OKADA

HYDRAULIC BREAKER

TOP SERIES SHOP MANUAL
FOR
OKADA DEALERS

Active
Innovat.
Young
Original
Network
OKADA

R082206KO

These hydraulically-operated, gas-assisted breakers have been developed by a highly experienced team of engineers. Reflecting many strength and durability improvements, these breakers are composed of the minimum number of parts to ensure powerful, trouble-free operation.
Proper handling, maintenance and inspection are crucial in order to obtain the optimum performance for the longest possible period of time.
Carefully read this instruction Manual before using the breaker to ensure satisfactory results. If you have any question, please contact us or our agents.
When replacing parts, be sure to use only OKADA genuine parts. Otherwise, the performance and durability of the breaker may be seriously impaired.

PRECAUTIONS WHEN USING HYDRAULIC BREAKERS

SAFETY FIRST

- When leaving the hydraulic excavator, lower the breaker to the ground and turn the engine off.
- Never attach a cable or sling to the breaker to hoist a load. Doing so is extremely dangerous.
- Remove the chisel before transporting the breaker.
- Keep all people and equipment away from the breaker during operation. Rocks flying from the breaker can cause serious accidents.

PRIOR INSPECTION

- Check that there is sufficient hydraulic oil and that it is not contaminated.
- Check that hoses, bolts and nuts are secure.
- Grease the shank part of the chisel.

THINGS TO AVOID

- Do not use the breaker in water (special specifications are available for underwater work).
- Do not continuously blow the same place for more than one minute.
- Do not operate the breaker when the cylinders of your excavator are located at their stroke end.
- Do not charge gases other than nitrogen gas into the gas cushion chamber and accumulator.

⚠ DANGER

- ✧ Keep all people and equipment away from the breaker during operation. Rocks flying from the breaker can cause serious accidents.
- ✧ When replacing the chisel:
  Use care because the chisel may come out suddenly.
- ✧ When filling the back cap or accumulator with nitrogen gas:
  The chisel may jump out. Do not stand in front of the chisel to avoid accidents.
- ✧ When disassembling or repairing the breaker:
  The back cap may jump out due to gas pressure. This is very dangerous. Be sure to release gas from the back cap before disassembly. Before filling the back cap with gas, be sure to completely tighten the side rod.
- ✧ When replacing the gas valve:
  The gas valve body may jump out due to gas pressure. Be sure to completely release internal gas before replacing the gas valve.

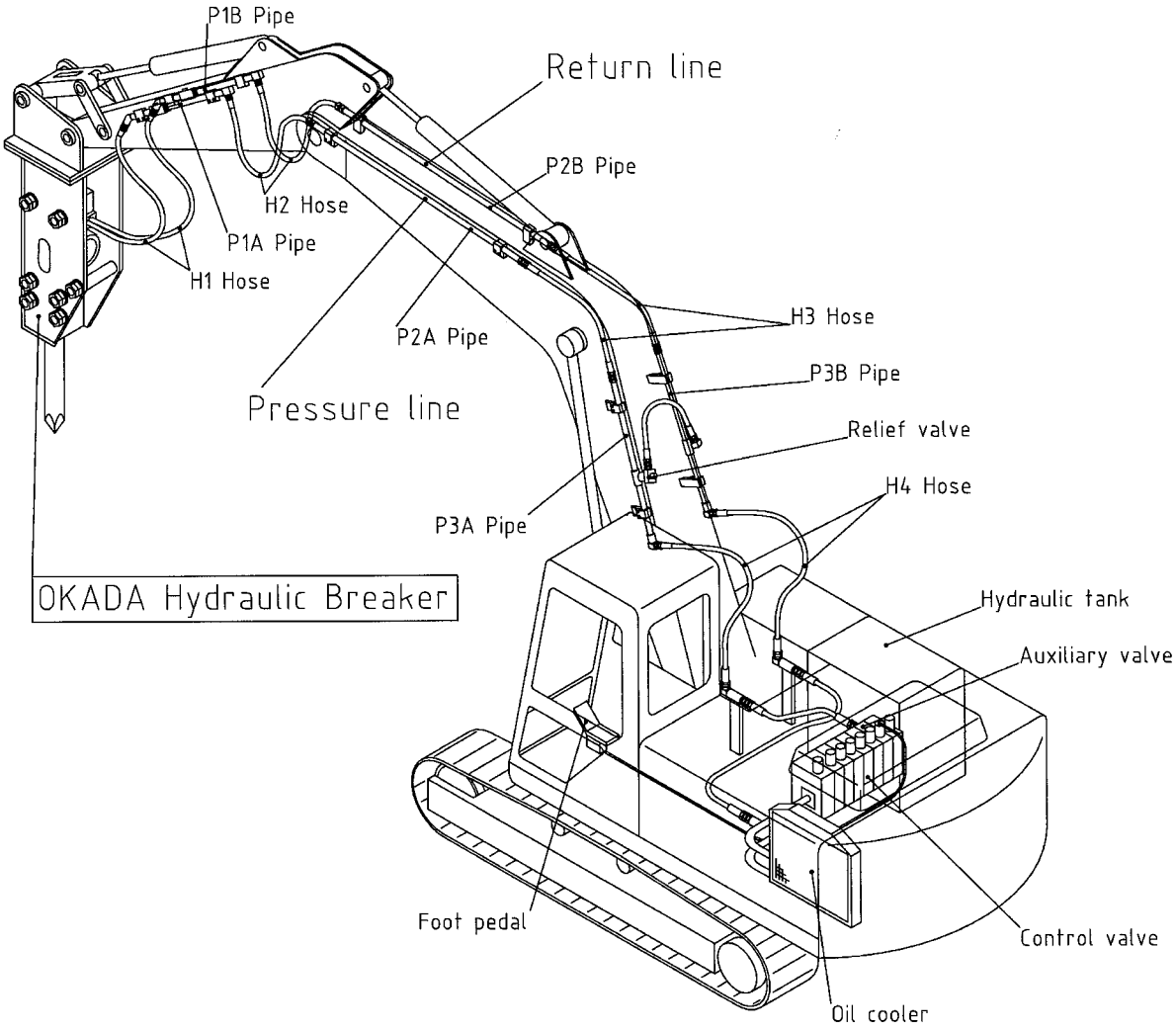
CONTENTS

Piping installation

◆ Piping Diagram

Piping for the hydraulic excavator for use with the hydraulic breaker is to be arranged as illustrated below.
When placing order for pipes and/or hoses, please specify the following:

- Manufacturer and model of the hydraulic excavator
- Model number of the hydraulic breaker used
- Identification numbers of the pipe(s) and/or hose(s) required



※ Hydraulic pipes identified with suffix A (for those used at high pressure side) and suffix B (for those used at low pressure side).

※ A separate manual titled “Piping Instructions” is available for reference in arranging piping.

◆ Inspection and adjustment after plumbing

The following inspection and adjustments must be performed after the completion of piping work to ensure the maximum performance of OKB breaker and carrier machine to prevent the serious mal-functions.

1) Flushing

Before turn on the engine, be sure to recheck the follows,

a) To see whether installed hydraulic circuit is wrong.
b) Quantity of hydraulic oil tank, if necessary, refill it to the specified range.
c) In case adding the change over valve in between pumps and existing control valve, loosen the adjusting screw of relief valve added to the moderate value.

Connect both piping tips at the edge of the arm as shown in bellow and open both stop valves for the pressure and return line.
After the engine of the carrier machine has sufficiently been warmed up, reduce the engine speed to minimum and operate the breaker operation pedal to let the high-pressure oil flow in the breaker circuit. In this time, check that any oil leakage and anything wrong do not happen on the carrier machine.
After confirming the piping condition, step up the engine speed to piping, then after hydraulic oil temperature is warmed up, accelerate the engine speed to maximum.
Perform the flushing work more than 30 minutes.

Caution: Do not keep the operating pedal on for more than 5 minutes continuously. Step off the operating pedal and rest the hydraulic apparatus for 1 minute several times in flushing.

2) Pressure adjustment

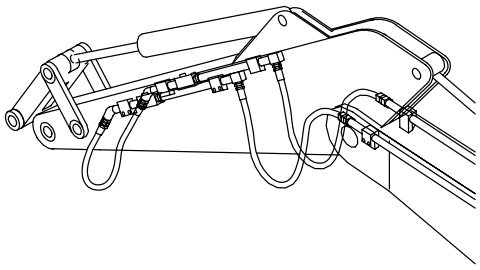


Fig. 1 Connection of hose for flushing.

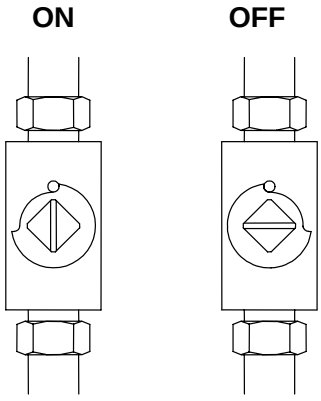
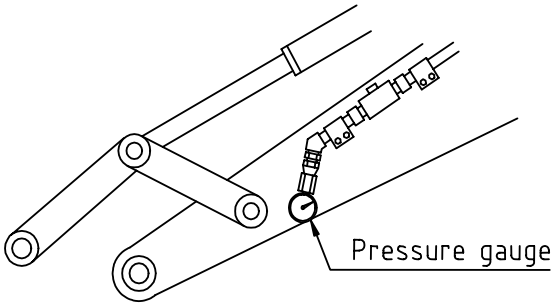


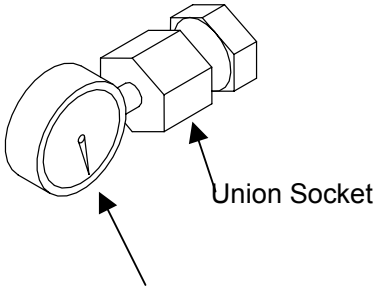
Fig. 2 Stop valve ON/OFF states

Install the pressure gauge at the front end of high pressure line pipe on the arm. Accelerate the engine speed to maximum without fail. Step on the breaker operating pedal, then measure the hydraulic pressure and exactly set the pressure at specified value by adjusting the secondary relief valve added into pressure line for the breaker.
Note again in case that existing pressure of carrier machine is higher than specified value for the breaker, add the relief valve to the piping and reduce the pressure for the breaker.

Caution : Never adjust the fixed main relief valve on the carrier in order to reduce the hydraulic pressure. Also, even if the existing pressure is lower than the specified pressure for the breaker, do not touch the main relief valve.

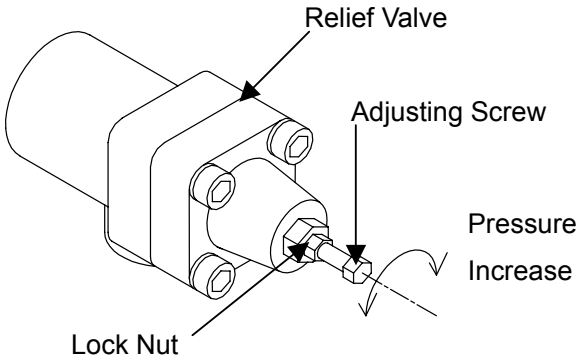


In case of piping method is “Take out from main pump directly”, firstly adjust the set pressure of relief valve added in between hydraulic pump and control valve at from 1 to 1.5 MPa over than existing pressure value so that added and existing main relief valve never interfere the each function mutually.



Pressure Gauge

Fig. 3 Example of gauge installation



◇Turning the screw clockwise increases the relief pressure.

◇Turning the screw counterclockwise reduces the relief pressure.

Fig, 4 How to adjust the relief valve pressure

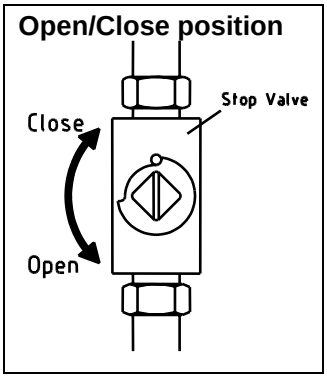
3) Check the others

Check that the all functions (electric device, each motion of hydraulic actuator etc.) are operated correctly. Also check the hydraulic oil quantity and the situation if it is deteriorated or contaminated.

Important : Whenever you install the breaker in an excavator of the first time use, practice this inspection and adjustment procedure without fail.

Handling

1. Preparation Before starting



(1) Check the level of hydraulic oil and replenish it if necessary. Be sure to use the same kind of hydraulic oil.
(2) Confirm that the stop valves are fully open.
(3) Check that the screwed connections of the hoses, bolts and nuts are tight. Retighten these if loose.
(4) Grease the shank part of the chisel.
(Force grease into this part with 5 to 6 strokes from a grease gun.)
(5) Run the excavator for about 10 minutes to warm up the machine. Start operation only after the oil temperature has risen.

Recommended working oil temp. range	50 to 80 °C 122 to 176 °F

2. Running-in

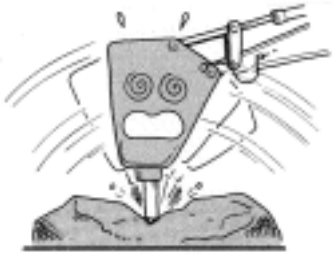
For the first one hour of the use of your breaker, position the chisel vertically onto the material to be broken, apply pressure downwards and do running-in at half engine speed in order to run in the sideways of all parts.
Note: *Do not tilt the chisel during running-in period.*

3. Precautions during operation

- Position the chisel on the material to be broken so that the crawler or the front wheels of the tires float slightly, then start hammering by applying pressure.
- Once the material shatters, stop hammering immediately.
- Avoid using the chisel as a lever or ripper and hitting any object against the chisel. *Caution: Force prying the material with the chisel may lead to breakage of the chisel.*
- When the chisel no longer goes into the material, change the hammering position. Do not hammer the material continuously for more than one minute at one spot. Otherwise, not only the chisel burns but also oil temperature rises abnormally, and these lead to trouble.
- Do not immerse the front cap of the breaker in water or sludge in all cases.

Apply pressure continuously.

Stop immediately when material shatters.



Do not pry.

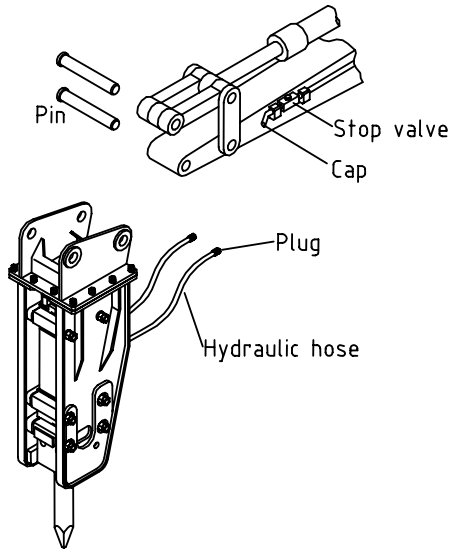
Do not immerse in water or sludge.

4. Installing and removing the breaker

(1) Remove the two pins of the bucket and replace the bucket.

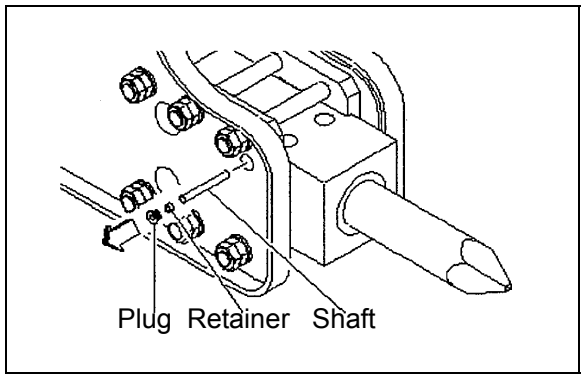
(2) To operate the bucket without using the hydraulic breaker, close the stop valve on the excavator's arm (turn the valves off) and disconnect the hoses connecting the stop valves to the breaker.

(3) Be sure to blind the disconnected hoses. The entry of sand and mud into the hydraulic hoses and pipes can be a cause for trouble.

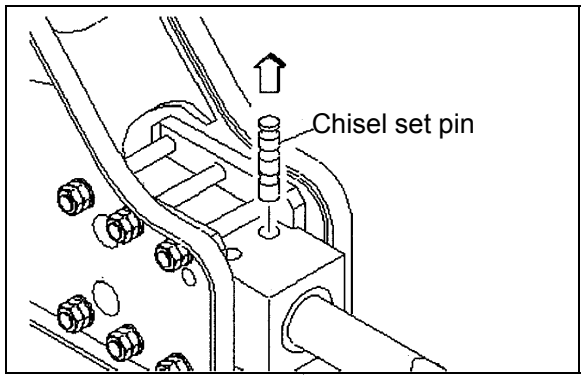


5. Changing the chisel

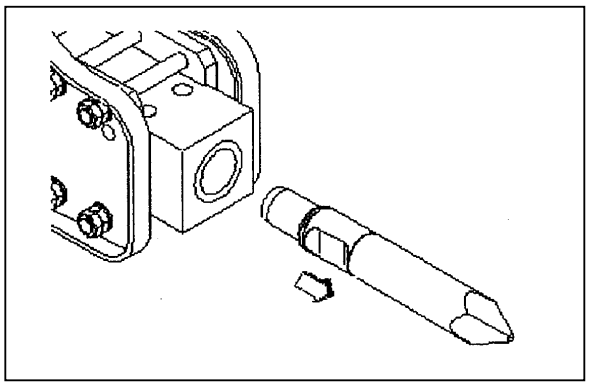
(1) Remove the plug and shaft retainer, and then push out the shaft.



(2) Push out the chisel set pins from the bottom using a screwdriver.



(3) Pull the chisel out.



Maintenance and inspection

1. Inspection of hydraulic oil and filter element

(1) The hydraulic excavator installed with the hydraulic breaker uses the engine and hydraulic oil more severely than does an excavator alone. Therefore, the hydraulic oil deteriorates more quickly, causing trouble in the breaker. The deteriorated or contaminated oil must be replaced with fresh oil as specified. Do not use low-grade or regenerated oil.
- Here is a simple method for determining the condition of the oil. lack of visidity or viscosity and formation of air bubbles indicate badly deteriorated oil. The appearance of blackish brown color and the emission of an offensive odor are proof of deterioration. The oil must be changed immediately in this case.
- When changing the oil, remove all the oil from the inside of the tank and the hydraulic cylinder, then thoroughly clean the interior of the tank. Do not add new oil to the oil. Be sure to replace all the oil.

