# PROBLEMS WITH PD 54823:2016

## A call for withdrawal or review

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# Problems with PD 54823:2016. A call for withdrawal or revision

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Acknowledgments

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## Introduction

PD 54823:2016 (herein referred to as the PD) has a number of problems that affect day to day safety of gas installations and the activities of installers. In places it contradicts both UK law (GSIUR, 1998) and the prescient international and British standard, BS EN ISO 10239:2017 (Small craft, LPG systems). There are 4 key areas where the PD causes significant issues in the marine sector that are discussed in this paper:

1. Regulator selection
2. Appliance operating pressures
3. Gas tightness testing
4. Installation of open-flued appliances

The PD is titled “guidance for the design, commissioning and maintenance of LPG systems in small craft”, and in the foreword states ISO 10239 takes precedence. The PD emerged from a predecessor British Standard, and can be seen placed amongst other documents as follows.

BS 5482-3:1979
BS 5482-3:1999
ISO 10239:2000
PD 5482-3:2005
ISO 10239:2008
ISO 10239:2014
PD 54823:2016
ISO 10239:2017 (no technical changes from the 2014 version)

*Figure 1 - Standards and documents, boat gas, 1979-2023*

With the introduction of ISO 10239 in 2000, BS 5482-3:1999 eventually becomes PD 5482-3:2005 (a ‘published document’), and is not, it states, to be regarded as a British Standard. However, it has a crucial role to play in ensuring gas safety, due to the limitations of the very general overarching ISO 10239.

This crucial role covers commissioning of gas systems, ensuring the safe operation of appliances, effective gas tightness testing and system maintenance; all of these areas are presently not covered by ISO 10239. It is therefore paramount that the PD gets this right, and unfortunately it doesn't.

This paper calls for withdrawal or revision ASAP in the interest of colleague and consumer safety. This paper is intended to highlight key procedural flaws as opposed to looking at editorial or display issues. The issues discussed affect registered gas engineers and boaters on a daily basis; the published document is overdue for revision.

Please note the intention of this personal work is to help bring about necessary change in the marine gas sector. The author is very grateful for the time given by stakeholders to address issues identified, including the response to recent research findings which has been positive and proactive.

## The four problems

It is first necessary to try and see why the PD is so important. The below table identifies where a registered gas engineer or perhaps a boatbuilder might get the information they require to install or modify key elements of a gas system on a small craft safely and legally. The highlighted green boxes show where the PD is required. The boxes highlighted red are where the problems exist that are discussed in this paper.

| Identifier | Work | Source | Clause |
|---|---|---|---|
| 1 | Select appliances | Manufacturer or<br>ISO 10239 | 7 |
| | Design flues | Manufacturer /<br>ISO 10239 | 8 |
| 2 | Design ventilation | PD 54823:2016 | Annex C |
| 3 | Specify cylinder requirements | PD 54823:2016 | Table 2 |
| 4 | Design storage and cylinder security | PD 54823:2016 | 8 |
| 5 | Specify regulator | ISO 10239 | 5 |
| 6 | Piping materials, size, jointing and installation | ISO 10239 | 6 |
| 7 | Hose materials, size, jointing and installation | PD 54823:2016 | 6.3 |
| 8 | Appliance installation | Manufacturer<br>ISO 10239 | 7 |
| 9 | Prove new piping – air test | ISO 10239 | 11 |
| 10 | Test system for gas tightness | PD 54823:2016 | D.2 |
| 11 | Verify regulator and appliance operation safe | PD 54823:2016 | Annex F<br>Annex H |
| 12 | Safety labels | ISO 10239 | 4.3 / 5.1 design pressure<br>6.6.4 shut off diagram<br>6.6.5 shut off location<br>7.5 gas type - propane / butane<br>7.6 asphyxiation warning |
| | | PD 54823:2016 | 6.6 Main shut off |
| 13 | Owner's manual | ISO 10239 | 13 |

*Figure 2 - Installer resource table*

Note that two of the red boxes are direct clashes with ISO 10239 (1 & 5) and two are where the PD is the only guidance available (10 & 11).

## 1. Appliances and Flues

The appliance and flues section of PD 54823:2016 is inaccurate and misleading, and directly clashes with ISO 10239:2017, mostly because it fails to account for a fundamental change in ISO 10239.

