Sound 1

Microphones

Classification:

Microphones are classified by:

Classification:

Microphones are classified by:

– Operating Principle

Classification:

Microphones are classified by:

– Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

Classification:

Microphones are classified by:

- Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?
- Directional Characteristic

Classification:

Microphones are classified by:

- Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?
- Directional Characteristic -- How does the microphone respond to sound arriving from different directions?

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

– Carbon

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo (piezo-electric)

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo
- Dynamic

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo
- Dynamic (moving coil)

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo
- Dynamic
- Ribbon

Classification:

Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo
- Dynamic
- Ribbon
- Condenser

Classification:

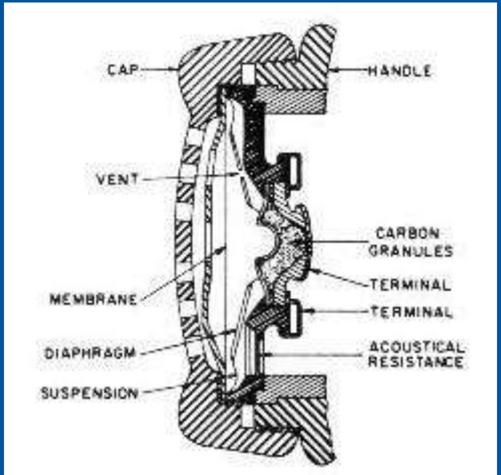
Operating Principle -- What physical principle is used to convert mechanical energy into electrical energy?

- Carbon
- Piezo
- Dynamic
- Ribbon
- Condenser (capacitor)

Carbon Microphone:

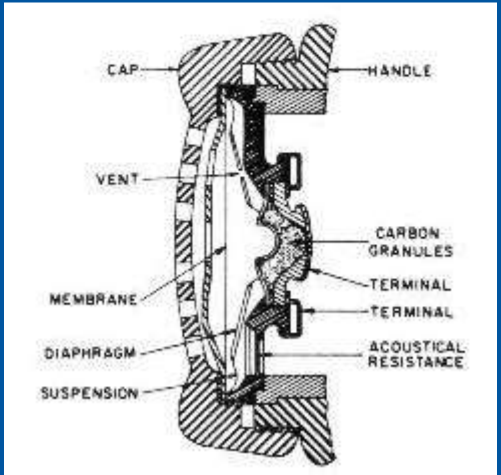
Carbon Microphone:

The movement of the diaphragm compresses carbon granules, varying the electrical current.



Carbon Microphone:

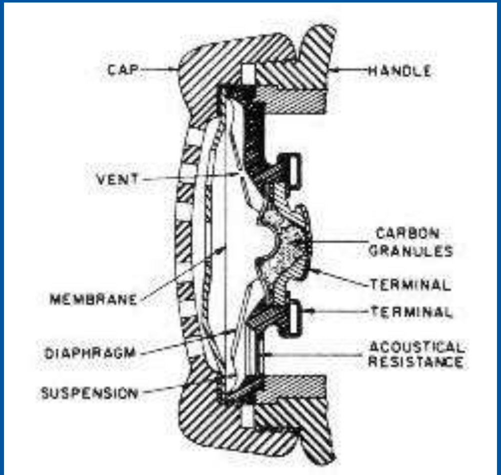
Advantages:



Carbon Microphone:

Advantages:

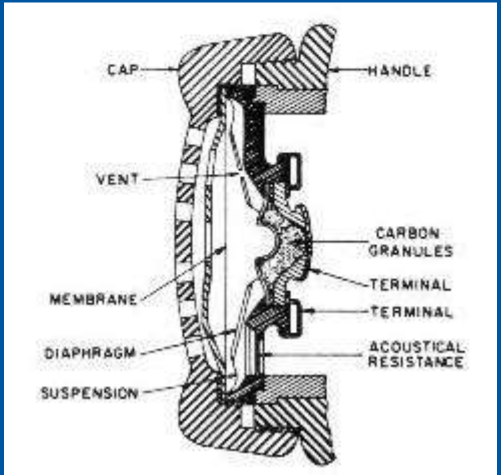
- Cheap to manufacture



Carbon Microphone:

Advantages:

- Cheap to manufacture
- Rugged

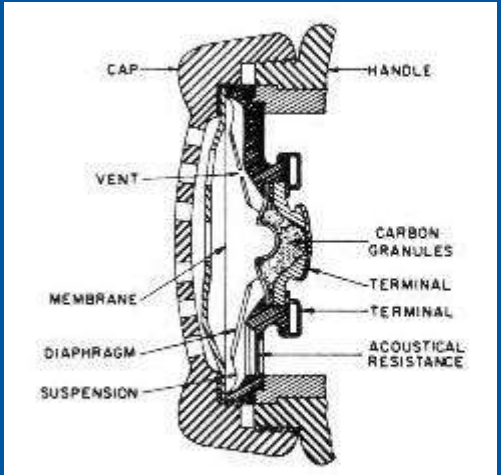


Carbon Microphone:

Advantages:

- Cheap to manufacture
- Rugged

Disadvantages:



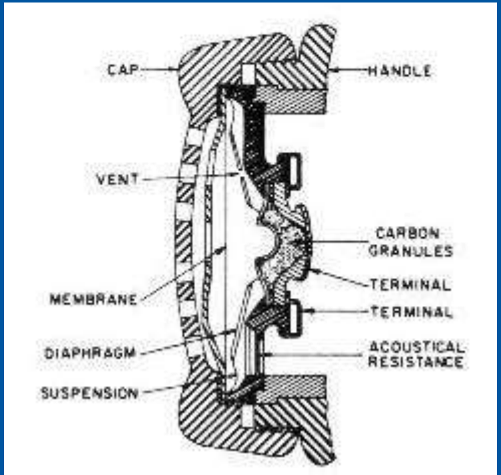
Carbon Microphone:

Advantages:

- Cheap to manufacture
- Rugged

Disadvantages:

- Requires external power source



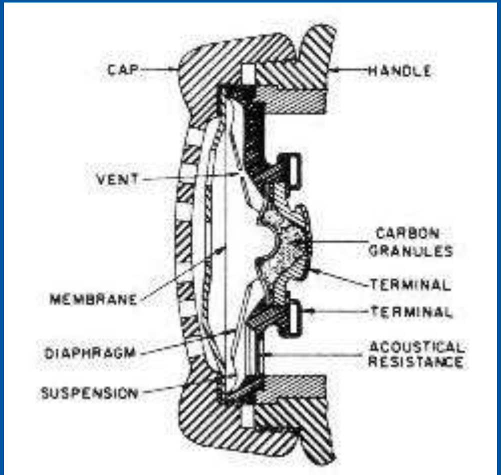
Carbon Microphone:

Advantages:

- Cheap to manufacture
- Rugged

Disadvantages:

- Requires external power source
- Limited frequency range



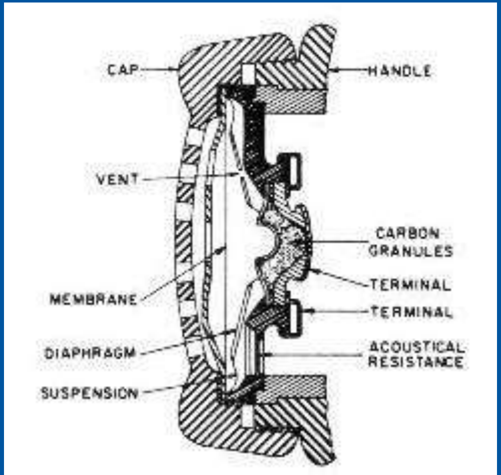
Carbon Microphone:

