OLYMPUS

FlexoFORM Scanner

User's Manual

10-003591-01EN [Q7780031] — Rev. 4
January 2020

This instruction manual contains essential information on how to use this Olympus product safely and effectively. Before using this product, thoroughly review this instruction manual. Use the product as instructed.

Keep this instruction manual in a safe, accessible location.

Olympus Scientific Solutions Americas, 48 Woerd Avenue, Waltham, MA 02453, USA

This document was prepared with particular attention to usage to ensure the accuracy of the information contained therein, and corresponds to the version of the product manufactured prior to the date appearing on the title page. There could, however, be some differences between the manual and the product if the product was modified thereafter.

The information contained in this document is subject to change without notice.

Part number: 10-003591-01EN [Q7780031]
Rev. 4
January 2020

Printed in Canada

Table of Contents

List of Abbreviations

CLK	clock
EFUP	Environment-Friendly Use Period
ID	identification
IP	International (ingress) Protection
OD	outside diameter
RH	relative humidity
RoHS	Restriction of Hazardous Substances
SDHC	secure digital high capacity
WEEE	Waste Electrical and Electronic Equipment

Labels and Symbols

Safety-related labels and symbols are attached to the instrument at the locations shown in Figure i-1 on page 1. If any of the labels or symbols are missing or illegible, please contact Olympus.

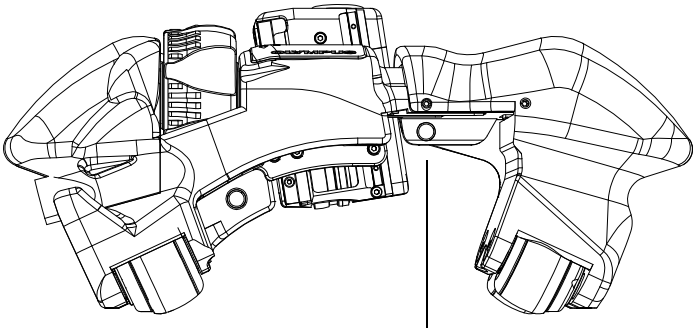
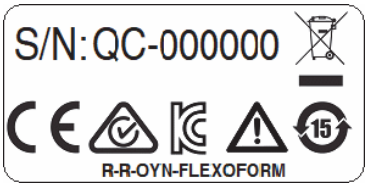
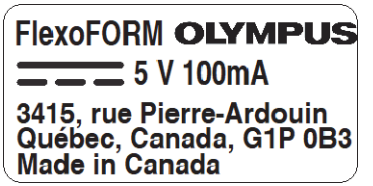


Figure i-1 Labels location for scanner

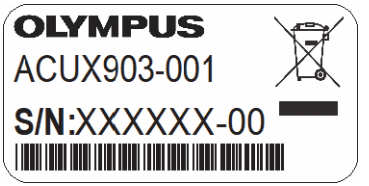
Table 1 Content of the rating and address labels

Scanner labels





Encoder label



Item	Description
CE	The CE marking is a declaration that this product conforms to all the applicable directives of the European Community. See the *Declaration of Conformity* for details. Contact your Olympus representative for more information.
	The regulatory compliance mark (RCM) label indicates that the product complies with all applicable standards, and has been registered with the Australian Communications and Media Authority (ACMA) for placement on the Australian market.
	Seller and user shall be noticed that this equipment is suitable for electromagnetic equipment for office work (class A) and it can be used outside the home. The MSIP code for the FlexoFORM scanner is the following: R-R-OYN-FLEXOFORM. The KC marking is a declaration that this product conforms to all the applicable standards of South Korea. Contact your Olympus representative for more information.

Table 1 Content of the rating and address labels *(continued)*

	The warning symbol indicates that the user must read the user's manual in order to find out the nature of the potential hazards and any actions to avoid them.
	The China RoHS mark indicates the product's Environment-Friendly Use Period (EFUP). The EFUP is defined as the number of years for which listed controlled substances will not leak or chemically deteriorate while in the product. The EFUP for the FlexoFORM scanner has been determined to be 15 years. **Note**: The Environment-Friendly Use Period (EFUP) is not meant to be interpreted as the period assuring functionality and product performance.
	The WEEE symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately.
S/N	The serial number.
	The direct current symbol.

Important Information — Please Read Before Use

Intended Use

The FlexoFORM scanner is designed to perform nondestructive inspections on industrial and commercial materials.

WARNING

Do not use the FlexoFORM scanner for any purpose other than its intended use. It must never be used to inspect or examine human or animal body parts.

Instruction Manual

This instruction manual contains essential information on how to use this Olympus product safely and effectively. Before using this product, thoroughly review this instruction manual. Use the product as instructed.

Keep this instruction manual in a safe, accessible location.

IMPORTANT

Some of the details of components and/or software images in this manual may differ from your instrument's components or software display. However, the principles remain the same.

Instrument Compatibility

The FlexoFORM scanner is compatible with the ancillary equipment listed in Table 2 on page 6. Also see "Spare Parts and Accessories" on page 65 for a list of compatible accessories.

CAUTION

Always use equipment and accessories that meet Olympus specifications. Using incompatible equipment could cause equipment malfunction and/or damage or human injury.

Table 2 Ancillary equipment

Part number	Description
Several available models (contact Olympus for details)	OmniScan series flaw detectors
CFU03 [U8780008]	Electric water pump and tubing, 120 V and 220 V
WTR-SPRAYER-8L [U8775001]	Eight liter manual water pump
OMNI-A-ADP27 [U8780329]	LEMO female to DE15 male adaptor for encoder connector on OmniScan MX flaw detector

Repair and Modification

The FlexoFORM scanner contains user-serviceable parts. See "Maintenance and Troubleshooting" on page 45 for information about authorized repairs and maintenance.

CAUTION

To prevent human injury and/or equipment damage, do not modify the FlexoFORM scanner.

Presence of Visual Interferences

IMPORTANT

Presence of strong electromagnetic interference could generate noise in the signal that is visually detectable. This interference is temporary and random in comparison with the signals generated by the physical features of the inspected part, which are coherent and persistent. This interference depends greatly on the nature, strength, and proximity of the electromagnetic source and it will only disappear when the source of the noise is no longer emitting signals.

Safety Symbols

The following safety symbols might appear on the instrument and in the instruction manual:

General warning symbol

This symbol is used to alert the user to potential hazards. All safety messages that follow this symbol shall be obeyed to avoid possible harm or material damage.

Finger crushing warning symbol

This symbol is used to alert the user to potential hazards to fingers from crushing by magnetic wheels. All safety messages that follow this symbol shall be obeyed to avoid possible harm.

 Magnetic field warning symbol

This symbol is used to alert the user to potentially strong magnetic fields. All safety messages that follow this symbol shall be obeyed to avoid possible harm.

Safety Signal Words

The following safety signal words might appear in the documentation of the instrument:

 **DANGER**

The DANGER signal word indicates an imminently hazardous situation. It calls attention to a procedure, practice, or the like that if not correctly performed or adhered to will result in death or serious personal injury. Do not proceed beyond a DANGER signal word until the indicated conditions are fully understood and met.

 **WARNING**

The WARNING signal word indicates a potentially hazardous situation. It calls attention to a procedure, practice, or the like that if not correctly performed or adhered to could result in death or serious personal injury. Do not proceed beyond a WARNING signal word until the indicated conditions are fully understood and met.

 **CAUTION**

The CAUTION signal word indicates a potentially hazardous situation. It calls attention to a procedure, practice, or the like that if not correctly performed or adhered to may result in minor or moderate personal injury, material damage, particularly to the product, destruction of part or all of the product, or loss of data. Do not proceed beyond a CAUTION signal word until the indicated conditions are fully understood and met.

Note Signal Words

The following note signal words could appear in the documentation of the instrument:

IMPORTANT

The IMPORTANT signal word calls attention to a note that provides information that is important or essential to the completion of a task.

NOTE

The NOTE signal word calls attention to an operating procedure, practice, or the like, that requires special attention. A note also denotes related parenthetical information that is useful, but not imperative.

TIP

The TIP signal word calls attention to a type of note that helps you apply the techniques and procedures described in the manual to your specific needs, or that provides hints on how to effectively use the capabilities of the product.

Safety

Before turning on the instrument, verify that the correct safety precautions have been taken (see the following warnings). In addition, note the external markings on the instrument, which are described under “Safety Symbols.”

Warnings

WARNING

General Warnings

- Carefully read the instructions contained in this instruction manual prior to turning on the instrument.

- Keep this instruction manual in a safe place for further reference.
- Follow the installation and operation procedures.
- It is imperative to respect the safety warnings on the instrument and in this instruction manual.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment could be impaired.
- Do not install substitute parts or perform any unauthorized modification to the instrument.
- Service instructions, when applicable, are for trained service personnel. To avoid the risk of electric shock, do not perform any work on the instrument unless qualified to do so. For any problem or question regarding this instrument, contact Olympus or an authorized Olympus representative.
- Do not touch the connectors directly by hand. Otherwise, a malfunction or electric shock may result.
- Do not allow metallic or foreign objects to enter the device through connectors or any other openings. Otherwise, a malfunction or electric shock may result.
- Make sure no FlexoFORM scanner components (screws, straps, etc.) have come loose or are lost in critical equipment being inspected. Thoroughly check your inspection area before and after an inspection to prevent foreign-object debris (FOD) that could potentially cause equipment damage, injury, or loss of life.

Equipment Disposal

Before disposing of the FlexoFORM scanner, check your local laws, rules, and regulations, and follow them accordingly.

CE (European Community)

CE

This device complies with the requirements of directive 2014/30/EU concerning electromagnetic compatibility, directive 2014/35/EU concerning low voltage, and directive 2011/65/EU concerning restriction of hazardous substances (RoHS). The CE marking indicates compliance with the above directives.

WEEE Directive

In accordance with European Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), this symbol indicates that the product must not be disposed of as unsorted municipal waste, but should be collected separately. Refer to your local Olympus distributor for return and/or collection systems available in your country.

China RoHS

China RoHS is the term used by industry generally to describe legislation implemented by the Ministry of Information Industry (MII) in the People's Republic of China for the control of pollution by electronic information products (EIP).

The China RoHS mark indicates the product's Environment-Friendly Use Period (EFUP). The EFUP is defined as the number of years for which listed controlled substances will not leak or chemically deteriorate while in the product. The EFUP for the FlexoFORM scanner has been determined to be 15 years.

Note: The Environment-Friendly Use Period (EFUP) is not meant to be interpreted as the period assuring functionality and product performance.

"中国 RoHS" 是一个工业术语，一般用于描述中华人民共和国信息工业部 （MII）针对控制电子信息产品 （EIP）的污染所实行的法令。

电气电子产品
有害物质
限制使用标识

中国 RoHS 标识是根据 " 电器电子产品有害物质限制使用管理办法 " 以及 " 电子电气产品有害物质限制使用标识要求 " 的规定，适用于在中国销售的电气电子产品上的电气电子产品有害物质限制使用标识。

注意：电气电子产品有害物质限制使用标识内的数字为在正常的使用条件下有害物质不会泄漏的年限，不是保证产品功能性的年限。

产品中有害物质的名称及含量

部件名称		有害物质					
		铅及其化合物 (Pb)	汞及其化合物 (Hg)	镉及其化合物 (Cd)	六价铬及其化合物 (Cr(Ⅵ))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
主体	机构部件	×	○	○	○	○	○
	光学部件	×	○	○	○	○	○
	电气部件	×	○	○	○	○	○
附件		×	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。

○：表示该有害物质在该部件所有均质材料中的含量均在 GB/T26572 规定的限量要求以下。

×：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T26572 规定的限量要求。

Korea Communications Commission (KCC)

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다 .

KC (South Korea Community)

This device complies with the requirements of KN 61000-6-2 and KN 61000-6-4 concerning electromagnetic compatibility. The KC marking indicates compliance with the above standards.

FCC (USA) Compliance

NOTE

This product has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the product is operated in a commercial environment. This product generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, might cause harmful interference to radio communications. Operation of this product in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

WARNING

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the product.

FCC Supplier's Declaration of Conformity

Hereby declares that the product,

Product name: FlexoFORM
Model: FlexoFORM-X-XXX, FlexoFORM-XXX, FlexoFORM-XX-XXXXX

Conforms to the following specifications:

FCC Part 15, Subpart B, Section 15.107 and Section 15.109.

Supplementary information:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation.

Responsible party name:

Olympus Scientific Solutions Americas Corp.

Address:

48 Woerd Avenue, Waltham, MA 02453, USA

Phone number:

+1 781-419-3900

ICES-001 (Canada) Compliance

This Class A digital apparatus complies with Canadian ICES-001.

Cet appareil numérique de la classe A est conforme à la norme NMB-001 du Canada.

Packing and Return Shipping

If the FlexoFORM scanner is not returned in its transport case, it could be damaged during shipping. Olympus reserves the right to void the warranty on instruments damaged while in transit if they are shipped without their transport case. Prior to returning any units, contact Customer Service to obtain the required RMA number(s) and any important shipping information.

