NLB Corp.

The Leader in High–Pressure Water Jet Technology

NCG8450A–3, NCG8450A–3L, and NCG8450A–3T Rotating Lances

Owner's Operation and Service Manual

VERSION 7 (November 2014)

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SECTION 1 – GENERAL INFORMATION

1.1 – Introduction

Thank you for purchasing an NLB high−pressure water jet accessory. This accessory, designed and manufactured by NLB Corp., a worldwide leader in water jet technology, brings to our customers performance and outstanding reliability when used and maintained in accordance with this manual.

Along with your paper manual, an electronic CD version is included on the inside back cover of this manual. This electronic version has the same information as the paper manual, but with enhancements such as color pictures and hotlinks to assist the user on navigation through the information.

NLB assumes no responsibility or liability for an accessory that has been modified or altered without NLB authorization. It is required that this NLB accessory be serviced, maintained, and operated in a manner consistent with this manual. In the circumstance that these guidelines are not followed, all warranties, either expressed or implied, are void. In the event that an information conflict is found to exist between this manual and your accessory, NLB must be contacted for clarification prior to operating or servicing it.

Only trained personnel in the operation and/or maintenance of NLB high−pressure water jet pumps and equipment should operate the accessory described in this manual. Prior to use, the accessory should be inspected and maintained in accordance with this manual. Equipment must be used in accordance to all applicable federal, state/local laws, orders and regulations that regulate operation and use of the equipment. Attention to safety must be adhered to while operating all water jet equipment. Refer to **Section 2** for safety information.

1.2 – Purposes and Objectives

The purpose and objective of this manual is to properly inform the operator on safety, operation, recommended maintenance intervals, service repair, parts ordering, and the NLB warranty process for this accessory.

This manual is mandatory reading for any person who will be operating, maintaining, or repairing this NLB high−pressure water jet accessory.

1.3 – Model Number and Serial Number Identification

Affixed on your NLB high−pressure water jet accessory is a Model/Serial Number stamping that carries the following information:

- Model Number
- Serial Number
- Job Number
- Maximum System Working Pressure

This information will be needed when contacting NLB regarding service, maintenance, or ordering parts for the high−pressure water jet accessory.

SECTION 2 – SAFETY AND RECOMMENDED PRACTICES

2.1 – Legend/Key to Safety Message Icons

The following safety alert signal words are used throughout this manual in accordance with the ANSI Z535–2006 standard:

"Danger" messages are reserved for the most extreme situations. Danger messages indicate a hazardous situation which, if not avoided, will result in death or serious bodily injury. Message text will be presented in **bold red**.

"Warning" messages indicate a hazardous situation which, if not avoided, could result in death or serious injury. Text will be presented in **bold orange**.

"Caution" messages indicate a hazardous situation which, if not avoided, could result in minor or moderate personal injury. Caution messages **appear in bold text**.

"Notice" messages are used to address practices not related to personal injury. If there is also a risk of injury as a result of not following the recommended practice, then a Caution, Warning, or Danger message is used instead of a Notice. Notice messages **appear in bold text**.

2.2 – Definitions of Terms, Equipment, and Standards

2.2.1 – Terms

High–Pressure Water Jet System: High–pressure water jet systems are water delivery systems which have nozzles or other openings whose function is to increase the speed of liquids. Solid particles or additional chemicals may also be introduced, but the exit in all cases will be a free stream. In terms of these recommended practices, the "system" shall include the pumps (pressure producing devices) and the hoses, lances, nozzles, valves and safety devices as well as any heating elements or injection systems attached thereto.

High–Pressure Water Cleaning: The use of high–pressure water, with or without the addition of other liquids or solid particles, to remove unwanted matter from various surfaces where the pressure of the liquid jet at the orifice exceeds 1,000 psi (*69 bar*).

⚠ WARNING

The lower limit of 1000 psi (*69 bar*) does not mean that pressures below 1000 psi (*69 bar*) cannot cause injury or require any less attention to principles of these recommended practices. Adequate precautions, similar to those of these recommended practices, are required at all pressures.

High–Pressure Water Cutting: The use of high–pressure water, with or without the addition of other liquids or solid particles, to penetrate into the surface of a material for the purpose of cutting that material, and where the pressure of the liquid jet exceeds 1000 psi (*69 bar*).

Operator: A person who has been trained and has demonstrated the knowledge and experience to perform the assigned task.

Operator Trainee: A person not qualified due to the lack of knowledge and/or experience to perform the assigned task without supervision.

Hose Assembly: A hose with coupling attached in accordance with manufacturer's specifications.

Nozzle: A device with one (1) or more openings where the fluid discharges from the system. The nozzle restricts the area of flow of the liquid, accelerating the water to the required velocity and shaping it to the required flow pattern and distributed for a particular application. Combinations of forward and backward nozzles are often used to balance the thrust. Such nozzles are commonly referred to as tips, jets, orifices, etc.

Dump System: An operator–controlled, manually–operated device or system that rapidly reduces the pressure to a level that yields a pressure flow at the nozzle that is considerably below the risk threshold.

Shotgunning: An application whereby a lance and nozzle combination can be manipulated in virtually all planes of operation.

Lance: A rigid metal tube used to extend the nozzle from the end of the hose.

Lancing: An application whereby a lance and nozzle combination is inserted into and retracted from the interior of a pipe or tubular object.

Moleing: Moleing is an application whereby a hose, fitted either with a nozzle or with a nozzle attached to a lance, is inserted into and retracted from the interior of a tubular product. It is a system commonly intended for cleaning the internal surfaces of pipes or drains. It can be self–propelled by its backward directed jets and is manufactured in various shapes, sizes, and combinations of forward and backward directed jets.

2.2.2 – Equipment and Standards

Pressurizing High–Pressure Pump: A unit designed to deliver high–pressure water or other fluid. This is usually based on positive displacement pistons or rubber diaphragm/hydraulic systems and discharges water into a common manifold to which either flexible hoses, or rigid tubing connecting to lances and nozzles are attached. These high pressure pumps can be either mobile or permanently mounted.

The pump should have a permanently mounted tag or tags providing the following information:

- Product and supplier.
- Product model and serial number or year of production.
- Maximum performance in terms of flow – measured in gpm (*lpm*), and pressure measured in psi (*bar*).
- An outline of recommended safety procedures.

Relief System: The system shall be equipped with an automatic relief device on the discharge side of the high–pressure pump.

2.2 – Definitions of Terms, Equipment, and Standards

Automatic Pressure Relief Devices: These may take the form of:

- **Pressure Relief Valve (By–Pass Valve) or Bursting Disc (Rupture Disc) in Holder:** Usually mounted on the pump discharge chamber to prevent the pressure exceeding the rated maximum pressure of the whole system.
- **Automatic Pressure Regulating Valve (Unloading Valve):** Limits the pressure at which the high–pressure pump operates by releasing a preset proportion of the generated flow back to the pump suction chamber or to waste. It may be used to regulate the water pressure from the pump and is individually set for each operation. This device may be integral with the pump hydraulic assembly. Where there is no demand for pumpage, the water pressure is brought down to zero.
- **By–Pass Valve:** A device which can be adjusted to control the flow and thus the pressure of the jet stream issuing from the nozzle by by–passing the excess flow to another circuit.
- **Pressure Gauge:** The system should be equipped with a gauge indicating the pressure being developed. Gauges shall have a a scale range of at least 50% above the maximum working pressure of the system.
- **Filter or Strainer:** The water system should be equipped with a filter or strainer to prevent particles from restricting orifices in the nozzle. The filter or strainer should be capable of removing particles smaller in size than the smallest orifice in The nozzle and usually smaller to protect the high–pressure pumps, etc.
- **Dry Shut–Off Control Valve:** This operator–controlled valve, normally hand–controlled, automatically shuts off flow to the lance and/or nozzle assembly when released by the operator, but retains the operating pressure within the supply line when so shut–off. This valve shall be used in systems with an automatic pressure regulating valve. This valve may alternatively be actuated by solenoid or pilot pressure system.

⚠ WARNING

Care should be taken to release the pressure in the dry shut–off valve and line when the pump is shut down, otherwise the valve operating lever may remain alive.

- **Dump System:** The system should be equipped with a device which will either shut down the unit, idle it to a safe rpm, by–pass the flow, or reduce the discharge pressure to a low level. The dump system actuator device should be shielded to preclude inadvertent operation. This device should immediately shut off the high–pressure water stream if the operator loses control.

- **Dump Control Valve:** This operator–controlled valve, normally hand–controlled, automatically terminates significant flow to the lance and/or nozzle assembly when released by the operator, thus relieving the operating pressure within the whole system by diverting the flow produced by the pump to atmosphere. A valve size should be selected that will not cause generation of or significant back pressure at the maximum possible pumping rate of the pump. This valve may alternatively be actuated by a solenoid or pilot pressure mechanism.
- **Solenoid and Electronically Operated Control Dump Systems:** All electrically controlled dump systems should be of a fail safe design. Voltage of an alternating current (AC) or direct current (DC) dump system handled by personnel should not exceed 24 volts.

High–Pressure Hose: This is a flexible hose which connects two (2) components and which delivers the high–pressure fluid to the gun or nozzle components. The hose should have a burst rating of of a minimum of two and one–half (2.5) times the intended working pressure. Operating levels below this ratio should require a protective shielding around that hose. The hose should be marked on one (1) end with the manufacturer's symbol, the serial number, and the maximum permissible operating pressure and test pressure. The high–pressure hose should be tested at one and a half (1.5) times the working pressure.

Hose Safety Shroud: A protective covering over a high pressure hose, which is designed to protect the worker from a high pressure water burst should a hose failure occur, or prevent leakage from a threaded connection or weep hole impacting a worker. The shroud should be constructed to prevent the burst from exiting the shroud. The shroud should be designed in a manner as to cover nearby threaded connections and weep holes and be removable to facilitate high pressure hose inspections. Typical shroud length, at minimum, should be six (6) feet. Longer shrouds are acceptable and, in certain situations, should be considered. Hose shrouds should be tagged with both an identification number, unique to each shroud, and a manufacturing date. Due to the sensitive protective position of the shroud, they should be visually inspected before each use.

End Fittings and Couplings: High–pressure hose, end fittings and couplings shall be manufactured to be compatible with the hose and tested as a unit.

Jetting Gun Extension: This is a length or lengths of tube carrying high–pressure fluid to the nozzle. Each shall be manufactured from suitable material for the application. End connections shall be suitable for the application. The extension is used in conjunction with a control valve. The extension shall have a minimum burst strength of at least two and one–half (2.5) times the highest actual operating pressure being used.

2.2 – Definitions of Terms, Equipment, and Standards

Nozzle: The nozzle creates the water–jet, or jets, at the required velocity, flow rate, pressure, shape, and distribution for a particular application. Combinations of forward and backward directed water jets are often used to balance the thrust. Such nozzles may be referred to as tips, jets, or orifices.

Water Jet: A jet stream of water produced from an individual outlet orifice of a nozzle. The shape of the jet is determined by the form of the orifice while the speed at which it travels is determined by the orifice design, orifice area and flow. The pressure drop at the orifice is a result of an increase in velocity. The most commonly used jet shapes are the straight–jet and fan–shaped jet.

- **Straight–Jet:** Concentrates the stream of water over a small area of the work piece by minimizing the spread. A typical application is for cutting or for general cleaning of matter with higher shear and/or bond strength.
- **Fan Jet:** Spreads the stream of water on one (1) plane, so giving a wide band coverage of the work piece. A typical application is for cleaning larger areas requiring less energy to remove unwanted matter.

Jetting Hand Manifold and Spray Bars: These are pieces of equipment into which individual nozzles are fitted.

Foot Control Valve: The lance/gun operator's control valve may be arranged for actuation by the operator's foot if desired, either in place of, or in addition to the hand–control. An adequate guard should be fitted to prevent accidental operation and the base plate area should be sufficient to ensure stability in use. If on the dump type, the layout should ensure that the dump line, if used, is restrained from whipping when the valve is released.

Jetting Gun: A portable combination of operator's control valve and nozzle which resembles a gun in layout and outline. The control valve is hand–operated, generally by a squeeze action of the hand of the operator, who should always have control of this device and may be of the dry shut–off, or dump type, the gun being named accordingly. The hand–control normally takes the form of a trigger or lever which should be provided with either a guard adequate to prevent accidental operation, or the means of being immobilized in the "OFF" position by means of a safety catch. The gun may be fitted with a shoulder pad or hand grips to facilitate back thrust control.

Retro Gun: A retro safety gun is fitted with forward and backward facing jets. This reduces the thrust experienced by the operator. This type of gun is used mainly for underwater high–pressure water jetting operations. The retro balance jet protection tube should be sufficiently long or constructed so as to prevent the operator from directing a retro balance jet at themselves.

Changeover Valve: An operator–controlled valve designed to properly direct high–pressure water flow from the pump to one (1) or another items of equipment at the operator's choice. It shall be designed to withstand the maximum pressure and can be power operated.

2.3 – Safety Precautions That Must Be Observed By User

Refer to this SAFETY section before operating any high–pressure water jetting components. **DO NOT** operate this or any high–pressure water jetting component or system without first reading and understanding the SAFETY section. If the safety section is missing from this manual, call NLB at (800) 227–7652 for a free copy.

2.3.1 – Safety Signs

All NLB high–pressure water jetting equipment have safety signs strategically placed on the equipment. If any become marred, painted over, or in any manner unreadable, contact NLB for free replacements. These signs are furnished as an aid to training employees and as a reminder to operators and their fellow employees. The safety signs are not intended to be used as a substitute for a specific company training program covering the operation and safety of the equipment. It is the supervisor's responsibility to call these signs to the attention of all personnel.

2.3.2 – Operator Safety Equipment (Personal Protective Equipment)

NLB offers complete operator safety suits for high–pressure waterblasting operations and recommends the use of all operator and jobsite safety equipment that is available. NLB also offers operation, maintenance and parts manuals, and jobsite barrier marking tape.

⚠ WARNING

Noise levels on this pump unit exceed 104 dbA. At this level, more than 15 minutes of exposure can cause permanent damage to hearing. The use of hearing protection is strongly advised when operating this equipment and for others nearby the worksite who may not be operating the equipment.

2.3 – Safety Precautions That Must Be Observed By User

Personal Protective Equipment available from NLB is listed in the following illustration:

Item	Part Number	Description
1	**TWA**	TurtleSkin® WaterArmor™
2	**TWA-vest**	Vest
3	**TWA-chaps**	Chaps
4	**TWAG**	Gaiters
5	**MB-951-size (07 through 13)**	Boots, with steel metatarsal guard, sizes 7-13 available
6	**HC-69**	Hard Hat
7	**7**	Face Shield Holder
8	**10**	Face Shield
9	**1100**	Goggles

Item	Part Number	Description
10	**6780**	Rubber Gloves
11	**MX-01**	Wet Suit, Small
	MX-02	Wet Suit, Medium
	MX-03	Wet Suit, Large
	MX-04	Wet Suit, X-Large
	MX-05	Wet Suit, XX-Large

Jackets and pants are also available separately. To order a jacket, simply add "01" to the part number of the suit size you need. To order pants, add "02".

EXAMPLES: Large suit: MX-03
Large jacket: MX-03-01
Large pants: MX-03-02

2.4 – Safety Aspects of High–Pressure Water Cleaning Systems

For maximum operational safety, the following equipment and manual procedures must be used where applicable:

2.4.1 – Equipment

High–Pressure Pump: The principle component of the high–pressure water jetting cleaning system is usually a positive displacement high–pressure pump which discharges water into a common manifold to which flexible hoses or lances with nozzles or other cleaning or cutting accessories are attached. The pumps are appropriately powered and can be either mobile or permanently mounted. They shall never be operated above NLB's recommended operating pressure.

Relief System: The system shall be equipped with an automatic relief device on the discharge side of the pump, adjusted so that the maximum allowable working pressure of the system is not exceeded by more than 3%.

Pressure Gauge: The system shall be equipped with a gauge to indicate the pressure being developed.

Filter or Strainer: The water system shall be equipped with a filter or strainer to prevent particles from entering the high–pressure pump and damaging the plungers.

Dump System: The system shall be equipped with a device which will by–pass the flow or dump the discharge pressure to a safe level immediately when actuated. An operator shall control this dump system.

Hose Assembly: Hose assemblies used on the discharge side of the pump shall have a safety factor of 3.0 based on the manufacturer's rated minimum burst pressure.

Hose Safety Shroud: A hose safety shroud must be used whenever it is likely that the high pressure hose will come into close contact with the worker. Typical applications are shotgun whips and rigid lancing. Typically the two areas of contact are next to the body and near the pump. The hydroblast pump, depending on design, is another area to be considered for high pressure hose shrouding. Often workers come in close contact with high pressure hoses during normal pump operations.

Fittings/Valves: All fittings and valves used in the discharge side of the pump shall have a safety factor of 3.0 based on the tensile strength of the materials.

Electrical Controls: All electrical controls handled by personnel shall either be fail–safe, low voltage or protected with an approved ground fault circuit interrupter.

2.4.2 – Personal Protective Equipment

It is essential that each operator wear the appropriate protective equipment to accomplish the job safely. The following is a list of NLB recommended safety equipment:

Body Protection: Liquid resistant suits.

Head Protection: Head protection equipment – hard hats.

Eye and Face Protection: Protective eye and face equipment – face shields.

Foot Protection: Steel–toed boots.

Hand Protection: NLB safety gloves.

Ear Protection: Ear plugs or other suitable protection shall be worn. Noise levels for this equipment exceed 104 dbA, which is higher than the US Occupational Safety and Health standards note as safe.

⚠ WARNING

Noise levels on this pump unit exceed 104 dbA. At this level, more than 15 minutes of exposure can cause permanent damage to hearing. The use of hearing protection is strongly advised when operating this equipment and for others nearby the worksite who may not be operating the equipment.

Recommendation: The safety engineer or someone thoroughly familiar with the potential hazards to be found at the location where the work is being performed should be consulted prior to starting work to determine potential environmental and/or personal problems peculiar to that specific task. If any are determined to exist, appropriate action must be taken prior to starting the job.

NOTICE

Refer to Section 2.3.2 for a list of PPE items that are available from NLB.

2.4.3 – Pre–Operational Procedures

Planning: Pre–job planning shall take place prior to start of any job. Personnel familiar with the equipment to be cleaned and the environment of the work area shall meet with the personnel who will be doing the cleaning or cutting and outline the potential hazards of the work area, environmental problems and safety standards.

Check List: A safety and equipment checklist shall be used.

Barricades: Barricades shall be erected to enclose hazardous areas. Barricades may be rope, safety tapes, barrels, etc. as long as an effective visible barrier is provided.

Hook–Up: Inspect all hoses and fittings for evidence of excessive wear and damage prior to installing. Hoses should be laid out in a safe and orderly manner. Hoses, pipes, and fittings shall be supported to prevent excessive sway, vibration, or stress on end connections. Hoses should be protected to prevent kinking or excessive wear.

Hose Safety Shroud: Visually inspect the shroud before each use to check for damage, wear, or fraying. Replace the shroud if damaged or worn.

Nozzles: Before installing the nozzle, the system shall be completely flushed with sufficient water to remove air and foreign particles. Inspect all nozzles for damage and/or plugged orifices before installing. The high–pressure water jetting unit should be shut–off and disconnected before installing nozzles.

2.4.4 – Operation Procedures

Work Area: All personnel working or entering the barricaded area while cleaning or cutting is in progress shall wear the required protective equipment in accordance with the job conditions.

Pressuring System: Pressure shall be increased slowly on the system while being inspected for leaks and/or faulty components. All leaks or faulty components shall be repaired or replaced. System shall be de–pressurized to effect repairs.

⚠ WARNING

Never leave the system unattended when pressurized.

2.4.5 – Training

Cutting Action: Demonstrate the cutting action and potential hazard involved through the use of audio–visual aids or actual use of the equipment. Cut through a piece of lumber, dissect a grapefruit, etc.

Personal Protective Equipment: Explain the minimal personal protective equipment required. Instruct *when* and *how* specific limb guards, special clothing and other types of devices should be worn per type of work performed, locations, etc.

System Operation: Explain the operation of the system, pointing out potential problems and proper corrective action.

Safety Devices: Explain the reason for and operation of safety devices. Stress the importance of not tampering with any safety devices.

Hose: Explain the proper method of connecting hoses, including laying out without kinks, protection from excessive wear and proper tools to use on couplings and fittings.

Hose Safety Shroud: Explain the procedure for removing an reattaching the safety shroud when repairs are to be done to the lance.

General: The system shall be de–pressurized any time the system is not in use. The system shall be de–pressurized any time an unauthorized person enters the barricaded area. The system shall be de–pressurized when any replacement or repairs are made to the system.

2.5 – Operational and Training Requirements

Qualified Operators: Only trained personnel shall operate high–pressure water jetting equipment and supervise the training of new operators.

Training: A personnel training program shall be developed by each employer and be presented to each employee before assignment to employees first high–pressure cleaning or cutting job. Such training shall include, as a minimum, coverage of all items listed in in these recommended practices.

Cutting Action: The cutting action of a high–pressure water jet and the potential hazard it poses to the human body shall be demonstrated through the use of audio/visual aids or actual use of equipment (i.e., by cutting through a piece of lumber, concrete block, etc.).

Personal Protective Equipment: The minimum personal protective equipment shall be explained. Instructions shall be given as to when and how specific clothing and other types of protective devices shall be worn according to the type of work performed, locations, etc.

System Operation: The operation of a system shall be explained with potential problems pointed out and proper corrective action.

Control Devices: The operation of all control devices shall be explained. The importance of not tampering with any control devices as well as the importance of keeping them in proper working order shall be stressed.

Equipment Maintenance: It should be pointed out that valves and seating surfaces in pressure regulating devices encounter high wear during high–pressure water jetting. These items require frequent inspections, maintenance and/or replacements in order to provide operation.

Hose: The proper method of connecting hoses, including laying out without kinks, protection from excessive wear, and proper tools to use on couplings and fittings shall be explained.

Hose Safety Shroud: The procedure for removing an reattaching the safety shroud when repairs are to be done to the lance.

Stance: The proper stance for sound footing and how to use the various devices for lancing, shotgunning, and moleing shall be demonstrated. The trainee, under close supervision, shall use the various devices while the unit is slowly pressurized.

Proficiency: Personnel shall demonstrate knowledge and skill in the proper operation of equipment through practical application.

(continued)

2.5 – Operational and Training Requirements

(continued)

General:

The system shall be de–pressurized when:

- Not in use
- An unauthorized or inadequately protected person enters the barricaded area.
- Replacement or repairs are made to the system
- Any recommended practices are violated.

Refresher Training: Operator training shall be on an annual basis or more frequently, if needed.

2.6 – Recommended Practices

2.6.1 – Introduction

These recommended practices cover the personnel requirements, operator training, operating procedures, and recommended equipment for the proper operation of all types of high–pressure water jetting equipment as normally used by industries concerned with construction, maintenance, repair, cleaning, and demolition work. Attention is drawn to the relevant or proposed OSHA, ASTM, and ANSI standards. It is intended that extension to this code will be produced in due course to cover specialist applications (e.g. multiple–gun operation, pulsed jets, cutting with the use of abrasives and high–pressure intensifiers) but in the meantime, these practices should be used as far as practicable.

The use of high–pressure water jets for cutting and cleaning is a rapidly evolving technology with current developments occurring. For this reason, these practices are dated and the association shall bi–annually review these practices for any required changes.

2.6.2 – Scope

- The recommended practices are intended to provide guidance on the proper operation of high–pressure water jet cleaning and cutting equipment.
- In this document, the word “shall” indicates a requirement that is to be adopted in order to comply with these recommended practices.
- The term “high–pressure water jetting” covers all water jetting, including the use of additives or abrasives at pressures above 1000 psi (70 bar) approximately.
- These recommended practices are also applicable at lower pressures where there is foreseeable risk of injury. As a guideline, the recommended practices are applicable where the product of pressure – measure in psi (*bar*), times flow – measure in gallons per minute (*liters per minute*) exceeds 2,000 psi times gpm (560 *bar* times *lpm*).
- Any person required to operate or maintain high–pressure water jetting equipment shall have been trained and have demonstrated the ability and knowledge to do so.

2.6 – Recommended Practices

2.6.3 – Care and Maintenance of Equipment

⚠ CAUTION

NLB warranty will be voided if non–NLB manufactured replacement parts are used. NLB's warranty is void as to any damages caused to the equipment and to exclude and liability as a result of injury, if such damage or injury can be linked to the substandard replacement part.

Compatibility: All component parts and fittings should be checked to ensure they are of the correct size and rating for the unit.

Tools: When maintaining or assembling high–pressure water jetting systems, the correct size tools must be used. The use of adjustable tools with serrated gripping jaws, (e.g., piping wrenches) which can damage equipment, is not recommended, particularly on the crimped portion of a hose fitting.

Maintenance Servicing and Repair: The following operations should only be carried out by competent personnel:

- NLB's servicing requirements.

The following items should be overhauled and checked for correct functioning at manufacturer's recommended intervals:

- Pressure relief valve (by–pass valve)
- Bursting discs (rupture discs)
- Pressure control valve
- Hand or foot operated dump control valve, shut off control valve
- Dry shut off valve or dump system
- Changeover valve

High–Pressure Water Jetting Unit: The unit shall be maintained in accordance with NLB's instructions. Where applicable, this should include daily checks on the following items:

- **Drive:** Lubricating oil, water, hydraulic fluid and fluid levels.
- **High–Pressure Pump:** Lubrication oil and gearbox oil levels.
- **Hydraulic Hose Reel:** Lubricating oil and fluid levels.
- **Condition of Guards and Shields:** Wear and/or damage.

(continued)

Filters and Strainers: All water filters should be checked at regular intervals, dependant upon the supply water conditions and in accordance with NLB's recommendations. Extreme care should be taken to filter the water source through proper micron filtration, to prevent foreign particles from cutting changeover valves and seating surfaces and to prevent clogging the changeover valve operating mechanism. Such clogging can cause a loss of control, which can be dangerous to the lance/gun operator.

Hose Assemblies: All hose assemblies shall be inspected prior to use with respect to the following:

- Correct pressure rating and size.
- Free from external damage – e.g., exposed or broken wires.
- All end fittings and couplings are in good order and of the correct pressure rating for the unit operating pressure.

Hose Safety Shroud: Visually inspect the shroud before each use to check for damage, wear, or fraying. Replace the shroud if damaged or worn. If any hose failure or burst has occurred inside the safety shroud during operation, remove the shroud from service and replace it.

Nozzles: All jetting nozzles shall be kept clean and the orifice shall be checked to ensure that it is not obstructed or damaged before installation. Defective nozzles shall not be used but should be replaced or repaired before installation. During the start–up, prior to operation, the nozzle should be removed from the lance and the system flushed thoroughly to remove air and foreign particles.

Jetting Guns and Lances: Jetting guns and lances shall be checked daily and the trigger mechanism and guard given a thorough visual examination to ensure correct operation. All high–pressure connections should be observed during operation of the equipment at pressure. If a leak is observed, the high–pressure water jetting unit shall be shutdown and the connection repaired or replaced before further operation.

Foot Control Valves: All foot control valves shall be checked and cleaned daily and the foot mechanism and guard given a thorough visual examination to ensure correct operation.

Electrical Equipment: All electrically operated high–pressure water jetting units shall be checked daily for external damage with special emphasis placed on connection, junction boxes, switches, and supply cables. Care should be taken to ensure that the electrical system is protected from the ingress of water. Correct direction of rotation of the electric motor should be checked on initial installation and after every re–connection.

(continued)

Trailers: Mounted high−pressure water jetting units shall be checked daily examining tires, braking systems, jacking points, towing hitch, lights, safety chains, structural damage and general cleanliness. The units should only be towed by vehicles fit for the purpose.

Engine Controls: All throttle cables and engine stop devices shall be checked daily to ensure that they are functioning properly.

2.6.4 – Protective Clothing and Personal Protection

Regulatory Compliance: All applicable local regulations covering personal protective equipment (for example, OSHA in the US) shall be followed.

Head Protection: All operators shall be issued with suitable head protection which shall be worn, where possible. This should also include a full face shield.

Eye Protection: Suitable eye protection (i.e., adequate for the purpose and of adequate fit on the person) shall be provided to all operators of high–pressure water jetting equipment and must be worn within the working area. Additionally, several states have regulations governing eye protection which must be conformed with. Where liquids liable to cause eye damage are encountered, it may be necessary to use either a combination of visor and goggles or a full face shield.

⚠ WARNING

Where liquids liable to cause eye damage are encountered, it may be necessary to use either a combination of visor and goggles or a full face shield.

Body Protection: All operators should be supplied with suitable waterproof clothing having regard to the type of work being undertaken. Garments should provide full cover to the operator–including the arms. Liquid or chemical resistant suits shall be worn when there is a reasonable probability of injury that can be prevented by such equipment.

Hand Protection: Adequate hand protection should be supplied to all operators and shall be worn when there is a reasonable probability of injury that can be prevented by such equipment.

Foot Protection: All operators should be supplied with waterproof boots with steel or aluminum toe–caps. A metatarsal guard should be used by water jetting lance/gun operators.

Hearing Protection: Most high–pressure water jetting operations produce noise levels in excess of 90 dB (A). Consequently, suitable ear protection issued in accordance with Occupational Safety and Health standards must be worn, and provisions should be made for its regular inspection and maintenance.

⚠ WARNING

All personnel around the work site, including non–operators as well as operators, should receive instruction in the correct use of ear protectors so that noise exposure lies within the limits as specified by Occupational Safety and Health standards.

2.6 – Recommended Practices

Respiratory Protection: A respiratory protection program shall be implemented where there is a reasonable probability of injury that can be prevented by such a program.

Equipment Limitations: It should be recognized that protective equipment may not necessarily protect the operator from injury by direct high–pressure water jet impact.

2.6.5 – Pre–Operating Procedures

Planning: Each job shall be preplanned. Personnel familiar with the equipment to be cleaned or the material to be cut and the work environment shall meet with personnel that will be doing the work and outline potential hazards of the work area, environmental problems, safety standards, and emergency aid procedures.

Checklist: A checklist shall be used to assure that the proper procedures and proper equipment selection are followed.

Dump Valve: All systems shall incorporate at least one (1) fluid shut off or dump device. The lance operator must always be able to shut down the water jet by releasing pressure on the trigger, switch or foot valve pedal.

Warning Barriers: Barricades shall be erected to encompass the hazard area and signs posted to warn personnel that they are entering a hazardous area. The perimeter should be outside the effective range of the water jet whenever possible. Barriers may be of rope, safety tape, barrels, etc., as long as they give an effective warning and are highly visible.

Hook–Up:

- **Hose:** Hose shall be arranged so a tripping hazard does not occur. Hoses, pipes, and fittings shall be supported to prevent excessive sway and/or wear created by vibration or stress of the end connections when laid on the ground, over sharp objects or vertical runs.
- **Fittings:** All fittings shall be cleaned and lubricated before installing in the system. Be sure all fittings, hoses, and nozzles are fit for the purpose.
- **Hose:** All hoses shall be checked for evidence of damage, wear, or imperfection. The check shall be made periodically during the operation.
- **Hose Safety Shroud**: Visually inspect the shroud before each use to check for damage, wear, or fraying. Replace the shroud if damaged or worn.
- **Pre–Flushing:** The system shall be completely flushed with sufficient water to remove any contaminants before installing the nozzle.
- **Nozzle:** All orifices shall be checked in all nozzles for any stoppage, damage or imperfections.
- **Electrical Equipment:** Any electrical equipment in the immediate area of the operation that presents a hazard to the operator shall be de–energized, shielded, or otherwise made safe.

2.6.6 – Procedures

Work Area: Where practical, work pieces to be jetted should be removed from plant areas to a high–pressure water jetting area. Where this is impractical, cutting or cleaning in place, or adjacent to the installed position, can be done with the necessary clearance and permission of the occupier.

- **Area Limits:** Area limits applicable to the cutting or cleaning operations shall be defined and the team shall mark these limits by barriers and notices to warn against access to other personnel. Suitable barriers shall be an approved form of hazard warning, rope or tape, as a minimum. Alternatively, a suitable barrier shield is acceptable at any reasonable distance. Notices should state the following (or in other suitable wording):

  "Danger Keep Clear, High–Pressure Water Jetting in Operation"

- **Corrosive Materials:** Where there is a possibility of encountering corrosive or toxic materials, the occupier shall be requested to inform the person in charge of high–pressure water water jetting of any precautions that may be necessary, including the collection and disposal of waste materials.
- **Work Surface:** Operators should have good access to the work piece, a safe working platform and secure footing. The area in which work is to proceed shall be kept clear of loose items and debris to prevent tripping and slipping hazards.
- **Access:** Access by unauthorized persons into the area where high–pressure water jetting is taking place shall be prevented. The area shall be cordoned off and warning notices displayed in prominent positions. The perimeter should be outside the effective range of the water jet wherever possible.
- **Approaching the Operator:** The occupier shall be requested to inform all personnel likely to require access to the area that high–pressure water jetting is in progress. Personnel having reason to enter the water jetting area should wait until the water jet is stopped and his presence is made known. Personnel wishing to have the jet stopped shall approach a team member other than the lance/gun operator. The lance/gun operator shall not be distracted until the water jet has been stopped.
- **Side Protection:** Target and side shields shall, where feasible, be suitably placed to safeguard personnel and equipment against contact with grit or solids removed by water jets.
- **Protective Equipment:** All personnel working or entering the barricaded area while cleaning or cutting is in progress shall wear the required protective equipment.

2.6 – Recommended Practices

Pressurizing the System: Pressure shall be increased slowly on the system while being inspected for leaks and/or faulty components. All leaks or faulty components shall be repaired or replaced. System shall be de–pressurized for repairs.

Team Operations: In most water jetting operations, it is accepted practice to employ a minimum of two (2) persons.

- **Supervision:** All high–pressure water jetting operations shall be controlled by a supervisor who is trained in all aspects of the high–pressure water jetting operation.
- **Number of Operators:** The operation of the high–pressure water jetting equipment should be by two (2) or more operators according to the equipment being used and the nature of the job. These operators shall work as a team with one (1) member in charge. The operator of the gun or lance (as defined below) shall take the lead role while jetting is in progress.
- **Lance/Gun Operator:** One (1) operator from the team shall hold the lance/gun or delivery hose with the nozzle mounted on it. His primary duty is to direct the water jet.
- **Second Operator:** The second operator of the team shall attend the high–pressure water jetting unit, keep close watch on the first operator for signs of difficulty or fatigue and watch the surrounding area for intrusion by other persons or unsafe situations.
- **Additional Operators:** Further operators are required in the following circumstances: To assist the first operator with the handling of the lance if it is too long or too heavy for one (1) person. To provide communication if the lance operator is out of sight of the high–pressure water jetting unit operator.
- **Job Rotation:** The team members should rotate their duties during any job to minimize fatigue to the operator holding the lance/gun.
- **Team Leader:** The team leader is responsible for basic equipment checks, the preparation of the working area for safe operation and for obtaining a permit to work where and when required.
- **Code of Signals:** Before starting a high–pressure water jetting operation, the team members (one [1] of whom must be in charge) shall agree on a code of signals to be used during the operation of the equipment.
- **Fitness:** The operator and other team members shall be physically and mentally capable of performing the required operations.

Single Person Operation: Single person operation is allowed where the pressure does not exceed 2,000 psi (137.9 *bar*) and the flow is less than 20 gpm (5.2 *lpm*).

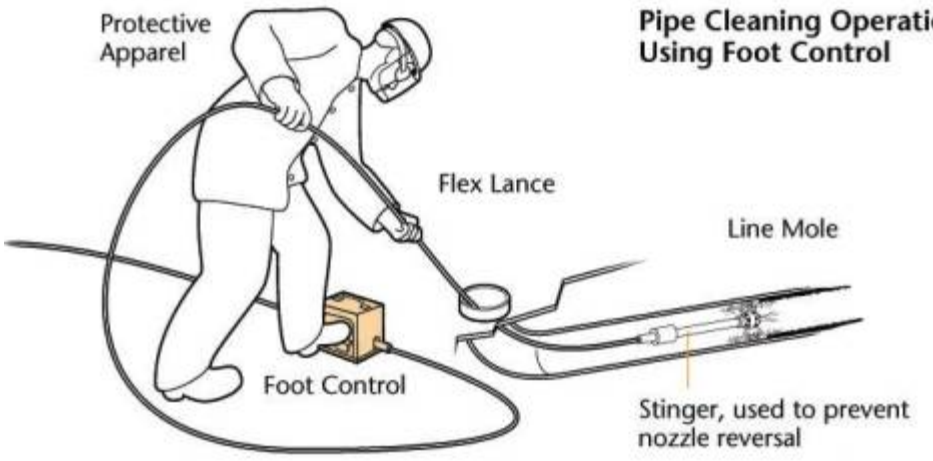
- **Single Operator Guidelines:** All other recommendations pertaining to team operations shall hold.

Shotgunning:

- **Attendance:** The system shall never be left unattended when pressurized.
- **Multiple Operation:** When more than one (1) shotgunning operation is being performed within the same area, a physical barrier shall be installed or adequate spacing between operators shall be maintained to prevent the possibility of injury of high−pressure water.
- **Target Holding:** Objects to be cleaned shall never be held manually.
- **Connection Protection:** The point where the hose connects to the gun must be shrouded by a protective device, (e.g., heavy duty hose, shoulder guard, etc.,) so as to prevent injury to operator should hose, pipe, or fitting rupture.
- **Minimum Length:** Where practicable, the minimum length of the shotgun lance extension should be four (4) feet (1.8 *m*) from the triggering device to the nozzle.
- **Hose Protection:** Steel braided hoses should be used on air−operated fail safe systems to keep the system from being activated by someone stepping on the hose or running over it.
- **Hose Safety Shroud**: A hose safety shroud must be used whenever it is likely that the high pressure hose will come into close contact with the worker.

Moleing or Flex Lancing:

- **Control:** The operator inserting the nozzle shall have direct control of the dump system.
- **Reversing:** A positive method shall be used to prevent the nozzle from reversing direction inside the item being cleaned, such as using a pipe behind the nozzle which has a length larger than the inside diameter of the item being cleaned. This pipe nipple is known as a “stinger”.