(2) Take care not to allow foreign matter to enter the hydraulic oil. Allow no foreign matter to enter the hoses and nipples during disconnection and connection of the hoses when changing the breaker and bucket. The entry of sand or other foreign matter in the hydraulic oil will cause a serious damage. The filter must be cleaned or replaced at the proper time.

(3) Always replenish with the same hydraulic oil in order to maintain the correct volume of oil. Using the breaker with insufficient oil will cause the oil to be deteriorated. In addition, cavitation may be caused by the entry of air. All of these factors may lead to trouble in the breaker.

(4) Avoid using the breaker at an oil temperature above 80°C (176°F). The recommended working temperature ranges from 50 to 80°C. Check that the cooler fins are not clogged and keep them clean. Soiled fins will impair the operation of the oil cooler.

(5) Entry of water in the hydraulic oil causes problems. If you are not going to use the hydraulic breaker, store the breaker indoors. Also, remove the drains from the tank at periodic intervals.

Change of hydraulic oil	Every 600 hours
Change of filter element	Every 100 hours
Change of engine oil and engine oil filter	To excavator manufacturer's specification

Note: *If deterioration or contamination is serious, replacement must be done as soon as possible even the listed time has not reached.*

2. Tightness of bolts and nuts

(1) Before starting work, check all the bolts and nuts for tightness including the side rod nuts of the breaker, accumulator set bolts, valve cap bolts and front bolt nuts of the bracket. Also be sure to retighten any loose bolts and nuts to the specified torque. Using the breaker with loose bolts and nuts will lead not only to oil leakage but also damage of the screw threads and bolt breakage. These can also cause defective operation.

(2) After the first 10 hours of use, retighten the bolts and nuts of all components and sections.

(3) At first, lightly tighten the bolts and nuts by referring to the following tightening torque. The bolts and nuts should be screwed down alternately and diagonally until all the bolts and nuts are tightened to the uniform torque.

3. Grease-up

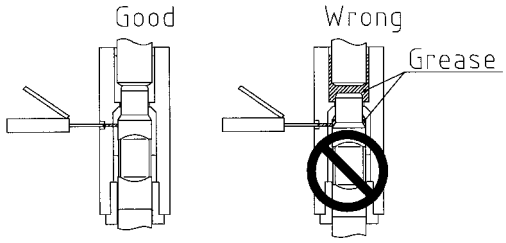
Grease up several times a day through the grease nipple on the side of the front cap using a grease gun.

- If the sliding surface of chisel becomes dry under severe operation condition, refill grease.
- For greasing, it is sufficient to press the grease gun several times.

Note: *While greasing , the breaker must be stood up-right and the chisel must be at the shank bottom to ensure that the grease will be provided between the chisel and the bushes. Do not fill up the space between the piston and chisel with grease, otherwise the dust seal may be damaged or it leads to defective hammering.*

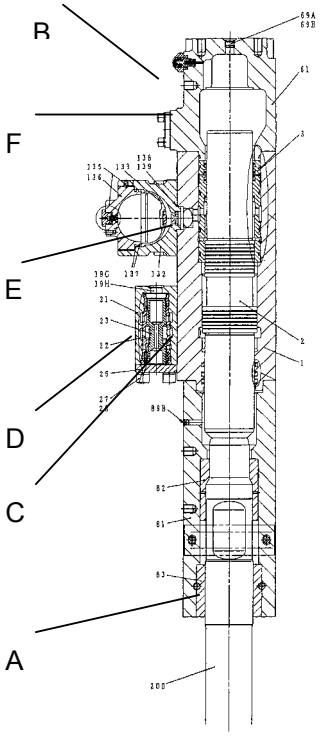
Specified grease

Type	Lithium grease
	Water resistant
Dropping point	170°C ~ 200°C
	338°F ~ 392°F
Max. working temperature	130°C
	266°F
Grade (thickness)	NLGI 00, 0, 1. 2



4. Inspection for oil leakage

	Location	Possible Cause	Remedy
A	Between the front cap bushing and the chisel.	Cylinder U-packing damaged, worn or hardened.	Replace U-packing.
B	Between the back cap and the hose.	Clamp bolt loosened, O-ring worn or damaged.	Retighten clamp bolt. Replace O-ring.
C	Between the cylinder and the valve box.	Valve box set bolts loosened, or O-ring worn, damaged or hardened.	Retighten valve box set bolts or replace O-ring.
D	Between the valve box and the valve cap.	Valve cap bolt loosened, or O-ring worn, damaged or hardened.	Retighten valve cap bolts or replace O-ring.
E	Between the accumulator and the cylinder	Accumulator set bolts loosened, or O-ring worn. damaged or hardened.	Retighten accumulator set bolts or replace O-ring.
F	Between the back cap and the cylinder.	Loosened side rods, or back cap O-ring worn or damaged.	Retighten side rods or replace back cap O-ring.



5. Inspection for gas leakage

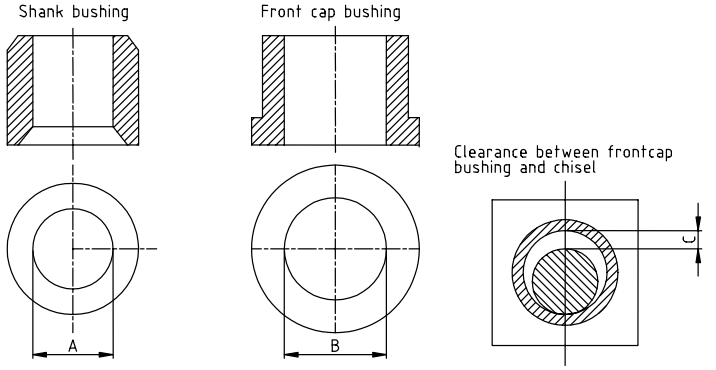
Location	Possible Cause	Remedy
Gas valve body inlet.	O-ring worn or hardened. Weak spring tension. Worn gas valve	Replace gas valve O-ring. Replace spring or gas valve.
Between the gas valve body and cap mount.	Loose gas valve body. Gas valve body O-ring worn or hardened.	Retighten gas valve body. Replace gas valve body O-ring.
Between the back cap and the cylinder.	Side rods loosened, or back cap O-ring worn or hardened.	Retighten side rods or replace back cap O-ring.

※ *Leaking point can be easily identified by applying soapy water.*

If gas is depleted shorter than expected although the above problems are not found, replace the back cap O-ring, cylinder sleeve O-ring, and sleeve U-packing.

Note: • *Before installing new U-packings, apply a slight coat of hydraulic oil to their surface.*
• *Pay attention not to damage or cut U-packing or O-ring when installing.*

6. Wear limit dimension of parts



TOP		25	30	35	45	45B	60	60B	90	100	200	205	210	300	
A	mm	43	48	48	56	56	67	67	80	90	113	102	102	139	
	inch	*1.7*	*1.9*	*1.9*	*2.2*	*2.2*	*2.6*	*2.6*	*3.1*	*3.5*	*4.4*	*4.0*	*4.0*	*5.5*	
B	mm	53	66	66	74	74	92	92	103	115	135	120	120	162	
	inch	*2.1*	*2.6*	*2.6*	*2.9*	*2.9*	*3.6*	*3.6*	*4.1*	*4.5*	*5.3*	*4.7*	*4.7*	*6.4*	
C	mm	4	5	5	6	6	7	7	7	10	10	10	10	12	
	inch	*0.1*	*0.2*	*0.2*	*0.24*	*0.24*	*0.28*	*0.28*	*0.3*	*0.4*	*0.4*	*0.4*	*0.4*	*0.5*	

※ *Piston and chisel must be replaced when the striking surface of the piston and chisel has been sunk or damaged.*

7. Precaution for handling chisel

(1) Chisel can sufficiently withstand shocks exerted in the vertical direction, but they are likely to break if subjected to impacts applied in a lateral direction or prying. To avoid breakage of chisel, adjust the excavator arm so that the chisel can move straight down.
(2) Chisel are prone to become brittle if subjected to low temperature. Avoid operating at the full capacity from the very beginning when used in cold area. Also, avoid leaving the chisel outdoors at night, and protect it with vinyl sheet.
(3) Deep indentations caused by hitting or deep rusting on chisels may result in breakage.
(4) The shank part of the chisel may develop heat due to the sliding action between the shank bushing, causing depletion of oil which results in early wear. Make it a practice to grease it up regularly.
(5) Continued use of chisel with worm tip not only degrades the crushing performance, but also leads to breakage of the chisel. Make sure that the edge of chisel is kept sharp at all time.
(6) Quenching the chisel may cause breakage. Avoid using it in such a situation that it may plunge into nearby pool of water after crushing a rock, etc.

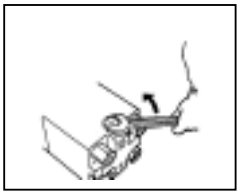
8. Storage precautions

(1) After the hydraulic breaker is removed from the excavator:
- Firmly close and cap the stop valves of the excavator and plug the hydraulic hoses.
- Grease and store the breaker indoors or completely cover it with a plastic sheet or other protective material. Do not leave the breaker outdoors in the rain.

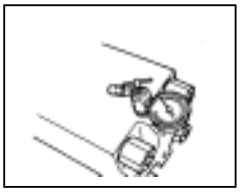
(2) If the hydraulic breaker is not to be used for a long period of time:

○ Release all gas from the gas cushion chamber. Press the piston from the front cap side into the cylinder as following procedures.

Remove the cover and gas cap.

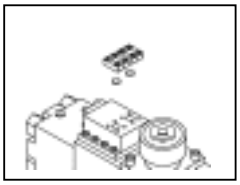


Screw the gas charging valve into the gas valve body, and remove the dust cap to release the N_2 gas from the back cap.

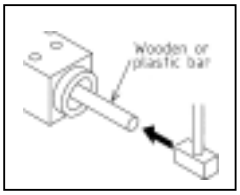


Turn the handle of the gas charging valve clockwise, and completely release the N_2 gas from the back cap. Keep this situation until all works are completed.

Remove the split flanges and rubber blinds, or the dust caps in case of smaller than OKB310.

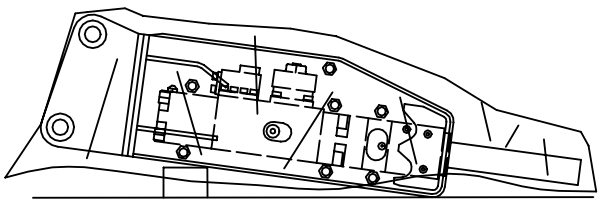


Press the piston from the front cap side into the cylinder by using a wooden or plastic bar.
Notice) Hydraulic oil may fly out from the port on the valve.



○ Spray anti-rust on the lower part of the piston and inner surface of the front cap.

○ Completely cover it with a plastic sheet or other protective material.



○ Do not leave the breaker outdoors in any cases.

Note) Any failure due to lack of above procedures are not covered by warranty, and are sure to shorten the life of breaker.

Troubleshooting

1. Major causes and suggested remedies for poor starting

	MAJOR CAUSES	SUGGESTED REMEDIES
Breaker	Increase in sliding resistance of piston owing to U-packing damage.	Replace the U-packings.
	Increase in sliding resistance of piston owing to natural hardening of U-packings occurring in low Winter temperature.	Push the chisel and stroke the piston.
	Damage of valve, valve box and valve box sleeve.	Repair the shallow flaws with an oil stone and abrasive paper. Replace it if the flaws are deep.
	Damage in the sliding areas between the cylinder and piston.	Repair the flaws with an oil stone and abrasive paper.
Excavator	Neglect in opening the stop valve or keeping the stop valve closed.	Fully open (turn on) stop valve or repair valve.
	Insufficient hydraulic pressure or discharge owing to damage to the secondary relief valve.	Repair or replace parts.
	Improper selection and damage of the directional valve.	Repair or replace.
	Clogging by foreign matter in the piping.	Disassemble and remove foreign matter.

※ *Remove scratches on the surface of valve using sand paper. Do not use an oil stone.*

2. Main causes and suggested remedies for occasional stopping during operation

	MAJOR CAUSES	SUGGESTED REMEDIES
Breaker	Damage of cylinder, piston, cylinder sleeve, valve, valve box and valve box sleeve.	Repair flaws with an oil stone and abrasive paper. (Unless damage is mended quickly, the parts become irreparable.)
Excavator	Use of excavator when oil temperature is above 80°C (176°F).	Avoid using the excavator above 80°C. Do not rev up the engine more than required.
	Clogging by foreign matter in the piping	Disassemble and remove the foreign matter.

3. Major causes and suggested remedies for irregularity in operation

	MAJOR CAUSES	SUGGESTED REMEDIES
Breaker	Improper pressure of the gas sealed in the gas cushion chamber.	Regulate the nitrogen gas pressure to proper pressure.
	Wear of shank bushing beyond limit.	Replace shank bushing.
	Damage of cylinder, piston, cylinder sleeve, valve, valve box and valve box sleeve.	Remove flaws with an oil stone and abrasive paper.
	Insufficient gas pressure of accumulator or damaged bladder.	Recharge nitrogen gas or replace the bladder.
Excavator	Lack of hydraulic oil.	Replenish with the same oil.
	Deterioration or contamination of the hydraulic oil.	Replace all oil with fresh oil.
	Defective operation or improper set pressure of the main relief valve and secondary relief valve.	Send the main relief valve to the manufacturer's designated service factory for adjustment. Regulate the secondary relief valve to correct the set pressure. Or repair or replace the damaged spring, seat, valve or piston.
	Insufficient discharge and pressure owing to a hydraulic pump malfunctioning.	Send the excavator pump to the manufacturer's designated service factory for repair.
	Use of the excavator while oil temperature has risen abnormally above 80°C (176°F).	Avoid using the excavator above 80°C (176°F).

4. MAIN CAUSES AND SUGGESTED REMEDIES FOR A DECREASE IN NUMBER BLOWS AND IMPACT FORCE

	MAJOR CAUSES	SUGGESTED REMEDIES
Breaker	Improper pressure of the sealed gas.	Regulate the sealed gas to the correct pressure.
	Wear of shank bushing beyond limit.	Replace the shank bushing.
	Wear beyond limit, damage or deformation of the striking surface of the piston, and the shank section, impact receiving surface and tip of chisel.	Replace the piston or chisel (use only genuine parts).
	Damage or wear of cylinder, piston, cylinder sleeve, valve, valve box and valve box sleeve.	Repair flaws with an oil stone or polishing paper or replace.
	Insufficient gas pressure of accumulator or damaged bladder.	Recharge nitrogen gas or replace the bladder.
Excavator	Half opening of stop valve.	Fully open the valve.
	Clogging by foreign matter in the piping.	Disassemble and remove foreign matter.
	Lack of hydraulic oil.	Replenish with the same hydraulic oil.
	Deterioration or contamination of hydraulic oil.	Replace all oil with fresh oil.
	Defective operation or improper set pressure of the main relief valve and secondary relief valve.	Send the main relief valve to the manufacturer's designated service factory for adjustment. Regulate the secondary relief valve to correct the set pressure. Or repair or replace the damaged spring, seat, valve or piston.
	Insufficient discharge and pressure owing to a hydraulic pump malfunctioning.	Send the excavator pump to the manufacturer's designated service factory for repair.
	Use of the excavator when oil temperature is above 80°C (176°F).	Avoid using the hydraulic breaker if the oil temperature is above 80°C (176°F).
	Disorderly operation of the pressure valve in the tank, and clogging of cooler fins or filter elements.	Send these parts to the manufacturer's designated service factory for repair or replacement.
	Improper selection and damage of directional valve.	Repair or replace.

EARLY WEAR AND DAMAGE OF PARTS

MAJOR CAUSES	PLACES
Lack, deterioration or contamination of hydraulic oil or use of regenerated oil.	Damage or formation rust on the cylinder, piston, valve, valve box and cylinder sleeve. Damage or wear of relief valves, pump or operating valve.
Entry of foreign matter during mounting or dismounting of the breaker, insufficient oil flushing after installation of piping, or entry of drains in the hydraulic oil tank.	Damage to the sliding parts between the cylinder and piston, and the sliding parts of the valve. Damage to the U-packings, clogging of the filter elements or damage to the relief valves
Abnormal rise of oil temperature.	Deformation or hardening of the U-packings and O-rings.
Insufficient greasing.	Damage and wear of shank bushing, the shank section of the chisel, and front cap bushing.
Loosening of screwed parts owing to insufficient or uneven tightening.	Wear and breakage of bolts, or gas leakage.
Excessive prying of chisel during operation.	Damage to the cylinder and piston, wear of the shank bushing, and front cap bushing, or failure of chisel or side rod.
Continuous blowing for more than 1 minute.	Breakage of bolts, wear of chisel or damage of relief valves and pump, and striking surface of piston.
Underwater use of a breaker with standard specification	Embrittlement of U-packings, damage to the cylinder and piston (contamination of hydraulic oil or damage to the hydraulic apparatus of the excavator).

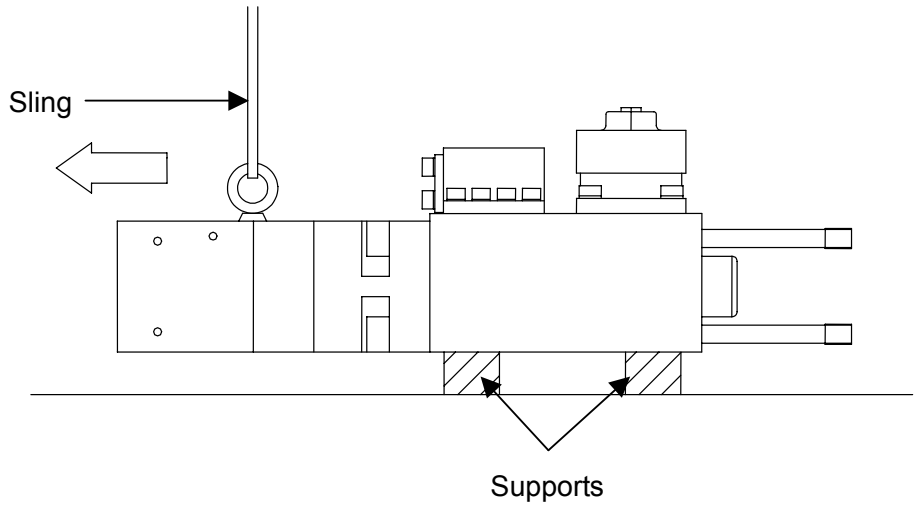
Disassembly and reassembly

1. PRECAUTION BEFORE DISASSEMBLY

(1) Be sure to carry out the disassembly and reassembly of the hydraulic breaker in a clean environment. Dust is harmful to the hydraulic breaker. If possible, do the job in your factory.
(2) Always use genuine parts for replacement. The use of parts other than the genuine parts will adversely affect the product's performance and durability.
(3) Release all gas from the back cap.

