Operating Instructions

SHLM MI4®

Source Holder

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48642

Nuclear

Revision Table

Version of manual	Description	Date
1.0	Initial release	150527

ISO 9001 approval by Lloyd's Register Quality Assurance Limited, to these Quality Management System Standards: ISO 9001:2008, ANSI/ASQC Q9002008, Approval Certificate No. 107563.

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1 About this Document

1.1 Intended Use

These **Operating Instructions** provide specific instructions for the safe setup and operation of the source holder. The instructions and procedures in the documentation are designed for users seeking product knowledge, usage, and functionality.

The instructions in this guide are written for qualified and well-trained personnel. Make sure you read and understand all the instructions and safety guidelines in the **Operating Instructions** before operating this equipment.

Figure 1.1 SHLM MI4

1.2 Targeted Group

The **Operating Instructions** not only provide instructions for the setup and operation of the instrument, but also specifically address topics and procedures required by an intermediate level user such as the following:

- Operator
- Instrumentation Technician
- Field Service
- Internal Support
- Process Engineers
- Field Sales

1.3 Explanation of Symbols

Danger

Identifies an imminently hazardous situation which, if not avoided, will result in death or injury.

Warning

Identifies a potentially hazardous situation which, if not avoided, could result in death or injury.

Caution

Identifies a potentially hazardous situation which, if not avoided, may result in minor or moderate injury or in equipment damage.

Note

Identifies tips or useful information about the instrument.

Radiation

Introduces information concerning radioactive materials or radiation safety.

- **Bulleted list**
  Indicates a list of items with no intended or implied sequence

1. **Steps or Sequence**
   Identifies successive steps in a procedure

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2 For Your Safety

2.1 General Safety

Make sure you read and understand all the instructions and safety guidelines in the **Installation and Operation Guide** before operating the source holder. The instructions in this guide are written for qualified and trained personnel.

Your equipment requires strict observance of standard regulations and guidelines. You must take note of the safety instructions in these operating instructions. In addition, you must adhere to the country-specific installation standards and all prevailing safety regulations and accident prevention rules.

2.2 Radiation Safety

The radiation safety information is included as a service to you and serves as a guide only in the most general terms. Regulatory agencies throughout the world have different requirements, regulations, and restrictions with respect to the use of nuclear instrumentation. You are responsible for familiarizing yourself with your national and local regulations. These regulations are enforced by agencies such as:

- U.S. Nuclear Regulatory Commission (NRC) or the Agreement State
- Atomic Energy Control Board (Canada)
- International Atomic Energy Agency (IAEA)

Your regulatory agency may limit or require certain activities including:

- Installation
- Maintenance
- Relocation
- Testing
- De-commissioning

Field Service Engineers have the proper licenses required to install and commission nuclear sources and can instruct you how to operate the source holder correctly and safely.

Refer to the **Radiation Safety Manual** for more detailed safety information and instructions.

*If individuals need to enter the vessel on which the gauge is used, you must follow proper lock-out procedures. See the **Radiation Safety Manual** for the specific lockout procedures and other safety responsibilities.*

2.3 Applications

Intended Applications

The SHLM MI4 source holder is designed for radiation-based measurement of applications including density and continuous and point level. The most common industries for the SHLM MI4 include:

- Chemical
- Petrochemical
- Offshore
- Refining

2.4 Certifications

This source holder is designed for certification compliance from the following agencies:

- AERB – India (B, C, and R only)
- CNSC - Canada
- ODH/NRC - Ohio Department of Health and Nuclear Regulatory Commission

Standards

The SHLM MI4 source holder is regulated by the U.S. Nuclear Regulatory Commission (NRC). Compliance certificates are issued by the State of Ohio under an agreement with the NRC.

2.5 Manufacturer's Responsibility

VEGA source holders are designed to International standards for construction and safety.

2.6 User's Responsibility

All users who operate and service the equipment are responsible for ensuring safety requirements are met. This responsibility requires a basic understanding of the nature of radiation and an adherence to all operating procedures.

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3 Product Description

3.1 Components

The SHLM MI4 source holder housing is a lead-filled, welded steel shell fitted with an internal stainless steel cable assembly that functions as a carrier for source capsules. The physical size determines the amount of lead each series model contains for shielding. The dash numbers following the model number are assigned to differentiate between the models with different amounts of shielding. A “4” has the most shielding and a “1” has the least shielding. The source holder design can use a point source in density and/or level measurement. The source holder design can also use multiple point sources for level measurement.

The source carrier(s) is attached to a stainless steel cable and can have up to four cables mounted in the cabinet to guide into the drywell. In all cases, the source carrier(s) is inserted into the vessel well and returned to the source holder for storage, where the sources can be locked in the OFF position.

Documentation

Documentation included with the equipment may include:

- Operating Instructions Manual
- Radiation Safety Manual

Caution - Radioactive Material Label

The Caution-Radioactive Material label provides the following:

- Isotope
- Activity
- Model Number
- Serial Number
- Date of Assay

You must not remove the stainless steel Caution-Radioactive Material Label.

Actuator Cabinet

The actuator cabinet houses the cable(s) used to insert and retract a source capsule(s) into the vessel by way of the drywell. The cabinet is built to house two (2) to four (4) cables, depending on the number of source carriers in the SHLM MI.

Figure 3.1 Actuator Cabinet

The actuator cabinet door is hinged at the bottom and opens from the top. You must be prepared for the weight of the door and avoid injury to your body if it falls open.

You may remove the hinge pins from the actuator cabinet door hinge in situations where the required 30 inches in front of the cabinet to lower the door is not available. Remember, you must be prepared for the weight of the door and avoid injury to your body.

Stainless Steel Cable

The stainless steel cable is used to insert and retract a source capsule(s) into the vessel by way of the drywell.

Figure 3.2 Stainless Steel Cable

3/8" Liquid-Tight Flex Conduit

The stainless steel insert cables are directed from the actuator cabinet to the source holder through a Liquid-Tight flex conduit. The flex conduit is made of a galvanized steel core with a durable thermoplastic rubber jacket that is heat, oil, and chemical resistant. When connecting the flex conduit from the actuator cabinet to the source holder, it is important to make as few bends as possible and to make the distance as short as possible. The conduit can be ordered in lengths of 10, 15, 20 and 25 feet.

Figure 3.3 Flex Conduit

Source Holder

The source holder is constructed from stainless steel or low carbon steel with a polyester powder coating and performs the following:

- Houses all radiation-emitting source capsules.
- Protects the radioactive source.
- Provides a means for shielding and locking out the radiation beam.
- Shields all areas in which radiation is not intended.

Figure 3.4 Source Holder

Source Material

The source material is either Cesium 137 (Cs-137)or Cobalt 60 (Co-60).

Shutter

A shutter is the mechanism that opens or closes the radiation beam port and either permits or denies the movement of the source carriers from the safe storage of the source holder into the process vessel..

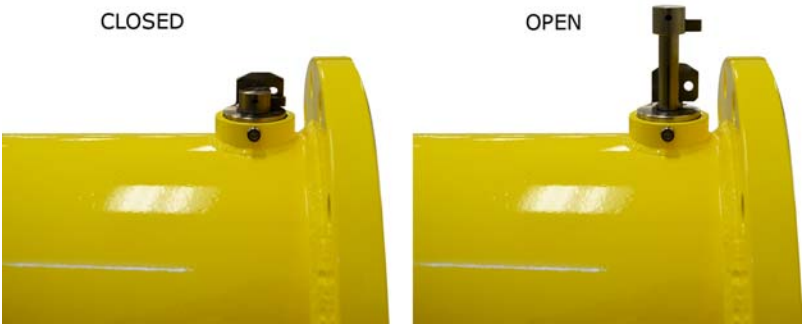

Figure 3.5 Shutter Closed Open

Bracket and Lifting Eye

A forklift bracket and the lifting eyes on the housing help when lifting the source holder into place for installation. Depending on the size of the equipment, the brackets and/or lifting eyes are configured as follows:

- Two lifting eyes are for models with active lengths of 18" and smaller.
- Four lifting eyes are for models with active lengths of 24" and larger.
- Forklift brackets are for models with active lengths of 30" and larger only.