Between 2000 and 2014, ISO 10239 was consistent on unattended appliances (e.g. a water heater); they must be room-sealed only. In a complete change, ISO 10239:2014 at clause 7.4.2 states non-room sealed appliances are permitted providing there are devices to prevent backdrafting:

**7.4.2** All appliances designed to function unattended shall have a combustion system in which either:

— incoming combustion air passes through sealed ductwork connected to the enclosed combustion chamber and terminating outside the craft, including any areas that can be enclosed by canopies, or

— mechanisms are incorporated in the appliance to prevent backdrafting from the exhaust and oxygen depletion in interior spaces.

*Figure 3 - Extract from ISO 10239:2014, appliance flue requirements*

PD 54823:2016, which obviously came after the 2014 change, completely overlooks this, and instead issues various contradictory positions that serves to only confuse installers, trainers and consumers.

In trying to decipher this, it is worth noting that the first position PD 54823:2016 takes regarding appliance selection is that all new or replacement appliances should comply with ISO 10239:2014.

**7 Appliances**

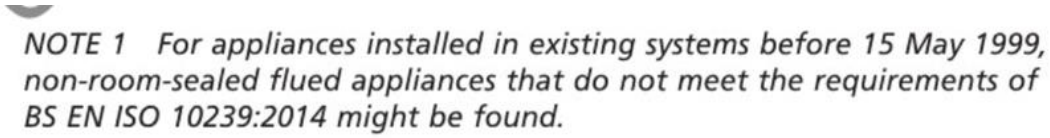
Any additional appliance should be installed in accordance with BS EN ISO 10239:2014.

Any replacement appliance should meet the appliance requirements of BS EN ISO 10239:2014.

*Figure 4 - Extract from PD 54823:2016, appliance selection 1*

This makes it simple for a boater who wants for example an open-flued IWH, because we know ISO 10239:2014 allows open-flued appliances.

Unfortunately the PD then continues to issue guidance that completely confuses the reader.

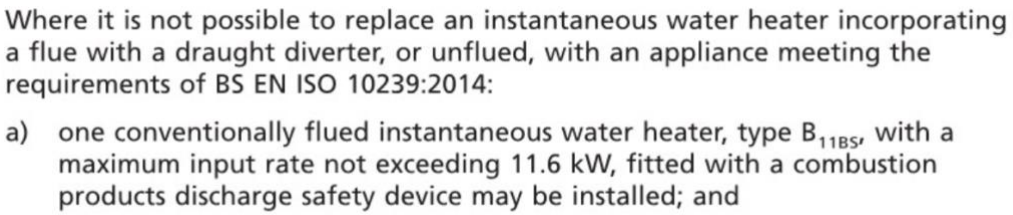


*NOTE 1 For appliances installed in existing systems before 15 May 1999, non-room-sealed flued appliances that do not meet the requirements of BS EN ISO 10239:2014 might be found.*

*Figure 5 - Extract from PD 54823:2016, appliance selection 2*

This statement is pointless, because there it is also perfectly acceptable to find non-room-sealed flued appliances in vessels built after 15 May 1999. There is nothing in UK law to prevent it, and as we know ISO 10239:2014 says it's OK. This statement in the PD exposes the total misunderstanding regarding this from the start.

The guidance continues:



Where it is not possible to replace an instantaneous water heater incorporating a flue with a draught diverter, or unflued, with an appliance meeting the requirements of BS EN ISO 10239:2014:

a) one conventionally flued instantaneous water heater, type $B_{11BS}$, with a maximum input rate not exceeding 11.6 kW, fitted with a combustion products discharge safety device may be installed; and

*Figure 6 - Extract from PD 54823:2016, appliance selection 3*

This is again a pointless statement, because it is possible to replace an open-flued instantaneous water heater (IWH) that meets ISO 10239:2014, but this is completely overlooked in the PD. This is problematic and has led to training centres teaching engineers that they can only fit open-flued water heaters as replacements to existing installations, backed up by a risk assessment as instructed by the PD. This of course completely contradicts UK law and ISO 10239:2014. As a result, this has penalised boaters who have been known to have to remove IWH to meet RCD compliance by over-zealous and misinformed surveyors and engineers.

