HOW TO CHECK CALIBRATION OF DISPENSERS ON PETROL STATIONS

G010041

Version: 3

Date: 15/09/2021

Document Identification	
Title	HOW TO CHECK CALIBRATION OF DISPENSERS ON SITE
Reference	D010041 (draft document) → upgraded to G010041
Prepared by	SG1
Creation Date	04/07/2012
At version	0a

Document Status		comment
Draft		← draft revisions are from 0a to 0z...
Final	3	← released revisions are from 1 and up

History of Changes			
Date	Author	Version	Description of Changes
04/07/2012	PCL	0a	Creation, on request of GA Barcelona May 2012 – Need of a guide for owners and non initiated people
25/07/2012	PCL	0b	Added adjustments with help of SK (Elaflex) and BB (Tokheim)
29/08/2012	PCL	0c	Added adjustments with help of MW (Elaflex)
11/12/2012	PCL	0d	Small adjust during TF meeting Hamburg
23/04/2013	PCL	0e	Small adjust on country specifics
25/04/2013	PCL	1	Upgraded to guide status
20/08/2019	PCL	2	Update and refresh
15/09/2021	PCL	3	Confirmation and update on EU directives and OIML Recommendations

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Publishing				
Destination	Level	Date	Authorized by (name)	Signature
Study Group only	SG CHAIR		PCL	Valid
Internal	TC CHAIR		PCL	Valid
Public	CECOD CHAIR			

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SCOPE:

This guide is to provide help, guidance and first level training to people wanting to control calibration of dispensers on petrol stations. Only applicable to Diesel and Unleaded fuels.

The purpose of this guide is to give instructions and reasons for such, so the measurement result coming from calibration checks is as fair and as good as possible.

The purpose of this guide is NOT to replace existing "state of the art" guides and rules, or to substitute any national established rule or practice.

This guide will not deal with health and safety issues linked to such activity, but will highlight in many places the need for good safety practices.

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1) Domain – short description of domain

- **Activity: check calibration of dispensers on petrol stations**
- **Exclusion: does not allow to dispute official calibration checks**
- **Linked activities or concerns**
  - **Safety: fuels are dangerous, flammable and toxic**
  - **W&M rules: each and every country has established rules for official calibration checks. This guide does not supersede those established rules.**
  - **Inventory: each calibration check will induce a "product return" to the station storage tanks. Special precautions to be taken with accounting on site**
  - **Spillage: any spillage must be avoided**
  - **Presence of public on station: during calibration checks, public shall be kept at distance**
  - **Traffic on station: during calibration checks, passing traffic shall be kept at distance**
  - **Programming/reprogramming of dispensers: during checks, some control functions of dispensers might need to be disengaged. It is operators responsibility to return dispenser to safe mode after calibration checks**
  - **Fuel return to storage tanks: specific accounting action might be needed to not conflict in accounting of station. Please check with official local rules and owner's best practice (if applicable)**

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2) References to standards

OIML R117-1 (2007): Dynamic measuring systems for liquids other than water. Part 1: Metrological and technical requirements

Access: http://www.oiml.org/publications/R/R117-1-e07.pdf

OIML R120 (2010) : Standard capacity measures for testing measuring systems for liquids other than water

Access: http://www.oiml.org/publications/R/R120-e10.pdf

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3) Terms, acronyms and symbols

MPE: Maximum Permissible Error

Error: result of calibration check process. The number can be

- **absolute (expressed in mL) or**
- **relative expressed in % (percent) or ‰ (pourmil) depending of country practices**

examples (to be checked with local authorities)

- **France: in ‰ (pourmil), negative if too much in can → MPE=0.5%**
- **Germany: in % (percent), negative is not enough in can → MPE=0.5%**
- **UK: record in ml (positive if too much), then calculate relative → MPE=0.5%**
- **Italy: record in ml (positive if too much), then calculate relative → MPE=0.5%**
- **Belgium: TBC**
- **NL: in % (percent), negative is not enough in can → MPE=0.5%**
- **Spain: YBC**
- **Denmark: in % (percent), negative is not enough in can → MPE=0.5%**
- **Portugal: in % (percent), negative is not enough in can → MPE=0.5%**

