Ground anchors
and micropiles

MALININ GROUP

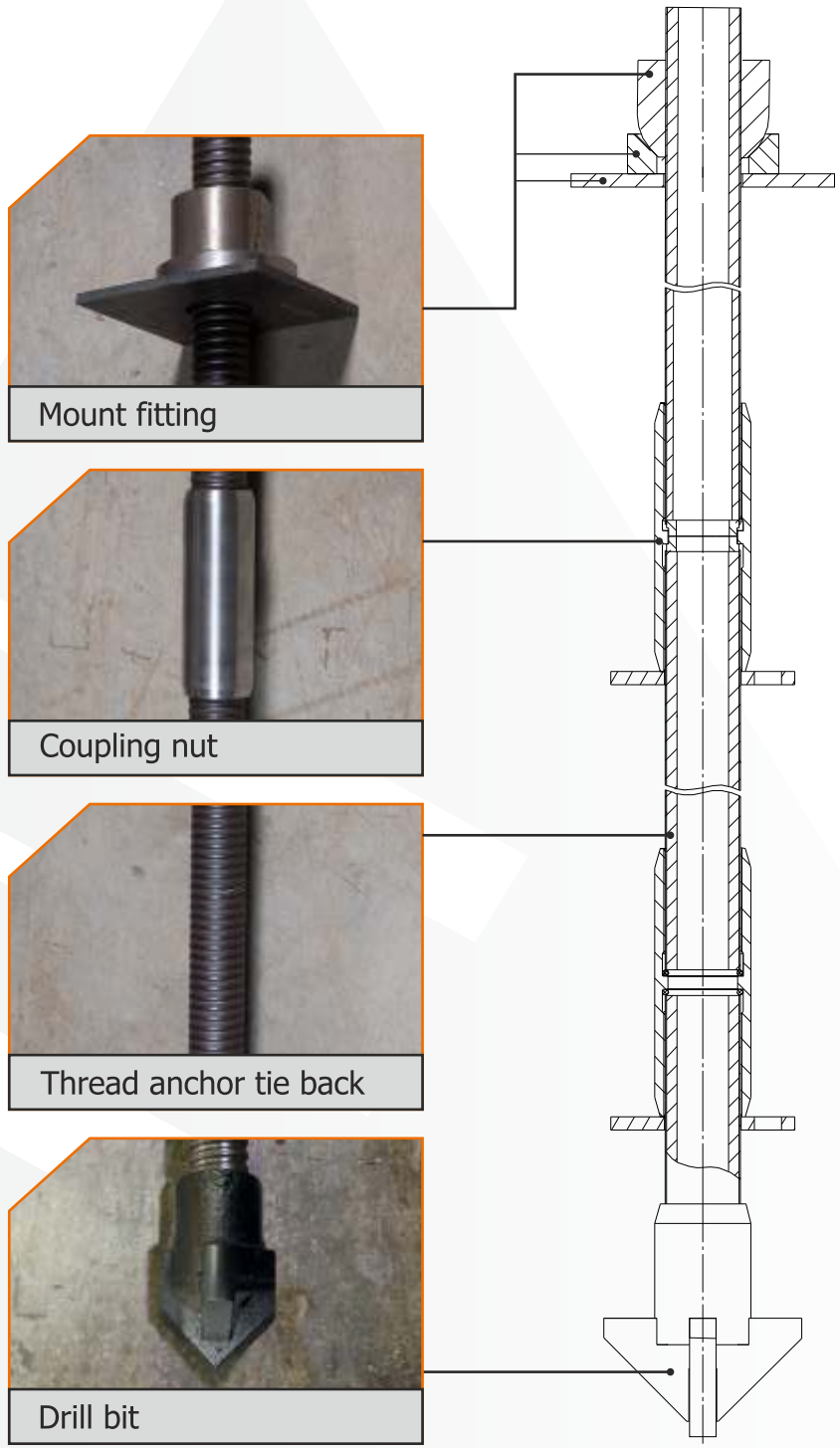
ANCHOR SYSTEMS

ATLANT anchor structure

ATLANT is the combination of well drilling and anchor installation.

