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APPLICAZIONI PRINCIPALI - MAIN APPLICATIONS:
• SOTTOFONDAZIONI - UNDERPINNING
• DIAFRAMMI - DIAPHRAGM WALLS
• CONSOLIDAMENTI DI GALLERIE - TUNNEL CONSOLIDATIONS
• TAMPONI DI FONDO - BOTTOM PLUGS
• CONSOLIDAMENTO DI TERRENI IN PENDENZA - SLOPES CONSOLIDATIONS
• DAM CUT-OFFS
• DIAPHRAGM WALLS GAPS
• BREAK-IN AND BREAK-OUT FOR TBM

VANTAGGI PRINCIPALI - MAIN ADVANTAGES:
• GRANDE VARIETA' DI TERRENI TRATTABILI - WIDE RANGE OF SOILS THAT CAN BE SUCCESSFULLY TREATED
• POSSIBILITA' DI OTTENERE COLONNE DI TERRENO CONSOLIDATO DA 60 A PIU' DI 300 cm DI DIAMETRO, PARTENDO DA FORI DI PICCOLO DIAMETRO NON SUPERIORI A 140 mm - CAPABILITY TO OBTAIN COLUMNS OF CONSOLIDATED SOIL WITH DIAMETER RANGING FROM 60 TO MORE THAN 300 cm BY USING SMALL DIAMETER DRILLED HOLES, NOT LARGER THAN 140 mm
• CAPACITA' DI OLTREPASSARE FONDAZIONI PRE-ESISTENTI, TROVANTI E STRATI ROCCIOSI - CAPABILITY TO OVERPASS PRE-EXISTING FOUNDATION, BOULDERS, ROCKY LAYERS
• USO DI MACCHINE PERFORATRICI LEGGERE E DI PICCOLE DIMENSIONI IN AREE ANGUSTE - USE OF LIGHT WEIGHT AND SMALL SIZE DRILLING RIGS IN SMALL WORKING AREAS
### METODI JETTING - JETTING METHODS

I metodi jet-grouting sono classificati in tutto il mondo in tre tipi a seconda del numero di fluidi di iniezione:

Jet grouting techniques are world-wide classified into three categories according to the number of injected fluids:

- **monofluido - mono-fluid**
  - Il cemento è usato come unico fluido per disaggregare il terreno ed effettuare il consolidamento.
  - *Grout is used as disaggregating and consolidating fluid.*

- **bifluido - double-fluid**
  - Il cemento ed aria sono usati per disaggregare e consolidare il terreno.
  - *Grout plus air are used as disaggregating and consolidating fluids.*

- **trifluido - triple-fluid**
  - L’acqua ed aria sono usati per disaggregare il terreno mentre il cemento è usato per il consolidamento.
  - *Water plus air are used as disaggregating fluids while grout is used as consolidating fluid.*

Il diagramma seguente rappresenta uno schema indicativo del tipo di tecnologia jetting più indicata in funzione del tipo di terreno e del diametro della colonna realizzabile.

*The following diagram gives an indication of the suitable jetting techniques in function of soil type and of the reachable column diameter.*
### JET GROUTING SWIVELS

<table>
<thead>
<tr>
<th>Model</th>
<th>Front section (mm)</th>
<th>Swivel length (mm)</th>
<th>Upper connection</th>
<th>Lower connection</th>
<th>Inlet size (BSPP)</th>
<th>Shape</th>
<th>ID (mm)</th>
<th>Pressure (MPa) Max / Working</th>
<th>Type of media</th>
<th>1st INLET</th>
<th>2nd INLET</th>
<th>3rd INLET</th>
<th>Max / Min C°</th>
<th>Max RPM dry run (2h)</th>
<th>Max RPM with cooling</th>
<th>Pull / Thrust (KN)</th>
<th>Type of drilling</th>
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<tr>
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<td></td>
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<td></td>
<td></td>
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<td>-30/+120°C</td>
<td>50</td>
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<td>1”-1/4 1”-1/4</td>
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<td>110</td>
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<td>AIR WATER</td>
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<td></td>
<td>-30/+110°C</td>
<td>25</td>
<td>100</td>
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<td></td>
<td></td>
<td>GROUT WATER</td>
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<td>-30/+110°C</td>
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<td>-30/+110°C</td>
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<td>100</td>
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<td>-30/+110°C</td>
<td>30</td>
<td>105</td>
<td>31</td>
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**Note:**
- GROUT: Grout
- WATER: Water
- AIR: Air
- ID: Internal Diameter
- D.Eq.: Diameter Equivalent
- MPa: Megapascals
- Max: Maximum
- Working: Working
- Pull / Thrust (KN): Pull / Thrust (Kilonewtons)
- Type of drilling: Drilling type

**See table key page 8**
## JET GROUTING SWIVELS

<table>
<thead>
<tr>
<th>JET GROUTING SWIVELS</th>
<th>J-WMHPSWD2</th>
<th>J-AMHPSWD2</th>
<th>J-WMHPSWD2</th>
<th>J-E06GMSF</th>
<th>J-8JRPS00</th>
<th>J-8JRPS5000</th>
<th>J-JSW13132R</th>
<th>J-J11JMPH90</th>
<th>J-SWC20C64</th>
<th>J-SW914550</th>
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### Front section (mm)
- J-WMHPSWD2: 170
- J-AMHPSWD2: 160
- J-WMHPSWD2: 160
- J-E06GMSF: 158
- J-8JRPS00: 180
- J-8JRPS5000: 188
- J-JSW13132R: 188
- J-J11JMPH90: 248
- J-SWC20C64: 248
- J-SW914550: 129

