“Design and Construction Considerations for a Protected Compressed Air Line to a Refuge Alternative”

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Pittsburgh, PA

Objective:

This proposed work will explore, in a practical way through laboratory tests, design and construction considerations regarding compressed air lines to a refuge alternative including but not limited to; materials, bending, crushing, tensile and other strength requirements, anchoring systems, protection of the compressed air lines and drainage.

Topics:

1. Surface Compressor Station Considerations and Air Delivery Limits

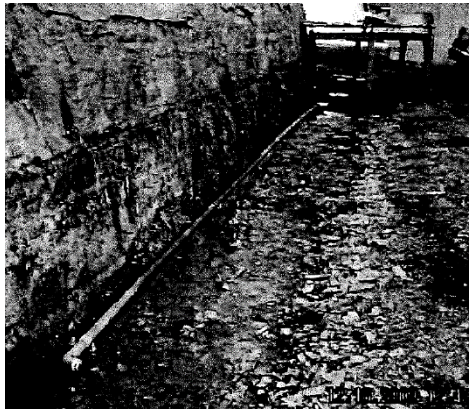
2. Protected Compressed Air Line Considerations:
   - Materials
   - Strength parameters
     - (Mechanical-Dynamical-Environmental)

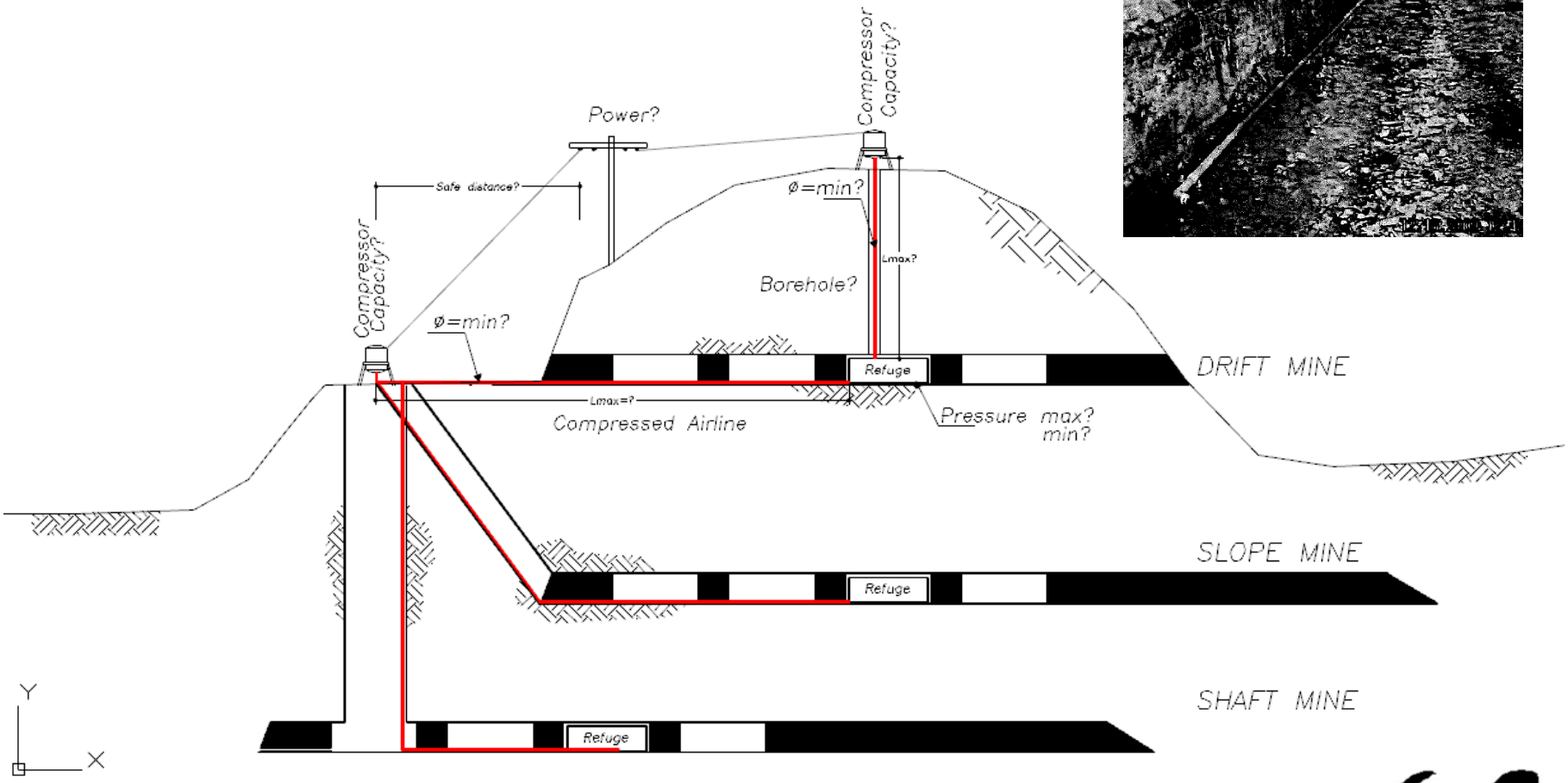
3. Anchoring

4. Procedures for extending and purging line

Surface Compressor Station Considerations and Air Delivery Limits

b) Compressor Station Considerations

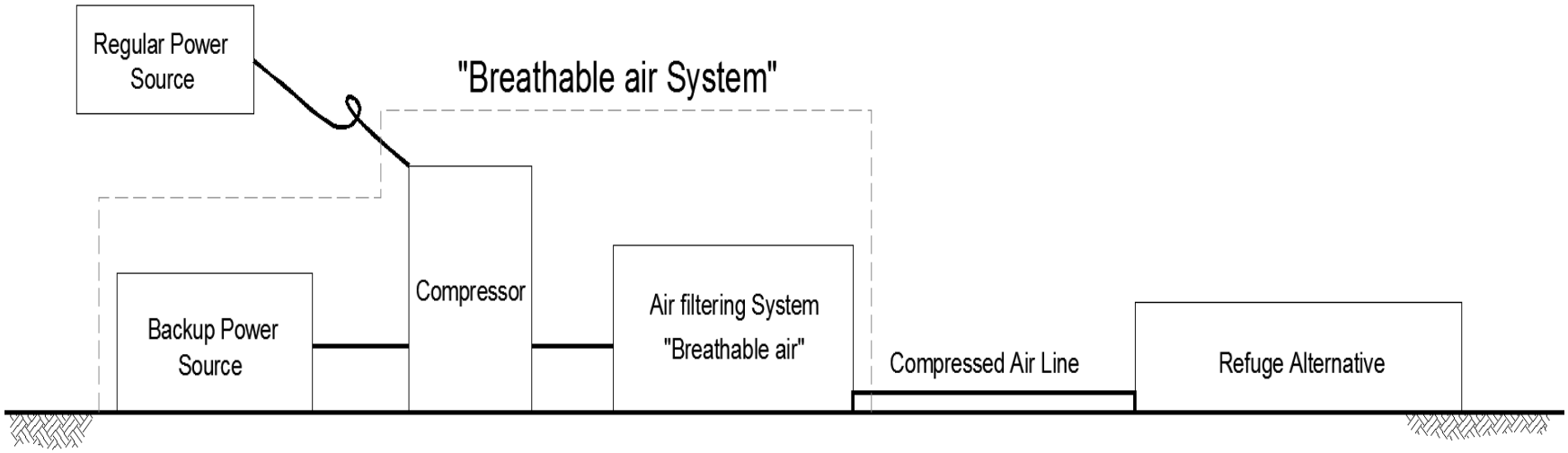




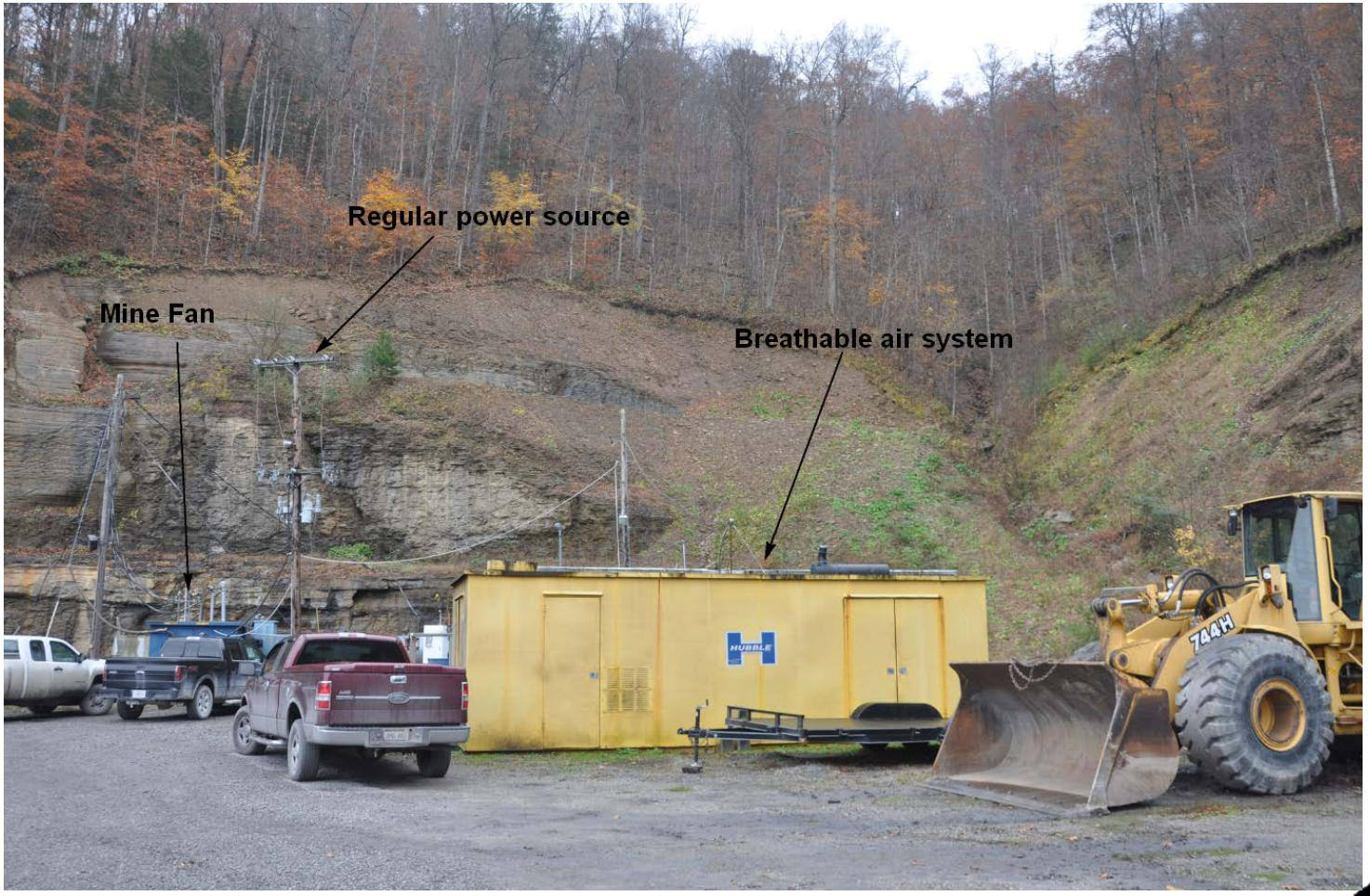
Overview

Field visits:

