

WinFrog Device Group:	PLOW
Device Name/Model:	AradoPlough
Device Manufacturer:	
Device Data String(s) Output to WinFrog:	See Telegram Specification section below.
WinFrog Data String(s) Output to Device:	See Telegram Specification section below.
WinFrog Data Item(s) and their RAW record:	PLOWDATA 490 ROV REF VEH NONE

DEVICE DESCRIPTION:

This device is designed to read data from the Arado Plough. It also outputs the data described in the WinFrog data String(s) Output to Device section above.

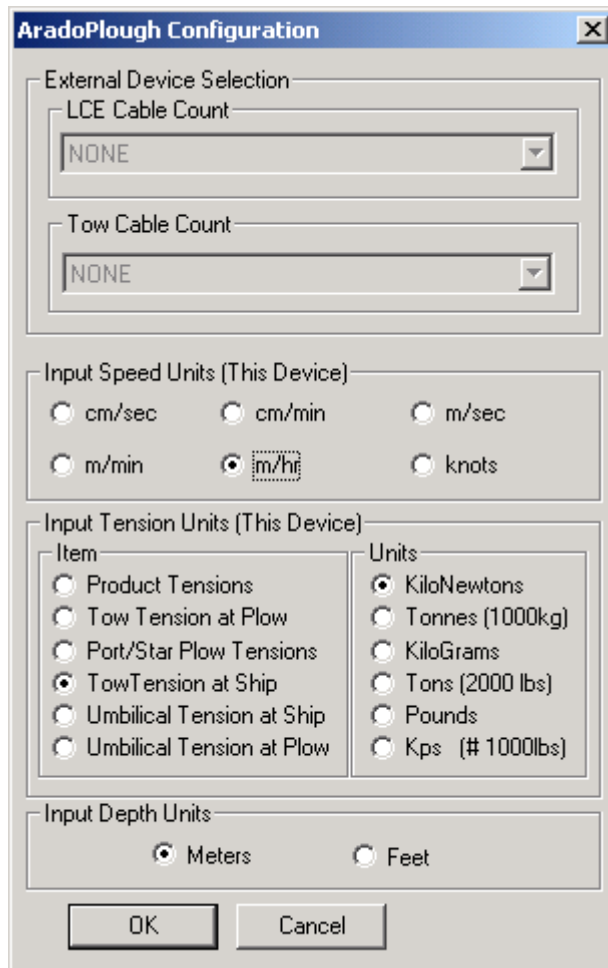
DEVICE CONFIGURATION INSTRUCTIONS

WINFROG I/O DEVICES > EDIT I/O:

Serial
Configurable Parameters

WINFROG I/O DEVICES > CONFIGURE DEVICE:

This device must be configured at the I/O Device window level. In the I/O Devices window, click the device name to select it, then right-click and select Configure Device. The AradoPlough Configuration dialog box appears, as seen below.



The image shows a Windows-style dialog box titled "AradoPlough Configuration". It contains several sections for configuring the device:

- External Device Selection:** Contains two dropdown menus, "LCE Cable Count" and "Tow Cable Count", both currently set to "NONE".
- Input Speed Units (This Device):** A group box containing six radio buttons: "cm/sec", "cm/min", "m/sec", "m/min", "m/hr" (which is selected), and "knots".
- Input Tension Units (This Device):** A group box containing two columns of radio buttons. The "Item" column has: "Product Tensions", "Tow Tension at Plow", "Port/Star Plow Tensions", "TowTension at Ship" (selected), "Umbilical Tension at Ship", and "Umbilical Tension at Plow". The "Units" column has: "KiloNewtons" (selected), "Tonnes (1000kg)", "KiloGrams", "Tons (2000 lbs)", "Pounds", and "Kps (# 1000lbs)".
- Input Depth Units:** A group box containing two radio buttons: "Meters" (selected) and "Feet".

At the bottom of the dialog are "OK" and "Cancel" buttons.