Guide Lanes

Guide lanes inside the actuator cabinet permit the collection and storage of each cable in an organized manner. The cables are protected from scratching by Teflon sliding surfaces both above and below each lane.

The Teflon plates act as guide lanes for the individual cables to allow easier insertion and retraction of the cables into the SHLM MI and the vessel. The plates also help organize the cables inside the actuator cabinet.

Figure 3.6 Teflon Plates

Joiners

Joiners define the diameter of the wound cable bundle and assist in the process of winding the cables in the guide lanes. Properly fixing this diameter minimizes the drag of the cables on the teflon surfaces and makes the process of winding the cables easier.

Figure 3.7 Joiners

Detent Assembly

The detent assembly consists of a detent plug and a socket. The detent plug slides easily along the cable until establishing the exact height in the vessel for the source. After the elevation is defined for the source, the set screw on the detent plug is tightened down so that the height is permanently established in the vessel. Once that height is confirmed, the detent plug can easily be released from the by pulling up on the socket. The cable can then be inserted and retracted in the vessel and returned to its exact location and locked into place, when necessary.

Figure 3.8 Detent Assembly

Cable Latches

Cable latches allow access to one cable at a time inside the actuator cabinet while inserting or retracting a cable into the vessel for ease of operation.

Figure 3.9 Cable Latches

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4 Operation

4.1 General

Measurement accuracy is highly influenced by the proper installation of the equipment. This section contains the guidelines for optimizing performance through proper installation. Also refer to the application sizing sheet and any installation drawings VEGA provided at the time of the order.

Before you begin installing the SHLM MI cable, it is important to make certain during the installation that the flex conduit from the actuator cabinet to the source holder, was connected with as few bends and with as short a distance as possible.

4.2 Unpack the Equipment

Make sure you read and understand all the instructions and safety guidelines in the **Installation and Operation Guide** before you unpack, install or operate the equipment. The instructions in this guide are written for qualified and trained personnel.

You must be familiar with radiation safety practices in accordance with your U.S. Agreement State, the U.S. Nuclear Regulatory Commission, or other local nuclear and international regulatory agencies before unpacking the source holder.

When you unpack your equipment, make sure you follow the steps below.

1. Unpack the unit in a clean, dry area.

Do not sit the source holder on the source carrier cover during unpacking. The source carrier cover cannot hold the weight of the source holder.

2. Visually inspect the source holder for damage.
3. Check the entire shipment for damage during shipment or storage.

4. File a claim against the carrier, reporting the damage in detail, if there was damage to the unit during shipment. Any claims against VEGA for shortages, errors in shipment, etc., must occur within 30 days of receipt of the shipment.

If you must return the equipment to VEGA, follow the instructions in the **Instrument Repair** section of the **Maintenance** chapter.

5. Make certain the shutter of the source holder is closed and locked.

If you find the shutter is open, close it immediately and secure it.

6. Compare the shipment against the packing slip to make certain you received your complete order.
7. If you are not installing or mounting the source holder immediately, find a storage area that is isolated and secure.

Low level radiation fields are always present around a source holder.

8. Allow access to authorized personnel only.
9. Maintain records of the shipping and receipt.
10. While not required, a survey and leak test provide additional assurance that the source holder is in safe condition.

4.3 Storage and Handling

You are responsible for familiarizing yourself with all national and local radiation safety guidelines and procedures prior to storing or handling radioactive materials. See the **Radiation Safety Manual** for specific details.

Source Holder

If you must store or package the source holder, follow these steps:

1. Ensure the shutter is closed and locked.
2. Check the current local regulations (U.S. NRC, Agreement State, or other) to determine whether this area must have access restrictions.
3. Store the source holder in a clean, dry, and secure area.

4.4 Location

At the time you ordered your equipment, VEGA sized the source holder for optimal performance for the designated application. If the location of the equipment has changed or is different from the original order, notify VEGA before installing the equipment.

Locate the source holder where process material cannot coat it. Appropriate location ensures the continuing proper operation of the source shutter, if applicable. Many regulatory agencies, such as the U.S. Nuclear Regulatory Commission (NRC), require periodic testing of the shutter. See the **Radiation Safety Manual** for details about current regulations.

Internal Obstructions

If an internal obstruction such as an agitator, baffle, or manway is directly in the path of the radiation beam, that obstruction can shield the radiation from the detector. Such an obstruction can diminish performance of the equipment.

If your instrument has a central agitator shaft, the source holder and the detector can mount to the vessel on a chord other than the diameter. Mounting the source holder and the detector in this manner allows the beam of radiation to avoid the agitator shaft.

External Obstructions

Any material in the path of the radiation can affect the measurement. Some materials that are present during the initial adjustment pose no problem because the adjustment accounts for the effect of those materials. Examples of such materials are:

- Tank walls
- Liners
- Insulation

However, when the materials change or you introduce new ones, an erroneous gauge reading is possible. For example, insulation that you add after adjustment absorbs the radiation and causes the gauge to erroneously read upscale.

Preferred Orientation

The SHLM MI4 mounts to a nozzle flange on the process vessel. VEGA Americas provides application drawings based upon your particular application. Make sure you refer to those drawings for the correct orientation of your source holder.

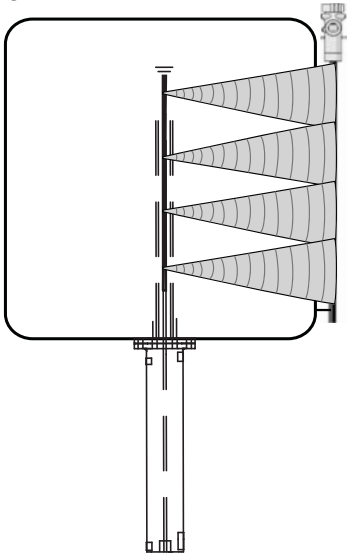


Figure 4.1 SHLM MI4 Preferred Level Orientation

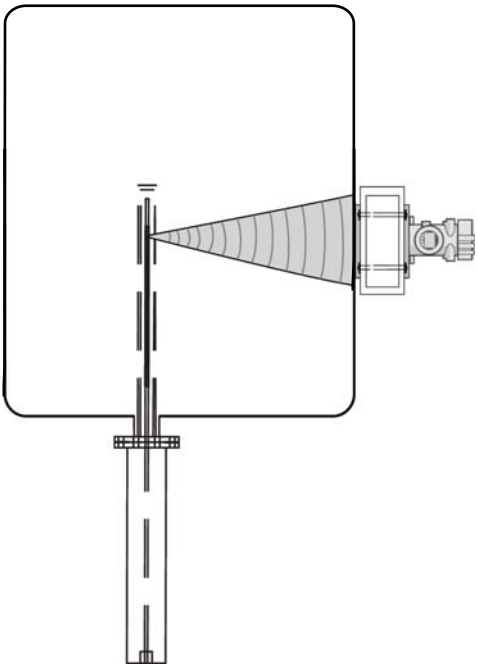


Figure 4.2 SHLM MI4 Preferred Density and Point Level Orientation

Source Interference

When multiple adjacent pipes, vessels, or conveyors have nuclear gauges, you must consider the orientation of the source beams so each gauge senses radiation only from its appropriate source. Maximize the distance between the source holders when mounting them on adjacent vessels. Make sure to maintain the appropriate source to detector distance as illustrated in **Figure 4.3**.

