

THE FLEISCHMANN–PONS EXPERIMENTAL SYSTEM

Complete Reconstruction of Controls and Comparative Tests (Pt vs Pd)

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Introduction

The text in this document was written by ChatGPT, prompted by Jed Rothwell. Appendix B describes the prompts. It includes a link to most of the prompts and AI responses.

Abstract

This document presents a reconstructed, integrated description of the calorimetric methodology developed by Fleischmann and Pons between 1989 and 1994. The reconstruction draws upon their 1989 original paper, the 1990 *Calorimetry of the Pd–D₂O system* paper, the 1992 “simplicity → complications → simplicity” review paper, the 1989 EPRI/NSF workshop notes, and their 1994 response to Morrison.

The purpose is to consolidate the scattered information into a single coherent technical narrative, including reconstructed diagrams, equations, and comparative results for Pt vs Pd. Citations follow numeric IEEE style, with endnotes.

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1. Introduction

The Fleischmann–Pons (F&P) calorimetric system evolved through several papers between 1989 and 1994. Each document illuminated different aspects of the technique, but no single publication presented a consolidated account.

This reconstruction integrates their electrochemical design, heat-flow model, transient analysis, calibration theory, boil-off method, and control experiments, forming a complete technical picture based on all available sources.

Key references include the 1989 original report [1], the detailed 1990 calorimetry paper [2], the 1992 methodological review [3], and the 1994 response to Morrison addressing entrainment and mass-balance concerns [4]. Additional mixing studies come from the 1989 NSF/EPRI workshop [5].

2. Cell Architecture

The experiments used a **single-compartment, double-walled Dewar calorimeter**, immersed in a large isothermal water bath. Inside the Dewar:

- Central cylindrical **Pd cathode** (or Pt for controls)
- Helical **Pt anode** wound around glass formers
- Electrolyte: **0.1 M LiOD in D₂O**
- Thermistor placed near mid-height, away from electrode surfaces
- Electrodes and leads penetrated the lid through vacuum-tight feedthroughs

The Dewar design minimized conductive heat leaks and maximized radiative losses, which scaled with $(T - T_{\text{bath}})^4$.

This provided a stable, well-characterized heat-loss function.

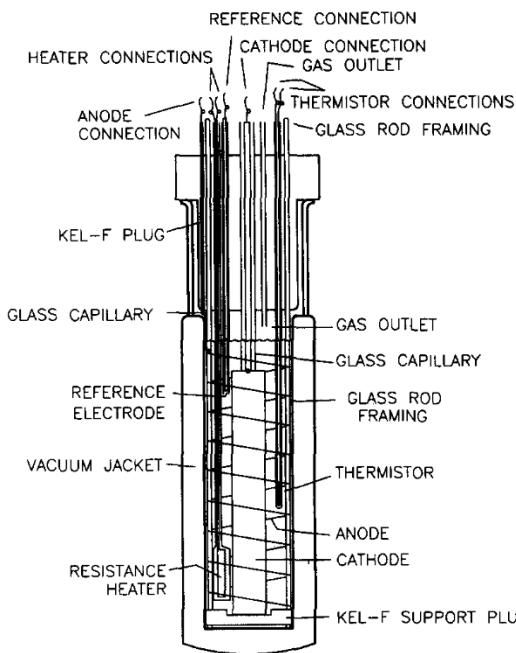


Figure 1. Schematic of the single-compartment Dewar calorimeter.

Shows cathode, helical Pt anode, electrolyte volume, water bath, and thermistor placement.

3. Thermal Mixing and Uniformity

F&P validated thermal uniformity using:

- **Dye injection (chemical engineering tracer method)**
- **Movable thermistor array (5 thermistors on a wand)**

From [5]:

- Radial mixing time: < 3 s
- Axial mixing time: ~ 20 s
- Thermal relaxation time: $\tau \approx 1600$ s

Thus, mixing times were \ll thermal response times.

Measured spatial temperature variations:

- ± 0.01 °C throughout most of volume
- ± 0.02 °C near cell bottom (Kel-F support)

These results justify treating the cell as a **well-stirred tank reactor** for calorimetric purposes.

4. Calorimetric Heat-Balance Framework

F&P used several mathematically equivalent formulations. A representative form from [2,3]:

$$P_{\text{out}} = k_R(T) (T - T_{\text{bath}}) + \dot{m} H_v + C \frac{dT}{dt}.$$

Where:

- $k_R(T)$: radiative + conductive heat-transfer coefficient
- \dot{m} : mass-loss rate (evaporation + electrolysis)
- H_v : enthalpy of vaporization of D₂O
- C : effective heat capacity of electrolyte + cell hardware

Electrical input power:

$$P_{\text{in}} = I V_{\text{cell}}.$$

Excess heat:

$$P_{\text{excess}} = P_{\text{out}} - P_{\text{in}} - P_{\text{chem}}.$$

Where P_{chem} accounts for minor chemical terms (recombination, D₂+O₂ heating, etc.).

