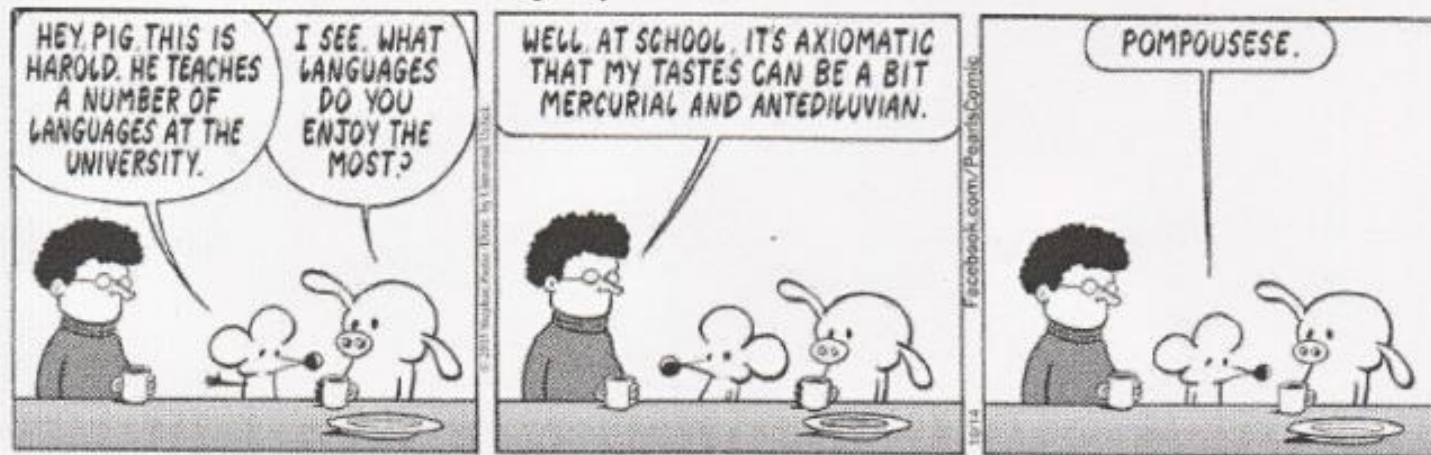# Effective Technical Writing Elements

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Technical Writing Fault Classes

- Sloppy
- Pompous
- Advertising Copy

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PEARLS BEFORE SWINE by Stephan Pastis

Sloppy Example

AIAA 2012-4161 original text

Introduction

Many challenges have to be overcome in order to enable sustained hypersonic flights. Among these, the management of heat loads and of surface temperatures has to be mentioned. The viscous dissipation of the high enthalpy flow across the hypersonic boundary layer can increase the flow temperature to levels that exceed the thermo-mechanical limits the available materials. The surface temperatures can be further increased by the interaction of the dissociated flow with the vehicle's surface. Neither current carbon nor ceramic-based materials are able to sustain the generated extreme surface temperatures for long exposure times. In addition, high pick heat fluxes are particularly dangerous even if characterized by small characteristic times, due to the material's spallation phenomenon. In this harsh environment, the cooling of the exposed structure, (i.e., surfaces exposed to external flows as well as internal flows as those typical of the combustor of a scramjet engine) is a stringent requirement. The transpiration cooling technique allows for a decrease in the heat flux at the wall through the issuing of coolant fluid from a porous material into the boundary layer. Furthermore, the issuing phenomenon near the wall generates a protective layer of coolant which favorably acts on preventing active oxidation phenomena that are known to quickly deteriorate the TPS when particular combinations of elevated temperatures and low partial pressures of oxygen occur.

222 words

Pompousese Example

excerpt from the Office of Naval Research Naval Science and Technology Strategic Plan as quoted in the June 2012 issue of Aerospace America (page 33).

"Central to achieving that vision is the development of a distributed system of heterogeneous unmanned systems relying on networkcentric, decentralized control that is flexible in **its** level of autonomy, with the ability to get the right level of information to the right echelon at the right time. **This** may include defeating asymmetric and emerging threats via persistent and stealthy distributed large-area presence, stimulation of suspect entities, and disruption and deception of potential hostiles."