Follow the steps below to return your FlexoFORM scanner:

1. Pack the FlexoFORM scanner back into the transport case that it came in using the original packing materials.
2. Include the RMA in the case, and reference the RMA number in your shipping documents.
3. Close the transport case and either:
   - Secure the transport case with plastic zip ties, or;
   - Pack the transport case within another box.

Warranty Information

Olympus guarantees your Olympus product to be free from defects in materials and workmanship for a specific period, and in accordance with conditions specified in the *Olympus Scientific Solutions Americas Inc. Terms and Conditions* available at http://www.olympus-ims.com/en/terms/.

The Olympus warranty only covers equipment that has been used in a proper manner, as described in this instruction manual, and that has not been subjected to excessive abuse, attempted unauthorized repair, or modification.

Inspect materials thoroughly on receipt for evidence of external or internal damage that might have occurred during shipment. Immediately notify the carrier making the delivery of any damage, because the carrier is normally liable for damage during shipment. Retain packing materials, waybills, and other shipping documentation needed in order to file a damage claim. After notifying the carrier, contact Olympus for assistance with the damage claim and equipment replacement, if necessary.

This instruction manual explains the proper operation of your Olympus product. The information contained herein is intended solely as a teaching aid, and shall not be used in any particular application without independent testing and/or verification by the operator or the supervisor. Such independent verification of procedures becomes increasingly important as the criticality of the application increases. For this reason, Olympus makes no warranty, expressed or implied, that the techniques, examples, or procedures described herein are consistent with industry standards, nor that they meet the requirements of any particular application.

Olympus reserves the right to modify any product without incurring the responsibility for modifying previously manufactured products.

Technical Support

Olympus is firmly committed to providing the highest level of customer service and product support. If you experience any difficulties when using our product, or if it fails to operate as described in the documentation, first consult the user's manual, and then, if you are still in need of assistance, contact our After-Sales Service. To locate the nearest service center, visit the Service Centers page at: http://www.olympus-ims.com.

Introduction

The FlexoFORM scanner is designed to inspect pipes and pipe elbows. A flexible, phased array ultrasonic probe is held and shaped by a water wedge that is contoured to fit the radius of curvature of the surface being inspected. The scanner adjusts to hold wedges of various sizes for a range of radius of curvatures.

Figure i-2 FlexoFORM scanner

NOTE

The FlexoFORM scanner is designed to be used with an OmniScan series instrument. For details on instrument and software operation, refer to the *OmniScan MX and MX2 User's Manual* or *OmniScan SX User's Manual*, as well as the *OmniScan MXU Software User's Manual*.

1. Overview

The FlexoFORM scanner kits can be composed of different components.

1.1 FlexoFORM Case Contents

The FlexoFORM scanner case contents are shown in Figure 1-1 on page 19. Main components are detailed in Figure 1-2 on page 20.

Figure 1-1 Case contents

WARNING

The FlexoFORM scanner has magnetic wheels that must be carefully handled to prevent the risk of injury and equipment damage from magnetic fields and inadvertent attractive forces. Before unpacking and handling, observe the magnetic wheel safety precautions, as outlined in the warning note on page 27.

The case is configured to hold the following parts (for details, see "Spare Parts and Accessories" on page 65):

- FlexoFORM scanner unit with cable assembly
- Set of water wedges for a range of inspection surface radii (optional)
- Flexible PA probe (FA1)
- Line marking template tool
- Flexible magnetic straightedge
- Spare parts kit including screws and o-ring seals for probe and water connections
- Wedge foam gaskets (spares)
- Printed copy of *FlexoFORM Scanner User's Manual*

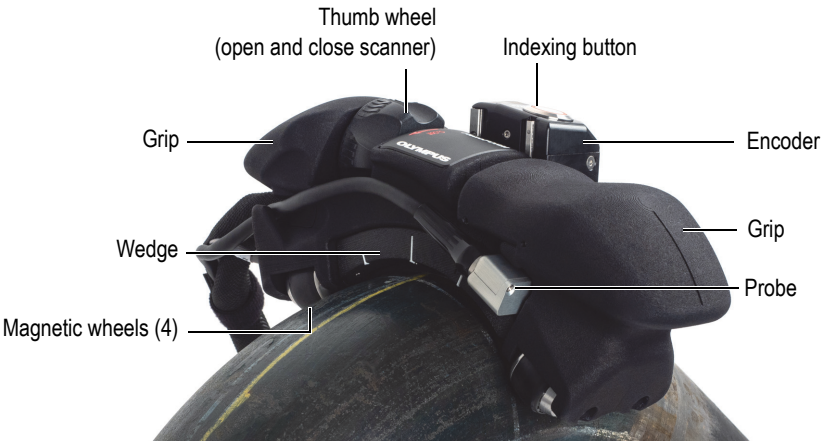


Figure 1-2 Scanner components

1.2 Alternative Components

The FlexoFORM scanner requires dedicated SFA1-FLEXO series wedges and a FA1-type flexible probe. However, the FA1-type probe can also be used with two other wedge series designed to scan without a FlexoFORM scanner:

- **Small-diameter wedge series (SFA1-SMALL)**: used to manually scan the extrados of elbows or pipes with outer diameters from 33 mm (1.3 in.) up to 102 mm (4 in.).
- **Automated 2D rastering wedge series (SFA1-AUTO)**: this wedge series can be used with the SteerROVER or MapROVER motorized scanner to perform automated corrosion inspection of pipes with outer diameters of 218 mm (8.625 in.) and greater in the longitudinal direction.

Both SFA1-SMALL and SFA1-AUTO wedges can be fitted with a Mini-Wheel encoder from Olympus, using the standard hardware kit provided with the encoder. This setup can be used to perform encoded, one-line scans (see Figure 1-3 on page 21).

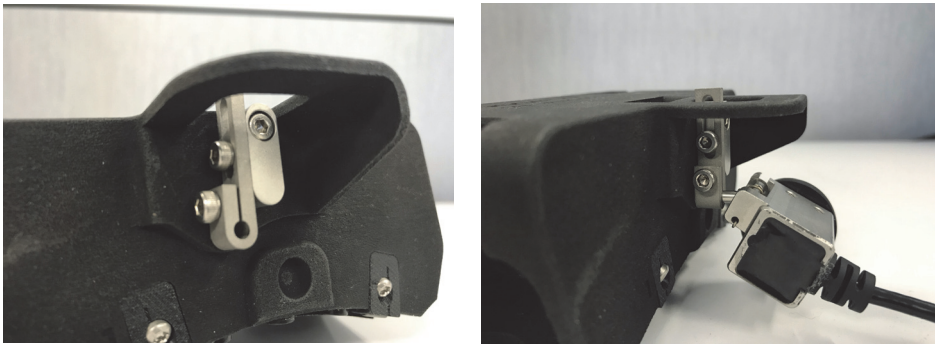


Figure 1-3 Mini-Wheel encoder standard hardware kit

2. Setup of Equipment

The FlexoFORM scanner and the instrument must be properly connected and set up to enable inspection.

2.1 Setting Up an Instrument Using a USB Key

You can load a predefined inspection-parameter setup from the supplied USB key into your OmniScan instrument. Or, if the predefined setups are not suitable for your requirements, you can create a new setup.

To set up an instrument using a USB key

- Load the setup from the USB key:
  a) Use a computer to transfer the setup from the supplied USB key to the OmniScan instrument's SDHC memory card.
  b) Insert the SDHC card into the OmniScan and then turn it on.
  c) Select the setup.

2.2 Setting Up an Instrument Using the Interface

Most common setups can be easily created by following the instructions in the *User's Manual* for your OmniScan instrument. The instructions below are specific to the FlexoFORM scanner, and should not be considered complete.

2.2.1 Setup Characteristics

To create an instrument setup, make the following selections on your OmniScan instrument:

- FA1-type probe model
- Depending on the application, one of the following three types of wedges:
  - FlexoFORM scanner applications: SFA1-FLEXO
  - Automated inspections: SFA1-AUTO
  - Small diameter inspections: SFA1-SMALL
- Select **Plate** in the **Specimen Type** parameter field (see Figure 2-1 on page 24).

  Although the probe has a concave shape, it is important to select **Plate**, even if you are inspecting a curved surface.

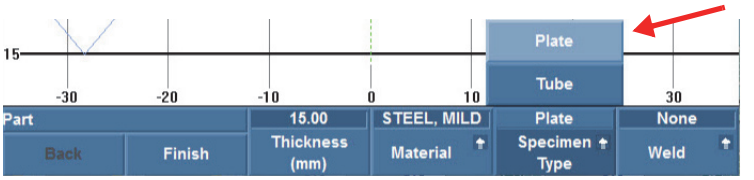


Figure 2-1 Selecting Plate in the Specimen Type field

2.2.2 Setting the Parameters for a Symmetrical Scan

For pipe elbow inspections, Olympus recommends the symmetrical scan pattern for a full 360° inspection around the circumference (see Figure 2-2 on page 25). The OmniScan instrument must be correctly set up to enable this type of inspection. For details about alternative inspection patterns for straight pipe surfaces, see “Setting Up to Inspect a Straight Pipe — Unidirectional or Bidirectional Scan” on page 75.

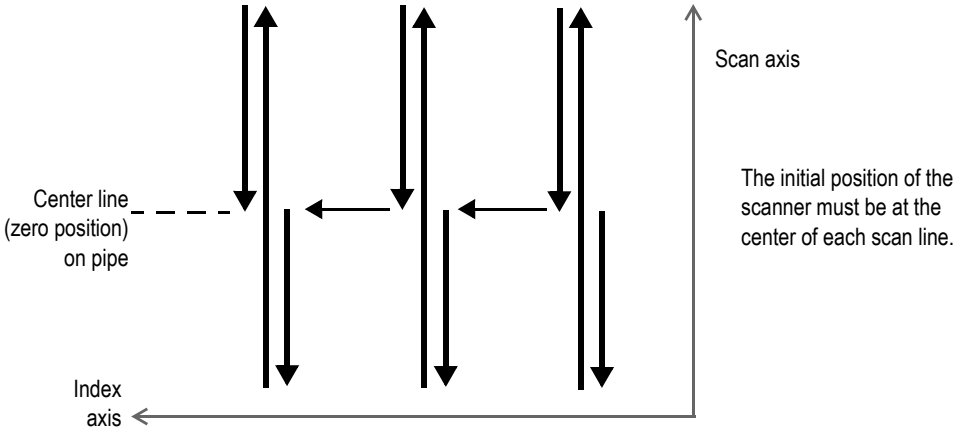


Figure 2-2 Symmetrical scan pattern for a pipe elbow inspection of 360°

In a symmetrical scan pattern, the indexing button is pressed once after completing a scan, which stops the acquisition and activates the button's red LED. Because of its "smart indexing" function, the FlexoFORM scanner can then freely move along the index axis to the next scan line without overwriting any acquisition data. When the scanner is in position at the center of the next scan line (the zero position, or origin), the indexing button is pressed once again, and the red LED turns off.

When the indexing button is released at the center of the next scan line, the position of encoder 1 is reset to the **Origin** parameter value (equivalent to **Scan > Encoder > Origin**). At the same time, the index value will be incremented by a predefined distance set in the (encoder 2) **Resolution** parameter (see "Setting Up the Scan and Index Parameters for an Elbow" on page 31).

To set the parameters for a symmetrical scan

1. Set the appropriate scan type in the OmniScan MXU software by selecting **Scan > Inspection > Type = Raster Scan**.
2. In the OmniScan MXU software, set the scanner's encoder number (1), type (Quad), and resolution (12 steps/mm):
   a) Select **Scan > Encoder > Encoder = 1**.
   b) Select **Scan > Encoder > Type = Quad**.
   c) Select **Scan > Encoder > Resolution = 12**.

3. Set the indexing button's encoder number (2), type (Clicker + Preset), and origin (0):
   a) Select **Scan > Encoder > Encoder = 2**.
   b) Select **Scan > Encoder > Type = Clicker + Preset**.
   c) Select **Scan > Origin = 0**.

   The resolution value will be set as detailed in "Setting Up the Scan and Index Parameters for an Elbow" on page 31.
4. Assign the digital input for the indexing button:
   a) Select **Preferences > Category = DIN**.
   b) Select **Preferences > Select DIN = DIN 3** and set the state:
      - Select **DIN3 > Assign DIN = Acquisition State**.
      - Select **DIN3 > State = On**.

2.3 Installing the Probe and Wedge

CAUTION

Because of its design, the flexible phased array probe can be easily damaged if handled incorrectly. It is not recommended to bring the probe into direct contact with a part. The probe should only be shaped using an Olympus SFA1 type wedge. Bending the probe too much could permanently damage it.

The flexible phased array probe slides into one of several available water wedge sizes (see Figure 2-3 on page 27).

Figure 2-3 Installing the probe and wedge

To install the probe and wedge

1. Choose the wedge size for the elbow size you are inspecting.
2. Slowly slide the probe fully into the wedge until it locks into place.

   As noted above, avoid overbending the probe, which could permanently damage it.

