

INSTRUCTION MANUAL

for the

BIRNS BLACKBIRN-I

Model 7701

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Table of Contents

Scope	1
Applicability	1
SAFETY PRECAUTIONS	2
General Information	3
Purpose	
Theory of Operation	
Product Description	
Unpacking Your System	5
How to contact BIRNS	6
Set-up	7
Mating and Unmating the Metal-Shell Connectors	8
Operation	9
Oil-Leak Detection	
Crack Detection	
Preventative Maintenance	10
Cleaning	
The Power Cable and Sunlight	
O-Ring Replacement	
Corrective Maintenance	11
Replacing the Snooperette Lamp	
Replacing the UV Lamp	
Technical Specifications	13
Materials	
Electrical/Lighting	
Environmental	

Scope

This Manual provides basic information and requirements for operation and maintenance of the BIRNS BLACKBIRN-I MPI/NDT (Magnetic Particle Inspection/Non-Destructive Testing) System. While certain variations on the basic system (E.g. models which do not include the SNOOPERETTE White Light and/or the ARTICULEG Electromagnet) invalidate those portions of this Manual, the balance of the Manual remains relevant.

Applicability

This Manual is applicable to the following Models:

- | | |
|-------------------|--|
| Model 7701 | Complete BLACKBIRN system, including UV light, Snooperette white light, Articuleg Electromagnet, Power Cable, and carrying case. |
| Model 7702 | BLACKBIRN with UV light only (without Snooperette, Articuleg, or carrying case), and Power Cable. |
| Model 7705 | The BLACKBIRN unit itself, with Snooperette white light attached, and with provision for powering the Articuleg. (Without Articuleg, Power Cable, or Carrying Case.) |
| Model 7706 | BLACKBIRN with Snooperette white light attached, and Power Cable. (Without Articuleg or provision for powering it, and without Carrying Case.) |

SAFETY PRECAUTIONS

- < Do not look directly into the light or shine it into another person's eyes, *especially* when the black UV-filter lens is removed. Serious eye injury could result.
- < Ensure that the power source is properly grounded (earthed).
- < Operate the system only on a power circuit with ground-fault circuit interrupter (GFCI or GFI) or earth leakage circuit breaker (ELCB) protection.
- < Disconnect the power cable when not in use.
- < Do not use the system out of water for longer than 2 minutes at a time, as it may overheat. If the black UV-filter lens is too hot to touch, shut off the unit until it is cool. Do not immerse the unit in water while it is hot—damage from thermal shock could result.
- < Always de-energize the power and disconnect the power cable when opening the unit or performing any maintenance on it.

GENERAL INFORMATION

Purpose

The purpose of the BIRNS BLACKBIRN-I MPI/NDT System is:

- C To locate cracks and weld defects in underwater steel structures
- C To locate underwater leaks of oil and other hydrocarbons

Theory of Operation

Oil Leaks

Oil and other hydrocarbons naturally fluoresce (glow) under ultraviolet (UV) radiation ("black light"). The BIRNS BLACKBIRN-I incorporates a powerful UV source, so shining the BLACKBIRN on submerged oil will cause the oil to glow, making it easy to follow the oil to its source.

Cracks

A crack in a steel structure interrupts magnetic lines of force when that structure is locally magnetized. This results in a net concentration of magnetic force around the crack. This concentration (and, hence, the crack) is made visible by the application of fluorescent particles (iron powder coated with a fluorescent dye) which are attracted to the region of greatest magnetic force. These particles fluoresce brightly under the UV radiation; this result can be filmed, photographed, or videotaped in color or black and white.

Product Description

Introduction

The complete BIRNS BLACKBIRN-I System includes everything necessary to perform underwater Magnetic Particle Inspection (MPI). It comprises a powerful ultraviolet source with a high-efficiency UV filter incorporated into the pressure dome; a compact tungsten-halogen SNOOPERETTE "white light" with color output tuned for color filming; a strong articulating electromagnet; a durable AQUAPRENE power input cable with integral underwater indexed metal-shell connector; and a rugged weather-proof carrying case.

The BLACKBIRN Unit

The BLACKBIRN ultraviolet light and control gear is housing in the main body. The ultraviolet radiation is generated by a 100-watt mercury-vapor gas discharge lamp. Nearly all visible light produced by the lamp is filtered from the system by the UV filter; this filter is "tuned" to produce spectral output at the high-efficiency peak of 360 nanometers, and is incorporated into the glass of the pressure port. This same pressure port is tempered for added strength and domed for extra depth capacity. There are no inefficient and wasteful "baffle" support plates needed for this port. Three protective "prongs" on the lens retaining ring protect the lens from random mechanical impact.