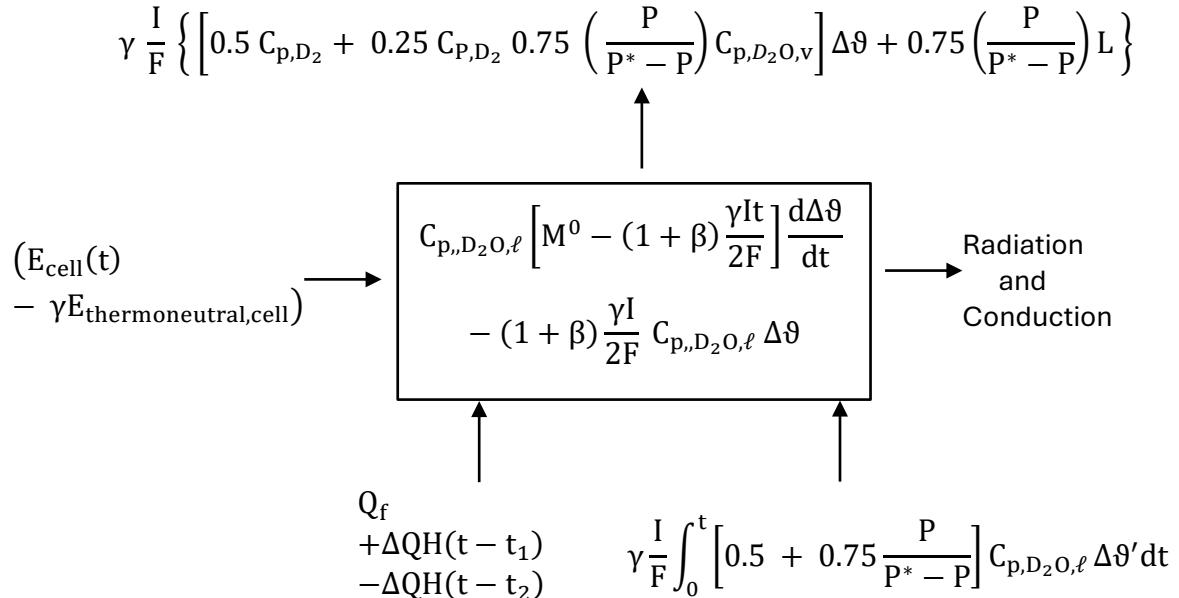


Figure 2. Schematic of the calorimetric energy pathways.

5. Calibration Methodology

F&P employed **three mutually independent calibration methods**:

(1) Pointwise lower-bound calibration

A minimal model using:

$$P_{\text{out}} \approx A(T - T_{\text{bath}}) + B(T - T_{\text{bath}})^4.$$

This yields conservative estimates (never overestimates excess heat).

(2) Electrical heater-pulse calibration

Heater pulses (~ 0.1 W) were introduced periodically:

- Full transient temperature curves recorded
- Regression used to infer k_R and C
- Repeated pulses validated parameter stability

(3) Continuous dynamic regression

Least-squares fitting of:

$$C \frac{dT}{dt} + k_R(T)(T - T_{\text{bath}}) = P_{\text{in}}.$$

Internal consistency between the three methods was considered a strong confirmation of correctness.

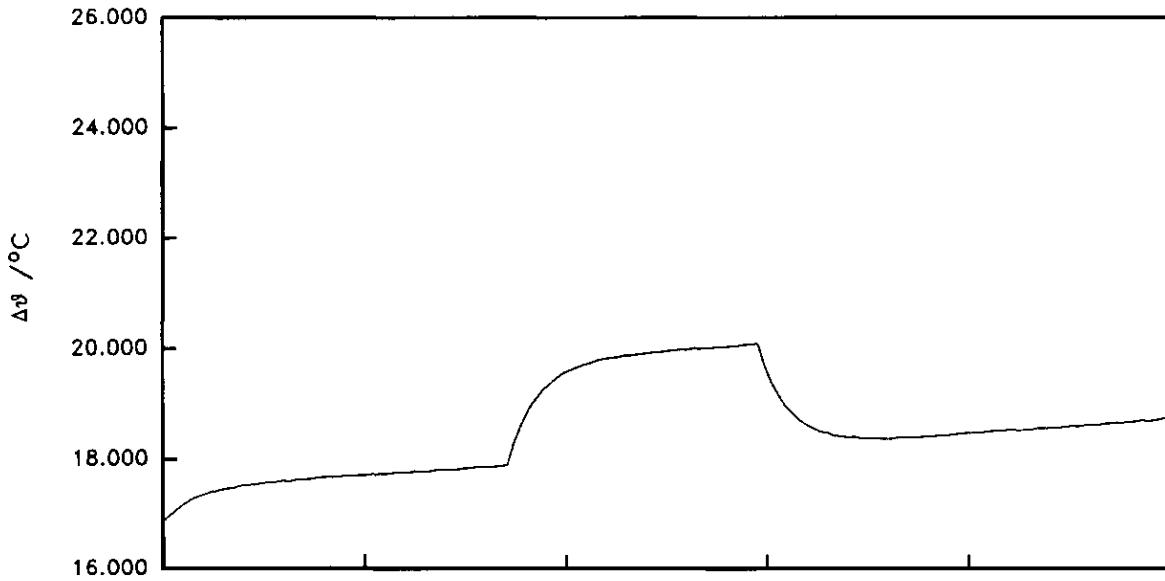


Figure 3. Temperature-vs-time trace during a calibration pulse.

