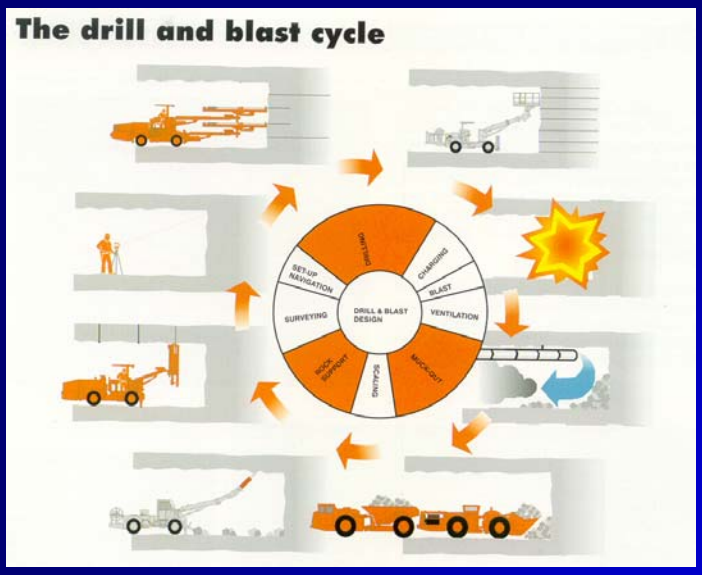
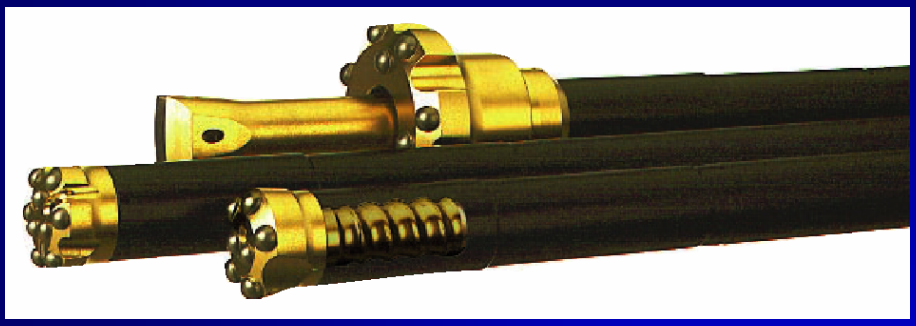
Conventional Road Heading