Advantages:

- Cheap to manufacture
- Rugged

Disadvantages:

- Requires external power source
- Limited frequency range
- Limited sensitivity



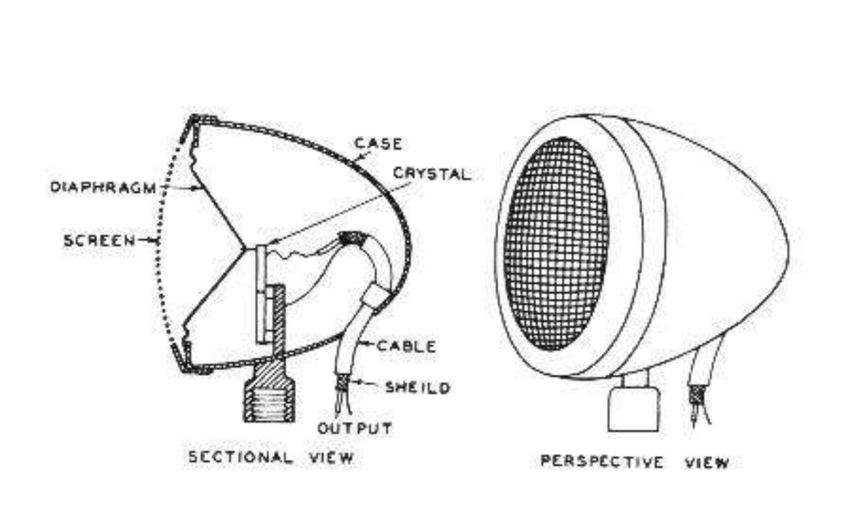
Carbon Microphone:

Piezo-electric Microphone:

Piezo-electric Microphone:

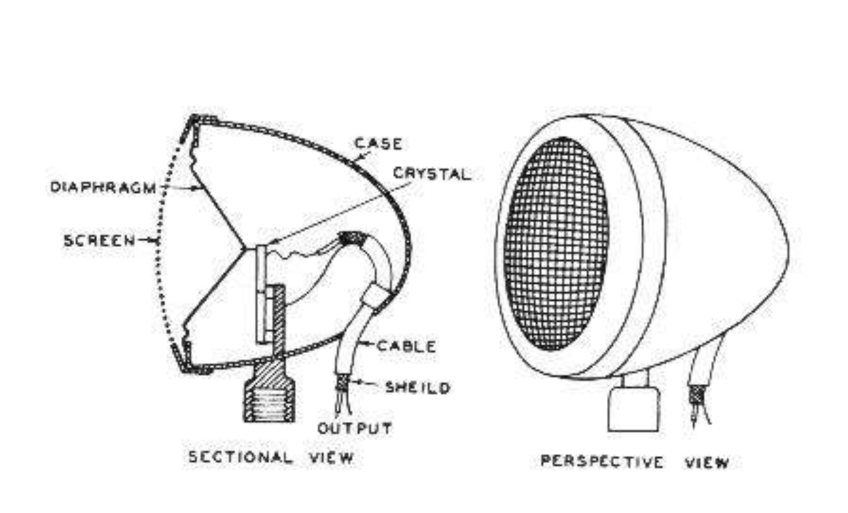
The movement of the diaphragm bends a crystalline materiel, varying the electrical current generated.

(Same principle as a BBQ starter wand.)



Piezo-electric Microphone:

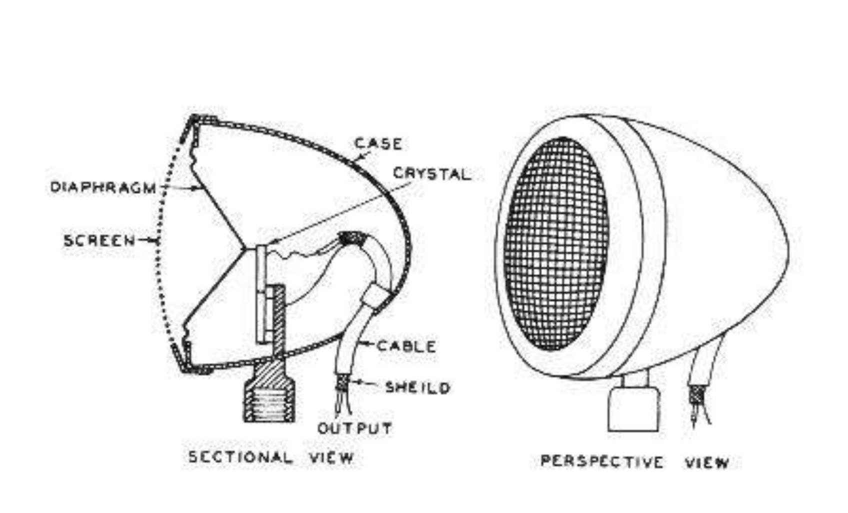
Advantages:



Piezo-electric Microphone:

Advantages:

- Cheap to manufacture

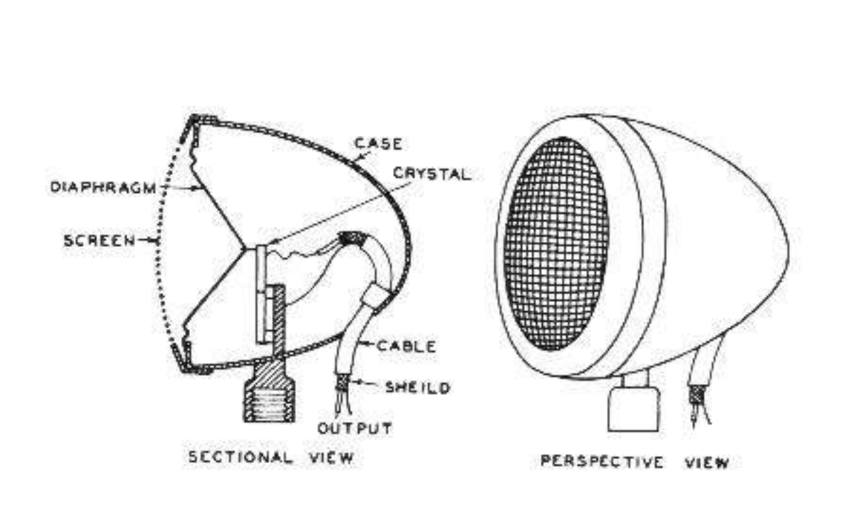


Piezo-electric Microphone:

Advantages:

- Cheap to manufacture

Disadvantages:



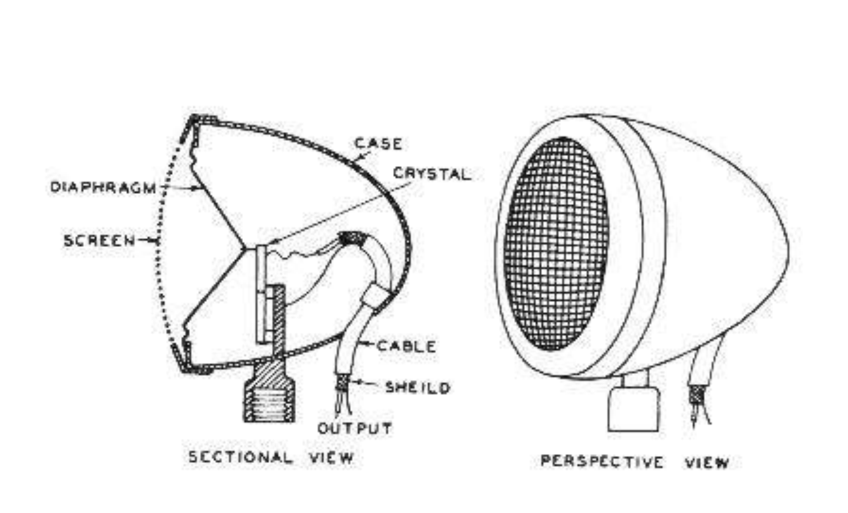
Piezo-electric Microphone:

Advantages:

- Cheap to manufacture

Disadvantages:

- Fragile



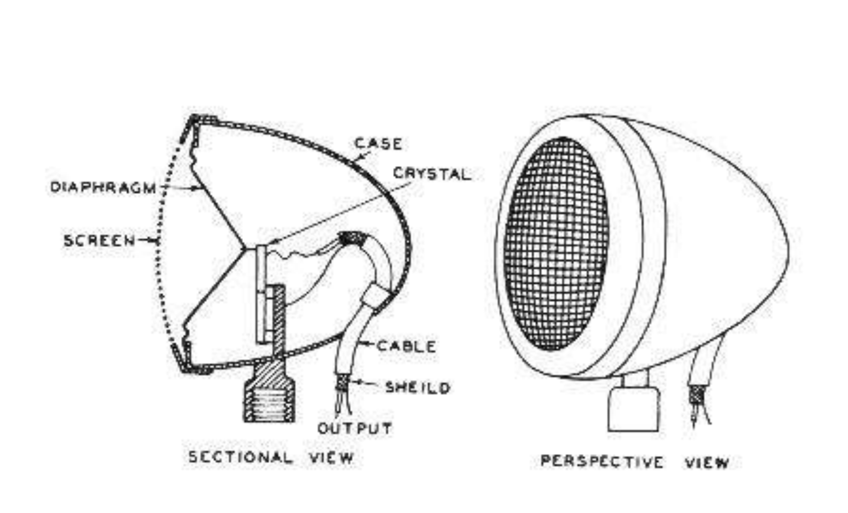
Piezo-electric Microphone:

Advantages:

- Cheap to manufacture

Disadvantages:

- Fragile
- High electrical impedance limits cable length



Piezo-electric Microphone:

Piezo-electric Microphone:

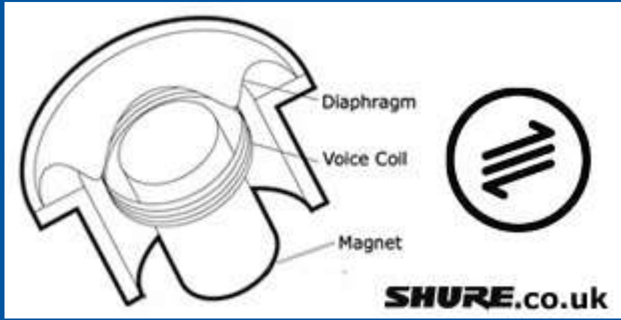
Piezo-electric Microphone:

Dynamic Microphone:

Dynamic Microphone:

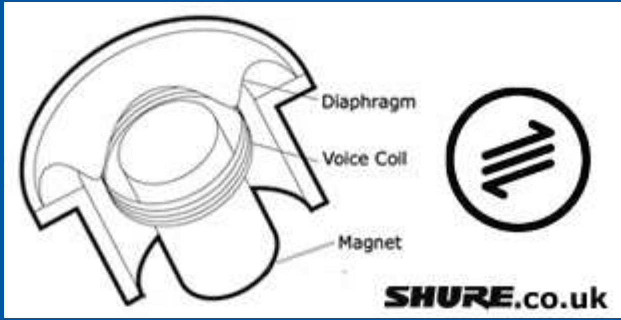
The movement of the diaphragm causes a small coil of wire to move in a magnetic field, varying the electrical current generated.

(Same principle as bicycle dynamo.)



Dynamic Microphone:

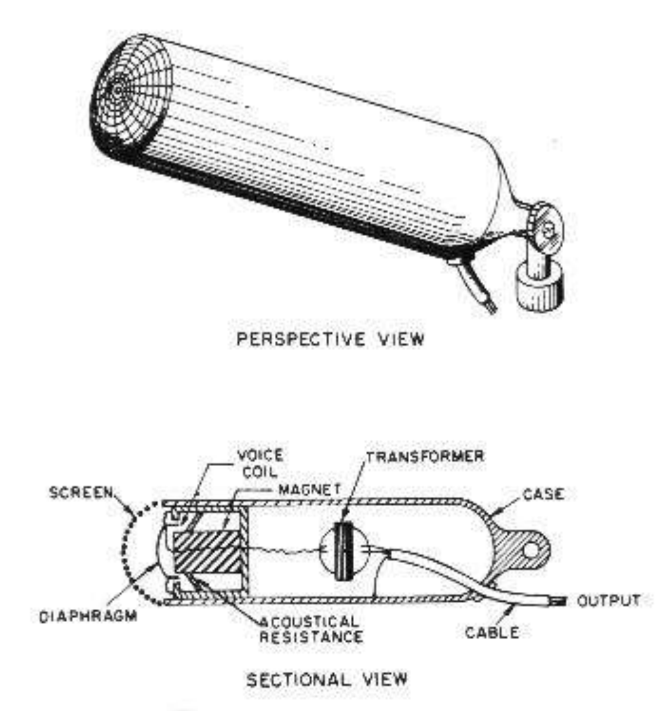
Advantages:



Dynamic Microphone:

Advantages:

- Good quality for reasonable price

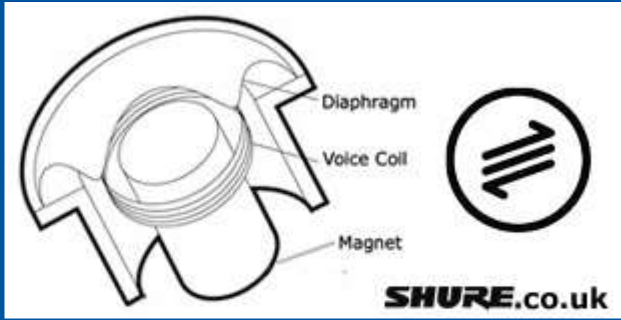


Dynamic Microphone:

Advantages:

- Good quality for reasonable price

Disadvantages:



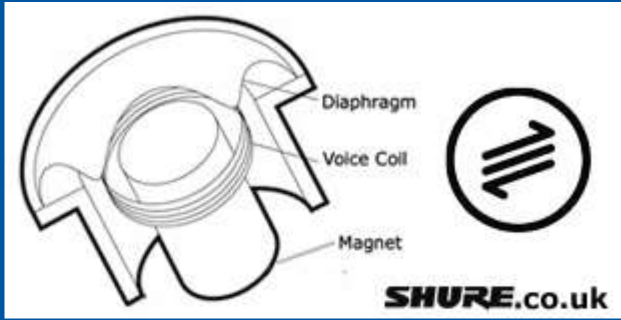
Dynamic Microphone:

Advantages:

- Good quality for reasonable price

Disadvantages:

- Susceptible to external magnetic fields (hum)



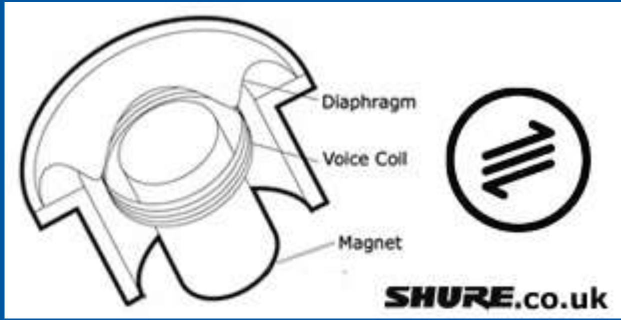
Dynamic Microphone:

Advantages:

- Good quality for reasonable price

Disadvantages:

- Susceptible to external magnetic fields (hum)
- Magnet is heavy



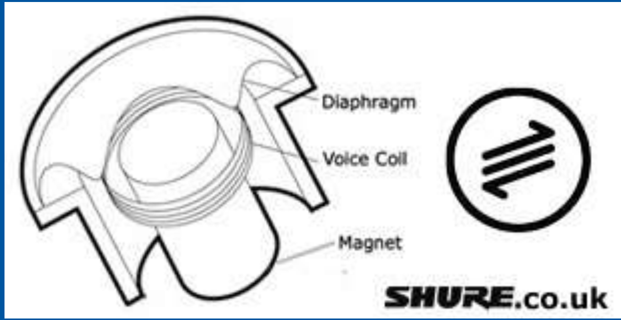
Dynamic Microphone:

Advantages:

- Good quality for reasonable price

Disadvantages:

- Susceptible to external magnetic fields (hum)
- Magnet is heavy
- Magnetic shielding is heavy



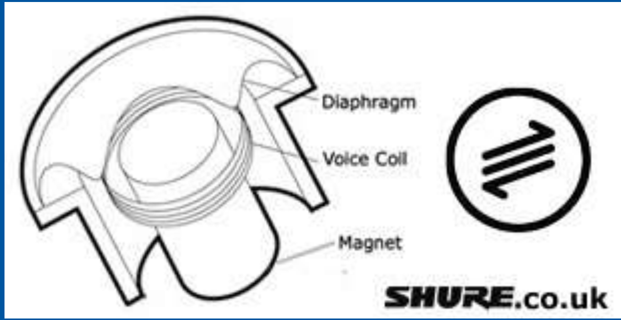
Dynamic Microphone:

Advantages:

- Good quality for reasonable price

Disadvantages:

- Susceptible to external magnetic fields (hum)
- Magnet is heavy
- Magnetic shielding is heavy
- Inertia of coil limits sensitivity

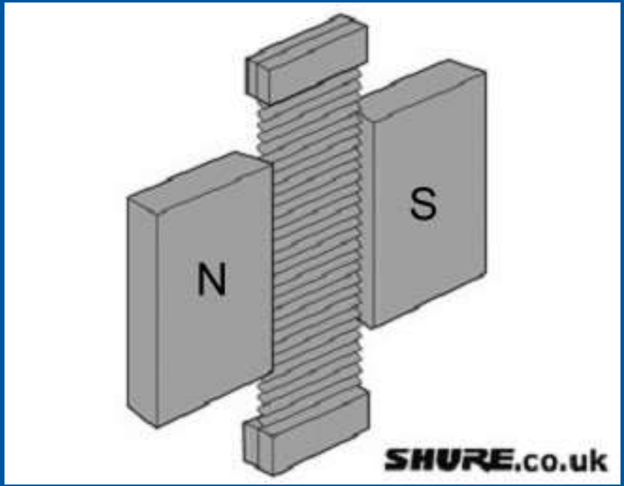


Dynamic Microphone:

Ribbon Microphone:

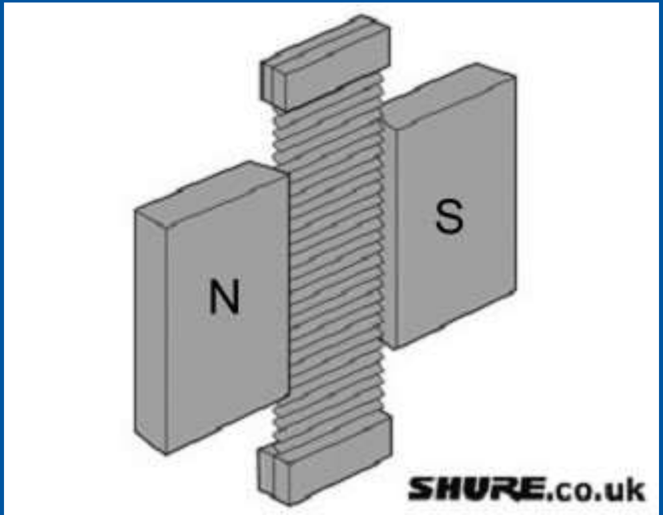
Ribbon Microphone:

The movement of the ribbon within a magnetic field varies the electrical current generated.



Ribbon Microphone:

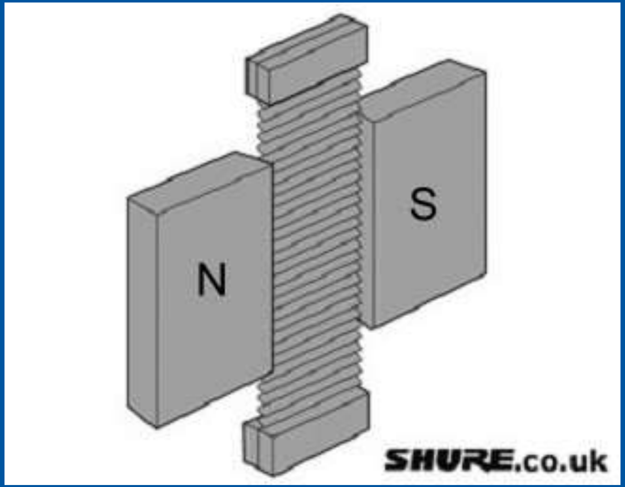
Advantages:



Ribbon Microphone:

Advantages:

- Good high frequency response

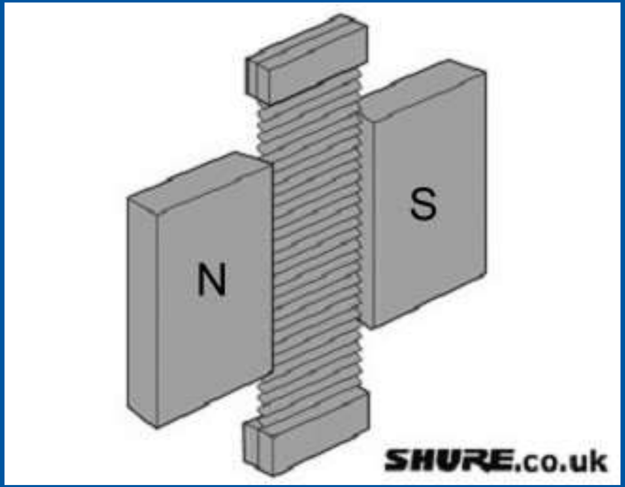


Ribbon Microphone:

