Microprocessor laboratory dual angle hazemeter

MZN–2002

User's guide

Safety recommendations

An automatic hazemeter may be operated only by the person who became completely acquainted with its function within the framework of the training, or who became thoroughly acquainted with the user's guide of this device.

Any manipulation with the measuring device, requiring taking off its cover or its part, is forbidden to execute without previous disconnecting of the device from the mains (by removing the plug from the socket).

Device protection against dangerous handling is achieved through connecting separate parts with the separated protective conductor, and therefore it must be plugged only into the corresponding socket equipped with the protective pin connected to the protective conductor of the mains. It is recommended to use the power cord delivered with the device for connecting the device.

In case of a contingent breakdown of the device that you are not able to identify or remove, contact the qualified service personnel who provides service for the delivered device.

Contents.

1. Specifications.

Dual angle hazemeter MZN 2002

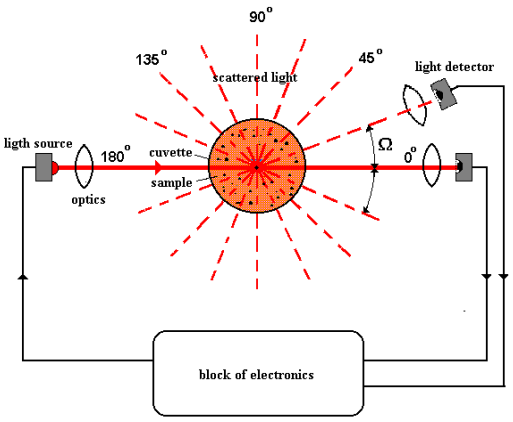
- Measuring range
  0-250EBC for a 90 degrees angle
  0-80EBC for a 12 degrees angle
- Measuring range selection : auto ranging
- Units: EBC (NTU, ppm, MU) - according to formazine standard
- Resolution:
  0,01EBC for 0-10EBC
  0,10EBC for 10-100EBC
  1,00EBC for 100-250EBC
- Accuracy: better than 2%
- Measuring angles: 90^{o}, 12^{o} and 0^{o} for ratio compensation
- Light source: halogen lamp
  standard model - white light (400-1000 nm)
  modification HR – red light (red light filter)
- Optical receivers: Si-PIN photo diodes
- Measurements:
  -in cuvette (outside diameter 15-95 mm, 60 mm standard)
  -in closed bottles (0,3-1l glass, up to 1,5l PET)
- Automatic bottle revolving, means of data and correction of bottles colour and shape
- Acquisition time: 12s
- Plastic measuring chamber with water immersion - usable up to 60 degrees of Celsius
- Display - two-lines sixteen-characters highlighted
- Easy controlled by pushing one button
- Easy periodic calibration through standard formazin suspension
- Output for computer connection by RS-232 interface
- Power voltage: 230V/50/60 Hz
- Power consumption: 60W
- Dimensions: 450x300x300 mm
- Weight: 9 kg
- Guarantee period: 12 months

2. Use of the hazemeter

The MZN hazemeter is the fully automated device that serves for measuring haze in liquids. It is specially designed for observing beverage purity in check-out and research laboratories of food industries, and for observing water purity and some products of biotechnological processes. It allows measuring the haze quantity of samples in closed bottles as well as in special cuvettes. The device is calibrated according to the internationally used standard formazin suspension, and in basic version the quantity of haze is displayed on the display in the most often used units for measuring the haze in food industries - in EBC units.

3. Principles of operation

The MZN hazemeter is designed and constructed in accordance with tested, classical, nephelometric principle combined with additional detection of light scattered in forward direction. The most up to date optoelectronic components and computer technology are used to insure precision accuracy, reproduction and reliability.
General block scheme of the hazemeter is depicted on the following picture:



The light from the source is focused in narrow beam passing the sample by using system of lenses and diaphragms. Part of light scattered on the small particles presented in the sample is recorded by optical detectors.
For MZN-2002 dual angle hazemeter the haze of a liquid is determined by simultaneous measurements of the light scattered in the sample at a 90 degrees angle and of the light scattered at a 12 degrees angle (related to the direction of the probing light beam propagation).
To certain concentration of scattering particles, it is valid that with the growth of the concentration the value of scattered light radiance grows up too. But the measured scattered light radiance can be changed in device even in consequence of other causes that are the changes of the particle concentration or their scattering features. This may be simply done by the change of some optical properties of system - for example the ageing of lamp, filled or dirty windows, absorption of the light in the liquid - i.e. its colour. To make removing these undesirable influences possible, it is simultaneously measured relative light irradiance in scattering optical channels (i.e. nephelometric and forward) as well as in transmission channel (i.e. the light that passed through the sample in straight direction). It is ensured by the construction of the device that the optical paths for passing and scattering beams are the same, so that previous mentioned changes of irradiance (not connected with concentration or scattering changes] in both the scattering and transmission channels take effect equally. So the ratio of UN/UT values of photo detectors output signals from the nephelometric and transmission channels determines the haze known as relative haze that is independent on the above mentioned factors.
This relative haze is then converted to the value of haze in units of a chosen scale by means of device calibrating formula (saved in the memory) which is based on