Registered gas engineers remain nervous about fitting open-flued water heaters; recent research by the author (www.smallcraftservices.com/technical) shows 77% of 30 engineers wrongly stated they could not fit them, because they believe it's illegal. This is leading

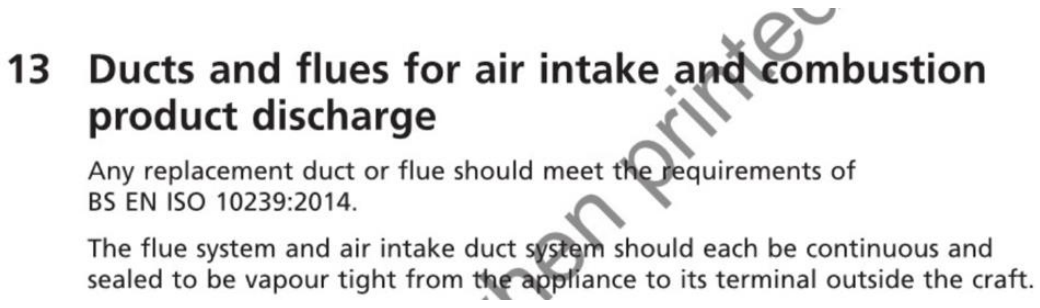
boaters to self-fitting unsuitable Chinese-made heaters available on the internet, which are completely unsuitable for boats (search ‘gas water heater’ on eBay).

This is all born out of 3 things, and has become a cultural issue that is difficult to change:

A. ISO 10239 said room sealed only between 2000 and 2014 (but note, it’s never been illegal in the UK to fit an open-flued water heater on a boat).
B. PD 54823:2016 overlooks the fact that ISO 10239:2014 said it was fine to fit open-flued appliances and takes a contrary position.
C. The various training materials and institutions also overlooked the change until 2023, meaning we have a 23 year legacy of “room-sealed only”.

The promulgation of this incorrect understanding is industry-wide; BSS training also included this erroneous position until recently changed (2021), and this itself took months to achieve because the technical team initially dismissed it as nonsense because it is so deeply ingrained; they didn’t believe what they were being told. The BSS are not alone; Annex 5 of MGN 280 (M) at clause 5.1 is similarly outdated, and contradicts itself in a similar way (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/905677/mgn280.pdf)

The contradiction regarding this in the PD continues to be backed up, in clause 13.



**13 Ducts and flues for air intake and combustion product discharge**

Any replacement duct or flue should meet the requirements of BS EN ISO 10239:2014.

The flue system and air intake duct system should each be continuous and sealed to be vapour tight from the appliance to its terminal outside the craft.

*Figure 7 - Extract from PD 54823:2016, flue selection requirements*

The first statement is clear, flues must meet the requirements of ISO 10239:2014. The second statement contradicts it, because it is calling for a vapour-tight flue between the appliance and the terminal outside. The PD is stating an open-flue cannot be installed, but

as this paper shows, ISO 10239:2014 permits this at clause 7.4.2. Again, the PD completely contradicts itself, the prescient standard ISO 10239, and GSIUR.

Some reading this might be thinking the problem doesn't exist, because as it says in the PD, ISO 10239 is prescient, so surely the PD should just be ignored. Unfortunately, a huge collateral problem for the marine sector is that the training registered gas engineers receive regarding appliance flues is based on PD 54823:2016, not ISO 10239 as shown in Figure 8 below (https://www.euskills.co.uk/wp-content/uploads/2022/03/CCLP1-B-7-Issue-7-2021-web-version.pdf note that the current document at this link has now had the REF section recently deleted, hopefully because it is being revised).

**Note 31/08/23: Figure 8 has been redacted by the author (blue boxes) after a stakeholder suggested a copyright infringement had occurred. While they also acknowledge matters of gas safety should not be secret, it seems even academic and technical work, written in the best interest of public safety, and demonstrably correct, presents unwelcome risks. No copyright infringement was intended or known about at the time of writing and this document was duly amended.**

**12. Chimney / Flueing Standards for appliances**

| KNOWLEDGE AND UNDERSTANDING | REF | I | R |
|---|---|---|---|
| 1. **open gas flue systems: natural draught:** | | | |
| (i) | | | |
| (ii) flue requirements, termination positions for open flues before May 1999 (refuelling) | | ✓ | ✓ |
| (iii) flueing appliances installed in boats (after May 1999) | | ✓ | |
| (iv) specific flue heights and termination positions for open and closed flues | | ✓ | |
| (v) risk assessments when replacing existing open flue water heaters | | ✓ | ✓ |
| (vi) Requirements for non-room-sealed refrigerators | | ✓ | ✓ |

*Figure 8 - Training framework extract, EU Skills*

This of course means that the training manuals written to support gas engineer training have also reflected the above until a published correction in 2021. (https://www.shop.niceic.com/pdf/a/700/Corrigendum_March%202021.pdf).

