GENERAL MAINTENANCE MANUAL
FOR

DRILL SERIES
AND
COMPETITOR SERIES

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DRILL SERIES

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GENERAL INFORMATION

Drill Series and Competitor Series

SECTION 1 - HAMMER MAINTENANCE

A) Maintenance Schedule

All hammers must be frequently disassembled and inspected for damage or wear. How often the hammer will be inspected depends on the drilling conditions. When used for standard dry drilling (little or no water), an inspection every 175-200 hours will be enough.

When using the hammer in wet conditions, in holes where mud is found, in water wells, when using water or foam injection, or when drilling in very hard rock, an inspection should take place every 100 hours. Damaged or worn parts must be replaced immediately. Also, a standard check of the tool after its first 6-10 hours of operation is beneficial to detect any early problems.

IMPORTANT: When using water or foam injection, remember to clean hammer thoroughly at the end of the day by flushing with clean water and compressed AIR then re-lubricate.

B) Wear Life of Parts

The hammer owner has the final judgement on the necessity to change or replace parts. Air slips past worn sealing areas and thus provides less pressure to the piston. When pressure drops, so does penetration. And when penetration becomes inadequate, parts must be repaired or replaced. One factor that determines how much wear there is on parts is large air volume which compensates for wear between the piston and piston case. Another is the cleanliness of the operating environment and precise use of lubrication.

Any kind of dirt, dust, or dampness can shorten the life of the parts or interfere with the quality of the oil twice as quickly. Close attention to the use of the hammer, its operating pressure, operating hours and penetration rate will inform its owner of safe service intervals.

SECTION 2 - HAMMER OPERATION

A) Principles of Operation

hammers and drilling products are drill rig operated, down-the-hole percussion hammers that meet or exceed standard percussion and rotary drill rates. With correct air compression and sufficient rotation, these hammers can out-perform many others. The hammers penetration comes from air flow and air pressure in the piston case. The cleaner the air and the sharper the bit, the better performance and longevity one gets from the hammer.

B) Safety Precaution

1. **Know your Product** - Close attention should be kept to the hammer's operation. It is a heavy tool and can hurt someone or be damaged if dropped. Be sure to have a clear area when moving the hammer. Do not exceed suggested operating limitations for use. Always use the proper tools for assembly and disassembly. Don't improvise. This will insure that your hammer works effectively for a long time to come.

2. **Proper Attire** - Safety starts with what you're wearing. Make sure work clothes fit snugly and there is no excess cloth that can be caught in the equipment. Protect your head with a hard hat, ear guards, and eye-wear that deflects matter thrown into the air during hammer use. Protect your hands with durable work gloves and your feet with sturdy steel toe shoes or boots.

3. **Know your Environment** - Always be aware of your drilling conditions. Take precautions for every possible occurrence from weather to chemical mixes in materials that can cause explosions. Evaluate every site carefully before drilling to be prepared for potential complications.

4. **Compressed Air** - Compressed air can be dangerous if not used correctly. Never direct air towards any person for any reason. Do not use it to clean anything but the hammer and make sure it doesn't blow anything **into** the hammer.

IMPORTANT: All safety precautions must be followed. Improper or negligent use of hammers and drill products can result in bodily injury, or death and/or severe damage to the hammer and parts.

C) Handling the Tool and Bit

All hammers are inspected and assembled prior to sale or shipment. The hammer is shipped assembled, but not ready for use. Every owner must tighten joints and adjust hammer to necessary performance specifications. Here are some general recommendations concerning hammer use:

1. All persons using the hammer must become extremely familiar with methods of use and mechanical specifications of the hammer prior to use.
2. To maintain the life of your hammer it should be inspected thoroughly on a regular basis to insure parts are in good condition, replacing those that are not. Mark new bits with their sizes to help decide which will be the best one to use.
3. Avoid excessive contact with the elements by keeping the hammer inside overnight and shielding its interior from dirt and other objects with a large cover.
4. During maintenance, use tools specifically designed for the hammer's measurements. Don't adapt other tools because they are close in measurement and temporarily convenient; the hammer can be damaged this way and its' life span shortened.

D) Thread Preparation

Threads must be cleaned well before they can be used. If any former thread compound is present, clean thoroughly prior to preparation with a wire brush and solvent. If any irregularities are found on the threads, such as burrs or nicks, remove them with an emery cloth for box threads and a file for pin threads. Dry with compressed air when finished.

Lightly coat threads and mating shoulders with compound of which at least 40 percent must be a powdered lead, zinc, or copper. Avoid anything heavier to coat threads that might cause a large reduction in the friction coefficient. Do not let any of the compound find its way into other tool parts while in use.

E) Drill Pipe Connection

When using new drill steel, be sure all cuttings have been cleared out. When attaching drill pipe, make sure all parts involved are thoroughly cleaned of mud, dirt, and other matter prior to connection. Make sure the pipe is not bent as this will cause undue stress on parts. See Chart 1, page 4.

As hammer is rotated onto drill pipe, make sure thread connections are firm and tight. If not, they may need to be rechecked for excess compound or the shoulder refaced. If the connections seem good, tighten them with a wrench to proper torque.

IMPORTANT: Do not depend on drilling action to tighten the threads later; make sure all are checked and tightened prior to ANY use.

For proper torque ranges for the Hammer threads, observe the following chart:

CHART 1

Proper Torque Ranges for Hammer

Model No.	Torque Ft.-Lb.	Torque Kg.-M
Drill 4	3500-4000	480-550
Drill 4 HD	3500-4000	480-550
Drill 5	5000-6000	760-830
Drill 5 HD	5000-6000	760-830
Competitor 50 R	5000-6000	760-830
Competitor 50R HD	5000-6000	760-830
Drill 6	9000-10,000	1,245-1,390
Drill 6 HD	9000-10,000	1,245-1,390
Drill 6 SE	9000-10,000	1,245-1,390
Drill 6 SE HD	9000-10,000	1,245-1,390
Drill 6 LV	9000-10,000	1,245-1,390
Drill 6 Stabilized	9000-10,000	1,245-1,390
Competitor CF 6	9000-10,000	1,245-1,390
Competitor CF 6 HD	9000-10,000	1,245-1,390
Competitor 60	9000-10,000	1,245-1,390
Competitor 60 HD	9000-10,000	1,245-1,390
Drill 8	19,000-21,000	2,620-2,900
Drill 8 Stabilized	19,000-21,000	2,620-2,900
Drill 8 5/8 Stabilized	19,000-21,000	2,620-2,900
Competitor 80	19,000-21,000	2,620-2,900
Drill 10	37,000-40,000	5,110-5,530
Drill 12	42,000-46,000	5,800-6,360
B53-15	8,500-9,500	1,175-1,315
53-25	8,500-9,500	1,175-1,315
63-15	13,500-15,500	1,865-2,145
100-15	30,000-33,000	4,150-4,565

F) Oil Consumption/Lubrication

Lubrication is always the obvious key to maintaining the life and productivity of the hammer. Rock drill oil is an effective lubricant and has three grades for varying environmental conditions, Grades 10, 30, and 50, Light, Medium, and Heavy respectively.