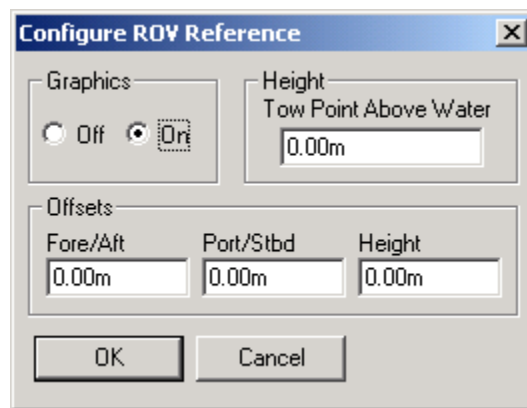
The External Device Selection is not applicable to this device. Data for the Telephone and/or Tow cables are read directly into the Plough Control Room's computer system and included in the data string from the Plough to WinFrog. The Input Speed Units as well as the Input Tension items and related Units are configurable from this dialog box. Input Depth Units can be set to meters or feet.

WINFROG VEHICLE > CONFIGURE VEHICLE DEVICES > DEVICE DATA ITEM > EDIT:

Adding the AradoPlough device creates two data items: ROV REF VEH and PLOWDATA. Once the data items have been added to the vehicle, they must be edited to suit the application.

Data item: ROV, AradoPlough, ROV REF VEH

This data item is attached to the vehicle in WinFrog that has a real-time positioning source (DGPS, etc.), typically the ship. This vehicle with its known position serves as the reference point for determining the Plow's position. Highlight this data item and click the Edit button to open the Configure ROV Reference dialog box seen below.

**Graphics:**

Select the On radio button to display the device name and a square at the location of the ROV, within the Graphics and Bird's Eye windows.

Tow Point Height:

The height of the tow point above water is added for layback calculations only if a towed vehicle model is used.

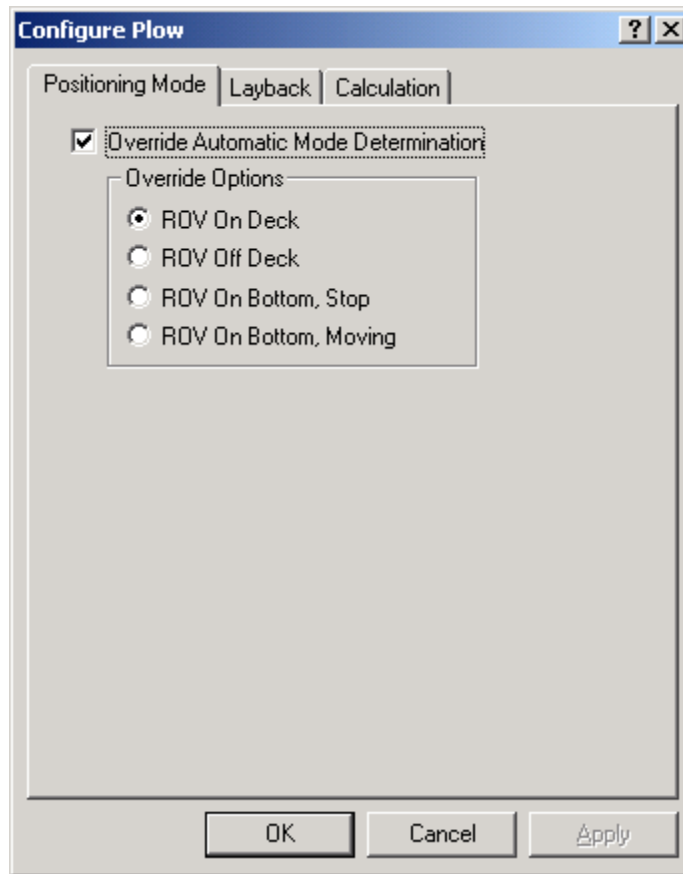
Offsets:

The X,Y,Z Offsets are applied from the CRP to the tow point (usually the winch) on the ship. These values are set similar to values that would be applied to any device offset within WinFrog. Note that the Height Offset is not used for operations involving plough vehicles.

Note: It is advised to use the waterline as the vertical CRP reference when sub-sea positioning devices are employed.

Data item: ROV, AradoPlough, PLOWDATA

This data item is typically attached to the Plough vehicle in WinFrog. Highlight this data item and click the Edit button to open the Configure Plow dialog box as seen below.



Positioning Mode tab

Override Automatic Mode Determination:

This checkbox determines whether WinFrog automatically determines the towed vehicle location and mode or whether the operator determines it.