- Hubble 07 underground coal mine (Pike County)
- Inspiration Mine




Regular Power Source
Breathable air System
Fan of the mine
Compressed air line


Regular power source
Mine Fan
Breathable air system
744H

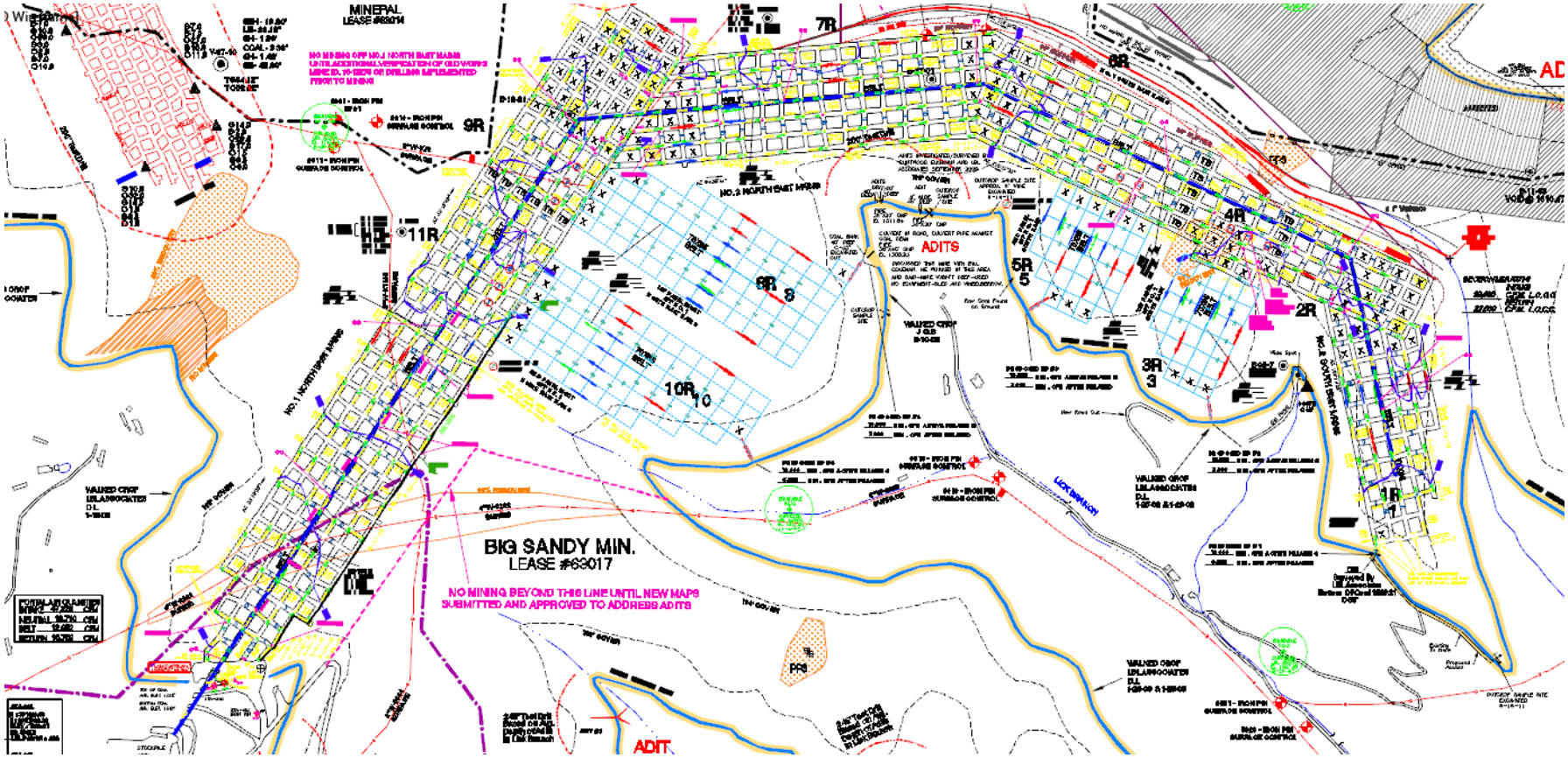
Flames burn out of control from a ventilation shaft at the Pike River Mine Photo: EPA

To date conclusions:

Separate the regular air system from the mine to the compressed air, it is recommended to have at least 100 to 200ft distance from the mine fan to the breathable air system.

The location for the breathable air system should be done in an area geotechnical stable. It is necessary to perform all slope stability analysis to avoid any failure of the ground were the system is located. Among the analysis, it is recommended to perform conventional kinematic analyses and limit equilibrium analyses. In all cases the factor of safety should be minimum of 1.5.

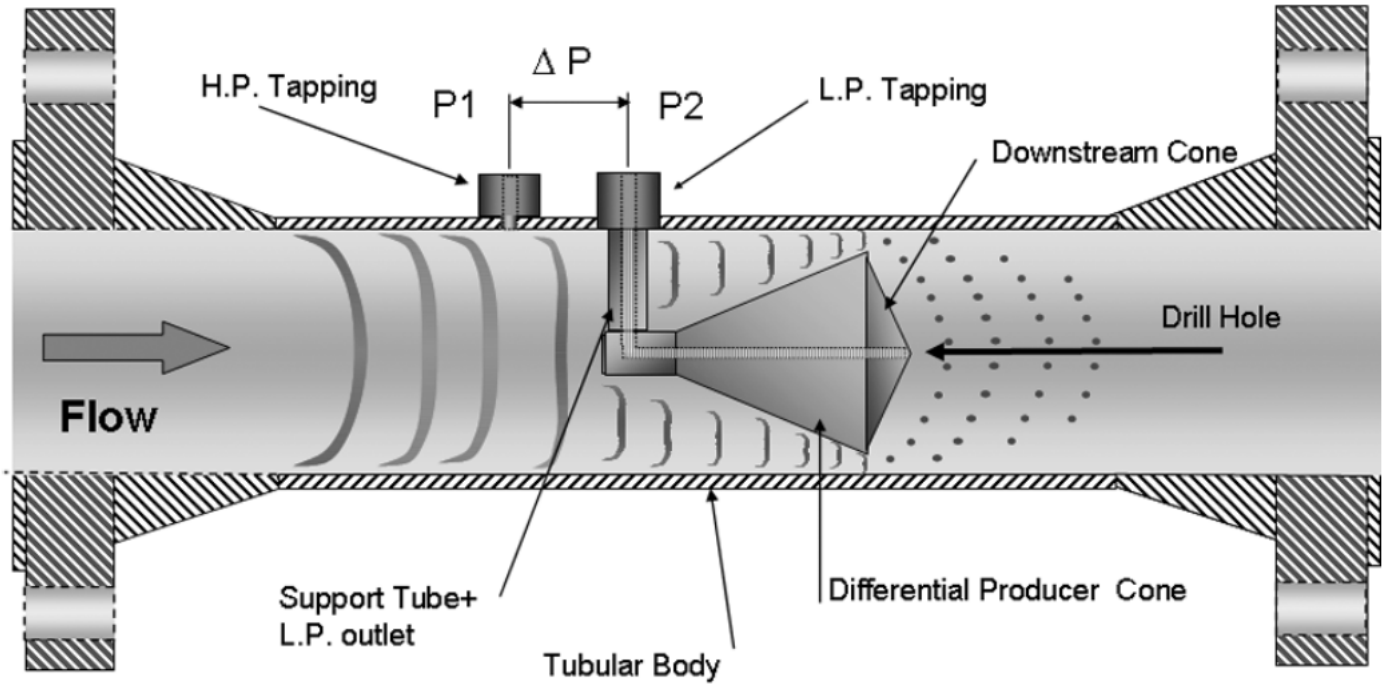
Hubble 07 underground coal mine (Pike County)



Hubble 07 underground coal mine (Pike County)

Pressure drop????
Flow????

Differential Pressure Cone Meter



Hubble 07 underground coal mine (Pike County)
Pressure drop????
Flow????