Main ideas:

- Drill rod = anchor or pile reinforcing element
- Economically priced one-time use drill rod and drill bit
- Using of the anchor bar as grouting conduit
- High quality structural steel
- Continuous thread for cutting or coupling anywhere along rod length



Technical data

ATLANT rods technical data

Rod dia., mm	Wall thickness, mm	Yield point, MPa	Bearing capacity, kN	Ultimate load, kN
30	8	470	260	326
42	8	550	470	590
42	10	550	553	694
57	6	600	576	759
57	8	590	730	973
57	10	580	856	1166
73	9	580	1050	1430
73	11	600	1285	1692
73	13	600	1445	1800
103	13	565	1942	2270
103	26	470	2670	3660

We choose a high quality structural steel for Atlant anchors manufacturing. This steel is not affected by hydrogen embrittlement, wich provides a life span of 60 years and more for permanent anchors.

Atlant anchors and piles installation technology

The main feature of ATLANT technology is combination of drilling and injection.

Drill rod using as grouting conduit for filling the annulus from the bottom-up guarantees a positive complete filling of the annulus as well as all fissures and cracks.

Grout injection continually scours and flushes the sides of the well enhancing mechanical connection to the soil. Cement sheath provides corrosion protection of the drill rod.

ATLANT anchors or piles length is determined in accordance with project for providing required bearing capacity.

ATLANT cross-section

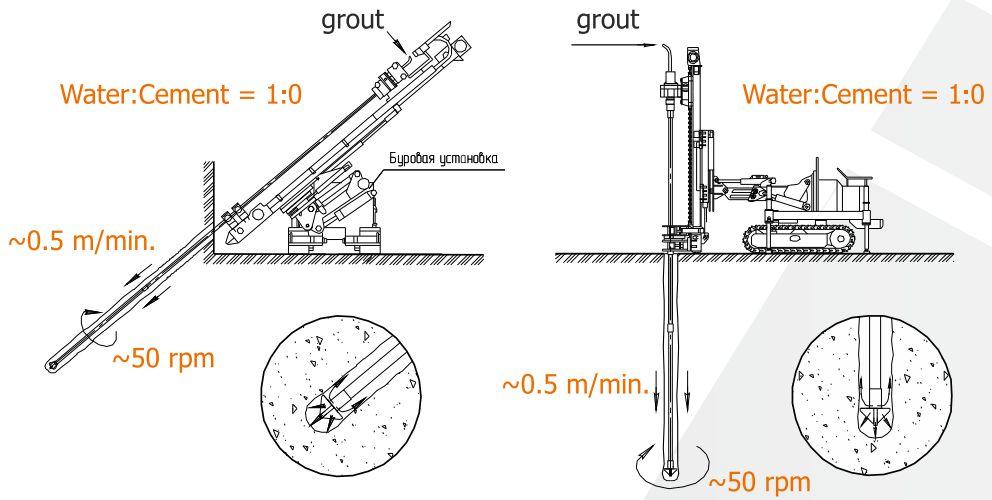
Step 1
Well drilling

ATLANT anchor piles installation is made by consequent rods drilling into the soil at the designed angle. Drill rods are use as anchor tie back or compression pile element. Continuous ATLANT thread guarantee the rod can be cut or coupled anywhere along its length.

1. Well drilling

1.1. Drill feeding speed into the soil - 0.5 m/min.;
Drill rod rotation speed - 50 rpm;
Flushing grout Water:Cement ratio - 1:0.

No temporary casing needs!



Well flushing

1.2. For grout preparation should be applied proper quality cement and water. Water should not contain impurities which may cause the metal corrosion and prevent the cement solidification.