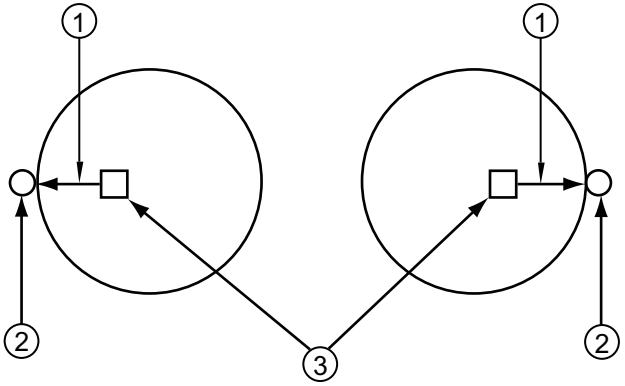


Figure 4.3 Source/Detector Arrangement for Adjacent Vessels

1. *Radiation Beam*
2. *Detector*
3. *Source Holders*

4.5 Temperature

Your source holder may have components that are sensitive to temperature extremes. Avoid exposure to temperatures beyond the specified limits. The maximum operating temperature for the vessel is + 260 °C (+ 500 °F). Consult the factory if this temperature is exceeded.

Ambient Temperature

You may use the source holder in continuous ambient temperature conditions from - 40 °C … + 60 °C (-40 °F … + 140 °F). Minimize direct exposure to sunlight when ambient temperatures exceed + 40 °C (+ 105 °F).

4.6 Principle of Operation

The SHLM MI4 is mounted onto a source well that extends into the process tank or vessel. In addition, the SHLM MI4 is used to position and protect a radioactive source in the process tank or vessel using a retractable stainless steel cable. Radiation from the source is broadcast through the process material and out of the vessel. A radiation detector placed outside the vessel measures radiation fluctuations caused by process condition changes. The detector correlates radiation levels to process conditions such as level and density.

Commission the Source Holder

Depending on the source holder type and the specific license requirements, the process of commissioning the source holder can include:

- Inspecting the mounting supports
- Testing the source holder for any source material leakage
- Conducting open and closed radiation surveys
- Performing an occupancy evaluation

See the **Radiation Safety Manual** for specific details.

Commissioning Call Checklist

In many installations, a VEGA Americas Field Service Engineer commissions the gauge. To reduce service time and costs, use this checklist to ensure the gauge is ready for commissioning before the engineer arrives:

- Allow access to the source holder for testing purposes.
- Have process ready for adjustment.
- To ensure the most accurate measurement, a process adjustment is necessary. This adjustment requires establishing and changing vessel levels. If process material is not available, you may use water in most cases.

- Do not remove the lock on the source holder.
- Notify your Radiation Safety Officer or contact VEGA Americas Field Service at 1-513-272-0131 if there is damage to the source holder.

4.7 Normal Operation

Before putting the source holder into operational use, be aware of the requirements for installing the source holder.

Source Holder Installation Requirements

The following statements are important in defining the requirements for the installation of a source holder:

- Regard each separate placement or relocation as a new installation.
- Installation is the process of preparing the mounted source holder for use and consists of the following:
  - Preliminary radiation survey
  - Leak test
  - Installation radiation survey
  - Shutter or cable mechanism operation test
- Only a specifically licensed individual can perform the installation.
- The specifically licensed person must use a calibrated survey meter and must be present at the site during the entire procedure.
- The licensee may perform future periodic tests by following the instructions in this manual.

Preliminary Survey

1. Ensure that the survey meter is calibrated and operational.
2. Conduct a radiation survey of the mounted unit by surveying the source holder and detector, omni-directionally, one foot from the surface.
3. If the radiation field is normal, less than 50 mSv/hr (5 mrem/hr) at 30 cm (12") for most VEGA Americas source holders, proceed with the leak test.
4. If the radiation field is greater than 50 mSv/hr (5 mrem/hr) at 30 cm (12"), complete the following: Post restrictions of the area, if required.
5. Verify with the manufacturer that this condition is normal for the type of source and source holder you are installing.

Perform a Leak Test

1. Remove the zip-top bag containing the swab stick.
2. Write the source serial number or other identification on the bag.
3. Open the zip-top bag and grasp the swab stick by the end opposite of the fiber tip.
4. Wipe the external surface of the source holder by using the fiber-tipped end of the swab stick. Wipe the locations where contamination would most likely accumulate in the event the source capsule was leaking.
5. Place the swab stick into the zip-top plastic bag and close.
6. Put the zip-top bag in an envelope and seal it.

Do not touch the fiber tipped end or allow the tip to touch other objects since this could spread contamination if the source is leaking. If the swab stick contains a significant amount of radioactive material, send an emergency notification, by telephone immediately. Contact the appropriate nuclear regulatory agency and VEGA Americas for assistance. You must make arrangements with VEGA Americas, or another specifically licensed person to take the source out of service.

Radiation Survey after Installation

1. Complete the survey sheets with measurements at 30 cm (12") omni-directionally to record the radiation pattern.
2. Survey in the closed (OFF) position and then in the open (ON) position.
3. Do an occupancy evaluation to determine the dose personnel might receive. There are two categories, each with a different limit:
    - Members of the general public can receive 20 mSv/hr (2 mrem/hr), not to exceed 1,000 µSv/yr (100 mrem/year). These numbers include only individuals who are in the area infrequently and have no assigned reason for exposure.
    - Occupationally-exposed individuals can receive 50,000 mSv (5,000 mrem) per year with no specified rate limit. This number includes anyone whose assigned duties require his presence in the vicinity of the source holder. Complete the evaluation to determine if the limit of 5,000 mSv (500 mrem) per year, which would require monitoring, is potentially reachable.
4. Decide if additional shielding is required to prohibit members of the general public from receiving radiation doses greater than 20 mSv/hr (2 mrem/hr).
5. Notify appropriate personnel of the presence of radioactive materials and precautions that they must take to minimize exposure.
6. If there are radiation fields above 20 mSv/hr (2 mrem/hr) present on the detector side, notify the RSO (Radiation Safety Officer) of the problem.
7. Restrict the area, if required.

Shutter Operation Test (on applicable source holders)

The shutter operation test verifies that the shutter is functioning.

If the shutter does not work correctly, see the **Radiation Safety Manual Emergency Guidelines**.

Shutter (ON/OFF) Mechanism (required every six months)

Depending upon whether or not your source holder uses a shutter or cable mechanism, checks are normally performed at intervals not to exceed six months.

To test the shutter mechanism, move the actuator back and forth several times between the OFF and ON positions.

Customers who have the ability to cycle shutters or check cables on a more frequent basis without disturbing production requirements are recommended to do so. The application of lubricating oil to the shutter mechanism will assist in maintaining the source holder in good working order.

The actuator should move easily, but not freely. There will be some resistance to movement due to bearing friction and inertia of the mechanism.

There are no ON/OFF indicators to verify that the shutter or cable mechanism is working correctly or that the source is in the shielded position. When the source shutter or positioning cable is in the retracted position and the shutter is closed, it is assumed that the source is in the shielded position. Monitoring of the radiation levels by level detectors or other means is necessary to ensure that the source is in the shielded position and not in the source well.

Keep the records of these tests, listing the date and name of the person performing the test, for at least three years.