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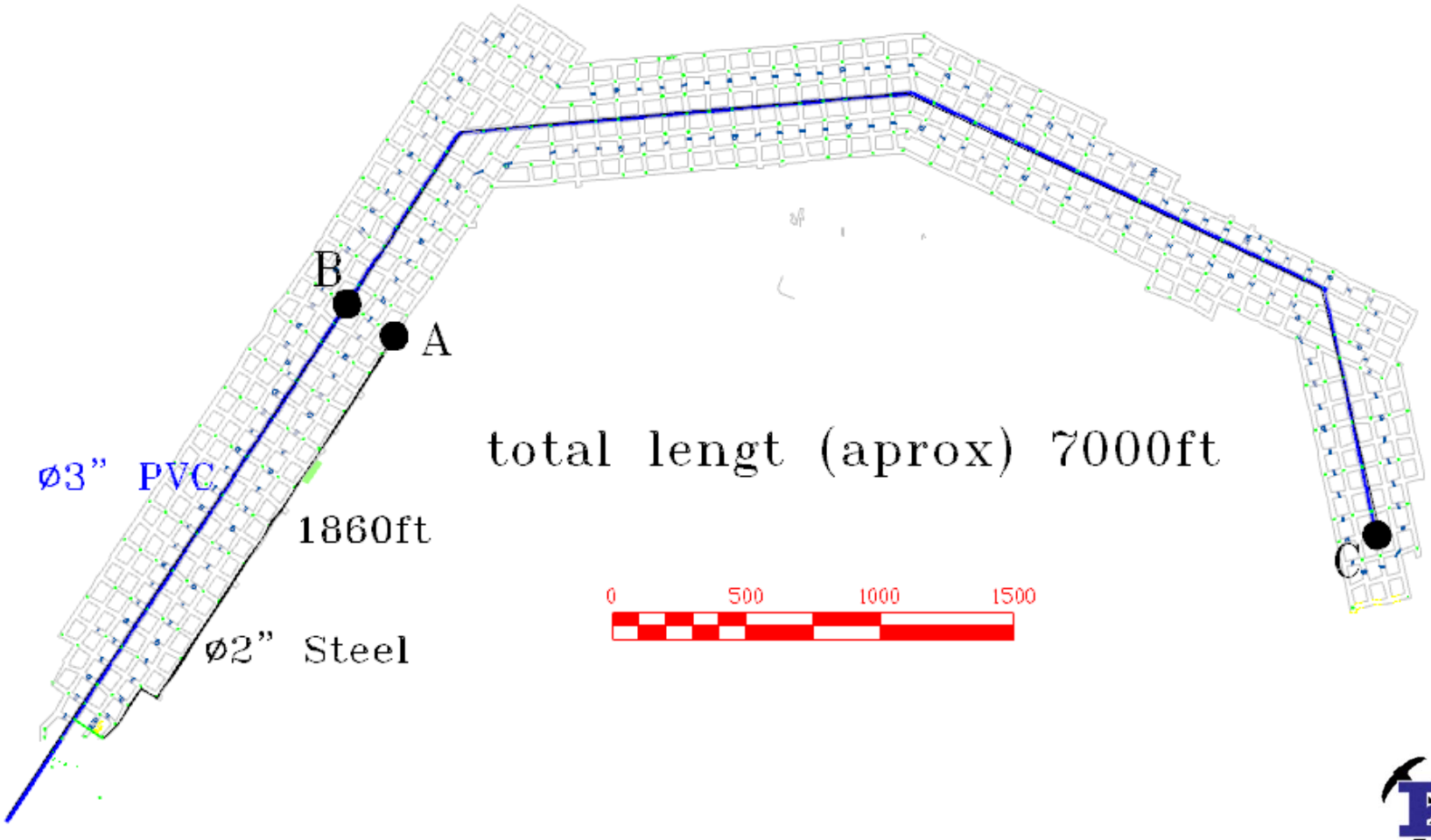
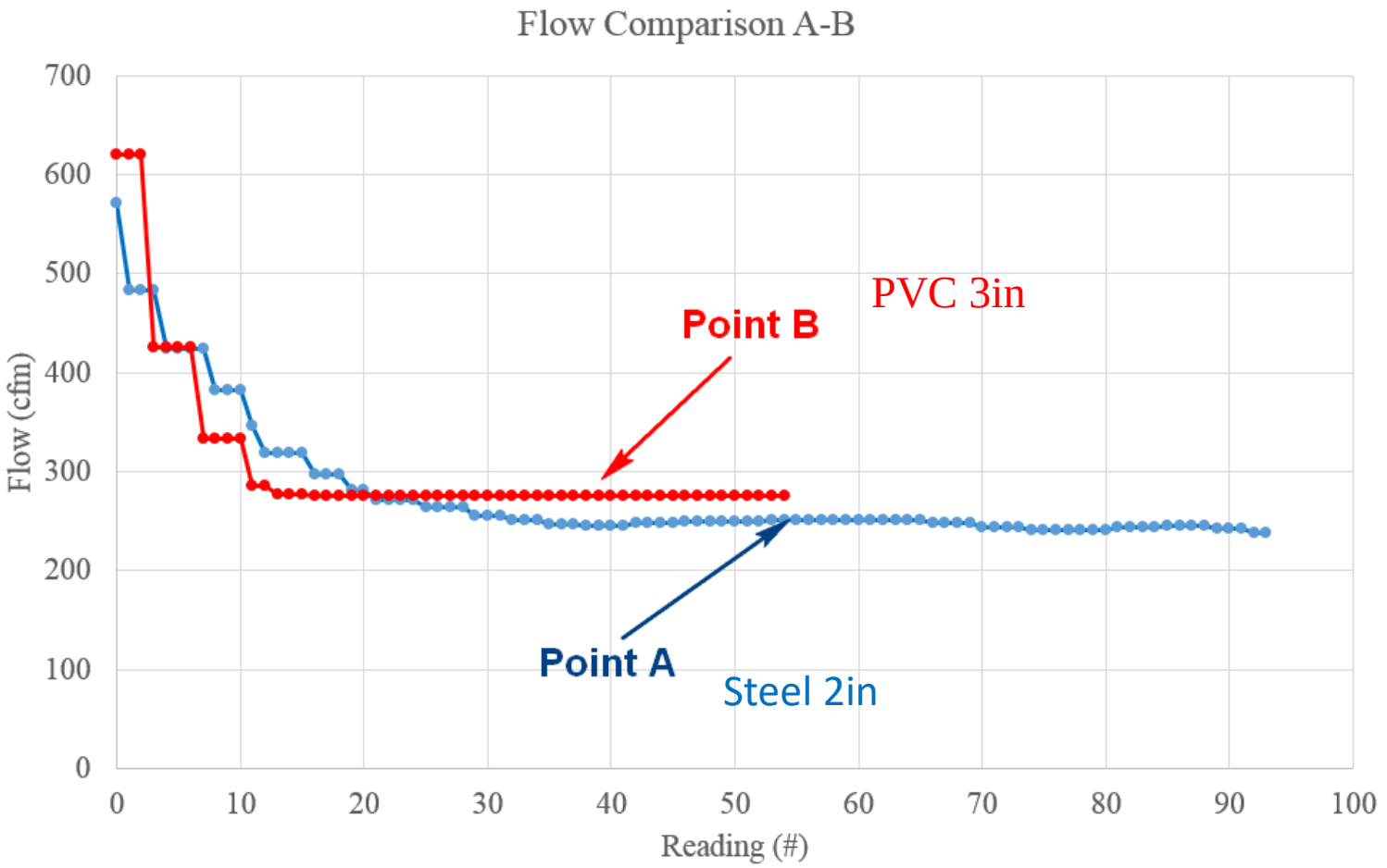


