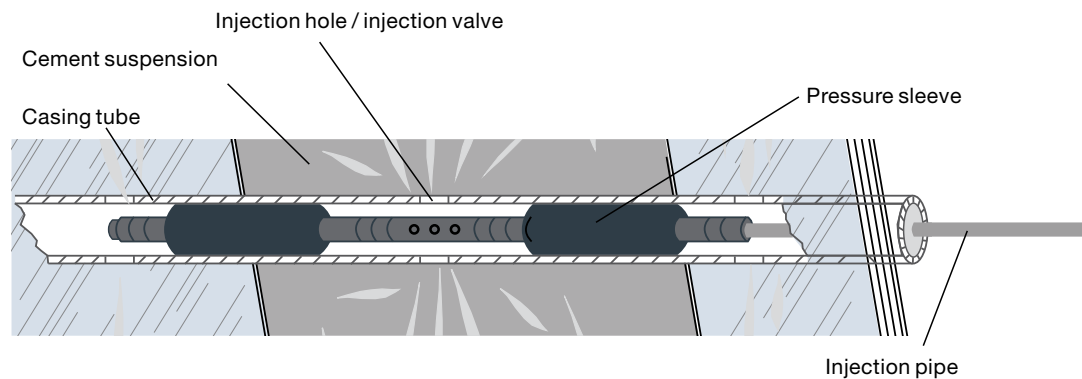
Example data recording

Company	DSI
Operator	Supervisor
Nominal pressure	12,0 bar
W/C ratio	1,0
Nominal volume	550 L
Total grouting volume	101 L
Total time	237 sec
Date	2002-09-01
Time	02:09 PM
Pipe Umbrella No.	6
Borehole No.	25
Borehole segment No.	10
Recording interval	10 sec



AT - Injection Packer

- Sectional pipe injection and ground improvement with the AT - Injection Packer
- Controlled injection in combination with the AT - Injection Flow-Pressure Meter



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