2. DISASSEMBLY PROCEDURE

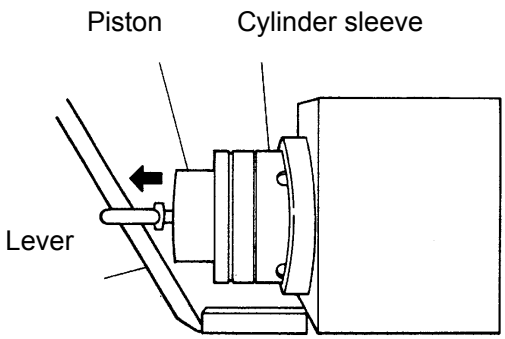
(1) Remove the chisel.
(2) Loosen the nipple, valve cap bolt, and valve box set bolt, and remove the valve cap. Draw out the valve with the valve box sleeve. Then remove the valve box.
(3) Remove the back nut and draw out the back cap.



(4) Draw out the front cap together with the side rods from the cylinder.
(5) Fit an eyebolt into the head part of the piston and by using a round bar as a lever, pull the piston together with the cylinder sleeve. (If it is difficult to pull the piston, insert a round bar from the front cap side and hammer out the piston.)
- At this time, slowly pull the piston, taking care not to gall the piston.
- If you have any hoisting device, place the piston upright, fit an eyebolt into the head part of the piston and hoist the piston together with the cylinder sleeve to easily remove it

(6) Remove the cylinder sleeve from the piston.
(7) Remove the U-packings and O-rings from the cylinder sleeve.
- It is recommended to use a 2 to 3 mm diameter rod that is tapered and pointed at the end when removing O-rings.

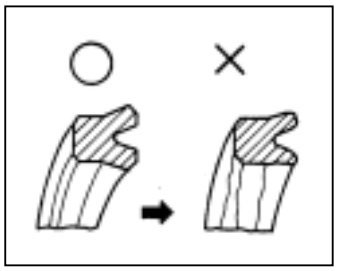
(8) Remove the U-packings from the cylinder.
(9) Disassemble the cover cap, and gas valve body from the back cap in this order.



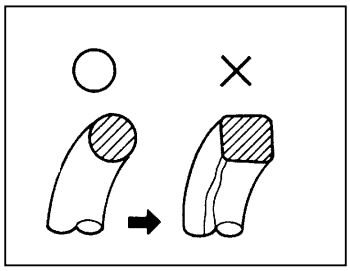
3. INSPECTION AND REPAIR AFTER DISASSEMBLY

(1) Inspecting the seals
Replace any worn, deformed or deteriorated seals with new ones as shown below.

● Worn or deteriorated U-packings



● Deformed, worn, flawed, twisted or deteriorated O-rings



(2) Inspection of the piston and valve sliding surfaces
● Check the sliding surfaces of the piston for flaws and blow surface for deformation. Remove the flaws and repair or replace the deformed parts.
● Check the valve sliding surfaces for flaws and remove or replace the flawed parts.

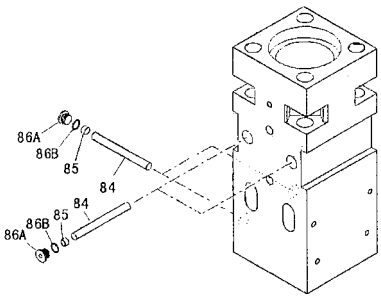
(3) Inspection of the front cap
● Replace the worn or deformed front cap bushing.
● Check the shank bushing for wear and flaws and replace the worn shank bushing.
● Replace the worn or deformed chisel set pin.

(4) Inspection of the cylinder plug
● The cylinder has been set with a plug. In a very rare case, this plug may loosen and case a small oil leak. The loosened plug must be tightened after resealing the tape seal or replacing the O-ring.

● PROCEDURE FOR REPLACING THE FRONT CAP BUSHING AND THE SHANK BUSHING

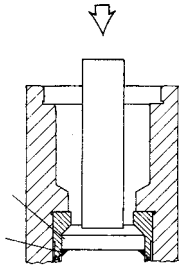
● *When replacing the front cap bushing, be sure to replace the shank bushing as well.*

(1) Remove the flange plugs and shaft retainers, and then push out the shafts.



Hydraulic press or hammer

Steel disc
Welding



(2) For removal of the front cap bushing and shank bushing, weld a steel disk as shown above and drive out them by hammering or using a hydraulic press.

(3) Remove burrs and flaws on the inner surface of the front cap using a bar grinder after removing the front cap bushing and the shank bushing.

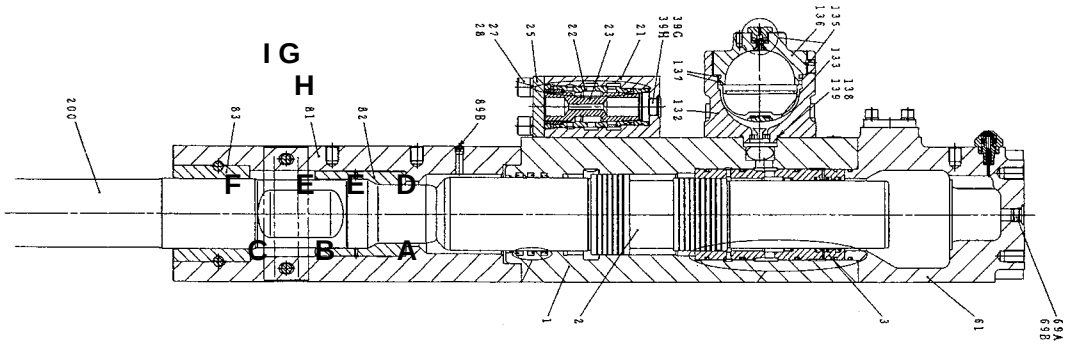
(4) Refrigerate the shank bushing and the front cap bushing with 15 kg (33 lbs) of dry ice in an ice box for 3 hours. Then insert the shank bushing into the front cap from the chisel side. After aligning the shaft grooves, insert the shafts and shaft retainers, and then install the flange plugs.
● *Be sure to wear leather gloves while doing this process. Complete this process swiftly, otherwise the bushing may stop on the way.*

(5) Install the front cap bushing in the same way as the shank bushing.

● REPAIRING SCRATCHES

The entry of foreign matter into the hydraulic breaker or the use of degraded or contaminated hydraulic oil can result in scratches on the inner wall of the cylinder, the external surface of the piston, the external surface of the valve, or on the inner wall of the cylinder sleeve. These scratches may increase oil leakage, generate excessive heat, and damage the U-packing. If these scratches are unattended, parts may seize, causing the breaker to malfunction. In the worst possible case, the breaker may become inoperative. The valve, valve box and valve box sleeve can also be scratched in the same way. It is, therefore, necessary to detect scratches early in their development and repair the scratches in an appropriate manner. Delay in repairing scratches may make repair impossible.

Note: *The criteria for judging scratches and finishes are based on the standard external surface roughness piece which conforms to JIS B 0659.*



Cylinder

(1) Surface roughness of the upper large diameter section (A) of the cylinder: 6.3S
Pay special attention to the area from the end surface to the first groove and repair any scratches in the area to prevent charged gas from leaking. To remove scratches, use a round or half-round oilstone while applying cleaning oil. The diameter of the oil stone should be as large as possible. Then finish the surface with #800 grinding paper to a surface roughness of 6.3S or less.

(2) Surface roughness of the cylinder's inner surfaces (B and C) other than the above mentioned surface: 12.5S
To repair scratches on the inner diameter surface, use a coarse round oilstone while applying cleaning oil. To remove burrs inside the seal grooves, use a comb-shaped diamond file. To finish the surface, use a coarse square oilstone while applying cleaning oil. Then use #800 grinding paper to finally finish the surface.
- *When an electric power supply is available, use a portable electric drill with grinding paper wrapped around the end of a rod to roughly remove the scratches. Then use flex hone to finish the surface. Quick finishing is possible with this method.*

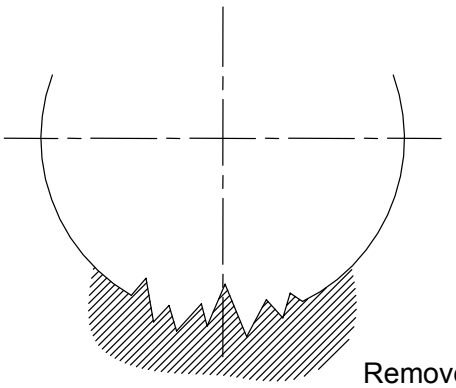
Piston

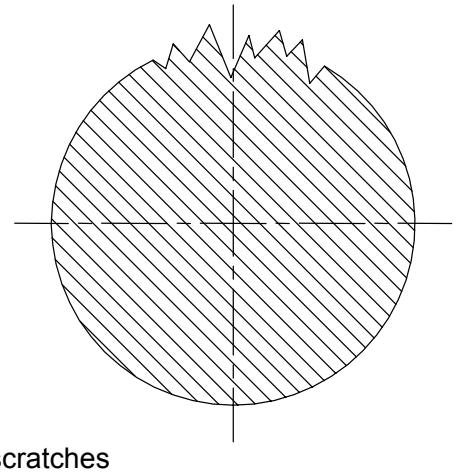
(1) Surface roughness of the upper and lower small diameter sections (D and F): 1.6S to 3.2S
To repair scratches, use a coarse square oilstone while applying cleaning oil until the surface roughness is 6.3S or less. Then finish the surface using #800 grinding paper.

(2) Surface roughness of the large diameter labyrinth section (E): 3.2S to 6.3S
To repair scratches on the external diameter section, use a square oilstone while applying cleaning oil until the surface roughness is 12.5S or less. Then use grinding paper to finish the surface. To repair scratches at the corners of the labyrinth grooves, use a coarse square oilstone while applying cleaning oil. To finish the groove surfaces, use #800 grinding paper.

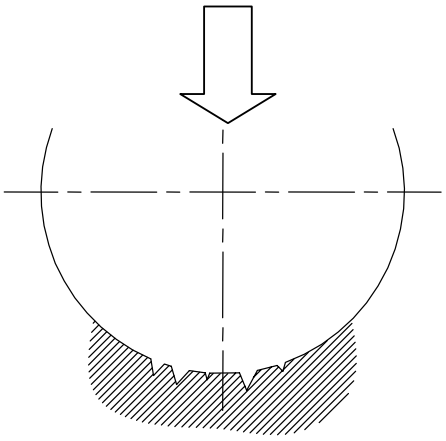
◆ **How to repair the scratches on the piston and cylinder**

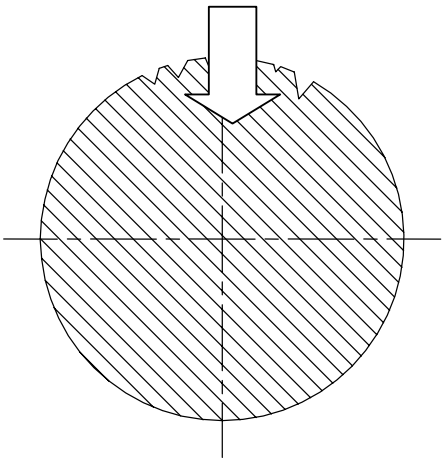
Cylinder **Piston**



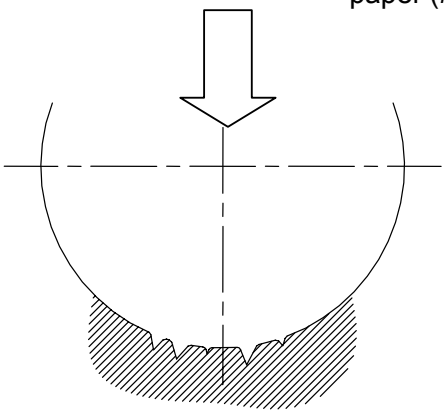


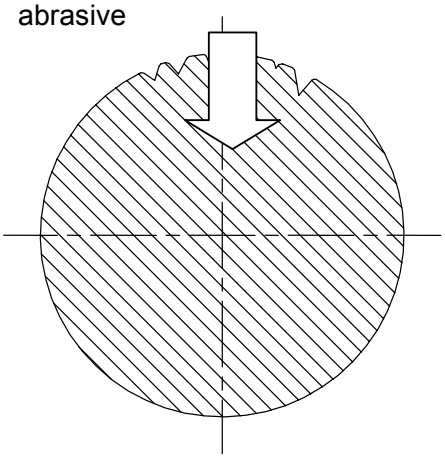
Remove the tips of scratches using an oilstone, never try to remove the whole scratches.





Round the corners of the repaired scratches using an abrasive paper (#800).





Surface roughness of the cylinder sleeve: 6.3S
Scratched surfaces with a surface roughness of 25S or greater cannot be repaired. Surfaces with smaller scratches can be repaired using #800 grinding paper. Do not use an oilstone.

Surface roughness of the valve (H): 3.2S
Scratched surfaces with a surface roughness of 25S or greater cannot be repaired. Surfaces with smaller scratches can be repaired using #800 grinding paper. Do not use an oilstone. If the end surface of the valve has been deformed or worn out, replace the valve.

Surface roughness of the valve box sleeve (I) and the valve box (G): 6.3S
Scratched surfaces with a surface roughness of 25S or greater cannot be repaired. To repair surfaces with smaller scratches, use a fine round oilstone while applying cleaning oil until the surface roughness of 12.5S or less is obtained. To finish the surface, use grinding paper.

- *When an electric power supply is available, use a portable electric drill with grinding paper wrapped around the end of a rod to roughly repair the scratches. To finish the surface, use a flex hone. Quick finishing is possible with this method.*

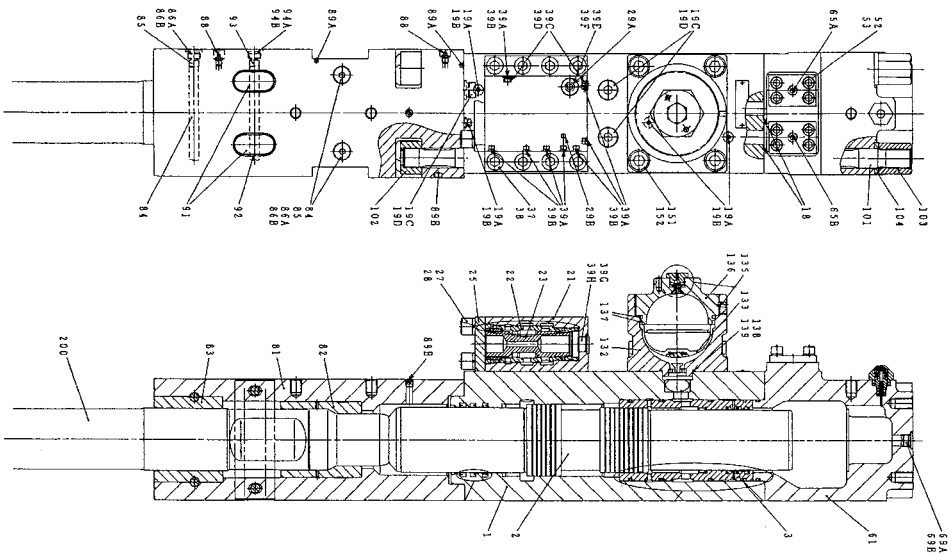
Repairing the piston end and chisel's impact surface
Repair any partial wear as necessary. If partial wear is unattended for a long time, serious problems may develop. If the end of the piston is worn out up to or beyond the protrusion section, replace the piston.

Front cap bushing and shank bushing
If the bushing is excessively worn, replace it according to the replacement procedure. If an excessively worn bushing is used, problems may develop.

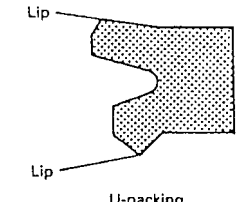
4. PRECAUTIONS BEFORE REASSEMBLY

(1) Thoroughly clean all parts.
(2) Be careful not to allow dust to enter which might cause scoring. Never use dirty cloth to clean the unit.

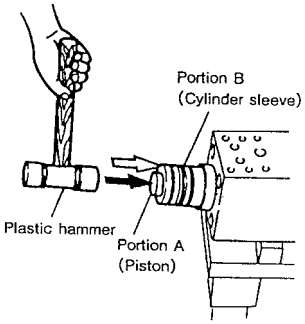
5. REASSEMBLY PROCEDURE



(1) Install the U-packings in the cylinder sleeve and cylinder.
- Before installing the seals, immerse them in hydraulic oil.
- Fit the U-packings in the grooves completely after making sure that its direction of installation is correct.
- Be careful so as not to damage the U-packing lip. A damaged lip can cause oil and gas leakage.



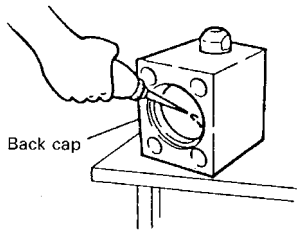
(2) Before inserting the piston in the cylinder all the way, place the cylinder sleeve over the piston.
- Apply a thin coat of hydraulic oil to the sliding surface of the piston and push in the piston by holding the upper part of the piston with hand. To ensure smooth insertion, place a wooden block under the piston.
- To facilitate insertion, drive in the piston by hitting portions A and B (in the figure) alternately with a plastic hammer. If a crane is available, hoist the piston with the cylinder sleeve using an eyebolt and insert them into the cylinder which has been placed upright.



(3) Install the valve and the valve box sleeve in the valve box. Install the valve cap, valve cap bolts and clamps in place. Secure the valve box assembly in the cylinder with the valve box set bolts.
- Apply a thin coat of hydraulic oil to all the sliding surface.
- Do not fail to install the O-ring.