### Swivel length (mm)
- J-WMHPSWD2: 498
- J-AMHPSWD2: 472
- J-WMHPSWD2: 472
- J-E06GMSF: 417
- J-8JRPS00: 534.5
- J-8JRPS5000: 397.5
- J-JSW13132R: 338
- J-J11JMPH90: 601
- J-SWC20C64: 749
- J-SW914550: 292

### Upper connection
- J-WMHPSWD2
- J-AMHPSWD2
- J-WMHPSWD2
- J-E06GMSF
- J-8JRPS00
- J-8JRPS5000
- J-JSW13132R
- J-J11JMPH90
- J-SWC20C64
- J-SW914550

### Lower connection
- J-WMHPSWD2
- J-AMHPSWD2
- J-WMHPSWD2
- J-E06GMSF
- J-8JRPS00
- J-8JRPS5000
- J-JSW13132R
- J-J11JMPH90
- J-SWC20C64
- J-SW914550

### Inlet size (BSPP)
- J-WMHPSWD2: 2" 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-AMHPSWD2: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-WMHPSWD2: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-E06GMSF: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-8JRPS00: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-8JRPS5000: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-JSW13132R: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-J11JMPH90: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-SWC20C64: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4
- J-SW914550: 1"-1/2 1"-1/4 1"-1/4 1"-1/4 1"-1/2 1"-1/2 1"-1/4

### 1st INLET
- **Shape**: ![Shape](image)
- **ID (mm)**: 45 35 35 20 20 32 30 50 25 36
- **Pressure (MPa)**: 56/40 56/40 56/40 56/40 56/40 56/40 56/40 56/40 56/40 3/2,4
- **Type of media**: WATER WATER WATER WATER WATER WATER WATER WATER WATER

### 2nd INLET
- **Shape**: ![Shape](image)
- **ID (mm)**: 33 D.Eq. 22 D.Eq. 22 D.Eq. 43 D.Eq.
- **Pressure (MPa)**: 56/45 3/2,4 56/45 3/2,4
- **Type of media**: WATER WATER WATER

### 3rd INLET
- **Shape**: ![Shape](image)
- **ID (mm)**
- **Pressure (MPa)**
- **Type of media**:

### Max / Min C°
- J-WMHPSWD2: -30/+120 °C
- J-AMHPSWD2: -30/+110 °C
- J-WMHPSWD2: -30/+120 °C
- J-E06GMSF: -30/+120 °C
- J-8JRPS00: -30/+120 °C
- J-8JRPS5000: -30/+120 °C
- J-JSW13132R: -30/+120 °C
- J-J11JMPH90: -30/+120 °C
- J-SWC20C64: -30/+120 °C
- J-SW914550: -30/+110 °C

### Max RPM dry run (2h)
- J-WMHPSWD2: 25
- J-AMHPSWD2: 30
- J-WMHPSWD2: 30
- J-E06GMSF: 30
- J-8JRPS00: 30
- J-8JRPS5000: 25
- J-JSW13132R: 30
- J-J11JMPH90: 30
- J-SWC20C64: 35
- J-SW914550: 30

### Max RPM with cooling
- J-WMHPSWD2: 100
- J-AMHPSWD2: 105
- J-WMHPSWD2: 105
- J-E06GMSF: 60
- J-8JRPS00: 60
- J-8JRPS5000: 100
- J-JSW13132R: 40
- J-J11JMPH90: 40
- J-SWC20C64: 110
- J-SW914550: 40

### Pull / Thrust (KN)
- J-WMHPSWD2: 31
- J-AMHPSWD2: 31
- J-WMHPSWD2: 31
- J-E06GMSF: -
- J-8JRPS00: -
- J-8JRPS5000: -
- J-JSW13132R: -
- J-J11JMPH90: -
- J-SWC20C64: -
- J-SW914550: -

### Type of drilling
- J-WMHPSWD2
- J-AMHPSWD2
- J-WMHPSWD2
- J-E06GMSF
- J-8JRPS00
- J-8JRPS5000
- J-JSW13132R
- J-J11JMPH90
- J-SWC20C64
- J-SW914550
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<td>ROUND SHAPE</td>
<td>☻</td>
<td>90° BENT INLET</td>
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<td>SQUARE SHAPE</td>
<td></td>
<td>VERTICAL INLET</td>
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<td></td>
<td>VERTICAL ANTI-SPINNING EYE</td>
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<td>GROUT MIX</td>
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<td>ANTI-SPINNING SIDE EYE</td>
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<td>WATER</td>
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<td>FLANGE CONNECTION</td>
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<td>AIR</td>
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<td>ROTATIVE DRILLING</td>
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<td>FEMALE THREAD</td>
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<td>DOWN THE HOLE HAMMER DRILLING</td>
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<td>NOT APPLICABLE</td>
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<td>TOP HAMMER DRILLING</td>
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<tr>
<td>D. Eq.</td>
<td>2*(√(A1-A2)/π)</td>
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**Symbols and Meanings for Attrezzatura Jet Grouting**

- **ROUND SHAPE**
- **SQUARE SHAPE**
- **VERTICAL ANTI-SPINNING EYE**
- **ANTI-SPINNING SIDE EYE**
- **FLANGE CONNECTION**
- **MALE THREAD**
- **FEMALE THREAD**
- **NOT APPLICABLE**
- **90° BENT INLET**
- **VERTICAL INLET**
- **GROUT MIX**
- **WATER**
- **AIR**
- **ROTATIVE DRILLING**
- **DOWN THE HOLE HAMMER DRILLING**
- **TOP HAMMER DRILLING**
Simultanea disgregazione e consolidamento ottenuti con iniezione di cemento. Il sistema può essere a rotazione, rotopercussione e con martello fondo foro (dth). Il portaugelli (monitor) può essere dotato di uno o più ugelli.

