Yamato

Fish Analyzer

Fish Analyzer ™ PRO [DFA110]

Operation Manual

Yamato Scale Co., Ltd.

- Please read this manual before using the device for correct use and keep it with you at all times for later reference.

Introduction

Thank you for purchasing the Fish Conditioner Fish Analyzer ™ or the Fish Analyzer ™ PRO. Please read this manual carefully for proper use and it is our hope that it can help improve the fish quality for your business or your organization.

Yamato Scale Co., Ltd.

Yamato

Message to our customers

Traditionally, the quality of marine (fish) products has been subjectively evaluated by the experiences of specialists and not on a quantified or objective basis. In order to digitize and make it objective, it requires specialized knowledge and special equipment and/or to rely on time-consuming chemical analysis. Our goal was to develop a compact device that can measure the content of fish fat, which is one of the major indicators for fish tastiness (deliciousness) index for quality marine products, easily and nondestructively.

In order to develop the Fish Analyzer™ Pro, we joined forces with Japan's top researchers and Universities such as: Nagasaki University Fisheries Department, Nagasaki Prefectural Fisheries Research Institute, Chiba Prefectural Fisheries Research Center, Yamato Scale Co., Ltd., Fisheries Research Institute (currently National Research Development Corporation Fisheries Research and Education Organization). We developed technology conferences with Agriculture and Forestry and Fisheries Technology 2010 "New Practical Technology Development Project to Promote Agriculture, Forestry and Fisheries Policy" and "Development of quality measurement equipment aiming at improvement of fish prices and provision of high-quality marine products and fish processing products". The result of our collaboration and development was the Fish Analyzer ™ Pro. We are proud to bring to market the Fish Analyzer™ Pro that can measure the fish fat content and fish freshness of horse mackerel, yellowtail, tuna, sea bream, bonito, and sardines and many more nondestructively, quickly and easily at any location.

In addition to measuring fish fat, the Fish Analyzer™ Pro can distinguish fish that have been previously frozen or thawed. The information you can gather by using the Fish Analyzer™ Pro will help to improve the taste and the freshness of the fish for superior aquatic product. The ability to make on the spot decisions by using the Fish Analyzer™ Pro at your processing site, warehouse or anywhere you choose will help to improve the quality of your fish products. We hope that the Fish Analyzer™ Pro can contribute to the sustainable supply of high-quality products to consumers.

Nagasaki University Fisheries Department	Doctor of Health	Katuyasu Tachibana
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Chapter 1 Read before use

1-1. For Your Safety

Read "For Your Safely" before using this product for protecting yourself and for others.
After you read it, keep it with care so as to be available whenever you need it.

● Marks and symbols used in this manual and its meaning

Danger:	Indicates operations that may result in fatal or serious injury
Warning:	Indicates operations that may result in bodily injury or damage of properties
Caution:	Indicates operations that may result in damage of the entire product.
Prohibit:	Indicates things to be prohibited, strong do not recommend
Enforce:	Indicates things to be enforced

● Before use please read “Danger”, “Warning” and “Caution” carefully and comply accordingly.

Danger

Preventing electric shock accidents

Do not remove any screw on the back of the housing case.

: Preventing from explosion or fire accident

This device does not have non-explosion features.
Do not use the device where flammable gas or hazardous substances exist.

: Preventing fire and/or electric shock accident

Using it in such an abnormal situation where there is smoke or unusual smell may result in fire and/or electric shock.
Remove batteries and confirm that no smoke comes out before asking the vendor for its repair.
Do not try to repair by yourself as it is dangerous.

⚠ Warning

⃠ Preventing from injury or damage

(1) When the housing case or electrodes are damaged from being dropped, stop using the device. It may damage the fish or injure you.

(2) When the display is damaged from being dropped and liquid leaks, stop using it as it is toxic. Please do not swallow or accidentally put it in your mouth.

⚠ Caution

⃠ Do not damage the device

(1) Use designated batteries. Otherwise, rupture or leakage of batteries may cause fire, injury or damage.

(2) Do not put a battery in fire or water, or heat it. It may burst

(3) Do not mix alkaline and manganese batteries. It may cause liquid leakage or explosion

(4) Set batteries correctly as shown by the polarity marks (+ and -). Incorrect installation may cause liquid leakage or explosion.

(5) Remove batteries when the equipment is left unused for a long time (about 1 month or longer). Otherwise, they may leak and cause the inside of the equipment to be corroded.

(6) Do not separate or modify the device.

(7) Do not drop the device. It may cause damage on the device.

(8) Do not sink the device in water or store it in a humid environment. It may damage the device.

1-2. Preparation

● In order to avoid common issues:

(1) Do not separate or modify the device.
(2) Do not hit the display and keyboard (buttons) with a nail tip or a sharp tool.
(3) Hold the main body portion when you carry it.
(4) Do not drop the device or do not give excessive shock or vibration.
(5) Do not apply thinner, benzine, etc.

● In order to keep the device accurate:

(1) Do not operate near fire, steam, direct sunlight or wind from the air conditioner.
(2) Do not operate near devices like a microwave, which generate excessive shock, vibration or electro-magnetic discharge.
(3) Operate under the designated environment (-10℃ ～ +40℃, 30%RH ～ 85%RH)
Measuring error may happen even under certain conditions if dew condensation generates:
1) Being operated or stored for a long time within a humid environment.
2) Sudden temperature changes even under low humidity (splashing cold water on the device)
3) Operating the device when exposed to direct cold air from a refrigerator or steam.

Storage and Disposal

●Storage

(1) Do not store the equipment in the place with high temperature/humidity or receiving direct sunlight for a long period of time. It should also be noted that substantial changes in the ambient temperature may cause condensation inside the equipment, resulting in a failure of the operation
(2) This is an electronic precision equipment. Do not store it in the place where vibration and/or shock can be expected.

●Disposal

(1) At time of disposal, it must be disposed of as an industrial waste (nonflammable waste). Make sure to observe local regulations when disposing.
(2) When used batteries are disposed of, put scotch tapes on electrodes and dispose according to the local regulations.

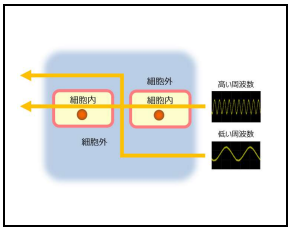
1-3. How the Fish Analyzer Pro works & Functions

1 Measurement method that does not damage the fish (Nondestructive).

Fish AnalyzerTM Pro uses "bioelectrical impedance method" to send weak electrical signals into the fish using the four electrodes (sensors) that estimates fat percentage and fish freshness. The result is displayed in only 4 seconds without damaging the fish.