(4) Install the front cap in the cylinder.

(5) Insert the side rods into the cylinder from above the cylinder, and install them in place.

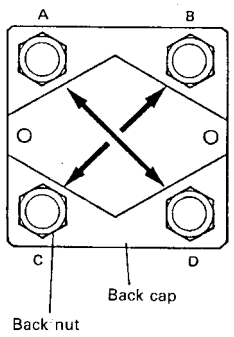


(6) Pass the side rods through the back cap and install the back cap in the cylinder.
- Do not fail to install the back cap O-ring.
- Pour 80 cc (0.02 gal) of hydraulic oil into the back cap before passing the side rods through it.

(7) Tighten the back nuts to the specified torque. When tightening, strictly follow the torquing sequence of A → D → B → C (alternate diagonal lines) in several passes.

(8) Charge nitrogen gas in the cushion chamber. For charging procedure, refer to the section “Procedure for Inspecting the Cushion Chamber Gas Pressure”.

(9) Force grease in several times using a grease gun through the grease nipple located on the lower side of the front cap.

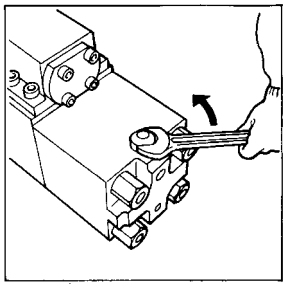


(Tighten in the sequence of A to D and B to C.)

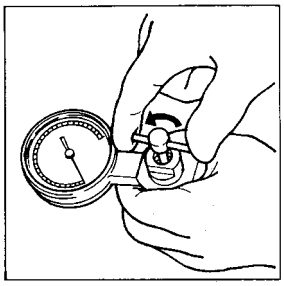
PROCEDURE FOR INSPECTING CUSHION CHAMBER GAS PRESSURE

The OKB series has been shipped from the factory with nitrogen gas charged in the back cap at the predetermined pressure. The nitrogen gas pressure, however, will decrease over time and use, resulting in reduced blowing force. When the blowing force is reduced, check the pressure of nitrogen gas in the back cap.

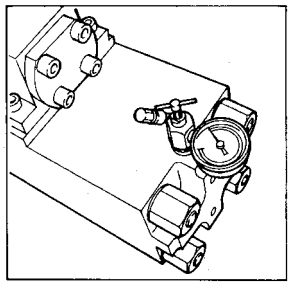
(1) Remove the cover and gas caps.



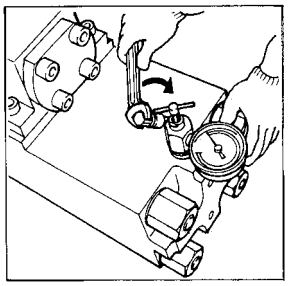
(2) Turn the handle of the charging device counterclockwise as far as possible (until it can no longer turned).



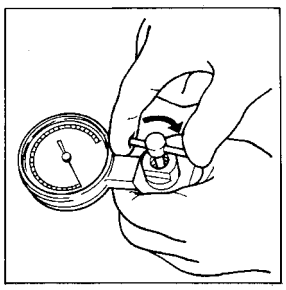
(3) Screw the charging device into the gas valve body.



(4) Turn the cap of the charging device clockwise to lock the cap.



(5) Turn the handle of the charging device clockwise. As you turn the handle, you will feel resistance at a certain position. Turn the handle farther. The pressure gauge will indicate the charging pressure.



Note:

- The gas pressure changes depending on the length of the chisel's protrusion. Check the pressure when the chisel is extended as far as possible.
- If the gas pressure is improper, adjust it.
- The gas pressure changes depending on the temperature.

Removing the charging device

(1) Turn the handle of the charging device counterclockwise as far as possible.
(2) Loosen the cap with an adjustable wrench to discharge the nitrogen gas that remains in the charging device.
(3) Remove the charging device from the gas valve body and tighten the gas and cover caps to lock them.

Proper tightening torque

Part	Torque	
	N·m	ft·lb
Gas cap	41±2	30.4±1.4
Cover cap	637±29	470.2±21.7

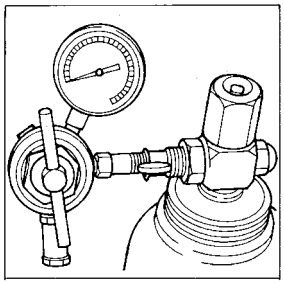
Reducing the gas pressure

(1) After checking steps (1) to (5), gently loosen the cap. The pressure will gradually lower. Tighten the cap when the proper pressure is reached.
(2) Regarding the steps to be taken hereafter, follow the procedure used to remove the charging device.

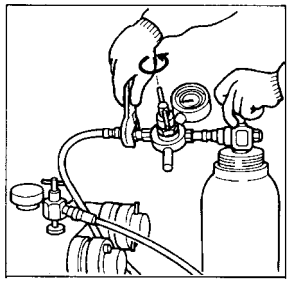
Replenishing nitrogen gas

After checking steps (1) to (3), take the following steps.

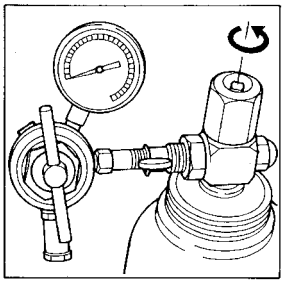
(1) Connect a regulator to the nitrogen gas cylinder.



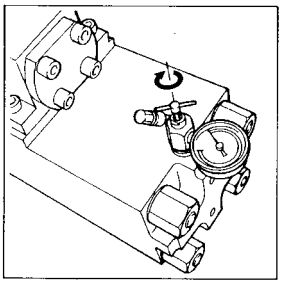
(2) Remove the cap of the charging device and connect the regulator to the charging device using a hose. Loosen the handle of the regulator by turning it counterclockwise.



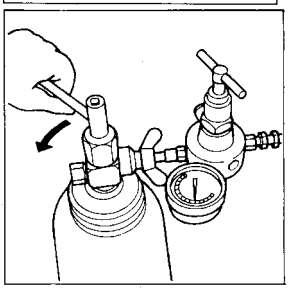
(3) Gently turn the main valve of the nitrogen gas cylinder counterclockwise. Turn the regulator handle clockwise until the regulator meter indicates stated pressure, and then turn the main valve clockwise to stop the gas supply.



(4) Turn the handle of the charging device clockwise. When the pointer of the charging device begins to move, stop turning the handle.



(5) Gently turn the main valve of the nitrogen gas cylinder counterclockwise again. While monitoring the meter, replenish nitrogen gas until the proper gas pressure is obtained.



(6) When the proper gas pressure is obtained, turn the main valve of the nitrogen gas cylinder clockwise to stop the gas supply . Turn the handle of the charging device counterclockwise to prevent the nitrogen gas replenished in the cushion chamber from leaking. Then remove the charging device.

Note:

- Do not use gases other than nitrogen gas.
- When nitrogen gas is charged, the chisel may jump out. To prevent injuries, stay away from the chisel.

Instruction for OKADA X Type accumulator

Application Model: TOP205, 250 and 300

⚠Warning

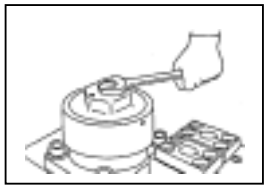
1) Be sure to use the only Nitrogen gas for the accumulator.
2) Keep the working pressure under predetermined maximum working pressure of the accumulator that is 17.6 MPa (2560 psi).
3) Completely release the charged N_2 gas in the accumulator without fail before disassembling it.
4) Never provide any machine work such as welding, drilling and gas heating.
5) When storing the accumulator and it's parts, be sure to keep them indoor to avoid corrosion. Exposure of the accumulator bladder to sun shine leads to deterioration.
6) Before handling the accumulator, read this manual. And after you get a proper appreciation about the accumulator, do the required maintenance work.

Maintenance and inspection

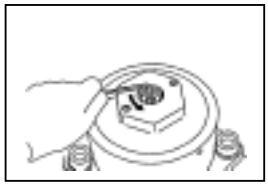
1) Check the charged N_2 gas pressure in the periodic interval. The specified interval is about 3 to 6 months.
2) Whenever checking the gas pressure, stop a engine of carrier and release the residual hydraulic pressure in the piping and the breaker.
3) During hammering if following symptoms arise on the breaker, the charged gas pressure must be checked.
   a: Hydraulic hoses used for high pressure line of piping are abnormally vibrated.
   b: Performance of the breaker is decrease.
   c: Oil leakage occurred from whichever the small hole in the accumulator body or between accumulator body and cover. Please note that the lubricant (NBR oil) is applied during its assembling process, so the lubricant may ooze through the above mentioned sections when hammering just after assembling the accumulator. This case is not the bladder failure.

Procedure for inspecting gas pressure

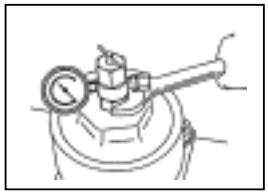
1) Remove the accumulator cover cap.



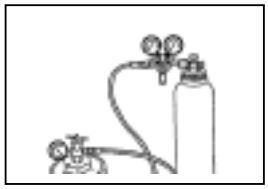
2) Slightly loosen the gas charging valve (cap screw fitted with O-ring) by using a hexagonal wrench. Be careful to loosen the gas charging valve only a little to avoid N_2 gas spouting out.



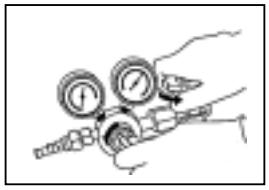
3) Screw the N_2 gas charging valve (3-way valve fitted with a pressure gauge) into the accumulator. Do not turn the handle of the N_2 gas charging valve at this moment.



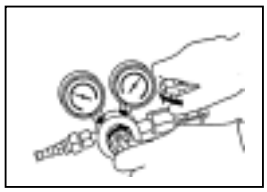
4) Connect a nitrogen gas cylinder to the N_2 gas charging valve with a gas hose.
   ❒ The nitrogen gas in cylinder must be filled over 5.9 MPa (853 psi) for OKB308, 310, 312B and 316 or 4.4 MPa (640 psi) for OKB318, 324 and 330.



5) In case that the N_2 gas cylinder is not equipped with a regulator:
   ❒ Slightly open the gas cylinder valve and then close it. While observing the pressure gauge, adjust the gas pressure in the gas hose to 5.8 MPa (OKB308~316) or 4.4 MPa (OKB318~330). If the gauge shows higher pressure than 5.8 MPa (OKB308~316) or 4.4 MPa (OKB318~330), adjust it by loosening the vent port of the N_2 gas charging valve.

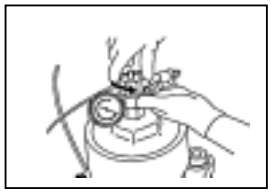


   In case that the N_2 gas cylinder is equipped with a regulator:
   ❒ Loosen the regulator handle as far as possible and open the gas cylinder valve. Adjust the gas pressure to 5.8 MPa (OKB308~316) or 4.4 MPa (OKB318~330) by turning the regulator handle and then close the gas cylinder valve.



   [State when completed clause 5]
   ❒ The nitrogen gas cylinder valve is closed.
   ❒ The pressure gauge shows 5.8 MPa (OKB308~316) or 4.4 MPa (OKB318~330).
   ❒ Though N_2 gas charging valve is mounted on the accumulator, the gas charging valve is still closed and N_2 gas is charged only in the gas hose.

6) Turn the handle of the N_2 gas charging valve counterclockwise by its end in one continuous motion and see the charge in the gas pressure on the pressure gauge.



7) In case that the pointer of the pressure gauge drops to 0 MPa or rises to more than 7.8 MPa (1138 psi), the accumulator bladder is probably damaged. In this case, replace the accumulator bladder.
8) In case that the gauge shows correct pressure, turn the handle of the N_2 gas charging valve clockwise and tighten it firmly.
9) Open the vent port of the N_2 gas charging valve to discharge the gas trapped in the N_2 gas charging valve and the gas hose. Then disconnect the gas hose from the N_2 gas charging valve and the N_2 gas cylinder.
10) Tighten the gas charging valve firmly by using a hexagonal wrench.
    Tightening torque of the gas charging valve is 19.6 Nm (14 ft-lb).
11) Apply soapy water at the gas charging valve and see if no gas leaks. Completely blow out the soapy water to avoid rust.
12) Put the accumulator cover cap back on the accumulator.

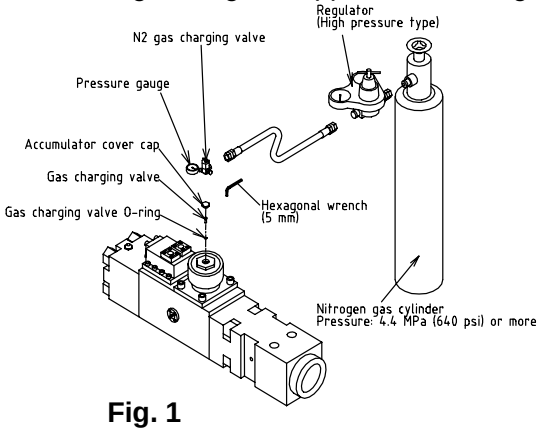


Fig. 1

Disassembling

Danger

Be sure to release any pressure inside the accumulator through the gas charging valve. Also stop the engine of carrier and release the residual pressure from the piping and the breaker.
Procedure

1) Clean the accumulator thoroughly. Remove the cover cap (No.14 in Fig.3) using spanner. Slightly loose the gas charging valve. Then screw down the N_2 gas charging valve (Fig.1) in order to release the pressure in the accumulator.
2) Turn the handle of the N_2 gas charging valve counterclockwise and completely release the pressure through the drain port of the N_2 gas charging valve.
3) Remove the accumulator set screw (No.15) by using the hexagonal wrench after remove the N_2 gas charging valve.
4) Slowly screw out the accumulator cover (No.10) by using a wrench. Note when the accumulator cover is unscrewed around 2 turns, make sure that no oil or gas is jetting from the safety hole locates on the side of the accumulator body (No.1).
5) Remove the bladder (No.2).

Assembling

1) Completely clean the accumulator cover and body by means of the cleaning oil. Entry of any impurities causes the accumulator failure. In case of using a thinner or gasoline as the cleaning oil, dry them out sufficiently after cleaning.
2) Apply the clean hydraulic oil evenly to the external face of the bladder.
3) Carefully handle the bladder to avoid scratching and properly fit the bladder in the accumulator body. Note that see if the bladder lip completely fit into the inside step of the accumulator body.
4) Fit the O-rings (No.11) in place. Apply the enclosed NBR oil to the bladder and the shaded portion in the Fig.2.
6) Tighten the accumulator cover so that both holes of accumulator cover and body for the set screw are aligned. Then screw down the set screw (N0.15) applying a threadlocker. Tightening torque of the set screw is 225 Nm (166.3 ftlb).

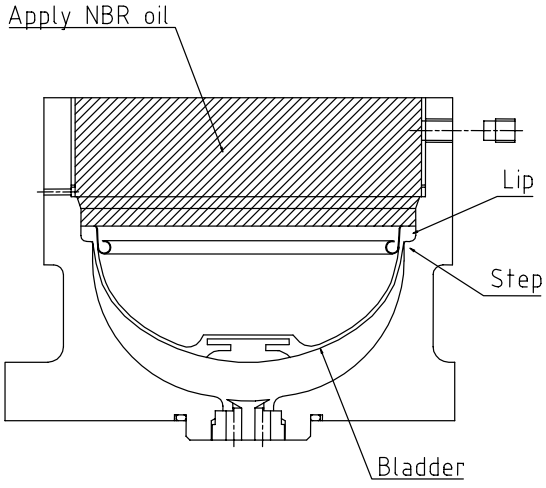


Fig. 2

Parts list for T180-3X

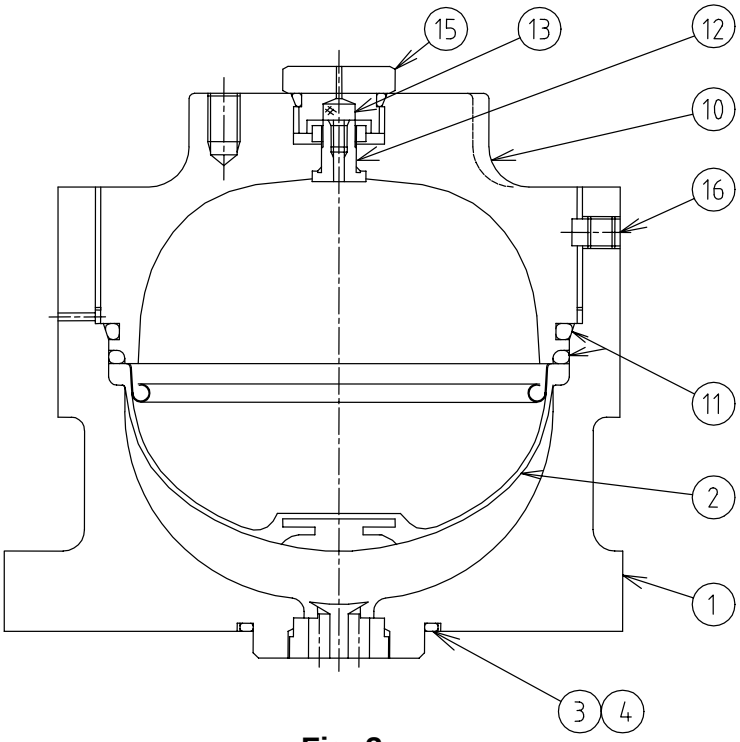


Fig. 3

No.	Part Name	Q'ty
1	Accumulator body	1
2	Bladder	1
3	Accumulator O-ring	1
4	Accumulator buck-up ring	1
10	Accumulator cover	1
11	Accumulator cover O-ring	2
12	Gas charging valve body	1
13	Gas charging valve w/O-ring	1
14	Accumulator cover cap w/O-ring	1
15	Accumulator set screw	1

Instruction for OKADA Y Type accumulator

Application Model: TOP205, 250 and 300

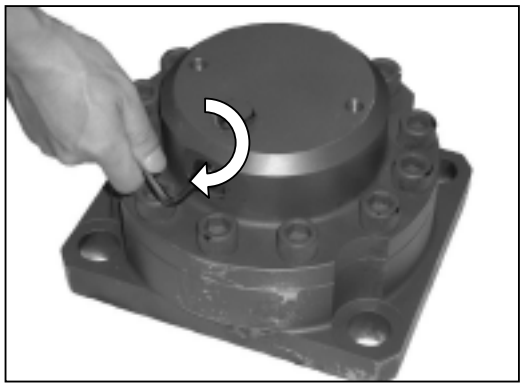
Maintenance and inspection

⚠ DANGER

1) Be sure to use the only Nitrogen gas for the accumulator.
2) Keep the working pressure under predetermined maximum working pressure of the accumulator that is 17.6 MPa (2560 psi).
3) Completely release the charged N_2 gas in the accumulator without fail before disassembling it.
4) Never provide any machine work such as welding, drilling and gas heating.
5) When storing the accumulator and its parts, be sure to keep them indoors to avoid corrosion. Exposure of the accumulator bladder to sun shine leads to deterioration.

