Overview
Sonic Drilling Technology
Overview

Sonic Rig/Tooling Manufacturer

Sonic Drill Service Provider (2012)
- 10 Sonic Drill Rigs (Trucks, Crawlers, Compact Crawlers)
  - 11<sup>th</sup> in production
  - Experienced Operators – Average >10 Yrs Sonic Experience

Small Business

Excellent safety record

2 Additional Locations in 2015
Current Locations
Integration of Complete Sonic Systems

Operations & Maintenance Training

Compact and Large Sonic

Oscillator Rebuild/Exchange

Complete Tooling
Full Capacity Manufacturing

*Complete Sonic Line*

- Compact Sonic Rigs (ATVs)
- Large Sonic Rigs
- Crawlers (ATVs)
- Truck Mount
- Skid Mount
- TSi Sonic Oscillators
- TSi Sonic Tooling
- Training
- Service
- Support

150,000 square foot facility
**TSi 150T**  
*Truck-Mounted*

- Sonic Power: 22,680 kg, 50,000 lbs. force
- Drill Capacity: 244 meters, 800 feet
- Tooling: 76mm-300mm, 3in-12in
- Torque: 6.3kNm, 4677 ft. lbs.
- Rotation: 80 rpm
- Frequency: 0-150 Hz.
- Horse Power: 186kw, 250 HP

**TSi 150T Sonic Rigs**

Separate deck engines and independent decks enable the TSi 150T to be mounted on any TSi approved truck frame anywhere in the world.
**TSi 150C Crawler**

- Sonic Power 22,680 kg, 50,000 lbs. force
- Drill Capacity 244 meters, 800 feet
- Tooling 76mm-300mm, 3in-12in
- Torque 6.3kNm, 4677 ft. lbs.
- Rotation 80 rpm
- Frequency 0-150 Hz.
- Horse Power 207kw, 278 HP

**TSi 150C Sonic Rigs**

The independent crawler with 278 HP engine drives the hydraulic pumps via PTO. The 150 series Sonic Rigs are the largest most robust in the industry, consistently drilling to the deepest depths achievable by Sonic.
**TSi 150CC**

**Compact Crawler**

- Sonic Power 22,680 kg, 50,000 lbs. force
- Drill Capacity 244 meters, 800 feet
- Tooling 76mm-300mm, 3in-12in
- Torque 6.3kNm, 4677 ft. lbs.
- Rotation 80 rpm
- Frequency 0-150 Hz.
- Horse Power 168kw, 225 HP

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**TSi 150CC Sonic Rigs**

The most versatile rig in the fleet, the TSi 150CC Compact Crawler utilizes the largest TSi 150 Series Sonic Oscillator, and can fit inside a 20 cubic yard sea container.
Drilling with Sonic Technology

What is Sonic Drilling?
“An mechanically induced vibration, created by an oscillation that repeats itself across a point of equilibrium.”

TSi 150 Sonic Head
Drilling with Sonic Technology

Resonant Sonic Drill Head

A wave force energy vertically oriented and coupled to tubular drill steel, delivering 50,000 pounds of oscillating force at a frequency of 150 hertz.
Drilling with Sonic Technology

Effect of the Energy Transferred to the Drill Pipe

Energy is stored in the elastic properties of the drill pipe allowing wave propagation bringing the pipe into resonance.
Drilling with Sonic Technology

Soil Fluidization and Liquefaction

- Stress waves move through the drill pipe inducing the fluidization or friction reduction of the formation by breaking the elastic bonds of the soil.