WARNING

Before handling the FlexoFORM scanner, observe the following general safety precautions related to its magnetic wheels (see "Changing a Magnetic Wheel" on page 46 for complete details on wheel safety):

- The magnetic fields around the wheels may affect pacemakers, watches, and other sensitive electronic devices, and anyone relying on such devices must keep a safe distance away from the wheels to avoid the risk of serious injury or death.
- Magnetic wheels present a risk of finger crushing if fingers are placed between the wheels and a ferromagnetic surface.
- The wheels may suddenly attract ferromagnetic objects or particles in their vicinity, which can cause injury, equipment damage, or malfunction.

---

3. Turn the thumb wheel to open the FlexoFORM scanner, and install the assembled wedge and probe.

4. Turn the thumb wheel the opposite way to close the scanner, and tighten it sufficiently to fasten the wedge in place.

2.4 Connecting the Scanner

The probe and scanner encoder cables are connected to the OmniScan instrument, and—together with the water supply tube—are held in a cable sleeve attached to the scanner.

To connect the scanner

1. Connect the LEMO encoder cable to the OmniScan instrument (see Figure 2-4 on page 28).
2. Connect the probe cable to the OmniScan instrument.
3. Connect the water supply to an Olympus couplant feed unit.

   For more details on the recommended CFU03 pump connection, refer to the *CFU03/CFU05/CFU-PWZ Couplant Feed Unit User's Manual*.

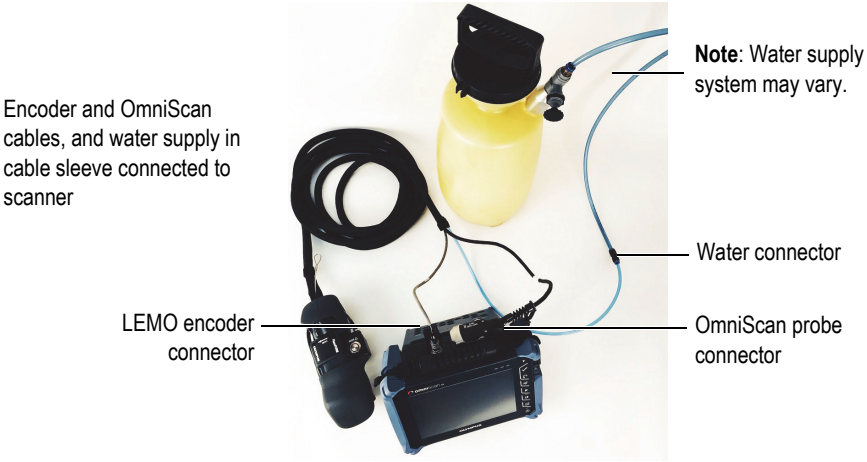


Figure 2-4 Scanner connections example

3. Preparation for Inspection

In addition to the setup detailed in "Setup of Equipment" on page 23, before you begin inspecting you must also clean the inspection surface and set up the instrument parameters. It is recommended that you also mark the scan lines.

3.1 Drop Precautions

Be sure to observe the following precautions when handling the FlexoFORM scanner.

WARNING

To prevent injury and equipment damage when operating the FlexoFORM scanner at heights 2 meters or higher above ground or floor level, secure it with a lanyard that is held taut (see attachment point in Figure 3-1 on page 30). Wear appropriate safety shoes that protect your feet in case you accidentally drop the unit during handling. Also ensure the inspection surface is free of rust, debris, or obstructions, and is continuously ferromagnetic so that magnetic wheels remain attached to the surface.

Figure 3-1 Attachment point for lanyard

IMPORTANT

Olympus recommends that you keep the wedge securely mounted in the frame while handling the scanner. This provides increased resistance to accidental impact.

3.2 Cleaning the Inspection Surface

The inspection surface must be free of scaling and other obstructions. A smooth surface helps maintain the water column and extends the life of the wedge's foam gasket that rubs against the surface during inspection.

CAUTION

To avoid the risk of injury, wear appropriate work gloves and safety glasses when cleaning the inspection surface using scrapers, metal brushes, or other cleaning tools.

To clean the inspection surface

1. Carefully use an appropriate metal scraper, chisel, or file to remove scaling, protruding metal, or weld residue on the surface, without affecting the structural integrity and curvature of the surface.
2. Use a metal brush to remove any remaining loose material on the surface.

3.3 Setting Up the Scan and Index Parameters for an Elbow

Before an inspection, on the OmniScan instrument, you must set the required scan and index parameters for your elbow size. These are determined by your probe's effective beam width, elbow dimensions, and desired scan overlap.

To set up the scan and index parameters for an elbow

1. Measure and record your elbow's *extrados* (maximum, outer elbow curve length on surface; see Figure 3-2 on page 31).

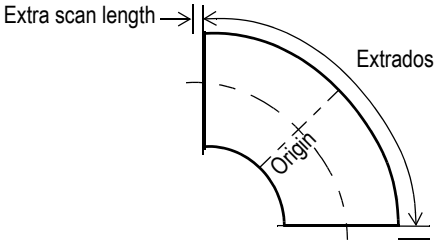


Figure 3-2 Extrados — maximum outer elbow curve length

2. Set the scan parameters:
   a) Divide the extrados value by two and add your preferred "safety factor," or extra scan length value (for example: 500 mm/2 + 10 mm = 260 mm).
   b) In the OmniScan MXU software, select **Scan > Area > Scan Start = [EXAMPLE –260.00]**, and **Scan End = [EXAMPLE 260.00]** (see Figure 3-3 on page 32).
   c) Set the **Index End** value equal to or greater than the pipe circumference value.

Figure 3-3 Example Scan Start and Scan End setting in the OmniScan

3. Set the index parameter (encoder 2 **Resolution** value):

   a) See Table 3 on page 42 to determine the effective beam width on the surface, and then subtract from it your desired scan overlap value.

   Because of the FlexoFORM scanner's flexible, curved probe—with a radius of curvature that is concentric to the surface radius of curvature—the effective beam width on the surface is smaller than the **Index Res** value calculated by the OmniScan. The OmniScan **Index Res** value (at right in Figure 3-3 on page 32) should therefore not be used, but instead you must obtain a value using Table 3 on page 42. For more details and alternative calculation, see "Correction Factors" on page 41.

   For example, for a 559 mm (22 in.) OD pipe and a focal law of 4 elements, Table 3 on page 42 provides an effective beam width value of 58.1 mm on the surface. If the desired overlap is 2 mm, then the **Index Res** value can be calculated as follows:

   58.1 mm − 2 mm = 56.00 mm, the nearest integer millimeter value

   This is the value you will enter in the encoder 2 **Resolution** parameter, which represents the distance between your scan lines.

   b) Select **Scan > Encoder > Encoder 2 > Resolution = [EXAMPLE 56.00]** (see Figure 3-4 on page 32).

Figure 3-4 Example index Resolution setting in the OmniScan

IMPORTANT

It is recommended to scan using an overlap between scan lines, with the **Index Res** value set according to the method above. For this, the **Linear at 0°** mode must be selected (**Focal Law > Configuration > Law Config. = Linear at 0°**).

If an overlap is not required, or if you want to use beam angles that differ from 0°, you need to use Linear mode (**Focal Law > Configuration > Law Config. = Linear**), and you must set the encoder 2 **Resolution** linked to the indexing button [also named Clicker] (**Scan > Encoder > Resolution**) to equal the **Index Res** value. As an example of an index value setting, Figure 3-3 on page 32 shows an **Index Res** value that would be transferred to the **Resolution** field shown in Figure 3-4 on page 32. However, if you use this scanning method, the surface actually covered by the ultrasonic beam is smaller than the **Index Res** value. This means that some portions of the surface may not have been covered by the scan. Therefore, **Linear at 0°** mode is recommended.

3.4 Marking the Scan Lines

Before an inspection, it is recommended that you lay out and mark scan lines to follow when moving the FlexoFORM scanner over a surface. The steps for determining the line length and spacing for an elbow are detailed in "Setting Up the Scan and Index Parameters for an Elbow" on page 31. However, it is also possible to inspect without scan lines, as detailed in "Inspecting a Part without Marked Scan Lines" on page 40.

To mark the scan lines

1. Define the required index value (encoder 2 **Resolution**).

   See the example (56 mm/step resolution) procedure in "Setting Up the Scan and Index Parameters for an Elbow" on page 31.
2. Determine your zero position (the middle, or center, of the scan line), and then draw your zero line perpendicular to the part's longitudinal axis, using the flexible straightedge wrapped around the circumference as a guide (see left illustration in Figure 3-5 on page 34).
3. Position the flexible magnetic straightedge so that one edge rests flat on the longest (extrados) section of the elbow or part, and draw your first scan line

parallel to the part's longitudinal axis (see right illustration in Figure 3-5 on page 34).

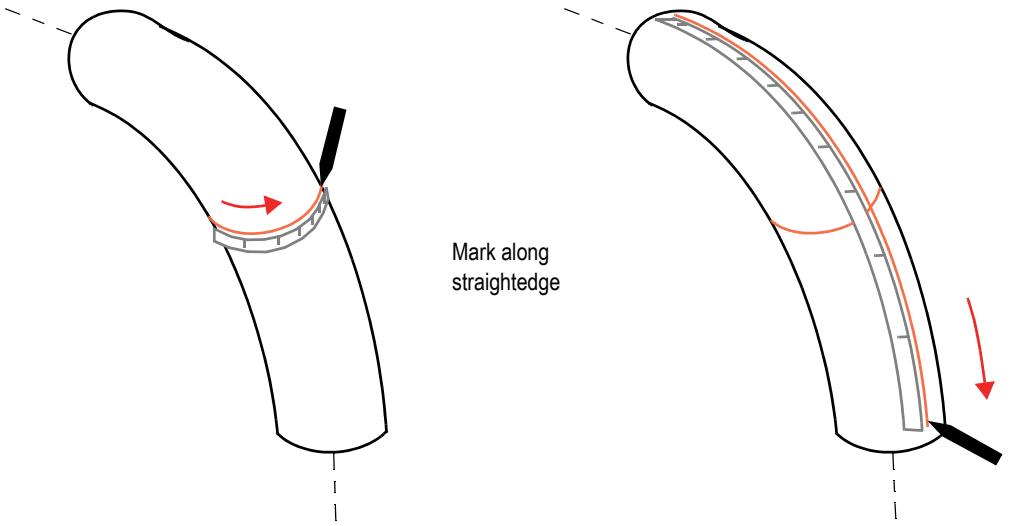


Figure 3-5 Marking the zero position (*left*) and scan (*right*) lines on an elbow

NOTE

A template marking tool is provided with the FlexoFORM scanner package to help you draw scan lines. The supplied tool has markings that help you draw a line a distance of 48 mm to 58 mm from the previous line.

4. Insert a paint marker (pen) into the hole in the template marking tool, then use the tool's markings as a guide to follow the first scan line and draw your next scan line at the required index distance (see Figure 3-6 on page 35). Draw the remainder of the scan lines this way around the circumference of the part.

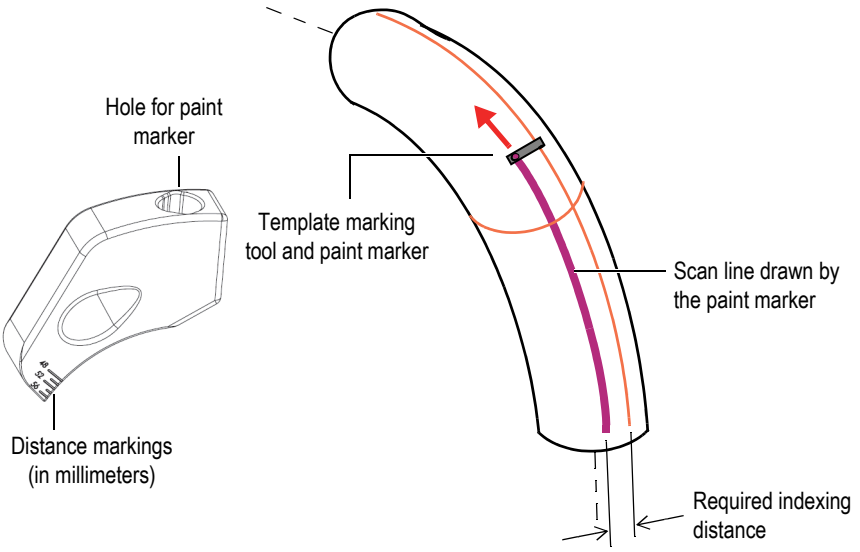


Figure 3-6 Drawing the scan lines on an elbow

4. Inspection

IMPORTANT

Before starting an inspection, make sure that the scanner and instrument setup and connections have been completed and your inspection surface has been prepared (see "Setup of Equipment" on page 23 and "Preparation for Inspection" on page 29).

4.1 Wetting the Surface and Purging Air Bubbles

Before an inspection, you must turn on the supply of water, wet the surface, and clear air from the water column between the inspection surface and the probe.

To wet the surface and purge air bubbles

1. Wet the surface, for example, by using a cloth soaked with water.
2. Open the water supply, and then position the FlexoFORM scanner on the inspection surface.
3. Move the scanner back and forth (and sideways, if necessary) over the inspection surface to help clear air bubbles.
4. Observe the instrument display for bubble indications.
5. If necessary, lift the scanner, wipe any bubbles from the probe using a finger, and repeat these motions until all bubbles are cleared (see Figure 4-1 on page 38).

