QSA GLOBAL.

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OPERATIONS & MAINTENANCE MANUAL. MAN-065

SAN886 & SAN887 SERIES.

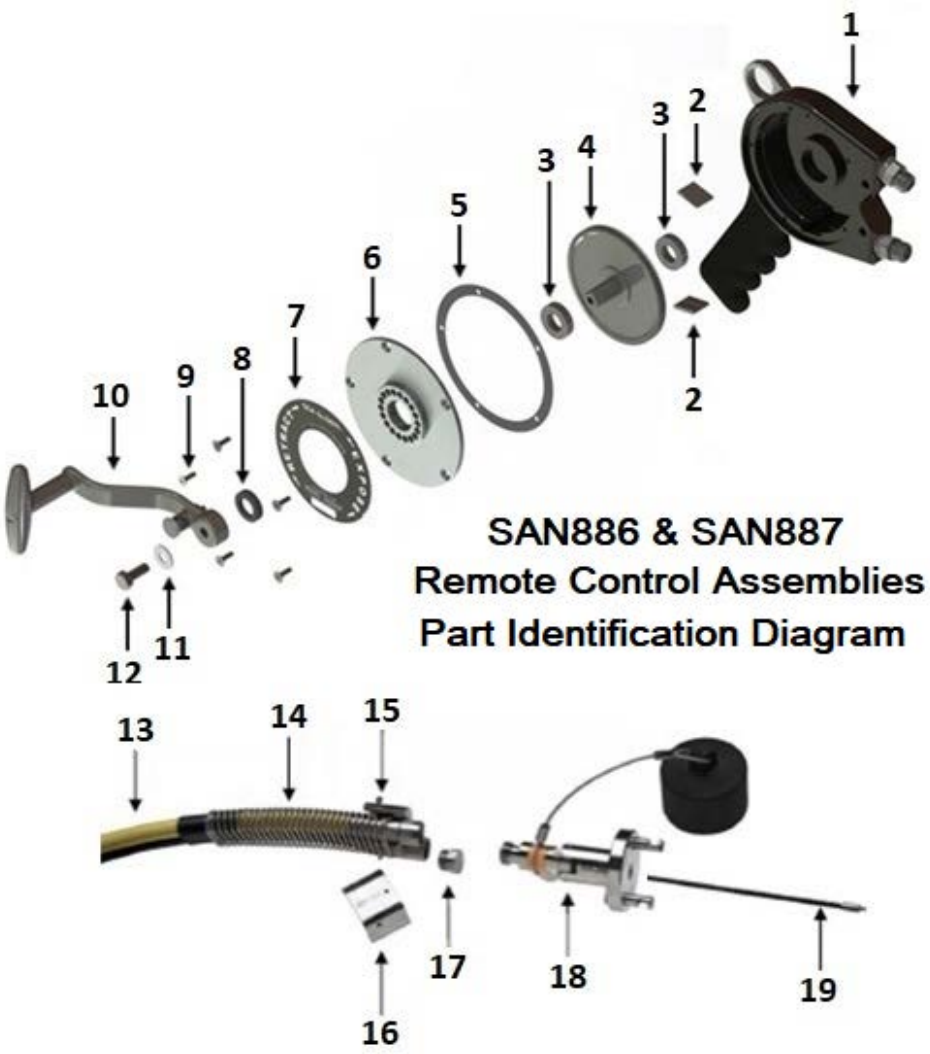
EXTREME CONDITION REMOTE CONTROLS

QSA GLOBAL.

TABLE OF CONTENTS.

1. TECHNICAL SPECIFICATIONS.

Manufacturer	QSA Global, Inc., Burlington, Massachusetts, USA.		
Standard Control Lengths	➢ 25 feet (7.6 meters) ➢ 35 feet (10.7 meters) ➢ 50 feet (15.2 meters)		
Product code/ Model Number	**Style**	**Conduit length**	
SAN88625	Extreme Condition Hand Crank	25 ft (7.6 m)	
SAN88635	Extreme Condition Hand Crank	35 ft (10.7 m)	
SAN88650	Extreme Condition Hand Crank	50 ft (15.2 m)	
SAN88625R	Extreme Condition Hand Crank	25 ft (7.6 m)	
SAN88635R	Extreme Condition Hand Crank	35 ft (10.7 m)	
SAN88650R	Extreme Condition Hand Crank	50 ft (15.2 m)	
SAN88725	Extreme Condition Reel	25 ft (7.6 m)	
SAN88735	Extreme Condition Reel	35 ft (10.7 m)	
SAN88750	Extreme Condition Reel	50 ft (15.2 m)	
SAN88725R	Extreme Condition Reel	25 ft (7.6 m)	
SAN88735R	Extreme Condition Reel	35 ft (10.7 m)	
SAN88750R	Extreme Condition Reel	50 ft (15.2 m)	



Item	Part No.	Qty	Description
1	95115	1	Crank Housing – SAN886
	95116		Crank Housing – SAN887
2	95102-2	2	Wear Bar
3	BBS032	2	Bearing
4	95005	1	Drive Gear
5	95102-5	1	Gasket
6	95102-6	1	Cover
7	95106-05	1	Label – 886 Std.
	95107-01		Label – 886 Rev.
	95108-01		Label – 887 Std.
	95109-01		Label – 887 Rev.