- Soil with water acts as a liquid lubricating the inside and outside of the casing, rods, and core barrels, sharply reducing resistance to penetration and side-wall skin friction.
Sonic Drilling Procedure

**Core Barrel Advancement**
No fluids, air, or mud used during coring.

**Casing Override**
Water possibly used between casings.

**Core Barrel Retrieval**
Barrel retrieval for sample extrusion.

**Repeat Core Barrel Advancement**
Advancement following sample extrusion.

**Step 1**

**Step 2**

**Step 3**

**Step 4**
Sonic Benefit
Sampling & Recovery

- Overburden
- Reinforced Concrete
- Rip-Rap
- Sands
- Gravels
- Cobbles
- Boulders
- Slag Piles
- Bedrock
- Delicate Formations
Drill Tooling
Sonic Samples
Sonic Samples
PQ Core Samples
Why Is Sonic Drilling Used

- **Speed**
  - 2-3 times faster than conventional drilling

- **Superior Information (continuous core sample)**
  - Lithology/geochemistry/hydrogeological

- **Waste Minimization**
  - ~80% less IDW than conventional drilling methods due to cased hole
  - Ability to “dry” drill

- **Better Well Construction**
  - Less development time/better yield

- **Safer and Cleaner**
  - No flights – just smooth drill tooling (great for landfill applications)
  - Elevated platform

- **No refusal**
  - Drill through cobbles, boulders, & hard layers/lenses
  - Great for heaving sands

- **Flexibility and Reduced Risk for Mistakes**
  - Ability to collect discrete water samples & inject remediation fluids
  - Angle wells/multi-cased wells w/o leaving casing in ground
  - Ability to shift to split spoons, shelby tubes, and/or coring
  - No cross-contamination
Drilling with Sonic Technology

Sonic Applications

- Environmental
- Mineral Exploration
- Geotechnical
- Geothermal
- GeoConstruction
Drilling with Sonic Technology

**Environmental Drilling**

- Continuous Soil Cores
- Ground Water Well Installations
- Ground Water Samples
- Vapor Extraction Wells
- Remediation Injection Points
Precision Drilling

- Auger
- Mud Rotary
- Sonic

10% Radius Potential Travel from Center of Well

20% Radius Potential Travel from Center of Well

No Travel Potential
Well Installation

Auger
- Inject grout, remove auger.
  *Note: poor adhesion to borehole wall, voids and bridging.

Sonic
- Inject grout mixture.
  *Note: Grout “knitted” into borehole wall.

Vibrate and remove Sonic casing: no voids or bridging.
Water Sampling
Eliminates Cross Contamination
Eliminates Cross Contamination
Sonic Applications - Investigations

- Contaminated Soil and Groundwater Investigations
- Plume Delineation – Vertical Aquifer Profiling
- Monitor Well/Recover Well Installation
- Deep Earth Dam/Levee Investigative Sampling
- Landfill Investigations/Expansions
- MGP Site Characterizations
- Mine Tailings Investigations
- Quantification of Aggregate Resources
Sonic Applications - Remediations

- Freeze Hole Boring – Earth Stabilization
- Micro-Pile Installation
- Earth Anchors Installation
- Grout Verification Sampling
- Effectiveness of Soil Mixing Applications
- Grouting – Grout Curtain Installation
- Air Sparge/Bioremediation Curtains
- Remedial Injections
Truck Sonic Rig
Bridge Crane
Crawler/Support Rig
Catch The Sonic Wave
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Saving Time and Money

• The bigger the job the more you save
  – “We have a quote for installation by H.S.A. and the IDW generated is enormous.” Your sonic quote “was about half the other quotes. It looked good.”
  – North Florida client
TerraSonic International is proud to work with:

- URS
- AECOM
- ARCADIS
- HDR
- CH2M
- GES
- Duke Energy
- Lehigh Hanson
- TRS
- CBI
- Golder Associates
- Geosyntec
- United States Environmental Protection Agency
- US Army Corps of Engineers
- S&ME
- CEC
- Cardno
- CDM Smith
- Kleinfielder
- Tetra Tech
- Black & Veatch
- Terracon
- PSI
- Gannett Fleming
Teaming with Other Suppliers

• Terra Sonic and Pine Environmental worked together on a recent project for CH2M Hill.
• SOW included 15 soil borings to 35 feet with discreet water sampling.
• Pine used their Frog system to analyze the samples.
Questions?

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