

**Tunnel  
Consolidation  
Rigs**

ST-15  
ST-20  
ST-60  
ST-120



# Tunnel Consolidation Rigs

**soilmec**®  
Drilling and Foundation Equipment



Nowadays, the increasing need and demand of transferring a series of infrastructures to the underground has brought about an impressive rise in the numbers of tunnels to be constructed, regardless of the nature of the soil to be penetrated.

The excavation of tunnels in loose soils, in presence of unstable formations or in presence of soils prone to landslide, requires the use of preventive consolidation of the arch and, if needed, of the walls and invert before the final lining is completed.

This has created a scenario of constant developing of technologies and machinery able to tackle any kind of situations.

The final aim is to reach the tunnel stability before the excavation through soil consolidation, avoiding expensive temporary supporting devices.

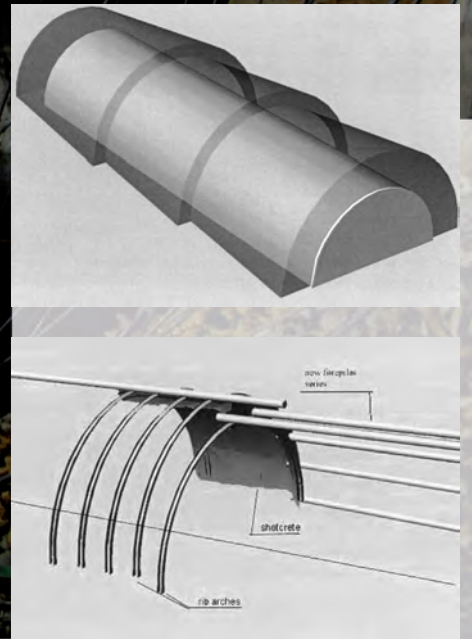
The Trevi Group has designed and successfully applied a tunnel consolidation technology known as RPUM (Reinforced Protective Umbrella System). The method finds its way in those tunnels with an unstable or short term stable core face condition. The technology envisages in the installation of a series of sub-horizontal elements aiming at consolidating the soil beyond the face of the tunnel before carrying out safely and speedily the excavation under the protection of the arch - like a shell - by

using specially designed forepoling machine. Once such an operation is completed, a quite popular one especially in Europe, the tunnel is excavated usually in two stages (top heading and bench) or full face opening, under the protection provided by the consolidation and by installing a temporary lining consisting of steel ribs and shotcrete. The length of each excavation step will be few meters shorter than the length of the protective umbrella forepoling, so as to allow an overlapping with the following series of forepoling. As might be understood, the above mentioned operations require pretty long execution times.

In order to avoid interruptions and delays in the working cycle, the operations must be performed to an extremely exact time schedule. That means the consolidation tasks must be completed in the shortest possible time and at a constant rate.

The technological development has therefore pursued two major ways:

- The study and design of the right equipment able to efficiently operate in confined spaces, to be quickly set up in the required drilling position and finally able to execute longer and longer sub-horizontal consolidation in one single stage,



RPUM method

thus dramatically reducing the cycle time.  
 - Design of the most suitable consolidation grout treatment for stabilizing the excavation and featured by mechanical strength to allow for the excavation and

to reduce the number of supporting ribs to be installed.

Model	ST-15		ST-20		ST-60		ST-120	
Power installed	90 kW	121 HP	124 kW	166 HP	135 kW	181 HP	176 +(2x90)*kW	236+(2x121)* HP
Max torque	1122 daNm	8275 lb <sub>f</sub> *ft	1350 daNm	9957 lb <sub>f</sub> *ft	1560 daNm	11506 lb <sub>f</sub> *ft	1550 daNm	11432 lb <sub>f</sub> *ft
Working radius (0°)	1880÷2550 mm	74÷100 in	1700÷4960 mm	67÷195 in	3700÷6500 mm	146÷256 in	3600÷6600 mm	142÷260 in
Weight	12500 kg	27558 lb	21000 kg	46297 lb	60000 kg	132276 lb	119000 kg	262347 lb

\* Electric motor for boom

# CONSOLIDATION RIGS

## R.P.U.M. method

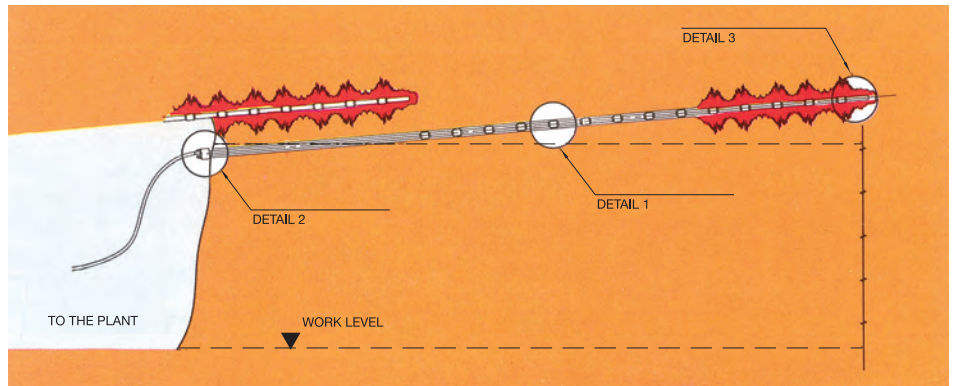
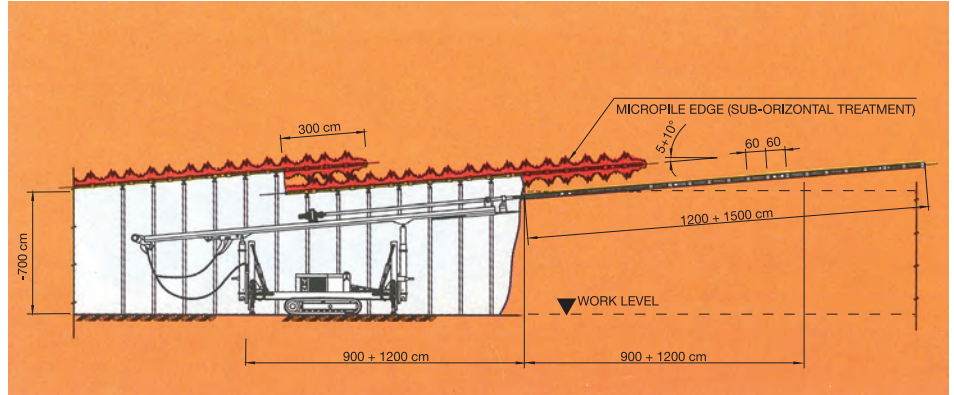
The **RPUM method** includes execution phases involving the installation of, either suitable reinforcing steel pipes, or of consolidated columns using the JET GROUTING system, reinforced by a steel pipe.