In short, when gas engineers go to a training centre, they are taught some incorrect things about appliance and flue selection. It is no surprise then that 77% of installers do not know what they can do. It is not clear why the PD needs an opinion on this at all – it could just say “follow ISO 10239”; it would certainly be safer if the PD did not comment on it at all.

## 2. Regulator Selection

At clause 5, the PD directs that all replacement regulators must have an over pressure shut off (OPSO) device. This contradicts ISO 10239 (also at clause 5) that calls for a ‘pressure relief governor, a pressure relief valve, or automatic safety shut off valve’. Furthermore, in UK law (GSIUR, 1998) at Regulation 14 (3)-(4) states an over-pressure device is only required where an automatic changeover device is fitted to four or more cylinders.

Previous versions of the PD do not include any such requirement, so this seems to have been added in 2016, the most likely reason being that the ISO standard requirements have been misrepresented during the PD review. This misinterpretation also made its way into the training manuals and colleges, and also the examination papers that registered gas engineers sit to qualify. The registered engineer has to put the ‘wrong’ answer in examination questions to get a pass – e.g. they have to put that an OPSO is required on all installations, when it’s not (note the training has now been amended as mentioned in the last section; unfortunately the exams remain as they were). It is also interesting to note that while propane regulators are available with OPSO devices, there does not appear to be a butane regulator available with an OPSO device incorporated (Williams, C. conversation August 2023).

Advice from Gas Safe Technical to engineers asking for help is then unclear, because there are differences in the documents. College tutors have been heard telling engineers to go back to marinas and use up existing stocks of non-OPSO regulators and only fit OPSO devices (private conversation, gas engineer, 2023). One major UK chandler reported to the author that a registered gas engineer insisted they couldn’t sell non-OPSO regulators. All of this has its origin in the PD.

It is worth noting that while it might be good practice (or even best practice) to fit a regulator with an OPSO, in some gas lockers it is just not possible to get one of these (often bulky)

devices in. The PD should not be potentially preventing routine replacement of this crucial safety item, because the owner can't physically fit one, so retains the original for far longer than the service life, pushing the boundaries of safety. It is also unclear as to why the decision was made by the review committee to adopt a new position not supported by any other documents or standards; in effect, the PD now exceeds the requirements of ISO 10239.

## 3. Tightness test procedures

The PD outlines the only gas tightness test procedure for boats that registered gas engineers can refer to, in Section D.2. Other tightness test procedures exist in IGEM documents (such as IGEM/UP/1B Edition 3) but are directed as not for use on boats. The BSS has its own manometer tightness test procedure for their examiners (notably, more stringent than the PD).

ISO 10239:2017 contains a procedure for air testing only, prior to connection to a gas supply. There is no commissioning process in ISO 10239 (see paper here as to why there should be); it is therefore crucial that the PD gas test procedure is solid, effective and reliable.

The PD details a conventional tightness test in Annex D, to be completed with a calibrated manometer, and provides allowances for pressure loss during the test based on appliances connected (Table D.1), known as a permissible pressure drop. The permissible drop has long caused issues in the sector, first appearing in PD 54823:2005.

Table D.1 **Permissible pressure drop for test with appliances connected and LPG supplied by cylinder(s) or bulk tank installation pipework**

| Volume of installation [A] m³ | Number of appliances installed | Permissible pressure drop | |
|---|---|---|---|
| | | Initial test pressure | |
| | | 37 mbar | 28–30 mbar |
| | | Pressure drop in 2 min mbar | |
| More than 0.001 | 3+ | 2.0 | 2.0 |
| | 2 | 1.5 | 1.5 |
| | 1 | 1.0 | 1.0 |
| Less than 0.001 | 3+ | 4.0 | 3.0 |
| | 2 | 3.0 | 2.0 |
| | 1 | 1.5 | 1.0 |

[A] The system volume can be calculated but, as a guide, if the system is piped in 15 mm pipe or larger and/or the appliances are distributed throughout a boat of large size, then the volume is likely to be at the top end of the range. Where the pipework is all small diameter and the appliances are installed in a compact space then the volume is likely to be low.

As a further guide, a 2 m length of 8 mm copper pipe has a volume of approximately 0.000 06 m³, a 2 m length of 10 mm copper pipe has a volume of approximately 0.000 1 m³ and the same length of 15 mm pipe a volume of approximately 0.000 3 m³.