To the naked eye, one can evaluate oil consumption by observing the thin layer of oil lubricating the inside of the drill pipe. Consumption of this oil is directly correlated to air consumption. Inlet air pressure and the restriction plug determine air consumption.

Temperature will dictate which grade of oil to use. It is important not to under-lubricate or over-lubricate. When a fine film of oil is evident on the bit face and exhaust ports while running the hammer at minimum bpm, the lubricator is adjusted properly. Proper adjustment insures prevention of part damage and correct hammer operation.

On occasion, excess oil will drain down the drill rods into the hammer when it is not in use and may demand a cleaning of the parts. Also, when using the hammer in the cold and wet, place it as far into the hole as possible to take advantage of ground heat.

If parts are new, use an extra quart/liter of oil per new joint of drill pipe. Also, use higher grades when in atmospheric conditions that can affect viscosity, such as water.

Observe the following chart to select the best grade of oil for your needs

CHART 2

Recommended Rock Drill Oil

Typical Operating Conditions		Ambient Temperature		Discharge Temperature		Rock Oil Grade
PSI	Bars	Deg.F	Deg.C	Deg.F	Deg.C	Oil Grade
100	7	Below 20'	7	Below 225	107'	Light
		Betweem 20' & 80'	Between -7' & -27'	Between 225' & 325'	Between 107' & 163'	Medium
		Above 80'	Above 27'	Above 325'	Above 163'	Heavy
250 & Above	17& Above	Below 20'	Below -7	Between 225' & 325'	Between 107' & 163'	Medium
		Above 20'	Above -7	Above 325'	Above 163'	Heavy

See the Chart 3 on page 6 for Rock drill oil use.

CHART 3

Recommended Minimum Oil Requirements

	Qt/Hr	Liter/Hr		Qt/Hr	Liter/Hr
DRILL 4	1	1	COMPETITOR 60	2.5	2.5
DRILL 4 HD	1	1	COMPETITOR 60 HD	2.5	2.5
DRILL 5	1.5	1.5	DRILL 8	3	3
DRILL 5 HD	1.5	1.5	DRILL 8 STABILIZED	3	3
COMPETITOR 50R	1.5	1.5	DRILL 8-5/8 STABILIZED	3	3
COMPETITOR 50R HD	1.5	1.5	COMPETITOR 80	3	3
DRILL 6	2.5	2.5	DRILL 10	3.5	3.5
DRILL 6 HD	2.5	2.5	DRILL 12	4.5	4.5
DRILL 6SE	2.5	2.5	B53-15	1.5	1.5
DRILL 6SE HD	2.5	2.5	53-25	1.5	1.5
DRILL 6LV	2.5	2.5	63-15	2	2
DRILL 6 STABILIZED	2.5	2.5	100-15	3	3
COMPETITOR CF 6	2.5	2.5			
COMPETITOR CF 6 HD	2.5	2.5			

1. Thread Lubrication

All three thread connections must be well lubricated to insure part durability. These three connections can be found on each end of the wearsleeve and on the backhead at its connection point to the drill rod. The instructions for lubrication are as follows:

a. Use a wire brush and cleaning liquid on all threads and shoulders. Use compressed air to dry.

b. Search threads and shoulders for burrs, nicks, and other irregularities. File male connections and use a fine grade emery cloth to smooth female ones. If necessary, use a grinder to eliminate leading edges that are too sharp.

c. Cover all thread connections with a good lead/zinc based tool joint lubricant.

2. Air Supply

Effective operation of the hammer depends heavily on the correct amount of air pressure. The diameter of the piping that connects the compressor to the hammer should be large enough to supply the desired pressure as well as the fittings. Valves that open all the way and pipes which are straight work best.

3. Air Consumption

The air volume necessary for drilling decides the air consumption rate and which choke is required for use. A choke is necessary to regulate the correct

amount of air pressure into the hammer and to insure that the user gets the maximum performance from the hammer. Using the hammer either over or under the recommended pressure can sacrifice durability and productivity.

Therefore, to get maximum performance, it may be necessary to "fine tune" the hammer to the compressor by changing the choke in the EDM Drill series or grinding a flat on the plug in the Competitor series.

To do this correctly, one must first find the air volume output from the compressor's rated PSI. Then find the correct size of choke and install it in either the rigid valve or the check valve depending on which series you have. Most likely, nothing more than a blank choke will be needed, except where air is needed for cleaning or if there is a considerable amount of water injected.

4. Altitude Correction

The following chart shows the adjustment necessary in the compression rating as altitude changes. Simply multiply the correction factor to the standard air compression rating (at sea level) to find the difference in compressor output.

CHART 4

ALTITUDE CORRECTION FACTOR

Feet	Meters	Correction Factor
4000	1200	.86
5000	1500	.82
6000	1800	.79
7000	2100	.76
8000	2400	.73
9000	2700	.70
10000	3000	.68
11000	3400	.65
12000	3700	.63

G) Drilling

Check recommended torque for joints and make sure they meet specifications.

Check to insure that the correct size choke is installed in the EDM Drill series rigid valve or in the Competitor series check valve. Look at bit markings to insure that you use bits in sequential order, from the bit with the largest diameter first, then the second largest, and so on.

Put the Drill Series driver sub or Competitor Series chuck over the bit and the O-ring and bit retainer ring. Tighten all of this into the EDM Drill Series piston case or Competitor Series wearsleeve by hand first; and, with the bit breaker afterwards. Check the recommended torque and be precise.

IMPORTANT: Always recheck lubrication in the drill pipe I.D., particularly if parts are new or replaced. Remember proper safety attire.