2.6 – Recommended Practices

- **Retrojets:** During manual operations, the entrance to a line or pipe shall not be cleaned with a nozzle containing back water jets without adequate shielding.
- **Clearance:** The clearance between the outside diameter of the hose, lance and nozzle assembly and the inside wall of the item being cleaned shall be sufficient to allow adequate washout of water and debris.
- **Pressurization:** During manual operation, the nozzle shall be inserted into the tube prior to pressurizing. Conversely, the system shall be de–pressurized before removal of the nozzle from the tube.
- **End Identification:** Hoses shall be conspicuously marked no closer than 24" (0.6 *m*) from the nozzle to warn the operator of the nozzle location.
- **Nozzle Support:** Where the length of the nozzle and rigid coupling is less than the inside diameter of the pipe, a length of rigid pipe (i.e., stinger) not less than the diameter of the pipe being cleaned should be fitted directly behind the nozzle or a suitable safety shield should be provided to protect the operator. This is to prevent the nozzle turning around 180 degrees and doubling back towards the operator.

Rigid Lancing:

- **Control:** The operator inserting the nozzle shall have direct control of the dump system.
- **Clearance:** The clearance between the outside diameter of the lance and nozzle and the inside wall of the item being cleaned shall be sufficient to allow adequate washout of water and debris.
- **Pressurization:** When under manual operation, the nozzle shall be inserted into the tube prior to pressurizing. Conversely, the system shall be de–pressurized before removal of the nozzle from the tube, unless proper shielding is provided.
- **Shields:** When lancing tubes with a rigid lance, a guard should be installed, where practicable, around the lance, to prevent a lance nozzle from being inadvertently withdrawn and causing injury.

Additives: Any water additive (e.g., chemical, detergent or sold particle) shall be used in accordance with the manufacturer's recommendations.

Proper Operation:

- **Start Up:** The high–pressure water jetting unit shall not be started and brought up to pressure unless each team member is in his designated position, the nozzle is held in, or directed at, the work piece and the lance/gun securely held.

- **Adjustments:** Apart from operation procedures, no attempt shall be made to adjust any nut, hose connection, fitting, etc., while the system is under pressure. The high–pressure water jet ting unit shall be stopped and any pressure in the line discharged prior to making any such adjustments.

⚠ WARNING

Care should be taken to release the pressure in the dry shut off gun and the line when the unit is switched off.

- **Equipment Malfunction:** If for any reason the water flow does not shut off when the trigger or foot pedal is released, work shall cease until the item has been serviced, repaired or changed by properly trained personnel.

- **Reaction Force:** The lance/gun operator should be allowed to experience the reaction force of the water jet progressively until the required operating pressure is reached. The lowest pressure should be used compatible with the work to be done. The pressure shall not be adjusted without the lance/gun operator's awareness.

- **Effect of Line Impulses:** Lance/gun operators should be made aware of the reactive effect of pressure in the line which can transmit a severe jolt to the operator when the dump valve or dry shut–off valve operated. To minimize this effect, total hose lengths should be kept as short as possible. Damping devices can be introduced into the system.

- **Thermo–Plastic Hoses:** Thermo–plastic hose should not be used for water jetting unless specifically designed for this purpose.

- **Operator Positioning:** The team members shall be safely positioned while operating the system and if any person should encroach into the working area, high–pressure water jetting shall be stopped.

2.6 – Recommended Practices

- **Work Stoppage:** Work shall stop when the following occurs: In the event that leaks or damage become apparent. If any person becomes aware of any change in conditions or any hazards be introduced or exist. If plant or work alarms are sounded. If any of the recommended practices in this document are not followed.

- **Hose Protection:** All the hoses should be protected from being run over and crushed by vehicles, fork lift trucks, etc.

- **Back Thrust:** The back thrust from a linearly directed jet can be calculated from the following equation:

$$\text{Back Thrust (lb.)} = 0.052\ Q\ (P)^{0.5}$$

Where: Q is the flow rate in U.S. gallons per minute

P is the jet pressure measured in psi

⚠ WARNING

It is not recommended that any one (1) person be required to withstand a back thrust of more than one–third (1/3) of their body weight for any extended period of time.

2.6.7 – Use of Lances and Nozzles

Lances: Lances which are rigid or semi–rigid having nozzles fitted to with any combination of forward, backward, or 90 degree angle jets shall be used with either a dump system or dry shut–off control valve. When a flexible lance or nozzle mounted on a hose is in use, the jet should not be operated at pressure unless the nozzle is properly positioned inside the work piece, or the lance operator is protected by screens or proper shielding from rear facing jets. If necessary, the lead–in to the work piece should be cleaned by other methods.

Flexible Lances: Flexible lances used to clean pipes, where the inside diameter of the pipe is not small enough to prevent the lance from turning back on itself, shall have a piece of rigid straight tube, slightly longer than the diameter of the pipe, fitted immediately behind the nozzle to prevent this from happening.

Distance Indicator: When an assembly is used which allows the nozzle to enter the work piece with restricted visibility, the lance, hose, or floor should be clearly marked in a manner which enables the lance operator to judge how far the nozzle is in the work piece before pressure is applied and conversely, so that pressure is released before the apparatus is completely withdrawn from the work piece.

Lance Length: The length of a rigid lance or combination of lances shall be such that the lance operator can maintain control at all times.

Jet Pressure: The nozzle and minimum operating pressure shall be selected by the lance operators to allow effective and efficient high–pressure water jetting.

Improper Use: Should a lance operator enter a manhole or access port for any purpose (preferably with the high–pressure water jetting unit turned off), the hose shall not be used to support their weight when climbing up or down.

“T” Pieces: When using a “T” piece or nozzle carrier “T” (devices for producing two [2] equal and opposite water jets at the end of the lance and at right angles to the normal flow), it should be inserted into a tube, a vessel, or between two (2) surfaces before the system is pressurized. This is necessary to ensure that should one (1) water jet be larger then the other, or one (1) water jet become blocked or partially blocked, the operator of the lance will not be spun out of control. When a “T” piece is used to provide a balancing jet on a long lance to clean a single surface, it is not always possible to check for equal thrust from both jets in the manner described above, therefore these lances should be checked by progressive pressure increases. This restraint shall also apply to any form of multi–jet nozzle, the jets issuing from which having a radial component.

Confined Working: Before entry into a confined work space for high–pressure water jetting, a certificate of clearance shall be obtained to ensure access is safe.

2.6.8 – Permanent Cleaning Areas

Enclosure: The areas shall be suitably enclosed and warning notices prominently displayed at the access points and perimeters.

Access: Access by persons other than the high–pressure water jetting team shall be strictly prohibited while work is in progress. If any unauthorized entry is made, all work shall cease immediately.

Hazards: The working area shall be free from hazards likely to trip personnel and be provided with adequate drainage and lighting fixtures.

2.6.9 – Freeze Precautions

During the periods where there is a risk of freezing, follow NLB's recommendations or take the following precautions on shutdown:

- Remove the gun or nozzle from the delivery hose
- Pump water from supply tank until level of water is just above the filter.
- Add recommended quantity of anti–freeze into the water tank.
- Place delivery hose into water tank and secure.
- Run the pump until the anti–freeze works through the system.
- Move the selector level to dump or recycle position until; the anti–freeze shows in the water tank.
- If no supply tank is fitted, follow NLB's recommendations.

⚠ WARNING

If a high–pressure pump or hose appears frozen, on no account must the pump be engaged or the engine started if there is direct drive to the pump, until the system has been thawed out and low pressure water has been allowed to flow through the system to the nozzle end of the lance (the lance having been removed).

2.6.10 – Accidents

Personal Injuries: In the event that a person is injured by the impact of a high–pressure water jet, the injury caused may appear insignificant and give little indication of the extent of the injury beneath the skin and damage to deeper tissues. Large quantities of water may have punctured the skin, flesh and organs through a very small hole that may not even bleed.

Operator Identification: Immediate hospital attention is required and medical staff must be informed of the cause of the injury. To ensure that this is not overlooked, all lance/gun operators engaged in high–pressure water jetting should carry an immediately accessible waterproof card which outlines the possible nature of the injury and titled with the following text:

"Important Medical Information"

This card is found in the inside back cover of this printed manual. If the card is missing contact NLB at (800) 227–7652 for a replacement.

Immediate First Aid: Where medical examination is not immediately possible in remote situations, first aid measures should be confined to dressing the wound and observing the patient closely until medical examination has been arranged.

Reporting: If any person or equipment is accidentally struck by the water jet, this fact must be immediately reported to a responsible party.

2.6 – Recommended Practices

2.6.11 – Responsibility

Purpose: These recommended practices are provided to assist persons unfamiliar with the operation of high−pressure water jetting equipment.

The responsibility of correct operation and use of the equipment is the sole responsibility of the operator. The operator should familiarize themselves with the identification of high−pressure water jetting metal fittings, hoses, lance/guns, and accessories. Modification of high−pressure water jetting equipment or accessories is not recommended without prior written approval by NLB.

Serious harm or injury may result from the misuse of high−pressure water jetting equipment, the use of improper fittings, hoses, or improper attachments.

DO	DO NOT . . . . .
Ensure that all pressure in lines is released on any shutdown.	DO NOT leave equipment unattended on site.
Upon completion, strip down equipment and store in clean condition.	DO NOT store unserviceable equipment. Notify the supervisor.
Clear the site of barriers, warning signs and debris to customer's satisfaction.	DO NOT leave the site in a dangerous or untidy condition.
Upon completion, endure that customer has signed the necessary paperwork (satisfaction notes, work sheets, etc).	DO NOT leave the site without notifying all parties (engineers, site agents, occupiers, etc).
Contact site engineer. Obtain necessary permits and note special precautions.	DO NOT commence work on site without necessary permission.
Erect barriers, rope off the clear area, and erect warning signs.	DO NOT commence any jetting operation until warning signs are on show and area is roped off.
Ensure adequate water supply.	DO NOT operate without adequate personal protection for eyes, head, ears, hands, feet, and body.
Check liquid levels on engine, gearbox, and pump (lubrication oil, fuel, and water).	DO NOT run any equipment with leakage whatsoever, without rectifying.

(continued)

(continued)

DO	DO NOT . . . . .
Lay out equipment and visually inspect for damage (hoses, connections, etc).	DO NOT attempt to tighten any pressure joint while equipment is under pressure.
Assemble all equipment, checking all joints.	DO NOT by–pass safety cutouts. DO check reasons for malfunctions (low water, blocked filters, low oil level, etc).
Ensure that filters are clean.	DO NOT operate guns or control valves that are not functioning correctly (leaking or failing to shut off).
Fully prime equipment and bleed where necessary.	DO NOT operate guns or control valves with the operating lever tied back, wedged, or locked in the “ON” position.
Fit gun or lances and/or control valves. Visually check that correct size and type of nozzle is fitted for the application.	DO NOT operate with badly worn or undersize nozzles.
Increase pressure slowly until operating conditions are reached.	DO NOT continue to operate if any unauthorized personnel enter the operating area.
Re–check hose couplings and joints for leaks.	DO NOT operate equipment at power levels which can produce a reaction force greater than the operator can comfortably absorb.
Rectify all leaks, ensuring that the unit is shut down and line pressure is released before making adjustments.	DO NOT leave high pressure water jetting unit running unattended.
Ensure all operators are wearing suitable protective clothing and are correctly positioned.	
Regularly check operating conditions (oil and water pressure, condition of filters, pipe work and hoses).	

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SECTION 3 – OPERATION INFORMATION

3.1 – Description and Operation

The NCG8450A–3, NCG8450A–3L, and NCG8450A–3T rotating lances all incorporate a DS8850A swivel that is designed to operate at pressures up to 40,000 psi (2,857 bar) and a flow rate of up to 6 gpm (22.7 lpm). The swivel is driven by an air motor through a timing belt, which is covered by a protective housing. The air motor is designed to operate to a maximum speed of 3000 rpm and incorporates an air flow adjustment located at the bottom of the handle.

⚠ WARNING

Never operate the rotating lance without high pressure water flowing through it or damage to components can result.

The triggers require low operator force for engagement. The forward trigger is adjustable for right– or left–hand operations. The lance has been ergonomically designed with the rotation drive mechanism near the operator, to minimize arm strain.

The NCG8450A–3, –3L, and –3T lances operate in conjunction with an NLB Bi–Mode™ valve. The purpose of the NLB Bi–Mode valve in a single rotating lance setup is to control the flow of high–pressure water to the lance when the trigger engagement and disengagement cycle occurs. In a dual Bi–Mode and lance setup, it controls the flow of high–pressure water, and also equalizes and maintains pressure under operation with either lance when the trigger engagement and disengagement cycle occurs. The Bi–Mode also changes supplied compressed air into filtered, regulated, and lubricated compressed air and then sends the compressed air to the lance to rotate the nozzles. With compressed air spinning the head on the lance, the horsepower generated from the high–pressure water is concentrated on the cleaning action of the lance.

The Bi–Mode valve has two separate inlet connections: one for compressed air and one for high–pressure water from the pump unit. When the supplied compressed air is connected to the Bi–Mode, it is run through an air filter, a regulator set at 90 psi, and then lubricated before it enters the rotating lance.

3.1 – Description and Operation

WARNING

Never operate a lance and Bi–Mode with a hose connection greater than 35 feet (7.2m) between them as it increases the dump valve reaction time, resulting in a delayed shut–off.

When the operator engages the air motor (rear) trigger, nozzle rotation begins and a low–pressure air signal is sent from the air motor to the front trigger. Next, the operator engages the front trigger, which allows the air signal to pass through it to the Bi–Mode through a quick exhaust valve. This quick exhaust valve operates a pilot valve that opens, allowing 90 psi of compressed air to flow through to a 65 psi non–adjustable regulator. After the air is regulated to 65 psi, it continues flowing to the air cylinder on the Bi–Mode. The air cylinder energizes and extends, applying pressure on the lever activating the pressure side port. This action allows high–pressure water to flow to the lance.

When either trigger is released, the air signal to the Bi–Mode is interrupted; this allows spring tension in the spring assembly to overcome the air actuator, moving the lever to activate the dump side port. In a single lance operation, the dump port is opened, diverting the water to atmosphere at low pressure. In a multiple Bi–Mode and lance setup, the dump port on each Bi–Mode has a restriction nozzle in it to keep the water pressure raised when leaving the dump valve. The pressure is diffused against a target in the dump assembly and exits the dump tube assembly at high–temperature/low pressure. This is necessary to keep both lances working at proper system pressure at all times during operation.

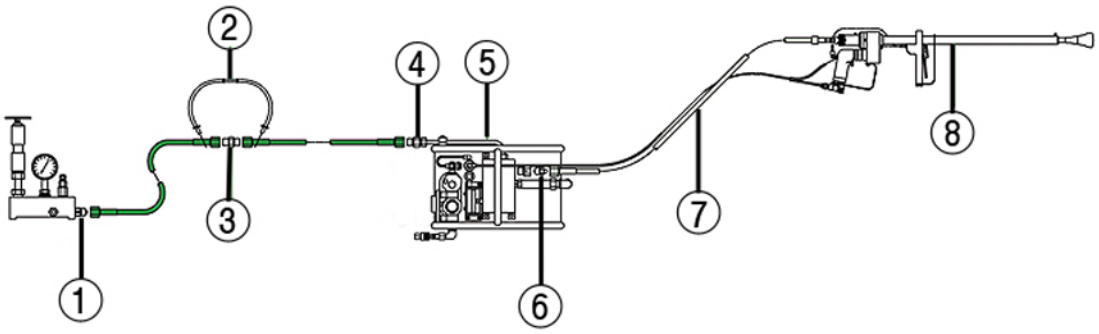
3.2 – Single Lance Operation

In a typical single lance operation, all of the available flow is directed to the lance. The Bi–Mode has an equal sized nozzle to that of the combined nozzles in the lance. This is done to suit the volume of water coming from the Bi–Mode. When the operator releases the triggers on the lance, the water dumps from the Bi–Mode at low pressure because there is no nozzle in the dump tube.

If it is desired to maintain constant pressure at the pump during operation, then it would be necessary to install a nozzle in the dump tube that matches the flow of the lance.

A typical single setup:

Two BN3539–025 or BN10095–25 sapphire nozzles in the lance @ 2.67 gpm (10.09 lpm) with the total equaling 5.34 gpm (20.18 lpm).



Item	Component	Part Number
1	Port–to–Hose Fitting	CM3680
2	Whip Check	PM7909
3	Hose–to–Hose Fitting	CM3679
4	Tube–to–Hose Fitting	CM7230
5	NLB8488 Bi–Mode™ Valve	NLB8488
6	Port–to–Hose Fitting	DM6023–241
7	Whip Hose Assembly	DM14150
8	Straight Nozzle Rotating Lance	NCG8450A–3

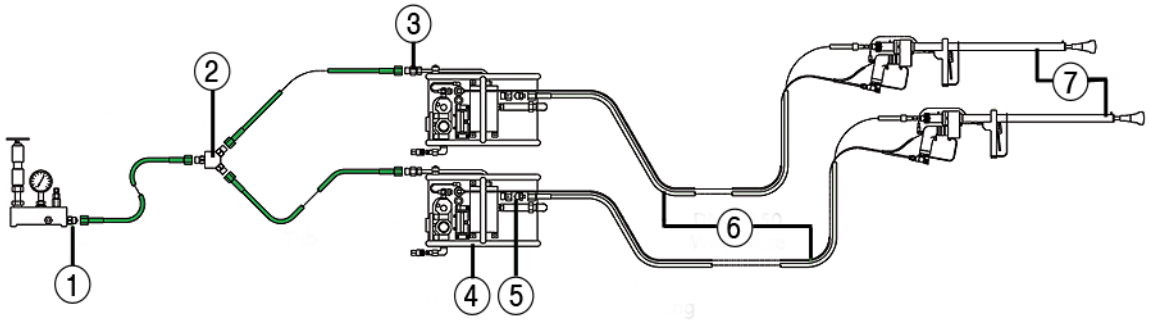
3.3 – Multiple Lance Operation

In a multiple lance operation, the available pump unit flow is distributed to each Bi–Mode valve. Each Bi–Mode will control one rotating lance. The lance contains between 2–5 nozzles in its attached rotating head. These nozzles must be the same size for proper operation. The Bi–Mode dump port nozzle must also be equal to the combined total flow of all the nozzles that are housed in the lance to which it is attached. The Bi–Mode dump port nozzle maintains system pressure, so if one lance is operating and the other one is dumping, the operating lance will not have a pressure variance.

When setting up your multiple lance operation, keep in mind to match the flow of each lance to the flow of the orifice in the Bi–Mode to which they are connected.

A typical dual lance setup:

Two BN3539–018 or BN10095–18 sapphire nozzles in each lance @ 1.38 gpm (5.23 lpm) with the total equaling 5.52 gpm (22.08 lpm). Also use one BN3539–025 @ 2.67 gpm (10.09 lpm) sapphire nozzle in each Bi–Mode.



Item	Component	Qty	Part Number
1	Port–to–Hose Fitting	1	CM3680
2	”Y” Adapter	1	CM13027
3*	Tube–to–Hose Fitting	2	CM7230
4*	NLB8488 Bi–Mode™ Valve	2	NLB8488
5*	Port–to–Hose Fitting	2	DM6023–241
6	Whip Hose Assembly	1	DM14150
7	Straight Nozzle Rotating Lances	1	NCG8450A–3

** Note: The connection fittings and Bi–Mode valves are identical for both lances.*

3.4 – NLB Sapphire Nozzles Configuration Calculator

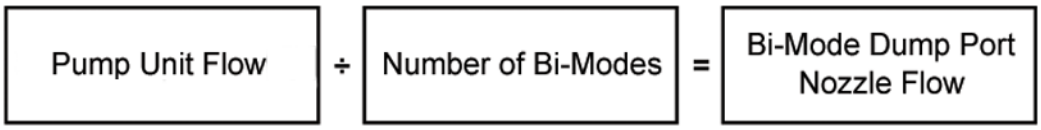
Prior to starting your calculations, remember that a single Bi–Mode/lance setup does not require a nozzle in the dump port. Multiple Bi–Mode/lance setups do require a nozzle in each dump port that must be equal to the total gpm of the all nozzles in the rotating head of the attached lance.

Nozzle size and quantities will vary depending on high–pressure pump usage and cleaning application/conditions. For optimum operation with diesel high–pressure water–jet pump units, adjust the engine speed and the by–pass valve so that little or no water flows from the by–pass valve.

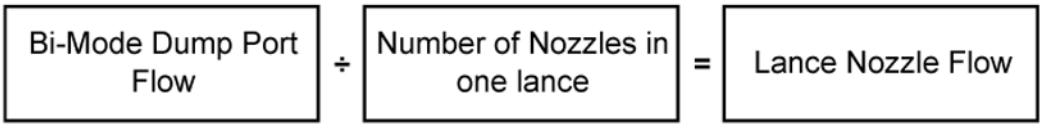
If you have any questions about your nozzle configuration, contact NLB Customer Service at (800) 227–7652 for details.

3.4.1 – Multiple Bi–Mode/Lance Nozzle Calculation – Equal Flow

This calculation is used when equal flow to all rotating lances is desired. You must first start with the water jet pump units desired flow, then divide that by the number of Bi–Modes you are using. This will give you your Bi–Mode dump port nozzle flow.



Next, to figure out your nozzle flow for each lance, take the dump port nozzle flow and divide that by the number of nozzles needed for the lance, this will give you your lance nozzle flow.



If you are viewing this manual as a PDF file, **click here** to use the flow calculator.

Once you have established your Bi–Mode dump port valve flow and your lance nozzle flow, compare them to the **nozzle size chart** with the appropriate system pressure to find the correct nozzle size. If the flow does not exactly match the flow listed on the chart, then always round down to the lower number.

3.4 – NLB Sapphire Nozzles Configuration Calculator

3.4.2 – Multiple Bi–Mode/Lance Nozzle Calculation – Specific Flow

This calculation will be used when you desire a different flow to each lance. You must first start with the water jet pump unit's actual flow, then figure out how many Bi–Modes that you would like to use and how much flow you would like for each of them. Remember that the combined amount of flow from the Bi–Modes cannot exceed the actual flow from the pump unit or else the system will not reach its desired operating pressure.

Also keep in mind that if the combined Bi–Mode flow total that you come up with is less than the pump unit's actual flow, the extra flow that is not used will exit through the pump unit's by–pass valve. If you are using a diesel/gas pump unit, you can lower your engine rpm to compensate for the lower flow amount as well.

After you have figured out how much flow you would like at each Bi–Mode, these numbers become your dump port nozzle flow for each Bi–Mode. Now you can start to calculate the flow for the lance nozzles. At this point each Bi–Mode circuit will be calculated individually. Take the desired flow to the Bi–Mode, divide that by the number of nozzles that are in the lance, the result is the nozzle flow. Refer to the **nozzle size chart** with the appropriate system pressure to find the correct nozzle size. If the flow does not exactly match to the flow listed on the chart, then always round down to the lower number.

If you are viewing this manual as a PDF file, **click here** to use the flow calculator.

Example:

Pump Unit Output – 40,000 psi at 5.52 gpm

Number of Bi–Mode Valves – 3

Bi–Mode A – 1 gpm (#15 nozzle) and the lance has 2 nozzle ports

Bi–Mode B – 1 gpm (#15 nozzle) and the lance has 3 nozzle ports

Bi–Mode C – 3.52 gpm (#28 nozzle) and the lance has 4 nozzle ports

1 + 1 + 3.52 = 5.52 *Bi–Mode Combined flow is equal to pump unit flow (5.52)*

Lance A – (1 divided by 2 = .5 nozzle gpm flow) = Qty. 2 – #10 nozzles

Lance B – (1 divided by 3 = .33 nozzle gpm flow) = Qty. 3 – #8 nozzles

Lance C – (3.52 divided by 4 = .88 nozzle gpm flow) = Qty. 4 – # 14 nozzles

3.4.3 – Nozzle Size Conversion Chart 20,000 psi – 29,000 psi

Nozzle #	Pressure (psi)										Nozzle Flow (gpm)
	20,000	21,000	22,000	23,000	24,000	25,000	26,000	27,000	28,000	29,000	
6	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.13	0.13	
7	0.15	0.15	0.15	0.16	0.16	0.17	0.17	0.17	0.17	0.18	
8	0.19	0.20	0.20	0.21	0.21	0.22	0.22	0.22	0.23	0.23	
9	0.24	0.25	0.26	0.26	0.27	0.27	0.28	0.28	0.29	0.29	
10	0.30	0.31	0.32	0.32	0.33	0.34	0.34	0.35	0.36	0.36	
11	0.36	0.37	0.38	0.39	0.40	0.41	0.42	0.42	0.43	0.44	
12	0.43	0.44	0.46	0.47	0.48	0.49	0.50	0.50	0.51	0.52	
13	0.51	0.52	0.53	0.55	0.56	0.57	0.58	0.59	0.60	0.61	
14	0.59	0.61	0.62	0.63	0.65	0.66	0.67	0.69	0.70	0.71	
15	0.68	0.70	0.71	0.73	0.74	0.76	0.77	0.79	0.80	0.82	
16	0.77	0.79	0.81	0.83	0.85	0.86	0.88	0.90	0.91	0.93	
17	0.87	0.89	0.91	0.93	0.95	0.97	0.99	1.01	1.03	1.05	
18	0.98	1.00	1.02	1.05	1.07	1.09	1.11	1.14	1.16	1.18	
19	1.09	1.12	1.14	1.17	1.19	1.22	1.24	1.26	1.29	1.31	
20	1.21	1.24	1.27	1.29	1.32	1.35	1.38	1.40	1.43	1.45	
21	1.33	1.36	1.39	1.43	1.46	1.49	1.52	1.55	1.57	1.60	
22	1.46	1.50	1.53	1.57	1.60	1.63	1.66	1.70	1.73	1.76	
23	1.60	1.63	1.67	1.71	1.75	1.78	1.82	1.85	1.89	1.92	
24	1.74	1.78	1.82	1.86	1.90	1.94	1.98	2.02	2.06	2.09	
25	1.88	1.93	1.98	2.02	2.06	2.11	2.15	2.19	2.23	2.27	
26	2.04	2.09	2.14	2.19	2.23	2.28	2.32	2.37	2.41	2.45	
27	2.20	2.25	2.31	2.36	2.41	2.46	2.51	2.55	2.60	2.65	
28	2.36	2.42	2.48	2.54	2.59	2.64	2.70	2.75	2.80	2.85	
29	2.54	2.60	2.66	2.72	2.78	2.84	2.89	2.95	3.00	3.05	
30	2.71	2.78	2.85	2.91	2.97	3.03	3.09	3.15	3.21	3.27	
31	2.90	2.97	3.04	3.11	3.17	3.24	3.30	3.37	3.43	3.49	
32	3.09	3.16	3.24	3.31	3.38	3.45	3.52	3.59	3.65	3.72	
33	3.28	3.36	3.44	3.52	3.60	3.67	3.74	3.82	3.89	3.95	
34	3.49	3.57	3.66	3.74	3.82	3.90	3.97	4.05	4.12	4.20	
35	3.69	3.79	3.87	3.96	4.05	4.13	4.21	4.29	4.37	4.45	
36	3.91	4.00	4.10	4.19	4.28	4.37	4.46	4.54	4.62	4.71	
37	4.13	4.23	4.33	4.43	4.52	4.62	4.71	4.80	4.88	4.97	
38	4.35	4.46	4.57	4.67	4.77	4.87	4.96	5.06	5.15	5.24	
39	4.59	4.70	4.81	4.92	5.02	5.13	5.23	5.33	5.43	5.52	
40	4.82	4.94	5.06	5.17	5.29	5.39	5.50	5.61	5.71	5.81	
41	5.07	5.19	5.32	5.44	5.55	5.67	5.78	5.89	6.00	6.10	
42	5.32	5.45	5.58	5.70	5.83	5.95	6.06	6.18	6.29	6.41	
43	5.58	5.71	5.85	5.98	6.11	6.23	6.36	6.48	6.60	6.71	
44	5.84	5.98	6.12	6.26	6.40	6.53	6.66	6.78	6.91	7.03	
45	6.11	6.26	6.40	6.55	6.69	6.83	6.96	7.09	7.23	7.35	

3.4 – NLB Sapphire Nozzles Configuration Calculator

3.4.4 – Nozzle Size Conversion Chart 30,000 psi – 40,000 psi

Nozzle #	Pressure (psi)											Nozzle Flow (gpm)
	30,000	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000	
6	0.13	0.14	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	
7	0.18	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.21	0.21	
8	0.24	0.24	0.24	0.25	0.25	0.26	0.26	0.26	0.27	0.27	0.27	
9	0.30	0.30	0.31	0.31	0.32	0.32	0.33	0.33	0.34	0.34	0.35	
10	0.37	0.38	0.38	0.39	0.39	0.40	0.40	0.41	0.42	0.42	0.43	
11	0.45	0.45	0.46	0.47	0.48	0.48	0.49	0.50	0.50	0.51	0.52	
12	0.53	0.54	0.55	0.56	0.57	0.57	0.58	0.59	0.60	0.61	0.61	
13	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.71	0.72	
14	0.72	0.74	0.75	0.76	0.77	0.78	0.79	0.80	0.81	0.83	0.84	
15	0.83	0.84	0.86	0.87	0.88	0.90	0.91	0.92	0.94	0.95	0.96	
16	0.95	0.96	0.98	0.99	1.01	1.02	1.04	1.05	1.06	1.08	1.09	
17	1.07	1.08	1.10	1.12	1.14	1.15	1.17	1.19	1.20	1.22	1.23	
18	1.20	1.22	1.24	1.25	1.27	1.29	1.31	1.33	1.35	1.36	1.38	
19	1.33	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.52	1.54	
20	1.48	1.50	1.53	1.55	1.57	1.60	1.62	1.64	1.66	1.68	1.71	
21	1.63	1.66	1.68	1.71	1.73	1.76	1.78	1.81	1.83	1.86	1.88	
22	1.79	1.82	1.85	1.87	1.90	1.93	1.96	1.99	2.01	2.04	2.06	
23	1.95	1.99	2.02	2.05	2.08	2.11	2.14	2.17	2.20	2.23	2.26	
24	2.13	2.16	2.20	2.23	2.26	2.30	2.33	2.36	2.39	2.43	2.46	
25	2.31	2.35	2.38	2.42	2.46	2.49	2.53	2.56	2.60	2.63	2.67	
26	2.50	2.54	2.58	2.62	2.66	2.70	2.73	2.77	2.81	2.85	2.88	
27	2.69	2.74	2.78	2.82	2.87	2.91	2.95	2.99	3.03	3.07	3.11	
28	2.90	2.94	2.99	3.04	3.08	3.13	3.17	3.22	3.26	3.30	3.34	
29	3.11	3.16	3.21	3.26	3.31	3.35	3.40	3.45	3.50	3.54	3.59	
30	3.32	3.38	3.43	3.49	3.54	3.59	3.64	3.69	3.74	3.79	3.84	
31	3.55	3.61	3.67	3.72	3.78	3.83	3.89	3.94	3.99	4.05	4.10	
32	3.78	3.84	3.91	3.97	4.03	4.08	4.14	4.20	4.26	4.31	4.37	
33	4.02	4.09	4.15	4.22	4.28	4.34	4.41	4.47	4.53	4.59	4.64	
34	4.27	4.34	4.41	4.48	4.54	4.61	4.68	4.74	4.80	4.87	4.93	
35	4.52	4.60	4.67	4.74	4.82	4.89	4.96	5.02	5.09	5.16	5.22	
36	4.79	4.87	4.94	5.02	5.10	5.17	5.24	5.32	5.39	5.46	5.53	
37	5.06	5.14	5.22	5.30	5.38	5.46	5.54	5.61	5.69	5.76	5.84	
38	5.33	5.42	5.51	5.59	5.68	5.76	5.84	5.92	6.00	6.08	6.16	
39	5.62	5.71	5.80	5.89	5.98	6.07	6.15	6.24	6.32	6.40	6.49	
40	5.91	6.01	6.10	6.20	6.29	6.38	6.47	6.56	6.65	6.74	6.82	
41	6.21	6.31	6.41	6.51	6.61	6.71	6.80	6.89	6.99	7.08	7.17	
42	6.51	6.62	6.73	6.83	6.94	7.04	7.14	7.23	7.33	7.43	7.52	
43	6.83	6.94	7.05	7.16	7.27	7.38	7.48	7.58	7.69	7.79	7.89	
44	7.15	7.27	7.38	7.50	7.61	7.72	7.83	7.94	8.05	8.15	8.26	
45	7.48	7.60	7.72	7.84	7.96	8.08	8.19	8.31	8.42	8.53	8.64	

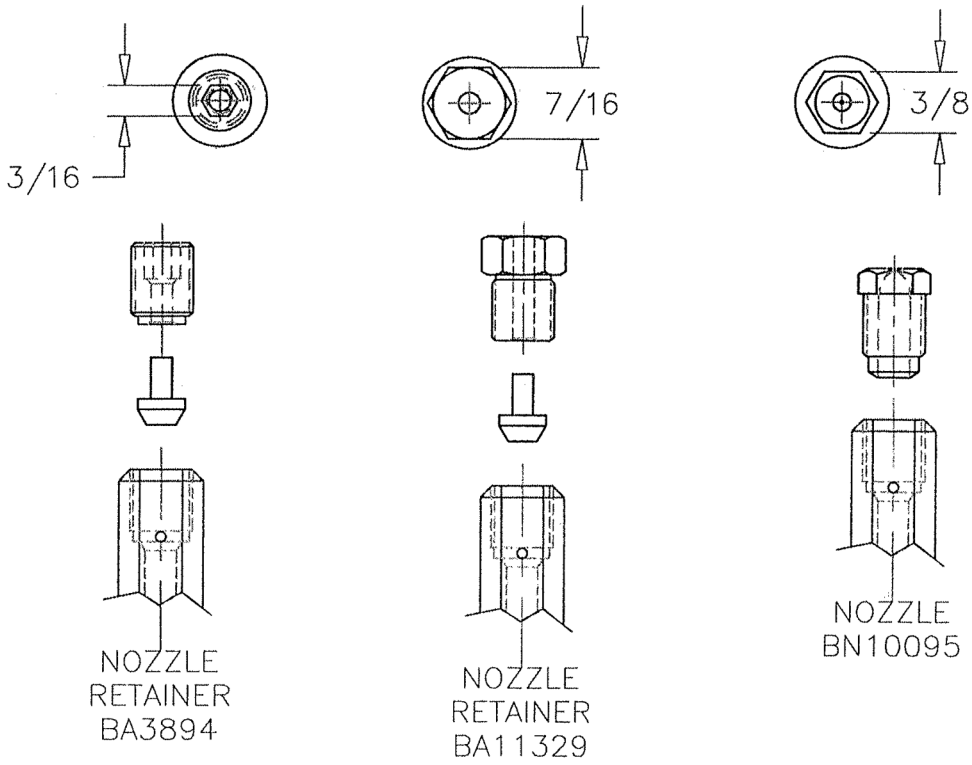
3.4.5 – Nozzle Thrust Chart (Theoretical) lb.f – Water

$$lb.f = .052 \times gpm \times \sqrt{psi}$$

The nozzle thrust chart below can be used to calculate the working thrust of your lance. Common industry standard is to operate a lance with approximately 60–65 lb–ft of thrust. This can vary due to the size and strength of the operator.

psi	1 gpm	2 gpm	3 gpm	4 gpm	5 gpm	6 gpm	7 gpm	8 gpm	9 gpm	10 gpm
1,000	1.7	3.3	5.0	6.7	8.3	10.0	11.7	13.3	15.0	16.7
2,000	2.4	4.7	7.1	9.4	11.8	14.1	16.5	18.9	21.2	23.6
3,000	2.9	5.8	8.7	11.5	14.4	17.3	20.2	23.1	26.0	28.9
4,000	3.3	6.7	10.0	13.3	16.7	20.0	23.3	26.7	30.0	33.3
5,000	3.7	7.5	11.2	14.9	18.6	22.4	26.1	29.8	33.5	37.3
6,000	4.1	8.2	12.2	16.3	20.4	24.5	28.6	32.7	36.7	40.8
7,000	4.4	8.8	13.2	17.6	22.0	26.5	30.9	35.3	39.7	44.1
8,000	4.7	9.4	14.1	18.9	23.6	28.3	33.0	37.7	42.4	47.1
9,000	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	50.0
10,000	5.3	10.5	15.8	21.1	26.3	31.6	36.9	42.2	47.4	52.7
11,000	5.5	11.1	16.6	22.1	27.6	33.2	38.7	44.2	49.7	55.3
12,000	5.8	11.5	17.3	23.1	28.9	34.6	40.4	46.2	52.0	57.7
13,000	6.0	12.0	18.0	24.0	30.0	36.1	42.1	48.1	54.1	60.1
14,000	6.2	12.5	18.7	24.9	31.2	37.4	43.6	49.9	56.1	62.4
15,000	6.5	12.9	19.4	25.8	32.3	38.7	45.2	51.6	58.1	64.5
16,000	6.7	13.3	20.0	26.7	33.3	40.0	46.7	53.3	60.0	66.7
17,000	6.9	13.7	20.6	27.5	34.4	41.2	48.1	55.0	61.8	68.7
18,000	7.1	14.1	21.2	28.3	35.4	42.4	49.5	56.6	63.6	70.7
19,000	7.3	14.5	21.8	29.1	36.3	43.6	50.8	58.1	65.4	72.6
20,000	7.5	14.9	22.4	29.8	37.3	44.7	52.2	59.6	67.1	74.5
36,000	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0
40,000	10.5	21.1	31.6	42.2	52.7	63.2	73.8	84.3	94.9	105.4

3.4.6 – Sapphire Nozzle Style Identification



3.5 – Basic Operation Instructions

Prior to start–up of the system, the lance and Bi–Mode should be visually inspected for damage, loose air fittings/lines, loose water fittings/lines. and loose fasteners.

The air regulator on the Bi–Mode should be set between 80 psi (5.5 bar) – 90 psi (6.2 bar) and the air lubricator should checked for proper oil level and drip rate (30 drops per minute).

Prior to connecting the water supply hose to the Bi–Mode, flush it with water to ensure that no debris or particles exist in the hose assembly.

After the high–pressure hose and lance have been properly connected and the pre–operation safety checks completed, the operator may now stance himself for operating the lance. The operator should stand with firm footing and be prepared to react to the **thrust force** generated from the lance operation. The lance should always be pointed at the work area with no other personnel in the immediate area.

3.5.1 – Diesel Pump Unit Operation

NOTE: Applies to NLB diesel–powered units with throttle control

When the operator actuates the operating handle, the water pressure is increased and the engine speed increases to the preset rpm. When the operating handle is released, the water pressure drops to a low level and the engine rpm drops to idle speed.

1. Set the throttle control on the pump unit to the idle position. The throttle is decreased by turning the adjustment handle clockwise and increased by turning the adjustment handle counter–clockwise.