*Figure 9 - Permissible pressure drop table from PD 54823:2016*

The reason given in the PD for a permissible drop is loosely detailed:

> *NOTE 2 Gas appliances, for practical reasons, are allowed a very small leakage, which can occasionally create a discernible pressure drop when complete installations are tested particularly if the pipework and appliance internal volume is small.*

*Figure 10 - Statement about appliance leakage, PD 54823:2016*

One example of a problem this causes is conflict with the BSS procedures, which works to zero drop. A BSS examiner can fail a gas system during a BSS examination for a drop of 2mbar over 2 minutes. A gas engineer can come along and see no problem, because the PD permits a drop during a test. However, gas engineers do not like the permissible drop; 93% of 30 gas engineers interviewed for recent research by the author, use zero drop. The BSS office will in certain circumstances permit a permissible drop on a case-by-case basis, presuming the reasoning for it's existence in the PD must have been robustly considered.

However, the reasons for its inclusion in the PD seem to be unclear. It is not stated what the practical reasons are for appliances to have permitted leakage, and no reference could be found to this being explicitly allowed in any gas appliance documents available.

The *EU Gas Appliance Directive / Regulation 2016/426 and the Gas Appliances (Enforcement) and Miscellaneous Amendments Regulations 2018: Great Britain*, states:

3.2. Unburned gas release

3.2.1. Appliances must be so constructed that the gas leakage rate is not dangerous.

*Figure 11 - Extract from EU gas appliance directive*

So not 'dangerous', but there seems to be no specific leakage rate. Anecdotally, gas engineers seem content that gas appliances in good condition generally do not leak, and research supports this by correlating gas leaks on boats to piping faults (see presentation at this URL http://www.smallcraftservices.com/technical).

To try and establish the origin of leakage rates, BSI were approached in 2022, who in reply suggested the committee who were convened to review the PD prior to its release in 2016 would be best placed to comment. BSI provided the below list of groups that formed the committee:

Association of Canoe Trades
Association of Manufacturers of Power Generating Systems
Berner Technical
British Marine
Gas Safe Register
International Institute of Marine Surveyors
Maritime and Coastguard Agency
National Association of Boat Owners
Royal Yachting Association
Yacht Designers and Surveyors Association

*Figure 12 - PD review committee members*

By their nature, coalitions are varied and have input from many different directions; this diversity is a strength as it prevents stagnation. However, being objective, there are only really four groups that might have domestic gas experts on hand (highlighted green). The

others may have had access, but how far the consultation within group membership goes during the review process is unknown. It is known that some committees in the inland waterways sector are ‘closed’ and do not consult their wider memberships.

All of the groups listed above were contacted for comment in 2022, but only two replied with any detail. There was no reply at all in most cases, some sent holding emails they did not follow up. No group called Association of Canoe Trades could be found.
Berner Technical replied, and are glazing experts, stating their committee ‘participation is with regard to ISO 12216 only, as a specialist in glass and general safety’ (fair enough).

Gas Safe Register did answer some further questions (in blue), with extracts from a longer conversation as follows:

A. Can you tell me why permissible pressure drops were included in PD 54823:2016?

   No, but then again what has changed since 2005

B. BS 5482-3:2005 and PD 54823:2016 both make reference in notes (page 19 and page 24 respectively) to permissible pressure drops being included as "gas appliances for practical reasons are allowed a very small leakage". Can you tell me what these practical reasons are, and where this statement came from?

   No. A brand new gas installation with new gas appliances being tested would not be expected to leak and no permissible drop would be allowed. However, the reality is that over the lifespan of an appliance (possibly 10-15 years or more) with consumer control taps/ gas valves being turned on and off on a regular basis, then a very small leakage over time may develop

C. Can you tell me which document or standard that the calculated permissible pressure drop for appliances was taken from? For example, in a propane gas system of less than 0.001m3, with 3 appliances, a 4mb leak over 2 minutes is detailed as a permissible pressure drop. I would be interested to know where the source information for these calculations came from, for further research.

   No, we cannot advise how this permissible allowance was originally sourced or calculated

*Figure 13 - Conversation with Gas Safe Register, regarding permissible drop*

It is realistic to infer that then, that if Gas Safe Register’s technical department cannot explain the permissible drop, that the committee who reviewed PD 54823:2016 also did not know why they continued to sanction a permissible pressure drop during a gas tightness

test. Nobody is able to say why it was added to the PD in 2005, but crucially, where the data comes from that supports its entry. Nobody can support why it was sanctioned in PD 54823:2016.

