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| Van Oord |
| Wavelogger V4 Manual |
| Manual for the 3rd version of the Waveloggers, complimentary to the previous manual: EMS wave logger data processing |

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| Poelhekke, Laurens (L), revised by Rob Swart & Ewoud Volbeda  2/10/2015 |

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# Introduction

The previous manual for the Waveloggers, written by Henk Jan Verhagen, *EMS wave logger data processing* is written for an earlier version of the Waveloggers. This manual is update to be used with version 3 of the EMS Waveloggers. It contains mainly practical information and guidelines to the operation and data processing. The theory of the working of the Waveloggers has not changed and can be found in the previous manual.

The manual is updated in February 2015 to include information about the settings for deployment. Additionally, a smarter way of calibrating is carried out and some tips and tricks are added.

# Setting up the Wavelogger

## Physical preparation

* The o-ring should be kept clean and sufficient Molykote 111 Compound (silicon sealant) should be applied before each deployment
* Close the cap tight!!. Check the other cap if it is sealed and closed tight!!
* SD card: open slot by moving it downwards, close by moving it upwards

## Wavelogger Settings

The Wavelogger has three modes:

1. **USB:** In this mode the logger can be connected to a PC using the USB cable. This allows for retrieving data, changing the settings and recharging.
2. **LOG:** The Wavelogger is logging the pressure according to the user defined settings.
3. **OFF:** The Wavelogger is off.

The LED switch allows you to see the function of the Wavelogger. Flashing means logging, continuous on means USB mode. The LED shall also be switched off to safe battery power when logging. Thurn it on to make sure the device is logging (led is flashing) and then turn it off for deployment.

## USB Cable

The supplied USB cable has a built in FTDI chip, to use it a driver has to be installed which is supplied on the DVD and can also be found here:

<http://www.ftdichip.com/FTDrivers.htm>

The virtual com port (VCP) driver is required and the easiest way is to download the executable setup file. Run this file as administrator (right click, ‘run as administrator’). It is recommended to connect the logger during driver installation and put it on USB mode.

After the driver is installed the device manager of Windows should be checked. Under *Ports* a USB serial port with a *COM* number should be found. Usually the *COM* number is *COM6*. You will need this when working with the *Command* program to communicate with the Wavelogger.

The cable may now be used to configure, retrieve data or charge the Wavelogger. The charging is either by pluging the USB plug to a computer port or to a common USB adaptor (for smart phones, for instance).

## Installing the Command program

To install the Command program copy the folder *SetupUtil* from the DVD to your PC and run the *setup* executable as administrator. Follow the steps and the command program will be installed.

## Connecting the Wavelogger to your PC

To retrieve data or configure the Wavelogger the *Command* program may be used.

1. Set the Wavelogger to USB mode.
2. Attach the USB cable to the PC and Wavelogger and open the *Command* executable.
3. In the command window select “do nothing’’ mode
4. Select the COM number that corresponds with the USB port. (see chapter USB Cable).
5. Press Open, if working correctly the program will return something that looks like this:

[2J[HSETUP

MENU

SELF\_TEST

INT: 300 *Setting for the interval, in seconds*

SAMPLES: 31 *Settings for the number of samples*

TIME: 2014/6/13 8:56:39

AD VAL: 151 *The measurement at this time (voltage)*

SD WRITE... *Status of the SD card*

TEST...OK

CMD...

Now you are connected, you can change the settings of your Wavelogger and either erase the memory on the SD card or leave it unchanged. The three possible operations are:

1. Configure settings + Do nothing
2. Configure settings + Erase memory
3. Configure settings + Download memory. This downloading does not work properly. See the next chapter for a description of the download procedure.

These are described below. Press *Close* to close the connection between the PC and the Wavelogger.

### Configuration

The two basic settings for the Waveloggers are the amount of samples to be taken during a measurement and the interval between successive measurements.

In the dropdown menu *Samples*  the amount of samples during a measurement can be set. The choices are given in the table below, including the time of the sample for a sampling rate of 4 Hz.

|  |  |
| --- | --- |
| Samples | Time |
| 2 | 0.5 s |
| 4 | 1 s |
| 8 | 2 s |
| 16 | 4 s |
| 32 | 8 s |
| 64 | 16 s |
| 128 | 32 s |
| 256 | 1m 4s |
| 512 | 2m 8s |
| 1024 | 4m 16s |
| 2048 | 8m 32s |

The interval between two successive samples can be set in the dropdown menu *Interval*. The choices are: 5, 10, 15 or 30 minutes.