measurements of standard calibration suspension The formazine suspension is the standard substance in basic hazemeter version, and the haze is displayed on the device display in international EBC units (or it is possible to choose other units – NTU, ppm or MU facultatively).
Haze measuring has great signification especially for beverages production in food industries. The hazemeter gives the possibility of objective quantifying the purity of beverages as one of the check-out parameters. Observing beverage's haze development depending on time brings even information about its durability in addition. That is why it is essential for the first-rate hazemeter to make possible haze measurements of liquid directly in closed bottles. The MZN hazemeters meet this demand. It is natural that ordinary beverage bottle is not the precise clear laboratory cuvette. The bottle very often presents noticeable ellipticity, uneven thickness of wall, unequal colour, used glass is from its optical qualities' point of view very inhomogeneous, and in consequence of common use of bottles their surface is often mechanically damaged. From these reasons the bottle is not too much suitable for the precise optical measuring. In addition, every glass vessel with curved surface filled with liquid (water) is itself an optical element (lens) so that it influences propagation of light beam.

To make measuring the haze value in ordinary bottles possible, these measurements to be comparable and their values to respond the real haze quantity, it is needed to:

1. remove "lens" effect - i.e. ensure that the geometry of the light beam is not dependent on the used design of the bottle,

2. eliminate the influence of the above mentioned defects occurring on bottles.

It is possible to remove "lens" effect by filling up the space around the bottle in the measuring chamber with suitable liquid known as immerse liquid - i.e. liquid with refractive index close to refractive index of glass (suppose the use of ordinary glass bottles). This problem is solved in this way in the hazemeters MZN, where the sample chamber is filled with pure distilled water.
Defects occurring on bottles can be largely considered as accidentally spread out along bottles' circumference. For suppression of their influence, it is therefore needed to take several measurements in different places along the circumference of the bottle and for the resulting value take the average of these measurements. In the hazemeter MZN, there is therefore the bottle placed on the revolving base that is driven by the motor. Revolving of the bottle is controlled by the single chip microcomputer in whose memory measured values from the nephelometric and transmission channels are being saved. Up to several hundreds of read-outs are performed during one turn of the bottle. The average value is then computed from these read-outs, and the quantity of the real haze in accordance with the size of the calibration curve is co-ordinated to this value.

4. Installation - putting the device into operation

4.1. Placing of the hazemeter

The case of the hazemeter must be placed on the flat surface (e.g. laboratory table top). For placing the hazemeter, you should count with the fact that it is inevitable to change the filling of the distilled water in the measuring chamber from time to time (recommendation is - every day – but true frequency depends on the number of measurements and on the dustiness of environment). Because it is not recommended to unnecessarily move the hazemeter or otherwise to manipulate with it, it is useful to ensure a free access to the water outlet tap and the overflow tube on the rear side of hazemeter. ***It is also recommended to connect these water outputs by plastic hoses to drain or sink to avoid possible contamination of working place by water from measuring chamber.***

4.2. Connection to the mains

Plug the power cord into the socket ~230 V on the rear side of the hazemeter and plug the other end of the power cord into the wall socket. The hazemeter is connected with the mains in this manner and may be switch on by the switch "POWER" on the front side.

4.3. Filling up with the immerse liquid

For suppression of undesirable reflections of the light on the optical boundaries (wall of the cuvette or bottle with the measured sample), the measuring chamber of the hazemeter has to be filled with pure water serving as immerse liquid.

It is recommended to use only distilled water to prevent creating of sediments on the walls and above all on the chamber windows.
Before the first filling up of the chamber, it is recommended to carefully remove any contingent bigger dirties that could get there during the transportation of the hazemeter and carefully rinse the chamber by clear water.

The drainpipe of internal overflow water system (which serves for drainage of excessive water from the chamber) as well as the water outlet tap should be connected (e.g. by plastic hose) to an appropriate sink.