Advantages:

- Good high frequency response

Disadvantages:



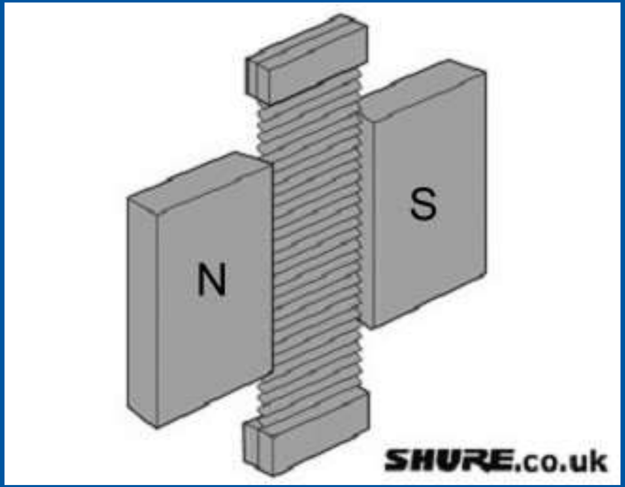
Ribbon Microphone:

Advantages:

- Good high frequency response

Disadvantages:

- Fragile to mechanical shock, wind, voice pops



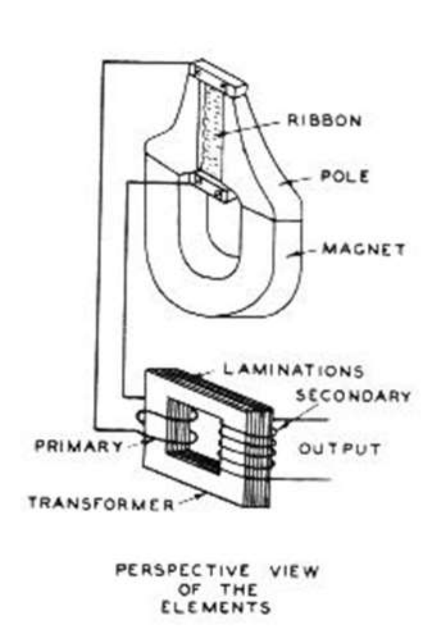
Ribbon Microphone:

Advantages:

- Good high frequency response

Disadvantages:

- Fragile to mechanical shock, wind, voice pops
- Very low electrical impedance requires transformer



Ribbon Microphone:

Condenser Microphone:

Condenser Microphone:

The movement of the charged diaphragm causes a change in electrical capacitance, varying the electrical current generated.

Condenser Microphone:

Advantages:

Condenser Microphone:

Advantages:

- Thin diaphragm is light

Condenser Microphone:

Advantages:

- Thin diaphragm is light
  - good sensitivity

Condenser Microphone:

Advantages:

- Thin diaphragm is light
  - good sensitivity
  - good high frequency response

Condenser Microphone:

Advantages:

- Thin diaphragm is light
  - good sensitivity
  - good high frequency response
- Can be made small

Condenser Microphone:

Advantages:

- Thin diaphragm is light
  - good sensitivity
  - good high frequency response
- Can be made small

Disadvantages:

Condenser Microphone:

Advantages:

- Thin diaphragm is light
  - good sensitivity
  - good high frequency response
- Can be made small

Disadvantages:

- Requires external voltage source

Condenser Microphone:

Advantages:

- Thin diaphragm is light
  - good sensitivity
  - good high frequency response
- Can be made small

Disadvantages:

- Requires external voltage source
- Expensive to manufacture

Condenser Microphone:

Condenser Microphone:

Directional Characteristics:

Directional Characteristics:

Omnidirectional

Directional Characteristics:

Omnidirectional

- Not directional

Directional Characteristics:

Omnidirectional

- Not directional
- Diaphragm only exposed on one side (front)

Directional Characteristics:

Omnidirectional

- Not directional
- Diaphragm only exposed on one side (front)
- Sensitive only to pressure variation

Directional Characteristics:

Omnidirectional

- Not directional
- Diaphragm only exposed on one side (front)
- Sensitive only to absolute pressure variation
- “Pressure microphone”

Directional Characteristics:

Bidirectional:

Directional Characteristics:

Bidirectional:

- Directional

Directional Characteristics:

Bidirectional:

- Directional
- Diaphragm exposed on both sides (front and back)

Directional Characteristics:

Bidirectional:

- Directional
- Diaphragm exposed on both sides (front and back)
- Sensitive to difference in pressure between front and back

Directional Characteristics:

Bidirectional:

- Directional
- Diaphragm exposed on both sides (front and back)
- Sensitive to difference in pressure between front and back
- “Pressure gradient microphone”

Directional Characteristics:

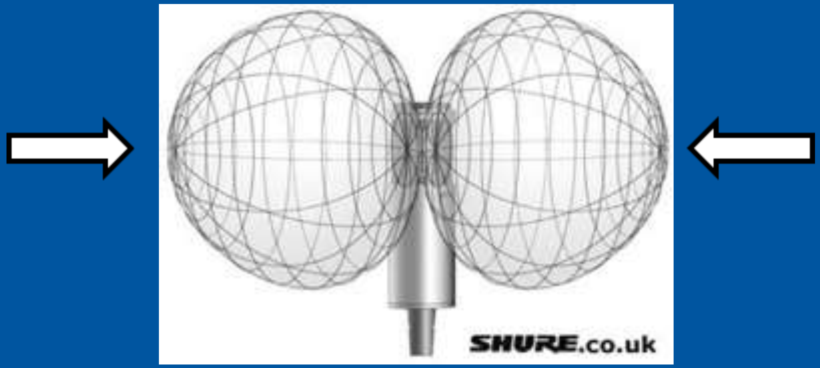
Bidirectional:

- Directional

Directional Characteristics:

Bidirectional:

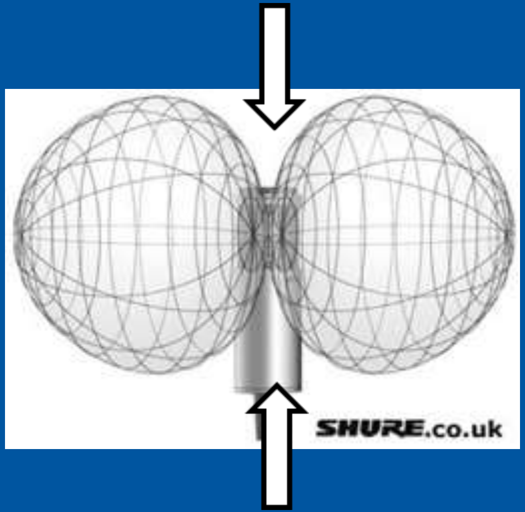
- Directional
  - Responds to sound from front and back



Directional Characteristics:

Bidirectional:

- Directional
  - Responds to sound from front and back
  - Rejects sound from sides



Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL
POLAR RESPONSE PATTERN	 

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL
POLAR RESPONSE PATTERN		
		

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL
POLAR RESPONSE PATTERN	 	 
POLAR EQUATION	1	COS Θ

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID
POLAR RESPONSE PATTERN			
			
POLAR EQUATION	1	COS Θ	1/2(1+COSΘ)

