Bulroc [U.K.] LTD

D.T.H. Reverse Circulation Equipment

What is - *Reverse Circulation Drilling?*

Reverse Circulation Drilling has been in use for quite a long time in Canada and the USA. where it is referred to as "Centre Sample Recovery" or "Dual Wall Drilling".

RC. drilling employs a Dual Wall Pipe where the drilling medium, normally high pressure air, is passed between the outer and inner tubes down to the face of the drilling bit where it is returned up the centre tube along with the sample cut by the drill bit.

The sample is directed through the centre of the air inlet swivel, through the rotary head and through the sample recovery swivel from where it decelerates into a larger diameter hose and is delivered into a cyclone collection arrangement. From here the sample is collected either as a continuous sample in long sausage type plastic bags or as a sample of a specific depth drilled.

From this it will be clear that the drilling rig will need to have certain features such as a hollow spindle rotary head of sufficient dimensions to accommodate the inner tube of the particular dual wall pipe to be used. It would also need to have a winch or rod handling facility since dual wall drill pipe is considerably heavier than conventional drill pipe. The rig would also need to be of substantial proportions so as to have the necessary rotary torque and pull back capabilities.

Good Reasons for Choosing Bulroc R.C.

No Contamination

The Bulroc R.C. System collects sample through the recovery holes in the face of the drill bit immediately as the cuttings or sample is formed. The sample then travels through the centre of the hammer, into the inner dual wall pipe and on to the cyclone collection point.
Unlike the conventional hammer and crossover sub arrangement, the drilled sample does not have to travel the length of the hammer, where contamination and loss of sample takes place.

Dry Sample

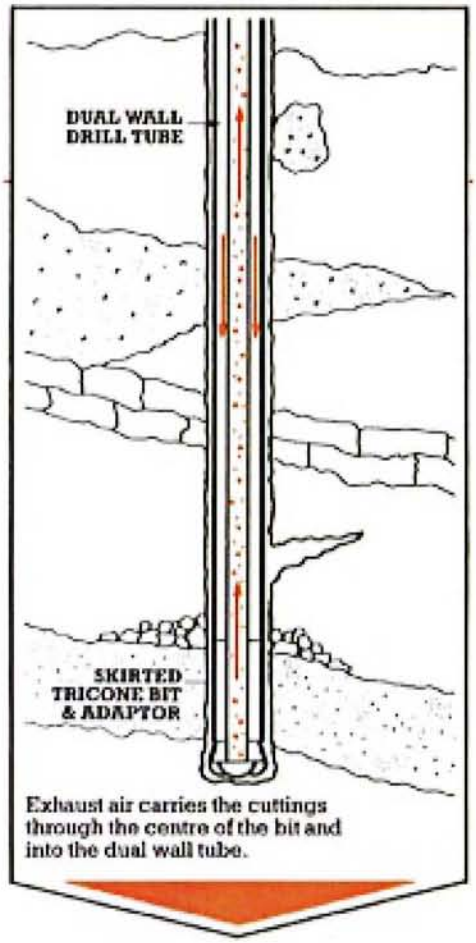
Even in certain water bearing stratas it is still possible to collect a dry Sample because the cuttings (sample) are collected as they are formed through the face of the drill bit and this system allows penetration of the dry sample ahead of the water.
During rod changes, it is inevitable that the sample will become wet but will very quickly return to a dry sample as drilling recommences. Naturally, a dry sample can only be obtained when the hammer is able to overcome the flow of water in the hole. Excessive volumes of water and inadequate operating pressures will effect the hammer's ability to maintain a dry sample