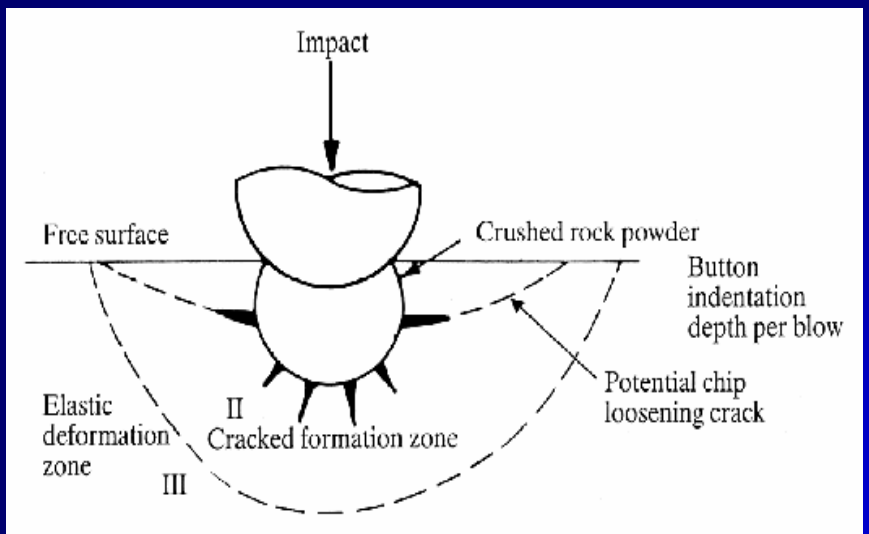


Drilling Jumbo

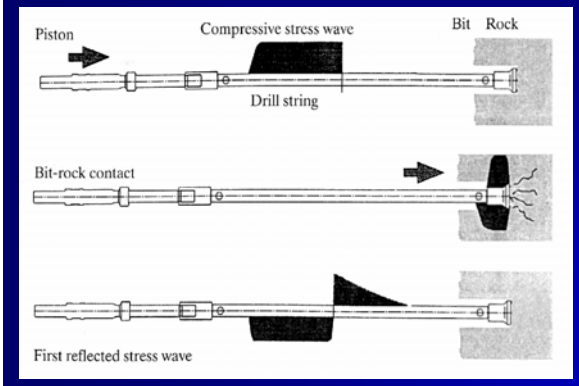
Percussion Drill Bits

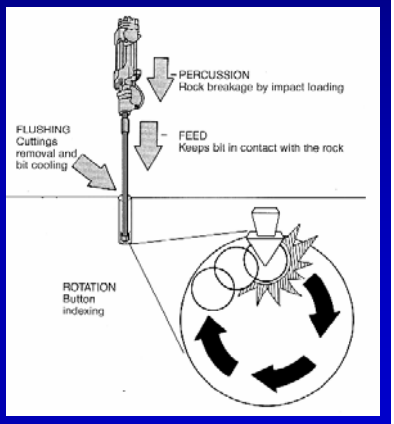


Rock Breakage in Percussive Drilling

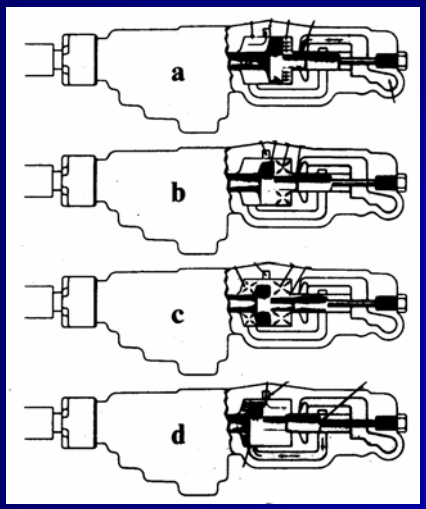


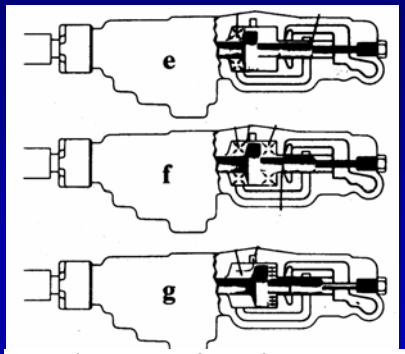
Top-Hammer Drilling





Working Principle of Pneumatic Hammer





a, g. Piston moves forward

b. Piston compresses the air in front of it

c. Front end of piston opens the exhaust port

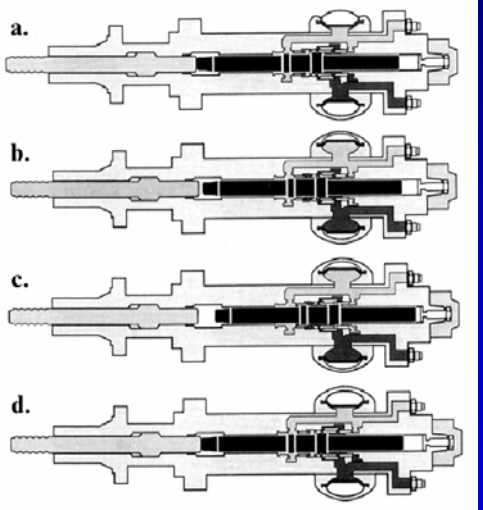
d. Back edge of piston flange opens the exhaust port

e. Piston accelerates back

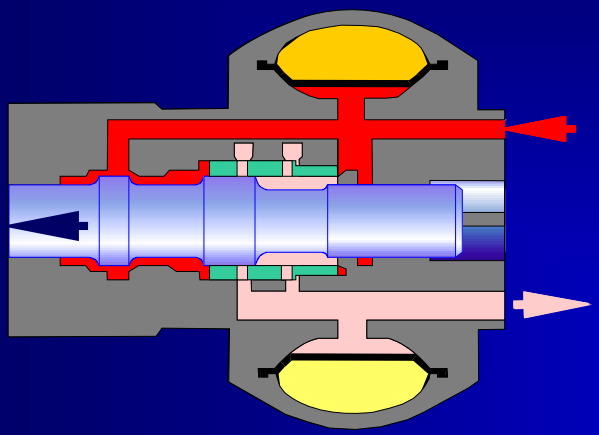
f. Return stroke finishes

Working Principle of Hydraulic Hammer

a. Piston at front end
b. Piston moves backwards
c. Piston in rear position
d. Piston moves forwards