1.3. Drilling should be performed only upon condition that grout returning and pulp lifting. If grout returninig stops it is necessary to reduce rod feeding speed or suspend feeding without rotation stopping. It is possible to continue drilling only after resumption of the grout returning.

1.4. Drilling and rod coupling is performed by drill rig.

1.5. It is required to leave out some part of the last rod for testing and construction fastening.

Step 2
Well pressure check

2.1. After reaching the design depth begins the dense grout injection.

Drill rod rotation speed - 20-30 rpm;
Flushing grout Water:Cement ratio - 0.4.

2.2. The interval between drilling and injection should not exceed one hour, otherwise there will be a solidification of drill cuttings. This will lead to in the cement sheath and anchor bearing capacity reduction.

2.3. ATLANT rod is used as conduit for injection. Grout output is provides by orifices in one-time-use drill bits.

2.4. Dynamic pressure check for filling the annulus from the bottom-up guarantees a positive complete filling of the annulus as well as all fissures and cracks.

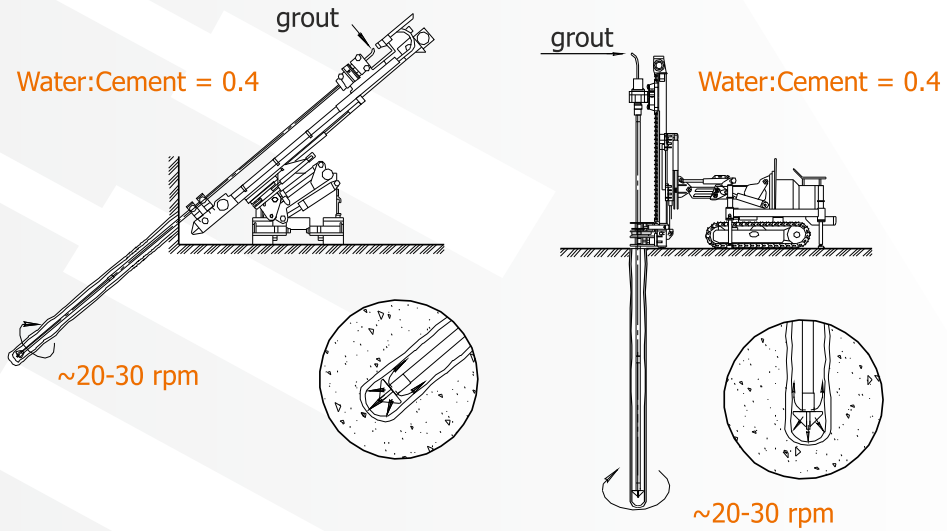
2.5. Pressure check is performed before injection grout returning.

2.6. In case there is no rinjection grout returning needs repeat pressure check in 15-30 min. Drill rod should be left in the well.

2.7. Flow rate at dynamic pressure check should account to 50-60 l per 1 r.m. anchor length (depending of drill bit diameter).

2.8. Drill rod should be used as anchor tie or compression pile member.

2.9 Atlant anchors fastening is allowed to start in 14 days after its installation.
No tension need!



Well pressure check

Atlant soil anchors and piles

www.anker-system.com

ATLANT technology is successfully applied in industrial, civil, transport and hydratechnical construction for installation of self-drilling anchors and piles. It provides a rapid, efficient method of installing tie back anchors in one step.

Application:

- pit walls;
- retained walls and underground constructions;
- landslides and slopes;
- installation, reinforcement and reconstruction of buildings foundations;
- mast reinforcement, supporting and other high-rise structures.

ATLANT anchors and piles can be installed in constrained and complicated geotechnical conditions without negative dynamic force.