**Note**: The sampling duration should have at least 100 waves to get a good spectral analysis. This means that the sampling time has to be around 20 minutes. A 20 minutes record is short enough to be stationary and long enough to obtain reasonably reliable averages. The solution with near continuously recording (1024 samples with a 5 minute interval) results in a short recording time. The batteries of the loggers are able to record continuously for only two days. Combining three records of eight minutes and a 30 minute interval extends the battery duration, while giving reliable results. For calibration, an interval of 5 minutes in combination with 1024 samples should be used.

When connecting the logger, always make sure to put the SD card option to *Do Nothing* for the first settings transfer in order to not lose the data.

Once you have selected your preferred settings click on the *Generate*  button and immediately after on the *Send* button. This will set the year, month, day, hour, minute, second, weekday and preferred settings on the Wavelogger. (The reason that you have to press send immediately is that otherwise the time on the Wavelogger will not match the time on your PC)

Press *Close* to close the connection between the PC and the Wavelogger.

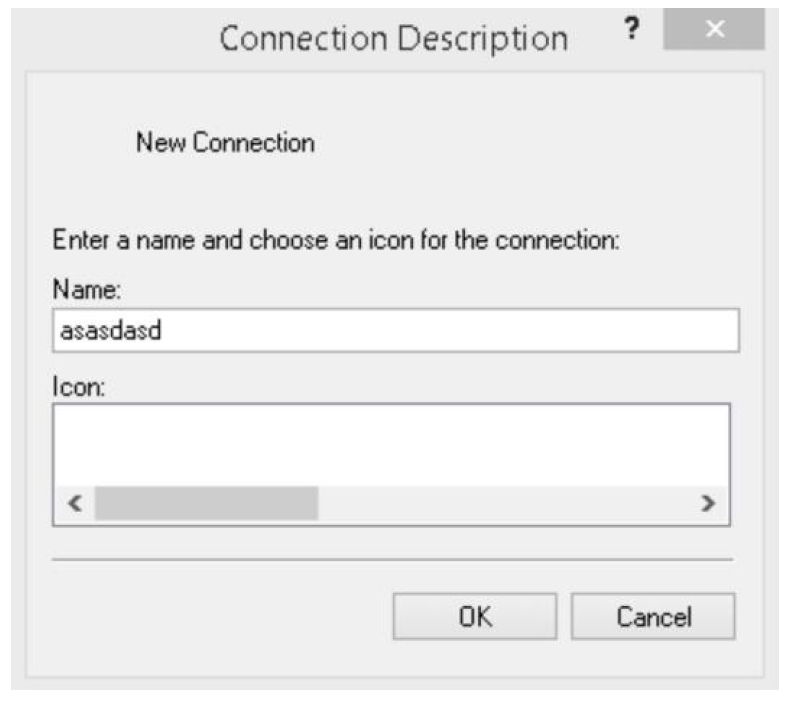
### Downloading data

There are two ways of getting the data out of the waveloggers:

1. Take the sd card out and put it in a card reader.
2. Use HyperTerminal in combination with Command

The first way is easy, but requires handling the sd card. The second way is a bit more difficult, but you don’t have to take the sd card out so it saves time. Below the second procedure is described.