Start the air, rotate the hammer slowly, and lower it into the hole. Stop before the bottom of the hole is reached and clear hole of water, mud, or gravel. Also, be aware of any other details such as casing, which could damage your bit if touched with casing.

Slowly begin to apply pressure until the hammer begins running and breaking rock. Then increase the down pressure until the hammer is running continuously and smoothly. The air pressure will begin to find its level.

1. Back Pressure

Back pressure occurs as you drill deeper. You could also encounter back pressure due to large amounts of water or mud. The more back pressure you have, the slower the penetration rate will be. To correct this, you must increase the inlet pressure so it outweighs and is higher than the back pressure. Do this by adding air volume and/ or a booster compressor until penetration rate increases.

2. Rotation Speed

Optimal rotation speed varies between 1-50 RPM, depending on rock hardness, slower RPMs for harder rock, higher RPMs for softer rock. As a rule of thumb, the RPM is about 1/2 the drill rate based on feet per hour.Staying in this range helps keep the bit young and durable. See **CHART 5**, page **9** to help determine optimal speed.

3. Water or Foam Injection

Water or foam injection aids in the drilling process, helps in maintaining the quality of equipment used and can make the process easier on the driller. Specific benefits include:

a. Occasionally parts can seize under the duress of drilling. Water or foam can reduce the temperature of the compressed air and avoid seizure.

b. Water or foam can absorb dust tossed into the air which can hurt the rig and the lungs and eyes of the driller. If the hole becomes collared, the injection of water can assist in cleaning the hole.

CHART 5

Hammer Size vs. RPM Operating Range

Hammer Size	RPM Operating Range		
	Soft Rock	Medium Rock	Hard Rock
Drill 4	48-59	28-39	12.5-19
Drill 4 HD	48-59	28-39	12.5-19
Drill 5	38-49	28-39	12.5-19
Drill 5 HD	38-49	28-39	12.5-19
Competitor 50R	38-49	28-39	12.5-19
Competitor 50R HD	38-49	28-39	12.5-19
Drill 6	38-49	28-39	12.5-19
Drill 6 HD	38-49	28-39	12.5-19
Drill 6SE	38-49	28-39	12.5-19
Drill 6SE HD	38-49	28-39	12.5-19
Drill 6LV	38-49	28-39	12.5-19
Drill 6 Stabilized	38-49	28-39	12.5-19
Competitor CF6	38-49	28-39	12.5-19
Competitor CF6 HD	38-49	28-39	12.5-19
Competitor 60	38-49	28-39	12.5-19
Competitor 60 HD	38-49	28-39	12.5-19
B53-15	38-49	28-39	12.5-19
53-25	38-49	28-39	12.5-19
Drill 8	28-39	18-29	9.5-19
Drill 8 Stabilized	28-39	18-29	9.5-19
Drill 8 5/8 Stabilized	28-39	18-29	9.5-19
Competitor 80	28-39	18-29	9.5-19
63-15	28-39	18-29	9.5-19
Drill 10	28-39	18-29	9.5-19
Drill 12	12.5-19	9.5-14	4.5-9
100-15	12.5-19	9.5-14	4.5-9

IMPORTANT: Follow these guidelines when using water or foam injection.

First and foremost, remember that water or foam injection is NOT a replacement for hammer and part maintenance. In fact, water and foam residue can damage parts if they are not inspected and cleaned frequently.

When using water, check several things. First, make sure there is no foreign matter in the water that might interfere with or damage the hammer. Also, check the pH balance of the water to insure that it is at least a pH of 10-12 to avoid possible corrosion of parts. When using water or foam, the oil injection rate must be increased.

IMPORTANT: When drilling is finished, even if used only for short periods of time, the hammer must be flushed with clean water, then well lubricated to help avoid corrosion.

H. Suggested Operating Procedures

Water may need to be injected on occasion into holes where mud is found blocking progress. An estimate for water injection is 2-4 gallons of water per minute, but refer to the following, Chart 6, for more precise figures:

CHART 6

Hammer size vs. Water Injection Rate

Hammer Size	GPM	Hammer Size	GPM
Drill 4	1-2	Drill 8	3-6
Drill 4 HD	1-2	Drill 8 Stabilized	3-6
Drill 5	2-3	Drill 8 5/8 Stabilized	3-6
Drill 5 HD	2-3	Competitor 80	3-6
Competitor 50R	2-3	Drill 10	3-6
Competitor 50R HD	2-3	Drill 12	3-8
Drill 6	2-5	B53-15	2-5
Drill 6 HD	2-5	53-25	2-5
Drill 6SE	2-5	63-15	3-6
Drill 6SE HD	2-5	100-15	3-8
Drill 6LV	2-5		
Drill 6 Stabilized	2-5		
Competitor CF6	2-5		
Competitor CF6 HD	2-5		
Competitor 60	2-5		
Competitor 60 HD	2-5		

Always make sure the hole is clean and free of matter. Good hold-down pressure is necessary to let the hammer function optimally. Rock formations can pose various problems. It can cause extremely rough rotation and can also cause the hammer to bind in the hole. If this happens, the hammer needs to be removed immediately.

Check and clear the hole and, while the hammer is off, work it back and forth into the hole to feel for resistance. When satisfied it won't bind again, proceed slowly and resume drilling.

Occasionally there will be an air pressure build-up due to a reduction in volume of the cuttings. When this happens, again work the hammer back and forth into the hole assuring it is free. Resume drilling.

If the hammer begins to drill extremely fast, it's a good sign that more hold down pressure may be required to keep enough weight on the hammer to keep it on the rock face. When this happens the piston continues to contact the bit which could cause shanking of the bit and/or form a lip on the bit retainer area which would make it difficult to remove the driver sub or chuck from the bit.

Damage can also be caused when rotation has stopped, but the bit still rests at the bottom of the hole. Always lift the hammer before resuming rotation.

In quarry operations occasionally chips and cuttings will spill from the surface into the hole making it harder to drill. If this is a problem, place a casing that is at least 1/2 foot higher than the surface of the ground to guard the hole. The casing must be stabilized by mud, dirt, or some other blocker in order for it to be effective.

SECTION 3 - TROUBLESHOOTING

A) Field Conditions

There are many environmental and other factors that will cause your hammer not to work as expected. However, before you assume the problem is inside the hammer, look at your surroundings to check that everything is in order. The following areas are generally the problems you will find if you are having difficulty:

1. The Correct Hammer

Make sure you have the correct size and model of both hammer and rig for the conditions you are about to drill.