2. Multi-frequency measurement method.

Fish AnalyzerTM Pro uses low and high frequencies bands to measure the fish fat content and fish freshness. When a low frequency band is used, electricity flows outside/around a fish cell. When a high frequency band is used, electricity flows into/through the fish cell. Fish AnalyzerTM Pro uses the multi-frequency measurement method to achieve high accuracy results.



3. Measuring fat percentage of 20 fish species.

This device can currently measure: Horse Mackerel 1, Mackerel 1, Mackerel 2, Sardine, Saury, Bluefin tuna (back, belly, tail), Sea bream, Alfonsino, Bonito 1, Salmon, Rainbow trout, Spanish mackerel, Butterfish, Sea bass, Sailfin sandfish, Grouper, Bonito 2, Sea eel, Horse mackerel 2.

4. Measuring fish fat for other fish species.

If you want to measure a fish species not listed in the above 20 that it currently supports, it's equipped with "calibration curve mode". This mode will provide custom calibration for the specific fish species. In impedance mode, the impedance value of 100 kHz is displayed instead of the fat percentage. From this number, you can figure out the approximate fat ratio. You can also refer to the Fish A, Fish B, and Fish C scale to create an original formula.

5. Detecting previously defrosted products

After freezing and thawing a fish, cell membranes of the fish are destroyed. This means that there is no difference in the flow of electricity within the fish. Knowing this phenomenon, a fish that has been previously frozen will display as "defrosted". However, please note that the fat percentage of the thawed product is not displayed.

6. Displaying the average value of measurement results.

If you want to measure many fish at once to determine an average fish fat percentage in a certain lot or container you received, use the "average value" calculation function. The average value is displayed at the bottom of the screen until you press  or turn off the power.

7. Displaying the 5 level of fish freshness index.

Fish AnalyzerTM PRO measures fish freshness along with fish fat in the same measurement. The freshness of fish is a function of changing cells within the cells of the fish. These changes in cells are “graded” as A ', A, B, C, D according to the deterioration of cells and decreasing water content. It can be used for cooking guidelines and quality control.

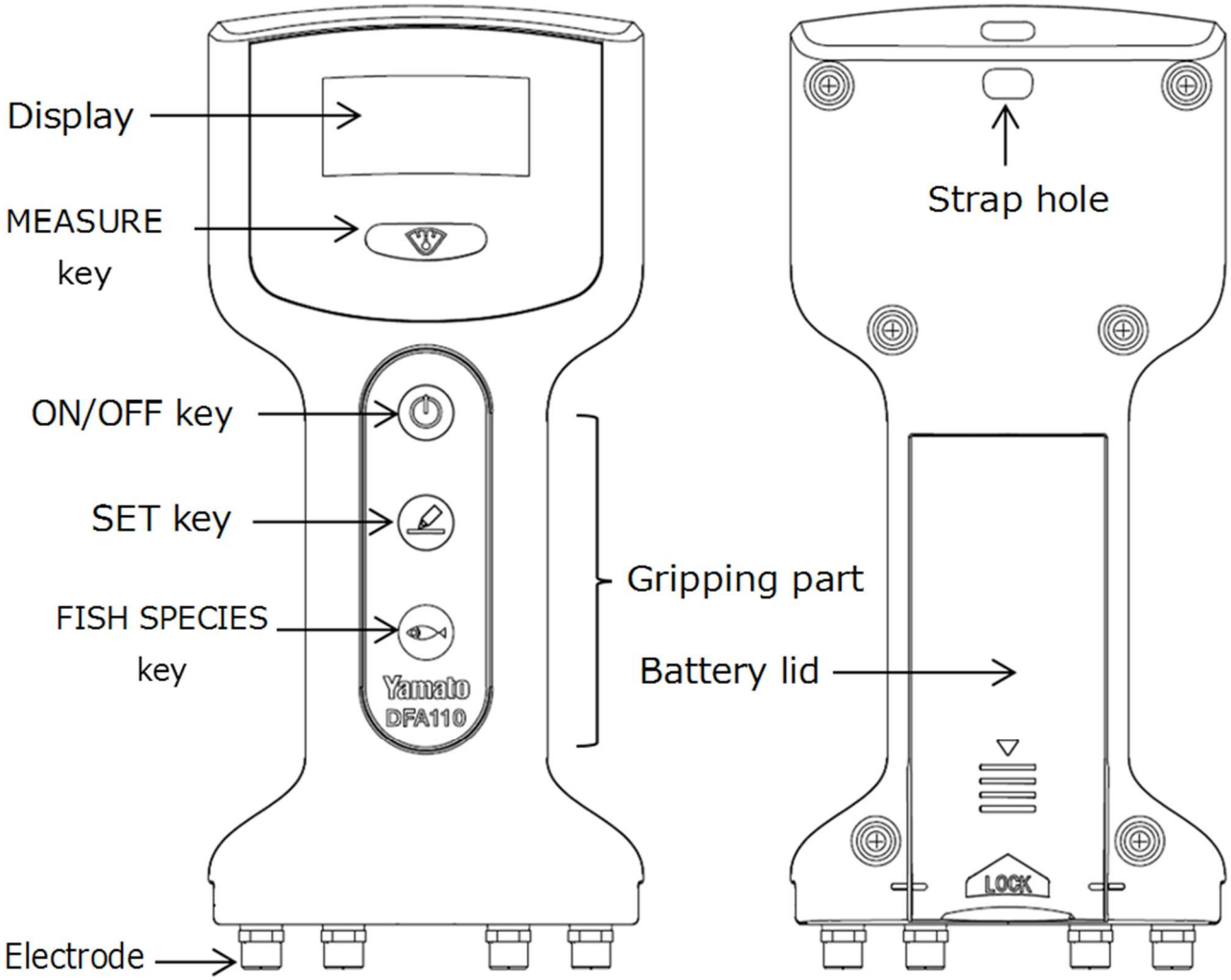
8. Strict quality control measurements.

Fish AnalyzerTM PRO is equipped with "Fish status mode". In this mode, 5kHz impedance is displayed along with the 5 levels of grading. As the impedance decreases, so does the fish freshness. These results allow for strict quality control for fish freshness.