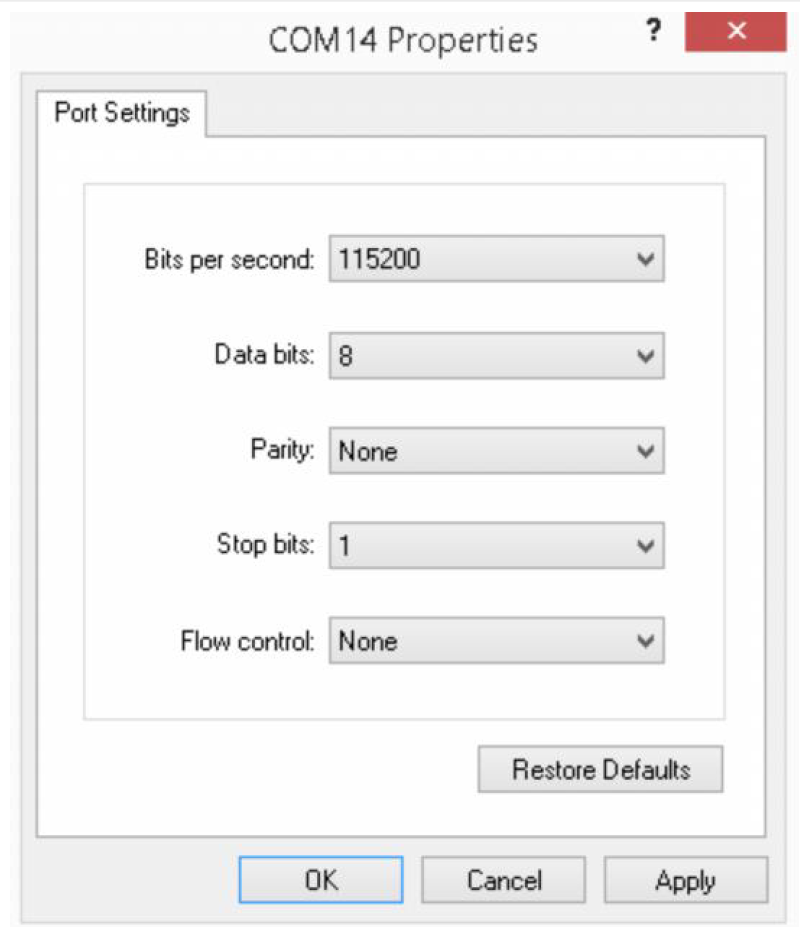
1. Open HyperTerminal
2. Enter any name into the ‘Connection Description’ dialog



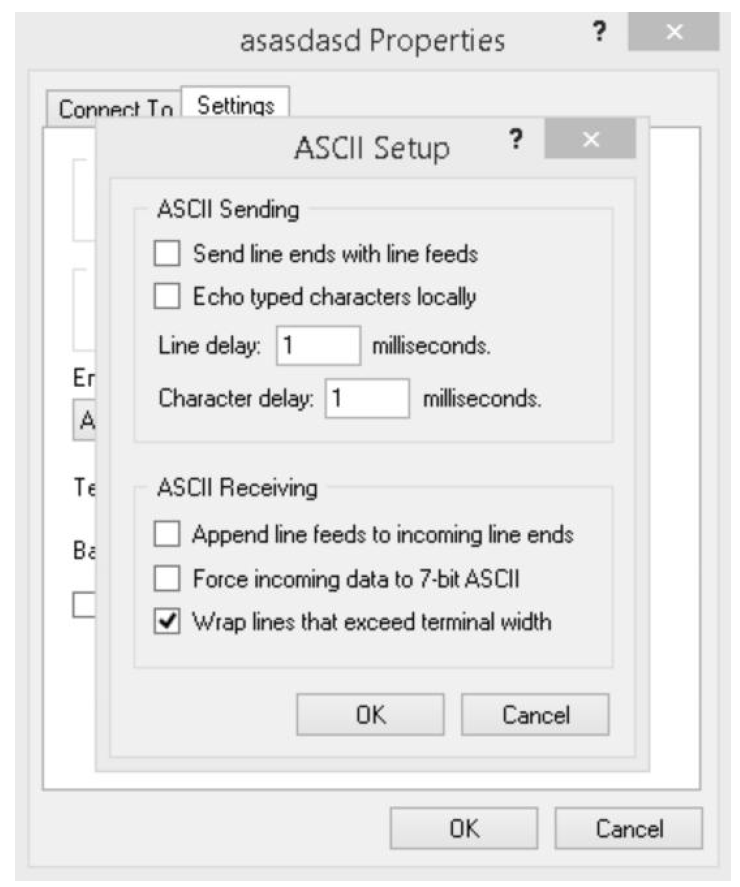
1. Select the com port that the logger is connected to