Before handling the accumulator, read this manual. And after you get a proper appreciation about the accumulator, do the required maintenance work.

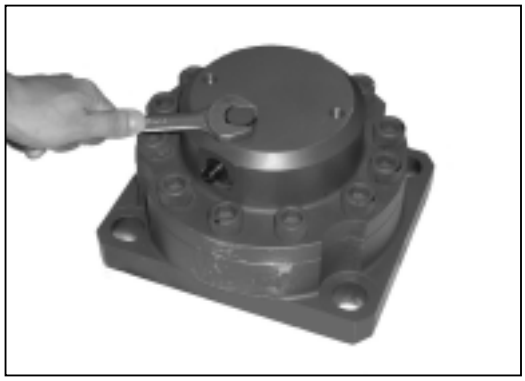
1. Remove the Cap 6 (With O-ring) of Accumulator cover side, then tighten the Gas charging valve 4.



⚠ CAUTION

If remove the plugs of upper side on the accumulator cover with loosen the gas-charging valve, spout out N2 Gas. Please be sure to make sure to tighten the plug before removing the plug.

2. Remove the plug 8 (With O-ring) of upper side on the accumulator cover.

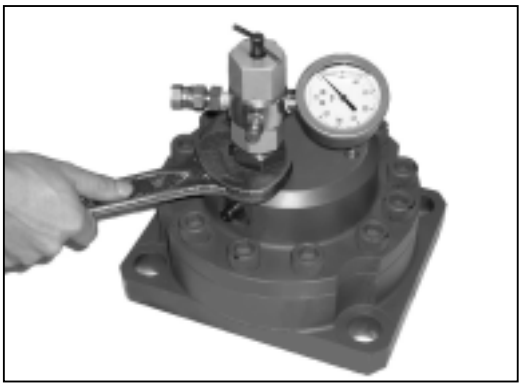


⚠ DANGER

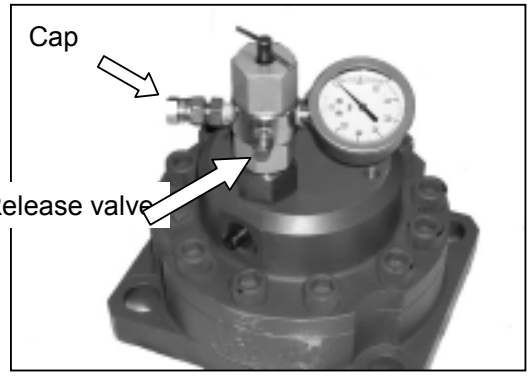
When removes the plug 8, do not come near to upper plug your hands and face. It may be flied the plug by inside pressure.

3. Install the accumulator charging kit on the accumulator cover, then tighten it until locking it with spanner.

※ When use the X type accumulator charging kit, please use the adapter. However, do not need a handling of the adjuster.



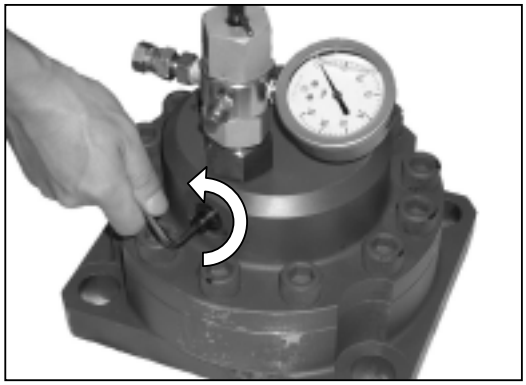
4. Make sure to tighten the Cap and release valve on the accumulator charging.



5. Works the pressure gauge when loosen the gas charging valve 4 to counterclockwise way slowly.
Make sure gauge pressure within the limits of range.

CAUTION

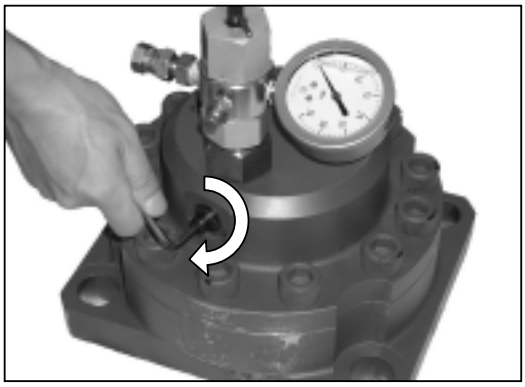
In case that N2 gas pressure is over 8 MPa (1160 [psi]), Hydraulic oil may be spouted



Remedies against N2 gas pressure inside accumulator.

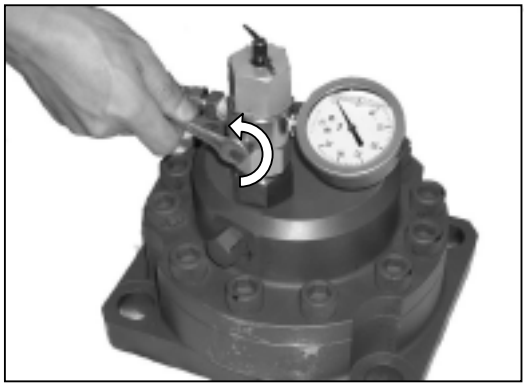
N2 gas pressure MPa (psi)	**Remedies**
0 ～ Less than 4 (580)	Break down the bladder is possible. Make sure the bladder.
4 (580)～Less than 6 (870)	N2 gas comes out. Charge N2 Gas into the accumulator.
6 (870)～Less than 8 (1160)	Within the limits of range. A rise of more or less pressure within the limits of range is Oil temp. Rise. (Refer『N2 gas P-T curve』Page 7)
More than 8 (1160)	Break down the bladder is possible. Make sure the bladder.

6. If gauge pressures within the limits of range tighten the gas charging valve 4 to clockwise way tightly. Then tighten the cap 6 (With O-ring) to the uniform torque.



Cap 6 (With O-ring) Uniform Torque
150[Nm] (111 [ft lb])

7. Open the release valve of Accumulator gas charging valve. Then emit the gas inside gas charging valve.



8. Remove the Accumulator gas charging valve, then tighten the plug 8 to the uniform torque, and then check no leaking the gas.

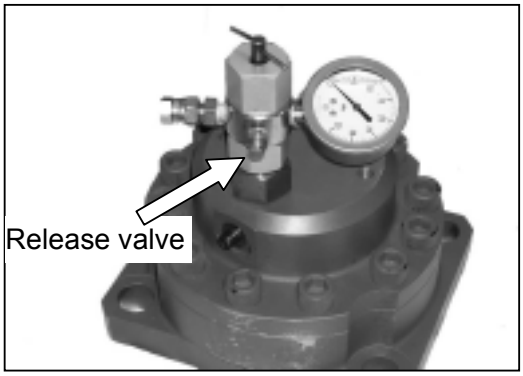
Cap 8 (With O-ring) Uniform Torque
150[Nm] 111 [ft lb]

How to charge N2 gas

⚠ DANGER

- Be sure to use the only Nitrogen gas for the accumulator.

1. After process (1-3) of 2: Inspecting gas pressure (Page 3), make sure to tighten the release valve of Accumulator gas charging valve.



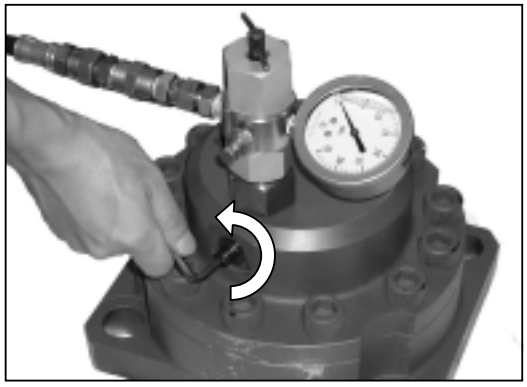
2. Install the regulator on the N2 gas cylinder, then connect a N2 gas cylinder to the N2 gas charging valve with a gas hose.

Important

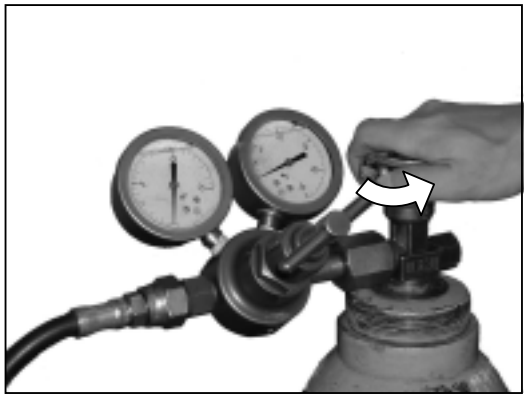
Be sure to us over 6 MPa (870 psi) of N2 gas cylinder pressure.

3. Loosen the regulator handle to the counterclockwise way.

4. Loosen the gas charging valve 4 to the counterclockwise around 1 turn.

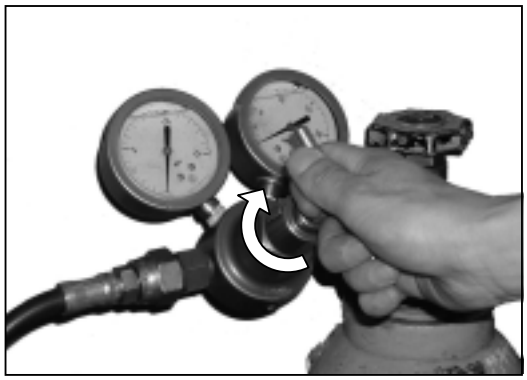


5. Open the main cock of Gas cylinder to the counterclockwise.

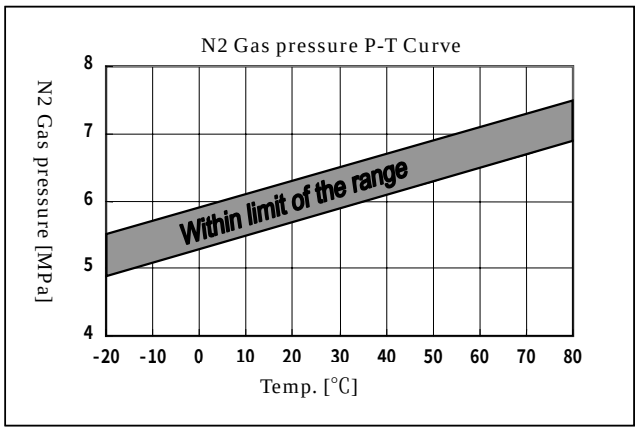


6. Fill the N2 Gas until correct pressure by turning the regulator handle to the clockwise way.

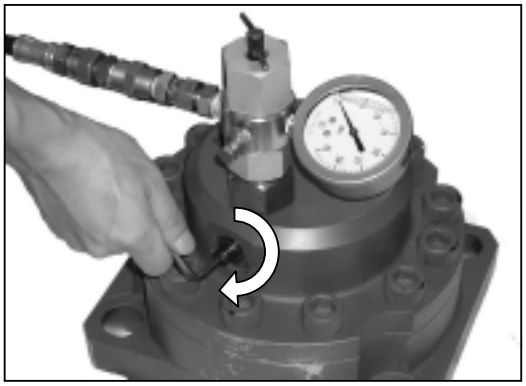
N2 gas pressure 20 C [68 F]
6±0.3 MPa (870±44 [psi])



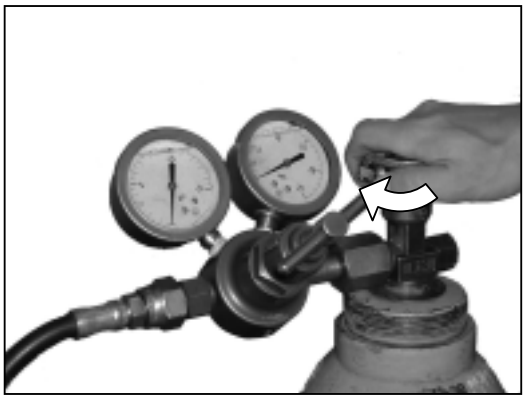
※Gas pressure are varied by temperature. Please adjust N2 gas pressure against accumulator temperature to the correct pressure.



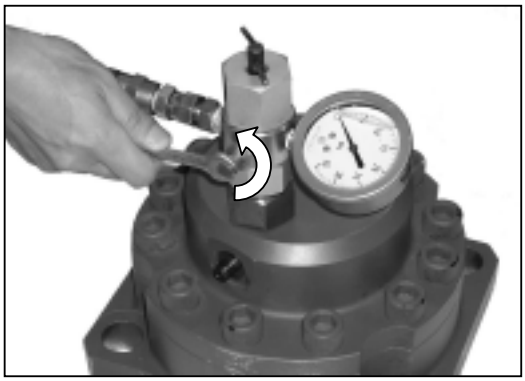
7. Tighten the gas charging valve 4 of accumulator side face to the clockwise way strongly.



8. Close the main cock of Gas cylinder.



9. Open the release valve of Accumulator gas charging valve. Then emit the gas inside gas charging hose.



10. Remove the gas charging hose, then remove the gas charging kit for accumulator from accumulator.

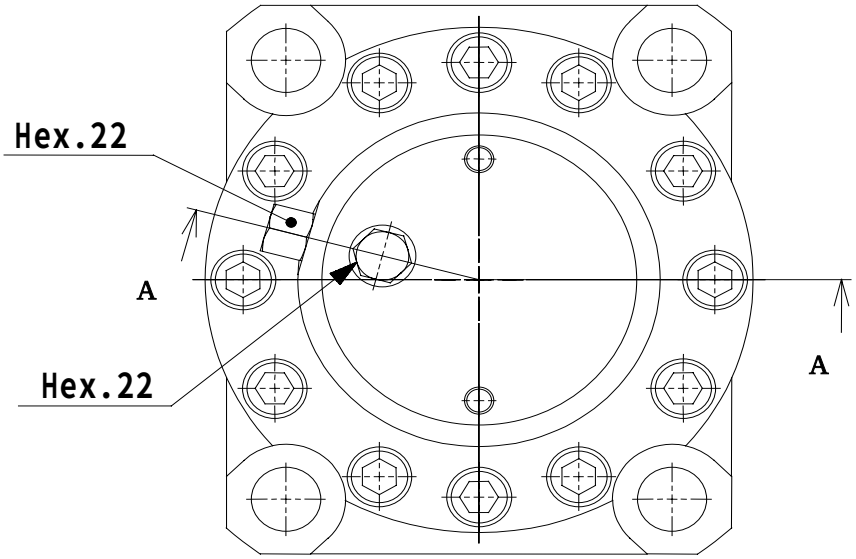
11. Tighten the cap (with O-ring) to the gas charging valve 4 with uniform torque.

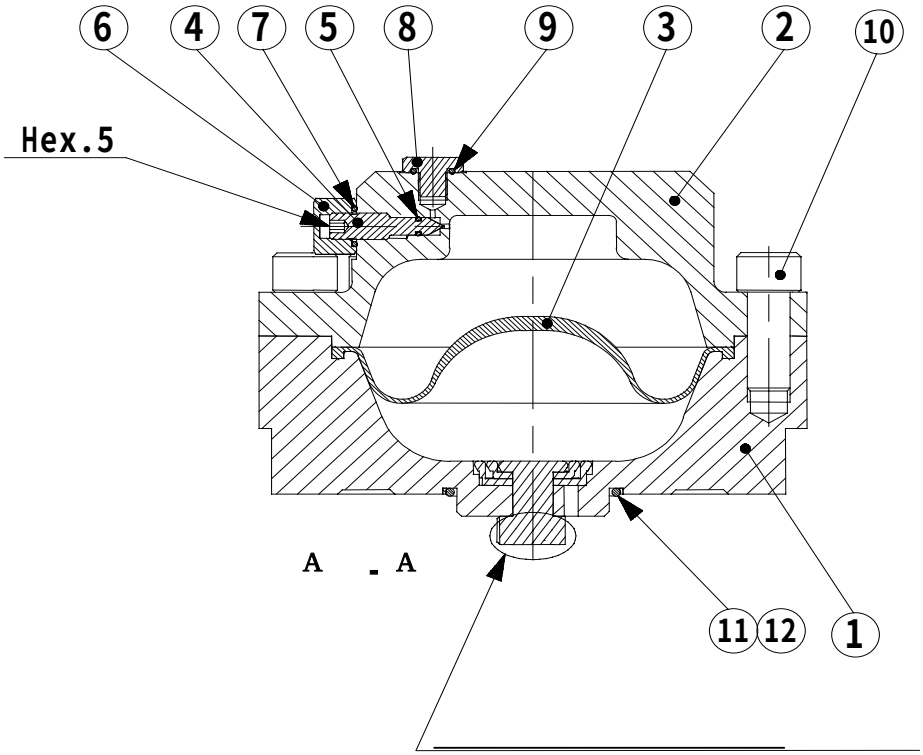
Cap 6 (With O-ring) Uniform Torque	150 Nm (111 [ft lb])

12. Tighten the plug 8 (with O-ring) to the upper of accumulator cover with uniform torque, then check no leaking the gas.

Cap 6 (With O-ring) Uniform Torque	150 Nm (111 [ft lb])

Exploded view





This part can not disassemble.