At the first indication that a shutter or cable mechanism is not working properly, contact the manufacturer for advice. A sticky shutter or a cable that will not retract is a warning that the proper operation is compromised and you need to address the inoperable mechanism.

If the shutter or cable mechanism becomes inoperable, contact your regulator and manufacturer immediately for advice. DO NOT attempt to free up the shutter or cable by mechanical means with the use of wrenches, hammers, channel locks, levers, etc. These devices may cause more damage and are prohibited. Such actions have been known to shear the source cable.

If a device has an inoperable shutter or cable, the source holder should not be removed without consulting the manufacturer.

4.8 Special Conditions

Radiation Fields Inside Vessels

You must measure the radiation fields inside a vessel when entering the vessel. Use the following statement when defining those requirements:

- Equipment that is mounted on vessels or has accessible air gaps must have written lockout procedures to ensure that access to the high levels of the primary radiation beam is not possible.
- In North America, many of these types of installation are considered by OSHA (Occupational Safety and Health Administration) as confined spaces and the radiation is classified as “other known energy hazards”. These installations require lockout documentation consistent with OSHA rules.

At a minimum, follow the steps listed below, where applicable:

1. Verify, by signature, that source holder is locked in the OFF (shutter closed) position.
2. Ensure that one person, who controls individuals entering the air gap, holds the key to the interlock system, if acquired.
3. Make certain the radiation field is very low by using the gauge electronics or a survey meter.
4. Check that the gauge electronics shows a high reading or maximum density, since no radiation is reaching the detector.
5. Make sure the survey meter allows for quantitative measurements. The fields measured should match very closely to background readings.
6. Ensure that the vessel is vacant and the entrance door is locked, after the work is completed.
7. Complete these steps before inserting the source holder and returning it to the ON position.

5 Mounting

5.1 Mounting Source Holder

Anyone with basic radiation safety awareness training can mount the source holder to the nozzle flange on the process vessel provided the source is locked in the OFF position and the following instructions are observed. Canadian licensees must have specific wording in their license that allows these operations.

Before beginning any installation steps, all technicians must be specifically licensed by a nuclear regulatory authority in order to perform any non-routine maintenance.

Mounting Checklist

Before beginning the mounting of the source holder, perform the following steps:

1. Conduct visual inspection of source holder.
2. Ensure that the shutter is closed and locked.
3. Ensure that external surfaces are not damaged.
4. Check that the mounting position of the source holder complies with manufacturer's engineering drawings and specifications. (See certified correct drawings or contact VEGA Americas.)
5. Ensure adequate clearance to operate shutter or cable mechanism.
6. Consider in advance any high temperature or corrosive environmental conditions. For example, you should consider the following items:
   - Adequate insulation to protect source holder from high temperature.
   - Special cooling system required to reduce source holder temperature.
   - Additional protection required to prevent corrosive material from settling on source holders.
   - Excessive vibration (over 1G).
7. Have personnel and equipment, cranes, hoists, and supports available to mount the unit.
8. Be prepared to handle the weight of the unit. Remember, source holders are very heavy.

Safety Shield

The source holder is transported with a safety shield in place to maintain the source holder in the safest condition possible. This safety shield is installed on the flange-end of the source holder. The shield limits the radiation field exiting from flange end of the holder to very low levels and should remain in the holder until the source holder is being prepared for mounting to the vessel. A 9/16" open end wrench is required to remove the four hex bolts that hold the shield in position. A minimum clearance of 4" is needed to remove the shield.

Figure 5.1 Safety Shield

Inserting Sources into a Dry Well

In this particular installation, it is necessary to insert the source capsules into a dry well from the bottom of the tank. The source capsules are pushed up into the well. As the capsules are moving from the source holder into the vessel, they are unshielded. Therefore, moving the sources into the well should be done as rapidly as possible. No direct contact with the sources is necessary and must not occur under any circumstance.

The shielding in the space between the source holder and the source well may be minimal. You should not allow the sources to remain in this area; the sources should be either inside the source holder or inside the source well.

After the sources are in the well, perform a radiation survey around the tank and the source holder. The radiation field inside the vessel can be greater than 100 mRem/hr (1 mSv/hr) when mounting an unshielded source in a vessel. Posting

and lockout procedures are required in this case. Refer to your license and the regulations for details.

5.2 Locating and Mounting Actuator Cabinet

The actuator cabinet requires a proper mounting location once the source holder has been mounted onto the vessel. A proper location requires the following:

- Stable mounting location for the actuator cabinet
- 30” clearance in front of the cabinet to permit the lowering of the actuator cabinet door
- Minimal bends in the cable path from the cabinet to the source holder.

The flex conduit requires a 90° turn at the exit of the actuator cabinet and another 90° turn upward to the source holder. Keep the path of the conduit between these two turns as linear as possible. Any bends or turns induces drag on the insert cable as it moves through the conduit, making the task of inserting the sources into the vessel more difficult.

Mounting Steps

1. Remove the shipping plate from the end of the source holder using a 3/4" socket and ratchet.
2. Use the same fasteners to temporarily attach the source carrier cover to the source holder.

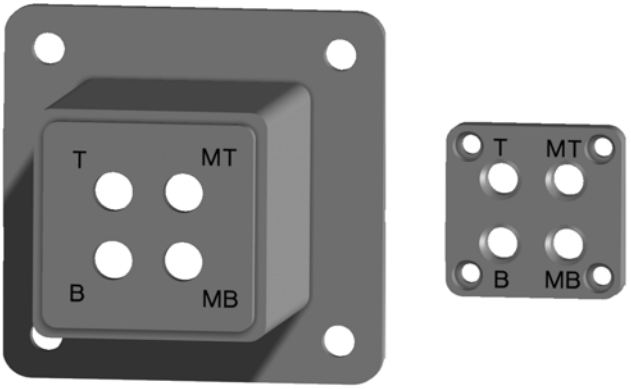


Figure 5.2 Attach Source Carrier Cover to Source Holder

NOTE

Make certain you align the engraved initials on the cover with the initials on the retainer plate. This temporary attachment greatly aids in identifying a suitable location for the actuator cabinet.

3. Firmly mount the actuator cabinet to a suitable surface.

NOTE

To aid the process of finding the best surface for mounting the actuator cabinet, a mounting frame is offered as an option. The frame allows the installer to move the cabinet to a location and distance from the holder so that bends in the flex conduit are minimal. Holes are provided in the base of the frame for anchoring.

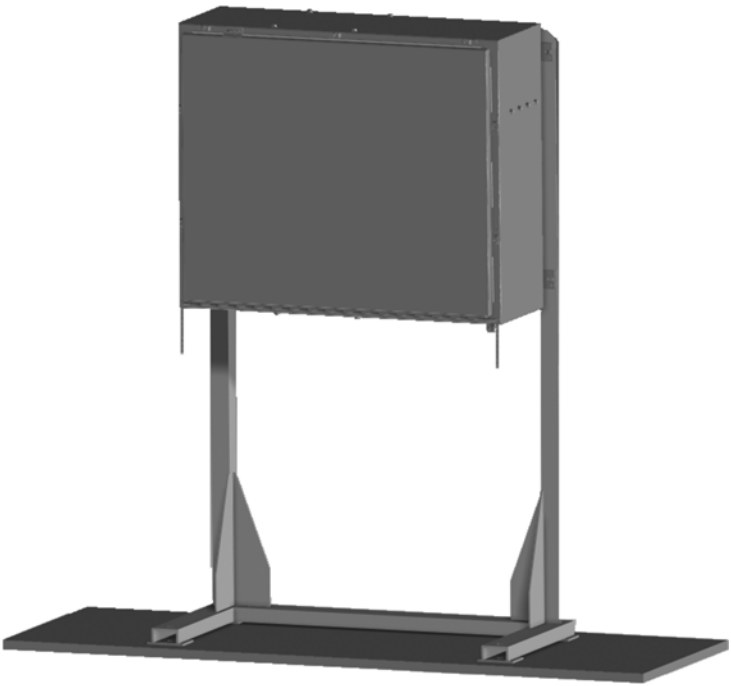


Figure 5.3 Mounting Frame with Cabinet

Figure 5.4 Mounting Frame without Cabinet

NOTES

6 Connecting the Cables

6.1 Cable Connections

Tools Needed

At a minimum, VEGA Americas recommends the following tools for connecting the cables to SHLM MI source holder:

- One (1) pair of all purpose, high grip gloves (optional)
- 3/4" socket and ratchet
- Large Phillips head screw driver
- (2) 7/16" open end wrenches
- 1/8" hex key
- Large flathead screwdriver

Preparation

1. Remove the shipping plate from the connection end of the source holder using the 3/4" socket and ratchet.

Figure 6.1 Shipping Plate

The four (4) hex bolts must be set aside and kept in a safe place because you will need them to attach the source carrier cover to the source holder.

2. Notice the initials of the source carriers engraved on the retainer plate.

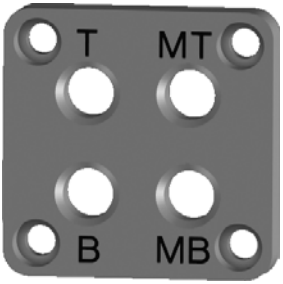


Figure 6.2 Retainer Plate with Source Carrier Initials

NOTE

These engraved names define the intended position of the source carriers when they are inserted into the vessel, and will match the names of the insert cables inside the actuator cabinet.

3. Use the large flat head screwdriver to release the door clamps, making note of the location of the door hinge at the bottom of the actuator cabinet.
4. If space permits, allow the actuator cabinet door to swing open to permit access to the inside of the cabinet.
5. If a minimum clearance of 30" is not available, the installer can remove the door by pulling the hinge pins out of the hinge on each side of the cabinet.

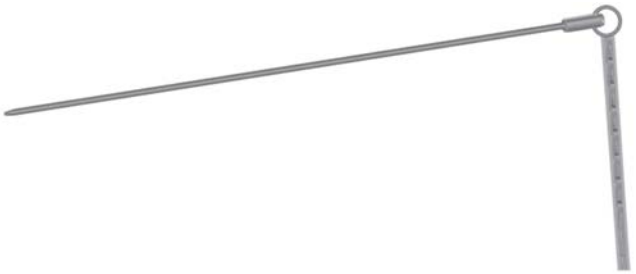


Figure 6.3 Hinge Pin

6. Reverse this process when reinstalling the door.

Inside the Cabinet

1. Make note of the labeling that is provided on the rear panel of the cabinet for the location and the source activity of each capsule in the vessel.

NOTE

The labels on the rear panel provide descriptions of each of the source carriers within the source holder.

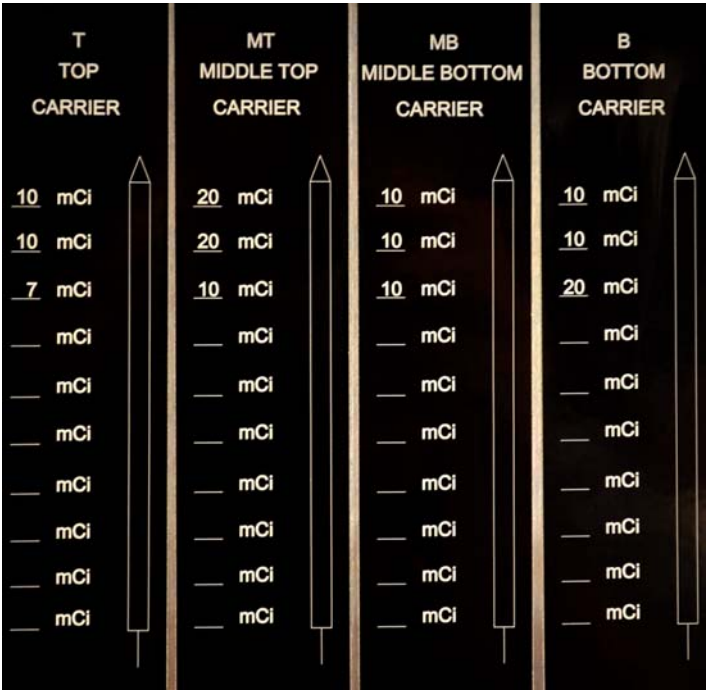


Figure 6.4 Source Carrier Description Labels

2. Before beginning to make connections, notice the labeling next to each of the insert cables on the right side of the cabinet. The names of the cables should match those of the source carriers.

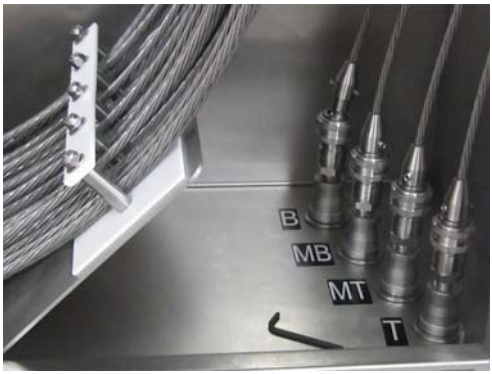
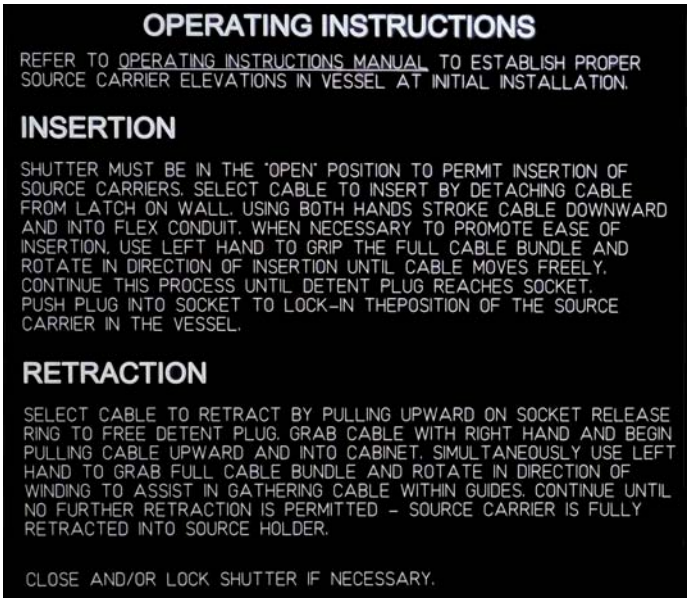


Figure 6.5 Cable Labels

3. Make sure you read the Operating Instructions label provided on the rear panel of the cabinet for the insertion and retraction steps for the cable(s).



OPERATING INSTRUCTIONS

REFER TO OPERATING INSTRUCTIONS MANUAL TO ESTABLISH PROPER SOURCE CARRIER ELEVATIONS IN VESSEL AT INITIAL INSTALLATION.