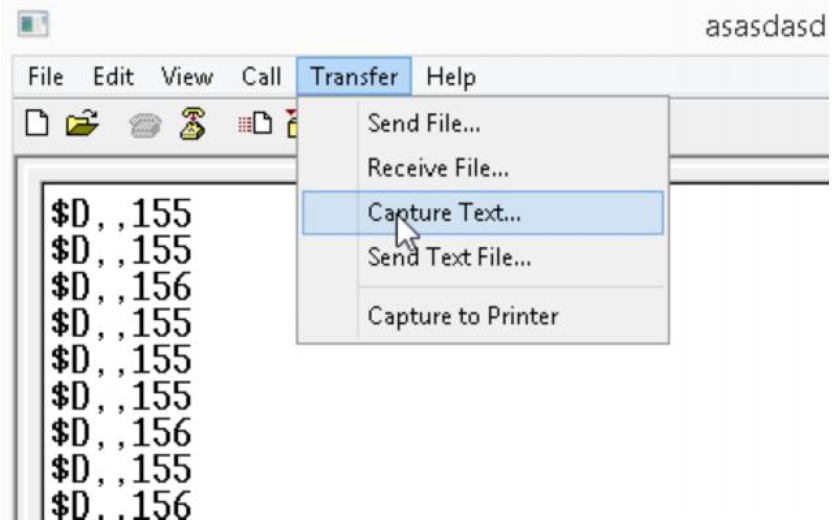
1. Enter the port settings as follows



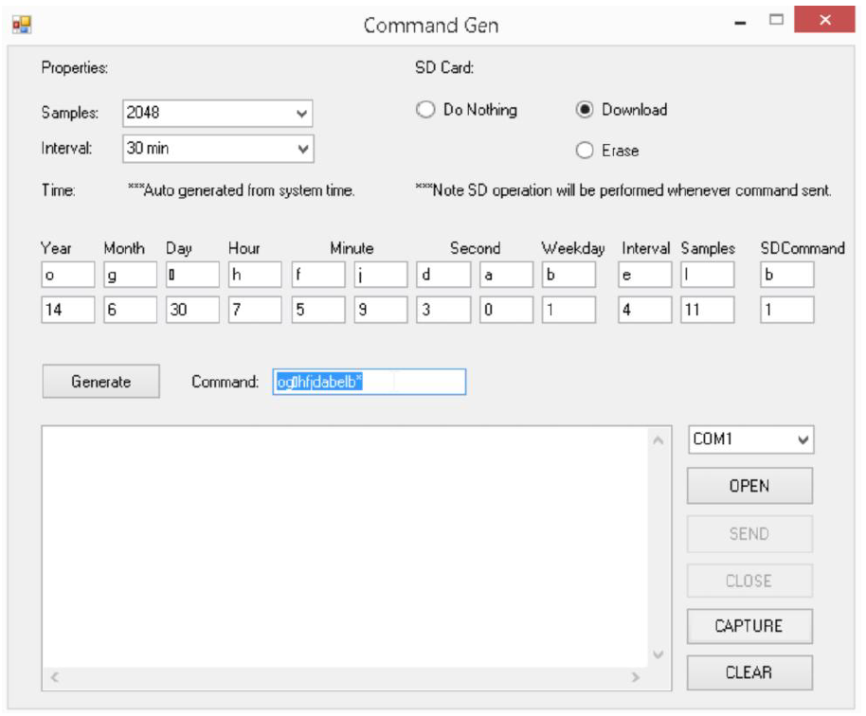
1. Click File->Properties->ASCII Setup, then enter delays as shown below



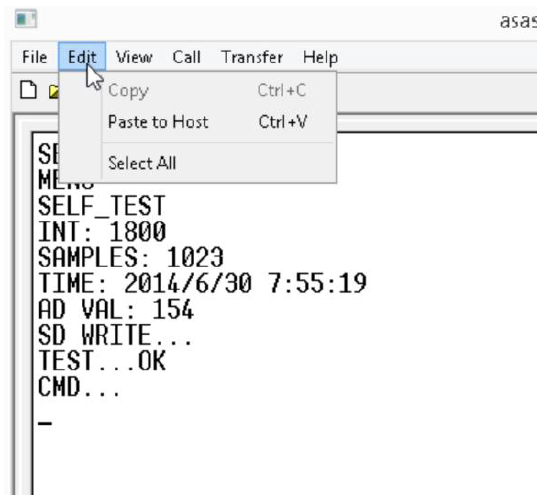
1. Click Transfer->Capture text… Select a file name and destination, then click START