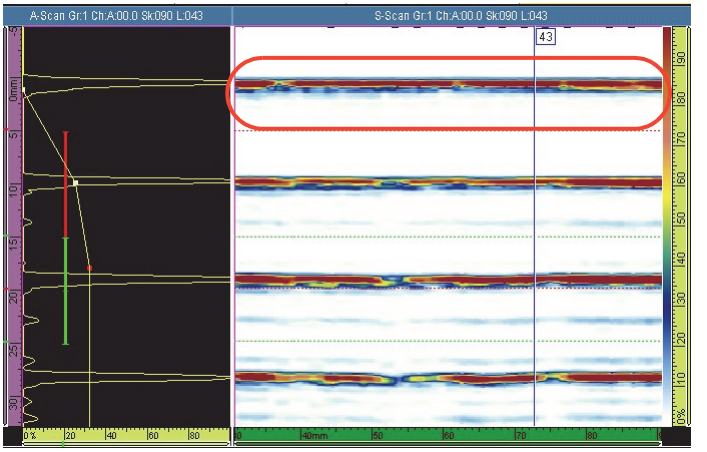


Figure 4-1 An example S-scan display free of bubbles

4.2 Inspecting a Part

Water must be turned on and air bubbles cleared before inspection can be started. You can inspect a part either with or without marked scan lines.

4.2.1 Inspecting a Part Using Marked Scan Lines

Use the following procedure if you have marked scan lines on your part surface.

To inspect a part using marked scan lines

1. Position the FlexoFORM scanner so that it is aligned with the (first) marked scan line and the start (zero) position (see Figure 4-2 on page 39).
   - Use the wedge's alignment mark and the encoder wheel to align on the scan line.
   - Use the alignment marks on the sides, between the wheels, to align on the zero position.

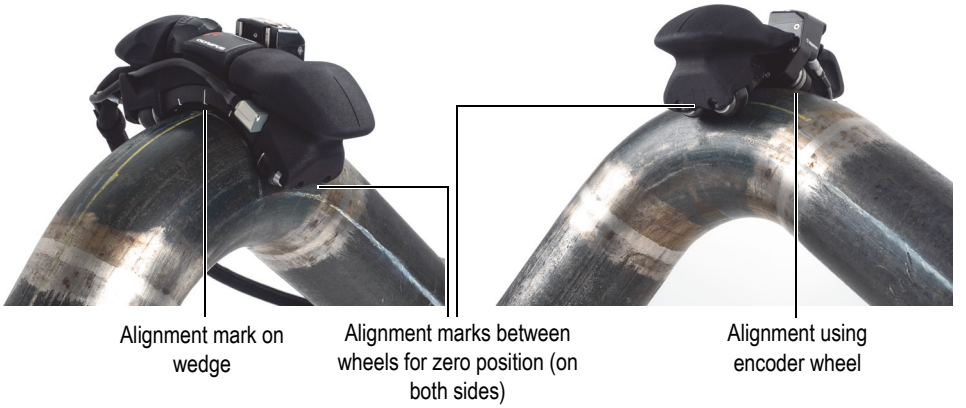


Figure 4-2 Alignment marks

2. On the OmniScan, press the Play key ( ) to set the encoder position to zero.
3. Move the FlexoFORM scanner along the scan line, and observe the instrument display to make sure that all data has been captured.

   The recommended 360° scan pattern for a pipe (or pipe elbow) is shown in Figure 4-3 on page 40.
4. After completing the first scan line, press the indexing button.
5. Slide the scanner over and align it on the next scan line and on the zero position line, as detailed in step 1.
6. Press the indexing button again (releasing it from indexing) to restart the acquisition, increment (increase) the index position, and reset the scan position.

IMPORTANT

To avoid the risk of overwriting a small portion of your acquisition data, wait at least one second after having pressed (and released) the button before starting to move the scanner along the next scan line.

7. Repeat steps 3 to 6 for the remaining scan lines to complete the inspection.

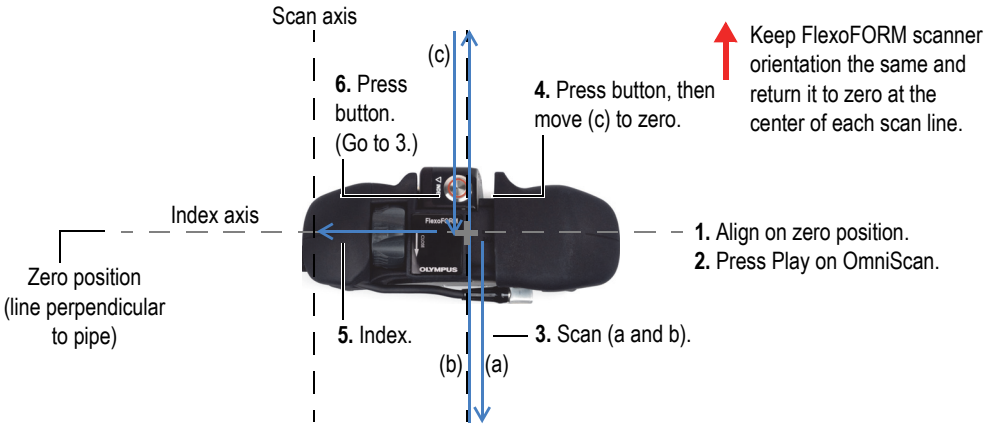


Figure 4-3 Scan pattern for a pipe elbow

4.2.2 Inspecting a Part without Marked Scan Lines

As an alternative to marking scan lines along the full length of your scan, you can make small starting marks on the pipe on which to align before a scan motion. However, your scan overlap value must be large enough to compensate for the scanner tracking error (its deviation from a straight path). For scanning procedure details, see “To inspect a part using marked scan lines” on page 38, which is similar except for the starting marks.

To inspect a part without marked scan lines

1. Align the FlexoFORM scanner on the zero position (line around the pipe circumference) using the alignment marks on the sides, between the wheels.
2. Use a pen to make a mark on the pipe at probe element 1 (see Figure 4-4 on page 41) and another mark at element 64. (Offset the marks towards the center of the scanner by an amount that corresponds to the overlap value.)

Figure 4-4 Probe element marks on the wedge

3. On the OmniScan, press the Play key ( ) to set the encoder position to zero.
4. Make your scan motion, and observe the instrument display to make sure that all data has been captured.
5. After completing the first scan, press the indexing button.
6. Slide the scanner over, align it on the next scan zero position, and align the element 1 mark on the wedge with the element 64 mark on the pipe.
7. Make your next mark at element 64, and then press the indexing button again and wait at least one second after having pressed the button before moving (to avoid the risk of overwriting your data).
8. Repeat the above steps 4–7 until you complete all necessary inspection scans.

4.3 Correction Factors

The probe's concave shape, its distance away from the inspection surface, and the number of elements in its beam affect the effective probe beam width and observed defect size in the following ways:

- The effective width covered by the probe beam on the inspection surface is smaller than the width of the probe's active aperture.
- The length of a defect (along the index axis) appears to be longer than it is in reality.
- As the inspection surface radius (pipe diameter) decreases, the above effects increase in magnitude.

To compensate for these effects, correction factors need to be applied.

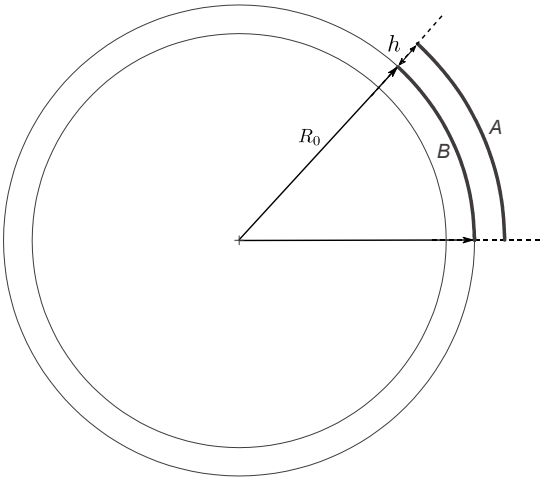
Effective probe beam width

Table 3 on page 42 provides corrected values for probe beam width for a range of pipe sizes and number of elements in focal laws.

It is also possible to calculate the corrected value using equation (1) on page 43. The equation's variables are illustrated in Figure 4-5 on page 43.

Table 3 Effective beam width on surface (mm)

Pipe OD (in.)	Law aperture					
	3 elem.	4 elem.	5 elem.	6 elem.	7 elem.	8 elem.
1.315	39.5	38.8	38.2	37.5	36.9	36.2
1.66	42.6	41.9	41.2	40.5	39.8	39.1
1.9	44.3	43.6	42.8	42.1	41.4	40.7
2.375	46.9	46.1	45.3	44.6	43.8	43
2.875	48.8	48	47.2	46.4	45.6	44.8
3.5	50.6	49.8	49	48.1	47.3	46.5
4	51.7	50.9	50	49.2	48.3	47.5
4.5	52.6	51.8	50.9	50	49.2	48.3
6.625	55	54.1	53.2	52.3	51.4	50.5
8.625	56.3	55.4	54.5	53.6	52.6	51.7
10.75	57.2	56.3	55.3	54.4	53.4	52.5
12.75	57.8	56.8	55.9	54.9	54	53
16	58.4	57.4	56.5	55.5	54.6	53.6
22	59.1	58.1	57.1	56.2	55.2	54.2
26	59.4	58.4	57.4	56.4	55.5	54.5
30	59.6	58.6	57.6	56.6	55.7	54.7
34	59.7	58.8	57.8	56.8	55.8	54.8
38	59.9	58.9	57.9	56.9	55.9	55
42	60	59	58	57	56	55.1
48	60.1	59.1	28.1	57.1	56.2	55.2
Flat	61	60	59	58	57	56



A = Active aperture length
B = Beam coverage width on the surface
h = Water column height (9 mm for SFA1-FLEXO and SFA1-AUTO wedge series, and 11 mm for SFA1-SMALL wedge series)
R_o = Outside radius

Figure 4-5 Variables for calculating probe beam width on the surface

$$B = \frac{R_o A}{(R_o + h)} \quad (1)$$

Defect length correction (only along index axis)

Table 4 on page 44 provides correction factors (multiplication factors) that must be applied to the measured defect length from inspection data along the index axis. The table provides multiplication factors for a range of defect depths in typical inspection applications.

For example, if a defect is measured to be 10 mm long along the index axis, 6 mm below the surface on a 114 mm (4.5 in.) pipe, the multiplication factor is 0.77 and the true defect length = 10 mm × 0.77 = 7.7 mm.

For inspection applications that fall outside the range of the table, the true defect length can be calculated as shown in “Calculating True Defect Length” on page 77.

Table 4 Multiplication factors for defect length correction along index axis

Pipe OD (in.)	Defect depth								
	2 mm	3 mm	4 mm	5 mm	6 mm	7 mm	8 mm	9 mm	10 mm
1.3	0.57	0.53	0.49	0.45	0.41	0.37	0.33	0.29	0.25
1.66	0.63	0.60	0.57	0.53	0.50	0.47	0.43	0.40	0.37
1.9	0.67	0.64	0.61	0.58	0.55	0.52	0.49	0.46	0.43
2.375	0.72	0.69	0.67	0.64	0.62	0.59	0.56	0.54	0.51
2.875	0.76	0.73	0.71	0.69	0.67	0.65	0.63	0.60	0.58
3.5	0.79	0.77	0.76	0.74	0.72	0.70	0.68	0.66	0.64
4	0.81	0.80	0.78	0.76	0.75	0.73	0.71	0.70	0.68
4.5	0.83	0.82	0.80	0.79	0.77	0.76	0.74	0.73	0.71
6.625	0.88	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.80
8.625	0.91	0.90	0.89	0.88	0.87	0.86	0.86	0.85	0.84
10.75	0.92	0.92	0.91	0.90	0.90	0.89	0.88	0.88	0.87
12.75	0.94	0.93	0.92	0.92	0.91	0.91	0.90	0.89	0.89
16	0.95	0.94	0.94	0.93	0.93	0.92	0.92	0.91	0.91
22	0.96	0.96	0.95	0.95	0.95	0.94	0.94	0.94	0.93
26	0.97	0.96	0.96	0.96	0.96	0.95	0.95	0.95	0.94
30	0.97	0.97	0.97	0.96	0.96	0.96	0.96	0.95	0.95
34	0.97	0.97	0.97	0.97	0.97	0.96	0.96	0.96	0.96
38	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.96	0.96
42	0.98	0.98	0.98	0.97	0.97	0.97	0.97	0.97	0.96
48	0.98	0.98	0.98	0.98	0.98	0.97	0.97	0.97	0.97
Flat	1	1	1	1	1	1	1	1	1

5. Maintenance and Troubleshooting

This chapter outlines procedures for basic maintenance to keep the product in good physical and working condition, as well as routine part changes. Basic troubleshooting advice is also provided.

5.1 Preventive Maintenance

Because there are few moving parts, the FlexoFORM scanner does not require much preventive maintenance. Only regular inspection of the scanner is recommended to ensure that it is functioning correctly. If necessary, clean the scanner or clean and/or change the wheels, as outlined below. Monitor the condition of the foam gasket and the water seals and replace as needed, as outlined below.