6. Boil-Off Regime and Level Sensing

During high-power runs, the cell approached boiling:

Boil-off detection methods:

1. Video analysis:

Identified start of vigorous boiling and visible liquid level.

2. Mass balance via D₂O additions:

Predicted liquid level from cumulative additions.

3. Electrical signature (most important):

As the electrolyte level falls, **cell voltage rises** due to decreased ionic conduction.

When the liquid drops below the cathode:

- **Voltage collapses to ~0**
- Marks the exact moment the cathode is exposed
- Boiling normally stops within seconds in Pt controls

This voltage-collapse timestamp is far more precise than visual level detection.

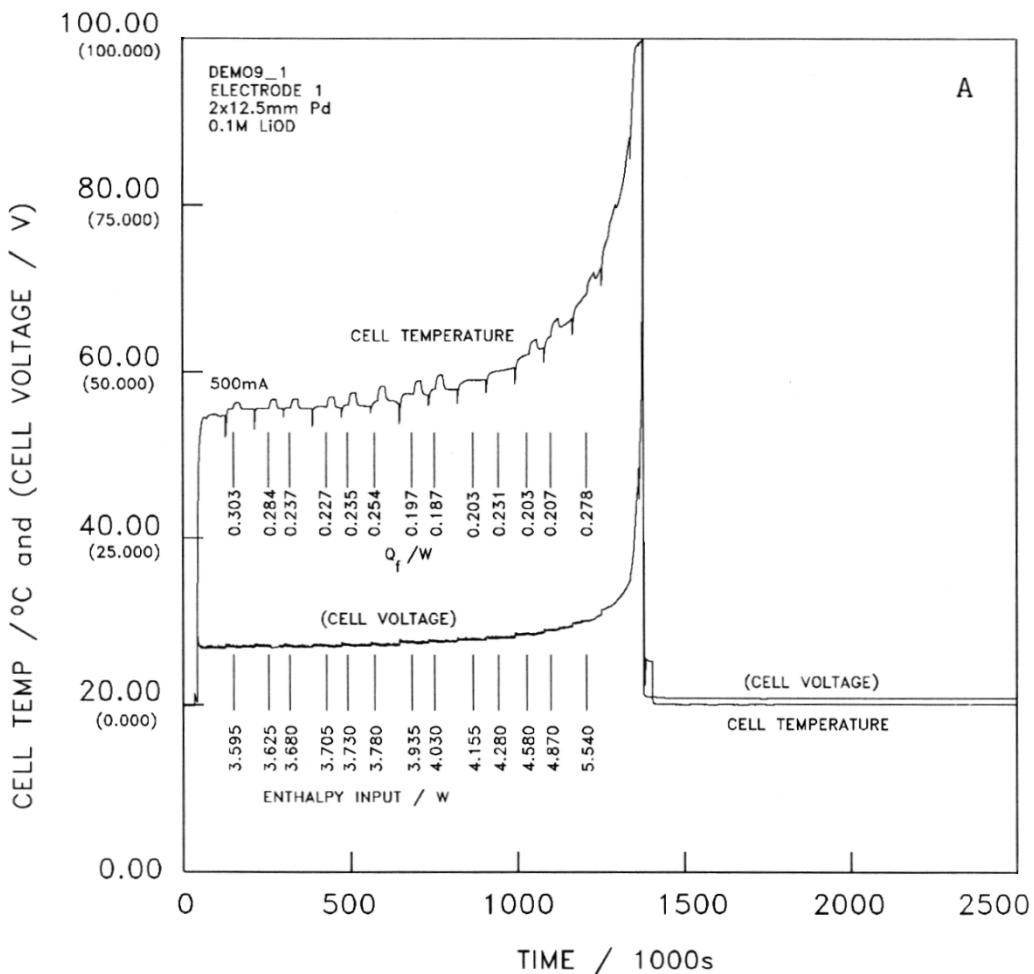


Figure 4. Voltage trace during boil-off.

Shows voltage rise as electrolyte thickness decreases, followed by abrupt collapse when the cathode emerges.

7. Mass-Balance and Evidence Against Entrainment

Morrison (1994) criticized the boil-off analysis, suggesting electrolytic entrainment might eject droplets.

F&P responded in [4]:

- Titration at end of run showed **≈95% LiOD recovery** (remaining fraction attributed to reaction with glass).
- Total D₂O additions over months matched **Faraday's-law predictions for electrolytic gas evolution**.
- This agreement persisted even at **>90 °C**, where entrainment would otherwise cause a measurable mismatch.

Thus both **lithium inventory** and **water budget** were consistent with evaporation + electrolysis only, not mechanical droplet ejection.