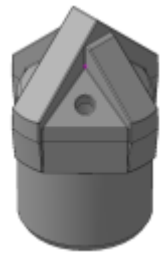
ATLANT anchor

ATLANT pile

Atlant drill bits

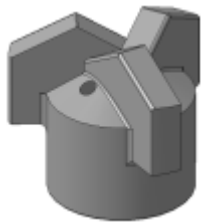
Lance-type bit

N	Purpose	Diameter, mm	Anchor type
1	clayey, powdery, sticky sand soils without solid inclusions	76	A30
		90	A42
		112	A57
		127	A73
		150	A103



3-blade casted bit

N	Purpose	Diameter, mm	Anchor type
2	clayey, powdery, sticky sand soils without solid inclusions	150/175/200	A57, A73

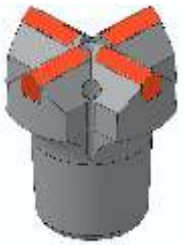


Cross bit

N	Purpose	Diameter, mm	Anchor type
3	hard sand, combined soils with solid inclusionsrein	90	A30
		90/112/127	A42
		127/150	A57, A73

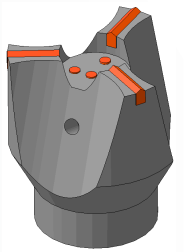
Cross bit with carbide inserts

N	Purpose	Diameter, mm	Anchor type
4	hard sand, combined soils with solid inclusionsrein	90	A30
		90/112/127	A42
		127	A57, A73



Studded drill bit

N	Purpose	Diameter, mm	Anchor type
5	forced concrete, rocks and gravel soil	90/112/127	A42
		112/127/150	A57, A73
		150/175	A103



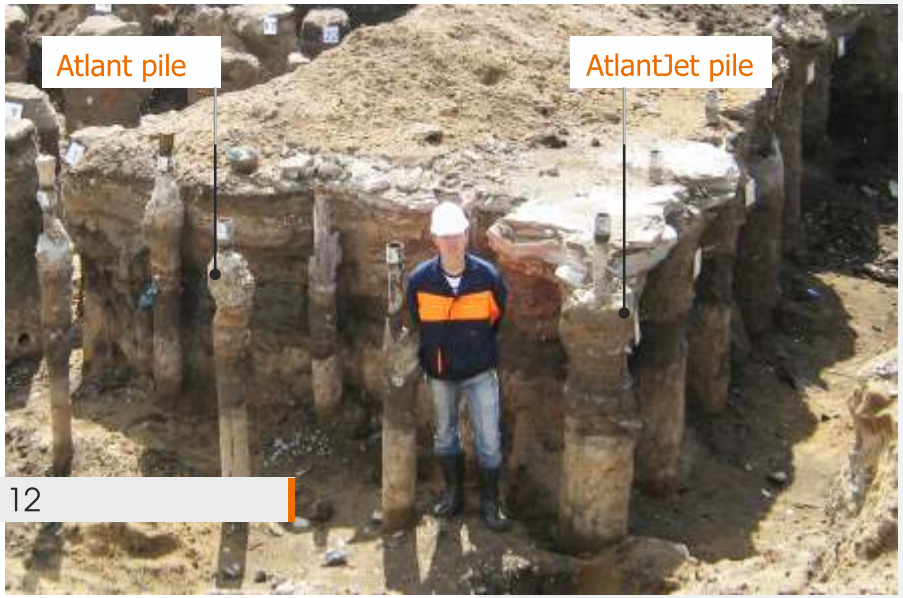
2-blade with carbide inserts

N	Purpose	Diameter, mm	Anchor type
6	mixed layered soils with coarse-grained inclusions	90/112/127	A42
		112/127/150	A57, A73
		150/175	A103

AtlantJet technology combined with jet-grouting

ATLANT techology modifigation is combination with jet-grouting at 20 MPa pressure. To execute jet-grouting drill bits are equipped with nozzles and couplings are require with aluminium seals.

The main advantage of AtlantJet technology is significant increase pile diameter in comparison with Atlant piles/anchors at low pressure.