5.2 Cleaning the Product

The FlexoFORM scanner's external surfaces may be cleaned when needed.

To clean the product

1. Turn off the equipment connected to the scanner.
2. Disconnect all cables.
3. If necessary, clean the scanner and encoder wheels using adhesive tape (recommended) or a cloth, according to the precautions and steps in "Cleaning the Magnetic Wheels" on page 49.

CAUTION

Although the scanner can be rinsed with water, do not rinse the PA probe connector if it is disconnected. Water in the connector may cause equipment malfunction, damage, electric shock, or injury.

4. If dirt or foreign particles have accumulated on the scanner surface or in its mechanism, gently rinse it with water to wash dirt away until the scanner opens and closes smoothly with the thumb wheel.
5. To bring the external surface back to its original finish, clean it with a soft cloth.
6. To get rid of persistent stains, use a damp cloth and a soft soapy solution. Do not use abrasive products or powerful solvents that might damage the finish.
7. Make sure that the connectors are dry before reconnecting them. If they are not dry, either dry them off using compressed air, or wait until they dry on their own.

5.3 Changing a Magnetic Wheel

Depending on use, it may be necessary to periodically change the magnetic wheels. The magnetic attraction forces around the magnetic wheels may pose certain safety risks, depending on use and operating conditions.

The magnetic wheels have a magnetic field strength of approximately 0.99 milligauss at a distance of 2.1 m (7 ft) away from the wheels. This is well below the 2 milligauss limit at which a product would be considered to be a magnetic material requiring special handling during shipment by air. This means that the FlexoFORM scanner can be shipped by air without restrictions.

CAUTION


Magnetic wheels present a risk of finger crushing if fingers are placed between the wheels and a ferromagnetic surface.

WARNING

The magnetic wheels can generate a magnetic field strong enough to affect pacemakers, watches, and other sensitive electronic devices, and anyone wearing or depending on such devices should keep a safe distance away from the wheels to avoid the risk of serious injury or death. This magnetic field can also demagnetize credit cards, magnetic ID (identification) badges, etc.

CAUTION

Sharp filings or other ferromagnetic objects can be attracted to the magnetic wheels, which can cause equipment malfunction or injury. It is important to keep the wheels clean (see “Cleaning the Magnetic Wheels” on page 49).

CAUTION

Be careful while using tools around magnetic wheels and while holding or moving the wheels. Tools, wheels, or other ferromagnetic objects in the vicinity may suddenly move and forcefully be attracted to each other, which could potentially cause injury or equipment damage. Be sure to allow sufficient free space around equipment and tools to prevent sudden attractive forces between them.

IMPORTANT

The FlexoFORM scanner’s replacement magnetic wheels are supplied as a set of two. The two wheels in a set have opposing polarity when installed. This provides a repulsive force between wheels that makes it easier to install them. However, wheels must be carefully handled and held to prevent accidental ejection, as outlined in the procedure below. It is recommended to replace the two wheels as a set on each side of the scanner.

To change a magnetic wheel

CAUTION

To avoid injury or equipment damage, be sure to carefully hold and restrict the movement of magnetic wheels when disassembling or assembling. The magnetic repulsive force between wheels may cause a wheel to suddenly eject if it is disassembled or assembled without an adequate hold.

1. Use a 3 mm Allen key to hold the shaft and a 2 mm Allen key to remove the screw on the wheel you want to replace (see Figure 5-1 on page 48).
2. Partially push out the shaft from the inside, then carefully pull out the shaft while holding the wheel to counteract the magnetic repulsive force, and then pull out the wheel with its bearings.
3. Similarly (see steps 1 and 2), remove the wheel next to it on the same side of the scanner.
4. Install the first new wheel with its bearings, and tighten the screw.
5. Install the second new wheel by carefully pushing against it to counteract the magnetic repulsive force from the other wheel, and tighten the screw.
6. Repeat for the set of wheels on the other side of the scanner, if needed.

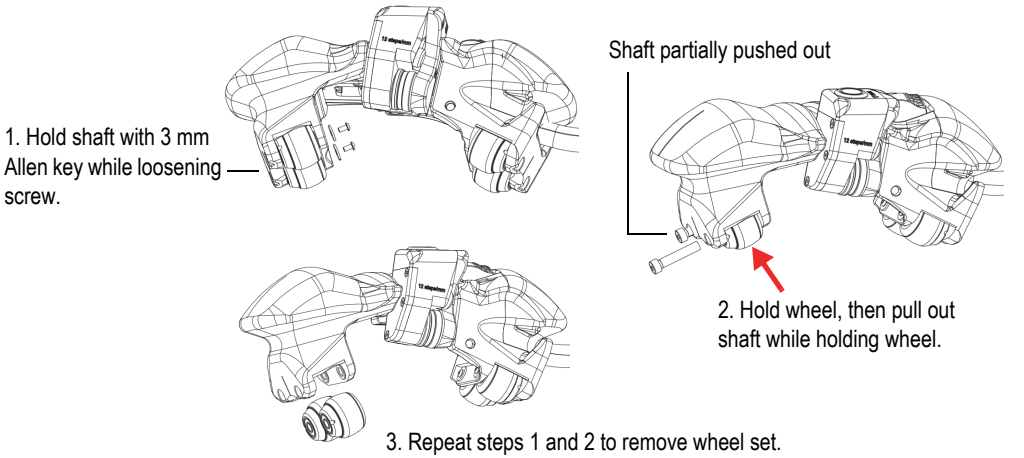


Figure 5-1 Changing a wheel

5.4 Cleaning the Magnetic Wheels

The scanner and encoder's magnetic wheels can attract sharp filings or other ferromagnetic objects or particles. The wheels need periodic cleaning to avoid accumulation of any particles that can cause injury or equipment malfunction. The cleaning frequency depends on your operating conditions.

Required materials:

- Work gloves
- Adhesive tape (recommended for best cleaning)
- Clean cloth (alternative, if adhesive tape is unavailable or inappropriate)

To avoid injury or equipment damage when handling magnetic wheels, take note of the magnetic attraction forces around the wheels, and observe the safety notes outlined in "Changing a Magnetic Wheel" on page 46.

To clean the magnetic wheels

1. Put on your work gloves.
2. Apply clean adhesive tape to the wheel, then pull the tape off to remove particles, and, if necessary, repeat until all particles have been removed. (This is the recommended wheel cleaning method.)

   OR

   If adhesive tape is unavailable, hold a clean cloth against the wheel, then turn it to remove particles (use the cloth to grab particles), and, if necessary, repeat with a clean section of cloth until all particles have been removed.
3. Repeat above step 2 for each wheel that needs cleaning.

5.5 Changing the Encoder

The encoder (with wheel) can be removed as a single unit.

To change the encoder

1. Use a 1.5 mm Allen key to remove the four screws on the encoder (see Figure 5-2 on page 50).
2. Remove the encoder.
3. Install the new encoder:
   - Apply a small drop of Loctite 425 thread locker to each of the four screws, position the encoder, and insert and tighten the screws.

     Olympus recommends Loctite 425 thread locker because it will not damage plastic parts in the vicinity if inadvertently spilled.

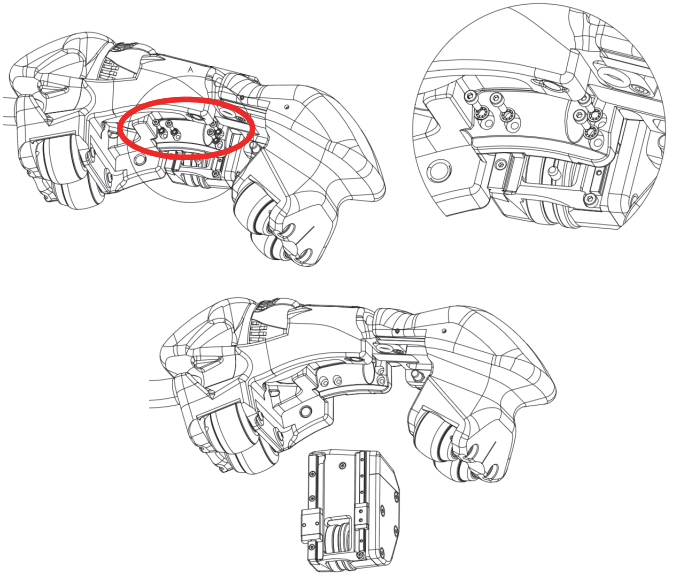


Figure 5-2 Changing the encoder

5.6 Changing the Foam Gasket and the O-ring Seals

The foam gasket on the wedge (which maintains the water column) must be changed periodically, depending on inspection conditions and surface roughness. The o-ring seals on the probe and on the water tube connection also may need replacement if they are worn or damaged.

To change the foam gasket

1. Pull off the old gasket, and, if necessary, carefully clean the mounting surface (see Figure 5-3 on page 51).
2. Choose the gasket model that is compatible with the wedge diameter.
3. Peel the backing off the adhesive on the new gasket.
4. Align the adhesive side of the gasket with the mounting surface, and then press it against the surface to install it.

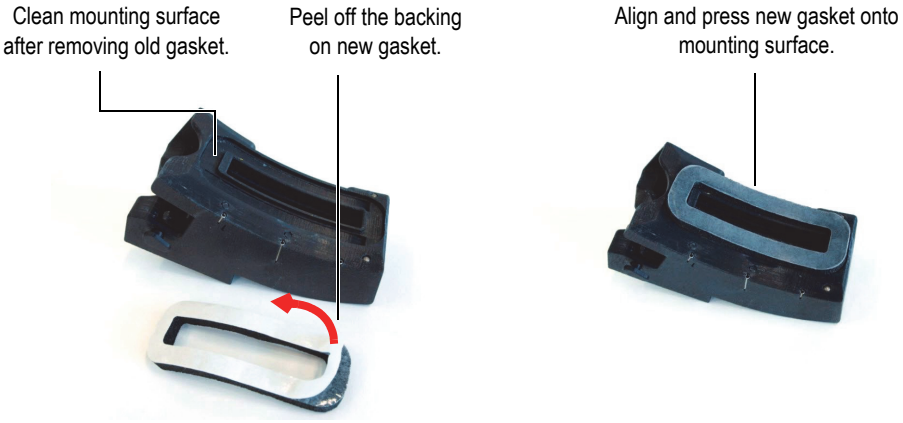


Figure 5-3 Changing the foam gasket

To change the o-ring seal between the probe and wedge

1. Use an appropriate tool such as a small flathead screwdriver to carefully lift and pull off the old o-ring seal without damaging the mounting surface on the wedge (see Figure 5-4 on page 52).
2. Install the new o-ring seal.

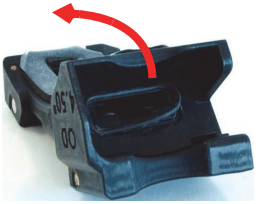


Figure 5-4 Changing the probe's o-ring seal on the wedge

To change the o-ring seal on the water connection

1. Use an appropriate tool such as a small flathead screwdriver to carefully lift and pull off the old o-ring seal without damaging the mounting surface (see Figure 5-5 on page 52).
2. Install the new o-ring seal.

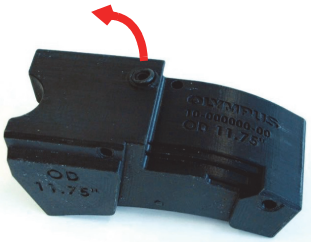


Figure 5-5 Changing the o-ring seal for the water connection

5.7 Changing the Water Tube

The water tube on the scanner can be changed if it is damaged.

To change the water tube

1. Remove the screw that fixes the water connector to the scanner (see Figure 5-6 on page 53).
2. Pull the connector off the water tube.
3. Pull back the cable sleeve to access the tube, disconnect it from the union connector, and pull it out of the scanner.

4. Feed the new tube through its channel on the scanner until it reaches the water connector.
5. Push the tube onto the fitting, install the connector, and then tighten its screw.
6. Cut the tube to the required length, connect it to the union connector, and then close the cable sleeve.

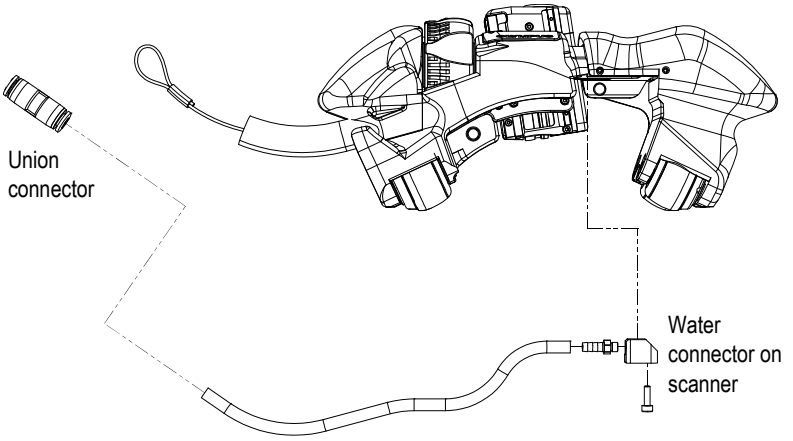


Figure 5-6 Changing the tube (shown disassembled)

5.8 Changing the Cable Sleeve

To change the cable sleeve, you must partially disassemble the scanner on one side, including two magnetic wheels (see Figure 5-7 on page 55).