This lamp/filter system emits a minimum of $1,250 \mu\text{w}/\text{cm}^2$ of UV energy. (A standard of the American Society for Metals Testing, and followed by the ASNT, the American Society for Nondestructive Testing, requires only $800 \mu\text{w}/\text{cm}^2$.) In 1983, surveyors of Det Norske Veritas in Oslo, Norway, measured the BLACKBIRN's output at $2,000 \mu\text{w}/\text{cm}^2$.

The BLACKBIRN's integral electronics are grounded (earthed), and each circuit is independently fused. The housing is dielectric to 500 VDC. Only low-voltage (12 VDC) is used for the SNOOPERETTE "white light" and the ARTICULEG Electromagnet; these are controlled by a single thumb-operated switch located to the front of the handle. The UV source is energized at all times that power is available to the system.

The Power Cable

The BLACKBIRN utilizes 14/3 Aquaprene type SO cable. Aquaprene cable is jacketed with a tough, oil- and abrasion-resistant material that maintains its flexibility even after years in seawater.

The Carrying Case

The BLACKBIRN's carrying case is made of marine-grade plywood, covered with tough fibreglass sheet and reinforced with anodized aluminum and galvanized steel. Cavities shaped to hold the BLACKBIRN and Articuleg are carved in the internal resilient foam.

Unpacking Your System

Step 1 - Unpack

Your BLACKBIRN-I System includes the following components. Please verify that you have received all items listed below:

1. The BLACKBIRN-I UV Light
2. The ARTICULEG Electromagnet
3. The Carrying Case
4. The Power Cable

Step 2 - Inspect for Damage

Carefully inspect all items for damage. Obvious damage to shipping or packing materials may signal potential damage to the goods themselves.

Signs of actual or potential damage include:

- < Items broken, bent, chipped or cut
- < Paint scraped or burnt
- < Loose parts, clinking or rattling sounds

Should any of these signs be evident, save all packing materials and immediately file a claim with the carrier. Notify your distributor and/or BIRNS directly, in writing, describing the damage.

How to contact BIRNS

You can contact BIRNS by telephone on:

- C 1-805-487-5393 (International)
- C 1-888-BIRNS-88 (Nationwide toll-free)

We have customer service personnel available to take calls Monday through Friday, 08:00-16:30 PST. In addition, we have 24-hour voice mail to take calls at other times.

You can contact BIRNS in writing by:

Mail: BIRNS, Inc.
P.O. Box 909
Oxnard CA 93032-0909 USA

24-hour Fax: 1-805-487-0427

Email: service@birns.com (or through our Internet address: www.birns.com)

You can ship goods to our receiving department at:

BIRNS, Inc.
Attention: (Name of your BIRNS customer service representative)
1720 Fiske Place
Oxnard CA 93033-1863 USA

Note: please always contact us prior to shipping items to us, and label the goods as for the attention of your customer service representative.

Set-up

The BIRNS BLACKBIRN-I System is designed to be completely “plug and play”. After unpacking the system and inspecting for damage, follow these steps:

1. Plug the ARTICULEG Electromagnet into the receptacle in the top of the BLACKBIRN. (Details on mating/unmating metal-shell connectors are found in the next section.)
2. Plug the Power Cable into the receptacle in the end of the BLACKBIRN.
3. Plug the other end of the Power Cable into a mains power outlet with ground-fault circuit interrupter (GFCI or GFI) or earth leakage circuit breaker (ELCB) protection, and energize the circuit.
4. Your BLACKBIRN-I is ready for use!

Note: Sometimes a very light hum may be heard, and/or a very delicate vibration may be felt in the unit when the circuit is energized. This is normal as long as it is very minor. However, should the hum get loud or the vibration become more intense, discontinue use of the unit immediately and contact your distributor and/or BIRNS.

Note: The UV lamp inside the BLACKBIRN requires approximately five minutes to reach full intensity. However, its operation can be verified almost immediately (do *not* look into the light to do this). To “see” the UV output, try putting one or more of these items into the UV light:

- C A credit card (some have invisible UV-sensitive markings)
- C A starched, laundered white shirt (some detergents fluoresce)
- C Oil
- C Fluorescent particles (try the kind that only glows in UV light for the best effect)

Mating and Unmating the Metal-Shell Connectors

The “plug” is the connector with a captivated brass hexagonal engaging nut (coupling ring). It has sockets.

The “receptacle” is the connector with a stainless steel body. It has pins recessed inside its body.

Note: The underwater metal-shell connectors on the Power Cable and Articuleg Electromagnet have three and four sockets, respectively. This makes them impossible to accidentally connect to the incorrect receptacle. Therefore, prior to mating the connectors, ensure that the receptacle has the same number of pins as the plug has sockets!

Note: These connectors are true underwater connectors and, when properly mated, will seal to depths of 20,000 FSW (6,000M). However, they are not underwater mateable! Do not attempt to mate or unmate these connectors underwater!