Using reinforcing pipes, the method consists in the installation of manchette-type steel pipes acting as reinforcement support for the next installation of the steel ribs. At the same time, they are also used as grouting pipes thus forming a continuous canopy of consolidated soil.

**1. DRILLING PHASE:** The drilling can be performed either by rotation or rotopercussion (*TUBEX-ODEX-like*). In the first case, the drilling string itself, fitted with a drag bit at its end, is left in place; while using the roto-percussion, is the casing that has to be left in place. In both cases, the drilling string or the casing, acting as reinforcing steel of the consolidation treatment, are fitted with special non-return valves, which are built within the wall thickness of the steel pipes and are such as not to suffer damages during the penetration of the soil.

**2. GROUTING PHASE:** basically there are two possible grouting techniques:

- a. The single valve injection technique, using a double packer placed across to each valve securing each individual valve is pressurization.
- b. The one shot technique for each individual fore pile by using a packer placed at the top of the pipe.



Grouted reinforcement steel pipe

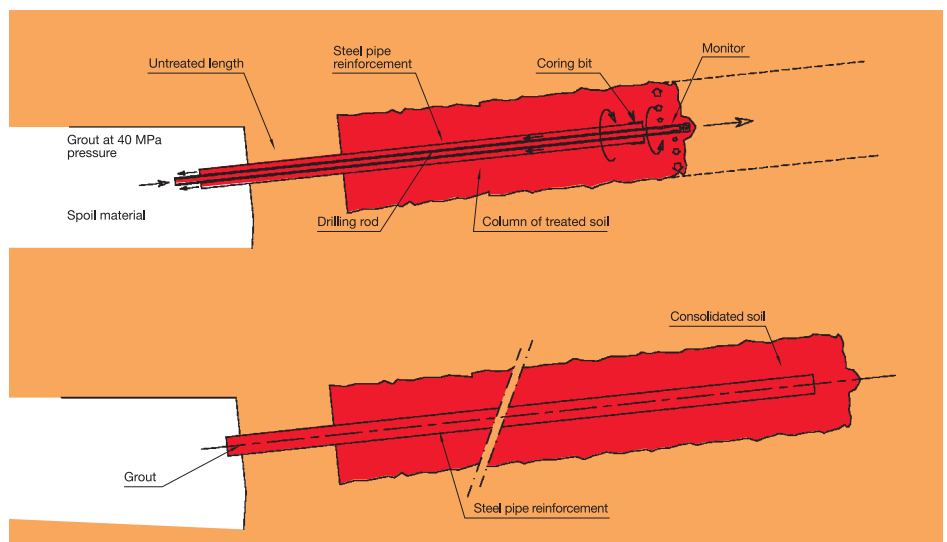


The use of **JET GROUTING reinforced columns** is also widely employed today thanks to its suitability in a variety of soils ranging from gravel to clay, but especially in very difficult conditions, where both weak soils and thin overburden are found. In fine soils, the column has a static function, while where there is water inflow it works as a barrier against the water.

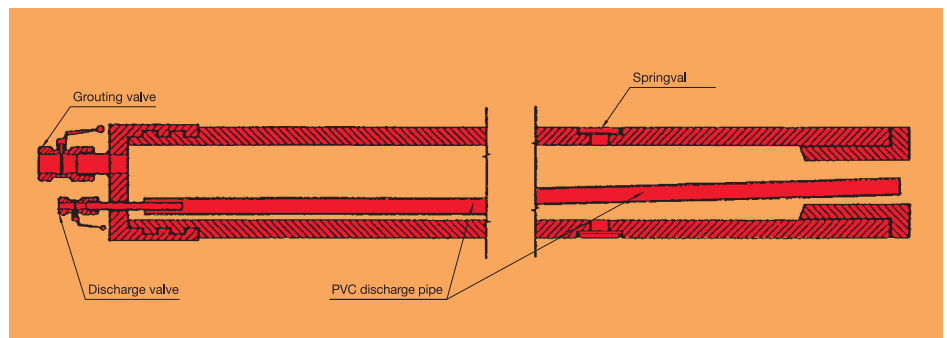
The execution phases of the so called Trevi Reinforced Jet Grouting in Progress (*normally T1 single fluid is suggested*) can be described as follows.

- The treatment is performed by driving both the rod and the casing simultaneously and performing the jetting during the penetration phase. The space between the rods and the pipe allows the jetting spoil to escape. On completion of the drilling/treatment, the jetting string is extracted from the casing which remains in place, acting as reinforcement.
- This type of consolidation obviously requires a rig fitted with double head.
- Drilling is carried out by using a rod string fitted with a monitor and a drilling tool, either by rotation or roto-percussion.
- During the drilling phase, the inside fluid escapes from the tool tip, easing therefore the soil penetration and keeping the drilling tool blades clean.
- When the drilling is over, the jet is diverted by closing the bottom valve and the grout escapes at high speed through the side nozzles, disaggregating and mixing the soil with the grout and thus creating the consolidated column. During this phase the drilling string is rotated and withdrawn at a pre-set rate.
- The peculiarity of this system is that the reinforcing steel pipe is installed during the jet grouting column execution. The jetting string and the casing rotate in opposite senses.
- The jetting rod itself, fitted with the monitor, is located inside the string with the jet grouting monitor over-passing the reinforcement pipe mouth of 20 cm approximately.
- The grouts used are generally binary. Cement/Water following a ratio of 0.8 to 1 and 1.3 with, in case, of use of admixtures.
- The High Pressure Jetting is carried out by suitable High Pressure Pumps.

of work in the most efficient and effective way, where speed and precision are demanded. In addition, such a process allows easier and more cost effective treatment of either soft soil or fractured and soft rock. Today, Soilmec can offer a wide range of equipment capable of covering radius of consolidations from 1880 mm to 6600 mm at 0°, thus applicable both in large tunneling sections for High Speed Railways and highways projects and in those tunnels thought for the city underground system, which consists normally of small sections.