Specialist consultants have too struggled to understand how the permissible drop leak rate was calculated. A BSS consultant reviewing tightness testing procedures in 2018 questioned one aspect, telling the BSS Technical Committee (private notes):

> “There is unfortunately no rationale as to why the committee for PD 54823:2016 chose different pressure drops based on number of appliances (possibly due to the allowable leakage rates on individual appliances)”.

Private and later conversations in 2022 about this with the consultant seem to confirm the permitted leak rate in the PD has its origin in data relating to appliance leakage (as suggested by Gas Safe Register), however, this is suspected to contain errors. The appliances the data was taken from are also not of the sort found on boats, and the maximum leak rates were calculated by adding various figures together. Nobody can trace the precise origin and the committee that signed off the 2016 standard do not know why they did it.

Clearly this needs urgent attention; the truth is, a 4mbar pressure drop over 2 minutes is a leak that can be found and stopped, rather than excused. Gas engineers know that.

This matters because the only gas tightness test registered gas engineers have is the one in the PD. The fact they choose to ignore it and work to zero drop is credit to them and their diligence. The PD has this wrong and this needs revision; while there might well be a case for a permissible pressure drop, it must be validated.

## 4. Operating pressures

The PD makes several statements about operating pressures and provides data for installers. This is a very confusing area of the PD document.

ISO 10239 at clause 6 requires installers to ensure piping size is correctly calculated, so as to ensure the pressure drop in a gas system is ≤2mbar; this is in turn to ensure correct pressures at gas-consuming appliances, to ensure safe operation. The PD makes a statement at clause 6.1 which partially supports ISO 10239 in a note as follows:

*NOTE For an existing system, a pressure drop with all appliances running in excess of 2 mbar is accepted, provided that the pressure at any appliance does not drop below the minimum pressure of appliance given in Table H.1.*

*Figure 14 - Extract of note from PD 54823:2016, 6.1*

This is theory is noble, as there are genuine reasons why a system might have pressure loss in excess of 2mbar in a system, for example previous versions of the standard (e.g. BS 5482-3:1999) did permit 2.5mbar loss.

However there are only really four engineering reasons for an excessive drop in gas operating pressure, and all are problems:

A. Piping design incorrect - undersized
B. Restrictions in piping or hoses e.g. blockage, damage
C. Faulty or incorrectly adjusted regulator
D. Inadequate gas supply

If low pressure exists, all of the above require eliminating to ensure safe appliance operation.

It is a legal requirement for a registered gas engineer to ensure a gas appliance is correctly installed and operating. GSIUR makes that clear in the following regulations, which requires the installer to:

26 (1) – Install appliances to manufacturer's instructions
26 (5) – Commission the installation fully
26 (9c) – Establish correct operating pressures
33 (1b) – Establish the appliance is operating at manufacturer's pressures

*Figure 15 - GSIUR requirements for operating pressures*

It is odd then that the PD allows a bigger drop for existing systems over new systems. There seems to be no good reason for different performance criterion.

It's disappointing that despite the PD being the only available document relating to maintenance of boat gas systems, it does not deal with these engineering issues. For example, there is no mention of clogged piping through oil separation (known as heavy ends), yet it is a commonly found problem.

Returning to Table H1 as referenced in Figure 14 above, this apparently details minimum safe appliance pressures. However, Table H1 does not contain safe minimum operating pressures for gas-consuming appliances, in fact the table itself is called:

> "Extract from standards showing pressure characteristics of various **pressure regulation devices**"

*Figure 16 - Caption from table H1, PD 54823:2016*

Table H1 contains data for parameters for operation of regulators, not gas-consuming appliances. The direction to use H1 could be considered a typo then, but unfortunately, the PD continues to make errors in this area.

Table H2 provides data regarding regulator operating pressures, taken from Table 5 in BS EN 16129:2013, which itself gets the data from EN 437. In H.5 of PD 54823:2016, there is a test outlined for ascertaining correct appliance operating pressures. At (f) it states:

f) Observe and record the operating pressure. Check that the operating pressure is not below the minimum value recommended by the appliance manufacturers or, in the absence of such information, then as shown in Table H.2. If below an acceptable level, identify the cause, which could be the pressure regulation device or the size of the supply line.