Hubble 07 underground coal mine (Pike County)
Pressure drop????
Flow????



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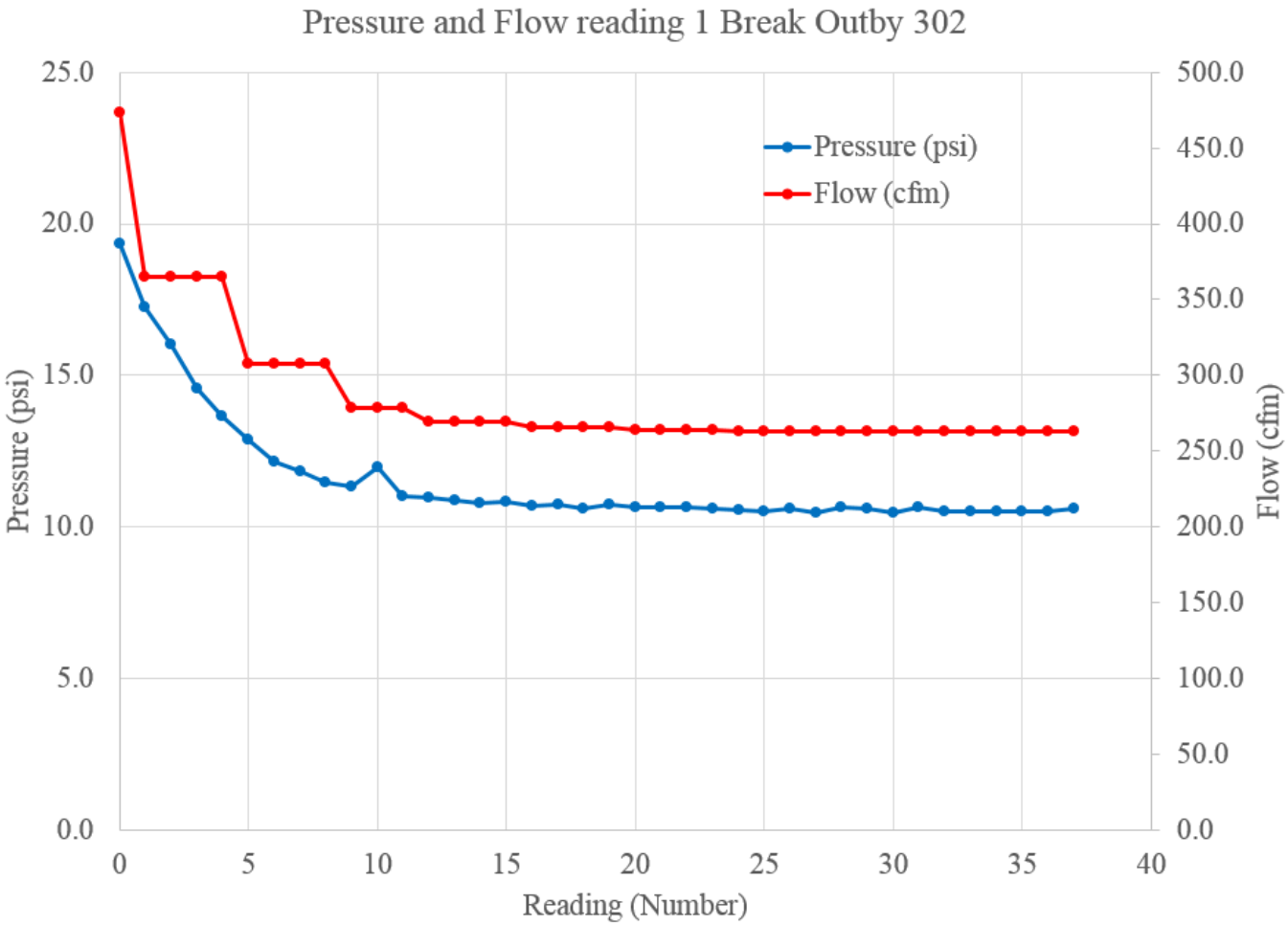
Flow????