Close the outlet tap and place the bottle centring basket into the chamber. (Before putting the basket into the chamber, remove any dirties and dust from the basket by washing it under the stream of water.)

Fill the chamber with limpid distilled water up to the high of cca 1 cm below the top of basket (approx. 0.7l). Exact volume of water that should be filled into the chamber depends on the volume of sample cuvette or bottle which is used. (It is guaranteed when at the inserted sample the water level approaches the upper edge of the basket). Water level in the chamber must never be below upper edge of windows during haze measurements.

During filling the chamber disconnect the hazemeter from the mains because of safety reasons.

4.4. Procedure for measuring the haze

After placing the centring basket into measuring chamber and filling up it with distilled water the hazemeter is ready for putting into operation.

Press the main switch POWER.

Then, controlling microcomputer is activated, the sound signal sounds and for several seconds the used program version and some introductory messages appear on the display. During that internal system tests are performed.

After their end there is displayed the following text on the display:

YOU CAN MEASURE
PRESS C (G,B)

Now, the hazemeter is fully activated and its controlling is done by pressing one key of the four-key keyboard with following design:

1 2 3 4.

Operational meaning of each key in different phases of work with the hazemeter is always indicated in the menu on the display. In the case that it is possible to choose from more options in the given moment, and the meaning of these options is displayed as abbreviation (symbol), the sequence of the stated abbreviation (symbol) from the left.

The same applies even to the basic operating mode where the abbreviations stated on the display have the following meaning:

C.....cuvette ..... responding key 1
G.....green bottle.....responding key 2
B.....brown bottle.....responding key 3

Depending on the diameter of the bottle or cuvette (that is to be measured) there is used an insertion piece (with appropriate hole) which is placed on the top of measuring chamber.




For hazemeters MZN as well as for any models of hazemeters working with the "white" light, the size of measured haze value is somewhat influenced by the colour of used

bottle's glass. The basic controlling program is directed at using in brewery laboratory. That is why there are saved correction relations for ordinary green and brown beer bottles in the memory. These corrections were gained on the basis of processing extensive set of bottles with 0,5 l capacity (see chapter Accuracy of results) and are valid only for light beer of pilsner type.

If you have the ***sample in the cuvette***, you will start the haze measuring by pressing the ***key 1***. If you are measuring beer in the ***green bottle***, press the ***key 2***. For measuring in the ***brown bottle***, press the ***key 3***.

After the start of the measuring, the controlling microcomputer lights the lamp in the hazemeter up. That is indicated by the light of green signal LED-diode labelled **LAMP** on the hazemeter's front panel. Then, it turns on the motor that drives the revolving base that the sample is placed on, and it starts the procedure of measuring the signals from photo detectors. During one revolution several hundreds of measurements are taken from which the average value is then computed (Cuvette or bottle with the sample is revolved for more than 360 degrees in the chamber because certain time is used for stabilization of the lamp and measuring circuits in the case of high accuracy measuring, but the measuring itself runs really only during revolution 360 degrees not to prefer any value of measured signal along the circumference of the bottle).

In dependence on the key that started the measuring it is then done corresponding correction to the calculation of the haze in EBC units (i.e. in basic version the correction for green or brown beer bottle).

The device itself cannot recognize if the sample was inserted in cuvette, green or brown bottle. That is why it is necessary to always start the measuring in corresponding mode to include the right correction. The mode, in which the measuring was started, is indicated on the display in its course.

.After the end of measuring the sound signal will sound and the resulting value of the haze is displayed on the display. For the dual angle model, the haze value in channel 90 degrees is indicated as H90 and haze value in channel 12 degrees is indicated as H12. Measured haze values are displayed on the display for so long, until one of the keys 1,2,or 3 is pressed again. By pressing one of the keys, the device is brought to the condition READY again, and the measuring of another sample can start.

The device is switched off by pressing the main switch POWER.

After the end of measurement it is recommended to always cover the measuring chamber with the cover to avoid the distilled water bath becoming dusty and dirty. If you are using the ordinary lighting in the laboratory, it is not necessary to use the cover of the chamber during the measuring because optics of the device is constructed in the way that the influence of the surrounding lighting on the measuring is suppressed to minimum. But if the hazemeter is placed under stronger light source and/or you are measuring sample having low haze, it is recommended to use the cover of the measuring chamber even during the course of measuring (especially in the case of turbid samples in the cuvette).