Item	Part No.	Qty	Description
8	RIN024	1	Shaft Seal
9	SCR520	5	Cover Screw
10	95008	1	Crank Arm
11	WSH045	1	Flat Washer
12	SCR219-03	1	Crank Bolt
13	95035	1	Control Conduit
14	95038	1	Strain Relief Spring
15	95037-2	1	Clamp, Bottom Half
16	95037-1	1	Clamp, Top Half
17	95039	1	Conduit Plug
18	66103	1	661 Connecting Plug
19	55005	1	50 ft Control Cable
	55010		67 ft Control Cable
	55009		96 ft Control Cable

2. GENERAL DESCRIPTION.

The radioactive sealed source in all QSA Global, Inc. gamma radiography systems are controlled by using a remote-control assembly. This manual provides instruction for using, inspecting, and servicing the new SAN886 and SAN887 series of remote controls.

The new SAN886 and SAN887 series of controls are designed and built with durability and robustness in mind to ensure your QSA Global, Inc. radiography system performs well in a wide range of environments.

There are five major sub-assemblies to the SAN886 and SAN887 series remote controls. These are the crank assembly, the control cable with a connector swaged at one end, the control conduit, the 661 connecting plug, and the protective rubber cap.

The crank assembly includes the crank housing which contains a diagonally cut, drive gear that meshes with the outer helical winding of the control cable. This worm-gear arrangement between the drive gear and the control cable provides the radiographer with a reliable means to project and retract the source assembly from and to the exposure device.

The crank assembly is equipped with a brake in the crank arm that retains the source assembly while in the exposure head. Beneath the crank arm is a label that indicates the direction for EXPOSE and RETRACT during use.

Radiographers can count the number of rotations of the crank arm to obtain an approximation of the travel distance. One full revolution of the crank arm is equal to approximately 12 in (30.5 cm) of travel.

The control conduit (sheaths, housings) consists of two conduits bonded together along their lengths but split at each end with one conduit colored yellow and the other black. The yellow conduit contains the working side of the control cable that drives the source assembly out of the exposure device and through the source guide tubes. The black conduit is the reserve conduit containing the length of the control cable necessary for projection of the source assembly. The remote-control conduits provide a degree of protection for the control cable against the elements common to the working environments that industrial radiography is performed.

A 661 connecting plug attaches to the yellow conduit opposite the crank housing end. It attaches the remote-control to the exposure device locking mechanism. The 661 connecting plug and the control cable connector are designed with tight tolerances to ensure a secure connection to the exposure device.

The control cable connector must first be securely attached to the source connector protruding from the exposure device locking mechanism before the 661 connecting plug can be attached to the device locking mechanism.

A protective end-cover must be installed after every use of the remote-control to ensure protection to the 661 connecting plug assembly and the control cable connector from the ingress of water, mud, sand, or other foreign matter.

The control cable is a flexible, steel cable with an outer helical winding. The length of control cable is approximately twice the length of the remote-control and includes a connector permanently attached to one end of the cable. The control cable when used in conjunction with the remote-control as a system provides a positive mechanical control of the source assembly at a distance. The control cable is a critical link for safe operation and is the radiographer's only means of control over the source assembly.

Therefore, the control cable's storage, use, daily inspections, and quarterly maintenance are critical elements to the prevention of a control cable failure.

In almost all cases, repairs for a control cable are not possible except for replacing the control cable’s Model 550 male connector every five years. Damaged, defective or control cables with unknown origin (non-traceable) must not be used and must be removed from service.

3. DAILY INSPECTIONS.

IMPORTANT

Do not compromise on safety. Always perform a daily inspection of the exposure device, projection sheaths and remote controls prior to use

3.1 Remote Control Inspection

3.1.1 Uncoil the remote controls at the site. Inspect the crank assembly to assure all screws are present and tightened and that the crank arm is properly secured.

3.1.2 Ensure the instructions on the label are legible. These instructions are important to safety, especially when assistants are being trained or during an emergency. Without the instructions it is conceivable a radiographer could become confused as to which direction the crank arm must be turned to retract or expose the source.

3.1.3 Ensure the brake is operational. Resistance should be felt while rotating the crank arm with the brake engaged (down in the ON position).

3.1.4 Inspect the control conduit fittings to verify they are secured to the fittings on the crank housing.

3.2 Control Conduit Inspection

3.2.1 Inspect the control conduit fittings at the end where they attach to the crank housing to verify the swaged fitting connections are not loose. There should be no evidence of cracks, breaks, or bulges in the conduit outer covering around both fittings.

3.2.2 Visually inspect the entire length of control conduit looking for dents, cuts, and thermally damaged areas. During this inspection, use your hand to feel for inward dents. Cuts and melted areas found on the control conduit outer covering should be sealed with PVC tape to prevent against the ingress of water.

3.2.3 Inspect the control conduit fittings at the end where they attach to the 661 connecting plug to verify the swaged fitting connections are not loose. There should be no evidence of cracks, breaks, or bulges in the conduit outer covering around both fittings.

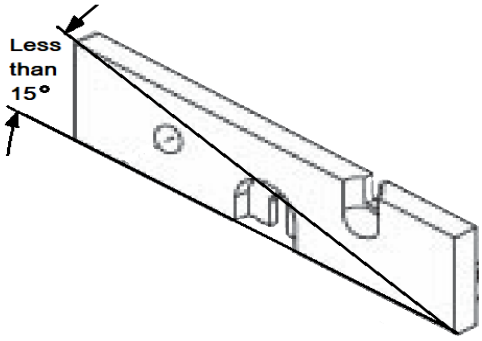
3.2.4 Remove the protective rubber dust cover from the 661 connecting plug. Inspect the 661 connecting plug to verify the movable jaws are not excessively loose and the connecting collar pins are not excessively loose or bent.