Comparison of technologies shows that application of jet-grouting significantly increases pile diameter. Pile diameter of standard AtaInt is 150-200 mm and pile diameter at application of high pressure is about 400-700mm.

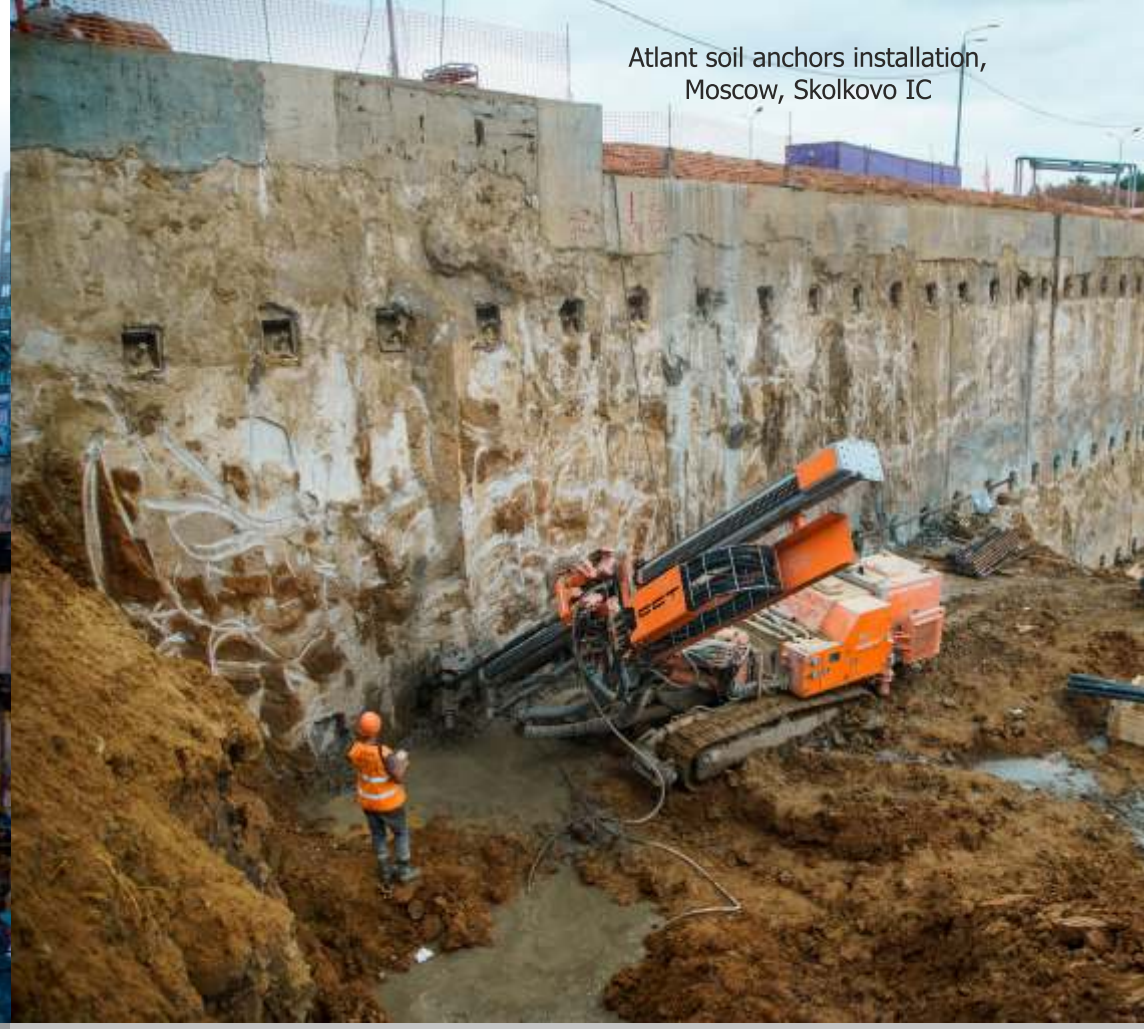
Application of jet-grouting in some cases is reasonable. These cases are pile installation in soft soil when you need to increase diameter to ensure bearing capacity. In other tasks increase of pile diameter is required for piles intercrossing, for example for installation of plugs between pits and close buildings etc.