5. Recalibration

The device is calibrated by formazine standard suspension according to international analytical conventions. The calibration curve is built in the controlling program of the hazemeter. For performing the calibration based on other standard (e.g. calibration regarding to concentration of particles with different scattering properties than the standard formazine suspension has) it is possible to use special calibrating program. (Note: that program is not part of the basic controlling program). With the aid of this program it is possible to change calibration constants in the main program. Calibration coefficients are gained on basis of measuring the set of normal solutions (for the detailed information of the procedure - see the description of calibrating program).

Though the device is constructed in the way to insure long-term stability and accuracy of measuring, it is recommended to regularly check out the settings with the aid of scattering standards. After some time it can - especially in consequence of an excessive pollution of optical parts - occur moderate shifting of the calibration. It is necessary to check out the calibration even after each replacing of the lamp.

For these purposes the special calibrating procedure is built in the device - known as the **calibration mode** that can be started after the initialization of the hazemeter by pressing the key **4**. To avoid starting this procedure by accidental pressing of that key by unqualified personnel, it is needed to hold the key pressed for longer period - approximately 5 seconds - for starting the procedure. After releasing it, the following message appears on the display:

```
  RECALIBRATION
YES =1        NO= 3
```

If you really want to start the calibration, press the key **1**. If you do not want to start the calibration press the key **3**.

If you proceed further it appears:

```
   INSERT    0 EBC
START= 1  STOP= 3
```

Insert the cuvette filled with the "zero" haze sample into the measuring chamber.

(Warning – recalibration must be done using only standard glass cuvette. Never try to recalibrate with bottles or cuvettes having other dimension than the standard one.)
The use of limpid non-turbid water is supposed (it is recommended to filter water through membrane filter 0.2 micrometer .

After pressing the key **1**, the device will take measurements and gained readings are saved in the memory. If you press the key **3** instead of the key **1**, calibrating procedure is interrupted.

After the end of measuring, following text will appear on the display:

INSERT 1 EBC
START= 1 STOP= 3

The cuvette filled with the standard calibrating solution with the haze 1.0 EBC is to be inserted into the measuring chamber this time.

Then analogically continue in the calibration by pressing the key **1**, or interrupt the calibration by pressing the key **3**.

After the measuring of standard 1 EBC the following message is displayed on the display:

CALIBR. CHANGE
YES= 1 NO= 3

If you press the key **3** now, the measured values for 0 EBC and 1 EBC will be ignored and the change of calibration won't be done.

After pressing the key **1**, the device will compute coefficients of correction for the calibrating constants values saved in its memory from the gained values in the calibration procedure, and these computed values are permanently saved. Since this time, the device will compute with corrections according to just performed calibration.

That is why it is needed to proceed very carefully and responsibly during the preparation of calibrating solutions and calibration procedure.
Note: Attention has to be paid to prevent the formation of any air bubbles that may strongly falsify measurements (recalibration) – mix samples thoroughly but gently.

6. Connection of the device to a computer

The hazemeter can be connected to the external personal computer through the standard RS232 interface that is on the rear panel of the hazemeter (nine-pin connector). Through this link the counted over value (in accordance with the calibrating relations saved in the memory of the single-chip microcomputer after each measuring) of the measured haze is sent. In addition, the signal values from optical detectors are sent. This allows the user to built in the superior computer almost unlimited amount of non-standard calibrations or corrections and extends the scopes of the hazemeter in this way.

Calibrating constants can be implemented through the RS232 link directly into the EEPROM memory of the controlling microcomputer in the hazemeter the constant values of the controlling program are left in the memory even after switching the device off.

Special programs were developed and tested for mutual communication between the computer and the hazemeter. These programs are not the part of the standard device delivery.

7. Description of the hazemeter

Brief characteristics.

The hazemeter MZN is the microprocessor controlled measuring device designated for automatic measuring of the haze in liquids. The device is assembled from two functional parts. The basic part of the hazemeter contains the measuring appliance, i.e. electromechanical block with the optical system that insures the measuring. This unit is connected to the specialized microcomputer that is used for the controlling of the unit and therefore the haze measuring goes automatically.