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Sign of error:

- **In some countries, result is expressed as positive if liquid appears to be in excessive quantity in calibration vessel**
  - **Visible fact to owner, the "dispenser is giving too much"**
- **In some countries, result is expressed as negative if liquid appears to be in excessive quantity in calibration vessel**
  - **Calibration check is on dispenser. The dispenser is indicating less (at dial) than what it really gave. This is OIML convention**

➔ **In this guide, we will always promote the use of relative information, in percentage, using OIML convention for sign of error**

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4) Best practice over process

Preamble

Machinery Directive: always pay attention to potentially dangerous parts in movement such as belts and pulleys, but also swinging doors and tangling hoses

ATEX – Explosion proof / Fire proof approach: keep all ignition sources away. If possible, use an adequate explosive atmosphere controller, and stop operations if atmosphere around dispenser becomes dangerous. You shall have access (easy and fast) to any firefighting means during calibration check activities. Also keep public at distance. DO not interfere with grounding cables to doors and motors.

W&M (MID) – Metrology: never try to break a seal or change a calibration setting if you are not authorized to do such.

LV directive: dispensers contain many electrical devices. Never try to interfere nor repair such if you are not a duly trained operator for such activity

EMC directive: turn off all mobile phones before approaching dispensers.

PED – Pressure Equipment Directive: if dispenser is combined with an LPG or a CNG dispenser, be aware that such operate at very high pressures

H&S – Health and Safety – Public and worker protection: refer to any national rules/law before any calibration check on dispensers. Unleaded vapors are toxic, and all fuels are toxic if ingested or sprayed in eyes or on skin.

- Protect yourself: wear appropriate clothing and safety shoes
- Protect public: isolate dispenser under control, and reroute traffic to avoid collisions
- Fool proof: always lock storage tank inlets between operations

Environmental – risk of pollution/contamination: all liquid fuels represent an environmental risk if spilled or sprayed. Contamination of water table, ground or sewage might also lead to civil responsibility

Waste approach: after calibration check, fuel in calibration vessel is NOT a waste. It must be returned to original storage tank of station

National specifics: check with local authorities for specific laws or rules applicable to calibration checks (if any) or fuel handling on petrol stations

Training people: please consider training as the first best practice to avoid accidents. Depending of country, training might require specific skills, and traceability of acquired knowledge before action.

4.1) Calibration can definition

Recommended calibration can shall
- be made of stainless steel, volume of 10 or 20 liters (see R117-1 clause 2.5.3 for MPE and influence of MMQ for calibration checks and applicable MPE). Also possible to have carbon or glass cans. For very high flow (above 80 lpm), consider using 50 liters cans.
- have no leak (any leak at window or sight glass is a show-stop)
- have no dents or visible impact (as this invalidates the can)
- have an official calibration certificate less than one year old, established by a recognized laboratory, and all seals of calibration window/sight glass shall be intact.
- it is preferable to use narrow collar calibration cans (less than 75mm width) to improve reading and reduce evaporation rate on gasoline (evaporation and wetting process can, account up to +/-0,2% in uncertainty calculation if not done properly)

Reading of can shall be done on a flat surface, checking that surface is horizontal.

If can is with a double sided reading window, final result shall be the average of both sides reading. If can with side tube reading or sight glass, special care must be taken for perfect horizontal reading

Operator shall be trained to understand reading of meniscus (need to read middle of curved interface surface between liquid and air with no parallax error)

4.2) wetting of can

Before using can, special care must be taken to properly wet can. Purpose is to create an inside skin of liquid to improve repeatability of readings and use can in the proper way to satisfy calibration settings, but also to bring can temperature as close as possible to fuel temperature. With high evaporation fuels, this is also to compensate for evaporation and misting during calibration fill.

Wetting consist in filling can with fuel considered for check, emptying can (see dripping 4.3) and use can for calibration check within a few minutes (5 to 10 minutes maximum).