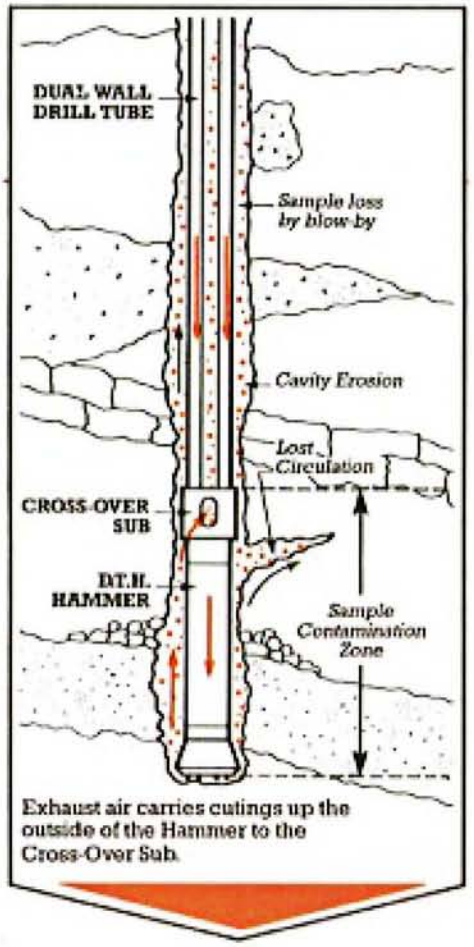
Higher Production

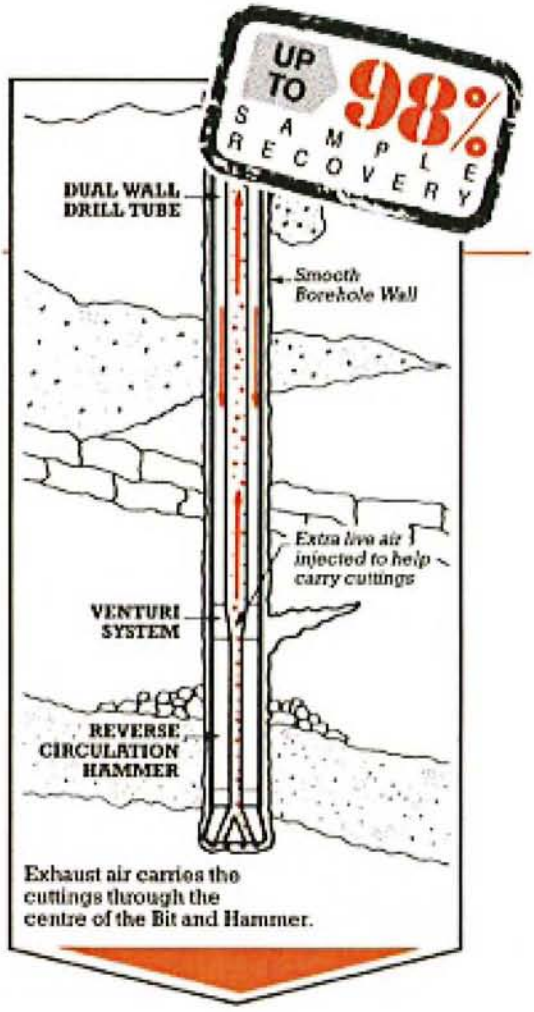
The Bulroc R.C. System is considerably faster thar tricone drilling in hard formations but will still deliver an uncontaminated sample.
Although conventional hammers with crossover subs may develop marginally higher penetration rates, the quantity and quality of sample cannot compare with that delivered by the Bulroc R.C.
In broken and fractured ground conditions, the Bulroc R.C., will often out perform the conventional hammer in terms of penetration rates and the smooth contours of the Bulroc R.C. System makes tripping out easier and quicker.

Higher Sample Recovery

Because the sample is collected through the face of the drill bit there is no loss of sample when drilling through broken or fractured ground.
Even when drilling through old mine workings the Bulroc R.C. hammer will provide a sample up to the point of breaking through and will immediately pick up sample when the hammer reaches the other side of the stope or heading.
And since the bit is matched to the chuck size, there is very little bypass of sample and recovery rates of up to 98% are generally achievable.







Tricone &: Drag Bits

When drilling in soft to medium formations, it is normal practice to use a modified Tricone bit with an adaptor sub to suit the particular dual wall pipe. In particularly soft formations such as sands, shales and coal etc. a carbide inset Drag Bit can be used, again incorporating an adaptor to suit the Dual Wall Pipe size.

Both modified Tricones and Drag type bits pick up sample directly from the bit face and the uncontaminated sample passes directly into the inner tube of the Dual Wall pipe.

However, in harder formations, these types of drill bits become uneconomical both as a result of escalating bit cost and the

Conventional Hammers

In harder formations it was necessary to change to a conventional, Down Hole Hammer fitted with a crossover or interchangeable sub positioned between the backhead and the dual wall pipe.

The hammer operates in the normal way, exhausting through the centre of the drill bit, carrying the cuttings along the length of the hammer where a certain percentage will enter the crossover sub and be transported to the surface through the centre of the Dual Wall Pipe.