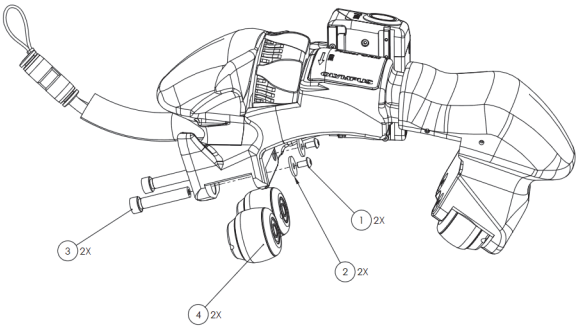
CAUTION

To avoid injury or equipment damage when handling the magnetic wheels, take note of the magnetic attraction forces around the wheels, and observe the safety notes outlined in “Changing a Magnetic Wheel” on page 46.

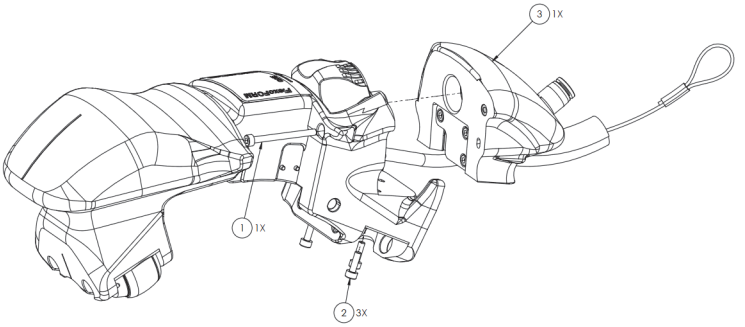
To change the cable sleeve

1. Carefully remove the two wheels on the sleeve side according to the procedure detailed in “Changing a Magnetic Wheel” on page 46. Be aware of magnetic forces that can suddenly attract or repulse parts.
2. Remove the screws that hold the scanner end piece, and pull it away.
3. Remove the screws on the bracket and pull the sleeve out of the end piece.
4. Follow the steps in reverse order to reinstall the (new) sleeve, and securely tighten all screws.

1.



2.



3.

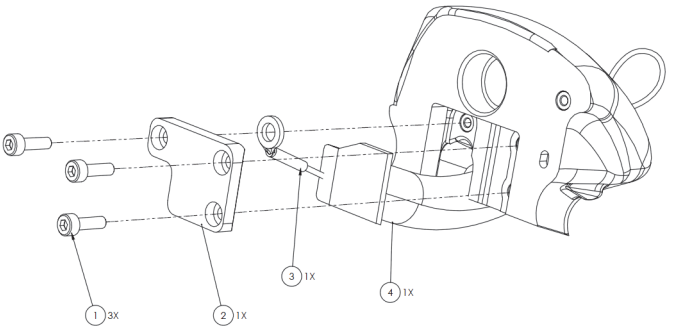


Figure 5-7 Disassembly steps for changing the cable sleeve

5.9 Troubleshooting

Table 5 on page 56 lists some problems that may arise, possible causes, and suggested solutions.

Table 5 Troubleshooting guide

Problem	Possible cause	Solution
Start-up message “No module detected”.	The acquisition module is incorrectly connected.	Make sure that the acquisition module is correctly attached to the base unit on the instrument.
Software crashes.	Wrong software was loaded.	Shut down the instrument and restart with correct software.
No C-scan displayed.	There is no encoder connection.	Check encoder connections between FlexoFORM scanner and instrument.
Black lines on C-scan.	Scanning is too fast.	Reduce scanning speed.
Scanner does not open and close easily during wedge change.	Mechanism contains dirt or foreign particles.	Gently rinse the scanner with water to wash dirt away until the mechanism opens and closes smoothly with the thumb wheel.

6. Specifications

6.1 General Specifications

The general specifications for the FlexoFORM scanner are listed in Table 6 on page 57.

Table 6 General specifications

Parameter	Value
General	
Dimensions (L × W × H)	26 cm × 10 cm × 10 cm
Weight	1.53 kg
Inspection surface curvature	From 114 mm (4.5 in.) minimum diameter up to a flat surface
Probe	Type: FA1 64 elements, flexible Cable length: 5 m Center frequency: 7.5 MHz Part number: Q3301201
Wedges	Type: SFA1-Flexo — multiple models for a range of inspection surface radii (see Table 7 on page 59 and Table 12 on page 71). Alternative wedges for inspections without a FlexoFORM scanner are described in "Alternative Components" on page 21, and listed in Table 13 on page 72 and Table 14 on page 73.
Minimum clearance	Required free access distance over inspection surface: • 85 mm for 114 mm (4.5 in.) pipe • 91 mm for 203 mm (8 in.) pipe • 98 mm for 1219 mm (48 in.) pipe

Table 6 General specifications *(continued)*

Parameter	Value
Magnetic field strength of wheels	0.99 milligauss at a distance of 2.1 m (7 ft) from the wheels (below the 2 milligauss limit at which restrictions would be imposed on air shipment)
Encoder	Recommended scanning speed: variable, dependent on OmniScan instrument and application setup used.
	Type: Quadrature
	Resolution: 12 steps/mm ±0.15 steps/mm
	Wet locations: Water resistant, IP55
	Pinout: See Figure 6-1 on page 61
	Voltage: 5 VDC Maximum current: 100 mA
	CLK frequency: 1 MHz
Environment	
Outdoor use	Yes
Altitude	Up to 2000 m
Operating temperature	0 °C to 45 °C
Maximum inspection surface temperature	100 °C (with water flow turned on)
Storage temperature	−20 °C to 60 °C
Relative humidity (RH)	N/A (water resistant; see IP rating below)
Pollution level	2
IP rating	IP55

6.2 Wedge Pipe Diameter Ranges

The FlexoFORM scanner's wedges have predefined curvatures according to the Nominal Pipe Size (NPS) standard. Although it is recommended to use a wedge that matches the exact diameter of the inspected pipe, each wedge has a narrow range of pipe diameters on which it can be used. Table 7 on page 59 provides the range of coverage for each standard wedge diameter.

Table 7 Range of pipe diameters covered by each wedge

OD (in.)	Min. OD (in.)	Max. OD (in.)
4.5	4.4	4.5
5.563	5.4	5.6
6.625	6.4	6.8
8.625	8.3	8.8
10.75	10.3	11.1
11.75	11.1	12.1
12.75	12.1	13.3
14	13.1	14.6
16	14.9	16.8
18	16.6	18.9
20	18.4	21.1
22	20.1	23.4
24	21.7	25.7
26	23.3	28
28	24.9	30.3
30	26.4	32.7
32	28	35.1
34	29.5	37.4
36	31.3	39.6
38	32.5	42.4
42	35.4	47.4
48	39.6	55.1
Flat	200	Flat

6.3 Flat Wedge Inspection Surfaces

When fitted with a flat wedge, the FlexoFORM scanner can be used to perform these inspections on the following parts:

- Flat plates
- Circumferential inspection of pipes:
  - With 48 in. and up outside diameters
  - With 20 in. and up inside diameters
- Longitudinal inspection of pipes:
  - With 200 in. and up outside diameters

IMPORTANT

The FlexoFORM scanner cannot be used to perform longitudinal inspection of pipes on the inside surface.

6.4 Cable Connector Pinout

The connector pinout for the scanner interface cable is shown in Figure 6-1 on page 61.

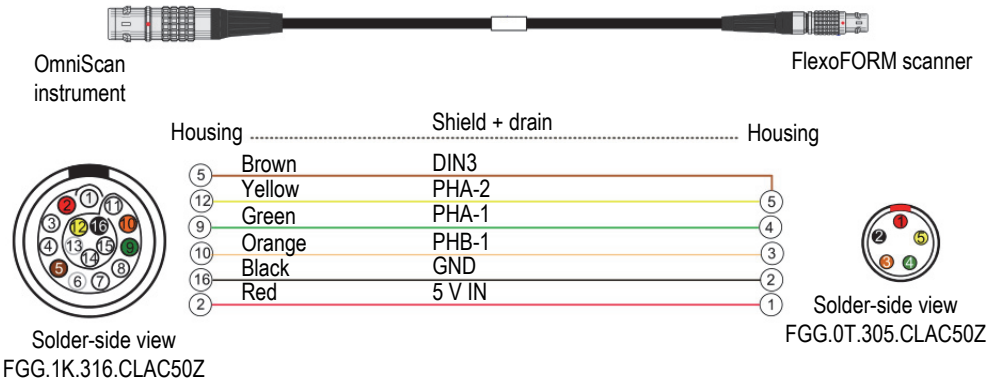


Figure 6-1 LEMO connector pinout diagram (5 pin to 16 pin)

6.5 Dimensions

The FlexoFORM scanner dimensions are shown in Figure 6-2 on page 62.

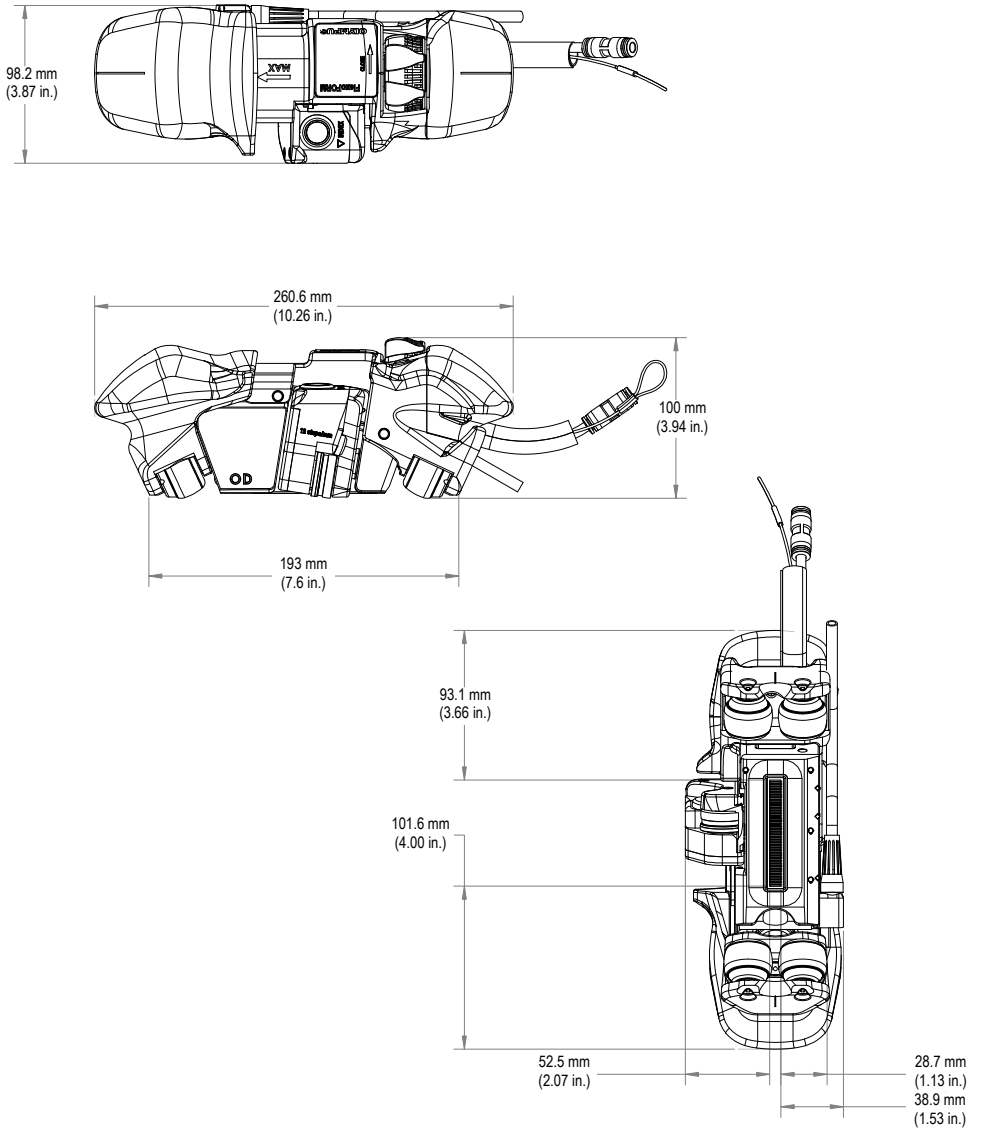


Figure 6-2 Scanner dimensions

The SFA1-SMALL wedge series dimensions and clearances are shown in Figure 6-3 on page 63, Figure 6-4 on page 64, and in Table 8 on page 64.