**Grout reinforcement columns**



**Grouted steel pipe**



Soilmec tunneling rigs have been specially designed and adapted to complete this type

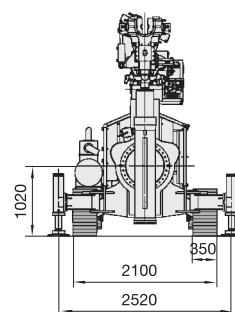
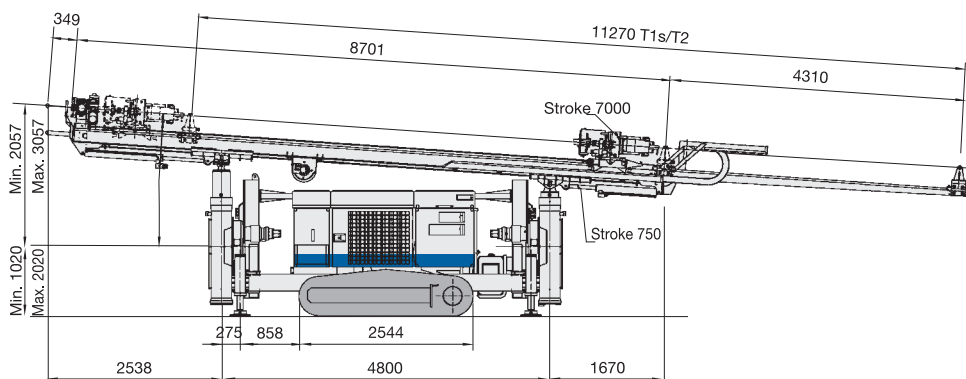
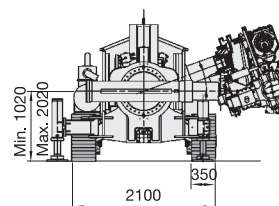
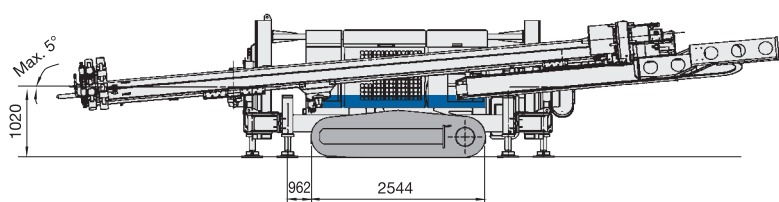
### Main features:

- Overall width: 2100 mm
- Overall length: 2780 mm
- Front and rear fixed telescopic rams
- Front and rear hydraulic slewing rings
- Diesel engine and electric motor interchangeable
- Rotary head achieving a max. torque of 1207 daNm
- Jet grouting optional by mast extension
- Class of the machine: 12 ton

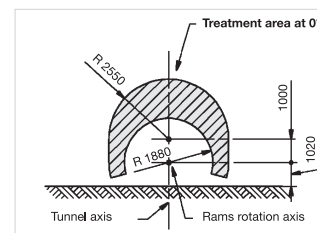
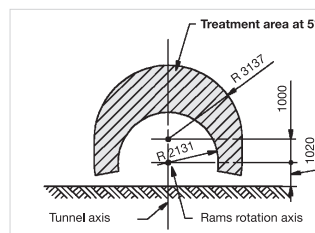
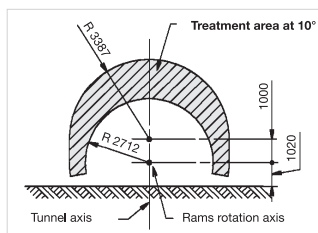
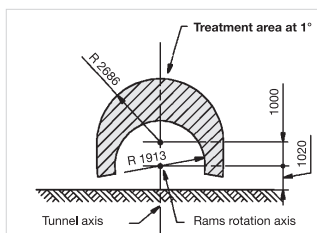
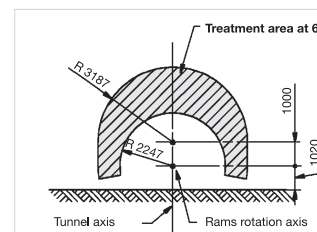
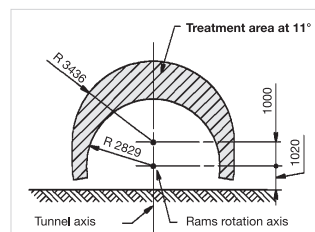
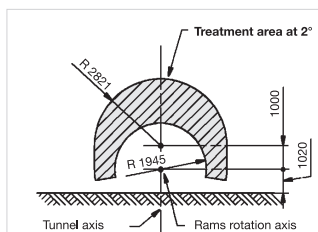
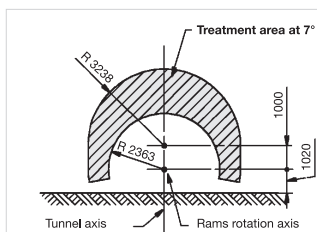
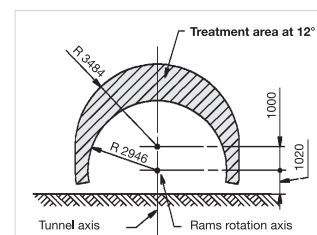
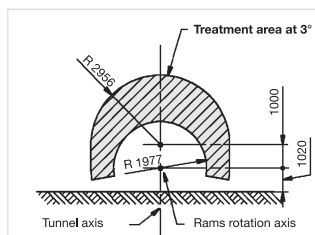
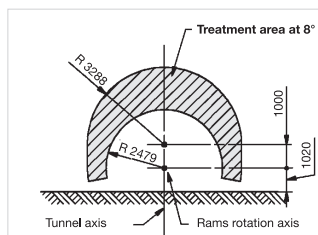
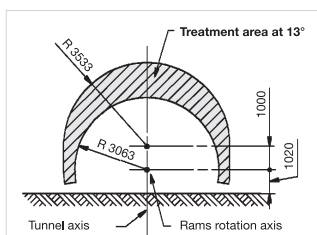
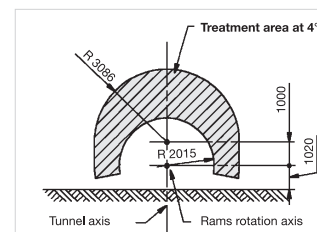
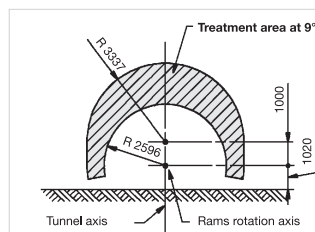
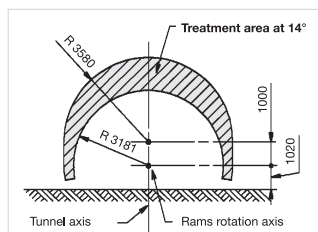
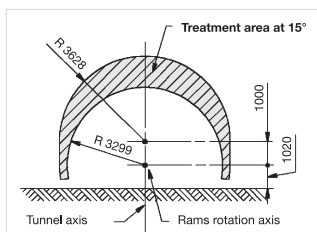