3.3 Control Cable Inspection

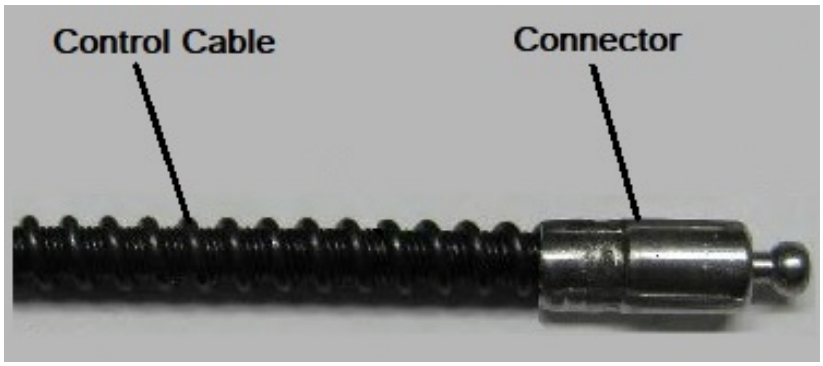
3.3.1 Expose approximately 12 in (30.5 cm) of the control cable, (male) connector end, out of the 661 connecting plug for inspection. The control cable connector should not be bent or as a worst case at an angle exceeding 15 degrees relative to the control cable centerline.

3.3.2 If a control cable connector is repeatedly bent at an angle greater than 15 degrees, damage to the control cable may be introduced by straightening the bend.

3.3.3 The 550 NO-GO gauge can be used as a guide to check for a 15-degree bend. Align the axis of the cable with the long side of the gauge holding the apex of the bend at one end of the gauge. The centerline of the connector must not exceed the width at the other end of the gauge. See the diagram below.



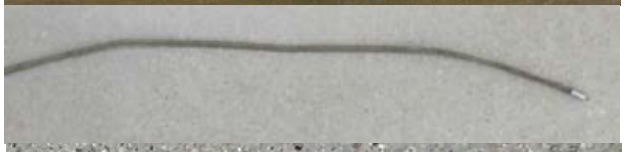
3.3.4 Inspect the control cable connector to verify that the stem and ball of the connector are not bent or cracked. Using hand pressure, attempt to twist the control cable connector off the control cable. If the control cable connector can be twisted using hand pressure or appears bent or cracked, remove the cable from service and label it as defective.



3.3.5 Pull approximately 12 in (30.5 cm) of control cable out of the 661 connecting plug assembly and inspect for the following anomalies directly behind the connector:

- Cuts, breaks, nicks or fraying of the spiral windings of the control cable.

- Areas with kinks or permanent bends.



- Rust (a red oxide) on the inner core of the control cable.

- Stretched or non-uniformity of the spacing between the outer helical windings of the cable.
- Also check for flattened areas and wear.

3.3.6 Bend the connector section of control cable back towards itself and release the cable to test for flexibility or ‘spring’ of the control cable. A cable that has been subjected to the flexibility test and remains in the bent position after the test provides an indication of internal corrosion and must be removed from service.

3.3.7 Verify that a light coating of mil-spec grease is present on the control cable. The light coating of grease is necessary to prevent the penetration of water and chemicals that can oxidize and permanently damage the control cable.

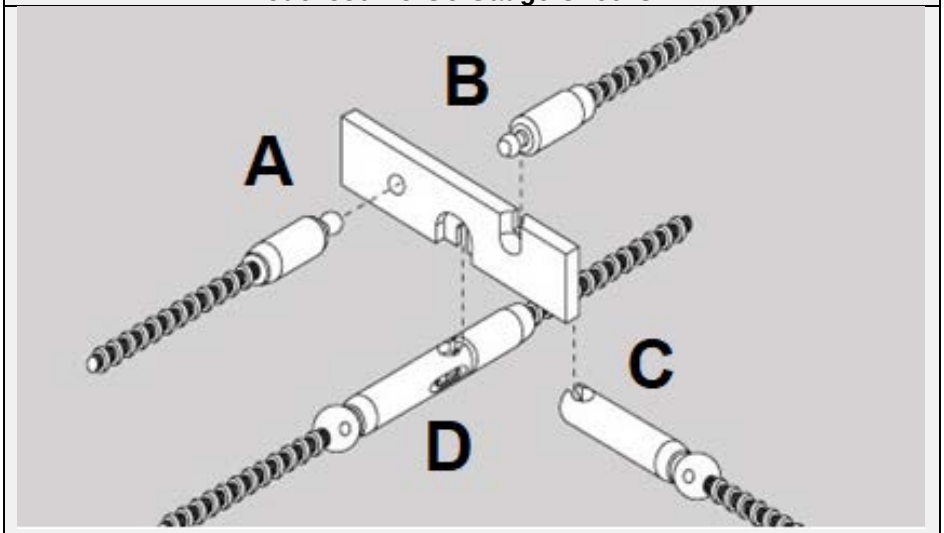
3.3.8 Rotate the crank arm back and forth approximately one-quarter turn to check for freedom of movement of the cable within the remote controls. During this check, take care to avoid cranking the greased cable onto the ground exposing it to dirt and sand.

3.3.9 If any resistance is felt during this check, re-inspect the control conduits for dents and/or depressions.

3.3.10 If dents are not present on the conduits, then the control cable may be rusted stiff somewhere within the conduit. Do not use remote controls that do not function properly, or exhibit defects described above.

3.3.11 A final check of the control cable connector and source assembly connector is accomplished by use of a Model 550 NO GO gauge to check for significant wear on the connectors that would affect safety. Without using excessive force, check the following four positions, A through D. Note that checks C & D should be performed on the source in the exposure device if the device is available.