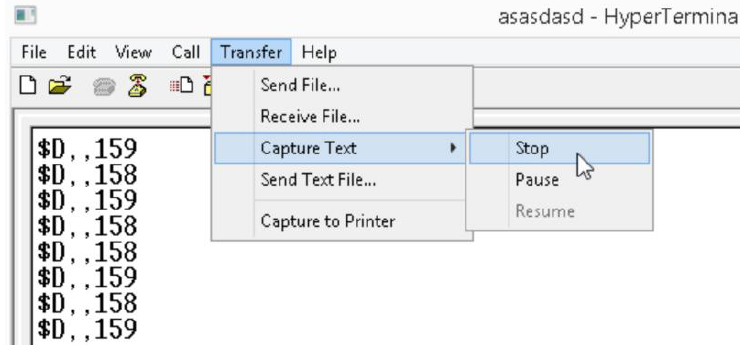
1. Open the Command program, and select Download, then generate the command, copy this to the clipboard



1. Click Edit->Paste to Host… The logger should start downloading, if it does not, regenerate the code then repeat the paste.



1. Once the logger is no longer sending data, click Transfer->Capture Text->Stop



# Operating the Wavelogger

## Calibration

For the calibration of the Wavelogger follow the report *Calibration of the Wave Loggers*. The excel file *Calibration Waveloggers* may also be used.

The setup for the calibration is shown in Figure 1. The Wavelogger is weighed down (5-10kg) and submerged at measured depths. The logger should be kept in place for about 1.5 minutes at the known depth to get an accurate reading. Measure depths on the way down **and** the way up.

|  |
| --- |
| C:\Users\LPX\Dropbox\Camera Uploads\2014-06-13 16.47.52.jpgC:\Users\LPX\Dropbox\Camera Uploads\2014-06-13 16.35.30.jpg |
| Figure Initial Setup Wavelogger calibration |

|  |
| --- |
| C:\Users\TJY\Desktop\DSCN0838.JPGC:\Users\TJY\Desktop\DSCN0840.JPG |
| Improved setup wavelogger calibration |

## Deployment

Deployment of the Waveloggers is done by vessel. In this case either with a small rubber speed boat or one of the tug boats. A GPS is needed to drop the Waveloggers at the desired location. The actual location of the loggers is obtained by getting a GPS fix. In general the depth at which the Waveloggers are deployed may be extracted from the data series. However, it is not unwise to get an idea of the depth to be able to compare and interpret the results correctly and to identify any malfunctioning.

The Waveloggers are attached to concrete anchors, see Figure 2. An anchor line and buoy are attached to the anchors. The anchor line should be at least twice the depth, to prevent the forces on the buoy to move the anchor. Preferably the line should be a little bit longer for easier retrieval. The maximum depth at which the Waveloggers operate accurately is approximately 7 meters. An anchor line of 15 meters is therefore advised.

The anchorline is attached by a shekel to one of the rebars. The shekel can slide up and down. Make sure that the bolt of the shekel is secured!!! Unsecured shekel may cause loss of equipment!!!

****

Figure 2: Wavelogger attached to anchor before deployment

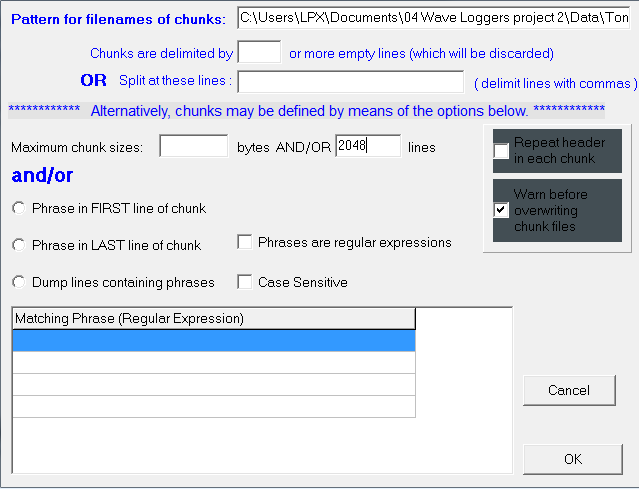
# Data processing

For retrieving data from the Wavelogger, please refer to Section ‎2.5.