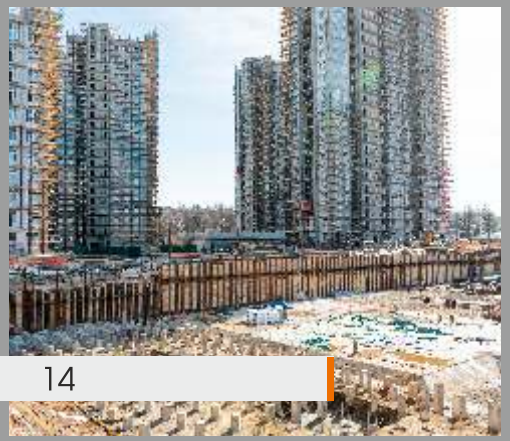
Application of AtlantJet technology in Moscow

Completed projects

Pit wall mounting
Moscow, ENITEO residential complex

Atlant soil anchors installation,
Moscow, Skolkovo IC





Moscow, Rasskazovka

Moscow, ZILArt residential complex

Reinforcement of pit wall
Moscow region, Pushkino, Chekhova St.

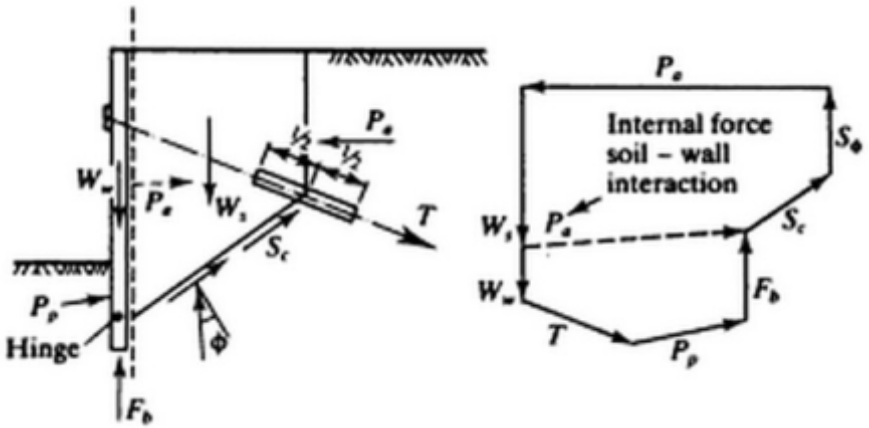
Construction of Olympic objects
in Sochi

Instalation of Atlant augercast piles.
Nakhodka, "Vostochniy" port.

Pit wall mounting,
resp. Crimea, MRIYA resort

Moscow, Bryanskiy Post st., vl.7,
Pit wall and retaining wall of piles and Atlant anchors

Generalized Kranz's force equilibrium method for stability analysis of an anchored wall



The polygon of forces acting on the soil wedge at limit equilibrium involves the active earth pressure of the retained soil P_a, the shearing resistance of the soil (i.e., S_c and S_ϕ), and the wall reaction P_A. The polygon of forces acting on the structural wall element involves the soil pressure P_A, the resisting prestress anchor load required to maintain equilibrium, the passive resistance of the foundation soil P_p, and the basal soil reaction F_b. The decision power of the polygon allows you to define the horizontal projection P_a bearing capacity of the anchor, which leads hatched the prism in a state of marginal stability.

Kranz equation is used to define the factor of safety

$$FS = R_L / R_m$$

with $R_L = F_w$ and $R_m = T$.