A jet of cement grout breaks-up and mixes the soil. The mono-fluid system is suitable for rotation-drilling, rotopercussion-drilling and DTH-drilling. The nozzles holder (monitor) can be equipped with one or more jetting nozzles.
SCHEMA IMPIANTO JET-GROUTING MONOFLUIDO
SINGLE FLUID JET-GROUTING PLANT
### TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>SWIVEL TYPE</th>
<th>INLET</th>
<th>ID (mm)</th>
<th>MAX RPM</th>
<th>MAX RPM</th>
<th>PRESSURE (MPa)</th>
<th>MAX / WORKING</th>
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<tr>
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<td>56 / 40</td>
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<td>30</td>
<td>105</td>
<td>56 / 40</td>
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</table>

**FIG. 3.1**

- **A**: J-60J14002
- **B**: J-60J14510
- **C**: J-J16TP230, J-J16TP270
- **D**: J-60J14530, J-60J14540
- **E**: J-J33TB012, J-CU12, J-J00UCXXX, J-CU14, J-J0VNR000, MR-TRSTE300, MR-TRSTE312
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<th>DESCRIZIONE</th>
<th>DESCRIPTION</th>
<th>EURO/CAD EURO/EACH</th>
<th>% SC. % DISC.</th>
<th>PESO WEIGHT</th>
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3.2 D.76 JET

TECHNICAL SPECIFICATIONS

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FIG. 3.2

Attrezzature per l’ingegneria delle fondazioni
Revisioni perforatrici ed accessori
Equipment for all foundation engineering technologies

Rev. 11 del 14-03-2019
### D.76 JET - REF. FIG. 3.2

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**FIG. 3.3**

- J-SW90278R
- J-SW9090JM
- J-889K6100
- J-8C2TS650
- J-889K6200
- J-J00TAL76
- J-889K4122
- J-889K4002
- J-889K4003
- J-889K4004
- J-CU14
- J-J00UCXXX
- J-J00TP200
- J-J00TP270
- J-J00TP210
- J-8C2149XX
- J-J33TB012
- J-J16TP211
- J-J00TP211
- J-TRH412J1
- J-TRH412J2
- MR-TRICO412
- MR-TRS412J1
- MR-TRS412J2
- MR-TRSTE412
- CLAWBIT412
- J-J889K5100
- J-J889K5000
- J-J0VNR000
## D.90 JET - REF. FIG. 3.3

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**FIG. 3.5**

- J-SW11312R
- J-SW1111JM
- J-127K3000
- J-127K2000
- J-127K1000
- J-127K3011
- J-127K4002
- J-127K4003
- J-127K6200
- J-8C2TS700
- J-8C2149XX
- J-CU12
- J-127K5200
- 238R312R-F/M
- MR-TRSTE612
- MR-TRICO612
- CLAWBIT612
### D.127 JET - REF. FIG. 3.5

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Disgregazione e consolidamento ottenuti con iniezione simultanea di cemento e getto coassiale di aria. Gli ugelli sono progettati per creare uno schermo intorno al getto di cemento che acquisisce una maggiore capacità di taglio ed è in grado di ottenere maggiori diametri della colonna di terreno consolidato.

Il sistema può essere a rotazione, rotopercussione e con martello fondo foro.

Le aste C2 possono essere utilizzate a rotazione e rotopercussione con martello fondo foro (DTH) e per il jetting monofluido.

La versatilità di questo progetto è garantita dall’utilizzo di una tubazione in gomma per alte pressioni che garantisce, alte portate, piccolo ingombro e assorbimento dei contraccolpi. L’asta esterna è frizionata con manicotti in acciaio ad alta resistenza.

Il sistema completo, è certificato CE.
La CRM produce un monitor speciale denominato s.t.r.a.jet (straight turbulence reducing appliance). Si tratta di un monitor a due vie da usarsi con le aste CRM C2 d.114. In confronto con un monitor standard lo s.t.r.a.jet fornisce, a parità di pressione e portata delle pompe in uso, una maggiore forza di taglio del getto di cemento. Lo speciale disegno del condotto interno del monitor mantiene il flusso laminare riducendo le perdite di carico, aumentando la forza di taglio del getto di cemento e di conseguenza il diametro della colonna di terreno consolidato. Nella fase di perforazione, è possibile usare acqua per lubrificare il bit. Nella fase di jet-grouting, quando la pressione nel condotto aumenta, una valvola automatica chiude il passaggio dell’acqua al bit ed il flusso di cemento + aria passa solo attraverso gli ugelli.