It is recommended to execute wetting process once if ambient temperature is between 5°C and 25°C, and twice if temperature is below 5°C or above 25°C. Do not leave can in the sun. Block collar of can with a plug after wetting to keep vapor atmosphere in it.

After initial wetting, any subsequent check done on same fuel is considered as a proper wetting as long as next check is done on same fuel, and done within 5 minutes maximum of prior emptying.

4.3) 30 seconds dripping

When emptying can (after wetting or after a calibration check), operator must pay special attention to

- position of can under an angle between 45° and 60°, to allow proper emptying and proper vapor trapping inside vessel (incoming air must saturate with vapors during process)
- when liquid stream breaks (end of emptying), operator shall wait and really stop emptying process after 30 seconds (+/- 3 seconds) to reproduce inside liquid skin and preserve vessel vapors. During those 30 seconds, drops are still falling. When the 30 seconds waiting period is finished, can is put back in the upright position even if there are still some drops falling.

4.4) closing can after dripping (preserve vessel vapors)

After dripping (see 4.3), operator shall plug collar of can with a cloth or any other adequate device to preserve vessel vapors.

4.5) Hose inflation influence

When lifting nozzle of a petrol dispenser, pump rebuilds pressure inside hose down to nozzle. Operator shall pay attention to display before starting any calibration check. Display shall remain zero-ed. If not, nozzle must be placed back on boot, and lifted again within a 5 seconds delay.

Better accuracy is achieved by “de-masking” hose inflation masking (authorized calculator function, please check manufacturers instruction to de-mask hose inflation…. Do not forget to reset hose inflation masking before putting dispenser back to service).

Such hose inflation masking/unmasking shall be part of the operators’ organization uncertainty calculation.

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4.6) filling can at high flow

Fill sequence for high flow check.

This high flow check is the most important check. After lifting nozzle, operator shall wait around 5 seconds to check that there is no leak at hose or at nozzle.
Nozzle shall be put pointing floor, above a dripping pan (or equivalent) to let any remaining fluid drip out of nozzle spout. Nozzle shall not be hit down to empty drops faster.

Then, nozzle is put in calibration can filler neck, and trigger is pulled as far as possible to achieve highest available flowrate to fill calibration can. Operator shall survey volume at dial and stop flow by closing the nozzle manually around 1.5 liter before target volume (volume of calibration can), than dispense smoothly to reach target volume.

Special care or tips for high flow fill of calibration can:

- at start of delivery, operator shall convince himself that hose inflation is nill, or anyway, as small as possible. To achieve this, operator can either:
  - de-mask hose inflation to see any spurious centiliter being displayed after nozzle is lifted from the boot, and before flow commences at nozzle. If such happens, operator to hang nozzle back, wait 3 seconds and lift nozzle again to redo check. If hose inflation remains unacceptable, operator can record information for further correction (displayed centiliters are not in the calibration can)
  - lift nozzle from the boot, wait for motor to start or display of pump to zero, then hang nozzle back, wait 3 seconds and lift nozzle again.

- The operator shall not bang nor drum nozzle spout on the edge of the calibration can.

- The flowrate during the high flow check shall be at least 5 times minimal flow rate (see W&M plate of instrument and see below note). Usual on petrol dispensers for cars is (example)
  - High flow rate = 40 l/mn
  - Low flow rate = 4 l/mn
  - ➔ So flow rate during high flow shall be 4 x 5 = 20 l/mn

Note: this calculation for high flow on site of use is coming from OIML R117-1

4.7) end of fill of can

Operator to target volume of calibration can on display of dispenser. Last 1.5 liter shall be done at a lower flow rate to avoid spillage, foam issues (on diesel) and overshooting target. At end, the nozzle spout shall not touch liquid (to prevent automatic shut-off) and the nozzle shall be left dripping in calibration can filler neck.

After 5 seconds dripping, nozzle can be either placed back on nozzle boot, or pointed in next calibration can (if process is to achieve 2 consecutive cans or to do a low flow check in another calibration can).

Don't forget to plug calibration can collar with a cloth to avoid evaporation before reading. Cloth shall not touch liquid surface.