When in automatic mode, WinFrog uses the following criteria to determine the mode of the towed vehicle:

ROV On Bottom, Moving is assumed if the speed is greater than .2 knots or the Use ROV Speed setting is off and the layback is calculated at more than 1 meter.

ROV Off deck is assumed if the speed is greater than .2 and the layback is calculated at less than 1 meter and the altitude is greater than 4 meters.

ROV On deck is assumed if the speed is 0 and the layback calculated is less than the sum of the depth offset entered on the Calculations tab and the Tow point above water entered on the ROV REF VEH dialog.

ROV On Bottom, Stopped is assumed if none of the others are true.

Override Options:

ROV On deck places the towed vehicle on the tow vessel 5 meters forward of the offset point entered in the ROV REF VEH dialog.

ROV Off deck places the towed vehicle on the tow vessel at the tow point, which is the offset point entered in the ROV REF VEH dialog.

ROV On Bottom, Stop leaves the vehicle where it was when this option was selected and makes no further calculations as to its position.

ROV On Bottom, Moving calculates the towed vehicle's position using the data available and updates all displays with this data.

The screenshot shows the 'Configure Plow' dialog box with the 'Layback' tab selected. The 'Positioning Mode' tab is also visible. The 'Layback Calculation Method' section has two radio buttons: 'Pythagorean' (selected) and 'Catenary'. To the right of these is a text box for 'Tow Cable Constant' containing the value '73.29051' and the unit 'N/m'. Below this are three sections: 'Use ROV Depth' with 'Yes' and 'No' radio buttons ('No' is selected), 'Use ROV Speed' with 'Yes' and 'No' radio buttons ('No' is selected), and 'Use ROV Tow Angle' with 'Yes' and 'No' radio buttons ('No' is selected). To the right of these is a 'Trench Depth' section with a text box for 'Offset' containing the value '0.0cm'. At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Apply'.

Layback tab

Layback Calculation Method

Pythagorean uses the depth and cable count to form a right triangle. The layback is then calculated and applied to the tow vehicle's offset position along with an azimuth based upon the previous towed vehicle's raw position. WinFrog will use this position to calculate an azimuth but use the calculated layback for the distance between the towed vehicle and the tow vehicle.

The right triangle is formed thus: the hypotenuse is the cable count and the vertical value is the sum of the depth, Tow Point Above Water and the z offset found on the Calculations tab.

Catenary requires the weight of the cable in newtons/meter, (1lbs/ft = 14.63nt/m). This calculation uses the cable count, depth of the towed vehicle and the tow tension to calculate the layback using a static catenary model. The azimuth used is the same as described above.

Use ROV Depth

Yes causes two actions:

- 1) The depth obtained from this device will be added to the depth offset and assigned to this vehicle. The depth offset is entered in the Calculation tab. The depth obtained from this device is either the manually entered value (if applicable) or the depth from one of the data items from the selected device.
- 2) The depth obtained from this device is used to determine the layback. No offset is applied except which may be applied at the source device.

No causes the depth for the layback calculation to be obtained from the vehicle. Essentially, this means the depth must be assigned by another device. This overrides the selection of a device or manual entry of depth.

Use ROV Speed

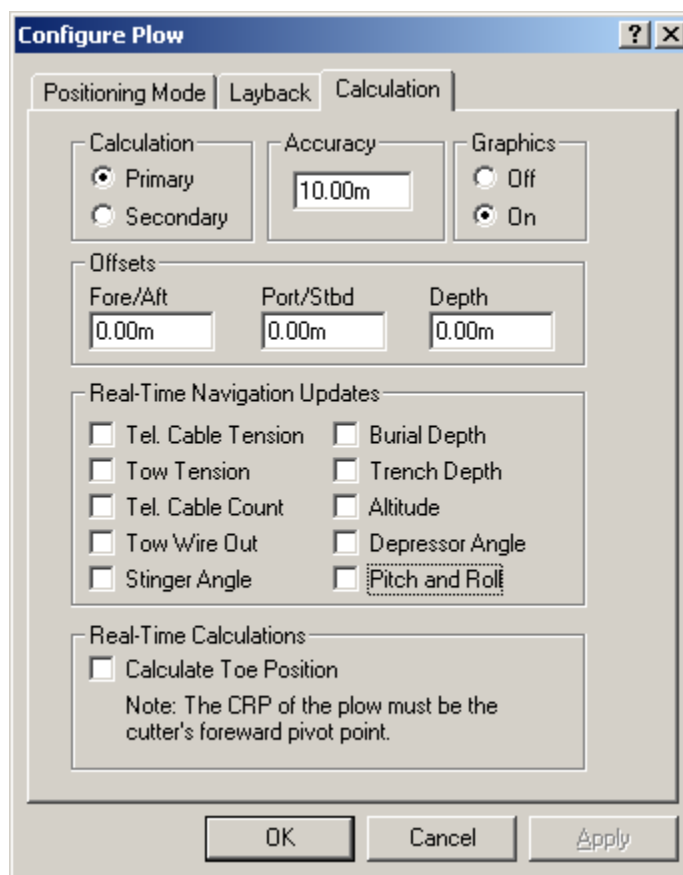
Yes causes the speed of the device to be obtained from this device. This requires that the towed vehicle in use must have the ability to output a speed in its data string. If it does not, then select No. **No** causes the speed to be calculated from the positional information and time. It will be assigned to the vehicle.