The CRM s.t.r.a.jet. (straight turbulence reducing appliance) is a two-ways nozzle holder equipped with d.114 C2 double fluid rods. In comparison with a standard two-ways nozzle holder the s.t.r.a.jet provides a greater cutting force of the grout mix on equal pump’s pressure and flow rate. The special design of the grout inner duct reduces the drag by keeping the flow laminar. This longer duct enhances the cutting power of the grout flow and gets columns of consolidated soil of a greater diameter. In the drilling step it is possible to use water to lubricate the bottom bit. In the jetting step, when the grout pressure is increased, an inner automatic valve closes the water passages to the bit letting the grout and the air pass through the nozzles only.
SCHEMA IMPIANTO JET-GROUTING BIFLUIDO
DOUBLE FLUID JET-GROUTING PLANT
### TECHNICAL SPECIFICATIONS

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**FIG. 4.1**

- **B**
- **C**

**VEDI CAP. 7**

**SEE CHAPT. 7**
FIG. 4.2

D.90 C2

J-8C214494
SINGLE FLUID ONLY

J-8C214492

J-8C214495

J-8C214702

J-8C214485

J-8C214483

J-8C2144753

J-8C214753

J-J00TP2XX

J-J00TP2XX

J-00UCXXX

J-00UCXXX

J-8C2149XX

J-8C2149XX

J-8C214901

J-8C214901

J-8C214900

J-8C214900

J-8C214921

J-8C214921

J-J0VNR000

J-J0VNR000

J-TRS412J2

J-TRS412J2

J-TRSTE412

J-TRSTE412

MR-TRICO412

MR-TRICO412

J-TRH412J2

J-TRH412J2

CLAWBIT412

CLAWBIT412

J-SW90278R

J-SW90278R

J-SW914550

J-SW914550

J-8C214300

J-8C214200

J-8C214100

J-8C214308

J-8C214308

J-8C214307

J-8C214307
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**FIG. 4.3**

- **E**  J-CU78  D-1555-4DXX
- **C**  J-CU78  D-1395-DXX-IV
- **A**  J-J01TP2XX  J-CU12  J-8C2149XX
- **B**  J-8C21490T  J-J33TB012  J-CU12  J-8C2149XX
- **D**  J-8C21490T  J-8C2149XX  J-8C214900  J-8C214902

**THEME**

- Jet Grouting equipment
- Attrezzature per l’ingegneria delle fondazioni
- Revisioni perforatrici ed accessori
- Equipment for all foundation engineering technologies

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### Attrezzatura per l’ingegneria delle fondazioni
Revisioni perforatrici ed accessori
Equipment for all foundation engineering technologies

**Attrezzature Jet Grouting**

**Jet Grouting equipment**

### D.114 C2 - REF. FIG. 4.4

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### CONFIGURAZIONI SPECIALI - SPECIAL CONFIGURATIONS

**D.114 DA C2 A MONOFLUIDO - D.114 FROM C2 TO SINGLE FLUID**

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### ACCESSORI - ACCESSORIES

**D.114 C2 CON BOTTONI ANTI USURA**

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<td>NOZZLES H. D.114 C2 150° CUTTING WALL</td>
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FIG. 4.5
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### ACCESSORI  - ACCESSORIES

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<th>PRESSURE (MPa)</th>
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**FIG. 4.6**

- J-AMHPSTD2
- J-AMHPSTAD2
- J-1C212702
- J-1C212483-P
- J-J01TP2XX
- J-1C212752
- J-JOVNR112
- 238R312F/M
- MR-TRICE600
- MR-TRICO600
- CLAWBIT600
- J-CU78
- D-1555-4DXX
- J-8C214900
- J-8C214902
- J-8C214901
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<td>J-AMHPSWD2</td>
<td>TESTA A.P. D. 35 D2 (CEMENTO 700 L/min-560 bar; ARIA 18000 L/min-17-24 bar)</td>
<td>H.P. SWIVEL D. 35 D2 (GROUT 700 L/min-560 bar; AIR 18000 L/min-17-24 bar)</td>
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<td>J-AMHP5AD2</td>
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<td>ASTA D.114C2x1000 De132 CALETT. PER MANDR. MASSIMA COPPIA</td>
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<td>ROD. D. 114X1000 C2</td>
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<td>J-8C21490T</td>
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<th>PESO WEIGHT</th>
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<td>J-MRTRC0600</td>
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<td>ROCK BIT D. 6”-1/2 L2</td>
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<tr>
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### FIG. 4.7

- **A**
  - J-CU12
  - J-8C2149XX
  - J-8C2149XX-H

- **B**
  - J-J33TB012
  - J-CU12
  - 238312R-F/M

- **MR-TRSTE600**
- **MR-TRICO600**
- **CLAWBIT600**
- **MR-TRSTE600**
- **MR-TRICO600**
- **CLAWBIT600**

### Jet Grouting Equipment

- **J-WMHPWD2**
- **J-WMHPAD2**
- **J-1C2H3000**
- **J-1C2H2000**
- **J-1C2H1000**
- **J-1C2H4000**
- **J-J01TP2XX**
- **MR-TRSTE600**
- **MR-TRICO600**
- **CLAWBIT600**
- **MR-TRSTE600**
- **MR-TRICO600**
- **CLAWBIT600**
- **MR-TRSTE600**
- **MR-TRICO600**
- **CLAWBIT600**

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*Attrezzature per l'ingegneria delle fondazioni*
*Revisioni perforatrici ed accessori*
*Equipment for all foundation engineering technologies*

*Rev. 11 del 14-03-2019*
### D.114 C2H - REF. FIG. 4.7

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Nota: Ugelli cemento-acqua intercambiabili - Note: Grout and water nozzles are interchangeable
### TECHNICAL SPECIFICATIONS