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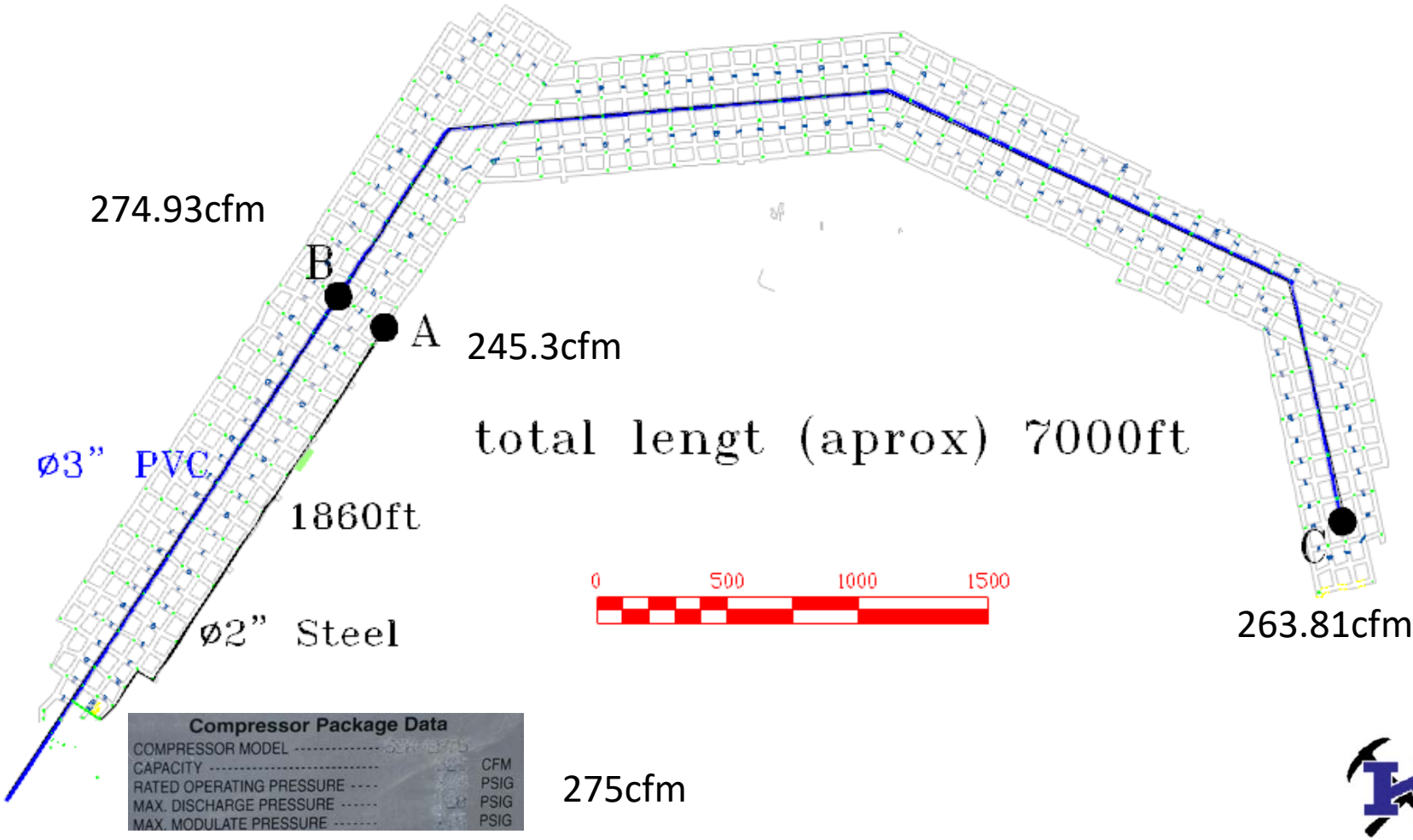
Flow????



Protected Compressed Air Line Considerations:

Materials

Strength parameters (Mechanical-Dynamical-Environmental)

Pipe samples:

Non-Metal Pipe — commonly called “plastic” pipe has been offered for many years as compressed air piping.

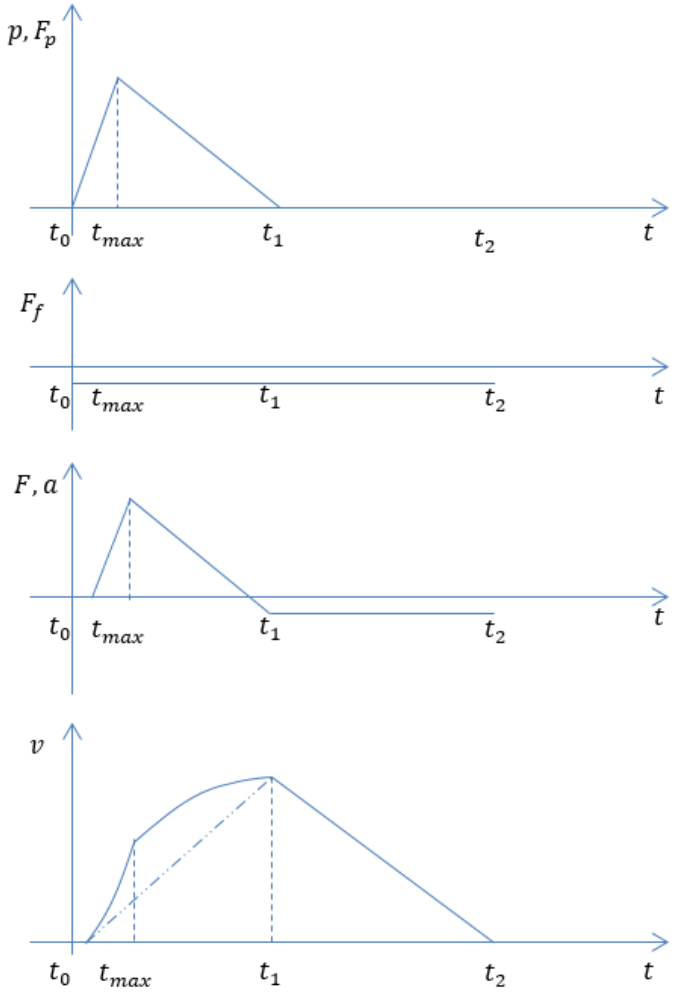
Metal Pipe **-** can be black iron, stainless steel, copper, aluminum, etc. with proper thermal and pressure characteristics.

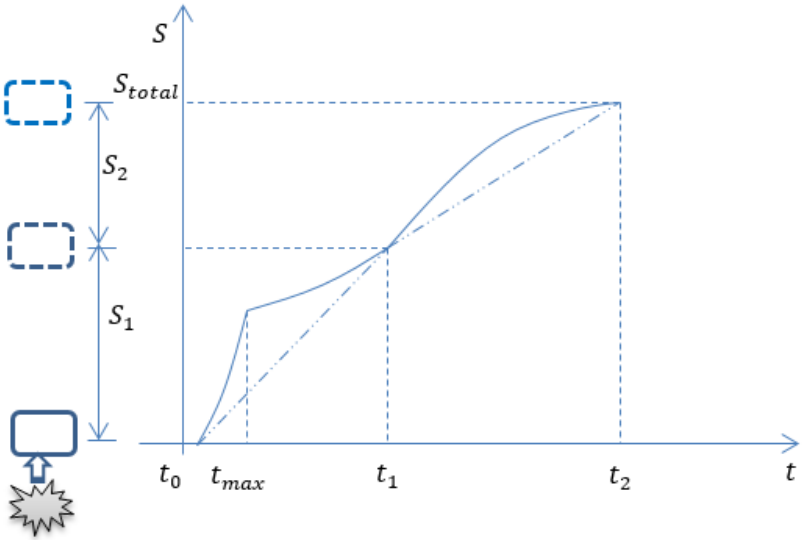
NIOSH

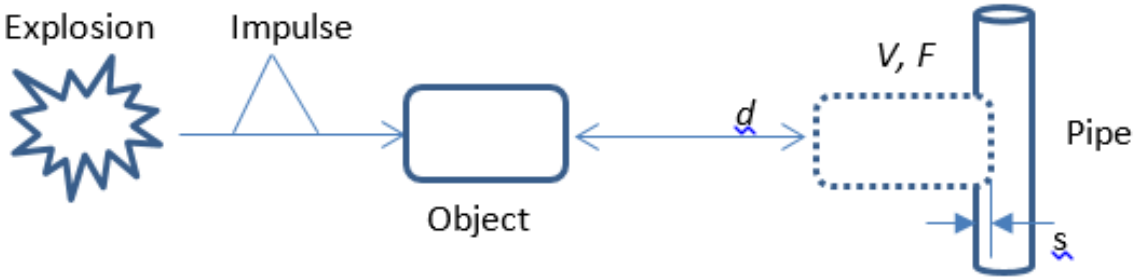
U.K.