IMPORTANT: Size the hammer to the rig compressor, then size the correct bit to the hammer.

2. The Rig

Make sure that the person who is operating the rig knows how to operate it properly. Check to see if the rig capacity is in line with the hammer operating requirements. Finally, make sure that the hammer's attachment to and position on the rig meets the specifications of the rig's manufacturer.

3. Lubrication

Assure adequate lubrication before, during, and after use of the hammer. An oil injection pump is **strongly** recommended as the hammer will break down very quickly without enough lubrication.

4. Air Supply

Maintaining the hammer's rated pressure is important in maintaining the life of the hammer. Refer back to the section on Air Supply and Volume for needed specifications.

5. **The Drill Pipe**

Make sure you have the correct size and diameter of drill pipe. Check that the threads are in good condition; and, that the pipe is not bent in **any** way. If the drill pipe is a flush joint pipe; and, if it is equal to or smaller than the O.D. of the hammer, it should operate fine.

6. **Back Pressure**

To avoid back pressure, refer to page 8, the section on Back Pressure for needed specifications.

7. **Rotation Speed**

Refer to page 8, the section on Proper Rotation for needed specifications.

8. **Total Weight on Bit**

The correct weight on the bit is not only necessary for effective drilling, but also to prevent unnecessary damage to the bit itself. Be sure to refer to the rig's specifications for operation and the previous section on this topic for other pertinent information.

9. **Corrosion**

The hammer must be maintained on a regular schedule to assure that the following elements or occurrences do not reduce the life of the hammer.

i. Dirty Water: Check for adequate filters and be sure that the system water is not contaminated with dirt and sand.

ii. Salt Water: When hammer is brought into contact with salt water, it must be cleaned immediately to prevent corrosion.

iii. Acidic Water: Acidic water can cause corrosion and the breakdown of essential parts. Check pH balance of water frequently to insure it is above the corrosive level of 10.

iv. Foam: Foam is very corrosive. Clean hammer immediately after use.

v. Foreign Matter and Objects: Prevent **anything** from falling into the hammer, no matter how small.

vi. Faulty Check Valve: Dirt and mud can build up in the pipe if the check valve fails to function properly. **KEEP IT CLEAN.**

50R, 60, CF6, 80 COMPETITOR SERIES DRILLS

SECTION 1 - HAMMER DISASSEMBLY

A) Suggested Tools

suggests that the tools most likely to be needed for disassembly and reassembly of our hammers are:

1. For all hammers. Screw Driver, Pliers, Wire Brush, "J" Wrench, Bit Retaining Wrench, Snap Ring Pliers, Hand-Held Grinder, Outside Micrometer, Inside Micrometer, Chain Vise, Brass Drift Rod.
2. In addition to the above we suggest, for use with the Competitor 60, an EDM bearing installer and an bearing remover.
3. In addition to the above, we suggest, for use with the Competitor CF 6, an EDM retainer ring tool, an cylinder strike cap, and an cylinder placement tool.

B) Disassembly - Preliminary Disassembly Instructions:

When beginning down-the-hole hammer disassembly, observe the following guidelines:

1. Always clean the outside of the hammer prior to disassembly.
2. Only work on the hammer when it is safely in your place of business or a garage.
3. Use brass drift or bar for removing internal parts.
4. Hardened parts have been known to break if dropped, move them carefully.
5. To avoid part loss, place all parts in an organized container.
6. When reassembling, assess the need for a wear spacer.

IMPORTANT: When removing chuck or backhead, do not use heat on the wearsleeve to loosen connections. Never use a pipe wrench on the O.D. of the hammer as it may bend or deform the hammer. Instead, use tongs with jaws that apply equal amounts of pressure all around the O.D. Never use tongs on the carbides; grip them on the body of the bit.

C) Chuck and Bit Removal

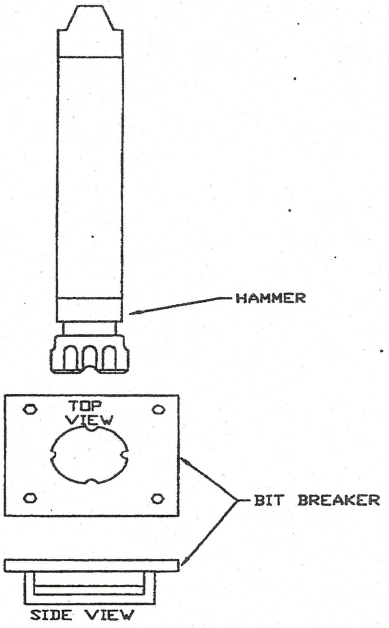
There are several ways to remove the chuck and the bit from the hammer. We suggest using a breaker and tongs. These procedures are as follows:

1. Bit Breaker

Place a rubber pad at the bottom of the bit breaker. This should protect the buttons.

Put the bit into the bit breaker. Lift the chuck 1/4" to 1/2" off the bit shoulder. Then use tongs to loosen a tight joint. In order to prevent damaging the threads, the chuck must be slowly unscrewed from the wearsleeve as the hammer is being lifted.

IMPORTANT: If the bit shifts it will damage the buttons, so keep the bit breaker lugs at the same size as the bit to avoid this problem.



2. Tongs

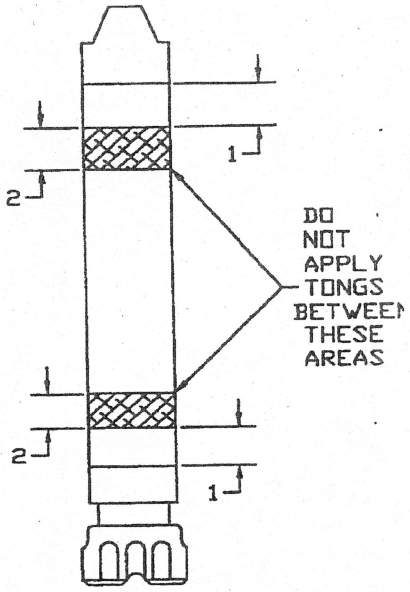
When using tongs, refer to Chart 7 on page 15 to find the correct placement for the tongs on the wearsleeve.

IMPORTANT: If the tongs are placed anywhere else, or if they are not held perpendicular to the wearsleeve while they are loosening the chuck and backhead joints, they can severely damage the wearsleeve.