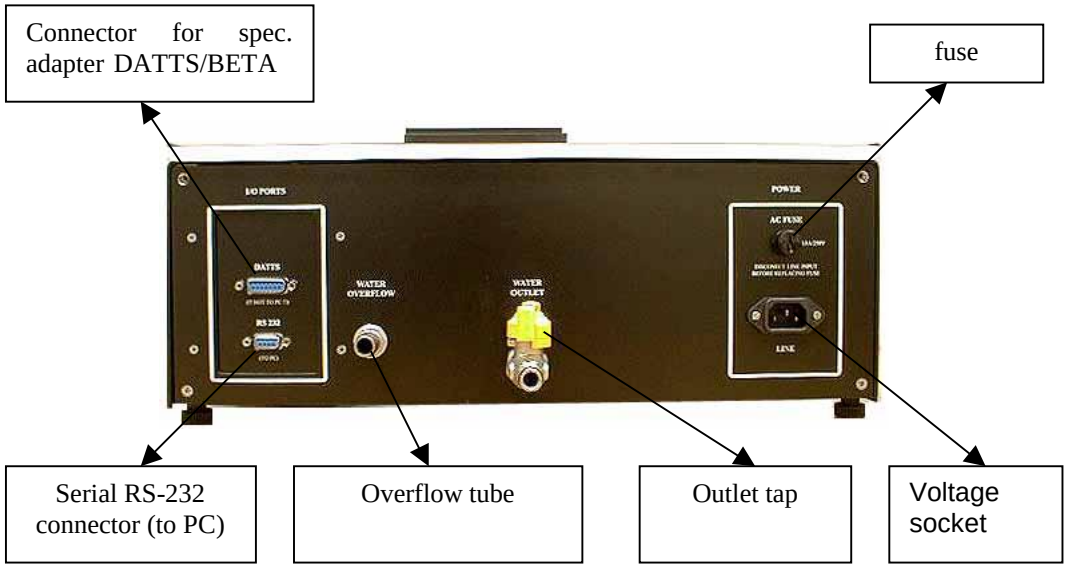
The hazemeter can be connected to the standard personal computer model according to customer's request for resulting processing of the gained data. Connecting is done through standard RS232 interface common for PC computers. The set may be completed with the program (for OS WIN9x or higher) that enables PC controlling haze measurements saving of the measured values on HD or FD and many non-standard procedures and operations (e.g. the haze measurements in time, statistical operation, nephelometric titration etc.).

Outward form

Minimum of controlling elements insures very easy operation with the hazemeter. On the front panel the LED-diode is placed that indicates function of the light source, and there is also main switch that indicates the device connecting to the mains. Then there is placed the display used for communication with personnel and four-elements keyboard.

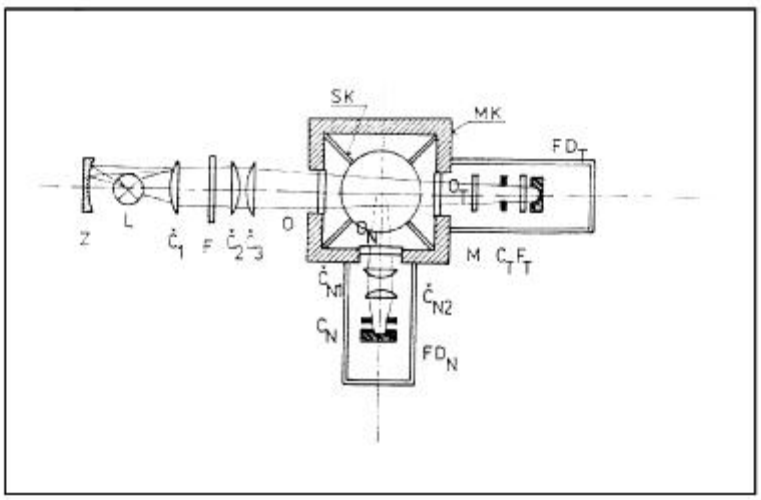
There are the main voltage socket with pertinent safety fuse, connectors for the computer connection (RS 232) and for special DATTS/BETA adapter (*do not connect this one with PC !!)* , water outlet of the measuring chamber and the end of pipe of the water overflow system on the rear panel of the device. Some type modifications have there also the input of the air condensation preventing system for measurements when measuring chamber is thermostabilized at temperatures below dew-point.

Described configuration is depicted in the following pictures.



7.1. Opto-mechanical parts

Basic optical, electrical and mechanical components are: cuvette's space or the measuring chamber MC in the cube shaped basin provided with the waterproof fixed windows with optical T-shaped axes for the entry of the exciting optical beam and the exit of the transmitted and scattered beam, then pertinent optical elements (the lamp case, tubes with lens and photodetectors), the light radiance source (halogen lamp 20 W), and the motor for bottle's revolving.
Arrangement of the optical part MZN is perceptible from the following schematic picture. The dual angle model in comparison with the one angle model has still one additional optical receiver placed in the transmission tube that detects the light scattered through the sample at a 12 degrees angle. The light scattered in this way is focused to the receiver by special optical system composed from specially modified lenses and screens.