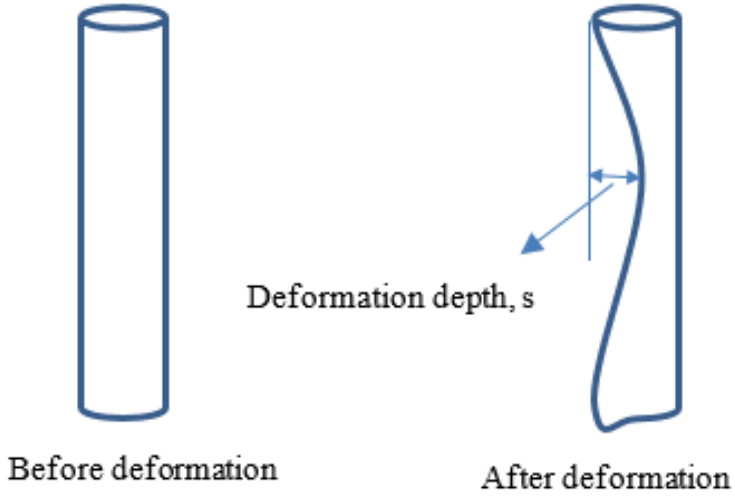
Explosion

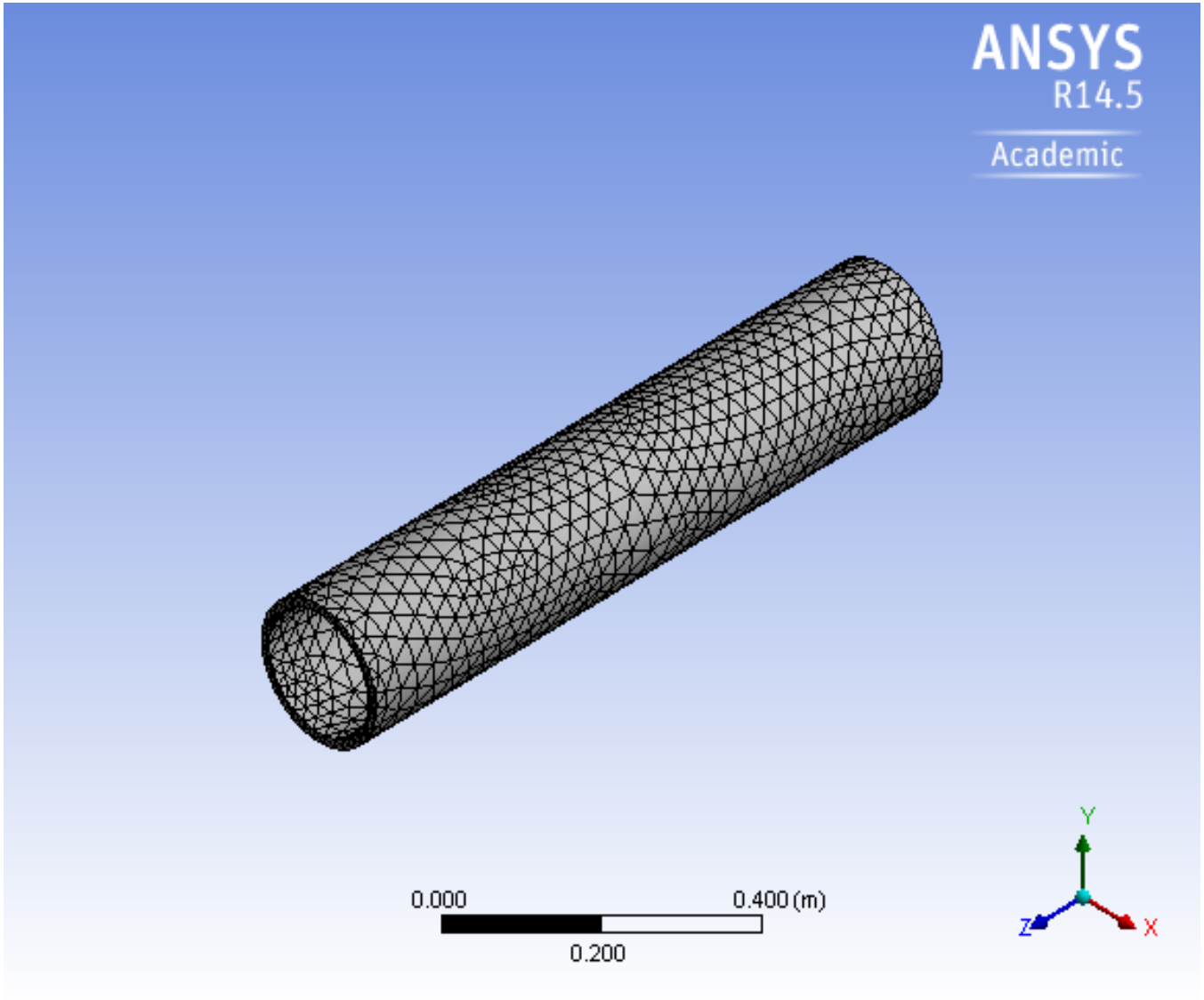

Pressure
S


p, F_p
t_0 t_{max} t_1 t_2 t
F_f
t_0 t_{max} t_1 t_2 t
F, a
t_0 t_{max} t_1 t_2 t
v
t_0 t_{max} t_1 t_2 t