Bearing capacity calculation

Anchors and piles bearing capacity according EN 14199:

$$F_d = \pi \cdot D \cdot l_r \cdot q_{sk}$$
$$D = d_w \cdot k_d$$

d_w - well diameter
k_d - anchor diameter enhancement factor
l_r - anchor root length
q_{sk} - anchor skin friction

Recommended values of anchor diameter enhancement factor shown in Table 1:

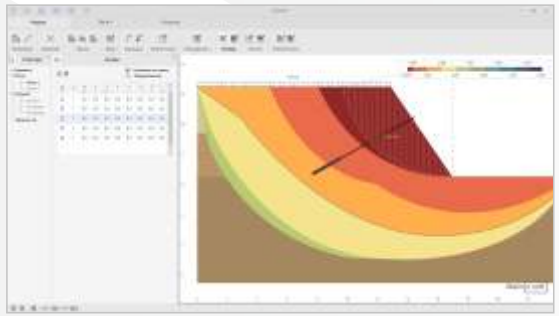
Table 1

Soil type	Enhancement factor k_d
Gravel	2,0
Sand	1,5
Sandy clay, clay loam	1,4
Clay	1,3
Rock	1,0

In the Table 2 below you can see calculated skin friction values.

Table 2

Soil type	Skin friction q_{sk}, kPa
Medium and coarse gravel	200
Sand, semigravel	150
Sandy clay, clay loam, clay	100



For anchors/piles calculation is recommended new geotechnical programs.

www.malininsoft.ru

Atlant soil anchors and piles tests

www.anker-system.com

The tests popouse:

- tension bearing capacity determination;
- compression bearing capacity determination;
- dependence between load and anchor displacement.

There are 3 types of anchor piles tests: trial, control and approval tests.

For anchor testing is need a jack with hydraulic station, deflectometers.

Anchor test types		
Trial	Control	Approval
Quantity of anchors/piles tested		
2% at least 3pcs.	10%	90%
Load on anchor/pile		
$1,75\ P_{culculate} \le P_{test} \le 0,95\ P_A$	$P_{test} = 1,5\ P_0$	$P_{test} = 1,25\ P_0$
Quantity of load steps		
6 steps with unload on each step	5 steps with unload on each step	4 steps with unload on the last step
Load holding time		
1-5: 10-60 min. 6: 30-120* min.	1-4: 5-20 min. 5: 30-60* min.	1-3: 1 min. 4: 2-40* min.

Required stabilization of anchor displacement is less than 0.05 mm last time interval.

P_{test} = test load
P_0 = initial load
$P_{calculate}$ = calculate load
P_A = load on anchor tube yield point

Testing and monitoring

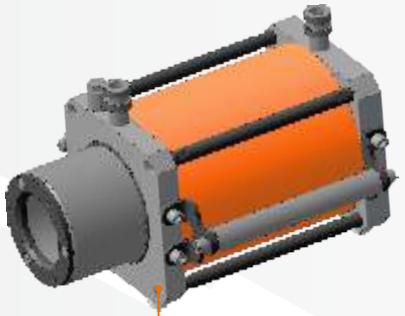
Ground anchors Atlant tension and testing are carried out by hollow hydraulic Jacks. Different types of Jacks are develop max load up to 2765 kN .

Jacks are made with space technologies using. Fiberglass body and aluminum structural elements significantly reduce Jack weight.

Jacks operation provides by hydraulic unit Jack 2E, max pressure is 60 MPa.

Anchor load monitoring in retaining constructions are provided by hydraulic load cells Atlant. They are consist of two ring-shaped stainless steel plates welded together. The anular space between the plates is filled under vacuum by deaired oil. The load is directly measured by manometer connected to the cell body.

Hydraulic load cell
Atlant



Jack

Hydraulic station
Jack 2E

Equipment for anchor piles installation

Equipment, required for installation of Atlant anchor piles include a drill rig, grout pump and mixing plant.

