In defense of the 6-part paragraph- Dr. Robert Niewoehner

My high school grades deceived me. I presumed that high marks in math, science and engineering necessarily meant that I could also write well. I did understand that good writing skills were characteristic of intellectual talent, and somehow I reasoned that since I thought I was an intellectual that must surely mean that I wrote well too. This was a leap without substantiation; neither my undergraduate degree nor my first graduate degree asked me to do any substantial writing. I believe I wrote more in my language minor than in all my other courses combined. I did not write a single page of prose for my engineering masters degree. Rather, the latter deceived me still further; if I can write well (a flawed inference from high school data), and I'm advanced at science and engineering, then I must surely be a good technical writer too.

In my late twenties, the Test Pilot School staff savaged my presumption, ripping into my writing, leaving it bloodied by their pens. They bluntly corrected my erroneous belief that I wrote well. Among their demands, they insisted that I comply with their formulaic 6-part paragraph. Submission to their demands arrested their bleeding on my prose.

Later, my dissertation advisor further humbled me in pursuit of my PhD. Isaac and I were the same age, and I delighted to read his technical prose. Though his work treated deep theoretical complexity, all his prose steered neatly through the complexity in very direct accessible ways. It seldom required a second reading. We were both in our early thirties, but he'd first learned English as an undergraduate, having emigrated from the USSR in his late teens. He wrote better in his third language than I did in my first.

Excellent technical reports persuade. Some sponsor/customer/agency paid for the testing, seeking an answer to some important question. "Is it safe?" "Will it meet my requirements?" "In what research direction should I invest?" The answer they receive may lead them to make or forgo a purchase, invest in further research, or grant a certification. The goal of the technical writer is to persuade the reader to embrace their conclusion. Technical writing is technical persuasion.

The paragraph is the basic building block of argumentation. Sentences express solitary thoughts; paragraphs order thoughts into arguments. Writing good sentences is indispensable to expressing our thoughts; writing good paragraphs is indispensable to our arguments. Hence, the well-written technical paragraph forms the cornerstone of good technical prose.

The US Naval Test Pilot School teaches its students to prepare basic report-body paragraphs in six parts. The precept is ordering technical thought into cogent technical argument.

1. Test Conditions/Method. This identifies the subject the paragraph will address, and possibly the method by which the data was collected, if not previously described.

2. Data/Results. Next the actual data is presented in figures, tables and prose. Figures and table must have referents in the prose so that the reader knows where that information is to appear in the argument's thread.
3. Analysis. Here's where trends and peaks are noted, and comparisons are drawn. Note that comparisons and contrasts are particularly powerful and may refer to other experiments, simulations, analytical predictions, or theory. This is the meat of the author's effort, connecting the discrete facts above with the conclusion that shortly follows.
4. Mission Relation. Here the author explains why their conclusion matters, and why the reader should care.
5. Conclusion. The author's reasoned judgment, which may include specification or regulatory compliance.
6. Recommendation(s). Here's the author's chance to influence the reader's action.

The sequence seems formulaic, and surely can be forced to be dull and lifeless. Yet it need not be so, if the author doesn't forget that his purpose is to persuade, bringing their reader into agreement with their reasoned professional judgment. Every part need not be a sentence; it can be several sentences, or several parts can be covered in a single sentence. The goal is covering the elements building an argument for the proffered conclusion and recommendations.

Here's an example paragraph:

> "The single engine rate of climb was evaluated at two, five, and ten thousand feet in the PA, PA-half, GR and CR configurations, using saw-tooth climbs with one engine at full rated power and the other propeller feathered [*test conditions/ method*]. The data are portrayed in figure 7, referred to standard weight and standard day conditions, and also extrapolated to sea-level conditions [*data*]. Standard-day results fed a model which projects the hot-day performance which is also portrayed. Table 3 presents the peak sea-level rate of climb and optimum airspeeds for each tested and projected condition. Each configuration exhibited performance meeting or exceeding the expected performance. The PA-half configuration clearly represents the best performance among the gear-down configurations[*analysis*], and will provide suitably safe performance for take-off and single-engine approaches [*mission relation*]. The single engine rate of climb met the requirements of the detailed specification and is suitable for the proposed mission [*conclusion*]. Recommend that the PA-half configuration be adopted for single engine approaches, and figure 8 be included in the pilots operating handbook [*recommendation*]."

Why does this pattern work so well?

The 6-part paragraph imitates the inductive flow of scientific reasoning, moving from observed particulars to general inferences. "This dog has four legs, and that dog has four legs. In fact, every dog I've ever seen has four legs. I infer *all dogs have four legs.*" The flow of the technical paragraph should imitate scientific reasoning moving from discrete

evidence, whether graphics, tables, numbers, or qualitative observations, through interpretation of the relationships and contrasts, to a sensible general inference stating what the author wants the reader to likewise surmise from the proffered data. The conclusion of a well-written paragraph is anti-climatic; the astute reader should infer the conclusion from the development by the time as it is stated.