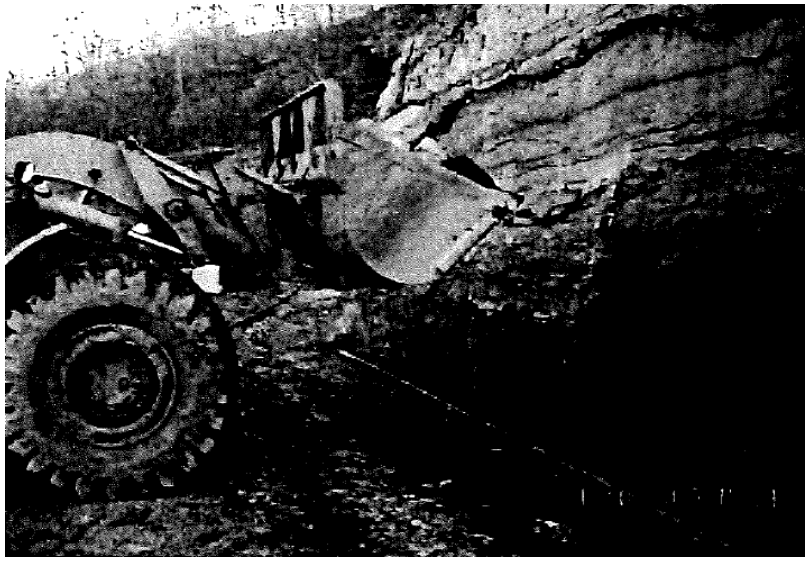

S
S_{total}
S_2
S_1
t_0 t_{max} t_1 t_2 t


Explosion
Impulse
Object
d
V, F
Pipe
s

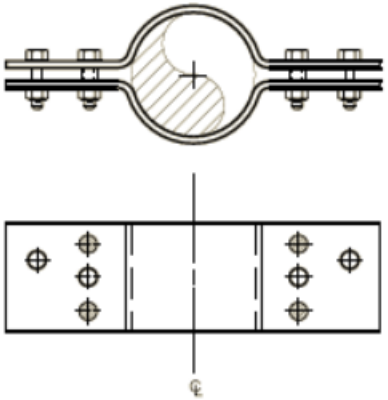

Deformation depth, s
Before deformation
After deformation

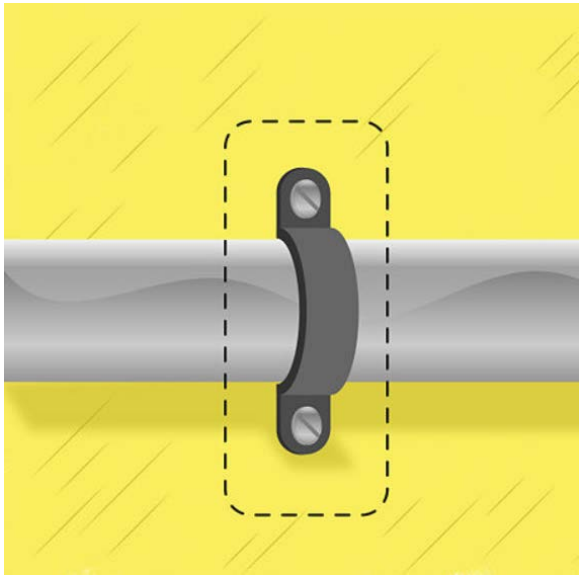

ANSYS
R14.5
Academic
0.000
0.400 (m)
0.200
Y
Z
X

Materials Properties

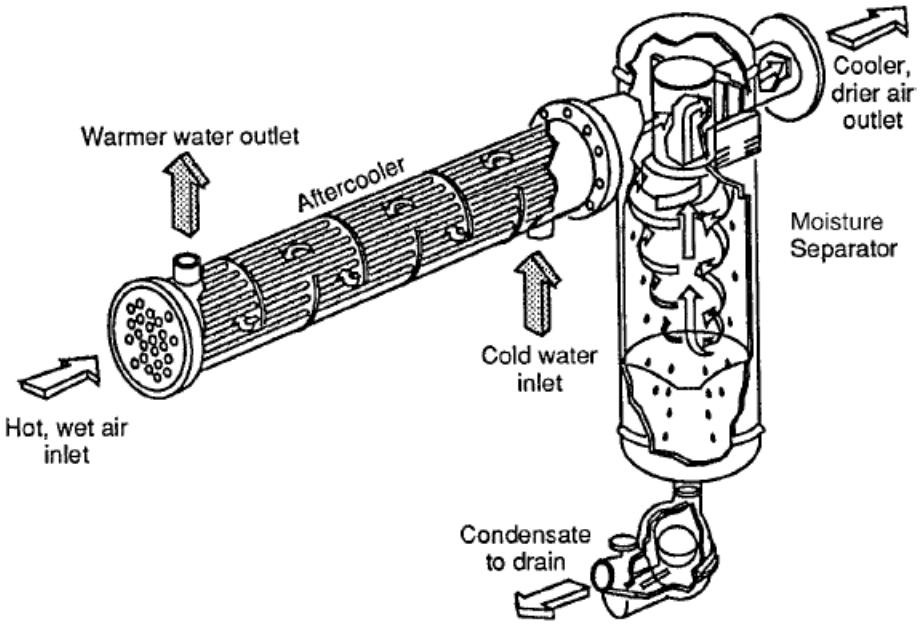


Anchoring





Purging lines



Underground Mining Equipment

The Total loaded weight is the sum of operating weight and carry capacity. Those which don't have operating weight are not takend account into total weight. Part of them have dimensions of tires and chain, even ground pressure. Some machins with lower weight have higher ground pressure. But the pressure on the air pipes may not just be the same to the ground pressure.

Mining Methods	Type	Model	Dimensions(ft)			Weight(tn)			Ground Contact (Tire,track. etc)	Ground Pressure(psi)	Cutting Profile(ft)	
			Length	Width	Height	Operating weight(Empty Load)	Carry Capacity(tn)	Total loaded weight			Cutting width	Cutting height
longwall systems	CST Drive System(right/left-angle drive system)	CST30	7.5	3.9	3.0	6.4		6.4	Maybe L*W			
		CST45	9.1	4.2	3.5	10.8		10.8				
		CST65	9.6	5.0	3.5	12.0		12.0				
	Roof Support System						support up to 1929 tons	/	Not provided			
	shearers	EL2000	45.1	40.6	20.5	77.0		77.0	Not provided			71-177
		EL3000	49.9	44.6	27	116.0		116.0				98-217
		EL4000	54.8	52.8	41.3	154.0		154.0				158-276
	Roof Support Carriers	SH620	31.2	9.3			22.0	/	tire			
		SH630	35.7	9.5			36.0	/				
		SH650	38.3	9.9			50.0	/				
		SH680	45.3	11.3			88.0	/				
		SH640D	30.2	8.7			44.0	/				
		SH660D	33.0	10.2			60.0	/				
		SH660HD	33.0	10.2			66.0	/				
		SH150	15.4	12.7			55.0	/				