




### OVERVIEW

- Walkover Locating Systems and signal
- Range
- Interference
- Determining Interference Signature
- Falcon Technology
- Case Histories





### WALKOVER GUIDANCE SYSTEM SIGNAL

Magnetic Field


- Direction
- Location
- Depth

Data Signal

- Roll
- Pitch
- Temperature
- Battery Status
- Fluid Pressure

A diagram showing concentric blue circles representing magnetic field lines above a dark ground surface. A red glow is visible on the ground surface. The text 'TRANSMITTER FIELD LINES' is written in the upper left of the diagram.

### RANGE OF A TRANSMITTER


A photograph of a construction worker wearing a hard hat and a high-visibility vest, walking on a dirt path. In the background, there is yellow construction equipment.

Signal strength

- Transmitting antenna
- Transmitted power
- Regulations


Signal reception

- Receiver design
- Signal processing
- Interference



### METHOD OF DETERMINING RANGE


J2520 is a SAE standard which defines how the range of a guidance system is to be determined.



1 m

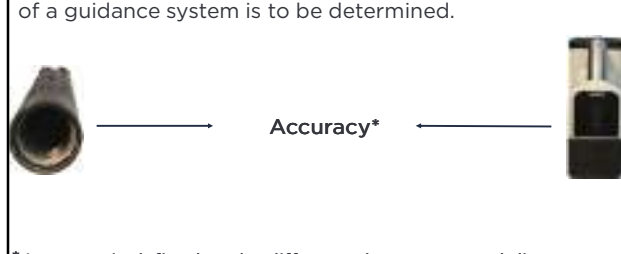
1 m

**\* Maximum distance where depth or data readings are lost**




### METHOD OF DETERMINING ACCURACY

J2520 is a SAE standard which defines how the range of a guidance system is to be determined.





**\*Accuracy is defined as the difference between actual distance and measured distance divided by actual distance expressed as % error**




### INTERFERENCE

Interference in the context of HDD locating is generally defined as being either active or passive.

### ACTIVE AND PASSIVE INTERFERENCE

<b>Active interference</b>	<b>Passive interference</b>
“Anything that emits a signal or generates its own magnetic field”	“Anything that blocks, absorbs or distorts a magnetic field”



### EFFECTS OF ACTIVE INTERFERENCE

- Erratic signal strength readings
- Erratic or impaired depth readings
- Loss of pitch and roll (data) signal
- Inaccurate depth calibration



### ACTIVE INTERFERENCE SOURCES



- Power Lines
- Traffic Signal Loops
- Cathodic Protection
- Cell Towers
- Security systems
- Unknown sources



### EFFECTS OF PASSIVE INTERFERENCE

- Depths may appear greater than actual
- Depths may appear less than actual
- All information may be blocked
- Drill head direction may be inaccurate
- Drill head location may be inaccurate
- Inaccurate receiver calibration may lead to depth errors



### PASSIVE INTERFERENCE SOURCES



- Reinforced concrete
- Salt Water
- Metal Fencing
- Conductive soils
- Guard Rails
- Unknown sources



### IDENTIFYING ACTIVE INTERFERENCE

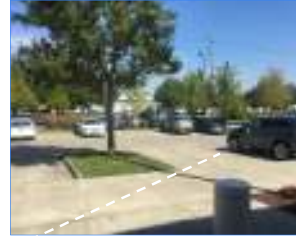
Use the receiver to measure interference by walking the bore path with transmitter powered off.



Signal measured must therefore be from other sources, i.e. interference



### IDENTIFYING PASSIVE INTERFERENCE



The potential for passive interference must be determined by observation.

Are parts of the bore path under reinforced concrete?

What other metallic structures or obstacles are present?



### TRADITIONAL MEANS OF DEALING WITH INTERFERENCE

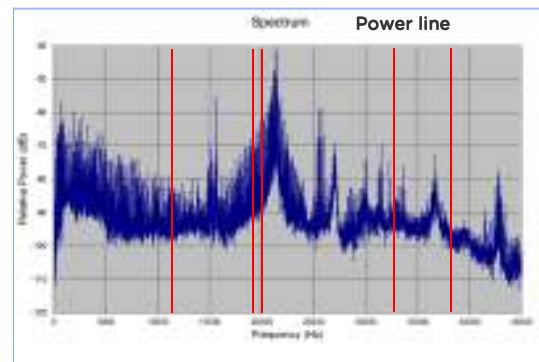
Achieve separation between the receiver and the source of interference