Advertising Copy Example

Focused execution is key to the success in so many of Eagleworks efforts. "Our focus on prioritization has allowed us to schedule efforts without having to forego any major milestones" said Joe Schmoe, Director of Eagleworks.   "We have laid out a 10 year plan on the continual advancement of technologies that map into our products with dual purpose funding aligned to this roadmap. This commitment to funding our entire technology development will ensure the maturation and transition to a full program platform."

Presentation Objective

- At the end of this session, the participant will be exposed to techniques for writing in a clear and succinct style

Introduction

- **Technical Writing Purpose:** Communicate with a reader to produce a desired result
  - **Proposal – Reader determines proposed offering is the best choice**
  - **Report – Reader achieves understanding of subject design/effort for later use**
  - **Process – Reader achieves understanding of required actions**

The Reader Rules

Introduction
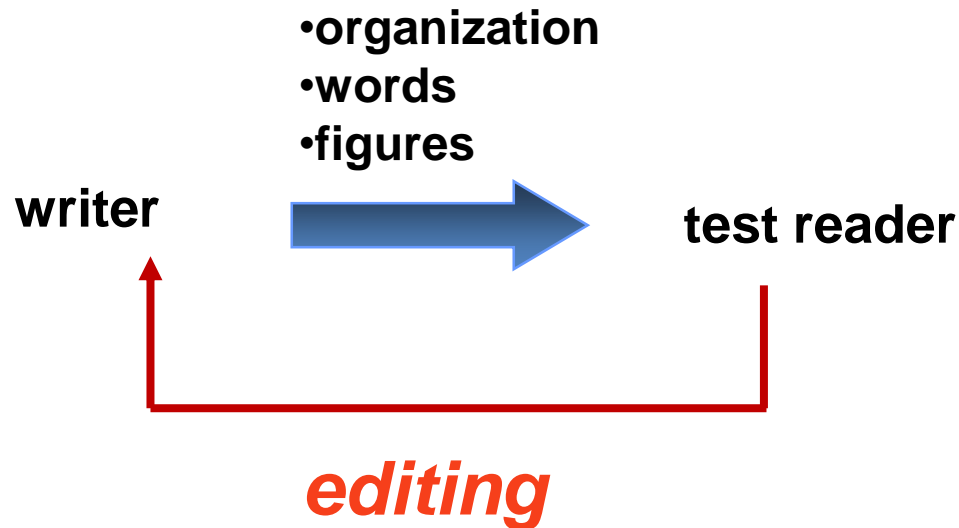
Writing is Fundamentally Different From Conversation

•**words**   •**phrasing**   •**organization**
•**intonation**   •**gestures**

speaker → **listener**   **Real-Time Feedback**

• **body language**
• **questions**

writer → **reader**

•**organization**
•**words**
•**figures**

Feedback Delayed or Non-existent

Different Tools, Different Feedback

Introduction

Writing Must be Tested to Simulate Feedback

- organization
- words
- figures

writer ⟶ **test reader**

editing

You Never Get it Right the First Time

Effective Technical Writing Features

- Understandable

- Unambiguous

- Data-Rich

- Grammatically correct

- Minimal

Every Word a Jewel

Technical Writing Sentence Types

Technical Writing Sentences Either:

1. **Describe something the author (or authors or team) did, is doing, or plans to do**

Or

2. **Describe results, features, plans, or techniques of the design, analysis, test, or process**

Sentences are Usually Linked to a Document Figure

Active Voice vs. Passive Voice

- Active Voice: subject acts (via a verb) on an object

- Passive Voice: subject is acted upon by a noun, usually unidentified

  - ***The team calculated the drag of the aircraft.*** **(Active)**

  - ***The drag of the aircraft was calculated*** *by the team.* **(Passive)**

- Technical writing often uses the same subject – passive voice is chosen to avoid restatement