2. Back off the by–pass valve.

3. Engage the PTO clutch. The pump is now operating at idle speed and water is being discharged from the dump port of the Bi–Mode.

4. The lance operator can now engage the air motor trigger first and then engage the front trigger immediately after.

5. Tighten the by–pass valve until the pressure reaches 5,000–8,000 psi.

6. The pump unit operator can now adjust the throttle control to increase engine rpm and the by–pass valve can adjust final water pressure. The pressure should be set just high enough for effective/efficient cleaning of the surface being worked on.

7. The lance operator can stop the cleaning operation by releasing either lance trigger. In a single lance operation, this will redirect the water to the dump port on the Bi–Mode. Decrease the engine speed to idle and decrease water system pressure. In a dual lance operation, the dump port is sized to maintain operating pressure when in the dump mode. Idle speed will not change.

3.5 – Basic Operation Instructions

3.5.2 – Electric Pump Unit Operation

NOTE: Applies to NLB electric–powered units

When the lance operator engages both triggers, the water system pressure is increased to the pressure that has been preset on the by–pass valve.

1. Set the by–pass valve to the full by–pass setting by turning the handle counter–clockwise.

2. Set the disconnect switch lever on the motor starter to the “ON” position.

3. Push the “HIGH PRESSURE PUMP” start button. After the pump starts, allow it to run for approximately 30 seconds before operating the lance.

4. The pump unit is now delivering low pressure water to the dump port on the Bi–Mode.

5. The lance operator can now engage both triggers and the unit operator can adjust the water system pressure at the by–pass valve. The pressure should be set just high enough for effective/efficient cleaning of the surface being worked on.

6. The lance operator can stop the cleaning operation by releasing either lance trigger. In a single lance operation, this will redirect the flow of water from the lance to the dump port on the Bi–Mode and decrease water system pressure. In a dual lance operation, the dump port nozzle is sized to maintain operating pressure for other operators when one of them is in the dump mode.

SECTION 4 – MAINTENANCE AND INTERVAL SCHEDULE

4.1 – Preventative Maintenance Overview

All machine parts will wear in time with equipment use. The wear does not always result in a complete equipment failure condition, but rather a slow process of tolerance loss that can cause gradual deterioration of components. A well–kept and applied program of preventative maintenance is strongly suggested to maintain long life and reliable operation of your NLB equipment.

Preventative maintenance is the systematic care, inspection, and servicing of equipment to detect and correct minor problems before expensive, time–consuming repairs/replacement parts are needed.

NLB strongly recommends that maintenance log sheets be filled out and recorded for each piece of equipment and accessory. They will serve as a master record indicating the condition of each component and when the inspections were performed. Properly filled out and recorded log sheets provide a wealth of information in the service world by aiding in the proper diagnostics of the equipment, if chronic problems persist.

4.2 – Maintenance Safety and Recommended Practices

⚠ WARNING

The safety discussed in this section pertains to common safety practices that should be adhered to while performing any service work to NLB equipment, to avoid damage to the equipment and prevent injury to personnel.

The maintenance safety and recommended practices include the following:

- Remove any loose objects such as trash and oil–soaked rags from the work area.
- Make sure that any equipment to be serviced has been properly shut down and depressurized before beginning repairs.
- Always wear OSHA–approved safety glasses and steel toe boots while servicing equipment.
- Never wear loose fitting clothing or jewelry while servicing equipment.

4.2 – Maintenance Safety and Recommended Practices

- To maintain safety at the highest level, be responsible and avoid horseplay at all times while working in and around equipment.
- All electrical components associated with this system are to be maintained in accordance with approved practices. Never jump wires across terminals or bypass fuses, fuse holders, or circuit breakers.
- Never perform work on any equipment that is only supported by lifting jacks or a hoist. Support stands must always accompany these items before continuing with a repair.
- Make sure that all pressure has been removed from a high–pressure water–jet system before performing repairs. Maintain heightened awareness for possible pressure when disconnecting any accessory from any equipment that utilizes pressure.
- To avoid personal injury, use a chain hoist or assistance from another person when lifting any object that is large in size or weighs more than 50 lbs. (23kg).
- Use care when working on any equipment that has just ceased operating. Components could be hot and cause severe burns.
- Always inspect repair tools for fatigue or damage prior to repairing any equipment. Failure to perform this inspection could result in personal injury.
- Always use NLB replacement parts for NLB equipment and accessories. Failure to do so will result in a void of all warranties, either expressed or implied, and release NLB from all liability.
- Never make unauthorized alterations or modifications without written authorization by NLB. Doing so will result in a void of all warranties, either expressed or implied, and release NLB from all liability.

4.3 – Preventative Maintenance Schedule

Daily or Approximately 8 Hours of Operation

- Water leakage from the weep holes during low system pressure is a normal condition. However, inspection of the swivel assembly weep holes for water leakage at high pressure is necessary. If leakage exceeds 20 drops per minute, the high pressure seal must be replaced.
- Inspect the lance for accumulated dirt/debris buildup. Clean as necessary.
- Inspect the air motor exhaust ports for debris obstruction. Clean as necessary.
- Inspect the lance for damaged components. Replace as necessary.
- Grease the zerk fittings with EP–rated grease.

Weekly or Approximately 40 Hours of Operation

- Replace worn sapphire nozzles.
- Lubricate planetary gear assembly in the air motor.

Monthly or Approximately 160 Hours of Operation

- Flush the air motor with WD–40® or equivalent.

Every 3 Months or Approximately 250 Hours of Operation

- Replace the endless timing belt.
- Inspect the rotating discharge barrel for wear along the bearing mating surface.
- Inspect the rotating barrel bearing for damage or wear. Replace as necessary.
- Inspect the swivel shaft for wear along the seal mating surfaces. Replace as necessary.

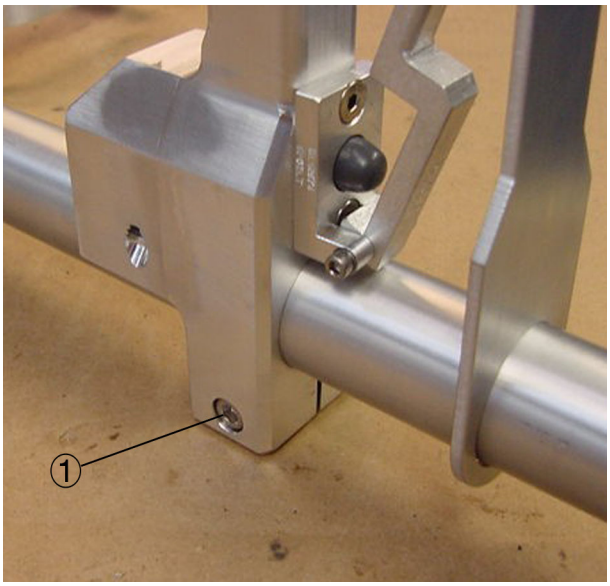
4.4 – Maintenance Record

Maintenance Record

Equipment Serial Number	Date	Hours	Result of Inspection	Parts Repaired/Replaced	Result of Inspection	Technician Initials

4.5 – Maintenance Procedures

4.5.1 – Side Trigger Adjustment



The side trigger can be adjusted by first loosening the side trigger adjustment pinch bolt (1). Adjust the trigger to the desired position on the barrel and re–tighten the pinch bolt.

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SECTION 5 – DIAGNOSTICS

5.1 – Introduction

The diagnostics section of this manual is intended to assist the technician in the repair of the NLB accessory. The diagnostics will aid in identifying the potential cause of a malfunction and establish a strategic action path to repair the failure.

The probable cause of each malfunction is listed; the corrective action is listed next to it, with a brief indication of what is the failure and how to address it.

Use the following guidelines when using these diagnostics to identify the cause of a malfunction:

1. Accurately define the symptom of a concern; this is a vital first step in diagnosing the problem.

2. Locate the concern listed in the diagnostics section that best matches the problem with your equipment.

3. Identify the most probable cause listed for your concern.

4. Use the corrective action procedure as your step towards repair of the accessory.

If the common diagnostics do not aid you in finding the malfunction/failure with your equipment, contact NLB Customer Service Department at (800) 227–7652.

5.2 – Diagnostic Symptom Charts

5.2.1 – Nozzle Head Rotational Speed Slows, Stops or Inoperative

Probable Cause		Corrective Action
1	Excessive Moisture in Air Line – Exhaust Frozen	Drain air tank and check air source. Use KILFROST® air tool oil in system.
2	No Lube Oil in Air System/Lubricator Assembly	Inspect air oil fluid level in lubricator reservoir on Bi–Mode. Fill as necessary. Inspect flow rate setting and adjust if necessary.
3	Lack of Lube Oil in Air System/Lubricator Assembly has Oil	Adjust the drip flow rate on the air lubricator. Recommended flow rate is 30 drops per minute.
4	Air Motor Gummed Up or vanes Swollen	Flush air motor with WD–40® or equivalent. Check for proper air tool oil.
5	Insufficient Air Supply	Inspect the inlet screen on the air motor for restriction/blockage. Check air source for leaks. Adjust air regulator to set air system at specified operating pressure. Minimum 80 psi (5.5 bar) – Maximum 90 psi (6.2 bar)
6	Endless Timing Belt	Inspect the endless timing belt wear/damage. Replace as necessary. Refer to **6.2**.
7	Air Motor Failure	Replace air motor assembly. Refer to **6.3**.
8	Swivel Assembly	Disassemble and inspect the seals, bearings, backup ring, and shaft for damage/wear. Replace as necessary. Refer to **6.6**.

5.2.2 – Cleaning Performance is Insufficient

Probable Cause		Corrective Action
1	Leaking Connections	Inspect and tighten all joints, connections, and nozzles.
2	Worn or Improperly Sized Nozzle Orifices	Replace the nozzles. Refer to **6.11**.

5.2.3 – Excessive Heat Experienced at Rotating Barrel Bearing

Probable Cause		Corrective Action
1	Insufficient Lubrication	Lubricate the zerk fitting with EP–rated grease.
2	Worn/Damaged Bearing	Replace the rotating barrel bearing. Refer to **6.9**.

5.2.4 – Water Leaking from Weep Holes on Swivel at High Pressure

Water leakage from the weep holes during low system pressure is a normal condition. However, inspection of the swivel assembly weep holes for water leakage at high pressure is necessary. Water leakage during high pressure operation should not be in excess of 20 drops per minute.

Probable Cause		Corrective Action
1	High Pressure Seal Worn	Replace the high pressure seal. Refer to **6.5**.
2	Worn/Scored Swivel Shaft	Replace the swivel shaft. Refer to **6.6**.
3	Bent Barrel	Inspect barrel for damage/bends. Replace if necessary. Refer to **6.8**.

5.2 – Diagnostic Symptom Charts

5.2.5 – No High Pressure Water at Nozzles

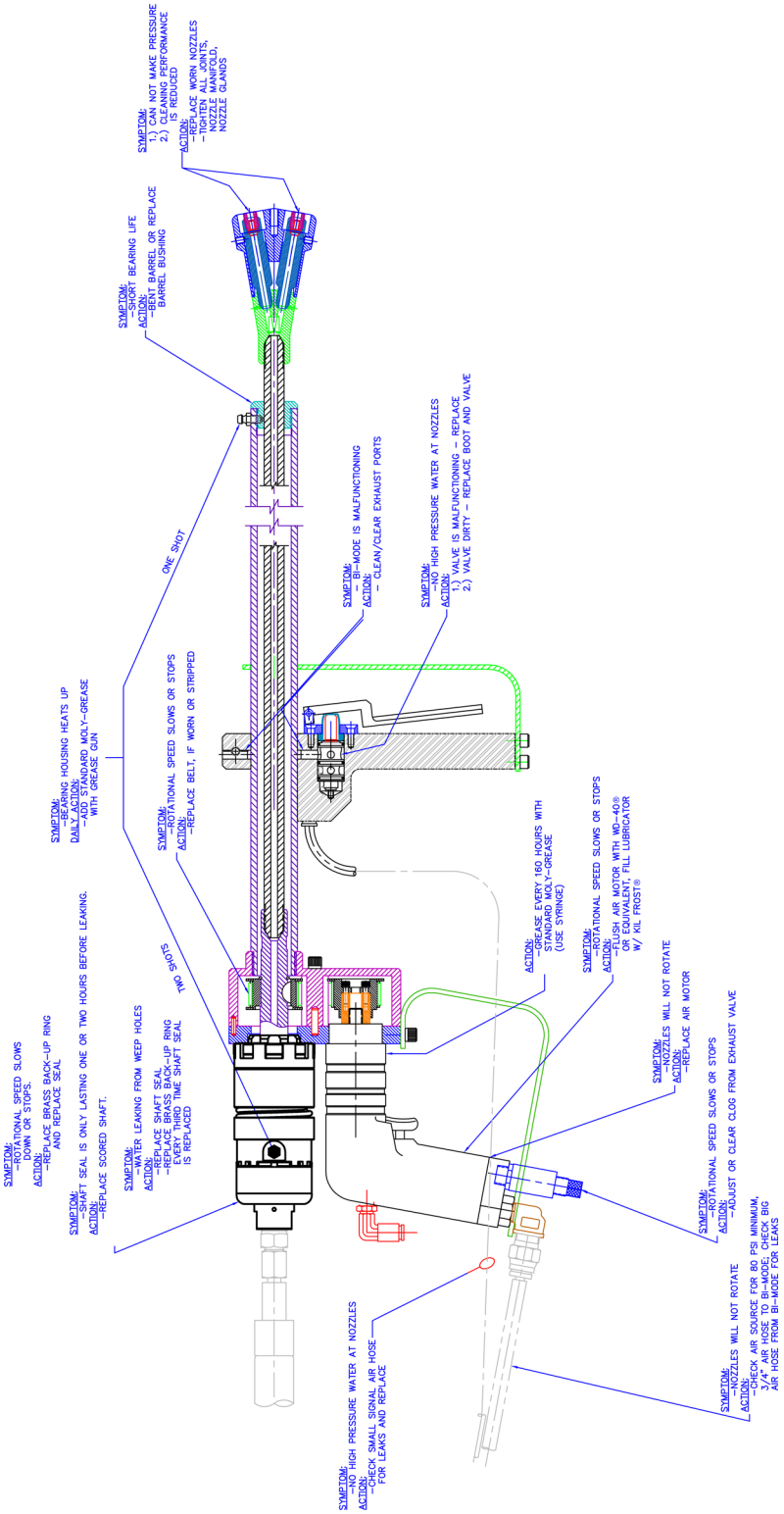
Probable Cause		Corrective Action
1	Air Signal Line	Inspect the air signal line and fittings for leaks. Replace or repair.
2	Side Trigger Valve Damaged/Dirty	Replace the side trigger valve. Refer to **6.10**.

5.2.6 – System Will Not Dump

Immediately remove the equipment from service and contact NLB Customer Support at (248) 624–5555 or (800) 227–7652.

5.3 – Diagnostic Drawing

Drawing DM26687 Revision E



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SECTION 6 – REPAIR

6.1 – Specifications

⚠ WARNING

Prior to performing any maintenance/service repair on the NCG8450A–3, –3L, or –3T lance, disconnect the high–pressure water and compressed air connections or else personal injury can result.

6.1.1 – Mechanical

Item	Value
Material	Stainless Steel and Aluminum
Nozzle Rotation (maximum)	3000 rpm

6.1.2 – Performance

Item	Value
Working Pressure (Maximum)	40,000 psi (2,800 bar)
Volume (Maximum)	6 gpm (22.7 lpm)

6.1.3 – Air Requirements

22 SCFM of air @ 80 psi (5.5 bar) to a maximum of 90psi (6.2 bar) is required.

Use of KILFROST® SAE 10W oil is recommended in high humidity areas.

6.1.4 – Torque Values

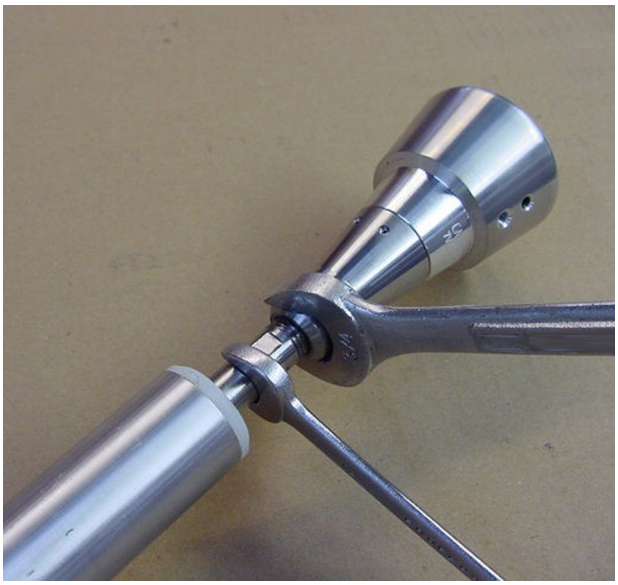
Item	English	Metric	Material
90° Air Line Elbow @ Air Motor Handle			Teflon® Tape and Anti–seize
Air Flow Control Valve @ Air Motor			Teflon® Tape and Anti–seize
Air Motor Mounting Plate Pinch Bolt			Anti–seize
Air Motor Drive Shaft			Anti–seize
Air Motor Sprocket Bolts			Anti–seize
Bearing Nut	15 lb–ft	20 N·m	Anti–seize
Discharge Barrel Housing			Anti–seize
Drive Belt Cover Bolts			Anti–seize
Nozzle Hub Set Screws			242 Blue Loctite®
Nozzle Orifice Holder			Anti–seize
Nozzle Retainer Gland	20 lb–ft	27 N·m	Anti–seize
Outlet End Cap Bolts	11 lb–ft	15 N·m	Anti–seize
Rotating Discharge Barrel			Anti–seize
Side Trigger Mounting Pinch Bolt			Anti–seize
Swivel Mounting Plate Bolts			Anti–seize
Trigger Bracket Bolts			242 Blue Loctite®
Trigger Guard Mounting Bolts			Anti–seize
Trigger Pivot Bolt Threads			242 Blue Loctite®

6.1.5 – Lubrication

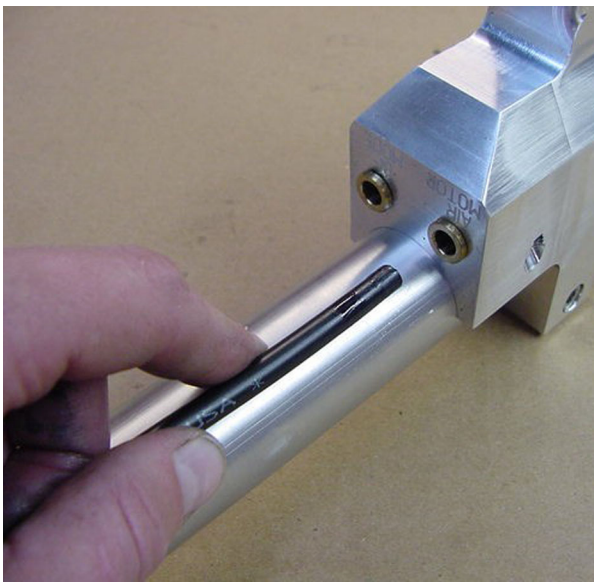
NLB recommends the use of extreme pressure (EP) rated grease for the lubrication of the NCG8450A–3, –3L, and –3T Rotating Lances.

6.2 – Endless Timing Belt Replacement

Removal

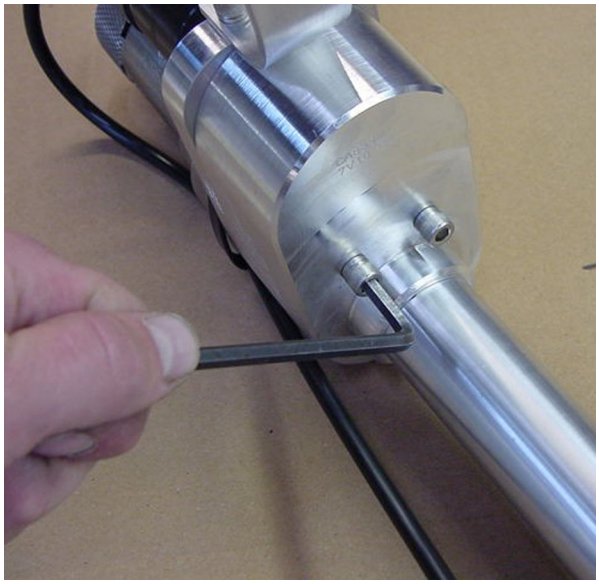


1. Remove the rotating nozzle hub assembly.

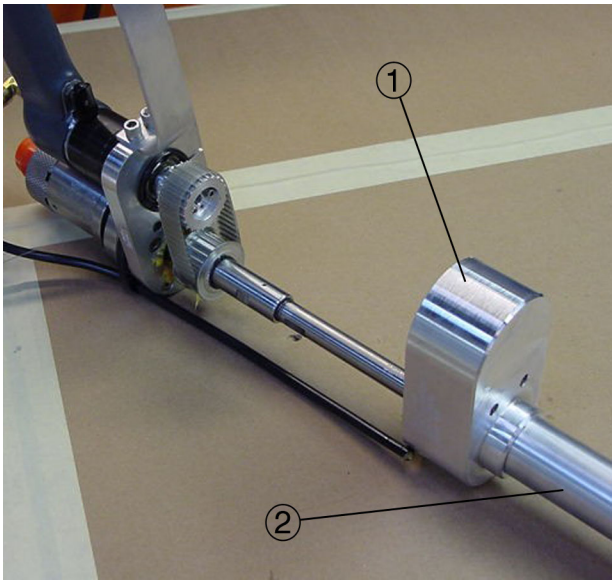


2. Disconnect the air signal line from the air motor port on the side trigger assembly.

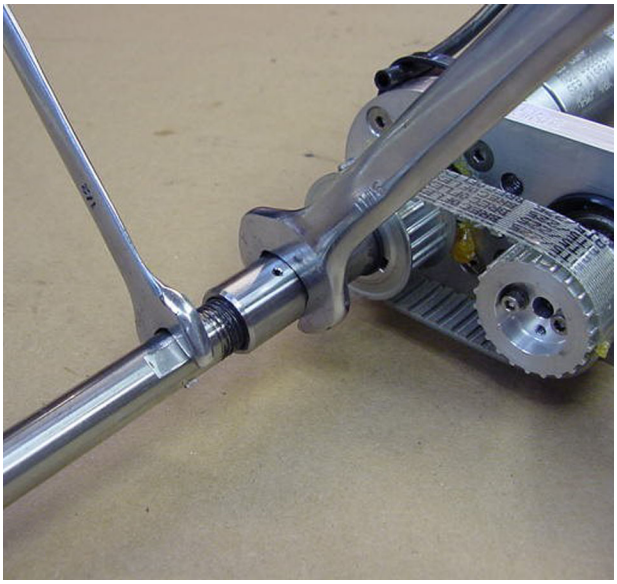
6.2 – Endless Timing Belt Replacement



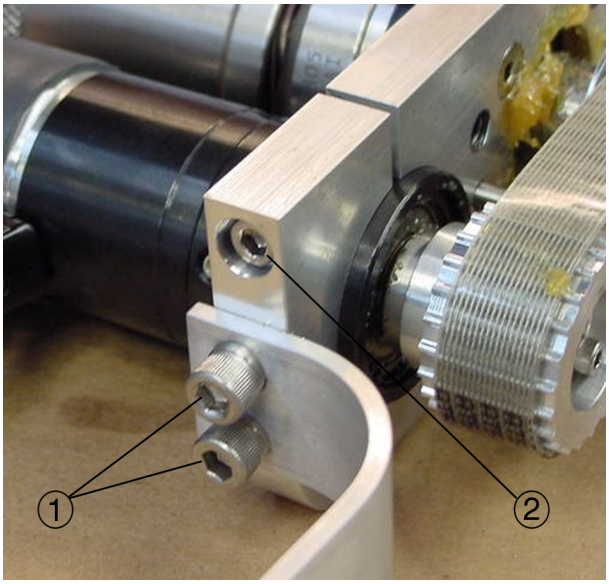
3. Remove the two belt drive cover bolts.



4. Remove the belt drive cover (1) and discharge barrel housing (2) from the lance as an assembly.

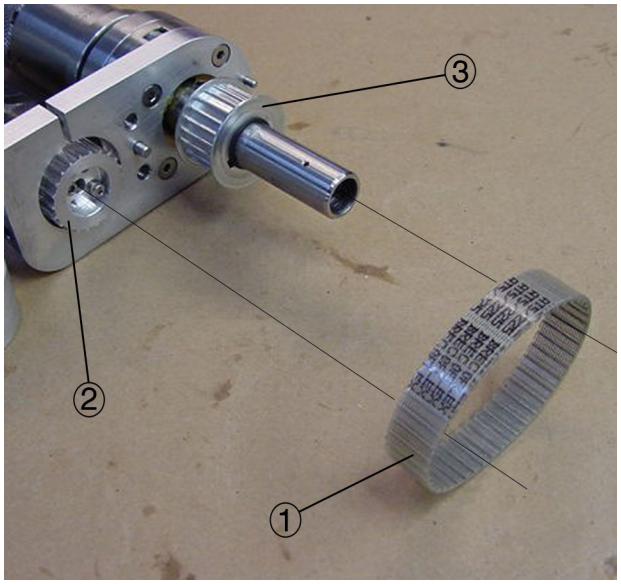


5. Disconnect the rotating discharge barrel from the swivel shaft.



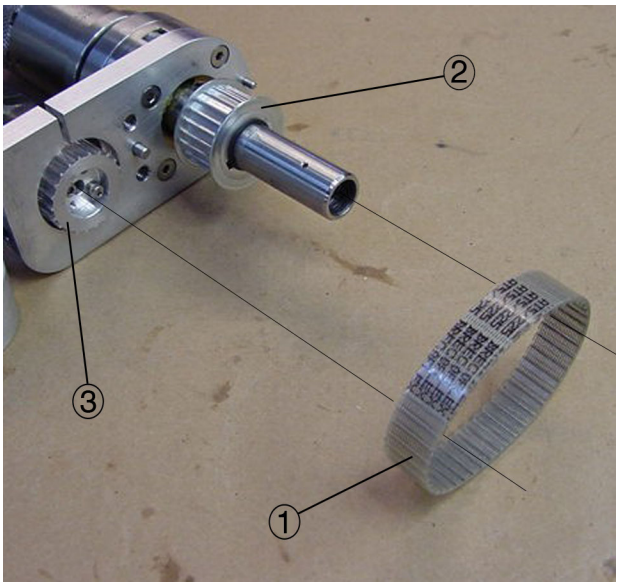
6. Remove the two trigger guard bolts (1) and loosen the air motor mounting bracket pinch bolt (2).

6.2 – Endless Timing Belt Replacement

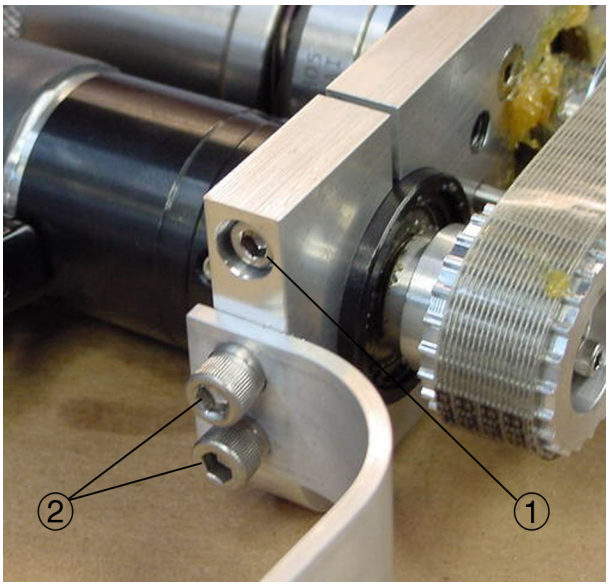


7. Slide the air motor away from the mounting plate at this time the belt (1) will slide off of the driver sprocket (2). Next remove the belt (1) from the driven sprocket (3).

Reinstallation

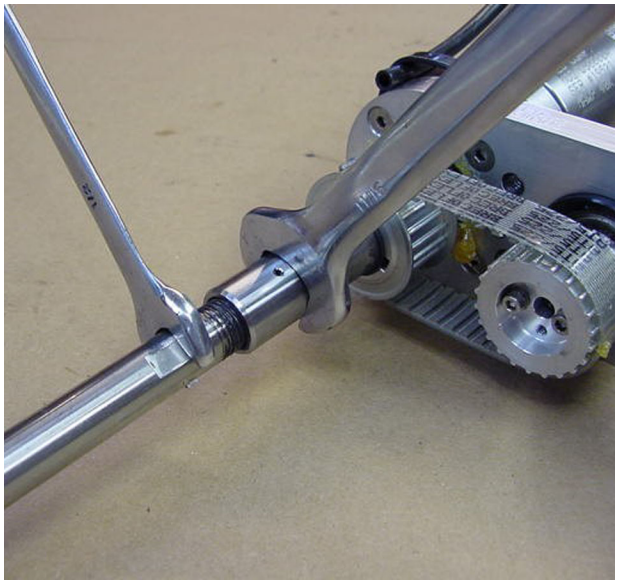


1. Place the belt (1) onto the driven sprocket (2), and slide the air motor back into the mounting plate while installing the belt (1) onto the driver sprocket (3).

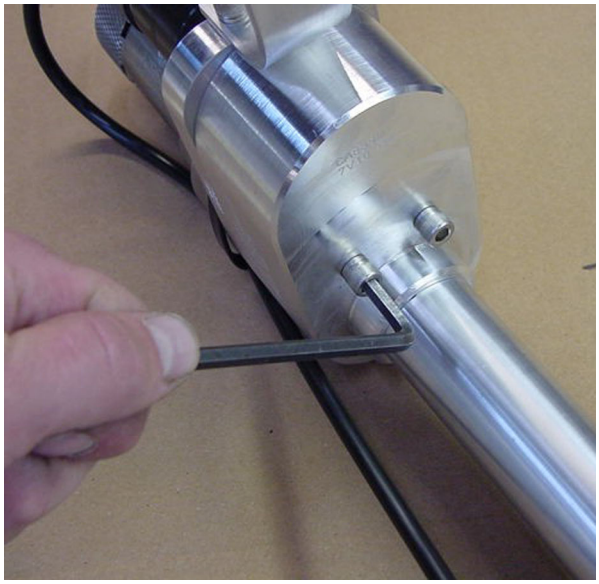


2. Tighten the air motor mounting bracket pinch bolt (1). Make sure the shoulder on the air motor is positioned flush with the mounting bracket before tightening the pinch bolt. Place a small amount of anti–seize on the threads on the two trigger guard bolts (2) and install them through the trigger guard, into the mounting plate.

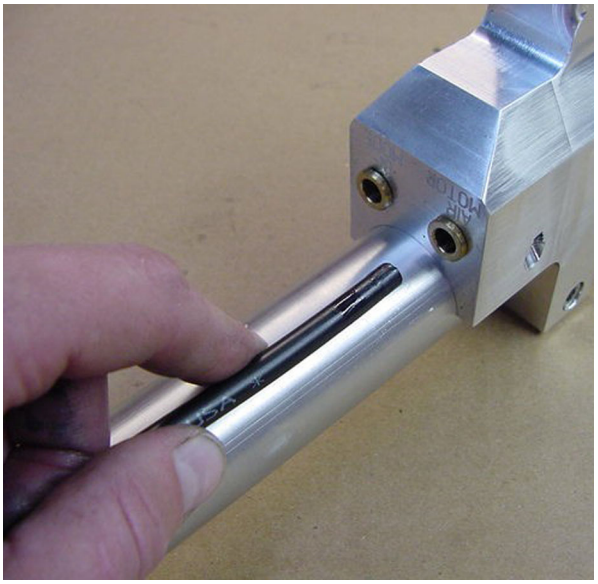
6.2 – Endless Timing Belt Replacement



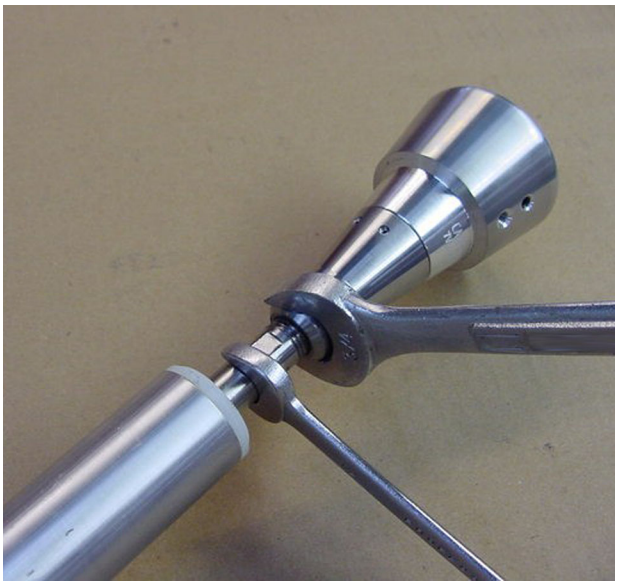
3. Place anti–seize on the threads of the rotating discharge barrel and install it to the swivel shaft.



4. Position the drive belt cover and discharge barrel housing assembly onto the lance. Place anti–seize on the threads of the two belt drive cover bolts and install them to the cover.



5. Connect the air signal line to the air motor port on the side trigger assembly.

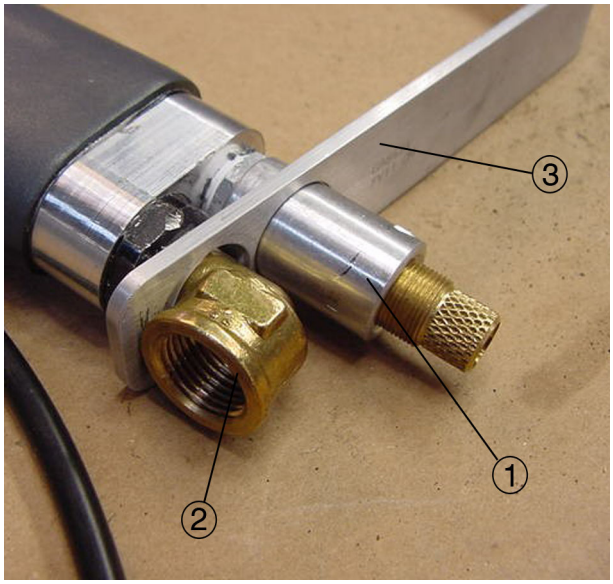


6. Place anti–seize on the threads of the rotating discharge barrel and install the rotating nozzle hub assembly.

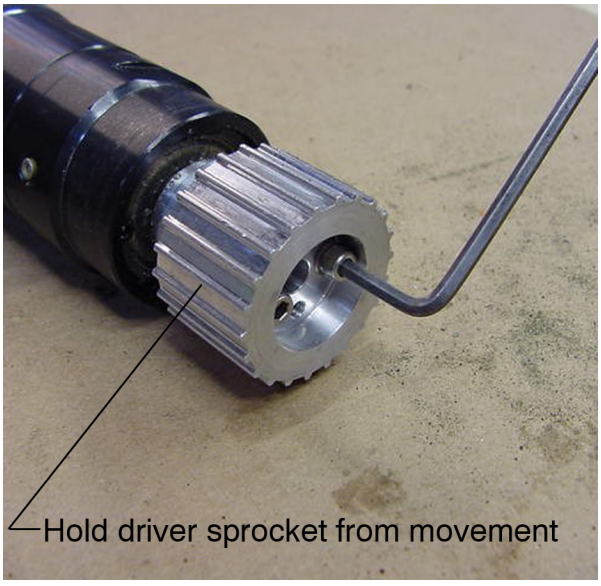
6.3 – Air Motor Replacement

Removal

1. Remove the endless timing belt. Refer to **6.2**.



2. Remove the air flow control valve (1) and the 90° elbow (2) from the air motor handle. The trigger guard (3) will also be removed at this time.



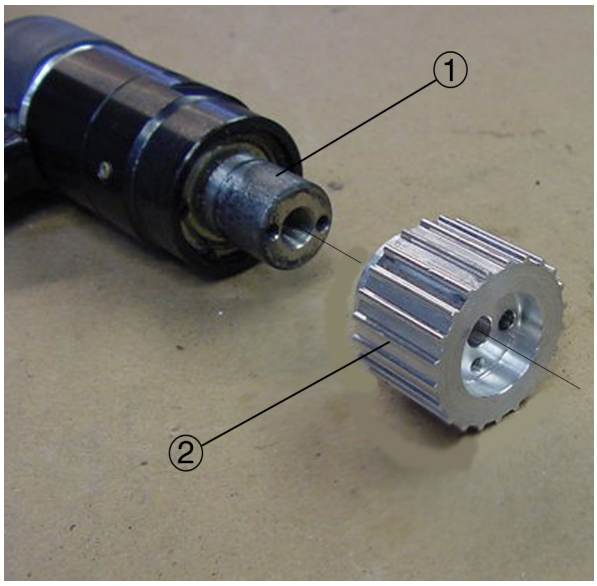
3. While holding the driver sprocket from movement, remove the two driver sprocket mounting screws. After the screws have been removed, the driver sprocket will slide off of the air motor shaft.

4. Remove the 90° air line fitting from the rear of the air motor assembly.

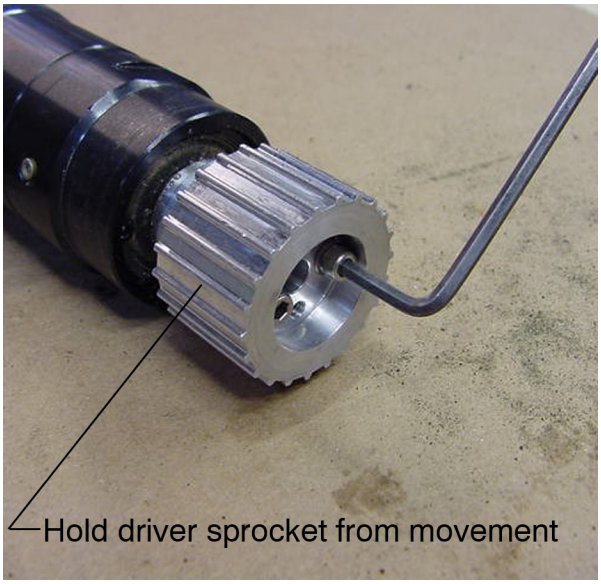
6.3 – Air Motor Replacement

Reinstallation

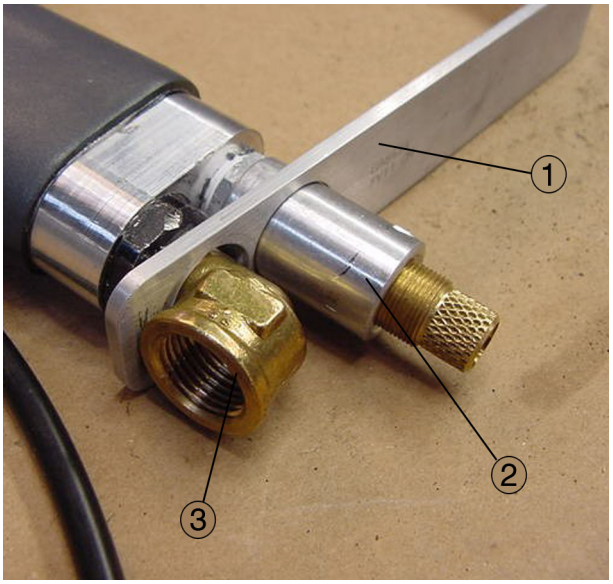
1. Install the 90° air line fitting to the rear of the air motor assembly.