Use ROV Tow Angle

This option only applies to the SeaplowVIII Device.

Trench Depth

Offset – If the Trench depth checkbox is selected on the Calculation tab (see below) then this value, 0.0 or otherwise, will be assigned as this vehicle's trench depth.



Calculation tab

Calculation

Primary – when selected, the layback described above will be used to calculate this vehicle's position, which will be assigned to it.

Secondary – when selected, this device will not determine this vehicle's position.

Accuracy

The Kalman filter uses this value as a weight factor. It should be set to a reasonable value.

Graphics

Select the On radio button to display a square in the Graphics and Bird's Eye windows at the offset position below.

Offsets

The **Fore/Aft** and **Port/Stbd** offset point is the reference point for the layback distance. Essentially the lay back distance is the distance between this point and the offset point of the tow vehicle described in the **ROV, AradoPlough, ROV REF VEH** section above. This can also be viewed as the beginning or 0 point of the tow cable. This offset point is from the towed vehicle's CRP to the tow point.

Depth is an offset from the CRP. It is applied in several different ways:

- 1) If **Use ROV Depth** is set to **Yes** (on the Layback tab) this value is added to the depth from this towed vehicle device and assigned to the vehicle's depth. See Use ROV Depth on the Layback tab above.
- 2) If the Pythagorean solution is selected, this value is added to the vehicle depth and the Tow Point Above Water value to get the vertical portion of the right triangle when computing the layback.
- 3) If the catenary solution is selected, this value is not used in the model.

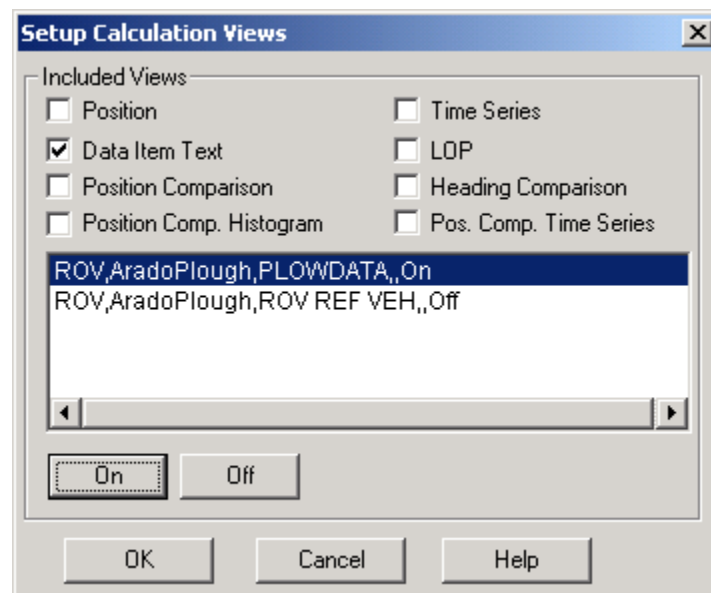
Real-Time Navigation Updates

Most Plow devices have the ability to provide real-time data updates via an umbilical. The Decoded data tab in the I/O Devices window will indicate what data is updated in real-time for each device. You should only select the checkboxes for data output by the device, as leaving these checkboxes selected causes data to be assigned to the vehicle. If the device does not output a particular type of data, 0 will be assigned for each item left selected and this will cause values from other devices to be overwritten.