Active Voice vs. Passive Voice

- Passive voice problems:
  - **Long sentences**
  - **Results separated from actions**
  - **More opportunity for grammar errors**
- Active Voice Benefits
  - **Shorter, livelier sentences – reader sees an action performed**
- Relieve monotony of same subject by allowing change of person – alternate from third person (e.g. company name, design team) to first person (we)
- Suggest ratio of one passive-voice sentence for every two active-voice sentences

Active vs Passive Voice Example

- **Original –**
  Part of the initial design steps, after choosing the airfoil and getting its resulting Cl, included choosing a range of desired aircraft weights. Using these estimated ranges, a range of wing areas <u>was determined</u> that could satisfy the requirements. The operating ranges <u>were then narrowed down and iterated</u> until workable values were obtained. Once the required wing area was known, along with the taper ratio, the chord dimensions <u>were chosen.</u>

- **Edited using active voice verbs (underlined)**

  After selecting the airfoil, the design team <u>established</u> a desired weight range for the aircraft. Using these weights and the Cl value of our airfoil as inputs, we <u>calculated</u> wing areas that provided the lift needed to achieve the takeoff requirement. We <u>iterated </u>this analysis and selected a wing area. The team then <u>selected</u> a taper ratio and established the chord dimensions.

Fewer Words, Livelier Reading, Improved Communication

Simple Tenses

- Problem: Technical writing describes both work performed and resulting designs or data – past and present get mixed up

- Solution:
  - **When describing the design or data development process, write in the past tense**
  - **When describing the features of the design, design process results, or data results, use present tense (e.g. *the data show*, not *the data showed*).**
  - ***Exception*: when describing a feature that was subsequently changed, past tense is appropriate.**

Simple Tenses

- Limit using past perfect, present perfect, and conditional tenses, as they add words.

- *Instead of -*   *Use -*

  has been, have been   was

  would be   is

Simple Tenses Example

- **Original - Present, past, present perfect, and future tenses used:**

    The fuselage <u>is</u> a simple cylindrical structure constructed from the EPP foam. It <u>is</u> permanently attached to the tail boom and <u>will</u> house the payload. This cylindrical structure <u>was</u> chosen for its aerodynamics and ease of construction. It <u>has been</u> positioned below the wing and centered on the center of gravity so that the addition of the payload weights <u>doesn't</u> disturb the center of gravity (CG) positioning. The payload itself <u>will</u> consist of lead bars cut to the length of the fuselage.

- **Edited – present and past tenses used**

    A cylindrical fuselage constructed from EPP foam <u>is</u> permanently attached to the tail boom. The cylindrical structure <u>was</u> selected for its desirable aerodynamics and ease of construction. The fuselage, which carries the payload, <u>is</u> positioned below the wing on the projected center of gravity (CG) to minimize CG shift with payload addition. The payload <u>consists</u> of lead bars cut to the length of the fuselage.

Reader Knows What Was and What Is

Simple Tenses – Proposal Document

When discussing work planned for the contract effort (in response to RFP paragraphs)

- **Use future tense**
  - o **Example – Company A/The team/We will perform the following tasks…**
- **In describing how the tasks will be performed the process is described in the present tense**
  - o **Example – Company A will perform this task using the process described in Figure X.XX. The first step gives the team information…. The second step provides insight that is used to optimize… Using this process, the team completes design cycles in less than three weeks.**

Only Essential Words

- Eliminate unnecessary adjectives - examples:

  We incorporated needed changes (vs. unneeded?)

  We made maximum use of (vs minimum?)

- Eliminate duplicate phrases – example:

  Original – two sets of duplicate words

  ***Additionally*, fuel burn has** little effect **on the center of gravity as well** *(less than a quarter of an inch shift)*.

  Edited –

  Fuel burn shifts the center of gravity less than 0.25-in.

Only Essential Words

- Eliminate introductory phrases – examples:

now that	from the start	to go about this
simply	the next step	from this

that

Original –

Now that the type of wing that was going to be built was selected, the next step was to select the airfoil that would be used. To go about this, research was conducted on different types of airfoils through various airfoil databases. During the search a program called Profili was discovered.

Edited –

With the wing configuration selected, we then evaluated airfoil options. We researched airfoil databases and found a program called Profili.