	<b>Performances</b>		
	- Max height of consolidation treatment a 0°	4570 mm	180 in
	- Max height of consolidation treatment a 5°	5157 mm	203 in
	- Radius of consolidation treatment a 0° (min/max)	1880 / 2550 mm	74 - 100 in
	- Radius of consolidation treatment a 5° (min/max)	2131 / 3137 mm	84 / 124 in
	- Height from working level of slew ring rotation axis	1020 / 2020 mm	40 / 80 in
	<b>Hoist and feed system</b>		
	- Feed stroke	7000/ 11250 mm	276 / 443 in
	- Max hoist force	52 kN	11690 lbf
	- Max feed force	52 kN	11690 lbf
	- Max speed (feed/hoist)	25 / 7 rpm	25 / 7 rpm
	- Rod diameter		
	<b>Diesel engine</b>	DEUTZ TCD 2012 L04	DEUTZ TCD 2012 L04
	- Max power	92 kW	123 HP
	- Rated power	85 kW	114 HP
	<b>Electric motor</b>	SIEMENS 4 POLS 50 Hz 380/660 V	SIEMENS 4 POLS 50 Hz 380/660 V
	- Power	90 kW	121 HP
	<b>Hydraulic system</b>		
	- Main pump (variable displacement axial pumps)	230 l/min	61 US gal/min
	- Auxiliary pump (gear pumps)	4 single gear pumps	4 single gear pumps
	<b>Rotary</b>		
	- Max torque	1207 daNm	8902 lbf*ft
	- Drilling speed	459 rpm	459 rpm
	<b>Clamp and hydraulic joint breaker</b>		
	- Size	60 - 225 mm	2 - 9 in
	- Max clamping force	159 kN	35744 lbf
	- Max breaking torque	3830 daNm	28248 lbf*ft
	<b>Undercarriage</b>		
	- Track shoe width	350 mm	14 in
	- Overall length	2544 mm	100 in
	- Overall width	2100 mm	83 in
	- Travelling speed	2,4 Km/h	1.5 mph
	<b>Weight</b>		
	- Total weight	12250 kg	27006 lb
	- Average pressure on ground	0,09 MPa	13 psi

Soilmec integrates high quality level components: Gearmatic, Hydromatic, Lohmann, Rothe erde, Trasmital, Zollern.



Working radius



**Main features:**

The following drilling techniques can be applied using the ST-20:

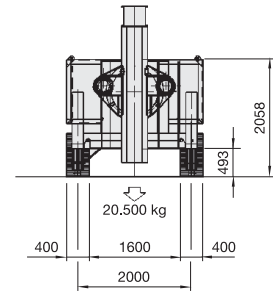
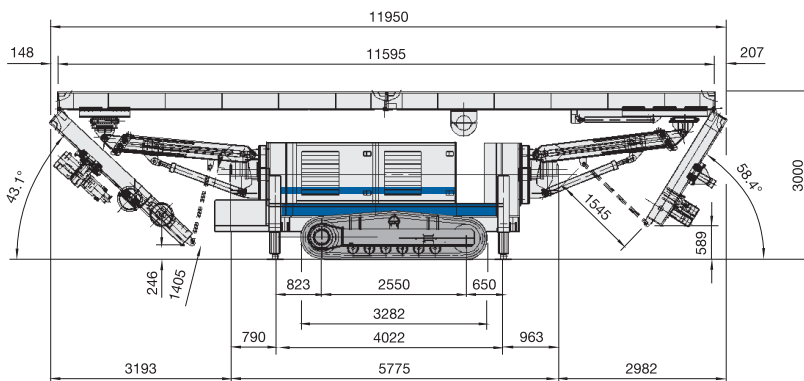
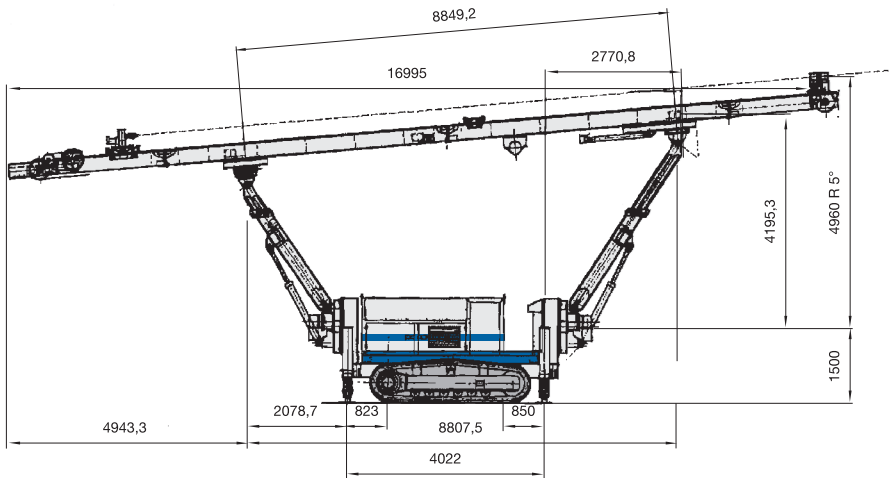
- Rotation (with or without casing)
- Rotopercussion by means of Top Hammer (with or without casing)
- Rotopercussion by means of Down the Hole Hammer (with Tubex, Odex or Simmetrix superjews system)



	<b>Performances</b>		
	- Max height of consolidation treatment a 0°	6200 mm	244 in
	- Max height of consolidation treatment a 5°	6470 mm	255 in
	- Radius of consolidation treatment a 0° (min/max)	1700 / 4696 mm	67 / 185 in
	- Radius of consolidation treatment a 5° (min/max)	2100 / 4960 mm	83 / 195 in
	- Height from working level of slew ring rotation axis	1500 mm	59 in
	<b>Hoist and feed system</b>		
	- Feed stroke	14200 / 16000 mm	559 / 630 in
	- Max hoist force	67 kN	15062 lbf
	- Max feed force	67 kN	15062 lbf
	- Max speed (feed/hoist)	32 - 9 rpm	32 / 9 rpm
	- Rod diameter		
	<b>Diesel engine</b>	DEUTZ 2013 L04 2V	DEUTZ TCD 2012 L04
	- Max power	129 kW	173 HP
	- Rated power	116 kW	155 HP
	<b>Electric motor</b>		
	- Power	90 kW	121 HP
	<b>Hydraulic system</b>		
	- Main pump (variable displacement axial pumps)	150 l/min	40 US gal/min
	- Auxiliary pump (gear pumps)	3 single and 1 triple gear pumps	3 single and 1 triple gear pumps
	<b>Rotary</b>		
	- Max torque	1350 daNm	9957 lb <sub>f</sub> ft
	- Drilling speed	460 rpm	460 rpm
	<b>Clamp and hydraulic joint breaker</b>		
	- Size	60 - 260 mm	2 - 10in
	- Max clamping force	159 kN	35744 lbf
	- Max breaking torque	3830 daNm	28248 lb <sub>f</sub> ft
	<b>Undercarriage</b>		
	- Track shoe width	350 mm	14 in
	- Overall length	2544 mm	100 in
	- Overall width	2100 mm	83 in
	- Travelling speed	2,4 Km/h	1.5 mph
	<b>Weight</b>		
	- Total weight	21000 kg	46297 lb
	- Average pressure on ground	0,09 MPa	13 psi

Soilmec integrates high quality level components: Gearmatic, Hydromatic, Lohmann, Rothe erde, Trasmital, Zollern.