Note: Mate and unmate these connectors only while the circuit is de-energized (i.e. the power is OFF). This is a much safer practice, and will avoid unnecessary wear and tear on the connectors.

To mate the metal-shell connectors, follow these steps:

1. Verify that the plug and the receptacle have the same number of sockets and pins. Ensure that both connectors are clean and dry.
2. Insert the plug into the receptacle. The plug has a “key” (a longitudinal raised bump, hemispherical in cross-section) which fits into a “keyway” in the receptacle, and indexes the connectors such that they can only be mated in one orientation.
3. Turn the engaging nut (coupling ring) clockwise such that it engages the threads of the receptacle.
4. Continue turning the engaging nut until the connectors are fully mated.

Note: These connectors will fully seal when “hand-tight”. There is no need to use a tool to engage them; higher torque applied will not improve the seal in the slightest, but can very possibly severely damage the connectors. If a tool is needed, something is wrong! Do not force the connectors together!

5. To unmate the connectors, simply turn the engaging nut counter-clockwise until the connectors are disengaged. Separate the connectors.

Operation

Oil-Leak Detection

To detect and locate submerged oil leaks:

1. Assemble the BLACKBIRN for use. Energize the circuit.
2. Enter the water with the BLACKBIRN, and proceed to the area of the leak.
3. Using the thumb-operated switch, de-energize the Snooperette light, such that only the UV light is operating.
4. Shine the UV light in the area until you see the tell-tale blue hydrocarbon fluorescence of oil in the water.
5. Follow the oil to its source.

Crack Detection

To detect and locate cracks in underwater steel structures:

1. Assemble the BLACKBIRN for use. Energize the circuit.
2. Enter the water with the BLACKBIRN, and proceed to the area to be inspected.
3. Using the thumb-operated switch, energize the Articuleg Electromagnet. Attach it to the structure (it will hold its weight). This will produce an invisible, temporary local magnetic field in the metal, slightly larger than the circle described by the Articuleg's two legs (prods).
4. Apply fluorescent particles to the magnetized area.
5. De-energize the Snooperette light. Shine the UV light on the applied particles, and inspect for indications of cracks or weld defects.
6. De-energize the Articuleg Electromagnet and remove it from the structure.

Preventative Maintenance

Cleaning

The single most important step to take care of your BLACKBIRN investment is to simply clean it well after each use.

- C Using fresh water, thoroughly rinse all seawater from the BLACKBIRN, the Articuleg Electromagnet and the Power Cable. Clean off all traces of salt or dirt encrustation, paying special attention to stainless-steel items and the places where they are installed (E.g. the stainless bolts and connector receptacles). Dry the unit well.
- C Thoroughly rinse and dry the metal legs of the Articuleg Electromagnet.
- C Clean all sand, grit, etc. from the connectors. The metal-shell connectors, too, may be rinsed in fresh water— even inside the receptacle. However, take care to dry them thoroughly afterwards.
- C Apply a light oil or grease to the metal legs of the Articuleg Electromagnet. (Silicone spray works well for this purpose.) Pay special attention to the joints.

The Power Cable and Sunlight

Natural sunlight includes ultraviolet radiation which, in large doses, is harmful to the jacket material of the Power Cable. Long-term exposure to sunlight may shorten the useful life of the Power Cable, as it may cause embrittlement and cracking of the jacket. Therefore, when the Power Cable is not in use, we recommend that it be stored, if possible, in a cool, dry, shady place.

O-Ring Replacement

Different opinions exist regarding the preventative replacement of o-rings. O-rings do have a limited life, but that lifetime is so affected by the unique conditions of your environment and usage that it is impossible to predict, and therefore impossible to recommend a precise time frame for preventative o-ring replacement.

Furthermore, the very act of replacing o-rings involves some risk. For example, the new o-ring could become damaged in the process, or may be incorrectly installed, or some particle or hair might fall into the o-ring groove, any of which may cause the new o-ring to leak— ironically, even when the old o-ring still sealed.

We recommend that those o-rings which are easy to access (E.g. O-ring P/N 59A-088 in the outside of the connector receptacles) and those which, by their function, have shorter lives due to the greater thermal stress placed upon them (E.g. the UV Lens O-ring 59A-067 and the Snooperette Lens O-ring 59A-005) be replaced once every 1-3 years.

