Metal Detector
Search Coil 101

by Lee Wiese
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http://www.mdhtalk.org
Search Coil

A circular (or other shaped) plastic housing containing single or multiple transmit and receive windings (wire coils) in a specific configuration.
Metal Detecting Search Coils
Names & Differences

A Search Coil Can be Called

- Antenna
- Coil
- Head
- Loop
- Spider Coil

Differences Between Search Coils

- Configuration (Concentric, Widescan or Doubt “D”, Mono)
- Shape (Circular, Elliptical, Open Web or Spider)
- Size (4 to 18 + inches)
Search Coils Types

**Concentric coil** uses two separate coils of wire, a Transmit & a Receive coil, one inside the other.

**Widescan coil** or (DD) uses two Transmit & two Receive D-shaped coils of wire that are placed back to back.

**Mono coil** uses one coil of wire for both the Transmit and Receive function.

**Note:** [Printed Spiral Search Coil](#) is made only by Tesoro for use with pulse induction circuitry. It offers good sensitivity to a broader range of target sizes and improved sensitivity to less conductive targets such as fine gold chains.

**Note:** [Big Foot Coil](#) is becoming very popular with competition hunters; also called the "figure eight" loop. This coil is very efficient for fast searching. The search area of this narrow 18 inch rectangular coil is nearly the entire coil.

**Note:** [Mono Coils](#) are for MPS technology detectors (SD & GP Series), Eric Foster’s High End PI Detectors.
### Metal Detecting Search Coils

**Concentric Search Coils**
Circular, Elliptical and Spider

<table>
<thead>
<tr>
<th>Size</th>
<th>4 inch</th>
<th>5.3 inch</th>
<th>7 inch</th>
<th>8 inch</th>
<th>9.5 inch</th>
<th>11 inch</th>
<th>9 x 12 inch</th>
<th>12 inch</th>
</tr>
</thead>
</table>

**Widescan (DD) - Double “D” Search Coils**
Circular, Elliptical

<table>
<thead>
<tr>
<th>Size</th>
<th>4 x 6 inch</th>
<th>8 inch</th>
<th>6 x 10 inch</th>
<th>10.5 inch</th>
<th>12 inch</th>
<th>14 inch</th>
<th>18 inch</th>
</tr>
</thead>
</table>
Search Coil Construction

- **Transmitter Coil** - The outer coil acts as the transmit antenna
- **Receiver Coil** - This inner coil loop acts as the receiver antenna

Search Coil Operation

- The Detector’s Electronics control an oscillator (an electric circuit capable of switching on and off very quickly determined by the Detectors Operating Frequency). This signal is directed to the search coil producing an electromagnetic field in the transmitter search coil.

- If the search coil is resting on the ground, the field it generates will extend outwards and downwards to a *depth roughly equal to the diameter of the coil for coin size targets*. When the coil’s magnetic field detects an alteration in the magnetic field, the control electronics produce a corresponding change in the detectors speaker tone or on the detectors display.

- This change tells us that we have detected a buried metallic object.
Search Coil Magnetic Field Pattern

Balanced Fields

Note: *Coil Height Above the Ground* The **Higher the Coil** the Less Ground Magnetic Penetration
Metal Detecting Search Coils
Scan Patterns

Search Coil Scan Pattern

Pattern View:

Widescan (DD)    Concentric    Mono

Ground Covered While Sweeping

Widescan (DD)    Concentric
### Metal Detecting Search Coils

#### Coil Size

<table>
<thead>
<tr>
<th>Factory Add on Coil</th>
<th>Factory Installed Coil</th>
<th>Factory Add on Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coil Size</strong></td>
<td><strong>4 inch</strong></td>
<td><strong>5.3 inch</strong></td>
</tr>
<tr>
<td></td>
<td><strong>7 inch</strong></td>
<td><strong>8 inch</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>9.5 inch</strong></td>
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<tr>
<td></td>
<td></td>
<td><strong>14 inch</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>18 inch</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>++</strong></td>
</tr>
</tbody>
</table>