Concise Wording Examples

Wordy	**Concise**
Is representative of	typifies
is clear that	clearly
at the present time	now
kept under surveillance	watched
made an investigation of	investigated
notwithstanding the fact that	although
on account of	because
on the basis of	by
along the lines of	like
pertaining to	about
pursuant to	following
separate into two equal parts	halve
take appropriate measures	act
in the majority of instances	usually

Concise Wording Examples – cont.

Wordy	Concise
for the purpose of	for or to
from the point of view	for
in accordance with	by or under
in addition (to)	also or besides
in close proximity	near
in excess of	more than
in conjunction with	with
in many cases	often
with respect to	about or concerning
in the absence of	without
in the event that	should or if
introduced a new	introduced
in view of the fact that	considering or because
In order to	to

Talk Technical

- **Do not use** adjectives or adverbs to quantify a topic
  - **Adjectives are subject to interpretation**
  - **Gives impression of not knowing specifics**
- Examples (**DO NOT USE**)

large (ly)	**severalgreat (ly)**
(in) significant (ly)some	**minimal (ly)**
extensive (ly)	**a few**
gradual (ly)	**low/high level of**
many	**(very) good**
excellent (ly)	**numerous**

- State a value or range of values, an order of magnitude, or a percentage. This provides the reader the quantitative perspective of the data comparison
- Adjectives with quantifiable meaning are acceptable
  - **Examples: (for a defined set) maximum/minimum, least/greatest, and majority/minority**

Talk Technical Example

The C-95 provides a SAR platform with exceptional flight-range and response-time capability for a true rescue capability. The C-95's unique ability to conduct search <u>and</u> recovery may substantially reduce the total time to bring survivors to medical attention as well as reduce the number of assets required for mission support and execution.

Better:

The C-95 provides a SAR platform with both range and response-time capability plus a rescue capability. The C-95's unique ability to conduct long-range search <u>and</u> recovery reduces the total time to bring survivors to medical attention and reduces the number of assets required to execute SAR missions.

Best:

The C-95 provides a SAR platform with range and response-time capability plus a rescue capability. The C-95's unique ability to conduct long-range search <u>and</u> recovery reduces the total time to bring survivors to medical attention by 30-50%, and reduces the number of assets required to execute SAR missions by over 50%.

Avoid Using Nouns from Verbs

- Eliminate nouns from verbs (ment, tion, al, – state a condition of an action occurring)
  - **Examples: measurement, substantiation, removal**
  - **Often used in passive voice sentences**
  - **Usually followed by the word "of"**

- Restructure sentence to use the verb form - sentences are more direct, use fewer words

  Original -
  <u>Measurement of</u> the aerodynamic forces acting on the model was accomplished by use of a three-component balance
  Edited –
  The aerodynamic forces acting on the model <u>were measured</u> with a three-component balance
  Or....
  We used a three-component balance <u>to measure</u> the aerodynamic forces on the model.
  Or...
  We <u>measured</u> the aerodynamic forces on the model with a three-component balance

Avoid Nouns from Verbs continued

- Avoid the noun-verb-noun morphing trap
  - Noun – *priority* – an item of importance relative to others
  - Verb – *prioritize* - the act of setting priorities
  - Noun – *prioritization* – the process of setting priorities
- Creates stilted sentences (pompous or unduly formal)

Original -
Prioritization of candidate options was needed to fit the task to the budget
Edited–
Prioritizing the candidate options was necessary to fit the task to the budget.
Or….
We needed to prioritize candidate options to scope the task to the budget.
Or….
We needed to set priorities for the candidate options to scope the task to the budget

- **PS** - **DO NOT USE Definitization!**

Danger Flag

any sentence containing …ment of, …ation of, …..ization of

- Editing Opportunity!
  - **Try substituting the …ing version of the root verb (as a present participle or gerund)**
  - **Try changing the sentence to use the verb form or the original noun form**

Example – Substituting "ing"

In this new role, Bryan will be responsible for the *identification and implementation of* quality improvements and their integration into process design. He will oversee the *development of* processes and systems to improve production and *delivery of* products based on building capability and will be responsible for the *research and development of* interfaces for future state inspection technologies.