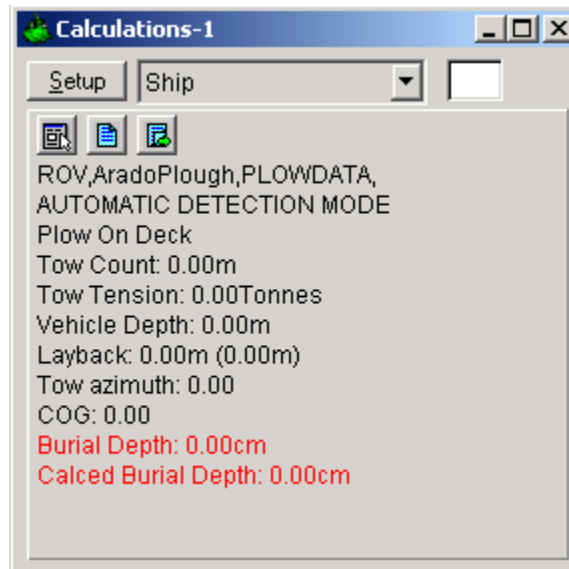
Real-Time Calculations

Calculate Toe Position – this option only applies to the Smart Cutter plow device.

The results of the above configurations are typically viewed in a Calculations window. To display the Calculations window, select View > Calculations from the main menu. Select the appropriate vehicle from the dropdown list and click the Setup button. Select **Data Item Text** and turn the data item **ROV, AradoPlough, PLOWDATA** on by highlighting it and clicking the **ON** button as seen below.



Exiting with OK will display the Calculations window as seen below.



From this window, you can monitor some of the input data as well as the layback calculation. This Calculation window also provides a shortcut to the Configure Plow dialog box by clicking the  button.

TELGRAM SPECIFICATION:

INPUT STRING (Comma delimited)

Field	Data
1	tow count (metres)
2	tow tension at the plow (hundredths of the user selected units. I.e. the value in the telegram is divided by 100)
3	umbilical cable count (metres)
4	umbilical cable tension (hundredths of the user selected units. I.e. the value in the telegram is divided by 100)
5	plow speed (units as selected by user)
6	plow travel (kilometres)
7	unused
8	burial depth (millimetres)
9	roll (degrees)
10	pitch (degrees)
11	as laid tension (units as selected by user)
12	plow depth (tenths of the units selected in the configuration, i.e. the value in the telegram is divided by 10)
13	plow heading (degrees)
14	<Line feed> or <carriage return><Line feed>

OUTPUT STRING (Comma delimited)

Field	Data
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- | | |
|----|---|
| 1 | Ship Latitude dd.mm'mmm.c where the mmm after the minutes mark (') is the decimal of minutes and the c after the second decimal point is character denoting the hemisphere ('N' or 'S') |
| 2 | Ship Longitude ddd.mm'mmm.c where the mmm after the minutes mark (') is the decimal of minutes and the c after the second decimal point is character denoting the hemisphere ('E' or 'W') |
| 3 | Ship speed (kilometres/hour times 100) |
| 4 | Ship Course Made Good (Grid, degrees times 10) |
| 5 | Depth (metres times 10) |
| 6 | Plow Latitude dd.mm'mmm.c where the mmm after the minutes mark (') is the decimal of minutes and the c after the second decimal point is character denoting the hemisphere ('N' or 'S') |
| 7 | Ship Longitude ddd.mm'mmm.c where the mmm after the minutes mark (') is the decimal of minutes and the c after the second decimal point is character denoting the hemisphere ('E' or 'W') |
| 8 | Plow depth (metres) |
| 9 | Ship heading (True, degrees) |
| 10 | X (Metres USBL beacon coordinate) |
| 11 | Y (Metres USBL beacon coordinate) |
| 12 | Z (Metres USBL beacon coordinate) |
| 13 | Cable tension at the ship (tonnes times 1000) |
| 14 | Plow distance along line (metres) |
| 15 | <Carriage return><Line feed> |
| 16 | <,> (a comma is added after the<Carriage return><Line feed>) |

Note: All terms include leading zeros