Figaro PAUK

The 3-wheeled drill rig Figaro Pauk was designed for use on steep slopes and embankments. This allows drilling to be carried out with low machine weights and in difficult and dangerous on-site conditions.

Two hudraulic winches make it possible to quickly and safely move and position Figaro Pauk rig on any terrain.

Thanks to the specially design features and the low weight, drilling efficiency and daily work performance are increase, but setup work and setup time are reduced.

The energy required for Figaro Pauk rig is generated by separate hydraulic power unit.

Figaro PAUK Technical data

Hammer CCT		
Max. torque, N·m	3000	1500
Max. rotation speed, rpm	70	140
Single blow energy, J	200	
No. of blows	1800 (2400)	
Mast		
Height, mm	2465	
Max rod length, mm	1500	
Extraction/feed force, kN	28/19	
Clamps		
Drill diameter, mm	20-100	
Weight		
Weight, kg	1300	
Power unit		
Drive (at option)	electric, diesel	
Hydraulic pressure, MPa	18	
Flow rate, l/min.	130	

Figaro Lafette

Drill Lafette is used for underground construction works:

- Installation of augercast piles;
- Reinforcement of buildings foundations;
- Jet-grouting;
- Installation of anchors.

Figaro Lafette is equipped with Morath or Figaro hummer.

Figaro Lafette is intended to work with hydraulic excavator of over 18-t weight.

Figaro Lafette Technical data

Hammer CCT		
Max. torque, daN·m	3000	1500
Rotation speed, rpm	70	140
Single blow force, J	200	
Frequency, blow/min.	2400	
Mast		
Mast length, mm	3300	
Max. length of rod, mm	3000	
Extraction/feed force, kN	40/40	
Chuck		
Drilling diameter, mm	60-150	
Requirements to hydraulic system		
Pressure, MPa	18	
Flow rate, l/min.	150	

MINI mixing/injection unit

MINI unit is designed for cement grout preparation and injection.

MINI unit consists of MINI Mixing plant and grout pump GP.

Pumps hydraulic scheme allows to control grout flow rate and grout pressure.

MINI 8 unit can be equipped with weighting terminal which allows automatic load of components according to set weight ratio.

MINI Technical data

Power, kW	14,3	
Dimensions LxWxH, mm	2500x1800x1720	
Weight, kg	1260	
MINI Mixing plant	MINI 5	MINI 8
Capacity, m^3/h	5	8
Tank capacity, l	200	200
Agitator tank capacity, l	500	500
Weighting terminal	-	+
Grout pump	GP-40	GP-60
Max. pressure, MPa	10	6
Adjustable pressure, MPa	0,2-4,0	0,2-4,0
Max. flow rate, l/min.	40	60
Adjustable flow rate, l/min.	5-40	5-60

Equipment for AtlantJET technology

www.anker-system.com

Jet-grouting compact unit AtlantJET 20/300

AtlantJET includes mixing plant and high pressure pump are integrated in the standard container.

On the top of the container are located fasteners for horizontal cement silo.

Technical data

Power consumption, kW	30
Dimensions, mm	6058x2438x2591
Weight,kg	13000
Mixing plant	
Capacity, m^3/h	20
High pressure pump	
Max.pressure, MPa	32
Max. flow rate, l/min	550
Engine power, kW	220

Figaro 1000 drill rig

The rig provides high productivity and reliability.
Portable electric remote-control desk guarantees safety and comfort to the operator.

Technical data

Transport dimensions, mm	6042x2234x2810
Weight, kg	9800
Diesel engine	
Power, kW	119
Rotary head F1000	
Max. torque, N·m	9400
Gears	2
Max. rotation speed, rpm	120
Mast	
Extraction/feed force, kN	67/90
Stroke, mm	3600
Clamps	
Clamping force, kN	200
Operation range, mm	40-320
Hydraulic system	
Hydraulic fluid pressure, MPa	25
Flow rate, l/min	189

Contacts

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