Principal schema of the MZN hazemeter's optical part arrangement

Symbol description: Z - mirror, L - lamp, $Č_1$, $Č_2$, $Č_3$ - lenses, F_1 - filter, O_1, O_2, O_3 - windows, MK - measuring chamber, SK - centring basket, K - cuvette (bottle), $Č_{N1}$, $Č_{N2}$ - lenses, C_N - screen, FD_N - photodetector, M - focussing screen, C_T - diaphragm, F_T - filter, FD_T - photodetector

7.2. Electronic parts

Electronic parts of the MZN hazemeters are formed by the main distribution inside the device, transformer and three special electronic boards.

Photodetectors board

The photodetectors board includes two (or three) analogically connected channels, It is connection of the current-voltage converter. The photodiode used as the photodetector is connected directly into the input of the operating amplifier with a big input resistance. In the feedback of this amplifier the analogue switch is connected that enables changing the gain by the use of logical signals from the controlling microcomputer. The connection includes the resistance trimmer for the compensation of the input offset of the amplifier and the current of the diode in the dark (it is set during the device calibration).

Supply and control board

The supply module contains two electronic switches with optoelectrical separation of the control signal determined for controlling the light source and the motor that controls revolving of the measured object. The switches are implemented with the use of the integrated circuits and with accessory circuits for editing input levels of the controlling signals from the microcomputer. The module contains even the accessory circuits for the motor's start. Four stabilized power supplies that provide voltage for all parts of the hazemeter including controlling microprocessor and the triggered light source are the substantial part of the module.

Mains distribution

The distribution of the mains supply voltage is reduced to the most necessary minimum. The device is connected to the mains by means of the mains socket placed on the rear side and the corresponding mains cord. In lead inside the device there is placed the fast blow (placed on the rear side of the device) that protects inner circuits using the mains supply voltage especially the mains transformer providing alternating voltage for stabilized power supplies and circuits of the synchronous motor used for revolving of the measured object.

Controlling microcomputer board

The circuits for the basic controlling and measuring functions of the MZN hazemeters are concentrated on the ZKL552 board. The single-chip is the basis of above mentioned circuits. The board contains common circuits that are needed for the function of the main circuit including batteries of the spared memory RAM ,the timer and EEPROM. There are also created needed contact circuits for other electronic circuits. The controlling microcomputer of the hazemeter is equipped with the serial interface that enables the communication with the connected PC computer equipped with pertinent software.

8. Maintenance

The common maintenance of the device consists in replacing the water filling of the measuring chamber and in contingent cleaning of the chamber and the windows and cleaning of the measuring cuvette.

8.1. Replacing and adding the water in the measuring chamber

As said above, the chamber can be filled on principle just with the distilled water. During common operation it is naturally becoming dirty, so it is needed to be replaced after some time. Considering that the pollution of the water depends on the outside factors (cleanness in the laboratory, the way of the bottles rinsing, the frequency of taking the measurements) it is not possible to strictly say how often it is needed to replace the water. As an auxiliary check for this purpose, measuring of the limpid distilled water in the well-cleaned cuvette can be used. The value of its haze should not exceed 0,05 EBC in common cases. If its haze is higher, the filling of the measuring chamber should be probably replaced. (If the haze has the same value even after replacing the water, it is needed to look after the cause of this high haze in the bad distillation or in insufficient cleanness of the used distilled water vessels).

During removing the sample out of the hazemeter measuring chamber, certain amount of the water gets stuck to the surface of the cuvette or bottle, and that is why the filling of the measuring chamber subsides in the case of taking the measurements often. That is why it is necessary to check the level of the water at random and to add the water so that **the water level during measuring (i.e. when the cuvette or bottle is in the measuring chamber) would not fall down to the level of the light beam.**
(The water level should be nearly at the top of the centring basket when the sample is placed in.)

8.2. Cleaning of the measuring chamber

If the water bath in the measuring chamber is too much polluted, it is recommended to clean the walls of the chamber during replacing of the water filling so that the pollution of the new filling would be avoided. Cleaning can be done with a weak solution of the common detergent followed by thorough and multiple rinsing of the chamber with clear and distilled water (removing of the detergent's rests).

The windows in the chamber should be cleaned in the same way, if needed they can be wiped with a soft piece of cloth (piece of skin) dipped in spirit. Don't forget to rinse the chamber with distilled water even in this case. It is **not recommended** to wipe the windows with such a piece of cloth (or for example cotton-wool roll) that would leave parts of fibres or fine hairs in the chamber or on the windows. If those dirties are in too high concentration in the chamber, there is undesirable scatter of the light and it therefore results in the false signal.