Model 550 No-Go Gauge Checks



A. The ball end of the control cable connector must **Not Go** into the hole of the gauge.

B. The shank or neck end of the control cable connector must **Not Go** into the smaller notch located on the side of the gauge.

C. The thickness of the gauge must **Not Go** into the end slot of the source assembly connector.

D. After a positive connection between the control cable connector and source assembly connector has been accomplished, verify the larger notch located on the side of the gauge will **Not Go** in the gap between the joined connectors.

3.3.12 Replace any components that fail any of the NO GO gauge tests, because a failure indicates significant wear that could allow safety features of the design to be defeated.

3.3.13 Defective equipment that is discovered during the daily inspection must be removed from service until repaired or replaced.

4. QUARTERLY AND ANNUAL MAINTENANCE REQUIREMENTS.

4.1 Tools Needed

Tool	Used for
Open end wrench, 11/16-inch	Conduit fittings
Box wrench or socket, 1/2 -inch	Crank arm bolt
Allen wrench, 3/32-inch	Cover screws
NO-GO wear gage, 55008	Control cable & source assembly connector inspection
Magnifying glass, 4x to 7x	Control cable & connector inspection
Drift pins, 1/8 & 3/16-inch	661 connecting plug

4.2 Materials Needed

Material	Used for
Large solvent pan with fresh mineral spirits or cleaning tank with circulating and filtered degreasing solvent	Cleaning and degreasing remote control assembly components, control cable and control conduits.
Compressed air source and hand nozzle	Blow drying and removal of cleaning solvents from the control conduit internal Teflon™ liners, control cable and components.
Gloves, safety glasses, cleaning bristle brushes, scrapers and clean rags etc.	General cleaning.
Mil-spec grease, MIL-G-23827B (or C), MIL-PRF-23827C (or equivalent radiation resistant grease) Sold in packets of two as part number **GRE-TUB**	Lubricating the control cable and crank housing components.
3M™ yellow and black polyvinyl tape or equivalent	Minor repair of cuts and abrasions to remote control conduits to prevent water ingress.
Loctite™ 242 blue or equivalent	Fastener retention after assembly.
Clean solvent: fresh mineral spirits recommended. Follow solvent manufacturer's safety precautions for use, handling, storage, and disposal.	Cleaning and degreasing remote control mechanism, control cable and cleaning the control conduits internally.

4.3 Misconnect Test

4.3.1 Perform a “Misconnect Test” before servicing controls to check for excessive component wear and after to ensure the controls have been assembled correctly.

4.3.2 The misconnect test performed on the exposure device including the radioactive source assembly and remote controls effectively tests the integrity of the entire locking system. This procedure detects long-term wear (or damage) of the interrelated failsafe system including identification of any excess wear on the 661 connecting plug, the control cable connector, the exposure device automatic securing mechanism and the source assembly connector simultaneously.

4.3.3 Component wear occurs to both the control assemblies and the device locking mechanisms over time, therefore, to ensure acceptable equipment operation, the misconnect test must be performed on each exposure device lock mechanism and control assembly that will be used for radiographic operations.

WARNING

The misconnect test is to be performed only by personnel that are formally trained, authorized and thoroughly familiar with annual maintenance procedures.

Exercise extreme care to prevent rotating the exposure device locking mechanism's selector ring beyond the LOCK position.

DO NOT ATTEMPT TO ROTATE THE SELECTOR RING INTO THE OPERATE POSITION DURING THE MISCONNECT TEST. DOING SO RISKS LOSING CONTROL OF THE RADIOACTIVE SOURCE ASSEMBLY.

4.3.4 There is a **risk of losing control of the radioactive source assembly** when performing the misconnect test if:

- the components are excessively worn or damaged
- the person performing the test intentionally or inadvertently rotates the selector ring from the CONNECT position to the OPERATE position
- the person performing the test intentionally or inadvertently pushes the lock slide into the EXPOSURE mode.
- Contact a QSA Global, Inc. service center if you have questions regarding the misconnect test.

4.3.5 The complete radiography system should be tested by the maintenance program administrator or Radiation Safety Officer.

4.3.6 All remote controls are to be tested using **ONLY** QSA Global, Inc. manufactured automatic securing mechanisms equipped with **ONLY** a QSA Global, Inc. manufactured source assembly, 550 jumper or A424-9XL mock source assembly to ensure the effectiveness of the misconnect test.

4.3.7 This test is performed **WITHOUT** first connecting the control cable connector with the source assembly connector and then attaching the 661 connecting plug into the exposure device's locking mechanism. The ability to then rotate the locking mechanism selector ring from the CONNECT position in the direction towards the LOCK position without connecting the control cable connector to the source connector indicates critical dimensions of the locking system are excessively worn to an unsafe condition.

4.3.8 **If the locking mechanism and remote controls fail this misconnect test, then the equipment must be removed from radiographic operations. The equipment must not be used until repairs are performed and misconnect test results are satisfactory.**

4.4 Conduit and Control Cable Inspection and Cleaning

4.4.1 Place the controls onto a clean and long work surface. Roll out the conduit until they are straight.

IMPORTANT

Protect the greased control cable from collecting dirt and sand when removing and/or cycling the cable to and from the control conduits.

4.4.2 Remove the rubber protective cover off the 661 connecting plug.

4.4.3 Remove the conduit plug.

4.4.4 Remove the top and bottom clamps holding the strain relief spring in place.

4.4.5 Remove the strain relief spring.

4.4.6 Rotate the crank arm back and forth approximately one-quarter turn to check the movement of the control cable.

4.4.7 If any resistance is felt, inspect the control conduits for dents, depressions, burns etc. by carefully and slowly running your hands along the entire length of conduit.