CHART 7

WEARSLEEVE O.D. DIMENSIONS FOR TONG

	DIMENSION 1	DIMENSION 2
COMPETITOR 50R	3"	3-1/2"
COMPETITOR 50R HD	3"	3-1/2"
COMPETITOR CF6	3"	4"
COMPETITOR CF6 HD	3"	4"
COMPETITOR 60	3"	4"
COMPETITOR 60 HD	3"	4"
COMPETITOR 80	3-1/2"	4-1/2"



D) Disassembly Instructions

1. Take chuck, bit, and bit retaining ring off of the wearsleeve.
2. Take O-ring and bit retaining ring off of the bit shank and remove chuck from bit.
3. Use snap ring pliers to take the retainer out of the chuck end of the hammer.
4. Remove washer, wear spacer (if used), and four disc springs from the chuck end of the hammer.
5. Use "J" wrench to take the backhead out of the wearsleeve and take O-ring off of the backhead. If necessary, use tongs to loosen tight joint, refer to chart above.
6. Remove the check valve and spring from the air distributor. Only remove the air restriction plug if it needs to be replaced.
7. Push washer, (wear spacer, if used), four disc springs, and air distributor out of the wearsleeve by placing a small rod through the piston blowhole and tap out. Replace the O-ring if necessary.
8. Stick a larger brass drift rod into the chuck end of the wearsleeve to push the piston up against the cylinder, tap again until the cylinder comes out of the top end of the wearsleeve. Replace retaining ring on the cylinder only if necessary. Be sure that the rod's O.D. is larger than the piston's blowhole, so it does not go thru or get stuck in the hole.
9. Remove the piston from the top end of the wearsleeve. Remove and replace the bearing from wearsleeve only if it is damaged.
10. If the bearing is damaged and needs to be replaced, push piston back into the backhead end of the wearsleeve until it touches the bearing.
11. If the hammer is a Competitor CF6, remove the bearing (by hand first) and then use the piston to remove the retaining ring.
12. If the hammer is a Competitor 60, use the piston or bearing tool to remove only the bearing.

SECTION 2 - PARTS - INSPECTION, CLEANING, AND REPAIR

A) Using a safe, nonflammable cleaning solution, wash all parts and use compressed air to dry.

B) Find any irregularities or damage to piston such as scratches, minor galling, or burrs. If they can be repaired with an emery cloth, do so. Otherwise, replace the piston.

C) Find any irregularities or heat damage to cylinder. Use a file or handstone to fix minor damage to the clyinder, but replace the cylinder if it is heat checked or cracked.

D) Search for nicks and indentations on cylinder retaining ring. If they are found, replace or use a wear spacer upon reassembly for the Competitor CF6 only.

E) Look for irregularities in air distributor and polish out minor ones. Replace if damage is extensive.

F) Search for nicks and indentations on the seat of air distributor. If found, a wear spacer may be necessary for reassembly.

G) Clearance greater than 0.10" or 0.254mm between the bit aligning bearing and the bit shank demands a remeasurement with a new bit. Bit and bit aligning bearing need to be replaced if clearance is still over specifications.

H) Look for irregularities on check valve and check valve spring, such as cracks and weakness. If valve does not work freely in air distributor, replace both parts.

I) If O.D. of wearsleeve has been worn down to 5-1/8", replace it. To prolong use of wearsleeve, check and measure it often, reversing it on the hammer to counteract wear.

J) Clearance greater than 0.015" or 0.381mm between the piston shank and cylinder requires a measurement with a new piston. Piston and cylinder must both be replaced if remeasurement does not correlate to above specifications.

K) Find irregularities on chuck such as cracks or breaks on the O.D. Use measurements from wearsleeve O.D. to determine how worn the chuck is and whether or not it needs replacement.

L) Place chuck on a new bit. Measurements exceeding 1.14" or 6.4mm on the torsional play requires a new chuck.

M) Find irregularities on backhead such as cracks or nicks. Replace if necessary.

N) Repair all threads that require it.

SECTION 3 - HAMMER REASSEMBLY

A) Wear Spacers

New down-the-hole hammers do not come with wear spacers already installed. Rather, they are provided as disconnected parts, two to each hammer. One wear spacer is installed at each end of the hammer to relieve the loss of compression in the disc springs caused by worn internal parts. In the down-the-hole hammer, four disc springs are used to hold the air distributor tightly in its place on the cylinder.

When assembled correctly, the internal end of the backhead provides force on the steel washer to compress these four disc springs. The internal end of the chuck also provides force on the washer compressing the springs and keeping parts snugly fit at that end of the hammer.

Somewhere between 100-200 hours of operation a check MUST be made to see if a wear spacer is necessary. The guidelines for this are as follows:

1. **Wear Spacer check for the Chuck End**
   a. Lay hammer horizontally
   b. Check wearsleeve for correctly seated bit retaining ring
   c. Screw chuck lightly into wearsleeve so that parts are held firmly together but the disc springs are not compressed.
   d. If a space is found of less than 1.6mm or 1/16" between the shoulder of the chuck and the end of the wearsleeve, a wear spacer is necessary.
   e. Where needed, install a spacer between the bit aligning bearing and the disc springs.

2. **Wear Spacer check for Backhead End**
   a. Take O-ring off backhead
   b. Screw backhead lightly into wearsleeve so that parts are held firmly together but the disc springs are not compressed.
   c. If a space is found of less than 1.6mm or 1/16" between the shoulder of the backhead and the end of the wearsleeve, a wear spacer is necessary.
   d. Where needed, install a spacer between the top washer and internal end of backhead.

IMPORTANT: Use your experience first and foremost to determine when parts become worn and need replacing. The hourly intervals recommended here are provided to assist the determination of need for replacement, but vary according to individual use.