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<th>FLUID TYPE</th>
<th>ID (mm)</th>
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<th>MAX RPM WITH COOLING</th>
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- **FIG. 4.8**

- **J-AMHPS4C2**
- **J-AMHPA4C2-12**
- **J-12C23000**
- **J-12C22000**
- **J-12C21000**
- **J-J02TP120**
- **J-J02TP070**
- **J-J0VNR140**
- **J-12C20752**
- **J-12C20483**
- **J-12C20702**
- **J-8C214901**
- **J-8C214900**
- **J-8C2149XX**
- **J-CU12**
- **J-8312R-F/M**
- **MR-TRSTE612**
- **MR-TRICO612**
- **CLAWBIT612**
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**FIG. 4.9**

- J-12C23000
- J-12C22000
- J-12C21000

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**D.127 C2 S.T.R.A.JET DOUBLE NOZZLE**

- J-AMHPS4C2
- J-CU78
- D-1395-DXX-IV
- J-8C214900
- J-8C214901
- J-8C214902

- 312R412R-F/M
- MR-TRST800
- MR-TRICO800

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**Jet Grouting equipment**

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[FIG. 4.10]

- **J-AMHPS4C2**
- **J-AMHPA4C2-14**
- **J-14C20702**
- **J-14C23000**
- **J-14C22000**
- **J-14C21000**
- **J-14C20752**
- **J-14C20753**
- **J-J02TP070**
- **J-J02TP120**
- **J-J0VNR140**
- **J-312R412R-M/F**
- **MR-TRSTE700**
- **MR-TRICO634**
- **MR-TRICO712**
- **CLAWBIT700**

---

*Attrezzature Jet Grouting*

*Jet Grouting equipment*

Rev. 11 del 14-03-2019
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Nel sistema C3 un getto coassiale di acqua ed aria anticipa nella fase di risalita (fase di jetting) il getto dell’ugello del cemento. Questa azione preventiva migliora l’efficacia del getto di cemento aumentando considerevolmente il diametro raggiungibile della colonna di terreno consolidato.

La testa di adduzione è del tipo monoblocco con tre ingressi. Il corpo è costituito in lega leggera di alta resistenza. Le parti interne, in acciaio bonificato, lavorano su cuscinetti di alta qualità. Le aste sono dimensionate per garantire alte portate e pressioni. Sono costituite di tre elementi coassiali, tutti con saldature a frizione e con manicotti in acciaio bonificato di alta resistenza. Le guarnizioni usate sono in poliuretano resistente ad una temperatura di -50°C.

In the C3 system, during the jetting step, a coaxial jet of water and air comes before the grout jet. The preventive of the coaxial jet of water and air makes the grout jet more efficient in breaking up and mixing the soil with the result of having larger columns of consolidated soil.

The swivel is en bloc with three inlets. It is manufactured in heavy duty aluminium alloy. Its high strength steel inner parts work on high quality roller bearings. The rods are designed for high capacities and pressures. Each rod consists of three coaxial rods friction welded with tool joints manufactured in high strength steel. The seals used are made in polyurethane capable of an operating temperature of -50°C.
### TECHNICAL SPECIFICATIONS

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<th>INLET Type</th>
<th>FLUID TYPE</th>
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**FIG. 5.1**

- CEMENTO: GROUT
- ACQUA: WATER
- ARIA: AIR

**Diagram**

- J-90K38100
- J-90K38000
- MR-TRSTE412
- MR-TRICO412
- CLAWBIT412
- J-00TP2XX
- J-90K38120
- J-WMHPSWT3
- J-90K35010
- J-90K33000
- J-90K32000
- J-90K31000
- J-90K349XX
- MR-TRSTE412
- J-90K34000
- J-90K34900
- J-90K347XX
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5.2 D.114 C3

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**FIG. 5.2**
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**FIG. 5.3**

- J-WMHPS4C3
- J-12C33000
- J-12C32000
- J-12C31000
- J-J02TP070
- J-J02TP120
- J-JOVNR140
- J-12C38000
- J-8C214900
- J-8C214902
- J-8C21490T
- J-CU12
- J-11K349XX
- J-J02TP120
- J-JOVNR140
- J-12C33000-SW
- J-12C34000
- J-11K349XX
- J-8C21490T
- J-CU12
- J-8C2149XX
- J-8C2149XX-H
- J-J02TP070
- J-J02TP120
- J-JOVNR140
- J-12C33000-SW
- J-12C34000
- J-11K349XX
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- J-CU12
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### D.127 C3 - REF. FIG. 5.3

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Attrezzatura progettata per la realizzazione di pannelli jet grouting e per la sigillatura di diaframmi. La forma esagonale del manicotto rende possibile la manovra delle aste in entrambi i sensi di rotazione. Esiste sia la versione monofluido che bifluido.

*Equipment designed for jet grouting panel sealing.*
*The hexagonal shape of coupling gives the possibility of turning the rods in both rotation directions.*
*Single-fluid and double-fluid's versions are available.*
### 6.1 JET HEX 80

#### TECHNICAL SPECIFICATIONS

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<th>SWIVEL CODE</th>
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<th>FLUID TYPE</th>
<th>ID (mm)</th>
<th>MAX RPM DRY RUN (2h)</th>
<th>MAX RPM WITH COOLING</th>
<th>PRESSURE (MPa)</th>
<th>MAX / WORKING</th>
<th>MAX TORQUE (KNm)</th>
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Nota: attrezzatura per pannelli jet grouting, per sigillatura diaframmi
Note: equipment for jet grouting panel sealing

---

**FIG. 6.1**
### JET HEX 80 - REF. FIG. 6.1

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<td>JET HEX80 150° NOZZLES HOLDER</td>
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**Nota:** attrezzatura per pannelli jet grouting, per sigillatura diaframmi

**Note:** equipment for jet grouting panel sealing
### C2 HEX 80 - REF. FIG. 6.2

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Le aste bifluido e trifluido CRM possono essere utilizzate a rotopercussione con martello fondo foro (DTH). I sistemi possono essere mono (bifluido) o bifluido.