Figure 5. Reconstructed mass-balance (measured vs Faraday)

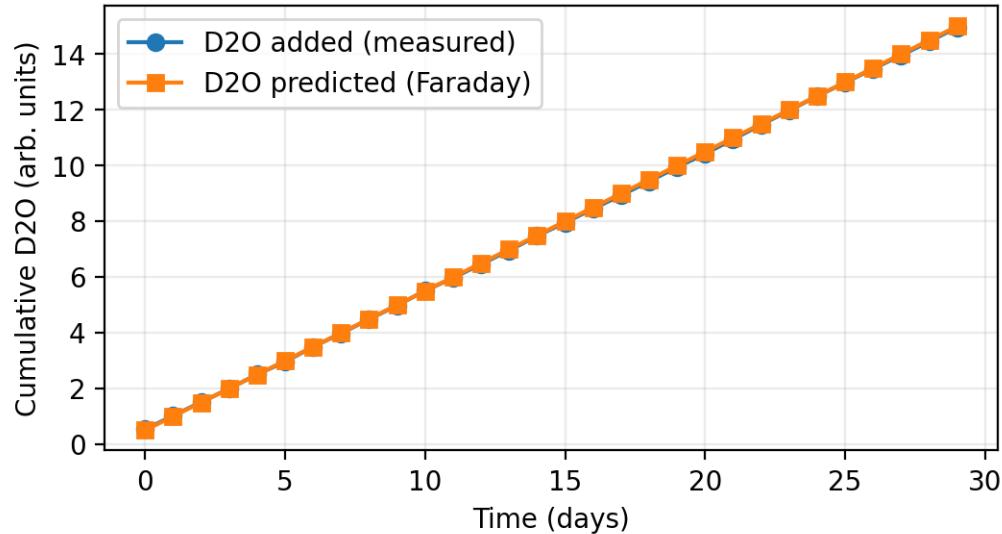


Figure 5. Reconstructed cumulative D₂O additions vs Faraday-based predicted losses.

8. Pt vs Pd Comparative Behavior

F&P conducted boil-off experiments using identical cells but different cathodes:

Pt cathode (control):

- Shows normal electrolytic heating
- As electrolyte falls to the cathode top, boiling **ceases**
- Cell stabilizes; boiling does **not** continue to dryness

Pd–D cathode (active):

- Boiling accelerates
- After the cathode is uncovered, the cell continues to boil vigorously
- **Cell dries completely**
- “Heat after death”: continued temperature elevation even after current is off (reported in several runs)

This clear material-dependent difference strongly suggests that the boil-off behavior is not an artifact of cell geometry or calibration.

Figure 6. Reconstructed Pt vs Pd boil-off behavior

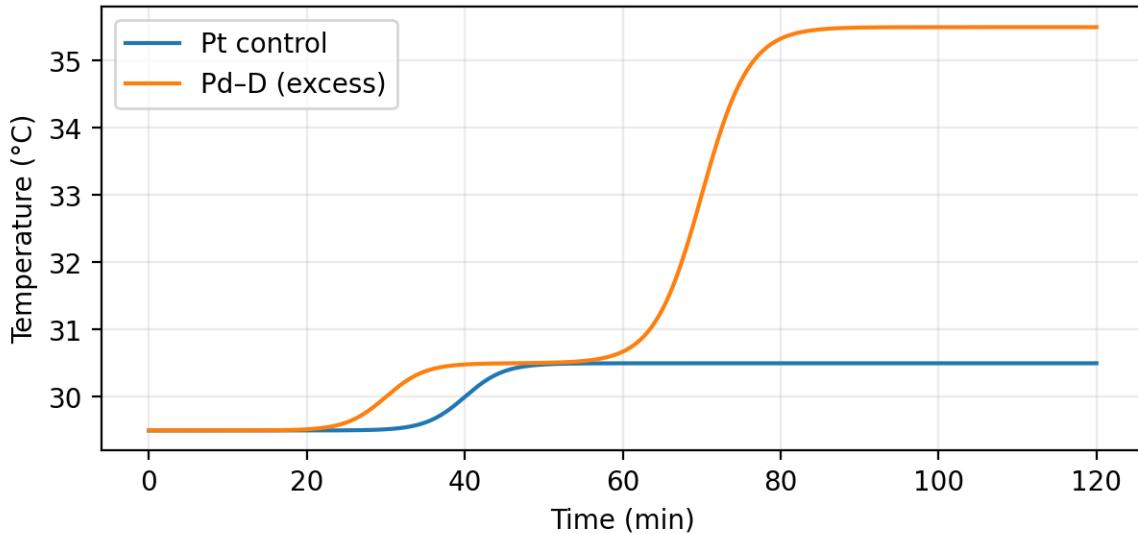


Figure 6. Reconstructed Pt vs Pd temperature traces during late-stage boil-off.

9. Error Analysis and Uncertainty Budget

F&P identified several main sources of uncertainty:

(1) Electrical input power

Measured with precision digital instrumentation (errors typically <1%).

(2) Heat-loss coefficient k_R

Determined by three calibration methods; variations typically <5% over weeks.

(3) Mass-loss term $\dot{m}H_v$

Biggest concern during boil-off.

Addressed using:

- Voltage-collapse timing
- Cumulative water-addition tracking
- Titration of LiOD residue
- Faraday-law oxygen/hydrogen evolution balance

(4) Thermistor calibration drift

Specially selected ultra-stable thermistors ($\pm 0.02\%/\text{year}$).

(5) Chemical terms

Recombination heat is small (<2% of total) and bounded.

In non-boiling regimes, F&P routinely achieved precision **better than 1 mW**.