The percentage of sample recovered depends on various ground factors but the weakness in this system is the inability to control the quality or purity of the sample recovered.

Disadvantages

Contamination of sample as it travels along the length of the hammer to the cross-over sub.

Loss of sample through void and broken ground.

Contamination of sample in water bearing strata.

Loss of sample through greater erosion of bore hole wall in soft broken strata.

BULROC RC. System

The Bulroc R.C. range of hammers operate in a similar way to conventional hammers but in the case of the Bulroc RC., the exhaust air is directed between the splines of the special drill bit and the chuck (Driver Sub). The air then travels over the face of the bit, through the face recovery holes, through the centre of the hammer and into the inner dual wall pipe.

The sample is collected immediately as it is formed and transported to the surface without any contamination -up to 98% of sample recovery.

The Bulroc RC. hammer can collect sample in broken and fractured ground, even through old mine workings the sample will be picked up immediately that the bit reaches the other side of the stope or heading.

BULROC - *The Original R.C. Hammer*

It has long since been accepted that the sample delivered by the Conventional Down Hole Hammer with a Crossover or interchange sub will have some degree of contamination

The degree of contamination will be effected by the geological make up of the rock as will the actual percentage volume of sample recovered per ft/metre of hole drilled.

Several attempts had been made to construct a "Hollow" Hammer so that uncontaminated sample could be collected from the bit face and travel through the hammer but no suitable alternative was found until in 1985, Bulroc U.K. introduced the first prototype RC. or C.S.R. Down Hole Hammer.

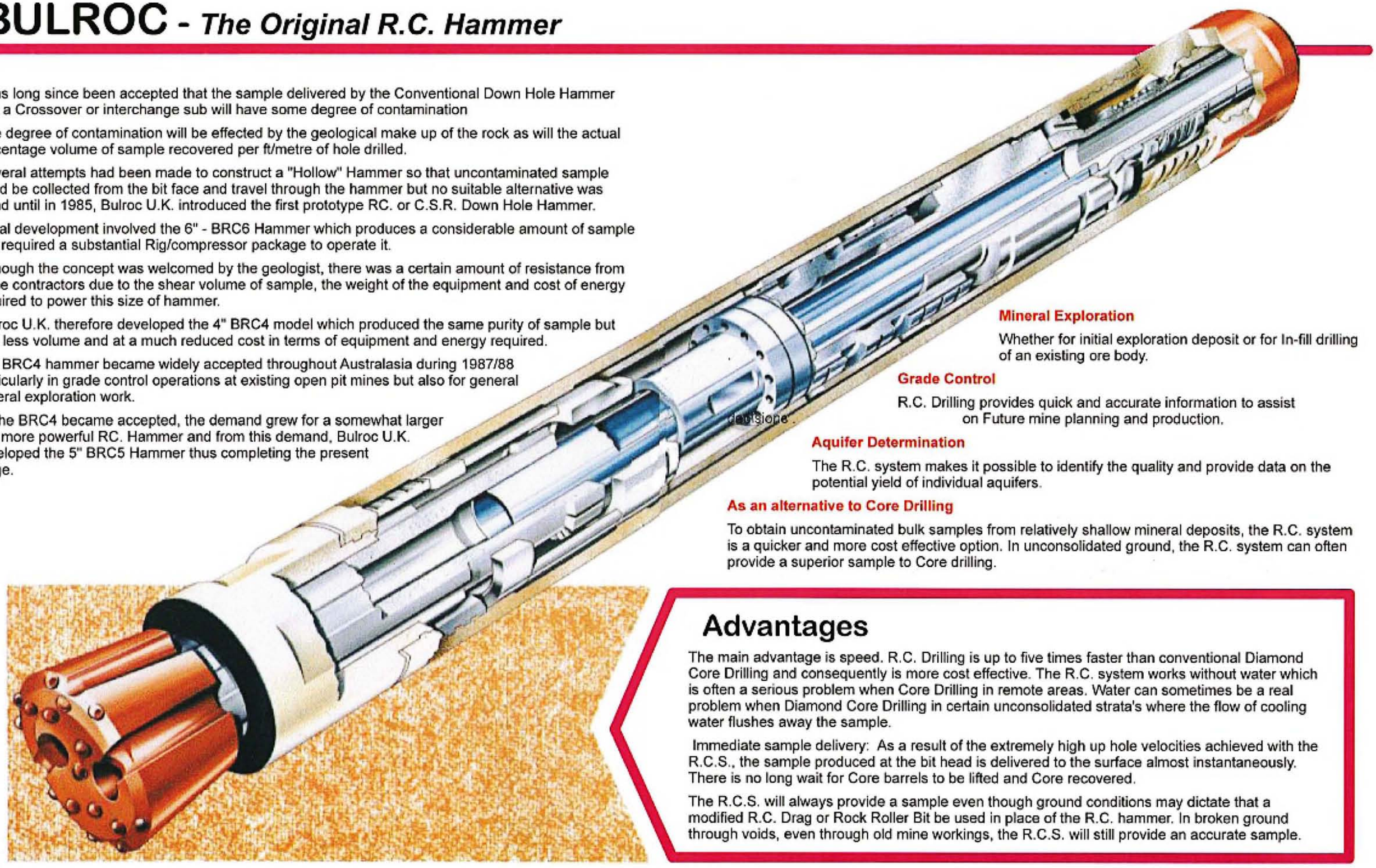
Initial development involved the 6" - BRC6 Hammer which produces a considerable amount of sample and required a substantial Rig/compressor package to operate it.