1-4. Product package: What included in the box

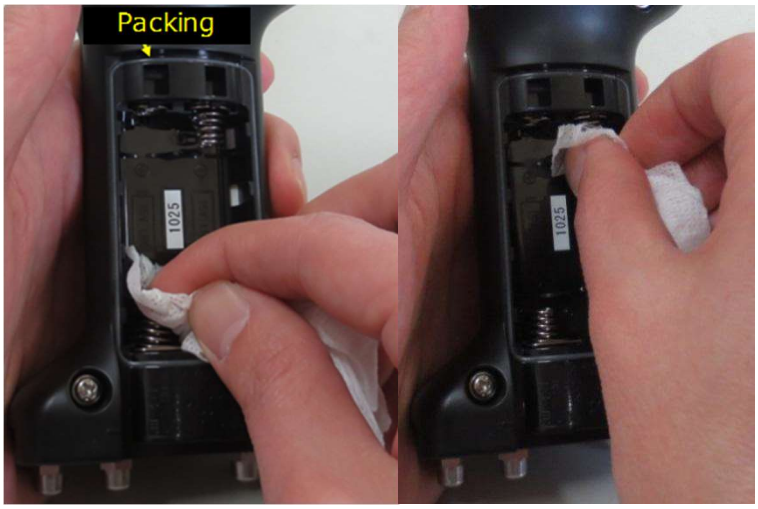
Main device	Accessories
	Attachment  Batteries (CCC size x 2)  Manual 

1-5. Main device interface & details

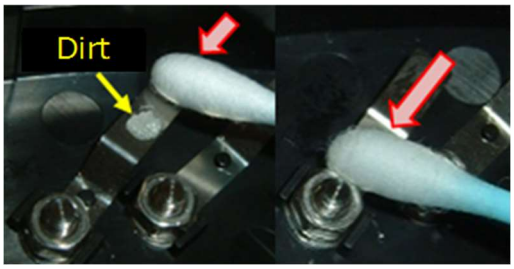
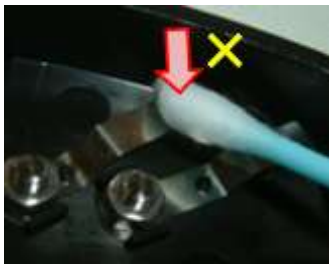


1-6. Maintenance & Upkeep

- Wipe off and clean the sensors after each use to avoid rust. If the sensor electrode and attachment have fish slime or sea salt water, it may rust. Use a wet wipe or towel to clean off the sensors.
- Do not drop and avoid vibrations. Use a strap that is provided through the strap hole.
- After replacing the batteries, make sure the battery cover is securely tight to avoid water, sand or any other foreign debris. If it's not securely tight, it may not be fully waterproof.
- The following images show how to slide the battery cover off and clean inside the battery box. Clean the inside of the battery box often and close the battery cover firmly when done.

Wipe off dirt and dust with a dry tissue for battery contacts. Wipe off any moisture. If any battery erosion or leaks are found, contact the distributor or place of purchase for detailed handling.	To make sure the battery cover is securely tight, push the battery cover firmly from the bottom so that there is no gap. Match the lines on the main unit as indicated below.
	

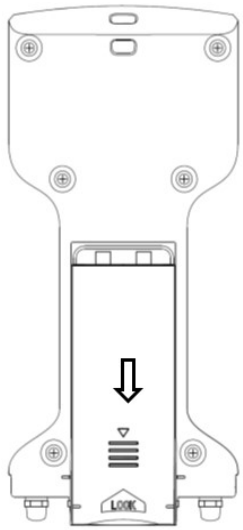
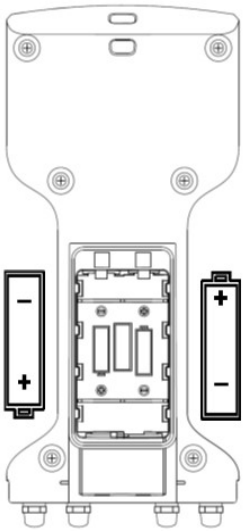
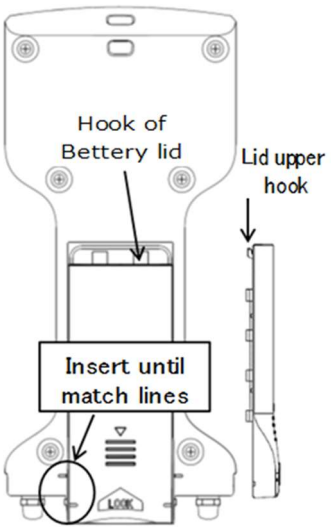
- If the attachment is used, use the same care as above. Wipe off fish slime, sea salt water, dirt or any other foreign debris each time after measurement.

Be sure to wipe off any dirt from the sensor electrodes with water or alcohol before mounting the attachment.	If dirt is found on the connection terminal of the attachment, moisten the tip of the swab with water or alcohol, then slide the swab toward the inside of the connection terminal to wipe off dirt.	Be careful. If you press the outside of the connection terminal downward, the connection terminal will bend outward.
		

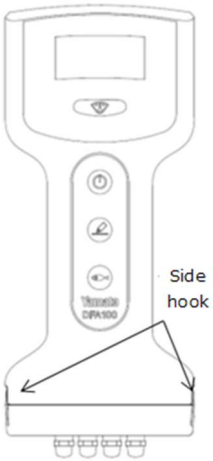
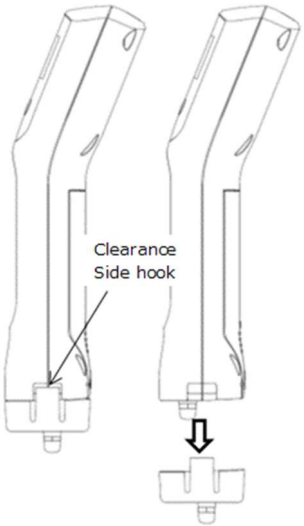
Chapter 2 Preparation before use

2-1. Battery & Sensor attachment setup

● Batteries

Step ①	Step ②	Step ③
Slide the battery lid down to remove.	Insert batteries and make sure polarity (+/-) align correctly.	Insert the top hook of the battery lid and push it upwards.
		