8.3. Cleaning of the measuring cuvette

It is needed to protect the cuvette from finger-prints and other soiling (mechanical damaging - scratching), and especially in the area where the light beam is coming through during the haze measuring.

The cuvette is cleaned with the use of common detergents (it is not recommended to use detergents that contain color and aromatic ingredients) followed by thorough rinsing with clear distilled water.

For cleaning do not use abrasive detergents in any case.

To determine if the cuvette is dirty, hold the cuvette against the light. It is recommended to rinse the cuvette before the start of taking measurements.

9. Accuracy of the results - corrections to measurements in common beer bottles

The total mistake that can influence the result depends on conditions of the measuring. Partially those mistakes are done by the device and partially those mistakes depend on outside factors.

The error done by the device itself is very small for determination of the haze under laboratory condition when people maintain the proper operational conditions (it is less than 1% in the range up to 2 EBC).
Mistakes caused by outside factors can be caused by the dirty cuvette, dirty water in the measuring chamber, unstable sample - its sedimentation and especially by the presence of gas bubbles in the sample.
Mistakes in consequence of pollution of water in the chamber do not usually exceed 10% at H90 (i.e. in nephelometric channel) under common circumstances but forward scattering channel H12 is much more sensitive.
The sedimentation and the presence of the of bubbles can become evident in a much higher degree. The size of the haze may also be distorted if you are measuring very dark samples - i.e. if the amount of the light that comes through the sample is highly decreasing and the device works on the limit of its sensitiveness.

Other errors can be done during evaluation of the beverage haze measured in closed bottles. As mentioned above, common bottles are not the most suitable from the point of view of their optical qualities for measuring the haze. The revolving of the bottle in the course of measuring and ascertaining the average of the great amount of the done measurements along the circumference of the bottle diminish the influence of optical defects on the given bottle, but naturally their complete compensation can not be reached. Though the reproducibility of taking measurements on the given bottle is better than 3%, the divergence gained from the measurements on different bottles can be up to 10%.

The particular problem is presented by error that can originate from the colour of the bottle and the colour of the measured solution. Simultaneous measuring in the nephelometric and transmission channels suppress to a considerable extent the influence of solution's colour. The scatter depends on the size and on the spectral (colour) composition of the incident light radiance. The glass of the colour bottle together with the colour solution works for the beam of polychromatic exciting light as the colour filter, it changes spectral composition and so it influences the size of the scattering signal. It is therefore valid that the output of each haze--meter working with the polychromatic light is sometimes influenced by the colour of the used bottle.

If you are taking a set of measurements under the same conditions (i.e. in the same bottles) and you are interested in the relative change of the haze only, it is possible to ignore this influence. The mistake that is done cannot be ignored if you want to know the absolute haze value gained from the measurements on different colour bottles.

The MZN device is designed particularly for the measurement beer haze. Therefore, attention was given to the possibility of comparing values of the beer haze in the common used brown and green bottles during the device's construction. For this purpose there is built in correction curve gained on basis of statistic processing of the bottles set in the memory of the computer. This curve enables to suppress undesirable effects partially and to gain haze values comparable with measuring in clean cuvette.

But this correction has been gained as the statistical one and it should be taken in mind that it is valid only for light, well-filtered beer of pilsner type and for common green and brown beer bottles being used in central Europe.

Considering that there are combined two unfavourable factors (heterogeneity of bottles and their colour) in this measuring, it is needed to count with possible mistake around 10%.

To give more precision, it is possible to adjust the given correction curve by your own calibration for the given kind of beers and bottles.

10. Language and units selection, reset

Hazemeters MZN enable to select different languages for display communication and different measuring haze units for haze measurements

The basic languages and measuring units are: Czechs, English, German and EBC,NTU,ppm and MU units.

The selection is made in so called ***selection mode*** which can be activated after the hazemeter is switch on.

The set up of each hazemeter is made in regard to the requirements of its user, so it is usually not necessary to change language or units. If you will need to do it nevertheless be very carefully and use the following instruction.

Activation of the mode selection

It is possible to activate this mode immediately after the hazemeter is switch on and there is the message

Initialise
please wait

lighting on the display.

Than you have to press simultaneously buttons (1) and (3).