Although the concept was welcomed by the geologist, there was a certain amount of resistance from some contractors due to the shear volume of sample, the weight of the equipment and cost of energy required to power this size of hammer.

Bulroc U.K. therefore developed the 4" BRC4 model which produced the same purity of sample but with less volume and at a much reduced cost in terms of equipment and energy required.

The BRC4 hammer became widely accepted throughout Australasia during 1987/88 particularly in grade control operations at existing open pit mines but also for general mineral exploration work.

As the BRC4 became accepted, the demand grew for a somewhat larger and more powerful RC. Hammer and from this demand, Bulroc U.K. developed the 5" BRC5 Hammer thus completing the present range.



Mineral Exploration

Whether for initial exploration deposit or for In-fill drilling of an existing ore body.

Grade Control

R.C. Drilling provides quick and accurate information to assist on Future mine planning and production.

Aquifer Determination

The R.C. system makes it possible to identify the quality and provide data on the potential yield of individual aquifers.

As an alternative to Core Drilling

To obtain uncontaminated bulk samples from relatively shallow mineral deposits, the R.C. system is a quicker and more cost effective option. In unconsolidated ground, the R.C. system can often provide a superior sample to Core drilling.

Advantages

The main advantage is speed. R.C. Drilling is up to five times faster than conventional Diamond Core Drilling and consequently is more cost effective. The R.C. system works without water which is often a serious problem when Core Drilling in remote areas. Water can sometimes be a real problem when Diamond Core Drilling in certain unconsolidated strata's where the flow of cooling water flushes away the sample.