In this new role, Bryan will be responsible for leading his team in *identifying and implementing* quality improvements and *integrating* them into process design. He will lead process and system development efforts aimed at *improving* production and product delivery, and will be responsible for *developing* interfaces for future-state inspection technologies.

Avoid

- **Ensure**
  - **DO NOT USE when referring to a outcome– Engineering is not that certain!**
  - **Merriam Webster: to make sure, certain, or safe: GUARANTEE… "may imply a virtual guarantee"**
  - **Substitute: Provide**
  - **OK to use if referring to accomplishing a task or executing a process – if a guarantee is inferred**
    - **Otherwise describe the action to be taken vs. the claimed result (e.g. validate, confirm, review)**

Avoid

- **Focus**
  - **Used as a substitute for several nouns, adjectives, and verbs –overused**
  - **Multiple uses blurs meaning in a sentence so the reader interprets as a "feel-good" statement without specific meaning**
  - **Alternatives to focus:**
    - **Noun (e.g. the focus of our investigation…)**
      - **priority** - **attention**
      - **emphasis** - **effort**
      - **subject**
    - **Adjective (e.g. a focused effort dealing with)**
      - **concentrated**
      - **defined**
      - **specific**
    - **Verb (e.g. it will focus on…)**
      - **concentrate** - **examine**
      - **deal (with)** - **emphasize**
      - **target (ed)** - **cover**
      - **apply (focused its efforts to….vs. applied its efforts to)**

Examples

- **The <u>Wall Street Journal</u> (2/14)**

NASA Administrator Charles Bolden said when it came to planetary mission there is now "a fundamental change in the way we do business" with ~~a focus~~ *an emphasis* on "medium-class missions" that would provide the "best science return for our dollar." Meanwhile, NASA Deputy Administrator Lori Graver said, "We are committed to ~~ensuring that our astronauts are once again launched~~ **regaining the capability to launch our astronauts** from US soil on American-made spacecraft...and this budget provides the funds to make this a reality."

- **<u>NASASpaceFlight</u> (2/24)**

While ~~focusing mainly on what the roadmap to first flight entails~~ **discussing elements of the roadmap to first flight**, the article notes ....

- **<u>Creamer Media's Engineering News</u> (2/24)**

The article notes "extending the operational life of satellites is a ~~key focus for the company~~ **company priority**."

Checklist

Use Active Voice	
Use Simple Tenses	
Use Only Essential Words	
Talk Technical	
Avoid Using Nouns from Verbs	
Avoid the Words *Ensure* and *Focus*	

Edited Sloppy example

Introduction

Hypersonic flight creates heat loads and resulting surface temperatures that challenge hypersonic vehicle designers. Hypersonic boundary layers are characterized by viscous dissipation of high-enthalpy flows and by dissociated flow interaction with vehicle surfaces, which together can create steady-state flow temperatures exceeding thermo-mechanical limits of available materials. In addition, even short-duration peak heat fluxes can spall surface materials. Therefore, hypersonic vehicle designers use cooling techniques for exposed structures (surfaces exposed to external flow or scramjet engine combustor flow). One technique, transpiration cooling, issues coolant fluid through a porous material into the boundary layer to 1) decrease the heat flux at the wall and 2) generate a protective layer of coolant to reduce surface oxidation, a concern for C-C/SiC- based materials.

121 vs 222 words

Edited Pompousese Example

Suggested Edit

"A key task in achieving this vision is developing a distributed network of heterogeneous unmanned systems relying on networkcentric, decentralized control that is flexible in its level of autonomy, and is able to get the right level of information to the right echelon at the right time. These systems can defeat asymmetric and emerging threats via 1)having persistent and stealthy distributed large-area presence, 2)stimulating suspect entities, and 3)disrupting and deceiving potential hostiles."

Edited Advertising Copy Example

"Setting priorities allows us to schedule efforts to meet all major milestones" said Joe Schmoe, Director of Eagleworks. "We developed a 10-year roadmap for advancing technologies that map into our products, and we aligned funding to this roadmap. The roadmap funds technology development through flight demonstration."

44 vs 81 words

Shaping the Future of Aerospace