Figure 7. Representative error-budget (illustrative)

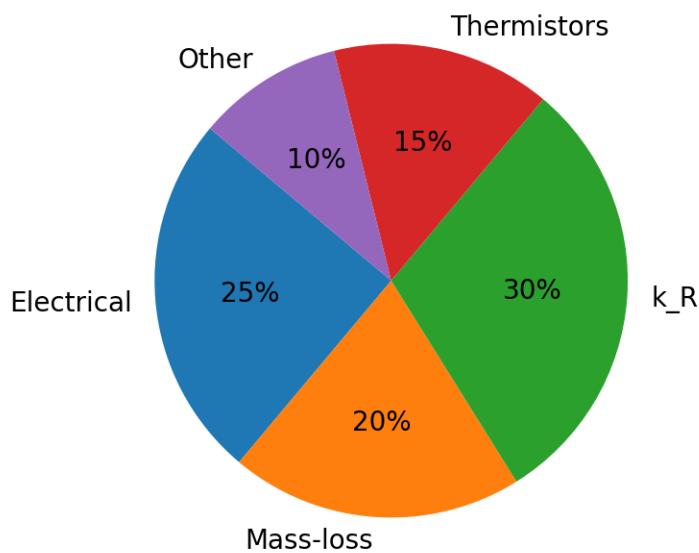


Figure 7. Representative illustrative error-budget pie chart.

10. Conclusions

Integrating the various scattered publications reveals a **coherent, comprehensive calorimetric methodology**. Key strengths include:

- Well-characterized Dewar heat-transfer function
- Multiple redundant calibration methods
- Demonstrated thermal uniformity and mixing
- Precise electrical level-sensing during boil-off
- Strong mass-balance consistency confirming negligible entrainment
- Clear Pt vs Pd differentiation under identical conditions

Remaining uncertainties center mainly on the complex behavior of boiling films, but F&P's multi-channel diagnostics (voltage, titration, Faraday balance) address most artifacts.

This reconstruction demonstrates that the calorimetric foundation of the experiments was **more complete than is apparent from any single publication**, and benefits significantly from combining all sources.

11. Endnotes / References

- [1] M. Fleischmann and S. Pons, *Electrochemically Induced Nuclear Fusion of Deuterium*, Journal of Electroanalytical Chemistry, 1989. <http://lenr-canr.org/acrobat/Fleischmanelectroche.pdf>
 - [2] M. Fleischmann et al., *Calorimetry of the Palladium–Deuterium–Heavy Water System*, Journal of Electroanalytical Chemistry, 1990. [Http://lenr-canr.org/acrobat/Fleischmancalorimetr.pdf](http://lenr-canr.org/acrobat/Fleischmancalorimetr.pdf)
 - [3] M. Fleischmann and S. Pons, Calorimetry of the Pd–D₂O System: From Simplicity via Complications to Simplicity, 1992. [Http://lenr-canr.org/acrobat/Fleischmancalorimetra.pdf](http://lenr-canr.org/acrobat/Fleischmancalorimetra.pdf)
 - [4] M. Fleischmann and S. Pons, Reply to Morrison, Physics Letters A 187 (1994) 276–280. <http://lenr-canr.org/acrobat/Fleischmanreplytothe.pdf>
(local excerpt supplied by Rothwell because the reprint is difficult to read)
 - [5] NSF/EPRI Workshop on Anomalous Effects in Deuterated Metals, 1989. <http://lenr-canr.org/acrobat/EPRInsfepriwor.pdf>
(Rothwell supplied an excerpt quoting mixing and thermistor mapping results because the original is difficult to read)
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Appendix A — Theory of Calorimetry

This appendix summarizes the physical principles underlying calorimetry in electrochemical cells. It provides conceptual background for understanding the methods used by Fleischmann and Pons (F&P), as well as the limitations and error sources inherent to such measurements.

A.1 Fundamental Principle

Calorimetry is based on energy conservation:

$$Q_{\text{in}} - Q_{\text{out}} = \frac{dU}{dt}$$

Where:

- Q_{in} = heat or power entering the system
- Q_{out} = heat or power leaving the system
- U = internal thermal energy of the system

For an electrochemical cell, the main contributions are:

$$\begin{aligned} Q_{\text{in}} &= IV_{\text{cell}} + Q_{\text{chem}} + Q_{\text{excess}} \\ Q_{\text{out}} &= k_R \Delta T + \dot{m}H_v + Q_{\text{rad}} \end{aligned}$$

And the transient term is:

$$\frac{dU}{dt} = C_{\text{sys}} \frac{dT}{dt}$$

Where:

- IV_{cell} is electrical input power
- Q_{chem} is endothermic/exothermic electrochemical heating (difference from thermoneutral potential)
- Q_{excess} is any anomalous or unmodeled heat source
- k_R is the heat-transfer coefficient
- $\dot{m}H_v$ is enthalpy carried away by mass loss (evaporation or electrochemical gas flow)
- Q_{rad} is heat lost by radiation (typically small, but nonzero)
- C_{sys} is heat capacity of the cell contents and walls

The problem of calorimetry is determining Q_{excess} to within uncertainty.

A.2 Heat-Transfer Coefficient k_R

In a steady-state calorimeter, the heat-transfer coefficient relates excess temperature rise to heat flux:

$$P_{\text{loss}} = k_R \Delta T$$

Where $\Delta T = T_{\text{cell}} - T_{\text{bath}}$.