4.8) reading can

Can shall be set flat to avoid errors in reading level of liquid. Use available spirit level or bull's eye spirit level to make sure can is set on an horizontal surface before reading. If can is with a double sided reading window, read both sides and average.

Don't forget to RECORD RESULT

4.9) emptying can – return to 4.2

After a calibration check, can is considered as "wet" for 5 to 10 minutes maximum (don't forget to plug collar of can with a cloth to preserve vessel vapors).

4.10) filling can at low flow

Fill sequence for low flow check.

This low flow check will be compared to high flow check result. Any difference above 0.2% might be a sign that meter has internal damage.

After lifting nozzle, operator shall wait around 5 seconds to check that there is no leak at hose or at nozzle. Nozzle shall be put pointing floor, above a dripping pan (or equivalent) to let any remaining fluid drip out of nozzle spout.

Note: if low flow test is done in sequence after the high flow test, before nozzle is put back on boot, the above dripping is reckoned to have been done already at end of high flow check (see 4.7)

Then, nozzle is put in calibration can filler neck, and trigger is pulled slowly to execute the check at the low flowrate for dispenser as indicated on its W&M plate. During fill of calibration can, operator shall survey speed and volume at dial and stop flow when target volume (for this calibration can) is reached by closing the nozzle smoothly.

Please note that this low flow check requires a bit of training. If low flow is done In sequence after high flow, target volume on dial is volume of can for high flow rate check + volume of can for low flow rate check. Example
High flow rate can = 20 liters
Low flow rate can = 10 liters
Target on display is 20 liters for first can, then 30 liters for second can (as fill of cans is done in sequence, with no reset of display to reduce uncertainties of check).

Special care or tips for low flow fill of calibration can:

- at start of delivery, operator shall convince himself that hose inflation is nill, or anyway, as small as possible. To achieve this, operator can either:
  - de-mask hose inflation to see any spurious centiliter being displayed after nozzle is lifted from the boot, and before flow commences at nozzle. If such happens, operator to hang nozzle back, wait 3 seconds and lift nozzle again to redo check. If hose inflation remains unacceptable, operator can record information for further correction (displayed centiliters are not in the calibration can)
  - lift nozzle from the boot, wait for motor to start or display of pump to zero, then hang nozzle back, wait 3 seconds and lift nozzle again.

- operator shall not bang nor drum nozzle spout on the edge of the calibration can.

- The flowrate during the low flow check shall be at least minimal flow rate indicated on W&M plate of instrument, but not much more. Usual on petrol dispensers for cars is (example)
  - High flow rate = 40 l/mn
  - Low flow rate = 4 l/mn
  - ➔ So flow rate during low flow shall be around 4 to 5 l/mn (centiliters count as fast as operator can speak out the sequence “one-two-three-four-five-six-seven-eight-nine-ten” at maximum speech speed)

4.11) end of fill of can

Operator to target volume of calibration can on display of dispenser. Operator shall stop flow at target by closing the nozzle smoothly and avoid spillage and overshooting target. At end, the nozzle spout shall not touch liquid (to prevent automatic shut-off) and the nozzle shall be left dripping in calibration can filler neck.

After 5 seconds dripping, nozzle can be either placed back on nozzle boot, or pointed in next calibration can (if process is to achieve more consecutive cans).

Don’t forget to plug calibration can collar with a cloth to avoid evaporation before reading. Cloth shall not touch liquid surface.

4.12) reading can

Can shall be set flat to avoid errors in reading level of liquid. Use available spirit level or bull's eye spirit level to make sure can is set on an horizontal surface before reading. If can is with a double sided reading window, read both sides and average.

Don't forget to RECORD RESULT

4.13) emptying can – return to 4.2

After a calibration check, can is considered as "wet".