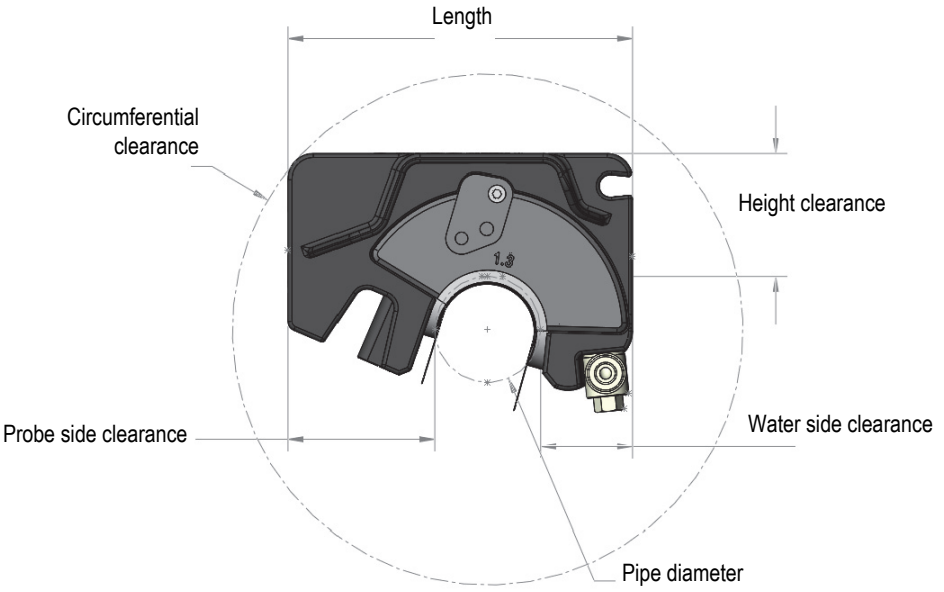


Figure 6-3 SFA1-SMALL wedge clearances

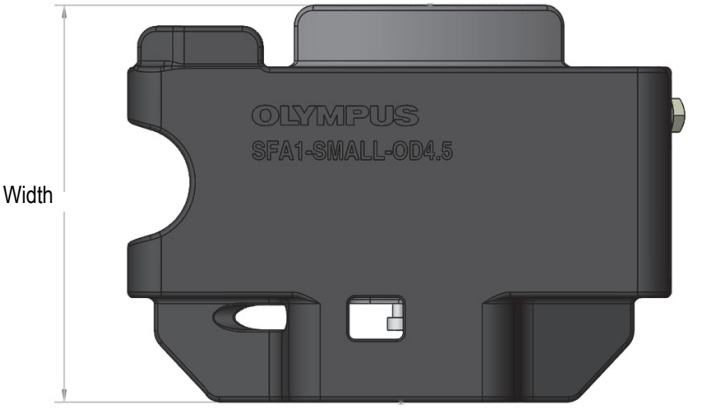


Figure 6-4 SFA1-SMALL wedge width

Table 8 SFA1-SMALL wedge series dimensions and clearances

Pipe diameter (in. OD)	1.315	1.66	1.9	2.375	2.875	3.5	4	4.5
Length (mm)	108.421	117.594	122.098	128.089	131.261	133.042	133.592	111.737
Circumferential clearance (mm)	160.537	170.563	176.208	185.836	195.147	206.707	216.223	226.052
Height clearance (mm)	38.5	38.5	38.5	38.5	38.5	38.5	38.5	38.5
Water side clearance (mm)	28.995	30.964	31.383	30.502	27.312	21.645	16.374	10.726
Probe side clearance (mm)	46.025	44.47	42.455	37.261	30.919	22.498	15.618	8.711
Width (mm)	95	95	95	95	95	95	95	95

7. Spare Parts and Accessories

An exploded view of the FlexoFORM scanner is shown in Figure 7-1 on page 65. A list of standard spare parts is provided in Table 9 on page 66. Accessories and spare part kits are listed in Table 11 on page 70 to Table 14 on page 73.

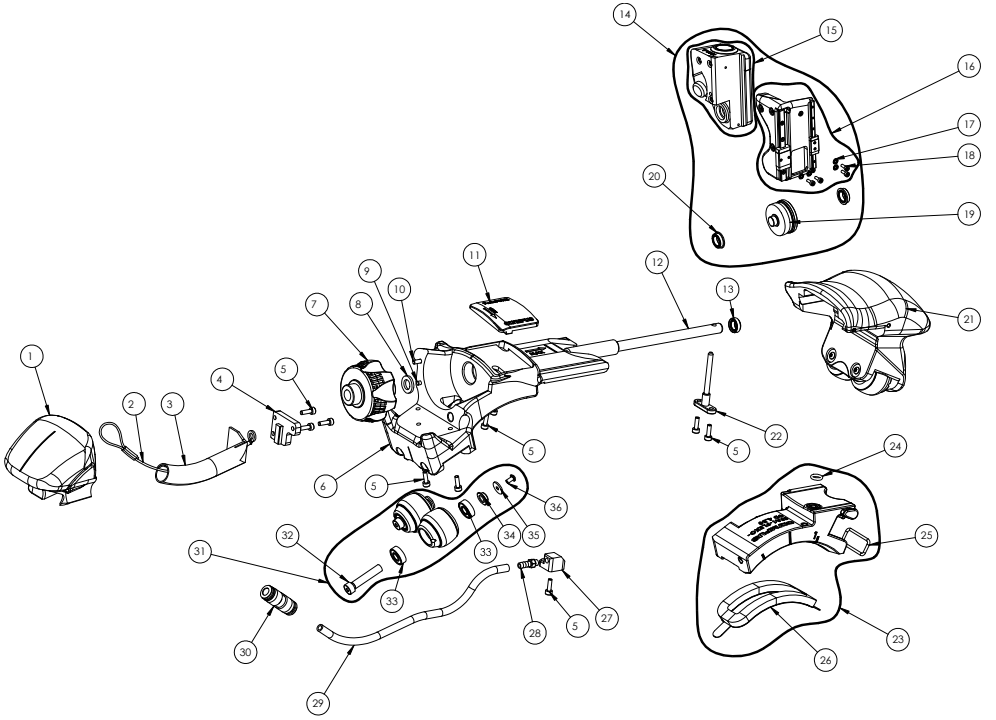


Figure 7-1 Scanner exploded view

Table 9 Spare parts

Item	Part order number	Qty	Description	Marketing number
1	Q8301415	1	Frame handle, side	N/A
2	Q8301416	1	Cable attachment, safety lanyard, 152 mm (6 in.)	N/A
3	Q8301417	1	Cable sleeve, 5 m	N/A
4	Q8301418	1	Lock plate for cable sleeve	N/A
5	U8908544	11	Screw, M3 × 10 mm, hex socket cap, stainless	N/A
6	Q8301419	1	Main frame, fixed	N/A
7	Q8301422	1	Thumb wheel	N/A
8	Q8301423	1	Washer, flat, 8.0 mm	N/A
9	Q8301424	1	Cotter pin, 3 mm × 6 mm, stainless steel	N/A
10	Q8301425	1	Screw, M3 × 35 mm, hex head, stainless	N/A
11	Q8301429	1	Name plate	N/A
12	Q8301430	1	Shaft, threaded	N/A
13	Q8301432	1	Wiper ring	N/A
14	Q8301433	1	Encoder, FlexoFORM	N/A
15	Q8301481	1	Encoder base, front	N/A
16	Q8301482	1	Encoder base, back	N/A
17	Q8301426	4	Lock washer, internal tooth, M2	N/A
18	N/A[a]	4	Screw, M2 × 6 mm, hex head, stainless	N/A
19	Q8301431	1	Encoder wheel	N/A
20	U8909086	2	Bearing, flanged, 8 mm ID × 12 mm OD × 3.5 mm W, stainless	N/A
21	Q8301434	1	Adjustable right-side frame without wheels	N/A
22	Q8301435	1	Screw, M6, custom	N/A
23	Multiple available	1	Wedge (see models listed in Table 12 on page 71, Table 13 on page 72, and Table 14 on page 73)	N/A
24	Q8301441	1	Kit of 20 o-ring seals for water input (on wedge)	N/A
25	Q8301442	1	Kit of 10 o-ring seals for probe (on wedge)	N/A

Table 9 Spare parts *(continued)*

Item	Part order number	Qty	Description	Marketing number
26	Q7500065	N/A	Kit of 12 foam gaskets for water wedge used on small pipe diameters, 114 mm (4.5 in.) to 203 mm (8.0 in) OD	FlexoFORM-SP-SFoam
	Q7500066	N/A	Kit of 12 foam gaskets for water wedge used on pipe diameters over 203 mm (8.0 in) OD	FlexoFORM-SP-LFoam
27	Q8301421	1	Water connector	N/A
28	N/A[a]	1	Fitting, barbed brass, 1/8 NPT × 10-32	N/A
29	Q8301438	1	Tube, water, 6.0 mm × 200 mm	N/A
30	Q8301439	1	Union, straight, QS-6	N/A
31	Q8301443	2	Wheel set (2)	N/A
32	Q8301420	4	Wheel shaft	N/A
33	Q8301462	8	Bearing, 6.0 × 5.0	N/A
34	Q8301463	4	Flanged bushing, ID 6.0 × 8.0 × 4.0 mm	N/A
35	Q8301427	4	Flat washer #4, M3	N/A
36	Q8301428	4	Socket button head cap screw (SBHCS), M3.0 × 0.5 × 6.0	N/A
N/A	Q7500060	N/A	FlexoFORM scanner (without probe, wedges, carrying case, spare part and accessories) for corrosion inspection of pipe elbows. Package includes: irrigation tubes as well as encoder cable with LEMO connector compatible with current generation of OmniScan and FOCUS PX instruments. Cable and tube are 5 m long. Requires FA1 probe and SFA1 water wedges, which are ordered separately.	FlexoFORM-SCN
N/A	Q8000207	N/A	FlexoFORM encoder cable, 5 m long with LEMO connector compatible with current generation of OmniScan and FOCUS PX instruments	FlexoFORM-SP-Cable
N/A	Q7500064	N/A	Basic spare part kit for FlexoFORM scanner — includes o-rings, screws and basic hardware (see Figure 7-2 on page 68).	FlexoFORM-SP-Basic
N/A	Q8301464	N/A	Line marking template tool	N/A
N/A	Q8301440	N/A	Flexible magnetic straightedge, 1.6 mm × 12.7 mm × 3.05 m (1/16 in. × 1/2 in. × 10 ft)	N/A
N/A	Q8301465	N/A	Allen key, 2.5 mm	N/A

Table 9 Spare parts *(continued)*

Item	Part order number	Qty	Description	Marketing number
N/A	Q8301466	N/A	Allen key, 2 mm	N/A
N/A	Q8301467	N/A	Allen key, 1.5 mm	N/A

a. Item included in spare parts kit (P/N: Q7500064)

Figure 7-2 Basic spare parts kit (P/N: Q7500064)

Figure 7-3 on page 69 shows an exploded view of the SFA1-AUTO and SFA1-SMALL wedges. A list of spare parts for these wedges is provided in Table 10 on page 69.

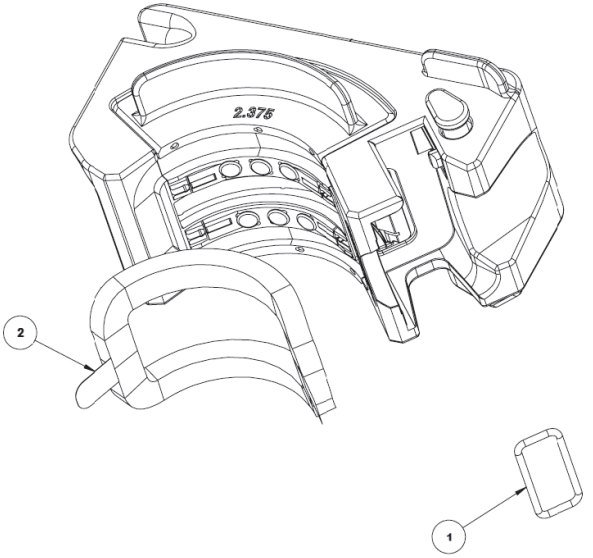


Figure 7-3 SFA1-AUTO and SFA1-SMALL wedges exploded view

Table 10 SFA1 wedge spare part list

Item	Part order number	Description	Marketing number
1	Q8301442	Kit of 10 o-ring seals for probe (on wedge)	N/A
2	Q7500066	Kit of 12 foams for SFA1-AUTO water wedges. Compatible with pipe diameters of 8.625 in. OD and up	FLEXOFORM-SP-LFOAM
	Q7201701	Kit of ten (10) foams for SFA1-SMALL-OD1.3 water wedge.	SFA1-SMALL-SP-Foam-OD1.3
	Q7201702	Kit of ten (10) foams for SFA1-SMALL-OD1.66 water wedge	SFA1-SMALL-SP-Foam-OD1.66
	Q7201703	Kit of ten (10) foams for SFA1-SMALL-OD1.9 water wedge	SFA1-SMALL-SP-Foam-OD1.9