2. Place a small amount of anti–seize on the air motor shaft (1) and position the driver sprocket (2) onto the shaft.



3. Place a small amount of anti–seize on the threads of driver sprocket screws. While holding the driver sprocket from movement, install the two driver sprocket mounting screws.



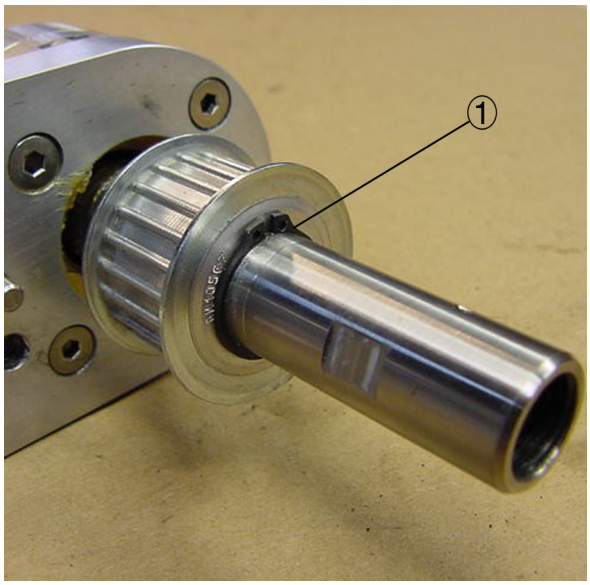
4. Position the trigger guard to the air motor handle (1). Apply Teflon tape, then a small amount of anti–seize on the threads of the air flow control valve (2) and the 90° elbow (3). Install the air flow control valve (2) and the 90° elbow (3) through the trigger guard (1) and into the air motor handle.

5. Install the endless timing belt. Refer to **6.2**.

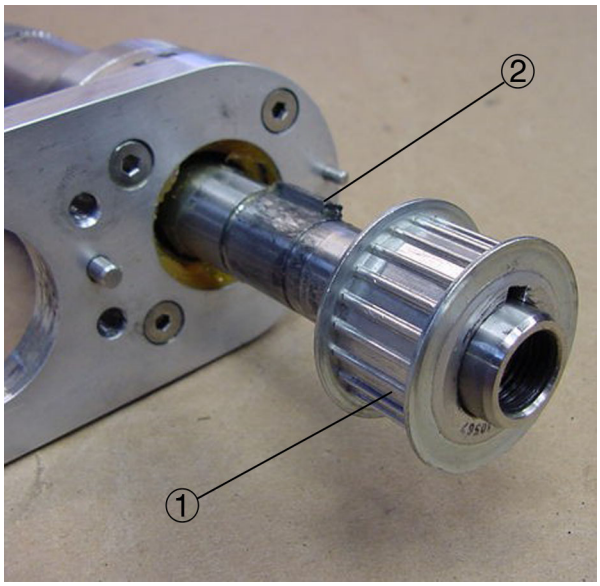
6.4 – DS8850A Rotating Swivel Replacement

Removal

1. Remove the endless timing belt. Refer to **6.2**.

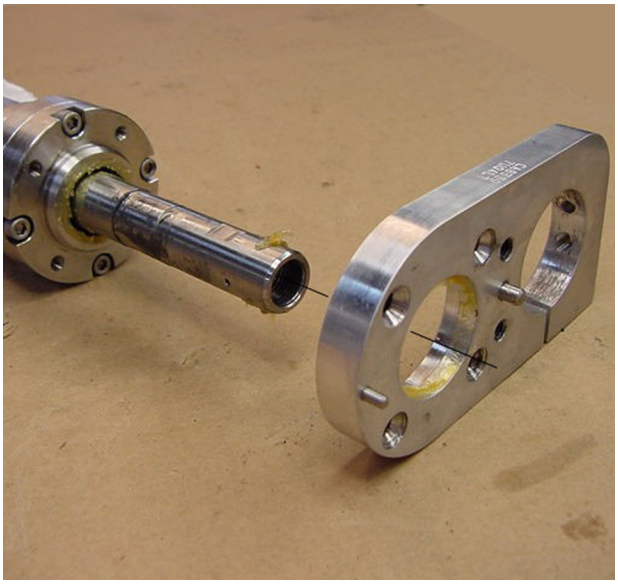


2. Remove the snap ring (1) from the swivel shaft.



3. Remove the driven sprocket (1) and the woodruff key (2) from the swivel shaft.

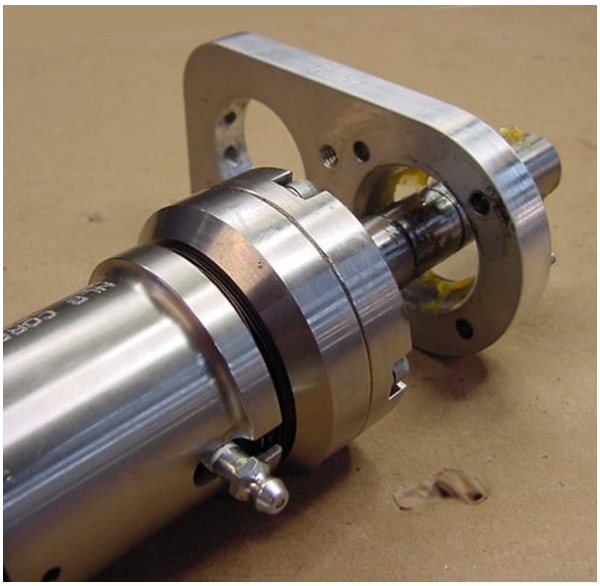
4. Remove the four rotating swivel mounting screws.



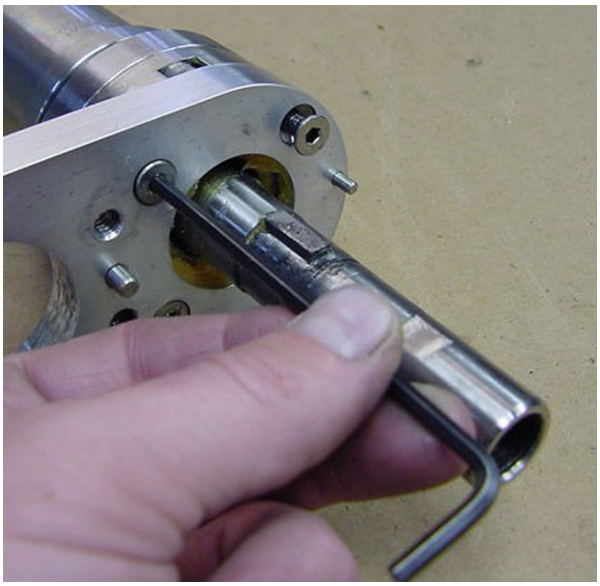
5. Separate the rotating swivel from the mounting plate.

6.4 – DS8850A Rotating Swivel Replacement

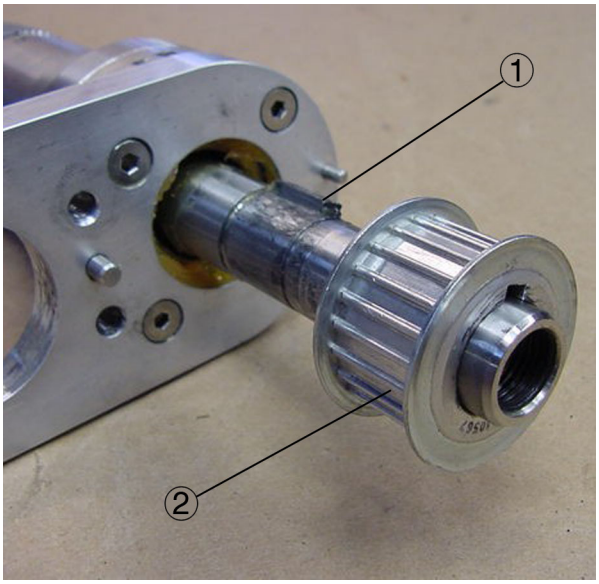
Reinstallation



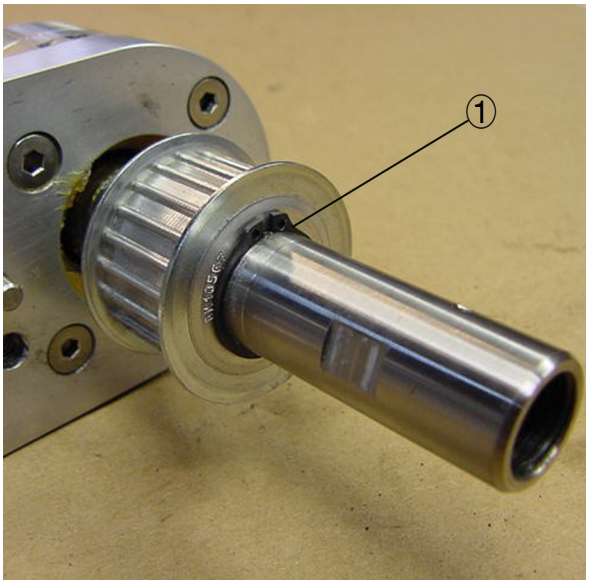
1. Position the rotating swivel into the mounting plate. Make sure that the swivel is positioned so that the zerk fitting will be located on the top of the lance.



2. Place a small amount of anti–seize on the threads of the four rotating swivel mounting screws, install them through the mounting plate and into the swivel.



3. Install the woodruff key (1) onto the swivel shaft and place a small amount of anti–seize onto the shaft. Install the driven sprocket (2) onto the swivel shaft.



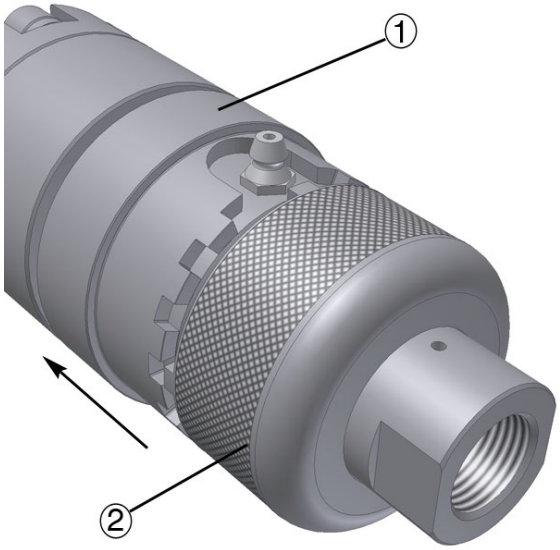
4. Install the snap ring (1) onto the slotted groove on the swivel shaft.
5. Install the endless timing belt. Refer to **6.2**.

6.5 – DS8850A High Pressure Seal Replacement

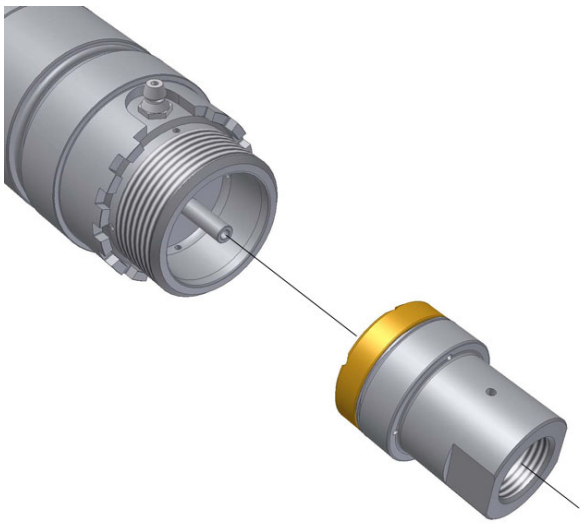
NOTICE

Whenever service to the H.P. seal or o–ring is necessary, use care not to scratch the bore of the seal housing. If the seal housing bore becomes scratched, the sealing surface has been compromised and the seal housing must be replaced.

Removal

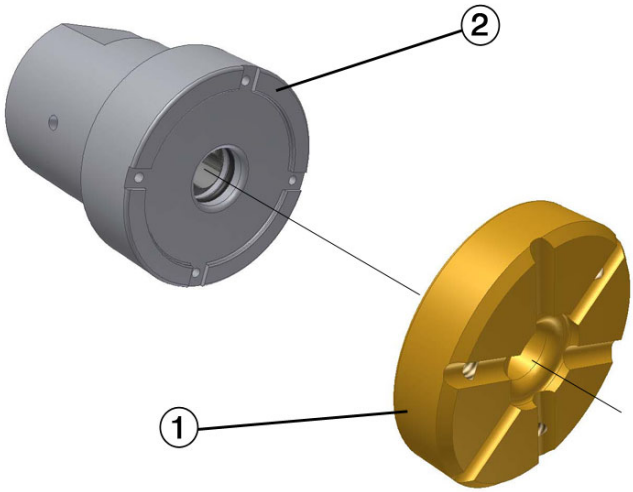


1. Push the anti–rotation sleeve (1) forward and unscrew the inlet endcap (2).



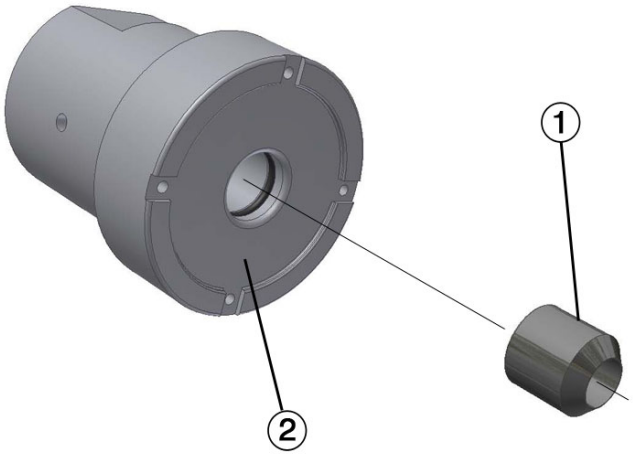
2. Remove the seal housing. During removal of the seal housing, the H.P. seal, o–ring, and backup ring will also be removed with it from the rotating swivel.

- Inspect the swivel shaft at the H.P. seal mating surface for any brass or plastic buildup. Buildup can be removed by use of a non–abrasive component cleaner, such as Scotch–Brite® or crocus cloth.

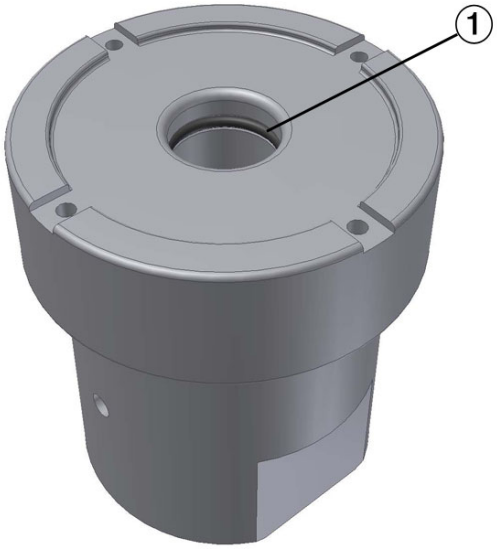


3. Remove the backup ring (1) from the seal housing (2). To ease the removal of the backup ring, use a twist and pull motion to overcome the holding force of the o–ring.

6.5 – DS8850A High Pressure Seal Replacement



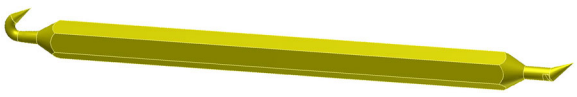
4. Remove the H.P. seal (1) from the seal housing (2). Make sure that all seal material is removed from the seal housing.



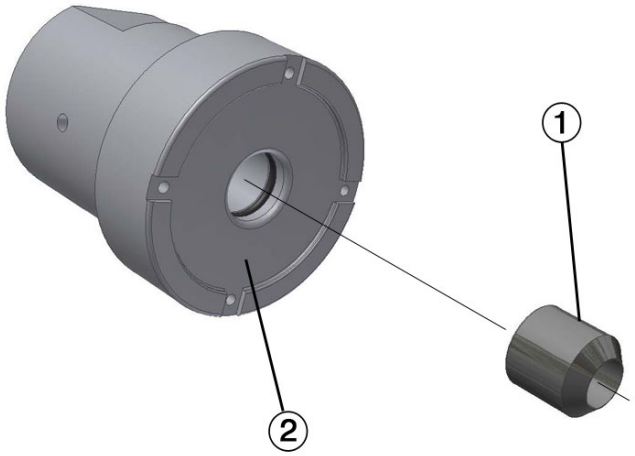
5. Inspect the o–ring (1) for damage or excessive wear. Replace if necessary.

NOTICE

Use the supplied special tool (PM33713, pictured below) to remove the O–ring (part AA–1045) that is located in the seal housing of the 8850 swivel. Removing the O–ring with anything other than this plastic tool can result in damage to the seal housing and a significant reduction in seal life.

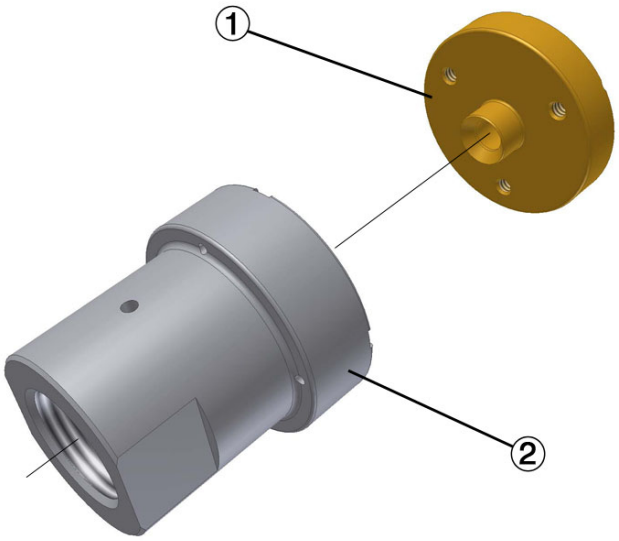


Reinstallation



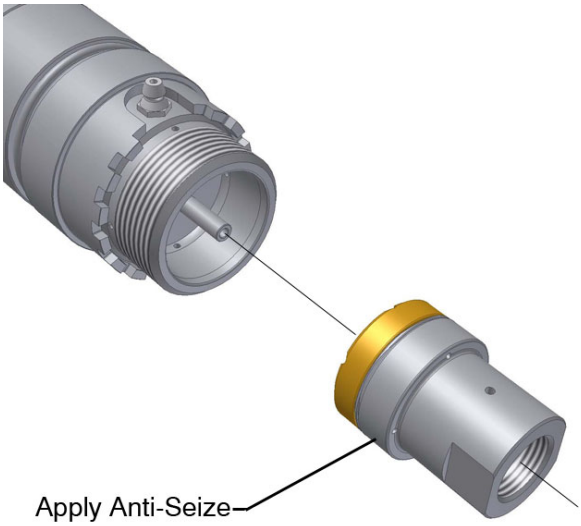
1. Ensure the o–ring is fully seated in its groove, using the special tool PM33713 if necessary, then install the H.P. seal (1) into the seal housing bore (2). During installation, make sure that the flat end of the seal is inserted in the housing first. *Tip: You may use the backup ring (without grease) to help push the seal into place.*

After the seal is in place, verify that the o–ring is still seated properly and was not pinched or sheared by the seal being pushed past it. If it was damaged, remove the o–ring and reinstall a new one.

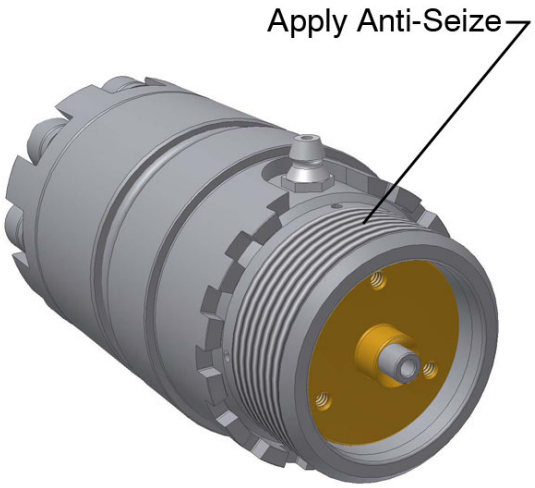


2. Install the backup ring (1) to the seal housing (2). Use of a light food grade grease on the shaft of the backup ring is recommended to ease installation.

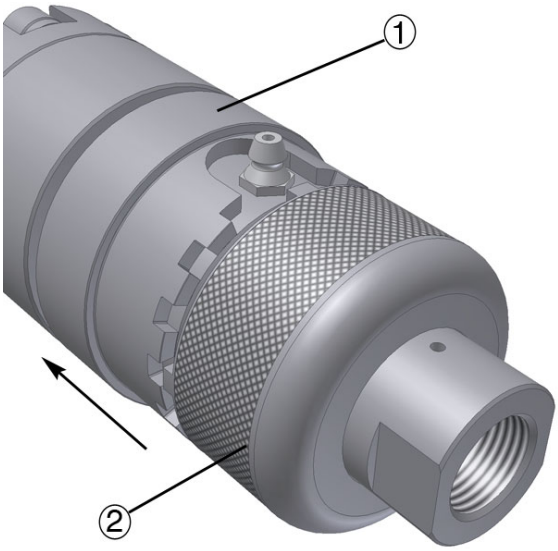
6.5 – DS8850A High Pressure Seal Replacement



3. Apply anti–seize to the O.D. of the seal housing and position it, along with all the assembled components, into the rotating swivel.



4. Apply anti–seize on the threads on the rotary seal body.



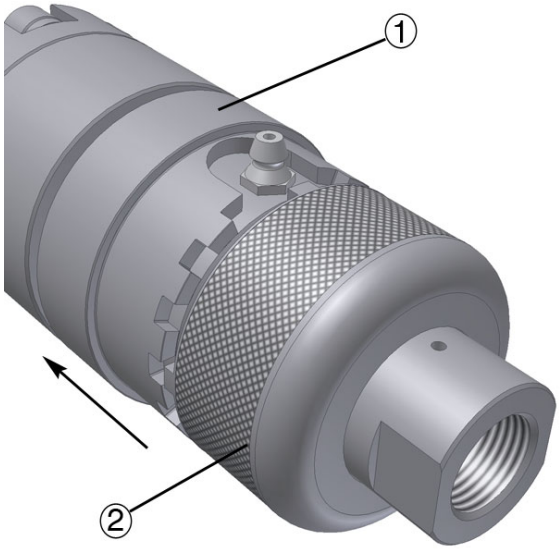
5. Push the anti–rotation sleeve (1) forward and screw the inlet endcap (2) to the rotary seal body. When the inlet endcap is tight, release the anti–rotation sleeve. Spring tension will hold the notch in the sleeve against the tab on the endcap to ensure that no movement occurs.

6. Grease the zerk fitting with EP–rated grease to lubricate the bearings.

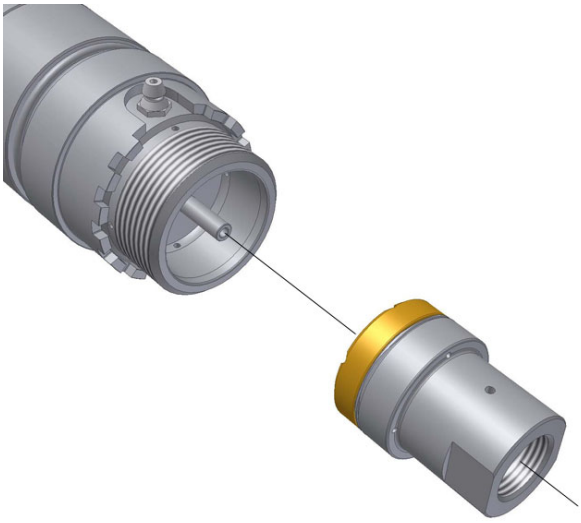
6.6 – DS8850A Rotating Swivel Disassembly and Assembly

Disassembly

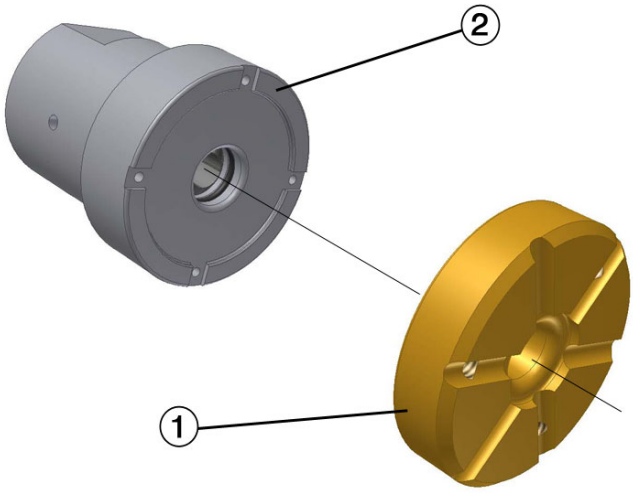
7. Remove the rotating swivel assembly from the NCG8450A–3 lance. Refer to **6.4**.



8. Push the anti–rotation sleeve (1) forward and unscrew the inlet endcap (2).



9. Remove the seal housing. During removal of the seal housing, the H.P. seal, o–ring, and backup ring will also be removed with it from the rotating swivel.

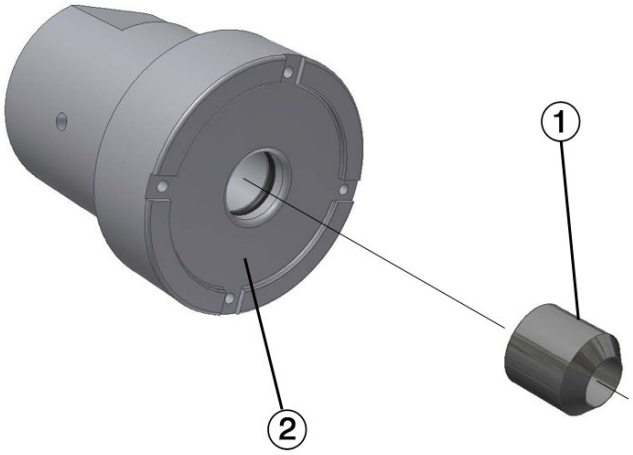


10. Remove the backup ring (1) from the seal housing (2). To ease the removal of the backup ring, use a twist and pull motion to overcome the holding force of the o–ring.

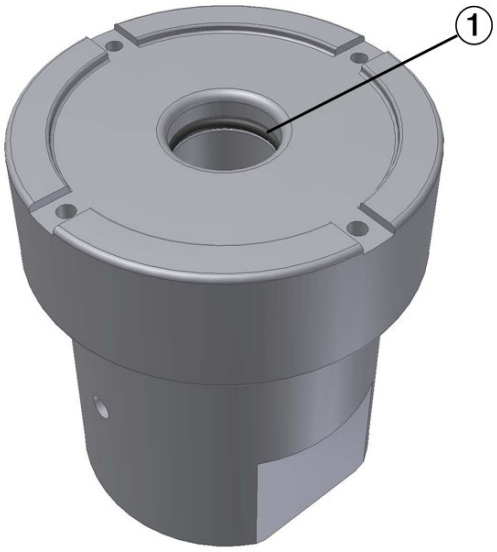
NOTICE

Whenever service to the H.P. seal or o–ring is necessary, use care not to scratch the bore of the seal housing. If the seal housing bore becomes scratched, the sealing surface has been compromised and the seal housing must be replaced.

6.6 – DS8850A Rotating Swivel Disassembly and Assembly



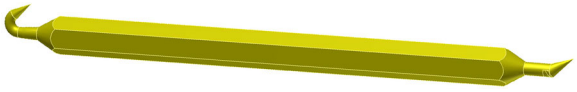
11. Remove the H.P. seal (1) from the seal housing (2). Make sure that all seal material is removed from the seal housing.

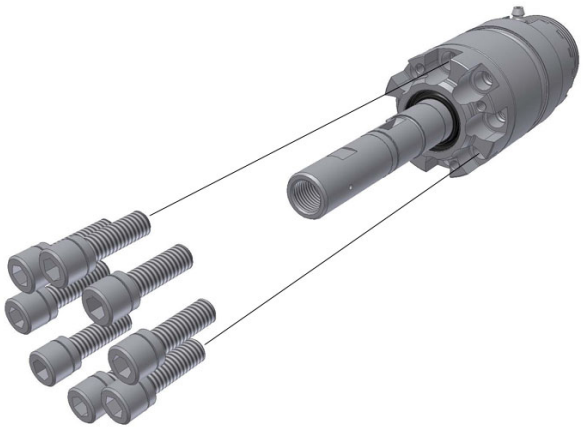


12. Inspect the o–ring (1) for damage or excessive wear. Replace if necessary.

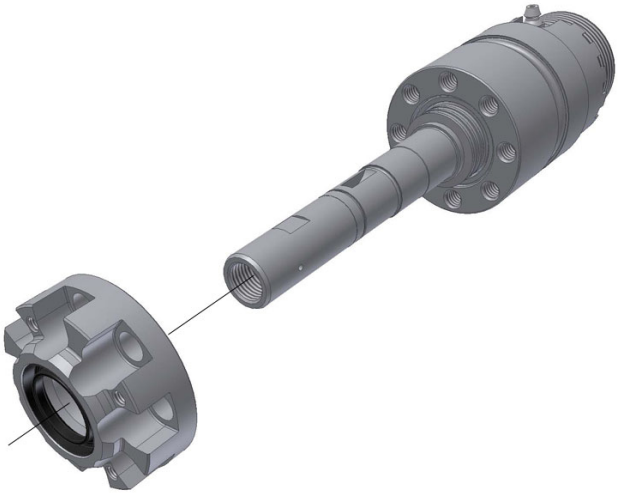
NOTICE

Use the supplied special tool (PM33713, pictured below) to remove the O–ring (part AA–1045) that is located in the seal housing of the 8850 swivel. Removing the O–ring with anything other than this plastic tool can result in damage to the seal housing and a significant reduction in seal life.



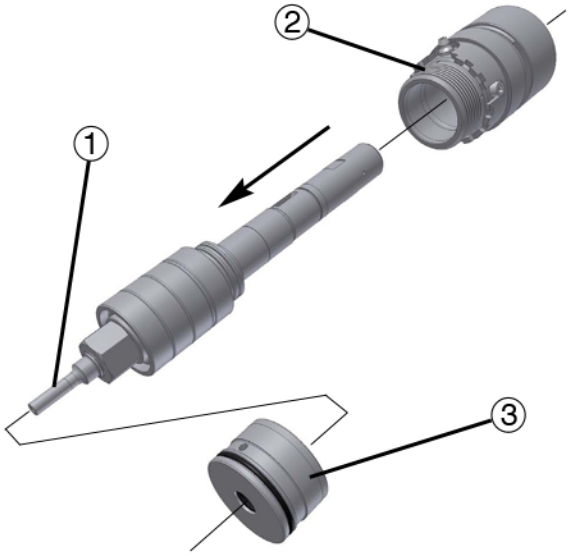


13. Remove the eight outlet endcap bolts.

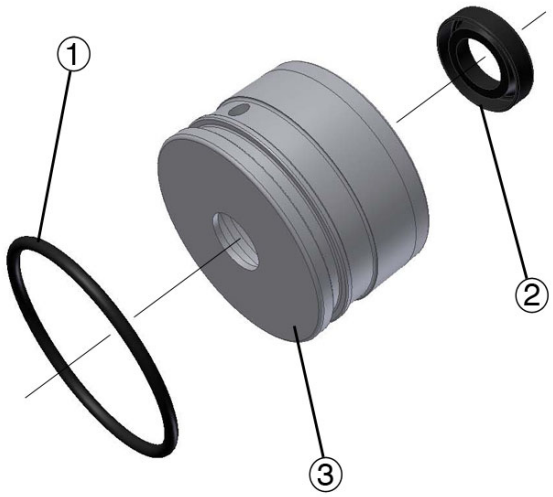


14. Remove the endcap. Inspect the endcap seal for wear or damage. Replace if necessary.

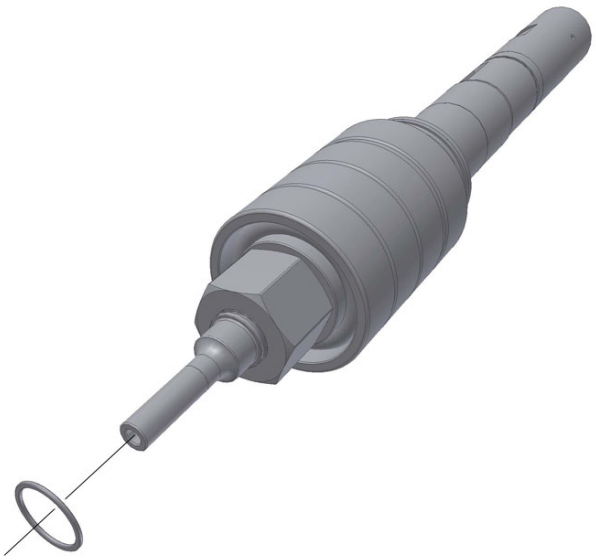
6.6 – DS8850A Rotating Swivel Disassembly and Assembly



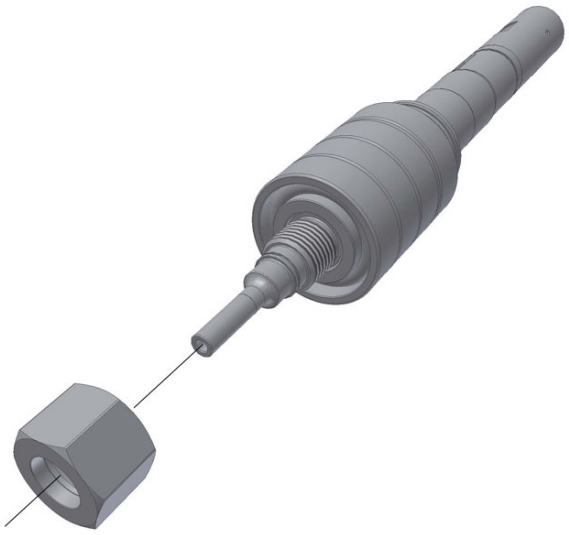
15. While holding the swivel body (2) from movement, gently tap the end of the swivel shaft (1) to remove it from the body. At this time the thrust spacer (3) will be removed, along with the lip seal o–ring.



16. Remove the o–ring (1) and the lip seal (2) from the thrust spacer (3).

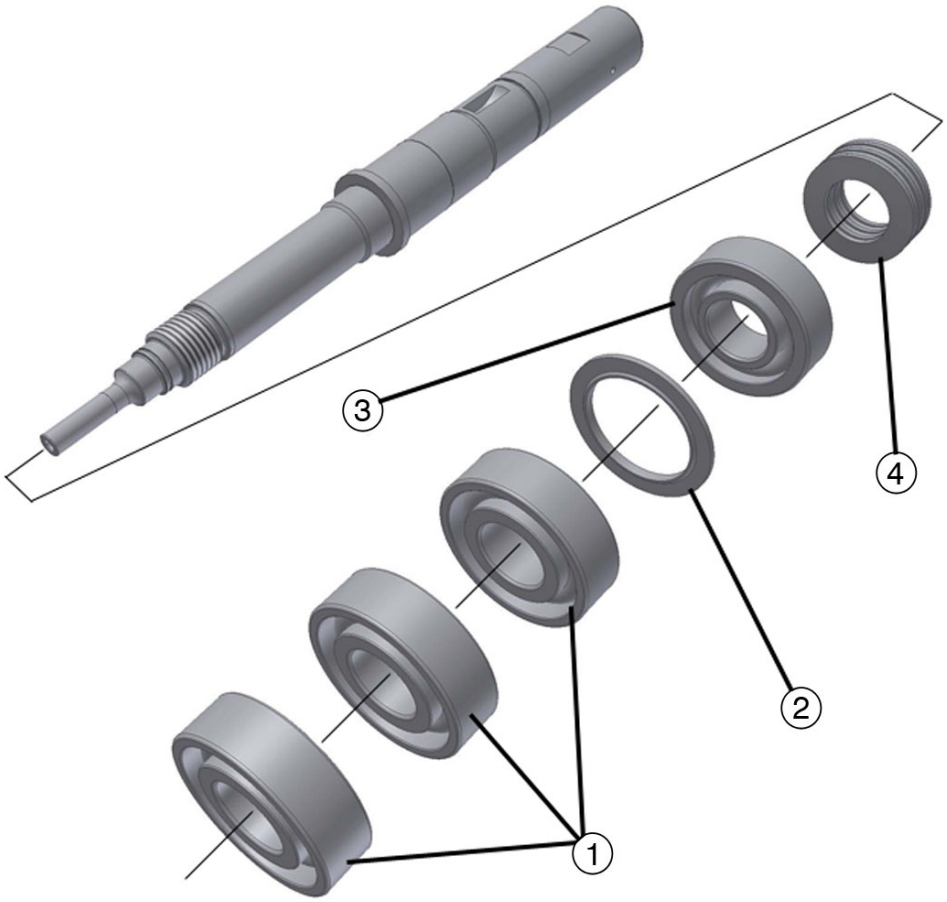


17. Remove the retaining ring from the swivel shaft.



18. Remove the bearing nut from the swivel shaft.

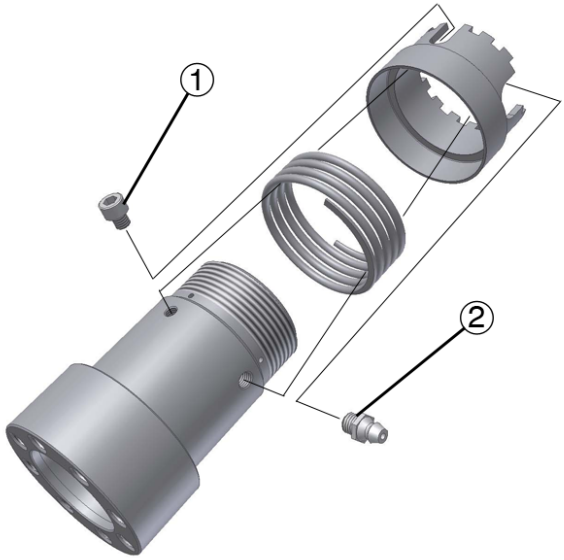
6.6 – DS8850A Rotating Swivel Disassembly and Assembly



19. Remove the three bearings (1), the bearing spacer (2), the remaining bearing (3), and the six spring discs from the swivel shaft.