4.4.8 If no damage is found but resistance is still felt, then the following may be the cause:

- A stiff, rusted, and/or damaged control cable.
- Dirt or debris in the control conduits.
- Damage or worn parts in the crank assembly.

4.4.9 **Rubber gloves** are recommended for handling the control cable, along with using a clean container to place the control cable into or having someone coil the cable as it comes out of the control assembly.

4.4.10 Crank the control cable out until it stops (a stop spring on the end of the control cable will engage the drive gear at this point). The control cable will be approximately halfway.

4.4.11 Use the 11/16-inch wrench to loosen and disconnect the black conduit fitting from the crank assembly.

4.4.12 Retract the crank arm several inches to expose the stop spring located at the end of the cable for removal.

4.4.13 Remove the stop spring from the end of the cable by unthreading the spring clockwise off the cable and then set the spring aside for reassembly later.

4.4.14 Turn the crank in the expose direction until the cable is past the drive gear and remove the remainder of the cable by hand from the assembly.

4.4.15 Coil the control cable in loops no less than a 12 in. (305 mm) diameter and place the coiled cable into the solvent tank or pan for cleaning.

CAUTION

Be sure to follow the solvent manufacturer's safety instructions and Material Safety Data Sheet recommendations.

4.4.16 Thoroughly clean the cable with cleaning solvent and bristle brush.

CAUTION

Wear safety glass and use caution when blowing compressed air.

4.4.17 After cleaning, blow dry with compressed air to remove residual solvent.

4.4.18 Allow some time to dry before re-applying grease.

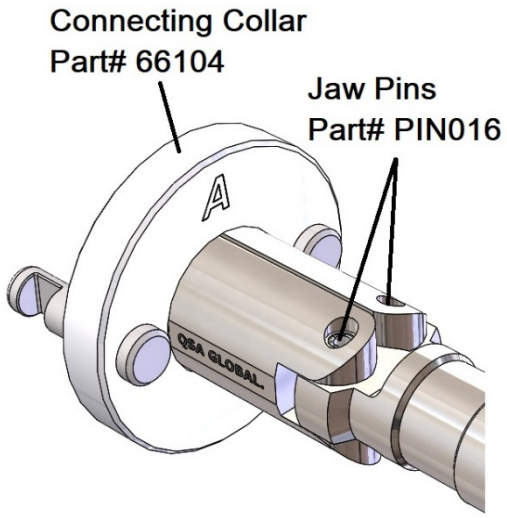
IMPORTANT

Make note of the conduit color when removing the conduit fittings from the crank housing and 661 connecting plug to ensure proper reassembly.

4.4.19 Disconnect the yellow conduit fitting from the crank assembly using the 11/16-inch wrench.

4.4.20 Remove the 661 connecting plug from the conduit using the 11/16-inch wrench.

4.4.21 Clean and inspect the 661 connecting plug. Refer to diagram below.



4.4.22 Replace any damaged, bent, or loose-fitting jaw pins **(PIN016)** by installing new pins in the larger side of the jaw hole until a 3/16-inch drift punch has bottomed, which will automatically center the pin.

4.4.23 Test for loose fitting pins by inserting a 1/8-inch drift punch and pushing against the pin by hand. Replace both if any movement is detected.

4.4.24 Inspect the connecting collar **(66104)** for loose, worn, broken or damaged (notched) connecting pins. Replace the connecting collar if necessary.

4.4.25 Examine the control conduit outer covering at all the swaged fittings for cracks, breaks, and bulges.

4.4.26 Check the conduit fittings to ensure the threads and hex nuts are not stripped and are clean. By hand, attempt to twist or rotate the conduit fittings off the conduits. If any movement is possible, remove the control conduit from service to be repaired.

4.4.27 Control conduits can only be repaired by the manufacturer or a **Certified Service Center.**

IMPORTANT

Cutting back control conduits more than one foot on each end may reduce the number of source guide tube extensions that can be used after the repairs.

CAUTION

Be sure to follow the solvent manufacturer's safety instructions and Material Safety Data Sheet recommendations.

Wear safety glasses and use caution when applying compressed air for drying parts.

4.4.28 Clean the interior of both control conduits by pouring 4-5 oz (100 ml) of clean solvent into one end. Use compressed air to blow the solvent through the entire length of conduit into a clean white cloth attached to the opposite end. Repeat this cleaning process until the solvent blown through the conduit comes out clean.

4.4.29 Once solvent runs clear through each conduit, place a cloth trap at one end and use a compressed air nozzle at the opposite end to remove residual solvent and thoroughly dry the inside.