Table 10 SFA1 wedge spare part list *(continued)*

Item	Part order number	Description	Marketing number
	Q7201704	Kit of ten (10) foams for SFA1-SMALL-OD2.375 water wedge	SFA1-SMALL-SP-Foam-OD2.375
	Q7201705	Kit of ten (10) foams for SFA1-SMALL-OD2.875 water wedge	SFA1-SMALL-SP-Foam-OD2.875
	Q7201706	Kit of ten (10) foams for SFA1-SMALL-OD3.5 water wedge	SFA1-SMALL-SP-Foam-OD3.5
	Q7201707	Kit of ten (10) foams for SFA1-SMALL-OD4 water wedge	SFA1-SMALL-SP-Foam-OD4
	Q7201708	Kit of ten (10) foams for SFA1-SMALL-OD4.5 water wedge	SFA1-SMALL-SP-Foam-OD4.5

Table 11 FlexoFORM scanner and probe kits

Part order number	Description	Marketing number
Q7500061	FlexoFORM scanner kit (without probe and wedges) for corrosion inspection of pipe elbows. Package includes: encoder cable with LEMO connector compatible with current generation of OmniScan and FOCUS PX instruments, irrigation tube, basic spare parts, and accessories packaged in a carrying case. Cable and tube are 5 m long. Requires FA1 probe and SFA1 water wedges, which are ordered separately.	FlexoFORM-K-SCN
Q7500062	FlexoFORM scanner kit for corrosion inspection of pipe elbows. Package includes: Flexible 7.5 MHz, 64 element FA1 phased array probe, one (1) SFA1 water wedge for 219 mm (8.625 in.) outside diameter, encoder cable with LEMO connector compatible with current generation of OmniScan and FOCUS PX instruments, irrigation tube, basic spare parts, and accessories packaged in a carrying case. All cables and tube are 5 m long. Requires SFA1 water wedges, which are ordered separately.	FlexoFORM

Table 11 FlexoFORM scanner and probe kits *(continued)*

Part order number	Description	Marketing number
Q7500063	FlexoFORM scanner kit for corrosion inspection of pipe elbows. Package includes: Flexible 7.5 MHz, 64 element FA1 phased array probe, six (6) SFA1 water wedges for 114 mm (4.5 in.), 168 mm (6.625 in.), 219 mm (8.625 in.), 273 mm (10.75 in.), 324 mm (12.75 in.), and 406 mm (16 in.) outside diameters, encoder cable with LEMO connector compatible with current generation of OmniScan and FOCUS PX instruments, irrigation tube, basic spare parts, and accessories packaged in a carrying case. All cables and tube are 5 m long.	FlexoFORM-Kit
Q3301201	Flexible phased array probe, 7.5 MHz linear array, 64 elements, 64 × 7 mm total active aperture, 1.00 mm pitch, 7 mm elevation, FA1 case type for FlexoFORM scanner, SFA1-SMALL and SFA1-AUTO wedge series, impedance matching to water, PVC sheathing, 5 m cable length, OmniScan connector	7.5L64-64X7-FA1-P-5-OM

Table 12 FlexoFORM standard wedges

Part order number	Description	Marketing number
Q7500067	Standard wedge for flexible array probe (FA1) and compatible with FlexoFORM scanner. The wedge is used to generate 0° longitudinal waves and features a curvature matching 114 mm (4.5 in.) OD for inspection of extrados and intrados of pipe elbows. The wedge also features a 9 mm high water column allowing inspection of up to 30 mm thick carbon steel materials.	SFA1-Flexo-OD4.5
Q7500068	As above, but for 141 mm (5.563 in.) pipe OD	SFA1-Flexo-OD5.563
Q7500069	As above, but for 168 mm (6.625 in.) pipe OD	SFA1-Flexo-OD6.625
Q7500070	As above, but for 219 mm (8.625 in.) pipe OD	SFA1-Flexo-OD8.625
Q7500071	As above, but for 273 mm (10.75 in.) pipe OD	SFA1-Flexo-OD10.75
Q7500072	As above, but for 324 mm (12.75 in.) pipe OD	SFA1-Flexo-OD12.75
Q7500073	As above, but for 356 mm (14 in.) pipe OD	SFA1-Flexo-OD14
Q7500074	As above, but for 406 mm (16 in.) pipe OD	SFA1-Flexo-OD16
Q7500075	As above, but for 457 mm (18 in.) pipe OD	SFA1-Flexo-OD18
Q7500076	As above, but for 508 mm (20 in.) pipe OD	SFA1-Flexo-OD20
Q7500077	As above, but for 559 mm (22 in.) pipe OD	SFA1-Flexo-OD22

Table 12 FlexoFORM standard wedges *(continued)*

Part order number	Description	Marketing number
Q7500078	As above, but for 610 mm (24 in.) pipe OD	SFA1-Flexo-OD24
Q7500079	As above, but for 660 mm (26 in.) pipe OD	SFA1-Flexo-OD26
Q7500080	As above, but for 711 mm (28 in.) pipe OD	SFA1-Flexo-OD28
Q7500081	As above, but for 762 mm (30 in.) pipe OD	SFA1-Flexo-OD30
Q7500082	As above, but for 813 mm (32 in.) pipe OD	SFA1-Flexo-OD32
Q7500083	As above, but for 864 mm (34 in.) pipe OD	SFA1-Flexo-OD34
Q7500084	As above, but for 914 mm (36 in.) pipe OD	SFA1-Flexo-OD36
Q7500085	As above, but for 1067 mm (42 in.) pipe OD	SFA1-Flexo-OD42
Q7500086	As above, but for 1219 mm (48 in.) pipe OD	SFA1-Flexo-OD48
Q7500087	As above, but for flat surfaces	SFA1-Flexo-Flat

Table 13 Wedges for automated inspections

Part order number	Description	Marketing number
Q7500088	Standard wedge for flexible array probe (FA1), compatible with MapROVER and SteerROVER scanners. The wedge is used to generate 0° Longitudinal waves and features a curvature matching 219 mm (8.625 in.) OD for inspection of extrados and intrados of pipe elbows. The wedge also features a 9 mm high water column allowing inspection of up to 30 mm thick carbon steel materials. Not compatible with FlexoFORM scanner.	SFA1-Auto-OD8.625
Q7500089	As above, but for 273 mm (10.75 in.) pipe OD	SFA1-Auto-OD10.75
Q7500090	As above, but for 324 mm (12.75 in.) pipe OD	SFA1-Auto-OD12.75
Q7500091	As above, but for 356 mm (14 in.) pipe OD	SFA1-Auto-OD14
Q7500092	As above, but for 406 mm (16 in.) pipe OD	SFA1-Auto-OD16
Q7500093	As above, but for 457 mm (18 in.) pipe OD	SFA1-Auto-OD18
Q7500094	As above, but for 508 mm (20 in.) pipe OD	SFA1-Auto-OD20
Q7500095	As above, but for 559 mm (22 in.) pipe OD	SFA1-Auto-OD22
Q7500096	As above, but for 610 mm (24 in.) pipe OD	SFA1-Auto-OD24
Q7500097	As above, but for 660 mm (26 in.) pipe OD	SFA1-Auto-OD26
Q7500098	As above, but for 711 mm (28 in.) pipe OD	SFA1-Auto-OD28

Table 13 Wedges for automated inspections *(continued)*

Part order number	Description	Marketing number
Q7500099	As above, but for 762 mm (30 in.) pipe OD	SFA1-Auto-OD30
Q7500100	As above, but for 813 mm (32 in.) pipe OD	SFA1-Auto-OD32
Q7500101	As above, but for 864 mm (34 in.) pipe OD	SFA1-Auto-OD34
Q7500102	As above, but for 914 mm (36 in.) pipe OD	SFA1-Auto-OD36
Q7500103	As above, but for 1067 mm (42 in.) pipe OD	SFA1-Auto-OD42
Q7500104	As above, but for 1219 mm (48 in.) pipe OD	SFA1-Auto-OD48
Q7500105	As above, but for flat surfaces	SFA1-Auto-Flat

Table 14 Wedges for small-diameter pipes

Part order number	Description	Marketing number
Q7500106	Standard wedge for flexible array probe (FA1) for manual inspection of small pipes or elbow extrados. (Not suitable for inspection of elbow intrados.) The wedge is used to generate 0° Longitudinal waves and features a curvature matching 33.4 mm (1.315 in.) outside diameter (OD) for inspection of elbow extrados. The wedge also features an 11 mm high water column allowing inspection of up to 35 mm thick carbon steel materials. Compatible with the Mini-Wheel encoder. Not compatible with FlexoFORM scanner.	SFA1-Small-OD1.3
Q7500107	As above, but for 42 mm (1.66 in.) pipe OD	SFA1-Small-OD1.66
Q7500108	As above, but for 48 mm (1.9 in.) pipe OD	SFA1-Small-OD1.9
Q7500109	As above, but for 60 mm (2.375 in.) pipe OD	SFA1-Small-OD2.375
Q7500110	As above, but for 73 mm (2.875 in.) pipe OD	SFA1-Small-OD2.875
Q7500111	As above, but for 89 mm (3.5 in.) pipe OD	SFA1-Small-OD3.5
Q7500112	As above, but for 101.6 mm (4 in.) pipe OD	SFA1-Small-OD4

Appendix A: Setting Up to Inspect a Straight Pipe — Unidirectional or Bidirectional Scan

Depending on your inspection needs, setup, and preferences, Olympus recommends the unidirectional or bidirectional scanning methods for straight pipe or cylinder surfaces.

Unidirectional scan

The principal advantage of performing a unidirectional scan is that the same starting reference is retained for each scan, because the encoder in the scan direction is always reset to the origin value every time the indexing button is pressed (see Figure A-1 on page 75).

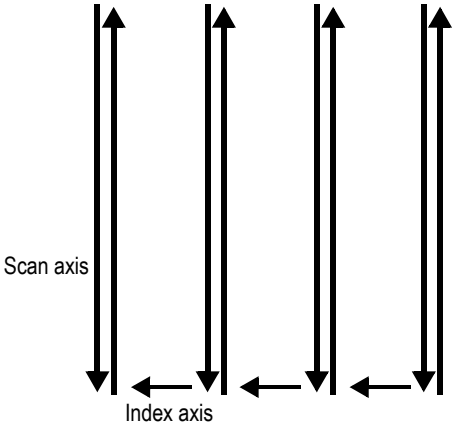


Figure A-1 Unidirectional scan pattern

To set up for a unidirectional scan

- Set the parameters as outlined in "To set the parameters for a symmetrical scan" on page 25. The setup and functionality are the same.

Bidirectional scan

The advantage of a bidirectional scan is that it is faster when inspecting long parts (see Figure A-2 on page 76).

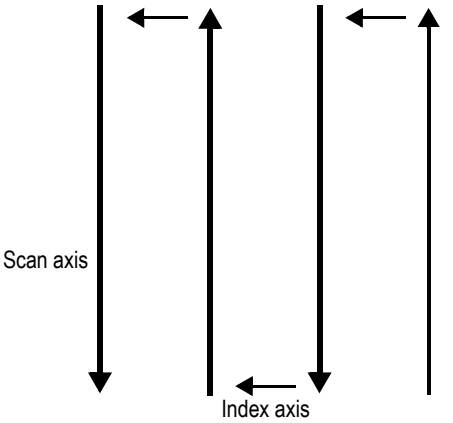


Figure A-2 Bidirectional scan pattern

To set up for a bidirectional scan

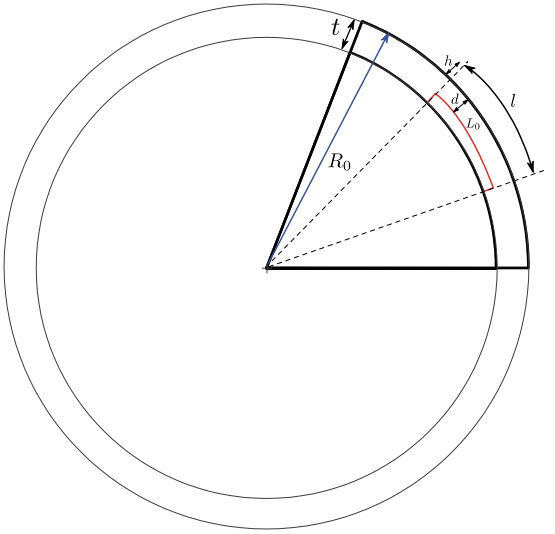
1. Set the scan encoder and input parameters according to steps 1, 2, and 4 in "To set the parameters for a symmetrical scan" on page 25.
2. Set the indexing button's encoder number (2) and type (Clicker):
   a) Select **Scan > Encoder > Encoder = 2**.
   b) Select **Scan > Encoder > Type = Clicker**.

A bidirectional scan differs from a symmetrical scan as follows:

- The scan start value can be set to **0** instead of a negative value (**Scan > Area > Scan Start**).
- The scan position value is not reset to zero when the indexing button is pressed.

Appendix B: Calculating True Defect Length

To calculate the true defect length (*Lo*) along the index axis, use equation (2) on page 77. The variables are illustrated in Figure B-1 on page 77.



L_o = True defect length
l = Measured defect length
R_o = Outside radius
h = Water column height (9 mm for SFA1-FLEXO and SFA1-AUTO wedge series, and 11 mm for SFA1-SMALL wedge series)
d = Measured depth of defect
t = Thickness of material (reference only)

Figure B-1 Variables for calculating true defect length along the index axis

$$L_0 = \frac{(R_o - d)l}{(R_o + h)} \quad (2)$$

List of Figures

List of Tables

Index