The data is processed by the Matlab script *Wavelogger.m.* This script processes files with one observation only. The Wavelogger produces one single data file with all observations in sequence. Also the data file contains some information that has to be removed in order for the script to work correctly. Therefore several steps have to be taken in order to process the data.

1. Open the raw data file (called LOG) and ensure the file contains headers starting with $H (eg, $H,457974752,24,216) and data points starting with $D (eg. $D,,148)
   1. Replace $D, with $D,, using Textwedge or Notepad
   2. Remove lines ‘Lacking $’ using textwedge to remove the zeros
2. Split the raw data file into separate chunks of each log using the program Textwedge. (any other text splitting program will also work)

Open the program and click on *File* -> *Load* and select your raw data file. Click on *Dialogs -> Configure Standard Splitting*.



Insert after how many lines a new file should be created. It should be the number of logs, depending on the Wavelogger settings.

Insert the location to save the files and the pattern of the file names. Pattern:

*Userdefined-<#>.txt*

Avoid underscores!! “\_”

Press *OK* and click on *Action -> Split and Save Chunks*. The file is now split in the number of data logs the Wavelogger logged. All observations from one ensemble should have the same name, and a different number now. For example: Logger2-140618-Part01.txt; Logger2-140618-Part02.txt; Logger2-140618-Part03.txt;… etc.

1. Process the split data files with the matlab script W*avelogger.m*

Open **Matlab 2014b** and *wavelogger.m*.

Enter the number of the wave logger.

At *NofFiles*, enter the number of files the script has to process. This is the number of files the raw data file is split into. If you want to skip the first few observations then set *StartFile* to a higher number.

In lines 71 – 92 additional input data may be altered to alter the calculations.

Run the script, it will ask you to select a file. In the drop down menu, first select ‘all files’. Select the first file of the series of split files. The script will run and save an excel file with the output in the same folder as the location of the script.

|  |  |  |  |
| --- | --- | --- | --- |
| Line nr | Variable name | Default value | description |
| 8 | Rho | 1030 | Density of the water (kg/m3) |
| 9 | g | 9.81 | Acceleration of gravity (m/ss) |
| 10 | Avolt | 254.1 \* | Calibration value A of the pressure meter (Pa/V) |
| 11 | Bvolt | -43250 \* | Calibration value B of the pressure meter (Pa) |
| 12 | TanAlfa | 0.001 \*\* | Bed slope in Battjes-Groenendijk calculations |
| 13 | NofFiles | 1 | Number of input files to be processed |
| 14 | StartFile | 1 | First input file to be processed |
| 73 | M | 25 | Smooth factor for the wave spectrum, a low value M=25, high value M=100 |
| 75 | high | 0.4 | highest frequency for plots |
| 76 | low | 0.05 | Lowest frequency for plots |
| 77 | cutoff | 0.08 | parameter to eliminate noise from the tail of the spectrum when the spectral value is less than a "cutoff"-fraction of the maximum value, then the spectral value is set to exact zero |
| 81 | extraplot | 2 | extraplot = 0 gives no plots, 1= only summary  2=include pressure, 3=include depth, 4= include pressure |
| 83 | method | 2 | method=1 uses Tm for calculating wave height from pressure  method=2 uses real period per wave |
| 85 | steepness | 0.03 | Maximum allowed wave steepness for individual waves |
| 86 | Hminimum | 0.10 | minimum wave height to be considered |
| 87 | interval | 0.25 | interval is the sample frequency interval of the sensor  do not change this value unless another wavelogger is used |

\*Calibration values are specific for each logger and have to be periodically checked by calibration

\*\* Very small value represents almost horizontal seabed

# Excel processing

Use =INT(A2)+MOD(B2,1) to put time and date in 1 cell. Use scatter plot to make graph.

# Possible future improvements

* Make the USB connector easier to use and less vulnerable.
* The SD card may be placed in a different position for easy removal.
* A more user friendly user-interface.
* Rechargeable batteries, for fast redeployment (slot-mounted, not soldered, suitable charger for faster charging)
* The open side of the Wavelogger may be built in the fashion of diving equipment, with quick release and waterproof connectors.
* Engrave logger number in both body and caps