In distinction, my prose paragraph immediately above exemplifies deductive reasoning, and was *not* inductive. It began by declaring the general principle, my conclusion, and then moved towards particulars justifying and explaining the implications of the general opening declaration. Our secondary education, and our humanities electives taught us to write this way, because it expressed the deductive argumentation most commonly seen in those disciplines. We shouldn't be surprised that a good student of science doesn't automatically write well technically. They may know how to think scientifically, but they've been taught to write deductively. They then force their scientific reasoning to fit a form of expression that's alien, inverting its natural order. Let me say it again, *the 6-part paragraph imitates the inductive flow of scientific reasoning.*

The six-part paragraph spans the elements of all thought. Eight elements are present whenever we think about *any* topic. Regardless of the topic, we think…

- towards some *purpose,*
- seeking to answer some *question,*
- from within a *point of view,*
- making *assumptions,*
- calling on *data and information,*
- which we organize with *concepts,*
- to draw a *conclusion or inference,*
- that entails *implications.*

These are present whenever we think about absolutely anything. Though, to be sure, we commonly don't recognize their presence, let alone make them each explicit.

The six-part paragraph explicitly addresses six of the eight elements.

- The *test condition and method* addresses the purpose of the paragraph and the question it's seeking to answer. The example paragraph from above explains that the purpose of the paragraph is evaluating the single-engine rate of climb, and the specific question is implicitly whether or not the performance is suitable for the mission.
- The *data* provides the factual substance about which the argument will build.
- The *analysis* draws heavily upon the relevant and significant concepts to organize the data into meaningful patterns.
- The *mission relation* touches the implications of the observed characteristics, though expressed in a way as to help justify the conclusion.
- The *conclusion* is the main inference, answering the question that's at hand.
- The *point of view* is implicitly experimental
- The assumptions may or may not be mentioned, such as might influence the data's scope.

Some examples:

22. The Fuel Ready switch was evaluated for functional operation and accessibility. The switch was located on the pilot fuel management panel immediately adjacent to the fuselage Fuel Dump switch as is depicted in figure B-1. Both switches were of similar design, shape, and operative sense. Forward movement of the Fuel Ready switch was required to receive fuel during aerial refueling. Forward movement of the Fuel Dump switch jettisoned fuel from the fuselage tank at the rate of 3,000 lbs/min. There were no tactile identification cues available, and the wrong switch was repeatedly actuated during blind operation. Rapid rendezvous and close formation flight during in-flight refueling will frequently require location of the Fuel Ready switch by tactile means only, resulting in actuation of the wrong switch, and flame out due to rapid depletion of remaining fuel. The proximity of the Fuel Ready switch to the similar Fuel Dump switch is a Part I deficiency which must be corrected as soon as possible.

23. The Power Condition Levers (PCL's), located forward on the port console as shown in figure B-2, were evaluated for functional operation and accessibility. With the shoulder restraining harness locked, the MAX power position of the PCL's exceeded the functional reach. With harness unlocked, no difficulty was experienced selecting MAX power with a slight forward movement of the torso. However, for simulated engine failures during takeoff or landing the evaluator was unable to apply maximum power on the operating engine until the shoulder harness was unlocked. Unlocking the shoulder harness required an average of three seconds. The delay in selecting max power caused by first having to release the shoulder harness lock will result in the loss of airplane and crew during an in-close waveoff. The inaccessible MAX Power Condition Lever position with shoulder harness locked is a Part I which must be corrected as soon as possible. Consideration should be given to reconfiguring the throttle quadrant throw for the MAX position.

TITLE	•What you're evaluating
TEST CONDITIONS	•Past tense •What was tested [that you're going to address] •What for..... •During..... •Include special conditions, relevant info
RESULTS	•Past tense (But, "data are presented in fig 1) •The word "data" is [are?] plural •Define the problem •May need one sentence to explain function, etc. •*Initial* result of problem and/or compensation •Problem's effect ON YOU as an operator •HQR's , Workload Scales, VAR's, etc.
MISSION RELATION	•*End* result of problem •How it impacts mission •Answers "So What?" ("will result in"..."will cause") •Don't "gripe the pilot" (the problem "will cause the pilot to....." not "the pilot will....") •Can combine MR and conc (don't forget rec) •Future tense
CONC/REC	•Present tense •Deficiency Statement: Stands alone, fully describes problem? •Read it alone, can you tell what's wrong? •Use an adjective •Don't use "poor"--it's non-descriptive •Don't use "inability"--gripes the pilot (things aren't *"able"*) •Avoid "difficult " ....it's non-descriptive •Don't use "lack of".....describe the problem
SPEC COMPLIANCE#	•If met, just say "Met spec" •If failed: spec para, how much (magnitude *and* %) •Past tense
SPEC REC#	•RFT only when justified (spending more $$) •Flight manual changes •Ways of fixing the problem •Present tense

RESULTS AND EVALUATION PARAGRAPH GUIDE

TITLE (check hierarchy format): _____
PARA NO: ____(sequential starting with intro)

A.) What was tested and conditions of the test. **Past tense**._____
_____
_____

B.) Results. **Past Tense/ Present Tense for data included as tables, figures, etc**. Qualitative and quantitative test results. Tables or figures are encouraged to summarize data. Do not repeat the data in scope.

_____
_____
_____

C.) F.) Analysis. Explain test results to convey intended meaning. State significance of test results. **Past Tense**

_____
_____

D.) Mission Relation. Offered as justification for the upcoming conclusions and recommendations. **Future tense** (" The XXXXXX will prevent the pilot from...."):_____
_____
_____

E.) Conclude and recommend timing of fix. State the characteristic and whether it is satisfactory, deficient, or enhancing. **Present Tense**.

_____
_____
_____

E2.) Specification compliance. Magnitude of noncompliance must be stated. Over specification magnitude may be stated with confidence level. **Past tense.**

_____
_____
_____

F.) Specific Recommendation. Present specific actions that the test team would like to see happen.
"Consideration should be given to..." ; " Recommend further testing to...";
"Recommend that..."

_____
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