● Sensor Attachment

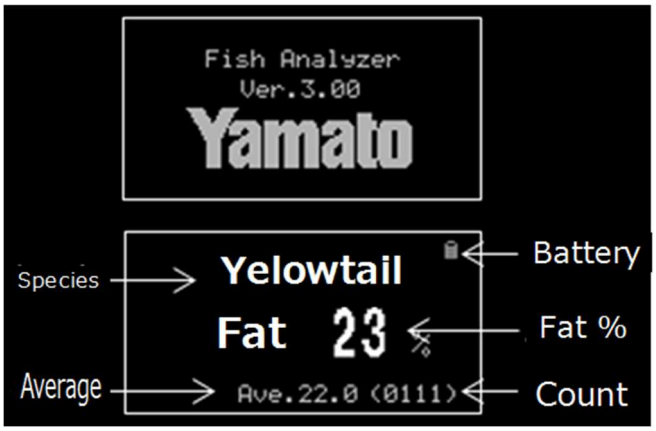
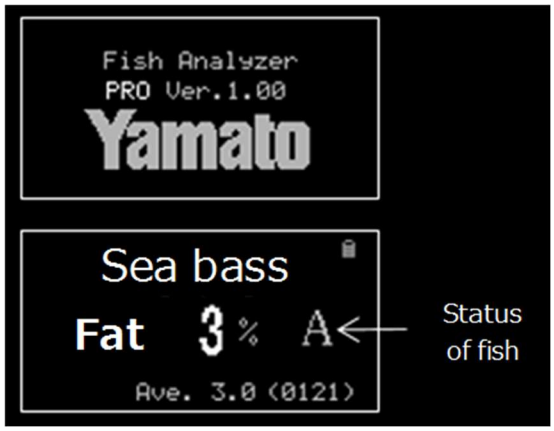
Step ①	Step ②	Step ③
Align the convex to the front and fit it straight up toward the body.	Installation is completed when the side hooks to the main body.	For removal, put your finger in the space on the side hook and pull it down slightly.
		

※1 Use the attachment for small fish such as Horse mackerel, Sardine, Saury, Grouper and Sea eel.

※2 For measuring in impedance mode or fish status (freshness), use an attachment if the thickness of fish is 3 cm or less.

2-2. Display and keys

● Display

Fish Analyzer ™ Ver.3.00	Fish Analyzer ™ PRO Ver.1.00
	

● Symbols and what they mean

Battery level	Battery level is displayed in 3 levels. Replace when only one ▬(bar) is shown.
Attachment	It means that the attachment is needed for measurement.
Next day	This means it's a measurement mode for the day after (24hrs) the catch. If you want to measure on the day of the catch, please select another mode.
Not in contact	It means that the contacts of the sensor electrode are not sufficient.

(Keys)

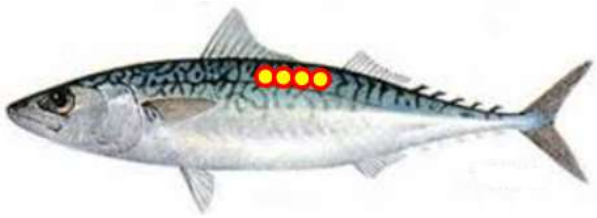
Measurement	Use this button to measure the fish. Press to return to the previous display under setting or measurement mode.
ON/OFF	Turn on the device. Return to the normal screen when setting or measurement mode. Long press for powering down (off) the device.
Set	Press to display the past measurement results. Long press for setting options. Press to select and to finalize the setting option.
Fish species	Press to display a fish species. Press to advance to the next display during setting or confirming the measurement result.

2-3. Fish species and recommended measuring spots/locations on the fish

No.1 Horse mackerel 1 Use attachment

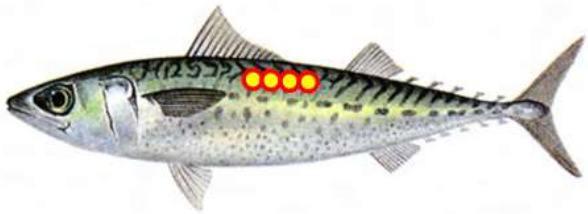
Center the sensor electrode between the first and second fins just above the sideline.

No.2 Mackerel 1



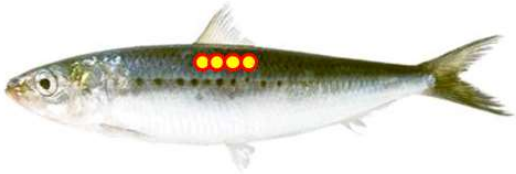
Center the sensor electrode on the back of the dorsal fin just above the sideline.

No.3 Mackerel 2



Center the sensor electrode on the back of the dorsal fin just above the sideline.

No.4 Sardine Use attachment

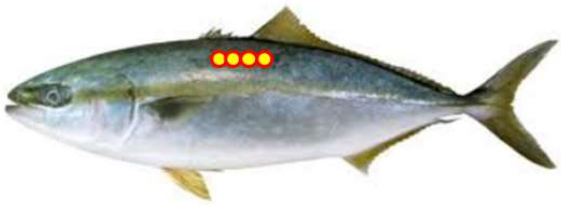


Center the sensor electrode on the center of the dorsal fin just above the sideline.

No.5 Saury Use attachment

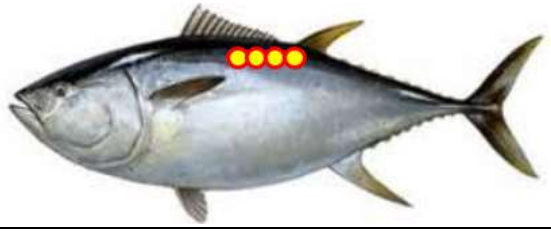
Center the sensor electrodes on the center of the belly fin just above the sideline.

No.6 Yellowtail



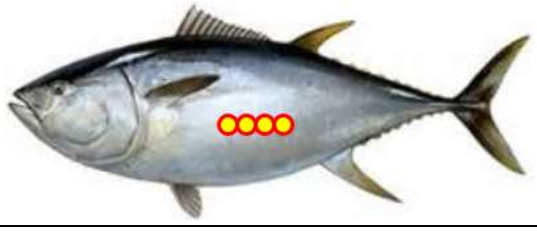
Center the sensor electrode between the first and second fins just above the sideline.

No.7-1 Bluefin tuna (back)



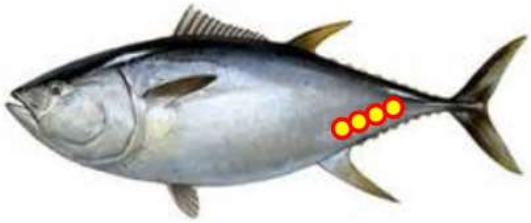
Align the tip of the sensor electrode to the back end of the chest fin just above the sideline.