4.14) end of checks on site

All results shall be recorded under format of annex A (if dispenser is not using temperature compensation).
As all metrology process, uncertainties and errors are our main enemies.
Mis-reading, rush testing, untrained operators are among worse of them.
Do keep in mind that best way to avoid unsatisfactory results and conclusions is to repeat test 3 times.
Also keep in mind the following numbers:

Temperature changes will change fuel volume:
- Around 0.13% per °C for unleaded fuels
- Around 0.085% per °C for diesel fuels

Calibration check is to be done while avoiding any environmental side effects. Also check if dispensers have ATC (automatic temperature compensation). If such is implemented, check with your local experts (maintenance company or W&M authority) on how to do calibration checks in such configuration (in that case, consider Annex B template for checks).

Avoid doing checks on very hot or very cold days. Windy days could also impact results by increasing evaporation on gasoline. Combination of wind and temperature can be worse.

Also always think SAFETY. When leaving site, think that public will use site just after you leave. They might see your operations in a strange way. Keep them away as long as you are handling fuel. Once all checks finished, return site to normal usage only after:

- Dispensers are set back to normal operation
- Credit card systems are also back in normal (expected) mode
- No calibration can is left unattended on site
- All underground filler necks are closed, locked and secured

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4.15) changing fuel

When switching fuels (after checking all unleaded nozzle, operator wants to check diesel nozzles), restart wetting process same as if calibration can was never used before.

4.16) special requirements for AdBlue ® (AUS32)

AUS32 dispensers can also be checked using this process. Just need to be very careful with AUS32:

- Avoid contamination of AUS32 (use dedicated specific calibration cans, ALWAYS in stainless steel)
- Be careful: AUS32 is pH=10

4.17) interpretation of results

Usual Maximum Permissible Error on petrol dispensers is +/- 0.5%.
Some countries might require +/- 0.3% or +/- 0.2%. Check with local authorities.

4.18) help in using templates:

If dispenser does not include temperature compensation AND ambient is between 10 and 20°C, use Annex A template

If dispenser does not include temperature compensation AND ambient is below 10°C or above 20°C, use Annex B template and apply correction of temperature variation between spout and can temperatures on final reading

If dispenser includes temperature compensation, use Annex B template and apply correction of temperature for difference between 15°C and can temperatures on final reading

If dispenser includes temperature compensation and has temperature check facility (see manufacturer's manual), use manufacturer's calibration check procedure (most likely, double stage

- Stage 1: check temperature probe reading
- Stage 2: check raw calibration (uncompensated) of meter
- Stage 3: check software identification/checksum or temperature correction device configuration.

ANNEX A
Proposed template for calibration checks without temperature reference (normal)

Station name and address:				
Date:			**Operator:**	
Reminders: - *all results in Percentage (%) versus target volume of can* - *result is negative if there is too much fuel in calibration can* *ALWAYS THINK SAFETY – NEVER FORGET PUBLIC IS THERE – NO SPARKS/FLAMES*				
Average ambient temperature:			**Wind conditions:**	
Pump side	**Nozzle/Fuel**	**High flow % (read error from can)**	**Low flow % (read error from can)**	**Comment (if any)**

ANNEX B

Proposed template for calibration checks with temperature reference (skilled operator or special case)

This form is to allow for recording of fuel temperature conditions during calibration checks. Requires special training and tools.

Station name and address:							
Date:			**Operator:**				
Reminders: - *all results in Percentage (%) versus target volume of can* - *result is negative if there is too much fuel in calibration can* *ALWAYS THINK SAFETY – NEVER FORGET PUBLIC IS THERE – NO SPARKS/FLAMES*							
Average ambient temperature:			**Wind conditions:**				
Temperatures are recorded here to allow for later correction if needed							
Pump side	**Nozzle or Fuel**	**High flow % (error)**	**Average temp at spout during can fill**	**Temp in can after 1mn stabilization**	**Low flow % (error)**	**Average temp at spout during can fill**	**Temp in can after 1mn stabilization**

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Bibliography

On OIML website:

OIML R117 (1995), OIML R117-1 (2007) and OIML R117-1 (2019)

OIML R120

On Europa website:

Measuring Instrument Directive 2014/32/EU

Adjustments to MID directive (see 2009/137/EC)

Temperature correction:

ASTM tables