- Inspect the bearings for ball damage or corrosion. Replace if necessary.
- Inspect the swivel shaft at the H.P. seal mating surface for any brass or plastic buildup. Buildup can be removed by use of a non–abrasive component cleaner, such as Scotch–Brite® or crocus cloth.
- Inspect for scoring and wear along the swivel shaft. Make sure that no damage or wear exists in the areas where the seals make contact with the shaft.

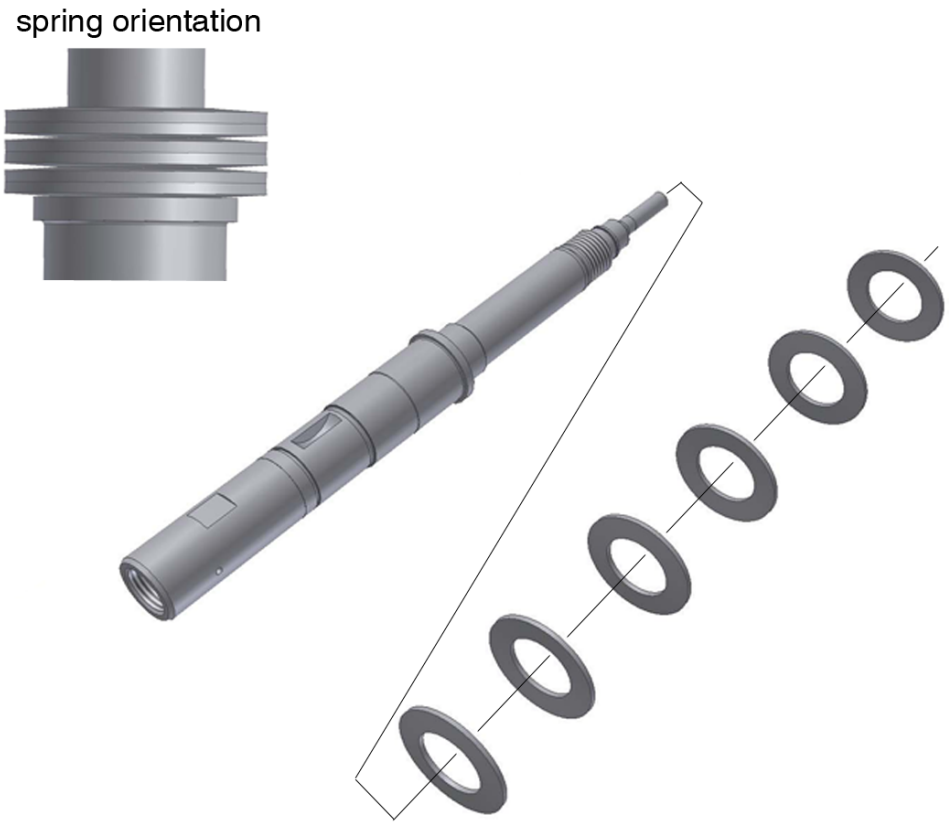
20. Inspect the anti–rotation sleeve and spring assembly for any binding or sticking.
    - If binding or sticking exists, move to the following step.
    - If normal operation is observed, move to the reassembly procedure.



21. Remove the grease zerk fitting (2) and the retaining bolt (1) to remove the spring and retaining sleeve. Clean all debris that may exist inside the sleeve and spring area. During reassembly, place Loctite® on the threads of the retaining bolt (1) and use anti–seize on the threads of the grease zerk fitting.

6.6 – DS8850A Rotating Swivel Disassembly and Assembly

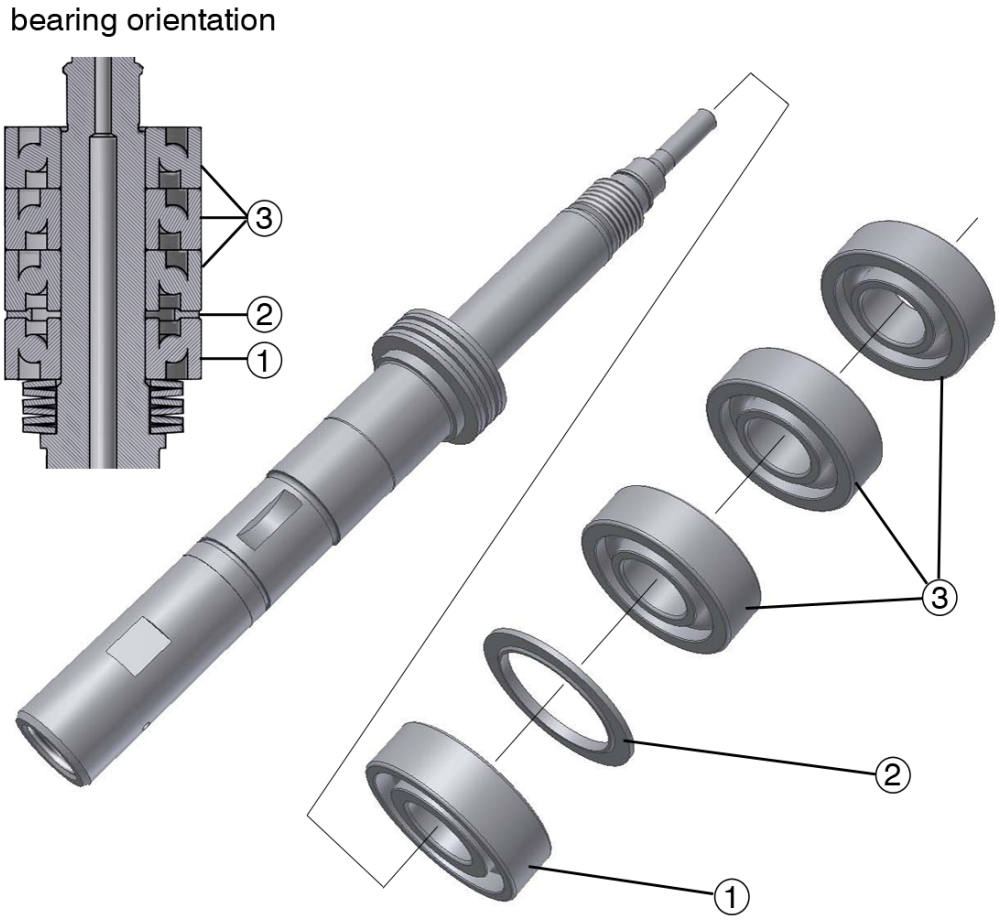
Reassembly



1. Install the six spring discs onto the swivel shaft. Make sure to position them on the shaft in the orientation shown in the illustration. This produces the proper bearing preload when the rotary seal is assembled. It is also important during installation of the spring discs to keep their outer diameters uniformly aligned or else binding of the swivel will occur.

NOTICE

Be sure to keep the outer diameters of the spring disks uniformly aligned or else binding of the swivel will occur.



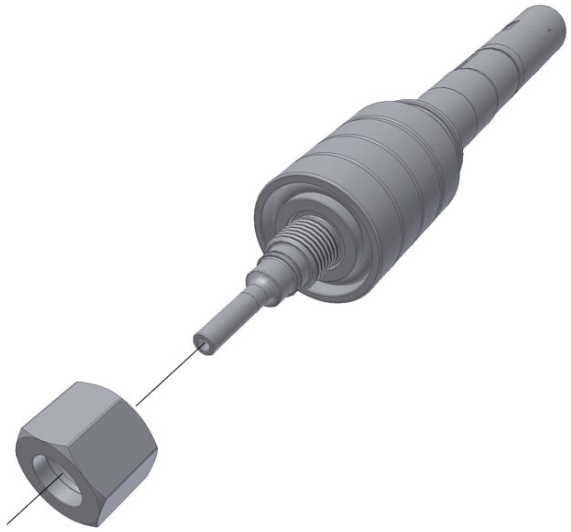
2. Install the following components in the order directed below. Note the orientation of the angular contact bearings. Proper orientation is crucial for optimum bearing life. Refer to the illustration in this step for assistance.

a. Install the bearing (1) onto the swivel shaft. The directional orientation of this bearing is positioned in the opposite direction of the remaining bearings (3).

b. Install the bearing spacer (2) onto the swivel shaft.

c. Install the three bearings (3) onto the swivel shaft. They must be positioned in the same directional orientation.

6.6 – DS8850A Rotating Swivel Disassembly and Assembly

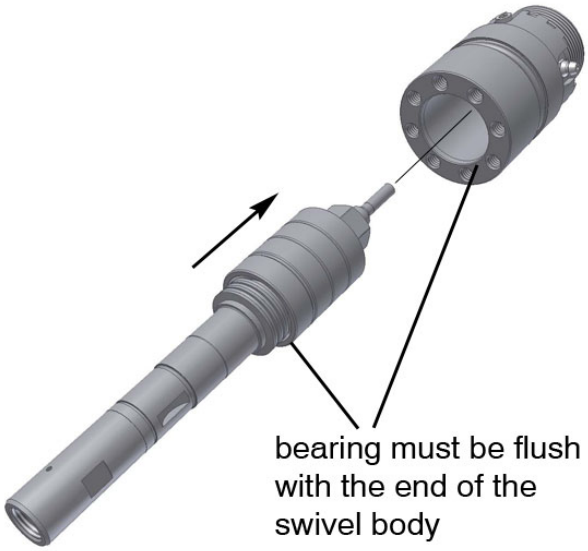


3. Apply a small amount of anti–seize on the threads of the swivel shaft. Start to install the bearing nut onto the swivel shaft. Prior to tightening the bearing nut, make sure that the bearing spacer is centered between the two bearings.

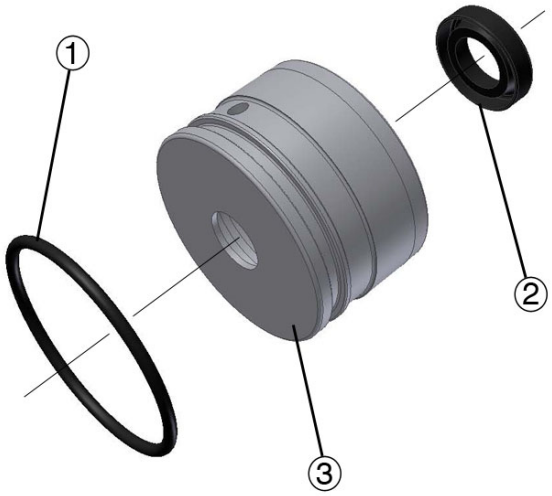
Tighten to 15 lb–ft (20 Nm).

4. Install the retaining ring onto slotted groove of the swivel shaft.

- Hold the four bearing O.D. races and rotate the shaft to check for free rotation. If binding occurs, inspect the bearings for proper orientation and fit on the shaft. Also inspect the six spring discs to make sure that their outer diameters are uniformly aligned.



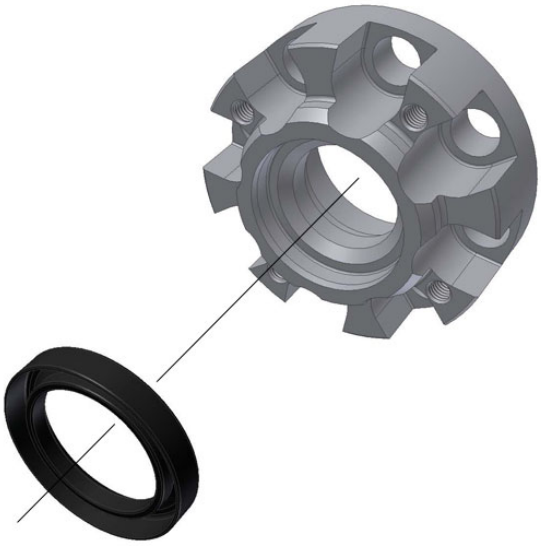
5. Install the swivel shaft, spring washer and bearing assembly into the swivel body. During installation, the last bearing must be flush with the swivel body.



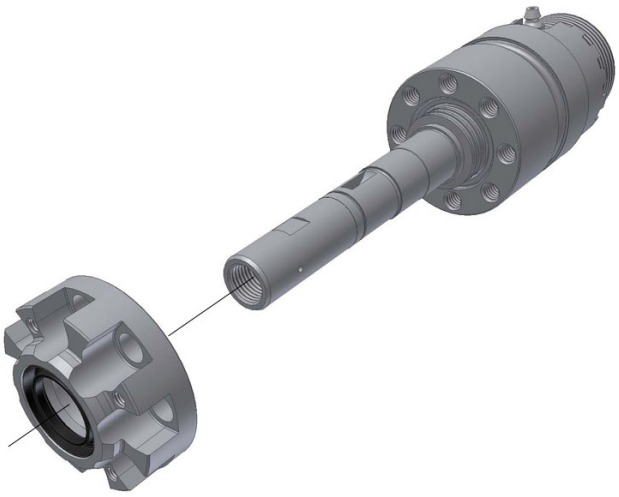
6. Install the o−ring (1) onto the slotted groove on the outer diameter of the thrust spacer (3). Place the lip seal (2) into the inner diameter of the thrust spacer (3). Make sure that the seal is positioned with the lip towards the inner shoulder on the thrust spacer.

6.6 – DS8850A Rotating Swivel Disassembly and Assembly

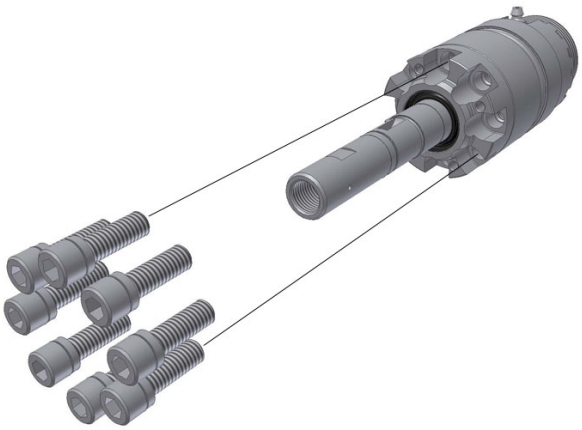
7. Apply a small amount of EP–rated grease to the o–ring seal and install the thrust spacer into the swivel bore.



8. Install the lip seal into the endcap. Made sure the lip on the seal is positioned facing outward.



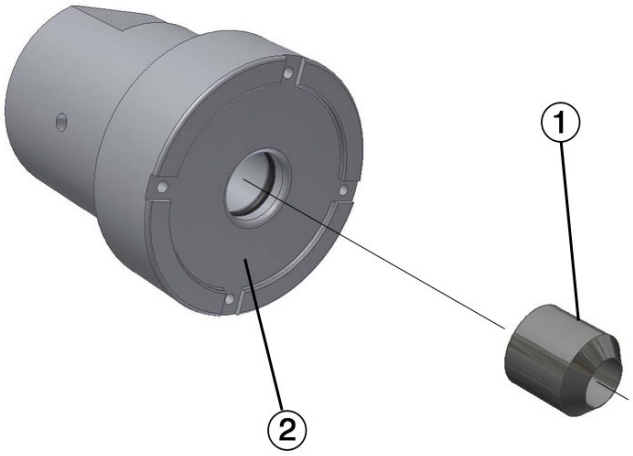
9. Install the endcap onto the swivel shaft and position it against the swivel body.



10. Apply a small amount of anti−seize on the threads of the eight outlet endcap bolts and install them into the endcap.

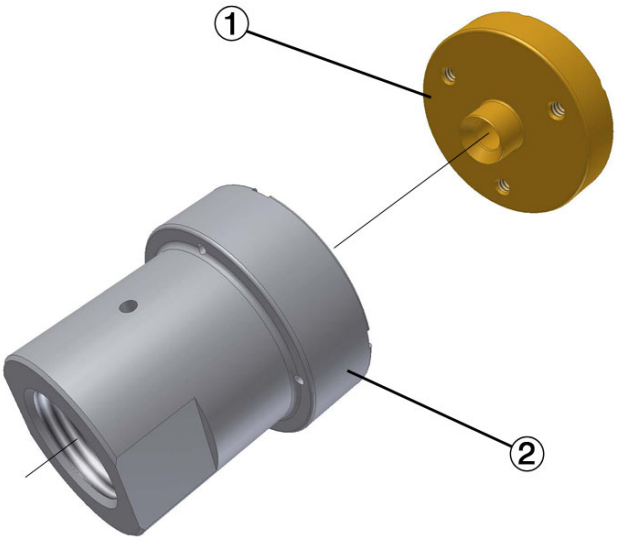
    Tighten to 11 lb−ft (15 Nm).

6.6 – DS8850A Rotating Swivel Disassembly and Assembly

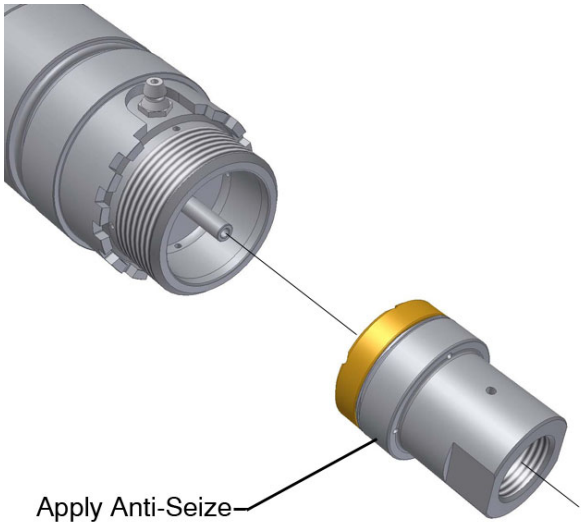


11. Ensure the o–ring is fully seated in its groove, using the special tool PM33713 if necessary, then install the H.P. seal (1) into the seal housing bore (2). During reinstallation, make sure that the flat end of the seal is inserted into the housing first. *Tip: You may use the backup ring (without grease) to help push the seal into place.*

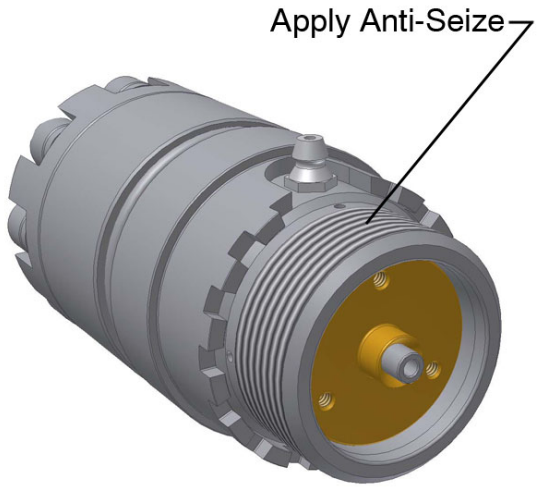
After the seal is in place, verify that the o–ring is still seated properly and was not pinched or sheared by the seal being pushed past it. If it was damaged, remove the o–ring and reinstall a new one.



12. Install the backup ring (1) to the seal housing (2). Use of a light food grade grease on the shaft of the backup ring is recommended to ease installation.

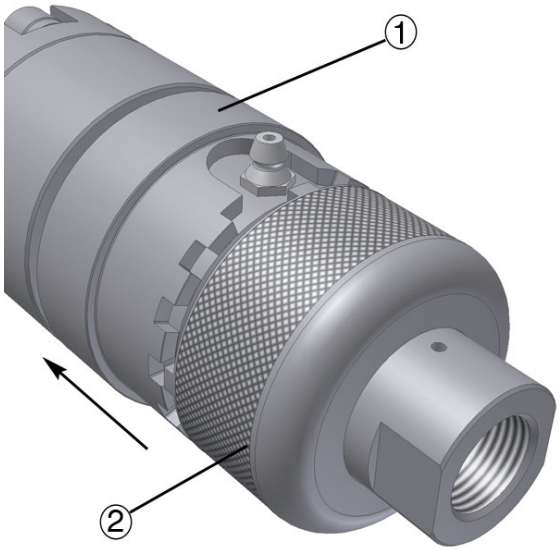


13. Apply anti–seize to the O.D. of the seal housing and position it, along with all the assembled components, into the rotating swivel.



14. Apply anti–seize to the threads on the rotary seal body.

6.6 – DS8850A Rotating Swivel Disassembly and Assembly



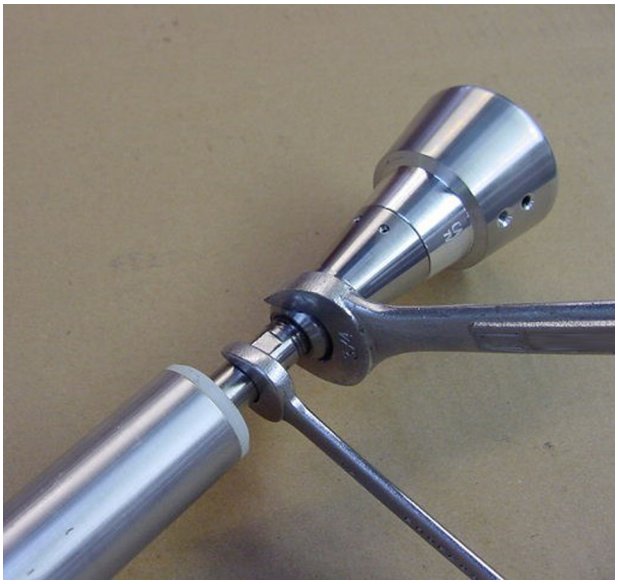
15. Push the anti–rotation sleeve (1) forward and screw the inlet endcap (2) to the rotary seal body. When the inlet endcap is tight, release the anti–rotation sleeve and spring tension will hold the notch in the sleeve against the tab on the endcap to ensure that no movement occurs.

16. Grease the zerk fitting with EP–rated grease to lubricate the bearings.

6.7 – Rotating Discharge Barrel Replacement

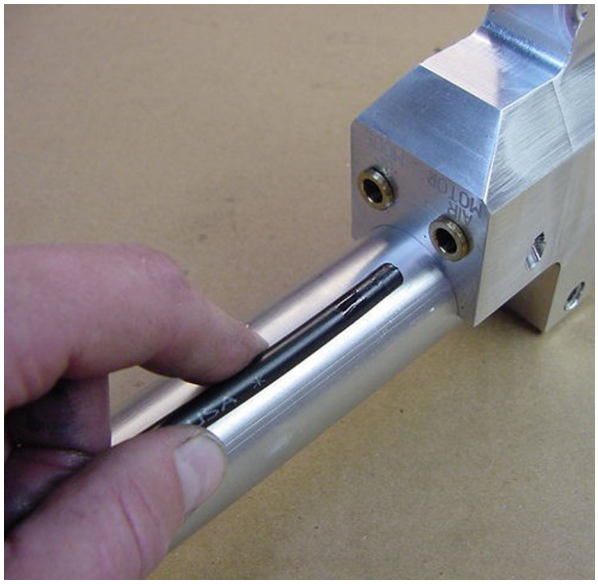
Removal

The rotating discharge barrel has been designed so that each end is uniform to the other. If the shaft has worn along the surface that contacts the rotating barrel bearing, it can be disconnected and repositioned on the other end to provide a new surface area to contact the bearing. When both ends have worn, the rotating discharge barrel will have to be replaced.

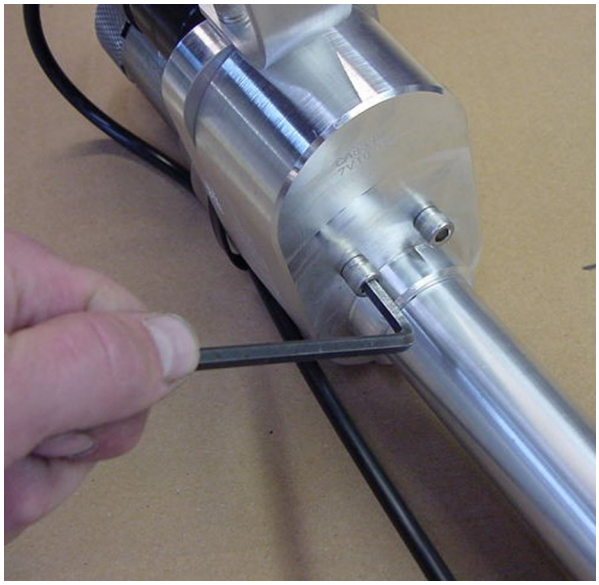


1. Remove the rotating nozzle hub assembly.

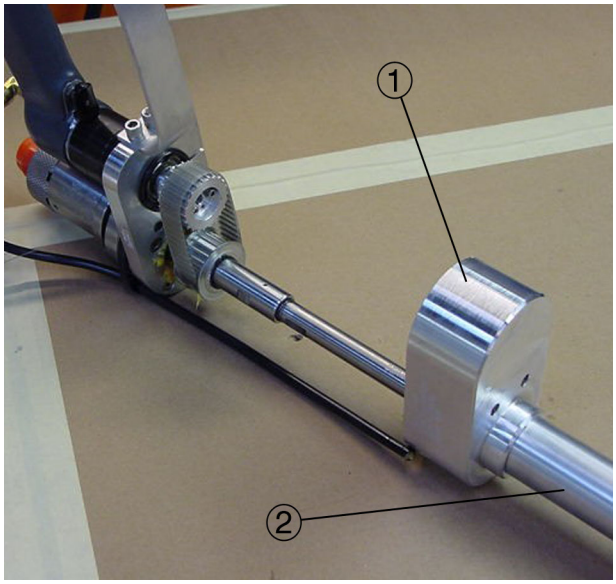
6.7 – Rotating Discharge Barrel Replacement



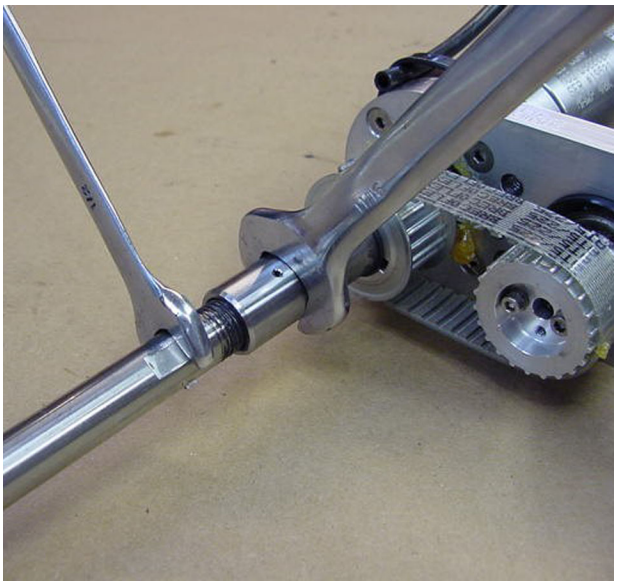
2. Disconnect the air signal line from the air motor port on the side handle assembly.



3. Remove the two belt drive cover bolts.



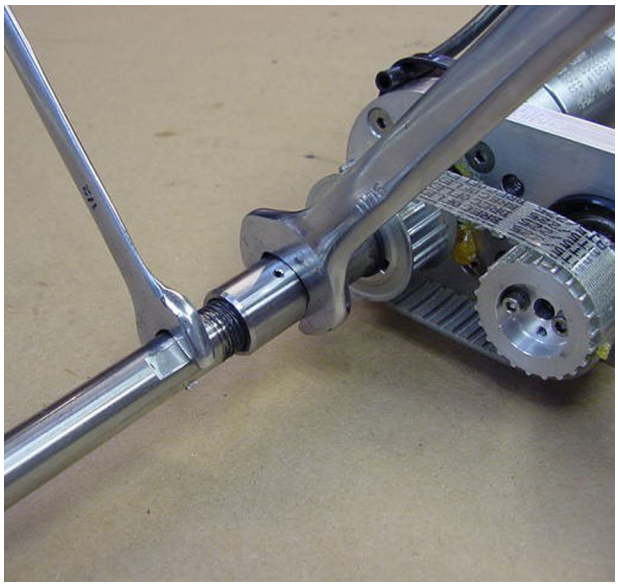
4. Remove the belt drive cover (1) and discharge barrel housing (2) from the lance as an assembly.



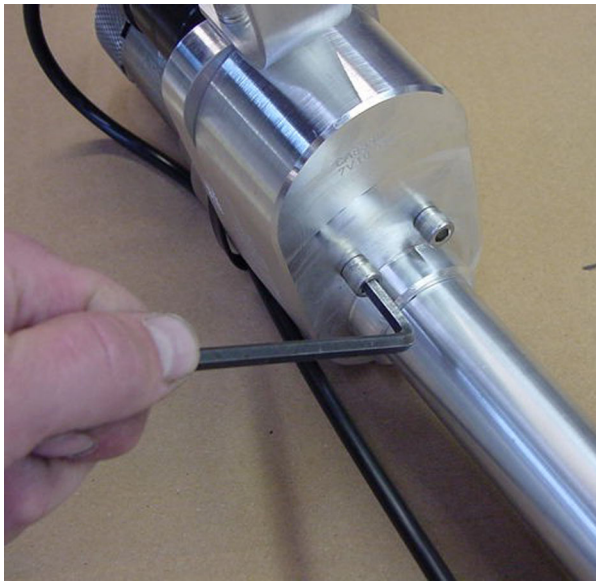
5. Disconnect the rotating discharge barrel from the swivel shaft.

6.7 – Rotating Discharge Barrel Replacement

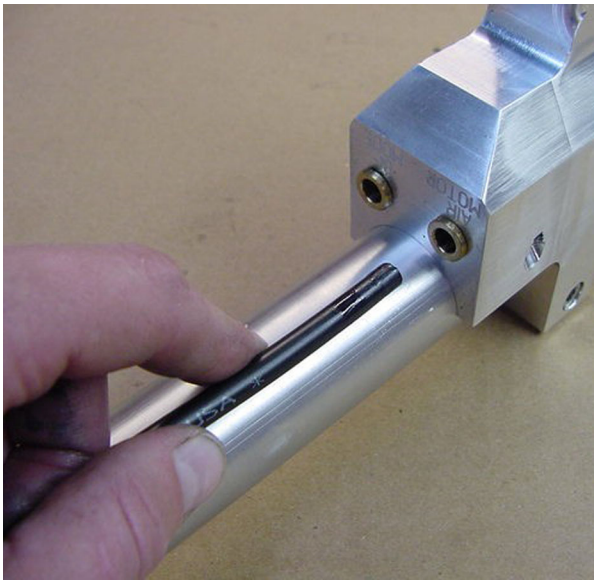
Reinstallation



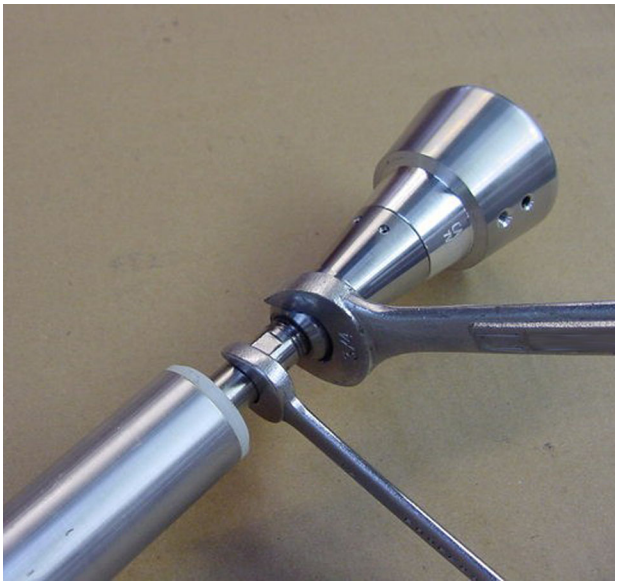
1. Place anti–seize on the threads of the rotating discharge barrel and install the barrel to the swivel shaft.



2. Position the drive belt cover and discharge barrel housing assembly onto the lance. Place anti–seize to the threads of the two belt drive cover bolts and install them to the cover.



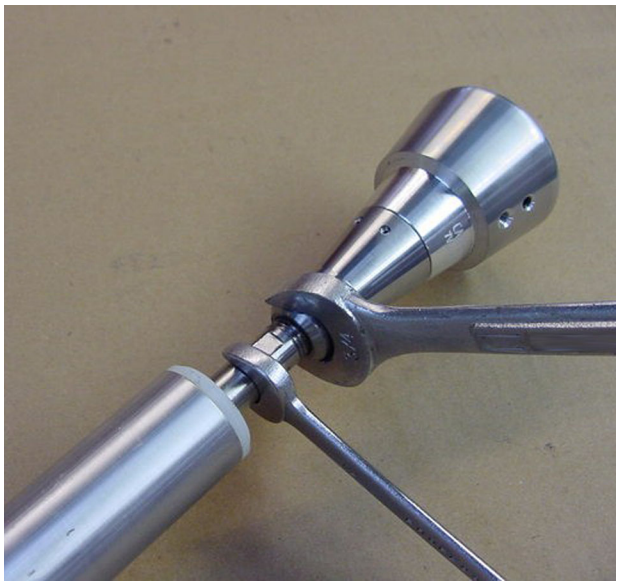
3. Connect the air signal line to the air motor port on the side handle assembly.



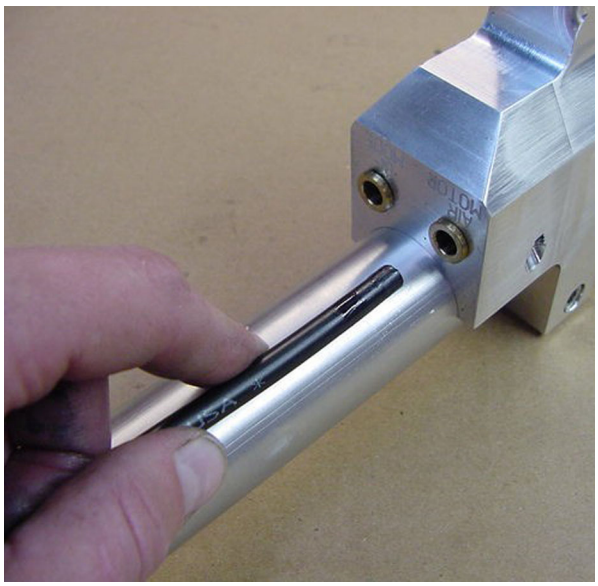
4. Place anti–seize on the threads of the rotating discharge barrel and install the rotating nozzle hub assembly.

6.8 – Discharge Barrel Housing

Removal

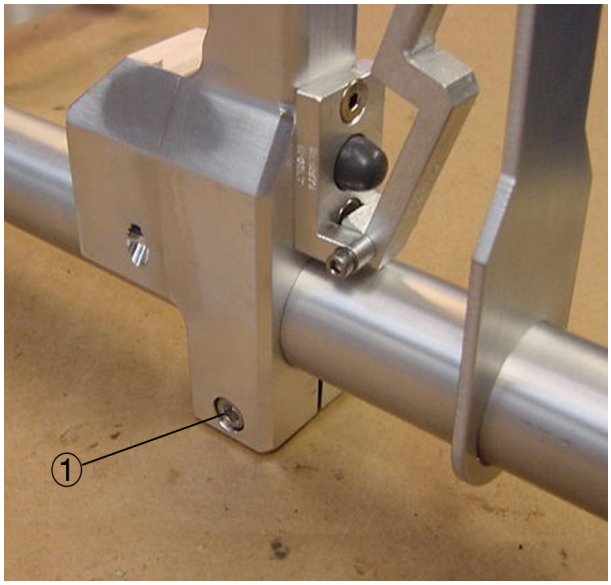


1. Remove the rotating nozzle hub assembly.



2. Disconnect the air signal line from the air motor port on the side handle assembly.

3. Remove the zerk fitting (1) from the end of the discharge barrel housing.



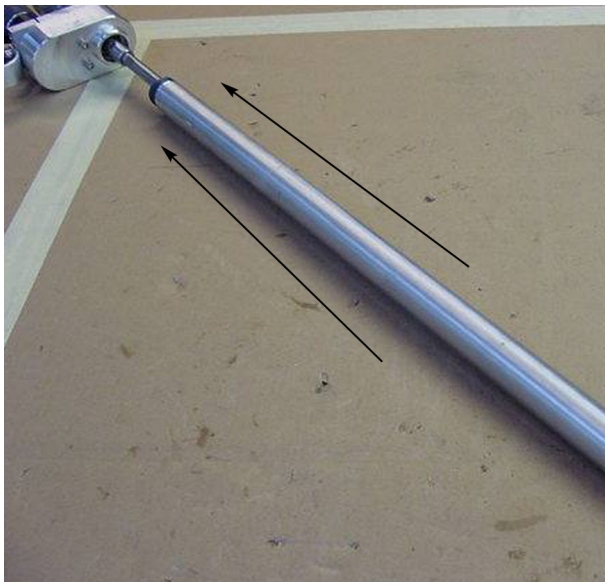
4. Loosen the side trigger adjustment pinch bolt (1) and slide the side trigger assembly off of the discharge barrel housing.