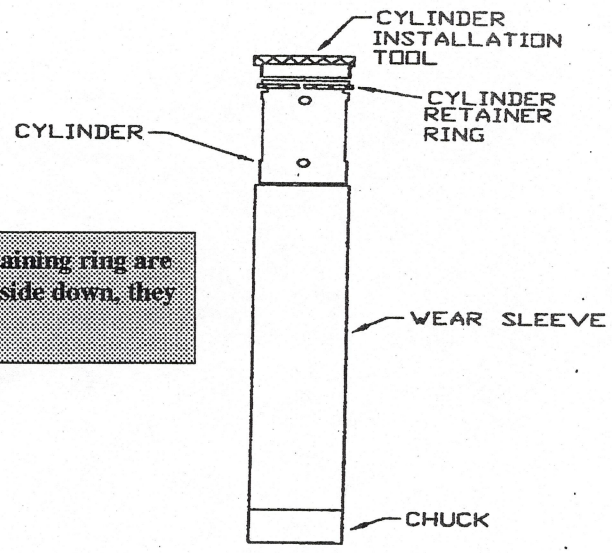
B) Reassembly

1. Lubricate parts well with rock drill oil prior to assembly.
2. Hold wearsleeve tightly in a chain vise. Never place threads in the chain wrench.
3. For CF6 only, reinstall the retaining ring (if removed) in wearsleeve until it locks into place.
4. Place bit bearing into the chuck end of wearsleeve. If it is a 60 series, use bearing tool to drive bearing until it shoulders.
5. If wear spacer is needed at chuck end, install it on bit aligning bearing.
6. Reinstall four disc springs at chuck end in correct sequence. If bevels do not face each other, you may do considerable damage to the hammer.
7. Reinstall retaining washer in the chuck end. Make sure the two retaining washers for either end are not mistaken for one another. To be certain, the I.D. measurements for each are: Top Retaining Washer = 3.390" or 86.1mm
   Bottom Retaining Washer = 3.5625" or 90.5mm
8. Look over the washer, disc springs, and wear spacer in the chuck end of the wearsleeve to insure that they are put together correctly. Then reinstall the spring retainer with snap ring pliers to secure these components in the hammer.
9. Before replacing the chuck onto the bit and securing the bit retaining rings at the back of the chuck, lubricate the chuck splines with a zinc-base too joint lubricant. Then reinstall the O-ring over the bit retainer ring.
10. Lubricate the chuck shoulder and threads.
11. Reinstall the chuck and bit combination into the wearsleeve. Screw it to the end of the wearsleeve firmly. Complete assembly by tightening with the bit detaching wrench to the proper torque.
12. Push piston all the way through its stroke into the backhead end of wearsleeve.

13. If the retainer ring was removed from cylinder, use an retainer ring tool to reinstall ring as follows:

a. Use tool to expand ring just enough to slip over bottom end of cylinder until it reaches the groove at the top end, then release the tool.

b. Return retaining ring and cylinder to wearsleeve with cylinder strike cap.



IMPORTANT: Be sure the cylinder and retaining ring are installed correctly. If they are installed upside down, they will not come out!

c. Keep sliding the ring and cylinder until the ring stops at undercut of wearsleeve with cylinder placement tool. (If using a Competitor 50R/60 Hammer, slide the cylinder into place.

14. Replace O-ring in the air distributor if necessary.

15. Reinstall disc springs in their original series. Make sure that they are in the correct series. If bevels do not face each other, you may do considerable damage to the hammer.

16. Reinstall springs on air distributor.

17. Reinstall washer while holding springs in place. Again refer to Step 7 to make sure you have the correct washer as they differ in I.D. dimension.

18. If during disassembly the need for a wear spacer is discovered, install one.

19. Push the stem end of air distributor into the cylinder until the air distributor shoulders against the cylinder..

20. Reinstall air restriction plug at the 3/8" or 9.5mm diameter port in the check valve. This is only necessary if the plug was damaged and replaced or an extra plug is wanted. Install the extra plug into the check valve with the flat end toward the valve spring.

21. Reinstall check valve assembly and check valve spring in the air distributor.

22. Install new O-ring into backhead, if a new one is necessary.

23. Lubricate backhead threads and shoulder.

24. Reinstall backhead into wearsleeve. Tighten with "J" wrench.

SERIES DRILLS

SECTION 1 - HAMMER DISASSEMBLY

A) **Preliminary Disassembly Instructions** - When beginning down-the-hole hammer disassembly, observe the following guidelines.

1. Always clean the outside of the hammer prior to disassembly.
2. Only work on the hammer at the shop. Anywhere else can damage the hammer.
3. Use brass drift or bar for removing internal parts.
4. Hardened parts have been known to break if dropped; move them carefully.
5. To avoid part loss, place them in an organized container.

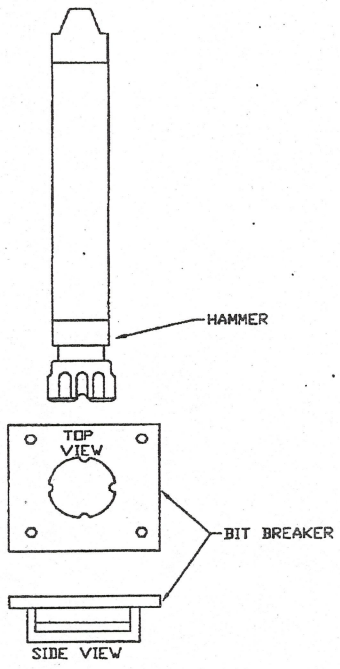
IMPORTANT: When removing driver sub or top sub, do not use heat on piston case to loosen connections. Never use a pipe wrench on the O.D. of the hammer as it may bend or deform it somehow. Instead, use tongs with jaws that apply equal amounts of pressure all around the O.D. Never use tongs on the carbides; grip them on the body of the bit.

B) **Driver Sub and Bit Removal**

There are several ways to remove the driver sub and bit from the hammer. We suggest using a Bit Breaker and Tongs. These procedures are as follows:

1. **Bit Breaker**

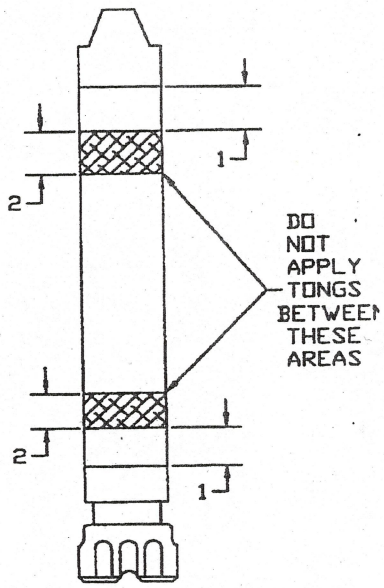
a. Place a rubber pad at the bottom of the bit breaker. This should protect the buttons. Put bit in bit breaker. Lift driver sub 1/4" to 1/2" off the bit shoulder, then use tongs to loosen a tight joint. In order to prevent damaging the threads, the driver sub must be slowly unscrewed from the piston case as the hammer is being lifted.