INSERTION

SHUTTER MUST BE IN THE "OPEN" POSITION TO PERMIT INSERTION OF SOURCE CARRIERS. SELECT CABLE TO INSERT BY DETACHING CABLE FROM LATCH ON WALL. USING BOTH HANDS STROKE CABLE DOWNWARD AND INTO FLEX CONDUIT. WHEN NECESSARY TO PROMOTE EASE OF INSERTION, USE LEFT HAND TO GRIP THE FULL CABLE BUNDLE AND ROTATE IN DIRECTION OF INSERTION UNTIL CABLE MOVES FREELY. CONTINUE THIS PROCESS UNTIL DETENT PLUG REACHES SOCKET. PUSH PLUG INTO SOCKET TO LOCK-IN THEPOSITION OF THE SOURCE CARRIER IN THE VESSEL.

RETRACTION

SELECT CABLE TO RETRACT BY PULLING UPWARD ON SOCKET RELEASE RING TO FREE DETENT PLUG. GRAB CABLE WITH RIGHT HAND AND BEGIN PULLING CABLE UPWARD AND INTO CABINET. SIMULTANEOUSLY USE LEFT HAND TO GRAB FULL CABLE BUNDLE AND ROTATE IN DIRECTION OF WINDING TO ASSIST IN GATHERING CABLE WITHIN GUIDES. CONTINUE UNTIL NO FURTHER RETRACTION IS PERMITTED – SOURCE CARRIER IS FULLY RETRACTED INTO SOURCE HOLDER.

CLOSE AND/OR LOCK SHUTTER IF NECESSARY.

Figure 6.6 Operating Instructions Label

Making Connections

At the Actuator Cabinet

1. Begin the process of connecting the insert cables to the source carriers by selecting the insert cable nearest the front of the cabinet labeled “T”.

The “T” cable is the insert cable for the source carrier intended for the top of the vessel. Likewise, each additional cable is an insert cable for the source carrier and is intended for a specific location in the vessel.

Depending on the number or source carriers for your application, the insert cables could be named M - middle, MT - middle/top of vessel, MB - middle/bottom of vessel, or B - bottom.

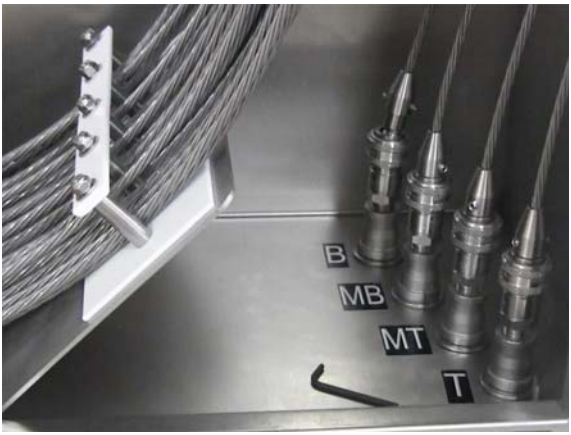


Figure 6.7 Insert Cables

2. Unhook the cable from the cable latch.

Figure 6.8 Cable Latches

3. With your right hand push approximately 48" of the cable downward and into the flex conduit.

This action will extend the “T” cable outward from the source carrier cover for easy identification and attachment at the source holder.

4. If necessary, while pushing the cable downward, use your left hand to rotate the coil of cable through the cable guides to keep things moving smoothly.

At the Source Holder

1. Locate the source carrier with the “T” identification. The source carrier has a threaded end that is covered by a thread protector.

Figure 6.9 Thread Protector

2. Rotate the thread protector to remove and to expose the connection threads on the source carrier.
3. Notice the jam nut that is on the source carrier.
4. For proper connection, make sure that the jam nut is threaded fully against the source carrier to expose the maximum thread.

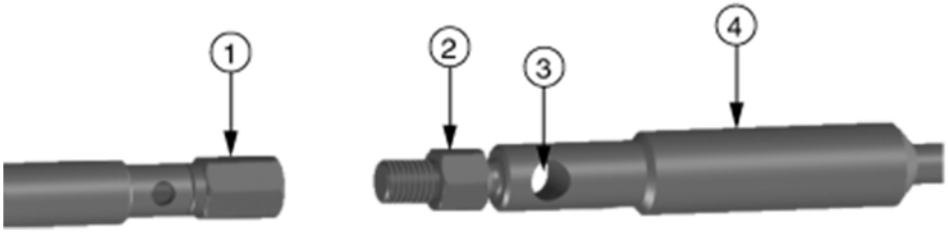


Figure 6.10 Connecting the Source Carrier

1. *Swivel Fitting*
2. *Jam Nut*
3. *Hole Used to Assist with Cable Attachment*
4. *Source Carrier*

5. Locate cable “T” that was extended from the actuator cabinet.

The cable will have a swivel fitting on the end that will permit it to be threaded onto the source carrier “T”.

6. To keep the source carrier from rotating during the connection process, insert a Phillips head screwdriver through the provided hole in the source carrier.
7. Thread the swivel fitting onto the source carrier until the threaded end of the carrier seats against the bottom of the fitting.
8. Use the Phillips head screwdriver and a 7/16" wrench to tighten the swivel fitting firmly onto the source carrier.
9. Thread the jam nut down against the swivel fitting.
10. Use (2) 7/16" wrenches to tighten the jam nut firmly against the swivel fitting firmly.

The process for connecting cable “T” to the source carrier is complete.

11. Follow the steps described above for all cables in the actuator cabinet.

Attaching Source Carrier Cover

The process for attaching the source carrier cover to the source holder is best performed with two (2) people since actions at both the source holder and actuator cabinet need to happen simultaneously.

At the Source Holder

1. Installer #1 should hold the source carrier cover and make sure that the orientation of the cover is such that the cables are in-line with their assigned source carriers.
2. Installer #1 should now be prepared to move the source carrier cover toward the source holder as Installer #2 winds the necessary length of each of the cables back into the cabinet.

At the Actuator Cabinet

1. Installer #2 retracts each of the cables back into the cabinet in short increments, while at the same time Installer #1 moves the source carrier cover closer to the source holder.

The task of retracting the cables requires the installer to pull a cable back into the cabinet with their right hand, while using their left hand to spin the full cable coil in a direction that will capture the cable within the guide lanes.

2. Continue the progression of retracting the cables until Installer #1 has the source carrier cover pressed fully against the source holder.
3. Fasten the source carrier cover to the holder using the 3/4" socket and ratchet and the same hex bolts that secured the shipping cover to the source holder when originally shipped.

Insert Sources and Establish Elevations

Tools needed for this part of installing the SHLM MI include:

- 1/8" hex key

1. Remove the combination lock from the shutter.
2. Pull the shutter outward until it locks into the detent.
3. Return to the actuator cabinet with the 1/8" hex key.
4. To establish proper source carrier elevation within process vessel:
5. Release the source carrier you wish to insert by releasing it from its cable latch inside the actuator cabinet.
6. Confirm the insert cable moves freely through the detent plug by making sure set screws in the plug are not tightened against the cable.
7. Begin inserting the source carrier into the vessel by pushing the cable downward and into flex conduit.

You may find it necessary to manually rotate the cable bundle within the cable guides to keep the cable moving easily during the insertion process.

8. Continue inserting the cable until the detector indicates that the proper sensing of the radioactive source has been achieved and that correct elevation of the source carrier exists.
9. Use the 1/8" hex key to tighten both set screws in the detent plug tightly against the insert cable.

Tightening the set screw against the cable, "locks-in" the position of the source carrier, and permits source carrier retraction and re-insertion back to the same elevation within the well.

10. Repeat steps five (5) through nine (9) for each cable.

6.2 Cable Insertion

One (1) pair of all purpose, high grip gloves is recommended to complete the insertion of the cable.

1. Pull the shutter outward until it locks into the detent.
2. Return to the actuator cabinet and open the door.

The actuator cabinet door is hinged at the bottom and opens from the top. You must be prepared for the weight of the door and avoid injury to your body if it falls open.