6.8 – Discharge Barrel Housing

5. Remove the rotating barrel bearing from the discharge barrel housing.

6. Unscrew the discharge barrel housing from the belt drive cover and remove it from the lance.

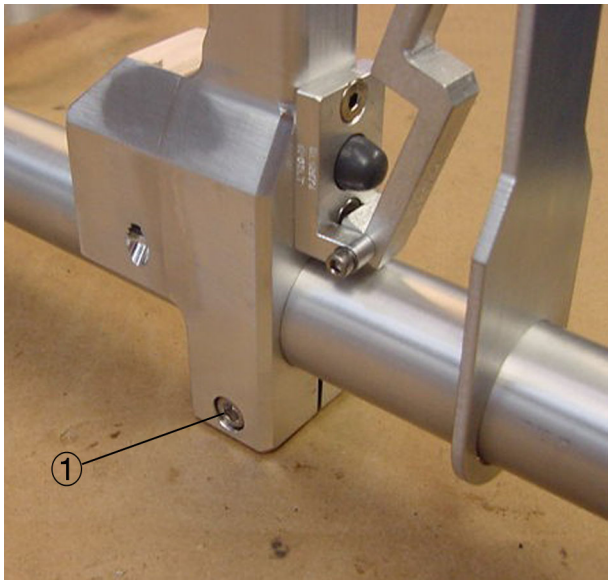
Reinstallation



1. Slide the discharge barrel housing over the rotating discharge barrel. Place a small amount of anti–seize to the threads on the housing and install it to the belt drive cover.

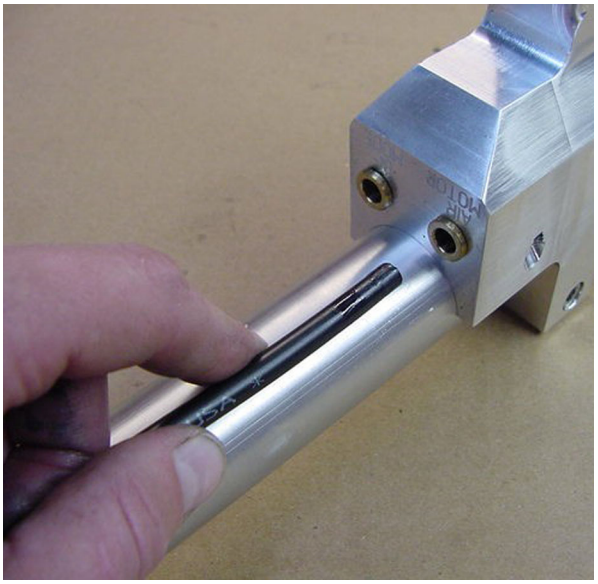
2. Install the rotating barrel bearing to the discharge barrel housing.

6.8 – Discharge Barrel Housing

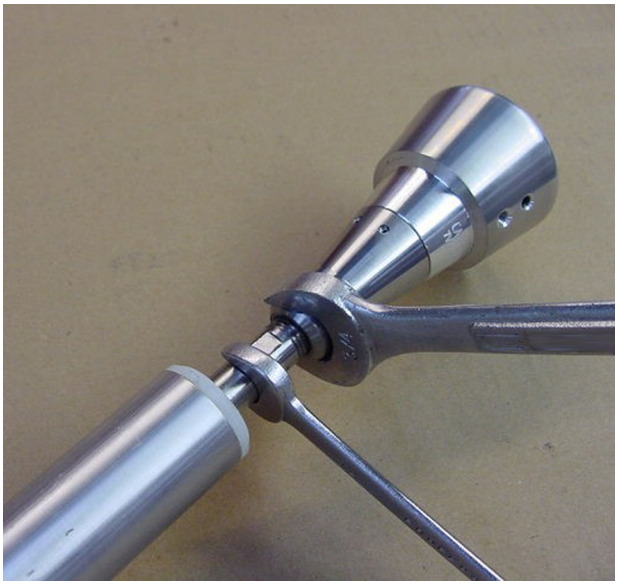


3. Slide the side trigger assembly onto the discharge barrel housing at the desired position and tighten the side trigger adjustment pinch bolt (1).

4. Install the zerk fitting (1) to the end of the discharge barrel housing. Grease the zerk fitting after installation.



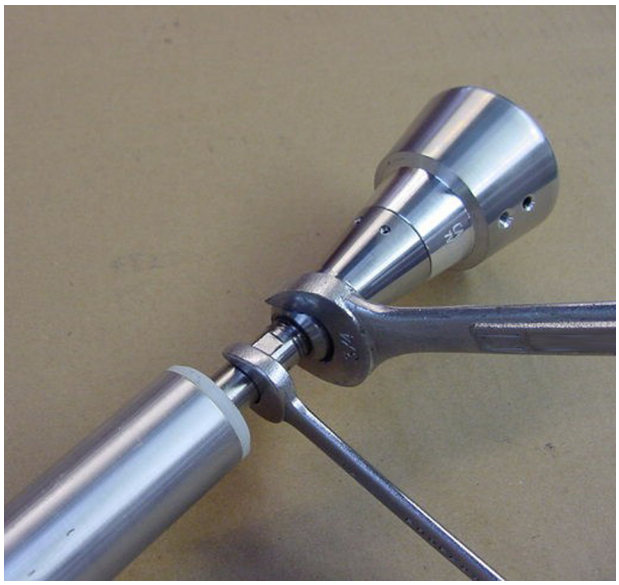
5. Connect the air signal line to the air motor port on the side handle assembly.



6. Place anti–seize on the threads of the rotating discharge barrel and install the rotating nozzle hub assembly.

6.9 – Rotating Barrel Bearing Replacement

Removal



1. Remove the rotating nozzle hub assembly.

2. Remove the zerk fitting (1) from the end of the discharge barrel housing.

3. Remove the rotating barrel bearing from the discharge barrel housing.

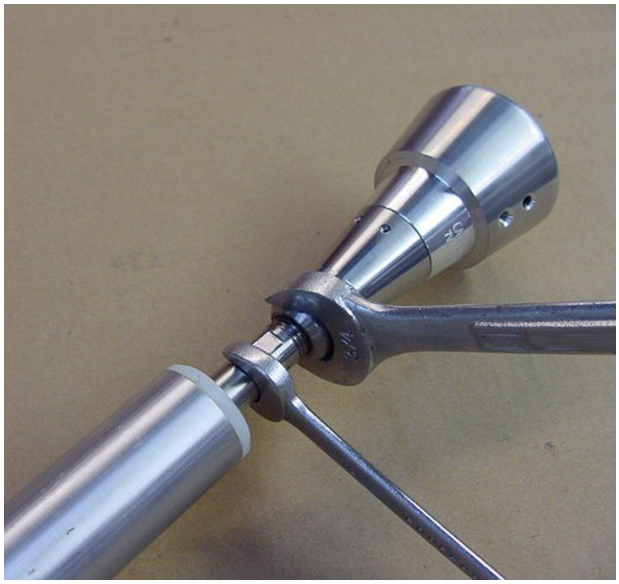
4. Inspect the rotating barrel bearing mating surface on the rotating discharge barrel for wear. If wear exists, the barrel will either need to be flipped over to use the other end of the barrel or replaced. Refer to **6.7**.

Reinstallation

1. Install the rotating barrel bearing to the discharge barrel housing.

6.9 – Rotating Barrel Bearing Replacement

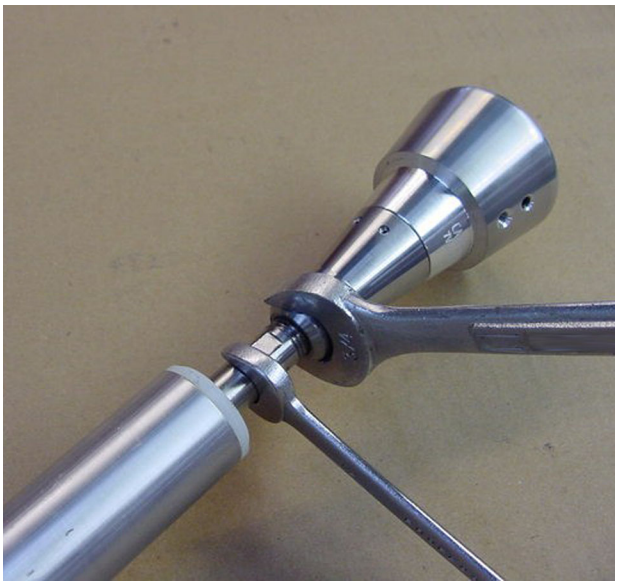
2. Install the zerk fitting (1) to the end of the discharge barrel housing. Grease the zerk fitting after installation.



3. Place anti–seize on the threads of the rotating discharge barrel and install the rotating nozzle hub assembly.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation

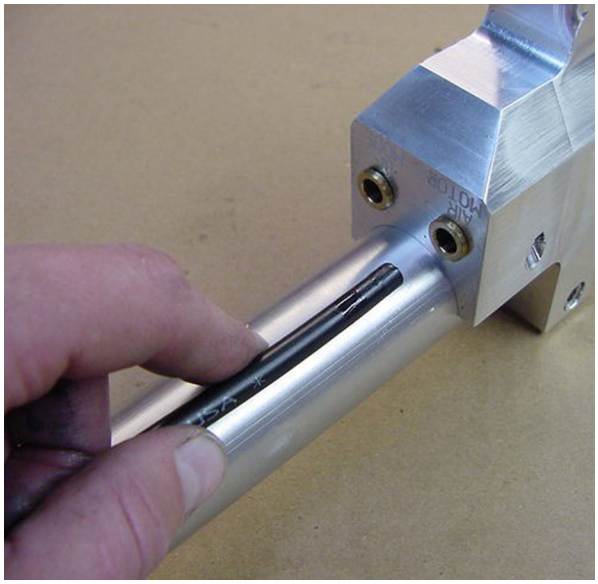
Removal



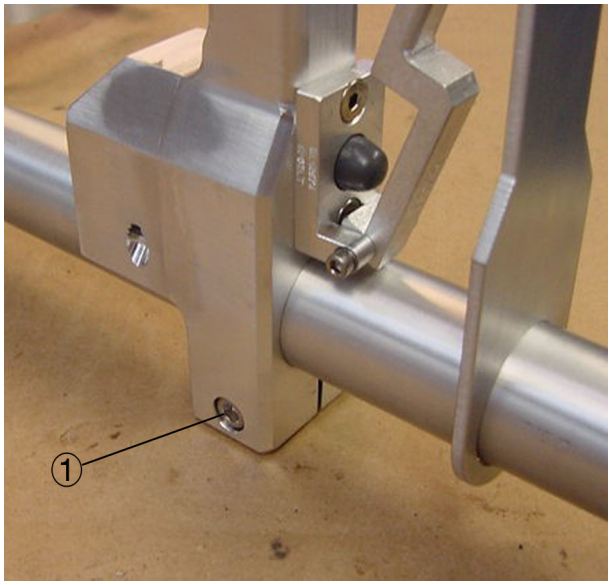
1. Remove the rotating nozzle hub assembly.

2. Remove the zerk fitting (1) from the end of the discharge barrel housing.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation



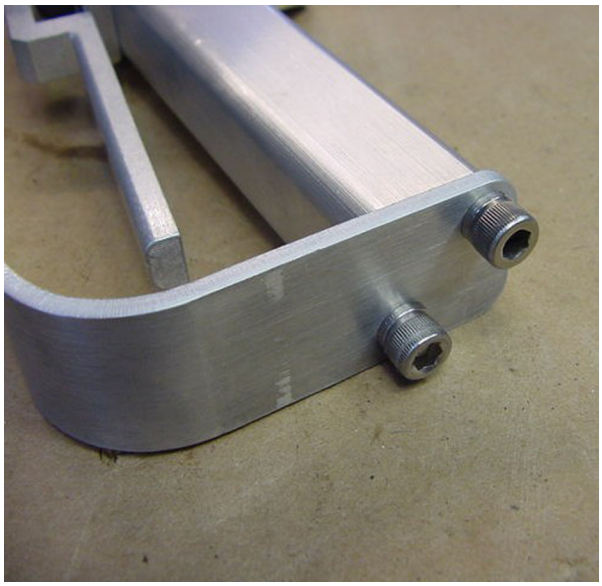
3. Disconnect the air signal line from the air motor port on the side handle assembly.



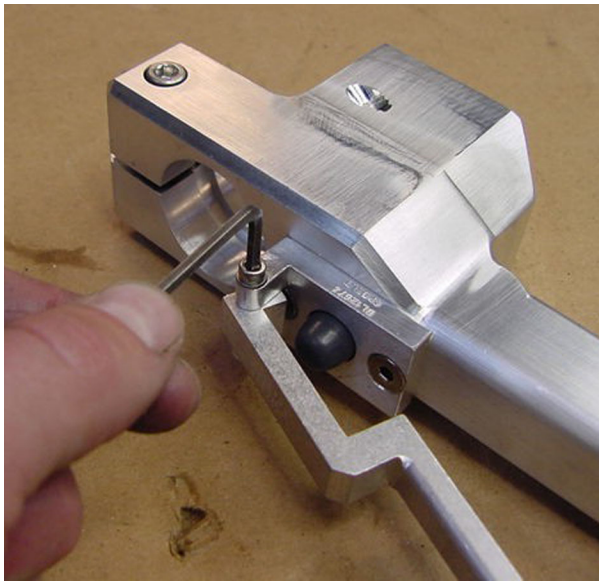
4. Loosen the side trigger adjustment pinch bolt (1) and slide the side trigger assembly off of the discharge barrel housing.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation

Disassembly

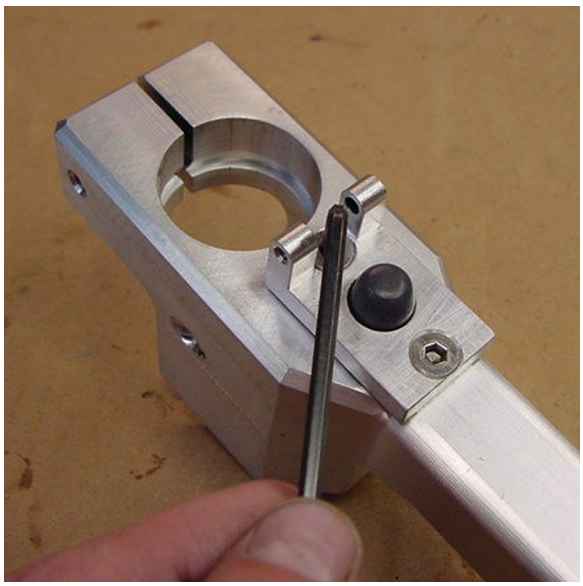


1. Remove the two mounting bolts and the side trigger guard.



2. Remove the side trigger pivot bolt.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation



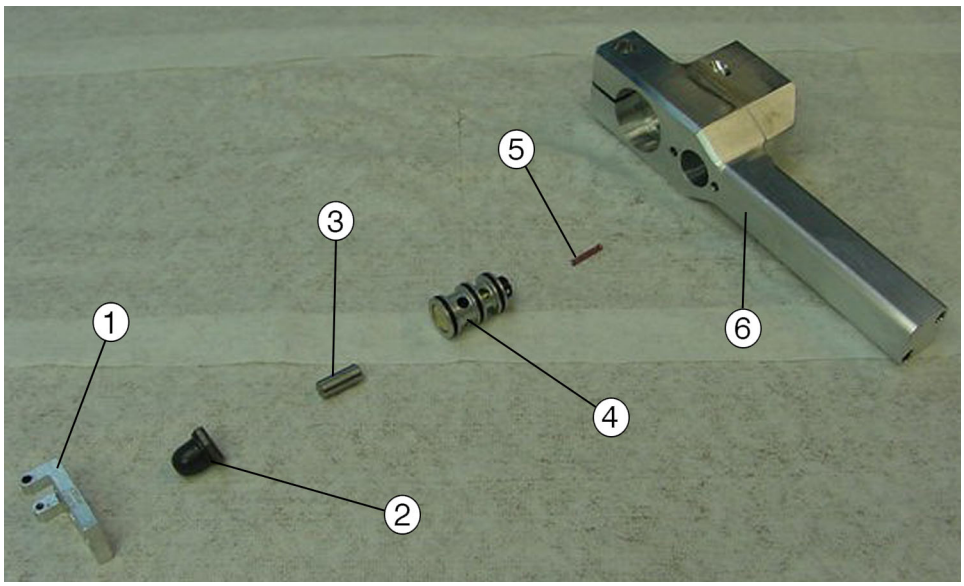
3. Remove the two trigger bracket bolts.

⚠ WARNING

Use care while compressed air is in use to remove the cartridge assembly from the side trigger handle. Place a shop cloth over the bore, and point the bore away from yourself and others to avoid injury during removal. It is recommended to point it at the workbench and use it as a stop for the cartridge.

Never place your hand over the bore to stop the cartridge during removal, or else injury can occur.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation



4. Remove the components in the numeric sequence shown.

   a. Trigger bracket (1)

   b. Protective boot (2)

   c. Dowel pin (3)

   d. Pneumatic cartridge valve (4)

   e. Pneumatic cartridge valve return spring (5)

To remove the valve (4), compressed air may be used in the air signal ports of the side trigger handle (6) to blow the valve out. Cover the bore with a shop cloth and point it toward the workbench to avoid injury during removal.

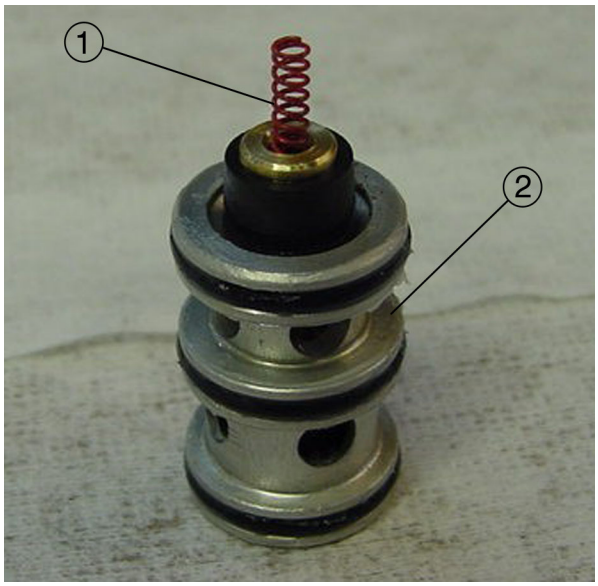
⚠ WARNING

Cover the bore with a shop cloth and point the bore away from yourself and others to avoid injury during removal.

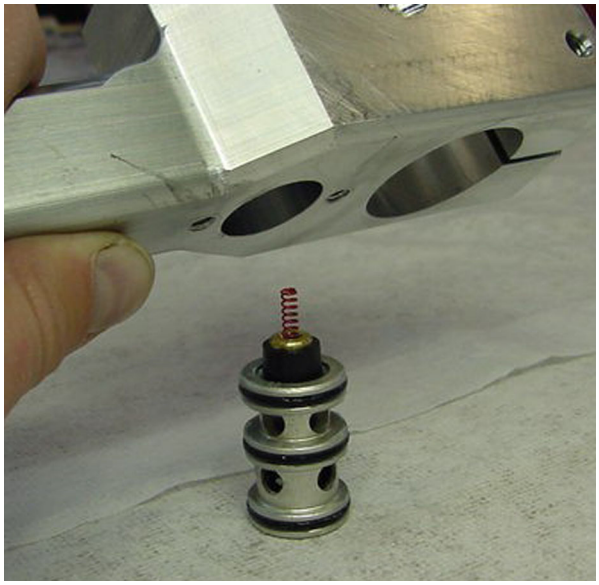
5. Clean and inspect the bore of the side trigger handle for wear and damage. Replace if necessary.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation

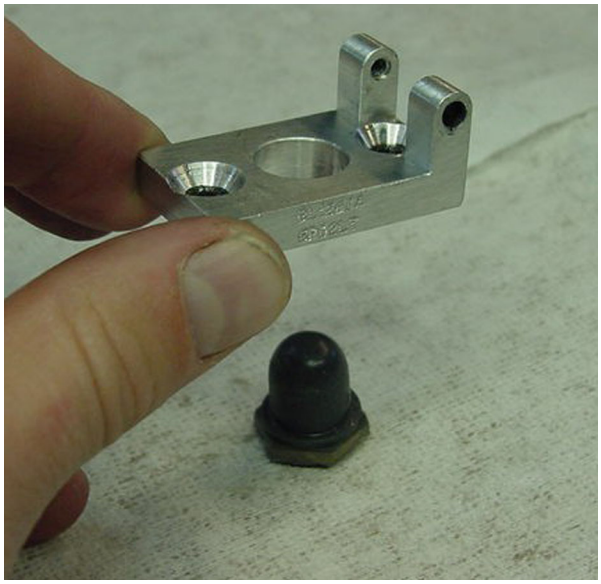
Reassembly



1. Place the pneumatic cartridge valve return spring (1) into the pneumatic cartridge valve (2). Place a small amount of food grade grease on the o–rings of the valve.

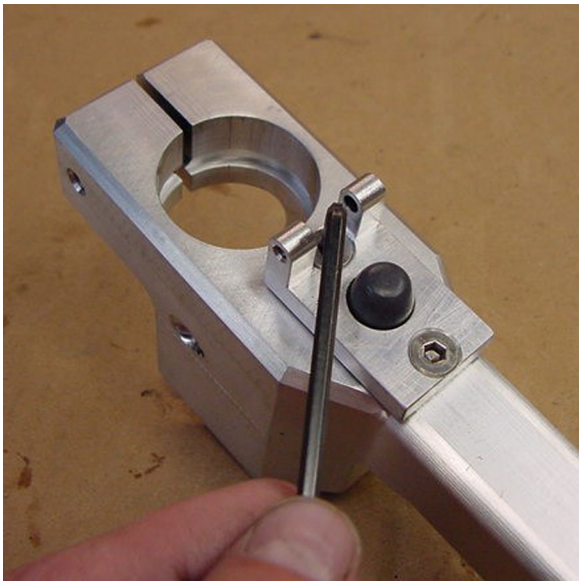


2. Place the side trigger handle over top of the pneumatic cartridge valve and spring assembly. Lower the side handle down onto the cartridge assembly to install it into bore of the handle.



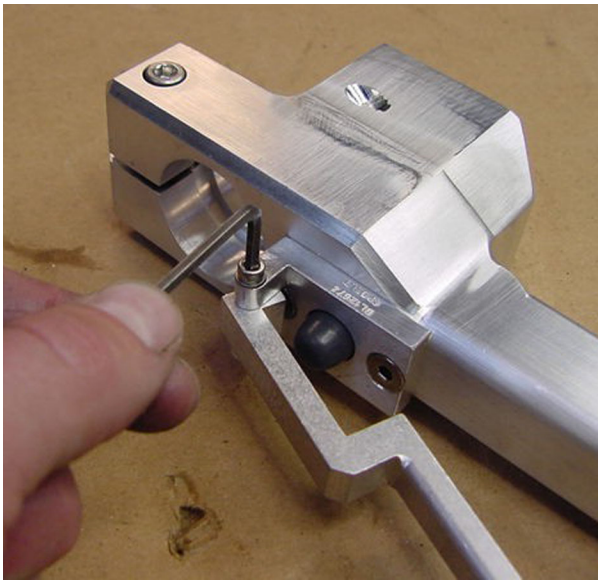
3. Install the trigger bracket to the protective cover.

4. Place the dowel pin into the pneumatic cartridge valve bore in the side trigger handle.

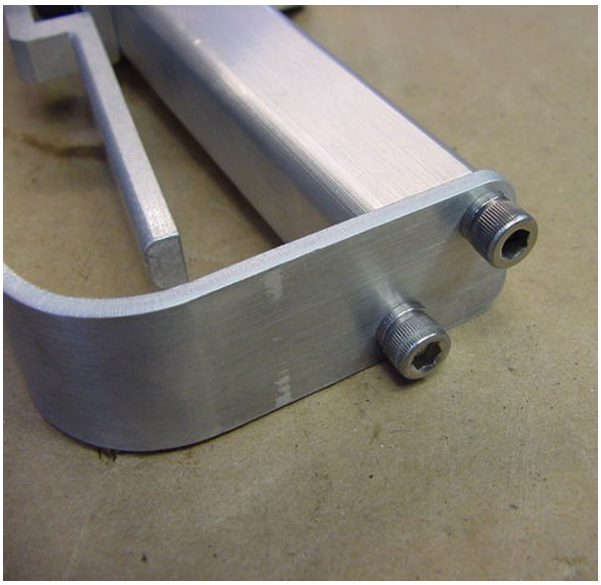


5. Install the trigger bracket and protective cover assembly over the dowel pin. Place a small amount of Loctite® onto the threads of the two trigger bracket bolts and install them to the side trigger handle.

6.10 – Side Trigger Removal, Disassembly, Assembly and Installation

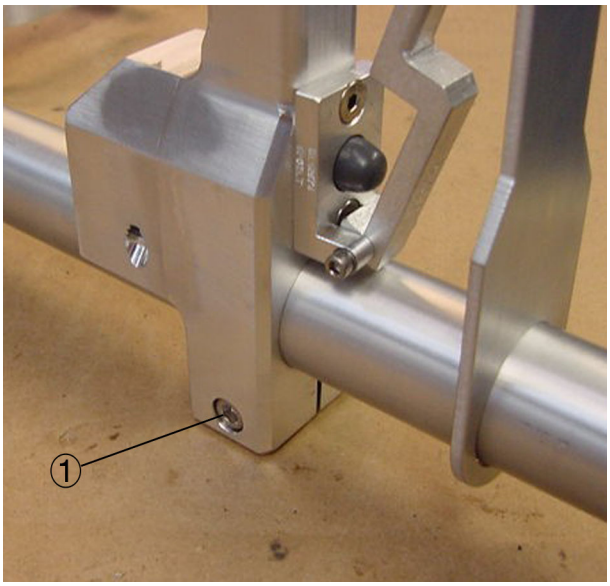


6. Position the trigger handle to the side handle. Place a small amount of Loctite® on the threads of the pivot bolt and install into the side handle.

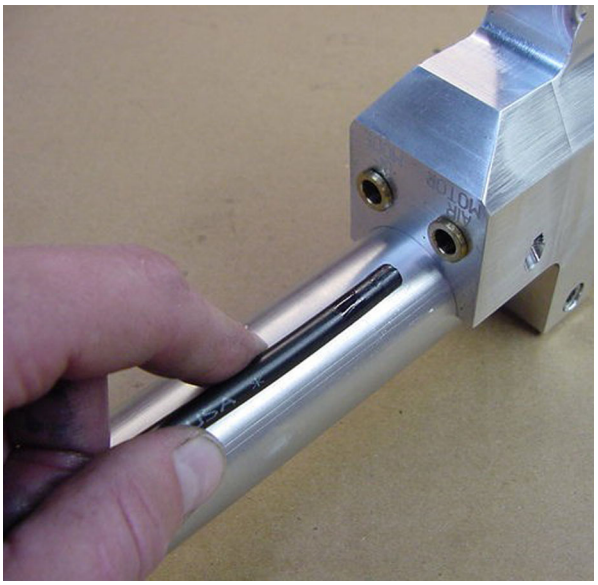


7. Position the side trigger guard to the side handle. Place a small amount of anti–seize to the threads on the two mounting bolts and install them into the handle.

Reinstallation



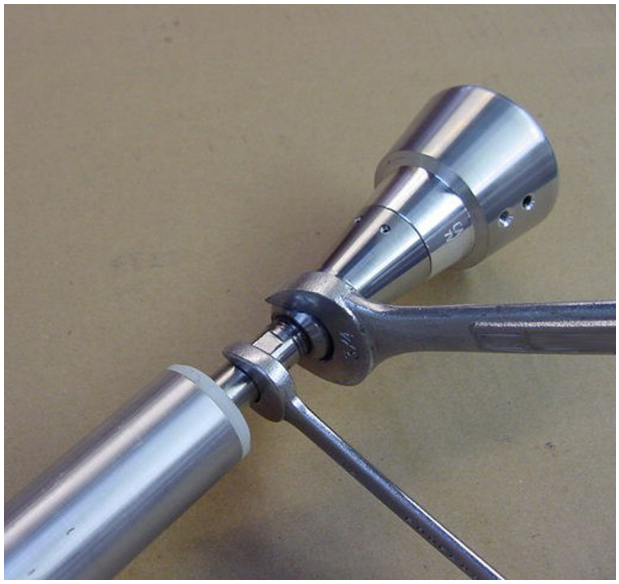
1. Install the side trigger assembly onto the discharge barrel housing. Position it at the desired setting and tighten the side trigger adjustment pinch bolt (1).



2. Connect the air signal line to the air motor port on the side handle assembly.

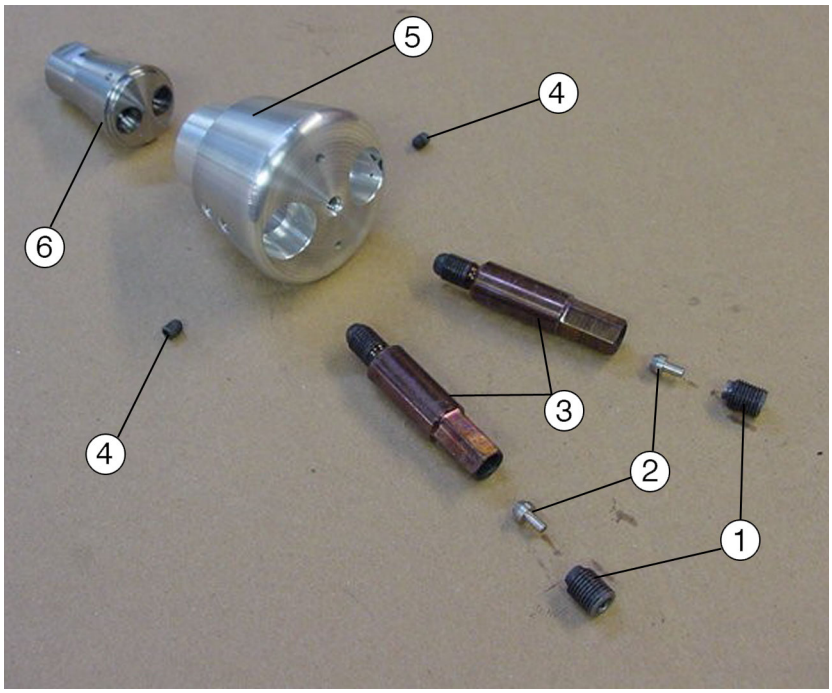
6.10 – Side Trigger Removal, Disassembly, Assembly and Installation

3. Install the zerk fitting (1) onto the end of the discharge barrel housing.



4. Place anti–seize on the threads of the rotating discharge barrel and install the rotating nozzle hub assembly.

6.11 – Nozzle Replacement/Nozzle Hub Disassembled View



The nozzle hub assembly is made up of the following components:

- Nozzle Retainer Gland (1)
- Sapphire Nozzle (2)
- 40K Nozzle Orifice Holder (3)
- Alloy Set Screws (4)
- Nozzle Protector Cover (5)
- Rotating Nozzle Hub (6)

Nozzle Replacement

1. Remove the nozzle retainer gland (1).

2. Remove the sapphire nozzle (2). Inspect the nozzle orifice holder (3) for wear and replace as necessary.

3. Place the new sapphire nozzle (2) into the nozzle retainer gland (3).

4. Apply a small amount of anti–seize to the threads of the nozzle retainer gland (2) and install it to the nozzle orifice holder (3).

   Tighten the nozzle retainer gland to 20 lb–ft (27 Nm).

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SECTION 7 – PARTS

7.1 – Introduction

This section identifies the NCG8450A–3, NCG8450A–3L, and NCG8450A–3T Cleaning Lance components, part numbers, and the quantity of each to complete the build of this accessory. The assembly drawings have callout numbers, which correlate to numbers on the part lists by item number.

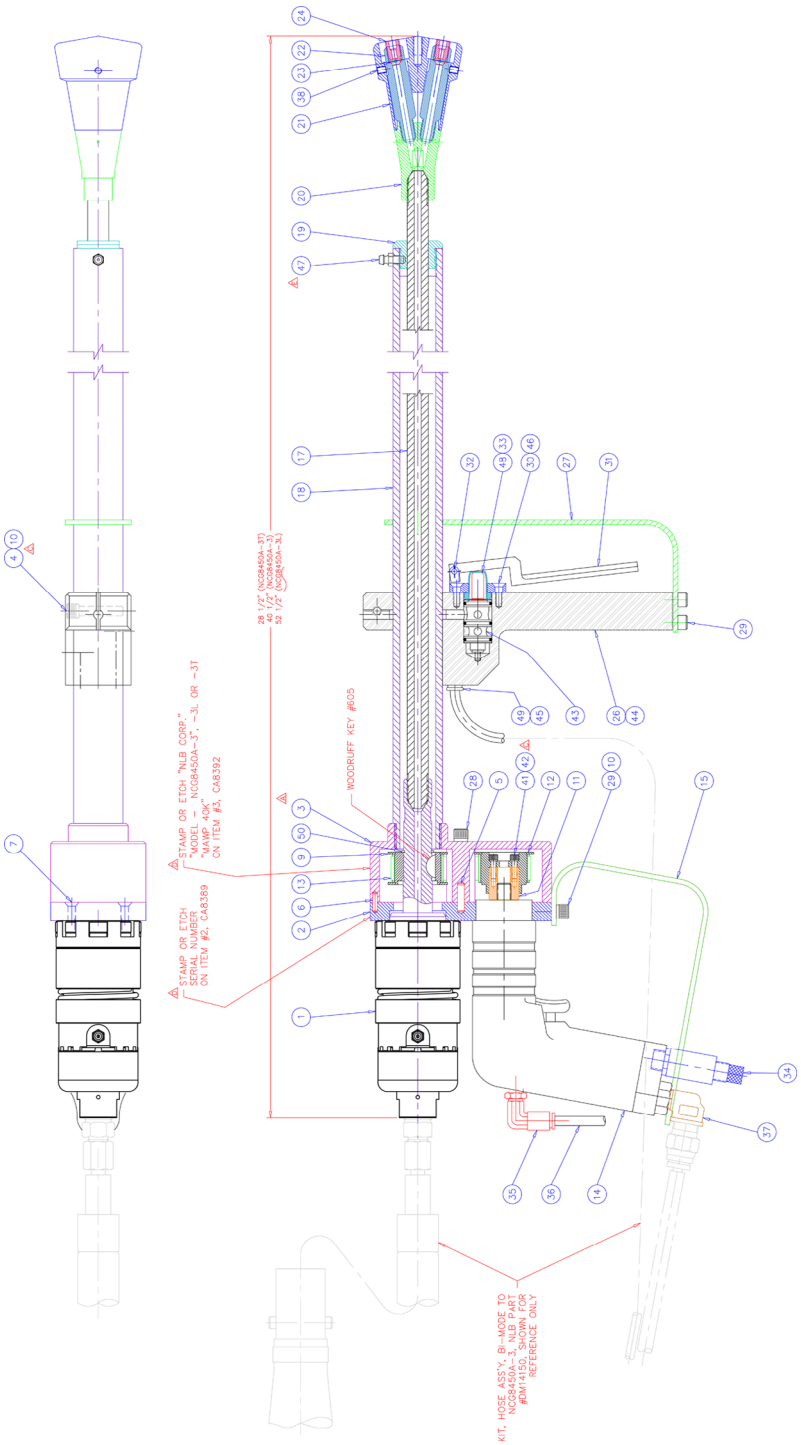
Items that are available from local sources such as clamps, washers, nuts and some hoses may be excluded from the parts list; however, they may be identified on the illustrations.

For direction on ordering parts for your NCG8450A–3, –3L, or –3T Cleaning Lance, refer to **Section 8**.

7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

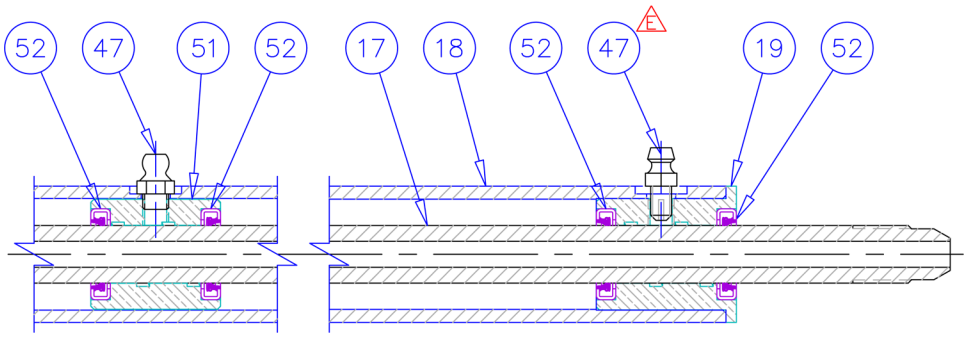
NOTE: The same engineering drawing is used for all three NCG8450A models (–3, –3L, and –3T). Only the parts lists differ. Parts lists follow the drawings.