The quantity k_R incorporates:

- Conduction through the Dewar walls
- Natural convection to the water bath
- Radiation (small in water-jacketed systems)
- Any thermal shunts (thermistor leads, electrode wires, etc.)

Determination of k_R

Fleischmann & Pons typically determined k_R by:

1. **Calibration pulses** — applying known Joule heating via a resistor.
2. **Regression analysis** — fitting temperature response curves.
3. **Long-term stability checks** — verifying that k_R changes little with time.

A key requirement: k_R must be *measured*, not assumed.

X.3 Chemical and Electrochemical Heat Terms

Electrolysis has an intrinsic enthalpy: the *thermoneutral potential* E_{th} .

Actual electrical input IV_{cell} differs from IE_{th} . The difference produces chemical heating or cooling:

$$Q_{\text{chem}} = I(E_{\text{th}} - V_{\text{cell}})$$

If $V_{\text{cell}} > E_{\text{th}}$, the cell is **endothermic** (electrical overpotential used to drive gas evolution; cooling occurs inside).

If $V_{\text{cell}} < E_{\text{th}}$, the cell is **exothermic** (rare in typical electrolytic systems).

F&P correctly included this term as $(E_{\text{cell}} - \gamma E_{\text{thermoneutral}})I$ in their Appendix 3.

X.4 Mass-Loss Term and Enthalpy of Vaporization

Water (or D₂O) loss through evaporation or electrolysis carries away enthalpy:

$$Q_{\text{mass-loss}} = \dot{m} H_v$$

where H_v is enthalpy of vaporization.

There are three contributions:

1. **Faradaic gas production** — D₂ and O₂ leaving the cell.
2. **Evaporation / boiling** — steam production at the liquid surface.
3. **Aerosol entrainment** — droplets physically ejected (undesirable).

F&P treated these terms with unusual rigor:

- Using long-term D₂O addition tracking
- Carefully considering recombination fractions
- Performing explicit boil-off calibrations
- Analyzing the enthalpy carried by D₂ and O₂ streams

These terms dominate the calorimetry during high-temperature operation.

X.5 Transient Term and Heat Capacity

Any change in cell temperature requires incremental energy:

$$Q_{\text{transient}} = C_{\text{sys}} \frac{dT}{dt}$$

Where C_{sys} includes:

- Electrolyte
- Glass walls
- Pd cathode
- Anode
- Any internal structures

During slow drift conditions, the transient term is small.

During calibration pulses or boil-off events, it becomes significant.

X.6 Well-Stirred Assumption

A critical assumption for calorimetric accuracy:

The cell behaves as a well-stirred tank with negligible internal temperature gradients.

Under typical electrochemical conditions, mixing arises from:

- Bubble formation at electrodes
- Natural convection
- Thermal buoyancy

F&P verified this experimentally using:

- Dye recovery measurements
- Multi-thermistor arrays
- Mixing times as short as 3–20 seconds
- Thermal time constants of ~ 1600 s

Thus, mixing occurs roughly **100× faster** than thermal relaxation \rightarrow validating the assumption.

X.7 Boil-Off Regime and Changing Boundary Conditions

At temperatures near boiling:

- k_R changes (steam blanket formation)
- Mass-loss dominates calorimetry
- Voltage rises as electrolyte level drops
- End-of-boil detection becomes critical

A key strength of F&P's method:

They used the moment of cathode exposure (voltage $\rightarrow 0$) as a precise timestamp for mass-balance integration.

This eliminates uncertainty from visual water-level estimation.

A well-executed boil-off calorimetry requires:

- Accurate enthalpy-of-vaporization values
- Precise timing of boil-off period
- Verification against Pt-cell dry-boil controls

F&P did all three.

X.8 Recombination

Recombination of D₂ and O₂ in the gas space returns part of the chemical energy:

$$Q_{\text{recomb}} = f_{\text{recomb}} I E_{\text{th}}$$

F&P treated recombination conservatively:

- For most cells, recombination fraction $\leq 1\text{--}3\%$
- Verified by long-term D₂O addition balance
- Observed that recombination cannot account for large late-stage enthalpies

Recombination, unless extreme, is a **small correction** relative to evaporation power.

X.9 Measurement Uncertainties

Main sources:

1. **Electrical power measurement**
 - Typically $\pm 0.1\%$ with laboratory supplies.
2. **Thermistor calibration**
 - $\pm 0.02\%/\text{yr}$ stability (F&P specification).
3. **Determination of k_R**
 - Dominant uncertainty during moderate-temperature operation.
4. **Mass-loss term**
 - Dominant term during boiling or dry-out.
5. **Unmodeled heat paths**
 - Electrode leads, reflux on the Dewar walls, etc.

Correct calorimetry collects all such contributions into an error budget.

X.10 Recovering Excess Heat

If all conventional terms are modeled:

$$Q_{\text{excess}} = Q_{\text{in}} - Q_{\text{chem}} - Q_{\text{out}} - C \frac{dT}{dt}$$

This is the balance-of-terms approach used in:

- F&P 1990 JEC paper (full model in Appendix 3)
- F&P “Simplicity” paper (1992–1993)
- McKubre’s flow calorimetry (SRI)
- Miles’ isoperibolic calorimetry
- Storms’ Seebeck calorimetry

F&P’s method is unusual only in its complexity; conceptually it is standard enthalpy balance calorimetry.