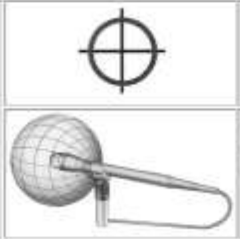
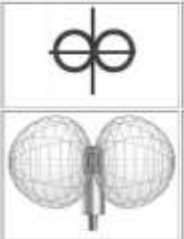
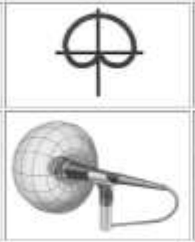
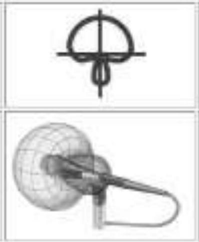
Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	SUPERCARDIOID
POLAR RESPONSE PATTERN			
			
POLAR EQUATION	1	$\cos\Theta$	$3/8 + 5/8 \cos\Theta$

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	HYPERCARDIOID
POLAR RESPONSE PATTERN			
			
POLAR EQUATION	1	COS Θ	1/4(1+3COSΘ)

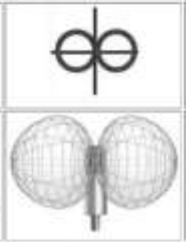
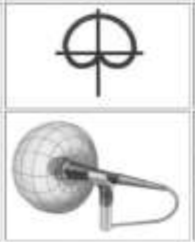
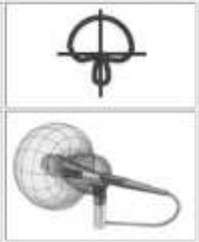
Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID	SUPERCARDIOID	HYPERCARDIOID
POLAR RESPONSE PATTERN					
POLAR EQUATION	1	$\mathrm{COS}\ \Theta$	$1/2(1+\mathrm{COS}\Theta)$	$3/8 + 5/8\ \mathrm{COS}\Theta$	$1/4(1+3\mathrm{COS}\Theta)$

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID	SUPERCARDIOID	HYPERCARDIOID
POLAR RESPONSE PATTERN					
					
POLAR EQUATION	1	COS Θ	1/2(1+COSΘ)	3/8 + 5/8 COSΘ	1/4(1+3COSΘ)
COVERAGE ANGLE (3dB Drop)	360°	90°	131°	115°	105°

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID	SUPERCARDIOID	HYPERCARDIOID
POLAR RESPONSE PATTERN					
POLAR EQUATION	1	COS Θ	1/2(1+COSΘ)	3/8 + 5/8 COSΘ	1/4(1+3COSΘ)
COVERAGE ANGLE (3dB Drop)	360°	90°	131°	115°	105°
ANGLE OF MAX. REJECTION (Null Angle)	—	90°	180°	126°	110°

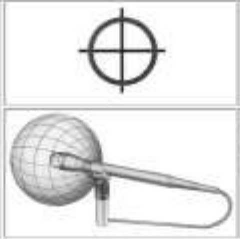
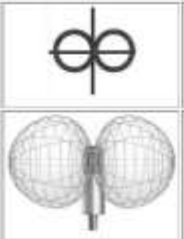
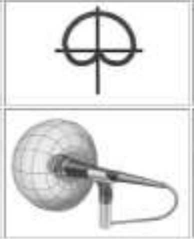
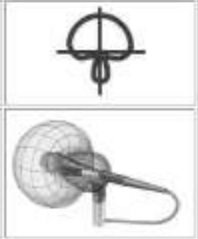
Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID	SUPERCARDIOID	HYPERCARDIOID
POLAR RESPONSE PATTERN					
					
POLAR EQUATION	1	COS Θ	1/2(1+COSΘ)	3/8 + 5/8 COSΘ	1/4(1+3COSΘ)
COVERAGE ANGLE (3dB Drop)	360°	90°	131°	115°	105°
ANGLE OF MAX. REJECTION (Null Angle)	—	90°	180°	126°	110°
REAR REJECTION (@ 180°)	0dB	0dB	25dB	12dB	6dB

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID	SUPERCARDIOID	HYPERCARDIOID
POLAR RESPONSE PATTERN					
					
POLAR EQUATION	1	COS Θ	1/2(1+COSΘ)	3/8 + 5/8 COSΘ	1/4(1+3COSΘ)
COVERAGE ANGLE (3dB Drop)	360°	90°	131°	115°	105°
ANGLE OF MAX. REJECTION (Null Angle)	—	90°	180°	126°	110°
REAR REJECTION (@ 180°)	0dB	0dB	25dB	12dB	6dB
RANDOM ENERGY EFFICIENCY (Relative to Omni)	0dB	-4.8dB	-4.8dB	-5.7dB	-6dB

Directional Characteristics:

CHARACTERISTIC	OMNIDIRECTIONAL	BIDIRECTIONAL	CARDIOID	SUPERCARDIOID	HYPERCARDIOID
POLAR RESPONSE PATTERN					
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RANDOM ENERGY EFFICIENCY (Relative to Omni)	0dB	-4.8dB	-4.8dB	-5.7dB	-6dB
DISTANCE FACTOR (Relative to Omni)	1	1.7	1.7	1.9	2

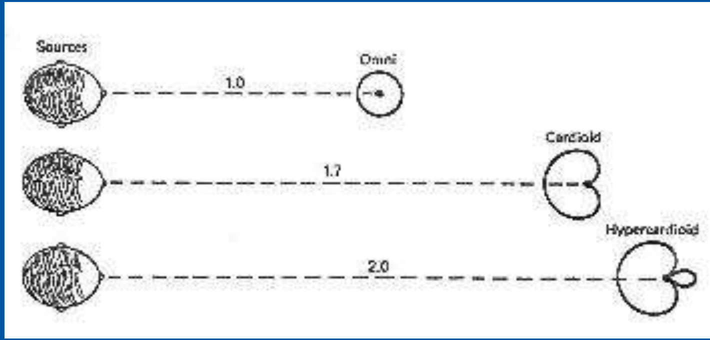
Directional Characteristics:

Distance Factor:

Directional Characteristics:

Distance Factor:

- Microphones with higher distance factor can work farther from source.



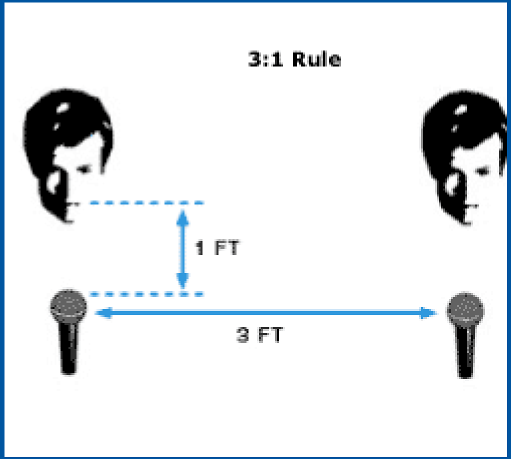
Directional Characteristics:

3:1 Rule:

Directional Characteristics:

3:1 Rule:

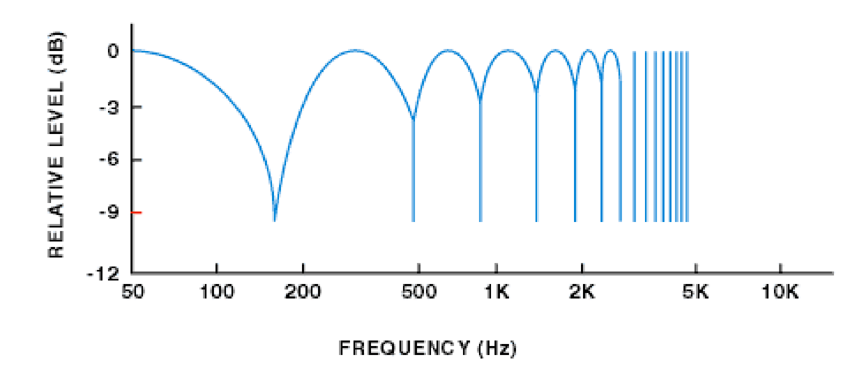
- Microphones should never be placed closer together than three times the distance between mic and source.