No.7-2 Bluefin tuna (belly)



Align the tip of the sensor electrode to the back end of the chest fin between the base of the belly fin and the sideline.

No.7-3 Bluefin tuna (tail)



Align the tip of the sensor electrode to the back of the anal position slightly below the sideline.

No.8 Sea bream

Center the sensor electrode on the back of the dorsal fin just above the sideline.

No.9 Alfonsino

Center the sensor electrode on the center of the dorsal fin, just above the sideline.

No.10 Bonito 1

Center the sensor electrode between the first and second fins just above the sideline.

No.11 Salmon

Center the sensor electrode on the center of the dorsal fin, just above the sideline.

No.12 Rainbow trout

Center the sensor electrode on the center of the dorsal fin just above the sideline.

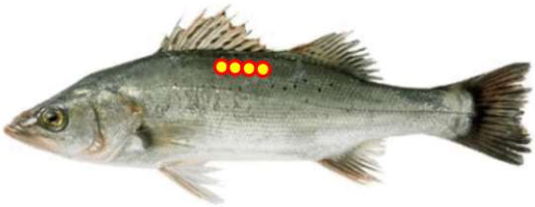
No.13 Spanish mackerel

Align the back of the sensor electrode to the tip of the second fin just above the sideline.

No.14 Butterfish

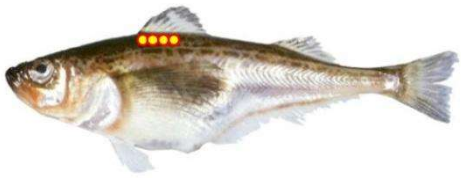
Center the sensor electrode on the tip of the dorsal fin just above the sideline.

No.15 Sea bass



Align the back of the sensor electrode to the back end of the 1st fin just above the sideline.

No.16 Sailfin sandfish Attachment

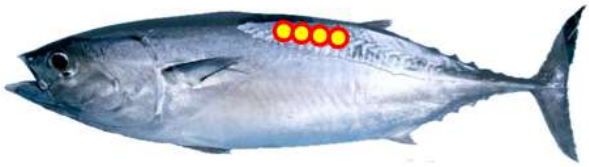


Center the sensor electrode on the tip of the dorsal fin just above the sideline.

No.17 Grouper

Center the sensor electrode on the tip of the dorsal fin just above the sideline.

No.18 Bonito 2



Center the sensor electrode between the first and second fins just above the sideline.

No.19 Sea eel Use attachment

Straightening the fish, align the tip of the sensor electrode to the anal position just above the lateral line.

No.20 Horse mackerel 2

Center the sensor electrode between the first and second fins just above the sideline.

2-4. Day of the catch and day after catch measurements

This device measures fish fat percentage based on the condition of its cells. These cells change from the day of the catch as the fish erodes. In order to measure the fish fat accurately, this device uses 2 measuring modes. One mode is to measure on the day of catch (within 24 hours) and the other mode is to measure in 72 hours after catch (day after the catch). The “day of the catch” refers to the day when the fish is caught and has died.

It also depends on the fish species. As for Saury, Bonito, Sea bream, Sailfin sandfish, Sea ell and Horse mackerel, use day of the catch mode since there is no mode for measuring the next day. For measuring correctly in both modes, fish should be kept in an ice storage.

● Taking measurements in the fish processing lines.

If you’re taking measurements in fish processing or in the warehouse, the fish may still be alive. If you take measurements immediately after when the fish died, you may get a lower fat percentage. We recommend that you first store the fish in ice and wait at least one hour before making measurements. Also, if a couple of days have passed since the death, please take the measurement using the “next day after catching” mode.

In Fish Analyzer™ PRO, the “status of the fish” or fish freshness is displayed in 5 levels next to the fat percentage. When a couple of days have passed since its death, as an approximate indication, if the device shows "A '" or "A", choose the “day of catching” mode. If it shows "B" or "C", choose the “next day of catching” mode.

● The “next day of catching” means measurement at the distribution site.

When using the Fish Analyzer™ to measure fish freshness, take the measurements as soon you receive the fish. The Fish Analyzer™ PRO displays the “status of fish” (fish freshness) along with the fish fat percentage in 5 levels. If the fish freshness level results in "D" grade, this refers to being difficult to obtain an accurate fat percentage and should not be used.

Chapter 3 How to measure

3-1. How to hold and place the device on the fish for accurate measurement

Although this device is a non-destructive device that does not destroy the fish, it must touch and make contact with the fish to take a measurement. Do not press firmly on the fish as it may distort the fish content that leads to inaccurate measurement results. Follow the guidelines below for accurate measurement.

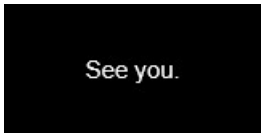
<table>
<tr><td>1 Proper device handling</td><td colspan="2">2 Fish placement</td></tr>
<tr><td> 
Press the ON button and choose a fish species with the fish species key.
Place your thumb on the measurement button and the remaining fingers grip the body.</td><td>If touching the fish is ok, support the fish with your fingertips and place the device.
  </td><td>If you can’t touch the fish, use your arm as a stand for stability.
  </td></tr>
<tr><td colspan="2">3 Sensor electrode contact</td><td>4 Confirm on screen display and by the sensor electrodes position</td></tr>
<tr><td colspan="2"> 

Lightly place the four sensor electrodes on to the fish. Make sure that they are firmly in contact and then press the measurement key. Apply the sensor electrode on a 45 degree like it’s shown on the image to raise the body a little.</td><td> 
Make sure the “*” mark is displayed and keep your eye on the sensor electrode position/location. Keep it steady and do not move it while taking measurements.</td></tr>
</table>

3-2. Taking Measurements

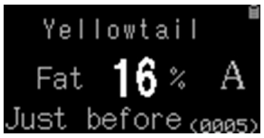
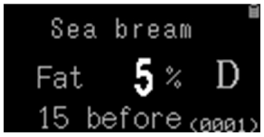
As an example, let's measure Yellowtail fish

	Operation	Screen
1	Press key to turn on.	
2	Press key to select "Yellowtail". Choose "Yellowtail 24". (day of the catch, within 24 hours)	
3	Go back to the home screen and place the sensor electrode onto the fish and press key to measure. During measurement, the "＊" symbol moves to indicate the device is measuring.	