Working Principle of Hydraulic Hammer



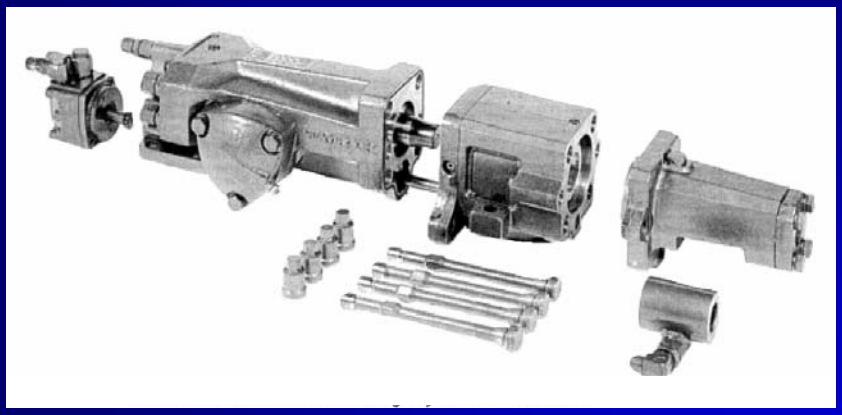
A) Piston at front end, starts moving backwards

B) Piston at rear end, finished moving backwards

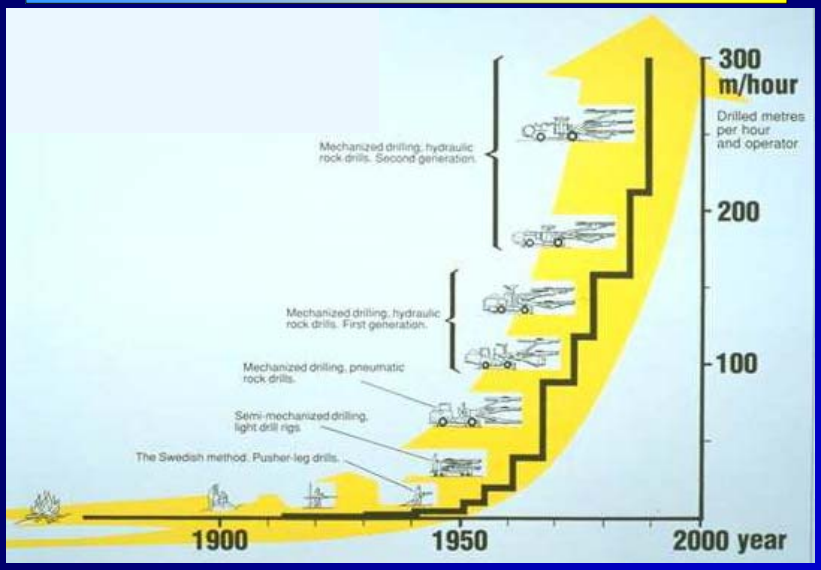
C) Piston at rear end, starts moving forwards