**Main features:**

The following drilling techniques can be applied using the ST-60:

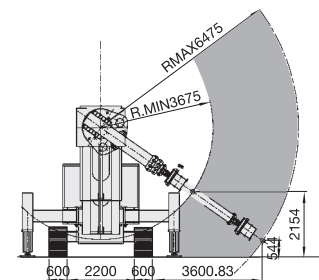
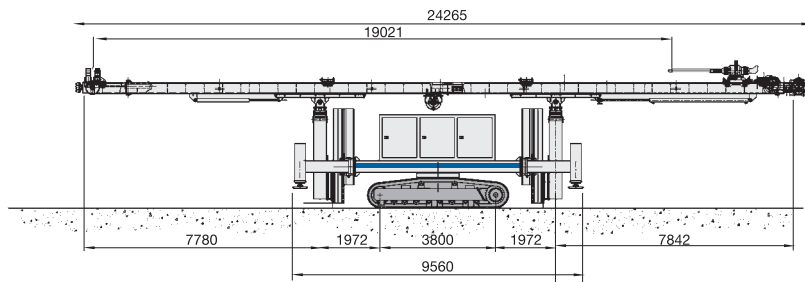
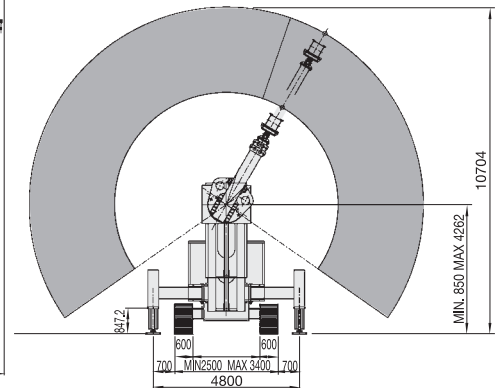
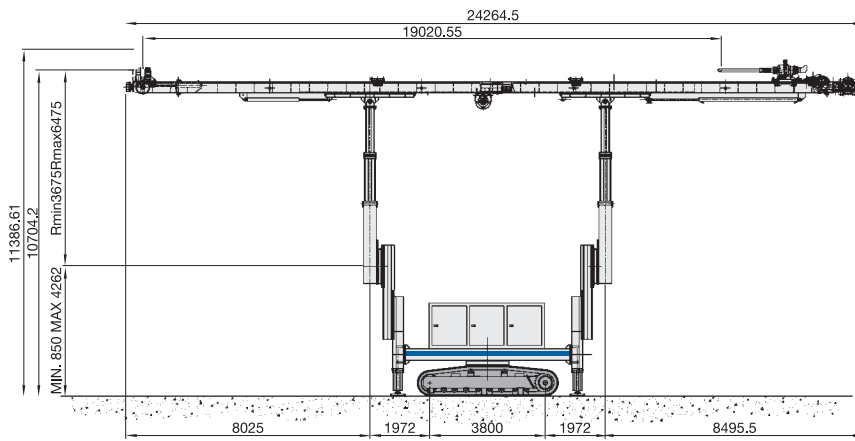
- Rotation (with or without casing)
- Rotopercussion by means of Top Hammer (with or without casing)
- Rotopercussion by means of Down the Hole Hammer (with Tubex, Odex or Simmetrix superjews system)



	<b>Performances</b>		
	- Max height of consolidation treatment a 0°	10700 mm	421 in
	- Max height of consolidation treatment a 5°	10700 mm	421 in
	- Radius of consolidation treatment a 0° (min/max)	3675 / 6475 mm	145 / 255 in
	- Radius of consolidation treatment a 5° (min/max)	3675 / 7147 mm	145 / 281 in
	- Height from working level of slew ring rotation axis	850 / 4262 mm	33 / 168 in
	<b>Hoist and feed system</b>		
	- Feed stroke*	19000 mm	748 in
	- Max hoist force	70 kN	15736 lbf
	- Max feed force	70 kN	15736 lbf
	- Max speed (feed/hoist)	26 rpm	26 rpm
	- Rod diameter		
	<b>Diesel engine</b>	DEUTZ TCD 2012 L06	DEUTZ TCD 2012 L06
	- Max power	155 kW	208 HP
	- Rated power	135 kW	181 HP
	<b>Electric motor</b>	SIEMENS 4 POLS 50 Hz 380V	SIEMENS 4 POLS 50 Hz 380
	- Power	110 kW	147 HP
	<b>Hydraulic system</b>		
	- Main pump (variable displacement axial pumps)	250 l/min	66 US gal/min
	- Auxiliary pump (gear pumps)	2 single and 1 double gear pumps	2 single and 1 double gear pumps
	<b>Rotary</b>		
	- Max torque	1747 daNm	12885 lbf <sup>2</sup> ft
	- Drilling speed	295 rpm	295 rpm
	<b>Clamp and hydraulic joint breaker</b>		
	- Size	60-250 mm	2 - 10in
	- Max clamping force	159 kN	35744 lbf
	- Max breaking torque	3830 daNm	28248 lbf <sup>2</sup> ft
	<b>Undercarriage</b>		
	- Track shoe width	600 mm	24 in
	- Overall length	4510 mm	178 in
	- Overall width	3500 mm	138 in
	- Travelling speed	1,5 Km/h	0.9 mph
	<b>Weight</b>		
	- Total weight	62000 kg	136685 lb
	- Average pressure on ground	0,12 MPa	17 psi

\* optional kit 2400 mm / 945 in

Soilmec integrates high quality level components: Gearmatic, Hydromatic, Lohmann, Rothe erde, Trasmital, Zollern.