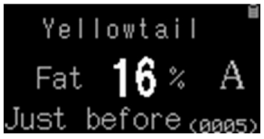
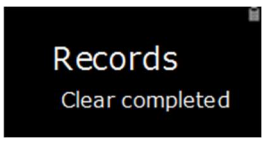
	Operation	Screen
④	When the measurement is finished, the fish fat percentage is displayed. When the average value display function is enabled, the average value is displayed at the bottom center of the screen (displayed to one decimal place). Fish Analyzer ™ PRO, it displays the "status of the fish" or the fish freshness in 5 levels/grades.	
4	Long press on the key to turn off the device when finished.	

3-3. See results from past measurements

● How to find past measurement results

	Operation	Screen
1	Press key from the home screen.	
2	Each of the past measurement results are displayed when the key is pressed.	
	Note: Up to 50 past measurement results are stored. The number of measurements is displayed up to 9999 times on the lower right of the screen and returns to 0 after 9999 times.	
3	Press key to return to the home screen.	

● Clearing/deleting measured result

	Operation	Screen
1	Long press down on the key to delete the measured result shown on the display.	
2	Holding down the key “Result clear” is displayed. Choosing <Yes> with a cursor by moving it with key, then press key.	
3	Clearing results is started, and when “clear complete” is displayed, deletion of the past measurement results is completed. Press key to return to the normal screen.	

Remarks: Please note that clearing results will erase all past measurement results and the number of measurements.

3-4. Determining Fish Freshness (Fish Status)

Fish AnalyzerTM PRO determines fish freshness by measuring the fish cell erosion electronically rather than using the K-value index that is based on biochemical analysis.

This device uses a multi-frequency measurement method. The cell membrane has high electrical capacity and insulation at low frequency bands and as electricity flows around/outside the cell without flowing through/inside the cell, thus the impedance (electrical resistance) is high. Conversely, at the high frequency band, the cell membrane is electrically shorted and electricity flows through/inside the cell, resulting in low impedance.

As the fish dies, the fish cells change with time. Right after the fish dies, there is high impedance that is in proportion to the tightness or the firmness of the fish. If the fish is “tight” or firm, it is graded at "A" or "A '" level. After some time, the fish starts to soften and the impedance starts to decrease but the cell's electrical characteristics are still maintained. This status is graded at "B" level.

If the fish is measured immediately after its death, the device may display “B” as the condition is similar to the one before the fish starts to tighten and if blood remains in the body of the fish, it may display "C". When freshness starts to decrease, the impedance from the lower frequency band drops significantly. This is because the cell structure changes and the cell electrical characteristics deteriorates. Moreover, the water content of cells decreases and the intracellular fluid flows out of the cells, which lowers the impedance at the lower frequency band. The ability to retain water in cells is undoubtedly an important factor in fish freshness. The electrical feature of the cells changes and the status of poor water content capacity is graded at “C” or “D”. The status of fish or the fish freshness does have some common ties to the K value. The condition of the fish corresponding to the K value of 1% to 20% is "A", "A '" or "B", and the K value that is 20% or more is equivalent to "C" or "D".

Note that grade “E” level is displayed when a measurement error occurs or “F” is displayed when the fish has been previously frozen and thawed.

Remarks: It’s not possible to decide whether the fish can be eaten raw only by the freshness evaluation or the K value. Fish such as salmon and mackerel, which are not eaten raw, should be cooked before eating even if the status of fish is determined to be good.

Chapter 4 Options and usage

4-1. Fish species selection

You can select the fish species to be measured by using the button, but you can select only the fish species you want to measure in advance and exclude all the fish species you don't want to measure from the display for faster measurement.

As an example, measuring of "Mackerel "

	Operation	Screen
1	Press key to turn on. From the home screen, hold down key until Menu is displayed.	
2	Match cursor (→) to "Fish species select" and press key to change screen.	
3	Move the cursor (→) by pressing key to a fish species (in this case, Mackerel) and press key. The species with check mark (レ) are only displayed.	
4	After confirming the selection, press key to return to Menu screen. Press key again to return to the home screen then setting is completed. Confirm that only the selected species are displayed with key.	

(List of all fish species)

Impedance mode	Bluefin tuna (back)	Salmon	Bonito 2
Horse mackerel 1	Bluefin tuna (back)	Salmon	Bonito 2
Horse mackerel 1	Bluefin tuna (belly)	Rainbow trout	Sea eel
Mackerel 1	Bluefin tuna (belly)	Rainbow trout	Horse mackerel 2
Mackerel 1	Bluefin tuna (tail)	Spanish mackerel	Fish A
Mackerel 2	Bluefin tuna (tail)	Spanish mackerel	Fish B
Mackerel 2	Sea bream	Butterfish	Fish C
Sardine	Sea bream	Sea bass	Status of fish
Sardine	Alfonsino	Sea bass	
Saury	Alfonsino	Sailfin sandfish	
Yellowtail	Bonito 1	Grouper	
Yellowtail		Grouper	

4-2. Energy saving mode for longer battery life

Settings for saving energy

1. Auto off 1 : Automatically turn off the power after a set time.

2. Auto off 2 : The screen display turns off automatically after a set time has passed. When the screen display is off, press any key turn it back on to the previously displayed screen. (The power will be turned off if the Auto Off 1 is selected)

3. Brightness : Choose the display brightness level from “Saving energy”, “Normal” or “Bright” mode.

(ex) If you want to turn off the display after 10 seconds of use. (set Auto off 2 at 10 seconds).

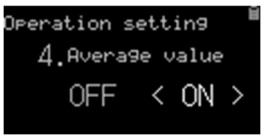
	Operation	Screen
1	Press key to power on the device. From the home screen, hold down key until Menu is displayed.	
2	Match a cursor (→) to Operation setting and then press key.	
3	When the operation settings are displayed, move the cursor (→) to 2. Auto off 2 by pressing key twice and then press key.	
4	Set 10 seconds by pressing (for decreasing) or pressing (for increasing) and then press key.	
5	Press key under operation setting screen to return to the home screen. Then the setting is completed.	

● Cancelling the setting for Auto off 1 or Auto off 2

	Operation	Screen
1	Choose <OFF> to cancel Auto off 1 or Auto off 2 with or key.	

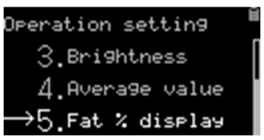
4-3. Display the average value

By enabling the operation setting "4. Average value", the average value of the measurement taken is displayed at the bottom of the screen. It can be used to determine the fat percentage from multiple measurements and from several fish within a container.