Nel sistema D.114 D2 monojet, si usano aste con doppo condotto in acciaio per alte pressioni. Nel condotto esterno passa l’acqua per alimentare il martello, nel condotto interno passa il cemento che va agli ugelli del monitor.

Il sistema T3 prevede aste a triplo passaggio per eseguire trattamenti di jet grouting trifluido o bifluido (con un condotto dedicato al passaggio del fluido per azionare speciali martelli fondo foro, progettati per l’utilizzo contemporaneo al trattamento Jet grouting).

Il sistema T3 cemento-aria-aria il condotto esterno riceve aria a 17-24 bar per azionare il martello durante la perforazione e lubrificarlo durante il trattamento in risalita jet grouting. Il passaggio intermedio riceve aria a 17-24 bar max e aziona un ugello concentrico al quello del cemento per l’esecuzione di un classico trattamento bifluido aria-cemento.

Nel sistema T3 com martelli ad acqua il condotto interno alimenta con acqua, nella fase di perforazione, il martello. Nella fase di jetting si inserisce una biglia nel condotto centrale che, all’aumentare della pressione del cemento, permette la chiusura del condotto di alimentazione del martello e la contemporanea apertura degli ugelli del cemento. La fase di jetting avviene come un normale trifluido.

Il sistema completo è certificato CE.

---

The CRM double and triple fluid jetting rods are suitable for DTH-drilling. These systems are suitable for single or double fluid treatments.

The D.114 jet DTH single fluid D2 system employs high pressure-resistant double steel rods. The water flows through the outer duct to the hammer. The grout flows through the inner duct to the grout-nozzles.

The T3 system employs triple passage rods for triple fluid or double fluid treatments (one passage is used to operate the hammer).

The T3 grout-air-air system operates the jet grouting hammer (Grout mix-Air-Air Dth). During the drilling air flows through the outer passage at 17-24 bar pressure and operates the hammer. During the jet grouting treatment air keeps lubricating the hammer. Air also flows through the intermediate passage at 17-24 bar pressure and operates a nozzle coaxial to the grout nozzle for a classic double fluid jet grouting treatment.

In T3 system for water hammers the inner passage is used in drilling step to feed the hammer. In jetting step a steel ball is placed into the inner passage. When the grout mix increases the pressure, this ball allows the closure of hammer feed passage and simultaneously the opening of grout nozzles passage. The jetting step is performed as a standard K3 system.

The complete system is CE certified.
7.1 D.90 JET 1 DTH AIR HAMMER

FIG. 7.1

PATENTED
RM 99A000395
## D.90 JET 1 DTH AIR HAMMER - REF. FIG. 7.1

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### D.90 JET2 DTH AIR HAMMER - REF. FIG. 7.2

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7.3 D.114 JET 1 DTH AIR HAMMER
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7.4 D.114 JET 2 DTH AIR HAMMER

FIG. 7.4

PATENTED
RM 99A000395
## D.114 JET 2 DTH AIR HAMMER - REF. FIG. 7.4

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## D.114 JET 2 DTH AIR HAMMER - REF. FIG. 7.4

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7.5 D.114 JET 1 DTH WATER HAMMER

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FIG. 7.5

5" WATER HAMMER
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<td>NOZZLES HOLDER JET 1 FOR D2 AND W. H.</td>
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<td>J-W114D240</td>
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<td>HP D2 F/M DTH JET W100JG ADAPT.</td>
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(*) OPTIONAL
7.6 D.114 HP T3 JET 2 DTH AIR HAMMER (GROUT-AIR-AIR)

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FIG. 7.6
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FIG. 7.7

STEP 1: DRILLING WATER
STEP 2: JETTING GROUT

ACQUA PER UGELLI
WATER FOR NOZZLES

ARIA PER UGELLI
AIR FOR NOZZLES
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7.8 D.114 HP T3 JET 2 DTH WATER HAMMER

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**FIG. 7.8**

**JETTING GROUT**

---

**ACQUA PER DTH**

**WATER FOR DTH**

**ARIA PER UGELLI**

**AIR FOR NOZZLES**

---

**J-W114T3**

**5" WATER HAMMER**

---

**J-8C21490T**

**J-J33TB012**

**J-CU12**

---

**J-CU12**

**J-11K349XX**

**J-8C214900**

**J-8C214921**

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**J-8C21491**
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7.9 D.127 C3 JET 2 DTH WATER HAMMER

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<td>37 De</td>
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<td>AIR</td>
<td>49 De</td>
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**FIG. 7.9**

- JETTING GROUT
- ACQUA PER DTH (WATER FOR DTH)
- ARIA PER UGELLI (AIR FOR NOZZLES)
- 2" WATER HAMMER
- J-12C38AC
- J-12C34BC2
- J-8C214900
- D-1555-4DXX
- J-CU12
- J-XMHPA4C3
- J-12C33000-SW
- J-12C32000
- J-12C31000
- 5" WATER HAMMER
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7.10 D.127 C3 JET 3 DTH WATER HAMMER