#### Performance Metrics

<table>
<thead>
<tr>
<th>Trash</th>
<th>Depth</th>
<th>Target Separation</th>
<th>Ground Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Good</td>
<td>Poor</td>
<td>Very Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Fair</td>
<td>Good</td>
<td>Fair</td>
<td>Good</td>
</tr>
<tr>
<td>Poor</td>
<td>Very Good</td>
<td>Poor</td>
<td>Very Good</td>
</tr>
</tbody>
</table>

*Note: The chart above provides a comparison of different coil sizes for metal detecting, highlighting their performance in terms of trash handling, depth sensitivity, target separation, and ground coverage.*
## Search Coil Comparison

<table>
<thead>
<tr>
<th></th>
<th>Concentric Coil</th>
<th>DD Coil</th>
<th>** Mono Coil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Factor:</td>
<td>Noise in Mineralized soils</td>
<td>Less ........... Less</td>
<td>Good</td>
</tr>
<tr>
<td>Ground Coverage:</td>
<td>Fair</td>
<td>Very Good .. Very Good</td>
<td>Good</td>
</tr>
<tr>
<td>Sweep Profile:</td>
<td>Half Overlap</td>
<td>Little Overlap . Little Overlap</td>
<td>Half Overlap</td>
</tr>
<tr>
<td>Sensitivity:</td>
<td>Greater</td>
<td>Less ........... Less</td>
<td>Greater</td>
</tr>
<tr>
<td>Operating Mode:**</td>
<td>All Modes</td>
<td>All Mode ...... All Modes</td>
<td>All Metal</td>
</tr>
<tr>
<td>Pin Pointing:</td>
<td>Center</td>
<td>Toe / Heel ...... Toe / Heel</td>
<td>Center</td>
</tr>
<tr>
<td>Pin Point Difficulty:</td>
<td>Easiest</td>
<td>Hard ............... Hard</td>
<td>Easiest</td>
</tr>
<tr>
<td>Coil Penetration Profile:</td>
<td>Cone Shape</td>
<td>Chisel Shape ... Chisel Shape</td>
<td>Cone</td>
</tr>
<tr>
<td>Number of Windings:</td>
<td>Two</td>
<td>Four ............... Four</td>
<td>One</td>
</tr>
<tr>
<td>Ground Balancing:</td>
<td>Good</td>
<td>Superior ............ Superior</td>
<td>Difficult</td>
</tr>
</tbody>
</table>

** Operating Mode = Discrimination and All Metal

** Mono Coils are for MPS technology detectors (SD & GP Series), Eric Foster’s High End PI Detectors
Detector / Search Coil Depth:

- **Depth** is Dependant on **Soil Conditions** - Mineralization, Moisture, Trash

- **Depth** is Dependant on **Target Material** - Type, Position, Size, Shape

- **Depth** is Dependant on the **Detector & Adjustments** – ie: All Metal vs. Discrimination, etc

- **Depth** is Dependant on **Operator Usage and Swing** – Coil Level, Height, Speed

- **Depth** is Dependant on the **Coil - Configuration, Shape, Size**

- **Depth** is Dependant on the **Magnetic Field Penetration into the Ground**
Search Coil Magnetic Field Pattern

Balanced Fields

Unbalanced Fields

Note: *Coil Height Above the Ground*, the **Higher the Coil** the Less Ground Magnetic Penetration
DD Coils Used for Air Test are: 5”, 8”, 10.5”, 15”
Detector Adjustments Held Constant for all Coils Sizes
Metal Detecting Search Coils

DD Coils Used for Air Test are: 5”, 8”, 10.5”, 15”
Concentric Used for Air Test are: 4”, 9.5”, 12”
Detector Adjustments Held Constant for all Coils Sizes
To Recap

- **Depth** is dependant on **Soil Conditions** - Mineralization, Moisture, Trash
- **Depth** is dependant on **Target Material** - Type, Position, Size, Shape
- **Depth** is dependant on the **Detector & Adjustments** – ie: All Metal vs. Discrimination, etc
- **Depth** is dependant on **Operator Usage and Swing** - Coil Level, Height, Speed
- **Depth** is dependant on the **Coil** - Configuration, Shape, Size
- **Depth** is dependant on the **Magnetic Field Penetration into the Ground**
Search Coil Class 101

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