*Figure 17 - Extract from PD 54823:2016, H.5*

These standards used in Table H.2 reference minimum and maximum parameters for regulators, and in the case of a 37mbar system states the minimum deliverable gas to an appliance should be minimum 25mbar. 25mbar seems low for a typical 37mbar gas appliance, and in stating this, the PD is making a somewhat unusual and unqualified assertion about an unknown appliance(s) and about what pressure it should be operating at.

The chart below shows a range of typical boat gas appliances with operating pressures as declared by the manufacturer.

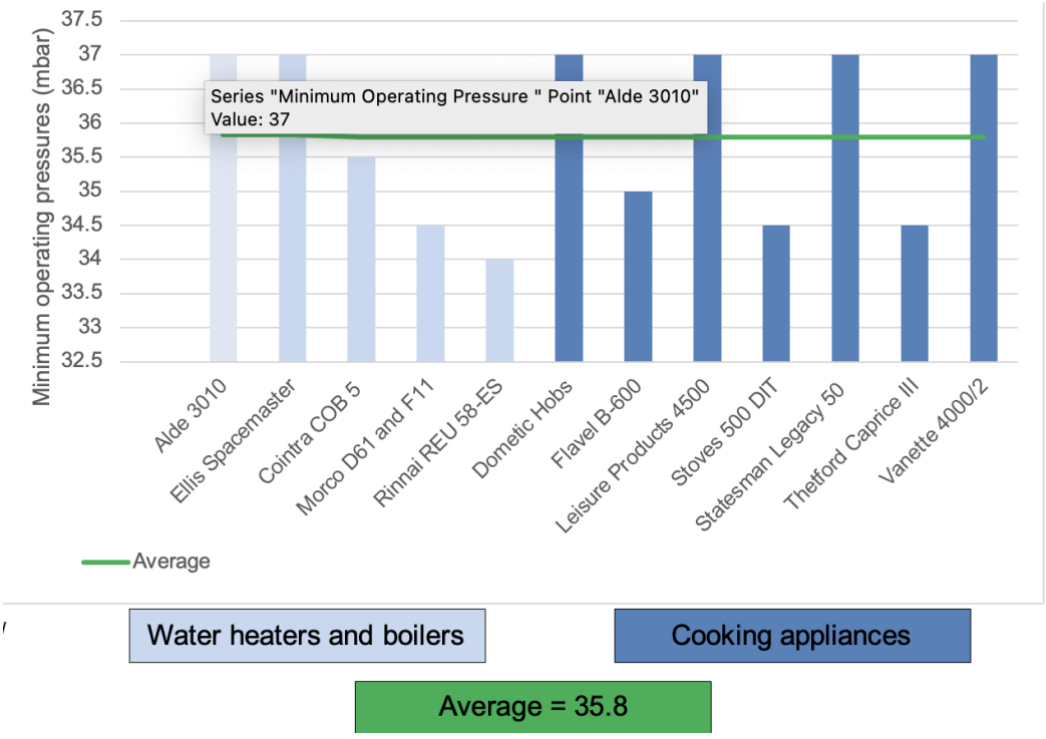



*Figure 18 - Various boat appliance operating pressures, propane*

With a nominal 37mbar required for the propane appliances detailed above, the average from Figure 16 being 35.8mbar, allowing 25mbar seems to be a long way short of what a manufacturer requires.

A further statement in the PD in Table H.2 seems to agree that 25mbar is risky:

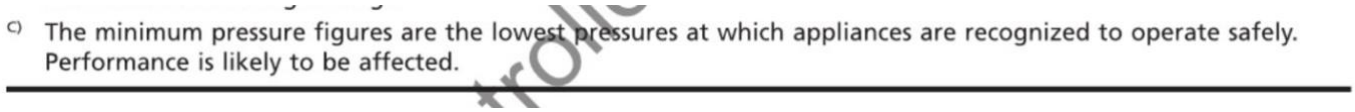

c) The minimum pressure figures are the lowest pressures at which appliances are recognized to operate safely. Performance is likely to be affected.

*Figure 19 - Extract from table H2, PD 54823:2016*

It seems bizarre that the PD makes the assertion that appliance performance will be affected, but that it's acceptable. If appliance performance is affected, then so is safety, and users are at risk.

This guidance also contradicts published technical advice from Gas Safe Register (https://registeredgasengineer.co.uk/technical/low-pressure-and-under-sized-pipework/) who advise where low pressure is found:

> "the appliance may not work in accordance with the manufacturer's instructions. The engineer in attendance must risk assess the installation and follow IGEM/G/11, the Gas Industry Unsafe Situations Procedure, if the appliance is working unsafely".