After this you will see on display:

mode selection
yes=1 no=3

(Warning !! - Be careful to press simultaneously only buttons (1) an (3) and not button {2). If you press all this three buttons you start **reset of the memory** and default the manufacture calibration constants would be taken from ROM and the values of last recalibration would be lost. This situation is indicated on display by message *ERROR CONST, OVERWRITING.* To start reset of the hazemeter may be useful in some unexpected situations when device behaves in unusual manner. It may also be automatically evoked when during initial self checking procedure microprocessor finds some errors /e.g. strong electric discharge may harm constants in memory/. Anytime reset was done it is recommended to check calibration of hazemeter and to recalibrated it if necessary.)

If you want to leave this mode press key (3) mode will be deactivated and initiation of hazemeter will continue with predefined settings. Selection procedures will be started by pressing key (1).

Language selection
If you have selected “yes” a propose for language change is made:

language
yes=1 no=3

If you want to change language press (1) if not - press (3).
Next offer is:

language
CZ=1 GB=2 D=3

Abbreviations are: CZ ... Czech, GB ...English, D... German. (So by pressing (1) you choose Czech etc.)

After language choice is completed selection mode continues with:

Units selection
The list of haze units you can choose is in the next proposal:

units EBC=1
NTU=2 PPM=3 MU=4

and you can choose appropriate units by pressing corresponding button.

Following message appears In the last step of selection mode:

Beer correction ?
yes=1 no=3

The MZN device was primarily designed to measuring the beer haze. Therefore, attention was given to the possibility of comparing values of the beer haze in the common used brown and green bottles during the device's construction. For this purpose there was built in correction curve (gained on basis of statistic processing of the bottles set) in the memory of the computer. This curve enables to suppress partially effects of the bottle colour on the haze measurements and to gain haze values comparable with measuring in colourless cuvette. (But it has to be stressed that this correction is correct only for light, well-filtered beer of pilsner type and for common green and brown beer bottles.)

When you are going to use hazemeter for measuring other types of samples than beer , you are using bottles having other colours or you have modified type of MZN hazemeter working with other than „white“ light it is recommended to measure without previously mentioned correction.

If you press button (3) measuring with correction will not be in use.
(Measuring with beer correction for green or brown bottles which are started by pressing buttons (2) and (3) respectively will be blocked).

This last step finishes selection procedure and initialization of the hazemeter firmware is made again.

After some short time device is ready to use.

All parameters chosen during mode selection will be used until new ones are activated in mode selection once more.

11. Troubleshooting

In the following part there is a well-arranged table where are some errors and troubles listed that could occur during the operation of the device, and then there are possible causes and the recommended procedure for their removing

If any trouble or obscurity occurs during the device operation whose removing is not a clear and easy thing for the user, it is recommended to give the device always to the service of the manufacturer or to the qualified service or at least to consult the procedure with the manufacturer.

The manufacturer is not responsible for any damage caused by unqualified manipulation with the device and by interference with its construction.

Error		Cause	Removing
- on the display appears:			
LOW TRANSMISSION PRESS ANY BUTTON	- lamp works	- too high haze or non-transparent sample	- thin the sample
	- lamp doesn't work	- breakdown of the lamp	- replace the lamp (contact the qualified service)
H90 OUT OF RANGE PRESS ANY BUTTON	- sample seems to be too much hazed	- too high haze	- thin the sample
	- sample seems to be clear, the same applies for the distilled water	- breakdown of the nephelometric channel electronics	- contact the qualified service
The display is lighted on, but no message is displayed		- defect in the electronic part	- contact qualified service
The device doesn't react on pressing keys		- defective keyboard or electronic part	- contact qualified service
Display is not lighted up, the device doesn't work		- defective fuse	- replace the fuse
		-defective switch	- replace the switch (see above)
	- the main switch is ON	- defect in the electronic part	- contact qualified service
The signal LED-diode is not lighted during measuring		- defective LED-diode	- replace the LED-diode (contact the qualified service)

The sample is not revolving during measuring	- defective motor	- contact the qualified service
	- loose drive belt	- fix screws on motor shaft
The sound signal doesn't sound after the end of measuring	- defective sound signaller	-replace the signaller (contact the qualified service)
On the display appears:		
CONSTANTS ERROR OVERWRITING	- data in EPROM memory were lost (e.g. in consequence of a strong electrical discharge)	- press one of the keys 1,2,3 and the values of constants set by the manufacturer will be copied from ROM memory - than check out the calibration
Measured haze values of the standard formazine suspension do not correspond with the nominal value	- dirty optical elements or water filling	- clean up the optics, water, or execute the calibration
	- optical parts badly justified	-justify the lamp and execute the calibration (it is recommended to contact the qualified service)
	- breakdown of the controlling mechanism	- contact the qualified service