4.4.30 Clean the control conduit exterior and wipe dry.

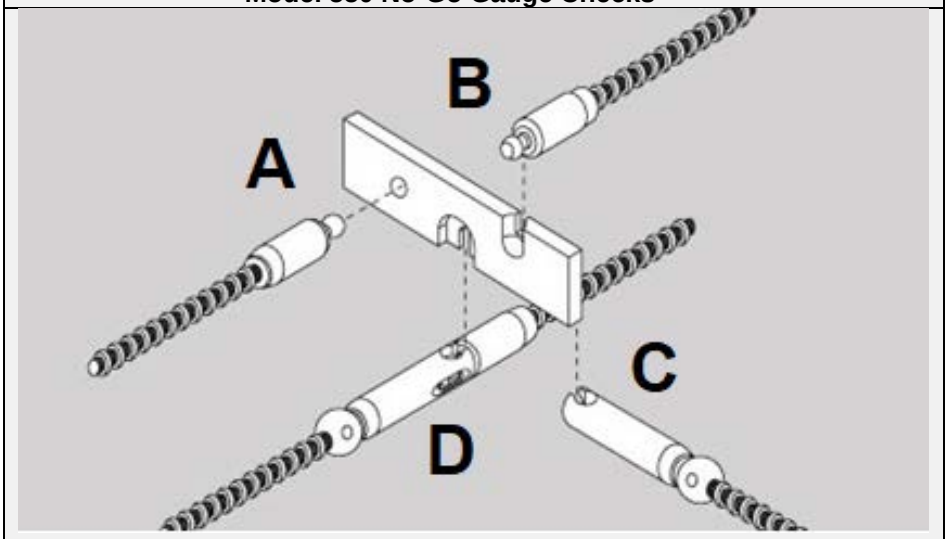
4.4.31 Inspect the control conduit for damage. Minor cosmetic conduit splits, cuts, or melted areas can be repaired using polyvinyl tape or equivalent material to block foreign material such as water and grit from entering the conduit.

4.4.32 Replace loose or missing shrink wrap bands placed under the strain relief spring end with tape to protect against chafing.

4.5 Control Cable Inspection & Lubrication

4.5.1 Use the Model 550 NO-GO gauge to inspect the control cable connector for excessive wear. Checks C & D should be performed on the source in the exposure device if the device is available.

Model 550 No-Go Gauge Checks



E. The ball end of the control cable connector must **Not Go** into the hole of the gauge.

F. The shank or neck end of the control cable connector must **Not Go** into the smaller notch located on the side of the gauge.

G. The thickness of the gauge must **Not Go** into the end slot of the source assembly connector.

H. After a positive connection between the control cable connector and source assembly connector has been accomplished, verify the larger notch located on the side of the gauge will **Not Go** in the gap between the joined connectors.

4.5.2 Inspect the connector for damage, bends or cracks in the neck (shank) area below the ball and impact marks to the body or ball area.

4.5.3 Inspect the connector axis to ensure it does not exceed an angle greater than 15 degrees relative to the control cable axis near the connector.

4.5.4 Check the cable to connector swage by attempting to twist or rotate the connector off the cable with your fingers. If any movement is felt or observed during this test, then the cable must be removed from service and the connector replaced so long as the cable passes all other inspection points.

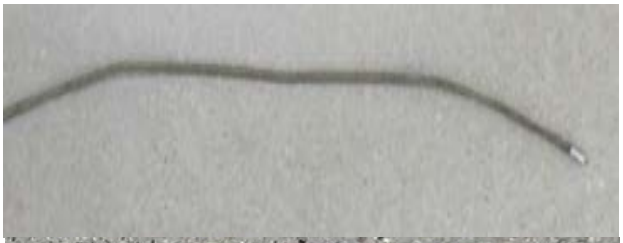
4.5.5 Most control cable wear, damage, corrosion, and breakage will occur directly behind the connector and along the next few feet from the connector.

4.5.6 Control cables and conduits are at risk of being run over, crushed, bent, burnt, stretched, and generally subjected to other harsh worksite environments at any point along their length. Because of this, check the cable along the entire length for impact damage, resulting kinks, etc. Use magnification to visually inspect the cable near the connector.

4.5.7 Carefully inspect the control cable for the following anomalies:

- Cuts, breaks, fraying or separation of any visible spiral windings of the cable.

- Kinks or permanent bends and excessive wear in the outer elbow of any kinked area.



- Rust (red oxide) visible on the inner and outer core or stiffness of the cable.

- Stretched or non-uniformity of the spacing between the outer helical windings of the cable.

- Check for flattening of the helical wrap or reduced cable diameter in the first foot behind the connector and at kinked areas.

- The minimum allowable cable diameter is 0.183 inches or 4.65 millimeters.

4.5.8 Check the flexibility of the control cable by:

- Extending twelve inches of cable vertically with the connector end at top.
- Hold the vertical cable secure at the lower end of the twelve inches.
- Grasp the control connector by hand and bend the cable down until it touches the lower held end.
- Release the connector end to allow it to spring back vertically.
- Internal cable corrosion may be present if the cable that does not spring back essentially vertical again.

4.5.9 Examine the entire length of the control cable looking for unusual stiffness. A ‘crunching” feeling and stiffness when bending the cable in other areas may also indicate a rusting problem.

4.5.10 Remove the cable from service if any damage or excessive wear is found during this inspection. Attach a status indicator tag and mark with described defect to prevent inadvertent use.

4.5.11 Replace control cable connectors at intervals not to exceed five (5) calendar years starting on the date code etched on the connector. Only QSA Global, Inc. Certified Service Centers can perform connector replacement service to ensure continued extended service beyond 5 years. In most cases it is recommended the new replacement connector be assembled opposite the previously used end of the cable (unused end).

4.5.12 It is the responsibility of the **maintenance program administrators** to maintain and record (traceability records-lot numbers) the replacement details of all “Safety Class A” designated components. New control cable connector lot number’s will be provided.

4.5.13 Lightly lubricate the entire control cable using MIL-G-23827B (or C), MIL-PRF-23827C, or equivalent grease. Apply additional grease onto the first three feet (1m) of cable from the connector end.

IMPORTANT

A clean and well lubricated control cable will extend the life of your equipment by reducing wear.

4.6 Crank Assembly Inspection and Cleaning

4.6.1 Check the brake to ensure it functions properly. Inspect the array of brake index holes in the cover for excessive wear and damage. Replace the cover if the index holes prevent the brake from functioning properly.