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**FIG. 7.10**

5" WATER HAMMER

**STEP 1:** WATER FOR DTH
**STEP 2:** JETTING GROUT
## D.127 C3 JET 3 DTH WATER HAMMER - REF. FIG. 7.10

<table>
<thead>
<tr>
<th>CODICE / CODE</th>
<th>DESCRIZIONE / DESCRIPTION</th>
<th>EURO/CAD EURO/EACH</th>
<th>% SC. % DISC.</th>
<th>PESO / WEIGHT</th>
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<td>MODULAR HP SWIVEL GROUT-WATER-AIR (INLET 2&quot;)</td>
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<td>J-12C3404K</td>
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<td>AIR NOZZLE 8C214900 REMOVING TOOL</td>
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<td>J-8C21490T</td>
<td>TAPPO M 1&quot;1/4 UGELLO ARIA</td>
<td>1&quot;1/4 AIR NOZZLE MALE PLUG</td>
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<td>J-J33TB012</td>
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<td>1/2&quot; GAS MALE PLUG HEX SOCKET</td>
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Attrezzature jet-grouting adatte a lavorare su posizionatori, per consolidare il terreno sciolto/instabile davanti al fronte di gallerie, prima dello scavo.

Jet-grouting equipment for tunnelling rig, is specifically designed for consolidating the weak/unstable soil ahead of the tunnel face before the excavation.
## 8.1 D.90 JET RP FOR TUNNELLING

### TECHNICAL SPECIFICATIONS

<table>
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<tr>
<th>WIVEL TYPE</th>
<th>INLET</th>
<th>ID (mm)</th>
<th>MAX RPM DRY RUN (2h)</th>
<th>MAX RPM WITH COOLING</th>
<th>PRESSURE (MPa) MAX / WORKING</th>
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<td>20</td>
<td>30</td>
<td>105</td>
<td>56 / 40</td>
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**FIG. 8.1**

- J-J0VNR000
- J-J00TP210
- J-SW90278R
- J-J00UCXXX
- J-CU14
- J-SW90900RP
- J-8JRP3000
- J-8JRP2000
- J-8JRP1000
- J-8JRP4600
- J-8JRP4620
- MR-TRICE412
- MR-TRSTE412
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<th>DESCRIPITON</th>
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<th>% SC.</th>
<th>PESO</th>
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<td>SWIVEL JET SOTTO TESTA 2&quot;7/8 AR F.</td>
<td>UNDER ROTARY JET SWIVEL 2&quot;7/8 A.R BOX</td>
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<td>J-SW9090RP</td>
<td>RID. TESTA J-SW90 F/M 90 JET R.P.</td>
<td>ADAPTER SWIVEL J-SW 90 F/M D.90 JET R.P.</td>
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<td>J-J00UC180</td>
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<td>JET NOZZLE D. 1.8</td>
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<td>JET NOZZLE D. 2.0</td>
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<td>J-J00TP210</td>
<td>VALVOLA AUT. JET 100BAR</td>
<td>JET CHECK VALVE 100BAR</td>
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<td>STEP DRAG BIT D. 4&quot;1/2</td>
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<td>MR-TRSTE412-H</td>
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<td>HEAVY-DUTY CHEVRON DRAG BIT D. 4&quot;1/2</td>
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<td>MR-TRIC0412</td>
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<td>D.4&quot;1/2 L2 IADC211 ROCK BIT</td>
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8.2 D.114 JET RP FOR TUNNELLING

TECHNICAL SPECIFICATIONS

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FIG. 8.2

TUBO INTERNO METALLICO
INNER STEEL PIPE

J-SW1111JP
J-SW11312R
J-J01TP212
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Sistema di perforazione a rotopercussione. Il sistema può essere monofluido o bifluido.

Nel sistema monofluido si ottiene la simultanea disgregazione e consolidamento del terreno tramite iniezione di cemento.

Nel sistema bifluido la disgregazione e il consolidamento sono ottenute con iniezione simultanea di cemento e getto coassiale di aria. Gli ugelli sono progettati per creare uno schermo intorno al getto di cemento che acquisisce una maggiore capacità di taglio ed è in grado di ottenere maggiori diametri della colonna di terreno consolidato.

Il portaugelli (monitor) può essere dotato di uno o più ugelli.

Rotopercussion drilling system. This system is suitable for mono fluid or double-fluid jetting.

In the mono fluid system a jet of cement grout breaks-up and mixes the soil.

In the double fluid system a jet of cement grout and air breaks-up and mixes the soil. The nozzles are designed so that the air-jet forms a shield all around the grout jet. This has the result of enhancing the grout jet cutting power and getting larger columns of consolidated soil. The nozzles holder (monitor) can be equipped with one or more jetting nozzles.
### TECHNICAL SPECIFICATIONS

<table>
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<tr>
<th>SWIVEL TYPE</th>
<th>INLET</th>
<th>ID (mm)</th>
<th>MAX RPM DRY RUN (2h)</th>
<th>MAX RPM WITH COOLING</th>
<th>PRESSURE (MPa) MAX / WORKING</th>
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**FIG. 9.1**