Parts List

No.	Part Name	AC-2Y		AC-3Y	
		TOP205		TOP300	
		Part Number	Q'ty	Part Number	Q'ty
1	Accumulator body	15401410	1	15651410	1
2	Accumulator cover	15401421	1	156514212	1
3	Bladder	154014311	1	156514311	1
4	Gas charging valve	15401442	1	15401442	1
5	O-ring	E1012005	1	E1012005	1
6	Cap	15401446	1	15401446	1
7	O-ring	E1012014	1	E1012014	1
8	Plug	15401448	1	15401448	1
9	O-ring	E1012014	1	E1012014	1
10	Cap screw	A030A4139	12	A0303A4569	12
11	O-ring	E1162231	1	E1162231	1
12	Accumulator back up ring	31380253	1	31380253	1

Specification

Gas			Nitrogen Gas	
Gas pressure (20℃) [68 F]			6±0.3 [MPa]	870±44 [psi]
Torque	Plug 8 (With O-ring) (Accumulator Upper side)		150 [N·m]	111 [ftlb]
	Cap 6 (With O-ring) (Accumulator side face)		150 [N·m]	111 [ftlb]
	Cap screw 10 (Accumulator cover for fixing)	AC-2Y	340 [N·m]	251 [ftlb]
		AC-3Y	440 [N·m]	325 [ftlb]

Routine and periodic inspection

Part	Check Item	Countermeasure	Frequency
Back nut	Tightness	Retighten	Everyday
Chisel set pin	Wear or damage	Replace	Everyday
Front bolt nut	Tightness or damage	Retighten or replace	Everyday
Accumulator set bolt	Tightness	Retighten	Everyday
Valve box set bolt	Tightness	Retighten	Everyday
Valve cap bolt	Tightness	Retighten	Everyday
Clamp bolt	Tightness	Retighten	Everyday
Adjuster case set bolt	Tightness	Retighten	Everyday
Hydraulic oil	Insufficiency, deterioration or contamination	Replenish or replace (every 600 hours)	Everyday
Bracket	Wear or damage	Repair or replace	Every 1 month
Chisel	Wear or damage	Repair or replace	Every 1 month
Oil filter element	Clogging	Clean or replace (every 100 hours)	Every 1 month
Cylinder sleeve O-ring	Damage or hardening	Replace	Every 3 months
Sleeve U-packing	Wear, damage or hardening	Replace	Every 3 months
Cylinder U-packing	Wear, damage or hardening	Replace	Every 3 months
Ring packing	Wear or damage	Replace	Every 3 months
Ring packing O-ring	Wear, damage or hardening	Replace	Every 3 months
Back cap O-ring	Wear, damage or hardening	Replace	Every 3 months
Valve	Flaws on the sliding surface	Remove flaws	Every 3 months
Shank bushing	Wear or damage	Remove flaws or replace	Every 3 months
Front cap bushing	Wear or damage	Remove flaws or replace	Every 3 months
Cylinder	Loosen plug	Retighten	Every 6 months
Cylinder sleeve	Flaws on the inner surface	Remove flaws	Every 6 months
Piston	Flaws on the inner surface	Remove flaws or repair	Every 6 months

※ Replace dust seal every 700 hours.
※ Use a grease gun to inject grease into the front cap through the grease nipple.
Grease should be injected several times each day, both in the morning and in the afternoon.
※ Shorten the inspection frequency if the breaker is repeatedly used continuously for many hours.

Caution of preparation for the under water application

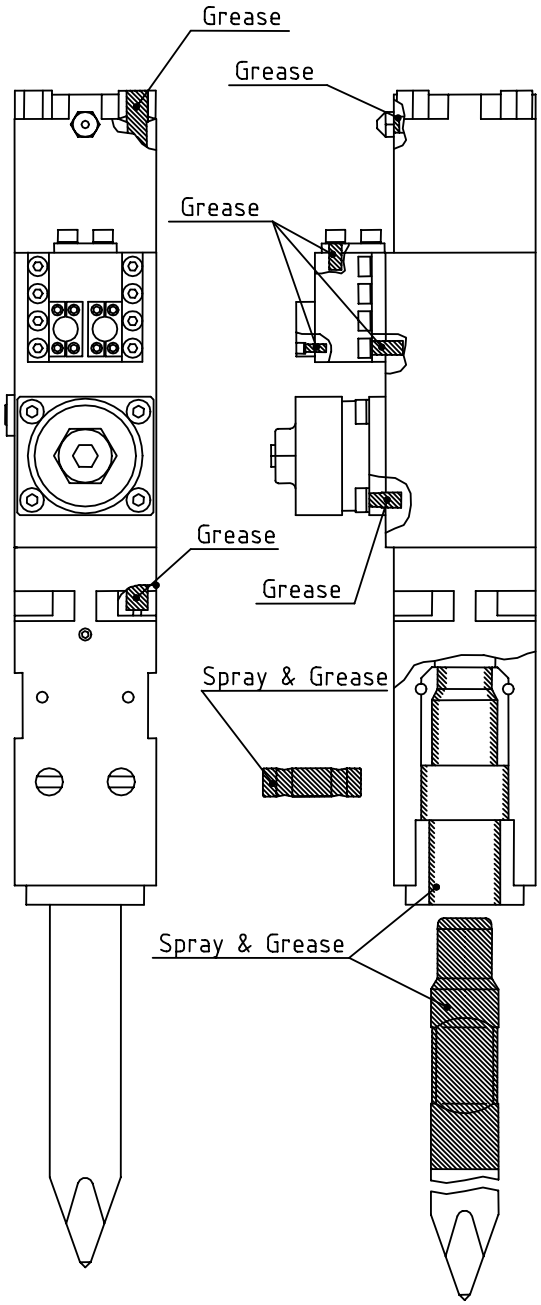
1. Upon completion of daily usage for underwater work, all parts marked as the diagonal should be thoroughly cleaned and sprayed with an anti-rust preventive solution for protection.

2. The bracket front bolts, the bracket and the link pins should be cleaned and greased.

3. When oil leaks for the breaker during operation, stop the operating immediately and check all seals and hoses for damage or loose fittings. After inspection or repair of parts, the procedure explained in No. 1 should be carried out.

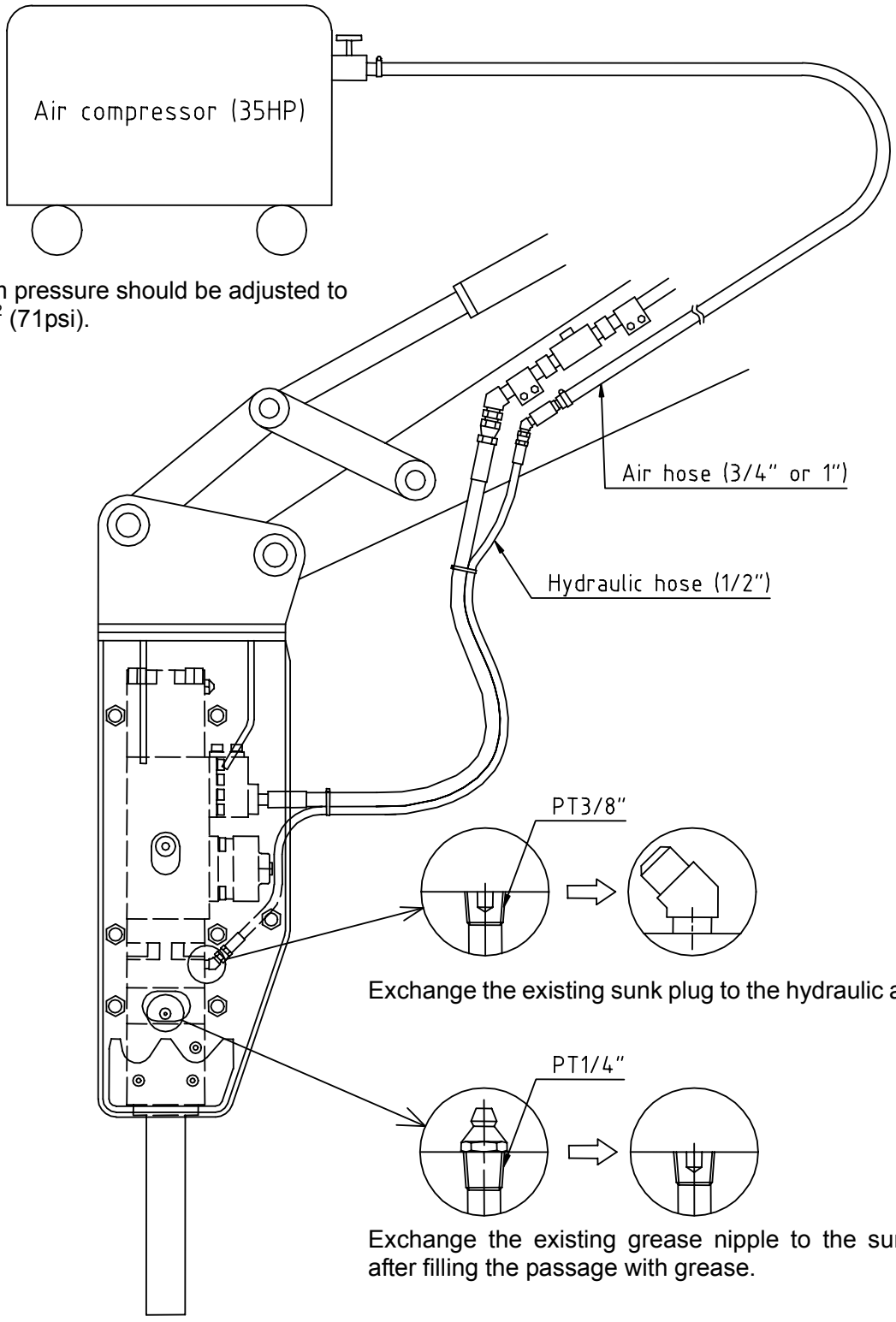
4. For general operating procedure and maintenance, please refer to the instruction manual.

5. Adjust N_2 gas pressure in the back cap of the breaker as shown the following table.



	Under water	On the ground
TOP100	0.59 to 0.64 MPa	0.29 to 0.34 MPa
	85 to 92 psi	*43 to 50 psi*
TOP200	0.49 to 0.54 MPa	0.20 to 0.25 MPa
	71 to 78 psi	*28 to 36 psi*
TOP250	0.54 to 0.59 MPa	0.25 to 0.29MPa
	78 to 85 psi	*36 to 43 psi*
TOP300	0.54 to 0.59 MPa	0.25 to 0.29MPa
	78 to 85 psi	*36 to 43 psi*

TOP series under water application piping



Maximum pressure should be adjusted to 5 kgf/cm^2 (71psi).

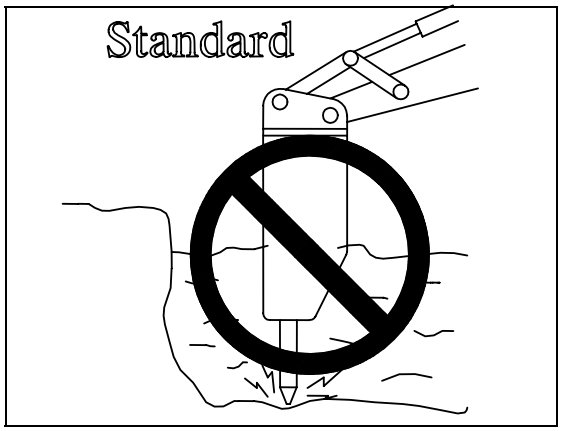
Exchange the existing sunk plug to the hydraulic adapter.

Exchange the existing grease nipple to the sunk plug after filling the passage with grease.

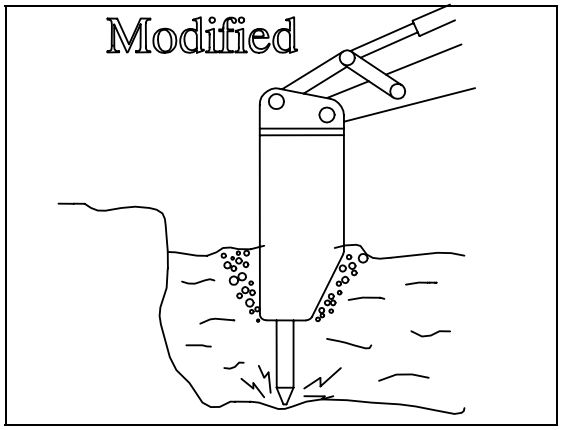
Precautions under water working

Take the special cautions to properly maintain whole hydraulic apparatus.

1. Never use the standard type OKB breaker under water. Otherwise, both carrier and the breaker will be damaged severely.



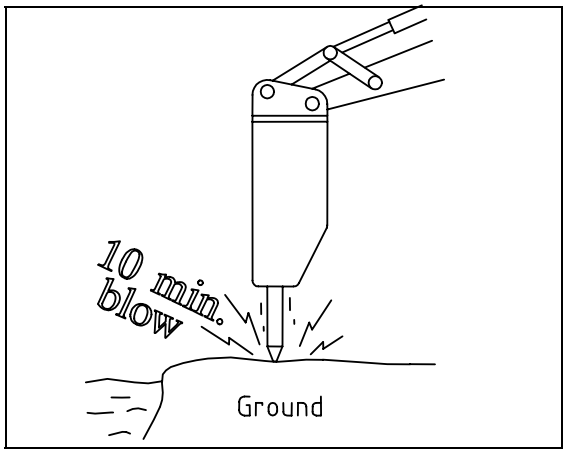
2. OKB305 and larger model can be modified so as to be suited for under water hammering, install the special parts as shown on the under water application sheet.



3. Extra maintenance work must be required the breaker body to protect any corrosion and rust.

4. Be sure to work the air compressor before place the breaker under water.

5. After under water working, over 10 minutes hammering on the ground must be provided.



6. If entering of water into the cylinder is found, stop the working at once, and then dismantle the breaker and provide integral repair. Also when under water working is no longer required, give it an overhaul.

Chisel Warranty Guide

The purpose of this guide is to enable you to advise your customer as the correct application of OKADA Working Tools and assist you to resolve complaints immediately they occur.
When a tool has apparently failed to give satisfactory service life, a visual inspection often quickly resolves the cause and saves transport costs and frustration when warranty is rejected.

How a Demolition Tool Breaks Rock and Concrete

When the hammer piston strikes the top of a working tool, it sends a compressive stress wave down to the working end of the tool. Provided the working tool is in contact with the rock or concrete which requires breaking, it is this compressive stress wave which fractures the rock. Immediately following the compressive stress wave, a tensile stress wave is formed due to the hammer piston lifting from the top of the working tool. This cycle of compressive and tensile stresses flowing down the tool is repeated for each hammer blow.
Obviously, anything that interferes with the 'strength' of the compressive stress wave during service, for example 'free running' or bending of the working tool due to leverage, will result in loss of breaker efficiency of up to 80% and possible fatigue failure of the tool itself.

Cause and Effect of Fatigue

The continuous cycle of compressive and tensile stresses in the working tool, even under correct operating conditions, create fatigue stress in the tool which can lead to the fatigue failure of a working tool before it is worn out. Again, anything which interferes with the cycle of compressive and tensile stresses will also increase the level of fatigue stress being applied to the working tool and thus increase the risk of early fatigue failure of the tool.

1. The main cause of increased fatigue stress in working tool is any form of side pressure during service which creates bending the tool as a lever, using the incorrect driving angle or attempting to break ground using the pull of the machine are all detrimental to the life of a working tool and should be avoided (see Figure 1).

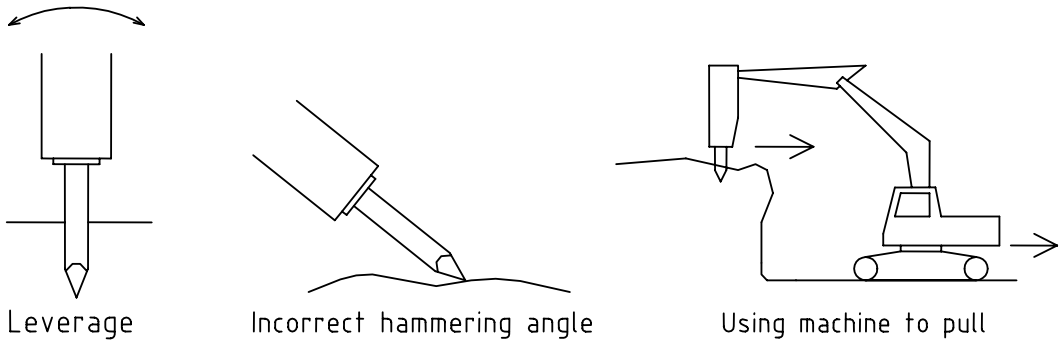


Fig. 1

Remember, the hydraulic power available in the machine far exceeds the strength of a working tool if it is being used incorrectly and can "snap the tool like a carrot "

2. Other causes of increased fatigue stress in a working tool include:

a) 'Free running'

In general this is any situation where the hammer piston strikes the top of the working tool, but the working end is not in proper contact with the rock or concrete to be broken. This includes jobs where the tool slides off the work and also when break-through of thin concrete slabs or boulders occurs.

b) Cold
Low temperature causes a working tool to be more susceptible to fatigue failure. Tools should be warmed before use.
c) Mechanical and thermal damage
Any form of damage to the surface of a working tool renders it more liable to suffer fatigue failure. Thus all care must be exercised to prevent accidental gouging, or contact welding ('galling' or 'pick up') due to contact between the tool and the bushings through the lack of lubrication or excessive bending (see Figure 2)

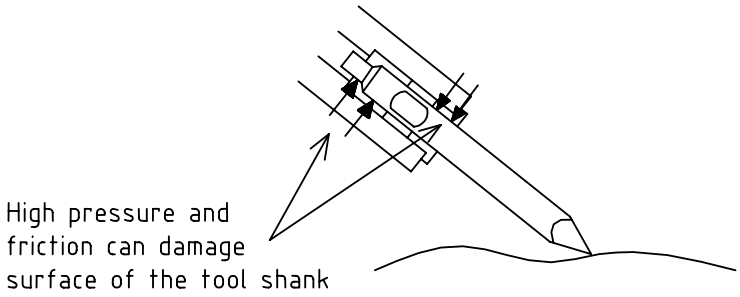


Fig. 2

d) Lubrication
Care must be taken to avoid metal to metal contact that, as a result of galling or pick-up, could cause deep damage marks which, in turn, lead to the formation of fatigue cracks and eventual failure of the working tool. Ensure that the shank of the working tool is well lubricated before locating in the machine. Molybdenum bisulphide grease is recommended.
e) Corrosion
A rusty working tool is more likely to suffer fatigue failure, thus keep tools well greased and sheltered from the weather when not in use.