E) Piston at front end, finished moving forwards

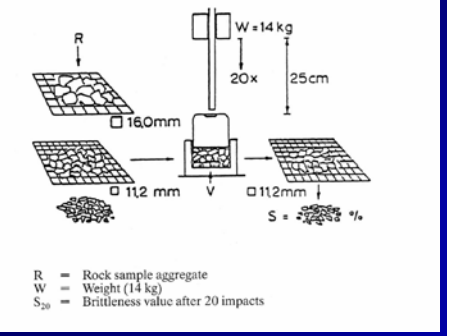
Modular design of modern rock drill



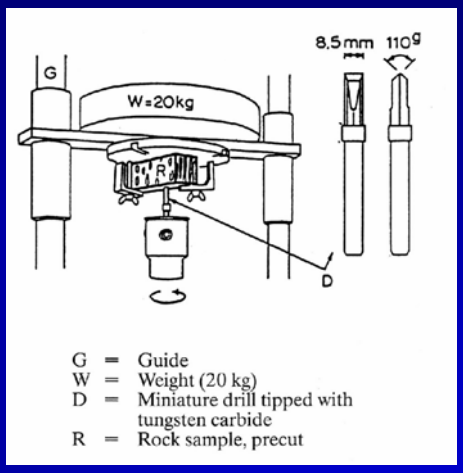
Drilling Development



Laboratory Test

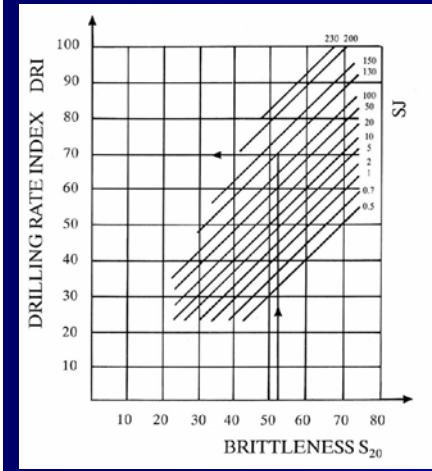


S_{20} Value



SJ Value

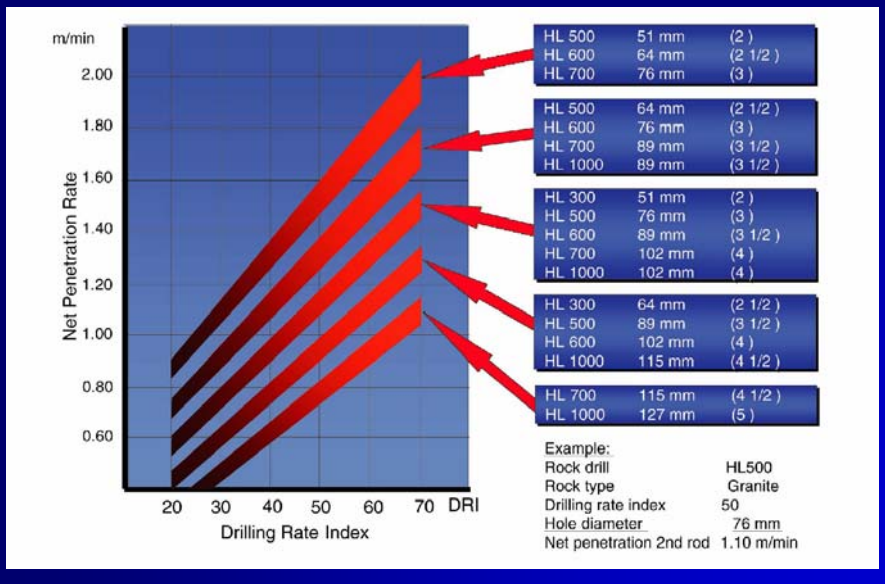
Drilling Index (DRI)



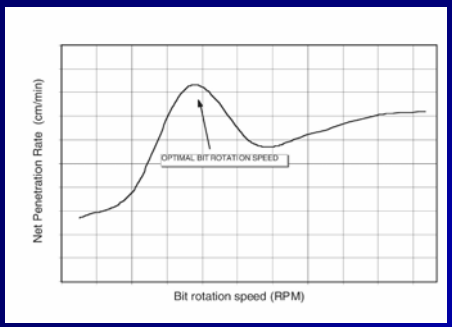
Rock type	DRI	Rocktype	DRI
Andesite	30...80	Graywacke	25...65
Anhydrite	85...115	Hematite ores	25...85
Anorthosite	30...50	Hornfels	30...50
Amphibolite	15...75	Limestone	30...100
Arkosite	29...75	Marble	40...110
Augen Gneiss	30...70	Magnetite ores	15...50
Basalt	20...75	Meta-Peridoties	40...105
Black Shale, Alum	40...70	Mica gneiss	25...75
Claystone, Slate	40...90	Mica schist	25...85
Coal *	110...120	Nickel ores	40...80
Concrete, C30	115	Norite	20...30
Conglomerate	25...75	Olivine basalt	20...60
Copper ores	30...90	Pegmatite	40...80
Chromite	70...125	Phyllite	35...75
Diabase, Dolerite	30...50	Porphyrite	30...80
Diorite	25...65	Quartzite	25...80
Dolomite	40...55	Rhyolite	30...65
Epidotite	25...40	Sandstone	15...90
Gabbro	30...65	Siltstone	30...145
Gneiss	25...75	Skarn	20...70
Granite	30...80	Sphalerite ores	90...105
Granite, Gneiss	25...80	Syenite	30...80
Granodiorite	30...55	Tonalite	30...70
Granulite, Leptite	20...45	Tuff	30...80
Green schist	40...70	Tuffites	35...145
Greenstone	20...75	TAMROCK** Granodiorite	43...49