You may remove the hinge pins from the actuator cabinet door hinge in situations where the required 30" in front of the cabinet to lower the door is not available. Remember, you must be prepared for the weight of the door and avoid injury to your body.

3. Unhook a cable from a cable latch making note of the cable identification.
4. Grab the cable with one hand and push the cable downward and into the flex conduit, while using the other hand to grab the full cable bundle and rotate it

the direction of the insertion to promote easy cable movement within the cable guides.

5. Continue this process until the detent plug comes around and meets the socket.
6. Center the plug over the socket.
7. Push the plug into socket until it locks in place.
8. Repeat steps three (3) through seven (7) for each cable.

6.3 Cable Retraction

One (1) pair of all purpose, high grip or heat resistant gloves is recommended to complete the retraction of the cable.

If the cable is retracted from a vessel that operates under high temperatures, heat resistant gloves are recommended when retracting the cable to avoid possible burn injury.

1. Return to the actuator cabinet and open the door.

The actuator cabinet door is hinged at the bottom and opens from the top. You must be prepared for the weight of the door and avoid injury to your body if it falls open.

2. Unhook a cable from a cable latch making note of the cable identification.

3. Pull up on the detent socket ring (located on the outside diameter of the socket) until the selected detent releases.

Figure 6.11 Detent Assemby

4. Use one hand to start pulling the selected cable back into the actuator cabinet while using the other hand to help rotate the coil of cable in the direction of the winding.
5. Continue this process until no further movement of the cable is permitted.

When no further movement of the cable is permitted into the actuator cabinet, the source is fully and safely retracted into the source holder.

6. Repeat steps two (2) through six (6) for each cable.
7. Return to the source holder and push the shutter inward to close.

7 Maintenance

This source holder contains no moving parts, so very little periodic maintenance is required. However, to prevent potential problems and comply with radiation regulations, VEGA recommends the following maintenance schedule.

7.1 Periodic Maintenance Schedule

Description	Frequency	Procedure
Source holder shutter check ON/OFF Mechanism (On applicable source holders)	Every six months unless otherwise required by applicable nuclear regulatory agency	See the Shutter (ON/OFF) Mechanism procedure.
Source wipe/ Leak test	Every three years unless otherwise required by applicable nuclear regulatory agency	See the Leak Test procedure.
Location	Annually	Ensure that the source holder is in the correct location. If the source is not in the correct location, contact your regulatory agency immediately.
Mounting brackets and hardware	Annually	Check for loose mounting hardware.
Tags and labels	Annually	Make certain the tags and labels are in place and legible.
General cleanliness	Annually	Make certain there is no buildup of dirt or process material on operating handles or cables.
Corrosion or rusting	Annually	Check the housing and operating handle.
Painting	As needed	Clean and paint as necessary. Do not paint labels.

7.2 Diagnostics

The source holder does not have any diagnostics that alert users to potential problems. However, emergency guidelines as outlined in the **Radiation Safety Manual** provide steps you can take for the following emergency situations:

- Stuck Shutter or Inoperable Cable
- Loss or Theft
- Entering a Tank or Vessel
- Fall, Collision, or Fire

7.3 Troubleshooting

The source holder is extremely reliable, but errors can occur during operation. Some of those potential problems are caused by the following:

Item	Action to Take
Abandoned or discarded source	In the United States, contact the U.S. NRC or an agreement state.
Damaged or failed source	Retract the capsules into the shielded position, if possible and contact VEGA Americas Nuclear Services.
Missing or broken lock	Do not remove the source from the crate or mount the source. If the source is already mounted, contact VEGA Americas Nuclear Services.
Cable not operating correctly	Contact VEGA Americas Nuclear Services.
Source leak	Evacuate the immediate area and control entry to the area. Contact VEGA Americas Nuclear Services.
Improper Handling	Contact VEGA Americas Nuclear Services.
Improper or damaged shielding	Contact VEGA Americas Nuclear Services.
Improper mounting	Contact VEGA Americas Nuclear Services.
Improper installation	Contact VEGA Americas Nuclear Services.

Item	Action to Take
Label damaged or removed	Contact VEGA Americas for a replacement and the procedures for installing the label.
Improper licensing	In the United States, contact the U.S. NRC or an agreement state.
Cables can get stuck	Contact VEGA Americas Nuclear Services.
Maximum weight of insertion element	Contact VEGA Americas Nuclear Services.
Apply too much force breaks cable and causes source to drop to bottom of vessel	Contact VEGA Americas Nuclear Services.

If you are unable to correct the problem, please contact VEGA Field Service at 513-272-0131.

7.4 Spare Parts

Spare parts are available directly from the VEGA Parts and Repairs Department for U.S. and Canadian installations. Countries outside the U.S. and Canada may purchase parts through their local VEGA representative.

7.5 Equipment Repair

To request source holder repair within the United States and Canada, contact an VEGA Americas Field Service Engineer.

Contact Information	**Telephone Numbers**
Monday through Friday, 8:00 A.M. - 5:00 P.M. EST (Eastern Standard Time)	1-513-272-0131
For emergencies after hours, call the number listed and follow the voice mail instructions.	1-513-272-0131

Repair Information

When calling VEGA Americas for repair, have the following information available:

- Product model that is being repaired.
- Description of the problem.
- VEGA Americas Customer Order (C.O.) Number.
- Purchase Order Number for the repair service.
- Shipping address.
- Billing address.
- Date needed.
- Method of shipment.
- Tax information.

8 Dismounting

Before you attempt to dismount the source holder, make sure you are aware of any potentially dangerous process conditions such as extreme temperatures, high pressure in the vessel, and toxic or corrosive materials.

8.1 De-commission the Source Holder

In many U.S. installations, a VEGA Field Service Engineer de-commissions the source holder. Only persons with a specific license from the U.S. NRC, Agreement State, or other nuclear regulatory agency may remove the source holder lock.

Users outside the United States must comply with the appropriate nuclear regulatory agency's regulations in matters pertaining to licensing and handling of the equipment.

See the **Radiation Safety Manual***,* and the appropriate current regulations for details.

Dismount or Removal Requirements

Before you remove the source holder, perform the following steps:

- Conduct a visual inspection of source holder. Make certain the external surface is smooth and not damaged.
- Check corroded and rusted units, which have been in service under extreme environmental conditions. These units may require special removal, handling, and shipping procedures.
- Ensure that the shutter is closed and locked on applicable source holders.

- Make sure the cable is retracted on applicable source holders.
- Have personnel and equipment, cranes, hoists, and supports available to remove unit.
- Inform all personnel involved in the removal, of the procedures necessary to limit radiation exposure. For example, how to reduce exposure using time, distance, and shielding.
- Be prepared to handle the weight of the source holder. The approximate weight of the source holder is on the certified correct drawing.

Specific requirements for removing the source holder include the following:

- Radiation Survey
- Leak Test, if shipping the unit.
- Only a specifically licensed individual can perform the removal.
- The specifically licensed person must use a calibrated survey meter. The radiation safety officer must be present at the site during the entire procedure.

The radiation field should conform to the installation survey or less than 50 mSv/hr (5 mrem/hr) at 30 cm (12") from the surface omni-directionally.

This information refers to work that should be performed prior to the removal of a source holder in the United States. Canadian licensees must have specific wording in their license that allows installation and removal.