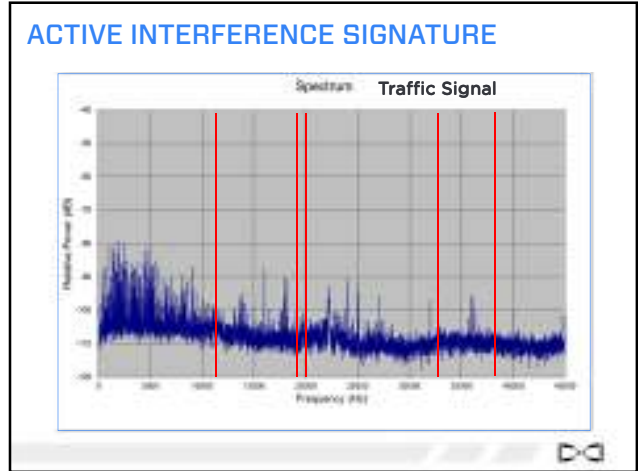
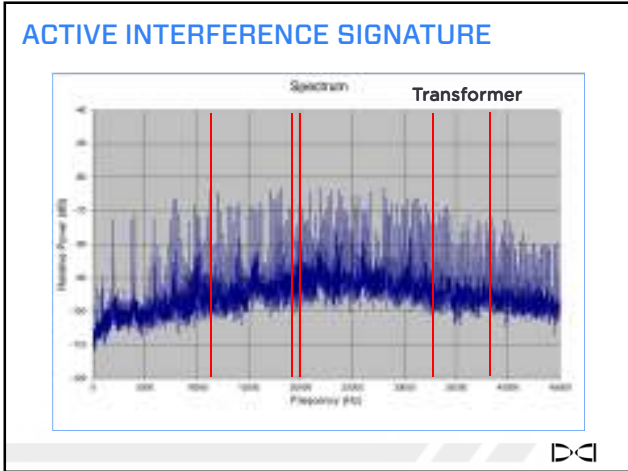
Use a different transmitting frequency

Use a more powerful (greater range) transmitter



### ACTIVE INTERFERENCE SIGNATURE





### FALCON TECHNOLOGY

Interference varies from site to site

There is no optimum operating frequency

Avoiding interference is more effective than trying to overpower it

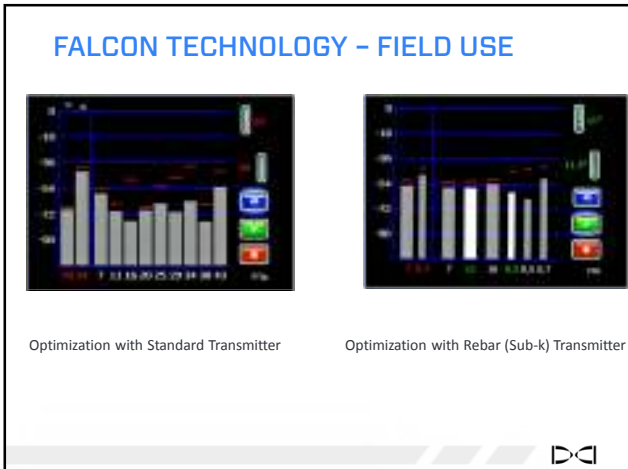
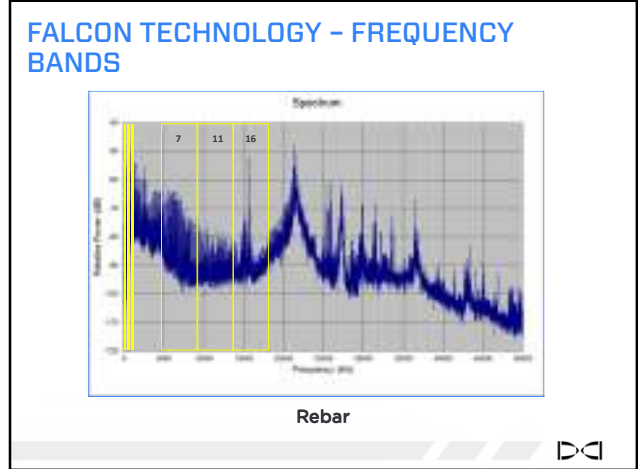
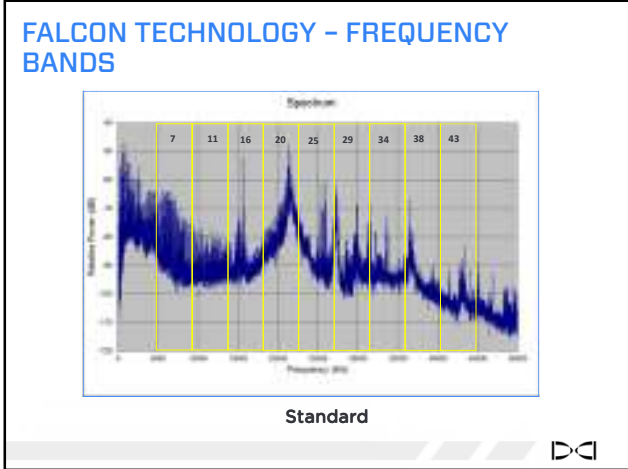


### FALCON TECHNOLOGY - FUNDAMENTALS



- Scan - analyze active interference
- Optimize - Find best frequencies
- Pair - Choose and pair bands





### FALCON TECHNOLOGY - FIELD USE

Once the bands have been chosen, the receiver and transmitter are paired using infrared (IR) ports.