IMPORTANT: If the bit shifts it will damage the buttons, so keep the bit breaker lugs up to the bit size to avoid this problem.

2. Tongs

When using tongs, refer to the following diagram to find correct placement for the tongs on the piston case.



IMPORTANT: If the tongs are placed anywhere else or if they are not held perpendicular to the piston case while they are loosening the driver sub and top sub joints, they can severely damage the piston case.

CHART 8

Piston Case O.D. Dimensions for Tong Placement

Hammer Model	Dimension 1	Dimension 2
EDM Drill 4	2-1/2"	3"
EDM Drill 4 HD	2-1/2"	3"
EDM Drill 5	3"	3-1/2"
EDM Drill 5 HD	3"	3-1/2"
EDM Drill 6	3"	4"
EDM Drill 6 HD	3"	4"
EDM Drill 6SE	3"	4"
EDM Drill 6 SE HD	3"	4"
EDM Drill 6LV	3"	4"
EDM Drill 6 Stabilized	3"	4"
EDM Drill 8	3-1/2"	4-1/2"
EDM Drill 8 Stabilized	3-1/2"	4-1/2"
EDM Drill 8-5/8" Stabilized	3-1/2"	4-1/2"
EDM Drill 10	4"	6"
EDM Drill 12	4"	6"
EDM B53-15	3"	4"
EDM 53-25	3"	4"
EDM 63-15	3-1/2"	4-1/2"
EDM 100-15	4"	6"

3. **Steps after Bit Removal.**

a. Take the O-ring off the bit retainer ring. Then inspect the split bit retainer ring. Don't lose either half.

b. With drills that have O-rings on the driver sub, take off and inspect them too.

c. Take driver sub off the bit.

d. Unscrew top sub from piston case, using method and guidelines on Chart 8, page 21 for tong placement.

e. With drills that have O-rings in the top sub, remove and inspect.

f. Take out check valve guide, dart, spring, make-up ring or metal disc springs, and rigid valve. Inspect carefully.

g. Take piston from the top of the piston case and then you can remove the piston retainer ring from the bottom.

SECTION 2 - PARTS - INSPECTION, CLEANING, AND REPAIR

A) Wear Allowance

1. Check Wear Allowance, Chart 9 below. Take O.D. and I.D. measurements from piston case and piston, the top sub and driver sub require O.D. measurements only. Make sure measurements are not falling into a dangerous area.

2. Clean all corrosion with emery cloth.

CHART 9

WEAR ALLOWANCE LIMITS - ENGLISH

Hammer Model	Piston Case Outside Diameter Wear Limit (")	Piston Case Inside Diameter Wear Limit (")	Piston Outside Diameter Wear Limit (")	Piston Case Clearance Wear Limit (")
Drill 4	3.445	2.7890	2.7780	0.0110
Drill 4 HD	3.445	2.7890	2.7780	0.0110
Drill 5	4.345	3.5675	3.5555	0.0120
Drill 5 HD	4.345	3.5675	3.5555	0.0120
Drill 6	5.205	4.3800	4.3680	0.0120
Drill 6 HD	5.205	4.3800	4.3680	0.0120
Drill 6SE	5.205	4.3800	4.3680	0.0120
Drill 6SE HD	5.205	4.3800	4.3680	0.0120
Drill 6LV	5.205	4.3790	4.3690	0.0100
Drill 8	6.465	5.3490	5.3370	0.0120
Drill 10	8.475	7.0050	6.9930	0.0120
Drill 12	10.075	8.0080	7.9925	0.0155
B53-15	5.125	4.2550	4.2430	0.0120
53-25	5.255	4.5050	4.4940	0.0110
63-15	6.065	4.8800	4.8680	0.0120
100-15	9.385	8.0080	7.9925	0.0155

CHART 10

WEAR ALLOWANCE LIMITS (METRIC)

Hammer Model	Piston Case Outside Diameter Wear Limit (mm)	Piston Case Inside Diameter Wear Limit (ww)	Piston Outside Diameter Wear Limit (ww)	Piston/Case Clearance Wear Limit (mm)
Drill 4	87.50	70.840	70.561	0.2794
Drill 4 HD	87.50	70.840	70.651	0.2794
Drill 5	110.363	90.614	90.309	0.3048
Drill 5 HD	110.363	90.614	90.309	0.3048
Drill 6	132.207	111.252	110.947	0.3048
Drill 6 HD	132.207	111.252	110.947	0.3048
Drill 6SE	132.207	111.252	110.947	0.3048
Drill 6SE HD	132.207	111.252	110.947	0.3048
Drill 6LV	132.207	111.252	110.972	0.2540
Drill 8	164..211	135.864	135.559	0.3048
Drill 10	215.265	177.927	177.622	0.3048
Drill 12	255.905	203.403	203.009	0.3937
B53-15	130.175	108.007	107.772	0.3048
53-25	133.477	114.427	114.147	0.2794
63-15	154.051	123.952	123.647	0.3048
100-15	238.379	203.403	203.009	0.3937

B) Top Sub

1. Go over top sub thoroughly and inspect threads for any kind of irregularities or wear. Clean threads and shoulders with an emery cloth and file.
2. Check wear allowance and if part exceeds it or is damaged, replace it.
3. Look over the check valve seat for scratches or irregularities and polish them out if found. Clean entire piece to remove any remnants of dust or steel and re-lubricate.

C) Check Valve Assembly

1. Clean check valve guide, spring, and dart well. Make sure movement is fluid and free from any hindrances. Re-lubricate.
2. Replace any worn or overused parts.

D) Rigid Valve

1. Clean rigid valve, finger, and/or assembly by removing all irregularities with an emery cloth. As with the top sub, clean all with solvent to remove remnants of dust and steel. Re-lubricate.
2. Replace any worn or overused parts.

E) **Piston**

1. Clean piston, check bore and O.D. for any cracks, burrs, or sub-standard irregularities.
2. Clean all with solvent to remove remnants of dust and steel. Re-lubricate.
3. Replace if worn or damaged.