Demolition Tool Fatigue Failure
A working tool fatigue failure will generally occur approximately 100 mm (4") either side of the chuck front face (see Figure 3) or through the retainer pin flat.
Another slightly less common failure area can fall approximately 200 mm (8") from the working end, subject to nature of use.
The fracture face itself will normally exhibit a semi circular polished area with the remainder being of a rougher appearance (see Figure 4).

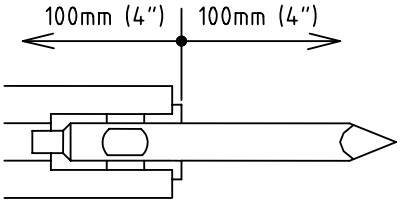


Fig. 3

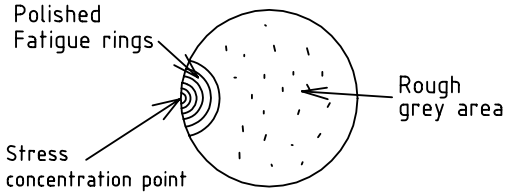


Fig. 4

The polished semi-circular are in Figure 4 is the fatigue area and generally stars from a damage mark or other stress raiser on the outside of the working tool and spreads inwards. The fatigue area slowly widens until the stresses being applied to the working tool cause sudden failure of the remaining section.

Generally, the size of the fatigue area indicates the level of stress applied to the tool, i.e. the smaller the fatigue are, the higher the stress level, although it must be borne in mind that once initiation of a fatigue crack has taken place, it requires a lower stress level to cause it to grow.

Typical Failures (guide to warranty claims)

OKADA AIYON working tools are manufactured from first class materials and then heat treated to produce a fatigue and wear resistant tool. Thus when a tool has apparently failed to give a satisfactory service life, a brief visual inspection can often give a quick indication of the cause.

Fig. 5. Typical fractures caused by excessive bending of the working tool. Warranty claims rejected.

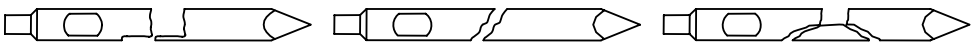


Fig. 5

Fig. 6. Typical of high stress fracture, usually caused by using the machine to 'pull'. Warranty claims rejected.

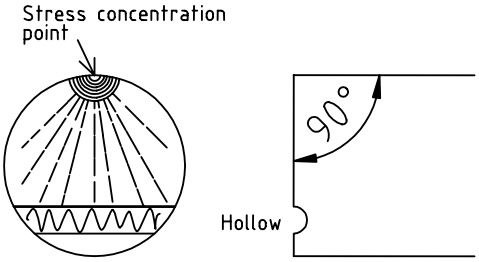


Fig. 6

Fig. 7. Typical fracture caused by levering tool while buried in the burden. Warranty claims rejected.

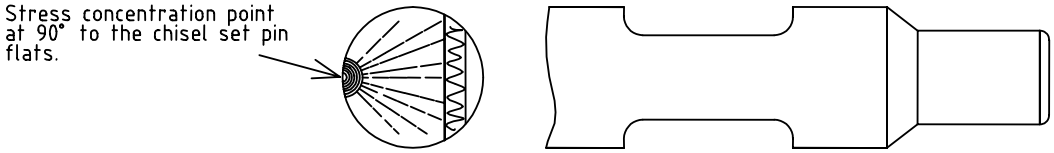


Fig. 7

Wear

Wear is influenced by ground conditions, but as a general guide the following applies:

Fig. 8. Blunt tools worn more than 1/3 diameter or moil points and chisels worn back more than 51 mm (2") of working end classed as reasonable life. Warranty claims rejected.

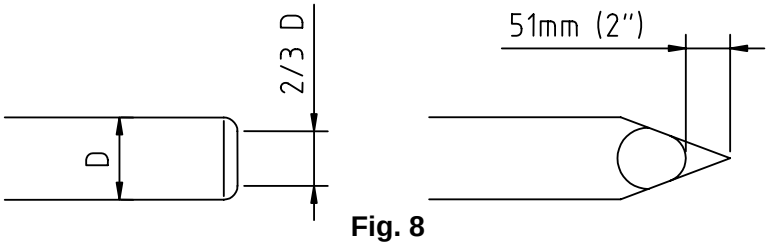


Fig. 8

Fig. 9. Mushrooming; this is caused by driving the point into hard dense material for too long a period of time without penetration. This generates intense heat, softening the point, thus causing it to 'mushroom'. This is not a manufacturing fault. Warranty claims rejected.

Fig. 9

Fig. 10. Note fatigue lines originate from internal point, not outer diameter. Very rare failure type due to steel defect. 100% warranty accepted.

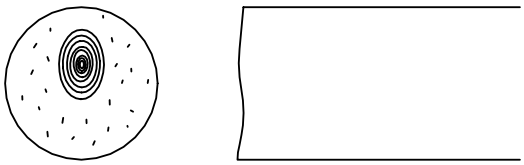


Fig.10

Hydraulic piping requirements for TOP series

Model TOP	Working pressure	Oil flow	Max. relief set pressure	Piping I.D.	Back pressure				Piping Accum.	
					Allowable back pressure	Condition				
						Piping I.D.	Oil flow	Oil temp.		
	MPa	l/min	MPa	mm	MPa	mm	l/min	°C	In	Out
	psi	gpm	psi	inch	psi	inch	gpm	°F		
25	8-15	18-38	17.5	13	2	13	38	50-60	X	X
	1170-2180	4.8-10.1	2500	1/2	300	1/2	6.6	122-176		
30	12-16	24-35	17.5	13	2	13	33	50-60	X	X
	1735-2320	6.3-9.3	2500	1/2	300	1/2	9.2	122-176		
35	12-16	40-55	17.5	13	2	13	55	50-60	X	X
	1735-2320	10.6-14.6	2500	1/2	300	1/2	11.9	122-176		
45B	12-16	65-81	17.5	13	2	13	80	50-60	X	X
	1735-2320	17.2-21.2	2500	1/2	300	1/2	21.2	122-176		
60B	12-16	48-80	17.5	19	2	19	72	50-60	X	X
	1735-2320	12.7-21.1	2500	3/4	300	3/4	19	122-176		
90	12-18	70-110	19	19	2	19	72	50-60	X	X
	2000-2620	18.5-29.1	2700	3/4	300	3/4	31.7	122-176		
100	14-18	80-115	19	19	2	19	115	50-60	X	X
	2030-2620	21.2-30.4	2700	3/4	300	3/4	30	122-176		
200	14-18	120-160	19	25	2	25	160	50-60	X	X
	2030-2620	31.7-42.3	2700	1	300	1	42	122-176		
205	14-18	100-130	19	25	2	25	160	50-60	X	X
	2030-2620	26.5-34.4	2700	1	300	1	42	122-176		
250	14-18	120-160	21	25	2	25	160	50-60	X	X
	2030-2620	31.7-42.3	3000	1	300	1	42	122-176		
300	14-18	160-215	21	25	2	25	215	50-60	X	X
	2030-2620	42.3-56.9	3000	1	300	1	57	122-176		

[012704]

[Note]

◇ The working pressure means the measured pressure while hammering beside the boom base on the piping for a hydraulic breaker. Calculate the average when the pressure is fluctuating.

◇ The measurement point of the max. relief set pressure is a piping tip of the arm.

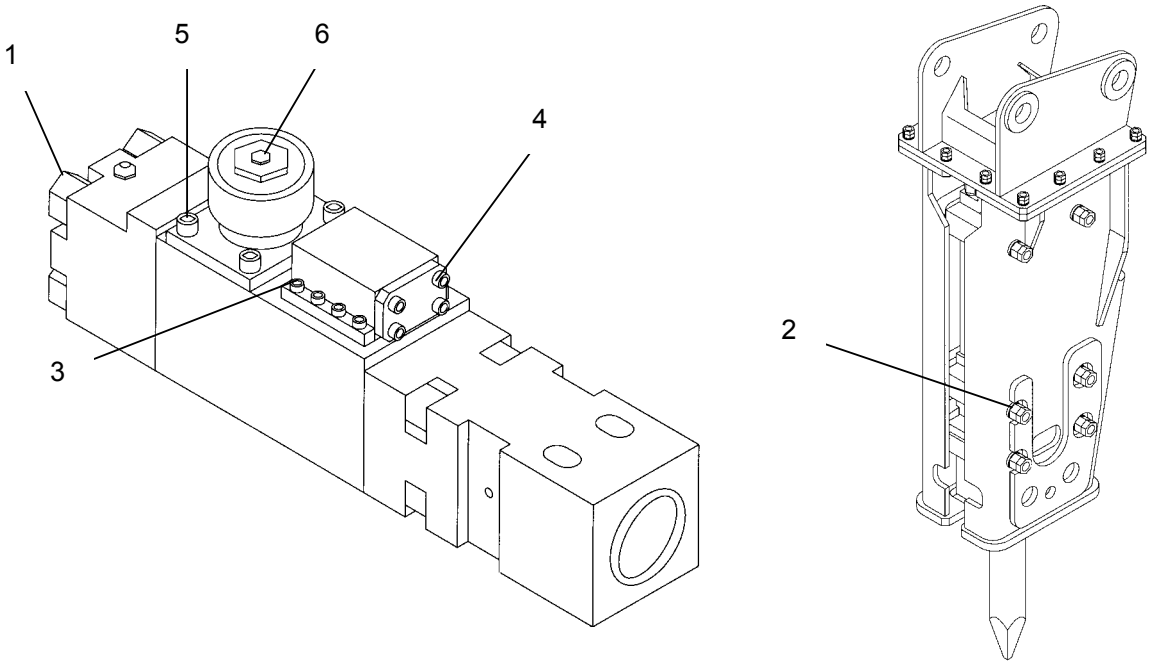
◇ The measurement point of the backpressure is a piping tip of the arm. Connect the pressure line and return line when measuring.

◇ The piping inner diameter shows minimum allowable number, so that the larger size is applicable.

◇ The above specifications are subject to change without notice.

◇ X means no require piping Accumulator.

TOP series tightening torque chart



Model	Unit	1 Side rod back nut	2 Front bolt nut	3 Valve box set bolt	4 Valve cap bolt	5 Adjuster case bolt	6 Acc. set bolt	7 Acc. Gas charging valve	8 Clamp bolt
25	N-m	400	784						
	ft-lb	**295**	**579**						
30	N-m	690	1180						
	ft-lb	**509**	**870**						
35	N-m	690	1180						
	ft-lb	**509**	**870**						
40	N-m	690	1180						
	ft-lb	**509**	**870**						
45B	N-m	690	1180						
	ft-lb	**509**	**870**						
60B	N-m	690	2060	390					
	ft-lb	**509**	**1519**	**287**					
90	N-m	880	2060	390	540				
	ft-lb	**649**	**1519**	**287**	**398**				
100	N-m	1180	1078	390	390				
	ft-lb	**870**	**796**	**287**	**287**				
200	N-m	1764	1764	784	784				255
	ft-lb	**1302**	**1302**	**579**	**579**				**188**
205	N-m	1764	1764	539	539	98	1078	20	255
	ft-lb	**1302**	**1302**	**398**	**398**	**72**	**796**	**14**	**188**
250	N-m	1960	1767	780	780		1080	19.6	250
	ft-lb	**1445**	**1303**	**575**	**575**		**796**	**14**	**184**
300	N-m	3230	2352	1270	1270		880	19.6	250
	ft-lb	**2382**	**1736**	**937**	**937**		**649**	**14**	**184**

012904

N_2 (Nitrogen) gas pressure by temperature

N_2 gas pressure into the back cap

	-20°C	0°C	20°C	40°C	60°C	80°C	100°C
	-4°F	*32°F*	***68°F***	*104°F*	*140°F*	*176°F*	*212°F*
TOP25	0.26	0.28	0.3	0.32	0.34	0.36	0.38
	37	*40*	***43***	*46*	*49*	*52*	*54*
TOP30	0.69	0.75	0.8	0.85	0.9	0.96	1.0
	98	*106*	***114***	*122*	*129*	*137*	*143*
TOP35	0.69	0.75	0.8	0.85	0.9	0.96	1.0
	98	*106*	***114***	*122*	*129*	*137*	*143*
TOP40	0.86	0.93	1.0	1.07	1.14	1.20	1.25
	123	*132*	***142***	*152*	*161*	*171*	*178*
TOP45B	0.86	0.93	1.0	1.07	1.14	1.20	1.25
	123	*132*	***142***	*152*	*161*	*171*	*178*
TOP60B	0.95	1.03	1.1	1.17	1.25	1.32	1.38
	135	*145*	***156***	*167*	*177*	*188*	*196*
TOP90	0.8	0.85	0.9	0.96	1.0	1.06	1.11
	114	*122*	***130***	*137*	*143*	*153*	*160*
TOP100	0.69	0.75	0.8	0.85	0.9	0.96	1.0
	98	*106*	***114***	*122*	*129*	*137*	*143*
TOP200	0.8	0.85	0.9	0.96	1.0	1.06	1.11
	114	*122*	***130***	*137*	*143*	*153*	*160*
TOP205	0.26	0.28	0.3	0.32	0.34	0.36	0.38
	37	*40*	***43***	*46*	*49*	*52*	*54*
TOP250	0.43	0.47	0.5	0.53	0.57	0.60	0.63
	61	*66*	***71***	*76*	*81*	*85*	*89*
TOP300	0.26	0.28	0.3	0.32	0.34	0.36	0.38
	37	*40*	***43***	*46*	*49*	*52*	*54*

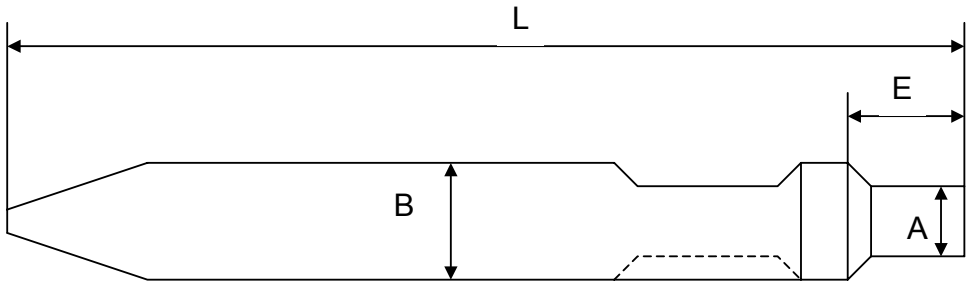
N_2 gas pressure into the accumulator

	-20°C	0°C	20°C	40°C	60°C	80°C	100°C
	-4°F	*32°F*	***68°F***	*104°F*	*140°F*	*176°F*	*212°F*
TOP205	5.1	5.5	5.9	6.3	6.7	7.1	7.4
	740	*798*	***856***	*914*	*972*	*1030*	*1073*
TOP250	5.1	5.5	5.9	6.3	6.7	7.1	7.4
	740	*798*	***856***	*914*	*972*	*1030*	*1073*
TOP300	5.1	5.5	5.9	6.3	6.7	7.1	7.4
	740	*798*	***856***	*914*	*972*	*1030*	*1073*

Unit	MPa
	psi

012904

TOP series Chisel chart



TOP	Part Number	A		B		L		E		W	
		mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
25	301-500	40	1.58	50	1.97	500	19.69	66	2.6	7	15.44
30,35	302A-600	45	1.78	61	2.41	600	23.62	80	3.15	11	24.26
45	303-700	50	1.97	68	2.68	700	27.56	116	4.57	17	37.49
45B	T45B-700	45	1.78	68	2.68	700	27.56	60	2.37	34	74.97
60, 60B	305-900	60	2.37	85	3.35	900	35.44	67	2.64	34	74.97
90	T90-925	75	2.96	98	3.86	925	36.42	100	3.94	46	101.43
100	308-1000	85	3.35	110	4.34	1000	39.37	100	3.94	65	143.33
200	T200-1200	95	3.75	125	4.93	1200	47.25	160	6.3	105	231.53
205, 250	T210-1200	105	4.14	135	5.32	1200	47.25	132	5.2	120	264.6
300	T300-1400	120	4.73	155	6.11	1400	55.12	150	5.91	185	407.93

071304

TOP series Bolt chart

	TOP25	TOP30	TOP35	TOP45	TOP45B
Valve cap bolt	- - -	- - -	- - -	- - -	- - -
Valve box set bolt	- - -	- - -	- - -	- - -	- - -
Clamp bolt	- - -	- - -	- - -	- - -	- - -
Bushing shaft	- - -	- - -	- - -	- - -	- - -
Chisel set pin	21310190	15134310B	15134310B	15144310B	15144310B
Spring pin (Bushing)	D0510409 (10 x 100)	D0510A17 (13 x 130)	D0510A17 (13 x 130)	D0510A17 (13 x 130)	D0510A17 (13 x 130)
Spring pin (Chisel)	- - -	SP13A-60	SP13A-60	SP13A-60	SP13A-60
Side rod	13012510	15032510	15032510	15142530	15142530
Front bolt	21320831 M26 x 221	21320831 M26 x 221	21320831 M26 x 221	21320831 M33 x 238	21320831 M33 x 238
Bracket bolt	- - -	- - -	- - -	- - -	- - -
Acc. Set bolt	- - -	- - -	- - -	- - -	- - -

TOP series Bolt chart

	TOP60	TOP60B	TOP90	TOP100	TOP200
Valve cap bolt	A030C4149 M18 X 50F	A030C4149 M18 X 50F	A030A4559 M20 x 45	A030C4129 M18 X 40F	A030A5349 M24 x 55
Valve box set bolt	- - -	- - -	A030C4149 M18 x 50F	A030C4149 M18 x 50F	A030A5359 M24 x 60
Clamp bolt	- - -	- - -	- - -	- - -	A030A3699 M16 x 35
Bushing shaft	21350071 (13 x 90)	21350071 (13 x 90)	101116100 (16 x 100)	21401071 (20 x 140)	21481195 (20 x 158)
Chisel set pin	21350190	21350190	15094310	15204310	15324310
Spring pin (Bushing)	D0520492 D0520356	D0520492 D0520356	D0520565 D0520395	- - -	- - -
Spring pin (Chisel)	D0520503	D0520503	- - -	- - -	- - -
Side rod	21351030	21351030	15092510	15202510	15322510
Front bolt	BC40168 RD36 x 290	BC40168 RD36 x 290	BC40168 RD36 x 290	BC40327 RD33 x 351	BC40063 RD36 x 440
Bracket bolt	BC40212 RD36 x 402	BC40212 RD36 x 402	BC40212 RD36 x 402	BC40212 RD36 x 402	BC40213 RD36 x 545
Acc. Set bolt	- - -	- - -	- - -	- - -	- - -