ISO 10239 also makes it clear that correct operating pressure is a requirement:

**6.1.3** Piping and hose shall be sized so that any pressure drop due to pipe resistance does not reduce the operating pressure at any appliance below that required by the appliance manufacturer when all appliances are operating simultaneously. See Annex A.

*Figure 20 - Extract regarding operating pressures from ISO 10239:2017*

It seems then, that contrary to what is required for safety and law, the PD data is basically allowing unsafe low pressures to exist in a gas system unchecked. Coupled with historical piping size data errors in ISO 10239:2008 (see presentation at this URL http://www.smallcraftservices.com/technical), which remained in published sources across the sector until 2023 (see amendment published by Gas Safe Register 2023 https://registeredgasengineer.co.uk/technical/amendment-to-boats-pipe-sizing-table/), the

PD, by ‘in the absence of manufacturer data’ has been legitimising low gas pressure at appliances. In reality a gas engineer should be following the unsafe situations procedure, but as the PD excuses an excessive drop across the system at H.1, H.2 then follows to support it. In this way, the PD has been rubber stamping poorly operating regulators, undersized piping, and clogged up or restricted gas systems, because the installer can use interpreted data in H.1 and H.2 to explain it.

The pressure data seems to be introduced in BS 5482-3:1999, and again the pressures table in 1999 (D.1) relates to regulator safe minimums, not necessarily gas consuming appliances. Preceding this, BS 5482-3:1979, which is a benchmark standard containing the most useful practical information, simply says the following at clause 21.2:

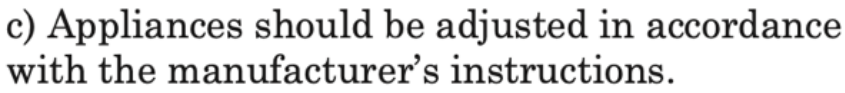



*Figure 21 - Caption from BS 5482-3:1979*

It is common sense that a gas installer will get operating pressure information from the appliance manufacturer, either from an appliance data plate or handbook. If the data is not for some reason available, for an existing appliance it would seem to be logical to say a minimum of 34.5mbar is the absolute lowest for a 37mbar propane system. This being 37mbar (nominal operating) minus 2.5mbar (maximum pressure loss for older standards). Even if there is some evidence available that 25mbar is the absolute safe minimum pressure for a particular appliance, it will not be suitable for all appliances, and is a risky assumption.

This worry seems to be further supported by another Gas Safe Register technical bulletin, (TB 080 https://registeredgasengineer.co.uk/wp-content/uploads/2017/03/Technical_Bulletin_080_revised.pdf) which states the following minimum outlet pressure:

> (c) Value is the minimum outlet pressure specified in the regulator standard to align with BS EN 437. However, it is recommended that, for the **UK market, the minimum operating pressure for propane regulators is 32mbar**

If Gas Safe Register are stating that in the UK the minimum operating pressure for a propane regulator is 32mbar, it therefore seems odd to state 25mbar is ok for an appliance. It is surprising to gas engineers that the PD can suggest anything other than what GSIUR – UK law - makes clear is a requirement. Anything else is surely unsafe and an unnecessary compromise.

## Summary

The PD contradicts both ISO 10239 and GSIUR and causes problems that affect users and installers. ISO 10239 is currently undergoing review, which in conversation has been cited as a reason for delaying a review of the PD. This seems odd as while there are many edits ongoing to ISO 10239, it is not likely to influence the problems that require resolving in the PD. While a full, thorough top-down rehash of the PD is necessary, resolving the key problems identified is simple. If the PD is weak or has errors, it sets off a chain reaction, influencing the curriculum, the materials, the delivery and the product.

In reality, most of the aspects of the PD that deal with design can be simply removed, as ISO 10239 is there for that. That would resolve the issues with regulator, appliance, and fluing in terms of selection, replacement and installation.

However, the key areas where the PD is found wanting, are both crucial to safety and the sector relies on the PD solely for expert guidance: gas tightness testing and appliance operation / maintenance.

The lack of coverage of these essential items in ISO 10239 means that review should not be delayed; a review committee with the appropriate depth, experience and qualification should be formed ASAP and work begun, because our safety depends on it.

Notes to Editors

Tom Keeling is a Chartered Engineer and Chartered Marine Engineer working as an inland waterways-based marine surveyor. He has run his independent consultancy businesses in this sector for many years, specialising in the survey of steel hull boats.



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