F) **Piston Case and Retainer Ring**

1. Clean the piston case well, then search for any cracks, scratches, corrosion, burrs, galling or wear. Check allowance in all the following areas: **I.D., O.D., threads, shoulders, piston retainer ring.**
2. Before reassembly, make sure the case is clean of any shavings or dust from cleaning hammers.
3. If damage is found and is not extensive, clean parts with a file or emery cloth until they are again in a usable condition. If damage is extensive, replace the part.

G) **Driver Sub**

1. Clean driver sub well, then search for any cracks, scratches, corrosion, burrs, or wear. Check allowance in all of the following areas: **I.D., O.D., threads and splines**. Make sure there are no obstructions that would prevent the bit from moving easily.
2. If damage is found and is not extensive, clean parts with a file or emery cloth until they are again in a usable condition. If damage is extensive, replace the part.

IMPORTANT: All parts must be cleaned extremely well prior to reassembly. If any parts are excessively damaged, THEY MUST BE REPLACED. Shavings or dust from cleaning products can also damage hammer or reduce its performance, so be sure they are not present as well. Finally, make sure all parts that need lubrication have it, particularly THE THREADS.

SECTION 3 - HAMMER REASSEMBLY

After properly cleaning and preparing the parts, the following steps for assembly should be followed:

A) Thoroughly lubricate all parts, whether used or new. Eventually the line oiler will lubricate the hammer, but not immediately, so this first lubrication will protect the parts until the line oiler takes over.

B) Lubricate all threads and shoulders with THREAD LUBRICANT (not the oil mentioned above). This will help prevent any damage to the hammer at the next disassembly.

C) Lay the bit on a secure, level surface. Keep the carbides protected and the foot valve installed. Then, lubricate the bit shank and splines with thread lubricant.

D) If the hammer uses an O-ring on the driver sub, install it now.

E) Install the driver sub on the bit and then the bit retainer ring.

F) If the hammer uses a bit retainer O-ring, install it on the bit retainer ring.

G) Lay the piston case on a secure, level platform. Then put the piston retainer ring in its place at the bottom of the piston case.

H) Install the piston into the top end of the piston case and check to make sure the piston moves freely and easily. (On the B53-25, install the piston from the bottom end of the hammer before piston retainer ring is installed.)

I) Then install the rigid valve O-ring on the rigid valve. Followed by installing the proper size choke into the rigid valve.

IMPORTANT: With the Drill 4 Model Rigid Valve the choke must be installed with the FLAT SIDE DOWN.

J) Install rigid valve stem end down toward the piston. Then install the make-up ring or the metal disc spring assembly.

K) Follow by installing the check valve guide, spring, and dart. Check to make sure the check valve dart moves easily and without obstruction.

L) Install "O" ring on the top sub if needed, lubricate the threads and install into the piston case.

IMPORTANT: When installing the top sub, in order to make sure the space between it and the piston case is accurate, secure it hand-tight. Then refer to CHART 11, Page 27 for the minimum space allowed.

If it turns out that the measurement for the space does not fall within the acceptable limits of the chart, there are two ways of fixing it:

1. Check the shoulders of the rigid valve and piston case for damage and replace the parts if damage is found.

2. If there is no damage to the parts, place thin metal shims into the case until the space achieves its minimum space tolerance.

IMPORTANT: In ALL models, in order to avoid serious damage to rigid valve and or piston, the minimum space requirement is essential to reassembly.

3. Then install the assembled driver sub and bit into the bottom of the piston case and tighten to proper torque. See Chart 1, Page 4.

For the **Drill 12 Model only**: First, attach the break-out ring to the top sub, then check for minimum space requirement.. After minimum space is achieved, secure break-out ring over driver sub and then secure the assembled driver sub and bit into the bottom of the piston case, and tighten to proper torque. See Chart 1, Page 4..

M) When ready to use the hammer, press down on the check valve and pour lubricant into it.

N) Make one last check before use that all thread joints are tightened securely before drilling starts.

CHART 11

METAL DISC SPRING ASSEMBLY MAKE-UP TOLERANCES

Hammer or Tool Model	INCHES Minimum	INCHES Maximum	MILLIMETERS Minimum	MILLIMETERS Maximum
Drill 4	0.045	0.020	1.143	0.508
Drill 4 HD	0.045	0.020	1.143	0.508
Drill 5	0.110	0.062	2.794	1.575
Drill 5 HD	0.110	0.062	2.794	1.575
Drill 6	0.107	0.070	2.718	1.778
Drill 6 HD	0.107	0.070	2.718	1.778
Drill 6SE	0.107	0.070	2.718	1.778
Drill 6SE HD	0.107	0.070	2.718	1.778
Drill 6LV	0.107	0.070	2.718	1.778
Drill 6 Stabilized	0.107	0.070	2.718	1.778
Drill 8	0.168	0.120	4.267	3.048
Drill 8 Stabilized	0.168	0.120	4.267	3.048
Drill 8-5/8 Stabilized	0.168	0.120	4.267	3.048

CHART 12

MINIMUM SPACE BETWEEN TOP SUB AND PISTON CASE FOR RUBBER MAKE-UP RING

Hammer or Tool Model	INCHES Minimum	INCHES Maximum	MILLIMETERS Minimum	MILLIMETERS Maximum
Drill 4	0.0625	0.1275	1.5875	3.2385
Drill 4 HD	0.0625	0.1275	1.5875	3.2385
Drill 5	0.1185	0.1905	3.0099	4.8387
Drill 5 HD	0.1185	0.1905	3.0099	4.8387
Drill 6	0.1245	0.1995	3.1623	5.0673
Drill 6 HD	0.1245	0.1995	3.1623	5.0673
Drill 6SE	0.1245	0.1995	3.1623	5.0673
Drill 6SE HD	0.1245	0.1995	3.1623	5.0673
Drill 6LV	0.1245	0.1995	3.1623	5.0673
Drill 6 Stabilized	0.1245	0.1995	3.1623	5.0673
Drill 8	0.1285	0.2215	3.2639	5.6261
Drill 8 Stabilized	0.1285	0.2215	3.2639	5.6261
Drill 8-5/8 Stabilized	0.1285	0.2215	3.2639	5.6261
Drill 10	0.1555	0.2215	3.9497	5.6261
Drill 12	0.1275	0.2335	3.2385	5.9309
B53-15	0.1245	0.1995	3.1623	5.0673
B53-25	0.0975	0.1725	2.4765	4.3815
A63-15	0.1285	0.2215	3.2639	5.6261
A100-15	0.1375	0.2125	3.4925	5.3975