Directional Characteristics:

3:1 Rule:

- Microphones should never be placed closer together than three times the distance between mic and source, to prevent comb-filtering.



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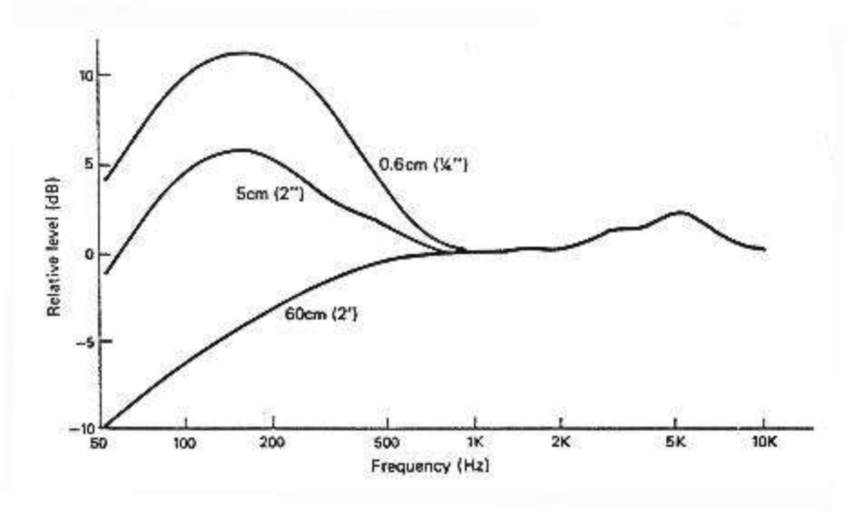

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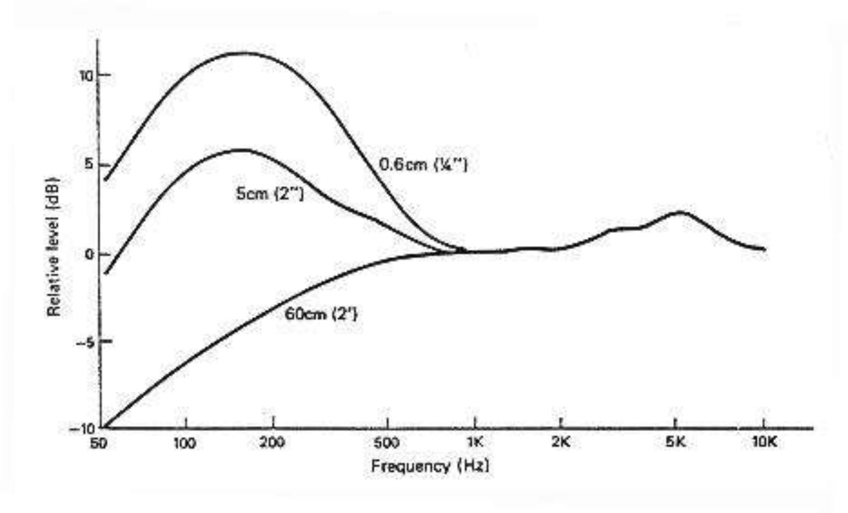
2 feet



Proximity Effect:

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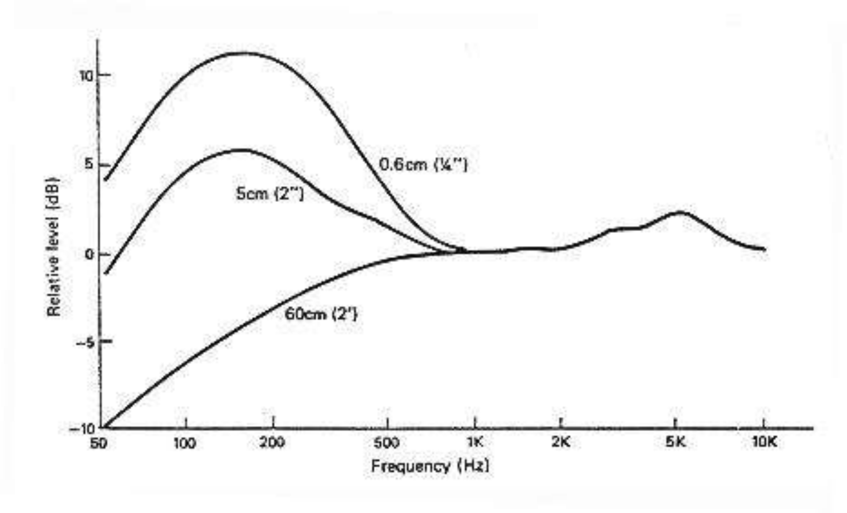
2 inches



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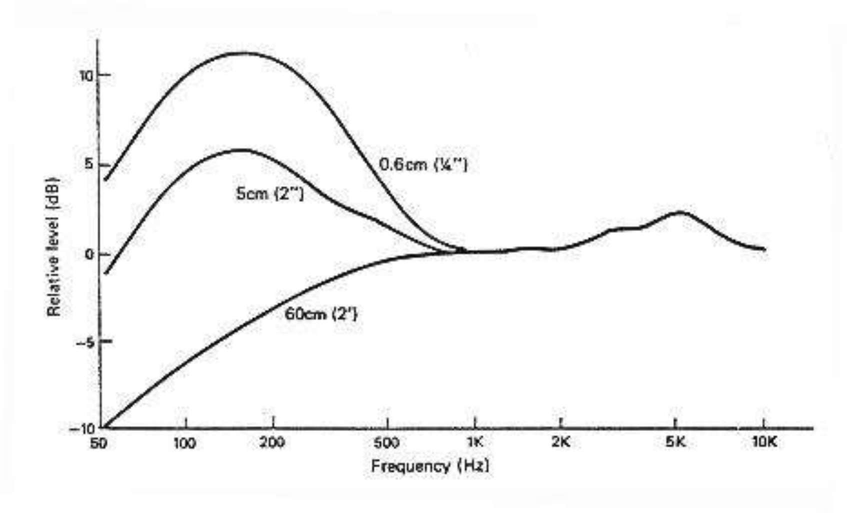
¼ inch



Boundary Effect:

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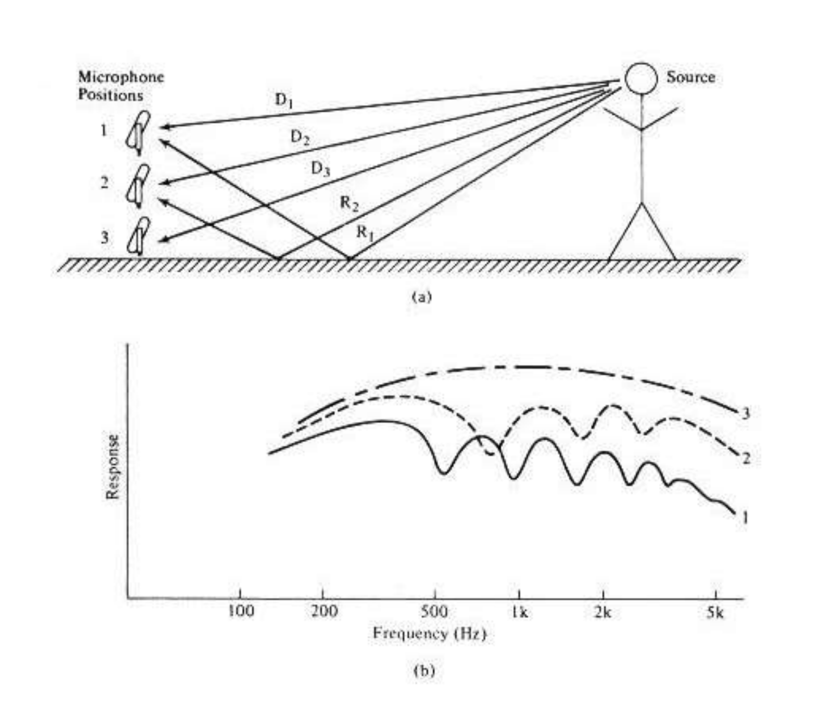

Boundary Effect:

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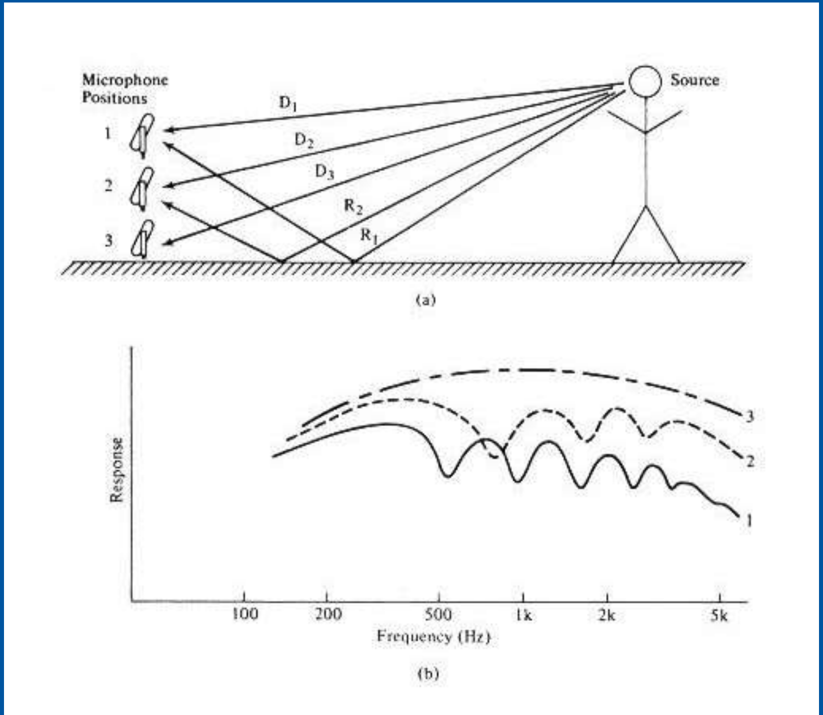
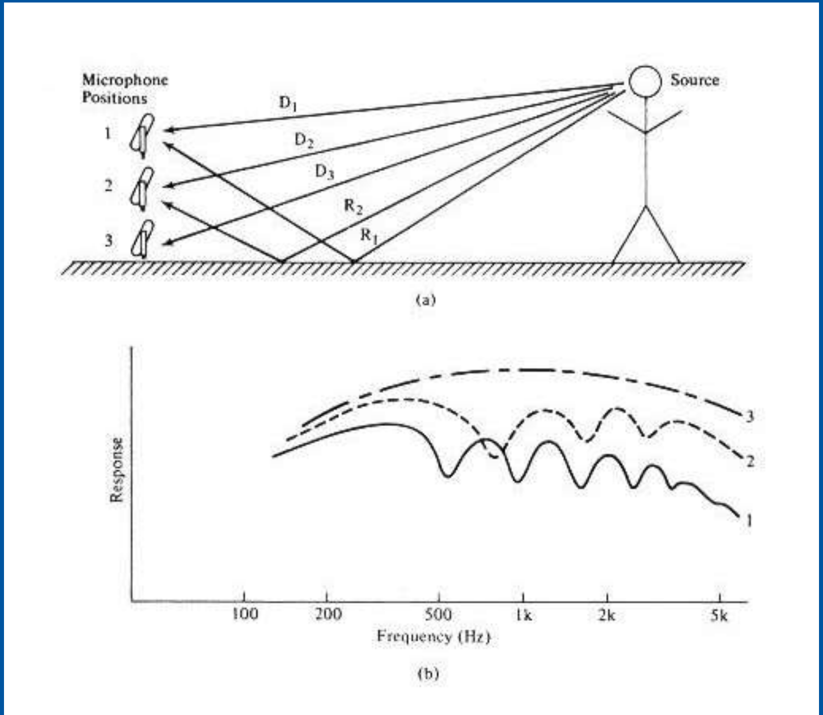
2. The closer to a surface the microphone is mounted, the higher the frequency at which the phase cancellation takes place.



Boundary Effect:

1. Sound waves reflected from the floor or other surface cause phase cancellation at some frequency.
2. The closer to a surface the microphone is mounted, the higher the frequency at which the phase cancellation takes place.
3. With the microphone mounted close to or directly on a large surface, any phase cancellation occurs at frequencies beyond the limit of hearing.



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- overall improvement of 9dB

Boundary Effect:

Microphone Inventory:

Microphone Inventory:

Manufacturer	Model	Quantity	Type	Pattern			Phantom Power	Comments	Photo
				Omni	Figure 8	Cardioid			
Audio-Technica	AT2050	2	Condenser				x	Switchable Pattern	
Audio-Technica	AT815	3	Condenser				x	Shotgun	
Audio-Technica	MB 5k	3	Dynamic					Snare/Tom	
Audio-Technica	MB 6K	1	Dynamic					Kick	

Microphone Inventory:

Manufacturer	Model	Quantity	Type	Pattern			Phantom Power	Comments	Photo
				Omni	Figure 8	Cardioid			
Audio-Technica	MB 4K	2	Condenser				x	Overheads	
Electrovoice	635A	1	Dynamic						
Electrovoice	664	2	Dynamic						
Neewer		5	Piezo					Acoustic Instrument Pickup	

Microphone Inventory:

Manufacturer	Model	Quantity	Type	Pattern			Phantom Power	Comments	Photo
				Omni	Figure 8	Cardioid			
Provider	PSL6	18	Condenser					Miniature Lavalier	
Sennheiser	MD-441U	1	Dynamic						
Sennheiser	E825S	4	Dynamic						
Shure	SM7B	1	Dynamic					Studio Vocals	

Microphone Inventory:

Manufacturer	Model	Quantity	Type	Pattern			Phantom Power	Comments	Photo
				Omni	Figure 8	Cardioid			
Shure	SM58	4	Dynamic						
Shure	WL93	11	Condenser					Miniature Lavalier	
Shure	WL185	2	Condenser					Miniature Lavalier	
Shure	MX392/C	8	Condenser				x	Boundary