8.2 Disposal

Source Disposal

Contact VEGA Field Service for information regarding the disposal of the source. The contact information for the U.S. and Canada is:

Contact Information	Telephone Number
Monday through Friday 8:00 A.M. - 5:00 P.M. EST (Eastern Standard Time)	513-272-0131
Emergencies: Follow the voice mail instructions	513-272-0131
Fax	513-272-0133

NOTES

9 Supplemental Information

9.1 Specifications

The following technical data provides a description of the attributes specific to your source holder. In addition, the dimensions provide the detailed length, width, and height of your source holder.

Technical Data

Maximum Cs-137 Activity	37 GBq (1000 mCi) for 50 uSv@305 mm (5mR/hr@12") 5 Ci for point sources 25 Ci total and 12 Ci/ft for multi-point sources
Maximum C0-60 Activity	1.85 GBq (5 mCi) for 50 uSv@305mm (5mR/hr@12") 500 mCi for point sources 500 mCi total and 50 mCi/ft for multi-point sources
Conduit	Santoprene surrounding flexible steel conduit
Fire Resistance	+538 °C (+1000 °F) for 5 minutes
Temperature	-40 … +60 °C (-40 … +140 °F)
Vessel Temperature (Maximum Operating)	+260 °C (+500 °F) Consult factory, if exceeded.
Weight	See drawing
Housing Versions	Low carbon steel with polyester powder coating Stainless steel
Materials - Shielding - Cable	 Lead Stainless
Temperature	-20 °C ... 50 °C (-4 °F ... 122 °F) extended temperature options available
Humidity	0-95%, non-condensing

Vibration	Tested to IEC 68-2-6, IEC 68-2-27, and IEC 68-2-36
Enclosure rating	NEMA 4 X IP66
Life Expectancy	20 years
Pressure	Atmospheric
Vibration	Mild (less than 5g)
Corrosion	Mild
Licensing	A general license for the use of this source holder must meet the requirements as outlined in OAC 3701:1-46-05 (10 CFR 31.5 equivalent). Any other use of the source holder requires a specific license.
Leak Test	At least once every 36 months
Shutter or Cable Test	At least once every 6 months
Transfer and Disposal	The transfer of this source holder containing the sealed source is only to a specifically licensed person or as specified in OAC 3701:1-46 (an equivalent to 10 CFR 31 and 32). If you need to transfer the source holder to another location or dispose of the source holder, specific licensees are required.
Handling, Installation, and Storage	A general licensee may initially mount the device. You may not put the source holder into service until it is inspected by a specific licensee. The manufacturer, or other specifically licensed persons, are the only people that may perform service.
Storage	Whenever you remove the device from its mounted position, mount the cover plate on the device to shield the beam port and keep foreign material out of the shutter assembly.
Physical Inspection	Perform physical inspections of the device and its labeling at least once every six months for corrosion prevention and maintenance in accordance with the manufacturer's instructions.

Dimensions

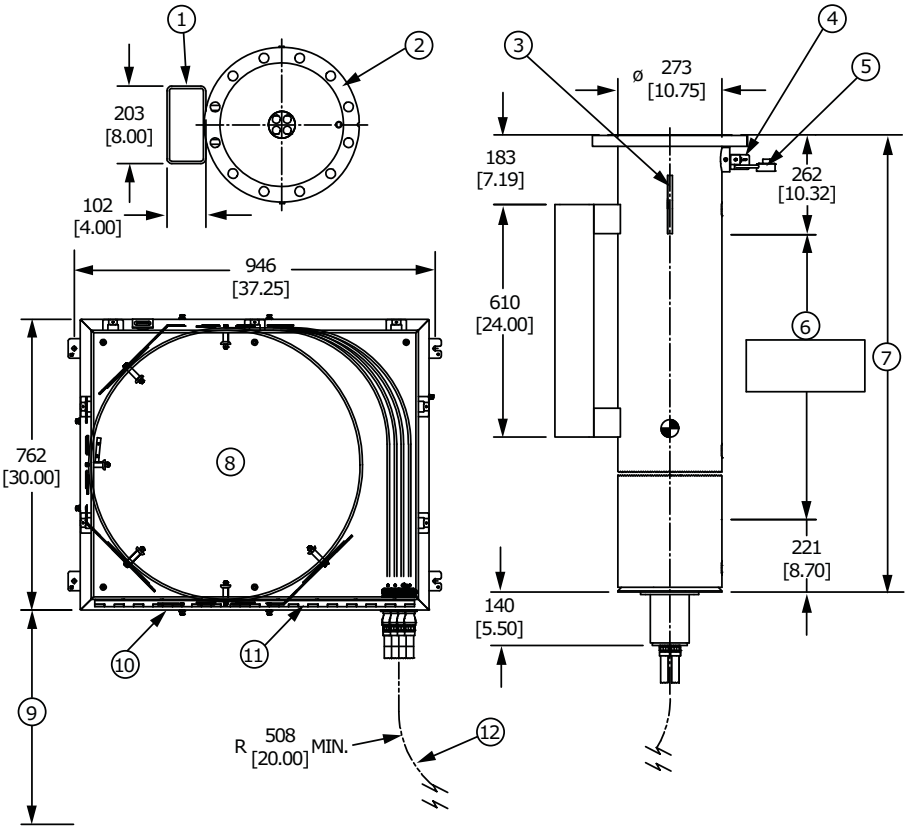


Figure 9.1 Dimensions

1. *Fork Lift Bracket*
2. *10" ANSI 150# Flange*
3. *2x ø32 [ø1.25] Lifting Eye*
4. *Locking Rod*
5. *Combination Lock*
6. *Active Length*
7. *Shielding Length - Depends on Active Length and Shielding (Consult Factory)*
8. *Enclosure Depth - 305 [12.00]*
9. *Service Clearance - 94 [36.00]*
10. *Actuator Cabinet Door (Not Shown for Clarity)*
11. *Actuator Door Hinge - 762 [30.00] Clearance Req'd for Actuator Door Swing*
12. *3/8" Liquid-Tight Flex Conduit (Not to Exceed 25 Ft)*

9.2 Accessories

Accessory	Description	Part Number
Leak Test Kit	Leak test kit for one source holder. Includes swab, shipping container, instructions, analysis and report	229555
Signage	"Caution Radioactive Materials" warning sign	238911
Survey Meter	General purpose digital survey meter	245644
Survey Meter	Model 2402 general purpose survey meter with scintillator probe and 1 m cable	240943

10 Customer Service

10.1 Find Help

In addition to the documentation provided with your equipment, you will find more information on the CD shipped with your source holder. If you are unable to find an answer to your specific question, VEGA has service personnel located throughout the world to assist you.

Some of the services available to you include:

- Emergency service telephone support available 24 hours a day
- Radiation survey meter calibration
- Wipe test and wipe test analysis
- Start up and commissioning
- Service, maintenance, and disposal of source material

10.2 U.S., Canada, and Worldwide

VEGA has Field Service Engineers available for on site service, emergency services or gauge start up.

Contact Information	**Telephone Number**
Monday through Friday 8:00 A.M. - 5:00 P.M. EST (Eastern Standard Time)	513-272-0131
Emergencies: Follow the voice mail instructions	513-272-0131
International (Worldwide)	513-272-0131
Fax	513-272-0133

10.3 Necessary Information

When you call with a question, please have the following necessary information available for the Field Service Engineer or representative:

- VEGA Customer Order (C.O.) Number - located on the engraved label on the source holder

NOTES

VEGA Americas, Inc.
4170 Rosslyn Drive
Cincinnati, Ohio 45209 USA
Phone: 1.513.272.0131
Fax: 1.513.272.0133
E-mail: americas@vega.com
www.vega-americas.com

All statements concerning scope of delivery, application, practical use, and operating conditions of the sensors and processing systems correspond to the information available at the time of printing.