# ST-120

## Tunnelling Rig

### Main features:

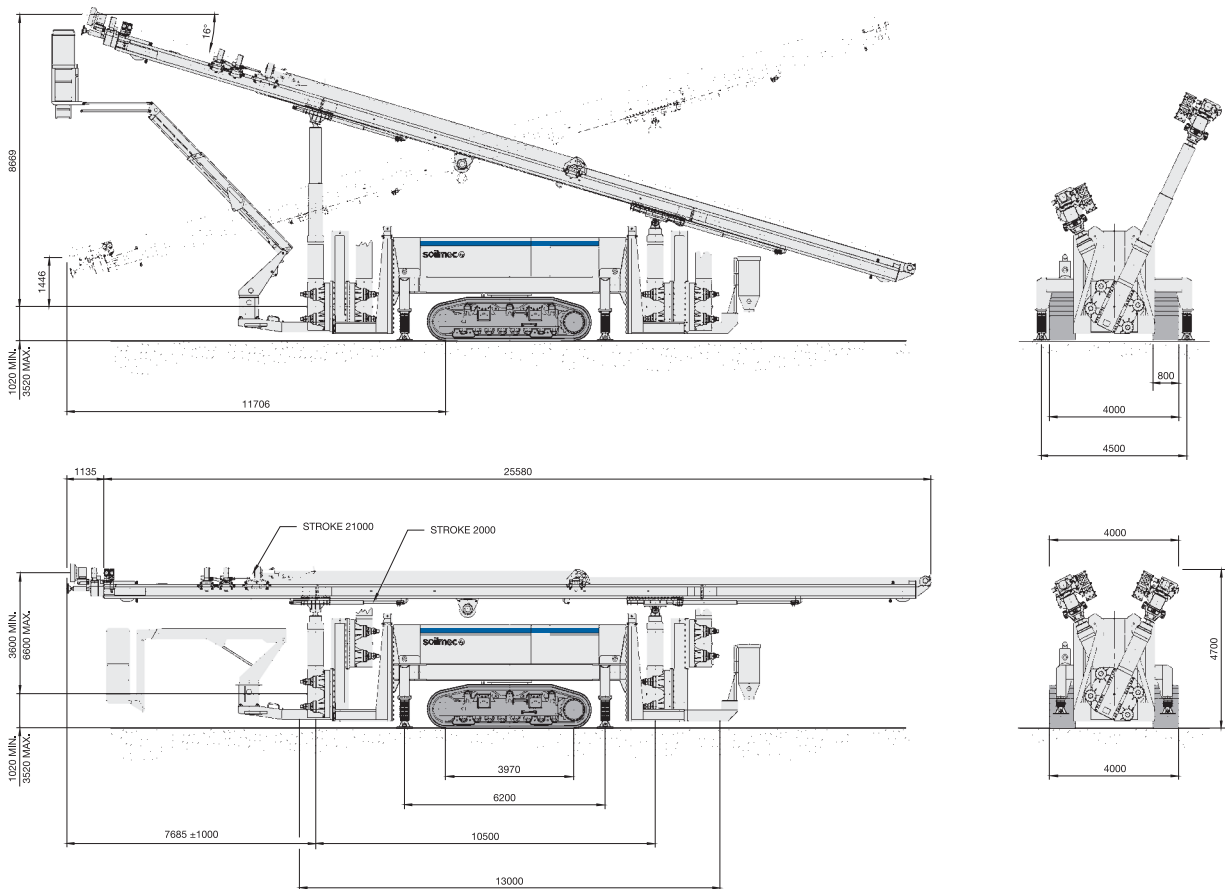
The following drilling techniques can be applied using the ST-120:

- Rotation (with or without casing)
- Rotopercussion by means of Top Hammer (with or without casing)
- Rotopercussion by means of Down the Hole Hammer (with Tubex system or without casing)



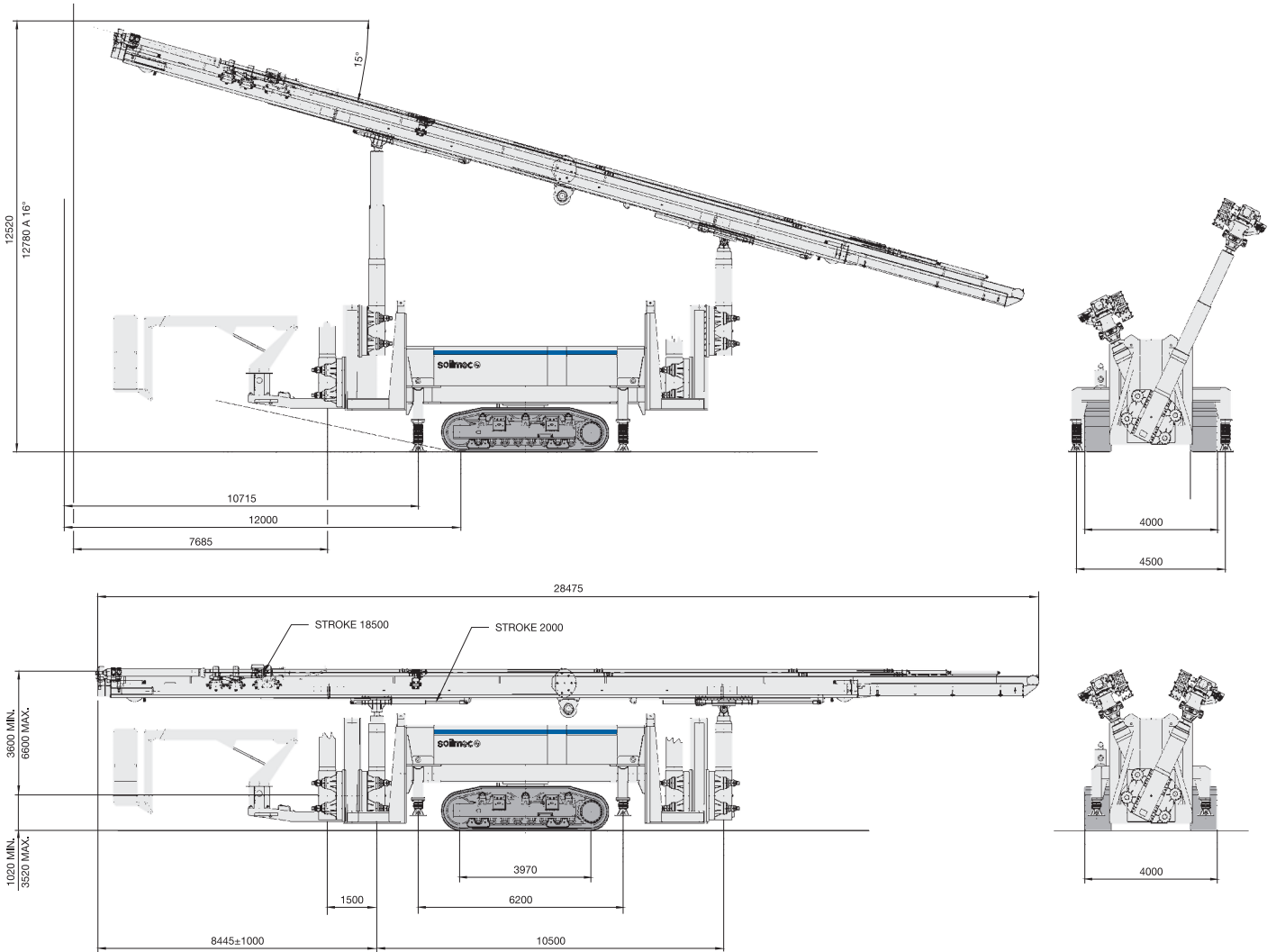
	<b>Performances</b>		
	- Max height of consolidation treatment a 0°	10120 mm	398 in
	- Max height of consolidation treatment a 5°	10736 mm	423 in
	- Radius of consolidation treatment a 0° (min/max)	3600 / 6600 mm	142 / 260 in
	- Radius of consolidation treatment a 5° (min/max)	5266 / 7216 mm	207 / 284 in
	- Height from working level of slew ring rotation axis	1000 / 3500 mm	39 / 138 in
	<b>Hoist and feed system</b>		
	- Feed stroke	16000 / 18000 / 21000 mm	630 / 709 / 827 in
	- Max hoist force	84 kN	18884 lbf
	- Max feed force	84 kN	18884 lbf
	- Max speed (feed/hoist)	30 / 5 rpm	30 / 5 rpm
	- Rod diameter		
	<b>Diesel engine</b>	Cummins 6 CTA A 8.3	Cummins 6 CTA A 8.3
	- Max power	164 kW	220 HP
	- Rated power	135 kW	181 HP
	<b>Electric motor</b>	SIEMENS 4 POLS 50 Hz	SIEMENS 4 POLS 50 Hz
	- Power	90 kW	121 HP
	<b>Hydraulic system</b>		
	- Main pump (variable displacement axial pumps)	(214+214)+142 / 2x(158+158)+2x158 l/min	(57+57)+39 / 2x(42+42)+2x42 US gal/min
	- Auxiliary pump (gear pumps)	1 single and 2 double gear pumps	1 single and 2 double gear pumps
	<b>Rotary</b>		
	- Max torque	1363 daNm	10053 lbf*ft
	- Drilling speed	457 rpm	457 rpm
	<b>Clamp and hydraulic joint breaker</b>		
	- Size	60 - 260 mm	2 - 10in
	- Max clamping force	159 kN	35744 lbf
	- Max breaking torque	3830 daNm	28248 lbf*ft
	<b>Undercarriage</b>		
	- Track shoe width	800 mm	31 in
	- Overall length	5041 mm	198 in
	- Overall width	3900 mm	154 in
	- Travelling speed	1,4 Km/h	0,8 mph
	<b>Weight</b>		
	- Total weight	120000 kg	264552 lb
	- Average pressure on ground	0,17 MPa	25 psi