Corrective Maintenance

Replacing the Snooperette Lamp

To replace the Snooperette lamp, follow these steps:

1. De-energize the circuit, and disconnect the Power Cable and Articuleg.
2. Remove the Snooperette Lens Retaining Ring 56A-003 by turning it counter-clockwise. Set aside.
3. Remove the Snooperette Lens Gasket 59B-003 and Lens 35A-007. Set aside.
4. Remove the Lamp Retaining Snap Ring 56B-003 and set aside.
5. Pull out the Snooperette Lamp 32C-003 as far as it will go. (Note: do *not* pull hard or force it out!)
6. Holding the Lamp Holder 32D-004 in one hand and the Snooperette Lamp 32C-003 in the other, gently pull the two straight apart. Discard the old lamp.
7. Gently install a new lamp into the lamp holder, making sure that the two lamp pins are installed straight into the two sockets in the lamp holder.
8. Gently insert the lamp and lamp holder into the Snooperette Housing 28B-001.
9. Install the Lamp Retaining Snap Ring 56B-003 to hold the lamp in place.
10. Install the Lens 35A-007 and put the Snooperette Lens Gasket 59B-003 atop it.
11. Reinstall the Snooperette Lens Retaining Ring 56A-003 by turning it clockwise until it is completely installed. (Note: do *not* apply too much torque; hand-tight is enough!)

Replacing the UV Lamp

To replace the UV lamp, follow these steps:

1. De-energize the circuit, and disconnect the Power Cable and Articuleg.
2. Allow the unit at least one hour (60 minutes) to cool completely, and to allow any energy stored in internal components to completely dissipate.
3. Remove the three stainless steel socket-head cap screws 23B-003 from the front of the BLACKBIRN, and set aside.
4. Open the front of the BLACKBIRN by gently pulling the Insert Ring 56C-001 straight out from the main unit. Note: this assembly is still attached by wires to the internal electronics, so do *not* pull hard!
5. Gently unscrew the UV Lamp 32F-001 from the Lamp Socket 33B-001 until the two separate.
6. Remove the three stainless steel Pan-Head Screws 23B-007 from the Insert Ring 56C-001 and set aside.
7. Remove the UV Lamp 32F-001 from the Insert Ring by gently pulling it straight out.
8. Install a new UV lamp into the Insert Ring. (Note: ensure that a Lens Gasket 59B-001 is in place under the lamp, to provide a cushion between the lamp and the insert ring.) Place the woven stainless steel mesh Lamp Cushion 52B-003 over the back of the lamp.
9. Reinstall the three stainless steel Pan-Head Screws 23B-007 into the Insert Ring.
10. Carefully and gently screw the UV Lamp 32F-001 (in the entire Insert Ring Assembly) clockwise into the Lamp Socket 33B-001 until it is completely installed. (Note: do *not* apply too much torque; hand-tight is enough!)
11. Carefully reinstall the Insert Ring Assembly into the main Housing 28A-009. Align the three holes in the Insert Ring with those in the Housing.
12. Reinstall the three stainless steel socket-head cap screws 23B-003 into the front of the BLACKBIRN to retain the Insert Ring.

Technical Specifications

Materials

Housing and lens ring:	Tempered cast type 357 aluminum, hard anodized per MIL-A-8625C type III class 1, housing vacuum impregnated per MIL-STD-276, enamel painted
Insert ring and support:	Type 6061-T6 aluminum, hard black anodized per MIL-A-8625C type III class 2
All hardware:	Stainless steel type 18-8
Switch shaft and receptacles:	Stainless steel type 316, passivated per QQ-P-35
UV Lens:	Tempered type 1041 ultraviolet-filtered soda-lime glass
O-rings and lens gaskets:	BUNA N (Nitrile-NBR) acrylonitrile-butadiene
Connector inserts:	Glass-reinforced epoxy (GRE)
Connector contacts:	Pins: brass 360 per ASTM B16; sockets: heat-treated beryllium copper; both gold-plated per MIL-G-45204
Snooperette body and ring:	Type 6061-T6 aluminum, hard black anodized per MIL-A-8625C type III class 2
Snooperette lens:	Tempered borosilicate glass
Connector engaging nut:	Naval brass type 464 per ASTM B21
Cable:	Type SO multi strand copper core, with styrene rubber (STR) primary insulation and black Aquaprene neoprene polychloroprene (CR) jacket

Electrical/Lighting

Input voltage:	115 +/- 15 VAC (standard)
UV Lamp details:	Mercury vapor PAR38 spot, admedium base
Wattage:	100 watts
Rated Lifetime:	16,000 hours*
Spectral Peak:	360 nanometers
Output:	1,250 microwatt/cm ² ultraviolet energy (min.)
Snooperette Lamp details:	Tungsten halogen with MR-16 dichroic multi mirror
Voltage:	12 VAC/VDC
Wattage:	50 watts
Light output:	2,160 mean Candelas; 895 initial lumens
Rated Lifetime:	3,000 hours*
Color Temperature:	3,050K

*Note: These ratings are determined by the lamp manufacturer based on laboratory tests under controlled conditions. Your own field results may vary.

Cable size:	14 AWG type SO, 3 conductor (standard)
Cable current rating:	15 amperes maximum
Cable voltage rating:	600 volts maximum

Environmental

Protection level:	IP68
Depth rating:	1,000 FSW (300 M) plus 50% safety margin