	Operation	Screen
①	Press key to turn on. Under the home screen hold down key until Menu is displayed. Match a cursor (→) to Operation setting and then press key.	
②	When the operation settings are displayed, move the cursor (→) to 4. Average value by pressing key and then press key.	
4	Choose <ON> by pressing key and then press key. Press key under operation setting screen to return to the home screen.	
5	The setting is completed. With this setting, the average value is displayed at the bottom of the screen. Press key or the power button to turn off the device.	

4-4. Limitations of Fish Fat measurements

In order for this device to measure accurate fish fat percentage, the fish needs to be “fresh”. If the fish is not fresh, the fish fat percentage displayed will not be accurate. If the “Fish status” is displayed as grade "D" level, the fish fat percentage will not display since the fish does not meet the “freshness” threshold and the fish fat cannot be accurately measured.

	Operation	Screen
①	Press key to turn on. Under home screen hold down key until Menu is displayed. Match a cursor (→) to Operation setting and then press key.	
②	When the operation settings are displayed, move the cursor (→) to 5. Fat % display by pressing key and then press key.	
4	Choose <Limited> by pressing key and then press key. Press key under operation setting screen to return to the home screen.	
5	The setting is completed. No fat % is displayed when the status of fish is "D".	

Chapter 5 Evaluation of measured result

5-1. Evaluation by impedance mode

The impedance mode is for actual measurement value for those who want to know:

1) Fish fat percentage of unregistered (not within the 20 supported) fish species listed in this document.
2) To make your own fish fat calibration. The impedance at 100 kHz is displayed instead of fat percentage (unit: Ω). This device measures fish fat by applying small electricity into a fish body. This electricity flows through the body easily when water is present but encounters high resistance when fat is present (no water). It's from these electrical characteristics that this device measures fat percentage. If it has high impedance (resistance) at high frequency bands, this means there is more fat content present in the fish body.

When using this impedance mode, it's important to be consistent when measuring. We recommend having a certain guideline of when to take measurements of the fish from time of catch (death). Once you have a guideline to have consistent results, you can easily evaluate the fish fat percentage going forward.

5-2. Evaluating "Fish Status" (fish freshness) with actual measurement

The status of fish (fish freshness) is a mode when you want to evaluate the fish quality for fish freshness. The impedance of 5 kHz is displayed along with the 5-level grading (unit: Ω). The measurement is carried out by applying small electric current to the fish. The electrical characteristics of the cells change with decreasing freshness. The water content of the cells decreases with time which makes the electricity easier to flow through in low frequency bands, thus reducing impedance (resistance).

In the status of fish (fish freshness) mode, it's necessary to keep track of the impedance at regular intervals. From the measured results, you can monitor the fish quality for strict quality control.

5-3. Measuring in impedance mode

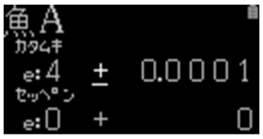
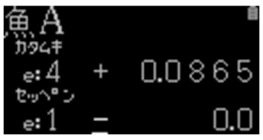
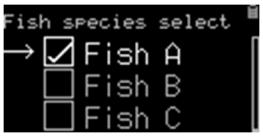
	Operation	Screen
①	Make sure that the "Impedance mode" has a tick mark (レ) under " fish species selection".	
②	Start measuring after choosing "Impedance mode" by pressing key.	
③	After measurement, the impedance value at 100kHz is displayed instead of the fat percentage.	

5-4. Custom Calibration: How to make an original algorithm

Fish Analyzer can be used to make custom calibrations mainly for research institutes use. It requires an environment in which the actual fish fat mass can be measured and Soxhlet method or hydrometry can be used.

“Fish A", "Fish B" and "Fish C" are provided in the fish species selection. These are fish species for displaying the percentage of fat in the original algorithm. First, measure the impedance value in the impedance mode and then measure the fat percentage using the Soxhlet method or hydrometry. Finally, regression analysis with impedance value is performed based on this fat percentage and by entering its slope and section, you can create your own fat percentage formula.

Example: Making an algorithm for “Fish A” by entering “0.0865” for slope and “-4.8” for section

Operation		Screen
1	Move the cursor（→）to Fish A and press key. Then put a check mark ”レ” (check mark) on Fish A.	
2	Hold down key awhile to go to slope and section screen. Press key to enter a value for slope.	
3	Press （decreasing） or （increasing） to enter the value. “e” means digits after the decimal point. Enter "4" for 4 digits after the decimal point.	
4	Next enter the sign (+ or -). In this case, no need to change from +, press key.	
5	Finally enter a numerical value. Press key to move the digit and enter "0.0865".	
6	Next match a cursor（>）to section by pressing key and then press key. Taking the same procedures ③～⑤, enter「-4.8」for section. After entry the cursor（>）locates on section, press key.	
7	After returning to fish species selection screen, press key to return to the home screen.	
8	Choose Fish A by pressing key and measure. The fish fat percentage based on the original algorithm is displayed.	

Chapter 6 Other topics - Error messages & FAQ's

6-1. Error messages

If any of the messages appear below, take corrective action accordingly.

If you encounter messages that are not listed below or the recommended fix do not work, please look at our "Product inquiry" on our website at http://www.yamato-scale.co.jp/en/

	Error Display	Recommendations on how to fix
①	E-3、Status E	This is displayed when sensor electrodes are not contacting the fish properly. Read section 3-1 for proper measurement techniques.
②	E-7	This is displayed when there is a problem with the surface of a fish. Wipe the surface with a damp cloth and measure with some moisture remaining.
③	E-2	This is displayed when stable measurement cannot be performed. After turning off the power, perform measurement again. If it still appears, contact http://www.yamato-scale.co.jp/en/.
④	E-4、Error100	Displayed when there is a device problem. After turning off the power once, measure again. If it still appears, please consult with http://www.yamato-scale.co.jp/en/

6-2. Frequent Q&A

Question	Answer
Q1. What kind of fish species does it measure fish fat percentage of?	Horse mackerel, Mackerel, Yellowtail, Sea bream, Bluefin tuna, Salmon, Rainbow trout, Sea bass, and many more. It supports 20 fish species. See section 2-3 for complete list.
Q2. Defrosted or F is displayed, what does it mean?	This means the fish has been previously frozen and it will not measure fish fat percentage. It's been "Defrosted". (Page 6)
Q3. The fish I want to measure is not listed in the 20 fish species support.	As the fish has not been pre-calibrated, you can use the impedance mode to measure the fish. (Page 20)
Q4. How many measurements can the device hold?	The device can store 50 past measurement results. (Page 15)
Q5.  What does it mean?	It means that an attachment should be used. (Page 10)
Q6.  What does it mean?	This means the fish is measured the day after catch (or fish death). Often used in fish distribution centers. (Page 13)
Q7.  What does it mean?	Means no contact or poor contact of sensor electrodes with a fish. (Page 10)
Q8. Power turns off automatically.	Make sure you don't have the automatic turn off modes enabled. (Page 18)