Solmec integrates high quality level components: Gearmatic, Hydromatic, Lohmann, Rothe erde, Trasmital, Zollern.

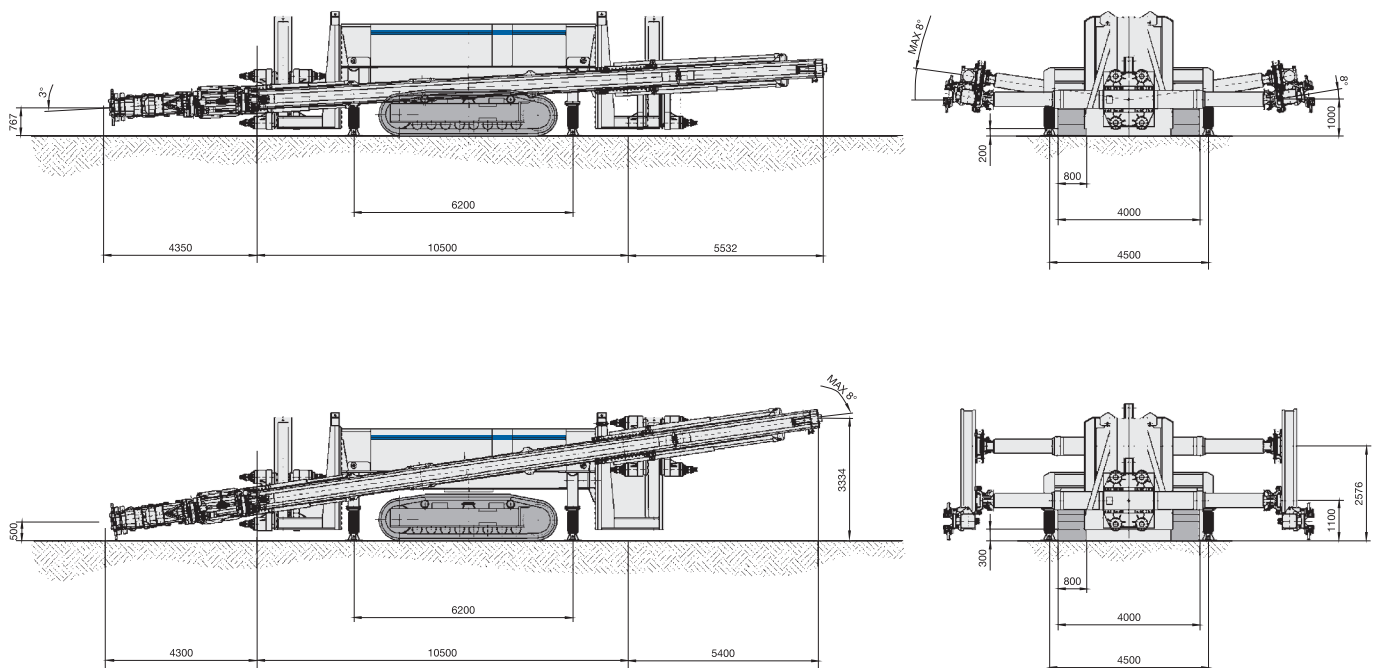


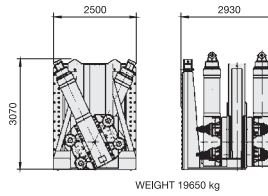
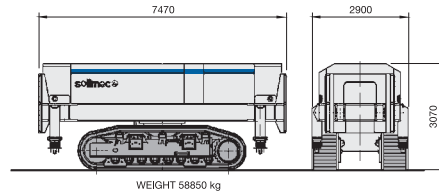
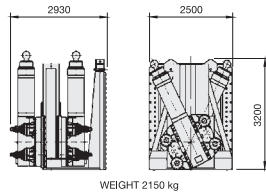
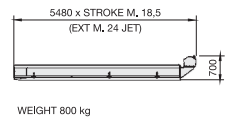
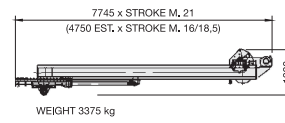
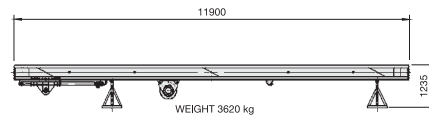
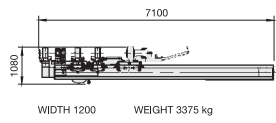
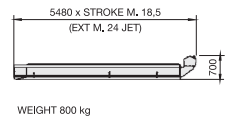
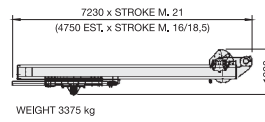
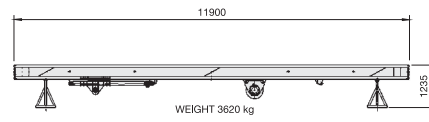
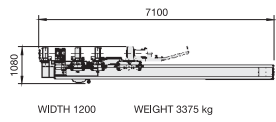
# ST-120

## Tunnelling Rig

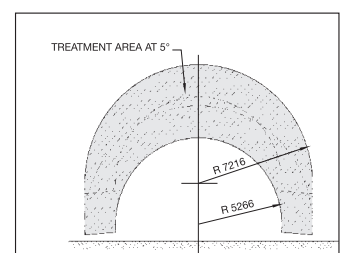
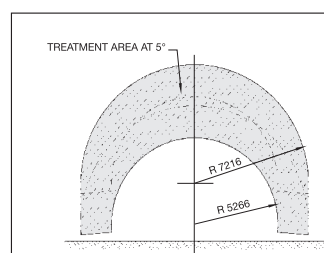
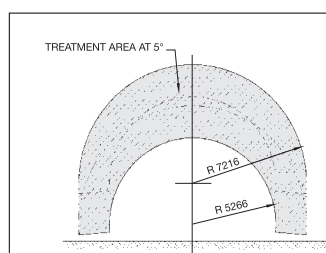
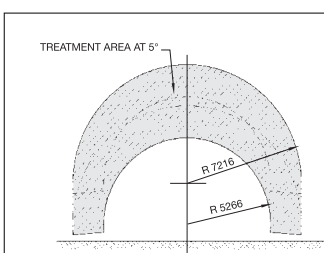