4.6.2 Remove the crank arm by using a 1/2-inch wrench or socket to first remove the crank bolt from the crank assembly.

4.6.3 Clean and inspect the crank arm and knob for loose and damaged parts.

4.6.4 Remove the five cover screws using a 3/32-inch Allen wrench.

4.6.5 Remove the cover by reinstalling the crank bolt several turns and then using it to pull up while holding the crank housing down. This will remove the cover and the drive gear from the crank housing.

4.6.6 Remove the cover from the drive gear.

4.6.7 Remove the shaft seal from the cover and inspect it for wear and damage.

4.6.8 Inspect the label on the cover. It is critical in an emergency that the instructions are clearly legible. Replace the label as needed. The standard direction label **(95106-05)** is black while the reverse direction label **(95107-01)** is silver. Ensure the “Expose” and “Retract” graphic and arrows indicating the direction of travel is legible.

4.6.9 Separate the bearings from the drive gear and set them aside. If the bottom bearing did not remove with the drive gear, remove it from the crank housing and set it aside.

4.6.10 Wipe down both bearings with a clean rag and check their seals for damage on both sides. Bearings should spin smoothly while holding the inner hub stationary and rotating the outer hub. Replace as needed. These are sealed ball bearings and do not require internal lubrication. Do not clean with solvent.

4.6.11 Inspect the gasket in the crank housing and replace if torn or damaged.

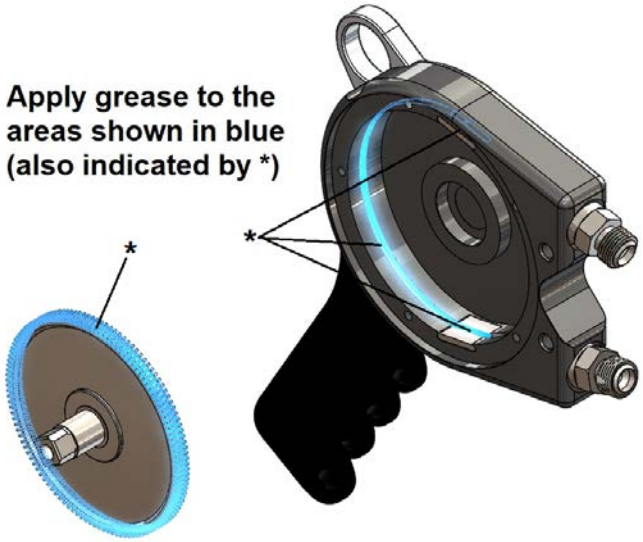
4.6.12 Clean and inspect the grooves in the wear bars for excessive wear. Replace the bars if heavily worn.

4.6.13 Clean the gear in solvent using a brush to dislodge any dirt especially between the gear's teeth. Inspect the gear looking for damage like broken, bent or missing teeth. If the drive gear has broken or bent teeth, use a file to grind the tooth flush with the drive gear. Up to three consecutive teeth can be missing from the drive wheel before a replacement is required. Replace the gear if damaged or excessively worn.

4.6.14 The handle grip, the hanger loop, and the two conduit connection fittings are permanently attached and are not field-serviceable items.

4.7 Remote-control Reassembly

4.7.1 Refer to the diagram below. Apply a thin layer or film of Mil-Spec grease to the groove in both wear bars, all teeth of the drive gear, and cable groove backside in the crank housing.



4.7.2 Assemble the ball bearings onto each end of the gear shaft and then install into the crank housing.

4.7.3 If the old gasket was removed, then replace it by first removing the tape off the back of the new gasket so the adhesive backing can stick to the surface of crank housing. Align the holes in the gasket with the screw holes in the housing. Press down on the gasket to stick.

4.7.4 Place the cover over drive gear shaft and align the serial number level with the bottom.

4.7.5 If needed, install a new shaft seal onto the drive gear shaft and into the cover pocket.

4.7.6 Install the cover screws by first applying a couple of drops of thread locker **Loctite™ 242** to the end of each screw thread and tighten using the 3/32 Allen wrench. A torque value of **15 +/-2 in-lb.** is recommended.

4.7.7 Spin the gear to ensure it rotates smoothly without any obvious resistance.

4.7.8 Loosely attach the yellow conduit to the expose side fitting on the crank housing and the black conduit temporarily onto the other housing fitting to square up the conduit assembly alignment.

4.7.9 Tighten down the yellow conduit fitting with a 11/16-inch open end wrench but DO NOT OVER-TIGHTEN.

4.7.10 Remove the black conduit fitting.

4.7.11 Reattach the 661 connecting plug onto the yellow conduit end fitting and the conduit plug onto the black conduit end fitting with the 11/16-inch open end wrench.

IMPORTANT
Do not over-tighten the conduit fittings.

4.7.12 Tighten the conduit fittings until snug using a 11/16-inch wrench. Overtightening will result in stripped wrench flats.

4.7.13 Assemble the strain relief spring and its two-part clamp.

4.7.14 Install the cleaned, inspected, and greased control cable into the 661 connecting plug until the cable end meets and engages with the drive gear, about half-way installed.

4.7.15 Assemble the crank arm without the crank bolt, temporarily, to retract cable about two inches outside of the crank housing fitting to allow installation of the stop spring.

4.7.16 Thread the stop spring counterclockwise onto the protruding end of the cable until the stop spring is flush with the end of the cable, then rotate the stop spring an additional two turns onto the cable.

4.7.17 Rotate the crank arm slightly to allow connection of the black conduit fitting and tighten the conduit fitting with a 11/16-inch wrench (DO NOT OVER-TIGHTEN).

4.7.18 Install the remainder of the control cable while being cautious not to allow the cleaned and lubricated cable to contact dirt or grit.