* Two rock samples only; coal is too brittle for the stamp test.
** Typical value for the TAMROCK test mine in Myllypuro.

Penetration Rate



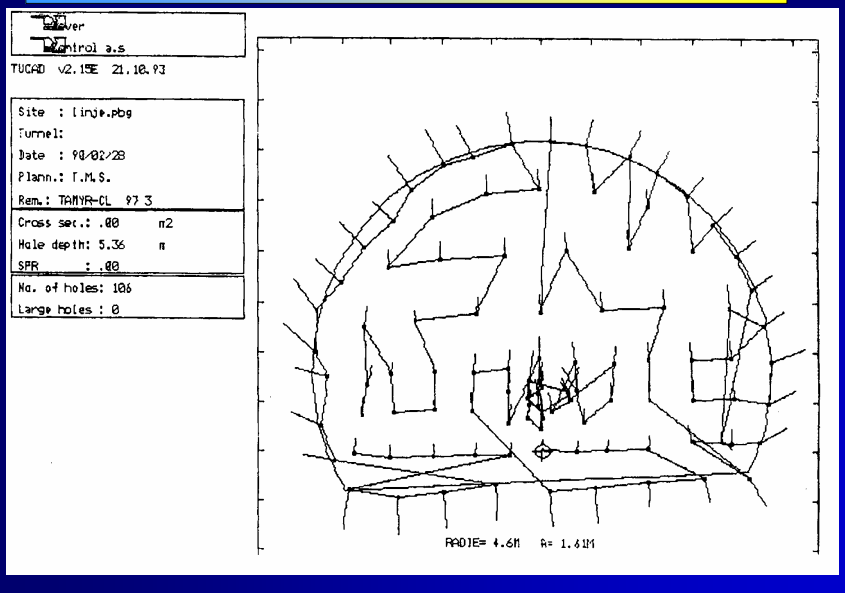
Influence of Rotation & Flushing



For Water Flushing a value of 50 litres per minute is a standard value.

Steel diameter, mm	25	32	38	45	51	64	76	87
Hole size, mm	Required air volume m³/min (air velocity = 15 m/s)							
32	0.28	*Drifting*						
38	0.58	0.30						
45		0.71	0.41					
51		1.11	0.82	*Long hole drilling*				
64		2.17	1.87	1.46				
76			3.06	2.65	2.24	1.19	*Tubes*	
89				4.17	3.76	2.70	1.52	
102					5.52	4.46	3.27	2.00
115					7.51		5.27	4.00
127								6.05

Record of a drilling Cycle



Comparsion
Hydraulic & Pneumatic Drilling

Hydraulic drilling	*Pneumatic drilling*
Efficient	Fairly inefficient
50% higher drilling capacity	Low capacity
Reliable, constantly high efficiency level	Efficiency level depends on outside supply of air and compressed air pipeline configuration
Easily adjustable to changing rock and drilling conditions, smoother drilling	Fairly inflexible
Ergonomic	Non-ergonomic
Less noise, moisture, mist, no surrounding temperature fluctuation	Noisy, air-water mist, cold air flow, uncomfortable working environment
Economical	Low-economy rock drill
High capacity, independent, minimal labor versatile and user friendly	Low capacity, non-independent (air lines and compressors), more labor-intensive

Actual & Future Developments