- **A**
  - J-CU14
  - J-J00UCXXX
- **B**
  - J-8JRP4002
  - J-8JRP4003
  - J-8JRP4004
- **C**
  - J-J16TP211
  - J-J00TP211
- **D**
  - J-KBIT0105
  - J-KBIT0105-C
  - J-KBIT0120
  - J-KBIT0120-C
  - J-KBIT0120-C
  - J-KBIT0105
  - J-KBIT0120

**J-SW9090RP**
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### TECHNICAL SPECIFICATIONS

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<th>SWIVEL TYPE</th>
<th>INLET</th>
<th>ID (mm)</th>
<th>MAX RPM DRY RUN (2h)</th>
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<td>D.61/2 (L2) Th. 31/2 AR ROCK-BIT</td>
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<td>CLAWBIT612</td>
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<td>D.61/2 (165) Th. 31/2 AR CLAW-BIT</td>
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### TECHNICAL SPECIFICATIONS

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<th>SWIVEL TYPE</th>
<th>INLET</th>
<th>FLUID TYPE</th>
<th>ID (mm)</th>
<th>MAX RPM (DRY RUN 2h)</th>
<th>MAX RPM (WITH COOLING)</th>
<th>PRESSURE (MPa)</th>
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<tr>
<td>J-SWC20C64</td>
<td>1&quot;-1/2</td>
<td>GROUT</td>
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<td>40</td>
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<td>AIR</td>
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<td>J-SWC2312R</td>
<td>1&quot;-1/4</td>
<td>GROUT</td>
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<td>AIR</td>
<td>55 De</td>
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<td>3 / 2,4</td>
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**FIG. 9.3**

- J-SWC20C64
- J-SWC2312R
- J-CU12
- J-8C2149XX
- J-8C214900
- J-8C214921
- J-J0VNR112
- J-J01TP270
- J-J01TP212
- J-J01TP215
- J-1C2RP752
- J-1C2RP750
- MR-TRICO600
- J-KBIT0130-C
- J-KBIT0130
- J-1C2RP300
- J-1C2RP200
- J-1C2RP100
- J-1C2RP400
- J-J01TP270
- J-J01TP212
- J-J01TP215
- J-1C2RP752
- J-1C2RP750
- MR-TRICO600
- J-KBIT0130-C
- J-KBIT0130

**D.114 C2 RP**

**Rev. 11 del 14-03-2019**
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<th>EURO/CAD EURO/EACH</th>
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<td>J-1C2RP750</td>
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<td>J-CU12</td>
<td>GUARNIZIONE UGELLO CEMENTO D.1/2“</td>
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<td>J-J33TB012</td>
<td>TAPPO M. 1/2” GAS EX INC</td>
<td>M. PLUG 1/2” GAS EX INC</td>
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<td>J-8C214900</td>
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<td>8C214900 AIR NOZZLE REMOVING TOOL</td>
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<td>J-8C21490T</td>
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<td>1”1/4 AIR NOZZLE M. PLUG</td>
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<td>BIT D.130 A CROCE FIL 78</td>
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<td>MR-TRIC0600</td>
<td>TRICONO D.6” L2 IADC311 3”1/2 ARM</td>
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<td>J-SWC2312-R</td>
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<td>KIT GUARNIZIONI SWIVEL SOTTO TESTA C2 JET</td>
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</table>
10 JET GROUTING WITH DEVIATION MEASUREMENT

In jet grouting it is very important knowing the real position of the grout column, especially when jet grouting is used for soil impermeabilization and there must not be gaps between columns. In this chapter we give indications on which adapters you need for assembling TIGOR BIJET by Jean Lutz on CRM double fluid system.

Nel Jet Grouting è molto importante conoscere l'esatta posizione della colonna di cemento, specialmente quando si tratta di impermeabilizzazioni del terreno e non ci deve essere distanza tra le varie colonne.

In questo capitolo si forniscono le indicazioni su quali adattatori sono necessari per assemblare il TIGOR BIJET di Jean Lutz sul sistema bifluido CRM.

Figure courtesy of Jean Lutz
10.1 D.114 C2 SYSTEM WITH TIGOR BIJET D.127

**FIG. 10.1**

- **D.114 C2 ROD**
  - L=3000
  - J-1C212300

- **ADAPTER**
  - D.114 C2 F/M D.127 C2
  - J-1C212CZ8

- **TGB7N23C**

- **TIGOR BIJET D.127**

- **TGB7N13L**

- **ADAPTER**
  - D.127 C2 M/M D.114 C2
  - J-1C212C2C

- **AIR ADAPTER WITH NO RETURN VALVE**
  - J-1C212702

- **NOZZLE HOLDER**
  - D.114 C2
  - J-1C212483

- **D.114 C2 BIT ADAPTER WITH NO RETURN VALVE**
  - J-1C212752

**TAM (NO-MAGNETIC ROD)**

**FOR SUB-HORIZONTAL DRILLING ONLY**
10.2 D.127 C2 SYSTEM WITH TIGOR BIJET D.127

- **D.127 C2 ROD**
  - L=3000
  - J-12C23000

- **ADAPTER**
  - D.127 C2 M/F
  - J-12C2MF13

- **TIGOR BIJET D.127**
  - TGB7N23C

- **TAM (NO-MAGNETIC ROD)**
  - FOR SUB-HORIZONTAL DRILLING ONLY

- **AIR ADAPTER WITH NO RETURN VALVE**
  - J-12C20702

- **NOZZLE HOLDER**
  - D.127 C2
  - J-12C20483

- **D.127 C2 BIT ADAPTER WITH NO RETURN VALVE**
  - J-12C20752

**FIG. 10.2**