Metal Detecting Search Coils

Metal Detector Search Coil 101

by Lee Wiese
March 1, 2008
Update: Sept. 2013
Update: May 15, 2016
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)
Metal Detecting Search Coils

Coil Types

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

Widescan (DD) - Double “D” Search Coils
Circular, Elliptical
Metal Detecting Search Coils
Construction & Operation

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.
Metal Detecting Search Coils
Field Patterns

Search Coil Magnetic Field Pattern

Balanced Fields

Unbalanced 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

<table>
<thead>
<tr>
<th>Pattern View:</th>
<th>Side</th>
<th>Front</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Widescan (DD)</strong></td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
</tr>
<tr>
<td><strong>Concentric</strong></td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
<tr>
<td><strong>Mono</strong></td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
</tr>
</tbody>
</table>

### Ground Covered While Sweeping

**Widescan (DD)**

![Image](image7)

**Concentric**

![Image](image8)
# 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>Coil</strong></td>
<td><strong>Class</strong></td>
</tr>
<tr>
<td>4 inch</td>
<td>5.3 inch</td>
<td>7 inch</td>
</tr>
<tr>
<td>8 inch</td>
<td>9.5 inch</td>
<td>10.5 inch</td>
</tr>
<tr>
<td>12 inch</td>
<td>14 inch</td>
<td>18 inch ++</td>
</tr>
</tbody>
</table>

## Comparison of Factory Add on and Factory Installed Coils

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

5/15/2016

Metal Detecting Hobby Talk
http://www.mdhtalk.org
# Metal Detecting Search Coils Comparison

## 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><strong>Noise Factor:</strong></td>
<td>Noise in Mineralized soils</td>
<td>Less .......... Less</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Ground Coverage:</strong></td>
<td>Fair</td>
<td>Very Good ..... Very Good</td>
<td>Good</td>
</tr>
<tr>
<td><strong>Sweep Profile:</strong></td>
<td>Half Overlap</td>
<td>Little Overlap . Little Overlap</td>
<td>Half Overlap</td>
</tr>
<tr>
<td><strong>Sensitivity:</strong></td>
<td>Greater</td>
<td>Less .......... Less</td>
<td>Greater</td>
</tr>
<tr>
<td><strong>Operating Mode:</strong>**</td>
<td>All Modes</td>
<td>All Mode ...... All Modes</td>
<td>All Metal</td>
</tr>
<tr>
<td><strong>Pin Pointing:</strong></td>
<td>Center</td>
<td>Toe / Heel ...... Toe / Heel</td>
<td>Center</td>
</tr>
<tr>
<td><strong>Pin Point Difficulty:</strong></td>
<td>Easiest</td>
<td>Hard .......... Hard</td>
<td>Easiest</td>
</tr>
<tr>
<td><strong>Coil Penetration Profile:</strong></td>
<td>Cone Shape</td>
<td>Chisel Shape ... Chisel Shape</td>
<td>Cone</td>
</tr>
<tr>
<td><strong>Number of Windings:</strong></td>
<td>Two</td>
<td>Four .......... Four</td>
<td>One</td>
</tr>
<tr>
<td><strong>Ground Balancing:</strong></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*
Metal Detecting Search Coils
Once Again

Search Coil Magnetic Field Pattern

Note: *Coil Height Above the Ground*, The **Higher the Coil** the Less Ground Magnetic Penetration
Metal Detecting Search Coils
Air Test

DD Coils Used for Air Test are: 5”, 8”, 10.5”, 15”
Detector Adjustments Held Constant for all Coils Sizes

Major Brand Detector Coil Depth Air Test

Coil Diameter (Inches)
Coil Sizes are: 5, 8, 10.5, 15 Inch

- 2 Gram Gold Ring
- One Silver Dollar
- Sode Can
- Silver Quarter

Coil Diameter = Coil Depth
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

Metal Detecting
Search Coil Class

Major Brand Detector Coil Depth Air Test

Coil Sizes are: 4, 5, 8, 9.5, 10.5, 12, 15 Inch. (C = Concentric Coil)

2 Gram Gold Ring  One Silver Dollar  Sode Can  Coil Diameter = Coil Depth
Silver Quarter
Metal Detecting Search Coils

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

Link to: Metal detectors coil and search head design - Patents and Utility Models