4.7.19 With the control cable fully installed, reposition the crank arm onto the drive gear shaft at a position preferred by the operator or as delivered, approximately 90 degrees to the right of the crank housing grip.

4.7.20 Install the crank bolt and flat washer by first applying two drops of thread locker **Loctite™ 242** to the end threads of the bolt. Engage the brake or hold the crank arm while tightening with a 1/2-inch socket wrench. A torque value of **120 +/-15 in-lb.** is recommended.

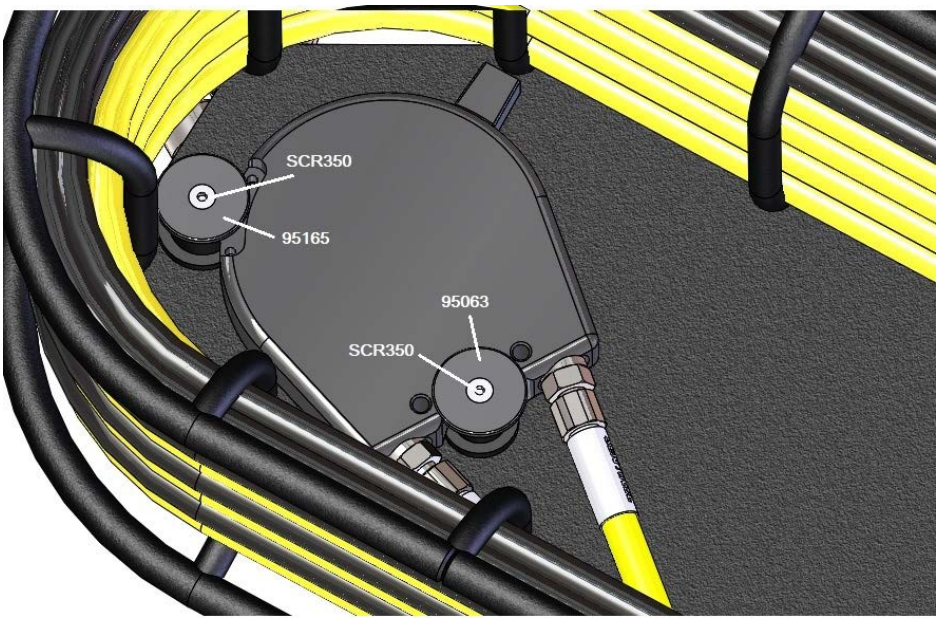
4.7.21 Operationally test the fully reassembled remote control by performing freedom of movement, plunger lock operation, Misconnect Test, and connection to a projector Posi-Lock.

4.7.22 Replace the protective rubber cap over the end of the 661 connecting plug.

4.7.23 Record all inspections performed. Refer to “Annual Maintenance Records” below.

4.8 Reel Style Controls Only

Attach the crank housing to the underside of the reel frame by first applying two drops of thread lockerLoctite™242 to the lower threads of the two flat head screws (SCR350). Mount the crank housing (without grip and hanger) onto the reel frame with the two flathead screws, one thrust plate washer (95063), and one thrust plate cup (95165). See the diagram below.



4.9 Quarterly and Annual Maintenance Records

4.9.1 Maintain records of all equipment inspected and serviced during the quarterly and annual maintenance.

4.9.2 Record the following items below:

- The date of the inspection and maintenance was performed.
- The name of qualified individual performing required inspections and maintenance.
- Any non-routine problems found and repairs performed to correct problem.
- Include the findings of the Misconnect Test if any.
- Include model and serial numbers of remote controls units and associated exposure devices tested.
- Record the model and serial number of the remote controls serviced. Also note any serial number or lot-controlled items of newly installed replacement parts.

5. TRAINING.

Formal classroom training in radiation safety, supervised hands-on training and certification by an independent certifying organization of radiographers are essential components for radiological safety in isotope radiography and is a regulatory requirement in the United States and Canada.

QSA Global, Inc. provides Radiation Safety, Inspection & Maintenance and Retrieval Training at the Baton Rouge, Louisiana and Houston, Texas facilities. On-site training is available by arrangement.

6. WARRANTY.

6.1 Warranty and Limitation of Liability

QSA Global, Inc. (herein referred to as the manufacturer) warrants its product which it manufactures and sells to be free from defects in material and workmanship for a period of one year from the date of shipment. This warranty shall not apply to any product or parts which have been subjected to misuse, improper installation, repair, alteration, neglect, accident, abnormal conditions of operation, or use in any manner contrary to instructions.

The manufacturer's liability under such warranty shall be limited to replacing or repairing, at its option, any parts found to be defective in such respects, which are returned to the manufacturer, transportation prepaid; or at its option, to returning the purchase price thereof.

The warranty on other manufacturer's components shall be that of the original manufacturer whose warranty shall be binding. In no event shall the manufacturer be liable for any incidental or consequential damages, whether or not such damages are alleged to have resulted from the use of such product in accordance with instructions given by or referred to by the manufacturer.

QSA Global, Inc. assumes no liability or responsibility for the usage of this device for the generation of penetrating radiation.

All other warranties, except those warranties expressly stated herein, including without limitation warranties of merchantability and implied warranties of fitness, are expressly excluded.

The warranty on this device is specifically limited to its use only with parts, and accessories manufactured by QSA Global, Inc. QSA Global, Inc. shall not be liable for any errors or omissions contained herein and the provision by QSA Global, Inc. of the information set out in this manual does not in itself constitute acceptance of any liability on the part of QSA Global, Inc.

7. CONTACT INFORMATION.

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