(Revision E)

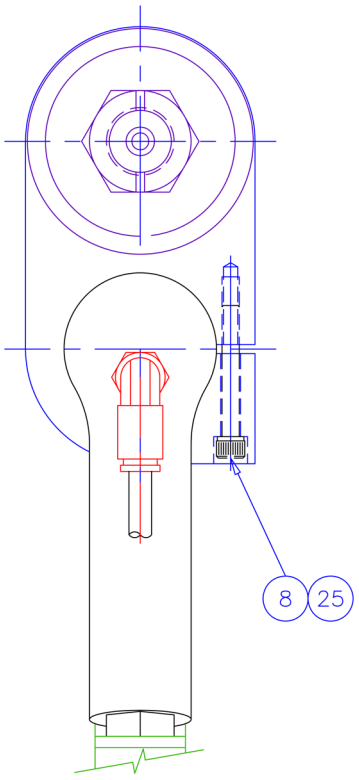


7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

(Revision E)



NCG8450A-3L Barrel Detail

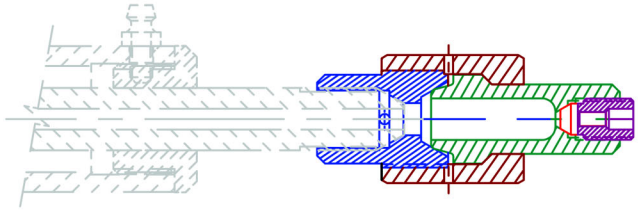


END VIEW

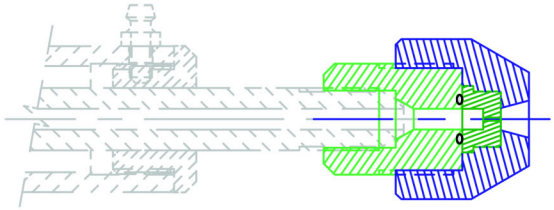
From Motor & Swivel End

7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

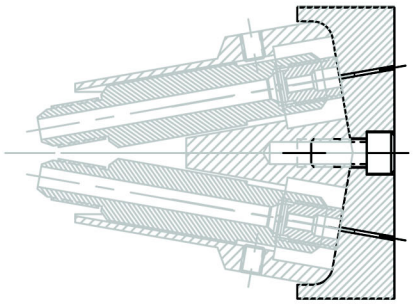
(Revision E)



NOZZLE HOLDER ASSEMBLY, SAPPHIRE ORIFICE
R.H. THREAD, 40K
(Optional) P/N BA11110



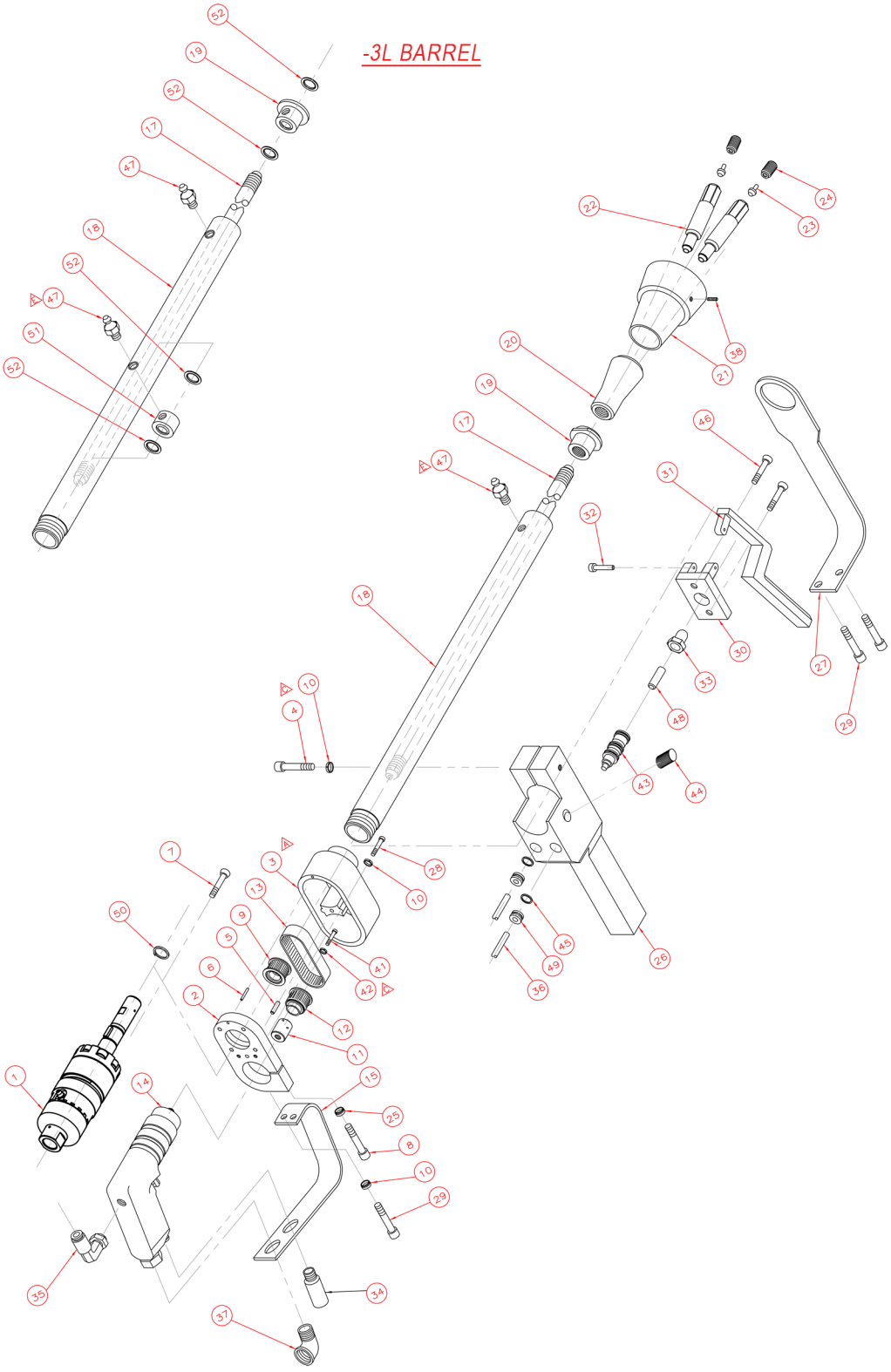
NOZZLE HOLDER ASSEMBLY, FAN SPRAY TIP
R.H. THREAD, 40K
(Optional) P/N BA11117



PLATE, WEAR, NOZZLE COVER ASSY
(Optional) P/N CL12681

7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

(Revision E)



7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

7.2.1 – Parts List for NCG8450A–3

(Revision E)

Item	Part	Description	Qty
1*	DS8850A	SWIVEL, ROTATING, 40K, LONG-LIFE	1 EA
2	CA8389	PLATE, AIR MOTOR AND SWIVEL MOUNTING,	1 EA
3	CA8392	COVER, BELT DRIVE, 36K SPIN GUN	1 EA
4	1/4-20X1-1/2SHS	SCREW, SOCKET HEAD, CAP, STAINLESS	1 EA
5	3/16X3/4PDSS	PIN, DOWEL, 3/16" DIA X 3/4", STAINLESS	1 EA
6	1/8X1/2PDSS	PIN, DOWEL, 1/8" DIA X 1/2", 18-8 SS	1 EA
7	10-32X7/8SHFSS	SCREW, SOCKET FLAT HEAD, 10-32 X 7/8",	4 EA
8	10-32X1-1/2SHSS	SCREW, SOCKET HEAD, STAINLESS	1 EA
9	BM10567	SPROCKET, DRIVEN, 22 TOOTH, 36K SPIN GUN	1 EA
10	1/4-HCLW-SS	WASHER, LOCK, HIGH COLLAR, STAINLESS	7 EA
11	BA8401	SHAFT, MOTOR EXTENSION, 36K SPIN GUN	1 EA
12	BA8671	SPROCKET, DRIVER, 22 TOOTH, AT5 PITCH,	1 EA
13~	PM8635	BELT, ENDLESS TIMING, 16MM	1 EA
14**	BA8406	DRILL, PNEUMATIC, REWORK, 36K SPIN GUN	1 EA
15	CA8434	GUARD, TRIGGER, 36K SPIN GUN	1 EA
16	MM6227	TIE, CABLE, 3M 14" PLASTIC	1 EA
17	BA8394-2	BARREL, ROTATING DISCHARGE, 29"	1 EA
18	BA8395-2	HOUSING, DISCHARGE BARREL, 27.75"	1 EA
19~	BA8396	BEARING, ROTATING BARREL, 36K SPIN GUN	1 EA
20	CA8397	HUB, ROTATING NOZZLE, 36K SPIN GUN	1 EA
21~	CA8637	COVER, NOZZLE PROTECTOR, 36K SPIN GUN	1 EA
22	BN7507	HOLDER, NOZZLE ORIFICE, 40K	2 EA
23~	*JB-NOZZLE*	*Nozzle to be specified on customer order*	2 EA
24~	BA3894	GLAND, NOZZLE RETAINER	2 EA
25	10-24HCLW-SS	WASHER, LOCK, HIGH COLLAR, STAINLESS	1 EA
26	DL12672	HANDLE	1 EA
27	BA8453	GUARD, SIDE HANDLE, 36K SPIN GUN	1 EA
28	1/4-20X2SHS	SCREW, SOCKET HEAD CAP, 304 STAINLESS	2 EA
29	1/4-20X1/2SHS	SCREW, SOCKET HEAD, CAP, 304 STAINLESS	4 EA
30	BL12674	BRACKET, TRIGGER	1 EA
31	BL12673	TRIGGER	1 EA
32	6-32X1SHSS	SCREW, SOCKET HEAD CAP SS	1 EA

(continued)

(continued)

Item	Part	Description	Qty
33~	PM12685	BOOT, PROTECTIVE	1 EA
34	PM12942	VALVE, FLOW CONTROL, AIR, 1/4" NPT	1 EA
35	DM2666-14	FITTING, 1/8" NPTM X 1/4" TUBE, SWIVEL	1 EA
36	DM2666-56	TUBING, AIR, 1/4" OD BLACK POLYETHYLENE	2 FT
37	PM12963	ELBOW, STREET, 1/4" MNPT X 3/8" FNPT,	1 EA
38	10-32X1/4SS	SCREW, SET, ALLOY	2 EA
40	PM7758	TAG, "GUN SAFETY PROCEDURES", YELLOW	1 EA
41	6-32X1/2SHSS	SCREW, SOCKET HEAD, 6-32 X 1/2 STAINLESS	2 EA
42	6-32 LWS	WASHER, LOCK, STAINLESS	2 EA
43~	PM12687	VALVE, PNEUMATIC, CARTRIDGE 3-WAY WITH	1 EA
44	1/4-20X3/8DPSS	SCREW, SET, HALF DOG POINT	2 EA
45	AA-4099	O-RING, 6MM ID X 2MM CROSS SECTION	2 EA
46	10-24X1/2FHSS	SCREW, FLAT HEAD SOCKET CAP, STAINLESS	2 EA
47	PM29675	FITTING, GREASE,1/4-28 TAPER, 11/16" OAH	1 EA
48	5/16X3/4PDSS	PIN, DOWEL 5/16"X 3/4"LG SS	1 EA
49	PM12686	ADAPTER, HOSE, AIR, 1/4"	2 EA
50	PM8630	RING, RETAINING	1 EA

COLOR KEY:

** Green shading indicates the item has a separate parts list and assembly drawing in this section.*

*** Gold shading indicates the item has additional documentation in the **appendix**.*

*~ Gray shading identifies recommended spare parts. For additional spare/rebuild parts, refer to **7.4** and **7.5.2**.*

7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

7.2.2 – Parts List for NCG8450A–3L

(Revision E)

Item	Part	Description	Qty
1*	DS8850A	SWIVEL, ROTATING, 40K, LONG-LIFE	1 EA
2	CA8389	PLATE, AIR MOTOR AND SWIVEL	1 EA
3	CA8392	COVER, BELT DRIVE, 36K SPIN GUN	1 EA
4	1/4-20X1-1/2SHS	SCREW, SOCKET HEAD, CAP, STAINLESS	1 EA
5	3/16X3/4PDSS	PIN, DOWEL, 3/16" DIA X 3/4", STAINLESS	1 EA
6	1/8X1/2PDSS	PIN, DOWEL, 1/8" DIA X 1/2", 18-8 SS	1 EA
7	10-32X7/8SHFSS	SCREW, SOCKET FLAT HEAD, 10-32 X 7/8",	4 EA
8	10-32X1-1/2SHSS	SCREW, SOCKET HEAD, STAINLESS	1 EA
9	BM10567	SPROCKET, DRIVEN, 22 TOOTH, 36K SPIN GUN	1 EA
10	1/4-HCLW-SS	WASHER, LOCK, HIGH COLLAR, STAINLESS	6 EA
11	BA8401	SHAFT, MOTOR EXTENSION, 36K SPIN GUN	1 EA
12	BA8671	SPROCKET, DRIVER, 22 TOOTH, 36K SPIN GUN	1 EA
13~	PM8635	BELT, ENDLESS TIMING, 16MM	1 EA
14**	BA8406	DRILL, PNEUMATIC, 8400	1 EA
15	CA8434	GUARD, TRIGGER, 36K SPIN GUN	1 EA
16	MM6227	TIE, CABLE, 3M 14" PLASTIC	1 EA
17	BM17711-1	BARREL, ROTATING DISCHARGE	1 EA
18	CM17708-1	HOUSING, DISCHARGE BARREL, 40K SPIN GUN	1 EA
19	BM17710	BUSHING, END	1 EA
20	CA8397	HUB, ROTATING NOZZLE	1 EA
21~	CA8637	COVER, NOZZLE PROTECTOR, 40K	1 EA
22	BN7507	HOLDER, NOZZLE ORIFICE, 40K, 2.60[66MM]	2 EA
23~	*JB-NOZZLE*	*Nozzle to be specified on customer order*	2 EA
24~	BA3894	GLAND, NOZZLE RETAINER	2 EA
25	10-24HCLW-SS	WASHER, LOCK, HIGH COLLAR, STAINLESS	1 EA
26	DL12672	HANDLE	1 EA
27	BA8453	GUARD, SIDE HANDLE, 36K SPIN	1 EA
28	1/4-20X2SHS	SCREW, SOCKET HEAD CAP, 304 STAINLESS	2 EA
29	1/4-20X1/2SHS	SCREW, SOCKET HEAD, CAP, 304 STAINLESS	4 EA
30	BL12674	BRACKET, TRIGGER	1 EA
31	BL12673	TRIGGER	1 EA
32	6-32X1SHSS	SCREW, SOCKET HEAD CAP SS	1 EA

(continued)

(continued)

Item	Part	Description	Qty
33~	PM12685	BOOT, PROTECTIVE	1 EA
34	PM12942	VALVE, FLOW CONTROL, AIR, 1/4" NPT	1 EA
35	DM2666-14	FITTING, 1/8" NPTM X 1/4" TUBE, SWIVEL	1 EA
36	DM2666-56	TUBING, AIR, 1/4" OD BLACK POLYETHYLENE	2 FT
37	PM12963	ELBOW, STREET 1/4"MNPT X 3/8"F	1 EA
38	10-32X1/4SS	SCREW, SET, ALLOY	2 EA
40	PM7758	TAG, "GUN SAFETY PROCEDURES"	1 EA
41	6-32X1/2SHSS	SCREW, SOCKET HEAD, 6-32 X 1/2 STAINLESS	2 EA
42	6-32 LWS	WASHER, LOCK, STAINLESS	3 EA
43~	PM12687	VALVE, PNEUMATIC, CARTRIDGE 3-WAY WITH	1 EA
44	1/4-20X3/8DPSS	SCREW, SET, HALF DOG POINT	2 EA
45	AA-4099	O-RING, 6MM ID X 2MM CROSS SECTION	2 EA
46	10-24X1/2FHSS	SCREW, FLAT HEAD SOCKET CAP, STAINLESS	2 EA
47	PM29675	FITTING, GREASE,1/4-28 TAPER, 11/16 LONG	2 EA
48	5/16X3/4PDSS	PIN, DOWEL 5/16"X 3/4"LG SS	1 EA
49	PM12686	ADAPTER, HOSE, AIR 1/4"	2 EA
50	PM8630	RING, RETAINING	1 EA
51	BM17709	BUSHING, MIDDLE	1 EA
52~	PM17713	SEAL, OIL	4 EA

COLOR KEY:

** Green shading indicates the item has a separate parts list and assembly drawing in this section.*

*** Gold shading indicates the item has additional documentation in the **appendix**.*

*~ Gray shading identifies recommended spare parts. For additional spare/rebuild parts, refer to **7.4** and **7.5.2**.*

7.2 – NCG8450A–3/3L/3T Cleaning Lance (DM26687)

7.2.3 – Parts List for NCG8450A–3T

(Revision E)

Item	Part	Description	Qty
1*	DS8850A	SWIVEL, ROTATING, 40K, LONG-LIFE	1 EA
2	CA8389	PLATE, AIR MOTOR AND SWIVEL MOUNTING,	1 EA
3	CA8392	COVER, BELT DRIVE, 36K SPIN GUN	1 EA
4	1/4-20X1-1/2SHS	SCREW, SOCKET HEAD, CAP, STAINLESS	1 EA
5	3/16X3/4PDSS	PIN, DOWEL, 3/16" DIA X 3/4", STAINLESS	1 EA
6	1/8X1/2PDSS	PIN, DOWEL, 1/8" DIA X 1/2", 18-8 SS	1 EA
7	10-32X7/8SHFSS	SCREW, SOCKET FLAT HEAD, 10-32 X 7/8",	4 EA
8	10-32X1-1/2SHSS	SCREW, SOCKET HEAD, STAINLESS	1 EA
9	BM10567	SPROCKET, DRIVEN, 22 TOOTH, 36K SPIN GUN	1 EA
10	1/4-HCLW-SS	WASHER, LOCK, HIGH COLLAR, STAINLESS	7 EA
11	BA8401	SHAFT, MOTOR EXTENSION, 36K SPIN GUN	1 EA
12	BA8671	SPROCKET, DRIVER, 22 TOOTH, AT5 PITCH,	1 EA
13~	PM8635	BELT, ENDLESS TIMING, 16MM	1 EA
14**	BA8406	DRILL, PNEUMATIC, REWORK, 36K SPIN GUN	1 EA
15	CA8434	GUARD, TRIGGER, 36K SPIN GUN	1 EA
16	MM6227	TIE, CABLE, 3M 14" PLASTIC	1 EA
17	BA8394-1	BARREL, ROTATING DISCHARGE, 17"	1 EA
18	BA8395-1	HOUSING, DISCHARGE BARREL, 16"	1 EA
19~	BA8396	BEARING, ROTATING BARREL, 36K SPIN GUN	1 EA
20	CA8397	HUB, ROTATING NOZZLE, 36K SPIN GUN	1 EA
21~	CA8637	COVER, NOZZLE PROTECTOR, 36K SPIN GUN	1 EA
22	BN7507	HOLDER, NOZZLE ORIFICE, 40K	2 EA
23~	*JB-NOZZLE*	*Nozzle to be specified on customer order*	2 EA
24~	BA3894	GLAND, NOZZLE RETAINER	2 EA
25	10-24HCLW-SS	WASHER, LOCK, HIGH COLLAR, STAINLESS	1 EA
26	DL12672	HANDLE	1 EA
27	BA8453	GUARD, SIDE HANDLE, 36K SPIN GUN	1 EA
28	1/4-20X2SHS	SCREW, SOCKET HEAD CAP, 304 STAINLESS	2 EA
29	1/4-20X1/2SHS	SCREW, SOCKET HEAD, CAP, 304 STAINLESS	4 EA
30	BL12674	BRACKET, TRIGGER	1 EA
31	BL12673	TRIGGER	1 EA
32	6-32X1SHSS	SCREW, SOCKET HEAD CAP SS	1 EA

(continued)

(continued)

Item	Part	Description	Qty
33~	PM12685	BOOT, PROTECTIVE	1 EA
34	PM12942	VALVE, FLOW CONTROL, AIR, 1/4" NPT	1 EA
35	DM2666-14	FITTING, 1/8" NPTM X 1/4" TUBE, SWIVEL	1 EA
36	DM2666-56	TUBING, AIR, 1/4" OD BLACK POLYETHYLENE	2 FT
37	PM12963	ELBOW, STREET, 1/4" MNPT X 3/8" FNPT,	1 EA
38	10-32X1/4SS	SCREW, SET, ALLOY	2 EA
40	PM7758	TAG, "GUN SAFETY PROCEDURES", YELLOW	1 EA
41	6-32X1/2SHSS	SCREW, SOCKET HEAD, 6-32 X 1/2 STAINLESS	2 EA
42	6-32 LWS	WASHER, LOCK, STAINLESS	2 EA
43~	PM12687	VALVE, PNEUMATIC, CARTRIDGE 3-WAY WITH	1 EA
44	1/4-20X3/8DPSS	SCREW, SET, HALF DOG POINT	2 EA
45	AA-4099	O-RING, 6MM ID X 2MM CROSS SECTION	2 EA
46	10-24X1/2FHSS	SCREW, FLAT HEAD SOCKET CAP, STAINLESS	2 EA
47	PM29675	FITTING, GREASE,1/4-28 TAPER, 11/16" OAH	1 EA
48	5/16X3/4PDSS	PIN, DOWEL 5/16"X 3/4"LG SS	1 EA
49	PM12686	ADAPTER, HOSE, AIR, 1/4"	2 EA
50	PM8630	RING, RETAINING	1 EA

COLOR KEY:

** Green shading indicates the item has a separate parts list and assembly drawing in this section.*

*** Gold shading indicates the item has additional documentation in the **appendix**.*

*~ Gray shading identifies recommended spare parts. For additional spare/rebuild parts, refer to **7.4** and **7.5.2**.*

7.3 – 3 to 3L Conversion Kit

An NCG8450A–3 lance can be converted to the longer barrel model NCG8450A–3L with the NCG8400A–3LCONKIT conversion kit. The kit contains the longer barrel and discharge barrel housing plus the necessary bushings and fittings.

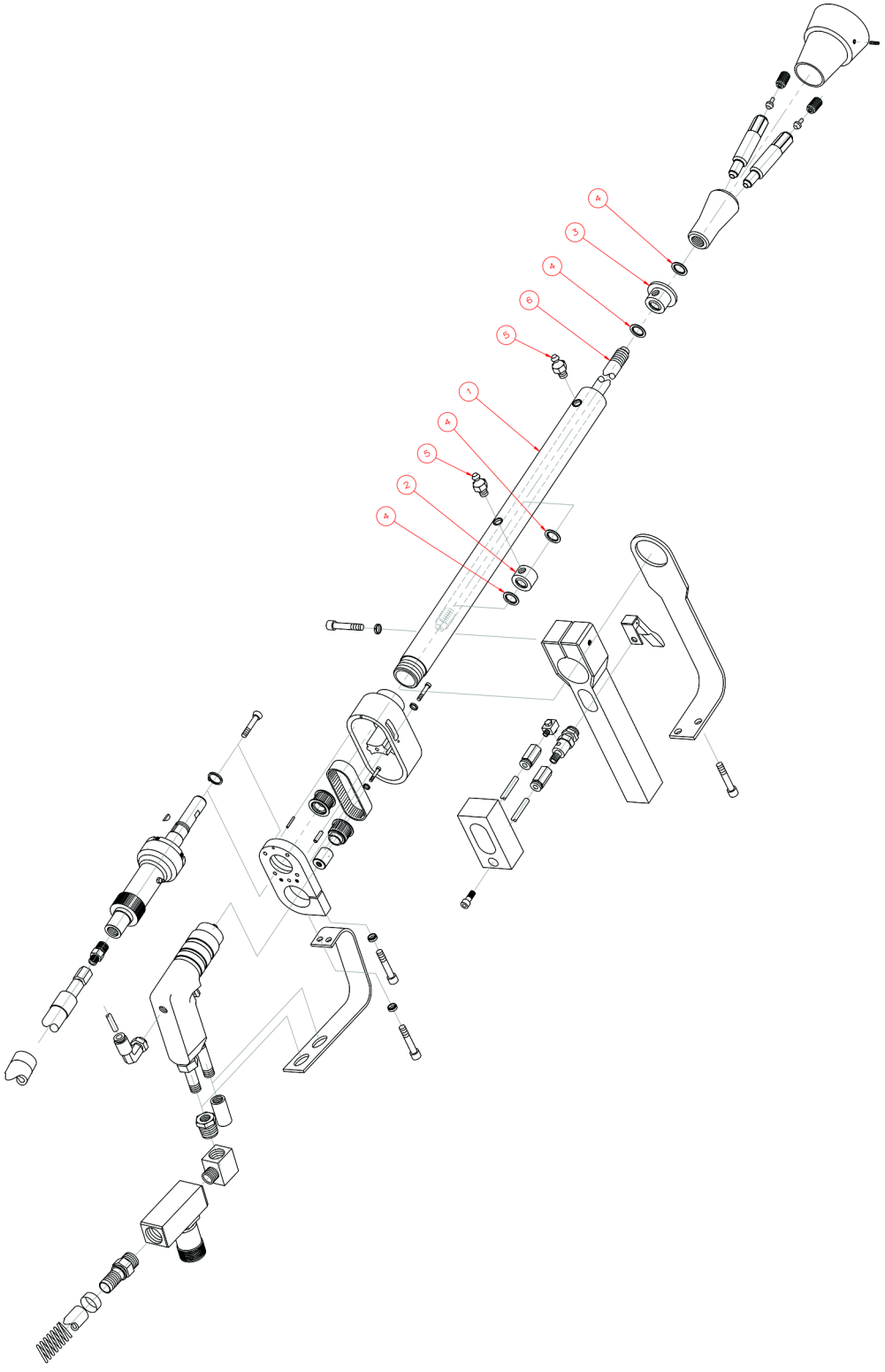
To convert your lance, use the repair procedures in **Sections 6.7** and **6.8** to remove the original parts and install the new parts from the conversion kit.

Parts List for NCG8400A–3LCONKIT (Revision A)

Item	Part	Description	Qty
1	CM17708-1	HOUSING, DISCHARGE BARREL, 40K SPIN GUN	1 EA
2	BM17709	BUSHING, MIDDLE	1 EA
3	BM17710	BUSHING, END	1 EA
4	PM17713	SEAL, OIL	4 EA
5	PM29675	FITTING, GREASE,1/4-28 TAPER, 11/16 LONG	2 EA
6	BM17711-1	BARREL, ROTATING DISCHARGE	1 EA

NCG8400A–3LCONKIT

(DM17712 Revision A)



7.4 – NCG8450A Spare Parts/Rebuild Kits

7.4.1 – Rebuilt Kit / Spares for Model NCG8450A–3

Kit #8450A–3RBKT

Item	Part	Description	Qty
1	DM26650	SHAFT, SWIVEL, ROTARY, DS8850A	1 EA
2	BM26626	SEAL, HP, DS8850A	5 EA
3	BM26620	RING, BACKUP, DS8850A	1 EA
4	AA-1045	O-RING	1 EA
5	PM26616	BEARING, ANGULAR CONTACT, 15mm ID 35mmOD	4 EA
6	PM26629	SEAL, OIL	1 EA
7	PM12646	SEAL, OIL 0.787 SHAFT	1 EA
8	PM8635	BELT, ENDLESS TIMING, 16MM	1 EA
9	BA8396	BEARING, ROTATING BARREL,	1 EA
10	CA8637	COVER, NOZZLE PROTECTOR, 40K	1 EA
11	BA3894	GLAND, NOZZLE RETAINER	2 EA
12	PM12687	VALVE, PNEUMATIC,CARTRIDGE 3-WAY WITH	1 EA
13	PM12685	BOOT, PROTECTIVE	1 EA
14	PM26624	RING, RETAINING	1 EA

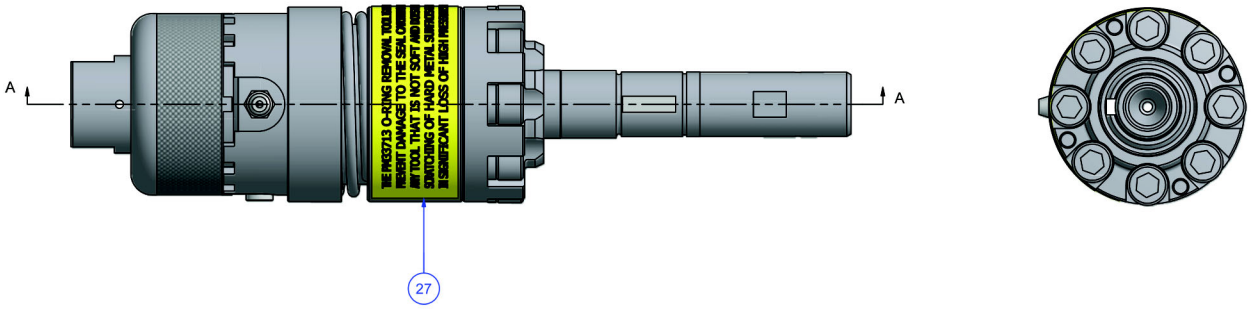
7.4.2 – Rebuilt Kit / Spares for Model NCG8450A–3L

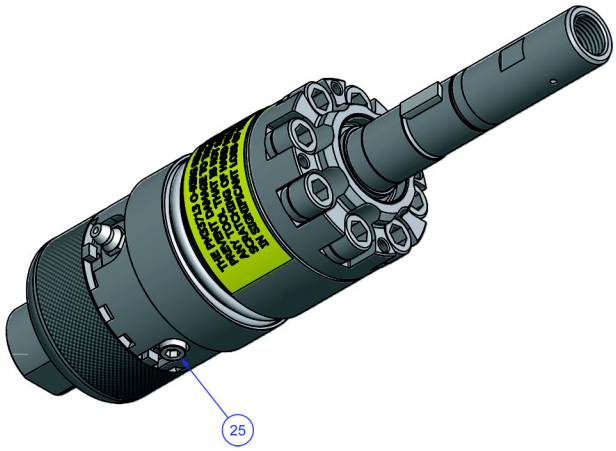
Kit #8450A–3LRBKT

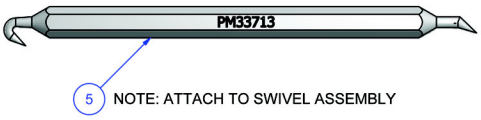
Item	Part	Description	Qty
1	DM26650	SHAFT, SWIVEL, ROTARY, DS8850A	1 EA
2	BM26626	SEAL, HP, DS8850A	5 EA
3	BM26620	RING, BACKUP, DS8850A	1 EA
4	AA-1045	O-RING	1 EA
5	PM26616	BEARING, ANGULAR CONTACT, 15mm ID 35mmOD	4 EA
6	PM26629	SEAL, OIL	1 EA
7	PM12646	SEAL, OIL 0.787 SHAFT	1 EA
8	PM8635	BELT, ENDLESS TIMING, 16MM	1 EA
9	BM17710	BUSHING, END	1 EA
10	CA8637	COVER, NOZZLE PROTECTOR, 36K SPIN GUN	1 EA
11	BA3894	GLAND, NOZZLE RETAINER	2 EA
12	PM12687	VALVE, PNEUMATIC,CARTRIDGE 3-WAY WITH	1 EA
13	PM12685	BOOT, PROTECTIVE	1 EA
14	PM26624	RING, RETAINING	1 EA
15	BM17709	BUSHING, MIDDLE	1 EA
16	PM17713	SEAL, OIL	4 EA

7.5 – DS8850A Rotating Swivel

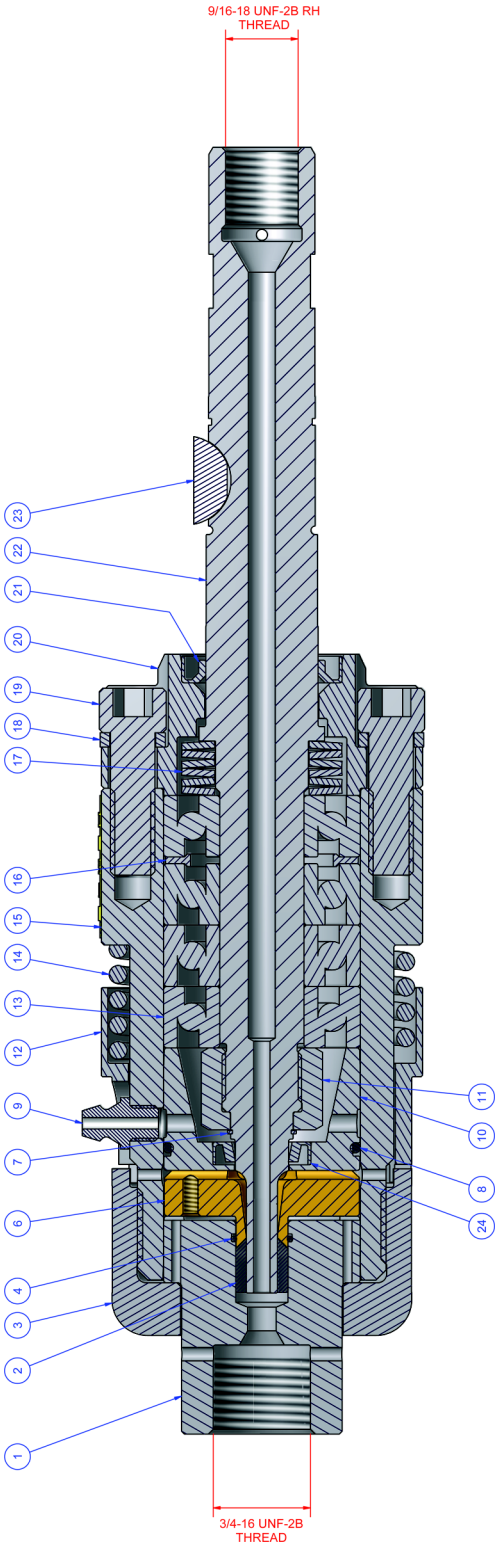
Drawing DM26614 (Revision C)







Drawing DM26614 (Revision C)



7.5 – DS8850A Rotating Swivel

7.5.1 – Parts List

(Revision C)

Item	Part	Description	Qty
1	BM28741	HOUSING, SEAL, DS8850A,-1, -4	1 EA
2*	BM26626	SEAL, HP, DS8850A	1 EA
3	BM26622	ENDCAP, INLET, DS8850A	1 EA
4*	AA-1045	O-RING	1 EA
5	PM33713	TOOL, O-RING REMOVAL PICK, PLASTIC	1 EA
6*	BM26620	RING, BACKUP, DS8850A	1 EA
7	PM26624	RING, RETAINING	1 EA
8*	AA-4101	O-RING	1 EA
9	PM7404	FITTING, GREASE, 1/4-28, SS	1 EA
10	BM26619	SPACER, THRUST, DS8850A	1 EA
11	BM26618	NUT, BEARING, DS8850A	1 EA
12	BM26623	SLEEVE, ANTI-ROTATION, DS8850A	1 EA
13	PM26616	BEARING, ANGULAR CONTACT, 15mm ID 35mmOD	4 EA
14	PM26628	SPRING, COMPRESSION	1 EA
15	CM26615	BODY, SEAL, ROTARY, DS8850A	1 EA
16	BM26631	SPACER, BEARING, DS8850A	1 EA
17	PM26630	SPRING, DISC	6 EA
18	5/16-HCLW-SS	WASHER, LOCK, HIGH COLLAR STAINLESS	8 EA
19	5/16-18X1SHS	SCREW, SPRING WELL, STAINLESS	8 EA
20	BM26617	ENDCAP, OUTLET, DS8850A	1 EA
21*	PM12646	SEAL, OIL 0.787 SHAFT	1 EA
22*	DM26650	SHAFT, SWIVEL, ROTARY, DS8850A	1 EA
23	PM12811	KEY, WOODRUFF, 3/16 X 5/8 X 0.235	1 EA
24*	PM26629	SEAL, OIL	1 EA
25	10-32X3/16SHS	SCREW, SOCKET HEAD CAP, STAINLESS	1 EA
26	BM33702	TOOL, SEAL REMOVAL, DS8850 SEAL, BM26626	1 EA
27	BM34919	TAG, O-RING REMOVAL FOR PM33713, DS8850A	1 EA

***** *Gray shading identifies recommended spare parts.*

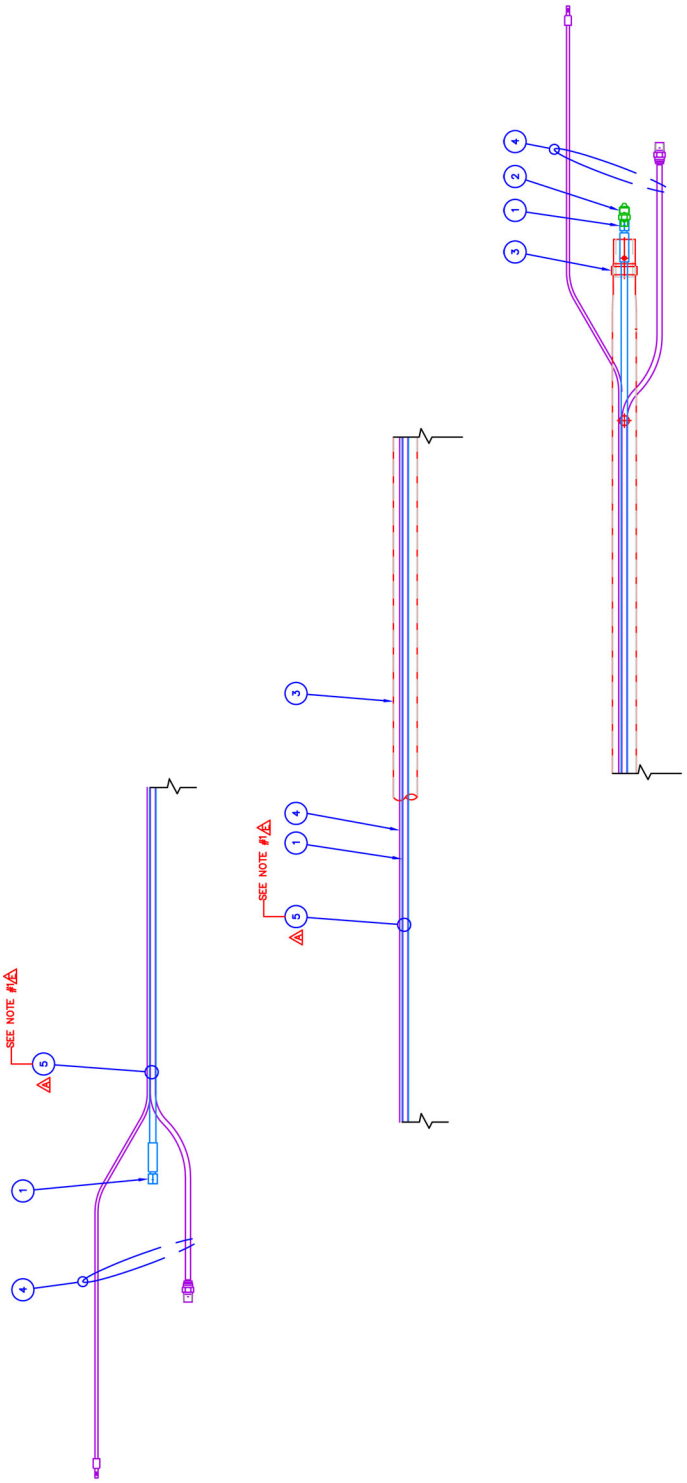
7.5.2 – Rebuild Kit

(8850ARBKT Revision A)

Item	Part	Description	Qty
1	BM26626	SEAL, HP, DS8850A	1 EA
2	AA-1045	O-RING	1 EA
3	BM26620	RING, BACKUP, DS8850A	1 EA
4	AA-4101	O-RING	1 EA
5	PM26616	BEARING, ANGULAR CONTACT, 15mm ID 35mmOD	4 EA
6	PM12646	SEAL, OIL 0.787 SHAFT	1 EA
7	DM26650	SHAFT, SWIVEL, ROTARY, DS8850A	1 EA
8	PM26629	SEAL, OIL	1 EA
9	PM26624	RING, RETAINING	1 EA
10	PM33713	TOOL, O-RING REMOVAL PICK, PLASTIC	1 EA