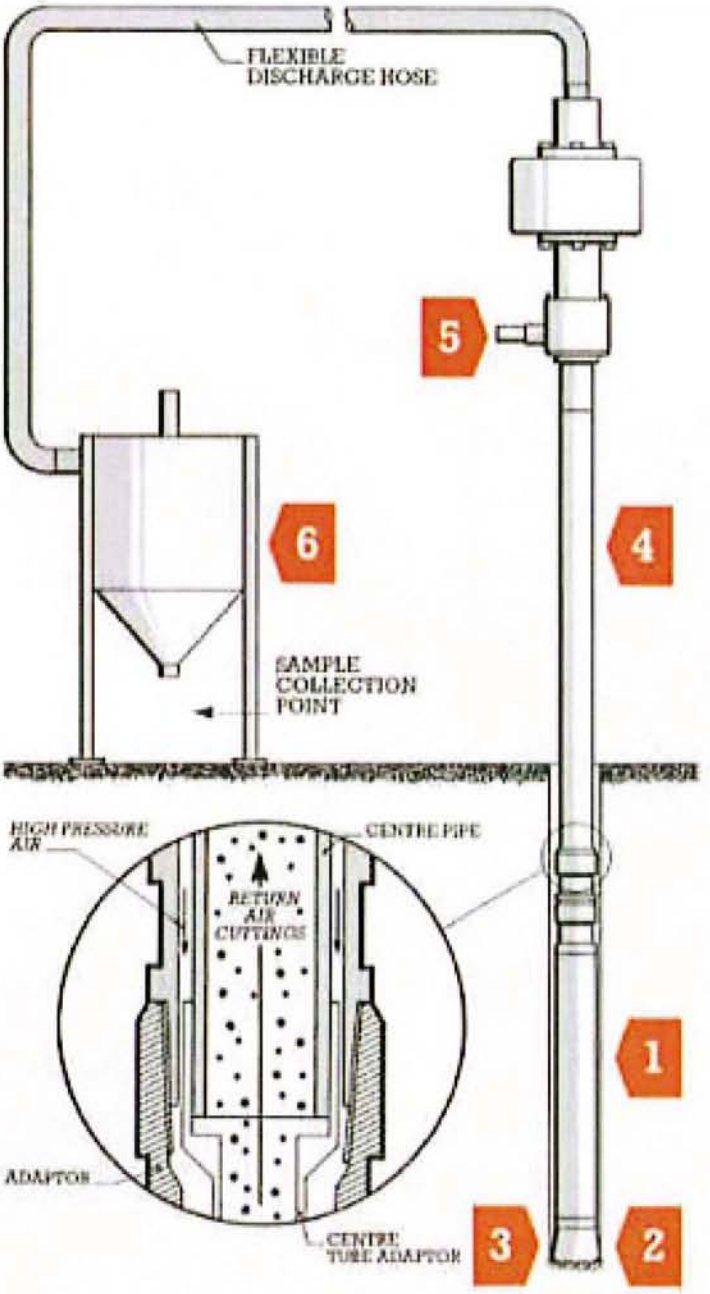
Immediate sample delivery: As a result of the extremely high up hole velocities achieved with the R.C.S., the sample produced at the bit head is delivered to the surface almost instantaneously. There is no long wait for Core barrels to be lifted and Core recovered.

The R.C.S. will always provide a sample even though ground conditions may dictate that a modified R.C. Drag or Rock Roller Bit be used in place of the R.C. hammer. In broken ground through voids, even through old mine workings, the R.C.S. will still provide an accurate sample.

BULROC - *The Complete R.C. Hammer*

2 RANGE OF R.C. BUTTON BITS

1 RANGE OF R.C. HAMMERS



R.C. Drilling is rapidly becoming a more widely accepted alternative method of producing accurate geological samples, particularly in the applications already mentioned.

Bulroc's commitment to R.C. Drilling is emphasised by the range of R.C. accessories offered - from the drill bit through to the collection cyclone - to suit all types of strata.

The Bulroc R.C. hammer is made to suit all types of dual wall drill pipes by means of a simple adaptor sub. The subs also have a centre sample tube which connects with the centre tube of the hammer - via the valve seat - and the centre tube of the particular dual wall pipe in use.

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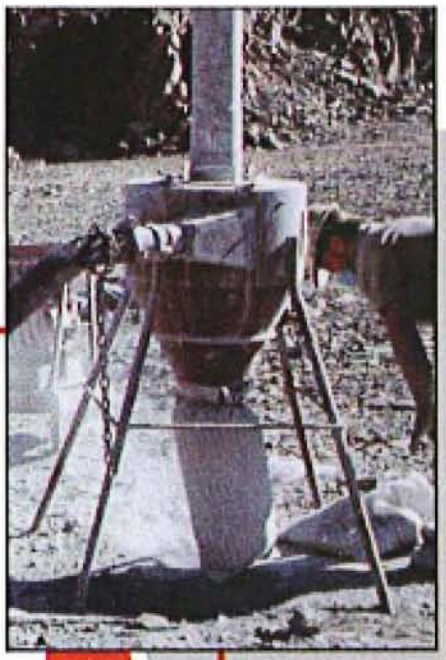
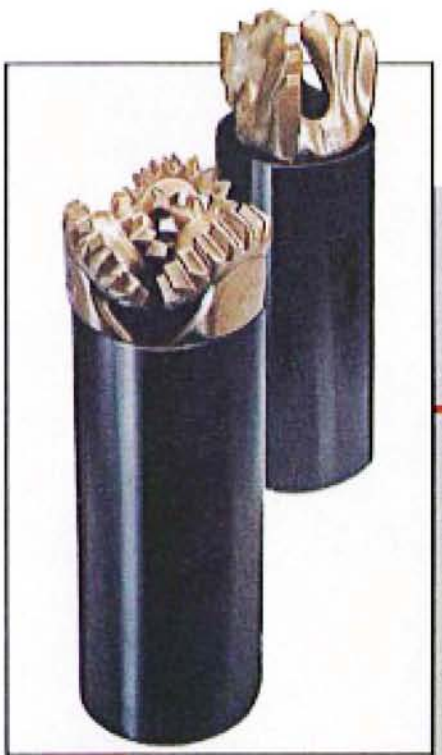
THE COMPLETE R.C. DRILLING SYSTEM