TOP series Bolt chart

	TOP210	TOP300			
Valve cap bolt	A030A5359 (M24 x 60)	A030A6079 (M30 x 70)			
Valve box set bolt	A030A5359 (M24 x 60)	A030A6079 (M30 x 70)			
Clamp bolt	A030A3699 (M16 x 35)	A030A3699 (M16 x 35)			
Bushing shaft	101120200 (20 x 200)	101125230 (25 x 230)			
Chisel set pin	15404310	15654310			
Spring pin (Bushing)	- - -	- - -			
Spring pin (Chisel)	- - -	- - -			
Side rod	15402510	25652510			
Front bolt	BC40063 RD36 x 440	BC40066A RD46 x 540			
Bracket bolt	- - -	- - -			
Acc. Set bolt	21381251	21480251			

TOP series Seal chart

	TOP25	TOP30	TOP35	TOP45	TOP45B
Valve box O-ring	- - -	- - -	- - -	- - -	- - -
Valve box cap O-rng	E1022040 G40B	E1022045 P45B	E1022045 P45B	E1022060 G60B	E1022060 G60B
Back cap O-ring	E1022085 G85B	E1022105 P105B	E1022105 P105B	E1022105 G105B	E1022105 G105B
U-packing (Lower)	E3120053 U53	E3120067 U67	E3120065 U65	10230070 U70	10230070 U70 31331017 ST70 E1161337 A337A
U-packing (Upper)	E3110048 U48	E3120065 U65	E3120067 U67	E3120067 U67	E3120067 U67
Seal kit	151210SK	150310SK	150310SK	150410SK	151410SK1

TOP series Seal chart

	TOP60	TOP60B	TOP90	TOP100	TOP200
Valve box O-ring	- - -	- - -	E1012030 P30B E1012049 P49B	E1012030 P30B E1012049 P49B	E1012022A P22AB E1012039 P39B
Valve box cap O-rng	E1022060 G60B	E1022060 G60B	E1022065 G65B	E1022060 G60B	E1022070 G70B
Back cap O-ring	E1022120 G120B	E1022120 G120B	E1012125 P125B	E1012140 P140B	E1022175 G175B
U-packing (Lower)	E3120075 U75	E3120075 U75 31350017 ST75 E1161338 A338B	10230097 U97	10230112 U112	10230136 U136
U-packing (Upper)	31330012 U73	31330012 U73	10230095 U95	10230110 U110 10245110 ST110 E1161350 A350	10230132 U132 10245132 ST132 E1161357 A357
Seal kit	150610SK	150610SK1	150910SK	152010SK	153210SK

TOP series Seal chart

	TOP210	TOP300			
Valve box O-ring	E1012016 (P16B) E1012035 (P35B)	E1012022A (P22AB) E112042 (P42B)			
Valve box cap O-rng	E1022080 (G80B)	E1022105 (G105B)			
Back cap O-ring	E2122165 (G165T2)	E1022190 (P190B)			
U-packing (Lower)	10250140 (U140B) 10230140 (U140)	10250160 (U160B) 10230160 (U160) 10230160E (U160x10)			
U-packing (Upper)	10230130 (U130)	10230150 (U150)			
Seal kit	154010SK	156510SK			

Unit conversion table

Length

m	cm	in	ft	yd
1	100	39.37	3.281	1.094
0.01	1	0.3937	0.03281	0.01094
0.0254	2.540	1	1/12	1/36
0.3048	30.48	12	1	1/3
0.9144	91.44	36	3	1

Area

m^2	in^2	ft^2	yd^2
1	1550	10.76	1.196
$0.6452X10^{-3}$	1	1/144	1/1296
0.09290	144	1	1/9
0.8361	1296	9	1

Cubic volume

m^3	c.c. (cm^3)	in^3	yd^3	L(litter)	gal (UK)	gal (US)
1	10^6	$6.102X10^4$	1.308	1000	220.0	264.2
10^{-6}	1	$6.102X10^{-2}$	$0.1308X10^{-5}$	0.001	$0.220X10^{-3}$	$0.2642X10^{-3}$
$0.1639X10^{-4}$	16.39	1	1/46656	0.01639	$0.3605X10^{-2}$	1/231
0.7646	$7.646X10^5$	46656	1	764.5	168.2	201.99
0.001	1000	61.02	$1.308X10^{-3}$	1	0.2200	0.2642
$0.4546X10^{-2}$	4546	277.4	$5.945X10^{-3}$	4.546	1	1.201
$0.3785X10^{-2}$	3785	231	$4.951X10^{-3}$	3.785	0.8327	1

Weight

kg	oz	lb	ton (metric)	ton (UK)	ton (US)
1	35.27	2.205	0.001	$0.9842X10^{-3}$	$0.1102X10^{-2}$
$0.6480X10^{-4}$	$0.2286X10^{-2}$	1/7000	$0.6480X10^{-7}$	$0.6378X10^{-7}$	$0.7143X10^{-7}$
0.02835	1	1/16	$0.2835X10^{-4}$	$0.2790X10^{-4}$	1/32000
0.4536	16	1	$0.4536X10^{-3}$	1/2240	1/2000
1000	35274	2205	1	0.9842	1.102
1016	35840	2240	1.016	1	1.12
907.2	32000	2000	0.9072	0.8929	1

Pressure

Pa (N/m^2)	bar	kgf/cm^2	psi	atm	Torr (mmHg)
1	10^{-5}	$0.1020X10^{-4}$	$0.1450X10^{-3}$	$0.9869X10^{-5}$	$0.7501X10^{-2}$
10^{-3}	10^{-8}	$0.1020X10^{-7}$	$0.1450X10^{-6}$	$0.9869X10^{-8}$	$0.7501X10^{-5}$
10^{5}	1	1.020	14.50	0.9869	750.1
$9.807X10^{4}$	0.9807	1	14.22	0.9678	735.6
$6.895X10^{3}$	0.06895	0.07031	1	0.06805	51.71
101325	1.01325	1.033	14.696	1	760
133.3	$0.1333X10^{-2}$	$0.1360X10^{-2}$	0.01934	1/760	1

Temperature

K	°C	°F
t	t-273.15	$(t-273.15)\ ^{9}/_{5}+32$
t+273.15	t	$t\ ^{9}/_{5}+32$
$(t-32)\ ^{5}/_{9}+273.15$	$(t-32)\ ^{5}/_{9}$	t
$t\ ^{5}/_{9}$	$t\ ^{5}/_{9}-273.15$	t-459.67

Power

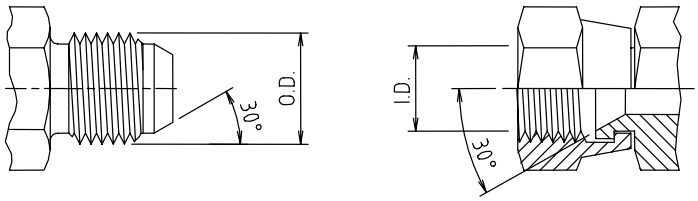
PS	HP	KW	kgf-m/sec	Kcal/h
1	0.986	0.736	75.0	633
1.01	1	0.746	76.1	642
1.36	1.34	1	102	860

Torque

J (Nm)	kgf-m	ft-lb
1	1.0197X10-1	7.3746X10-1
9.80665	1	7.2346
1.35552	1.3822X10-1	1

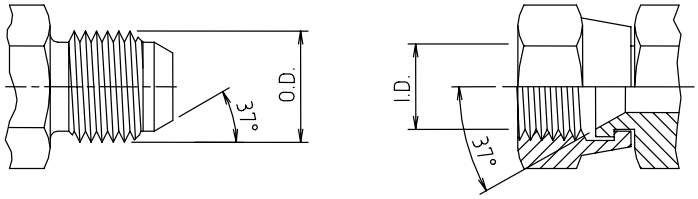
Thread standard

○ **JIS B 8363 Parallel Pipe Threads (PF)**



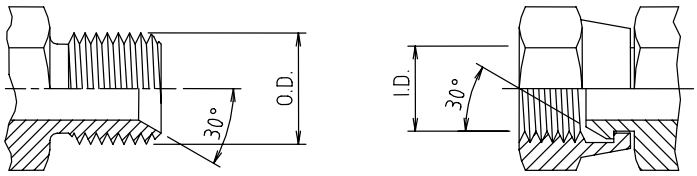
OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
NPF03	1/8	1/8-28	9.7	0.38	8.6	0.34
NPF06	1/4	1/4-19	13.2	0.52	11.4	0.45
NPF09	3/8	3/8-19	16.7	0.66	15.0	0.59
NPF13	1/2	1/2-14	21.0	0.83	18.6	0.73
NPF19	3/4	3/4-14	26.4	1.04	24.1	0.95
NPF25	1	1-11	33.2	1.31	30.3	1.19
NPF32	$1^1/_4$	$1^1/_4$-11	41.9	1.65	39.0	1.54
NPF38	$1^1/_2$	$1^1/_2$-11	47.8	1.88	44.8	1.76
NPF50	2	2	59.6	2.35	56.7	2.23

○ **SAE J514, 37° Flare**



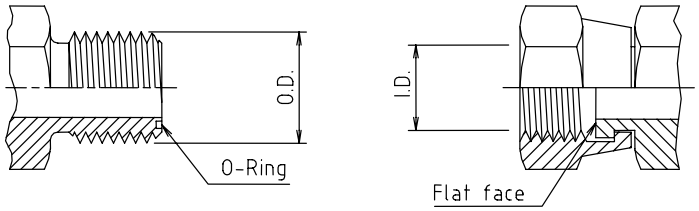
OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
UNF03	1/8	5/16-24	7.9	0.31	6.9	0.27
UNF06	1/4	7/16-20	11.2	0.44	9.9	0.39
UNF09	3/8	9/16-18	14.2	0.56	12.9	0.51
UNF13	1/2	3/4-16	19.0	0.75	17.0	0.67
UNF15	5/8	7/8-14	22.3	0.88	20.3	0.80
UNF19	3/4	$1^1/_6$-12	26.9	1.06	24.9	0.98
UNF25	1	$1^5/_{16}$-12	33.3	1.31	31.0	1.22
UNF32	$1^1/_4$	$1^5/_8$-12	41.4	1.63	39.1	1.54
UNF38	$1^1/_2$	$1^7/_8$-12	47.7	1.88	45.5	1.79
UNF50	2	$2^1/_2$-12	63.5	2.50	61.2	2.41

○ **JIS B 8363 Parallel Pipe Threads (PF)**
○ **British Standard Pipe - BSPP**



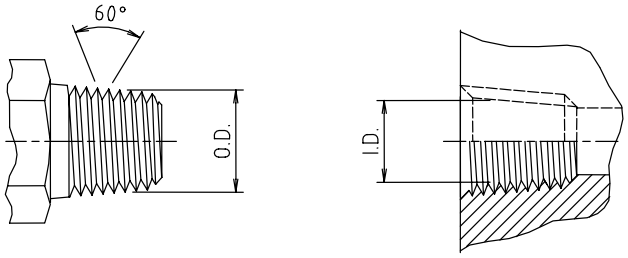
OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
NSF03	1/8	1/8-28	9.7	0.38	8.6	0.34
NSF06	1/4	1/4-19	13.2	0.52	11.4	0.45
NSF09	3/8	3/8-19	16.7	0.66	15.0	0.59
NSF13	1/2	1/2-14	21.0	0.83	18.6	0.73
NSF19	3/4	3/4-14	26.4	1.04	24.1	0.95
NSF25	1	1-11	33.2	1.31	30.3	1.19
NSF32	$1^1/_4$	$1^1/_4$-11	41.9	1.65	39.0	1.54
NSF38	$1^1/_2$	$1^1/_2$-11	47.8	1.88	44.8	1.76
NSF50	2	2	59.6	2.35	56.7	2.23

○ **SAE J1453 O-Ring Face Seal**



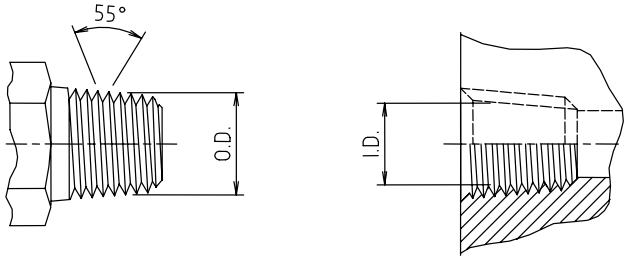
OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
ORS06	1/4	9/16-18	14.2	0.56	12.9	0.51
ORS09	3/8	11/16-16	17.3	0.68	16.0	0.63
ORS13	1/2	13/16-16	20.6	0.81	19.0	0.75
ORS15	5/8	1-14	25.4	1.00	23.6	0.93
ORS19	3/4	$1^3/_{16}$-12	30.0	1.18	27.8	1.10
ORS25	1	$1^7/_{16}$-12	36.6	1.44	34.5	1.36
ORS32	$1^1/_4$	$1^{11}/_{16}$-12	42.7	1.68	40.6	1.60
ORS38	$1^1/_2$	2-12	50.8	2.00	48.8	1.92

○ **JIS B 8363 Tapered Pipe Threads (PT)**
○ **British Standard pipe - BSPT**



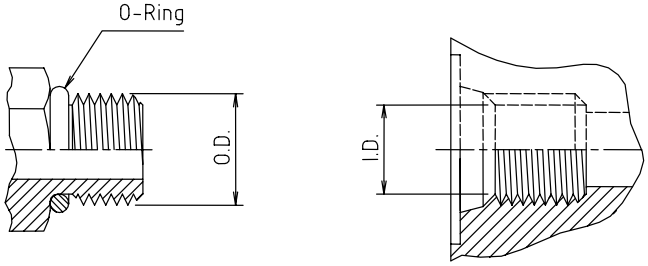
OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
PT03	1/8	1/8-28	9.7	0.38	8.6	0.34
PT06	1/4	1/4-19	13.2	0.52	11.4	0.45
PT09	3/8	3/8-19	16.7	0.66	15.0	0.59
PT13	1/2	1/2-14	21.0	0.83	18.6	0.73
PT19	3/4	3/4-14	26.4	1.04	24.1	0.95
PT25	1	1-11	33.2	1.31	30.3	1.19
PT32	$1^1/_4$	$1^1/_4$-11	41.9	1.65	39.0	1.54
PT38	$1^1/_2$	$1^1/_2$-11	47.8	1.88	44.8	1.76
PT50	2	2	59.6	2.35	56.7	2.23

○ **American Dryseal Pipe Threads (NPT)**



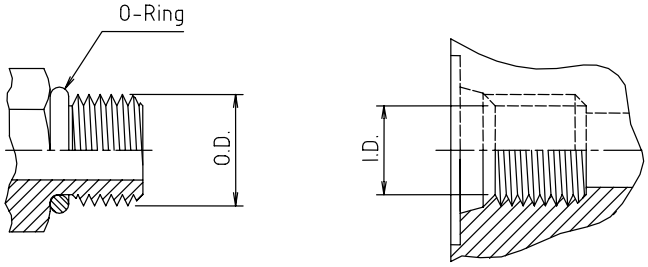
OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
NPT03	1/8	1/8-27	10.3	0.41	9.4	0.37
NPT06	1/4	1/4-18	13.7	0.54	12.4	0.49
NPT09	3/8	3/8-18	17.3	0.68	15.7	0.62
NPT13	1/2	1/2-14	21.3	0.84	19.3	0.76
NPT19	3/4	3/4-14	26.9	1.06	24.9	0.98
NPT25	1	1-$11^1/_2$	33.3	1.31	31.5	1.24
NPT32	$1^1/_4$	$1^1/_4$-$11^1/_2$	42.2	1.66	40.1	1.58
NPT38	$1^1/_2$	$1^1/_2$-$11^1/_2$	48.3	1.90	46.2	1.82
NPT50	2	2-$11^1/_2$	60.4	2.38	57.9	2.28

○ **JIS B 2351 Parallel Pipe Threads (G)**



OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
PFO03	1/8	1/8-28	9.7	0.38	8.6	0.34
PFO06	1/4	1/4-19	13.2	0.52	11.4	0.45
PFO09	3/8	3/8-19	16.7	0.66	15.0	0.59
PFO13	1/2	1/2-14	21.0	0.83	18.6	0.73
PFO19	3/4	3/4-14	26.4	1.04	24.1	0.95
PFO25	1	1-11	33.2	1.31	30.3	1.19
PFO32	$1^1/_4$	$1^1/_4$-11	41.9	1.65	39.0	1.54
PFO38	$1^1/_2$	$1^1/_2$-11	47.8	1.88	44.8	1.76
PFO50	2	2	59.6	2.35	56.7	2.23

○ **SAE J514, Straight Thread O-Ring Boss**



OKADA size	Inch size	Thread	Male thread O.D.		Female thread I.D.	
			mm	inch	mm	inch
UNFO03	1/8	5/16-24	7.9	0.31	6.9	0.27
UNFO06	1/4	7/16-20	11.2	0.44	9.9	0.39
UNFO09	3/8	9/16-18	14.2	0.56	12.9	0.51
UNFO13	1/2	3/4-16	19.0	0.75	17.0	0.67
UNFO15	5/8	7/8-14	22.3	0.88	20.3	0.80
UNFO19	3/4	$1^1/_6$-12	26.9	1.06	24.9	0.98
UNFO25	1	$1^5/_{16}$-12	33.3	1.31	31.0	1.22
UNFO32	$1^1/_4$	$1^5/_8$-12	41.4	1.63	39.1	1.54
UNFO38	$1^1/_2$	$1^7/_8$-12	47.7	1.88	45.5	1.79
UNFO50	2	$2^1/_2$-12	63.5	2.50	61.2	2.41