During the pairing process the receiver communicates the selected frequencies to the transmitter.

A photograph showing a person's hands holding two devices. One device is a handheld transmitter with a green antenna, and the other is a handheld receiver. They are positioned close together, demonstrating the pairing process.

**FALCON TECHNOLOGY - STRONG ACTIVE INTERFERENCE**



**Munster, Indiana (US)**

- 600 mm gas line, 365 m in length
- Maximum depth of 13 m
- Heavy active interference due to overhead power and in-ground utilities
- Wireline guidance system planned for guiding the pilot bore the contractor (NPL)
- Electronic bore profile required by client for approval before pull back could begin



**FALCON TECHNOLOGY - STRONG ACTIVE INTERFERENCE**

**Munster, Indiana (US)**

Pretest above ground with **F5 (classic)** system

- 12 kHz - Roll/Pitch data lost at 3.7 m distance
- 19 kHz - Roll/Pitch lost at same distance
- 12 and 19 kHz frequencies were hit hard

Pretest above ground with **Falcon F5** system

- Scanning revealed band 43 as optimum
- Roll/Pitch solid to a distance of 13 m
- Distance (depth) readings accurate at 13 m
- Decision made to drill with Falcon F5 system



**FALCON TECHNOLOGY - STRONG ACTIVE INTERFERENCE**

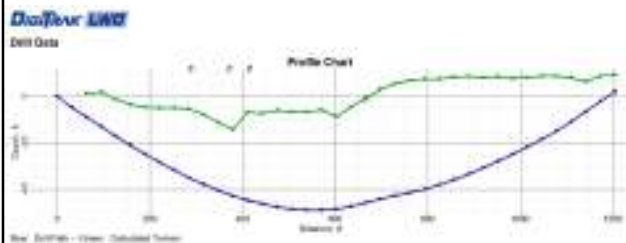


**Results**

- Pilot bore completed in 13 hours
- No loss of Roll/Pitch data
- Depth and location readings were not affected
- The client accepted the bore profile
- The Log While Drilling (LWD) documentation verified the accuracy of the readings



**FALCON TECHNOLOGY - STRONG ACTIVE INTERFERENCE**



**FALCON TECHNOLOGY - HEAVY PASSIVE INTERFERENCE**

**San Diego, California (US)**

- 50 mm conduits, 150 m in length
- Depth of 2 m
- Going beneath active taxiways at San Diego International Airport
- Heavily reinforced concrete, 600 mm thick
- Drilling could only take place between midnight and 5 in the morning

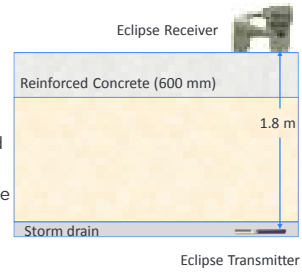


**FALCON TECHNOLOGY - HEAVY PASSIVE INTERFERENCE**

**San Diego, California (US)**

Above ground test with **Eclipse** system

- Drainage pipe at 1.8 m depth
- Contractor had to prove to inspectors that guiding the head was achievable
- Depth readings with Eclipse were around 3.5 m and location was incorrect.
- Airport authorities did not allow drilling to commence.

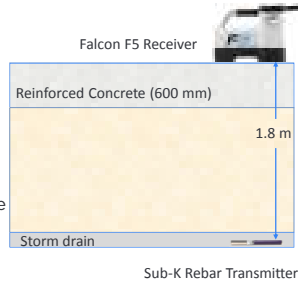


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**FALCON TECHNOLOGY - HEAVY PASSIVE INTERFERENCE**



**Results**

- Pilot bore completed in under 2 hours
- No issues with guiding the head
- Receiving pit hit at target depth
- 12 total bores successfully completed
- Every bore logged using Falcon LWD and iGPS





### FALCON TECHNOLOGY - HEAVY PASSIVE INTERFERENCE



### SUMMARY

- Interference is encountered on majority of job sites
- The underground is increasingly more crowded
- Traditional means of dealing with interference becoming less effective
- Avoiding interference more effective than trying to overpower it
- Identify local interference and choose optimum frequencies
- The guidance system can now be “custom fitted” to each job site

QUESTIONS ?