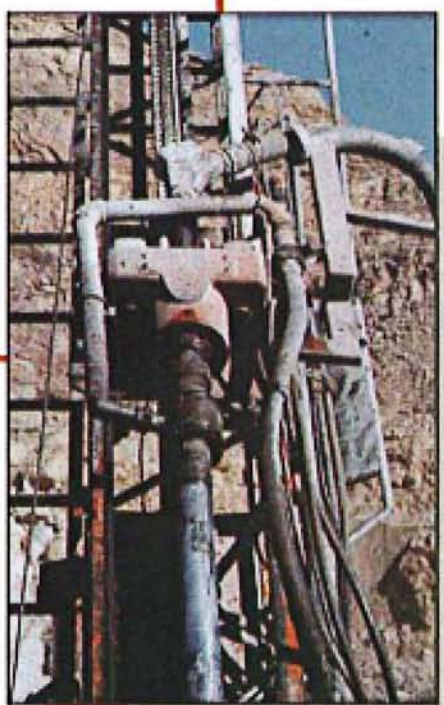


6 CYCLONE UNITS



3 DRAG & TRICONE BITS

4 DUAL WALL PIPE



5 SWIVELS & ADAPTORS

Bulroc R.C. Hammers

IMPERIAL SIZES									
Model	Outside Diameter	Length w/o Bit	Weight w/o Bit	Piston weight	Free Air Consumption - Without Venturi (C.F.M.)				
					150 psi	200 psi	250 psi	300 psi	350 psi
BRC4	3.88"	40.35"	88lb	15.52lb	150	200	260	330	400
BRC5	4.75"	45.90"	130.9lb	19.14lb	180	250	340	425	512
BRC6	5.63"	45.82"	182.6lb	29.2	275	385	524	660	800

METRIC SIZES									
Model	Outside Diameter	Length w/o Bit	Weight w/o Bit	Piston weight	Free Air Consumption - Without Venturi (M^3/min)				
					10.2 bar	13.6 bar	17.0 bar	20.4 bar	23.8 bar
BRC4	98mm	1025mm	40kg	6.6kg	4.3	5.6	7.3	9.3	11.3
BRC5	121mm	1166mm	59kg	8,7kg	5.1	7.1	9.6	12.0	14.5
BRC6	143mm	1164mm	83kg	13.3kg	7.8	10.7	14.8	18.7	22.6

Venturi Option

All Bulroc R.C. Hammers can be fitted with a modified valve seat which will develop a strong venturi action and assist in collecting loose and unconsolidated materials in the hole, at the same time improving up hole velocity within the inner tube and reducing the incidence of blocking off.

Operating Pressure PSI	150	200	250	300	350
Addition Air Required CFM	80	110	130	165	195

Operating Pressure BAR	10.2	13.4	17.0	20.4	23.8
Addition Air Required M^3/min	2.28	3.00	3.66	4.60	5.48

Bulroc R.C. Button Bits

Bit Dia		Weight		Part No.
mm	Ins	kg	lb	
108	4¼	9.0	19.8	BBS103CC108HS
133	5¼	14.2	31.2	BBS104CC133HS
159	6¼	21.7	47.7	BBS105CC159HS

Bulroc Dual Wall Drill Tubes

Outside Diameter	Inner Tube Bore	Effective Length	Part No.
3.5"	2.0"	3M	DCWT5830M
		6M	DCWT5860M
4.5"	2.5"	3M	DCWT5930M
		6M	DCWT5960M

Bulroc R.C. DUAL Wall Swivels

Swivel	Pipe Size	Part No.
Air Inlet Swivel	3.5"	AIS44222
	4.52	AIS44333
Sample Return Swivel	3.5"	SR55222
	4.5"	SR55333

Adaptor Subs

Bulroc R.C. Hammers are connected to the dual wall drill tube by way of a simple sub incorporating a central sample tubes.
The make of dual wall drill tube intended to be used should be specified when ordering Bulroc R.C. Hammers.