Questions	Answer
Q9. Screen turns off automatically, what is going on?	Make sure you don't have the automatic turn off modes enabled. (Page 18)
Q10. How do I change display brightness?	The screen brightness can be chosen from "Saving power", "Normal" or "Bright". (Page 18)
Q11. What does "E-3" mean?	This error message is displayed when measuring error occurs, or when the device is damaged. (Page 22)
Q12. What does "Status E" mean?	This is displayed when an issue with sensor electrodes not making correct contact with the fish. (Page 22)
Q13. Why is the fish fat % not displayed?	Fish fat % will not display when the status of fish is grade "D" level or below. (Page 19)

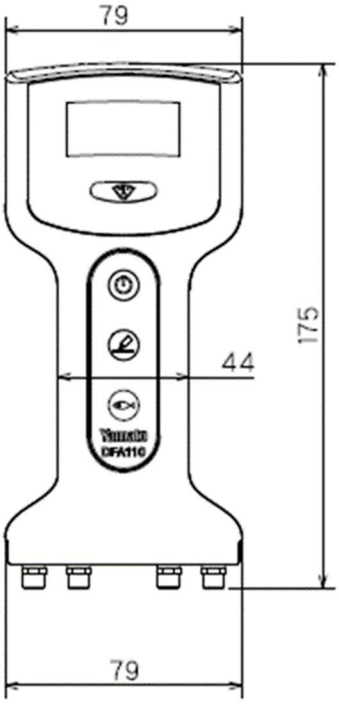
6-3. Specifications

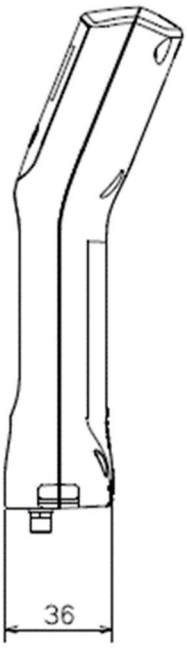
■ Product appearance and specifications are subject to change without notice.

1.	Product name／Model	Fish Analyzer ™ PRO／DFA110
2.	Measuring method	Bioelectrical impedance method (4 sensor electrode type)
3.	Fish species	20 fish species in total: Horse mackerel 1, Mackerel 1, Mackerel 2, Sardine, Saury, Yellowtail, Bluefin tuna (back, belly and tail), Sea bream, Alfonsino, Bonito 1, Salmon, Rainbow trout, Spanish mackerel, Butterfish, Sea bass, Sailfin sandfish, Grouper, Bonito 2, Sea eel, Horse mackerel 2 Original 3 fish（Fish A, Fish B and Fish C） Impedance mode（Impedance at 100kHz band） Status of fish (fish freshness) (Impedance at 5kHz band)
4.	Display	
	・Display method	Organic EL display (white), dot matrix system
	・Main display	
	Fat percentage	1 to 70%（unit: 1%）
	Impedance	30Ω to 999Ω（unit: 1Ω）
	Status of fish (fish freshness)	Freshness A'、A、B、C、D (5 levels), E＝Error, F = Defrosted
	Battery level	3 levels (bar) for remaining battery indication
	Others	E-3、Status E、E-7、E-2、E-4、Error100
5.	Keys	Refer to 2-2. Display and keys
6.	Functions	
	・Fat % display	Displays fish fat amount that a raw fish contains
	・Status of fish display	Displays freshness in 5 levels (grading)
	・Display of defrosted	Determine if it has been previously frozen and defrosted
	・Impedance entry	Make original algorithm (custom calibration)
	・Auto off 1	Automatically turns off device power (0 to 60 minutes)
	・Auto off 2	Automatically turns off display screen (0 to 60 minutes)
	・Brightness	Brightness in 3 levels
	・Average fat % display	Displays the average fat percentage of measurements
	・Store result	Stores up to 50 past measuring results
7.	Appearance	
	・Dimensions	
	Main body	(W) 79 × (D) 36 × (H) 175mm
	Main body+ attachment	(W) 79 × (D) 36 × (H) 189mm
	・Net weight	
	Main body	Approx. 155g（excluding batteries）
	Main body+ attachment	Approx. 180g（excluding batteries）
	・Material	

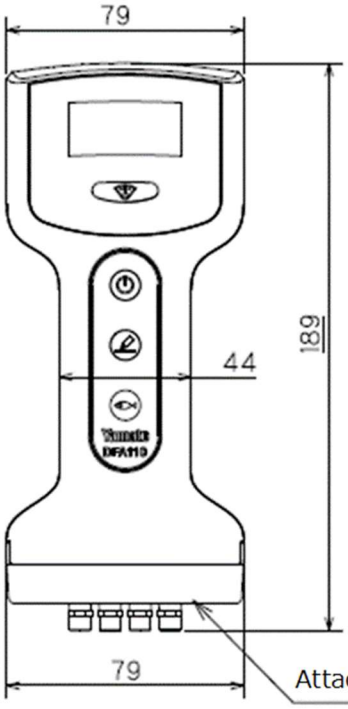
	Housing	ABS resin
	Electrodes	SUS304
8.	Protection	IP65
9.	Power	
	Power source	2 x C3 dry battery
	Rated voltage	DC3V
	Power consumption	Approx. 90mA
	Battery life	Measure up to 15,000 times with alkaline batteries
10.	Operating conditions	
	・Operating temperature	-10℃ to +40℃
	・Operating humidity	30% R.H. to 85% R.H. (no condensation)
11.	Diagram measurement unit	unit : mm (millimeters)

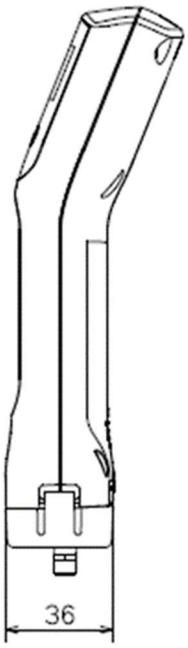
● Standard





● With attachment





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