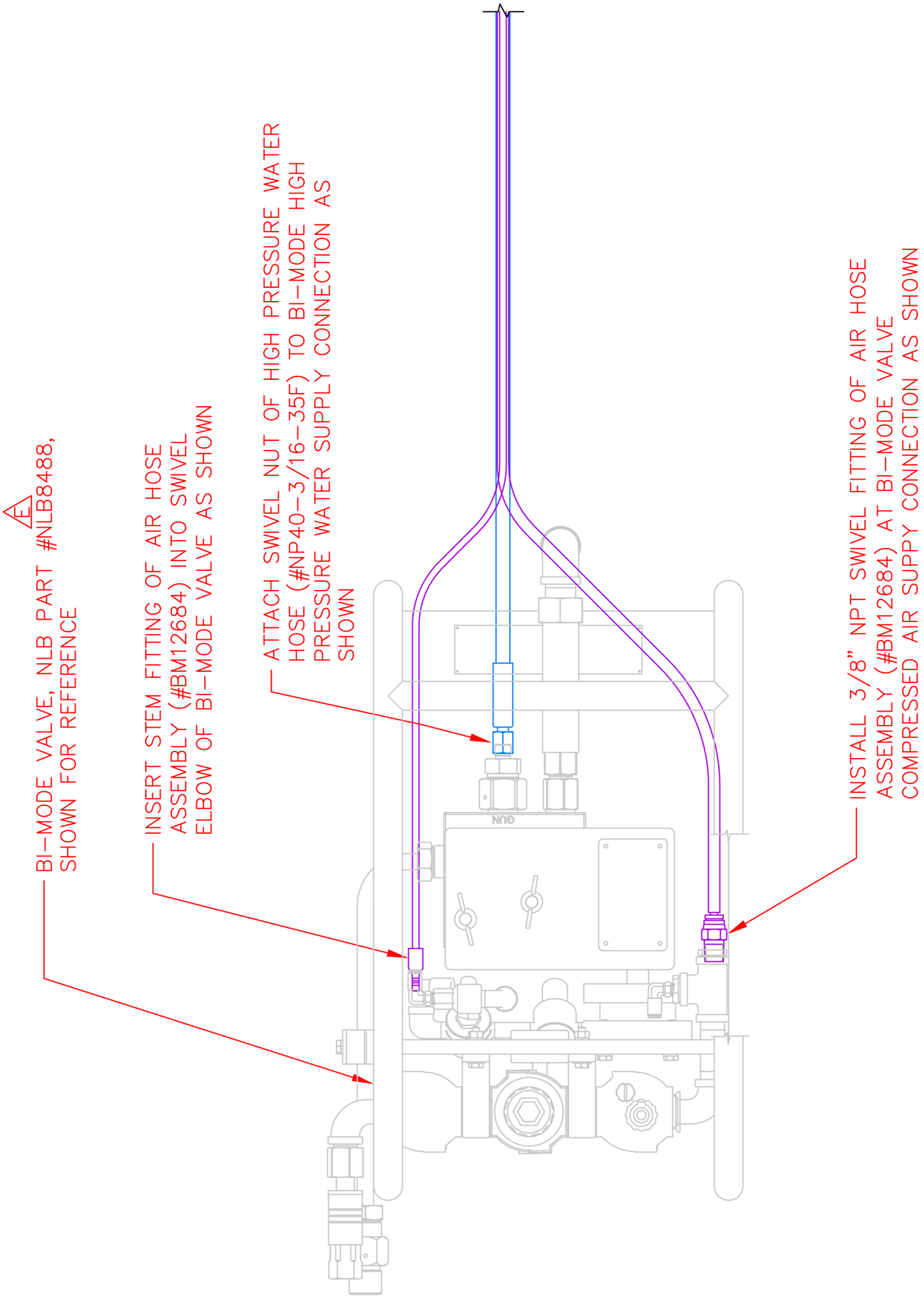
7.6 – Bi–Mode to Lance Hose Assembly (DM14150)

Component Callouts (Revision E)



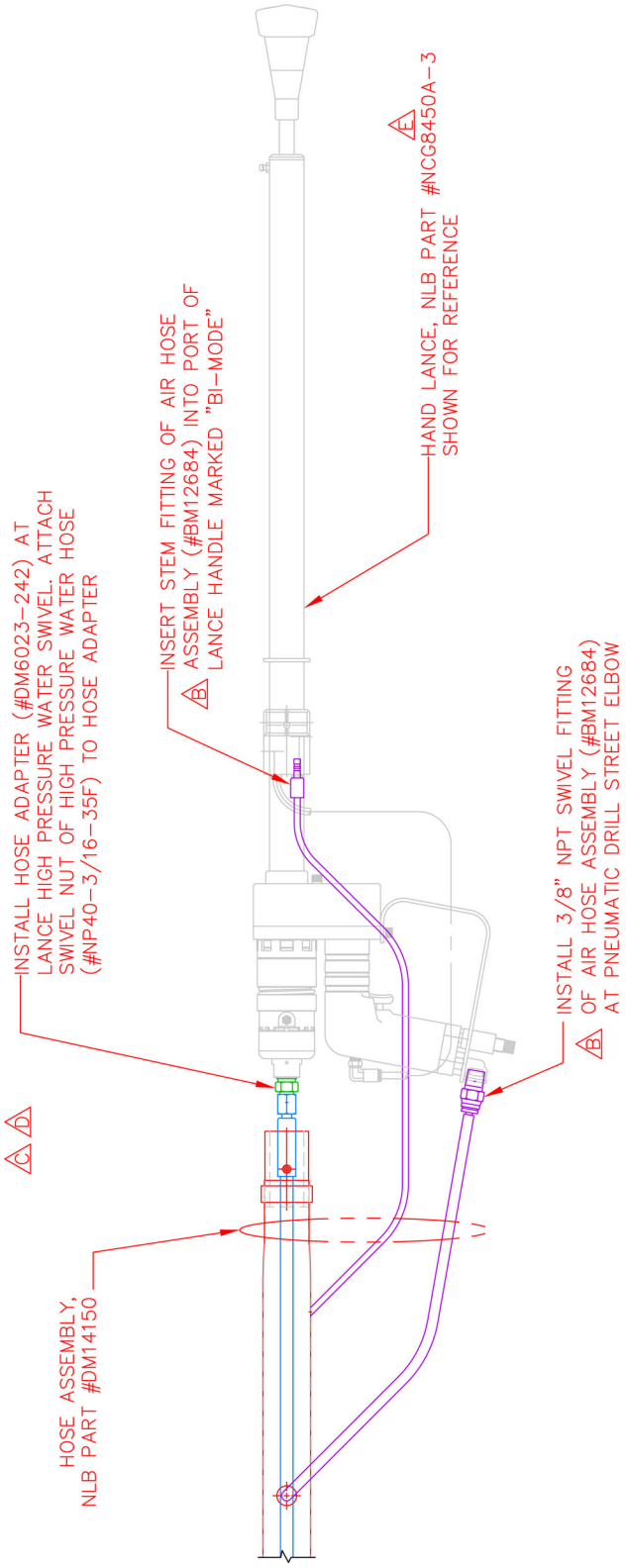
7.6 – Bi–Mode to Lance Hose Assembly (DM14150)

Assembly Guidelines: From Bi–Mode Valve



7.6 – Bi–Mode to Lance Hose Assembly (DM14150)

Assembly Guidelines: To Lance Inlet



7.6 – Bi–Mode to Lance Hose Assembly (DM14150)

WARNING

NLB recommends that the hose assembly used to connect the Bi–Mode Valve to a rotating lance not exceed the provided 35 feet. Additional length increases the dump valve reaction time, resulting in a delayed shut–off. This may result in personal injury if immediate shut–off is needed.

7.6.1 – 35–Foot Option

Parts List for DM14150 (Revision E)

Item	Part	Description	Qty
1	NP40-3/16-35F	HOSE, 3/16"X 35',40K,9/16-18	1 EA
2	DM6023-242	ADAPTER, HOSE, 9/16-18 TYPE M MALE	1 EA
3	CM10671	SHROUD, HOSE ASSEMBLY	1 EA
4	BM12684	HOSE, AIR, ASSEMBLY, 36' NOMINAL LENGTH	1 EA
5	MM6227	TIE, CABLE, 3M 14" PLASTIC	15 EA

7.6.2 – 15–Foot Option

Parts List for DM14150–15 (Revision E)

Item	Part	Description	Qty
1	NP40-3/16-15F	HOSE, 3/16"X 15',40K,9/16-18	1 EA
2	DM6023-242	ADAPTER, HOSE, 9/16-18 TYPE M MALE	1 EA
3	CM10671	SHROUD, HOSE ASSEMBLY	1 EA
4	BM12684	HOSE, AIR, ASSEMBLY, 36' NOMINAL LENGTH	1 EA
5	MM6227	TIE, CABLE, 3M 14" PLASTIC	12 EA

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SECTION 8 – CUSTOMER SUPPORT

8.1 – Introduction

NLB Corporation recognizes the important role of customer support in eliminating and/or decreasing equipment downtime due to unscheduled maintenance or repair. We pledge to contribute the technical assistance needed to help customers during equipment installation and operation maintenance. We maintain a large inventory of parts available for shipment within 3 business days.

NLB Wixom Headquarters

Located in Wixom, Michigan, USA, our Customer Service Department is staffed with trained, knowledgeable personnel who are dedicated to delivering customer satisfaction. They can provide information and support for items such as:

- Parts availability
- Price information
- Technical support
- Warranty information
- Parts return authorization (RA) process

Customer Service Department
29830 Beck Road
Wixom, MI 48393–2824
(248) 624–5555 or (800) 227–7652
Fax: (248) 624–0538

Website: **http://www.nlbcorp.com**

e–mail: nlbparts@nlbusa.com

The Customer Service Department representatives are available Monday through Friday, 8:00 a.m. to 6:00 p.m. and Saturday 8:00 a.m. to 12:00 p.m. (EST) to assist you. After hours emergency customer support is also available.

8.1 – Introduction

NLB Regional Offices

Also available to our clients are NLB regional offices for support with sales, parts and service.

	Address	Hours
California	1323 E. Hill St. Signal Hill, CA 90755 Phone: (562) 490-3277 FAX: (562) 733-0780	Monday - Friday 8:00 am - 5:00 pm (PST)
Indiana	1075 Breuckman Dr. Crown Point, IN 46307 Phone: (219) 662-6800 FAX: (219) 662-1400	Monday - Friday 8:00 am - 5:00 pm (CST)
Louisiana	14302 Hwy. 44 North Gonzales, LA 70737 Phone: (225) 622-1666 FAX: (225) 622-7366	Monday - Friday 8:00 am - 5:00 pm (CST)
Michigan Rental Operations	25005 Trans X Drive Novi, MI 48375 Phone: (248) 347-1780 FAX: (248) 347-1763	Monday - Friday 8:00 am - 5:00 pm (EST)
New Jersey	159 Harmony Road Mickelton, NJ 08056 Phone: (856) 423-2211 FAX: (856) 423-0997	Monday - Friday 8:00 am - 5:00 pm (EST)
Texas	11506 Spencer Hwy. La Porte, TX 77571 Phone: (281) 471-7761 FAX: (281) 471-8738	Monday - Friday 8:00 am - 5:00 pm (CST)

8.2 – Warranty Policy

All components manufactured by the seller are warranted to be free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment. At its option, the seller may either repair the defective parts or furnish new parts free of charge, FOB at the seller's factory. This warranty will only apply upon the seller's determination after inspection, that such parts are defective in material or workmanship. The warranty expressed in this paragraph shall constitute buyer's exclusive remedy.

Equipment and accessories not manufactured by the seller are only warranted to the extent of the original manufacturer's warranty and are subject to their allowance to the seller.

Charges for labor and/or parts incidental to the removal and remounting of defective parts or accessories are the responsibility of the buyer and are not covered by this warranty.

This warranty does not apply to, and the company assumes no responsibility for, any equipment or parts that have been improperly installed, misused, altered, abused, or neglected. Under no conditions will the seller be liable for any delays or consequential damages or losses in the fulfillment of this warranty.

The seller's liability under this warranty is limited to the repair and replacement of defective parts as stated above and the seller is not responsible for any damages, expenses, or losses of income resulting from such defects.

8.3 – Ordering Parts

8.3.1 – Parts Found to be Defective Under the Terms of the Warranty

- If parts are found to be defective under the terms of warranty, NLB Customer Service will determine whether to repair of replace faulty components. The parts will then be shipped to the customer at no charge. However, shipping charges are not covered by warranty.
- In the event that parts are urgently needed while equipment is still under warranty and under inspection, it is recommended that the customer issue a new purchase order for the required parts.
- If the part is in stock, it will be shipped within 3 working days from the time the order is placed. If the part is not in stock, the customer will be given an estimated shipping date.
- If the warranty claim is approved, NLB Corp. will either repair, replace, or issue a credit memorandum for the parts. A copy of the credit memorandum will be forwarded to the customer. This credit can be used on future orders.

8.3.2 – Parts Found Not to be Defective Under the Terms of the Warranty

In the event that parts are found not to be defective under the terms of the warranty, Service will notify the customer and will give the following options at that time:

- Issue a purchase order to have the parts repaired.
- Request that the parts be returned at their expense.
- Request, with a written request submitted, that the parts be scrapped by NLB Corp.
- In the event that notification has not been relayed from the customer to NLB Corp. on what their desire may be with the parts in question, after 10 business days, the parts will be shipped to the customer at their expense.

Use the **PARTS Section** to assist you in finding the correct part you wish to order, then contact our Customer Service Department and have the following information available:

- Part name
- Part number
- Quantity desired
- Date required
- Shipping location information
- Purchase order number

If the part desired is in stock, it will be shipped within 3 working days from the time the order is placed. If the part is not currently in stock, the customer will be given an estimated shipping date when the order is placed. In the event of an equipment breakdown, same day shipments can be made only if the requested part is in stock and the order is received before 3:00 p.m. EST.

8.4 – Parts Received with Damage

All shipments leaving NLB Corp. are packaged according to good standard packaging practice. NLB Corp. cannot be held responsible for any parts damaged in transit. Responsibility for damaged shipment lies with common carrier. When parts are received in damaged condition, but with the shipping container intact, the customer should make a **Concealed Damage Report** to the carrier within 3 business days of the delivery. The customer must make all claims to the common carrier. Whenever possible, NLB Corp. will be glad to render the customer all possible assistance to secure satisfactory adjustment of damage claims.

8.5 – Parts Return Authorization (RA) Process

In order for parts to be returned to NLB Corp. quickly and efficiently, customers returning parts for any reason must follow the Parts Return Authorization (RA) Process. Customers must obtain a Return Authorization (RA) Number, this number is issued by NLB Customer Service, it is unique to your claim and used to track customer returned parts through the return process. Obtaining a Return Authorization Number does not guarantee warranty or credit for the parts being returned.

All returns must be pre−authorized by a Customer Service Representative and will not be accepted without a return authorization number. Unauthorized returns will be shipped back to the customer at their expense.

Parts built to customers specification, parts unique to custom engineered systems, or parts that have been modified by the customer cannot be returned for credit under any circumstances.

8.5.1 – How to Acquire a Return Authorization Number

Please follow this process any time parts are returned for any purpose. Contact NLB Customer Service (800) 227−7652 (USA and Canada) or (248) 624−5555 and request a Return Authorization Number and instruction on how to return parts.

Before calling NLB Customer Service, have the following information to help them assist you:

- Company name, address, telephone and fax number.
- Shipping address (if shipping address is different from company address).
- Contact name, telephone number, and fax number (if contact phone and fax number is different from company).
- Original purchase order number.
- Itemized list of parts to be returned, quantity, part number/serial number, and physical description of each part.
- Details of the system from which the parts were removed, if applicable, job number, model number, serial number, and hours of use if available.
- Explanation for the return of the parts.
- Any additional information that may assist the process in resolving your request.

8.5 – Parts Return Authorization (RA) Process

There are five different Return Authorization Procedures to follow for returning parts for you to follow depending on the reason for return:

- Parts Ordered in Error by Customer – Returned for Credit
- Unused Parts Returned for Credit – Less than One Year Old
- Parts Shipped in Error by NLB Corp. – Returned for Credit
- Parts Returned for Repair
- Parts Returned for Warranty Repair or Credit

8.5.2 – Parts Ordered in Error by Customer – Returned for Credit

1. Acquire a Return Authorization Number and return parts shipping prepaid to NLB Corp. Collect shipments will not be accepted by NLB Corp.

2. The parts will be examined by Customer Service to verify that the parts are unused, in new condition, and free of damage. If parts are determined to be new, the customer will receive full credit for the amount charged, minus a 20% restocking fee. A copy of the credit memorandum will be forwarded to the customer; the credit can be used on future orders.

3. If the parts are not in new/satisfactory condition, NLB Corp. will notify the customer as to their disposition.

8.5.3 – Unused Parts Returned for Credit – Less than One Year Old

1. Acquire a Return Authorization Number and return parts shipping prepaid to NLB Corp. Collect shipments will not be accepted by NLB Corp.

2. The parts will be examined by Customer Service to verify that the parts are unused, in new condition, and free of damage. If parts are determined to be new, the customer will receive full credit for the amount charged minus a 20% restocking fee. A copy of the credit memorandum will be forwarded to the customer.

3. If the parts are not in new/satisfactory condition, NLB Corp. will notify the customer as to their disposition.

8.5.4 – Parts Shipped in Error by NLB Corp. – Returned for Credit

1. Acquire a Return Authorization Number.

2. The parts will be examined by Customer Service to verify that the parts are unused, in new condition, and free of damage. If parts are determined to be new, the customer will receive full credit for the amount charged. A copy of the credit memorandum will be forwarded to the customer; the credit can be used on future orders.

3. If the parts are not in new/satisfactory condition, NLB Corp. will notify the customer as to their disposition.

4. If the correct replacement parts are in stock, they will be shipped within 3 business days or on the same day for urgent requests.

8.5.5 – Parts Returned for Repair

1. Acquire a Return Authorization Number and return parts shipping prepaid to NLB Corp. Collect shipments will not be accepted by NLB Corp.

2. NLB will provide a verbal, or upon request a written quotation for the repair cost, including labor assuming the equipment can be repaired. Return freight will be charged as incurred.

3. Customer will issue a purchase order for the repair amount.

4. Damaged or worn parts will be returned to the customer along with the new parts. If the customer decides not to have the damaged parts returned, they must notify NLB Corp. in writing.

5. If components are not repairable, beyond cost–effective to repair, or not approved for repair, they will be returned to the customer at their expense or scrapped at NLB upon receipt of the written customer request.

8.5.6 – Parts Returned for Warranty Repair or Credit

1. Acquire a Return Authorization Number.

2. Warranty replacement and/or repair will be handled according to NLB Corp. Standard warranty practices. Warranty service extends only to the original purchaser and is not transferable without NLB Corp. consent. If you have any questions regarding warranty issues, contact NLB Customer Service (800) 227–7652.

3. NLB Customer Service will inspect and test all returned parts thought to be defective by the customer to verify that components are covered by NLB Corp. warranty. Claims will be handled as promptly as possible. After a warranty determination has been reached, the components will be handled accordingly.

8.6 – Packaging Parts for Return

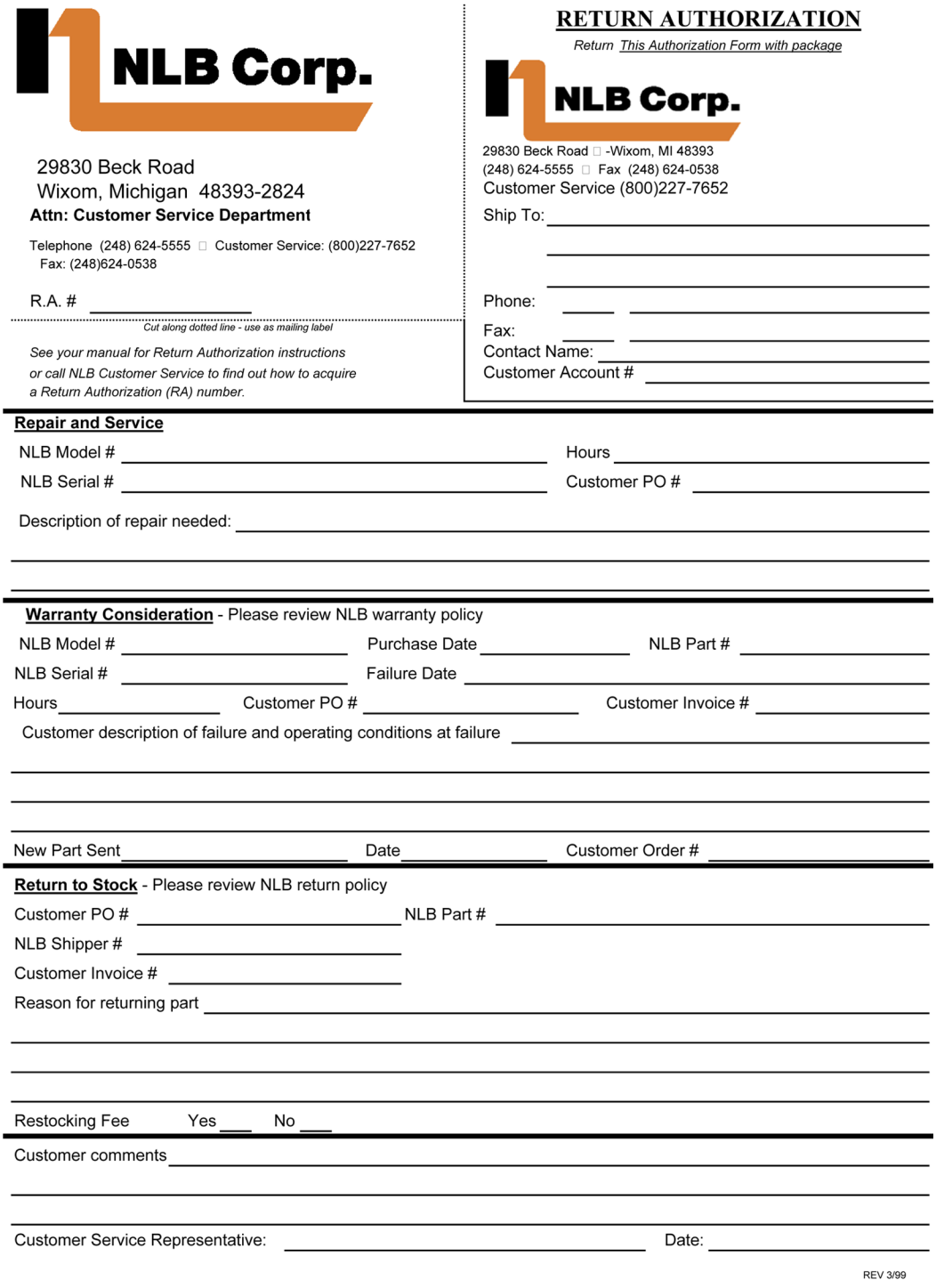
Use this method when packaging parts to be returned to NLB Corp.

Fill out the Return Authorization Form with all applicable information and include this with the package being returned. Use the pre–printed label found on the Return Authorization Form and ship prepaid to NLB Corp., attention Customer Service, or to a location stipulated by the Customer Service Representative. Confirmation of purchase is required before any warranty service is rendered.

Excluding parts sent for warranty or repair, all parts must be clean and in saleable condition and be returned in their original packaging or other suitable protective container.

8.6 – Packaging Parts for Return

TIP: Click the image below to display a printable version of the RA Form (or locate the PDF file on the CD in the back of this printed manual).



NLB Corp.

29830 Beck Road
Wixom, Michigan 48393-2824
Attn: Customer Service Department

Telephone (248) 624-5555 □ Customer Service: (800)227-7652
Fax: (248)624-0538

R.A. # _____

Cut along dotted line - use as mailing label

See your manual for Return Authorization instructions or call NLB Customer Service to find out how to acquire a Return Authorization (RA) number.

RETURN AUTHORIZATION

Return This Authorization Form with package

NLB Corp.

29830 Beck Road □ -Wixom, MI 48393
(248) 624-5555 □ Fax (248) 624-0538
Customer Service (800)227-7652

Ship To: _____

Phone: _____

Fax: _____

Contact Name: _____

Customer Account # _____

Repair and Service

NLB Model # _____ Hours _____

NLB Serial # _____ Customer PO # _____

Description of repair needed: _____

Warranty Consideration - Please review NLB warranty policy

NLB Model # _____ Purchase Date _____ NLB Part # _____

NLB Serial # _____ Failure Date _____

Hours _____ Customer PO # _____ Customer Invoice # _____

Customer description of failure and operating conditions at failure _____

New Part Sent _____ Date _____ Customer Order # _____

Return to Stock - Please review NLB return policy

Customer PO # _____ NLB Part # _____

NLB Shipper # _____

Customer Invoice # _____

Reason for returning part _____

Restocking Fee Yes ___ No ___

Customer comments _____

Customer Service Representative: _____ Date: _____

REV 3/99

GLOSSARY

Definitions of common words for operating components of water jet systems

Abrasive – Any solid particles, either soluble or insoluble in carrier fluid, that are introduced into a water jet before it hits the target surface. Such particles are often used to increase the effectiveness of pure water jets for some applications. Abrasives can be used to prepare a surface for painting as well as for cutting materials.

Abrasive Feed System – A system that includes a storage vessel/hopper for the abrasive, a hose/tube to carry the abrasive to the point where its inserted into the water–jet, and a device to insert the abrasive to the water jet stream.

Abrasive Jet – A water jet where solid particles are introduced into the jet stream before the jet hits the target. Abrasive particles can be introduced to the jet stream in three ways: entrained abrasive, external abrasive, and slurry abrasive.

- **Entrained Abrasive** – The particles are added to the jet stream after the jet has accelerated through an orifice, but before the resulting stream has been reshaped through a focusing nozzle.
- **External Abrasive** – The particles are added to the jet stream after it has left the final orifice.
- **Slurry Abrasive** – The particles are added to the water before its accelerated through an orifice.

Automatic Pressure Relief Devices – Devices included in a high–pressure water jet system to provide a way of automatically limiting system pressure. There are several types of automatic pressure relief devices:

- Automatic pressure regulating valves
- Bursting and rupture discs
- Bypass valves
- Pressure relief valves

An automatic pressure relief device should be mounted close to the discharge outlet of the pressurizing pump because the pressure at that point is the highest in the system. That location will also allow a quicker release in system pressure without retaining higher pressures in downstream components of the system.

Automatic Pressure Regulating Valve – A valve used to automatically control the working pressure in the high–pressure water jet system by controlling the bypass water flow. When the pressure in the system exceeds a set level, the valve will partially open, as the valve opens more water is bypassed and less flows to the nozzle. The water passing through the valve can be directed either back to the supply reservoir or to other disposal. An automatic pressure–regulating valve may be used to control the operating pressure at which a system operates. It should be checked before each use to make sure it is set at the correct value.

Bursting/Rupture Disc – This is typically a metal disc, held in place by a specially designed housing that will fail when the pressure applied to it exceeds a set level. Discs can be made of different material and different sizes.

Bypass Valve – A valve that can be adjusted by the operator either manually or automatically, to control the flow/pressure of the jet stream exiting the nozzle.

Burst Pressure – The internal pressure within a component of a high–pressure water–jet system at which it will fail.

Catcher – When a plain or abrasive laden water jet is used in a cutting application, a device can be placed on the opposite side of the work piece to catch the spent jet, abrasive and particles of the material. This catcher is fitted with a waste tube that carries the spent material from the area.

Changeover Valve – A valve that the operator can adjust to send the water from the pressurizing pump to either one or several pieces of water jet equipment that are supplied by the pump. This valve can be operated either manually or by a secondary power circuit attached to the high–pressure water jet system.

Collimating Nozzle – The secondary nozzle used below the mixing chamber to refocus the stream of high–pressure water and abrasive in conventionally mixed abrasive water jet systems.

Dry Shut–Off Control Valve – Usually a valve that is manually controlled by the nozzle operator to start and stop the flow of water to the nozzle. Closing this valve stops the water flow to the nozzle, but keeps pressure in the supply line at the systems working pressure. When this valve is used it typically is also fitted with an automatic pressure–regulating valve to ensure that the system does not exceed operating pressure.

Dual Trigger Gun – A gun that requires two triggers engaged to activate the high–pressure water jet.

Dump System – The system is equipped with a device that will either shut down the pump, idle it to a low revolutions per minute (rpm), bypass the flow of water, or reduce the discharge pressure to a low level. The nozzle operator controls the dump system by use of hand or foot control. The dump system actuator should be shielded to prevent accidental operation. In situations where the dump system is released to a dump line instead of open atmosphere, the dump line must be secured so that it does not whip when active.

Dump Control Valve – Usually a valve that is manually controlled by the nozzle operator and closed to send water to the nozzle. When the valve is released, it stops water flow to the lance/nozzle by opening a much larger flow passage through which the water is diverted at low pressure. This valve can also be used with an electrical or pilot pressure system that includes additional circuits that must be engaged for the valve to actuate. These systems should also be designed so that if the valve fails, it opens to relieve pressure.

Dump Systems – Solenoid and Electrical Operated Control – All electrical controlled dump systems are a fail–safe design. Voltage of an alternating current (AC) or direct current (DC) dump system that is handled by personnel should not exceed 24 volts and should be fuse protected.

End Fittings and Couplings – High–pressure hose end fittings and couplings are manufactured to be compatible with the hose and should be tested as an assembly.

Filter or Strainer – The water system must be equipped with a filter or strainer to prevent particles to enter the system, restricting the flow of water through orifices or damaging seals and valves located inside the pump unit. At the minimum, the filter/strainer must be capable of removing particles that are smaller in size than half of the diameter of the smallest opening in the system. Smaller filter/strainer sizes are strongly recommended and should be checked and replaced at regular intervals to maintain system performance and longevity of equipment.

Flexible Lance – A flexible tube or hose section carrying water to the nozzle. Typically located between the trigger control valve and the nozzle.

Foot Control Valves – A control valve that is designed so that the operator can activate it using their foot, which allows the operator the lance/nozzle with use of both hands. When a foot valve is used, it must be placed within a frame that will guard the valve from accidental operation and that is sturdy enough so that it cannot be knocked over or moved during operation.

Hand Lance – This hand–operated device is often used in manual water jet application. It is typically connected to the high–pressure system by use of a high–pressure hose assembly. The gun consists of a control valve mounted within a guard, a lance section, and a nozzle(s). The gun may also include a support bracket, shoulder stock and one or more support handles. The type of control valve that's used to release the pressure can further define the gun. A dump gun is the type that the pressure is dumped to atmosphere when the valve is released. A dry shut–off gun is the type that the pressure is retained in the system by using a dry shut–off control valve.

Hand Lance Trigger – The control valve has a trigger that makes it easier for the operator to control the device. It includes a catch or lockout function for safety so that it cannot be operated until the catch is released.

High Pressure Hose – A flexible hose that can be used to carry liquids from one part of the high–pressure water jet system to another. The hose should have a minimum burst rating of 2.5 times the intended working pressure that it is certified for use by the manufacture.

Hose Assembly – A hose with a suitable end coupling attached at each end.

Hose Safety Shroud – A protective covering over a high pressure hose, which is designed to protect the worker from a high pressure water burst should a hose failure occur, or prevent leakage from a threaded connection or weep hole impacting a worker. The shroud should be constructed to prevent the burst from exiting the shroud. The shroud should be designed in a manner as to cover nearby threaded connections and weep holes and be removable to facilitate high pressure hose inspections. Typical shroud length, at minimum, should be six (6) feet. Longer shrouds are acceptable and, in certain situations, should be considered. Hose shrouds should be tagged with both an identification number, unique to each shroud, and a manufacturing date.

High–Pressure Water Jet Systems – High–pressure water jet systems are water delivery systems that have nozzles that restrict water flow to increase the speeds of the liquid as they are released. High–pressure water jet systems are used in several ranges of pressure, which are listed as **high–pressure water cleaning, high–pressure water cutting, pressure cleaning, pressure cutting, ultra high–pressure water cleaning, and ultra high–pressure water cutting** and are listed below**.**

- **High–Pressure Water Cleaning** – The use of high–pressure water, with or without the aid of other liquids or solid particles, to remove unwanted matter from various surfaces where pump pressure is between 5,000 psi (340 bar) and 30,000 psi (2,041 bar).

- **High−Pressure Water Cutting** − The use of high−pressure water, with or without the aid of other liquids or solid particles, to penetrate the surface of a material with the purpose of cutting that material where pump pressure is between 5,000 psi (340 bar) and 30,000 psi (2,041 bar).
- **Pressure Cleaning** − The use of pressurized water, with or without the aid of other liquids or solid particles, to remove unwanted matter from various surfaces where pump pressure is below 5,000 psi (340 bar).
- **Pressure Cutting** − The use of pressurized water, with or without the aid of other liquids or solid particles, to penetrate the surface of a material with the purpose of cutting that material where pump pressure is below 5,000 psi (340 bar).
- **Ultra High−Pressure Water Cleaning** − The use of high−pressure water, with or without the aid of other liquids or solid particles, to remove unwanted matter from various surfaces where pump pressure exceeds 30,000 psi (2,041 bar).
- **Ultra High−Pressure Water Cutting** − The use of high−pressure water, with or without the aid of other liquids or solid particles, to penetrate the surface of a material with the purpose of cutting that material where pump pressure exceeds 30,000 psi (2,041 bar).

Jet Manifold − The manifold provides an attachment at the end of the lance for individual nozzles or nozzle holders to be threaded to distribute the water jet over a given pattern.

Lancing − An application whereby a rigid or flexible lance/nozzle combination is inserted into the interior of a pipe or tubular product.

Mole Lancing − An application where a hose fitted with a nozzle is inserted into and retracted from the interior of a tube. This is typically used with a self−propelled nozzle for cleaning the internal surfaces of pipes or drains. Moles can be self−propelled by their backward−directed jets or can be manufactured to be fitted with various shapes, sizes, and combinations of forward−directed and backward directed jets. A mole should have a section of rigid pipe or tubing directly behind it to prevent the mole from turning around within the pipe.

Nozzle − A device with one or more orifices through which the water discharges from the system. The nozzle restricts the area of flow of the fluid, which in turn accelerates the water to the required velocity and shaping it to the required flow pattern. Nozzles are also referred to as bits, tips or orifices.

Nozzle Holder − The threaded fitting that holds a nozzle insert and attaches it to the jet manifold or shotgun lance.

Nozzle Insert – A replaceable nozzle, typically fitted with one orifice and designed to fit into a nozzle holder.

Operator – A person who has been trained by NLB and has demonstrated the knowledge, skill and experience to assemble, operate and maintain a high–pressure water jet system.

Operator Trainee – A person that is not qualified due to lack of knowledge, skill and/or experience to perform as an operator without supervision.

Orifice – The opening at the end of a nozzle through which the water or fluid jet exits from the system.

Pressure Gauge – The high–pressure water jet system should be equipped with a gauge indicating the pressure being developed. Gauges must have a scale range of at least 50% above the maximum working pressure of the system and should also be fitted with a pressure snubber for a more accurate pressure reading.

Pressure Pump – Pumps that will increase the pressure of water delivered to it and deliver it into a common manifold by which flexible hoses or rigid tubing are connected to lances/nozzles. These pumps can either be mobile or permanently mounted and are usually of a positive displacement style plunger that will provide a constant flow of water at a given speed of rotation.

NLB high–pressure water jet units have a permanently mounted tag designed to provide the following information:

- Name of manufacture
- Model, serial number, and year of manufacture
- Maximum performance in terms of gallons/liters per minute, pressure in bar/psi
- An outline of recommended safety procedures

Pressure Relief – The high–pressure water jet system is equipped with an automatic relief device on the discharge side of the pump.

Pressure Relief Valve – A valve that is normally held in the closed position by a mechanical device, such as a spring. It's designed to open when the operating pressure in the system exceeds a set value.

PTO Clutch – Power take–off clutch.

Pulsating Water Jet – A jet that consists of individual slugs of water or liquid.

Rigid Lance – A rigid metal tube used to extend the nozzle from the end of the hose or jet gun.

Self−Rotating Nozzle Assembly − A device using a bearing or swivel assembly that fits onto a hose or lance section. The device contains a minimum of two jets that are offset so that the reaction force from the jets causes the nozzle assembly to rotate without any additional external force being applied.

Shotgun Blasting − A hand−held application whereby an assembly of a lance and a nozzle can be manually controlled in virtually all planes of operation.

Spray Bar − A special manifold designed to distribute nozzles along a linear tube or pipe. A spray bar is most often used to provide an array of fan−jets that overlap, and is frequently used to clean large areas.

Starter Rod/Stinger − A length of rigid tubing or pipe mounted behind the nozzle assembly for use with a flexible lance.

Support Handle − An additional handle that can be attached to a jet gun to provide additional support to the operator in directing the gun. A support handle can be fitted with a switch for additional control functions.

Thermoplastic Hose − Since thermoplastic hose can fail and create a small hole that can cause a hazardous jet to be formed, it is not recommended for water jet use unless it has been designed for use in a specific water jet application.

Water Jet − A rapidly moving stream of water of different shapes and styles exiting from the nozzle orifice. The speed of the jet can vary depending on the pressure drop across the nozzle surface.

- **Fan Jet** − A jet designed to spread out as it leaves the orifice. The divergence is typically restricted to one plane. The degree at which the jet tapers out from the central axis is often used to designate the jet produced. A standard application is for cleaning larger areas requiring less energy to remove unwanted matter.
- **Retro Jet** − A jet that is directed in the reverse position of motion of the nozzle. A retro jet is typically used to provide a thrust force to move the nozzle into the work piece and to provide jets to clean in otherwise inaccessible locations. It may also be used to balance the forward jet, thus providing zero thrust for underwater applications or those on scaffolding.
- **Straight Jet** − The straight jet exits from circular orifice and is used to carry the maximum force to the target with a minimum of energy dispersion. A typical application would be for cutting or for general cleaning of matter with higher shear and/or bond strength. Since it is not designed to spread, a straight jet is also known as a zero−degree jet.

Whip−Lock/Check − A short length of wire or cable looped over each end of two hoses that are connected by a coupling. A whip−lock or whip−check is designed to stop the ends of the hose from whipping around in the event of a coupling failure.

Working Area – The area within the barriers setup to provide warning and restricted access, in which water jet operation will take place.

Working Pressure – The maximum pressure, recommended by the manufacture, at which a component is to be used. This pressure is sometimes referred to as the operating pressure.

APPENDIX A – MANUFACTURER'S LITERATURE

This appendix lists selected components supplied to NLB that are used to build this Cleaning Lance.

Additionally, the CD on the inside back cover of this manual includes these same documents in PDF format.

Pneumatic Drill **(NLB Part BA8406)**	*Ingersoll Rand Air Drill 6A Series* Product Information* (Includes Lubrication details) Product Safety* Parts

** NOTE: The complete PDF version of these documents contains numerous languages. Only English is included in the NLB printed manual.*

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