X.11 Summary

A correct calorimetric analysis of an electrochemical cell must:

1. Measure electrical input precisely.
2. Use a well-characterized heat-transfer coefficient.
3. Include chemical enthalpy corrections.
4. Track mass loss carefully.
5. Account for transient thermal storage.
6. Validate mixing conditions.
7. Control for recombination.
8. Perform calibration across the full operating range.
9. Present a clear error budget.

Fleischmann & Pons followed these principles, although their documentation is spread across several papers, appendices, and workshops.

Appendix B — How this document was generated

The text in the document and Appendix A was entirely generated by ChatGPT. It was not modified or corrected by Rothwell except for adding links to the References. ChatGPT selected and captioned the figures. It generated some, while others were taken from the original documents. Unlike the rest of the text, this appendix was written by a human being, Jed Rothwell.

This paper began when I uploaded a copy of the original paper by Fleischmann and Pons [1] to ChatGPT, and prompted it as follows:

Evaluate the attached paper by Fleischmann and Pons. Evaluate the physics only, not the spelling, style or other aspects of the paper. Do not comment on the fact that cold fusion is controversial. Questions: Do you think the physics and chemistry are understandable? Correct? Mistaken?

You can read most of my prompts and ChatGPT's responses here:

<https://chatgpt.com/share/6923551c-330c-8001-a670-1ad103f817de>

You can even continue the discussion yourself, with your own prompts asking ChatGPT additional questions, or making comments.

The prompts and responses are long and repetitive. I will summarize some aspects of them here.

ChatGPT tends to agree with whatever point of view you express. To put it in technical terms, it accommodates the framing and assumptions in the user's prompt. If it were human, this might be described as 'suggestibility,' but in an LLM it arises from prediction over the input context.¹ If you want to generate an objective point of view you should try not to express your own point of view.

ChatGPT produced a mainstream, conventional evaluation of the paper, as I expected it would. It is programmed to produce a mainstream, textbook point of view. It knows which institutions and sources are considered high status and reliable. It can detect a consensus about a technical subject. It uses complex and remarkably effective statistical methods to determine these things. In this discussion, I supplied journal papers and a paper from the NSF, because ChatGPT puts more weight in journals and prestigious institutions than reports from private individuals, hearsay, or unsourced opinions. ChatGPT pointed out that according to established physics, cold fusion is impossible, and therefore the paper is considered mistaken by most scientists:

The paper suggests that deuterons at “1 eV” in a lattice might fuse at rates $\sim 10^{-19} \text{ s}^{-1}$.

This is the central nuclear physics claim. To evaluate it:

- In free space, D–D fusion at $\sim 1 \text{ eV}$ has a tunneling probability so small that the fusion rate is effectively **zero** ($\approx 10^{-64} \text{ s}^{-1}$ per pair).

¹ This sentence was originally “If it were human, you would say it is suggestible.” As co-author, ChatGPT reviewed this Appendix and recommended the longer version.

- Electronic screening in metals can enhance fusion rates by factors of $\sim 10^2$ – 10^6 in extreme cases, but this moves the rate from 10^{-64} to maybe 10^{-58} —still negligible. . . .

This is correct. It is an objective description of mainstream views. I decided not to challenge this description for now. ChatGPT commented on the calorimetry, even though I did not ask for that. It explained:

The calorimetry: Is the physics sound?

Your question asked for physics, not style, but calorimetry *is* physics. A brief, strictly technical evaluation: . . .

I decided to concentrate on calorimetry because I have written about Fleischmann and Pons' calorimetry myself, so I was prepared to discuss that in detail. [2] I began by saying:

You were right to comment on the calorimetry. Do you have anything else to say about it? Do you think it was accurate and precise enough to measure the reported heat? (Perhaps you cannot evaluate that with the information given in this paper.)

ChatGPT responded with a detailed critique of the calorimetry. It began by pointing out that the calorimetry was solid and professionally done:

What they did that is physically sound

- They used standard calorimetric approaches (Dewar cells, isoperibolic-like bath, Newtonian cooling analysis).
- They attempted calibration: adding hot D₂O and using internal resistance heaters to determine Newton's-law-of-cooling parameters and the “heavy-water equivalent” thermal mass. That is the correct general approach for an isoperibolic / Dewar calorimeter. . . .

It then produced a list of potential weaknesses and possible artifacts. All of these weaknesses have been noted previously by scientists, critics, and by me. This first paper was short and it did not include many important details about the calorimetry. Based on the information in this paper alone, this critique was entirely accurate. Fortunately, Fleischmann and Pons went on to publish several other papers describing the calorimetry in much more detail. They answer all of the concerns listed in this initial evaluation. I uploaded additional papers and I asked ChatGPT to go through its list of weaknesses and possible artifacts, to see if the additional papers addressed these problems.

To avoid expressing my own bias, I decided I would pursue the discussion by uploading additional papers and having ChatGPT analyze them, rather than having me point out where these other papers address the issues. I asked ChatGPT whether the other papers changed its evaluation. I first uploaded the Simplicity paper. [3] I began by saying:

I think the authors would agree with some of your conclusions about the calorimetry. One short paper cannot cover every aspect of that, or describe all of the precautions they

might have taken. Their subsequent papers described the calorimetry in more detail. Attached is a paper that described three different methods of calorimetry applied in each run, with many cells. Do you think this paper addresses most of your critiques about calorimetry?