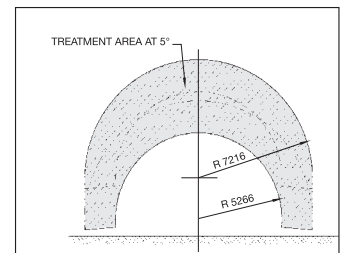
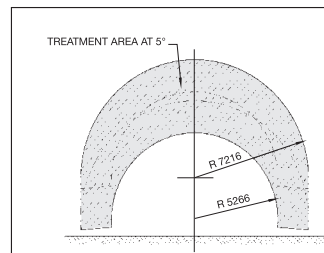
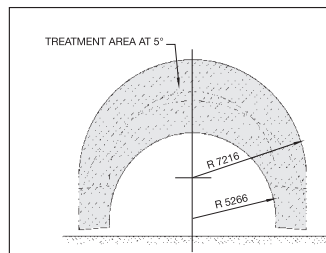
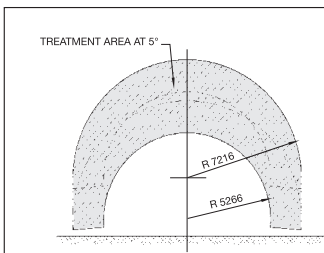
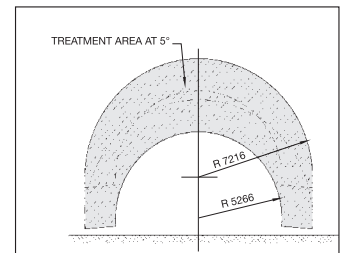
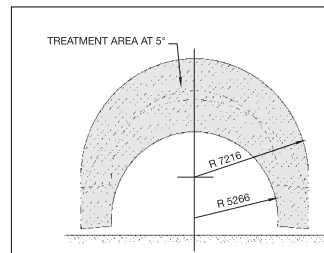
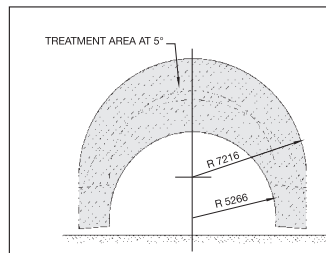
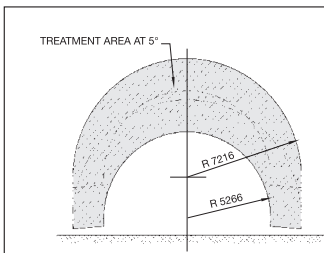
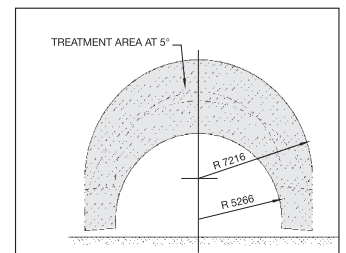
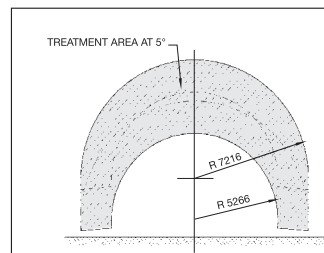
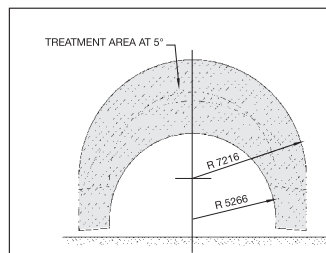
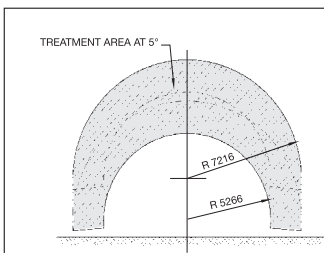


## Tilting configurations





## Working radius





SOILMEC distributes machinery and structures all over the world, supported by SOILMEC subsidiary companies and dealers. The complete Soilmec network list is available on the webpage [www.soilmec.it](http://www.soilmec.it)