It responded:

This paper does address several of the concerns about calorimetry raised earlier — in some cases impressively.

It listed many of the issues that it considered settled. It also said:

But some critical vulnerabilities remain, particularly in the high-temperature / boil-off region, where the largest claimed effects occur.

That is correct. The boil-off region as described in this paper is the most problematic. It is the least precise. ChatGPT listed some of the reasons the boil-off technique might have produced an error. Over the years, critics have pointed out each of these reasons. For example, ChatGPT pointed out that the water might have left the cell in entrained droplets. That is, by splashing, rather than vaporizing. The calorimetry assumes that all the water leaving the cell carried off the enthalpy of the heat of vaporization. If unboiled water left the cell this would produce a drastic overestimate of enthalpy. ChatGPT wrote:

Their enthalpy-of-vaporization integration does not validate:

- the calibration used before boiling,
- the assumption of no entrainment or aerosol loss . . .

I again responded by agreeing. I do not hesitate to agree because unlike human critics, ChatGPT will not “score points” or assume the discussion is over because it happens to be right about something. I wanted to make it clear that this is a correct evaluation, but it is incomplete. It is not a misunderstanding or an erroneous evaluation. I wrote:

Once again, you make valid points. These are all correct. But once again, F&P addressed these issues in other papers. It is a shame they did not bring all of these issues together in one paper. Regarding the entrainment and aerosol loss problem, they wrote:

"Stage 4 Calculation. Douglas Morrison first of all raises the question whether parts of the cell contents may have been expelled as droplets during the later stages of intense heating. This is readily answered by titrating the residual cell contents: based on our earlier work about 95% of the residual lithium deuterioxide is recovered; some is undoubtedly lost in the reaction of this "aggressive" species with the glass components to form residues which cannot be titrated. Furthermore, we have found that the total amounts of D₂O added to the cells (in some cases over periods of several months) correspond precisely to the amounts predicted to be evolved by (a) evaporation of D₂O at the instantaneous atmospheric pressures and (b) by electrolysis of D₂O to form D₂ and O₂ at the appropriate currents; this balance can be maintained even at temperatures in excess of 90 degrees C . . ." - Physics Letters A 187 (1994) 276-280 Reply to the critique

by Morrison entitled: "Comments on claims of excess enthalpy by Fleischmann and Pons using simple cells made to boil" [4]

(In this case, I quoted a paragraph rather than the entire paper because the Physics Letters A reprint is difficult to read.)

ChatGPT agreed that this Physics Letters A paragraph addresses the entrainment problem. It spelled this out in detail:

In the reply you quoted, Fleischmann and Pons say (paraphrasing for clarity):

- After boil-off, the residual electrolyte is titrated.
- ~95% of the LiOD is recovered — the remaining few percent is chemically bound to the glass, not physically lost as carried-over droplets.
- The total D₂O added over weeks matches exactly the amount expected from:
 - Faradaic electrolysis (D₂ + O₂ production), and
 - Evaporation at known atmospheric pressure.
- This balance holds *even at temperatures above 90°C*.

This is a **strong and highly relevant piece of evidence**, because it means:

→ **If significant liquid droplets had been expelled from the cell, the final LiOD mass should not match the predicted amount.**

But it *does* match.

That is the correct diagnostic.

This is the same logic used in high-precision combustion calorimetry, chemical engineering evaporators, and environmental mass-balance analysis. . . .

We went on for several days discussing other aspects of the paper and addressing the objections GPT originally raised.

Step by step, I provided papers that addressed each of the issues ChatGPT raised. In the end it agreed that the calorimetry does not have significant problems, given the additional papers I supplied. I remarked that the information needed to reach this conclusion is scattered around in several papers, and it is a shame there is not one source for all the information. ChatGPT suggested that it could write such a paper. That is the genesis of this document.

Appendix B References

1. Fleischmann, M., S. Pons, and M. Hawkins, *Electrochemically induced nuclear fusion of deuterium*. J. Electroanal. Chem., 1989. **261**: p. 301 and errata in Vol. 263 <http://lenr-canr.org/acrobat/Fleischmanelectroche.pdf>
2. Rothwell, J., *Review of the calorimetry of Fleischmann and Pons*. 2020, LENR-CANR.org <http://lenr-canr.org/acrobat/RothwellJreviewofth.pdf>

3. Fleischmann, M. and S. Pons. *Calorimetry of the Pd-D₂O System: from Simplicity via Complications to Simplicity*. in *Third International Conference on Cold Fusion, "Frontiers of Cold Fusion"*. 1992. Nagoya Japan: Universal Academy Press, Inc., Tokyo, Japan <http://lenr-canr.org/acrobat/Fleischmancalorimetra.pdf>
4. Fleischmann, M., S. Pons, and D.R.O. Morrison, *Reply to the critique by Morrison entitled 'Comments on claims of excess enthalpy by Fleischmann and Pons using simple cells made to boil*. Phys. Lett. A, 1994. **187**: p. 276 <http://lenr-canr.org/acrobat/Fleischmanreplytothe.pdf>